Book of Abstracts

National Seminar
on
Smart Technologies for Sustainable Agriculture and Environment

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad

22-23 February 2024

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Organized by

Indian Society of Agrophysics, New Delhi

and

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Climatic Risk Assessment for Water Availability of Rainfed Crops in Bihar

A Sattar*, R.K. Jha and G. Singh

Centre for Advance Studies on Climate Change, Dr. Rajendra Prasad Central Agricultural University, Pusa (Samastipur)-848125, Bihar
**Corresponding author: asattar@rpcau.ac.in*

Climate change is real and it is affecting the crop production potential to a large extent at national and local level. In this context, precise evaluation of water availability of an area is vital to ensuring successful crop production under rainfed condition. Hence, for sustainable agriculture appropriate agro-climatic measures need to be introduced to mitigate climatic risks at micro-level. Variability in rainfall, sowing rain, onset of growing season, length of growing period (LGP), etc provide useful information for evaluation of climatic potential for agricultural development and for evolving suitable cropping patterns under rainfed eco-system. Keeping all this in view, a study was conducted for three districts of Bihar *viz.* Darbhanga, Araria and Jahanabad located across three agroclimatic zones of the state to evaluate the risks associated with water availability of rainfed crops grown during both *kharif* and *rabi* seasons. Probabilistic Moisture Adequacy Index (Im_a), which is the ratio of actual evapotranspiration (AE) to potential evapotranspiration (PE) and sowing rain have been employed in this study. Im_a was estimated at 50 and 75 per cent probability levels at different phases of crop growth in order to identify appropriate planting schedules for major cropping systems in different soil textual classes of these districts. Thornthwaite climatic water balance model was employed to estimate AE using historical weather data of these districts. The results of the study revealed that the rainfed crops could be fitted more successfully in Araria district in Zone II. On the other hand, the adoption of such crops in Jahanabad district under Zone IIIB could be riskier. Crop fitting analysis based on AE/PE at 50 and 75 % probability levels as per AE/PE requirements during various phenophases of rainfed crops indicated that *kharif* maize could successfully replace *kharif* rice in areas where moisture stress at different growth phases due to erratic monsoon affects rice cultivation under rainfed condition. The study helped precisely assess climatic risks associated with crops at different growth phases. It has several practical implications for field application and for breeding appropriate crops and varieties of crop matching with water availability. The study showed that irrigation can be appropriately scheduled at critical moisture sensitive stages of crops in order to avoid moisture stress.

Key words: Climate, Rainfall, Water, Bihar

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Screening of French Bean Germplasm for Salt Stress Tolerance at Seedling Stage by Principal Component Analysis

K.G. Shilpa Shree*, M.D. Prathibha and L.R. Varalakshmi

ICAR-Indian Institute of Horticultural Research, Bengaluru-560089, Karnataka
**Corresponding author: Shilpashree.G@icar.gov.in*

Increasing pressure of producing more food per unit available arable land has forced the extensive use of saline groundwater for irrigation. Use of saline irrigation water has been an important cause for secondary salinization in irrigated lands of our country. Salt stress is one of the abiotic factors that affects the growth and yield of crops. French bean (*Phaseolus vulgaris*) is an important legume crop known for its protein value. French bean is also reported to be a sensitive crop for salt stress. The knowledge of tolerance and sensitivity of a crop germplasm to salinity plays an important role in explaining the salt tolerance mechanism for development of salt tolerant varieties. The present study was conducted to evaluate the salt tolerance among four French bean varieties Arka Anoop, Arka Suvidha, Arka Komal and Arka Arjun by principal component analysis. Different salinity levels like control, 2 dS m^{-1}, 4 dS m^{-1} and 7.5 dS m^{-1} were selected in order to classify them into sensitive and tolerant French bean varieties based on seven parameters. Salinity levels significantly affected the shoot length, root length, shoot and root fresh weight, shoot and root dry weight and potassium-sodium ratio in all the four varieties. A significantly higher potassium-sodium ratio was observed in Arka Arjun at higher salinity levels of 4 dS m^{-1} and 7.5 dS m^{-1} compared to other varieties. The principal component analysis of seven morphological and ionic ratio variables indicated that Arka Arjun and Arka Anoop were salt tolerant and Arka Suvidha was salt sensitive at the seedling stage.

Key words: Salinity, Principal component analysis, French bean, Seedling stage

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Foliar Application of Nano Zn and Zn EDTA for Mitigation of Water Stress in Pearl Millet (*Pennisetum glaucum*)

Arun K. Shanker*, Kavita Singh, Visha Kumari and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: arunshank@gmail.com*

A study was conducted at the ICAR-Central Research Institute for Dryland Agriculture, explores the efficacy of nano Zinc (Zn) and Zn EDTA in mitigating water stress in pearl millet through a pot experiment in a Completely Randomized Design (CRD). The primary focus was to assess the impact of these treatments on the photosynthetic efficiency, particularly in terms of Photosystem II (PSII) electron transport under water deficit conditions. In this experiment, foliar sprays of nano Zn and Zn EDTA were applied, and their effects on the photosynthetic apparatus of pearl millet under water stress were closely monitored. The results indicated that nano Zn spray and Zn EDTA reduced the loss in photosynthetic efficiency in water-stressed plants. This improvement was primarily attributed to the role of Zn in maintaining the functional integrity of PSII. The mechanism underlying this stress alleviation was identified as the reduction in the net rate of PSII Reaction Center (RC) closure (Mo) and an increase in the probability that an absorbed photon would be effective in moving an electron into the Electron Transport Chain (ETC). Furthermore, nano Zn spray led to an increase in total carotenoids concentration, which plays a protective role for PSII during water stress. The application of nano Zn and Zn EDTA emerges as a promising approach to enhance the tolerance of pearl millet to water stress, primarily by bolstering the photosynthetic efficiency and stabilizing the PSII complex. This study paves the way for further research into nano-nutrient applications as a viable agronomic practice for crop stress management.

Key words: Nano Zn, Pearl Millet, Completely Randomized Design (CRD)

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Developing Double Cropping System with Precise Crop Management for Rainfed Alfisols

V. Visha Kumari*, Gopinath K.A., Suvana S., Manoranjan Kumar, Sarath Chandran M.A., A.K. Shankar, B.M.K. Raju, N. Jyothilakshmi, G. Venkatesh, G. Gayethri, M.S. Rao and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: V.Visha@icar.gov.in*

India is a proud nation enjoying self-sufficiency in food grain production and sustainable food security despite burgeoning population and various climatic stresses. The productivity of crops in rainfed areas is critically linked to the availability of resources particularly water and nutrients. In rainfed area, we generally go for one crop. These lands offer a huge potential niche for pulses and oilseeds production, further, growing short legumes and oilseed, offers an opportunity to utilize residual moisture for crop production. A field experiment was carried out with 13 pulse oilseed cropping system to identify a remunerative and climate adaptive double cropping system and to quantify the effect of rain water management and rotation benefit on partitioning of assimilate and safflower yield. The systems were greengram-safflower (without rainwater management), green gram-safflower (with rainwater management), cowpea -safflower (without rainwater management), cowpea - safflower (with rainwater management), blackgram-safflower (without rainwater management), blackgram - safflower (without rainwater management), green gram-sesame (without rainwater management), green gram-sesame (with rainwater management), cowpea -sesame (without rainwater management), cowpea-sesame (with rainwater management), blackgram-sesame (without rainwater management), blackgram-sesame (with rainwater management) and sorghum + pigeonpea. The pulses were sown during the *kharif* and the oilseed crops were sown after the harvest of pulse crop (October). The crops under rainwater management were given 2 supplementary irrigation (3mm) from the water harvested. The objective of this study was to compare existing practices with new double cropping system and develop precise double-cropped managed systems by optimizing economic returns, adjusting the planting time, spacing and rain water management. The plant growth and yield parameters were significantly influenced by the crop potential as well as external water management. The highest system productivity of 1695 kg/ha were obtained with cowpea-sesame (with rainwater management), followed by cowpea -sesame (without rainwater management) (1484 kg/ha) on par with cowpea- safflower (with rainwater management) (1407 kg/ha). The study shows precision approach for developing double cropping system simultaneously increase yields, resource efficiency, and profitability.

Key words: Crop, Rainfed, Pulse, Rainfed, Food

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Long-term Effect of Tillage, Crop Residue and Nitrogen on Soil Properties and Crop Yield of Sorghum and Castor in Rainfed Condition

A.K. Indoria[1]*, K. Sammi Reddy[2], Munna Lal[1], K. Srinivas[1], Sumanta Kundu[1], M. Manjunath[1], M. Prabhakar[1], G. Pratibha[1], K.L. Sharma[1], K.V. Rao[1] and Vinod Kumar Singh[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]ICAR-National Institute of Abiotic Stress Management, Baramati-413115, Maharashtra
**Corresponding author: ashok.indoria@icar.gov.in*

A field experiment was conducted at HRF of ICAR-CRIDA, Hyderabad to study the long-term effect of tillage, crop residue and N application on soil organic carbon, crop yield and sustainable yield index (SYI) under sorghum-castor cropping systems. Treatments includes two tillage levels viz. conventional tillage (CT) and minimum tillage (MT), three surface residue application levels viz. sorghum residue @ 2t ha^{-1} (SS), fresh gliricidia loppings @ 2t ha^{-1} (GL) and no residue (NR), and three levels of N viz., 0 (No), 30 (N_{30}), 60 (N_{60}) and 90 (N_{90}) kg N ha^{-1}. The results of the study revealed that CT recorded 8.3% higher sorghum grain pooled yield as compared to minimum tillage. Application of GL (1282 kg ha^{-1}) and SS (1187 kg ha^{-1}) significantly increased the sorghum grain pooled yield by 21.6 and 12.6%, respectively as compared to NR. The increase in sorghum grain pooled yield in N_{30}, N_{60} and N_{90} were 54, 81, and 98%, respectively as compared to N_0. Similarly, CT recorded significantly higher castor pooled yield (18%) as compared to MT. Application of GL and SS significantly increased the castor pooled yield by 22 and 15%, respectively as compared to NR. The increase in castor pooled yield in N_{30}, N_{60} and N_{90} was 46, 70 and 91%, respectively over N_0. In both the crops, the SYI followed the order as CT>MT; GL>SS>NR; and N_{90}>N_{60}>N_{30}>N_0. The higher SOC content recorded in MT as compared to CT in different soil depths. Among the residue treatments, the increase in SOC in SS and GL was to the extent of 30 and 39%, respectively over NR. The increase in SOC in N_{30}, N_{60} and N_{90} was to the tune of 7, l3 and 22%, respectively over N_0. The trend in bacterial and fungal population follows the trend MT>CT; SS>GL>NR; and N_{90},> N_{60}>N_{30}>N_0. A reverse trend in bulk density was observed with respect to the above treatments.

Key words: Microbes, SOC, Castor, Sorghum

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Potential Overestimation of Soil Organic Carbon and Nutrient Stocks in Soils with Abundance of Coarse Fragments

K. Srinivas*, A.K. Indoria, S.S. Balloli, M. Ranjith, D.G.M. Saroja, B. Mamatha and Munna Lal

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: K.Srinivas1@icar.gov.in*

Measurements of soil properties based on 2 mm sieved soil and expression on quantitative areal basis such as kg/ha, Mg/ha without accounting for coarse fragments can lead to inflated measurements in soils with significant coarse fragment (> 2mm) fraction. The differences in stocks of soil organic carbon, available nitrogen and available phosphorus with and without accounting for coarse fragments in a sandy loam with abundant coarse fragments is elucidated in this article using data from a field experiment at Hayathnagar, Hyderabad . There was considerable short range spatial heterogeneity in volumetric coarse fragment fraction in the soil in the experimental field. The proportion of coarse fragments by volume across the 21 plots in the field ranged from 3.16% to 33.67% with a mean of 11.98% in the 0-20 cm depth and 4.21% to 30.52% with a mean of 18.56% in the 20-40 cm depth. Averaged over all the experimental plots in the field, the total stock of organic carbon, available nitrogen and available phosphorus up to a depth of 40 cm were overestimated by 34.38%, 33.74% and 28.49% respectively when the volumetric coarse fragment fraction was not accounted for. The results emphasize the need to account for coarse fragments larger than 2 mm for more accurate and realistic determination of stocks of organic carbon and nutrients in soils with abundance of coarse fragments.

Key words: Potential, Soil, Nutrient, Hyderabad

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Comparative Performance of Millets-based Intercropping Systems under Organic and Integrated Production Systems in Rainfed Areas of Telangana

K.A. Gopinath*, V. Visha Kumari, S. Suvana, G. Pratibha, A.K. Indoria, M. Manjunath, B.M.K. Raju, G. Venkatesh, B. Rajkumar and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: KA.Gopinath@icar.gov.in*

Cultivation of millets can help to address some of the challenges such as nutrition and health needs, climate change mitigation and adaptation, and livelihoods of smallholders particularly in resource-constrained rainfed areas. Identification of millets-based cropping systems and appropriate production technology is one of the researchable issues to enhance millets productivity in rainfed areas. A field experiment was conducted during *kharif* 2022 at Gungal Research Farm of ICAR-CRIDA, Hyderabad to evaluate the performance of finger millet (*Eleusine coracana*) + pigeonpea (*Cajanus cajan*) (2:1), foxtail millet (*Setaria italica*) + pigeonpea (2:1) and little millet (*Panicum sumatrense*) + pigeonpea (2:1) under organic, control (chemical) and integrated crop management systems. The experiment was laid out in a strip-plot design with three production systems and three intercrop ping systems. In the plots under organic management, gliricida (harvested from research farm) was applied on the N equivalent basis to all the three cropping systems. In the plots under integrated management, 25% of equivalent recommended N (10 kg/ha) was applied through gliricidia. The remaining 75% N (30 kg/ha) and 100% P (20 kg/ha) and K (20 kg/ha) was applied through chemical fertilizers. The plots under control (chemical) received recommended dose of chemical fertilizers (40:20:20 kg NPK/ha) for all the three intercropping systems. In general, among the three intercropping systems, finger millet + pigeonpea (2:1) system produced 17.2 and 26.9% higher finger millet equivalent yield (FMEY) (2199 kg/ha) than foxtail millet + pigeonpea (2:1) and little millet + pigeonpea (2:1) systems, respectively. Among the three production systems, averaged across three intercropping systems, organic and integrated management being on par with each other produced significantly higher FMEY than control (chemical). Similarly, both organic and integrated treatments produced similar but significantly higher FMEY of finger millet + pigeonpea (2:1) and foxtail millet + pigeonpea (2:1) systems compared to control. However, organic management recorded significantly higher FMEY (1746 kg/ha) of little millet + pigeonpea (2:1) compared to integrated management and control.

Key words: Millet, Organic, Rainfed, Telangana

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Classifying Nutrient Stress Using Deep Convolutional Network from Field Digital Images

N. Ravi Kumar*, N. Raj Melchi, N. Jyothilakshmi, Basudeb Sarkar, K. Srinivas, V. Visha Kumari, Vinod Kumar Singh, M. Prabhakar and N. Manikyala Rao

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
Indian Institute of Technology, Mandi-175005, Himachal Pradesh
**Corresponding author: ravi.nakka@icar.gov.in*

Timely irrigation is essential for crop survival and optimal productivity. Crop exhibit stress symptoms when soil wetness is insufficient to the crop. To address this problem experiments were conducted to capture water stress symptoms for automating the process of identifying stress from digital images. Captured 1,00,500 RGB from plant phenotyping facility from Maize Stress experiments. Plant photographs were taken from side view 0 degrees, side view 90 degrees and top view. A software tool was developed in MATLAB for extracting features and quantifying the biomass from high throughput RGB digital imageries database. Captured 2000 field stress and healthy digital images. Image classification has been further accelerated with advent of Transfer Learning. Transfer learning allows us to use a pre-existing model, trained on a huge dataset, for this task. Consequently, reducing the cost of training new deep learning models. In this work pre-trained Image Classification model VGG-16 was used. The model has 13 convolutional layers, 5 pooling layers, 3 dense Layers. In all the permutations best accuracy values (0.855) was obtained when the image resolution is equal to 512 pixels, the optimisation algorithm is SGD, ReLU activation function and the batch size is 32.

Key words: Nutrient, Digital Image

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Impact of Night Shelter on Backyard Poultry Production among Tribal Population in Adilabad District of Telangana

Vijay Kumar*, B. Prakash, L.L.L. Prince and U. Rajkumar

ICAR-Directorate of Poultry Research, Rajendranagar, Hyderabad-500030, Telangana
**Corresponding author: drvijaykumar.ext@gmail.com*

Backyard poultry is an important source of income, healthy food i.e. meat and eggs, provide employment to rural and tribal people and also contribute significantly in national egg and chicken meat production. ICAR-Directorate of Poultry Research, Hyderabad (Telangana) has been continuously working with tribal community in Adilabad district of Telangana through backyard poultry intervention. A longitudinal time series analysis was conducted among 34 beneficiaries among tribal household of Mankapur village of Adilabad under Tribal Sub Plan. The major emphasis was to create an alternative and supportive source of income, food security, enhancing the animal protein availability and employment generation by providing grown up chicken birds, nigh shelter and other necessary input. The night shelter is necessary to protect the birds from predators' attack especially during the night. The dimension of the night shelter was suitable for 10-12 birds (length, width & height: 4×3×2.5 feet and leg 1 feet). It was made up of durable iron for longer life. Predators attack was the major cause of mortality and was recorded 3±0.81 birds/household before using night shelter. Under the intervention program night shelter was given to every beneficiary household. After one year the mortality due to predator was significantly reduced to 0.75 bird/ household (300% reduction). The value of survived birds was calculated to be [1] 2656 per year for each household. Due to birds supply and mortality reduction average flock size in the household was increased by 174.7%. Outcome of these intervention was increased egg consumption from 3.08 eggs/ week to 8.6 eggs/ week (increased by 179.2%) and chicken meat consumption increased by 1 bird/ month to 3.3 birds/month/ household (increased by 230%). The study concluded that the night shelter intervention in the study area of tribal village lead to significant improvement in the income and animal protein consumption.

Key words: Night Shelter, Tribal, Population, Telangana

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Hyperspectral Remote Sensing of Wheat Yellow Rust (*Puccinia striiformis* f.sp. *tritici*)

Souramita Chakraborty, Deb Kumar Das*, Rabi Narayan Sahoo, Selvaprakash Ramalingam and Rajeev Ranjan

Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: dkdas.iari@gmail.com*

The potential of hyperspectral reflectance data was explored to assess the severity of yellow rust disease (Biotroph *Puccinia striiformis*) of winter wheat in the present study. The hyperspectral remote sensing data was collected for 10 wheat (Triticum aestivum L.) genotypes at different levels of disease infestation (0 to 9 Disease Score) using a field spectroradiometer over the spectral range of 350 to 2500nm.Visible, near-infrared and short-wave infrared regions were more pronounced to differentiate disease severity levels. 1st derivative (red edge) spectral reflectance study was led to find most sensitive spectral ranges 530-580 nm region in the yellow band and 670 - 740 nm in the red edge region. Two novel spectral disease indices were proposed utilizing sensitive wavebands; Normalized Yellow Rust Index 1 and 2 with high accuracy for disease severity prediction having R^2 value more than 0.85. Among the multivariate techniques, Partial Least Square Regression (PLSR), Multiple Linear Regression (MLR) and Random Forest (RF) were performed to develop spectral models for differentiating various degrees of severity. PLSR was found to be the best predictor with the highest R^2 of 0.977. The result showed that the developed model had a great potential for precise delineation and detection of yellow rust disease in winter wheat crop.

Key words: Wheat yellow rust, Hyperspectral Reflectance, Disease Score, Spectral Disease Indices

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Rainfall and Temperature Projections and Theirimpact Assessment Using Multiple Models under Different RCP Scenarios for the North Eastern Region of India

Saurav Saha[1]*, B.U. Chaudhury[2], P. Pandey[1], Debasish Chakraborty[3], Bappa Das[4], Amit Kumar[1], S. Hazarika[3], V.K. Mishra[3] and R. Devdas[1]

[1]ICAR Research Complex for NEH Region, Sikkim Centre, Tadong-737102, Sikkim
[2]ICAR Research Complex for NEH Region, Tripura Centre, Kolasib, Lembucherra -799210, Manipur
[3]ICAR Research Complex for NEH Region, Umiam-793103, Meghalaya
[4]ICAR Central Coastal Agricultural Research Institute, Old Goa-403402, Goa
**Corresponding author: sauravs.saha@gmail.com*

Due to the changes in temperature and precipitation, North East India, a region renowned for its abundance of natural resources, has recently seen a marked increase in the frequency and severity of extreme weather events. Understanding future variations in precipitation and temperature can aid in comprehending extreme events, and different actions can be implemented to adapt to the changes. With this background, our present study looked to analyze temperature (maximum and minimum) and precipitation using CORDEX climate projections across 126 districts of North East Indian (NEI) states using nine Global Climate Models under different Representative Concentration Pathway(RCP) scenarios (2.6, 4.5 and 8.5) over two future projection windows viz. 2040-2069 & 2070-2099; against the historical base period 1951-2005. The rise in maximum temperature ranged between 2.1 to 2.9 ºC. We observed widespread rise over the Lower Assam region (which includes Mizoram and Manipur) under RCP 4.5 and RCP 8.5 (3.1 – 5.0 °C). Moreover, the highest rise was projected across the Tawang region of Arunachal Pradesh likely ranging between 2.8°C (RCP 2.6) to 5.6°C (RCP 8.5). The projected rise in Tmin was highest over Assam and the Lushai hill region viz. 1.5 °C (RCP 2.6) to 4.8 °C (RCP 4.5), respectively. The prominent decline in Diurnal Temperature Range (DTR) over the Assam region, from -0.23°C to -1.1 °C (except RCP 8.5; 2040-2069) was evident with limited overall changes in annual rainfall. Overall rise in heat wave occurrences is more likely to occur over Meghalaya, Barak valley, and the nearby Lushai hill region. The observed changes in weather anomalies have substantial potential to induce a negative impact on regional food production across NE India. Field testing and wide-scale adaptation of climate resilient technologies will shield the small and marginal farmers from the periodic weather aberration-induced crop loss and ensure the regional food security of NEI.

Key words: Future projection, CORDEX modeling, Representative Concentration Pathway (RCP), Heat wave, North East India

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Effect of Microbial Consortium on Drought Tolerance, Growth and Yield of Sunflower under Rainfed Conditions

S. Subbulakshmi* and B. Bhakiyathu Saliha

Agricultural Research Station, Kovilpatti-628502, Tamil Nadu
**Corresponding author: sumiagri@rediffmail.com*

Sunflower is a major source of vegetable oil in the world**.** In India, sunflower is cultivated over an area of 2.28 lakh hectare with a production of 2.12 lakh tonnes with the productivity of 930 kg ha^{-1}. Sunflower is an exhaustive crop and inadequate and imbalanced crop nutrition affects the yield of crop in rainfed region which encounters drought frequently. Hence, to ensure food security, farmers and crops must be saved from the brunt of drought and nutrient deficiencies. Microbial species play a major role in the dissolution of different minerals under different stress conditions thereby ensuring better uptake of these minerals and to alleviate drought stress and economize the cultivation cost of rainfed farmers. Hence, the present study was undertaken to find out the effects of different microbial sources on the morphological traits, post anthesis stress management, yield and economics of sunflower under rainfed conditions. Field experiments were conducted during *rabi* 2018-19 at Agricultural Research Station, Kovilpatti, Thoothukudi district of Tamil Nadu to study the effects of various bio-fertilizers on the growth, post-anthesis stress and yield of sunflower under dry land medium black vertisols. The experiment was laid out in randomized block design with treatments that included single and different combinations of silicate solubilizer, sulphur oxidizer (for seed treatment 600 g ha^{-1} and for soil application 2 kg ha^{-1}), Pink Pigmented Facultative Methylotrophs (PPFM) @ 2% spray at 50 and 65 DAS and Vesicular Arbuscular Mychorrhiza (VAM) @ 280 kg ha^{-1} and replicated thrice. The results revealed that combination of seed and soil application of silicate solubilizer and sulphur oxidizer along with soil application of VAM + PPFM spray recorded significantly higher plant height (170.6 cm), leaf area index (2.45), dry matter production (4289 kg ha^{-1}), number of seeds capitulum (732), 1000-seed weight (50.4 g), yield (1359 kg ha^{-1}) and gross returns (40770 ha^{-1}). Higher net returns of Rs. 11399 ha^{-1} and B: C ratio of 1.47 were recorded by seed and soil application of Silicate solubilizer + Suphur Oxidizer + PPFM spray due to low input cost. However, The relative leaf water content and soil moisture content recorded at 65 DAS showed that higher leaf relative water content (82%) and available soil moisture (29.8%) were also recorded with the combined application of VAM + PPFM spray which may be attributed to drought inducing capacity of these two microbes.

Key words: Microbial Consortium, Growth, Sunflower, VAM, Tamil Nadu

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Differential Response of Blackgram Genotypes to Water Deficit Stress at Flowering Stage

N. Jyothi Lakshmi*, M. Vanaja, B. Sarkar, P. Sathish, K. Salini, H.B. Santosh, Bharath Kumar, Arun K. Shanker, M. Srinivasa Rao, M. Prabhakar and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Santhoshnagar, Hyderabad-500059, Telangana
**Corresponding author: n.jyothi@icar.gov.in*

The response of drought stress on morpho-physiological and biochemical characters was assessed in 12 black gram genotypes in a field experiment. Water stress was applied at flowering stage of the crop by withholding the irrigation for 15 days and various morpho-physiological and biochemical characters were analyzed under control and water stress conditions. Water stress decreased the relative water content, membrane stability index and increased the proline and malondialdehyde content. The mean seed yield across 12 genotypes decreased by 37.6%, followed by seed number/ plant (36.6%), pod weight (36.3), leaf weight (36.1), total biomass (34.4), filled pods per plant (31.6), stem weight (23.3), Harvest index (4.2) and test weight (0.56%). The standardized range for leaf, stem weight and filled pods per plant was higher under stress compared to control conditions while standardized range was higher in control for seed weight, pod weight, total biomass and seed number per plant revealing the existence of wide variability for these parameters under moisture stress. PLU-826, PSRJ-95016 and PUD-1 had higher grain yield under control conditions while PLU-826, UH-85-5 and STY-2868 had higher yield than other genotypes under stress conditions. Based on overall performance for various morpho-physiological and biochemical characters, genotypes PLU-826, PUD-1, STY-2868 and UH-85-5 were found to be tolerant to drought stress as compared to others.

Key words: Blackgram, Water, Flowering

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Soil Microbial Activities in Different Rainfed Groundnut Growing Regions of India

M. Manjunath[1]*, G. Ravindra Chary[1], K.C. Nataraja[2], B. Sahadeva Reddy[2], H.S. Latha[3], Mudalagiriappa[3], N.I. Patel[4], D.S. Hirpara[5], N. Jyothilakshmi[1], A.K. Indoria[1], G. Pratibha[1], K.A. Gopinath[1], S. Savitha[1], Arun Shanker[1], M. Srinivasa Rao[1], V.K. Singh[1] and S. Vijayalakshmi[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]AICRP for Dryland Agriculture, Ananthapuramu-515001, Andhra Pradesh
[3]AICRP for Dryland Agriculture, Bengaluru-560065, Karnataka
[4]AICRP for Dryland Agriculture, Sardar Krishinagar-385506, Gujarat
[5]AICRP for Dryland Agriculture, Rajkot-360003, Gujarat
**Corresponding author: m.manjunath@icar.gov.in*

Soil microorganisms play vital roles in biogeochemical cycles of nutrients, decomposition of organic matter, management of various biotic and abiotic stresses. Crop and soil management practices significantly affect the soil microbial functions and health of soil. The aim of the present study was to assess microbial activity in different rainfed groundnut growing regions of the country. Soil samples were collected from Ananthapuramu, Bengaluru, Sardar Krishinagar and Rajkot representing arid (hot), semi-arid (hot moist), semi-arid (hot dry), and semi-arid (hot dry) climatic conditions respectively. Soil enzyme activities are generally used as an indicator for soil health. Hence, microbial activities were assessed in terms of soil enzymes such as dehydrogenase, acid and alkaline phosphatase and microbial biomass carbon by following standard procedures. The results of the study showed the variations in microbial parameters across different regions. Significant difference (pd"0.05) in dehydrogenase activity was observed between Sardar Krishinagar and Ananthapuramu soil samples. Whereas, acid phosphatase activity differed significantly between Bengaluru and Ananthapuramu samples. Further, Sardar Krishinagar and Bengaluru samples recorded highest and lowest alkaline phosphatase activity respectively. Maximum microbial biomass carbon was observed at Bengaluru and lowest was observed at Ananthapuramu samples. Overall, the results indicate that, Ananthapuramu soil samples recorded lower microbial activities as compared to other groundnut growing regions.

Key words: Dehydrogenase, Groundnut, Microbial parameters, Rainfed, Soil microorganisms

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Development of Tillage and Residue Mulch Module in InfoCrop V2.1 Model to Simulating Yield, Water, and Nitrogen Productivities of Maize

Sujan Adak, K.K. Bandyopadhyay[1]*, S. Naresh Kumar, R.N. Sahoo, V.K. Sehgal, P. Krishnan, S.P. Datta, R.S. Bana, A. Sarangi and Priya Bhattacharysa

ICAR-Indian Agricultural Research Institute, New Delhi-110012
[1] ICAR-Indian Institute of Water Management, Bhubaneswar-751023, Odisha
**Corresponding author: kk.bandyopadhyay@gmail.com*

There is a significant impact of tillage and mulching crop residue on crop yield, soil characteristics, and input usage efficiency. The InfoCrop V2.1 model, an indigenous generic crop simulation tool, has limited ability to simulate the impacts of different tillage and residue mulching practices. The goal of this study was to develop the tillage and residue mulching module in InfoCrop model V2.1 to simulate its effect on crop growth, water productivity (WP) and nitrogen productivity (NP) of maize. Tillage intensity, which is a function of both tillage efficiency and mixing efficiency, primarily determines how much tillage affects soil qualities and processes. The bulk density and the ensuing effects of altered soil water characteristics in surface and subsurface soil layers were the primary focus of the tillage module development. Using parameters such as residue application timing and amount, as well as residue mulching coverage, the residue mulch module was implemented with an emphasis on how mulch affects soil evaporation and the ensuing implications of altered soil water characteristics. The InfoCrop V2.1 model's tillage and residue module were developed using these ideas. The developed model was calibrated using field experiment data of a five-year-old long-term tillage experiment under standard management practices on maize under a maize-wheat system and validated with the independent data of the field experiment for the year 2019 and 2020 at ICAR-Indian Agricultural Research Institute, New Delhi. The treatment comprised of different tillage (conventional tillage (CT) and no tillage (NT)), residue (with residue mulch (R+) and without residue (R0), nitrogen (N) (60, 120 and 180 kg N ha^{-1}) and irrigation (full irrigation (IF) and deficit irrigation (ID) laid out in a Split factorial design. The evaluation of the modified InfoCrop-Tillage and Residue Mulching module showed that the model could account 93% variation in the observed grain yield of maize with an RMSE of 374 kg/ha and nRMSE of 7.7%. The InfoCrop model also showed satisfactory result for validation of WP and NP of maize with R^2 0.92 and 0.96, RMSE of 0.11 and 4.67, and nRMSE of 6.3 and 8.5%, respectively. The addition of the tillage and residue mulching module to InfoCrop, therefore, provides opportunities to evaluate the effects of various agronomic management practices, particularly conservation tillage and conventional tillage practices, on maize yield, water productivity, and nitrogen productivity. It also helps to make important decisions regarding input optimisation to achieve higher resource use efficiency under current and future climate change scenarios.

Key words: Tillage, InfoCrop, Water, Nitrogen, Maize

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Changes in Morpho-physiological, Biomass and Yield Parameters Under Elevated Carbon Dioxide-Response Variability of Groundnut (*Arachis hypogaea* L.) Genotypes

M. Vanaja*, P. Sathish, N. Jyothi Lakshmi, B. Sarkar, A. Sushma, Ch. Mohan, V. Maruthi, M. Srinivasa Rao, M. Prabhakar and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: m.vanaja@icar.gov.in*

The industrial revolution and deforestation are the major contributors for increasing atmospheric CO_2 concentration. As CO_2 is the substrate for photosynthesis, especially for C3 plants it improves the growth and biomass. Groundnut (*Arachis hypogaea* L.) is an important oil seed crop, which is grown as a source of edible oil and vegetable protein. The impact of elevated CO_2 of 550ppm on phenology, physiological, biochemical, biomass, and yield parameters of four groundnut (*Arachis hypogaea* L.) genotypes was quantified by raising the crop in OTCs. Under eCO_2, the phenology of 50% flowering was early by two days with Dharani, Kadiri Lepakshi (K 1812), and Visishta (TCGS 1694), while it was delayed by three days in K-9. The groundnut genotypes recorded increased Anet (up to 32.4%), WUE (up to 35.4%), RWC (up to 5.2%) and reduced Tr (up to 30.7%). Similarly, the content of total chlorophyll (up to 27.0%), TSS (up to 26.4%), proline (up to 95.1%), MSI (up to 8.8%) increased with eCO_2, while it decreased MDA (up to 33.3%) revealing that eCO_2 condition is promoting better growth of this C3 oilseed crop. The eCO_2 improved both vegetative and reproductive biomass of all four groundnut genotypes over ambient CO_2, however the magnitude of response to eCO_2 varied with genotype. Among the four groundnut genotypes, highest response for Anet and WUE with eCO_2 was recorded with K-9; the content of TSS, proline with better RWC was recorded with Visishta. Among the yield parameters, number of pods/pl significantly increased under eCO_2 and the highest response (27%) was recorded with Dharani. The increased seed yield (19%) with eCO_2 was due to increased seed number (up to 14%) as well as test weight (up to 10%). The higher impact of eCO_2 was with reproductive biomass than vegetative biomass in Dharani resulted increased HI of this genotype.

Key words: Biomass, Yield Parameters, Carbon Dioxide, Groundnut

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IOT Based Soil Moisture and Weather Data Management

N.S. Raju*, N. Ravi Kumar and Nagarjuna Kumar

ICAT-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: ns.raju@icar.gov.in*

In India, where 60-70% economy depends on agriculture, there is a great need to modernize the conventional agricultural practices for the better productivity. The system proposed in this paper is an advanced solution for monitoring the weather conditions at a particular place and make the information visible anywhere in the world. The technology behind this is Internet of Things (IoT), which is an advanced and efficient solution for connecting the things to the internet. In this project we have established IOT sensor Network with ESP 8266 (Node MCU) Microcontroller board and other sensors are LM 100 is Soil moisture sensor, DHT11 for Temperature, humidity sensor and Rain drop sensor to collect rainfall information. We have collected data from the IoT sensors are then transmitted back to a central point (or the cloud) for analysis, visualisation and trend analysis. The complete system has been developed and deployed on a pilot scale, where the sensor node data is wirelessly collected using web-services into remote server. The temperature, humidity, soil moisture and rainfall information is collected in 10 minutes interval and transferred to remote location with Arduino Wi-Fi technology. The data stored in this system can be accessed from anywhere through internet. The resultant data can be used to optimise farming operations, identify trends and make subtle adjustments to conditions to maximise crop yield and quality.

Key words: IOT, Soil Moisture, Weather

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Phenotyping and Genotyping of Black Gram (*Vigna mungo* L. Hepper) for Insights into Genetic Diversity and Drought Stress Tolerance Mechanisms

Basudeb Sarkar*, Tejasree K., H.B. Santosh, Bharath Kumar Alam, K. Salini, N. Jyothi Lakshmi, M. Prabhakar, M. Vanaja, Savitha Santosh, M.S. Rao and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: b.sarkar@icar.gov.In*

Black gram, a major grain legume cultivated in India, faces considerable yield losses due to drought stress, particularly when exposed during flowering stage. To gain a comprehensive understanding of the impact of drought stress on black gram, we evaluated forty black gram genotypes for morpho-physiological, and yield traits. Two treatments, a well-watered control and water stress, were imposed during the flowering stage in field conditions. Additionally, genotyping was carried out using 40 genic and 58 genomic SSRs to study the genetic diversity among genotypes at the genomic level. Analysis of variance results indicated the significance of genotype, treatment, and their interactions for morpho-physiological and yield traits. Among traits studied SPAD chlorophyll meter reading (SCMR) and Normalized Difference Vegetation Index (NDVI) decreased across all genotypes under stress, with the reverse trend occurring for canopy temperature depression (CTD). The relative water content (RWC %), membrane stability index (MSI) and total soluble sugars (TSS) showed distinct values in tolerant and susceptible genotypes, effectively differentiating their responses to drought stress. Among genotypes evaluated IPU-2-43, IPU-9-16, IPU-94-1, LBG-623, IPU-96-7, IPU-2-37, IPU-13-5, IPU-13-1, IPU-10-16, LBG-787, and WBG-108 showed drought stress tolerance. Additionally, genotypes IPU-96-7, WBG-108, and PSRJ-95016 displayed both drought tolerance and higher seed yield and its attributes as compared to others. The genotyping using SSRs detected a total of 268 alleles with an average of 2.75 per SSR among genotypes while average polymorphism content (PIC) was 0.44 with a range of 0.13 to 0.79. Cluster analysis, done by UPGMA following Nei's similarity matrix grouped 40 genotypes into two major clusters comprising 25 and 15 genotypes respectively. Among traits studied, NDVI, RWC, and TSS emerged as key indicators, in identifying drought tolerant genotypes for screening of germplasm and understanding mechanism of drought tolerance in black gram. The identified genotypes for enhancing crop resilience in the face of climatic stresses.

Key words: Phenotyping, Genotyping, Genetic Diversity

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Total Mixed Ration (TMR): A Nutritional Management Tool for Better Adaptability in Indigenous Sheep

Prabhat Kumar Pankaj*, D.B.V. Ramana, G. Nirmala, V. Maruthi, K. Sreedevi Shankar, K. Ravi Shankar and Vinod Kumar Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: pankaj.pk@icar.gov.in*

An experiment was conducted to determine the adaptive effect of feeding total mixed ration (TMR) as compared to separate ingredient feeding using straw, stover and chunni in Nellore ram lamb for a period of 90 days (May to July, 2023) during summer stress of more than 80 (Temperature Humidity Index) THI for minimum four hours in a day. A total of 24 Nellore ram lambs of 3-4 m age were selected and divided into 4 treatment groups having 6 ram lambs in each randomly having similar average body weight (9.47±0.39 kg). Existing feeding practice at farmer's field as separate offering of greens, dry fodder and concentrate was considered as control group. In another three groups, animals were fed TMR based on Maize stover, Red gram chunni and Sorghum straw, respectively as crop residue for the dry roughage component of TMR for TMR_1, TMR_2 and TMR_3. Fresh feed intakes were significantly ($p<0.05$) higher in control group (more than 30%) than those of animals in TMR_1, TMR_2 and TMR_3 groups. DM intake, CP/TDN intake was significantly higher in control group. Digestibility of feeds were significantly ($p<0.05$) superior when used in the form of total mixed ration than fed individually. Body weight gain of animals differ significantly ($p<0.05$) among the treatment groups. Finally, it may be concluded that chunni based TMR gives better results in terms of growth rate, and economic returns as compared to straw or stover based TMR, however, TMR based feeding was found to be always beneficial than the separate feeding practices and are able to provide better adaptive means during summer stress period.

Key words: Fortification, Nutritional security, Sheep, goat, Climate change

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Changes of Soil Organic Carbon in Traditional Rice-fallow System of Eastern Himalayan Region

Bullo Yami[1]* and N.J. Singh[2]

[1]*Division of Soil Science, IARI Mega University Hyderabad hub, ICAR-CRIDA, Hyderabad-500059, Telangana*
[2]*School of Natural Resource Management, College of Post Graduate Studies in Agricultural Sciences, Central Agricultural University, Imphal, Umiam-793103, Meghalaya*
**Corresponding author: bulloyami598@gmail.com*

The soil carbon is dominantly controlled by topographical settings, soil-crop management and farming practices and is essential for soil health and sustainable crop productivity, however, there are challenges on real time soil organic carbon (SOC) estimation. This study aims to quantify the changes of SOC during last 20 years using geoinformatics technique. Approximately 100 numbers of composite soil samples from 3000 ha collects from the lowland rice field of Bhoirymbong block representing lowland of Eastern Himalayan region at 0-15 cm depth and analysed the soil properties using standard protocol. The cloud free (<10%) Landsat data of 1999, 2009 and 2019 are accessed from the USGS earth explorer website and 15 different predefined remote sensing (RS) indices generated. A suitable model finds out using multiple linear regression (MLR), partial least square regression (PLSR) and principal component regression analysis (PCA-R). It considers the SOC as dependent variable and RS indices as predictors variable in the regression analysis. The result reveals a strong correlation of SOC with SOCI (r = 0.87) and NDVI (r = 0.72) among 15 different RS indices. The MLR-stepwise (R^2 0.87, RMSE 0.026) found superior over the other models of PLSR (R^2 0.71, RMSE = 0.05) and PCA-R (R^2 0.27, RMSE 0.11). The SOC changes during last 20 years under traditional rice-fallow system as -0.09% (1999 - 2019) and during 10 years as -0.17% (2009 - 2019). Among the RS indices, SOCI and NDVI are the most influencing indices for SOC prediction of traditional rice-fallow system in the lowland of Eastern Himalayan region.

Key words: SOC, Slope, Regression

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Effect of Short-term Impact of Flyash Application on Water and Nutrient Use Efficiency of Maize-Wheat System in a Sandy Loam Soil

P. Nayak[1], K.K. Bandyopadhyay[1#*], P.P. Maity[1], S. Biswas[1], D.K. Sharma[1] and D.R. Biswas[1]

[1]ICAR-Indian Agricultural Research Institute, New Delhi-110012
[#]Present Address: ICAR-Indian Institute of Water Management, Bhubaneswar-751023, Odisha
**Corresponding author: kk.bandyopadhyay@gmail.com*

The field experiment was conducted at the Indian Agricultural Research Institute, New Delhi, during 2022-23 in the second year of an ongoing long term field experiment in maize-wheat cropping system in sandy loam soil to study the short-term impact of fly ash application on water and nutrient use efficiency of maize-wheat system of a sandy loam soil. The field experiment was conducted in a randomized block design statistical layout with the treatment comprised of T1 -Control (only recommended NPK to every crop); T2-FYM @5t/ha (every kharif season) + Recommended dose of NPK; T3- Fly Ash @10 t/ha (every year) + T2; T4- Fly Ash @ 20 t/ha (every year) + T2; T5-Fly Ash @ 40 t/ha (every year) + T2; T6- Fly Ash @20 t/ha (every alternate year) + T2; T7- Fly Ash@ 40 t/ha (every alternate year) + T2; T8-Fly Ash @80 t/ha (every alternate year) + T2; T9- Fly Ash @100 t/ha (once) + T2; T10-Fly Ash @ 200 t/ha (once) + T2;T11- Fly Ash @ 400t/ha (once)+T2 and T12-Fly Ash @ 20 t/ha (once) + T1. The results indicated that with the increase in the fly ash dose there was increase in the profile moisture storage but both seasonal evapotranspiration and water use efficiency of maize and wheat showed no significant difference among the treatments. In case of maize crop, application of fly ash @10t/ha every year along with recommended dose of NPK and FYM @ 5t/ha (T3) registered maximum yield and partial factor productivity of N, P and K (PFPN, PFPP, PFPK) and there was significant decrease in yield and partial factor productivity of N, P and K when fly ash was applied without FYM (T12). The residual effect of fly ash application on grain and biomass yield of wheat was not significant while the highest PFPN, PFPP and PFPK in wheat crop was registered under the treatment FYM @5t/ha (every kharif season) with Recommended dose of NPK (T2). Therefore, application of Fly ash @10t/ha every year along with recommended dose of NPK and FYM @ 5t/ha is recommended for obtaining higher yield and nutrient use efficiency without any adverse effect on soil health in maize-wheat cropping system in Inceptisol.

Key words: Flyash application, Water, Maize-Wheat, Sandy Loam Soil

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Estimation of Soil Loss and Prioritization of Vulnerable Areas for Soil and Water Conservation Interventions in Northern Dry Zone of Karnataka

R. Rejani*, K.V. Rao, M.S. Shirahatti, K. Sammi Reddy, G.R. Chary, K.A. Gopinath, M. Osman, M. Prabhakar and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: r.rejani@icar.gov.in*

Northern dry zone of Karnataka is frequently affected by prolonged dry spells and is subjected to high soil erosion and is facing reduction in crop yield. Hence, estimation of soil loss and planning and prioritization of suitable interventions and its adoption are very important. In this study, soil loss was estimated spatially using Revised universal soil loss equation (RUSLE) and GIS for a period of 70 years (1951 to 2020). Thematic layers of rainfall, soil, land use and topographic datasets were intersected in GIS and RUSLE was applied. Erosivity was estimated using the equations developed at ICAR-CRIDA using daily rainfall data. The mean annual rainfall varied spatially from 420 to 3700 mm, R factor varied from 2606 to >15000 MJ mm ha^{-1} h^{-1} $year^{-1}$ and mean annual soil loss ranged from <2.0 to >15.0 t ha^{-1} y^{-1} in Northern dry zone of Karnataka. For most of the study area, the mean annual rainfall varied spatially from 550 to 800 mm and soil loss was <10.0 t ha^{-1} y^{-1}. Higher rainfall and soil erosion rates were observed in western part of the selected area where high rainfall is predominant. The spatial soil loss was estimated catchment wise and prioritized to determine the vulnerable areas. It was found that 7.69% of area with soil loss >= 15.0 t ha^{-1} y^{-1} needs top priority for planning interventions (Priority 1) followed by 10.49% area with soil loss ranging from 10.0 to 15.0 t ha^{-1} y^{-1} (Priority 2) and 42.7% of the area under 5.0 to 10.0 t ha^{-1} y^{-1} (Priority 3) and remaining area has lower priority. The study indicated that considerable amount of top soil is lost as erosion and hence, planning and adoption of suitable soil and water conservation interventions is the need of the hour.

Key words: Erosivity, RUSLE, soil loss, vulnerable areas

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Livestock and Its Role in the Livelihoods of Rural Poor in Telangana

Josily Samuel[1]*, Pushpanjali[1], C.A. Rama Rao[1], B.M.K. Raju[1], P.K. Pankaj[1], Jagriti Rohit[1], Shiva Prasad Reddy[1] and Ajay Anto Soy[2]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]Divison of Agricultural Economics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: josilysamuel@gmail.com*

The Livestock sector has a unique combination of being the backbone of the rural livelihood while also showing consistent growth and export potential. Over 60% of rural households have livestock as part of their economic activity and livelihood. Livestock is a source of reliable income and a source of upward economic mobility for the poorest, while also being a net exporter and has shown a steady 6% Compound Annual Growth Rate (CAGR) over the past five years. The state wise livestock population was categorized in low, medium and high for cattle, Buffaloes, sheep and Goat using 2019 district wise livestock census. The state wise and livestock category wise maps were generated, and the states were divided into low, medium and high category of livestock (Cattle, Buffalo, Sheep and Goat) population. In order to study the impact of livestock on farm income and farmer livelihoods the primary data was collected from livestock rearing farmers on their profile, ownership pattern of livestock, land size, social hierarchy, capacity to invest, access to resources, family size, constraints faced by them from states of Karnataka and Telangana. The analysis showed that among livestock farmers only 26.26 per cent cultivate fodder crops and few (13 percent) farmers only were beneficiaries of government schemes on livestock. Seventy four percent of farmers went for distress sale. The major reasons as expressed by famers to rear livestock were to increase their incomes and to utilize available resources.

Key words: Livestock, Livelihood, Rural Poor, Telangana

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Optimizing Pomegranate Cultivation in Shallow Skeletal Soils: Comparative Analysis of Planting Methods

Rajagopal Vadivel[1]*, K.S. Reddy[1], Yogeshwar Singh[2] and D.D. Nangare[1]

[1]ICAR-National Institute of Abiotic Stress Management, Baramati Pune-413115, Maharashtra
[2]Rani Lakshmi Bai Central Agricultural University, Jhansi-284003, Utter Pradesh
**Corresponding author: v.rajagopal@icar.gov.in*

Pomegranate cultivation in areas with marginal and shallow skeletal soil is gaining popularity due to its potential for increased farm income. However, farmers often encounter challenges in achieving sustainable fruit production, highlighting the necessity to standardize planting techniques. This study aimed to compare various planting strategies, including trench, wider pit, pit, and auger dug methods, with varying dimensions, soil types and depth. Additionally, two farmer approaches were assessed in terms of their impact on the growth and development, nutrient content of leaves, and fruit quality of pomegranate. The results revealed that the trench and wider pit methods exhibited significantly higher biomass (>3.03 t ha^{-1}), root biomass (2.5 t $tree^{-1}$) production, crown spread area (3.3 m2 $tree^{-1}$), leaves N (1.6%) and fruit dimensions (length >65 mm, width >63 mm), whereas the root length density was lower at 0.28 m3 m-3. However, the trench method exhibited higher effect of higher P (0.28%) & K (1.8%) contents, juice content (48.5%), total soluble solids content (16.05 ^{o}Brix) and fruit yield (>9.3 t ha^{-1}) over other methods. Further, a marginal interaction effect of soil types and pits was observed in root biomass, root length, fruit yield, fruit width, and juice content. The root biomass and length were consistent across all soil types under the auger method, while it was higher under the soil mixture to the remaining pits. Similarly, fruit width, juice, and total soluble solids content were consistent across all soil types under the auger and pit methods, with the soil mixture exhibiting higher content than the other soil types. In conclusion, the trench method, filled with the soil mixture up to 1m depth, demonstrated superior drought tolerance and high-quality fruit production compared to other methods for 8-year-old pomegranate trees in shallow and skeletal lands. These findings have significant implications for achieving high-quality and sustainable fruit production, ultimately contributing to the improvement of farmers' livelihoods under the soil stress conditions.

Key words: Planting techniques, Pit types, Soil types, Skeletal soil, Sustainable fruit production, Pomegranate, Fruit quality, Nutrients concentration

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Unreaped Yield Potentials of Major Rainfed Crops and Scope for Bridging Yield Gaps - *A Decision Support System through a Mobile app*

R. Nagarjuna Kumar*, B.M.K. Raju, C.A. Rama Rao, Josily Samuel, A.V.M. Subbarao, M. Srinivas Rao, G. Nirmala, N.S. Raju and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: nagarjunakumar191@gmail.com*

Bridging yield gaps is recognized as an important element of the strategy for raising productivity and farm incomes. Identifying and targeting districts, the administrative units at which most of the development planning and resource allocation is done in the country, where considerable yield gaps exists will be useful in planning interventions needed. With this, districts with considerable yield gaps were identified (Raju et al., 2013,2018) and was made available in the form of a Decision Support System (DSS)(http://www.icar-crida.res.in:8129/.). In this scenario, it is expected that integration of ICTs in agricultural extension will provide needed impetus to agricultural sector and ICTs can complement the traditional extension system for "Knowledge Resource" delivery to the millions of the farmers. To facilitate this mobile based technology dissemination in agriculture provides significant opportunity for farmers and extension workers to work together more effectively. Mobile phone enabled information delivery mechanism can help to meet the information needs of small farmers by reducing their knowledge gaps. Therefore, a mobile app for Unreaped Yield Potentials of Major Rainfed Crops and Scope for Bridging Yield Gaps 'was developed based on developed DSS. The App lists the model districts for a given crop and target District and indicates possible crop management for bridging yield gap. The App identifies 3 model districts having climate, soil, share of irrigated area under the crop and share of a particular season in area under the crop similar to the district (target) selected. The output can be downloaded as word file or in Excel sheet format for further use.It is very useful for the policy makers, researchers, extension workers.

Key words: DSS, Unreaped Yield Potentials, Knowledge Resource, Yield Gaps

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Rainfall analysis for assessing sowing risks in Central India

Manish Bhan[1]*, A.V.R. Kesava Rao[1] and Sreenath Dixit[2]

[1]Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, Madhya Pradesh
[2]ICRISAT Development Centre, ICRISAT, Patancheru-502324, Telangana
**Corresponding author: bhan.manish@gmail.com*

An attempt to assess sowing risks due to changes in rainfed crop-growing period during 1961-2016 years using daily gridded rainfall data in Madhya Pradesh. During SWM, rainfall variability is low at about 20-25 percent in central and eastern parts compared to about 26-37 percent in western and northern parts of the state. Results indicated that rainfed crop-growing period starts as early as 20 June in eastern parts, and Burhanpur district. It starts by 10 July in north, and by 01 July in the remaining regions. Season ends as early as 20 October in north and western; while it ends as late as 20 November in eastern part of the state. Total LGP varies from 100 days in the north-west to about 155 days in the south-east region. Changes in LGP between baseline (1961-1990) to recent (1991-2016) indicated a little change of five days in most of the state, whereas twenty-five districts observed a reduction of about 6-15 days. Small patches in Sagar, Damoh, Narsimhapur, Seoni, Shivpuri, Bhind and Tikamgarh districts observed a decline of 15 days. In certain years, presence of long dry spell after sowing leads to seedling death and necessitates re-sowing, and considered as sowing risk. Based on daily rainfall data, sowing risks was about 11-27 per cent in northern parts along with patches in Neemuch, Ratlam, and Ujjain districts during 1961-90 years. This has expanded to western parts during 1991-2016 years however, less in eastern parts of the state. In eastern region, higher rainfall receives with relatively lower risks than northern and western regions that receive lower rainfall with more sowing risks. Soybean, maize, groundnut, and cotton are the major crops sensitive to moisture stress, hence emphasis needed in providing sowing advisories to these farmers based on seasonal and medium range weather forecasts.

Key words: Rainfall, Sowing, Weather, Central India

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Optimisation of Machine Learning Models for Location-Specific Crop Yield Prediction using Weather Indices

Ajith S.[1]*, M.K. Debnath[2] and B.M.K. Raju[3]

[1]*CIMMYT-India, Hyderabad, Telangana*
[2]*Department of Agricultural Statistics, Uttar Banga Krishi Viswavidyalaya, Pundibari-736165, West Bengal*
[3]*ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana*
**Corresponding author: ajithagristat@gmail.com*

The crop yield prediction gains growing importance for all stakeholders in agriculture. The yield decline is often not realised at the macro level but has been a serious concern at the regional or district level. The changes in climate-yield relationship are more pronounced at the local level than across relatively large regions. Hence, district-level yield prediction may be an appropriate approach. In order to obtain a location- and crop-specific model, different models with different functional forms have to be explored. In the present study, two machine learning models namely, Artificial Neural Network (ANN) and Support Vector Regression (SVR) were fitted using weather indices as input variables. ANN model was trained with three different activation functions and various combination of hidden layer neurons. Similarly, SVR model was trained with three different kernel functions with various combinations of hyperparameters. Stepwise Regression (SR), Principal Component Analysis (PCA) and Partial Least Square Regression (PLSR) were employed to select the input variables before fitting models to avoid overfitting issue and increase speed of model training. The crop selected for the present investigation is Rapeseed-mustard and study area is four northern districts of West Bengal namely, Cooch Behar, Jalpaiguri, Malda and Uttar Dinajpur. The results revealed that SR-ANN and PCA-ANN models with Tangent hyperbolic activation function performed better for Cooch Behar and Jalpaiguri districts while PLSR-ANN model with logistic activation function performed better for Uttar Dinajpur district. The PLSR-SVR model with Radial Basis Function (RBF) kernel performed well for Malda district. The study concluded that the best-fitted model for a location or crop may not perform better for another location or crop. Hence, different models with different functional forms have to be fitted to obtain a location- and crop-specific model since the crop yield is complexly associated with many weather factors.

Key words: Optimisation, Location specific model, Machine Learning models, Hyperparameter tuning, Weather indices

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Effect of Different Land Use System on Soil Chemical Properties in Kodagu District, Karnataka

Syed Ali[1]*, Shubhashree Sahu[2], Salma[3] and Vasudev L.[4]

[1]*College of Forestry, Sirsi, Uttara Kannada, UAS, Dharwad-581401, Karnataka*
[2] *V.C.S.G. Uttrakhand University of Horticulture and Forestry, Bharsar-249145, Uttarakhand*
[3]*Indira Gandhi Krishi Vishwavidyalaya, Raipur-492012, Chhattisgarh*
[4]*College of Horticulture, Hiriyur, KSNUAHS, Shivamogga-577598, Karnataka*
**Corresponding author: syedalipeer511@gmail.com*

Land use system has a significant effect on soil properties. Understanding the impacts of various land-use systems on the soil properties is essential for implementing optimal land management practices. The present study was carried out to know the effect of different land use system on soil chemical properties in Kodagu district, Karnataka. Five different land use systems viz., T_1 - Natural Forest, T_2 - Coffee based agroforestry, T_3 - Teak plantation, T_4 - Agriculture field and T_5 - Fallow land were selected for soil sampling. A randomized complete block research design was used to carry out this experiment with five treatments and four replications. Soil samples were collected in three depths *i.e.,* d_1 - 0-15 cm, d_2 - 15-30 cm and d_3 - 30-45 cm from all the five land use systems. The study revealed significant difference in soil chemical properties in different land use system. The highest mean value of available N (443.98) and SOC (3.72) was recorded in Natural Forest (T_1) followed by Coffee based agroforestry (T_2), Teak plantation (T_3) whereas least values of available N and SOC was found in Fallow (T_5) and Agriculture land (T_4). The results also show that highest mean value of available P (47.54) and K (331.13) was observed in Coffee based agroforestry (T_2) followed by Natural Forest (T_1) and Teak plantation (T_3) whereas lowest values were recorded in Fallow(T_5) and Agriculture land (T_4). The highest mean value of soil pH and EC was recorded in Fallow(T_5) and lowest soil pH and EC was observed in Natural Forest (T_1). It was also evident that all chemical parameters values decreased with increasing soil depth except soil pH. The soil chemical properties under Agriculture and Fallow land were poorer than the soil under other land use system which indicated that change in land use have an impact on soil chemical properties.

Key words: Soil chemical properties, Land use system and Agroforestry

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Performance of *Dendrocalamus stocksii* and Associated Crops under Agroforestry Situation in Humid Region of Karnataka

Salma[1]*, Ramakrishna Hegde[2], Syed Ali[3] and Dhanushree K.[2]

[1]Indira Gandhi Krishi Vishwavidyalaya, Raipur-492012, Chhattisgarh
[2]College of Forestry, Ponnampet, Kodagu, KSN UAHS, Shivamogga-571216, Karnataka
[3]College of Forestry, Sirsi, Uttara Kannada, UAS, Dharwad-581401, Karnataka
**Corresponding author: salmadysp@gmail.com*

The utilization of bamboo in agroforestry has gained recent recognition as a promising land-use system with the potential to enhance ecological stability and economic efficiency for agricultural communities. The present study was conducted in four years old *Dendrocalamus stocksii* plantation at Main Agricultural Research Station at Iruvakki, Shivamogga district during 2022-23. The study was carried out in split-plot design with three spacings *i.e.,* T_1 (8 m × 4 m), T_2 (8 m × 6 m) and T_3 (8 m × 8 m) of *Dendrocalamus stocksii* as main plot and sub plot consists Curcuma *longa* and *Alpinia galanga* as intercrops. The study findings indicated that *Dendrocalamus stocksii* showed superior growth performance when planted with a wider spacing, specifically at T_3 (8 m × 8 m), followed by T_2 (8 m × 6 m). In contrast, the least growth performance was observed in the closely spaced T_1 (8 m × 4 m). Moreover, the research unveiled differences in intercrop yields across distinct bamboo spacing arrangements. Turmeric and galangal recorded the highest yields in the wider spacing of T_3 (2677 kg ha^{-1}), followed by T_2 (2309 kg ha^{-1}), whereas the lowest yields were recorded in the closely spaced T_1 (1764 kg ha^{-1}). In all the spacing regimes, the yield of galangal was found significantly greater (4129 kg ha^{-1}) than the yield of turmeric (371 kg ha^{-1}). The highest combined biomass of turmeric and galangal was found in T_3 (3374.55 kg ha^{-1}), followed by T_2 (2902.94 kg ha^{-1}), while the lowest was found in T1 (2235.81 kg ha^{-1}). Therefore, this research highlights the significance of optimizing bamboo spacing and incorporating intercropping strategies to improve the overall productivity and sustainability of bamboo-based agroforestry systems. In this current study, it is suggested that a relatively wider spacing of 8 m × 8 m appears to be the most suitable geometry for establishing *Dendrocalamus stocksii*-based agroforestry in the humid region of Karnataka. This spacing is recommended for achieving better yields and overall productivity.

Key words: Bamboo based agroforestry, Intercrops, Spacing, Yield and productivity

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Identification of Appropriate Thermal Response Function for better Growth Simulation in Pigeonpea

Thimmegowda M.N.*, Manjunatha M.H., Lingaraj Huggi, Jayaramaiah R., Soumya D.V., Pooja R.S., Arpitha V. and Nagesha L.

AICRP on Agrometeorology, University of Agricultural Sciences, GKVK, Bangalore-560065, Karnataka
**Corresponding author: mnthimmegowda@gmail.com*

Among several production sectors agriculture is the major one experiencing the major impact of climate change. Such impacts themselves are characterized by their spatial and temporal variability. Impact on global agricultural production may be small, regional vulnerabilities may increase, imparting regional food security. Such differential impacts are mainly due to climatic aberrations, which under the changing climate scenario, vary with respect to time and space. Reports have shown considerable variation in the onset, cessation, quantum and distribution of rainfall besides the increasing temperature. Rainfall being a quantitative parameter, can be assessed using statistical tools. On the other hand, qualitative parameters like temperature require knowledge of sensitivity of crops for variations in temperature. Such sensitivities are analyzed using '*Thermal Response Functions*' and are incorporated into process based simulated models. Five such response functions adopted by various models *viz.,* Non-linear, Linear, Linear Plateau, Linear_max and Trapezoidal were evaluated for TTB-7 variety of pigeonpea based on the long-term (2003-2019) datasets on growth and yield. Dataset from 2003 to 2015 was considered for calibration and from 2016 to 2019 for validation purpose was used based on observed days to attain each phenological stage (emergence, anthesis and physiological maturity) sown under three dates of sowing (early, normal and late sowings). Results revealed better agreement of Linear_max for emergence (0.47, 1.00, and 1.00 RMSE, r and R^2, respectively), Linear_plateau (AQUA) for both the stages of anthesis (21.23, 0.99 and 0.99 RMSE, r and R^2, respectively) and physiological maturity (61.05, 0.88 and 0.78) had confirmed better agreement with simulated days for attaining that particular phenological stages, rendering them a better function for reducing uncertainties in growth and yield simulation in pigeonpea.

Key words: Thermal, Growth, Pigeonpea

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Assessment of Major Crop Yield Levels using Climate Projection for Regional Food Security in Karnataka

Manjunatha M.H.*, Thimmegowda M.N., Lingaraj Huggi, Padmashri H.S., Jayaramaiah R., Soumya D.V. and Nagesha L.

AICRP on Agrometeorology, University of Agricultural Sciences, GKVK, Bangalore-560065, Karnataka
**Corresponding author: mh.manjunatha@rediffmail.com*

Agriculture sector is one among several production sectors on which the climate change impact is observed within a short span. Such impact is characterized by its spatial and temporal variability, but it is expected that the impact on global agricultural production may be small. However, regional vulnerabilities may increase, imparting regional food security. Climate variability therefore, have a direct impact on regional food security. Such impact is majorly due to climatic aberrations, which under the changing climate scenario vary with respect to time and space. Reports have shown considerable variation in the onset, cessation, quantum and distribution of rainfall besides the increase in temperature. These have major impact on food production especially in the states having major rainfed regions such as Karnataka. In order to assess the impact of changing climate on the productivity of different crops in the districts of Karnataka. A study was conducted using projected climatic scenarios and simulation model '*InfoCrop*'. Being a generic crop model, *InfoCrop* considers the impacts of weather, soil, management (planting, nitrogen, irrigation and residues) and pests on crop growth and yield, soil nutrient dynamics (soil organic carbon and nitrogen), resource use (water and nutrient) and greenhouse gas emissions. The model was calibrated using long-term historical crop yield dataset (1990-2018) and yields were simulated for 2035. Outcome revealed varying trends in productivity of crops in the state. Increase in yield levels of crops like chickpea (13.5%), cotton (55.6%), maize (24.5%), sorghum (20.3%), soybean (28.9%) and pigeonpea (19.2%) and decrease in yield levels were observed in rice (5.6%) and wheat (0.6%) under the changed climate scenario in 2035 as compared to baseline yields. Further, assessment of regional level crop yields revealed loss of productivity of rice in South Interior Karnataka (SIK) and Coastal Region (CR), wheat in North Interior Karnataka (NIK), Chickpea, Maize, Rice, Sorghum and pigeonpea in Hilly Region (HR) of the state. Looking into the outcomes, recommendations were made to reduce area under rice in SIK and CR, Wheat in NIK, Chickpea, Maize, Rice, Sorghum and pigeonpea in HR and potential alternate crops were recommended in place of those crops. In addition to increasing crop productivity, the outcomes of the study also support planning the management practices for yield improvement in the crops identified with decreasing yield and hence to achieve regional food security.

Key words: Climate, Food Security, Crop, Karnataka

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Assessment of Spectral Indices in Relation to Irrigation Scheduling in Wheat Varieties

Megha Singh* and Manish Bhan

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, Madhya Pradesh
**Corresponding author: meghas682@gmail.com*

Madhya Pradesh state of central India is a major producer of wheat, and some of its varieties are marketed globally. The quality and quantity is affected with varying irrigated conditions. A remote sensing approach is used to monitor crop water status and identify water stress, as based on a principle of spectral reflectance. On this basis, a field experiment was started with an aim to identify water sensitive growth stages using spectral indices in wheat varieties under varied irrigated water applied at fixed depth: Cumulative Pan Evaporation (IW: CPE) levels. It was laid out in a factorial randomized block design with wheat varieties (LOK1 and MP 3336) as first factor, while four different IW: CPE ratio at 1.0, 0.9, 0.8, 0.7 as the second factor. The crop sown manually with row spacing of 20 cm and recommended management practices were practiced. The canopy reflectance (spectral range: 350-1100 nm, 0.5 nm band width) was recorded by using handheld spectro-radiometer on bright sunshine day at five phenological stages; boot, spikelet emergence, milk, soft dough and physiological maturity stages, respectively. Five spectral indices namely water index (WI), normalized water index-1(NWI-1), normalized water index-2(NWI-2), normalized water index-3(NWI-3), and normalized water index-4 (NWI-4) were used for the assessing irrigation sensitive stages in wheat. All the water stress indices varied with changes in water content. Spectral indices, WI, NWI-1, NWI-2, NWI-3 and NWI-4 were found significantly correlated with grain yield and straw yield at soft dough and physiological maturity among both the varieties. Water index found to be highly correlated with the grain and biomass yield among both the varieties, followed by NWI-1 and NWI-4 indices. Among the varieties, LOK-1 showed water sensitive at soft dough and physiological maturity stages whereas MP 3336 at milk and soft dough stages in wheat.

Key words: Wheat, Irrigation, Madhya Pradesh

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Monitoring and Evaluation of Real Time Contingency Measures for Management of Agricultural Drought in Rainfed Cotton

Chorey A.B.[1]*, Patode R.S.[2], Mali R.S.[3], Ganvir M.M.[4] and Gabhane V.V.[5]

AICRP for Dryland Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444104, Maharashtra
**Corresponding author: chiefscientist1057@gmail.com*

Cotton (*Gossypium hirsutum* L.) is the most important fibre crop of the semi-arid tropics of Indian sub-continent that is predominantly rain dependent. The field experiment was conducted at research field of AICRP for Dryland Agriculture, Dr. PDKV, Akola (MS) during 2021-2022 and 2022-23 to study the effect of real time contingency measures adopted in cotton such as opening of furrows in each row after 30-35 days after sowing and foliar sprays on yield and economics of cotton is studied and analysed. The experiment was laid out in large plot design (Randomized within the plot) with the cotton variety PDKV JKAL-116 BT sown at the spacing of 90 x 45 cm with two treatments viz; T_1: Management of crop during dry spell (Real Time Intervention and T_2: Control (No real time intervention). In treatment T_1 real time interventions such as opening of furrows in each row at 30-35 DAS and foliar spray of 19:19:19 mix water soluble fertilizer at flowering stage are implemented to cope up with the dry spells whereas in control plot no intervention as applied. Results indicated that the soil moisture status under RTCP treated plot was higher at 0-15 and 15-30 cm depth both as compared to control plots during and also recorded less water runoff of 15.66 mm and 41.8 mm as compared to control (19.74mm and 44.3 mm) during both the years. During the year 2021-22 and 2022-23 the treatment of management of crop during dry spell (Opening of furrows in each row and foliar application of 19:19:19 mix fertilizer at flowering stage) recorded higher seed cotton yield (1111 and 1224 kg ha^{-1}), NMR (40437 & 66023 Rs ha^{-1}, B:C ratio (1.79 & 2.65) and RWUE (1.15 & 1.18 kg $ha^{-1}mm^{-1}$) than the treatment of control *i.e.* with seed cotton yield (1019 and 1086 kg ha^{-1}), NMR (38921& 55867 Rs. ha^{-1}), B:C ratio (1.70 & 2.47) and also the RWUE (1.05 &1.04 kg $ha^{-1}mm^{-1}$). Seed cotton yield increased by 9.09 per cent and 12.71 per cent than control plot (No RTI) during both the years studied.

Key words: Monitoring, Real Time, Cotton, Maharashtra

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Spatial Trends and Seasonal Variability of Consecutive Dry Days (CDD): A Potential Predictor for Drought Forecasting

K.G. Sumesh*

AICRPAM, Vijayapura Centre
**Corresponding author: bjp.aicrpam@gmail.com*

This study investigates the variations in the cumulative number of consecutive dry days (CDD) across India over five-year intervals for four distinct seasons: January to March, April to June, July to September, and October to December. The analysis reveals significant increasing trends in consecutive dry days over southern and central India during the April to June and October to December seasons, while decreasing trends are observed in northern India during the same periods. Conversely, an increasing trend in consecutive dry days is observed over northern India, with a decreasing trend over southern and central regions during the July to September season. Consequently, the findings suggest an anticipated increase in the number of dry days over southern and central India during the April to June and October to December seasons, accompanied by a decrease in northern India. Conversely, an increase in dry days is expected over northern India during the July to September season, with a decrease in southern and central regions. These trends are anticipated to impact crop productivity in respective areas, necessitating proactive measures for agricultural management and drought mitigation.

Key words: Consecutive Dry Days (CDD), Forecasting, Crop

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Evaluation of Different Empirical Models for Estimating Global Solar Radiation in East Madhya Pradesh

G. Rupa[1]*, Manish Bhan[2] and Saon Banerjee[3]

[1]*Department of Agronomy, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur-482004, Madhya Pradesh*
[2]*Department of Physics and Agrometeorology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, Madhya Pradesh*
[3] *Agrometeorologist and Professor, AICRP on Agrometeorology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741235, West Bengal*
**Corresponding author: gandirupa@gmail.com*

Sun is the source of energy for all the physical and biological processes on earth. The energy is transferred through electro-magnetic solar radiation as a complex fluctuation of latitude, day of the year, solar inclination angle, and solar constant. Accurate estimation of incoming global solar radiation is useful for renewable energy resource, solar energy-based technologies, hydrological systems, agriculture, etc. The measurement of global solar radiation (GSR) needs pyranometer instrument which is not available in many locations. To overcome this, empirical models can be used to estimate GSR using weather parameters available at surface meteorological observatory. On this basis, a study was conducted of testing Angstrom equation, its quadratic and cubic forms as Angstrom-Prescott, Ogelman, and Bahel models, their best-fit, and a common constant used in central Indian conditions. Daily recorded solar radiation and bright sunshine hour's data were recorded at Jabalpur from 2019-2021 years. The extra-terrestrial radiation was calculated for the same years of Jabalpur using equation given by Castellvi. The results revealed that GSR varied from 11.9 - 24.4 MJ m^{-2} day^{-1}. It was observed that Bahel model exhibited better performance with RMSE of 0.83 MJ m^{-2} day^{-1} and MBE of 0.21 MJ m^{-2} day^{-1}, as compared to the other models. Correlation coefficient was similar among the three Angstrom equations and close to unity, however, R^2 values exhibited maximum in Ogelman and Bahel models. Thereby concluded that Bahel model is good in predicting GSR for central Indian conditons.

Key words: Angstrom equation, Extra-terrestrial radiation, GSR, Pyranometer and Sunshine hours

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Water Productivity of Sunflower under Subsurface Drip in an Inceptisol of Eastern India

Sanatan Pradhan*, P. Panigrahi, Biswaranjan Behera and Ankhila R.H.

ICAR-Indian Institute of Water Management, Bhubaneswar-751023, Odisha
**Corresponding author: sanatan28@gmail.com*

A field experiment was conducted during *rabi* season of 2022-2023 to study the effect of resource conservation technologies involving different irrigation methods and preceding maize residue on crop growth, yield and water productivity of sunflower (cv. DRSH-1). The experiment was laid out in a randomized block design with four replications involving ten treatments. The treatments included permanent broad-bed furrow irrigation (PBBF), permanent broad-bed furrow irrigation with residue (PBBF+R), permanent narrow-bed furrow irrigation (PNBF), permanent narrow-bed furrow irrigation with residue (PNBF+R), zero-till surface drip irrigation (ZTDI), zero-till surface drip irrigation with residue (ZTDI + R), zero-till sub-surface drip irrigation (ZTSDI), zero-till sub-surface drip irrigation with residue (ZTSDI+R), zero-till flatbed flood irrigation (ZTFBF), conventional till flatbed furrow irrigation with residue (CTFBF+R). The sunflower seed yield was the highest under ZTSDI+R (2.04 t/ha). The seed yield of ZTSDI+R was statistically ($P<0.05$) at par with ZTSDI, ZTDI+R and ZTDI. The seed yield was the lowest in CTFBF (1.42 t/ha). There was no significant yield difference between PNBF+R, PNBF, PBBF+R, PBBF, ZTFBF+R and CTFBF treatments. The ZTSDI+R provided a 44% higher yield as compared to CTFBF. The water use varied between 293-498 mm under various treatments. The lowest water use was in ZTSDI+R and the highest water use was in ZTFBF+R and CTFBF. The highest seed yield and the lowest water use led to the highest water productivity (6.97 kg/ha-mm) under the ZTSDI + R. The ZTSDI + R registered 26%, 38%, 39%, 73%, 74%, 83%, 113% and 144% higher crop water productivity as compared to the ZTDI + R, ZTDI, PBBF + R, PBBF, PNBF+R, PNBF, ZTFBF and CTFBF, respectively. It may be concluded that zero tillage subsurface drip irrigation may be practiced for higher water productivity of sunflower in the Inceptisol of Eastern India.

Key words: Zero Tillage, Subsurface Drip Irrigation, Sunflower, Water Productivity

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Natural Farming in Light of Changing Climate and Soil Health

Pushpanjali*, S. Kundu, K.S. Reddy, P.K. Pankaj, T.V. Prasad, A. Gopala Krishna Reddy and Josily Samuel

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: pushpanjali@icar.gov.in*

Indian agriculture is a critical determinant of national food security. The sector has made enormous strides since the 1990s, moving from widespread food deficits to net food exports and surpluses in spite of population growth. India reached staple grain self-sufficiency over the past five years, and this trend is expected to continue in the future. Intensification of Indian agriculture has resulted in burgeoning costs for producers and severe environmental degradation. A major and urgent area for intervention is increasing the resilience (and thus reducing the vulnerability) of livelihoods, particularly among the poor who are highly dependent on natural resources and exposed to climate risks. The Economic Survey (2019) categorized alternative farming practices like Natural farming as one of the farming models which highlights elimination of agro-chemical and support sustainable agricultural production with eco-friendly processes in tune with nature. It is documented that the adoption of natural farming practices will improve the soil quality parameters like soil structure-aggregate stability, water holding capacity, soil organic matter, base saturation, nutrient pools, pest and pathogen suppression, and the delivery of mineralizable nutrients. Enhancement of soil microbial community can lead to the removal of methane emission and in turn, may lead to a reduction in GHG emissions, and improved carbon sequestration. In view of this, an experiment was initiated in ICAR-CRIDA-Hayathnagar Research Farm in 2022 to evaluate the impact of natural farming on soil health and crop productivity in rainfed production systems. It was found that there was substantial increase in soil respiration in the experimental plots treated with jeevamritam compared to conventional farming. Weed suppression and better soil moisture was also observed in the natural farming plots.

Key words: Climate change, Soil health, Food security

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Comparative Analysis of Maize Crop Evapotranspiration Derived from UAV-based Multispectral & Thermal Sensors with Eddy Covariance Flux Tower Measurements

Charan Babu A.[1]*, T.L. Neelima[2], Chandrasekar K.[3], Nidhi Misra[3] and K. Avil Kumar[2]

[1]Department of Agronomy, College of Agriculture, Rajendranagar, [2]Water Technology Centre, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad-500030, Telangana
[3]Water Resources Group, National Remote Sensing Centre, Balanagar, Hyderabad-500037, Telangana
**Corresponding author: charanbabu4927@gmail.com*

The Evapotranspiration (ET) is the major component of the terrestrial hydrological cycle. The ET is sensitive to the deficiency in soil moisture and can be used in water productivity and drought studies. A study was conducted at the Maize Research Center, Professor Jayashankar Telangana State Agricultural University (PJTSAU), aimed to estimate crop evapotranspiration (ET_c) of maize crop under two different irrigation treatments i. 20% (I_{20}) and ii. 40% (I_{40}) Depletion of Available Soil Moisture (DASM) during the *rabi* season of 2022-23. The ET_c was estimated from the Unmanned Aerial Vehicle (UAV) mounted optical and thermal sensors based on METRIC (Mapping EvapoTranspiration at high Resolution and Internalized Calibration) model and compared it with ET_c estimated using Penman-Monteith method. During the study, the irrigation water applied was 400 mm and 316 mm for the I_{20} and I_{40} treatments, respectively. The METRIC model used the UAV-based high-resolution optical and thermal spatial data to compute ET_c and the Penman-Monteith method estimated ET_c using the parameters from the Eddy Covariance (EC) flux tower and field observations. Between the two irrigation treatments, the $METRIC_{UAV}$ ET exhibited 16% and 20% higher average daily and seasonal ET_c respectively for the I_{20} treatment (2.50 mm day^{-1} and 318 mm) compared to I_{40} treatment (2.15 mm day^{-1} and 265 mm) while the PM_{EC} showed 17% and 21% higher average daily and seasonal ET_c for the I_{20} (2.61 mm day^{-1} and 332 mm) compared to the I_{40} treatment (2.23 mm day^{-1} and 276 mm). However, comparing the crop ET estimates derived from $METRIC_{UAV}$ and PM_{EC} with the soil water balance approach, an underestimation of 6% and 2% was observed respectively. Based on the analysis, it can be concluded that the evapotranspiration of maize crop can be estimated through the UAV-based optical and thermal sensors and using the weather and field parameter from EC flux tower. It was found that, the maize crop under 20% DASM treatment exhibited higher evapotranspiration compared to 40% DASM.

Key words: Evapotranspiration, Irrigation, UAV, Eddy covariance

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Coupling Biophysical Parameters with Thermal and Visible Imaging for Predicting Yield of Yellow Rust Affected Wheat Crop using Machine-learning Algorithms

R.N. Singh[1]*, P. Krishnan[2], A.K. Singh[1] and K. Sammi Reddy[1]

[1]ICAR-National Institute of Abiotic Stress Management, Pune-413115, Maharashtra
[2]ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: rns.iari@gmail.com*

Field experiments were conducted for two years (2017-18 and 2018-19) to evaluate the effect of yellow rust on biophysical parameters of wheat cultivars with varying levels of resistance to yellow rust and to construct machine-learning models for yield prediction. Results revealed that as the level of rust increased, so did the canopy temperature and there was a significant decrease in crop biophysical parameters. The yield reduction varied from 15.9 – 61.1%. The machine learning models were able to give early yield estimates, with the accuracy increasing as the harvest approached. Among the models tested, Cubist was found to be the most effective in predicting wheat yield under yellow rust conditions. The study quantified the influence of rust on various crop characteristics and highlighted the effectiveness of employing machine-learning models to predict crop yield early in instances of biotic stress by utilizing remote sensing and biophysical parameters.

Key words: Stripe rust, Machine learning, Standardized Ranking Performance Index

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Promoting Bamboo and Teak Boundary Plantations in Tribal Areas for Generating Plantation based Green Carbon Credit

Sridhar K.B., Manoranjan Kumar, Venkatesh G., J.V.N.S. Prasad, Narsimlu, B., P.K. Pankaj, G. Ravindra Chary and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: sriaranya@gmail.com*

The Government of India on October 13, 2023, notified, Green Credit Programme (GCP), mainly to incentivize voluntary environmental actions. Green credit' is a single unit of an incentive provided for a specific activity that delivers a positive impact on the environment. Farmers are the important stakeholders. The Indian Council of Forestry Research and Education (ICFRE), Dehradun, is the administrator. The administrator verifies activities and after verification, issues a tradeable green credit certificate. The GCP includes activities, such as: i) Tree Plantation ii) Water, iii) Sustainable agriculture, iv) Waste management, v) Air pollution reduction, vi) Mangrove conservation and restoration, vii) Ecomark viii) Sustainable building and infrastructure. ICAR Central Research Institute for Dryland Agriculture, Hyderabad, Telangana under Tribal Sub Plan is promoting teak and bamboo based boundary plantations in tribal villages viz, Malkapur, Keslapur, Borjuguda, Pittabongaram and Mutnoor of Adilabad district in Telangana. The quality planting material of teak and bamboos were sourced from AICRP AF, Nagpur. The seedlings after establishment will start sequestering carbon. Each carbon credit represents 1 tonne of carbon dioxide or the equivalent greenhouse gas (CO2e) avoided, reduced or removed. The global average price is $4 (330 INR) per carbon credit. Teak may yield 300-351 tonnes of carbon per hectare after 20 years which result in obtaining INR 1,15,550/-. Bamboo, can sequester up to 60 tonnes of CO_2 per year which result in INR 79,200/year. This initiative marked the transition from only carbon credit to green credit with anticipated far-reaching environmental benefits.

Key words: Bamboo, Teak, Plantation, Carbon

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Effect of Zinc Oxide Nanoparticles (ZnO NPs) on Rice under Temperature Stress Condition

Achchhelal Yadav*, Monika Kundu, Arti Bhatia, S.P. Sharan and Anup Kumar

ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: achchheyadav@yahoo.com*

The study investigated the potential of zinc oxide nanoparticles (ZnO NPs) in mitigating the adverse effects of elevated temperature on rice plants. The experiment was conducted in a Free Air Enriched Temperature (FATE) facility at ICAR-Indian Agricultural Research Institute, New Delhi, and the effects of ZnO NPs were compared to a control in FATE and a group treated with zinc sulfate ($ZnSO_4$). The results revealed that ZnO NPs treatments improved crop physiological parameters such as photosynthetic rate (Pn) (15.6%), stomatal conductance (gs) (8.2%), chlorophyll concentration (5.2%) at flowering stage as compared to the control and $ZnSO_4$ treatments in FATE. These physiological parameters were also significantly ($p<0.05$) reduced under control in FATE as compared to the absolute control (control in ambient). The ZnO NPs soil application increased superoxide dismutase (SOD) and catalase (CAT) enzyme activity significantly ($p<0.05$) over the control in FATE. These biochemical parameters were significantly lower ($p<0,05$) in control than the absolute control (control in ambient). The total root length, total surface area, average diameter of ZnO NPs increased significantly ($p<0.05$) over the control and $ZnSO_4$ treatments under FATE. The grain yields ($hill^{-1}$) of control and $ZnSO_4$ manipulated soil under FATE reduced significantly ($p<0.05$) compared to the absolute control. However, the ZnO NPs manipulation of soil improved grain yield ($hill^{-1}$) significantly over the control as well as group of $ZnSO_4$ treatments in FATE. The studied yield parameters were non-significantly different between ZnO NPs manipulated soil and absolute control. The zinc content in rice grains was significantly higher in the ZnO NPs treatments, while iron concentration did not show significant changes. The phytic acid content was significantly reduced in the ZnO NPs-treated soil. These results indicate that ZnO NPs could mitigate the adverse effects of elevated temperature on physiological, biochemical and yield attributes.

Key words: Zinc Oxide, Rice, Temperature, Nanoparticles

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Seasonal Incidence of Cotton Pink Bollworm in Relation to Weather Parameters and its Forewarning using Statistical Approach

A.R. Tupe[1]*, A.B. Chorey[2], M.M. Ganvir[2], R.S. Patode[2], V.V. Gabhane[2] and S.T. Morey[1]

[1]AICRP on Agrometeorology, [2]AICRP for Dryland Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444104, Maharashtra
**Corresponding author: tupearvind@rediffmail.com*

To find out the effect of weather parameters on the incidence of pink bollworm and also to predict the occurrence of the pest using statistical methods for predicting the outbreak of this pest for taking appropriate measures operationally to control the damage of the pest on cotton with these objectives the study were conducted on the role of weather factors on pink bollworm was studied on seven cotton varieties as seven treatments viz., AKA-9916, AKH-081, AKA-0905, AKA-07, BT AKH-081, Balwan and JKL-116 with three replication under randomized block design, natural epiphytotic conditions for the year 2021 at Dryland Agricultural Farm Dr. PDKV, Akola. The numbers of pink bollworm larva in green bolls were recorded at weekly interval starting from first week of September to first week of December for the year 2021, the larval incidence on green bolls in cotton varied from 1.00 to 8.00 larvae per ten green bolls. The incidence started from first week of September (36th MW) 1.00 larvae per ten green bolls and later, the larval population increased gradually with first peak of 7.00 to 8.00 larvae per ten bolls during 44th to 47th MW. The peak incidence was noticed in 47th MW (10-16 Sept) i.e. 8 larvae/10 bolls. The larval population declined with nil after 48th MW. Neither of the weather parameters acts in insolation but in combination in influencing the insect pest. Cotton pink bollworm (dependent variables) was regressed with a combination of weather parameters (independent variable) viz, temperature (maximum and minimum current, Lag I, and Lag II), Mean relative humidity current, Lag I, and Lag II, and rainfall that were identified as relevant weather variable by the correlation analysis. Regression equations developed to predict the incidence of pink bollworms based on different weather parameters explained variance percentages of multiple regression analysis showed that the effects of current, Lag I and II maximum temperature, current, Lag I mean relative humidity (RH) and current, Lag I rainfall on AKA-9916 cultivars with significant positive correlation (r2=0.949) similar, model prediction developed for AKH-081, AKA-0905 and AKA-07. Relation with a regression model for Bt. cultivars viz., Bt. AKH-081, Balwan, and JKL-116 showed that significant positive correlation of pink bollworm with very little combination of weather parameters. A significant positive correlation (r = 0.990) was found between pink bollworms with current temperature, Lag II minimum temperature, and Lag I mean relative humidity in Bt. AKH-081. Similarly, the model developed in Balwan and JKL-116 cultivars with significant positive correlation (r = 0.992) respectively.

Key words: seasonal incidence, green boll damage, larval population, pink boll worm

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Knowledge Level of Rainfed Farmers on Natural Resource Management Practices

C.N. Anshida Beevi*, K. Ravi Shankar, G. Nirmala, K. Nagasree, Jagriti Rohit, B.M.K. Raju and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: anshida.cn@icar.gov.in*

Agriculture sector is dependent on natural resources. One of the greatest challenges facing the world today is meeting the rising demand for food with a sustainable natural resource base. Awareness and knowledge about the technology significantly contribute towards the effective transfer of technologies and understanding the knowledge level of farmers is also very important as it influences the adoption of technologies to a great extent. Better knowledge on NRM practices are critical inputs in farming activities in rainfed areas. Hence, it is important to make farmers aware on the importance of natural resource management (NRM). This calls for measuring the knowledge level of farmers on NRM practices. The present study attempted to construct a knowledge test to measure the knowledge level of rainfed farmers. Based on the standard procedure, a total of 18 items were selected in the final knowledge test. Further, knowledge level of rainfed farmers were measured using the standard test developed. Comparison of knowledge level between control and treated groups was done by applying t-test and it was found to be significantly different among these groups. The knowledge test developed in this study could be used for assessing the knowledge level of farmers on NRM practices across the country.

Key words: Knowledge, Farmer, NRM

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Enhancing Climate Resilience in Agriculture through Institutional Interventions: Experiences from NICRA

Nagasree K.*, Pratibha G., Prasad J.V.N.S., Ramarao C.A., Prabhakar M., Srinivas I., Ravishankar K., Jagriti Rohit, Anshida Beevi C.N. and Subbarao A.V.M.

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: nagasreeicar@gmail.com*

Climate change can exacerbate existing social and economic inequalities, with vulnerable populations often bearing the brunt of the impacts. Disruptions to livelihoods, displacement, and the loss of homes and assets can contribute to increased social tensions. Local governments, communities, and individuals can take adaptive measures to mitigate these impacts, but effective responses often require coordinated efforts at regional, national, and international levels. It is in this context, the technology demonstration component of NICRA aims to deploy suitable strategies for adaptation and resilience to Climate Change at grassroots level for enhancing coping ability of farming communities. The National Innovations on Climate Resilient Agriculture (NICRA) initiative in India under technology demonstration component implements institutional interventions at the village level to enhance agricultural resilience in the face of climate change. These interventions focus on community empowerment through the formation and strengthening of farming community groups, capacity-building programs, and the establishment of demonstration farms. Emphasis is placed on providing climate information services, promoting diversified agriculture, improving water harvesting and management, and facilitating market linkages. Additionally, risk management strategies, community resource persons, and collaborative research efforts are key components of these interventions. The overall goal is to strengthen local capacities, disseminate climate-resilient agricultural practices, and foster sustainable development in farming communities. The focus of the programme is not only to demonstrate the climate resilient agriculture technologies but also to institutionalize mechanisms at the village level for continued adoption of such practice in sustainable manner. Access to Institutions at village level enabled participation and decision-making of farmers which facilitated coordinated action and build social capital. Hence institutional interventions like community seed bank, fodder bank, farm machinery custom hiring centre etc. are being implemented under NICRA through active involvement of farmers /stake holders across the districts. The institutional setup in NICRA villages is unique in the way that they are tailored to the needs of the communities and their functioning varies across the different sites of country based on the location specific problems. The project experience from the earlier two phases of NICRA reveals that the presence of dedicated institutions enhanced the resilience with ecofriendly practices with improved access to climate resilient technologies, weather-based advisories and information on coping mechanisms which also ensured the persistent efforts to support and protect farmers.

Key words: Climate, Agriculture, NICRA, Institutional Intervention

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Synthesis and Standardization of a Nano-sized Form of Sodium Nitroprusside and its Impact on the Initial Growth of Maize (*Zea mays* L.) Seedlings under PEG Induced Moisture Stress

Bobbe Sivakumar[1]*, M. Mohamed Yassin[1], S. Marimuthu[2], M.K. Kalarani[3] and S. Thiyageshwari[4]

[1]Department of Agronomy, [2]Centre for Agricultural Nanotechnology, [3]Directorate of Crop Management, [4]Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: bsky100100@gmail.com*

Sodium nitroprusside (SNP) is a common substance used to decrease the harmful effects of abiotic stress and to improve the germination and early seedling growth of crops. However SNP use is limited by its short lifespan and photosensitivity. With this context, current study taken up to that synthesize of SNP loaded chitosan nanoparticles and to standardize for the seed treatment. SNP loaded chitosan nanoparticles were successfully synthesized by using ionic gelation method. A variety of characterization techniques utilized *viz.*, Dynamic Light Scattering (DLS), Fourier-Transform Infrared Spectroscopy (FT-IR) and release kinetics. A laboratory experiment was conducted to standardize the ideal SNP nanoformulation dosage for seed treatment in order to minimize the negative impacts of drought stress in maize. The treatments involved soaking seeds in solutions containing various concentrations of SNP nanoformulation, including 20, 40, 60, 80 and 100 ìM including control. The experimental results indicated that, among SNP nanoformulation concentrations, seeds treated with @ 100 ìM concentration showed the highest germination percentage (85%), promptness index (82.3%), vigor index (1624%), shoot and root length (8.4 cm and 11 cm), fresh and dry weight of shoot (123.7 and 61.6 mg/20seedlings) and root (52.6 and 25.0 mg/20 seedlings) respectively, under PEG-induced drought stress conditions compared with control.

Key words: Chitosan, DLS, FTIR, Maize, PEG and sodium nitroprusside nanoparticles

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Water Resources Conservation Strategies in On-Farm Percolation Tanks for Sustainable Productivity in Rainfed Ecosystem

Boini Narsimlu[1]*, J.V.N.S. Prasad[1], T.V. Prasad[1], A. Amarender Reddy[2], K.S. Reddy[1], R. Rejani[1] V.K. Singh[1] and G. Ravindra Chary[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]ICAR-National Institute of Biotic stress management, Raipur-493225, Chhattisgarh
**Corresponding author: narsimlu.boini@icar.org.in; narsimlu@yahoo.com*

Godavari zone of Telangana has been classified is characterized by semiarid climate with farming situation of vertisols/alfisols with 1150 mm precipitation and major cropping pattern of cotton, rice during kharif season and chickpea, safflower and sesamum during rabi. Agriculture is the major source of livelihood of the people and productivity in the region is very poor due to lack of water resources during the terminal drought situation in spite of good annual average rainfall. The habitats of the region are poor farmers and mostly belongs scheduled caste families. The specific problem of this region is the subsoil layers are impermeable with limestone formations of sedimentary origin. To enhance agricultural productivity, income and livelihoods, a two years (2020-2021) Onfarm field study was carrriedout using on-farm percolation tank (OFPTs) with water resources conservation and management strategies (desilting, providing surplus weirs and sluice). Study conducted in three modules, OFPTs with conservation and management strategies, OFPTs without conservation measures and control without any OFPTs for integrated farming in rainfed ecosystem. The sizes of OFPTs are ranging from 2500 m3 to 4500 m3. Significantly highest cotton equivalent yield (2813 kg/ha), net returns (Rs 136050/ha), benefit cost ratio (5.44) and higher water use efficiency (2.21 kg/ha-mm) were recorded in farmers' field OFPTs with conservation and management strategies followed by control without any OFPTs, (CEY 1063 kg/ha). Followed by control without any OFPTs (CEY 1063kg/ha) and least in farmers' OFPTs with without conservation measures (CEY (783 kg/ha). Reasons for this result were water resources conservation and management strategies and efficient utilization of conserved rainwater during terminal as well as intermittent stage of dryspell and crop diversion from paddy to cotton. The study reveals that the OFPTs technology is one of the promising techniques for increasing the agricultural productivity of rainfed ecosystem.

Key words: Onfarm percolation tanks, Resource conservation, Livelihoods, Cotton equivalent yield

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A Real Time Object Detector for Crop-weed Discrimination in Bt Cotton

Aditya Kanade[1]*, Milind Potdar[2], Aravinda Kumar B.N.[3] and Gurupada Balol[4]

[1]Department of Agronomy, University of Agricultural Sciences, Dharwad-580005, Karnataka
[2]AICRP (Dry Land Agriculture) Regional Agricultural Research Station, Vijayapur-586101, Karnataka
[3]AICRP (Irrigation Water Management), Agricultural Research Station, Arabhavi-591306, Andhra Pradesh
[4]AICRP on MULLaRP, University of Agricultural Sciences, Dharwad-580005, Karnataka India
**Corresponding author: adityakanade276@hotmail.com*

Weeds, often considered unwanted plants, present a significant challenge to agricultural crops like cotton by competing with them for vital resources such as nutrients, sunlight, and water. Traditional manual methods for identifying and managing weed infestations are labor-intensive and time-consuming, thus limiting their effectiveness for farmers. To tackle this issue, an experiment was conducted during the kharif-2022 season at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka . The aim was to develop a precise and efficient real-time technique for detecting and locating weed plants within cotton crops. High-resolution images were captured using a DSLR camera mounted on a tripod stand, positioned vertically downward at a height of 80 cm. The study utilized advanced YOLO (You Only Look Once) object detector, specifically employing YOLOv8s. This detector integrates convolutional neural networks (CNNs) and anchor boxes to identify and categorize objects within images. The primary focus was on detecting weeds in cotton crop images and distinguishing them as either grass or broadleaf. The detectors underwent training using a dataset comprising 2000 images. Evaluation of the algorithms yielded promising results, with detection accuracy expressed as mean average precision (mAP) of 77.40% at a 0.5 IoU (Intersection over Union) threshold level. These findings underscore the efficacy of convolutional neural network-based object detection algorithms in real-time weed detection within cotton fields. This approach presents a cost-effective and efficient solution for targeted weed management, enabling farmers to accurately locate and detect weeds. Consequently, farmers can implement focused herbicide applications, reducing the need for indiscriminate spraying and ultimately enhancing crop yields.

Key words: Cotton, Weed detection, Computer vision, Deep learning

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Soil and Weather Data Collection using Internet of Things and RPA Tools

N. Mahesh Teja, N.S. Raju, Lakshmi Saroja G., Manikyam, Sai Ram J., N. Ravi Kumar and Nagarjuna Kumar

ICAR-Central Research for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: narisettynani@gmail.com*

The system proposed in this paper is an advanced solution for monitoring the weather conditions at a particular place and make the information visible anywhere in the world. The technology behind this is Internet of Things (IoT), which is an advanced and efficient solution for connecting the things to the internet. In this project we have established IOT sensor Network with ESP 8266 (Node MCU) Microcontroller board and other sensors are LM 100 is Soil moisture sensor, LM35 for Temperature, humidity sensor and Rain drop sensor to collect rainfall information. We have collected data from the IoT sensors are then transmitted back to a central point (or the cloud) for analysis, visualisation and trend analysis. The complete system has been developed and deployed on a pilot scale, where the sensor node data is wirelessly collected using web-services into remote server. The temperature, humidity, soil moisture and rainfall information is collected in 5 minutes interval and transferred to remote location with Arduino Wi-Fi technology. The data stored in this system can be accessed from anywhere through internet. The resultant data can be used to optimise farming operations, identify trends and make subtle adjustments to conditions to maximise crop yield and quality.

Key words: Soil, Weather, Internet of Things, RPA Tools

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Constraints in Adopting Agromet Advisories Service (AAS) by Farmers of Dryland Regions

Jagriti Rohit*, S.K. Bal, C.N. Anshida Beevi, K. Nagasree, K. Ravi Shankar, G. Nirmala, B.M.K Raju and Vinod Kumar Singh

ICAR-Central Research for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: jags.rohit@gmail.com*

Climate change is associated with extreme weather events leading to damaging impacts on crops and livestock. Dryland areas are particularly affected by the changing climatic scenario. An Agromet Advisory Service (AAS) relies on scientific insights from meteorology in conjunction with agricultural information. This comprehensive package of information is then disseminated to farmers with the objective of "empowering farmers to plan their agricultural activities strategically to minimize crop damage during adverse weather conditions" (Tall et al., 2014). In India, the National Centre for Medium Range Weather Forecasting (NCMRWF) Meteorological Department (IMD) n Council of Agricultural Research (ICAR), and State Agricultural Universities (SAUs) work together to provide farmers with weather forecasts and Agrometeorological Advisory Services (AAS) advice on how to manage their crops accordingly. Medium-range weather forecasts, which predict weather conditions for the next 2 to 3 weeks, are used to create location-specific forecasts for each agroclimatic zone and district. This helps farmers to get the most relevant information for their area (Chaubey et al., 2018). It has been observed that seasonal climate projections have shown potential for informing agricultural decisions, but the actual adoption of climate information by farmers has been relatively slow and limited (Goddard et al., 2010; Lemos and Rood, 2010). Hence, the present study was conducted to assess the constraints faced by the farmers in adopting AAS. Two districts namely Anantapur and Kurnool were selected for study where in 280 farmers were the respondents of the investigation. The findings revealed that inputs not being available on time while implementing the messages in the field and difficulty in comprehending the messages while putting in action in the field situation were the barrier in adoption of AAS.

Key words: Adoption, Agromet Advsioy services, Constraints

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Change Impact Assessment on Blackgram Genotypes in North Interior Karnataka: A DSSAT Modeling Approach for Resilient Agricultural Strategies

Abburu Pravallika* and R.H. Patil

University of Agricultural Sciences, Dharwad-580005, Karnataka
**Corresponding author: abburupravallika@gmail.com*

Blackgram, an important pulse crop in North Interior Karnataka (NIK), faces climate-related challenges in both rainfed and irrigated conditions. Climate change, marked by rising temperatures and erratic rainfall, poses a significant threat to its productivity. To evaluate the impact of projected climate conditions from 2021 to 2040, a comprehensive study was initiated. Experimental data for model calibration and validation, aiming to obtain the genetic coefficients of twelve blackgram genotypes (DBG-5, DBG-19, DBG-31, DBG-33, DBG-34, DBG-93, DBG-16, DBG-96, DBG-90, DBG-61, DU-1, and DBG-95), were collected from trials conducted in 2022 at the Main Agricultural Research Station (MARS), UAS, Dharwad. The CROPGRO model simulated scenarios under current (2011-2020) and projected (2021-2040) climates, tailored for black and red soils in each district of NIK. Across the 12 districts, certain genotypes, notably DBG-61, displayed consistent performance in anthesis and maturity under current conditions. Simulations for projected climates revealed a reduction in days to anthesis and maturity, with DBG-61 maintaining high yields, especially on black clay soils. Genotypes like DBG-61, DBG-96, and DBG-93 consistently showed increased grain and biomass yields, highlighting their resilience to changing environmental conditions in NIK.

Key words: DSSAT Modeling, Resilient, Blackgram, Karnataka

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Impact of Temperature Extremes on Crop Phenology across Diverse Agro-ecological Regions in India

Mamta Kumari[1]*, Abhishek Chakraborty[1], Vishnubhotla Chakravarathi[2], Varun Pandey[1], Parth Sarathi Roy[3] and V.M. Chowdary[1]

[1]Agriculture Sciences and Agriculture Group, Remote Sensing Applications Area, National Remote Sensing Centre, Balanagar, Hydearbad-500037, Telangana
[2]Centre for Earth, Ocean and Atmospheric Sciences, University of Hyderabad, Gachibowli-500032, Telangana
[3]Sustainable Landscapes and Restoration, World Resources Institute India, New Delhi-110016
**Corresponding author: mamta9507@gmail.com*

Global warming has altered the timing of crop seasonal events in South Asia, as highlighted in the IPCC 6th report. Remote sensing emerges as a crucial tool, providing valuable information on long-term changes in crop seasonality at the regional scale and can be useful in assessing the impact of extreme temperatures on agriculture. Despite the importance of this issue, there is a scarcity of studies analyzing the effects of extreme heat events on crop phenology, particularly in a country like India.Therefore, the primary objectives of this study were twofold: (a) to determine the spatio-temporal trends in hot extremes using the Heat Wave Magnitude Index daily (HWMId) across different Agro-Ecological Zones (AERs) in India from 2001 to 2018, and (b) to analyze the impacts of monthly and seasonal hot extremes on *rabi* crop phenology in the country. The study utilized long-term CPC temperature datasets (0.5°×0.5°) to characterize monthly and seasonal extreme heat events. Additionally, Normalized Difference Vegetation Index (NDVI) data from MODIS at a 250 m scale were employed to extract crop phenology metrics. Results indicated a significant increase in the HWMId for the month of March over AER-15, 17 (eastern), AER-2 (western), AER-1, 14 (northern), and AER-3, 8, 9, and 12 in India. Furthermore, the analysis of the impacts of monthly and seasonal hot extremes on crop phenology demonstrated that the end of the season was advanced with an increase in HWMId in January, February, and March, particularly in the Indo-Gangetic plains (IGP) of India. A notable shortening of the length of the season was also identified, supported by a significant negative correlation with HWMId in the IGP and the southern part of India. In conclusion, the findings of this study offer valuable insights in developing strategies to adapt to the changing climate and minimize losses from extreme weather events.

Key words: Extreme heat events, HWMId, Crop phenology, Trend, Satellite

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Maize Leaf Nitrogen Status Estimation in Maize using Artificial Intelligence

Shivashakar, K.[1], M.P. Potdar[2], D.P. Biradar[3], K.K. Math[4] and Gurupada Balol[5]

[1]Rejuvenating Watershed for Agricultural Resilience through Innovative Development (REWARD) project, Dharwad, University of Agricultural Sciences, Dharwad-580005, Karnataka
[2]AICRP on Dry land Agriculture, Regional Agricultural Research Station, Vijayapura, University of Agricultural Sciences, Dharwad-586101, Karnataka
[3]Department of Agronomy, College of Agriculture, Dharwad, University of Agricultural Sciences, Dharwad-580005, Karnataka
[4]Department of Soil Science & Agricultural Chemistry, College of Agriculture, Dharwad, University of Agricultural Sciences, Dharwad-580005, Karnataka
[5]AICRP on MuLLARP, University of Agricultural Sciences, Dharwad-580005, Karnataka
**Corresponding author: ksshivu98@gmail.com*

Now the world is experiencing revolutions in agriculture 5.0 due to artificial intelligence (AI), machine learning based decision making systems for resource use efficiency and overall sustainability. AI can be applied for assessing soil and crop nutrient status where AI algorithms assess the images captured by remote sensors or digital cameras and calculates variations within a field, generating a nutrient map which enables to diagnose the crop nutrition status which provides information on the supply of nutrients to plants. Hence an attempt was made to estimate the maize leaf nitrogen status using artificial intelligence. The experiment was conducted during *rabi*-2020-21, at University of Agricultural Sciences, Dharwad, Karnataka . The experiment was laid out in randomized complete block design comprising of nine graded levels of nitrogen (Absolute control, 25, 50, 75, 100, 125, 150, 175 and 200% RDN), replicated thrice. The organization used by the developed model is typically picture acquisition, processing and classification. For classification, self-acquired real-time images of the maize leaves were captured from the experimental plots receiving varied levels of nitrogen. The images of leaves were captured from 15 DAS up to 90 DAS at frequent intervals (weekly twice) from different levels of nitrogen applied plots. Large number of images were collected during *rabi* season which were used as dataset to develop a model. AI based algorithm developed using Convolutional Neural Network (CNN) with programming language of python achieved a maximum accuracy of 76.3 per cent in detection of the maize leaf nitrogen status of maize.

Key words: Algorithm, Artificial Intelligence, Convolutional Neural Network, Maize, Nitrogen

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Digital Soil Mapping Approach for Studying Spatial Variability of Soil Properties and Delineation of Management Zones

Arunima Chakraborty*, Justin George K. and Suresh Kumar

Indian Institute of Remote Sensing n Space Research Organization, Department of Space, Government of India, Dehradun-248001, Uttarakhand
**Corresponding author: urmi.arunima.25@gmail.com*

Managing soil nutrients sustainably and having a thorough grasp of the geographical variability of soil properties, crop yield can be increased and soil deterioration can be prevented. Soil properties are dynamic they vary spatially due to presence of different nutrients and physical properties are different even within a field. The present study was conducted in 2023 in a part of Saharanpur district of Uttar Pradesh. Soil samples from 117 geo-referenced locations were collected from 0-15 cm of soil surface region. Samples were taken to laboratory for analysis of various physio-chemical properties and tested for EC, pH, texture, BD, SHC, AWHC and nutrients like N, P, K, OC. The mean values of EC, pH, OC, N, P, K, AWHC, SHC, CEC are 0.10, 7.01, 0.47, 0.07, 26.29, 94.45, 1.55, 33.13, 16.61. NDVI and SAVI images used to study the vegetational information of the area and other vegetation indices were computed to get idea about the soil reflectance behaviour due to various concentration of mineral salts present. Terrain indices were computed to get rough idea about the drainage characteristics and sloping pattern of the area. Interpolation by Kriging and Co-Kriging were done as geo-statistical analysis to show the spatial distribution pattern of soil variables and spatial dependency is classified between weak, moderate and strong. Computation of error from best fitted semi-variogram models by co-kriging was lesser giving the better mapping of soil properties. From principal component analysis (PCA) we got 4 principal components (PCs) having Eigen value>1 and by taking the scores of selected PCs for each location points, fuzzy c means clustering has been done with to get the optimum number of clusters that can be represented as management zones. For so, we used two indices Fuzzy Performance Index (FPI) and Modified Partition Entropy (MPE) and got four number of clusters or management zones where we can imply similar management practices. ANOVA analysis is computed to indicate the significant difference between soil, terrain and vegetation parameters among the four MZs. Thus, within zone and between zones variability of different attributes can be made for proper management of soil and as a result can show improvement in agricultural production. In order to maximize crop output in the region, the study stressed that the methodology for defining MZs may be applied successfully for site-specific soil nutrient management for various crops.

Key words: Soil properties, Spatial distribution, Geo-statistics, ANOVA

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Potassium Release in Relation to Charge Characteristics of Shrink-swell Soils (Vertisols) in India

Priya P. Gurav*, S.K. Ray, S.C. Datta and P.L. Choudhari

All India Coordinated Research Project on Dryland Agriculture, ICAR-CRIDA, Hyderabad-500059, Telangana
**Corresponding author: priyaguravnbss@gmail.com*

Studies concerning the charge properties of clay minerals have been widely published; however, studies on the evaluation of the location of charge within clay minerals and the charge density in smectitic dominant soils are rare. The relationship between the charge characteristics and the location of charge within clay minerals with potassium (K) fixation/release is unclear. The objectives of this study were: i) to determine the total charge density of clays and the location of charge within the clays in three Vertisols of regional importance; and ii) to relate K release from clays to the charge characteristics of the clays. Total and tetrahedral cation exchange capacities (CEC) were measured in these experiments, and octahedral CEC was estimated using the difference between total and tetrahedral CEC. The results indicated that 60, 60 and 64% of the total charge was due to tetrahedral charge in the Kheri, Panjari and Teligi soil series respectively. The tetrahedral CEC and tetrahedral charge density were negatively correlated with K release threshold values, and with all fractions of K. The tetrahedral CEC contributed more to the K fixation/release compared to octahedral CEC. The beidellite content of the clays in these soils probably contributed to the tetrahedral CEC/charge density of these soils, which indicated a tendency to fix K, and release K more reluctantly compared to lower charge smectitic clays.

Key words: Potassium, Vertisols, Soil

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Rainfall Probability and Crop Planning for Ratnagiri district of Konkan Region in Maharashtra

V.G. More*, V.G. Chavan, V.A. Rajemahadik, P.S. Bodake and D.B. Malve

Department of Agronomy, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri-415712, Maharashtra
**Corresponding author: morevijay1966@gmail.com*

The rainfall plays a core role in every agricultural activity in Konkan region of Maharashtra and the detailed rainfall variability and trend study is important in Konkan region. The daily rainfall data over a period of 51 years (1972 to 2022) were obtained from Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (M.S.) . The data were analysis by using Weather Cock 14 software developed by All India Coordinated Research Project on Agrometeorology, Central Research Institute for Dryland Agriculture, Hyderabad. The annual precipitation trend analysis of 51 years shows slight increase in precipitation tend. The annual maxima and minima of precipitation was 5290.80 and 2330.70 mm with 123 and 90 rainy days recorded during 1990 and 2015, respectively. The monthly maximum precipitation received during the month of July (1249.25 mm) within 27.9 rainy days. The more deviation of rainfall was observed during month of June to August during SW monsoon. The weekly precipitation start decrease from 43rd meteorological week (22 October to 28 October). The stable value of CV is observed in 24th (11 June to 17 June) to 37th (10 September to 16 September) SMW indicating the assurance of rainfall in the region. The probability of heavy rainfall was expected during the period of 27th (2 July to 8 July) to 32nd (6 August to 12 August) SMW which coincide with the transplanting operation in rice which is major field of the region and this rainfall is effective for puddling operation during transplanting of rice crop. The sowing of *kharif* crops must be completed by 23rd to 24th meteorological weeks (04th to 17th June) and sowing of groundnut must be completed by 32nd to 33rd meteorological weeks (06th August to 19th August) for normal monsoon in Konkan region. In case of delay in monsoon, it is advised to use short duration rice varieties recommended by Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli for Konkan region. The precipitation received during 41st SMW onward is less than 1 per cent of annual rainfall which underline the rain water harvesting of surplus water form 36th SMW i.e. in the month of September onward to provide lifesaving irrigation to *kharif* crop at critical growth stage during dry spell and early sowing of *rabi* crops.

Key words: Rainfall, Crop, Maharashtra

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High-yielding Horse Gram Varieties Suitable for Rainfed Agriculture

Salini K., B. Sarkar, V. Maruthi, M. Vanaja, N. Jyothilakshmi, S.S. Shisodia, P.R. Reddy, M. Srinivasa Rao and V.K. Singh

Division of Crop Science, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: salinik2007@gmail.com*

Horse gram [(*Macrotyloma uniflorum* (Lam.) Verdc.] is a climate-resilient leguminous crop used as food, fodder, green manure and cover crop with medicinal properties. As the variability is limited in the available germplasm, mutation breeding was resorted to create variability followed by selection. Two genotypes namely K-42 and Hyderabad Local were used as parental lines and variability was induced through physical mutagen, ã-ray irradiation of seeds. Surviving viable mutants with improved plant type were selected and advanced in subsequent generations. Several stable lines were developed by selections being carried out from M_1 to M_6 generations. Promising lines were entered in to the Initial Varietal Trial (IVT) of All-India Multi-location trials of the National Network Research Project on Arid Legumes and promoted to Advanced Varietal Trial I and Advanced Varietal Trial II (AVT) for identification and release as a variety. Based on multi-location evaluation under AICRP on Arid Legumes in different years of evaluation, four superior mutants CRIDA-18R, CRHG-4, CRHG-19 and CRHG-22 were identified and subsequently released as variety by Central Variety Release Committee (CVRC) for South India.

CRIDA 18R: The variety was released in 2009 for South India evolved through ã ray irradiation of K 42. It is a brown seeded variety and matures in 85-90 days. It is a dual-purpose variety with 750 – 1150 Kg/ha grain yield and 2500 – 3000 Kg/ha fodder yield. It shows synchronized flowering with brisk podding behavior and non-shattering pods. Resistant to yellow mosaic virus, powdery mildew, leaf blight and root rot and tolerance to mites.

CRHG-4 (CRIDALATHA): Developed by mutation breeding of Hyderabad Local through g rays irradiation and released for south India in 2010. It matures in 85-95 days. It is a dual-purpose variety yielded on an average 785 kg/ha with 700 – 1100 Kg/ha grain yield and 2700 – 3300 Kg/ha fodder yield. It is a black-seeded variety having non-shattering pods. Shows higher tolerance to powdery mildew, anthracnose, YMV and mites

CRHG – 19 (CRIDAHARSHA): Drought tolerant high yielding horse gram variety released and notified for South India under rainfed conditions. in 2014. Mutant derivative of K-42

evolved through ã ray irradiation. Yields on an average 760-1300 kg/ha of grain 2800-3500 kg/ha of fodder and matures in 85-90 days. Tolerant to Powdery Mildew, Anthracnose Yellow Mosaic Virus, Cercospora leaf Blight and Whiteflies.

CRHG-22 (CRIDAVARDHAN): High yielding, drought-hardy horse gram variety released & notified for South India in 2016. Mutant derivative of Hyderabad Local evolved through ã ray irradiation. Yields on an average 855-1500 kg/ha of grain 2827-3524 kg/ha of fodder and matures in 95-100 days.

Innate climate resilience of these varieties suggests their scope as a suitable alternative in the present climate change scenario. The farmers stand to gain substantially by cultivating this drought tolerant, dual purpose, medium duration, high yielding, highly nutritious, disease and pest tolerant, non-shattering podded variety as compared to the local varieties under changing climatic conditions also. Resilience to changing climatic conditions, and adaptability to poor soil conditions made it a popular variety in north and eastern states also. These varieties are having untapped potential to support poor and marginal farming communities of drylands by providing income, food, feed and nutritional security in the present and future changing climatic scenario.

Key words: Rainfed, Horse gram, Crop

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Analysis of Annual and Seasonal Rainfall Variability and Extreme Events over Jammu Province

Charu Sharma[1], Mahender Singh[1], Monika Banotra[1], B.C. Sharma[1], Rohit Sharma[1] and Lobzan Stanzin[2]

[1]Agrometeorology Section, Sher-e-Kashmir University of Agricultural Sciences & Technology Jammu, Jammu-180009, Jammu & Kashmir
[2]Krishi Vigyan Kendra, Reasi-182301, Jammu & Kashmir
**Corresponding author: charu.soilsc@gmail.com*

Climate Change can have an influence on rainfall that significantly affects the magnitude frequency of floods and droughts. Therefore, analysis of variability and trends of rainfall is of utmost important for sustainable management and planning of agriculture and water resources under changing climate. The analysis of trend and variability of annual, seasonal and monthly rainfall of stations of Jammu province based on years monthly rainfall data (1983-2022) is an important objective of this study. Nonparametric Mann-Kendall (MK) and Spearman's rho (SR) tests were used to achieve if there are an increasing and decreasing trend in the time series. The results from both statistical tests, MK and SR, were consistent with one another. No significant trends were observed for the seasonal and annual precipitation time series at Jammu, Katra and Banihal stations. At Batote and Bhaderwah stations, there were significant negative trends in the pre-monsoon (March-May) season whereas positive trends in the monsoon (June-September) season at Bhaderwah station. On monthly scale, June month show increasing trend significant for Banihal. March showed decreasing trend at all stations significantly for Batote and Bhaderwah station. As for as heavy rainfall (64.4 < R d" 124.4) events is concerned decreasing trend was observed at Katra and Bhaderwah stations whereas increasing trend was observed for Banihal and Batote stations. No trend was observed at Jammu station. This study can be helpful for regional scale planning about pre and post disaster floods, drought mitigation and agricultural development.

Key words: Annual and Seasonal Rainfall, Jammu

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Analyzing the Impact of the Southwest Monsoon on *Kharif* Rice Acreage in different Blocks of the Raipur district using Microwave Remote Sensing

Gostham S.[1], Gopi Krishna Das[2] and Prashant Khawishwar[3]

[1]National Remote Sensing Centre, Hyderabad-500037, Telangana
[2] Indira Gandhi Krishi Vishwavidyalaya, Raipur-492012, Chhattisgarh
[3]Chattisgarh Council of Science and Technology, Raipur-492014, Chhattisgarh
**Corresponding author: somasundharamgowtham7120@gmail.com*

This study utilized Synthetic Aperture Radar (SAR) data from Sentinel-1 to estimate the *kharif* paddy acreage in the Raipur district. The unique capability of microwaves to penetrate clouds enabled the mapping of paddy fields even during the monsoon season. Supervised classification based on training samples was employed to delineate paddy fields. The results demonstrated that the estimated paddy area closely matched the reported area, with error percentages of 5.3% and 8.6% in 2017 and 2019, respectively. The analysis of data from 2011 to 2019 revealed a consistent decline in both paddy acreage and rainfall during that period. Furthermore, the block-level analysis indicated significant spatial variations, with the Arang blocks having the largest paddy cover and the Raipur block the least. Moreover, a strong correlation was observed between southwest monsoon rainfall and the *kharif* rice cultivation, with paddy acreage decreasing during SW monsoon deficit years. These findings shed light on the impact of monsoons on rice cultivation and can guide agricultural planning and water resource management strategies in the region.

Key words: Synthetic Aperture Radar (SAR), *kharif* paddy acreage, Monsoon season, Supervised classification, Sentinel-1

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Assessment of Important Soil Properties of India using Mid-Infrared Spectroscopy

Nishant K. Sinha*, K.M. Hati, M. Mohanty, R.S. Chaudhary, Prampd Jha, J.K. Thakur, M. Vassanda Coumar, Dhiraj Kumar, N.K. Lenka, Jitendra Kumar and Rahul Mishra

ICAR-Indian Institute of Soil Science, Bhopal-462038, Madhya Pradesh
**Corresponding author: nishant.sinha76211@gmail.com*

Spectroscopy is emerging as one of the most promising technologies for rapid and cost-effective alternatives to routine laboratory analysis for many soil properties. This study was conducted to evaluate the potential of the mid-infrared spectroscopy technique for rapid and non-destructive measurement of some important soil properties in major soil orders of India. More than 1500 geo-referenced soil samples from 0-15 cm soil layer of Alfisols, vertisols, and inceptisols were collected from the different parts of India. The partial least-squares regression, random forest, and support vector machines were compared to calibrate spectral data with wet chemistry soil data. The coefficient of determination, root mean square error and residual prediction deviation (RPD) were used for the model evaluation. We found that the PLSR-based predictive models performed better than the other two regression techniques for all the soil properties. Good predictions with independent validation data sets were obtained for clay, sand percentage, and soil organic carbon (SOC) content, while satisfactory predictions were achieved for silt percentage and pH value. However, the performance of the predictive models was poor in the case of EC and extractable nutrients such as available phosphorus and potassium contents of the soil. Specific regions of the MIR spectra that contributed to the prediction of soil SOC, pH, clay, and sand percentage were identified. The study demonstrated the potential of the MIR spectroscopic technique in simultaneous estimation of SOC content, sand, clay, silt percentage, and soil pH.

Key words: Soil, Spectroscopy

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Decadal Analysis of the Impact of Future Climate on Wheat Production in Central India

Jitendra Kumar*, Nishant K. Sinha, M. Mohanty, N.K. Lenka, Dhiraj Kumar, Rahul Mishra and Alka Rani

ICAR-Indian Institute of Soil Science, Bhopal-462038, Madhya Pradesh
**Corresponding author: jitendra.iari@gmail.com*

The evidence of climate change is ubiquitous with an increase in temperature and CO_2 concentration, changing precipitation patterns, and increased number and severity of climate-related natural disasters, such as heatwaves, droughts, severe storms, cyclones, and flooding. Since agriculture is heavily dependent on weather and climate, the climate extremes may interrupt crop growth, irrigation patterns, water use efficiency, soil health, and biodiversity, which leads to a reduction in food production and, thus, poses threats to food security. The global mean temperature has increased by 0.8°C since the 1850s. It is projected to increase by 2 to 7°C at the end of the century. The rising temperature and CO_2 concentration could significantly affect crop production. This study has performed the decadal impact of climate change on maize productivity in central India using the ensemble global climate models (GCM). The GCMs, namely BCC-CSM1-1, BCC-CSM1-1-M, GFDL-CM3, GFDL-ESM2G, GFDL-ESM2M, GISS-E2-H, and GISS-E2-R, were ensembled to generate future climate data (2040–2090) for central India, under scenarios RCP4.5 and RCP8.5. The results show a decrease in up to 30% of wheat grain in varying decades under the RCPs studies.

Key words: Climate, Wheat, Central India

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Effect of Ca-bentonite Application on Soil Nutrients and Moisture Availability in Maize-Pigeonpea Crop Rotation under Rainfed Condition

A.K. Indoria[1], S. Kundu[1], V.K. Singh[1], K. Srinivas[1], K. Sammi Reddy[2], S.S. Balloli[1], M. Manjunath[1], G. Pratibha[1], K.V. Rao[1] and H. Sahu[1*]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]ICAR-National Institute of Abiotic Stress Management, Baramati-413115, Maharashtra
**Corresponding author: hemant.sahu@icar.gov.in*

A field experiment was conducted at the GRF of ICAR-CRIDA, Hyderabad, to study the effect of Ca-bentonite application on soil nutrients and moisture availability in maize-pigeonpea crop rotation under rainfed conditions. Treatments include: T1=Control, T2=75% of the recommended dose of N, P & K (RDF), T3=100% RDF, T4=5 t Ca-bentonite/ha+75% RDF, T5=10 t Ca-bentonite/ha+75% RDF, T6=15 t Ca-bentonite/ha+75% RDF, T7=20 t Ca-bentonite/ha+75% RDF, T8=5 t Ca-bentonite/ha+100% RDF, T9=10 t Ca-bentonite/ha+100% RDF, T10=15 t Ca-bentonite/ha+100% RDF, and T11=20 t Ca-bentonite/ha+100% RDF. The maize crop was raised under rainfed conditions, and no supplement irrigation was given during the crop-growing season. Results show a significantly higher (12.7%) maize grain yield recorded in 100% RDF as compared to 75% RDF. About 12.8% higher grain yield was recorded in 20 t Ca-bentonite+100% RDF as compared to 100% RDF. About 26.7 higher yield was recorded in the 20 t Ca-bentonite+100 RDF as compared to the 75% RDF. 15 t Ca-bentonite+75% RDF and 20 t Ca-bentonite+75% RDF did not differ significantly. There was a slight decrease in the available soil nitrogen and a slight build-up of soil P and K with the added level of Ca-bentonite, along with 75% and 100% RDF treatments. The soil nitrogen did not significantly differ among the Ca-bentonite+RDF treatments. There was a build-up of the available P and K with the added level of Ca-bentonite. The soil protease activity and acid phosphatase activity decreased, while L-glutaminase and alkaline phosphatase activity increased in the Ca-bentonite+RDF treatments. Results further show that higher soil moisture (0.56 to 56.78%) was recorded in the Ca-bentonite treatments as compared to the control during the maize growing season. The effect of the Ca-bentonite was more pronounced during dry spells as compared to just after rain. The water release pattern shows that it linearly releases the water as pressure increases. The overall results of the study revealed that the application of Ca-bentonite in rainfed conditions enhanced soil moisture dynamics, nutrient availability, and crop yield.

Key words: nitrogen, phosphorus, potassium, micronutrients, soil enzymes

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Simulation of Maize Growth, Yield and Nitrogen Dynamics under Conservation Agriculture (CA) based Nitrogen Management using CERES-Maize

Kamlesh Kumar[1,2]*, C.M. Parihar[1], T.K. Das[1], P.C. Ghasal[2], A.L. Meena[2], Simardeep Kaur[3], Peyush Puniya[2], R.P. Mishra[2] and Sunil Kumar[2]

[1]ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]ICAR-Indian Institute of Farming System Research, Modipuram, Meerut-250110, Uttar Pradesh
[3]ICAR-Research Complex for NEH Region, Umiam-793103, Meghalaya
**Corresponding author: kamleshsoni39@gmail.com*

A field experiment was conducted during the rainy (*kharif)* seasons of 2020 and 2021 at ICAR-Indian Agricultural Research Institute (IARI), New Delhi to investigate the effects of different tillage and nitrogen management methods on the growth pattern, productivity and nitrogen intricacies in maize (*Zea mays* L.) crop in a conservation agriculture (CA)-based maize-wheat system. Three contrasting tillage methods [conventional tillage (CT), zero tillage with residue (ZT) and permanent beds with residue (PB)] in main plots and five nitrogen options [Control (Zero nitrogen), N (urea) @150 kg N/ha, Green Seeker-GS based N application, urea super granules-USG + GS based N and basal application of slow release fertilizer (SRF) @150 kg N/ha] in sub plots were taken with three replication in a split plot design. CERES-Maize (DSSAT) model was used to simulate the growth behavior, yield and nitrogen dynamics of the crop. The model accurately predicted days to anthesis and physiological stages within 5% of observed values. Furthermore, the simulated leaf area index (LAI) curve closely matched observed data across treatments, with an RMSE of 0.57 and nRMSE of 10.33%. The root mean square error (RMSE) for grain and biomass was 457 and 1755 kg ha-1, respectively, for the validation year (2022-23). The normalized RMSE (nRMSE) of the measured and simulated grain yield were 9.27 and 10.60%, respectively. The simulated grain yields of maize generally matched the measured values well in most of the treatments except for N0 treatments in both CT and ZT tillages in which model slightly over-predicted the grain yield. Despite this exception, the model's performance in predicting grain and biomass yields for most treatments was accurate, highlighting its effectiveness in simulating maize crop productivity. Additionally, the model successfully simulated soil ammonical and nitrate concentrations as well as nitrogen uptake by the crop within an error margin of 5-11%, highlighting its efficacy in predicting various aspects of nitrogen dynamics.

Key words: Maize, Nitrogen, CERES

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Influence of Surface and Subsurface Soil Hydraulic Conductivity on Runoff Generation Process for the North-West Himalayan Region of India

Saswat Kumar Kar[1]*, R.M. Singh[2], S.K. Samal[1], S. Patra[3] and M. Sankar[3]

[1]ICAR-Indian Institute of Soil & Water Conservation, Research Centre, Sunabeda, Koraput-763002, Odisha
[2]Department of Farm Engineering, Banaras Hindu University, Varanasi-221005, Uttar Pradesh
[3]ICAR-Indian Institute of Soil & Water Conservation, Dehradun-248195, Uttarakhand
**Corresponding author: saswatkumarkar@gmail.com*

The present study is focused on the effect of landuse [conservation agriculture (CA), conventional tillage (CT) and undisturbed sal forest] changes on soil hydraulic properties and runoff generation processes for the north-western Himalayan region. At the surface layer, the forest had a significantly ($p < 0.05$) higher hydraulic conductivity than other land uses. Moreover, the subsurface (below 15 cm soil depth) NSSHC at 0 cm pressure head followed the magnitude like forest > RT > CT > ZT. However, at the subsurface layer, the hydraulic conductivity of the forest was significantly higher than ZT and CT, although no significant difference was observed among ZT, RT, and CT. Among the tillage treatments, ZT showed a lower subsurface hydraulic conductivity value than CT and RT, which may be attributed to comparatively lower SOC, lower MWD, and higher BD. A higher subsurface hydraulic conductivity in CT than in CA was observed, possibly due to the forming of a more consolidated layer in the latter land use. In the present case, for the surface soil layer, the macropores, and meso + micropores contributed 61.99 -73.44 % and 26.56 - 38.01% of total flow, respectively, and for the subsurface layer, the macropores and meso + micropores contributed 65.61 - 76.08 % and 23.92 - 34.39 % of total flow respectively, across the land uses. The contribution of macropores to water flow in the surface layer follows the trend forest > ZT > RT > CT, and for the subsurface layer, forest > RT > CT > ZT. Above all, for the forest, ZT and RT, percolation (P), and subsurface flow (SSF) combined together were more prevalent, whereas the IOF pattern was more significant for CT. In the Himalayan region, there is a greater possibility of overland flow due to the land use transition to CT from the native forest.

Key words: Rainfall partitioning, Hydraulic conductivity, Infiltration, Himalayan region

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Tomato Yield as Influenced by Micro Meteorological Parameters Grown Under Different Mulching Materials and Bio-Stimulants

Aswini Ambadi, Shankarappa Sridhara* and Girish R. Kashyap

Center for Climate Resilient Agriculture, Keladi Shivappa Nayaka University of Agricultural & Horticultural Sciences, Shivamogga-577418, Karnataka
**Corresponding author: sridhars@uahs.edu.in, sridharas2017@gmail.com*

A field experiment was conducted at the Centre for Climate Resilient Agriculture, Shivamogga during the 2020 and 2021 *kharif* growing seasons to know the effect of mulching materials and biostimulants on growth, yield and quality of tomato. The experiment was laid out in factorial randomized complete block design consisting of four mulching materials (M_1: Pongamia leaves @ 4 t ha^{-1}, M_2: Polyethene mulch, M_3: Paddy straw @ 10 t ha^{-1} and M_4: No mulch) and three biostimulants (N: Nano nitrogen @ 4 ml lit^{-1}, B: Brassinolide @ 5 ml lit^{-1} and C: Control) with three replications in open field conditions. Phenophases of tomato and micrometeorological parameters were analyzed. Among the micrometeorological parameters, soil temperature showed a negative correlation to the yield of tomato from 50% flowering to peak fruiting (r = -0.319**) and from peak fruiting to final fruit pick stage (r = -0.475**). A significant positive correlation with the yield of tomato was noticed in soil moisture during peak fruiting to final fruit pick stage (r = 0.612**). A significant negative correlation with the yield of tomato was noticed in canopy temperature during 50% flowering to peak fruiting and peak fruiting to final fruit pick stage (r = -0.599** and r = -0.514**, respectively).

Key words: Soil temperature, Soil moisture, Canopy temperature, Correlation

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Effect of Weather Parameters on Growth and Productivity of Maize Varieties Under different Sowing Environments

Mahender Singh, S.K. Bal*, Charu Sharma, Monika Banotra, Rohit Sharma and Veena Sharma

*Agrometeorology Section, Division of Agronomy, *PC (Agrimet, CRIDA, ICAR, Hyderabad), SKUAST-J, Chatha, Jammu-180009, Jammu & Kashmir*
**Corresponding author: drmahendersinghg@gmail.com*

Agriculture is always vulnerable to unfavorable weather events and climate conditions. Despite technological advances such as improved crop varieties and sowing dates, weather and climate are important factors, which play a significant role in agricultural productivity. Maize crop grown in a range of agro-climatic zones, from severe semi-arid to sub-humid and humid climates. The field experiment was conducted to develop the crop weather relationships under different sowing environments and maize varieties at the research field, Agrometeorology Section, SKUAST-J, Chatha, Jammu. The experiment was laid out in a randomized block design (RBD) and replicated thrice. There were nine treatment combinations, including three-date of sowing (21st June, 02nd July and 15th July) and three varieties (V_1: Kanchan-517, V_2: Pratap Makka-3 and V_3: Kanchan-612) during *Kharif* 2015, 2016 and 2017.The result revealed that yield decreased consequently with subsequent delay in sowing. Highest grain yield of 37.8 q ha^{-1} was recorded with early planting on June 21st, while the lowest grain yield of 32.3 q ha^{-1} was obtained with late sowing (July 15) due to the reason that early sown crop had a longer growth period and consume more radiation as compared to the late sown crop**.** The emergence is positive significantly with rainfall & sun shine hours, while negatively significant with minimum temperature, evaporation, morning and evening relative humidity. At tasselling stage maximum temperature significant negatively and rainfall positively related. Hence the tasselling stage was found moisture sensitive and higher temperature cause pollen sterility, which effect the seed yield of maize crop under subtropical region. The dough and physiological maturity positive significant with minimum temperature & evening relative humidity while negatively with morning humidity.

Key words: Maize, Weather, Environment, Sowing

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Impact of Foliar Nutrition on Kernel Yield and Forage Quality of *Kharif* Groundnut (*Arachis hypogaea* L.)

S. Karak[1]*, K. Jana[1], U. Thapa[2], J. Suresh K.G.[3], T. Mitran[3] and Sujatha G.[3]

[1]Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, West Bengal
[2]Department of Vegetable Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, West Bengal
[3]Soil and Land Resources Assessment Division, National Remote Sensing Centre, Hyderabad-500037, Telangana
**Corresponding author: Subhadeep_k@nrsc.gov.in; karakbckv@gmail.com*

Foliar nutrition refers to the precise and targeted application of essential nutrients directly onto a plant's leaves. This targeted delivery method ensures maximize nutrient uptake efficiency, minimize waste, optimize plant growth and reduced environmental footprint. The present experiment was conducted during *kharif* season of 2021 at Jaguli Instructional Farm, B.C.K.V., Mohanpur, Nadia, W.B. The main aim of this research investigation was framed to find out the effect of foliar nutrition applied at pre-flowering and pod formation stages on growth, yield attributes, oil content and kernel yield, forage (haulm) yield and crude protein yield. The experiment was laid out in Randomized Complete Block Design replicated thrice consisting of 8 treatments [T_1: RDF + Panchagavya @ 3%, T_2: RDF + SSP @ 2%, T_3: RDF + KNO_3 @ 2%, T_4: RDF + NPK (19:19:19 @ 1%) T_5: RDF + Zinc @ 0.5%, T_6: RDF + Boron @ 0.2%, T_7: RDF + Multinutrients (Zn+Cu+Mn+Mo+Bo) spray @ 1%, T_8: RDF (N, P_2O_5 and K_2O: 20, 40, 50 kg ha^{-1}) only]. The highest plant height of 38.10cm, 59.47cm and 84.93cm, respectively was obtained during the different sampling period (40 DAS, 60 DAS and at harvest) with treatments T_4.The maximum LAI (4.51) & highest dry matter accumulation (644.71 g m^{-2}) were obtained from T_4 at 60 DAS. The values of CGR were recorded highest of 4.40 g.m^{-2}.day^{-1}, 22.99 g.m^{-2}.day^{-1} and 33.77 g.m^{-2}.day^{-1} at different sampling dates (0-40 DAS, 40-60DAS and 60 –harvest) from T_4. In case of yield attributing characters, amongst the different treatments, T_4 recorded the highest (29.26) numbers of pods per plant, highest kernel yield (17.44 q.ha^{-1}) and highest forage yield (40.91 q.ha^{-1}) followed by T_1. All other growth and yield attributing characters were found minimum from the T_8. From the present investigation it may be concluded that foliar application of N:P:K (19:19:19) @ 1% at pre-flowering and pod formation stages along with recommended dose of fertilizers (N, P_2O_5 and K_2O 20:40:50 kg ha^{-1}) help in getting the higher productivity and profitability of groundnut.

Key words: Nutrition, Yield, Groundnut

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Evaluation of Mineral Based Nutrient Source Along with Nanofertilizers on Yield of Wheat Crop

Alok Singh Jayara*, Rajeew Kumar, Anil Shukla and Priyanka Pandey

Department of Molecular Biology and Genetic Engineering, G.B. Pant University of Agriculture & Technology, Pantnagar-263145, Uttarakhand
**Corresponding author: aloksingh.jayara@gmail.com*

An experiment was conducted in NEB Crop Research Centre, G B Pant University of Agriculture & Technology in year 2021-22 and 2022-23, to test the efficacy of nano urea in addition to basal dose of nitrogen (through prilled urea) as alternative to recommended dose of nitrogen through urea (RDN) and a indigenous mineral based product (IMBP) along with nano DAP/ nano K as alternative to the recommended P & K. The experiment was laid out in strip plot design with three horizontal factors as sources of P & K (P1: recommended P & K, P2: IMBP + Nano DAP; P3: IMBP + Nano K) and four vertical sources of nitrogen (N1: control/ no nitrogen; N2: 3 sprays of nano urea alone; N3: Basal + 2 sprays of nano urea; N4: RDN). The germination percentage in both years of experiment was reported to be non-significantly impacted by the treatment application. Among P & K sources, both grain yield and straw yield was reported at par for all the three sources of P & K. Among different nitrogen sources, highest grain yield was recorded with RDN and it was followed by basal + 2 sprays of nano urea with non-significant difference. The straw yield was also reported higher for RDN in both years of experiment; however, it was at par with basal + 2 sprays of nano urea only in first year of experiment. Nanourea was effective only with the additional application over basal dose rather than alone application.

Key words: Wheat, Nanofertilizers, Mineral based nutrient source, Grain yield, Straw yield

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Usefulness of Weather Based Agro-met Advisory Service to the Farming Community of Jamnagar District of Gujarat

Savaliya A.V., Ambaliya N.D., Baraiya A.K. and Baraiya K.P.

Krishi Vigyan Kendra, Junagadh Agricultural University, Jamnagar-361006, Gujarat
**Corresponding author: ankurv.savaliya@gmail.com, kvkjamnagar@gmail.com*

A study was conducted during year 2021-22 to 2022-23 to know the Usefulness of Weather based agro-met advisory service provided by GKMS project of DAMU scheme to the farming community of Jamnagar district of Gujarat. For this analysis, sample set consisted of 300 farmers selected who get weather based agro-met advisory bulletin prepared by Krishi Vigyan Kendra, Junagadh Agricultural University, Jamnagar. Farmer respondents were purposively selected and conducted personal interview. Results indicated that majority of farmers belonged to the middle age group, secondary education, possessed more than 4 acres of landholding, farming along with animal husbandry practiced, have one or two milch animals, income above 2 lakhs, they have a membership with two organizations, belongs to a joint family. According to utilization of agro-met advisory, local language is very useful to understating for farmers (4.17 wt. mean); warning about natural calamities to take precaution measures (4.11 wt. mean); it also helps for decide harvesting time according to rainfall, fog, cloudy condition, frost and other calamities (3.95 wt. mean). Highest responses observed towards neutral usefulness of agro-met advisory service with 46.33 percent followed by useful responses (33.00 percent) towards usefulness of agro-met advisory service. For better improvement of the advisory farmers suggested to include natural farming, organic farming, horticultural crops, animal husbandry and market intelligence & price forecast along with agro-met advisory; village level long-range forecast is also helpful for pre-seasonal planning.

Key words: Agro-met advisory, Harvesting, Rainfall

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Carbon Sequestration Practices (CSQs) for Mitigating Global Climate Change

Subhash Chand*, Shanir A. Bangaroo, Shaista Nazeer, Suraj Kumar and Bhavani Singh

Division of Soil Science, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar-190025, UT of Jammu and Kashmir
**Corresponding author: subhashchandm1@gmail.com*

Carbon is found naturally in all aspects of the environment. The carbon cycle is necessary for life. Humans have dramatically increased the amount of CO2 mobilized in the carbon cycle by fifteen per cent in the last century the carbon cycle is the biogeochemical cycle by which carbon is exchanged between the biosphere, geo-sphere, hydrosphere and atmosphere of the Earth. (Other bodies may have carbon cycles, but little is known about them.) All of these components are reservoirs of carbon. The cycle is usually thought of as four main reservoirs of carbon interconnected by pathways of exchange. The reservoirs are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans, and sediments (includes fossil fuels). The annual movements of carbon, the carbon exchanges between reservoirs, occur because of various chemical, physical, geological, and biological processes. The ocean contains the largest pool of carbon near the surface of the Earth, but most of that pool is not involved with rapid exchange with the atmosphere. The global carbon budget is the balance of the exchanges (incomes and losses) of carbon between the carbon reservoirs or between one specific loop (e.g., atmosphere - biosphere) of the carbon cycle. An examination of the carbon budget of a pool or reservoir can provide information about whether the pool or reservoir is functioning as a source or sink for carbon dioxide.

Key words: Carbon budget, Geological, Terrestrial biosphere, Fossil Fuels

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Effect of Decomposer Enriched City Waste Compost Application on Growth and Yield of Broccoli

Sabina Devkota* and Parbati Adhikari

Nepal Agricultural Research Council, (NARC), Khumaltar, Lalitpur-44700, Nepal
**Corresponding author: Sabina.devkota@gmail.com*

Waste is a major problem in main city of the Nepal which tends to increase with rapid urbanization, improved living standards and changing consumption patterns. Management of increasing amounts of solid waste has become a major challenge in many cities in developing countries. City compost produced at mechanical composting plants in Asian countries including Nepal are generally low in plant nutrients. Hence enrichment is necessary for improving nutrient status and quality of compost. Considering the nutritional significance, fast decomposition rate and quality of the compost the study was conducted to enrich the city waste compost with waste decomposers. The present study was undertaken to evaluate the decomposer enriched city waste compost on broccoli growth and yield. The study was done in two locations i.e. In Jitpur, Bara and in Malepatan, Pokhara. The study used a Randomized complete block design (RCBD) with eight treatments and 3 replications. Five types of decomposers namely prarambha dhulo, prarambha jhol, jeevatu, Sathi, and Sanjivani were used to decompose the city waste. The treatments were Control, NPK (Full dose of recommended fertilizer), FYM, Compost 1 (Prarambha dhulo enriched). Compost 2 (Prarambha Jhol enriched), Compost 3 (Jeevatu enriched), Compost 4 (Sathi enriched) and Compost 5 (sanjivani enriched). The composting time lasted for 40 days. The results showed that, not all waste decomposer enriched compost showed good results. However, most of the waste decomposer enriched compost showed higher yield and other yield attributes as compared with control and chemical fertilizers in both location.

Key words: Waste, Waste decomposer, Compost, Broccoli

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Crop Growth Monitoring by Dual Polarimetric Radar Vegetation Index (DpRVI) Using Sentinel-1 SAR Data for the Soybean Crop in Latur District of Maharashtra

Gargi Gaydhane*, Upasana Singh and Ashutosh Pawar

Semantic Technologies and Agritech Services Private Limited, Pune-411016, Maharashtra
**Corresponding author: gargi.gaydhane@semantictech.in*

The utilization of Sentinel-1 Synthetic Aperture Radar (SAR) satellite data offers an exceptional opportunity for crop growth monitoring due to its better revisit frequency and extensive spatial coverage. This study leverages Sentinel-1 SAR data, specifically the dual-pol data comprising VV (Vertical-Vertical) polarization and VH (Vertical-Horizontal) polarization, to apply remote sensing and geospatial techniques in agriculture. These techniques harness Sentinel-derived information to support crop growth monitoring, particularly as an alternative to Sentinel 2A optical data, which can be hindered by cloud coverage. while previous literature has explored the use of backscatter data for crop characterization, this research takes a novel approach. It combines scattering information, including the degree of polarization and eigenvalue spectrum, to derive a new vegetation index known as the Dual Polarimetric Radar Vegetation Index (DpRVI) from dual-pol SAR data. This innovative index provides valuable insights into vegetation dynamics. Furthermore, this study focuses on assessing plant growth in the Bhada Revenue Circle, Latur district, Maharashtra. It does so by considering key crop biophysical parameters such as Plant Area Index (PAI), Vegetation Water Content (VWC), Normalized Difference Vegetation Index (NDVI), and Land Surface Water Index (LSWI) at various crop phenological growth stages. This approach allows for a comprehensive analysis of crop development throughout its lifecycle, emphasizing each critical growth stage. To validate the accuracy of these assessments, statistical analyses, including Linear regression, are employed. These analyses reveal correlations between each biophysical parameter and the Dual Polarimetric Radar Vegetation Index (DpRVI). These correlations provide valuable insights into Soybean crop performance, aiding in the prediction of crop yields and overall crop health. The study's findings indicate promising results for Soybean crop monitoring and highlight the potential of SAR data in agricultural applications. Indeed, the accumulation of key biophysical parameters including Plant Area Index (PAI), Vegetation Water Content (VWC), Normalized Difference Vegetation Index (NDVI), and Land Surface Water Index (LSWI) plays a significant role in plant growth development. In this context, The Dual Polarimetric Radar Vegetation Index (DpRVI) is a useful monitoring plant development during the kharif season, when microwave data may be used instead of optical data. Its correlation with biophysical parameters like PAI, VWC, NDVI, LSWI enhances yield predictions and supports informed decision-making, improving agricultural productivity and crop management practices.

Key words: Soybean, DpRVI, PAI, VWC, NDVI, LSWI, Dual Polarization

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Impact of Establishment Methods and Sensor Based Irrigation Regimes on Root Characteristics of Rice and on Carbon Sequestration

A. Suryakala[1]*, G. Karuna Sagar[2], R. Mahender Kumar[3], G. Pratibha[1] and V. Umamahesh[4]

[1]*ICAR-Central Research Institute of Dryland Agriculture, Santoshnagar, Hyderabad-500059, Telangana*
[2]*Acharya N.G. Ranga Agricultural University, Lam, Guntur-522034, Andhra Pradesh*
[3]*ICAR-Indian Institute of Rice Research, Hyderabad-500030, Telangana*
[4]*Agricultural College, Naira-532186, Andhra Pradesh*
**Corresponding author: adhikarisuryakala@gmail.com*

Sequestering carbon in the soil is one possible way to lessen the effects of global warming. The amount of carbon stored in the soil is twice that of the atmosphere, with the majority coming from photosynthesis that stores carbon in root structures and root exudates into below-ground storage. A field trail was conducted during *rabi*, 2021-22 and 2022-23 at Indian Institute of Rice Research, Rajendranagar, Hyderabad with three establishment methods *viz.*, normal transplanting, mechanized SRI and wet DSR as main plots and sensor based irrigation regimes *viz.*, alternate wetting and drying at 5, 10, 15 cm depletion and flooded water management as subplots arranged in split plot experimental design. Root characteristics *viz.*, root length and root volume were estimated by Win RHIZO software and root dry weight was by hot air oven method. The results revealed that among all the establishment methods, significantly higher root density, root length and root volume were registered with mechanized SRI resulting in higher carbon sequestration which was attributed by higher soil and plant organic carbon content. Lower root characteristics were registered with wet DSR, resulted in lower carbon sequestration. Within the various irrigation regimes, AWD at 15 cm depletion registered significantly higher root attributes, which inturn results in high carbon sequestration, while lower were registered with flooded water management.

Key words: Sensor, Irrigation, Rice, Carbon

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Long Period Weather-Based Study over Key Pests and Disease of Cotton in the Semi-arid Region of Haryana

Anil Kumar[1]*, Raj Singh[1], C.S. Dagar[1], Anil Jhakar[2], Anil Kumar Saini[2], S.K. Bal[3] and M.L. Khichar[1]

[1]Department of Agricultural Meteorology, CCS Haryana Agricultural University, Hisar-125004, Haryana
[2]Cotton Section, CCS Haryana Agricultural University, Hisar-125004, Haryana
[3]AICRP on Agrometeorology, ICAR-Central Research Institute of Dryland Agriculture, Santoshnagar, Hyderabad-500059, Telangana
**Corresponding author: anilmeteo@gmail.com; anilmeteo@hau.ac.in*

In this study considered three experiments with the main objective weather effects on pests and diseases and its prediction i.e. Jassid, white fly, CLCU (major disease of cotton crop). The handling, weekly data for the statistical analysis and management at open field level, in the experiments and weather data used the adjacent field of experiment at agromet observatory (Latitude: 29° 10′ N; Longitude: 75° 46′ E & Altitude: 215.2 Meters (AMSL), CCS HAU, Hisar). This study was performed as collaboration among the meteorologists, entomologists and plant pathologists, over period of time. This work was performed as interdisciplinary efforts which provide valuable insights into the complex interactions between weather and cotton crop health during growing season. As the many seasons was observed and analyzed the pest and disease data, here understand the relation to the weather conditions under different meteorological weeks. Underscores the intricate relationship between weather patterns and the incidence of key pests and diseases in cotton crops in the semi-arid region of Haryana. The correlation and regression were performed with the different weather parameters. On RCH650 jassid weather-relation existing as Maximum temperature (-0.04), pan evaporation (-0.06) and accumulated rainfall (-0.12) showed non-significant correlation and sunshine hours (-0.24) showed significant negative correlation. The optimum range of maximum and minimum temperatures for white fly population build-up worked out to be 29.8 to 40.9 °C and 16.9 to 28.7 °C, respectively. The optimum range of morning and evening relative humidity was 55.2 to 91.8 % and 28.3 to 76.7%. The per cent incidences of cotton leaf curl disease data (2005 to 2022) were correlated with the meteorological parameters. The maximum temperature (-0.58), minimum temperature (-0.44), wind speed (-0.61), actual vapour pressure (AVP) at morning (-0.20) and evening (-0.14), evaporation (-0.65), and rainfall (-0.07) showed negative correlation. Then Stepwise multiple linear regression equation for whitefly was carried out 11 seasons, i.e., 2007-08 and 2012 to 2021 to identify best suited model for the predictability (explain from 30 to 45%) of white fly population on used above significant weather variables. For the Multiple

regression equation for PDI prediction (Cotton leaf curl virus disease and different combination of model developed. model predictability explains 51 to 52 percentage. The variability in occurrence of cotton leaf curl disease of Hisar zone was explained up to 62% with the help of significant weather parameters. M1, M2, M3, M4 respectively. 1:1 graph plotted-Scatter plot of observed vs predicted PDI of cotton leaf curl virus disease to validate the model for the year 2022 (four set of regression models). The model 3rd was predicted more points as closer to ±30% prediction of weekly PDI.

Key words: Cotton weather insect-Pest & disease, Correlation, Regression, Prediction

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Area-wide Crop Damage Assessment Due to the Invading Grasshopper Using High Resolution Multispectral Space-borne Data

M. Prabhakar*, K.A. Gopinath, N. Ravi Kumar, M. Thirupathi, G. Srasvan Kumar and U. Sai Sravan

ICAR-Central Research Institute of Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: prab249@gmail.com*

Grasshoppers are infamous for their voracity and polyphagy, and can migrate to distant places in a short time. During kharif, 2019 a severe incidence of short-horned grasshopper (*Hieroglyphus nigrorepletus* Bol) was noticed in Telangana State. These hoppers were believed to have migrated from long distances and reported to cause crop damage up to 50-70%. Traditionally, when such sudden pest out beak occur, the damage assessment is done with field scouts, which is time consuming and laborious. Remote sensing and geospatial technologies offer timely data to assess the risk of impending pest outbreaks on real-time basis. Extensive field surveys were conducted in three villages *viz.*, Gudikandula, Ghanapur and Govardhanagiri of Thoguta mandal, Siddipet district, Telangana during September- October, 2019. Ground-truth data was collected from 40 fields in these villages for grasshopper damage assessment, along with position details using Global Positioning System (Trimble GeoXT). The grasshopper damage incidence was categorized into three grades (healthy, medium and severe). The satellite data was acquired from Copernicus Sentinel-2 satellite Level-1C Hub for two dates i.e. 27 August, 2019 (pre-damage) and 1 October, 2019 (post-damage). These images were atmospherically corrected using Sen2cor procedure available in the Sentinel-2 SNAP (Sentinel Application Platform) toolbox. Different vegetation indices viz., Normalized Difference Vegetation Index (NDVI), Leaf Area Index (LAI) and Fraction of Vegetation Cover (FCover) derived from the Sentinel-2 satellite data were used for mapping grasshopper damage. Paired t-test was performed to compare suitability of the vegetation indices for assessing damage levels. Crop classification was performed using maximum likelihood classification. The vegetation indices tested showed significant differences between two dates (pre and post damage) in the surveyed fields. Results showed that NDVI decreased from 0.72 to 0.24, LAI from 2.53 to 0.57 and FCover from 0.70 to 0.32 due to grasshopper damage in the affected fields. Classification of satellite date identified major crops in study area as cotton (2635 ha), rice (943 ha) and maize (826 ha). Further the changes in spectral vegetation showed that the grasshopper damage was recorded only on maize. About 15 % of maize (124 ha) in the study area was severely affected by the grasshopper. The study showed the potential use of space-borne remote sensing for rapid assessment of defoliating pest damage, spatial distribution of the damaged fields and the resultant yield loss over a large area in a short time. This would enable to develop effective area-wide pest management strategies.

Key words: Crop, Grasshopper, Multispectral

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Impact of *e*CO_2 and *e*Temp on *Spodoptera Exigua* (Hub.) in Chickpea

Srinivasa Rao M.*, Prasad T.V., Gayatri D.L.A., Vanaja M. and Singh V.K.

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: msrao909@gmail.com; Ms.Rao@icar.gov.in*

Climate change is unequivocal and causes a serious threat to the sustainability of agriculture and affecting crop production and protection. Quantifying insect herbivore-climate relationships is the key to developing the pest management strategy. Chickpea (*Cicer arietinum* L.) is a highly nutritious pulse crop and among the biotic stresses influencing chickpea production, beet armyworm (*Spodoptera exigua* Hubner.) (Noctuidae: Lepidoptera) is an extremely destructive and economically important insect pest. At ICAR-CRIDA, several experiments were conducted to quantify the interactive effects of *e*CO_2 and *e*Temp on the growth and development of *S. exigua* on chickpea using a unique facility i.e., CO_2 Temperature Growth Chambers (CTGC). Insect Primary data on growth and development and life table parameters viz., r, the intrinsic rate of increase; λ, the finite rate of increase, Ro, the net reproductive rate; T, the mean generation time were estimated at different conditions of *e*CO_2 and *e*Temp and were plotted against the tested temperatures to compare the thermal sensitivities of parameters and further generated the quantified relationships. The results indicate that Finite (λ) and intrinsic rates of increase (rm), net reproductive rate (Ro), mean generation time (T) and doubling time (DT) of *S. exigua* varied significantly with temperature and CO_2 and were found to have quadratic relationships with temperature. The present results on life table parameters showed that the 'rm' values of *S. exigua* were higher indicating a significant influence of *e*CO_2 and *e*Temp. The reduction of 'T' was noticed from a maximum of 50 days at 20°C to minimum of 22 days at 35°C and 'λ' which is the indicator of reproductive value of new eggs was highest at 35ÚC and showed a negative relationship with temperature. Non-linear models will be of immense help for predicting the pest scenarios during future climate change periods.

Key words: *e*CO_2, *e*Temp, Chickpea

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In-season Monitoring of Jute Crop and Its Biomass Modelling Using Machine Learning and Geospatial Technology over Parts of West Bengal

Rajyasri Adhikari*, Ashutosh Panda, Varun Pandey, Abhishek Chakraborty, Mamta Kumari, A. Lesslie, Parichay S. Raju and V.M. Chowdary

Agro-ecosystem and Modelling Division, Agricultural Sciences and Applications Group, National Remote Sensing Centre, ISRO, Hyderabad-500037, Telangana
**Corresponding author: rajyasrinrsc@gmail.com*

Globally, jute is the second largest natural fibre produced, with an estimated average production of 3 million tonnes per year. India is single largest producer of jute goods in the world, contributing about 60% of the global production and providing employment to 4.85 million farm families, industrial workers and traders. The study focuses on Nadia and Murshidabad districts, which contribute significantly to jute cultivation in West Bengal. Encompassing roughly 25% of the country's jute-cultivable area, these districts follow a typical March-August cultivation season. This study presents a comprehensive approach of mobile app-based crop surveillance, satellite-based crop mapping/monitoring, and machine learning (ML)-based biomass estimation in the study area. A customized mobile app ("BHUVAN JUMP") for jute crop facilitated real-time data collection on crop attributes, enabling fortnightly reports on crop health and yield potential. Temporal Sentinel-2 (optical)/ Sentinel-1 (SAR) analysis using decision tree classification achieved >90% accuracy in jute crop mapping. The crop map and other crop condition parameters were used to identify 220 optimal locations for crop-cutting experiments using a stratified random sampling technique. Data from these experiments on jute biomass, along with the corresponding map and condition information, were then used to train and validate ML models. Jute biomass modelling using Random Forest (RF) and Neural Network (NN) models incorporating diverse data inputs (rainfall, NDVI, LSWI, backscatter, insolation, PET) achieved normalized Root Mean Square Error (nRMSE) of 11% (RF) and 12-13% (NN). These results demonstrate the potential of ML-driven jute monitoring for biomass prediction with considerable accuracy (>85%). Further upscaling is planned across four key jute-producing eastern Indian states (West Bengal, Bihar, Assam, and Odisha) to develop a comprehensive Jute Crop Information System, empowering data-driven management and decision-making for a larger region.

Key words: Jute, Crop monitoring, Sentinel data, Biomass, Machine learning, Modeling

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EO Based In-season Assessment of Paddy Stubble Burnt Area Progression over Punjab and Haryana

Ashutosh Panda*, Rajyasri Adhikari, Abhishek Chakraborty, Mamta Kumari, Parichay S. Raju and V.M. Chowdary

Agro-ecosystem and Modelling Division, Agricultural Sciences and Applications Group, National Remote Sensing Centre, ISRO, Hyderabad-500037, Telangana
**Corresponding author: ashutosh25panda@gmail.com*

Paddy stubble burning is recurrent practice in the north-western states of India particularly over Punjab, Haryana, primarily to clear the residue after harvesting for preparing the field for the next cropping cycle in a short span of time. Systematic monitoring of the burning events and progression of burnt area in near-real time is of utmost importance for any policy making and in-season interventions as it has adverse ecological, economic, environmental and social effect across the states. Present study aims at assessing the dynamics of the farm fire locations and burnt area using multi-temporal, multi-platform satellite data. In-season kharif rice crop map derived using multi-temporal Sentinel-1 SAR data was obtained from MNCFC. Near-real time Suomi-NPP VIIRS (375m) based active fire locations were utilized to assess the farm fires by masking out the non-farm fire locations using LULC based agricultural layer followed by rice mask over Punjab and Haryana. Continuous monitoring and assessment of the actual paddy stubble burnt area and its weekly/fortnightly progression was carried out for kharif 2023 (15th September to 30th November) for Punjab & Haryana states using Sentinel-2 based Mid Infrared Burn Index (MIRBI) which utilizes a combination of two SWIR bands to estimate the burnt area. Total kharif rice area of Punjab and Haryana was estimated to be 29.19 and 11.95 lakh ha respectively. Total farm fire locations over Punjab and Haryana till 30th November was found to be 30884 and 2801 respectively. Till 30th November, the total burnt area of Punjab and Haryana was found to be 18.09 and 3.27 lakh ha respectively. So, nearly 62% and 27% of the total rice area were found to be burnt for Punjab and Haryana respectively. Further research is directed towards estimation of amount of rice stubble biomass burnt and GHG gases emitted using bottom up approach. Such geospatial product can also assist to model further dispersion and transport of the GHG across the area.

Key words: Stubble Burning, Active Fire Locations, Mid-Infrared Burn Index (MIRBI), Short Wave Infrared (SWIR), Sentinel-1, Sentinel-2, Visible Infrared Imaging Radiometer Suite (VIIRS)

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Agroadvisory Services in India

Alok Kumar Pandey*, Akhilesh Kumar Dubey and Ram Lakhan

Krishi Vigyan Kendra, ICAR-Indian Institute of Sugarcane Research, Lucknow-226002, Uttar Pradesh
**Corresponding author: akpmausam@gmail.com*

Agro-advisory services are farm decisions taken in response to past, current and future weather changes. It includes agronomical, pest and disease, water and input management. Basic considerations for preparing weather-based agro-advisories are weather-sensitive crops, their weather-sensitive stages and weather-sensitive farm operations. Weather plays a crucial role in agriculture and changes in weather patterns can have a significant impact on crop yields. Weather-based crop advisory services can provide real-time information about weather patterns, crop health and appropriate measures for the farmers, enabling them to make informed decisions about various crop management practices, leading to higher yields and increased income. It helps the farmers to take weather sensitive decisions like sowing/transplanting of crops, pesticide and fertilizer application, scheduling irrigation, timely harvesting of the crops and vaccination of animals. Biweekly bulletins, daily weather forecast and nowcast information are also disseminated to the farmers and Impact-based forecasts (IBFs) for agriculture is also being prepared by AMFUs and DAMUs based on the severe weather warnings for different districts of various States and UTs across the country issued by National Weather Forecasting Centre (NWFC), New Delhi and RMCs of IMD. Agro-met Advisories are disseminated to the farmers through multichannel dissemination system like print and electronic media, Door Darshan, radio, internet, WhatsApp etc. including SMS using mobile phones through Kisan Portal and also through private companies under Public Private Partnership (PPP) mode. Farmers access the weather information including alerts and related agro-met advisories specific to their districts through the mobile App *viz*., 'Meghdoot'& Damini launched by the Ministry of Earth Sciences, Government of India.

Key words: Agro-advisory services, Biweekly Bulletins, Impact-based forecasts, Crop health

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Long-term Effect of Surface Crop Residue Application Under Minimum Tillage on Soil Mineral N, Crops Yield and SYI in Sorghum-cowpea Cropping Systems in Alfisols

Munna Lal[1]*, A.K. Indoria[1], K. Sammi Reddy[2], K. Srinivas[1], Sumanta Kundu[1], M. Prabhakar[1], K.L. Sharma[1], G. Pratibha[1], K.V. Rao[1] and Vinod Kumar Singh[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]ICAR-National Institute of Abiotic Stress Management, Baramati-413115, Maharashtra
**Corresponding author: munnalalsingh10@gmail.com*

A study was conducted to assess the long-term effects of surface crop residue applications on soil mineral N, crops yield and sustainable yield index (SYI) in sorghum-cowpea cropping systems under minimum tillage at HRF of ICAR-CRIDA, Hyderabad . Treatments includes the application of dry sorghum stover @ 0 t ha^{-1} (no residues, T1), 2 t ha^{-1} (T2), 4 t ha^{-1} (T3) and 6 t ha^{-1} (T4) along with the 100% stover of cowpea crop during cowpea growing years under minimum tillage (direct plough planting of the crops, and no tillage operations carried out). Results revealed that the pooled yield of sorghum varied from 1584 to 2036 kg ha^{-1}. Significantly higher pooled sorghum yield was observed with the surface application of crop residue @ 2 t ha^{-1} (1726 kg ha^{-1}), 4t ha^{-1} (1905 kg ha^{-1}) and 6 t ha^{-1} (2036 kg ha^{-1}) as compared to no residue application (1584 kg ha^{-1}). The increase in the sorghum yield with T2, T3, and T4 was found to be 9%, 20%, and 28%, respectively, compared to no residue application (T1). Similarly, the higher sustainable yield index (SYI) was recorded with T2 (0.55), T3 (0.63) and T4 (0.65) as compared T1 (0.48). While the pooled yield of cowpea varied from 439 to 718 kg ha^{-1}. The treatments T2, T3, and T4 recorded higher cowpea pooled yield of 588, 677 and 718 kg ha^{-1}, respectively as compared to T1 (439 kg ha^{-1}). The increase in cowpea yield with T2, T3, and T4 was found to be 34%, 54%, and 64%, respectively, as compared to control (T1). The SYI of cowpea was found to be highest with application of 6 t ha^{-1} of residue (0.19) as compared to rest of the treatments. The increase in soil NH_4^+ N with surface application of sorghum residue @ 2, 4 and 6 t ha^{-1} was to the extent of 5.4, 21.8 and 33.3%, respectively over no residue application. The increase in soil NO_3^- N with surface application of sorghum residue @ 2, 4 and 6 t ha^{-1} was 10.3, 21.2 and 37.3%, respectively over no residue application.

Key words: Minimum tillage, Nitrogen, Sorghum stover, SYI

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Performance of Pigeon Pea in Different Sowing Dates in Marathwada Region of Maharashtra State

M.G. Jadhav*, D.M. Patil and G.N. Gote

Department of Agricultural Meteorology, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani-4310402, Maharashtra
**Corresponding author: jmadhukar03@gmail.com*

The field experiment was laid out in split plot design with three replication and two factors *viz*., date of sowing D_1 (MW25), D_2 (MW26), D_3 (MW27) and D_4 (MW28), and varieties V_1 (BDN-711) and V_2 (BSMR-736) to study the effect different dates of sowing and varieties on yield of pigeon pea. The results found that the seed yield was highest in treatment D_2 (MW 26) *i.e.* 1367 Kg/ha as compare to other treatments. Among the varieties, V_2 (BSMR-736) produced higher seed yield *i.e.*1656 kg/ha and lower yield was recorded from V_1 (BDN-711) *i.e.* 897.08 Kg/ha. During 50% flowering to pod formation stage rainfall play important role in pod formation. In D_2 (MW 26) rainfall received 5.2 mm. was more as compared to D_1 (MW 25) (3.2 mm.), whereas in D_3 (MW 27) and D_4 (MW 28) no rainfall received which was adversely affected on pod formation. During flowering period morning relative humidity recorded was highest in D_2 (MW26) *i.e.* 84% followed by D_1 (MW25) *i.e.* 82%, D_3 (MW27) *i.e.* 78% and same in D_4 (MW28) *i.e.* 78%. Mean afternoon relative humidity in D_1, D_2, D_3, D_4 was recorded 48%, 53%, 42%, 40% respectively. Maximum temperature during whole crop growth was highest in D_1 (MW25) i.e. 31.0°C and lowest in D_4 (MW28) *i.e.* 29.8°C. Lowest minimum temperature during whole crop growth period was lowest in D_4 (Mw28) *i.e.* 16.6C. During sowing to emergence stage of crop; rainfall, rainy days, showed positive association and during 50% flowering to pod formation stage only bright sunshine hours showed highly significant positive association. Whereas maximum temperature and mean temperature showed negative association. During grain formation to physiological maturity stage maximum, minimum and mean temperature, morning, afternoon and mean relative humidity, evaporation and wind speed showed significant negative association.

Key words: Seed yield, Rainfall, Temperature, Humidity, Correlation

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Relationship between Greenhouse Gas Emissions during Wheat with Soil Properties under Different Tillage and Residues Management in an Inceptisol

Priya Bhattacharya, K.K. Bandyopadhyay#*, P. Krishnan, P.P. Maity, A. Bhatia, T.J. Purakayastha, B. Chakrabarti, M. Roy and Sujan Adak

ICAR-Indian Agricultural Research Institute, New Delhi-110 012
#Correspondence: ICAR-Indian Institute of Water Management, Bhubaneswar-751023, Odisha
**Corresponding author: kk.bandyopadhyay@gmail.com*

Greenhouse gas emissions (GHG), particularly carbon dioxide (CO_2) and nitrous oxide (N_2O) are major contributors to climate change and are closely linked to soil carbon and nitrogen pools, as well as other soil properties. Understanding the relations between emissions and soil properties is essential for developing effective management and mitigation strategies. A study was conducted during the year 2020-21 and 2021-22 in a long-term tillage experiment on maize-wheat cropping system being conducted in a Typic Haplustept at the Indian Agricultural Research Institute, New Delhi since 2014 to monitor CO2 and N2O emissions during wheat growth and find their relationship with soil properties. The soil physical parameters considered were Bulk Density (BD), Soil Hydraulic Conductivity (SHC), Soil Moisture Content (SMC), Mean Weight Diameter (MWD), Water Stable Aggregates (WSA), Porosity, and Soil Temperature at 0 and 5cm. The soil chemical and biological parameters considered were Soil Organic Carbon (SOC), Total Organic Carbon (TOC), Microbial Biomass Carbon (MBC), Very Labile Organic Carbon (VLOC), Labile Organic Carbon (LOC), Less Labile Organic Carbon (LLOC), Non Labile Organic Carbon (NLOC), Dissolved Organic Carbon (DOC), Nitrate (NO_3^--N), Ammonium (NH_4^+-N), Hydrolysable Ammonia-N (HAN), Hydrolysable Ammonia Suga-N (HASN), Hydrolysable Amino Acid-N (HAAN), Unidentified Hydrolysable-N (UHN) and Total Hydrolysable-N (THN), Glomalin, Beta glucosidase and Fluorescence diacetate (FDA). The correlation between CO_2 and SMC, MWD and WSA were significant at $P<0.05$ having correlation values r= -0.97, -0.82 and -0.68, respectively. DOC (r= -0.50) and MBC (-0.40) were also negatively correlated with CO_2 emissions. However, NO_3-N (r=0.77) and HASN (r=0.83) were strongly positively correlated ($p<0.5$) with CO_2 emissions. Biological properties like Beta glucosidase and FDA were also negatively correlated with CO_2 emissions with values of r= -0.43 and -0.53, respectively ($p<0.5$). Porosity and soil temp at 0 and 5 cm were strongly negatively correlated to N_2O emissions with values r= -0.90 and -0.84, respectively ($p<0.5$). Organic nitrogen pools such as HAAN, UHN and THN were positively correlated with N_2O emissions with r= 0.79, 0.92 and 0.79, respectively. Enzymatic activities like beta glucosidase,

glomalin and FDA were also positively correlated with N_2O emissions with values of correlation coefficient as 0.93, 0.96 and 0.94, respectively. Thus, it can be concluded from the study that among various physico-chemical parameters, soil moisture, soil temperature, MBC, soil organic nitrogen pools such as HASN, HAAN, UHN and THN, beta glucosidase and FDA strongly influenced GHG emissions. These identified soil properties need to be managed properly to minimize the GHG emissions. Relationships were developed between GHG (CO_2 and N_2O) emissions and C and N pools using Least absolute shrinkage and selection operator (LASSO) regression technique, which can be used to predict GHGs emissions.

Key words: Greenhouse, Wheat, Soil, Inceptisol

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Soil Resilience Potential of Marayur High Hill Soils to Anthropogenic and Climate Change Induced Abiotic Stresses

Muthyala Abhiram*, Naveen Leno and Krishnapriya M.K.

Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani, Kerala Agricultural University, Thiruvananthapuram-695522, Kerala
**Corresponding author: muthyala-2022-21-052@student.kau.in*

Anthropogenic as well as climate change induced abiotic stresses have a detrimental immediate and long-term impact on the stability and resilience of soils, critical for regenerative agriculture. Despite having a tropical sub humid monsoon climate (23.7°C and 1276 mm of rainfall), the Marayur Hills in Idukki district, Kerala, lie within a rain-shadow region, receiving minimal precipitation. The soil quality influenced by soil organic carbon dynamics play a key role in imparting capability to withstand abiotic stresses and gain resilience. Assessment of physicochemical and biological soil health indicators and the biological resilience to transient heat stress (50 °C for 80 h) and persistent copper stress (1mL of 1.57 M $CuSO_4$ $5H_2O$) were studied in the sugarcane, cool season vegetables, fruits and forest land use systems. Principal component analysis revealed organic carbon, electrical conductivity, sand and silt textural separates to be the key soil health indicators. Available calcium, magnesium, sulphur, boron, and copper content are also critical determining factors of soil health. Biological resilience assay studies revealed that forest soils exhibited superior soil stability index (SSI) (0.827, 0.723) and soil resilience index (SRI) (0.711, 0.647) for both heat and copper induced stresses respectively. Carbon mineralization potential of the sugarcane and cool season vegetable land use systems exhibited an increase after 12 days of incubation. Fruits land use system soils proved to be least resilient with low SSI (0.460, 0.502) and SRI (0.385, 0.410) for applied heat and copper stresses. Regression analysis revealed a perfect fit of the SRI with soil organic carbon content under heat stress (R^2= 0.997) and copper stress (R^2= 0.906). The soils of forest land use system with a 62.58% higher carbon content over sugarcane land use system had a profound impact on the dynamics and intrinsic regenerative properties of the soil organic carbon content.

Key words: Soil, Climate, Abiotic Stresses

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Predictive Modeling of Soil Hydraulic Parameters using IoT Sensors in Inceptisol and Entisol Soils of Western Maharashtra

M.K. Krishnapriya[1]*, G.D. Patil[2], Naveen Leno[1], M. Abhiram[1] and S. Arya[2]

[1]Department of Soil Science and Agricultural Chemistry, College of Agriculture, Vellayani, Kerala Agricultural University, Thiruvananthapuram-695522, Kerala
[2]Department of Soil Science and Agricultural Chemistry, College of Agriculture, Kolhapur-416004, Maharashtra
**Corresponding author: mkkrishnapriya7@gmail.com*

This study underscores the pivotal role of soil hydraulic characteristics in achieving sustainable agricultural goals, particularly in irrigated farmlands of Western Maharashtra. The infiltration rate of soil water stands out as a critical factor in water management for agricultural and broader water resource operations. To assess this, ten geo-referenced locations each from the inceptisol and entisol soil regions were studied in irrigated farms. IoT-driven double ring infiltrometers were employed to gauge the infiltration rate. Estimating infiltration rates using IoT sensors involves deploying these sensors within the soil to monitor and collect real-time data on various soil parameters that influence water infiltration. In inceptisol soils, attributes like sand, hydraulic conductivity, and calcium carbonate content positively correlated with infiltration rate, while silt exhibited a negative correlation. In entisol soils, parameters such as porosity, silt, hydraulic conductivity, organic carbon, and calcium carbonate content positively influenced infiltration rate, while clay, sodium content, and bulk density displayed negative correlations. Various statistical criteria were employed to compare and assess the performance of four infiltration models, namely Kostiakov, modified Kostiakov, Philip, and Horton. The modified Kostiakov model consistently demonstrated superior performance across various metrics in both inceptisol and entisol soils, boasting the highest correlation coefficients among Kostiakov, modified Kostiakov, Philip, and Horton models. In inceptisol soils, it yielded correlation coefficients of 0.997 (modified Kostiakov), 0.991 (Kostiakov), 0.978 (Philip), and 0.826 (Horton). Similarly, in entisol soils, the correlation coefficients were 0.998 (modified Kostiakov), 0.984 (Kostiakov), 0.965 (Philip), and 0.857 (Horton). Moreover, the modified Kostiakov model exhibited the smallest maximum absolute errors (0.77 in inceptisol and 0.48 in entisol) and the lowest root mean square errors (1.13 in inceptisol and 0.84 in entisol) among all models tested. Additionally, it showcased the highest nash-sutcliffe efficiency coefficients, registering values of 0.991 in inceptisol and 0.995 in entisol soils. The modified Kostiakov model emerged as

notably superior in both inceptisol and entisol soils based on criteria including correlation coefficient, decision factor, maximum absolute error, root mean square error, nash–sutcliffe model efficiency coefficient, and paired t test. This innovative predictive modeling methodology stands as a potential solution, offering predictive insights into soil water infiltration rates in the absence of real-time data. Estimating infiltration rates using IoT sensors empowers farmers and water resource managers with real-time, data-driven insights, fostering sustainable and efficient agricultural practices while conserving vital water resources.

Key words: Soil, Sensor, Maharashtra

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Impact of Long-term Fertilization on the Carbon Metabolism in Rice-Rice Cropping System of the Alfisols

S. Suvana[1]*, T.J. Purakayastha[2], C. Bidisha[2] and K.K. Bandyopadhyay[2]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]ICAR-Indian Agricultural Research Institute, New Delhi-110 012
**Corresponding author: suvana.sukumaran@icar.gov.in*

Carbon metabolism is at the core of ecosystem function. Decomposers play a critical role in this metabolism as they drive soil C cycle by mineralizing organic matter to CO_2. Their growth depends on the carbon-use efficiency (CUE), defined as the ratio of growth over C uptake. The CUE of microbes in the presence and absence of substrate were studied to study the CUE pattern of microbes under different C saturation levels in soils of Alfisols. It was determined by studying the substrate induced (cellulose) microbial biomass C and C mineralization for a period of 30 days at 37°C. The soils from the rice-rice cropping system of the long-term fertilizer experimental sites at Pattambi (Kerala) and Bhubaneswar (Orissa) were considered for the study. In the absence of substrate, CUE increased with the addition of FYM with 100% NPK, 100%NPK and in the control plots, while in the presence of substrate it was found to be least in 100% NPK and highest in the control plots in the surface and subsurface soils of Bhubaneswar. The lower CUE in the fertilized plots compared to the control could be due to the increase in cumulative CO_2 evolved with the addition of substrate. In the rice-rice cropping system of Pattambi, the CUE with the addition of substrate was observed to be higher in the control plots compared to the fertilized plots as these treatments had soils with C sources which was lacking in the control plot and hence CUE increased here in the presence of substrate. The microbial and metabolic quotient in all the soils except that of Bhubaneswar (higher microbial quotient was observed in 150% NPK amended soils) was higher in 100% NPK + FYM plots compared to the other treatments. The higher values indicate that manuring practices play a positive and significant role in proliferating microbial population and hence better nutrient cycling.

Key words: Alfisols, CUE, Microbial Quotient, Metabolic Quotient

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Crop Water Productivity of Rainfed Okra Grown under Different Sowing Environments

Arnab Banik[1], Asis Mukherjee[2]*, Sagar Sarkar[1], Aishi Mukherjee[1], Manish Kumar Naskar[1], Saon Banerjee[2] and Arup Chattopadhyay[3]

[1]Department of Agricultural Meteorology and Physics, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal
[2]AICRP on Agrometerology, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal
3 AICRP on Vegetable Crops, Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal
**Corresponding author: asismukherjee@gmail.com*

India is the highest okra production country (59.7% of global production) in the world with the productivity of 12,177 kg ha^{-1} (FAOSTAT, 2022). West Bengal contribute 13.8% share (second highest) of India's total Okra production (Ministry of Agriculture of India, 2022). It is primarily cultivated between June and September, during the rainy season. Due to variations in the sowing window, okra crop experiences variable weather conditions (temperature, rainfall, etc.) during different crop growth periods, which ends up resulting in varying growth and production. The present study was carried out at C block farm, BCKV, Kalyani during 2022 to evaluate the growth, productivity and water use efficiency of two Okra cultivars grown in different sowing environment under rain-fed condition. The experiment was set up in split plot design, where three dates of sowing (D_1: 8th June, D_2: 22nd July and D_3: 31st August) were kept in main plot treatment and two variety (V_1: Bidhan Sahebmukto (BCO-1) and V_2: Japani Jhar) were allotted in sub-plot treatment. Results showed that the highest LAI (3.55) value was observed at D_1, which was 0.10 and 0.89 less under D_2, and D_3 respectively. V_1 consistently showed higher LAI values than V_2 throughout every development stage. Early sowing produced the highest pod yield (68.25 q ha^{-1}), which declined by 19.7% in D_2. Yield further declined by 36.6% in D_3. The highest seasonal evapotranspiration (SET) value was observed in D_1 (412.3 mm), followed by D_2 (390.5 mm) and D_3 (250.1 mm). D_1 (8th June) sown okra cultivar BCO-1 used water more efficiently (WUE: 1.86 kg m^{-3}) than other treatments. Best on the performance of the crop, it is concluded that Bidhan Sahebmukto is best for June sowing in New Alluvial Zone of West Bengal.

Key words: Okra, sowing dates, Soil moisture, Yield and water use efficiency

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Variation of PAR Use Efficiency of Lady's Finger Governed by Three Different Sowing Environment

Jayanta Kumar Mridha[1], Saon Banerjee[1]*, Suvam Mandal[1], Sarathi Saha[1], Asis Mukherjee[1] and Arup Chattopadhay[2]

[1]Department of Agricultural Meteorology and Physics, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal
[2]Department of Vegetable Sciences, Faculty of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal
**Corresponding author: sbaner2000@yahoo.com*

Lady's finger (*Abelmoschus esculentus*), the largest produced vegetable in India, can favourably grow at a temperature range of 18 ^{0}C to 35 ^{0}C. The availability of Photosynthetically Active Radiation (PAR) plays a pivotal role in determining plant productivity and overall crop yield. Understanding the variations of intercepted PAR and its impact on different plant species under varying weather conditions are crucial for optimizing agricultural practices and increasing the crop production. The present study aims to investigate the influence of PAR on lady's finger crop and the main objectives taken were to study the diurnal and seasonal variation of incident, intercepted and absorbed PAR on lady's finger and to determine the PAR use efficiency of the two varieties of lady's finger. The field experiment was conducted in the *Kharif* season in the C block research farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal. The experiment was laid out in split plot design. Three different sowing environment, namely, D1 (8th June, 2022), D2 (22nd July, 2022) and D3 (31st August, 2022) were taken as the main plot treatment and two different lady's finger varieties *Bidhan Sahebmukto* 1 (BCO1) and *Japani Jhar* were taken as the sub plot treatment. Plant biophysical data and meteorological data were taken on 30DAS, 45 DAS, 60DAS, 75DAS and 90 DAS. Incident, intercepted and absorbed PAR data was taken from 8:00 hr to 16:00 hr with two hours interval. The results revealed that the diurnal variation, as well as, the seasonal variation of PAR showed a sinusoidal trend. Incident PAR showed its lowest value at morning and reached the peak value in the mid-day. IPAR and APAR was lowest at 30 DAS ranging from 18-46% and at the peak at 60 DAS or 75 DAS depending on the variety and sowing date ranging above 80%. *Bidhan Sahebmukto* 1 showed LAI range from 0.33 to 3.54, whereas, *Japani Jhar* showed the range from 0.34 to 3.34. *Bidhan Sahebmukto* 1 and *Japani Jhar* produced average yield 64.03 qha^{-1} and 50.25 qha^{-1} respectively. The PAR use efficiency of *Bidhan Sahebmukto* 1 and *Japani Jhar* were 2.08 g. MJ^{-1} and 1.78 g. MJ^{-1} respectively. Among the three sowing environment, June (70.46 qha^{-1}) sown crop produced higher yield over the other two sowing environment, i.e. July (54.76 qha^{-1}) and August (46.16 qha^{-1}) sown crops. Thus, it can be concluded that for the New Alluvial Zone of West Bengal farmers should opt for June sowing and in terms of radiation utilization, the *Bidhan Sahebmukto* 1 variety is better than *Japani Jhar.*

Key words: Lady's finger, Radiation use efficiency, LAI, intercepted PAR, Canopy temperature

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Effect of Long-term Conservation Agricultural Practices on Soil Hydraulic Properties

Nandita Mandal*, Pragati Pramanik Maity, T.K. Das, K.K. Bandyopadhyay, N. Subash, Abhradip Sarkar, Avadhesh Sharma and Simran Maurya

Division of Agricultural Physics, ICAR-Indian Agriculture Research Institute, New Delhi-110012
**Corresponding author: nanditamandal0034@gmail.com*

A study was undertaken to evaluate the long-term effect of different conservation agriculture (CA) practices on infiltration characteristics of soil and empirical Kostiakov model and physical process based Green and Ampt, and Philip models were used to predict infiltration rates. The performance of different models was evaluated using statistical criteria. Six treatments were selected, viz. conventional tillage (CT), permanent narrow bed (PNB), permanent narrow bed with residue (PNB+R), permanent broad bed (PBB), permanent broad bed with residue (PBB+R) and zero tillage (ZT). Results showed that the initial infiltration rate was highest (6.45 cm hr-1) in PBB+R and was lowest (2.15 cm hr-1) in CT. Cumulative infiltration of all the treatments followed the order: PBB + R> PNB + R> PBB> PNB> ZT + R>ZT>CT. The 'a' value of Kostiakov model was 10.12 and 8.48 for PBB and PBB+R respectively which was much higher as compared to 3.2 in CT. Steady state infiltration (ic) of Green and Ampt model was found to be highest (8.66 cm hr^{-1}) in PBB+R and was lowest (2.55 cm hr^{-1}) in CT. Sorptivity (S) parameter (cm hr-0.5) of the Phillip model was found to be highest in PNB (67.33) followed by PBB+R (39.6) and lowest in CT (15.77). Highest saturated hydraulic conductivity ('K') value of Phillip model was obtained in PBB+R After checking the model performance, it has been found that simple empirical Kostiakov (1932) infiltration model represented the infiltration rate and time relationship in a better way and characterized the best fit with the experimentally observed field infiltration data.

Key words: Conservation agriculture, Infiltration, Kostiakov model, Green and Ampt model, Philip model

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Prediction of Hydraulic Conductivity Using Different Machine Learning Approaches

Abhradip Sarkar[1]*, Pragati Pramanik Maity[1] and Mrinmoy Ray[2]

[1]Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]ICAR-Indian Agricultural Statistics Research Institute, New Delhi-110012
**Corresponding author: abhradipubkv97@gmail.com*

Measurement of hydraulic conductivity (HC) in the field and laboratory is time-consuming, laborious, and expensive. In this study, 121 soil samples were used to predict HC using Multi Linear Regression (MLR), and four machine learning-based models i.e., Artificial Neural Network (ANN), Support Vector Machine (SVM), Classification and Regression Trees (CART) and Random Forest (RF). Two sets of input data were used i.e., dataset 1: texture data, BD, OC, and glomalin content and dataset 2: D, BD, OC, and glomalin content (Dataset 2). The models were evaluated based on Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), Nash–Sutcliffe model efficiency (NSE), Root Mean Square Error (RMSE), and correlation coefficient. ANN with three hidden layers performed significantly for both input sets. The RMSE value was decreased by 17% in the training dataset and by 25.12% in the testing dataset when D was added to the input set for ANN. For both datasets, RF performed better and outperformed CART in predicting HC. According to the results, SVM with dataset 2 outperformed all other models which showed the inclusion of D in the dataset could predict HC more efficiently. However, further study is required for different combinations of datasets for evaluating the prediction efficiency of machine learning models for various regions.

Key words: Bulk density, Organic carbon, Texture, Support vector machine

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Relationship of Crop Yield and Soil Physical Health Indicators

Animesh Panda[1]*, Pragati Pramanik Maity[1], Vinay Kumar Sehgal[1], T.K. Das[1], Nataraja Subash[1], Bidisha Chakrabarti[1] and Mrinmoy Ray[2]

[1]ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]ICAR-Indian Agricultural Statistics Research Institute, New Delhi-110012
**Corresponding author: animesh270799@gmail.com*

Soil health is defined as the capacity of soil to function, within ecosystem boundaries towards sustainability. Scientists use soil health indicator to evaluate how well soil functions. Soil physical health indicator provide information about soil hydrologic characteristics, such as water entry and retention, that influences availability to plants. Some indicators are related to nutrient availability by their influence on rooting volume and aeration status. Soil organic matter can enhance the soil's water storage capacity, promote soil water conservation and gas diffusion and increase crop yields and water use efficiency. The optimal soil pH for many crops ranges between 6.0 and 7.0 because all essential nutrients can exist in available forms in this range. Typical values of soil hydraulic conductivity for greater yield are 500 cm day^{-1} for sand, 50 cm day^{1} for loam, and 5 cm or less day^{-1} for clay. While increased soil water retention enhances crop yields, reduced water infiltration capacity of the soil results in anaerobic condition that hampers nutrient cycling and root growth, thereby reducing crop production. Microbial abundance and activity can be used as important soil health indicators that were enhanced by no-tillage with increased cropping intensity and related to crop yield.

Key words: Bulk density; Crop yield, Organic carbon, Texture

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Physico-chemical Properties of Soil under Different Land Use Systems in Terai Zone of West Bengal

Bappa Paramanik[1]*, Shovik Deb[2], Bimal Das[3], Debjyoti Majumder[4], Biswesswar Mahato[5], Partha Sarathi Patra[2], Swarbinay Mahanta[3] and Ashok Choudhury[2]

[1]Dakshin Dinajpur Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Majhian, Dakshin Dinajpur-733133, West Bengal
[2]Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar-736165, West Bengal
[3]College of Agriculture, Uttar Banga Krishi Viswavidyalaya, Majhian, Dakshin Dinajpur-733133, West Bengal
[4]Malda Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Ratua-732205, West Bengal
[5]Kalyan Krishi Vigyan Kendra, Purulia-723147, West Bengal
**Corresponding author: paramanikbappa@gmail.com*

A study under four different land use systems (cultivated land, orchard land, social forest / agro forest land and fallow grass land) was conducted under *Terai* region of West Bengal to characterise the soils physico-chemical properties, enzyme activity and soil respiration pattern. The study revealed that significant responses of different soil physico-chemical properties except pH and EC. The difference in management practices resulted in difference organic carbon contents. Social forest exhibited highest average organic carbon content (1.30%) followed by orchard (1.16%), fallow grass land (1.08 %) and cultivated land (1.05%). The higher range of available N (245-267 kg ha^{-1}) was exhibited by social forest soils. Particle size analysis followed by the use of USDA textural triangle revealed that most soils were sandy loam while maximum water holding capacity ranged between 37.67-62.44 %. The activity of dehydrogenase was found significant effects of different crop rotations where Jute-Rice-Fallow rotation produced significant higher activity in bulk soil (22.69 μg TPF g^{-1} soil h^{-1}) than other three rotations. Microbial respiration at 0-91 days from fine and coarse POM mixed sand incubated at 28ÚC and 35ÚC were higher in conservational agricultural practices like social forest and fallow grass land than cultivated land, followed by a steep slope of decline for CO_2 release. Given that conservational agricultural managements significantly promotes soil respiration due to higher enzymatic activities for acid phosphates, alkaline phosphates and glucosaminidase were found in bulk soils from fallow grass land than cultivated land. The comparison of the status of the physico-chemical properties at different ecosystems emphasizes the need for proper management of the soils to refrain from soil erosion, reduction in soil fertility and land degradation.

Key words: Land use pattern, Nutrients, Soil respiration, Soil enzyme

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Impact of Bio-fertilizers and Potassium Levels on Growth and Yield of Pearl Millet (*Pennisetum glaucum* L.)

Gowriraja Gayethri*

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Email: gayethrigowryraja@gmail.com*

A field experiment was carried out to study the impact of bio-fertilizers and varying amounts of Potassium on the development of pearl millet. The trial was conducted using a randomised complete block design, consisting of ten treatments and three replications. The treatments used in the study had been as follows: T1 (Azospirillum 25g/kg + Potassium 30kg/ha), T2 (Azospirillum 25g/kg + Potassium 40kg/ha), T3 (Azospirillum 25g/kg + Potassium 50kg/ha), T4 (Azotobacter 25g/kg + Potassium 30kg/ha), T5 (Azotobacter 25g/kg + Potassium 40kg/ha), T6 (Azotobacter 25g/kg + Potassium 50kg/ha), T7 (Azospirillum + Azotobacter 25g/kg + Potassium 30kg/ha), T8 (Azospirillum + Azotobacter 25g/kg + Potassium 40kg/ha), T9 (Azospirillum + Azotobacter 25g/kg + Potassium 50kg/ha), and T10 (Control). The application of bio-fertilizers and potassium, either individually or in combination, resulted in increased plant growth, shoot and root dry biomass, and nutrient content (nitrogen, phosphorus, and potassium) compared to the control group. The highest plant performance and yield was observed with biofertilizers (25g/kg Azospirillum + Azotobacter + 50 kg/ha Potassium), as measured by plant height (150.25 cm), number of leaves per plant (12.65), and dried biomass of shoots and roots (17.19 g/plant). Subsequently, an assortment of biofertilizers and potassium treatments were evaluated. Based on the results of this study, it can be inferred that the implementation of treatments, either individually or in combination, has the potential to enhance pearl millet yield in low-input agriculture. Therefore, the combination of Azospirillum and Azotobacter at a rate of 25 g/kg, combine with a potassium application of 50 kg/ha, resulted in considerably highest grain production (3.16 t/ha), increased gross returns (Rs.79000/ha), net returns (Rs.48878.20/ha), and a benefit-cost ratio of 1.62 was significantly recorded as compared to all other treatments. A combination of biofertilizers and 50 kg/ha of potassium could be suggested for the cultivation of millet in the area under consideration.

Key words: Azospirillum, Azotobacter, Biofertilizers, Pearl millet, Potassium, Yield

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Effect of Conservation Agriculture on Yield and Soil Properties of Rainfed Cotton Based Cropping System in Alfisols of Semi-Arid Southern India

Sumanta Kundu[1]*, V.K. Singh[1], G. Pratibha[1], Ch. Chandra Sekhar[1], B. Pooja[1], J.V.N.S. Prasad[1], A.K. Indoria[1], I. Srinivas[1], V. Girija Veni[1], K.V. Rao[1], K. Sammi Reddy[1] and Ch. Srinivasarao[2]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]ICAR-National Academy of Agricultural Research Management, Hyderabad-500030, Telangana
**Corresponding author: Sumanta.K@icar.gov.in*

Feasibility of practicing CA in rainfed regions is very much crop and location specific. A field experiment was conducted since 2016 in sandy loam soil of Gunegal Research Farm at ICAR-Central Research Institute for Dryland Agriculture (ICAR-CRIDA), Hyderabad with zero tillage (ZT- no till, direct seeded with residue retention), minimum tillage (MT- One ploughing, sowing with residue retention) and conventional tillage (CT- two ploughings with disk plough, one harrowing and sowing) as main plots and 75% RDF, 100% RDF (cotton: 120-60-60 Pigeon pea: 20-50-0 kg N, P_2O_5, K_2O ha^{-1}) and 125% RDF as subplots, to study the effect of tillage practices and different doses of fertilizers on performance of cotton (ADB 542) - Pigeon pea (WRGE 93) rotation. Pooled data of 8 years (2016-2023) revealed that significantly higher cotton equivalent yield (CEY) was obtained with MT than the CT, but at par with ZT. Significantly higher drymatter production, number of branches per plant (13.2), no. of bolls/plant (13.89) was observed in 125% RDF. Significantly higher urease activity was observed in MT followed by CT and ZT. Higher urease activity was observed in 125% RDF followed by 100% and 75% RDF. There was a reduction of 25.36% of N_2O in ZT compared to CT. There was a build up of available P (5.6 kg/ha) in top 0-15 cm soil depth in ZT. Significantly higher soil organic carbon (SOC) was observed in ZT (6.9 g/kg) and MT (6.5 g/kg) compared to CT. There was a slight decrease in bulk density (1.60 g/cc) in ZT compared to CT (1.67 g/cc). Significantly higher water soluble and exchangeable K was observed in ZT and MT compared to CT. Hence, reduction of tillage, residue retention with higher nutrient doses (125% RDF) can be a sustainable practice for rainfed cotton-based system for higher yield and reduction of GHGs emission in light textured degraded Alfisols.

Key words: Cotton equivalent yield, Zero tillage, Residue, Bulk density, GHGs emission

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Effect of Long Term Fertilization and Manuring on Soil Quality and Nutritional Quality of Maize (*Zea mays* L.)

Bommireddy Mamatha[1]* and G.G. Kadalli[2]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]University of Agricultural Sciences, GKVK, Bengaluru-560065, Karnataka
**Corresponding author: mamathabommireddy1997@gmail.com*

A study on "Effect of long term fertilization and manuring on soil quality and nutritional quality of maize (*Zea mays* L.)" under finger millet-maize cropping system was carried out in LTFE plots which has been in progress since 1986 at UAS, GKVK, Bengaluru. Eleven treatments were laid in randomized block design with three replications. Soil samples (0-15 cm depth) collected after the harvest of 35th crop cycle of finger millet (*kharif* 2021) were analyzed for 22 soil quality parameters and soil quality index (SQI) was assessed. The hybrid maize was grown in LTFE plots during *Rabi* 2021-2022 and qualities of grain and fodder were assessed. Higher SQI (0.95) was recorded in 100 per cent NPK+ FYM+ lime and lower (0.65) was in control treatment. Application of 100 per cent NPK+ FYM+ lime recorded significantly higher grain quality *viz*., geometric mean diameter (7.63 mm), bulk density (791 kg m^{-3}), 1000 grain mass (444.10 g), colour (L*72.91, a*4.68, b*27.48), crude protein (10.35%), ash (1.73%), moisture (8.19%) and crude fibre (1.85%). The same treatment also recorded better fodder quality *viz*., moisture (9.04%), ash (9.29%), crude fat (2.89%), crude fibre (33.10%), non fibre carbohydrates (37.18%), dry matter digestibility (60.20%), acid detergent fibre (36.84%) and neutral detergent fibre (58.23%). Inorganic fertilization alone, 100% N, 100% NP and control treatments recorded poor SQI and intern produced poor quality grain and fodder. The conjoint use of organic manures along with chemical fertilizers in balanced form is essential to maintain good soil quality and for quality maize production.

Key words: Fertilization, Soil, Maize

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Variation in Summer Rice Productivity in West Bengal's New Alluvial Zones Under Various GCM-driven Scenarios from the Past and the Future Using the ORYZA2000 Model

Debjyoti Majumder[1]*, Lalu Das[2] and Bappa Paramanik[3]

[1]*Malda Krishi Vigyan Kendra, Ratua, Uttar Banga Krishi Viswavidyala, Rukundipur-732205, West Bengal*
[2]*Bidhan Chandra Krishi Viswavdyalaya, Department of Agricultural Meteorology and Physics, Mohanpur, Nadia-741252, West Bengal*
[3]*Dakshin Dinajpur Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Dakshin Dinajpur-733133, West Bengal*
**Corresponding author: majumder.debjyoti@gmail.com*

A study was conducted to investigate climate change impact on rice production in six districts of Gangetic West Bengal , using observational data and CMIP5 GCMs simulation. Boro rice production's climate sensitivity is assessed with the ORYZA 2000 model, calibrated and validated using field experiments from 2016-17 and 2017-18. To ensure the accuracy of the ORYZA 2000 model, field experiments spanning two consecutive *Boro* seasons (2016-17 and 2018-18) were conducted. These experiments generated essential input parameters crucial for calibrating and validating the model. Once validated against local environmental conditions and the specific characteristics of two selected rice varieties, the model was applied to predict future yield production. The evaluation extended to examining the yield gap, a critical indicator of the disparity between potential and observed productivity. The study unveils potential production scenarios for each of the six districts under scrutiny, taking into account local meteorological parameters and the unique attributes of the rice varieties. Future yield change scenarios are meticulously scrutinized under two contrasting Representative Concentration Pathways (RCPs), namely RCP4.5 and RCP8.5. To ensure a robust analysis, multi-model ensemble yield production scenarios are formulated, offering insights for both mitigation and adaptive management practices. Over a 55-year period, the districts experienced a discernible upward trend in average temperatures. Notably, the temperature surge during the *kharif* season surpassed that of the *Boro* season. Rainfall trends, a critical factor in agriculture, exhibited regional variability. Some districts witnessed a reduction in rainfall, while others experienced an increase during both seasons. GCM-simulated data contributed additional layers of complexity, revealing model-dependent variations in temperature and rainfall estimations. Specific GCMs stood out for their reliability in precipitation studies (e.g., CCSM4, CESM1-BGC, CanESM2), while others demonstrated efficacy for temperature assessments in Gangetic West Bengal (e.g., NorESM1-

ME, MIROC5). The ORYZA 2000 model demonstrated high accuracy in representing dry matter accumulation and yield, further bolstering the credibility of the study's findings. The historical context of potential yields revealed variability among districts, with yield gaps ranging from 46% to 53%. Projections into the future foretell a shortened crop growth period and diminished yields under both RCP4.5 and RCP8.5. The study, thus, underscores the urgency of adopting multifaceted climate scenarios and adaptive strategies to ensure the sustainability of agriculture in the face of evolving climatic conditions.

Key words: Global circulation model, Representative concentration pathway, Crop simulation model, ORYZA 2000, *Boro* rice, Climate change

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Effect of Weather Parameters on Growth and Yield of Sorghum Varieties Under Rainfed Conditions

S. Subbulakshmi*, A. Solaimalai and B. Bhakiyathu Saliha

Agricultural Research Station, Kovilpatti-628502, Tamil Nadu
**Corresponding author: sumiagri@rediffmail.com*

Sorghum is ranked as the fifth key cereal crop globally and acts as a source of grain, animal feed, pasturage, fodder, fiber, fuel, bio ethanol, alcoholic beverage as well as building material. In India, the national average productivity of sorghum is very low (880 kg/ha) as against high yield obtained in USA and China. Low productivity can be attributed to poor management practices in alignment to changing weather conditions. With the threat of climate change looming large on productivity of the crop, the most vulnerable regions of the world are the tropics, particularly the semi-arid regions where higher temperature and increases in rainfall variability could have substantially negative impacts. It is important to assess the effects of weather on sorghum crop. Hence, a field experiment was conducted during 2021-22 at Agricultural Research Station, Tamil Nadu Agricultural University, Kovilpatti, Thoothukudi district, Tamil Nadu to study the effect of various weather factors on the growth and yield of sorghum varieties under rainfed condition. The experiment was laid out in split plot design with three replications. The treatment comprises of three dates of sowing *viz*., 39th standard week (Sep 24th-30th), 41st standard week (Oct 8th to 14th) and 43rd standard week (Oct 22nd to 28th) in main plots and four varieties *viz*., K 12, K 8, CSV 20 and CO 30 in sub plots. The results of the study revealed that, the sowing windows *viz*., 39th standard week (D_1), 41st standard week (D_2) and 43rd standard week (D_3) received 599.4, 518.7 and 510.7 mm of rainfall with 31, 26 and 25 rainy days respectively. The 39th standard week sown crop received higher amount of rainfall during seedling and grain development stages and the 43rd standard week sown crop recorded very meager amount of rainfall during these periods. Higher plant height of 240.0 cm, number of seeds panicle^{-1} (835 nos), 1000 seed weight (19.3 g) were recorded by 39th standard week sown crop than 41st and 43rd standard week sown crop. Among the varieties tested, sorghum variety CSV 20 recorded significantly higher plant height of 261.6 cm and number of seeds panicle^{-1} (618 nos) and 1000 seed weight (17.2 g). The crop sown before the onset of monsoon (39th standard meteorological week) recorded the higher grain yield of 1832 kg ha ^{1} than 41st (324 kg ha ^{1}) and the 43rd (276 kg ha ^{1}) standard meteorological week sown crop. Among the sorghum varieties, higher grain yield of 2299 kg ha^{-1} was recorded by CO 30 variety which was followed by CSV 20 (2269 kg ha^{-1}) indicating that sowing of sorghum varieties CO 30 and CSV 20 during the 39th standard week viz., Sep 24th to 30th in the semiarid agroclimatic zone of Tamil Nadu can generate higher sorghum crop yield and better yield attributes.

Key words: Weather, Sorghum, Rainfed, Tamil Nadu

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Changes in the Growth and Yield of Rainfed Maize Hybrids as Influenced by Weather Conditions

B. Bhakiyathu Saliha, S. Subbulakshmi and A. Solaimalai*

Agricultural Research Station, Kovilpatti-628502, Tamil Nadu
**Corresponding author: sumiagri@rediffmail.com*

Global climate change threatens the food production globally by varying intensity and frequency of rainfall, occurrence of extreme weather and increment in greenhouse gases. Increased occurrence of extreme climate events results in greater variability of agricultural production. *India ranks 4th in area and 7th in production*, representing 4% of the world maize area and 2% of total production. The country has produced 31.5 lakh million tones of maize in an area of 9.9 million hectares during 2020-21. Increase in average day and night temperatures affects maize development by increased requirement of water which reduces the economic yield. It is already reported that increase in maximum temperature causes more effect on the maize grain yield in comparison to the minimum temperature for CO_2 levels viz., 380 ppm and 760 ppm for both rainfed and irrigated conditions respectively. Hence, it is necessary to find out the effects of various weather factors on growth and yield of maize under rainfed condition. Field experiments were conducted during 2021-22 at Agricultural Research Station, Kovilpatti, TNAU to study the effects of different weather elements on growth and yield of maize hybrids. The experiment was laid out in split plot design with three replications. The treatment combinations comprised of four dates of sowing *viz*., 39th, 40th, 41st and 42nd standard meteorological weeks in main plot with four different maize hybrids *viz*., S 6850, NK 6240, RMH 3033, CO HM 6 in sub plots. The result of the experiments revealed that the duration of maize crop was reduced under delayed sowing of 41st and 42nd standard meteorological week which was mainly attributed to increased maximum temperature and less rainfall at later reproductive phases *viz.,* milking, dough and maturity stage of the crop. The maize hybrids *viz.,* COHM 6 and NK6240 has taken minimum number of days for completion of each phenophase with significantly higher yield than other hybrids which is advantageous in rainfed situations. Higher growth parameters *viz.,* plant height (268.2 cm), leaf area index (LAI) (6.24), cob length (16.82 cm), cob girth (15 cm), grain rows / cob (16.6) and grains /row (28.8), the highest grain yield (4652 kg/ha) and stover yield (7916 kg/ha) were observed on 39th standard week sown crop. Among the maize hybrids evaluated COHM 6 recorded maximum plant height (278.4 cm), LAI (6.36), cob length (16.42 cm), cob girth (16.18 cm), grain rows / cob (15.78), grains /row (28.6) and test weight (33.2 g), highest grain yield (4123 kg/ha) and stover yield (8354 kg/ha). Maize hybrids sown during 39th meteorological standard week received good amount of rainfall (486 mm) throughout the crop growth period and hence it is infered that under rainfed situations of dry semi arid zones it is recommended for maize sowing during 39th standard meteorological week with maize hybrids such as CO HM 6 and NK 6240 for obtaining higher yields and better net returns.

Key words: Maize, Hybrid, Weather, Kovilpatti

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Effect of Weather Factors on Pest Dynamics in Mustard

Sameer Kumar Singh[1]*, Priyanshi Kamal[1], Anil Kumar Singh[2], Umesh Chandra[1] and Kamal Ravi Sharma[1]

[1]Department of Entomology, College of Agriculture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229, Uttar Pradesh
[2]Department of Agricultural Meteorology, College of Agriculture, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229, Uttar Pradesh
**Corresponding author: drsameerent@nduat.org*

The present investigation as carried out at Students' Instructional Farm, A.N.D.U.A. & T., Kumarganj, Ayodhya (U.P.) during *Rabi*, 2022-23. The incidence mustard aphid, mustard sawfly, painted bug initiating after sowing till harvesting. The highest and lowest incidence of aphid was recorded at 7th SMW and 51st SMW (110.80 and 0.80 aphids/10cm central twig/plant), mustard sawfly highest 49th SMW (1.80 larvae/plant) and lowest 47th (0.20 larvae/plant), painted bug was recorded highest and lowest at 8th SMW and 5th SMW (2.20 and 0.20 bugs/plant). The highest and lowest population of coccinellids was recorded at 9th SMW & 4th SMW (5.40 & 0.80 adults/plant) and highest & lowest syrphid flies was at 9th SMW & 2nd SMW (5.40 & 0.40 grubs/plant). Mustard aphid population showed non-significant negative correlation with minimum temperature (r= -0.690) and maximum temperature (r= 0.153), sunshine (r= 0.228) had non-significant positive correlation and relative humidity (r= -0.704**), windspeed (r= -0.508*) showed significant negative correlation whereas *Coccinellids* (r= -0.429) & syrphid flies (r= -0.422) showed non-significant negative correlation. Mustard sawfly population showed non-significant positive correlation with minimum (r= 0.321), maximum temperature (r= 0.511), windspeed (r= 0.098) and relative humidity (r=0.547*) showed non-significant negative correlation, whereas sunshine showed significant positive correlation (r= 0.547*) although relative humidity (r= -0.066) showed negative non-significant correlation. The population of Painted bug had significant positive correlated with minimum (r= 0.629**), maximum temperature (r= 0.629**) and sunshine (r= 0.488*) whereas relative humidity (r= 0.007), windspeed (r= 0.261) non-significant positive correlation.

Key words: Population dynamics, Pest, Weather factors, Mustard

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Soil Microbial Activities in Different Cropping System of Deep Sandy-loam Soils of Gurdaspur, Punjab

Savitha Santosh[1]*, M. Manjunath[1], Anil Khokar[2], G. Ravindra Chary[1], Basudeb Sarkar[1], H.B. Santosh[1], Priya Gurav[1], M. Srinivasa Rao[1] and V.K. Singh[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]Krishi Vigyan Kendra, PAU Research Station, Gurdaspur-143521, Punjab
**Corresponding author: savitha.santosh@icar.gov.in*

Soil microorganisms are pivotal in nutrient cycling, breaking down organic matter into elements accessible to plants and sustaining soil health. The diversification of cropping systems can impact soil microbes, influenced by differences in disturbance, substrate quantity and quality, as well as availability. These variations, along with distinct inputs required for different crops, differentiate diversified systems from conventional ones. Recognizing and leveraging soil microbial activities are crucial for sustainable agriculture, ecosystem preservation, and addressing environmental challenges. A well-balanced and diverse microbial community is fundamental for the enduring productivity and resilience of soils globally, playing a critical role in maintaining the health and functionality of terrestrial ecosystems. The current investigation aimed to assess soil microbial activities in deep sandy loam soils of Gurdaspur under various cropping rotations. Rhizospheric soil samples were collected at the vegetative to flowering stage from different cropping patterns, including Black gram - Mustard, Black Gram - Lentil, Sesame - Lentil, Sesame - Wheat, Sorghum Fodder - Mustard, Black Gram - Wheat, and Sesame - Chickpea. These samples were analyzed to determine soil microbial biomass carbon and dehydrogenase activity, serving as indicators of soil biological activities. Additionally, total microbial counts of bacteria, fungi, and actinomycetes were estimated. Among the various crop rotations, the combination of sorghum fodder-Mustard exhibited the highest dehydrogenase activity at 10 μgTPF/g/24h, soil microbial biomass carbon (SMBC) of 260 μg/g soil, bacterial count of 21 $*10^6$ CFU/g soil, fungal count 4.1* 10^3 CFU/g soil, and actinomycetes count 2.3*10^2 CFU/g soil. The study revealed that different crop rotations had a significant impact on soil biological activity. Consequently, soil biological properties emerge as a promising tool for estimation of soil quality.

Key words: Soil, Cropping, Deep, Soil, Punjab

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Android-based Application for Precision Nitrogen Management in Maize: Paving the Way for Enhanced Productivity, Nutrient Use Efficiency, and Agricultural Sustainability

Sayantika Sarkar[1]*, Pravin Kumar Upadhyay[1], Abir Dey[1], Utpal Ekka[1], Sanjay Singh Rathore[1], Rajiv Kumar Singh[1], Anchal Dass[1], Kapila Shekhawat[1], R.N. Sahoo[1] and V.K. Singh[2]

[1]ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: st.20032000@gmail.com*

To enhance global food security, policymakers and stakeholders are redirecting their emphasis from production-centric agriculture to resource-efficient practices. Improving nutrient use efficiency by integrating precision nutrient management technologies, utilizing data analytics is vital for addressing agronomic, environmental, and health concerns. Android-based apps tailored for nutrient management holds promise for empowering farmers with real-time data, sensors, and advanced algorithms, ensuring precise crop nutrition, fostering optimal growth, and resource utilization in modern agriculture. Therefore, based on experiments conducted for 3 years, a nitrogen prescription algorithm was developed from the greenness values of captured leaf images, which was converted into a mobile based android application capable of real-time N recommendation to crops. Additionally, a field experiment was conducted in maize at ICAR-IARI, New Delhi during the kharif of 2023 to validate the developed application and investigate its potential benefits in terms of enhancing the biological yield (BY), harvest index (HI), and agronomic efficiency of nitrogen (AE). The experiment was conducted in a randomized complete block design with six treatments and four replications. The treatments comprised of 50kg (N_{50}PK) and 75kg (N_{75}PK) of Nitrogen applied as basal, with remaining N applied as split according to the precision nitrogen management techniques like android-based application (App) and GreenSeeker™ (GS), which were compared with the conventional recommended dose of fertilizer (RDF). The results revealed that BY under different precision N management techniques was statistically at par with the RDF, though they differed significantly with the control plots. The highest BY was recorded with N_{75}PK + App, which produced 6.16% higher BY than N_{50}PK + App. The HI followed a similar trend though N_{50}PK + GS treatment showed a higher HI than the other treatments. There was significant difference in the AE amongst the treatments. The AE of N_{50}PK + App plots was 12.73% and 7.85% higher than the RDF and N50PK + GS plots respectively. Thus, the Android application facilitates optimal resource allocation, advocates for sustainable nutrient management practices, all while upholding overall farm productivity in maize.Top of Form

Key words: Android-based Application, Nitrogen, Maize, Nutrient

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Optimizing Cowpea Yield and Soil Health Through Seed Treatment and Foliar Application

Joshna V.[1]* and Sharu S.R.[2]

[1]Department of Agronomy, IARI Mega University Hyderabad Hub, ICAR-CRIDA, Hyderabad-500059, Telangana
[2]Department of Agronomy, College of Agriculture, Vellayani, Kerala Agricultural University, Thiruvananthapuram-695522, Kerala
**Corresponding author: joshnareddyvanam@gmail.com*

Seed treatment with bioagents not only provides plant protection but also promotes plant growth, soil microbial diversity, and root development for better soil structure and aggregation. Foliar application reduces reliance on soil by efficient absorption of nutrients. It can also stimulate microbial activity on plant canopy and surrounding soil, contributing to nutrient cycling by increased organic matter input into the soil, can also support plants during water stress. The field experiment was conducted at Coconut Research Station, Balaramapuram, Kerala during *rabi* 2021-22. It was laid out in RBD, with 18 treatment combinations replicated thrice. It consisted of three seed treatments each @ 20 g kg^{-1} seed [(s_1- *Trichoderma* sp. (KAU isolate), s_2- PGPR Mix II (Microbial consortium of *Pseudomonas flourescens* + *Bacillus subtilis*), s_3- control (no seed treatment)] and six levels of foliar application of nutrients at 40 DAS [f_1 - urea 2%, f_2 - DAP 2%, f_3 - KCl 2%, f_4 - urea 2% *fb* DAP 2%, f_5- KCl 2% + DAP 2%, f_6- control]. Soil analysis before the experiment revealed that soil reaction was strongly acidic with EC (0.10 ds m^{-1}), OC (0.5%), and available NPK (in kg ha^{-1}) 201.2, 27.9, and 162.82, respectively. Results revealed that seed treatment and foliar application had significant influence on available NPK. Higher OC (0.56%), N (260.64), P (23.97) and K (131.34) were recorded in s_2 while the lower OC content, N and K content were recorded in s_3. Higher N (255.06) and P (24.77) were observed in f_4. Higher K (133.77) was recorded in f_5. In case of seed treatment, higher seed yield (1451.67 kg ha^{-1}) was recorded in s_2 and while in foliar application f_4 recorded higher (1631.38 kg ha^{-1}). These findings offer practical insights for sustainable farming approaches, emphasizing the intricate relationship between crop performance and soil health.

Key words: Cowpea, Soil health, Seed treatment, Foliar application

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Effect of Phosphorus Management through Organic and Microbial Sources on Root Growth of Baby Corn and Nutrient Availability of Soil

Subrata Bag[1,2]* and Yudh Vir Singh[2]

[1]Division of Agronomy, IARI-Hyderabad Hub, ICAR-CRIDA, Hyderabad-500059, Telangana
[2]Division of Agronomy, ICAR-Indian Agricultural Research Instiute, New Delhi-110012
**Corresponding author: subratabag025@gmail.com*

Baby corn (*Zea mays* L.) is a special type of maize that is harvested young when the silks have either not emerged or just emerged. Phosphorus (P) is the second most important essential nutrient. Achieving higher crop yield along with increasing phosphorus use efficiency without degrading soil fertility requires an efficient alternative sources chemical P fertilizers. To evaluate the performance Phosphate rich organic manure (PROM) as an alternative of DAP, an experiment was conducted in ICAR- IARI, New Delhi in *Kharif* season of 2022 in baby corn (var. Pusa HM 4 (Shishu)) with ten treatments comprising different combination of DAP, PROM, PSB, AMF and Control. Treatments were replicated three times in randomized block design. Root samples collected from 0-15 cm depth using root auger of 15 cm diameter at peak tasselling stage and after washing root parameters were analyzed with WINRHIZO software. Baby corn yield with husk and without husk recorded in total six picking. Green fodder yield also recorded. After the harvest of baby corn, soil samples were collected from 0-15 cm depth and were analyzed for OC, available N, P, K by standard protocol. Application of 27 kg P ha^{-1} through PROM resulted higher root volume density, root length density, root dry weight density compared to 27 kg P ha^{-1} through DAP application and they were statistically non-significant. 27 kg P ha^{-1} by PROM enhanced baby corn yield without husk by 4.32% and 55.08% over DAP application and control respectively. Available P was recorded significantly higher in 27 kg P ha^{-1} PROM compared to 20 kg P ha^{-1} application. Higher positive available P balance was estimated in 27 kg P ha^{-1} PROM compared to other treatments. Moreover, combined application of 20 kg P ha^{-1} through PROM along with PSB (500 g ha^{-1}) and AMF (12.5 kg ha^{-1}) resulted non-significant difference in corn yield and P availability. Use of PROM demonstrated that it can be a potential alternative of DAP for optimizing productivity of baby corn and increasing resource use efficiency.

Key words: Baby corn, Phosphorus management, Phosphate rich organic manure (PROM), PSB, AMF, Root parameters

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Impact of Fertilizers, FYM and Lime on Soil pH and Nutrient Availability in an Acid Soil of North-Western Himalayas

Ankita Mohapatra[1,2]* and Raj Paul Sharma[2]

[1]Department of Soil Science, IARI-Hyderabad Hub, ICAR-CRIDA, Hyderabad-500059, Telangana
[2]Department of Soil Science, College of Agriculture, CSK Himachal Pradesh Agricultural University, Palampur-176062, Himachal Pradesh
**Corresponding author: ankitamohapatra0798@gmail.com*

Achieving higher crop yield without deteriorating soil fertility requires an adequate and balanced supply of plant nutrients through organics and chemical fertilizers. Monitoring soil pH is also essential for achieving optimum productivity and restoring soil health. By evaluating the effects of fertilizers, farmyard manure (FYM), and lime on soil pH, nutrient availability, and maize yield, the study aims to provide insights into the most effective soil management strategies under acidic conditions. The experiment was conducted at Palampur, Himachal Pradesh, during *kharif* 2021 with seven treatments comprising different combinations of 100% NPK, 10t ha^{-1} FYM, and lime [100% and $1/10^{th}$ Lime Requirement (LR)], and control, replicated three times in a randomized block design. After the harvest of maize, soil samples were collected from 0-0.15 m depth, and the data on grain and stover yield of maize was recorded. The soil samples were analyzed for pH, available N, P, K, and S, and exchangeable Ca and Mg using standard methods. The treatments comprising lime with 100% NPK or lime with 100% NPK and FYM recorded higher pH than the rest of the treatments. The combined application of FYM and lime with 100% NPK resulted in significantly higher available N, P, K, and S, and exchangeable Ca and Mg over the sole application of 100% NPK. The highest grain and stover yields of maize were recorded in the treatment comprising 100% NPK + 10t FYM ha^{-1} + lime incorporation @ 100% LR, which was at par with 100% NPK + 10t FYM ha^{-1} + lime incorporation @ $1/10^{th}$ LR in furrow. The integrated application of chemical fertilizers, manure, and lime significantly improved the pH and available nutrients in soil and maize yield. Moreover, the furrow application of lime at a reduced dose of $1/10^{th}$ of LR did not cause any significant reduction in yield. Hence, a balanced approach in soil management is essential for optimizing crop yield without compromising soil health and sustainability.

Key words: Acid soils, Available nutrients, fertilizers, FYM, Lime, pH

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Climatic Classification of Indian Districts under Climate Change Scenarios

B.M.K. Raju[1]*, C.A. Rama Rao[1], Adlul Islam[2], K.V. Rao[1], Ravindra Chary[1], V.K. Singh[1], R. Nagarjuna Kumar[1], Josily Samuel[1], A.V.M. Subba Rao[1], G. Pratibha[1], N. Swapna[1] and S. Ajith[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]NRM-Division, ICAR, Krishi Anusandhan Bhawan - II, New Delhi-110012, Inida
**Corresponding author: bmkraju@yahoo.com*

Revisited climatic classification at district level using the data pertaining to the period 1971-2005 revealed that moist sub-humid pockets in Chhattisgarh, Orissa, Jharkhand, Madhya Pradesh and Maharashtra states have turned dry sub-humid (to a larger extent) compared to classification based on data for the period 1901-1950. Other notable observations were substantial increase of arid region in Gujarat and, a decrease of arid region in Haryana and increase in semi-arid region in Madhya Pradesh, Tamil Nadu and Uttar Pradesh due to shift of climate from dry sub-humid to semi-arid. Climate projections from an ensemble of CMIP 5 models under RCP 4.5 scenario projected a wetter and warmer climate during 2020-2049 in India. In view of this it is important to investigate probable shifts in climate in future at district level based on RCP 4.5, most fitting scenario for Indian context and an extreme scenario of RCP 8.5 which have implications for future crop policy in India. Estimated daily scale Precipitation (P), Max T and Min T data at district level from grid level (0.5^0 x 0.5^0) data sourced from IMD for 1976-2005. Climate projections of multi-model ensemble for Precipitation, Max T and Min T at daily scale for 2050s (2040-2069) for RCP 4.5 and RCP 8.5 scenarios of CMIP 5 models were also brought to district level from grid level in GIS environment. Computed Potential Evapotranspiration (PE) at district level for 1976-2005 period and 2050s with RCP 4.5 and 8.5 scenarios from Max T and Min T data using Hargreaves method. These PE estimates were calibrated using FAO recommended Penman-Monteith method as standard. Computed moisture index from P and PE and assessed climate at district level (Arid, Semi-arid, Dry sub-humid, Moist sub-humid, Humid and Per humid). Climatic shifts are observed in 32 districts (5.17% of country's geographical area) as per RCP 4.5 in 2050s. Moisture index is projected to rise in few districts of Gujarat, West Bengal, Orissa and Uttar Pradesh where as it is expected to decrease in few districts of Jammu & Kashmir and Himachal Pradesh. Climatic shifts are observed in 45 districts (8.62% of the geographical area in the country) as per RCP 8.5 in 2050s. The States/UTs where moisture index is projected to decrease remained same as compared to RCP 4.5. However, the states where moisture index is projected to rise spread to many states compared to RCP 4.5. By and large moisture index is projected to rise in India indicating enhanced moisture availability in future. How ever negative impacts of projected rise in temperature pose a threat to Indian agriculture.

Key words: Climate Change, Chhattisgarh, Orissa, Jharkhand, Madhya Pradesh, Maharashtra

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Farmer FIRST Approach for Dissemination of Sustainable Dryland Technologies: Experiences and Learnings

G. Nirmala*, B. Sanjeev Reddy, P.K. Pankaj, Ravi Shankar K., Dinesh A. and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author. g.nirmala@icar.gov.in*

Farmer FIRST is an ICAR programme that aims to move beyond production and productivity and prioritise the complex, diversified, and risk-prone circumstances of the majority of farmers through improving farmer-scientist communication and multi-stakeholder participation. Complex problems dealt with multifaceted solutions such as multiple stakeholders, views, realities, multifunctional agriculture, and multi-method methods. Integrating components of technology for application in rainfed agroecosystems with focus on innovations and feedback constitute the technology assemblage component. Problems identified and prioritised based on which crop, NRM technology, horticulture, small farm machinery and livestock components were grouped and demonstrated for each farm household. Some of the technology components grouped were Crop+NRM; Livestock+ fodder crop + good management practices (GMP); Poultry + GMPs, horticulture+ NRM+ GMPs, Crop+ Farm machinery+ NRM etc., Technologies demonstrated improved yield, reduced soil loss, reduced cost of cultivation and overall income of farmers. Capacity building and partnership with state department, SAU and NGO further improved feedback and ensured modification of interventions. Content mobilisation contributed to upscaling of program to achieve sustainability of ecosystem. Grass root institutions like Farmer society and FPO have contributed to self-sustenance of the program.

Key words: Farmer FIRST, Sustainable, Technology, Horticulture

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Optimization of the Yield of Indian Mustard Cultivars by Adjusting the Sowing Dates Through Crop Simulation Modeling

D. Ray, D.K. Das*, V.K. Sehgal, J. Mukherjee and R. Dhakar

Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: dkdas.iari@gmail.com*

The normal date for sowing the Indian mustard is the second fortnight of October to get the high yield in the northwestern part of India. A study was conducted through crop modelling to check whether sowing in this period is still valid to get the highest yield or if some adjustment in sowing date is required keeping in view the new cultivars, and terminal heat stress vis a vis climate change. Two crop growth models, AquaCrop and InfoCrop were calibrated using the experimental data generated through field experiments on Indian mustard cultivars, viz, Pusa Vijay, Pusa Mustard 21, and Pusa Bold at ICAR-IARI, New Delhi over the period (2014-2022). Daily mean weather data of the *rabi* season of the last 10 years were used for running the models. The models were run at 5-day intervals starting from September 15th to December 14th. The seed yield was simulated by running the models for three cultivars and 19 sowing dates were compared. The simulation through the AquaCrop model indicated that the yield would be the maximum by cultivars Pusa Vijay (2.401 t/ha) and Pusa Mustard 21 (2.387 t/ha) if it could be sown on October 15th. However, the cultivar, Pusa Bold could be sown on October 20th to get the highest seed yield (2.231 t/ha). The simulation through the InfoCrop model also indicated that cultivars Pusa Vijay and Pusa Mustard 21 could give the highest yield of 2.497 t/ha and 2.402 t/ha, respectively, when it would be sown on 15th October. But the cultivar Pusa Bold needs to be sown on October 10th to get a maximum yield (2.289t/ha). Overall, it could be concluded that a sowing window from the 10th to 20th of October (which was the 15th to 31st of October) might be perfect for the Indian mustard cultivars for optimization of seed yield under the present condition.

Key words: Mustard, Sowing, AquaCrop, InfoCrop

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Modelling Land Degradation Vulnerability in a West Coast River Basin of India Using Advanced Geospatial Techniques

Bappa Das[1]*, Sujeet Desai[1], Nirmal Kumar[2], G.P. Obi Reddy[2] and Parveen Kumar[1]

[1]ICAR-Central Coastal Agricultural Research Institute, Old Goa-403402, Goa
[2]ICAR-National Bureau of Soil Survey & Land Use Planning, Nagpur-440033, Maharashtra
**Corresponding author: bappa.iari.1989@gmail.com*

Management of natural resources and fostering sustainable development necessitates a comprehensive assessment and modeling of land degradation. This study focuses on evaluating land degradation in the Mandovi river basin of western India by employing an integrated approach. Various parameters derived from remote sensing and legacy data such as topography, vegetation, pedology, and climate were utilized to assess land degradation. The Analytical Hierarchy Process (AHP) was used for integration of these factors through weighted overlay analysis leading to the creation of land degradation map. Subsequently, the AHP output, in conjunction with the conditioning factors, was employed to develop AHP combined machine learning models specifically, gradient boosting machine (AHP-GBM), random forest (AHP-RF), and support vector machine (AHP-SVM). Model performance evaluation was conducted using the area under the receiver operating characteristic (AUC), with AHP-RF exhibiting the highest AUC (0.996), followed by AHP-SVM (0.987), AHP (0.977), and AHP-GBM (0.975). The study identified high rainfall, steep slopes, and inappropriate land use as primary contributors to land degradation in the examined region. Notably, the integration of AHP with random forest significantly enhanced model performance compared to the standalone AHP approach. The insights garnered from this research will provide valuable information for policymakers, enabling them to devise targeted land rehabilitation action plans by implementing effective soil and water conservation measures.

Key words: Machine learning models, Hybrid modelling, Land degradation vulnerability index, Mandovi river basin

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How Good are Technological Interventions in Enhancing Yield Resilience to Drought? A Study in Semi-arid Maharashtra

C.A. Rama Rao[1*], B.M.K. Raju[1], K. Ravi Shankar[1], S.S. Deshmukh[2], K. Nagasree[1], Jagriti Rohit[1], C.N. Anshida Beevi[1], R. Nagarjuna Kumar[1], Josily Samuel[1], S. Lokesh[1], J.V.N.S. Prasad[1], G. Pratibha[1] and V.K. Singh[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]Krishi Vigyan Kendra, Ahmednagar, Maharashtra
**Corresponding author: chitiprolu@yahoo.com*

Increasing frequency and intensity of extreme events is an important manifestation of climate change necessitating technological and other strategies for reducing adverse impacts at farm, household and society level. Developing and disseminating technologies for protecting crop yields against the incidence of such extreme events is currently at the top of the agenda of agricultural research and development agencies in India. In this context, the paper reports on the performance of various technological interventions in protecting the yield from incidence of drought. The study was conducted in Ahmednagar district of Maharashtra with a semi-arid climate and limited access to irrigation. As part of the project, viz., National Innovations in Climate Resilient Agriculture, various adaptation technologies for enhancing resilience were promoted. It was observed that silage pit, integrated disease management n pomegranate, change of crop variety, application of mineral mixture for livestock, integrated pest management for managing fall army worm in maize are among the most adopted technologies. Natural resource management technologies on the other hand witnessed relatively lower levels of adoption. An analysis of resilience of yield to drought showed considerable yield losses in soybean (7.05 q/ha) and chickpea (7.42 q/ha) during a drought year. Adaptation interventions viz., change of variety in soybean and foliar spray in chickpea helped reduce yield losses to 2.95 and 4.17 q/ha, respectively and enhancing yield resilience to 0.75 (0.56 with no adaptation) and 0.32 (0.21 with no adaptation) in soybean and chickpea, respectively. These adaptation technologies helped saved 58% an 44 % of avoidable yield losses in these two crops. Efforts are therefore needed to scale out adoption of such adaptation technologies for more resilient crop production and farm incomes.

Key words: Technological, Interventions, Maharashtra

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Biofortification for Improved Nutritional Traits in Pigeonpea Crop Grown Under Rainfed Conditions

K. Sreedevi Shankar[1]*, M. Manjunath[1], K. Srinivas, V. Visha Kumari[1], M. Vanaja[1] and Asma Siddiqua[2]

[1]ICAR-Central Research Institute for Dryland Agriculture, Santosh Nagar, Hyderabad-500059, Telangana
[2]Dr. Y.S.R. Horticultural University, Venkataramannagudem-534101, West Godavari District, Andhra Pradesh
**Corresponding author: sreedevikobaku@gmail.com*

A field experiment was carried out at ICAR-CRIDA to improve the nutrient quality in pigeon pea in terms of essential nutrients such as Fe & Zn using bacterial inoculants. Pigeon pea variety PRG-158 seed was biofortified/treated with PSB at the time of sowing. Absorption of these essential nutritional parameters to the edible part /grain is equally important, while taking care of plant growth, yield parameter etc. The effect of biofortification with *Burkholderia cenocepacia (PSB-3)* on the basis of its ability to solubilise inorganic forms of phosphate ($Ca_3(PO_4)_2$) and Zinc (ZnO and $ZnCO_3$) and to produce siderophores (Fe^{3+} chelating compounds) in vitro, along with soil application with RDF was studied in field condition to study the absorption of essential nutritional parameters in the Pigeon pea grain.

A field experiment was carried out at HRF, Hayath Nagar with the following ten treatments: NP, NP+PSB, NP+FYM, NP+FeSO4(SA) with PSB, NP+ZnSO4(SA) with PSB, NP+FeSO4+ZnSO4 (SA) with PSB, NP+FeSO4(FS) with PSB, NP+ZnSO4(FS) with PSB, NP+FeSO4+ZnSO4 (FS) with PSB, NP+FeSO4+ZnSO4 (SA) + one FeSO4+ZnSO4 (FS) with PSB. Pigeon pea variety PRG-158 seed was biofortified/treated with PSB-3 at the time of sowing. The effect of biofortification with PSB-3 on the basis of its ability to solubilise inorganic forms of phosphate (Ca3 (Po4)2) and Zinc (ZnO and ZnCO3) and to produce siderophores (Fe3+ chelating compounds) in vitro, was studied in field situation at HRF, to study the absorption of essential nutrients/minerals i.e., Fe, Zn, Ca, Mg, Cu and Mn, P, protein, to reach from soil to root, leaves and finally to the edible part of the pigeon pea crop were analysed. Absorption of these essential minerals/nutrients to the edible part /grain is equally important, while taking care of plant growth, yield parameter etc. Foliar micronutrient application is more suitable than soil application. Plants are capable of absorbing soluble compounds and gases through leaves, phenomena that have been utilized for delivering plant nutrients by foliar spraying. Increasing interest is focus on the effects of foliar application on improving the micronutrient density and other quality characters in crop edible portions (Hong et.al., 2017). The increase in iron content may be due to a change into ferric within the leaves and thus accumulated in the leaf tissues (Hussein et al, 2009). These data indicate that while plants tend to maintain nutrient concentrations in the grain within predetermined limits, application of fertilizers can alter the balance. Understanding the factors which influence the balance may be important when selecting for accumulation of a specific nutrient.

Key words: Biofortification, Nutritional, Pigeonpea, Rainfed

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Land Resources Inventory of Some Selected Soil Series of Begur Micro Watershed of Gundlupet Taluk, Chamarajanagara District, Karnataka

Chaitra, B.K.[1]*, Vasanthi, B.G.[2], Jagadeesha G.S.[1], A. Sathish[1] and Mamatha, B.[1]

[1]Department of Soil Science and Agricultural Chemistry, [2]AICRP on Dryland Agriculture, GKVK, University of Agricultural Scienes, Bangalore-500065, Karnataka
**Corresponding author: chaitra1492@gmail.com*

The present study was undertaken to characterize soils in Begur micro watershed located in the southern dry zone of Karnataka. The study revealed that the pedons were classified as upland to lowland categories in some selected soil series *viz*., Begur, Kamrahalli, Chikkamadure and Santhemarahalli were deep to very deep. They showed brown to very dark gray colour in dry condition, very dark grayish brown to dark grayish brown colour when wet at surface layers while in subsurface layers colour varied from brown to black both in dry and wet conditions. The soils were clay in texture with moderate medium sub-angular blocky to strong medium angular blocky structure in surface and in sub-surface sub-angular to angular blocky. The pedons expressed slightly hard to hard consistency when dry, firm when moist and moderately to very sticky and moderately to very plastic when wet with moderate calcareousness in surface layers to highly calcareous at sub-surface layers. All the pedons exhibited an abrupt smooth and clear smooth boundary, strong to violent effervescence with dilute HCl. In pedons clay dominated over sand and silt, the clay content increases with depth. Soil pH was moderately to strongly alkaline nature with non-saline, organic carbon decreased with depth. The dominant cations in the soil was Ca followed by Mg >Na >K with high CEC, it increased with depth followed the trend of clay. Base saturation was high with irregular trend with depth, a higher ESP (>15%) indicated the sodic nature. The results revealed that sand, silt, and clay content influence each other, and organic carbon has a significant relationship with various parameters such as sand, silt, clay, pH, Ca, and Mg. Additionally, electrical conductivity and exchangeable cations are related to pH and other cationic properties of the pedons.

Key words: Begur, Micro watershed, Pedons, Parameters, Correlation

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Studying the Genetic Variability for Drought Tolerance in Groundnut (*Arachis hypogaea* L.)

Bharath Kumar Alam*, Basudeb Sarkar, H.B. Santosh, K. Salini, Tejasree K., N. Jyothi Lakshmi, M. Vanaja, Savitha Santosh, M.S. Rao and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: bharath.alam@icar.gov.in*

Groundnut (*Arachis hypogaea* L.), commonly known as peanuts, is an important leguminous plant that is widely cultivated in the tropics and subtropics spanning latitudes between 40°N and 40°S. Globally, groundnut cultivated in 327 lakh hectares with the production of 539 lakh tonnes yielding 1648 kg per hectare (FAOSTAT, 2021). Global warming, an increasing threat, is expected to increase the water scarcity in the environment, affecting plant growth and metabolism. Over two-third of global peanuts are grown mainly in seasonally rainfed regions across arid and semi-arid zones where drought is a major yield limiting factor. Four hundred and fifty-seven groundnut genotypes of various countries from 6 continents were evaluated under rainfed condition in augmented block design with four checks (TG-37A, Dh-256, K-6, Dharani) repeated in 15 blocks at ICAR-CRIDA, Hyderabad. The genotypes were clustered into 6 groups with cluster sizes I (86), II (86), III (14), IV (137), V (81) and VI (31) based on the various morpho-physiological parameters. Among the 6 clusters, cluster III has highest mean value for yield related parameters followed by cluster VI. The promising lines ICG1015, GGP3185, WCG173, NCAC2791, NCAC601, NCAC737, NCAC2890, NCAC458 along with varieties Dh-256, GG2, Kadiri Amaravathi, GKVK5, Dheeraj, GG7, R2001-2, Dh-3-30, Kadiri 9 were found to be drought tolerant. These promising lines, alongside susceptible genotypes, will be studied in-depth to unravel the genetic mechanisms governing drought tolerance. The insights gained will contribute to genetic enhancement strategies aimed at developing groundnut varieties resilient to water scarcity, ensuring agricultural sustainability in the face of climate change challenges.

Key words: Genetic, Groundnut, Drought tolerance

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Simulation of Solar-Induced Fluorescence in Wheat under Water and Nitrogen Stress Using SCOPE Radiative Transfer Model

Shreya Gupta[1]*, Vinay Kumar Sehgal[1], Rajkumar Dhakar[1], Rakesh Pandey[2] and Niveta Jain[3]

[1]Division of Agricultural Physics, [2]Division of Plant Physiology, [3]Division of Environment Science, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: shreya14146@gmail.com; vk.sehgal@icar.gov.in*

A study was undertaken where the realm of fluorescence in wheat crop was analyzed, employing the Soil Canopy Observation of Photosynthesis and Energy fluxes (SCOPE) model to simulate passive multi-wavelength Sun Induced Fluorescence (SIF). Complementing the simulation, hands-on measurements in the field using the OS5P$^+$ fluorometer, specifically focusing on active fluorescence was done. The input parameters crucial for the simulations were meticulously observed from wheat field at ICAR-IARI positioned at 28º35'N latitude, 77º12'E longitude, and at an elevation of 228.16 m above mean sea level. The field experiments spanned the agricultural years 2022-23, featuring wheat crop of the HD2967 cultivar. To assess the impact of stress, varied nitrogen doses and irrigation levels were given. Analyzing the results of the simulations, it was observed that the simulated SIF exhibited distinct peaks ranging from 640 to 840 nm. Notably, the 687 nm peak appeared comparatively smaller than its counterpart at 740 nm. The study was extended beyond mere simulation and involved a rigorous comparison between the SCOPE-simulated SIF at wavelengths 687 nm and 740 nm with the observed variable fluorescence from the OS5P$^+$ instrument. A significant positive correlation was found, affirming the reliability of the simulated SIF in relation to variable fluorescence. Expanding the scope of analysis, the relationships between the simulated SIF and crucial physiological parameters was also studied. Notably, positive correlations emerged with key factors such as leaf area index, chlorophyll content, nitrogen levels, and photosynthetically active radiation. This multifaceted approach allowed us to establish correlation between the SCOPE model derived SIF and real time plant fluorescent data of wheat crop under different physiological stress conditions.

Key words: Fluorescence, Nitrogen, Water, Radiative Transfer Model, Crop

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Effect of Foliar Nano Zinc Application on Nutrient Use Efficiencies of Rice

Pebbeti Chandana*, C.R. Chinnamuthu and K.R. Latha

Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: chandanareddy660@gmail.com*

Zinc (Zn) in rice is useful for nitrogen assimilation, chlorophyll synthesis, protein, auxin, carbohydrate and growth regulator metabolism, pollen development and maintaining biological membrane integrity. Widespread lack of zinc in the world was noticed in both plants and soils. Thus, a field experiment was carried out at Tamil Nadu Agricultural University, Coimbatore during 2021 with an objective of optimization of time and dose of foliar application of nano Zn in transplanted rice. Treatments comprised of T_1: Control; T_2: 100% NPKZn (150:50:50:25 kg NPKZn ha^{-1}); T_3: 100% NPK + 2 ml lit^{-1} Nano Zn at active tillering (AT); T_4: 100% NPK + 2 ml lit^{-1} Nano Zn at AT and panicle emergence (PE); T_5: 100% NPK + 4 ml lit^{-1} Nano Zn at AT; T_6: 100% NPK + 4 ml lit^{-1} Nano Zn at AT and PE; T_7: 100% NPK + 6 ml lit^{-1} Nano Zn at AT; T_8: 100% NPK + 6 ml lit^{-1} Nano Zn at AT and PE; T_9: 100% NPK + 8 ml lit^{-1} Nano Zn at AT; T_{10}: 100% NPK + 8 ml lit^{-1} Nano Zn at AT and PE; T_{11}: 100% NPK + 10 ml lit^{-1} Nano Zn at AT; T_{12}: 100% NPK + 10 ml lit^{-1} Nano Zn at AT and PE. Among the various treatments imposed, application of 100% NPK + nFZn 8 ml lit^{-1} of water at AT and PE (T_{10}) resulted in the highest agronomic efficiency of 7.75. The next best treatments observed were 100% NPKZn (T_2: 7.49) and 100% NPK + nFZn 6 ml lit^{-1} of water at AT and PE (T_8: 6.48). Foliar zinc nanoparticles aid in the slow release of macro and micronutrients in small quantities and boost the spraying efficacy over chelated or sulphate forms. Additionally, employing nano forms lower the soil pollution created due to exploitation of chemical fertilizers.

Key words: Foliar, Nano, Zinc application, Rice

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Extreme Event and Groundwater Analysis in Kanker and Bemetara districts of Chhattisgarh

J.L. Chaudhary*, Rajendra Lakpale and Mukesh Dewangan

Department of Agrometeorology, Indira Gandhi Krishi Vishwavidyalaya, Raipur-492012, Chhattisgarh
**Corresponding author: jlcagromet@gmail.com*

The present study was carried out to find out the trend of dry and wet spells and groundwater status alongwith the cropping pattern in two former NICRA-AICRPAM districts of Chhattisgarh. To conduct the study, long term groundwater depth data has been collected from Central Ground Water Board, Raipur (Chhattisgarh). The trend analysis of dry and wet spells was computed with the help of TREND software by Mann-Kendall method and wet spell analysis is done by spell OS ("O" Resource Software) analysis. Groundwater depth trend was computed with the help of Linear Trend Graph method. Trend analysis of dry spells of different tehsils of Bemetara and Kanker districts has been carried out. Only significant trends was found for highest value component. Bemetara tehsil has been found to be having significant increasing trend while Nawgarh tehsil of Bemetara districts is showing significant decreasing trend. It indicates that there are increasing tendencies for extreme events in Bemetara tehsil. Based on the trend analysis of wet spells by using Mann Kendall method, wet spells of Bemetara and Kanker districts for different tehsils are computed by different criteria i.e. rainfall (100 mm for 1 day), rainfall (50 mm for 2 day), rainfall (25 mm for 3 day) and rainfall (10 mm for 7 day). Kanker and Bemetara districts are affected by floods though temporary water logging phenomenon in low lying areas. Jowar and maize crops are getting affected in areas of stream banks during July-Aug when water table is high and situation is aggravated when overflowing occurs. Groundwater is a very precious commodity and its proper recharge plan is a top priority requirement in present climate change scenario. The data about groundwater level shows the depth at which water is available and unit for the data is mbgl (meter below ground level). It is very important to understand the meaning of trend of groundwater i.e. increasing trend shows that the groundwater level is going down and decreasing trend shows groundwater level recharging over the area. Outcome of linear trend graph analysis for annual groundwater depth indicates significantly increasing trend for Bemetara and Saja tehsils of Bemetara district and Koelibeda tehsil of Kanker district. Durgkodal tehsil of Kanker district is showing significantly decreasing trend. District wise trend analysis of groundwater depth analysis is showing significant increasing trend of Bemetara district while Kanker district is showing non-significant increasing trend. On the basis of outcome of trend analysis of groundwater depth crop plans are to be prepared which suggested that some tehsils in the two districts have depletion of groundwater. It is suggested to grow low water requirement crop instead of existing crop like sugarcane to cope with groundwater decline.

Key words: Groundwater, Software, Chhattisgarh

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Performance of Tamarind (*Tamarindus indica* L.) Accessions under Dryland Conditions

A. Gopala Krishna Reddy*, M.D. Osman, T.V. Prasad, K. Sreedevi Shankar, Pushpanjali, N. Jyothilakshmi, M. Srinivasa Rao, C.V.K. Nageswara Rao and R. Ramesh Babu

Department of Horticulture, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: Agk.Reddy@icar.gov.in*

The research was conducted at the ICAR-CRIDA Hayatnagar Research Farm in Hyderabad . The plant material consisting of tamarind trees that were planted in 1998 with a 5 m spacing to improve the morphological and reproductive characteristics of elite genotypes as well as quality among the forty tamarind accessions maintained at the research farm. The experiment was started in 1998 and observations were taken over the fruiting season of 2020-2021 with forty tamarind accessions, the experiments were established in a randomized block design. The trees were identified for their consistent health and development. Biometric observations mainly average number of flowers per inflorescence, average number of inflorescence per Branch, average number of branches per tree, average fruit weight (g), average yield per plant (kg), fruit, pulp, seed weights as well as shell, fibre, fruit, number of normal seeds per pod as well as damaged number of seeds per pod were recorded and analyzed statistically. Significant differences among the tamarind accessions evaluated, NZB(S), Hasanur #5, Salem 132, NTI-14 and SMG-3 recorded the highest values in all the growth, pod and yield characters. NZB(S) recorded the highest number of flowers per inflorescence (14.62) while Hasanur # 5 recorded the highest number of inflorescence per branch (13.87). In yield attributes, NZB(S) recorded the highest average yield per plant (kg) (15.72) followed by Hasanur #5 (15.09), Salem 132 (14.81) and NTI-14 (14.65). The results revealed that NZB(S) showed the highest mean performance in terms of growth, yield and quality characters. The best performing accessions are being multiplied through vegetative propagation methods for planting on large scale in different locations.

Key words: Accessions, Flowering, Growth, Pod characters, Tamarind, Yield

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Zeolite as Promising Technology to Enhance Nutrient Availability and Maize Productivity in Rainfed Alfisols

V. Girijaveni[1]*, K. Sammi Reddy[2], J.V.N.S. Prasad[1], Ch. Srinivasarao[3], Sumanta Kundu[1] and K.V. Rao[1]

[1]Central Research Institute for Dryland Agriculture, Santoshnagar, Hyderabad-500059, Telangana
[2]ICAR-National Institute of Abiotic stress Management, Malegaon, Baramati-413115, Pune, Maharashtra
[3]National Academy of Agricultural Research Management, Rajendranagar, Hyderabad-500030, Telangana
**Corresponding author: girijgirij3@gmail.com*

Since the advent of the Green Revolution in the mid-1960s, the proportion of fertilizer N in the total N input for crop production in India is increasing, but NUE has declined substantially. Soil moisture and nitrogen (N) are two most important factors in improving the production of maize in rainfed Alfisols. One of the best management strategies to improve both these factors is zeolite. Zeolites are the naturally occurring crystalline aluminosilicate with empirical formula: $M_{2/n}O\ Al_2O_3\ xSiO_2{\cdot}yH_2O$, where n is the valence charge on that element; M is an alkali or alkaline earth element, and y is a number from 2 to 7. They have high CEC due to which they have wider applications in many fields. Because of their excellent qualities, there are also synthetic zeolites available in the market. In order to study the application of zeolite (Z) (0, 2, 4 and 8 ton ha^{-1}) and N (0, 40, 80 and 120 kg/ha) in *maize grown* under rainfed Alfisols, an field experiment was carried out with three replicates for two years in randomised block design. The highest fresh and dry weight were achieved with zeolite application of 8 t/ha along with N application @ 120 kg N $ha^{"1}$. Nitrogen use efficiency (NUE) which is referred to as the grain yields per unit of available N is found higher with zeolite application as compared to sole application of N with maximum NUE of 41.25 $kg.kg^{-1}$. Results of the experiment also revealed higher N uptake in maize. Thus, zeolite application can be a possible technology to improve soil available N and crop production without any addition input of N fertilizer for high yielding varieties.

Key words: CEC, Maize, Nitrogen use efficiency and Zeolite

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Impact of Modified Microclimate on the Performance of Greengram under different Planting Systems in Jorhat Condition of Assam

Karabi Pathak[1], Prasanta Neog[2]*, Kuldip Medhi[1], Rajib Lochan Deka[1], Kushal Sarmah[1], Khagen Kurmi[3] and Santanu K. Bal[4]

[1]Department of Agricultural Meteorology, Assam Agricultural University, Jorhat-785013, Assam
[2]Department of Agricultural Meteorology, B.N. College of Agriculture, Biswanath Chariali-784176, Assam
[3]Department of Agronomy, Assam Agricultural University, Jorhat-785013, Assam
[4]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: neogprasanta@rediffmail.com; Kuldip.medhi@aau.ac.in*

The problem of deficit or excess moisture in successful cultivation of mungbean in Assam receiving high rainfall with uneven distribution pattern can be addressed by modifying microclimate in the crop fields by growing the crop in different planting systems. Therefore, a field experiment was conducted in the Instrutional Cum Research farm of Assam Agricultural University, Jorhat during the *summer*, 2021 to study the impact of modified microclimates on growth and yield of greengram under different planting systems. The variety *SGC-16* was grown in a split-plot design with 3 dates of sowing i.e., 20th February (D_1), 6th March (D_2) and 20th March (D_3) in main plots and three planting systems i.e., ridge and furrow (P_1), raised bed with two rows in bed (P_2) and flatbed (P_3) in sub-plots, with three replications following recommended agronomic practices. The average soil moisture content was recorded highest in the upper 30 cm soil profile under D_3 (80.4 mm), followed by D_2 (75.0 mm) and D_1 (66.4 mm). The number of nodules per plant at maturity irrespective of sowing dates and planting systems varied from 18.5 to 34.1 with an overall mean of 25.4; and maximum under ridge and furrow planting system (P_1) which ranged from 20.2 to 34.1 with a mean value of 27.6. Drop in weekly evening soil temperatures under P_1 and P_2 was up to 2.1 and 1.4°C, respectively when compared with P_3. Regardless of sowing dates, mean leaf area index (2.06) and pods per plant (16.7) were recorded highest under P_1. The seed yield under different sowing dates and planting systems ranged from 286.3 to 681.0 kg ha^{-1} with an overall mean of 509.8 kg ha^{-1}. Correlation studies between seed yield and LAI and soil moisture in upper 30cm soil profile confirmed the existence of a significant and positive correlation between them.

Key words: Green gram, SGC-16, Microclimate, Planting system, Soil moisture

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Remote Sensing and GIS-Enabled Crop Health Assessment of Soybean at Revenue Circle Level in Satara District (*Kharif* 2023)

Ashutosh Pawar, Gargi Gaydhane, Upasana Singh and Priyanka Shamraj*

**Corresponding author: kvk.metero@gmail.com*

Experiment is carried out by Semantic Technologies and Agritech Services Pvt Ltd, Pune, during kharif season 2023-2024. Agriculture is the dominant sector in Satara district, with over 70% of the workforce engaged in agriculture. Districts area under sowing of soybean crop is showing increasing trends. Crop area identification involves the determination and mapping of the spatial extent of different crops in a given region or agricultural area. This information is essential for effective land-use planning, resource allocation, and agricultural policymaking. Modern technologies such as satellite imagery, drones, and geographic information systems (GIS) are often used to identify and monitor crop areas. The crop classification and identification method details by random forest method followed in R studio software and the results mentioned have an accuracy of over 95%. Crop health management is a comprehensive approach to ensure the well-being and productivity of agricultural crops. It involves the use of various techniques and strategies to monitor, prevent, and mitigate factors that can negatively impact crop health. These factors can include pests, diseases, nutrient deficiencies, adverse weather conditions, and more. Crop health management aims to optimize crop growth, minimize losses, and promote sustainable agricultural practices through the judicious use of resources and technology. Satellite based images were collected from MODIS and COPERNICUS. NDVI, NDWI deviation from normal VCI form of NDVI/NDWI measures the greenness and vigor of crops, offering insights into their overall health and growth. Higher NDVI values indicate healthier vegetation. LSWI assesses soil moisture levels, helping farmers identify areas of drought stress or waterlogging that can impact crop health. All images have been updated till September 2023, as per the availability of the satellite images. Revenue wise realized rainfall data analysis also carried out in which rainfall is indicated about 50% deficiency than normal values in most of the circles in all months (July-September). Final conclusion was the Soybean crop in Satara is experiencing a decline in vegetation vitality. So, we can conclude the fact that rainfall and health parameters had a direct relationship with each other, which resulted in poor health condition for Soybean crop in Satara district.

Key words: GIS, Remote Sensing, NDVI, VCI, LSWI, Satara district, Rainfall, Soybean

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Effect of Different Fertilizer Levels on Native Lead Metal Availability in Red Soil and its Entry into Fodder Maize

B. Pooja[1]*, M. Chandini Patnaik[2] and Sumanta Kundu[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Santhoshnagar, Hyderabad-500059, Telangana
[2]Agricultural Research Institute, Rajendranagar, Hyderabad-500030, Telangana
**Corresponding author: poojapoojitha1911@gmail.com*

A pot culture experiment was conducted at ARI, Rajendranagar with fodder maize as a test crop on three red soils that have low, medium and high categories of available lead status and 0, 75%, 100% RDF (100-40-30 kg N, P_2O_5 and K_2O ha^{-1}) and 125% RDF to understand the effect of different fertilizer levels on native lead metal availability in red soil and its entry into fodder maize. The highest fresh fodder yield (56.03 g pot^{-1}) and dry fodder yield (11.51 g pot^{-1}) was noticed with 125 % RDF. Low lead content (2.84 mg kg^{-1}) and uptake (32.93 ìg pot^{-1}), high zinc content (23.30 mg kg^{-1}) and uptake (331 ìg pot^{-1}) were noticed in low lead containing soils compared to soils with medium and high lead status. High contents of nitrogen, phosphorus and potassium (1.2, 0.33 and 0.92%) and their uptakes (148, 40 and 112 mg kg^{-1}), respectively were found in 125% RDF compared to 75 and 100 % RDF. In post-harvest soil, available lead status decreased from 1.78 in control to 1.69 mg kg^{-1} and zinc content increased from 1.04 to1.09 mg kg^{-1} at 125% RDF. The soil available nitrogen, phosphorus, potassium status increased significantly with increased levels of RDF from 146 to 223, 66 to 89 and 240 to 278 kg ha^{-1}, respectively over control. Hence, application of 125% RDF resulted in reduction of lead entry in the produce *i.e.,* 33.18% and increase in the available nutrients *i.e.* NPK and Zn might be due to increase in the levels of RDF application when compared to RDF in normal agricultural soils.

Key words: Available lead, Fodder yield, Zinc, Nitrogen, Phosphorus, Potassium

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Scope of Inducing Solar Energy in Farm Power Availability for Farm Mechanization

Ravikant V. Adake*, I. Srinivas, B. Sanjeeva Reddy, Ashish S. Dhimate, V. Mallikarjun, G. Kartik, S. Vijaykumar, K.V. Rao and V.K. Singh

**Corresponding author: a.ravikant@icar.gov.in*

Agricultural productivity is associated with farm power availability. As of now, total farm availability in India is about 2.2 kW/ha which need to be increased by 4.5 kW/ha to meet the food grain demand by 2035. Besides the increasing tractor and power tiller, overall mechanization status is about 47 percent which mainly dependent on crude oil source. Continuous and increased use of these sources not only adds environmental pollution but also farmers has to face increased operational cost due to escalating prices. Small farm holders are another concern where appropriate mechanization is required. In this context, development of E-vehicles for sustainable energy management and reducing environmental pollution is one of the options. In India, plenty of solar energy is available that can be harnessed for farm mechanization. keeping this point in view, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad, has developed solar energy operated E-prime mover for multiple farm operations. It consists of 1.5-HP BLDC motor, motor controller, solar power system, solar charge controller, power transmission, farm tool hitch etc. SPV modules are stationary unlike on-the-go system developed by several researchers. Power generated from solar system is provided to the prime mover through suitable cable. The prime mover is tested for various farm operations using 3-tyne cultivator and mini riders for shallow tillage, three row planter for sowing, and blade harrow/rotary weeder for row crop weeding. It observed that performance of prime mover was varied with solar radiations availability at the time of operations, and type of tools used. Except three row planter other tools are performed satisfactorily giving field capacity in the range of 0.06-0.12 ha/hr when solar power system produces minimum current of 18 amps and voltage of 48 V. Study indicated that developed model is suitable for small farm holders.

Key words: Solar energy, Farm power, Farm mechanization, Pollution

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Generalization Ability of Bagging and Boosting Type Deep Learning Models in Evapotranspiration Estimation

Manoranjan Kumar, Pushpanjali, K.V. Rao and V.K. Singh

Division of Resource Management, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: Manoranjan.Kumar@icar.gov.in*

The successful implementation of application of high-end computing system in estimating water requirement has been abundantly reported in the literature in last two decades. However, little has been reported in generalizing ability of these computing techniques. In the present study, generalization capability of machine learning models developed for crop water estimation were investigated. Three ensembled machine learning models namely (1) Extreme gradient boosting (XGBoost), (2) Gradient boosting machine (GBM) and (3) Random Forest (RF) were developed using the comprehensive data of one location (1976-2017) and then directly implemented at 11 different locations without any local calibration. The model was evaluated for its ability to estimate the numerical values of crop water requirement (PM ETo values) for test period January 2018 to June 2020. The XGBoost model slightly and significantly performed better than GBM and RF model respectively. The weighted standard error of estimate was less than 0.85 mm/day and model efficiency were varying between 96-99 % across various locations. The lower noise to signal ratio suggested that the model is robust in performance. Given the accuracy in estimating crop water requirement and its generalization capability, such model can be easily integrated with real time water management system at regional scale. All the three selected methods exhibit the generalization ability though at varying degree. The wider adopted RF model as computational tool in estimating PM ETo though satisfactorily performed in most of the location, lags significantly when compared with GBM and XGBoost. The GBM and XGBoost both utilizes the fastest convergence algorithm performed at par. However, the WSEE error was as low as 0.19 mm/day for location Bengaluru. This is expected because this station data is used for model training and validation. The contrasting observation is about the generalization ability of XGBoost and GBM model which performed fairly good for locations that were not included in model training and validation. One of the reasons for this good performance may be inclusion of temporal and spatial data such as Julian day, quarter of the year, latitude and longitude to map the seasonal variability. This is particularly important because most of the modeling work of this kind only considers the basic daily climatic data of six parameter namely sun shine hour or solar radiation, maximum and minimum

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temperature and humidity and wind speed whereas the PM method too indirectly considers the temporal and spatial data in estimating ETo. Thus, present framework of modeling approach complies with the underlying evapotranspiration process as defined by the PM method resulting in greater accuracy. The ETo at any day is not directly related to the previous day climatic conditions because of high degree of non-linearity. The ensembled models able to map the underlying nonlinear evapotranspiration process with limited input data. Thus, the results suggest that fairly accurate P-M ETo estimates could be obtained using these models. Also, given the generalizing ability of these type of numerical models, the result can be successfully implemented to other location. Though in present study, daily data were chosen, the same model can be implemented for even hourly data as well. The results revealed that the ensembled machine learning algorithm-based decision tree. The ETo estimation enables "on-demand" irrigation water supply which has the potential to enhance the overall irrigation efficiency in the command area of major irrigation projects.

Key words: Evapotranspiartion modeling, XGBoost, Gradient boosting machine, Random forest algorithm, Deep learning model

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Bamboo based Rainfed Agroforestry Systems with different Soil and Water Conservation Measures in Alfisols

G. Venkatesh[1], K.A. Gopinath[1], V.K. Singh[1], K. Sammi Reddy[2], R. Rejani[1], G.R. Rao[1] and K.V. Rao[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]ICAR-National Institute for Abiotic Stress Management, Baramati-413115, Maharashtra
**Corresponding author: g.venkatesh1@icar.gov.in*

Bamboo has the potential to be incorporated into rainfed agroforestry systems due to their diverse adaptability, multiple utility and quick returns. A study on bamboo was initiated during 2021 at the Hayat Nagar Research farm, ICAR- CRIDA, to assess the potential of bamboo-based rainfed agroforestry system to enhance system productivity and economic returns. This study will enable to develop and standardize bamboo-based agroforestry system suitable for rainfed Alfisols. The experiment was set up with three bamboo species (*Bambusa balcooa*, *Bambusa tulda* and *Bambusa nutans*), four different soil and water conservation measures and three intercrops (finger millet, pigeon pea and green gram) with three replicates. The survival of all three bamboo species was 97% at the end of second year of planting. Observations on 5th internodal length species^{-1}(cm) and 5th internodal diameter species^{-1} (cm), number of culms species^{-1} ha^{-1} and inter- crops grain yield ha^{-1} under each bamboo species raised with different soil and moisture measures were recorded. On an average, *Bambusa balcooa* grown with rectangular trench, recorded maximum 5th internodal length and 5th internodal diameter compared to other bamboo species under different soil and water conservation measures. On an average, *Bambusa tulda* grown with tri-centric pits, recorded maximum number of culms ha^{-1} compared to other bamboo species under different soil and water conservation measures. Combination of three bamboo species with four different soil and water conservation measures under rainfed conditions, revealed that, annual crops under *Bambusa balcooa* , *Bambusa tulda* and *Bambusa nutans* with HSS trench recorded maximum yield (grain) of finger millet (7.34 q ha^{-1}), pigeon pea (8.5 q ha^{-1}) and green gram (5.9 q ha^{-1}), respectively. The bamboo has very high potential to enhance the farm income, but its potential has not been harnessed fully under rainfed agroforestry systems.

Key words: Rainfed, Agroforestry, Bamboo, Inter-crops, Trenches

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Accumulated GDD, Heat use Efficiency and Productivity as Influenced by Growing Environments of Mustard Varieties

A.K. Singh*, S.R. Mishra, A.N. Mishra and Sameer Kumar Singh

Department of Agricultural Meteorology, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229, Uttar Pradesh
**Corresponding author: akmausam@gmail.com*

A field experiment was conducted at Agromet. Research Farm of Acharya Narendra Deva University Agriculture & Technology Kumarganj, Ayodhya (U.P.) during rabi seasons of last nine years (2014-15 to 2022-23). The experiment was conducted in split plot design with three crop growing environment viz. 25th October, 4 November and 14 November kept in main plot and three varieties viz. NDR 8501, Bio-902 and Varuna kept in sub plot. The experiment was replicated three times. Results of pooed data analysis reveal that highest GDD at all the phenophase of mustard was obtained in 25th October of crop growing environment while lowest GDD at all the stages was recorded in November 14th crop growing environment of mustard crop. Among the varieties, NDR 8501 recorded higher accumulated GDD at all the phenophases as compared to rest of the varieties tested under study. Highest heat use efficiency and seed yield was recorded in 25th October growing environment due to congenial temperature and bright sunshine during vegetative and reproductive phases. Lower temperature and bright sunshine during these both stages in late sown growing environment (14th Nov.) identified as meteorological constraints and consequently led to lower productivity of mustard in Eastern U.P. Seed yield increased with increase in mean temp. during vegetative phase. The unit increase in mean temp. during vegetative period increases the seed yield of mustard by about 1.0 q/ha.

Key words: Heat, Efficiency, Environment, Mustard, Uttar Pradesh

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Adaptation and Mitigation Options for Sustainable Livestock Sector in India

D.B.V. Ramana*, P.K. Pankaj, D. Sudheer and J.M. Upendra

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: Ramana.Dbv@icar.gov.in*

The livestock sector globally faces a dual challenge of navigating the impacts of climate change while also mitigating its own contributions to environmental stressors. With rising temperatures, erratic precipitation patterns, and an increase in extreme weather events, the resilience of livestock is being tested, threatening the sector's sustainability and productivity especially in tropical countries like India. One should be critical in recommending adaptation and mitigation options in view of much diversified and heterogeneous group of farmers and the resources accessible to them. Adaptation strategies within the livestock industry include the implementation of resilient breeding programs to enhance the heat and disease tolerance in different livestock breeds. Improvements in animal housing, nutrition, and healthcare are also crucial to ensure the well-being of livestock in the face of changing climate conditions. Furthermore, advancements in early detection of disease epidemics and disease management protocols are vital to address emerging challenges and containment of trans-boundary disease epidemics in future. Sustainable feeding practices, including the use of alternative and locally sourced feeds, need to be promoted and adopted in large scale to minimize the industry's impact on land and water resources. Promoting good manure management practices, such as the adoption of anaerobic digesters and bio-digestion systems, contribute not only to waste reduction but also to the generation of renewable energy. Integration of renewable energy sources, such as solar and biogas, into livestock farming operations lead to future green animal farming. This not only aligns with global efforts to transition to a low-carbon economy but also offers economic benefits to farmers through reduced energy costs, increased energy independence and carbon credits. A holistic approach is needed to enhance resilience and sustainability in the Indian livestock sector. Balancing adaptation and mitigation measures is crucial for ensuring the long-term viability of livestock farming amidst the challenges posed by climate change. It is crucial to recognise the importance of supportive policies, research initiatives, and community engagement to foster a resilient and environmentally responsible livestock industry in the face of an evolving climate scenario in India.

Key words: Adaptation, Mitigation, Livestock

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Integrated Crop Management Practices in Tube Rose (*Polianthes tuberosa)* through Front Line Demonstrations Enhanced Productivity and Net Returns of Farmers in Southern Telangana Region

G. Sri Krishna*, S.M. Vidhya Sekhar, D.B.V. Ramana, V. Maruthi, A.G.K. Reddy and V.K. Singh

ICAR-Krishi Vigyan Kendra, ICAR-Central Research Institute for Dry Land Agriculture, Hyderabad-501505, Telangana
**Corresponding author: Gs.Krishna@icar.gov.in*

Thirty front-line demonstrations (FLDs) on tube rose with integrated crop management practices viz. improved varieties, bulb treatment, Raised bed, Drip, Fertigation, use of microbial consortia and micronutrient foliar sprays and Integrated pest, and disease management were conducted at Farmers' fields of adopted villages Phalgutta, Khandawada in Rangareddy District (Telangana) during the years 2019-20, 2020-21 and 2021-22. Based on the year's overall average, it is attributed that about 126.1% higher flower yield was recorded under FLDs than that of the farmers' traditional check/ practice. The study exhibited a mean extension gap of 8850 kg/ha, a technology gap of 2635 kg/ha with mean technology index of 14.2%. An additional investment of Rs. 39000/ha coupled with integrated crop management practices in nutrients, water management, plant protection measures, scientific monitoring and non-monetary factors resulted in additional mean returns of Rs. 316350/ ha. Based on mean data of three years, overall average Incremental benefit: Cost ratio was calculated as 8.11.

Key words: Tube rose, Integrated crop management practices, Economics, Extension gap, Gap analysis, Flower yield, Technology dissemination, Technology gap

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Determination of Net Irrigation requirement and Forecast-based Irrigation Scheduling for Maize using Crop Simulation model

S. Mohamed Naziq* and N.K. Sathyamoorthy

Agro Climatic Research Centre, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: mohamednaziqs@gmail.com*

In the view of India's ground water resource assessment from 2004 to 2023, it was showing that the Annual Ground Water Extraction for Irrigation, Domestic & Industrial uses steadily increasing. The sustained growth of irrigated agriculture depends on optimal irrigation scheduling in the face of growing competition for water supplies to the crop in different regions. The best irrigation schedule, however, is limited by a number of goals that conflict with one another and operates in an unpredictable environment. The new proposed methodology framework consists of a coupled simulation-optimization system that is capable of using probabilistic weather forecasts to assist decision making on irrigation scheduling. By using this approach, we are going to work on framing the net irrigation requirement and deriving irrigation schedule for maize through a crop simulation model (AquaCrop 6.0). we have considered the data from European center for medium-range weather forecast, it consists of a single forecast (HRES) and our ensemble (ENS) which together give detailed information about the evolution of weather up to 15 days ahead. The main aim of using forecast data for irrigation scheduling is to inform the timing of the next irrigation event to minimize both the risks of stressing the crop and/or wasting water under uncertain future weather. In this presentation, we mainly focus on simulating the growth and yield of maize under MRWF based irrigation scheduling and also designed effective irrigation scheduling using ECMWF data for enhancing water and crop productivity through the incorporation of above collected forecast data and other required data such as soil and crop characteristic etc,. in the latest version of computerized crop simulation model (AquaCrop 6.0).

Key words: Net irrigation, Maize, Crop, Model

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Effect of Conservation Agriculture and *In-situ* Moisture Conservation Practices on Soil Physical and Chemical Properties in Groundnut-Sorghum System under Rainfed Conditions

P.S. Prabhamani* and H.B. Babalad

Department of Agronomy, University of Agricultural Sciences, Dharwad-580005, Karnataka
**Corresponding author: prabha829@gmail.com*

A field experiment was initiated on a fixed site during 2013-14 at UAS Dharwad, Karnataka with the objective to study the effect of conservation tillage and *in-situ* moisture conservation practices on soil physical properties and nutrient dynamics in groundnut-sorghum cropping system. The experiment was laid out in strip block design with six different tillage practices in three replications [CT_1: No tillage (NT) with BBF (Broad Bed and Furrows) and crop residues (CR) retained on the surface, CT_2: Reduced tillage (RT) with BBF and partial incorporation of CR, CT_3: NT with Flat Bed (FB) and CR retained on the surface, CT_4: RT with FB and partial incorporation of CR, CT_5: Conventional tillage (CT) with CR incorporation and CT_6: CT with no application of CR as control. The Study revealed that all conservation tillage systems recorded significantly higher water stable soil aggregates (ranging from 62.7-63.2%) and maximum water holding capacity (MWHC) (ranging from 53.7-54%). However, CT_5 revealed significantly lower percent soil aggregate stability and MWHC than conservation tillage practices (61.2 and 50.6% respectively) and found significantly superior over CT_6 (60.6 and 48.0% respectively). Among the tillage practices CT_1 and CT_3 recorded significantly higher soil organic carbon (SOC) content (8.84 and 8.76 g kg^{-1}) over CT_5 and CT_6 (6.31 and 5.46 g kg^{-1} respectively). At 15-30 cm depth data showed CT_5 recorded significantly higher SOC content (6.16 g kg^{-1}) as compared to rest of the tillage practices. The data on available soil NPK at 0-15cm soil depth CT_1 recorded significantly higher available soil NPK (290, 41.9 and 449.5 kg ha^{-1} respectively).

Key words: Conservation, Soil physical, Chemical, Groundnut-Sorghum

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Seasonal Incidence of Pod Sucking Bugs on Medium Duration Cultivars of Pigeonpea in Telangana

Daravath Veeranna*, G. Padmaja, N. Sandhya Kishore, M. Madhu and R. Uma Reddy

Regional Agricultural Research Station (PJTSAU), Warangal-506007, Telangana
**Corresponding author: veerudharavath67@gmail.com*

Pigeonpea (*Cajanus cajan*(L.) Millsp.) is one of the most important grain legume crop grown in Telagana . Since years long, its yield potential has not been fully realized. Among the pod damaging insect pests of pigeonpea, next to pod borers, pod sucking bugs, *Clavigralla spp., Riptortus spp.* and *Nezara spp.* has become a real threat to quality grain production in pigeonpea as they attack the crop at pod formation stage. Both nymphs and adults feed on the developing grains by piercing, thereby resulting in premature shedding of pods, deformation and shriveling of grains. In recent years, this insect has assumed the status of a major pest on pigeonpea in Telangana region. The main reasons may be varietal characteristics and prevailing and preceding weather conditions during reproductive stage of the crop. Hence, the present study has been conducted at Regional Agriculture Research Station, PJTSAU, Warangal, Telangana during *Kharif*, 2022 to know the incidence and population density of pod sucking bugs on popular grown medium duration pigeonpea cultivar, WRG 255 with respect to abiotic factors. The results revealed that the pod bug incidence started from 45th standard week when the crop was at pod formation stage and peak population was recorded at 51st and 52nd standard week, when the crop was at pod maturation stage. The bugs remain in the field till harvesting of the crop. The insect showed negative correlation with minimum temperature, sunshine hours and RH II (r = -0.013, -0.115 & -0.062), positive with maximum temperature and RH I (r = 0.128 & 0.111). However, no rainfall has been recorded during this period. The present study provides basic information on abundance and distribution of pod sucking bugs on pigeonpea in relation to weather parameter as it helps in determining appropriate time of action.

Key words: Pigeona pea, Pod bugs, abiotic factors

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Understanding Rainfall Anomalies and their Impacts on Agriculture in the High Rainfall Region of Northeastern India

D. Chakraborty[1]*, S. Saha[2,3], N.U. Singh[1], S.K. Das[3], D. Daschaudhuri[4], A. Nomita Chanu[5], I. Walling[6], P.S. Rolling Anal[1], K. Bhagawati[7] and S. Hazarika[1]

[1]ICAR Research Complex for NEH Region, Umiam-793103, Meghalaya
[2]ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib-796082, Mizoram
[3]ICAR Research Complex for NEH Region, Sikkim Centre, Gangtok-737102, Sikkim
[4]ICAR Research Complex for NEH Region, Tripura Centre, Agartala-799210, Tripura
[5]ICAR Research Complex for NEH Region, Manipur Centre, Imphal-795004, Manipur
[6]ICAR Research Complex for NEH Region, Nagaland Centre, Jharnapani, Medziphema-797106, Nagaland
[7]ICAR Research Complex for NEH Region, Arunachal Pradesh Centre, Basar-791101, Arunachal Pradesh
**Corresponding author: debasishagri@gmail.com*

Understanding the anomalies in rainfall events over the high rainfall region of north-eastern (NER) India remained less explored. This study analyzed long-term datasets from two sources i.e. regional and measured rainfall datasets from different stations over NER. Analysis of 146 years of regional data revealed a distinctive pattern: during the monsoon season, the northeast experienced 19 excess years and 31 deficit years, indicating a higher frequency of rainfall deficits compared to the rest of India. Additionally, a substantial negative trend in monsoon rainfall (-3.97 mm/year, $p<0.05$) was observed in the last three decades. Temperature trends also revealed significant changes, the annual maximum temperature increased notably, with some areas witnessing 1.4°C per decade. Consequent to the simultaneous changes in weather parameters, moisture availability has been influenced which was studied through different indices. These indices varied in their complexity and inputs starting from only rainfall data to effective precipitation, evapotranspiration, and water balance. It was seen that different indices show varied sensitivities though the broad pattern was captured. The result showed that when the water balance component is included in the calculation of moisture anomalies, the actual situations of rainfall deficits can become very vivid. The whole NER is mostly rainfed and the crops are highly dependent on the rainfall. Though the region receives a high amount of total rainfall there exist large inter and intra-seasonal variations. The study results revealed that effective Reconnaissance Drought Index (eRDI) which accounts for the water balance component could capture the variation in the rice yield of Meghalaya when the anomalies were computed for the growth phase of the crops. Hence, results suggest the use of appropriate rainfall anomaly indices to capture the impact on crops in a better way facilitating the monitoring and policy interventions.

Key words: Rainfall anomalies, Crop, Northeastern

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Evaluating Effect of Application of Nanoformualtions of Phosphorus on Nutrient Content in Wheat

Rajeew Kumar[1], Pradeep Ram[2], Vijay Pal Singh[1], Chandra Bhusan[3], Poonam Gautam[4] and Priyanka Pandey[5]

[1]Department of Agronomy, [4]Department of Soil Science, College of Agriculture, [5]Department of Molecular Biology and Genetic Engineering, College of Basic Science and Humanities, G.B. Pant University of Agriculture & Technology, Pantnagar-263145, Uttarakhand
[2]National Bank for Agriculture & Rural Development, Mumbai-400016, Maharashtra
[3]Department of Agronomy, Banaras Hindu University, Banaras-221005, Uttar Pradesh
**Corresponding author: kumarrajeew2@gmail.com*

A field experiment was conducted during *Rabi* 2016-17 and 2017-18 at N. E. Borlaug Crop Research Centre, GB Pant University of Agriculture & Technology, Pantnagar, Uttarakhand on wheat crop (cv DPW- 621 50). The soil is silty clay loam in nature with neutral pH and medium to high organic carbon content. Nanohydroxyapatite was synthesized by utilizing egg shells. The experiment was laid in randomized block design with 9 treatments and three replications with T_1 (RDF); T_2(RDF + spray of nRP); T_3(RDF + spray of nHA); T_4(50% RDF); T_5 (50% RDF + spray of nRP); T_6(50% RDF + spray of nHA); T_7(Control); T_8 (Control + + spray of nRP); T_9(Control + + spray of nHA). Here RDF is 150 kg N; 60 kg P_2O_5 and 50 kg K_2O/ ha and control means without any application of fertilizers. N P K content in grain was determined following standard procedure. Nitrogen content of grain was significantly higher in 2016-17 for RDF alone and with application of nRP and nHA over rest of the treatment combinations. However, in second year of experiment all the treatment combinations were at par with each other. Reducing RDF to 50% didn't have significant influence on the phosphorus content when there was spray of nHA or nRP in both year of study. All the treatments were reported at par performance for potassium content irrespective of treatment combinations except, in first year of experiment, there was significantly lower values reported for treatment having only spray of nRP and nHA in first year of experiment compared to their combination with RDF.

Key words: Nano phosphorus, Nutrient content, Wheat

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Appropriate Farm Equipment for Control Traffic Agriculture for Precision in Small Holding Rainfed Farms

I. Srinivas, B. Sanjeev Reddy, R.V. Adake, Ashish Dhimate, G. Pratibha, K.V. Rao, S. Vijayakumar and Anna Shiva Kumar

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: I.Srinivas@icar.gov.in*

It is often observed that the critical agricultural operations like sowing and weeding on broad beds, raised beds and for making furrows for in-situ water conservation needs the appropriate tractor drawn equipment for meeting the recommended agronomic practices which include proper seed and fertilizer placement, inter row weeding without much soil disturbance apart from moderate earthing up operations during interculture. Precise and timiliness spraying is also a critical operation which mostly effects on crop yields until and unless it is aimed on the crop canopy in a proper way. CRIDA tractor drawn BBF planter and Variable width raised bed planter cum herbicide/pesticide applicator are such equipment which meet required precision during sowing and bed making operations with least top soil disturbance and helps to follow the control traffic agriculture. These equipment can be customized to run in the tractor track as per the type of tractor by making minor adjustments in the shank and ridgers placement so that the tractor tires will follow the same track during the return pass there by reduces the soil- tractor- tire interaction there by limits soil compaction which results in least soil profile disturbance. Usage of this equipment saves 20-30% seed and fertilizer apart from saving 30 % spray chemicals. In addition to that, all four operations (bed making, seeding, fertilizer application and furrow making) at one go reduces the energy requirement by 30 to 40% when compared to the conventional methods. Precision in bed making reduces the seed movement in soil due to heavy down pours which is normally observed in conventional method of sowing in alfisols of rainfed region. The field level studies proved that the yield increase in Redgram, sorghum, cotton and maize crops was significant. This method also helps in soil conservation along with sustainable nutrient availability to the crops.

Key words: Farm equipment, Small holding, Crop

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Seed Hub Programme for Climate Smart Pulse Production

P. Rama Krishna*, S.M. Vidya Sekhar, D.B.V. Ramana, Vijaya Kumar and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: Ramakrishna.P@icar.gov.in*

Quality seed is essential for rainfed farmers to ensure the cultivation of healthy crops resilient to biotic and abiotic stresses. Extreme cold and heat adversely impact the production of important pulses such as Gram, Arhar, and lentils, necessitating the development of tolerant and resistant varieties. Maintaining genetic purity of popular high-yielding pulse varieties further supports increased production. The cultivation of pulse crops not only contributes to fixing nitrogen, energy savings, and nutrient use efficiency but also plays a crucial role in organic matter recycling, improving soil properties, and enhancing overall ecosystem services. Fourteen pulse crops are cultivated across the country, with marketing facilities available for selected pulses under the Minimum Support Price (MSP) scheme, providing stability despite weather aberrations. In response to these challenges, the Ministry of Agriculture and Farmers' Welfare, Government of India, initiated the establishment of Seed Hubs in Krishi Vigyan Kendras (KVKs) nationwide. KVK-Ranga Reddy, one of the designated hubs, focuses on producing short-duration pulse varieties. Infrastructure, including storage and seed processing plants, was created, and a revolving fund of Rs.100 Lakhs facilitated seed production of crops like Redgram, Greengram, and Horsegram. Under the Seed Hub project, KVK-Ranga Reddy, in collaboration with registered farmers, successfully processed significant quantities of Pigeon pea, Horse gram, and Greengram seeds. Over the last few years, 424.32 quintals of seed were produced and supplied to rainfed farmers in Ranga Reddy district, resulting in the adoption of varieties like PRG-176 (Pigeon pea), WGG-42 (Green gram), and CRHG- 22 (Horse gram) over extensive areas. The adoption of these certified varieties has not only increased farmers' income by approximately 25% but has also demonstrated positive environmental impacts through enhanced soil health, water retention, and temperature moderation. Despite challenges posed by extreme climatic events, the Seed Hub initiative has proven to be a valuable strategy for augmenting pulse production and sustaining the livelihoods of rainfed farmers.

Key words: Seed, Climate, Pulse, Livelihood

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Spatial Variability Assessment of Quality of Himalayan Nettle Fibre through Geostatistical Approach in Selected District of Uttarakhand

Biplab Saha*, Nilimesh Mridha, Sujai Das, Sourav Pal, Gunasindhu Sardar and Jayanta Mondal

ICAR-National Institute for Natural Fibre Engineering and Technology, Kolkata-700040, West Bengal
**Corresponding author: biplabsa@yahoo.com*

Girardinia diversifolia, which is commonly known as Himalayan Nettle or Nilghiri nettle is a wild perennial plant found growing in temperate and sub-tropical Himalayas, at altitudes between 1200 - 3000 metres. Fibre-yielding plant, Himalayan nettle (*Girardinia diversifolia*), is found to be occurring abundantly in the Garhwal region of Uttarakhand. The fiber is found in the stem and is smooth, strong and light. It was lying unexplored till few years' back, on realizing its potential in the field of textiles, research and development activity on the possibilities of handloom based product development in nettle was inintiated. Present study aimed to develop methodology to assess the spatial variability of nettle fibre quality over major districts of Uttarakhand state using geostatic approach. Geostatistics were used to show the spatial dependence of fibre quality and its interrelationships with various soil properties. The study was carried out in major nettle growing districts of Uttarakhand like Almora, Bageshwar, Rudraprayag, Chamoli and Uttarkashi. Ground truth data like GPS points, crop information, soil information and fibre samples from thirty locations were collected. The collected soil samples and jute fibre samples were analyzed to estimate different fibre quality parameters and to measure the content of different soil nutrients. The IDW and kriging interpolation methods were applied to develop thematic maps of fibre quality parameters and soil nutrients in GIS platform. The performance of maps were evaluated using Mean Square Error (MSE) method. Lab analysis of fibre samples showed that different quality parameters showed different level of spatial variability in terms of coefficient of variation ranging from 20-45%. Bundle strength of the fibre varied from 15.7g/tex in RudraPrayag district to 27.4 g/tex in Bageshwar district. Average value of bundle strength was found to be 22 g/tex. Fibre fineness value varied from 1.6tex in Uttarkashi to 3.10 tex in Chamoli district. Average fineness value of the nettle was 2.10tex .The results revealed that among soil properties, higher variability CV>50% was observed in case of available Phosphorous. However, moderate variability CV<30% was observed in case of available nitrogen, organic matter (%), aluminum (Al) and iron (Fe) content in soil. Organic matter (%), Al and Fe showed positive correlation with the fibre fineness and yield of the fibre. Inverse distance weight (IDW) showed higher efficiency than Kriging as a prediction method for mapping the fibre quality properties in the study area.

Key words: Spatial variability, Nettle fibre quality, IDW, Krigging, Interpolation

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Growth and Development of Rice Genotypes as Affected by Heat Stress in East and South Eastern Coastal Plain Agroclimatic Zone of Odisha

Tushar Ranjan Mohanty*, Saumya Shree Parida, Chinmaya Kumar Sahu, Gourisankar Panigrahi, Deepanjali Dugal and Srimanta Mohanty

College of Agriculture, Orissa University of Agriculture & Technology, Bhubaneswar-751003, Odisha
**Corresponding author: bbs.aicrpam@gmail.com*

An experiment was conducted at Bhubaneswar to quantitatively establish the relationship of environment with growth and development of rice as varied with the dates of transplanting in east and south eastern coastal plain agro-climatic zone of Odisha to identify the different developmental stages affected by temperature stress conditions, identify the most affected parameters under high temperature stress conditions, and identify rice varieties suitable for high temperature stress conditions. Five rice varieties (Mandakini, Bina Dhan-11, MTU-1001, Sahbhagi Dhan & Naveen) was planted with four dates (15 January, 31 January, 15 February & 28 February) to study the growth, yield, phenology and physiology. Rice yield was high (4280 Kg/ha) with transplanting on15 January and it decreased to 1656 Kg/ha with delayed transplanting on 28 February. Biological yield & harvest index followed the pattern of grain yield. The decline in yield due to delayed transplanting was mainly due to reduced number of panicles/m^2, number of fertile grains/ panicles, fertility % & pollen viability %. MTU1001 transplanted on 15th January recorded the maximum yield (4838 Kg/ha) followed by Naveen (4300 Kg/ha). However, the cultivar MTU1001 when transplanted on 28th February recorded the minimum yield of 788 Kg/ha as compared to other cultivars. The cultivar 'Mandakini' recorded the maximum yield of 2080 Kg/ha on the last date of transplanting. 'Mandakini' performed better among all the cultivars across the transplanting dates. Transplanting on 15 January took maximum number of days to reach panicle initiation (72.3 days), booting (88.6 days), flowering (91.1 days), soft dough (103 days), hard dough (107.1 days) and physiological maturity (114.2 days) as compared to crops sown later. As the date of transplanting was delayed, there is an increase in accumulation of GDD, HTU & PTU values so as to reach different phenological stages across the transplanting dates.

Key words: Rice, Heat stress, Coastal plain, Odisha

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Effect of Sowing Window on Yield of Dual Purpose Sorghum under Changing Climate using Infocrop

Yerradoddi Sindhu Sree[1]*, R. Karthikeyan[1], K. Boomiraj[2], S.D. Sivakumar[3], M. Djanaguiraman[4] and M. Thirunavukkarasu[1]

[1]Department of Agronomy, [2]Department of Environmental Sciences, [4]Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
[3]Institute of Agriculture, Kumulur-621712, Tamil Nadu
**Corresponding author: sindhureddy2510@gmail.com*

A field experiment was conducted at the research farm of the Department of Agronomy, TNAU, Coimbatore, during summer 2022, *Kharif* 2022 as an irrigated crop and *Rabi* 2022-2023 as a rainfed crop, to study the effect of the sowing window on the yield and quality of dual-purpose sorghum under changing climate conditions in the Coimbatore district of Tamil Nadu. Sensitive analysis was performed to simulate crop growth and yield in future climates using the InfoCrop model. The field experiment followed a strip plot design with varied sowing dates as Factor I, *i.e.,* the first fortnight of February, March, and April during the summer 2022 season; I FN of May, June and July during the *Kharif* 2022 season; and the II FN of August, September and October during the *Rabi* 2022-2023 season. Six different crop geometries were considered as Factor II: 45×15 cm (S_1), 45×10 cm (S_2), 45×5 cm (S_3), 30×15 cm (S_4), 30×10 cm (S_5) and 30×5 cm (S_6), replicated thrice. Data for calibrating the InfoCrop sorghum model for the variety Co-32 included seed rate (SEEDRT, kg ha^{-1}), sowing depth (SOWDEP, cm), thermal time for germination (TTGM, degree days), thermal time for flowering (TTVG, degree days) and thermal time for grain filling (TTGF, degree days). After calibration, the model was validated by comparing it with experimental data, including days to 50% flowering, days to maturity, leaf area index (LAI) and grain yield. Simulation results demonstrated good agreement between observed and simulated values for phenology, growth and yield parameters, with a maximum deviation of (±)15%. Climate change is anticipated to have negative impacts on sorghum productivity in both irrigated and rainfed conditions. Yield reduction due to climate change is projected to be less until 2050, after which a higher reduction is expected in rainfed conditions, whereas in irrigated conditions, the reduction is more until 2050, followed by a lessening of the impact.

Key words: Sowing window, Sorghum, InfoCrop, Simulation, Climate change

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Growth and Yield of Blackgram Varieties under Rainfed Vertisols Conditions

S. Manoharan[1], M. Manikandan[1], V. Sanjivkumar[1], K. Baskar[2], A. Solaimalai[1] and B. Bhakiyathu Saliha[1]*

[1]AICRPDA Main Centre, Agricultural Research Station, Tamil Nadu Agricultural University, Kovilpatti-628502, Tamil Nadu
[2]VOC Agricultural College & Research Institute, TNAU, Killikulam-628252, Tamil Nadu
**Corresponding author: arskovilpatty@tnau.ac.in*

Field study was conducted at AICRPDA main centre, Kovilpatti during the years 2018-19 and 2019-20 *rabi* season with an objective of identifying suitable blackgram variety under rainfed vertisol conditions. The experiment was laidoutunder factorial RBD and replicated five times. The factor one was land configuration methods with ridges and furrows and compartmental bunding. The factor twowas blackgram varieties *viz*., VBN 6, VBN 8 and MDU 1. The pH of the experimental soil was 8.12 with an EC value of 0.18 dSm^{-1}, low in availablenitrogen (138 kg/ha), low in availablephosphorus (10.5 kg/ha) and high in available potassium (395 kg/ha). The seasonal rainfall received was 218 mm and 426.4 mm during 2018 and 2019 respectively as against the mean seasonal rainfall of 396 mm.The results of the study revealed that the highest dry matter production of 2890 kg/ha was recorded with the blackgram variety MDU 1 which was significantly superior to VBN 8 and VBN 6. Among the varieties, the variety VBN 8 registered the highest mean yield of 930 kg/ha and significantly superior than MDU 1 (790 kg/ha) and VBN 6 (760 kg/ha) with a net return of Rs. 27200/ha and a BC ratio of 2.11 with rainwater use efficiency of 3.03 kg/ha mm. Among the land configuration methods, compartmental bunding registered the highest mean yield of 980 kg/ha when compared to ridges and furrows (810 kg/ha).The ridges and furrows method recorded a net return of Rs.26300/ha with BC ratio of 2.26 and RWUE 3.19 kg/ha mm. It can thus be concluded that growing of blackgram variety VBN 8 with land configuration method of compartmental bunding can be recommended as a suitable dryland technology for obtaining higher yield under rainfed vertisol conditions in southern agro climatic zone of Tamil Nadu.

Key words: Land configuration methods, Blackgram varieties, Grain yield, Rainwater use efficiency

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Performance of Rainfed Sorghum (K 12) as Influenced by Foliar Feeding Nutrients under Deep Black Vertisols of Tamil Nadu

V. Sanjivkumar[1]*, S. Manoharan, M. Manikandan, G. Guru, K. Bhakiyathu Saliha and J.V.N.S. Prasad

AICRPDA main centre, Agricultural Research Station (TNAU), Kovilpatti-628501, Tamil Nadu
**Corresponding author: Sanjivkumar.v@tnau.ac.in*

A field experiment was conducted in the Agricultural Research Station, Kovilpatti under rainfed situation from 2017-'20 to study the effect of foliar application of plant nutrients during moisture stress condition in sorghum under rainfed condition. This experiment was conducted in split plot design replicated thrice under rainfed deep black soil (vertisols). The treatments consisted of main plots: M_1-Foliar spray during dry spell, M_2 - Foliar spray after relieving of stress/dry spell (with favorable soil moisture), Subplots: S_1-Urea @ 1%, S_2-Urea @ 2%, S_3-Water soluble complex fertilizer (19:19:19) @ 0.5%, S_4-Water soluble complex fertilizer (19:19:19) @ 0.5% + recommended dose of micronutrient for foliar spray, S_5-$ZnSO_4$ @ 0.5%, S_6-Water spray, S_7-Control (no spray of any material/water). The results showed that the application of water soluble complex fertilizer (19:19:19) @ 0.5% sprayed during the dryspell registered higher grain yield (1448 kg/ha), stover yield (2288 kg/ha), net returns (Rs. 8748/ha), B: C ration (1.16) and RWUE (3.85 kg/ha-mm). The same treatment registered significant higher total major plant nutrient uptake *viz.,* Nitrogen (22.3 $kgha^{-1}$), phosphorus (4.56 $kgha^{-1}$) and potassium uptake (26.0 $kgha^{-1}$). Hence, it is recommended that during the dryspell condition of rainfed sorghum, foliar application at vegetative stage (30-40 DAS) and flowering stage (50-70 DAS) of the sorghum crop can facilitate in obtaining better yield.

Key words: Dry spell, Water soluble fertilizers, Drought, Foliar and sorghum

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Evaluation of Yield Prediction Model of Rice Yield based on Weather Parameters

Riya K.R.[1]*, Ajithkumar B.[1], Dayana David[2] and Lincy Davis P.[1]

[1]Department of Agricultural Meteorology, [2]Department of Agricultural Statistics, College of Agriculture, Kerala Agricultural University, Thrissur-680656, Kerala
**Corresponding author: riyaaliyot@gmail.com*

Rice serves as the staple food source in Kerala and is extensively grown throughout the state. Almost the entire food grain production in Kerala, accounting for around 100%, consists of rice. Since cultivation of rice is largely dependent on rainfed conditions during the kharif season, weather plays a crucial role in influencing rice productivity and overall production. Recognizing this, the primary objective of yield forecasting is to provide precise and early predictions of crop yield by considering the impact of weather parameters during the growing season. Various yield prediction models, including statistical and machine learning models, were developed to achieve this goal. To achieve this objective, yield prediction models were developed using machine learning techniques such as Gradient Boosting Regression, K-nearest Neighbour, Random Forest Regression, and Artificial Neural Network (ANN) were employed. Separate models were developed for each phenophase and for the entire crop period. The performance of each model was evaluated using metrics like R^2 and Mean Absolute Percentage Error (MAPE). The yield prediction models, particularly those developed for individual phenophases, demonstrated strong agreement with actual yields, with the highest prediction accuracy observed in the last phenophase (*i.e.* from 50% flowering to physiological maturity) in most of the models. In the Gradient Boosting Regression model exhibited a constant agreement with actual yields across all phenophases ($R^2 > 0.9$, MAPE less than 4%), with the highest accuracy in the model developed during panicle initiation stage. Among the various models developed for the entire crop period, the Gradient Boosting Regression model stood out with the highest R^2 value (0.986) and the lowest MAPE (3.8%). In contrast, the K-nearest Neighbour Regression model exhibited the lowest R^2 (0.610) and the highest MAPE (21.3%). This underscores the utility of considering weather impacts on rice yield to issue timely warnings for necessary mitigation practices and to provide stakeholders with accurate yield predictions.

Key words: Rice, Yield prediction, Machine learning

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Effect of Organic Manure on Tulaipanji Rice Production

Debasis Mahata[1]*, D. Mandal[1], S. Sarkar[1], M. Dey[1], A. Sharma[1], D. Sekhar[1], S. Nandi[1], S. Mahapatra[1], P. Barman[1] and B. Paramanik[2]

[1]Uttar Dinajpur Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Chopra, Uttar Dinajpur-733207, West Bengal
[2]Dakshin Dinajpur Krishi Vigyan Kendra, Uttar Banga Krishi Viswavidyalaya, Patiram, Dakshin Dinajpur-731204, West Bengal
**Corresponding author: dmahata1987@gmail.com*

The aromatic variety 'tulaipanji' is an Indian rice cultivar from the West Bengal state of India, known for its unique aroma and organoleptic qualities. It is indigenous aromatic rice grown mainly in the Raiganj subdivision of Uttar Dinajpur district and some pockets of Dakshin Dinajpur district. Traditionally, tulaipanji rice is grown without fertilizer in mid to high-land conditions and preferably in jute-harvested fields after the rainy season during August–December. The current experiment was conducted during the kharif seasons of 2019 and 2020 at the Instructional Farm of Uttar Dinajpur Krishi Vigyan Kendra, Chopra, Uttar Dinajpur, West Bengal. The experimental site is located in the Terai region with sub-tropical par-humid to humid tropical climates. The current experiment consisted of four treatment combinations viz. without organic manure, FYM @ 10 t ha^{-1}, Vermicompost @ 3 t ha^{-1} and FYM @ 5 t ha^{-1} + Vermicompost @ 1.5 t ha^{-1}. The highest seed yield (26.45 and 26.78 q ha^{-1} in 2019 and 2020, respectively), aroma content, and no. of effective tillers per hill was recorded under the combined application FYM @ 5 t ha^{-1} + Vermicompost @ 1.5 t ha^{-1} which was closely followed by Vermicompost @ 3 t ha^{-1} with 24.43 and 25.55q ha^{-1} in 2019 and 2020, respectively.

Key words: Tulaipanji rice, Vermicompost, Farm yard manure, Yield and aroma

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Performance of Soybean + Minor Millet Intercropping System on Broad Bed Furrow under Dryland Condition of Akola

Mahipal Ganvir*, Anita Chorey, Vijay Gabhane, Rajesh Patode, Arvind Tupe and Ravikiran Mali

All India Coordinated Research Project for Dryland Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444104, Maharashtra
**Corresponding author: ganvir08@gmail.com*

The experiment entitled "Performance of soybean+ minor millet intercropping system under dryland condition of Akola" was conducted at the research farm of AICRP for Dryland Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola during *kharif* season of 2022-23. Akola is situated at 20^0 42′ North latitude and 77^0 02′ East longitude. The experiment was laid out in Split plot design with three replications. Main plot treatment comprised of seven cropping system *viz* T_1- Sole Soybean, T_2- Soybean + Foxtail millet (2:2), T_3-Soybean + Foxtail millet (4:4), T_4-Soybean+ Finger millet (2:2), T_5-Soybean+ Finger millet (4:4), T_6-Soybean+ Barnyard millet (2:2) and T_7-Soybean+ Barnyard millet (4:4) and sub plot treatments consist of two *In-situ* moisture conservation practice *viz.* M_1- Broad Bed Furrow (BBF) and M_2- Non BBF. The experimental site was clay in texture, slightly alkaline in nature (pH-8.1) containing organic Carbon (0.54%), available N (187.3 kg ha^{-1}), available P (14.8 kg ha^{-1}) and available K (316.0 kg ha^{-1}). The objectives of experiment was to study the productivity and economics of the soybean +miner millets strip intercropping system under dryland condition. In cropping system, significantly highest seed yield of soybean and straw yield was observed in sole soybean. Soybean seed equivalent yield was found significantly higher in soybean + foxtail millet (4:4) cropping system and found on par with soybean + foxtail millet (2:2) cropping system. In moisture conservation practices, significantly higher soybean seed equivalent yield was recorded in BBF than Non BBF treatment. In respect of economics, in cropping system, Significantly higher gross monetary returns and net monetary returns (Rs. 80911 and 46524 ha^{-1}, respectively) was recorded in soybean + foxtail millet (4:4) cropping system and found on par with soybean + foxtail millet (2:2) cropping system (Rs. 77959 and 43678 ha^{-1}, respectively). Maximum B:C ratio was observed in soybean + foxtail millet (4:4) cropping system and followed by soybean + foxtail millet (2:2) cropping system. In moisture conservation practices, significantly higher gross and net monetary returns was recorded in BBF than Non BBF treatment. Interaction effect was found non significant in respect of soybean seed equivalent yield, gross and net monetary returns.

Key words: Soybean, Millet, Dryland, Akola

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Performance of Organic and Inorganic Fertilizers on Rice yield and Profile Distribution of Soil Organic Carbon Fractions in Rice - Rice Cropping System of Godavari Delta

Raju, B.E.N.V.V.D.N.[1]*, Ch. Sreenivas[2] and I. Usha Rani[3]

[1]*Department of Soil Science, IARI Mega University Hyderabad Hub, IARI-CRIDA, Hyderabad-500059, Telangana*
[2]*Department of Agronomy, Regional Agricultural Research Station, Maruteru-534122, Andhra Pradesh*
[3]*Department of Soil Science, Agricultural College, Acharya N. G. Ranga Agricultural University, Bapatla-522101, Andhra Pradesh*
**Corresponding author: narayanaraju.b1997@gmail.com*

Organic carbon is an important indicator of the productivity and soil health of an agro-ecosystem. In addition to enhancing soil health, increasing soil organic carbon (SOC) has the potential to help in reducing climate change. A field experiment entitled "Performance of Organic and Inorganic Fertilizers on Rice yield and Profile Distribution of Soil Organic Carbon Fractions in Rice - Rice Cropping System of Godavari Delta" was carried out under field conditions during *kharif* 2022 at Regional Agricultural Research Station, Maruteru, West Godavari district in the ongoing All India Coordinated Rice Improvement Project on long term soil fertility management in low land rice soils of Godavari delta under Rice-Rice cropping system. The treatments consisted of control (T_1), 50 % NPK (T_2), 50 % NPK + 50 % N-FYM (T_3), 50 % NPK+ 50 % N-Green manure (T_4), 50 % NPK + *Azospirillum* (T_5), FYM @ 10 t ha^{-1} (T_6), 100 % NPK + Zn + S (T_7), 100 % NPK + Zn + S + FYM @ 5 t ha^{-1} (T_8). All together there were eight treatments laid out in randomized block design (RBD) with three replications. The carbon pools were estimated after harvest of crop by analysing soil samples collected at different depths and total organic carbon stock, carbon buildup/depletion were calculated after 33 years (1989-2022) of rice cultivation at the end of *kharif* season, 2022. The influence of long-term use of organic and inorganic fertilizers and their combination were evaluated for soil biological health by assaying dehydrogenase activity, soil microbial biomass carbon. Organic carbon fractions, total organic carbon and total organic carbon stocks were estimated at four different depths 0-15 cm, 15-30 cm, 30-60 cm and 60-100 cm. At 0-15 cm, organic carbon fractions (VL, L, LL and NL) and total organic carbon were observed highest in FYM @ 10 t ha^{-1} (T_6). At (15-30 cm), (30-60 cm) and (60-100 cm) total organic carbon and its fractions were observed highest in 100 % NPK + Zn + S + FYM @ 5 t ha^{-1} (T_8). Soil biological properties like microbial biomass carbon and dehydrogenase activity and yields (grain and straw) were recorded highest in (T_8). This long-term study concludes that applying 100 % RDF + Zn + S + FYM @ 5 t ha^{-1} is a superior alternative in terms of yield components, supplementing inorganics with organics is the optimal strategy for preserving soil quality, crop production and considerable increase in total organic carbon and all kinds of soil organic carbon pools.

Key words: Organic carbon, Rice-Rice cropping system, Soil biological health

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Climate Resilient Nitrogen Management to Enhance the Productivity of Late Sown Short Duration Rice Varieties

D. Venkatesh[1]*, Mangal Deep Tuti[2], K. Lakshman[1] and Brajendra[2]

[1]*Agricultural College, Acharya N.G. Ranga Agricultural University, Bapatla-522101, Andhra Pradesh*
[2]*ICAR-Indian Institute of Rice Research, Hyderabad-500030, Telangana*
**Corresponding author: durgamvenkateshswaero@gmail.com*

One of the major causes of low nitrogen (N) use efficiency in rice is the application of fertilizer N in excess of crop requirement at times when it is not required by plant during late sown conditions. This experiment was conducted at ICAR-Indian Institute of Rice Research Rajendranagar farm, Hyderabad during *kharif* 2021. The objective of the experiment was to study the performance of short duration rice varieties under late sown conditions, to find out the best climate resilient nitrogen management practices under late sown rice cultivation. The experiment was laid out in split plot design with three replications. Main plots with three short duration rice varieties DRR Dhan-44, MTU 1010, MTU 1156 and four nitrogen levels (sub plots) recommended dose of nitrogen (RDN) @ 120 kg ha^{-1}, silicon coated urea (SCU) @ 90 kg ha^{-1}, Leaf Colour Chart (LCC), Soil test crop response (STCR) @ 114 kg ha^{-1}. The results of the experimental trial revealed that among the varieties, leaf area index of rice were recorded the highest (4.12) in MTU 1156 variety, lowest were recorded in MTU 1010. With regard to nitrogen management practices, highest LAI (4.18) with application of LCC based N application 105 kg N ha^{-1}, however, on par with RDN @ 120 kg N ha^{-1}. The highest grain (5707 kg ha^{-1}) of rice were obtained with MTU 1156 (M_3) and the lowest was and kg ha^{-1} in MTU 1010 (M_2). Among N management practices, application of N @ 105 kg ha^{-1} based on LCC reading 3 resulted in the highest grain (5758 kg ha^{-1}) however, on par with RDN @ 120 kg N ha^{-1}.

Key words: LCC, Nitrogen use efficiency, STCR, Short duration variety, Silicon coated urea

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GIS and Remote Sensing Approach for Land Use Change Detection in Watershed

R.S. Patode*, V.V. Gabhane, A.B. Chorey, V.P. Pandagale, Ranee Wankhade, M.M. Ganvir, A.R. Tupe and R.S. Mali

All India Coordinated Research Project for Dryland Agriculture,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444104, Maharashtra
**Corresponding author: rspatode@gmail.com*

Remote sensing and GIS techniques have been used for land use and land cover mapping in order of identification of *kharif* and *rabi* crops. Digital change detection methods by using multispectral satellite imagery helps in understanding agriculture crop changes during dissimilar crop seasons. The current study determines the spatio-temporal dynamics of land use of Kajaleshwar-Warkhed watershed in Barshitakli Taluka of Akola District, Maharashtra. The area of this watershed is about 1011 ha. Sentinel-2 satellite data of two divergent time periods, i.e., Sentinel-2 of 2017 and of 2018 were collected from USGS and earth explorer site and computed the agriculture crop changes in the watershed during 2017 (*kharif*) and 2018 (*rabi*) seasons. In this study, supervised classification method was used for land use change detection mapping using maximum likelihood technique. Five different land use classes namely single crops, double crops, waste/fallow lands, built-up lands and water bodies has been identified in the watershed. The results revealed that during 2018 r*abi* season, the area under agriculture land was found increased as compared to 2017 *kharif* season. Also, during 2018 *rabi* season, the area under waste land was found converted to agriculture land due to groundwater availability in watershed area. These results inveterate the benefits of RWH activities undertaken in the watershed for conserving, storing and use of harvested rainwater.

Key words: GIS, Remote sensing, Watershed, Maharashtra

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Effect of Time of Application and Different Foliar Sprays on Yield and Economics of soybean

Mali R.S.[3], Chorey A.B.[1]*, Patode R.S.[2], Ganvir M.M.[4] and Gabhane V.V.[5]

All India Coordinated Research Project for Dryland Agriculture,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola-444104, Maharashtra
**Corresponding author: ravikiranmali111@gmail.com*

Soybean (*Glycine max*.) is the most popular short duration oilseed crop of Kharif season in the semi-arid tropics that is predominantly rain dependent. The field experiment was conducted at research field of AICRP for Dryland Agriculture, Dr. PDKV, Akola (MS) during 2022-23 to study the effect of foliar sprays on yield and economics of soybean. The experiment was laid out in Factorial Randomized Block Design with the Soybean variety JS-335 sown at the spacing of 45 x 5 cm with eight treatments in two situations viz; T_1: Foliar spray during dry spell and T_2: Foliar spray after relieving of stress. The eight treatments applied were foliar application of viz; S_1-urea@ 1.0 %, S_2-urea@ 2.0%, S_3- 19:19:19 water soluble complex fertilizer @ 0.5%, S_4-19:19:19@0.5% + $ZnSo_4$ @ 0.5 %, S_5- Zn So_4 @0.5 %, S_6- Water Spray, S_7 - KNO_3@1.0 % and S_8–Control. During the year 2022-23 the results showed that, treatment of foliar spray during dry spell recorded higher soybean seed yield (1861 Kg ha^{-1}), NMR (Rs. 65003/-) B:C ratio (2.82) and high rainwater use efficiency (1.79 Kg ha^{-1} mm^{-1}) than treatment of foliar spray after relieving of stress. Treatment of foliar spray of 19:19:19 mix water soluble fertilizer + ZnSo4 @0.5% recorded significantly higher seed yield (2072 Kg ha^{-1}), NMR (Rs. 75863/-) (with B:C ratio (3.09) and higher rainwater use efficiency (1.99 Kg ha^{-1} mm^{-1}) than rest of the treatment.

Key words: Application, Foliar spray, Soybean, Maharashtra

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Evaluation of Aldor as Alternative Nitrogen Source on the Available Nutrients in Rice-Wwheat Cropping System

Ram Pravesh Rajbhar[1]*, Rajeew Kumar[1], Priyanka Pandey[2] and Alok Singh Jayara[1]

[1]Department of Agronomy, [2]Department of Molecular Biology and Genetic Engineering, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar-263145, Uttarakhand
**Corresponding author: rprajbhar80@gmail.com*

Urea is commonly applied source of nitrogen in Rice-wheat cropping system which is associated with various losses leading to reduced use efficiency. Aldor has been developed by Sirius Minerals Pvt Ltd as alternative source of nitrogen in addition of sulphur and potassium. Field experiment was conducted at NEB Crop Research Centre for Rice-Wheat rotation with eleven treatments including 60%, 80%, 100% and 125% N supplied from urea and the four treatments having equal amount of aldor as that of urea as source of nitrogen. Available nitrogen recorded highest value for 125% N supplied from urea which was at par with that with aldor equal to amount of urea supplying 100% and 125% N. Both sources of nitrogen recorded parallel values for available phosphorus for varying doses. Available potassium was highest with aldor equal to amount of urea supplying 125% N which was at par with both sources of nitrogen. Similarly, available sulphur recorded highest value for 125% N which was again par for both sources of nitrogen with all the varying doses. It can be inferred that the aldor used as alternative source of nitrogen can be effective in maintaining nutrient availability as urea.

Key words: Nitrogen alternative, Nutrient availability

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Studies on the Effect of Thermal Performance of Maize (*Zea mays* L.) Varieties on different Sowing Dates at Central Plain Zone of Uttar Pradesh

C.B. Singh, S.N. Pandey, Ajay Kumar, N. Khan, Shivam Mishra and Sandeep Kumar

AICRP on Agrometeorology, Department of Agronomy, Chandra Shaker Azad University of Agricultural & Technology, Kanpur - 208002, Uttar Pradesh
**Corresponding author: knp.cbsingh@gmail.com*

The field experiment was conducted during *kharif* season of 2017 to 2022 under AICRP Agro-meteorology project at students' instructional farm of Chandra Shekhar Azad University of Agriculture and Technology, U.P. India, situated at 125.9m altitude, 26.4148^{0}North latitude, 80.2321^0 East longitude, to study "Effect of thermal performance of maize (*Zea mays* L.) varieties on different sowing dates". The treatment consisted three sowing dates viz., 19-June, 29-June and 9- July with three varieties Viz., Azad Hybrid-1, Azad Hybrid-2 and DKC-7074 and the treatments were accommodated in split plot design with four replications. Various thermal indices including growing degree days (GDD), phenothermal index (PTI) and heat use efficiency (HUE) were calculated by using standard methods for above treatments. The results showed that early sown 19 June maize took significantly more number of days (96 days) and growing degree days (1915.8 ^{0}Cdays) to complete physiological maturity, higher phenothermal index (18.8 ^{0}C days day^{-1}) and recorded higher heat use efficiency with dry matter and grain yield (10.65 kgha^{-1} ^{0}C day and 3.25 kgha^{-1} ^{0}Cday) and higher grain yield (62.2 qha^{-1}) as compared to subsequent delayed sowing. Among the maize varieties Azad hybrid-2 took higher number of days (96 day), growing degree days (1875.2 ^{0}C days) and heat use efficiency with dry matter and grain yield (10.88 kgha^{-1} ^{0}Cday and 3.31 kgha^{-1} ^{0}Cday) to complete physiological maturity and registered higher biomass and grain yield (204.1qha^{-1} and 62.1qha^{-1}) of *Kharif* maize as compared to tested variety Azad Hybrid-1 and DKC-7074.

Key words: Varieties, Growing degree days, Heat use efficiency

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Evaluation of Maize based Intercropping Systems under Rainfed Midland Situation of Bastar Plateau Zone of Chhattisgarh

A.K. Thakur[1], T. Chandrakar[1]*, N.K. Nag[1], J.V.N.S. Prasad, G. Ravindra Chary[2] and K.A. Gopinath[2]

[1]SG College of Agriculture & Research Station, Indira Gandhi Krishi Vishwavidylaya, Jagdalpur-494001, Chhattisgarh
[2]Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: tejpal031012@gmail.com*

A field experiment was conducted in *Kharif* during 2020 to 2022 at dryland agriculture research field of Shaheed Gundadhur College of Agriculture and Research Station Jagdalpur, District Bastar. The experiment was conducted in random bock design with five treatments which were T1: Sole maize, T2: Sole cowpea, T3: Sole horse gram, T4: Maize + cowpea (4:2) and T5: Maize + horse gram (4:2) replicated four times. The soil was loamy clay, Sub angular blocky with WHC of 24.34%, neutral in reaction, low in available nitrogen, medium in soil available phosphorus and potassium. The higher Maize crop equivalent yield (6132 kg/ha) was obtained from maize + cow pea (4:2) followed by sole cowpea. The lowest MCEY was noticed in sole horse gram (1976 kg/ha) but higher *Land equivalent ratio* and *Monetary advantage index* were higher when maize was intercropped with horse gram, in case of economics, net return and BC ratio was found maximum in treatment maize + cowpea (4:2).

Key words: Maize, Plateau zone, Chhattisgarh

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Groundnut Based Double Cropping Systems for Enhancing System Productivity and Profitability under Dryland Condition in Bastar Plateau Zone of Chhattisgarh

A.K. Thakur[1], T. Chandrakar[1]*, N.K. Nag[1], J.V.N.S. Prasad, G. Ravindra Chary[2] and K.A. Gopinath[2]

[1]SG College of Agriculture & Research Station, Indira Gandhi Krishi Vishwavidylaya, Jagdalpur-494001, Chhattisgarh
[2]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: tejpal031012@gmail.com*

A field experiment was conducted in *Kharif* during 2020 to 2022 at dryland agriculture research field of Shaheed Gundadhur College of Agriculture and Research Station Jagdalpur, District Bastar. The experiment was conducted in random bock design with five treatments which were T_1: Ground nut-Safflower, T_2: Ground nut-Toria, T_3: Ground nut-Mustard, T_4: Ground nut – Linseed and T_5: Ground nut sole replicated four times. The soil was sandy loam with WHC of 22.5 %, acidic in reaction (pH 5.98), low in available nitrogen, medium in soil available phosphorus and potassium. The higher groundnut CEY (1967 kg/ha) was recorded from groundnut-mustard and found comparable with double crop groundnut-safflower. The lowest groundnut CEY was noticed with sole ground nut (1250 kg/ha). Groundnut-mustard was observed higher net returns and B:C ration during two years of experimentation.

Key words: Groundnut, Dryland condition, Cropping system, Chhattisgarh

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Long-term Effects of Conservation Agriculture-based Practices on Soil Physical Health in Cotton-wheat System

Gunturi Alekhya[1]*, T.K. Das[1], Rishi Raj[1] and Pragati Pramanik[2]

[1]Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: gunturialekhya57@gmail.com*

Maintenance of soil physical health at its optimum level is essential for sustainable crop production and rational use of natural resources without jeopardizing their quality. The present intensive tillage practices, crop residue removal and highly mechanized traditional agriculture production system has been identified as responsible for soil crusting and erosion hazards, destruction of soil structure, decrement in soil infiltration and soil compaction. Under such circumstances, conservation agriculture (CA) will be a one-stop solution for improving soil physical health along with enhanced system productivity. So, the present study was conducted in a 13 years long-term CA-based Cotton-Wheat system at Research farm of ICAR-IARI, New Delhi to appraise soil physical properties and productivity. The experiment was laid out in Randomized complete block design comprising of 10 treatments with three replications. The treatments include control (Farmers practice-conventional tillage (CT)), different crop establishment methods such as permanent narrow bed (PNB), permanent broad bed (PBB) and zero till flat bed (ZTFB) with and without residues. The residual plots of PNB, PBB and ZTFB has two different doses of Nitrogen (75% and 100%). The experimental results revealed that the CA practices with residue resulted in 28.7-46.3% higher water-stable aggregates, 29.7% higher porosity over CT. Among the CA practices, PBBR100N significantly registered higher geometric mean diameter of 44.7%, 33.8% and 20% at 0-5 cm, 5-15 cm and 15-30 cm soil depths respectively than CT plot. Similar trend was seen in case of mean weight diameter by PBBR100N and was found on par with other establishment methods with residue retention. Significantly higher system equivalent yield of 26.7% and 41.03% was recorded by PBBR100N compared to treatments without residue and CT respectively.

Key words: Conservation agriculture, Permanent narrow bed, Permanent broad bed, Mean weight diameter

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Effect of Long Term Application of Nutrients in Direct Seeded Rice-field Pea Cropping System on Balance Sheet of Nitrogen, Phosphorus and Potassium under Rainfed Midland Situation of Bastar Plateau

T. Chandrakar[1]*, A.K. Thakur[1], N.K. Nag[1], J.V.N.S. Prasad, G. Ravindra Chary[2], K.A. Gopinath[2] and B. Narsimlu[2]

[1]SG College of Agriculture & Research Station, Indira Gandhi Krishi Vishwavidylaya, Jagdalpur-494001, Chhattisgarh
[2]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: tejpal031012@gmail.com*

A long term field experiment has been conducted since *kharif* 2014 at long term field trial of dryland farm of Shaheed Gundadhur College of Agriculture and Research Station Jagdalpur, district Bastar, State Chhattisgarh. The experiment was conducted in random bock design with twelve treatments which were T_1 control, T_2 100% recommended dose of fertilizer (100:60:40 kg ha^{-1}), T_3 (100% PK), T_4 (100% NK), T_5 (100% NP), T_6 (100% NPK+5 t FYM), T_7 (100% NPK+5 t FYM+ $ZnSO_4$@25kg ha^{-1}), T_8 (100% NPK+5 t FYM+ $ZnSO_4$@25kg ha^{-1} + Lime 3 q ha^{-1}), T_9 (50% NPK), T_{10} (50% NPK + 5 t FYM), T_{11} (50% NPK + 5 t FYM+ $ZnSO_4$@25kg ha^{-1}) and T_{12} (50% NPK + 5 t FYM+ $ZnSO_4$@25kg ha^{-1}+ Lime 3 q ha^{-1}) replicated four times. Soil available N, P and K determined in the laboratory by standard procedures after *rabi* harvest of 2022-23. There were 36% more build up of N in T12 (50% NPK + 5 t FYM+ $ZnSO_4$@25kg ha^{-1}+ Lime 3 q ha^{-1}) followed by T3 (100% PK) and other treatments showed depletion of N. Treatment 4 (T4-100% NK) has highest solubilization of native phosphorus *i.e.* 10.5% followed by control and maximum fixation occurred in T3 (100% PK) *i.e.* 5%. There were net solubilization of potassium from native source in all the treatments and maximum solubilization occurred in Treatment 5 (100% NP) *i.e.* 57%.

Key words: Application, Rice, Nitrogen, Phosphorus, Potassium, Plateau

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Assesment of Soil Structure using 3D Image by X–Ray Computed Tomography

Chandana Mudigiri[1*], Etikela Anusha[2] and Navya K.[1]

[1]*Department of Soil Science, Professor Jayashankar Telangana State Agricultural University, Hyderabad-500030, Telangana*
[2]*Department of Agronomy, Professor Jayashankar Telangana State Agricultural University, Hyderabad-500030, Telangana*
**Corresponding author: chandanamudigiri@gmail.com*

While most conventional soil physical investigations are destructive and have variable spatial resolution, making it difficult to assess soil structure, which is characterized by complex morphological and functional properties, the use of X-ray computed tomography (CT), a non-destructive technique, presents significant progress in this it can be used to study soil structure at the millimeter scale. Examining the intact internal structure of soils has proven to be a viable use for X-ray CT. In comparison to other imaging modalities like magnetic resonance imaging and nuclear magnetic resonance it is less impacted by paramagnetic components in soil. X-ray CT is a non-invasive technique that can be used to visualize the interior of objects in 2D and 3D based on the principle of attenuation of an electromagnetic wave. Generally, X-ray CT scanners consist of three common parts: an X-ray source, a sample manipulation stage and a detector. X-rays emitted from the source pass through the sample and are progressively attenuated by absorption and scattering as the object itself becomes a secondary source of X-rays and electrons through atomic interactions. The characteristic of a material to either absorb or scatter a photon is called the attenuation coefficient. The acquired images from soil-based X-ray CT scans frequently have three main phases: mineral grains, pore space and organic materials. The grey values in the images are ordered according to attenuation density, so that mineral grains as the densest are represented by bright (high attenuation), and air-filled pore spaces, the least dense, have darker (low attenuation).

Key words: X-ray computed tomography, Attenuation coefficient

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KAU Agri-Infotech Portal: Transformative Digital Learning in Agriculture for Empowering Stakeholders

B. Ajithkumar*, Jilzy Job M., Aswin Raj, Jackson Jose, Krishnaraj R., Anju R. and Gopika Rani V.

Centre for e-Learning, Kerala Agricultural University, Thrissur-680656, Kerala
**Corresponding author: ajith.balakrishnan@kau.in*

Digital learning in agriculture is a dynamic and vital domain, continually evolving to drive the ongoing development of agricultural practices. The progress in agriculture relies on the continual enhancement of existing methodologies and the incorporation of innovative approaches. The integration of modern technologies into the teaching and learning processes has proven to be transformative in the field of agriculture. Interactive e-learning portals play a pivotal role by offering multimedia materials for education and facilitating knowledge sharing. KAU Agri-Infotech Portal, a farmer-friendly, bilingual (English and Malayalam) digital learning platform developed by Centre for e-Leaning, Kerala Agricultural University. Serving as an Information and Communication Technology (ICT)-enabled hub, the portal caters to the diverse educational needs of farmers, extension workers, scientists, and students in the agricultural field. Its extensive content covers Crop Husbandry, Animal Husbandry, Fisheries, Agri Inputs and Services, Seed Rate and Spacing, KAU Fertulator, Agri Almanac, Farm Machinery, Agri Enterprises, e-DID, e-Resources, Weather Advisories, Market Intelligence Service, Agri Videos, Weekly Crop Advisories, Kerala Directory, and Library, with each section comprises disseminate information on technologies developed by Kerala Agricultural University and ICAR research stations. The portal's user-friendly interface positions, it as a valuable resource for stakeholders involved in agriculture, including farmers, researchers, and students. With a vision to create awareness and provide online courses, the platform operates as a free-of-cost educational tool, actively promoting e-learning and digital literacy across various aspects of agriculture. Through its diverse services and faithful commitment to education, the KAU Agri-Infotech Portal stands as an ideal model for leveraging digital technology to empower and educate individuals within the agricultural sector. Furthermore, the portal extends its offerings with five online certificate courses and eleven Massive Open Online Courses (MOOCs). Benefiting a total of 13,067 participants for moocs. Notably, 63% of these beneficiaries are males, while 37% are females. In the realm of online certificate courses, 779 participants benefited, with 53% being females and 46% males. Since 2012, cumulative number of visitors stands at 73,24,117.

Key words: KAU Agri-Infotech Portal, e-Learning

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Effect of Different Levels of Drip Fertigation on Growth and Yield of Aerobic Rice in Western Zone of Tamil Nadu

Nunavath Umilsingh[1]*, K. Vaiyapuri[2], N. Thavaprakaash[3], S. Selvakumar[4] and K. Vanitha[5]

[1]Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
[2]Department of Agro forestry, Forest College & Research Institute (TNAU), Mettupalayam-641301, Tamil Nadu
[3]Department of Agronomy, Coconut Research Station (TNAU), Aliyarnagar-642101, Tamil Nadu
[4]Centre for Water and Geospatial Studies, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
[5]Department of Fruit Science, Horticultural College & Research Institute, TNAU, Coimbatore-641003, Tamil Nadu
**Corresponding author: umilsingh1459@gmail.com*

Over half the global population relies on rice grown in transplanting conditions. With the escalating global water crisis traditional irrigated rice systems are unsustainable. Transitioning to aerobic rice by utilizing drip irrigation method to addresses water scarcity while meeting optimal crop growth and yield through efficient water and nutrient management. A field experiment was conducted at wetland farm, Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore during summer 2022 and 2023. Field experiment was analysed in randomized complete block design (RCBD), replicated thrice. In aerobic rice thirteen treatments comprised of three fertigation levels (75%, 100% and 125% RDF), three irrigation levels (50% PE up to 30 DAS+100% PE up to 60 DAS+150% PE up to 90 DAS, 75% PE up to 30 DAS+125% PE up to 60 DAS+175% PE up to 90 DAS and 100% PE up to 30 DAS+150% PE up to 60 DAS+200% PE up to 90 DAS) and surface irrigation was scheduled based on IW/CPE ratio of 1.2 with conventional fertilizer (100% RDF). Seed of Co-51 variety was used as test crop for both season of study. Application of drip fertigation (DF) @ 100% pan evaporation (PE) up to 30 DAS+150% PE up to 60 DAS+200% PE up to 90 DAS with 125% recommended dose of fertilizer (RDF) (25% through normal fertilizer (NF)+75% through water soluble fertilizer (WSF)) (T_9) found to be significantly higher TDMP (988.2 and 1025.4 g m^{-2}), no. of productive tillers m^{-2} (416 and 434) and grain yield (4316 and 4446 kg ha^{-1}) as compared to other treatments, respectively during summer 2022 and 2023. DF at 50% PE up to 30 DAS+100% PE up to 60 DAS+150% PE up to 90 DAS with 75% RDF (75% through NF+25% through WSF) (T_1) recorded least growth and yield than other treatments during summer 2022 and 2023.

Key words: Drip fertigation, Rice, Growth, Tamil Nadu

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Long-term Conservation Agriculture Upheld the Productivity, Nitrogen and Sulphur Economy and Soil Health in Maize-mustard System

Arkaprava Roy[1]*, T.K. Das[1], Anchal Dass[1], Arti Bhatia[2], Ranjan Bhattacharyya[2], Pragati Pramanik Maity[3], Susama Sudhishri[4], Suman Sen[1], Priyanka Saha[1] and Trun Sharma[1]

[1]Division of Agronomy, [2]Centre for Environment Science and Climate Resilient Agriculture,
[3]Division of Agricultural Physics,[4]Water Technology Centre,
ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: arkaprava2510@gmail.com*

Sustainability of a system depends on productivity, use efficiency of resources (land, water, energy, pesticides, human), soil and environment quality and socio-economic feasibility. Conservation Agriculture (CA) has emerged as a sustainable approach for meeting up increasing crop production demand while preserving the environment. Several factors, including nutrients influence the sustainability of maize-mustard system as both maize and mustard are exhaustive crops. Management of nutrients like nitrogen (N) and sulphur (S) are crucial, but has been less or not studied in CA-based maize and mustard system. Therefore, a field experiment was undertaken during 2020-21 and 2021-22 to assess the effects of N and S on maize and mustard in the 11th and 12th year of a long-term conservation agriculture. The experiment was laid out in a split-split plot design with three replications. The main plot treatments included four CA practices, i.e. zero till maize (ZTMz)- zero till mustard (ZTMs), ZTMz + mustard residue (MsR)- ZTMs +maize residue (MzR), ZTMz + MsR + brown manuring (BM) - ZTMs+ MzR, and ZTMz+ mungbean (Mb) residue (MbR)- ZTMs+MzR – ZTMb + MsR, and a conventional practice i.e. conventional till maize (CTMz)-conventional till mustard (CTMs). The sub-plot treatments constituted of 75 and 100% recommended dose of N of both crops (RDN: 120 and 80 kg N/ha), and sub-sub plot treatments had 0 (control), 50 and 100% recommended dose of S for mustard crop only (RDS: 40 kg S/ha). Results revealed that the maize-mustard cropping system under CA framework could offer enhanced grain and straw yield, net return, and improved soil physical, chemical and biological properties through better management of N and S. Among CA practices, the ZT triple cropping with three crops residue retention [~ ZTMz + mungbean residue (MbR) – ZTMs+MzR - ZTMb+ MsR] resulted in ~ 24.2, 24.5, 14.3% and ~20.8, 23.1 and 12.3% higher total soil organic carbon (TOC), Walkley-black carbon (WBC) and soil organic carbon stock (SOC) stock in 0-5 and 5-15cm, respectively compared to CT (CTMz-CTMs) system. This treatment also led to higher microbial biomass carbon (MBC), microbial

biomass sulphur (MBS), and dehydrogenase (DHA) and alkaline phosphatase activities in both 0-5 and 5-15cm soil depths. Thus, this CA-based ZT triple cropping practice with three crops residue would be an alternative to traditional rice-wheat system. This CA-based maize-mustard system with the 75% N to both maize and mustard and 50% S to mustard upon long-term adoption of CA may be recommended for sustainable production in the north-western Indo-Gangetic plains of India.

Key words: Conservation, Nitrogen, Sulphur, Economy, Soil, Maize

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Studies on the Effect of Important Weather Parameters on Performance of Timely Sown Varieties of Wheat [*Triticum aestivum* L.]

Prashun Sachan[1]*, V.K. Verma[1], Anil Kumar Sachan[2], Anil Kumar[3], Pradeep Kumar[4], S.N. Pandey[5] and C.B. Singh[5]

[1]Department of Agronomy, [2]Directorate of Seed and Farms, [3]Department of Soil Science and Agriculture Chemistry, [4]Department of Plant Pathology, [5]AICRP on Agrometeorology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur-208002, Uttar Pradesh
**Corresponding author: prashun.sachan@gmail.com*

Field experiment was conducted during *Rabi* season of 2017-18 at students' instructional farm of Chandra Shekhar Azad University of Agriculture and Technology, U.P. India, situated at 125.9m altitude, 26.4148^{0}North latitude, 80.2321^0 East longitude, to study "The effect of important weather parameters on performance of timely sown varieties of wheat [*Triticum aestivum L.*]". The experiment comprised ten wheat varieties (K307, K402, K607, K1006, HD2733, DBW17, HD2967, PBW343, PBW502 and PBW550) considered as individual treatment. The treatments were accommodated in randomized block design with three replications. The soil of experimental field was sandy loam in texture, having low organic carbon (0.42%), medium in available nitrogen (179 kg ha^{-1}), low in available phosphorus (12 kg ha^{-1}), medium in available potassium (156 kg ha^{-1}) with normal pH(7.95). In present agro-climatic situation the mean maximum temperature ranged 17.1^{0}C to 39.4^{0}C, minimum temperature 5.3^{0}C to 26.2^{0}C during 48th standard meteorological week (SMW) to 17th standard meteorological week, the relative humidity varied from 42% to 83.8% whereas rainfall varied from 0-10 mm during the crop season. Experimental results revealed that maximum value of grain yield (5590 kg ha^{-1}), harvest index (42.23%), net return (Rs.80490 ha^{-1}) and B:C ratio (2.89) was recorded in the variety HD-2967 followed by PBW343 found significantly at par. Among important weather parameters maximum temperature, minimum temperature and cumulative heat unit recorded positive correlation with grain yield (r=0.177, 0.326 and 0.228 respectively), harvest index (r=0.253, 0.370* and 0.327 respectively). The variety HD-2967 and PBW-343 recorded maximum cumulative heat unit (1907.9) though heat use efficiency of HD2967 (2.93 kg0C day^{-1}) and PBW343 (2.76 kg^{0}C day^{-1}) ranked lower as compared to K-402 and PBW-550 (3.05 kg^{0}C day^{-1}).

Key words: Wheat, Maximum temperature, Minimum temperature, Cumulative heat unit, Heat use efficiency and correlation

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Response of Soybean Crop to Water Stress at Specific Growth Stages in Marathwada

K.K. Dakhore[1], Y.E. Kadam[2] and R.B. Mane[1]

[1]AICRP on Agrometeorology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani-431402, Maharashtra
[2]FASAL, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani-431402, Maharashtra
**Corresponding author: dakhorekk@yahoo.com*

The most critical growth stage of soybean for water stress was identified and percent yield reduction of soybean crop was quantified. The experiment was conducted at AICRP on Agrometeorology, VNMKV, Parbhani, during Kharif 2020-21 & 2022-23 with artificial water stress at different phenological stages in soybean crop. Treatments comprised of eight treatment *i.e.* T_1 - Rainfed (Control), T_2- Vegetative (V), T_3 - Flowering (F), T_4 - Pod formation (PF), T_5 - Pod Development (PD), T_6 - Vegetative & Flowering, T_7 - Flowering & Pod formation, T_8 - Pod formation & Pod development. The results revealed that the plant height at the time of harvest was recorded least in T_6 and T_2 which was less than T_1 by 26.5% and 25.9% respectively & number of branches was approximate 34.7% less in treatment T_3 & 24.5% less in treatment T_6 as compared to T_1 however Leaf area & dry matter was found to be less in T_3 & T_6 treatment. The test weight was least at reproductive stage and late reproductive stage because of shrinking of the seeds consequences into reduction of seed weight. The least numbers of pods (g plant^{-1}) and seed yield (kg ha^{-1}) was recorded in T_3 which was approximate decreased by 64.3% and 63.5% respectively as compared to T_1. Water stress induces decreased photosynthetic carbon assimilation capacity, and seriously affected seed weight in soybean. The protein content was mostly affected by the water stress at flowering and pod formation stage and also water stress at two consecutive stages. The soybean crop water requirement at different phenophase was ranged from 1.49 to 5.07 mm/day. The lowest values of NDVI & bacteria, actinomycetes and fungi were found in treatments where stress was given at two consecutive stages *i.e.* T_6 due to this the canopy temperature was maximum as compared to control treatments. The most critical stage of soybean for water stress was flowering and pod formation because due to water stress, leaf senescence, maximum number of flower abortion, low leaf area, dry matter, least number of pods, low seed yield was observed.

Key words: Water stress, Phenological stages, Growth & yield characters, Canopy temperature & NDVI

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Climate Smart Nutrient Management for Enhancing Maize Crop Productivity under Various Moisture Regimes

B. Bhakiyathu Saliha*, A. Senthilkumar and K. Gurusamy

AICRPDA Main Centre, Agricultural Research Station, Tamil Nadu Agricultural University, Kovilpatti-628501, Thoothukudi, Tamil Nadu
**Corresponding author: bhakiyathusaliha@tnau.ac.in*

The vagaries of climate change are unpredictable and it is always safe and better to be in the preparedness mode for scientific management of nutrients and water - the two critical inputs for maize farming. Field investigations were conducted in the D block, Agricultural College Research Institute, Madurai during *kharif* & *rabi* 2021 and *summer* 2022 to assess the influence of deficit and excess water conditions on productivity of maize crop CO (H)M 6 .The experiment was laid out in a split plot design with three replications comprised of three moisture regimes as the main plot based on IW/CPE ratio of I.0 (I_1), I 0.8 (I_2) and I 0.6 (I_3) and ten subplot nutrient management treatments *viz*., different sources and levels of STCR NPK (125,100 &75%) along with foliar spray of 2%NPK (19:19:19), 1%pink pigmented facultative methylobacteria (PPFM), 1% micronutrient mixture and control (RDF). Foliar application was given on 25 and 45 DAS of maize crop for each treatment in the subplot. Recommended dose of NPK for maize hybrid 250:75:75 kg ha^{-1} was applied to control plots and other treatments as specified. Combined effect of IW/CPE 1.0 along with 125% STCR NPK and foliar spray of 1% micronutrient mixture (I_1N_8) registered significantly higher number of seeds cob^{-1}, cob weight (g) and seed weight (g cob^{-1}) thereby increasing the grain and stover yields by 28.5 percent over other treatment combinations. The treatment100 % STCR NPK and foliar spray of 1% micronutrient mixture at IW/CPE 0.8 recorded the highest grain yield of 8766 kg ha^{-1} and straw yield of 10358 kg ha^{-1}, which was statistically on par to thetreatment IW/CPE 0.8 along with 125% STCR NPK and foliar spray of 2% NPK (19:19:19) (I_2N_2) with values of 8692 and 10234 kg ha^{-1} respectively.The better moisture supply with optimum mobility and absorption of nutrients contributed to favorable growth attributes which in turn resultedin better values for the yield components. Significantly lower yields of grain and stover (5445 and 5531 kg ha^{-1}) were recorded at IW/CPE 0.6 and RDF alone. Irrigating at IW/CPE 0.6 coupled with STCR NPK (125 or 100 percent levels) along with foliar spray of 1percent PPFM registered significantly higher water use efficiency (19.18 kg ha^{-1} mm^{-1}) and water productivity (252.30 Rs. ha^{-1} mm^{-1}) with 355 mm of water consumed.

Key words: Climate, Maize, Crop, Moisture

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Seasonal Incidence of Insect Pests of Castor with Reference to Weather and Development of Forewarning Models

K. Ashok Kumar*, P. Radhika, K.V.S. Sudheer, Y. Pavan Kumar Reddy and D. Kanchana

Agricultural Research Station, Acharya NG Ranga Agricultural University, Ananthapuramu-515001, Andhra Pradesh
**Corresponding author: k.ashokkumar@angrau.ac.in*

Monitoring of castor insect pests was carried out to study the influence of weather parameters on the incidence of insect pests in castor during *kharif* 2021-22 and 2022-23. The data was analyzed statistically with weather parameters using correlation and Regression techniques. Correlation studies showed significant and positive correlation (0.759*) by thrips and significant and negative correlation (-0.720*) by semilooper with minimum temperature during *kharif* 2021. The multiple regression equations were developed for castor insect pests using linear regression and regression with stepdown selection models. By using the multiple linear regression models, biotic stresses *viz*., thrips and semilooper, were predicted to an extent of 95% and 97% respectively, while the step down selection model the prediction rate of the same pests were 82% and 92% respectively during 2021. The same trend was observed in the correlation studies during 2022-23 with reference to thrips (0.744) and spodoptera (0.673), while significant and negative correlation with minimum temperature by leafhoppers (-0.643) and capsule borer (-0.643) . By using the multiple linear regression models, biotic stresses viz., thrips and spodoptera, were predicted to an extent of 88% and 99% respectively, While the step down selection model the prediction rate of the same pests were 55% and 70 % respectively during the year 2022. The step down selection model the prediction rate of the capsule borer was 57% during kharif 2022.

Key words: Castor, Insect pests, Correlation, Regression, Weather factors, Forewarning models

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Response of Tillage and Mulching on Growth, Yield, and Economics of Indian Mustard (*Brassica juncea* L.)

Naidu Bhargavi Naga Kalyani[1]*, K. Nandini Devi[2], Jamkhogin Lhungdim[2], Herojit Singh[2] and N. Gopimohan Singh[2]

[1]Department of Agronomy, Agricultural College (ANGRAU), Bapatla-522101, Andhra Pradesh
[2]College of Agriculture, Central Agricultural University, Imphal-795004, Manipur
**Corresponding author: bhargavinagakalyani1996@gmail.com*

Soil erosion can have a huge impact on the productivity of crops, especially in hilly areas where there is severe rainfall. It can lead to poor growth and low yields due to the erosion of fertile soil. One way to address this issue is by implementing conservation agriculture practices such as reducing tillage and mulching. These practices can help minimize the impact of soil erosion and ensure high productivity and profitability of crops in these areas. Field experimentation was conducted during the *rabi* season of 2019 at Research Farm, College of Agriculture, Central Agricultural University, Manipur to evaluate the "Effect of tillage and mulching on growth, yield, and economics of Indian mustard (*Brassica juncea* L)". Here factors were taken tillage and mulching, where main plot with two tillage treatments, Conventional tillage (L1), Minimum tillage (L2), and where subplot with four mulching treatments, No mulch (M1), Rice straw mulch (M2), Polythene mulch (M3), Tree leaves mulch (M4) which were laid out in Split plot design with eight treatment combinations and replicated thrice. Among the various treatment combinations, the treatment (L1M3) recorded significantly highest growth and yield attributes whereas the lowest plant height, number of siliqua per plant, number of seeds per siliqua, seed yield, stover yield was recorded in (L2M1) but the treatment (L1M2) recorded highest harvest index. The highest gross income (116350 Rs/ha) was recorded in (L1M3), and net return (47461 Rs/ha) was found best in (L1M2). The highest B: C ratio (0.72) was observed in (L2M2) whereas the lowest gross return (93,708 Rs/ha) was recorded in (L2M1), the lowest net return (858 Rs/ha) and B: C ratio (0.007) were obtained from the treatment (L2M3). Hence best treatment combination was observed in the L2M2 treatment.

Key words: Conventional tillage, Minimum tillage, Rice straw mulch, Polythene mulch, and Tree leaves mulch

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Effect of Nano Nitrogen Fertilizer on Canopy Development, Yield, Quality and Use Efficiency in *Rabi* Sunflower (*Helianthus annuus* L.)

Lingaraj, Umesh, M.R.*, Ajayakumar M.Y., Sidram Waded Lokesh G.Y., Vikas Kulkarni, Poornima and V.N. Ghante

AICRP on Sunflower, Main Agriculture Research Station, University of Agricultural Sciences, Raichur-584104 Karnataka
**Corresponding author: mrumeshagri@gmail.com*

Fertilizer management in field crops aimed at increasing its use efficiency. Among several approaches adopted and found effective, in recent years use of nano technology was found effective to increase nutrient use efficiency. A field experiment on effect of nano nitrogen fertilizer on canopy development, yield, quality and use efficiency in sunflower was conducted during *rabi* 2021-22 at Raichur on *Vertisols* with soil reaction (pH 7.77), lower available nitrogen, phosphorous and potassium. The experiment was laid out in RCBD with three replications. Treatments comprised of soil application of conventional and foliar application of nano formulated nitrogen fertilizers at varying doses. Results showed that application of 67.5 kg N ha^{-1} at basal followed by nano-N spray @ 4 ml l^{-1} at 45 DAS was recorded significantly higher seed yield (2279 kg ha^{-1}), stalk yield, oil yield (967 kg ha^{-1}) and yield attributes like head diameter, seed yield per plant and seed volume as compared to rest of the treatments. However, it was found on par with basal application of 45 kg N ha^{-1} followed by nano nitrogen spray @ 4 ml l^{-1} and 8 ml l^{-1} at 45 DAS. Significantly higher nitrogen uptake was noticed by basal application of 67.5 kg N ha^{-1} followed by nano nitrogen spray @ 4 ml l^{-1} at 45 DAS (145.4 kg ha^{-1}). Application of 22.5 kg N ha^{-1} at basal followed by nano nitrogen spray @ 4 ml l^{-1} at 45 DAS was recorded higher agronomic efficiency (25.98 kg kg^{-1} N) and recovery efficiency (2.05 kg N uptake kg^{-1} N). Significantly higher net returns (Rs. 91789 ha^{-1}) and benefit-cost ratio (4.17) was obtained in basal application of 67.5 kg N ha^{-1} followed by nano nitrogen spray @ 4 ml l^{-1} at 45 DAS. It was confirmed that application of nano formulated nitrogen fertilizer to supplement soil applied solid fertilizer enhanced growth and yield of sunflower in Vertisols of Northern Karnataka.

Key words: Nano, Nitrogen, Sunflower, Quality

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Innovative Organic Nutrient Management Strategies to Improve Productivity and Profitability in Transplanted Rice (*Oryza sativa*) under Organic Production System

Rajashree*, Satyanarayana Rao, B.K. Desai, B.G. Mastana Reddy, Mahadev Swamy, Vishwanath, J. and S.B. Goudar

University of Agricultural Sciences, Raichur-584104, Karnataka
**Corresponding author: rajashreehalke@gmail.com*

Rice (*Oryza sativa* L.) serves as the primary staple food crop in India as well as globally. The majority of rice production relies on conventional and input-intensive farming techniques. However, the excessive and indiscriminate use of chemical fertilizers and pesticides has resulted in detrimental effects on the environment and soil quality, rendering this approach unsustainable in the long term. Organic and natural farming methods may provide a potential solution to address this issue. However, the adoption of organic agriculture is hindered by the limited availability of organic manure. Instead of relying entirely on just one organic manure source, organic manures can be combined with liquid organic manures. This integration helps in reducing the bulky organic manure requirement. Further, split application of organic manures and liquid organic manures at different growth stages of the crops helps in more effective growth and development of rice. Hence, the present study was conducted over three seasons to assess the impact of different innovative organic nutrient management practices on the productivity, profitability and soil health in organic transplanted rice. The experiment was laid out in randomized complete block design with three replications and ten treatments. Among all the treatments, the treatment receiving combined application of organic manures (75% RDN) and liquid organic manures (Beejamrutha, jeevamrutha, 10% cowurine and 10% vermiwash) resulted in on par yields with that of FYM (100% RDN), FYM+VC (100% RDN). In addition these treatments resulted in higher monetary returns than that of only organic manure applied treatment because of lower cost incurred for inputs.

Key words: Organic, Rice, Profitability

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Performance of CERES-Rice Model for Growth and Yield of Medium Maturing Rice in Central India

Subrat Jain[1]* and Manish Bhan[2]

[1]*Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, Madhya Pradesh*
[2]*Department of Physics and Agrometeorology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, Madhya Pradesh*
**Corresponding author: jainsubrat48@gmail.com*

Crop modeling tools can be used to compute the gaps between projected and actual grain yield that may help to upgrade best management practices under changing climate conditions. On this basis, a field experiment was conducted in kharif 2023 with an aim to generate, evaluate and validate genetic coefficients of medium duration 'kranti; variety of rice grown in east Madhya Pradesh. It was sown in three thermal environments (10 July, 25 July and 10 August) with the recommended management practices of direct seeded rice in the field. The collected minimum datasets are later used to generate eleven genetic coefficients using CERES-Rice model embedded in Decision Support System for Agro technology Transfer (DSSAT) programme. The evaluation between simulated and observed data was done at anthesis, physiological maturity, and maximum leaf area index and grain yield. The results during evaluation exhibited a RMSE and d value of , 3.1 days and 0.3 at anthesis, 1.5 days and 0.89 in physiological maturity, 76.5 kg/ha and 0.93 in grain yield, , and 0.92 and 0.27 at maximum Leaf area Index. This suggested a good-fit and coefficients were validated with 2015, 2016,2018,2019,2020 years of datasets. The validation analysed with RMSE and d value of 1.8 days and 0.87 at anthesis day, 2.3 days and 0.73 at physiological maturity day, 0.27 and 0.81 as maximum leaf area index, and 207 kg/ha and 0.52 at grain yield. This proved to be a good fit with less percent of error, and can be used for analyzing adaptative measure under climate change conditions.

Key words: Direct-seeded rice, CERES, DSSAT, Kranti, climate change

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Assessment of Sowing Window and Yield of Early Maturing Sahbhagi Rice under Climate Change Scenario using CERES-Rice for Major Rice Producing districts of Eastern M.P.

Maitryi Chourasia[1]* and Manish Bhan[2]

[1]Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, Madhya Pradesh
[2]Department of Physics and Agrometeorology, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur-482004, Madhya Pradesh
**Corresponding author: maitryi21@gmail.com*

Climate change affect growth and yield of cereals in the coming years. Assessing its impact may help to alleviate losses caused by it. On this basis, a field experiment was initiated in kharif 2023 at Jabalpur, MP to generate, evaluate, and validate genetic coefficients of early maturing rice variety and its impact in the coming years in major rice producing districts of eastern Madhya Pradesh. Rice variety 'Sahbhagi' was sown at three different thermal environments (25 June, 10July and 25 July), and applied with the recommended management practices in the field. The minimum dataset was collected for generating eleven genetic coefficients using CERES-Rice model embedded in Decision Support System for Agrotechnology Transfer programme. The results were analyzed using root mean square error (RMSE) and d-value. The genetic coefficients were generated and evaluated for grain yield of Jabalpur district. It exhibited a relative difference between observed and simulated yield in a range of -1.5 to 22.6 % among different thermal environments with RMSE of 349.8 kg/ha, and d- value of 0.47. The observed grain yield from 2013-2021years was validated with simulated datasets of the same year, with RMSE of 75.4 kg/ha and d-value of 0.45 that suggested a good-fit method. The futuristic weather data from 2030-40 years using representative concentration pathway 2.6 and 8.5 were selected, and their average used for comparing with observed grain yield generated from baseline (average of 1901-2020 years) of 25 June sowing of major rice growing districts of east MP. The results suggested an increase in grain yield by 55% from baseline in Seoni; 36% in Mandla; 4% in Rewa; 53-56% in Balaghat; whereas 10% yield decline in Satna district. It suggested as around June 25, preferable after onset of south-west monsoon as time of sowing direct seeded rice to counter climate change in rice growing districts, except Satna district of east M.P.

Key words: Direct seeded rice, Sowing window, CERES-Rice, DSSAT, RCP 2.6 and 8.5

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Custom Hiring Service Centre – Boon for Rainfed Farmer

B. Sahadeva Reddy, Ch. Appa Rao*, K. Madhu Sudhan Reddy and Y. Pavan Kumar Reddy

AICRP for Dryland Agriculture, Agricultural Research Station, ANGRAU, Ananthapuramu-515001, Andhra Pradesh
**Corresponding author: ch.apparao @angrau.ac.in*

In rainfed areas of scarce rainfall zone of Andhra Pradesh, small and marginal farmers may not afford to purchase high cost machinery, there by a custom hiring centre is a better solution to provide high cost machinery to farmers on rent basis or custom hiring. Groundnut is the major crop grown under rainfed in an area of about 5.0 lakh hectare in Ananthapuram district. The farmer has to perform timely field preparation, sowing of crop with narrow sowing window, intercultivation, spraying, harvesting and threshing of groundnut to save time and to get higher productivity. Custom hiring centre was established at AICRPDA, Agricultural Research Station, Ananthapuram during 2011-12 with the financial assistance under *RKVY* to provide farm implements to farmers of Ananatapuramu district for timely operations and reduction of cost of cultivation. Sub soilers, duck foot cultivators, planters, intercultivation equipments and multi crop threshers were purchased and kept in implement shed for custom hiring. A committee was constituted in the university under the chairmanship of University Head Farm machinery and Power Engineering and custom hiring charges and deposit amounts for farm machinery and equipments are fixed. Demand is more for planters (66%) and threshers (10%) compared to other implements. From 2011 to 2023, center out reached to the farmers of 23 mandals, 200 villages of Ananthapuramu district and generated revenue of Rs.20.63lakhs. Based on the success of the custom hiring cetres, the Govt.of Andhra Pradesh under RKVY established custom hiring centres in KVKs. Crop based custom hiring centers were also established at *Rythu Bharosa Kendras* (RBKs) in villages to farmers in entire Andhra Pradesh.

Key words: Rainfed, Farmer, Custom, Ananatapuramu

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A Comprehensive Study on the Influence of Varied Size Zinc Oxide Nanoparticles on Rice Agronomic Traits

Sharan Paranimuthu[1], Rakesh Pandey[2], P. Krishnan[1] and Achchhelal Yadav[1]*

[1]Division of Agricultural Physics, [2]Division of Plant Physiology,
ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: achchheyadav@yahoo.com*

Conventional zinc fertilizers have limitations in micronutrient delivery and often require high application rates. Zinc oxide nanoparticles (ZnO-NPs) offer potential alternatives due to their unique properties. This study tested the impact of zinc oxide nanoparticles (ZnO-NPs) with different sizes on rice growth and yield in two rice cultivars, PB-1121 (long duration) and PB-1509 (short duration). Rice plants were grown in pots and ZnO-NPs were treated in three size ranges (30, 40, and 95 nm) through three different methods *viz*., soil application only, soil +foliar application or conventional $ZnSO_4$ fertilization. Stomatal conductance, chlorophyll content, growth rates, root parameters and grain yield were taken into consideration. All ZnO-NP treatments increased stomatal conductance compared to $ZnSO_4$ in both cultivars. Notably, 30 nm ZnO-NPs applied via soil +foliar significantly enhanced total chlorophyll in both cultivars. Compared to $ZnSO_4$, 30 nm ZnO-NPs (soil +foliar) significantly improved the relative growth rate, net assimilation rate, root length, surface area, grain weight per panicle, biomass, filled grains per panicle and harvest index of both the cultivars. Smaller ZnO-NPs (30 nm), particularly with soil +foliar application, effectively enhanced key agronomic traits in both rice cultivars. This approach holds promise for improving zinc delivery, overcoming micronutrient imbalances and has the potential to boost the crop yield.

Key words: ZnO nanoparticles, Rice cultivars, Agronomic traits, Crop yield

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Nano-Technology Applications in Crop Growth: A Paradigm Shift in Agricultural Practices

N. Sandeep*

Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: sandeepnenavath9911@gmail.com*

Nano-technology has emerged as a revolutionary tool in the field of agriculture, offering innovative solutions to enhance crop growth, yield, and sustainability. This abstract provides an overview of the current state of nano-technology applications in crop agriculture, highlighting its potential benefits and challenges. Nano-materials, typically ranging in size from 1 to 100 nanometers, exhibit unique physical and chemical properties that can be harnessed for targeted agricultural interventions. In crop growth, nano-technology has shown promise in improving nutrient delivery, water management, pest control, and stress tolerance. Nano-fertilizers, for instance, enable controlled release of nutrients, enhancing nutrient uptake efficiency and minimizing environmental impact. Additionally, nano-sensors aid in precision agriculture by monitoring soil conditions, allowing farmers to optimize resource utilization. Nano-pesticides offer a sustainable alternative to traditional chemical pesticides, providing targeted delivery to pests while minimizing ecological harm. Furthermore, nano-particles have been utilized to enhance plant stress tolerance, enabling crops to withstand adverse environmental conditions such as drought, salinity, and temperature extremes. Despite the potential advantages, the adoption of nano-technology in agriculture raises concerns regarding its long-term environmental impact and potential toxicity. Therefore, responsible and ethical deployment strategies must be established to ensure the safe integration of nano-materials in farming practices. This abstract highlights the transformative potential of nano-technology in crop growth and agriculture. As research in this field progresses, understanding the implications, addressing challenges, and establishing regulations will be crucial to harness the full benefits of nano-technology for sustainable and resilient crop production.

Key words: Nano, Crop, Paradigm shift, Application

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Crop Area Estimation under Jurala Command Area using RPA & Remote Sensing Techniques

Lakshmi Saroja G.*, N. Mahesh Teja, N.S. Raju, Manikyam, Sai Ram J., N. Ravi Kumar and Nagarjun Kumar

ICAR-Central Research for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: ganapathilakshmi811@gmail.com*

General crop area estimation surveys are conducted throughout the country for estimating crop area of all major crops. Currently in India, the crop statistics cover 51 food crops and 15 non-food crops and are based on land revenue system. In three permanently settled states (Kerala, Orissa and W. Bengal), 20 percent sampling on rotation basis is used, north eastern states rely on ad hoc surveys, while full enumeration approach is adopted in the remaining parts of the country. These conventional methods are time consuming and unbiasedness of the survey. In this paper we have estimated karif crop area under jurala command area (command area spreads in part of mahabub nagar, karnool districts), with Indian remote sensing satellite data IRS LISS III, 23 mt dataset using unsupervised classification technique with single date approach. Major results and conclusions are: (1) IRS LISS III 23 m resolution data was adequate for accurate identification and area estimates of different crops at district as well as state level.

Key words: Crop, Remote sensing, Technique

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Enhance Water use Efficiency in Farm Pond Based Solar Powered Micro Irrigation System for Various Crops

S. Vijaya Kumar*, K.V. Rao, R.V. Adake, Harika Reddy, D. Suneeth, J. Sudharshan Reddy, D.B.V. Ramana and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: s.vijayakumar@icar.gov.in*

Water is one of the most important and basic inputs for agricultural production, it increases agricultural production per unit volume of water, per unit of cropland area , per unit time. Efficient use of every drop of water through micro-irrigation is imperative to improve crop productivity, production and water use efficiency through micro-irrigation to achieve sustainable improvement in the living standards of small and marginal farmers in the state and generate additional income for farmers. A 6.0 ha micro-watershed with Farm Pond and Solar System was developed at KVK, Hayat Nagar Research Farm of Central Research Institute for Dryland Agriculture (CRIDA) to study the effect of land use on water yield in Farm Pond based solar powered micro irrigation systems at Alfisols. A farm pond of 700 m3 (top: 21 m x 19 m, bottom:11 m x 10 m, depth: 3.5 m, side slope: 1:1) was constructed and lined with an HDPE sheet. In solar-powered micro irrigation systems, electricity is generated by solar photovoltaic (PV) panels and used to operate pumps for the abstraction, lifting and distribution of irrigation water. The solar system solar panel's maximum power (Wp) is 1500 Wp (watt peak), the total number of panel's 16, AC Motor, capacity of 5HP / 3-Phase, system power of 440 volts & 3730 watts (3.73kw) in running with easy & low maintenance, under and overvoltage protection. It is observed that the field experimentation and testing suggested that the system performance for various crops production was found satisfactory as the water use efficiency in Rain Pipe Irrigation 80 to 85%, Micro Sprinklers Irrigation 75 to 80%, Micro Sprinklers Irrigation 70 to 80%, In-Line Drip Irrigation more than 90% and On-Line Drip Irrigation 90% respectively.

Key words: Solar energy, Solar water pump, Farm pond, Micro irrigation

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Fabrication of Cellulose-guar Gum Nano Composite for Moisture Triggered Release of Herbicides for Increasing Weed Control Efficiency in Crop Production Systems

Jakku Prasanna*, S. Marimuthu and Golla Gowtham

Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: prasanna.j10@gmail.com*

Chemical weed control plays a vital role in intensive agriculture. Atrazine, a broad-spectrum selective herbicide, which is used extensively to control weeds in sorghum, corn and sugarcane. Application of atrazine blocks the electron transport in photosystem II, thus inhibiting the photosynthetic process of targeted weeds. However, the persistence and mobility of atrazine in the soil contaminates groundwater and other non-target areas through runoff in irrigated crop productions systems. Chemical weed management is again an effective strategy for controlling weeds in rainfed agriculture. However, soil active herbicides require optimum soil moisture for facilitating the diffusion of herbicides into sub soil areas to inhibit the germinating weeds. However, rainfall is a truly random event, which makes chemical weed management challenging in the rainfed crops. The absence of rainfall during the application of herbicides triggers the volatilization of active herbicide molecules, while multiple rainfall events also cause leaching out of herbicides. These situations limit herbicide availability in the target sites resulting in low weed control efficiency in the rainfed crop production systems. Nano encapsulated formulation loaded with atrazine will reduce the adverse impacts in the terrestrial irrigated ecosystems, while the encapsulated atrazine applied along with sowing of seeds in rainfed farming gets protected from volatilization, photo degradation and microbial activity in the soil until the receipt of rainfall. The rainfall triggers the diffusion of herbicides form the formulation will inhibit the germinating weeds. Hence smart delivery system was designed through encapsulation of atrazine into guar gum-cellulose nano composite using borax as cross-linking agent. Atrazine entrapment efficiency was found to be 91.5 per cent. The release profile of atrazine loaded hydrogels exhibited slower release rates compared to that of pure atrazine without encapsulation.

Key words: Nano, Herbicides, Crop, Moisture

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Long Term Conservation Agriculture Improved Soil Organic Carbon in Pigeon Pea-wheat Cropping System

Priyanka Saha*, T.K. Das, Raj Singh, Rishi Raj, Dibakar Mahanta, M.C. Meena, Suman Sen and Arkaprava Roy

ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: priyankasaha993352@gmail.com*

In the face of global climate change, the imperative to enhance and stabilize soil organic carbon (SOC) is paramount for sustainable agriculture. Conservation agriculture (CA) practices, particularly diversified cropping systems and residue retention, emerge as promising strategies. This study focused on evaluating three distinct crop establishment practices under CA (CA-PBB, CA-PFB, and CA-PNB) and comparing them with a conventional tillage (CT) plot in a pigeon pea-wheat cropping system. Over the 12-year study period, the adoption of CA exhibited noteworthy results in SOC dynamics. There was a remarkable increase of approximately 32.02% and 56.53% in total SOC in the 0-5cm and 5-15cm soil layers, respectively. This underscores the efficacy of CA in promoting the accumulation of organic carbon in the soil, crucial for mitigating climate change impacts. Among the different crop establishment systems under CA, CA-PFB demonstrated the highest improvement in total SOC levels. CA-PFB outperformed CA-PBB and) and CA-PNB in both soil layers. These findings highlight the significance of residue retention and diversified cropping systems, particularly those involving pigeon pea and wheat. The enhancement of SOC stock further accentuated the benefits of CA practices. In the 0-5cm soil layer, CA-PFB, CA-PBB, and CA-PNB exhibited approximately 36.61%, 22.87%, and 15.53% higher total SOC stock, respectively, compared to CT plots, which registered an SOC level of approximately 5.241 Mg ha”1. In the 5-15cm layer, the gains were substantial at ~35.84%, 28.47%, and 19.49% over CT. These results emphasize the role of CA in not only increasing total SOC but also in building SOC stocks, vital for sustaining soil fertility and mitigating the impacts of climate change. The prominence of CA-PFB suggests that practices involving residue retention play a pivotal role in optimizing soil health and carbon sequestration, contributing significantly to the broader goals of sustainable agriculture in a changing climate.

Key words: Conservation agriculture, Soil, Organic, Pea, Wheat

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Comparative Efficiency of Methods of Irrigation and Weed Management on Root Parameters in Groundnut

Arpitha H.C.[1]* and T. Selvakumar[2]

[1]Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
[2]Maize Research Station, Vagarai, Dindigul-624613, Tamil Nadu
**Corresponding author: arpipoornachandra@gmail.com*

A research study conducted in Coimbatore during the *Kharif* season of 2021 focused on evaluating the comparative efficiency of different irrigation and weed management methods on root parameters in groundnut. The experiment adopted a split-plot design with three replications. The main plots were assigned to three irrigation methods: Surface (M1), Drip (M2) and Rain hose (M3). The subplots involved five weed management practices: Pre-emergence *fb* Hand weeding + Earthing up (S1), Pre-emergence *fb* Post-emergence *fb* Earthing up (S2), Pre-emergence *fb* Post-emergence *fb* Post-emergence (S3), Post-emergence *fb* Post-emergence *fb* Earthing up (S4), and Hand weeding *fb* Hand weeding + Earthing up (S5). Results indicated that surface irrigation (M1) resulted in significantly longer root length (11.20 - 15.53 cm), comparable to drip irrigation (M2) (11.07-15.49 cm) from 30 days after sowing (DAS) until harvest. Rain hose irrigation showed significantly lower root length (9.99 – 14.84 cm). Weed management practices did not exhibit significant variations in root parameters. Drip irrigation (M2) produced significantly higher root dry matter, ranging from 0.239 to 2.624 g plant^{-1}, from 15 DAS until harvest. This was comparable to rain hose at 15 DAS (0.228 g plant^{-1}) and 30 DAS (0.776 g plant^{-1}), with rain hose showing higher values after 30 DAS until harvest (1.401 to 2.475 g plant^{-1}). Surface irrigation (M1) resulted in the lowest root dry weight, ranging from 0.124 to 2.267 g plant^{-1} from 15 DAS until harvest. In summary, the study highlighted the significant impact of irrigation methods, particularly favouring surface and drip irrigation for optimal root development, while weed management practices showed no substantial influence on root parameters. Drip irrigation exhibited superiority in promoting root dry matter compared to other irrigation methods.

Key words: Irrigation, Weed, Root, Groundnut

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Sustainable Production and Characterization of Amorphous Nano-silica from Rice Husk: An Eco-Friendly Synthesis Approach

S. Pradeep Kumar[1]*, M. Mohamed Yassin[1], S. Marimuthu[2], M.K. Kalarani[3], S. Thiyageshwari[4] and Guru Meenakshi[5]

[1]Department of Agronomy, [2]Centre for Agricultural Nanotechnology, [3]Directorate of Crop Management, [4]Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
[5]Department of Food Science and Nutrition, Community Science College and Research Institute (TNAU), Madurai-625104, Tamil Nadu
**Corresponding author: pradeepagro004@gmail.com*

This study presents an environmentally benign chemical process for the eco-friendly synthesis of amorphous nano-silica from rice husk. Employing various material characterization techniques, including X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FT-IR), Field Emission Scanning Electron Microscope (FESEM), Energy dispersive X-ray spectroscopy (EDS), and Particle size analyzer (PSA), the nanoparticles' properties were thoroughly examined. The objective of this research is to environmentally synthesize amorphous nano-silica from rice husk, utilizing a green chemical process. The environmentally friendly synthesis process involved a variety of material characterization techniques, including XRD, FT-IR, FESEM, EDS, and PSA. The nanoparticles' properties were confirmed through detailed analysis. Results indicate the successful extraction of amorphous silica nanoparticles. Transmission electron microscopy-selected area electron diffraction patterns and XRD analyses confirm the amorphous nature of the silica sample. Fourier-transform infrared spectroscopy reveals the presence of siloxane and silanol groups. Microscopy images depict the initial presence of nanoparticles, accompanied by secondary microparticles due to agglomeration. The extracted amorphous silica exhibits an average particle diameter of 35 nm. These synthesized nanoparticles hold potential applications in agriculture, nano-additives, microelectronics, sensors, and various other fields. This research contributes to the sustainable production of nanomaterials, offering versatile applications across multiple industries.

Key words: Nano-silica, Rice, Eco-friendly, Electron Microscope

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Effect of Weed Management in Yield of Maize

Gunjan Guleria*, Yogeshwar Singh[1], Sushil Kumar Singh, Anusuiya Panda and Rajiv Nandan

Rani Lakshmi Bai Central Agricultural University, Jhansi-284003, Uttar Pradesh
**Corresponding author: gunjan.guleria915@gmail.com*

Maize is a very versatile crop in India as it is the third most important crop after rice and wheat and in world it ranks first in production. Having highest nutritive value and yield potential among cereals, it is commonly referred as Queen of cereals. Maize can be grown for the purpose of grain for human well as fodder for animals. A field experiment was carried out to find out best weed management practice during *Kharif* season, 2023, at the Research Farm, Rani Lakshmi Bai Central Agricultural University, Jhansi, Uttar Pradesh (India). The experiment consists of eleven treatments *viz*., T_1: CT+PE herbicide (Atrazine @ 1.25 kg a.i. ha^{-1}) ; T_2: CT+PE herbicide (Atrazine @ 1.25 kg a.i. ha^{-1}) *fb* POE herbicide (Tembotrione @ 150 g a.i. ha^{-1}); T_3: CT+PE (Atrazine @ 1.25 kg a.i. ha^{-1}) *fb* Hand weeding (at 25-30 DAS); T_4: ZT+PE herbicide (Atrazine @ 1.25 kg a.i. ha^{-1}); T_5: ZT+PE herbicide (Atrazine @ 1.25 kg a.i. ha^{-1}) *fb* POE herbicide (Tembotrione @ 150 g a.i. ha^{-1}); T_6: ZT+PE herbicide (Atrazine @ 1.25 kg a.i. ha^{-1}) *fb* Hand weeding (at 25-30 DAS); T_7:ZT+R (moong bean @ 3t ha^{-1}) + PE herbicide (Atrazine @ 1.25 kg a.i. ha^{-1}); T_8: ZT+R (moong bean @ 3t ha^{-1}) + PE herbicide (Atrazine @ 1.25 kg a.i. ha^{-1}) *fb* POE herbicide (Tembotrione @ 150 g a.i. ha^{-1}); T_9: ZT+ R (moong bean @ 3t ha^{-1}) + PE herbicide(Atrazine @ 1.25kg a.i. ha^{-1}) *fb* Hand weeding (at 25-30 DAS); T_{10}: CT+Weedy check; T_{11}: CT+Weed free plot. The experiment was laid out in factorial randomized block design and replicated thrice. The experimental soil texture was sandy loam and has pH-7.64 and EC was 0.24 dS/m the fertility status of soil viz. low in OC (0.45%), low in available N (178.02 kg ha^{-1}), low in available P (9.79 kg ha^{-1}) and medium in K (198.10 kg ha^{-1}). Under present case study, application of pre-emergence (Atrazine @ 150g a.i./ha) along with post emergence herbicides (Tembotrione @0.25kg a.i./ha) after 25-30 DAS resulted in higher grain yield of maize. Weed interference in weedy check treatments leads to yield reduction as compare to yield of maize when pre-emergence and post-emergence herbicides both were applied. Application of both pre-emergence and post-emergence herbicides also enhanced yield over handweeding treatments. In maize diverse weed population were found. *Phyllanthus urinaria*, *Cyperus rotundus*, *Echinocloa crusgalli*, *Tridax procumbens*, *Celosia* spp., *Eleusine indica* were the weed species. In conclusion herbicides are effective for controlling weeds in maize. Specially, application of pre-emergence herbicides (Within 72 hours of sowing) and post-emergence herbicides (25 DAS).

Key words: Maize, Post-emergence, Weed

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Estimation of *Kharif* Paddy Area in Cauvery Delta Region by Integrating Sentinel-1A and Sentinel-2A Data

Sugavaneshwaran K.*, K.P. Ragunath, S. Pazhanivelan and R. Kumaraperumal

Department of Remote Sensing & GIS, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: sugavaneshwarank@gmail.com*

For Paddy crop area delineation in the Cauvery delta comprising Thanjavur, Thiruvarur and Nagapattinam districts region of Tamil Nadu in the *kharif* season, research was conducted using Sentinel-1A SAR satellite data and Sentinel-2A Optical data. Around 200 paddy and 100 non-paddy points were collected in the study area, which was used for training and validation of paddy area estimation. Refined and classified training sites were iterated to attain a considerable amount of accuracy. Considering the good accuracies obtained through the individual analysis of SAR and optical data, an agreement assessment between the data was performed to understand the classification by the two methods. So, the integration of Optical and SAR data is done. The integrated optical and SAR data recorded a total rice area of 86152.20 ha with Nagapattinam district having the highest area of 41993.47 ha followed by Thanjavur and Thiruvarur districts with 24025.69 and 20133.03 ha respectively. The block wise statistics showed Orathanadu, Mannargudi and Mayiladudurai blocks to have the highest area and Budalur, Kudavasal and Talanayar blocks with the lowest area of kharif paddy among other blocks in Thanjavur, Thiruvarur and Nagapattinam districts respectively. The accuracy assessment of the integrated product revealed that the rice points were classified with an accuracy of 96.0 per cent while non-rice points were classified with an accuracy of 90.0 per cent and an overall accuracy of 94 per cent with a kappa index of 0.86.

Key words: Paddy, SAR, Optical, *kharif*

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Global Invasion Risk of Rice Yellow Stem Borer *Scirpophaga incertulas* (Lepidoptera: Crambidae) under Current and Future Climate Scenarios

Timmanna*, Shravani Sanyal, B. Gundappa, A.V.M Subba Rao, S.K. Bal, Sarath Chandran M.A., A. Amarender Reddy, P.R. Shashank, V.K. Singh and P.K. Ghosh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: timmanna@icar.gov.in*

Rice yellow stem borer, *Scirpophaga incertulas* (Walker) (Lepidoptera: Crambidae) is a serious pest, that causes significant yield loss (10-40%) in rice crops at major rice growing in India and the world. Ongoing climate change favors most insect pests' biology, feeding rate, distribution, and further spread, which results in significant economic damage to various crops of agriculture and horticulture importance. With this background, there is an urgent need of the hour for sustainable pest management with proper prediction of the occurrence and spread of this pest in the current and future climate scenarios. The prediction of global invasion risk of *S. incertulas* under current and future climate scenarios using the maximum entropy (MaxEnt) algorithm. The possible habitat distribution was modeled using the Maxent algorithm. The climate niche for *S. incertulas* was established by analyzing the correlation between the pest occurrence data from nine major rice-growing states in India with seven important bioclimatic variables *viz*., seven (annual mean temperature, mean diurnal range, isothermality, max temperature of warmest month, annual precipitation, precipitation of wettest month and precipitation). The model performance was good as it exhibited a strong Receiver Operating Characteristic Curve value of 0.949. Based on the Jackknife test, annual mean temperature (30 °C) (Bio 01) exhibited the highest level of significance in predicting the distribution of *S. incertulas* with an accountability of 68.5% of the overall contribution in the model. Similarly, precipitation of the wettest month (Bio 13) (10-700 mm) exhibited the highest gain value and emerged as the primary abiotic factor exerting influence on the potential habitat distribution. The study suggested that, In India, some parts of Odisha, Chhattisgarh, West Bengal, Assam, and the western coast of India were considered as suitable areas. In other countries viz., Thailand, Laos, Cambodia, Vietnam, Malaysia, Bangladesh, and western parts of China were considered moderately suitable areas for *S. incertulas*. The data generated here may be useful for researchers, policymakers, and farmers to understand the related important bioclimatic variables as well as mapping suitable and unsuitable areas for designing better management strategies to mitigate this pest and further spread in a rapidly changing global environment.

Key words: Rice, Weather, *M*odeling, Yield loss, Management

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Location-specific Adaptation Strategies for Sorghum under Future Climates in India

Sarath Chandran M.A.*, Jeevanand P., Visha Kumari V., Raju B.M.K., Rama Rao C.A., Subba Rao, A.V.M. and Bal, S.K.

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: sarathagri@gmail.com*

The impact of projected climate on Sorghum at six locations (Akola-CSV15, Coimbatore-CO 30, Surat and Udaipur-CSH16, Dharwad, and Solapur-M-35-1) in India was evaluated using an ensemble of 30 GCMs and DSSAT crop simulation model. The genetic coefficients for individual cultivars and locations were collected from secondary sources from the study region. A seasonal analysis module in DSSAT was used to simulate the growth and yield of Sorghum during baseline (1980-2010). Future climate scenarios were developed using an ensemble of 30 GCMs, bias-corrected and spatially disaggregated for mid-century (2040-2069) under RCP4.5 and RCP8.5 emission scenarios. Compared to the baseline period, the mean seasonal rainfall is projected to decrease in Coimbatore (-25%, -32%), Udaipur (-10% and -7%), and Dharwad (-3.2%) under both RCP4.5 and 8.5 scenarios, respectively. However, at Akola (+7% and +9%), Surat (+5.5%, +9%), and Solapur (+22%, +27%), the mean seasonal rainfall is projected to increase during mid-century under both RCP4.5 and 8.5 scenarios, respectively. Both Tmax (in the range of 0.3-2.3°C) and Tmin are projected to increase across the locations under both scenarios and the magnitude of increase in Tmin was greater than that of Tmin. Under future climate, except at Solapur, the sorghum yield is projected to decrease when compared to the baseline. The reduction in yield ranged from -0.3% (Akola) to -38% (Coimbatore) under RCP4.5 and -0.5% (Akola) to (Coimbatore) under RCP8.5. Seven adaptation strategies viz., late sowing by 15 days, increase in N-dose (from 80 to 100 kg ha^{-1}), supplemental irrigation of 50 mm before anthesis, and their combination were evaluated in these locations. The best adaptation options identified for each location under both RCP4.5 and RCP8.5 are Akola, Udaipur - a combination of additional N and irrigation; Coimbatore - delayed sowing and supplemental irrigation; Surat - additional N; Udaipur - a combination all the three adaptation options.

Key words: Location, Sorghum, Future

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Modified Crop Weather Calendars for Improving Agromet Advisory Services

A.V.M. Subba Rao[1]*, Dipti Verma[1], M.A. Sarath Chandran M.A. [1], S.K. Bal[1], A. Suryachandra Rao[2] and S. Hareesh[1]

[1]All India Coordinated Research Project on Agrometeorology, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]Indian Institute of Tropical Meteorology, Pune-411008, Maharashtra
**Corresponding author: avmsubbarao@gmail.com*

Agriculture, always depends on the uniform distribution of the weather parameters during the crop season for producing higher yield and its sustainability. Crop Weather Calendars (CWC) are comprehensive guide to farmers and many other stakeholders. They are static in nature and provides information on the weather normal present during sowing, germination / emergence, transplanting (in case of rice), vegetative growth, flowering, grain formation and maturity as per the Standard Meteorological Weeks. CWC also consists of favourable weather conditions during the year of highest yield attained in the years reported, besides thumb rule-based pest/ disease information. But this information is not sufficient for taking decisions in agriculture. In view of the above, revision of crop weather calendars of groundnut at Anantapur, pigeon pea at Parbhani were carried out. Some more parameters were added for upgrading the existing crop weather calendars by incorporating the weekly occurrence of dry and wet spell probabilities, soil moisture, PET, droughts and extreme rainfall conditions week wise and at each stage of the crop. After testing for farm level decisions, the information provided in the CWC was too short and more information on Agrometeorological indices, week wise extreme weather events etc. will be more useful to the stakeholders under the frequent variable weather conditions. During drought years, the crop weather calendar reveals heightened vulnerability with reduced precipitation, increased temperatures, and prolonged dry spells. These conditions adversely impact crop development, water availability, and soil moisture, necessitating adaptive measures to mitigate yield losses. Conversely, heavy rainfall years exhibit contrasting challenges, characterized by excessive water accumulation, increased risk of flooding, and heightened susceptibility to waterborne diseases. Understanding the temporal dynamics of these conditions is crucial for tailoring Agromet advisories that enable farmers to optimize resource utilization, mitigate risks, and enhance resilience. Agrometeorological advisories derived from comprehensive crop weather calendars empower farmers to make informed decisions in the face of climatic uncertainties. The implementation of such advisories promotes sustainable agriculture by enhancing productivity, reducing environmental impacts, and bolstering the adaptive capacity of farming communities. This research contributes valuable insights for policymakers, agronomists, and extension services, facilitating the development of resilient and adaptive agricultural practices tailored to the challenges posed by drought and heavy rainfall events.

Key words: Crop, Weather, Agromet

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Effect of Farm Pond Supplemental Irrigation on Rainfed Pigeonpea and Groundnut in Micro-Watershed of North-Eastern Region of Karnataka

R.H. Rajkumar[1]*, M.R. Umesh[1], S.N. Bhatt[1], J.N.V. Prasad[2] and G. Ravindra Chary[2]

[1]AICRP for Dryland Agriculture, MARS, University of Agricultural Sciences, Raichur-584104, Karnataka
[2]AICRP for Dryland Agriculture, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: halidoddiraju@gmail.com*

The long term field experiment was conducted to find out the catchment–storage-command relationship for enhancing water productivity in micro-catchment of UAS campus, Raichur. A square shaped (trapezoidal section) farm pond of size 18 x18 m top width 10 x10 m bottom width and 2.70 m depth was excavated. The total capacity of the pond was 547.0 m^3. The catchment and command area were delineated as 8 and 1 ha respectively. During 2019, there were six runoff events. The sediment yield was calculated by collecting the runoff samples from the runoff events and it was 0.40 t/ha against the rainfall of 113.00 mm and runoff volume of 2985.50 m^3 which was highest during the season. During second year, the highest amount of sediment yield recorded was 0.358 t/ha against the rainfall of 83.60 mm and runoff of 33.84 mm with runoff volume of 1596.40 m^3. The supplemental irrigation (SI) was provided in first year to pigeonpea crop during pod filling stage and the higher yield of 12.27 q/ha was recorded as compared to without supplement irrigation (11.20 q/ha) field. The percentage increase yield in SI over without SI was 8-10. The higher rain water use efficiency (RWUE) of 1.85 kg/ha-mm was obtained under supplemental irrigated field as compared to without supplement irrigated field (1.76 kg/ha-mm). Higher net returns of Rs. 39620 and benefit cost ratio of 2.17 was recorded in SI field as compared to without SI field. During second year, the SI for groundnut was provided during pod setting stage and higher yield was recorded (15.26 q/ha) as compared to without SI (13.15 q/ha) field. The increase yield in SI over without SI was 13.8-16 %. The higher RWUE of 2.87 kg/ha-mm was recorded in SI field as compared to without SI (2.57 kg/ha-mm) field. Higher net returns of Rs. 41878 and benefit cost ratio of 2.07 was recorded in SI as compared to without SI field. In semi-arid regions of Karnataka, the runoff water harvesting in a pond and using the collected water through SI would be the best option for enhancing the productivity of pigeonpea and groundnut.

Key words: Micro catchment, Storage, Command, Farm pond, Runoff, Supplemental irrigation, Yield, Rain water use efficiency, Sediment yield

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Sustainable Farming Practices: Impact of Land Configuration and Cropping Sequences on Yield, Economics and RUE under Rainfed Conditions

Sreedhar Chauhan[1], D. Mohan Das[2] and M. Raghuveer[1]*

[1]Agricultural Research Station, Adilabad-504001, Telangana
[2]Krishi Vigyan Kendra, Adilabad-504001, Telangana
**Corresponding author: rmraghu2312@gmail.com*

A field experiment was conducted during *kharif* and *rabi* seasons of 2018-19 to 2020-21 at Agricultural Research Station, Adilabad. PJTSAU, Telangana State to study the influence of land configuration under various cropping sequences on yield, economics and Rain water use efficiency (RUE) of cropping sequences under rainfed condition. The experiment was laid out in split plot design with 3 main plot treatments of land configuration (Broad Bed Furrow system, Ridges & Furrow and flat bed method) and 5 sub plot treatments of cropping sequences (Soybean - Chickpea, Soybean - *Rabi* Jowar, Soybean-Safflower, Soybean + Redgram (7:1) and Cotton + Redgram (4:1). The mean data of 3 years revealed that amongst land configuration methods, sowing of main and cropping sequence crops with Broad Bed Furrow (BBF) system exhibited significant effect on seed yield of main, inter and sequence crops and highest main crop equivalent yield (MCEY) of 4786 kg ha^{-1} as well as total system gross return (Rs. 176006 ha^{-1}) and B:C ratio of 2.09:1 and RUE (5.5 kg ha^{-1} mm) compared to other land configuration methods. The cropping sequence did not show any significant effect on yield, economics and RUE. However, highest MCEY was obtained with cotton + redgram (4:1) sequence (4427 kg ha^{-1}) followed by soybean - chickpea sequence (4307 kg ha^{-1}), respectively. Soybean-Chickpea sequence resulted in highest total system gross return (Rs. 167111 ha^{-1}), B:C ratio (1.98:1) and RUE (5.9 kg ha^{-1} mm) as compared to other cropping sequences. With these findings, it can be concluded that adopting BBF system for land configuration with soybean-chcikpea cropping sequence can lead to improved seed yield, econoimc returns and RUE under rainfed conditions.

Key words: Land configuration, Cropping sequence, MCEY and RUE

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Impact of Foliar Application of Salicylic Acid and Micronutrients on Wheat Productivity in the Indo-Gangetic Plains of Uttarakhand

K. Srikanth Reddy[1,2,3*], J. Kwatra[2], S. Chandra[2], C.M. Parihar[1], P. Panneerselvam[3], K. Sreenivasa Reddy[1] and G.S. Reddy[1]

[1]ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]G.B. Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand
[3]International Rice Research Institute (IRRI), South Asia Regional Center, Varanasi-221106, Uttar Pradesh
**Corresponding author: srikanthreddykalwala@gmail.com*

A field experiment was executed to investigate the impact of foliar application of salicylic acid and micronutrients on productivity and profitability of wheat under different fertility levels in the Tarai region of Uttarakhand. Experiment was executed at E-2 block of Norman E. Borlaug Crop Research Centre at GBPUA&T, Pantnagar during rabi season 2020-21. The design opted was factorial randomized block design with two factors; i) fertility factor with 75% and 100% recommended dose of fertilizer (RDF), and ii) foliar spray factor with combinations of salicylic acid and micronutrient mixture. Variety employed for the trial was HD-2967, because of its wide range of acceptability. The foliar application involved using a micronutrient mixture at a rate of 2.5 ml litre^{-1} and salicylic acid at a concentration of 0.4 grams litre^{-1} (400 ppm). The study's findings indicate that application of salicylic acid and micronutrient mixture via foliar spray enhances crop performance in terms of both yield and profitability. Notably, the yield from plots treated with 75% RDF along with these compounds (5.7 t/ha) was at par with plots treated only with 100% RDF (5.6 t/ha). This implies that using foliar application of salicylic acid and micronutrients can offset the yield reduction associated with lower fertilizer levels (75% RDF) while yielding higher returns. Additionally, under 100% RDF conditions, using these compounds, either individually or in combination, lead to 15.4% increase in harvest with 13.6% higher benefit-to-cost ratio on an average.

Key words: Salicylic acid, Micronutrient mixture, Wheat, Productivity, Profitability

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Monitoring the Drought 2023 with Various Indices for their Comparative Assessment

K.V. Rao*, G.S. Pratyusha Kranthi, J.V.N.S. Prasad and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: Kv.Rao@icar.gov.in*

Drought is a complex and pervasive environmental challenge with profound implications for ecosystems, agriculture, and human societies. Remote sensing technologies have become invaluable for monitoring and assessing drought conditions, offering a systematic and efficient means of gathering spatial and temporal information. This abstract focuses on three key indices for drought monitoring: the Normalized Difference Moisture Index (NDMI), the Normalized Difference Water Index (NDWI), and the Normalized Difference Drought Index (NDDI). The Normalized Difference Moisture Index (NDMI) is derived from satellite or aerial imagery, typically utilizing near-infrared (NIR) and shortwave infrared (SWIR) bands. NDMI provides insights into vegetation moisture content, making it particularly relevant for evaluating agricultural drought conditions and assessing the health of vegetation. The Normalized Difference Water Index (NDWI) is designed to detect the presence of water in various surfaces, including vegetation and soil. Calculated from specific bands, such as green and NIR, NDWI is instrumental in monitoring changes in surface water bodies and soil moisture, contributing to a comprehensive understanding of hydrological droughts. The Normalized Difference Drought Index (NDDI) integrates information from Normalize Difference Vegetation Index (NDVI) and NDWI to create a holistic measure of drought severity. By quantifying the differences in moisture and water content, NDDI offers a robust indicator that accounts for the complex interplay between vegetation health and water availability. This abstract explores the principles underlying NDMI, NDWI, and NDDI, emphasizing their collective utility in drought monitoring. The integration of these indices in a multi-temporal framework provides a comprehensive and effective approach for assessing drought conditions. The abstract demonstrates the significance of these indices in enhancing the ability to monitor, analyse, and respond to drought events across India during *Kharif* season. These indices are found to be very effective in drought monitoring studies.

Key words: NDMI, NDWI, NDDI, Drought indices

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Runoff Prediction of Ungauged Catchments in Bhima Upper and Lower Basins

K.V. Rao, Deepika S., G.S. Pratyusha Kranthi, R. Rejani and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: Kv.Rao@icar.gov.in*

Rainfall-runoff process models are typically used to estimate stream flows, Simple Hydrology (Sim HYD), a lumped conceptual daily rainfall-runoff model, can be used to simulate runoff from the catchments successfully with limited data, using the Rainfall-Runoff Library (RRL) tool. Present study aims to suggest model suitability for Bhima upper and Bhima lower basin and to predict the runoff of ungauged catchments to help understand, control, and monitor the quality and quantity of water resources. Total area of the Phulgaon catchment is 2202 sq km and of Jeewangi is 1920 sq km. Daily rainfall, evapotranspiration and daily streamflow are the inputs to SimHYD model to determine daily discharge. Discharge date for the period of 7 years i.e 2012 to 2018 of Phulgaon and for the period of 11 years i.e during 1980 to1990 of Jeewangi was collected from WRIS and used for calibration and validation. Model prediction effectiveness was assessed using Nash–Sutcliffe efficiency (NSE) values. NSE during calibration and validation of Phulgaon catchment for period 2012-2015 and 2016-2018 was 0.64 and 0.79 respectively, similarly for Jeewangi the periods of callibration and validation are 1980-1985 and 1986-1990 with the values of 0.66 and 0.83 respectively. Therefore, it is observed that the model performs very well for the monthly stream flow predictions for the ungauged catchments by fixing the parameter values same as validated catchments in both the basins.

Key words: Bhima Upper, Bhima Lower basin, Runoff prediction, Ungauged data

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Productivity and Profitability of Fodder Maize-based Intercropping Systems as Influenced by Nitrogen Management

Uma Devi B.S.* and B.G. Shivakumar

**Corresponding author: umadevibss@gmail.com*

A field experiment was conducted during *kharif* 2022 at IGFRI, SRRS, Dharwad to study productivity and profitability of fodder maize based intercropping systems as influenced by nitrogen management. The experiment was laid-out in randomized block design with sixteen treatments replicated thrice. Treatments comprised of three intercropping systems *viz*., fodder maize + fodder cowpea, fodder maize + soybean and fodder maize + dolichos with three nitrogen levels *viz*., 50%, 100% and 150% RDN. The results of the experiment showed that the maximum green fodder yield and dry fodder yield was recorded in sole fodder maize with 100% recommended dose of nitrogen (37.6 t/ha and 18.6 t/ha respectively). Among different intercropping systems, fodder maize + cowpea in 3:1 row proportion with 150% RDN on *pro rata* basis recorded higher green and dry fodder yield (33.4 t/ha and 16.4 t/ha respectively) and treatments with 150% RDN were at par with it. Larval count per plant and leaf damage score was significantly higher in sole fodder maize with 100% recommended dose of nitrogen. Nitrogen uptake by fodder maize was significantly higher in fodder maize + cowpea in 3:1 row proportion with 150% RDN on *pro rata* basis (222.4 kg/ha), and intercrops was sole cowpea with 100%recommended dose of nitrogen (163.6 kg/ha). Higher crude protein content of fodder maize and intercrops was recorded in fodder maize + cowpea in 3:1 row proportion with 150% RDN on *pro rata* basis (9.0% and 17.6% respectively). Fodder maize + soybean in 3:1 row proportion with 150% RDN on *pro rata* basis showed higher land equivalent ratio (1.4), relative crowding coefficient (5.2) and system productivity index (52.5). Higher gross returns (100130 Rs/ha), net returns (65258 Rs/ha) and benefit cost ratio (2.87) was recorded in fodder maize + cowpea in 3:1 row proportion with 150% RDN on *pro rata* basis.

Key words: Maize, Nitrogen, *kharif*, Dharwad

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Optimizing Wheat Productivity through the Conjoint Application of Urea and Nano-urea along with Zinc Fertilization

Kadapa Sreenivasa Reddy and Yashbir Singh Shivay*

Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: ysshivay@hotmail.com*

Effective utilization of nutrients in agriculture is essential for sustainable production. However, recent declines in factor productivity are due to unscientific management and soil health deterioration. The use of urea and nano-urea in conjunction with Zn could improve crop performance with reduced inputs. Hence, the present study was conducted at ICAR-IARI, New Delhi to appraise the productivity of wheat during two consecutive *rabi* seasons of 2021–22 and 2022–23. The experiment was laid out in a split-plot design with treatment consisting of five nitrogen sources in the main plots i.e. control, 130 kg N/ha (100% N through urea), 97.5 kg N/ha (75% N through urea) + nano-urea @ 1.25 litres/ha (2 foliar sprays), 65 kg N/ha (50% N through urea) + nano-urea @ 1.25 litres/ha (2 foliar sprays), 65 kg N/ha (50% N through urea) + prill-urea @ 500 litres/ha (2 foliar sprays) and in sub-plot treatments i.e. control, foliar application of 0.5% Zn through $ZnSO_4.7H_2O$, 0.1% foliar spray of nano-Zn oxide, cyanobacterial formulation BF1 (*Anabaena* sp.) priming of seeds, and foliar application at maximum tillering stage, anthesis or pre-flowering stage and initiation of grain filling stage. Results highlighted that among nitrogen sources and levels, significantly higher ($p<0.05$) grain and straw yield was recorded with the application of 100% N through urea in 3 splits followed by 75% N through urea in 2 splits + nano urea 2 foliar sprays and in different zinc fertilization treatments, the highest grain and straw yield was recorded with 0.1% foliar spray of nano-Zn oxide. Application of 130 kg N/ha through urea has recorded 23.2, 33.1% higher grain yield compared to the control followed by application of N through urea 97.5 kg/ha + nano-urea (2 foliar sprays) which was 18.9, 24.1% higher grain yield over the control during both the years. In contrast, utilizing 97.5 kg/ha and 65 kg/ha of N, along with nano-urea foliar sprays, resulted in yield reduction of 3.3, 6.7% and 7.8, 12.4% in both years, in comparison to 130 kg/ha application. Similarly, 0.1% foliar spray of nano-Zn oxide increased the grain yield by 3.7% and 5.8% over no Zn application during both years.

Key words: Foliar spray, Nano urea, Nano-Zn oxide, Yield

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Crop Classification and Assessment of Cropping System Efficiency Using Geospatial Technology in *Tarai* Region of Uttarakhand

Arjun Shreepad Hegde[1]*, Rajeev Ranjan[2] and Samarth Shreepad Hegde[3]

[1]Division of Agriculture Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]Department of Agrometeorology, College of Agriculture, G.B. Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand
[3]Department of Computer Science and Engineering, MVJ College of Engineering, Bengaluru-560067, Karnataka
**Corresponding author: arjunhegde19@gmail.com*

Accurate and timely mapping of cropping systems plays a crucial role in ensuring food security, guiding economic decisions, and shaping environmental policies. Crop maps serve multiple purposes, including assessments of agro-environmental conditions and monitoring crop water usage. Consequently, precise and accurate crop classification becomes imperative for effective agricultural management. Satellite remote sensing, with its ability to provide periodic large-scale observations of ground objects, has been recognized as an advanced tool for characterizing crop types and their distributions at a regional level. Hence, an attempt was made to assess the efficiency of the cropping system followed in Udham Singh Nagar district of Uttarakhand state. To achieve this, high-resolution, multispectral images captured on October 13, 2021, December 7, 2021, and March 6, 2022, by the Sentinel-2 satellite from the European Space Agency (ESA) were employed for classification. Ground truth points were manually collected using the 'Mapmarker' Android app and Google Earth. Additionally, preprocessing of satellite imagery, including resampling, mosaicking, and sub-setting, was carried out using the Sentinel Application Platform (SNAP) software. Crop classification and acreage estimation was conducted using Artificial Neural Network in ENVI 4.7 software. Rice and sugarcane areas of 108,884 ha and 11,479 ha, respectively, were estimated from the October 13, 2021 image. Pea crop area was estimated as 6,227 ha from December 7, 2021 image. Using March 6, 2022 image, wheat and mustard crop areas were estimated as 105,334 ha and 2,018 ha, respectively. The estimated area of each major crop is further utilized to calculate three indices namely, Multiple Cropping Index (MCI), Area Diversity Index (ADI) and Cultivated Land Utilization Index (CLUI) whose values were 174.4%, 2.4 and 0.7 respectively. Based on these values it is recommended to include short-duration crops to make the cropping system more sustainable.

Key words: Crop classification, Sentinel-2, Image processing software, Crop acreage estimation, Multiple cropping index, Cropping intensity

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Weather, Insect, and Disease Interactions of Okra in the Ranchi Region of Jharkhand

Atul Marandi[1]*, Pragyan Kumari[2] and Ramesh Kumar[3]

[1]Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]Department of Agrometeorology & Environmental Science, Birsa Agricultural University, Kanke, Ranchi-834006, Jharkhand
**Corresponding author: amarandi047@gmail.com*

The study conducted at Birsa Agricultural University, Ranchi, 2021, explored the complex interactions between weather, insect-disease infestations, and their cumulative effect on the growth and yield of okra. Utilizing a systematic agricultural approach, the research assessed the crop across different sowing dates with an emphasis on the onset and progression of pests and diseases. The experiment was laid out in a Randomized Block Design with four replications along with seven treatments (March 15th to June 15th). The weather data revealed a linear increase in both maximum (29.8°C to 38.5°C) and minimum temperatures (20.2°C to 25.1°C) throughout the cropping period. Morning and afternoon relative humidities fluctuated between 82-87.3% and 67.1-70.4%, respectively, while received rainfall ranged from 0 to 314.4 mm. These conditions proved critical for phenological development, with varying implications for early and late sowings. Correlation analysis demonstrated a positive relationship between higher maximum temperatures and okra yield, yet a negative one with minimum temperatures. Pests such as aphids, jassids, whiteflies, and the fruit and shoot borer populations exhibited significant negative correlations with increasing temperatures. Conversely, rainfall showed a generally positive correlation with pest incidence. Multiple regression models accounted for substantial variability in pest and disease occurrences: 56% for aphid populations, 60% for jassid activity, around 53% for whitefly populations, and 59% for fruit and shoot borers. Moreover, the analysis of Okra Yellow Vein Mosaic Virus and Cercospora leaf spot indicated that weather parameters could explain up to 43% and 54% of the variations in these diseases, respectively. The study propounds that early sowing dates, particularly March 15th, lead to improved production outcomes with minimal pest and disease infestation. It advocates for the forecasting of pest and disease outbreaks based on weather analytics.

Key words: Weather, Okra, Pest, Disease, Correlation, Regression

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Characterization of Plant Biophysical Attributes in Rice under Foliar Application of Nano Urea

Suman[1], Debashis Chakraborty[1]*, P.K. Upadhyay[2], Achchhelal Yadav[1], Vijay Paul[3] and Mahesh C. Meena[4]

[1]Division of Agricultural Physics, [2]Division of Agronomy, [3]Division of Plant Physiology, [4]Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: sumandagar883@gmail.com*

The world's population is expected to grow by 2-3 billion by 2050, leading to a 70% increase in demand for agriculture. This means that there will be a rise in cereal production and global fertilizer-N demand. Rice, a crucial crop in feeding over half of the world's population, needs to have its nutrient utilization optimized, particularly with regards to nitrogen fertilizers. A new government-approved N-fertilizer source called 'IFFCO nano urea' has been developed to address this issue. A research study entitled "Characterization of plant biophysical attributes in rice under foliar application of nano urea" was conducted to monitor plant biophysical processes in basmati rice (var. Pusa Basmati-1692) at IARI farm during kharif season (2022) [both field and pot grown rice]. The experiment consisted of three treatments viz., T1 [recommended dose of N, P and K-soil application], T2 [75% of N-soil application + foliar sprays at active tillering and flowering stage of 2% prilled urea solution] and T3 [75% of N + foliar spray at active tillering and flowering stage of nano-formulation @ 4ml L^{-1}] with four replications. Nitrogen fertilizers, whether administered through soil application or a combined soil + foliar approach, exhibited minimal impact on overall plant growth. Neither the fertilizer type nor the application method demonstrated appreciable effects on root growth. Chlorophyll a, b, and carotenoid content showed a significant increase in T3 (nano urea spray) during anthesis but displayed lower levels at the tillering stage. T3 also had higher stomatal conductance, internal CO_2 concentration, and transpiration rate. However, the photosynthetic rate was comparable to T1. Various yield attributes, such as panicle and flag leaf length, as well as the number of total and filled grains, higher with nano urea application; however, the yield was comparable to soil application of urea-N, indicating more research is necessary to recommend on the effective substitution of conventional soil application of N by nano urea foliar spray.

Key words: Rice, Foliar application, Nano urea and Soil nitrogen balance

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Indigenous Technical Knowledge on Drought Mitigation Techniques on Yield of Groundnut and Adoption of Farmers in Rainfed Areas of Kurnool District of Andhra Pradesh

M. Jayalakshmi[1]*, G. Prasad Babu[2] and B.H. Chaithanya[1]

[1]Regional Agricultural Research Station (ANGRAU), Nandyal-518503, Andhra Pradesh
[2]ICAR-CTRI Krishi Vigyan Kendra, Kandukuru-523105, Andhra Pradesh
**Corresponding author: jayalakshmimitnala@gmail.com*

Frontline demonstrations were carried out to study and disseminate Indigenous Technical Knowledge (ITK) in groundnut drought mitigation techniques. ITKS in groundnut includes summer deep ploughing, sub soiling with chisel plough after summer showers, application of farm yard manure, sowing across the slope, forming of dead furrows at every 2 meters with 30 cm depth. Ten demonstrations were conducted each year during the *kharif* seasons of 2018, 2019 & 2020 in farmers' fields Bodabanda and Venkatapuram villages of Kurnool district of Andhra Pradesh. The demonstrations conducted in ten locations revealed that groundnut demo plot resulted in highest no of pods (20, 22) and yield (354 ,450 kg ha^{-1}) in the years 2018 and 2019 respectively. Ground nut the demo plot got an extra income of Rs. 5200/- ha^{-1} and Rs 5800 ha^{-1} in the years 2018 and 2019 respectively in where as check plot got loss due to severe drought. In the year 2020 ground nut the demo plot resulted in 16.39% lower yields (1300 kg/ ha) than check (1450 kg/ha) as 83.6 % higher rainfall the year 2020. The majority of the farmers followed the drought mitigation techniques (75%) which were disseminated through front line demonstrations during *kharif* seasons of 2018 and 2019, and 86.7% of farmers used the technique of forming of dead furrows at every 2 meters with 30 cm depth for sowing operations followed by summer deep ploughing (63.3 %). Ninety eight percent of farmers expressed overall satisfaction with the timely drought mitigation techniques disseminated by the KVK Banavasi.

Key words: Knowledge, Groundnut, Farmer, Andhra Pradesh

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Prediction of Mustard Yield for Different Zones of Rajasthan using Machine Learning Approach

Ananta Vashisth* and Avinash Goyal

Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: ananta.iari@gmail.com*

Mustard is the most important oilseed crop grown during *Rabi* season in north-west part of the India. Weather parameters like maximum temperature, minimum temperature, relative humidity, rainfall, etc. have a great impact on crop yield. Adverse weather drastically reduces the mustard yield. Weather variables affect the crop differently during different stages of development. Weather influence on crop yield depends not only on the magnitude of weather variables but also on weather distribution pattern over the crop growing period. Hence, developing models using weather variables for accurate and timely crop yield prediction is foremost important for crop management and planning decisions regarding storage, import, export, etc. Considering the challenge of food security at domestic and international level, it is desirable to develop an accurate and dynamic crop yield prediction model. It allows an agricultural producer to take more informed in-season corrective crop management and financial decision. Many techniques have been developed to predict crop production. Regularization and feature selection techniques enhance the prediction accuracy and prevent statistical over fitting in a predictive model. To overcome the problems of predicting non-linear and non-stationary time series dataset machine learning techniques has been used. Machine learning plays a significant role, to overcome the problems of predicting non-linear and non-stationary time series dataset, as it has a decision support tool for crop yield prediction. The models for mustard yield prediction for study areas were developed using long-term weather data during the crop growing period along with mustard yield data. Techniques used for developing the model were variable selection using stepwise multiple linear regression (SMLR) and artificial neural network (SMLR-ANN), variable selection using SMLR and support vector machine (SMLR-SVM), variable selection using SMLR and random forest (SMLR-RF), variable extraction using principal component analysis (PCA) and ANN (PCA-ANN), variable extraction using PCA and SVM (PCA-SVM), and variable extraction using PCA and RF (PCA-RF). Optimal combinations of the developed models were done for improving the accuracy of mustard yield prediction. Results showed that, on the basis of model accuracy parameters nRMSE, RMSE, and RPD, the PCA-SVM model performed best among all the six models developed for mustard yield prediction of study areas. Accuracy of mustard yield prediction done by optimum combinations of the models was better than the individual model.

Key words: Mustard, Machine learning, Rajasthan

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Multistage Wheat Yield Estimation for Different Districts of Punjab using Machine Learning Techniques

Aravind K.S.[1], Ananta Vashisth[1]*, P. Krishnan[1], Monika Kundu[1], Shiv Prasad[2], M.C. Meena[3], Achal Lama[4], Pankaj Das[4] and Bappa Das[5]

[1]Division of Agricultural Physics, [2]Division of Environment Science, [3]Division of Soil Science and Agricultural Chemistry, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[4]ICAR-Indian Agricultural Statistical Research Institute, New Delhi-110012
[5]ICAR-Central Coastal Agricultural Research Institute, Old Goa-403402, Goa
**Corresponding author: ananta.iari@gmail.com*

India is an agrarian country, with approximately 60% of rural households reliant on agriculture as their primary source of income. Crop yield varies spatially due to variability in weather, soil, and agro-management practices. Therefore, an in-season crop estimation can help farmers adopt timely actions to increase productivity and is beneficial for government organizations to develop effective planning. In this research paper, machine learning techniques were applied to a multivariate meteorological time series data for estimating the wheat yield of five districts of Punjab. Wheat yield data and weather parameters over 34 years were collected from the study area and the model was developed using stepwise multi-linear regression (SMLR), artificial neural network (ANN), support vector regression (SVR), random forest (RF) and deep neural network (DNN) techniques. Wheat yield estimation was done at the tillering, flowering, and grain-filling stage of the crop by considering weather variables from 46 to 4th, 46 to 8th, and 46 to 11th standard meteorological week (SMW). Weighted and unweighted Meteorological variables and yield data were used to train, test, and validate the models in R software. The evaluation results showed a consistent and promising performance of RF, SVR, and DNN models for all five districts with an overall MAPE and nRMSE value of less than 6% during validation at all three growth stages. These models exhibited outstanding performance during validation for the Faridkot, Ferozpur, and Gurdaspur districts. Based on accuracy parameters MAPE, RMSE, nRMSE, and percentage deviation, the RF model was found better followed by SVR and DNN models and, hence can be used for district-level wheat crop yield estimation at different crop growth stages.

Key words: Wheat, Machine, Techniques, Punjab

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Integrated Farming System for Improving Soil Carbon Balance and Climate Resilience

Puspa Parameswari[1]* and Sohan Singh Walia[2]

[1]Department of Agronomy, [2]School of Organic Farming,
Punjab Agricultural University, Ludhiana-141004, Punjab
**Corresponding author: pushpaagro95@gmail.com*

In today's time, climate change has become a most pressing issue. Climate change has also impacted agriculture and the natural resource base of the earth. Making agriculture climate smart through integrated approach is also an ideal solution to ensure the food security of the ever-increasing global population at a time when there are twin problems of land degradation and carbon emissions. A multi-pronged strategy is required to check climate change and integrated farming is one of the options to achieve it. It provides multiple benefits that are sustainable and can pave the way for climate-smart agriculture (CSA). Reducing the release of greenhouse gases (GHG) and facilitating the sequestration of atmospheric carbon (C) are among the environmental benefits that integrated farming can offer. Integrated farming systems (IFS) have gained significant recognition as they aim to achieve increased production while minimizing environmental impacts. The primary characteristics of an Integrated Farming System (IFS) involves the recycling of residues (utilizing wastes or by-products from one component as inputs for another) and optimizing land-use efficiency (where two subsystems share or occupy part or the entire space required for each subsystem). The IFS approach exhibits the capacity to reduce CH_4 absorption, through organic farming practices. This improvement may be associated with enhanced abundance and activity of methanotrophs, potentially leading to decreased air diffusion that could impair CH_4 diffusion. Practices such as nutrient management through composting, utilization of crop residues, and incorporation of legumes for nitrogen fixation can enhance crop resilience to changing climate and reduce GHG emissions. Furthermore, these systems emphasize on increased residue recycling, offsetting the adverse effects of climate change by sequestering more carbon into the soil. It has been observed that there is a positive net GHG emissions in conventional systems and negative emissions in IFS systems, primarily attributed to higher soil carbon sequestration in IFS systems counterbalancing N_2O emissions. IFS is recommended as a promising strategy for increasing agricultural production and mitigating GHG emission. Improved agronomic management contribute to resilient, productive, and sustainable systems, ultimately reducing environmental pollution. IFS is a viable strategy to reduce GHG emissions and nutrient loss by emphasizing better nutrient recycling and the use of crop residues as animal feed. The incorporation of different components into the farming system not only provides food and income for small farmholders but also serves as a source of livelihood while sequestering atmospheric carbon. The integrated farming system hence is a combined approach aimed at efficient sustainable resource management for increased productivity in the cropping system.

Key words: IFS, GHG Emissions, Climate smart agriculture, Carbon sequestration

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Rainfall Partition Measurement in Four Biofuel Plantations in Semiarid Region

Sanjeeva Reddy, B.*, B. Krishna Rao, Mallikarjuna, V.R., R.V. Adake, S. Deepika and G. Nagesh Kanth Rao

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: Bs.Reddy@icar.gov.in*

Area under agroforestry and horticulture crops are increasing as viable land use alternative in Semiarid tropics. But, tree plantations adopted in wide areas are likely to produce major alterations in farm level hydrology and micro environment. When compared to crop cover, grassland and tree cover increases rainfall interception by improving rainwater infiltration and limits evaporation of soil moisture. Besides these, raindrop erosivity is also reduced because of continuous leaf litter addition and as a cover to soil surface. In Indian conditions very, limited studies were carried on rainfall partition by agroforestry and plantation tree species. Therefore, a study was taken up in established blocks of four biofuel species namely simaruba, pongamia, mahua, jatropha and three species planted in the year 2003 and Jatropha is 3 years old and are in close proximity to each other. The present paper summarizes the result obtained in the study. The rainfall portions have been measured using different types of devices in agriculture, simple or even automated equipment. The measurement of throughfall and stemflow is critical, since an error in collector devices setting and data collection may over- or sub-estimate the results. So, the funnel method for measuring stemflow data from selected tree species was used and the funnels were specially prepared using 1mm thick aluminium sheet material and attached to the tree trunks or stems. The stem flow collected in funnels was drained into 20 lit cans through a hose connector. Through fall was measured by placing the catch cans in different directions in three concentric circles to cover the tree canopy base. The measurements were noted within 12 hr of rainfall event and all devices are cleaned every week throughout rainy season and even in prolonged period of dry spells. In two years, continuous study, the rainfall observed was 648.4 and 825mm and majority of rain events fallen in low to moderate range. The mean stem flow increased with increase in total rainfall of events of about 30mm and thereafter decreased in all the four species studied. The Mahua biofuel tree stands recorded highest stem flow in all the events when compared to other three and ranged from 8.53 to 19.72%. The simaruba and pongamia stem flow percentages were very close to each other in all different ranges of rainfall events. The through fall recorded was higher at low rainfall events and decreased up to 20mm in pongamia and Jatropha and up to 30mm in simaruba, but plateau in mahua in all the events. The similar tends were observed in both the years in rainfall partition of plantations. However, still finer analysis is required and lack of rainfall intensity data is one of the prohibitive factor to carry these analysis.

Key words: Rainfall, Four biofuel plantations, Semiarid

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Crop Weather Pest Parasitoid Disease Relationship in Redgram

K.V.S. Sudheer*, P. Radhika, K. Ashok Kumar and B. Sahadeva Reddy

Agricultural Research Station, Ananthapuramu
**Corresponding author: sksudheerkaipa@gmail.com*

Pigeon pea is one of the most important pulse crops widely cultivated during kharif season across semiarid tropics like India due to its feasibility in various cropping systems and drought tolerance. The yields are invariably limited by several constraints caused due to unfavourable environment particularly the weather parameters which prevail during the crop growth period which play a predominant role in determining the course and severity of pest incidence. Among various pests and diseases, spotted pod borer, *pammanopsis* leaf folder and its *Apantales sp.* prasitoid and sterility mosaic disease are most predominant in the study area which could cause immense losses to the farming community. A field experiment was conducted during *kharif* 2021-22 and 2022-23 at Agricultural Research Station, Ananthapuramu to study crop weather pest parasitoid *Apantales sp.* and disease relationships in pigeonpea with reference to spotted pod borer, *pammanopsis* leaf folder and its *Apantales sp.* parasitoid and sterility mosaic disease. The correlation analysis revealed that Sterilty mosaic incidence had significant positive relationship with morning relative humidity. The disease had significant negative correlation with both maximum and minimum temperatures, wind speed and evaporation. The severity of spotted pod borer incidence had significant positive association with morning relative humidity. The prevalence of number of host larvae of *pammanopsis* leaf folder and its parasitoid was significantly negatively correlated with morning relative humidity. The *Apantales sp*. parasitoid emergence and per cent parasitisation also had significant negative correlation with morning relative humidity. The forewarning models developed with regression analysis are best fit for the region to predict outbreak of the pests and disease which help the farming community to adopt suitable control measures.

Key words: Correlation, Pigeonpea, SMD, Spotted pod borer, Weather variables

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How Much Conserved is Agriculture through Conservation Agriculture?

T.K. Das*, Rishi Raj and Prabhu Govindasamy

ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: tkdas64@gmail.com*

Declining/ stagnating crop yield and income, shrinking water resource, erosion and soil health deterioration, higher global warming, declining biodiversity, and air and ground water pollution are a host of problems that grapple the sustainability of conventional agriculture. Conservation agriculture (CA) is a concept for resource-saving, efficient and sustainable crop production system/proposition that takes into cognizance of crop, soil, water, bio-diversity (above- and below-ground), environment, and humans in a holistic manner and enhances natural and biological processes above and below the ground. Several resource conservation technologies (RCTs) may be included with three principles of CA. Several long-term conservation agriculture experiments have been undertaken at ICAR-Indian Agricultural Research Institute, New Delhi under rice – wheat/winter maize, rice/ maize - mustard, cotton/maize/pigeon pea – wheat cropping systems. A 13-year old long-term CA experiment revealed that a triple cropping system involving ZT DSR with summer mungbean (SMB) residue (MBR)- ZT wheat (ZTW) with rice residue (RR)– ZT summer mungbean (ZTSMB) with wheat residue (WR) was superior to conventional puddled transplanted rice (PTR) - conventional till wheat (CTW) system, giving higher system productivity and net returns. This CA system had higher C-sequestration at 0-5, 5-15 and 15-30 cm soil layers than CT and could be a superior alternative to PTR-CTW system and an adaptation and mitigation strategy to climate change. Similarly, a long-term CA experiment (13 years old) revealed that the CA-based ZT permanent broad, narrow, and flat beds with residue resulted in significantly higher crop and system yields than CT in cotton-wheat, pigeon pea-wheat and maize-wheat systems. The CA-based cotton-wheat system had higher earthworm population and C-sequestration than CT. Similarly, the CA-based cotton-wheat system besides higher productivity, led to a saving of 25% N. The three CA-based cotton/maize/pigeon pea - wheat systems could be the promising crop diversification option for rice-wheat system and an important adaptation and mitigation strategy to climate change. In rainfed ecosystem, the CA could make double cropping possible with limited/low rainfall. The triple ZT rice-wheat-mungbean system led to 25-30% savings in irrigation water and 91% higher system water productivity than PTR-CTW system. In the wheat-based system, the system water productivity (SWP) was highest in zero-till broad bed with residue, and cotton-wheat (C-W) resulted in higher SWP than pigeon

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pea–wheat (P-W) and maize–wheat (M-W) systems. Similarly, the net energy gain and energy productivity (0.42 kg/MJ) was highest in ZT broad bed with residue in cotton-wheat system (189263 MJ) and lowest was in zero till flatbed pigeon pea-wheat system (113833 MJ). The CA (ZT+R) had higher soil aggregate stability, higher aggregate size values and total organic carbon in soil aggregates than CT (conventional tillage). Wheat root length density (RLD) of upper 0-30 cm in the zero-tilled wheat following direct-seeded rice with or without residue was significantly higher than that in conventionally-sown wheat after transplanted rice. The MBR+ DSR - rice residue + ZTW- SMB resulted in almost 13% higher total SOC concentration than conventional rice-wheat in the 0-5 cm soil layer. There was an increase of almost 396 kg/ha/yr in total SOC stock (Mg ha^{-1}) achieved in this MBR + DSR - rice residue +ZTW–summer mungbean treatment over TPR-CTW system. The CA based systems resulted in higher available N (20%) in soil compared with conventional practice. Among the different N fractions there was increase in TN, organic fractions of TN and NH_4-N. Similarly, CA based systems resulted in higher available soil K (28%) compared with CT. The enhancement in available K was highest in cotton-wheat and rice-wheat. Significantly higher content of SO_4^{2-} (23.80 mg/kg), inorganic sulphur (28.27 mg/kg), organic sulphur (225.3 mg/kg) and total sulphur (507.1 mg/kg) was found in treatments having direct-seeded rice with zero-till wheat (DSR-ZTW) compared to PTR-CTW. Under rice-wheat system, the CA based practice, namely, mungbean residue + DSR– rice residue + ZTW – ZT summer mungbean with wheat residue resulted in significantly higher glomalin content and alkaline phosphatase activity at 0-5 cm depth, and nitrate reductase activity at both 0-5 cm and 5-15 cm depths than in other CA practices. The CA may reduce CO_2 and N_2O emissions through preventing residue burning and enhancing nitrogen-use efficiency. There was 34% reduction in global warming potential (GWP) upon shifting from TPR (3118 kg CO_2 ha^{-1}) to DSR (2047 kg CO_2 ha^{-1}). Zero tillage helps in timely sowing, and reduces terminal heat effects compared to conventional till (~ 77 kg/ha/day) even under late planting. Zero-tillage with residues keeps canopy temperatures lower by 1-1.5 ºC during grain filling stage (cooling due to transpiration) owing to sustained soil moisture availability to the plants. The shift from conventional to conservation agriculture is a challenging task towards attaining sustainability in production systems and aligning agriculture in harmony with nature. India despite having enormous scope for adoption of CA lags behind, particularly due to limited availability of ZT machinery and inadequate policy environment. Furthermore, crop residues competitive role & allelopathic effects, and nematodes & soil-borne insects/pathogens, changing weed dynamics may impose/create barriers towards adoption of CA. These problems should be addressed through strategic planning/management and suitable government policy.

Key words: Agriculture, Conservation, Crop

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Impact of Establishment Methods and Integrated Nutrient Management on Soil Physical Properties

G. Naveen Kumar*, P.K. Singh and R.K. Naresh

Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut-250110, Uttar Pradesh
**Corresponding author: gundlapallinaveen26@gmail.com*

This study looks into the complex interactions between planting techniques and integrated nutrient management on physical properties of soil. The study includes a comprehensive field experiment conducted during kharif 2019, using a split plot design to assess the impact of different planting techniques, namely (M1-Reduced Tillage-Transplanted Rice (RT-TPR), M2-Conventional Tillage-Transplanted Rice (CT-TPR), M3-Furrow Irrigated Raised Beds (FIRB), and M4-Unpuddled-Transplanted Rice (UP-TPR)) as main plot treatments. Concurrently, various fertility levels (S1-Control, S2-100 percent NPK Chemical fertiliser, S3-100 percent N (FYM), S4-50 percent NPK + 50 percent N (FYM), S5-75 percent NPK + 25 percent N (FYM), S6-100 percent NPK + 25 percent N(FYM)) were applied as subplots to investigate their synergistic effects on soil physical properties. Soil pH measure with Soil pH was determined (1:2 soil: water suspension) using a pH meter fitted with a calomel glass electrode. EC of 1:2 soil: water supernatant was estimated using a solubridge. Soil aggregates were determined by wet sieving analysis separated soil into four fractions: coarse macroaggregate (>2.0 mm), mesoaggregate (2.0 to 0.25 mm), microaggregate (0.25 to 0.05 mm), and 'silt + clay' sized fractions (0.05 mm). Results revealed that planting techniques and fertility levels does not have any significant difference on soil pH and EC. FIRB had the highest macro-aggregates (6.25%), while CT-TPR had the highest micro-aggregates (84.75%) at 0-10 cm. Similar trends were observed at 10-20 cm (FIRB: 6.51%, CT-TPR: 98.73%) and 20-30 cm (FIRB: 6.68%, CT-TPR: 95.86%). Fertility levels did not show any significant on soil aggregates. However, FYM applied treatments shown better soil aggregates.

Key words: Planting techniques, Fertility levels, Soil pH, Soil aggregates

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Comparison of Dimension Reduction Techniques for Different Crops Classification using PRISMA Hyperspectral Data

B. Laxman*, K.K. Choudhary, V.M. Chowdary and K. Srinivas

Agricultural Science and Applications Group (ASAG), Remote Sensing Applications Area, National Remote Sensing Centre (NRSC), ISRO, Hyderabad-500037, Telangana
**Corresponding author: laxman_boggarapu@nrsc.gov.in*

Hyperspectral data provides information in continuous and narrow spectral bands. It also provides detailed spectral information with high spectral resolution which can be used for different spectrally similar crops. But It gives most of the redundant information by correlating the bands each other. According to Hughes phenomenon, with the increase of the spectral bands, the number of training samples for training the classifier increases exponentially. Hence, it can significantly reduces classification accuracies. Therefore, instead of using the full set of bands for classification, it can be essential to apply dimension reduction techniques. The objective of this study is to assess spectrally-spatially complexity reduction techniques for different crops classification using the PRISMA (183 bands after noise removal) hyperspectral data which was acquired over the part of the Nizamabad district, Telangana State. The methodology comprises the following main steps: (1) Pre-processing(Removing noisy bands) (2) applying the dimensionality reduction techniques namely Principal Component Analysis(PCA), Minimum Noise Fraction technique(MNF) and Independent Component Analysis(ICA) (3) Applying the classification technique on each of the dimensionally reduced data cubes. In the PCA analysis, The first five Principal components contained 98% cumulative variance (Information Content of the original data). The first ten MNFs extracted 92.8% cumulative variance. In the ICA analysis, The first five PCs extracted 98% cumulative variance of the original PRISMA data. For the MNF technique, significant eigen values were considered and the selected MNFs explained the less cumulative variance because of the presence of the noise. Finally, Classification technique was applied on the selected Components for classifying the four crop classes, which were derived using PCA, MNF and ICA techniques. The results revealed that different crops classification using the dimensionally reduced data cubes achieved good results. Among the classification results of the dimensionally reduced data cubes, ICA- transformed components performed best with overall classification accuracy of 96%, followed by the PCA transformed components with overall classification accuracy of 92% and the MNF transformed components with overall accuracy of 90%. Further, the results can be validated with multiple satellite passes and other agro-ecosystems.

Key words: Principal Component Analysis (PCA), Minimum Noise Fraction (MNF), Indipendent Component Analysis (ICA), PRISMA Hyperspectral Image, Dimensionality Reduction, Crop classification

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Soil Fertility Status as Influenced by different Land Use Systems in Northern Transect of Bangalore, Karnataka

Mudalagiriyappa[1], Tejashvini, A.[2]*, Sreshma, C.K.[2], Subbarayappa, C.T.[2], Rangani Mamatha[2] and Vasanthi, B.G.[1]

[1]All India Coordinated Research Project for Dryland Agriculture, UAS, GKVK, Bangalore-560065, Karnataka
[2]Department of Soil Science and Agricultural Chemistry, UAS, GKVK, Bangalore-560065, Karnataka
**Corresponding author: teju75ashwini@gmail.com*

The study was conducted to know the soil fertility status of different land use systems in northern transect of Bangalore. In each land use systems (Agriculture, Horticulture, Forest, Sericulture, Organic farming and Barren lands), representative soil samples were collected from 0-20 cm depth at 20 locations randomly. Soil characterization revealed that soils were slightly acidic to moderately acidic in range with low soluble salts. Surface soils in agriculture land use system were moderately acidic in reaction. Medium in soil available nitrogen (329.66 kg ha^{-1}), available phosphorus (35.29 kg ha^{-1}), and available potassium (265.82 kg ha^{-1}) compared to other land use system. The nutrient status of soil for all the land use system was found medium with respect to major nutrients. Forest land use system has recorded significantly higher soil organic carbon (20.1 g kg^{-1}), dehydrogenase activity (36.65 µg TPF $g^{-1}h^{-1}$), nitrogen biomass (63.38 mg kg^{-1}), carbon biomass (402.05 mg kg^{-1}) followed by organic farming system. Among the land use systems, significantly lower soil chemical and biological properties were recorded in barren land compared to other two land use systems. However, the content of available nutrients decreased with depth in all cropping systems.

Key words: Nutrient status, Land use system, Soil fertility

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Evaluation of Fertility Status of Soils under Agriculture Land Use System in Semi-arid Tropics of Karnataka

Mudalagiriyappa[1], Tejashvini, A.[2]*, Vanitha, T.[2], Subbarayappa, C.T.[2] and Rangani Mamatha[2]

[1]All India Coordinated Research Project for Dryland Agriculture, [2]Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, GKVK, Bangalore-560065, Karnataka
**Corresponding author: teju75ashwini@gmail.com*

A survey was conducted to assess the fertility status of soils under agriculture land use system in southern transect of Bangalore. The four representative soil samples were collected from ten locations and analyzed for soil physico-chemical properties viz., soil acidity, electrical conductivity, organic carbon content, available N, P_2O_5, K_2O, S, and micronutrient status. The results of the study indicated that about 15% of soils were neutral, 35% under acidic and 50% under alkaline in reaction. With respect to electrical conductivity of soil 65% of samples were low, 10% medium (critical for sensitive crops) and remaining 25% high (critical for tolerant crops) in soluble salts. About 30, 5, 65 per cent of samples were low, medium, and high in soil organic carbon. Regarding the major nutrients in agriculture land use soils, about 30, 35 and 10 per cent of samples were low and 70, 65 and 90 per cent samples were medium in available N, P_2O_5 and K_2O, respectively. The nutrient index of soils of southern transect remained medium (NI: 1.67 to 2.33) fertility with respect to pH (2.15), available nitrogen (1.70), potassium (1.90), sulphur (2.10), zinc (2.10), and boron (1.95) status. However, low (NI :< 1.67) nutrient index was noticed in EC (1.60) and available phosphorus (1.65). Whereas, the higher (NI: >2.33) nutrient index was with OC (2.35), available Fe (2.60), Mn (2.90) and Cu (2.85).

Key words: Soil fertility, Nutrient index, Agriculture land use

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Effect of Phosphorus Fertilization on *Aus* (*Oryza sativa* L.) Rice Landraces

B.C. Verma[1]*, S. Roy[1], P. Sar[1], Aiswarya V.S.[1,2], Firos T.M. Basha[1,2], R. Deo[3], D. Bhaduri[4], K. Chakraborty[4], U. Ngangkham[5], A. Banerjee[1], S. Saha[1], J. Kumar[1] and N.P. Mandal[1]

[1]Central Rainfed Upland Rice Research Station, ICAR-NRRI, Hazaribag-825302, Jharkhand
[2]ICAR-Indian Agricultural Research Institute, Jharkhand, Gauria Karma-825411, Jharkhand
[3]Birla Institute of Technology, Mesra, Ranchi-835215, Jharkhand
[4]ICAR-National Rice Research Institute, Cuttack-753006, Odisha
[5]ICAR Research Complex for NEH Region, Manipur Canter, Imphal-795004, Manipur
**Corresponding author: bibhash.ssac@gmail.com*

Phosphorus (P) is the second most important nutrient required for growth and development of crops. Among the cereals crop rice is an important crop which is grown across the world and important food for majority of the population. Limited availability of P in soil particularly in upland areas with acidic soils triggers to identify the suitable management options to increase the P use efficiency. Genetic improvement or approaches are one of the best options to select or develop new varieties which are more P efficient. There is need to screen the available landraces which are P efficient. With this, objectives 181 aus rice accessions along with four check varieties were evaluated for agronomical traits under P stress and P sufficient conditions for consecutive two years at our research farm. Data related to phenotypic characters (agronomic traits) were recorded under both the P conditions. Collected data were analyzed and ANOVA was performed to compare the variance. Results showed that phenotypic or agronomic traits recorded under low-P and high-P conditions were significantly ($P < 0.0001$) differ for plant height, tiller number, grain yield and total biomass. All the recorded traits showed a significant reduction under low P conditions. Based on grain yield, under high and low P the accessions are grouped into four different groups. On the basis of phenotypic traits, stress indices were also calculated and correlated with the yield at both the P conditions. PCA was performed with the yield data and stress indices to get idea of trait relationships for different accession. This information will be used further for knowing the presence of particular genes responsible for the differential behaviour under different P condition. It will be helpful to identify the more P efficient accession which can be used for the breeding programme for development of P efficient varieties.

Key words: Rice, Phosphorus, Phenotype, Agronomic traits

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Effects of Long-term Application of Organic Manure and Mineral Fertilizer on Soil Biological Properties in *Alfisols* of Karnataka

Vasanthi, B.G.[1], Mudalagiriyappa[1], Latha, H.S.[1], Roopashree, D.H.[1], Devaraja, K.[1], Tejashvini, A.[2] and Harish, M.C.[1]*

[1]All India Coordinated Research Project for Dryland Agriculture, [2]Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, GKVK, Bangalore-560065, Karnataka
**Corresponding author: harishmcharish97@gmail.com*

Long-term fertilizer inputs along with FYM and maize residue affect the biological properties of soil. A thirty-nine year, long-term fertilization experiment was conducted to explore how soil biological properties respond to different nutrient management under long term experimental site of AICRP for dryland Agriculture at UAS, GKVK, Bangalore under finger millet groundnut rotation using groundnut as test crop. The experiment was laid in Complete Randomized Block Design (RCBD) with eight treatment combinations of organic and inorganic fertilizers (T_1-Absolute control; T_2-FYM @10 t ha^{-1}; T_3-FYM @10 t ha^{-1} + 50% RDF; T_4-FYM @10 t ha^{-1} + 100% RDF; T_5-100% RDF; T_6-Maize residue @ 5 t ha^{-1}; T_7-Maize residue @ 5 t ha^{-1} + 50% RDF; T_8-Maize residue @ 5 t ha^{-1} + 100% RDF) replicated four times. The results of the experiment indicated that, among the different nutrient management practices, combined application of FYM @ 10 t ha^{-1} along with 100% RDF (T_4) recorded higher microbial biomass carbon (399.50 μg g^{-1}), microbial biomass nitrogen (45.94 μg g^{-1}), dehydrogenase activity (86.09 μg TPF g^{-1} $24h^{-1}$), acid phosphatase (μg PNF g^{-1} h^{-1}), followed by application of only organic manure FYM @ 10 t ha^{-1} which recorded 313.28 μg g^{-1}, 35.32 μg g^{-1}, 47.84 86.09 μg TPF g^{-1} $24h^{-1}$, & 48.44 μg PNF g^{-1} h^{-1} of MBC, MBN, DHA, acid phosphatase, respectively. However, application of only inorganic/ mineral fertilizers recorded lower biological properties than application of organic manures. Among different organic manures application of FYM recorded significantly higher microbial activity than application of maize residues. Thus, combined application of mineral fertilizer along with organic manure (INM) helped in enhancing the soil biological properties. The change in soil biological properties also proved the validity of integrated application and provided a better understanding of how long-term fertilization affects soil biological properties.

Key words: Long term fertilizer experiment, Biological properties, FYM, Maize residue

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Tillage and Crop Residue Management Effects on Productivity and Nutrient Status of Soil in Finger Millet-Pigeon pea Cropping Sequence in Semi-arid Agro-ecosystems

Mudalagiriyappa[1], Harish, M.C.[1], Vasanthi, B.G.[1], Latha, H.S.[1], Roopashree, D.H.[1], Devaraj, K.[1] and Tejashvini, A.[2]

[1]All India Coordinated Research Project for Dryland Agriculture, UAS, GKVK, Bengaluru
[2]Department of Soil Science and Agricultural Chemistry, College of Agriculture, UAS, GKVK, Bengaluru
**Corresponding author: harishmcharish97@gmail.com*

Conservation agriculture (CA) is considered as a sustainable practice with the potential to maintain or increase crop productivity and improve environmental quality and ecosystem services. It typically improves soil quality and water conservation. The impact of tillage and crop residue management on soil quality is well known, in the Pigeon pea+ Finger millet cropping system under dryland condition. The study tested three tillage levels: Conventional-tillage, reduced tillage and zero tillage and crop residue retention: Sun hemp and Horse gram. Tillage was the main factor to influence the productivity, economics and nutrient status of soil under the finger millet + pigeon pea cropping system in dryland condition. The conventional tillage increased the pigeon pea and finger millet yield (974 & 2486 kg ha^{-1}, respectively). B: C ratio of pigeon pea (2.05) and finger millet (3.06) was recorded maximum in reduced and zero tillage, respectively. Different tillage practices influenced nutrient status of soil with higher soil organic carbon (5.4 g kg^{-1}), available nitrogen (313.95 kg ha^{-1}), available phosphorus (113.45 kg ha^{-1}), and available potassium (197.73 kg ha^{-1}) in reduced tillage compared to conventional tillage and zero tillage. Among the cover crops grown significantly higher soil organic carbon (5.7 g kg^{-1}), available nitrogen (304.24 kg ha^{-1}), available phosphorus (113.12 kg ha^{-1}), and available potassium (200.71 kg ha^{-1}) was recorded in horse gram followed by sunhemp. This study revealed that conservation tillage with horse gram as cover crop improves soil quality and crop productivity in the Finger millet + Pigeon pea (8:2) cropping system under dry land condition.

Key words: Conservation agriculture, Tillage, Nutrient status, Crop productivity, Soil quality

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Influence of Different Sources and Levels of Zn Application in a *Vertisol* of Chhattisgarh

K. Bhargavi Roy[1]* and V.N. Mishra[2]

[1]*Division of Soil Science, IARI Mega University Hyderabad Hub, ICAR-CRIDA, Hyderabad-500059, Telangana*
[2]*Department of Soil Science and Agricultural Chemistry, Indira Gandhi Krishi Vishwavidyalaya, Raipur-492012, Chhattisgarh*
**Corresponding author: bhargaviroyk97@gmail.com*

Zinc is one of the most important micro-nutrient for the growth of rice in submerged condition. It is also required by crops for maximum potential yield, regular growth and reproduction. A field experiment was conducted at Instructional cum Research farm of Indira Gandhi Krishi Vishwavidyalaya, College of Agriculture, Raipur, with the objectives: a. to study the effect of zinc application on yield and yield attributes of Rajeshwari rice variety; b. to evaluate the nutrient uptake in relation to zinc application. The treatments consisted of three levels of Zn through mono and heptahydrated $ZnSO_4$ as a source of Zn and control. The experiment was laid out in a randomized block design (RBD) with three replication. All the soil parameters were determined and the results showed no significant difference between before and after the application of Zn fertilizer except for available Zn content in soil. There was a significant increase in yield parameters of rice due to application of zinc except for effective tillers per hill. The grain and straw yields significantly increased with different doses of Zn through mono and heptahydrated sources ($ZnSO_4.H_2O$, $ZnSO_4.7H_2O$) over control. N, P and Zn uptake increased significantly due to Zn application whereas K uptake did not have any effect by the Zn application. Due to higher solubility, diffusion and mobility of applied Zn and high fixation of zinc in clay soil, there was a significant increase in available zinc. The Zn fertilization also plays an important role in biosynthesis of the IAA and initiation of primordia for reproductive parts resulting in favorable effect of zinc on the metabolic reactions within the plants.

Key words: Mono and heptahydrated $ZnSO_4$, Rice, Vertisol, Nutrient uptake

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Response of Groundnut (*Arachis hypogaea*) to Fertilizer Levels and Liquid Biofertilizers

B. Pavan, K. Lakshman*, M. Sree Rekha, R. Naseeruddin and B. Sreekanth

Department of Agronomy, Agricultural College Bapatla, Acharya N.G. Ranga Agricultural University, Bapatla-522101, Andhra Pradesh
**Corresponding email: k.lakshman@angrau.ac.in*

A field experiment was carried out on sandy clay soil of Agricultural College Farm, Bapatla during *kharif*, 2019 to study the response of groundnut to fertilizer levels and liquid biofertilizers. The experiment was taken up with eleven treatments comprising control, 100% soil test based fertilizer recommendation (STBR), three levels of fertilizer (100%, 75% and 50%) applied on soil test basis, along with combination of conventional carrier based biofertilizers (Rhizobium & phosphorus solubilizing biofertilizer), liquid based bio-fertilizers (Rhizobium and PSB) and liquid NPK microbial biofertilizer consortia in randomized block design with three replications. From the results, it is found that more number of pods plant^{-1} (18.07), highest pod yield (2921 kg ha^{-1}) and haulm yield (3616 kg ha^{-1}) of groundnut was recorded with 100% soil test based fertilizer recommendation+liquid NPK microbial biofertilizer consortium and found on par with 75% STBR+biofertilizer application.

Key words: Carrier based biofertilizers, Microbial consortia, Liquid biofertilizers, Shelling percentage, Soil test based recommendation

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Effect of Magnetic Field on Growth Characteristics of Wheat

Swagata Das[1], Ananta Vashisth[1]*, P. Krishnan[1], Monika Kundu[1] and Shiv Prasad[2]

[1]Division of Agricultural Physics, [2]Division of Environment Science, ICAR-Indian Agricultural Research Institute, New Delhi- 110012
**Corresponding author: ananta.iari@gmail.com*

Modern agricultural science has long focused on the effects of external stimuli to boost seed germination and seedling vigour for uniform crop establishment. Expose of seeds to magnetic field is fascinating, safe, affordable and eco-friendly method for improving the seedling vigour. Among various crops, wheat is a crucial staple in the world's food production, which has led scientists to explore the potential effects of magnetic fields on the growth and productivity of this crop. Therefore, an experiment has been conducted at Indian agricultural research institute, New Delhi, for standardizing the static magnetic field and duration for maximum enhancement in germination characteristics of wheat seeds. The seeds were exposed to different magnetic fields of strength from 0 to 250 mT in steps of 50 mT for ½ hour and 1 hour in all the fields. Results indicate that magnetic field application enhanced the seed performance in terms of laboratory germination, speed of germination, seedling length, seedling dry weight and seedling vigour significantly compared to unexposed control. But the response varied with field strength and duration of exposure. Among the various treatments, exposures of 100 mT (1/2 hour) and 150 mT (1/2 hour) are found best. Seeds exposed to these two magnetic treatments have been sown in the field along with untreated control under three irrigation levels for further study. In field, these treated seeds are showing significantly increased seedling growth, leaf area index, biomass and root characteristics of one month old plants.

Key words: Magnetic, Wheat, Field, Modern agricultural

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Effect of Temperature on Biological Parameters of *C. carnea* (Stephens) under Laboratory Conditions

Rajareddy G., Jayanth, B.V., Shashikala, M., Udaykumar E. and Bishwajeet Paul*

Biological Control Laboratory, Division of Entomology,
ICAR-Indian Agricultural Research Institute, New Delhi-110 012
**Corresponding author: rajareddygundreddy422@gmail.com*

Among the predators, the green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae), is a crucial part of biological control in integrated pest management for vegetables and crops. It is present in almost every environment on Earth. Temperature is one of the most important environmental factors that influence the developmental rate of a particular insect species. Research was done in the lab to look at the biological factors of *Chrysoperla carnea* immature stages feeding on *Corcyra cephalonica* eggs at five constant temperatures: 20 ±1 °C, 25 ±1 °C, 30 ±1 °C, 35 ±1 °C, and 40 ±1 °C. The incubation duration was 7.19, 5.95, 4.67, 4.08, and 3.45 days at each of the five temperatures, according to the data. During five different temperatures, the first instar took 7.67, 6.97, 5.61, 4.54, and 3.94 days to form; the second took 7.35, 6.66, 4.14, and 3.68 days; and the third took 8.63, 7.23, 5.58, 4.86, and 4.59 days. At five different temperatures, the larval developmental time was recorded as 22.48, 19.63, 13.54, 12.11, and 11.21 days, while the pupal duration was recorded as 20.22, 15.36, 11.26, 9.41, and 8.13 days. The overall lifetime of males was 56.25, 45.32, 30.14, 20.34, 16.78, and females was 80.83, 70.92, 55.63, 41.45, and 31.67 days at the corresponding temperatures. The biological cycles of immature stages were 47.26, 39.05, 28.48, 24.64, and 22.18 days, respectively. The findings show that there were substantial differences in the immature stages developmental cycle at five different temperatures and that the developmental cycle dramatically shortened as the temperature increases.

Key words: Green lacewing, Biological parameters, Temperature

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Enhanced Sorghum Area Estimation Through Integrating Multi-temporal SAR Data for Agricultural Monitoring

Chandrakant Raj H.[1]*, K. Boomiraj[2], S. Pazhanivelan[3], N.K. Sathya Moorthy[4] and M. Prasanthrajan[5]

[1]Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]Department of Environmental Science, [3]Centre for Water and Geospatial Studies, [4]Agro Climate Research Centre, [5]Centre for Agricultural Nanotechnology, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: chandrakantraj98@gmail.com*

In the backdrop of India's robust agricultural and aerospace research infrastructure, this summary introduces an exploration into the collaborative integration of Synthetic Aperture Radar (SAR) data and Map-scape technology. This combination establishes a robust framework for intricately assessing rabi- sorghum cultivation at a detailed level, surpassing the constraints of conventional mapping methodologies. Furthermore, this integration might pave pathway for technological applications within the insurance sector. Concentrating on domains such as loss assessment and product design. The research involved the acquisition of twin satellite SAR data at approximately 12-day intervals, subjected to a series of pre-processing steps to generate temporal images. District and block-level statistics were generated from the extracted sorghum area using Sentinel-1A microwave data estimating the sorghum cultivation area at approximately 50,482 hectares. A dataset comprising around 150 sorghum and 100 non-sorghum data points was collected for analysis. To validate the mapped area, a confusion matrix was implemented, resulting in an accuracy of 89.9% for sorghum and 83.3% for non-sorghum. The overall accuracy was determined to be 88.7%, with a kappa coefficient of 0.74.

Key words: SAR data, microwave, Data-set, Accuracy-kappa coefficient

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Perception of Extension Personnel and Constraints in Adoption of Technologies by Farmers from State Dept. of Agriculture, NGO and Private Extension Agency in Anantapuramu District of Andhra Pradesh

K. Ravi Shankar*, G. Nirmala, K. Nagasree, P.K. Pankaj, C.N. Anshida Beevi, Jagriti Rohit, C.A. Rama Rao, B.M.K. Raju and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: kr.shankar@icar.gov.in*

The major objective of the study is to ascertain the perception of farmers about extension personnel from private extension agency, Non-government organization and state department of agriculture (SDA) viz., Coromandel Fertilizers Limited (CFL), Watershed Support Services and Activities Network (WASSAN) and SDA respectively from Anantapuramu district of Andhra Pradesh. In Anantapuramu, Nallacheruvu (WASSAN), Bukkarayasamudram (CFL) and Atmakur (SDA) mandals were selected for the study. Care was taken in selecting the mandals (along with villages and respondent farmers) that were mutually exclusive to avoid overlapping of data from each agency i.e., Nallacheruvu was selected to collect data from WASSAN, Bukkarayasamudram for CFL and Atmakur for data from SDA. A sample of 40 farmers from each agency were selected randomly for the study. The data was collected using a pre-tested interview schedule and focus group discussion from the farmers belonging to each agency. Frequency, percent analysis, means, standard deviation etc. were employed for data analysis. Conclusions were drawn based on the interpretation of results. The main crops in the study villages are ground nut, red gram, paddy, banana, tomato and other vegetables. Farmers major perception about extension personnel was advisor + input provider at 40% for CFL sample; facilitator + input provider at 57.5% for SDA, while it was facilitator + advisor + equal partners in research for WASSAN at 100%. Major constraints in adoption of technologies for CFL, WASSAN and SDA farmers are technical (like watershed management, illiteracy, less know-how on crops, less awareness of soil and water conservation measures) at 100% each respectively.

Key words: Farmer, Extension, NGO, Andhra Pradesh

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Nano-solutions for Global Warming: Unveiling the Role of Nanotechnology and Green Innovation

Tatiparthi Praisy* and P. Sandhya Rani

S.V. Agricultural College, ANGRAU, Tirupati-517502, Andhra Pradesh
**Corresponding author: praisytatiparthi@gmail.com*

Nanotechnology offers promising benefits in addressing the challenges of global warming and climate change through the unique properties of nanoparticles. Comprising core, shell, and surface layers, nanoparticles may contain various molecules such as polymers, surfactants, and metal ions, or a combination of materials. The size of nanoparticles, smaller than 50 nm, influences their properties, leading to phenomena like super para-magnetism, quantum confinement, and surface plasmon resonance. For instance, copper nanoparticles exhibit super hardness distinct from bulk copper's characteristics. Research indicates that nanoparticles enhance solar radiation absorption in photovoltaic cells compared to thin films, contributing to the reduction of global warming. A critical factor in global warming is the excessive reliance on fossil fuels, resulting in elevated levels of greenhouse gases, particularly CO_2. The combustion of fossil fuels, such as coal, gas, and oil, significantly contributes to increased atmospheric CO_2 levels, currently at 387ppm. This poses severe threats to the ozone layer, human health, and the environment, necessitating urgent global attention. Addressing global warming involves improving technology efficiency, reducing energy consumption, transitioning to renewable energy, and managing carbon emissions. Nanotechnology plays a crucial role in enhancing current technologies' efficiency. The emerging concept of green nanotechnology focuses on developing clean technologies using nano-products and nano-manufacturing to mitigate potential health and environmental risks. Green nanotechnology aims to create nano-materials that address environmental issues while ensuring engineered nano-materials have no adverse effects on human health or the environment. Principles of green engineering and chemistry guide the production of non-toxic nano-materials using renewable resources and minimizing energy consumption. Lifecycle thinking is incorporated into the production process to consider the environmental impact of nano-manufacturing. In summary, nanotechnology, particularly green nanotechnology, offers innovative solutions to combat global warming by enhancing energy efficiency, reducing reliance on fossil fuels, and developing environmentally friendly nano-materials and technologies.

Key words: Nano, Global warming, Green innovation

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A Soil-Centric Approach: Conservation Agriculture's Influence on Soil Health Indicators in Maize-Mustard Cropping Systems on Inceptisols

A. Jaya Kishore Kumar Reddy*, Shrila Das, R. Bhattacharyya and Prem Kumar B.

ICAR-Central Research Institute for Dryland Agricultural Research Institute, Hyderabad- 500059, Telangana
**Corresponding author: jayakishore1436@gmail.com*

Soil Organic Carbon (SOC) serves as a crucial indicator of soil health. SOC enhances nutrient availability, soil structure, and water retention, fostering a healthy environment for plant growth. It fuels microbial activity, stabilizes pH, and contributes to carbon sequestration, collectively influencing soil health and productivity. To assess the impact of conservation agriculture on organic carbon pools and carbon cycling enzymes, a study was conducted to analyse the impact of conservation agriculture (CA) in a maize (MZ)-mustard(M) system on soil organic carbon pools and carbon cycling enzymes within soil aggregates, specifically focusing on Inceptisols in the upper Indo-Gangetic plains. For this, soil samples were collected after maize harvest from the on-going conservation field experiment started from 2010-11 at ICAR-IARI, Pusa, New Delhi, comprising of the following treatments T1: Zero Tillage (ZT) ZTMZ-ZTM; T2: ZTMZ(+R)-ZTM(+R); T3: ZTMZ(+R)+BM-ZTM(+R); T4: ZTMZ-ZTM-ZTSMB; T5: ZTMZ(+R)- ZTM(+R)-ZTSMB(+R); T6: Convectional Tillage (CT)CTMZ-ZTM; T7: CTMZ-CTM. The highest Total Carbon (TC) was recorded in the T5 treatment, which was on par with T4 and 11.68% higher than the T7 treatment at the 0–5 cm soil layer. Total organic carbon (TOC) showed similar results as that of TC, where T5 treatment had 13.15 and 13.35% higher TOC over the T7 at 0-5 and 5-15 cm depths, respectively. Similarly, ZT treatments with and without residue retention (R) had higher proportion of labile carbon pools in bulk soil as well as aggregates (macro and micro-aggregates) than T7 treatments at both depths. ZT (R) treatments recorded high dehydrogenase and â-glucosidase activities in bulk soil as well as in aggregates. These Conservation practices demonstrate potential for enhancing soil health and productivity, and its positive impact on soil organic carbon by enhancing its preservation through reduced soil disturbance and increased organic inputs.

Key words: Soil organic carbon, Conservation agriculture, Carbon cycling enzymes, Cropping system, Maize-mustard, Inceptisols

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Influence of Seaweed Extract on Performance of Soybean

Yuktha D.U.[1] and J.A. Hosmath[2]

Department of Agronomy, College of Agriculture,
University of Agricultural Sciences, Dharwad-580005, Karnataka
**Email: yukthadu55@gmail.com; hosmathja@uasd.in*

Seaweed extract is referred as a new generation potential natural organic product that paves the way for crop improvement. In this regard an experiment was conducted during *Kharif*- 2022 laid out in RCBD, replicated thrice with nine treatments on *Vertisol* in order to evaluate the efficiency of seaweed extract (*Ascophyllum nodosum*) on growth, yield attributes and economics of soybean (*Glycine max* (L.) Merrill) at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka. The treatments comprising of T_1- Seaweed extract @ 250 ml ha^{-1}, T_2- Seaweed extract @ 500 ml ha^{-1}, T_3- Seaweed extract @ 750 ml ha^{-1}, T_4- without seaweed extract (T_1-T_4 received 75% RDF, T_1-T_3 foliar application of extract at flower initiation and pod formation stage), T_5- Seaweed extract @ 250 ml ha^{-1}, T_6- Seaweed extract @ 500 ml ha^{-1} and T_7- Seaweed extract @ 750 ml ha^{-1} at flower initiation and pod formation stage respectively, T_8- without seaweed extract (T_5-T_8 received 100% RDF) and T_9- RPP (100% RDF + Urea @ 2% and KNO_3 @ 1% spray). The results revealed that, significantly higher plant height (45.7 cm), number of branches $plant^{-1}$ (6.09), dry matter accumulation (15.47 g $plant^{-1}$), number of pods $plants^{-1}$ (35.67), seed yield $plant^{-1}$ (6.64 g), grain yield (2169 kg ha^{-1}), net return (¹ 92952 ha^{-1}) and B:C (3.07) ratio were recorded with the soil application of 100% RDF + foliar application of seaweed extract @ 750ml ha^{-1} twice on 20 and 40 DAS. The presence of micro and macro nutrients, trace elements, humic acid, amino acids, plant growth hormones, vitamins, antibiotics, carbohydrates, metabolite enhancers and other organic matters in seaweed extract enhanced the growth, yield and economics traits of soybean.

Key words: Seaweed, New generation, Soybean, Karnataka

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Enhancing Growth and Yield of *Rabi* Sorghum (*Sorghum bicolor* L. Moench) through Nano-DAP Foliar Application

Girish R. Satannavar[1]* and Bandiwaddar T.T.[2]

Department of Agronomy, College of Agriculture,
University of Agricultural Sciences, Dharwad-580005, Karnataka
**Corresponding author: girishsatannavar111@gmail.com*

A field study was undertaken during *Rabi* season of 2022-23 to know the impact of Nano-DAP foliar application on the growth and yield of *rabi* sorghum (*Sorghum bicolor* L. Moench) at AICRP on Sorghum, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The experiment was laid out in split-plot design with three replications, consisting of two main plots (Fertilizer levels), six subplots (Foliar nutrition) and a control (only RDF). The study revealed that among fertilizer levels, application of 100% RDF recorded significantly higher plant height (201.70 cm), panicle length (17.56 cm), grain weight panicle^{-1} (78.7 g), grain yield (36.34 q ha^{-1}), stover yield (8.98 t ha^{-1}), total nutrient uptake (N-111.62, P-33.69, K-103.91 kg ha^{-1}), net returns (₹ 88640 ha^{-1}) and B-C ratio (3.03) over 75% RDF. Among foliar nutrition, foliar spray of Nano-DAP @ 2 ml l^{-1} at PI (Panicle Initiation) and FL (Flag Leaf) stages recorded significantly higher plant height (202.15 cm), grain weight panicle^{-1} (77.3 g), grain yield (37.16 q ha^{-1}), stover yield (9.20 t ha^{-1}), total nutrient uptake (N-111.25, P-33.65, K-103.09 kg ha^{-1}), net returns (₹ 89777 ha^{-1}) and B-C ratio (3.01) compared to other foliar sprays. Among interaction, application of 100% RDF + foliar spray of Nano-DAP @ 2 ml l^{-1} at PI and FL stages recorded significantly higher plant height (207.43 cm), grain weight panicle^{-1} (86.25 g), grain yield (39.56 q ha^{-1}), stover yield (9.94 t ha^{-1}), total nutrient uptake (N-116.23, P-36.74, K-107.06 kg ha^{-1}), net returns (₹ 98650 ha^{-1}) and B-C ratio (3.15) compared to other treatments. Thus, foliar application of Nano-DAP @ 2 ml l^{-1} at panicle initiation and flag leaf stages along with RDF can be recommended to obtain higher yield and profit in *rabi* sorghum than with RDF alone.

Key words: Sorghum, Growth, Nano-DAP, Application

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Quantification of Greenhouse Gas Emissions from Managed Biofuel Plantations in a Semi Arid Landscape

G.R. Rao* and P. Sathi Reddy

ICAR-Central Research Institute of Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: grrcrida@gmail.com*

Jatropha curcas L. and *Pongamia pinnata* (L.) Pierre, are promising biofuel species in peninsular India. We quantified greenhouse gas fluxes from managed 9-year-old plantations of these species for all seasons in three consecutive years (2012-2013, 2013-2014 and 2014-2015) using manually-operated closed chamber method. CH_4, N_2O and CO_2 were analysed by using Varian 450-GC based on Gas Chromatography. The mean soil CO_2, CH_4, and N_2O emissions in the Jatropha curcas plantation recorded were 7.720 t ha^{-1} y^{-1}, 0.023 t ha^{-1} y^{-1} and 0.017 t ha^{-1} y^{-1}, respectively. While in Pongamia pinnata soil CO_2, CH_4, and N_2O emissions were recorded to be 7.633 t ha^{-1} y^{-1}, 0.008 t ha^{-1} y^{-1} and 0.019 t ha^{-1} y^{-1}, respectively. Our results indicate that Jatropha curcas has higher GHG emissions than Pongamia pinnata. A pronounced seasonal variability was observed in CH_4, N_2O and CO_2 flux rates. The highest emissions for Jatropha curcas occur during rainy season, whereas for Pongamia pinnata it occurs during winter. Soil moisture and temperature being the most influencing factors for CO_2 fluxes from soil. We conclude that these plantations have an effect on soil-atmosphere GHG exchanges and can act as a good source of mitigation of greenhouse gases.

Key words: Climate mitigation, Greenhouse gases

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Analysis of Extreme Weather Events for Pune, Satara, Sangli, Kolhapur and Solapur districts of Western Maharashtra using RCLIMDEX model

V.M. Londhe[1]*, P.Y. Durgawale[2], V.T. Jadhav[3], S.V. Khadtare[1], N.J. Ranshur[4] and V.A. Sthool[5]

[1]All India Coordinated Research Project on Agrometeorology, Zonal Agriculture Research Station, Solapur-413002, Maharashtra
[2]Department of Agrometeorology, [3]Department of Agronomy, [5]Department of Agrometeorology, College of Agriculture, Pune-411005, Maharashtra
[4]Director of Research, Zonal Agriculture Research Station, Solapur-413002, Maharashtra
**Corresponding author: slp.aicrpam@gmail.com*

The study was carried out at Department of Agricultural Meteorology, College of Agriculture, Pune during 2021-2023 on topic entitled, "Analysis of extreme weather events of Western Maharashtra using RclimDex model". The objective of the experiment was to estimate the temperature and precipitation-based extreme indices of five districts viz. Pune, Satara, Sangli, Kolhapur and Solapur districts of Western Maharashtra. The required data was collected from India Meteorological Department's official website (IMD, Pune). The 27 core indices were studied based on daily temperature and daily precipitation amount. The extreme temperature and precipitation-based indices were calculated by using RClimDex model (Zhang and Yang, 2004). Tropical nights (days) (TR23) and Warm nights (days) (TN90p) were found significantly increasing trends in all the districts *viz*., Pune, Satara, Sangli, Kolhapur and Solapur districts over the period of 1982-2022. Similarly Maximum Tmin (°C) (TNx) was observed with a significantly increasing trend in the Satara, Sangli, and Kolhapur districts over the studied period. Cool nights (days) (TN10p) and Diurnal Temperature Range (DTR) were found to be significantly decreasing trend in all the districts *viz*., Pune, Satara, Sangli, Kolhapur and Solapur districts throughout 1982-2022. Similarly, Cold days (days) (FD15) and Cold spell duration indicator (days) (CSDI) were also found significantly decreasing trends in all the districts except Solapur district. Maximum Tmax (°C) (TXx) was observed with a significantly decreasing trend in Kolhapur and Solapur district and it was found non-significantly decreasing trend in rest of the districts. In case of precipitation indices studied Consecutive wet days (days) (CWD), Very wet days (days) (R95p), Extremely wet days (days) (R99p) and Annual total wet days precipitation (mm) (PRCPTOT) were found to be significantly increasing trend in all the districts except Solapur over the period of 1982-2022. Number of heavy precipitation days (days) (R10) was significantly increasing in Pune, Satara and Sangli districts whereas Number of heavy

precipitation days (days) (R20) was observed to be increasing trend in Pune and Satara districts. Where rest of the districts shows non-significant increasing trend. Simple daily intensity index (mm/day) (SDII) was observed with increasing trend in Pune and Satara districts. However, non-significant decrease was observed in Solapur district. Consecutive dry days (days) (CDD) were found to be in non-significantly increasing trend in all the districts *viz*., Pune, Satara, Sangli Kolhapur and Solapur districts over the period of 1982-2022.

Key words: Extreme, Weather events, RclimDex model, Cold, Hot, Days night, Temperature, Precipitation, Pune, Satara, Sangli, Solapur, Kolhapur

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Analysis of Extreme Weather Events for Dhule, Nandurbar, Jalgaon, Nashik and Ahmednagar Districts of Western Maharashtra using RCLIMDEX Model

S.V. Khadtare[1]*, R.S. Landge[2], V.M. Londhe[1], V.T. Jadhav[3], N.J. Ranshur[4], S.V. Bagade[2] and V.A. Sthool[2]

[1]All India Coordinated Research Project on Agrometeorology, Zonal Agriculture Research Station, Solapur-413002, Maharashtra
[2]Department of Agrometeorology, [3]Department of Agronomy, College of Agriculture, Pune-411005, Maharashtra
[4]Director of Research, Zonal Agriculture Research Station, Solapur-413002, Maharashtra
**Corresponding author: slp.aicrpam@gmail.com*

The study was carried out at the Department of Agricultural Meteorology, College of Agriculture, Pune during 2021-2023 on topic entitled, "Extreme Weather Events Analysis of Northern Maharashtra by using Rclimdex Model". The objective of the experiment was to estimate the temperature and precipitation-based extreme indices of five districts viz. Dhule, Nandurbar, Jalgaon, Nashik and Ahmednagar districts of Western Maharashtra. The required data was collected from India Meteorological Department's official website (IMD, Pune). The 27 core indices were studied based on daily temperature and daily precipitation amount. The extreme temperature and precipitation based indices were calculated by using RClimDex model (Zhang and Yang, 2004). The temperature indicators like Tropical nights (TR20), warm nights (TN90p) and TMIN mean were found significantly increasing trend in all the five districts viz., Dhule, Nandurbar, Jalgaon, Nashik and Ahmednagar over the period of 1982-2022. Similar trend was observed in case of temperature indices like Tropical nights (TR25) and Cool days (TX10p) in all the districts expect Nashik district where it was shown non-significant increasing trend. In case of summer days (SU40) two districts i.e. Jalgaon and Ahmednagar was found significantly increasing trend. Cool nights (TN10p), Cold spell duration indicator (CSDI), Diurnal Temperature Range (DTR) and TMAX mean were observed to be decreasing trend in all five districts Dhule, Nandurbar, Jalgaon, Nashik and Ahmednagar from 1982 to 2022. Warm nights(TX90p) and Warm spell duration indicator(WSDI) found to be significantly decreasing trend in all the districts except Nashik district over the period of 1982-2022.The five precipitation indices out of eleven showed Significantly increasing trend in case of Simple daily intensity index (SDII), Number of heavy precipitation days (R10), Number of very heavy precipitation days (R20), Very wet days (R95p) and Annual total wet-day precipitation

(PRCPTOT) in all the five district i.e. Dhule, Nandurbar, Jalgaon, Nashik and Ahmednagar districts of western Maharashtra over the period of 1982-2022. Consecutive dry days (CDD) was observed to be significantly decreasing in Ahmednagr district over the period of 1982-2022. Max 5-day precipitation amount (Rx5day) were found significantly increasing trend in Dhule, Nandurbar and Nashik district.

Key words: Extreme, Weather events, RclimDex model, Cold, Hot, Days, Night, Temperature, Precipitation, Dhule, Nandurbar, Jalgaon, Nashik and Ahmednagar

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Time Dependent Release and Kinetics of Nitrogen from Organic Sources in Ultisol

Lumbini Kalita[1]* and N.J. Singh[2]

[1]Department of Soil Science, Assam Agricultural University, Jorhat-785013, Assam
[2]School of Natural Resource Management, CPGS-AS, CAU-Imphal, Umiam-793103, Meghalaya
**Corresponding author: lumbini_k27@yahoo.com*

Tribal communities rely on age-old traditional farming methods, utilizing locally available organic inputs such as farmyard manure (FYM) (T_1), poultry manure(T_2), pig manure(T_3) and vermicompost(T_4) as alternatives for organic farming in their region. To ensure a timely nitrogen supply to crops and to better synchronise active crop growth period with maximum nitrogen release from organic sources, a 100-days long incubation study was conducted at 10 days intervals. The study revealed that nitrogen mineralization commences early in the incubation process. Pig manure exhibited the highest nitrate nitrogen levels (144.74% at 40 Days After Incubation), followed by poultry manure (113.44% at 40 Days After Incubation), vermicompost (83.48% at 40 Days After Incubation), and farmyard manure (74.91% at 50 Days After Incubation).The control group, without organic sources, showed the lowest nitrogen mineralization. Examining ammonical nitrogen, pig manure displayed the highest amount (77.06% at 60 Days After Incubation), followed by poultry manure (70.64% at 60 Days After Incubation), vermicompost (51.37% at 60 Days After Incubation), and farmyard manure (38.52% at 60 Days After Incubation). Nitrogen release kinetics, analyzed through first-order and second-order models, indicated that the first-order kinetics model best predicted nitrogen mineralization rates at different time points (R^2=0.8-0.9). Furthermore, the incorporation of organic sources led to increased soil pH, electrical conductivity, and cation exchange capacity compared to the control in Ultisol.

Key words: Nitrogen mineralisation, Organic sources, Ultisol

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Productivity and Sustainability of Maize and Pigeonpea Intercropping System under *in-situ* Moisture Conservation Technologies

G. Pratibha*, I. Srinivas, K.V. Rao, Rodda Chandana Devi, V. Soujanya and Shivakumar Anna

ICAR-Central Research Institute of Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: g.pratibha@icar.gov.in*

Productivity of maize + pigeonpea cropping systems is dependent on competitive and interactive effects on resource availability. Controlling these interactions may increase the productivity associated with optimized crop yields. For getting a sustainable crop production under rainfed condition, the conservation of rain water and its efficient recycling are imperative. The aim of the study was to comprehensively assess the changes in yield and sustainable production maize and pigeonpea monoculture transition to intercropping system under *in-situ* moisture conservation technologies. A field study was conducted at ICAR-Central Research Institute of Dryland Agriculture during *Kharif*, 2022-23 in split plot experimental design with moisture conservation technologies (flat bed sowing, flat bed with conservation furrow (CF), raised bed with CF and paired row with CF) in main plots and nitrogen levels in sub plots (control, 75 % RDN, 100% RDN and 125 % RDN). The results indicated that highest moisture was conserved with the *in-situ* moisture conservation technologies *viz.,* flat bed with CF, raised bed with CF and paired row with CF compared to flatbed sowing. Among different moisture conservation practices pigeon pea equivalent yields were higher in maize + pigeonpea intercropping system as compared to no moisture conservation practices. The higher system productivity was recorded in maize + pigeonpea intercropping indicating that the cropping system is more sustainable than the sole crops. The intercropping system with in situ moisture conservation were more climate resilient as compared to sole crops.

Key words: Maize, Pigeonpea, Moisture, Productivity

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Analysis of Length of Growing Period (LGP) for Efficient Crop Planning and Water Management in the Southern District of Theni

Krithika P.A.* and Ga Dheebakaran

Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: krithi28kritz@gmail.com*

A study is conducted to analyse the seasonal crop planning and water management in the Southern district of Theni by computing LGP i.e Length of growing period. The Length of growing period typically refers to the number of days in a year when the environmental conditions are suitable for the growth of crops and that the crop gets sufficient moisture for its growth continuously without any interruption. Jeevanandha reddy method is used to calculate the "Length of growing period" by using the meteorological data of weather parameters rainfall and Potential evapotranspiration for the years 2014- 2020. Weekly Rainfall and Weekly Potential evapotranspiration is used to calculate the length of growing season, period of moisture availability, wet period, dry period. This method of computing LPG takes into account the rainfall and PET, that method is highly useful to harvest the best from the available climate. The computed LGP aids to select the suitable cropping pattern for a particular area in additional to selection of best agro techniques for the identified LGP. Meteorological parameters of Rainfall, Maximum and Minimum temperature are collected for Theni district for the years of 2014-2020 and are used to calculate the weekly Rainfall and weekly Potential Evapotranspiration. The analysis revealed that the effective growing period for each year starts around 35th to 40th meteorological week and Theni has a distinct wet and dry season and suitable agricultural practices can be adopted to improve the production and productivity of crops in the region.

Key words: Length of growing period, Crop planning, Effective growing period, Rainfall, Potential evapotranspiration

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Comparative study of Rainfall Prediction using Artificial Neural Network and Machine Learning Algrithms over Coimbatore Region

Oviya K.*, Maragatham N. and Ravikumar R.

Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: oviyakandasamy1406@gmail.com*

Rainfall forecasting plays an important role in catchment management applications, the flood warning system being one of them. Rainfall forecasting is one of the most difficult tasks given the variability of space, time and other given conditions change rapidly. Over the years, with the evolution of the intelligent computing methods, many rainfall prediction methods have been proposed, Artificial Neural Network being one of the most prominent. Since the last decade, many researchers have proposed different artificial neural network models in order to create accurate rainfall prediction models. In this paper, different artificial neural networks have been created for the rainfall prediction of Coimbatore, southern region in India. These ANN models were created like multilayer perceptron algorithm. The number of neurons for all the models was kept at 20. ANN model was compared with Machine Learning Algorithm namely Random tree forest regressor .The mean squared error was measured for each model and the best accuracy was obtained by feed-forward distributed multilayer perceptron algorithm with MSE value as low as .0083.

Key words: Rainfall prediction, Coimbatore, Artificial neural network, Random tree forest, Machine learning, Multilayer perceptron algorithm

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Effect of different *Kharif* Paddy Straw Management Options on Nitrogen Requirement to *Rabi* Rice

Navya K.[1]*, Uma Reddy R.[1], Krishna Chaitanya A.[1] and Suneetha Devi K.B.[2]

[1]Department of Soil Science and Agricultural Chemistry, [2]Department of Agronomy, Agricultural College, Professor Jayashankar Telangana State Agricultural University, Polasa, Jagtial-505529, Telangana
**Corresponding author: navyakaringula49@gmail.com*

An experiment was conducted on "Effect of different *kharif* paddy straw management options on nitrogen requirement to *rabi* rice" during rabi, 2020-21 at Regional Agricultural Research Station, Polasa, Jagtial, Professor Jayashankar Telangnana State Agricultural University. The experiment was laid out in randomized block design with factorial concept (FRBD) with three replications. Three paddy straw management options viz., paddy straw burning, paddy straw incorporation without phosphorous and paddy straw incorporation with phosphorous and four nitrogen levels viz., 100% RDN, 110% RDN, 115% RDN and 120% RDN were adopted, thus a total of 12 treatments were imposed. The soil of the experimental site is sandy clay loam, which is medium in organic carbon (0.54%), low in soil available nitrogen 157.6 kg ha^{-1}, high in soil available phosphorus (31.05kg ha^{-1}) and potassium (309.5kg ha^{-1}). The recommended dose of fertilizer was 150:60:40 kg N, P_2O_5, K_2O ha^{-1}. *Kharif* paddy was harvested manually and incorporated after *insitu* in *rabi* rice. In burning plot straw was uniformly spread and burnt, immediately burning the plot were flooded. 5.5 t ha^{-1} paddy straw was incorporated 10 day before transplanting and the nitrogen excess of RDN was applied at basal. The results of the investigation reported that incorporation of paddy straw whose C:N ratio was 71:1 resulted in immobilization of soil mineral nitrogen. About 7.2, 9.3 and 7.03 kg ha^{-1} of available nitrogen was immobilized during 7, 15 and 30 DAT, respectively in paddy straw incorporation without phosphorus, whereas in case of paddy straw incorporation with phosphorus treatment, about 10.94, 14.75 and 11.04 kg ha^{-1} of available nitrogen was immobilized during day 7, 15 and 30 DAT, respectively. Significantly higher soil available nitrogen of 169.7, 161.2 and 151.9 kg ha^{-1} was observed under paddy straw incorporation with phosphorus, incorporation without phosphorus and paddy straw burning respectively. Graded levels of nitrogen application influenced soil available nitrogen. From the above results it was recommended to incorporate the paddy straw into the soil along with phosphorus fertilizer @ 60 kg ha^{-1} and application of 15% excess of RDN *i.e.,* application of 172.5 kg ha^{-1} with excess of RDN at basal for overcoming the immobilization effect and to get maximum crop yield.

Key words: Paddy straw, Incorporation, Burning

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Profitability, Productivity and Nutrient use Efficiency of Double Zero Indian Mustard (*Brassica juncea* L.*)* as Influenced by different Nutrients

Gajjela Indira[1]* and R.B. Yadav[2]

**Corresponding author: indiragajjela@gmail.com*

A field experiment entitled "Profitability, productivity and nutrient use efficiency of Double Zero Indian mustard (*Brassica juncea* L.*)* as influenced by different nutrients" was conducted at Crop Research Centre, SVPUAT, Modipuram, Meerut. The experiment comprised of 12 treatments of various nutrient combinations and were tested in Randomised Block Design. The treatments comprised of Control (T_1), 100% N (T_2), 100% NP (T_3), 100% NPK (T_4), 125%NPK (T_5), 100% NPK+ S@40kg ha^{-1} (T_6), 100%NPK+ Zn@5kg ha^{-1} (T_7), 100%NPK + B@1kg ha^{-1} (T_8), 75% NPK+ VC@ 2t ha^{-1} (T_9), 75%NPK+FYM@ 6t ha^{-1} (T_{10}), 75%NPK + VC@ 2t ha^{-1}+ Azotobacter (T_{11}) and 75% NPK + FYM@6t ha^{-1} + Azotobacter (T_{12}). Indian mustard cultivar Pusa Mustard 31(PDZM -31) was grown during winter (*rabi*) season of 2020-21 to compare the production potential & economic viability under different nutrient management practices. Results revealed that treatment T_{11} and T_{12} exhibited significant influence on the growth, yield attributes and yields of mustard as compared to the application of 100% NPK alone. Significant improvement in growth parameters, yield attributes and yields was recorded with the application of T_{11} and T_{12}. Application of 75% NPK + FYM@6t ha^{-1} + Azotobacter (T_{12}) and 75%NPK + VC@ 2t ha^{-1}+ Azotobacter (T_{11}) recorded higher gross return and net return but the B:C ratio was lower due to higher cost of vermicompost. It can be concluded that to obtain higher seed yield of Indian mustard *cv.* Pusa Mustard 31 and sustain soil health, the application of 75% NPK + FYM@ 6t ha^{-1} + Azotobacter will be most beneficial followed by 75%NPK + VC@ 2t ha^{-1}+ Azotobacter and 100% NPK+ S@40kg ha^{-1}.

Key words: Productivity, Soil health, Double zero Indian mustard, Nutrient management

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Machine Learning-based Crop Yield Prediction using Remotely Sensed Data for Wheat in Madhya Pradesh

Hemant R. Salunkhe, Varun Pandey, Karun Kumar Choudhary and V.M. Chowdhary

**Corresponding author: hemantrs105@gmail.com*

Agricultural productivity is crucial for ensuring food security, and accurate crop yield prediction is pivotal for informed decision-making at various administrative levels. This research presents a comprehensive study focused on wheat crop yield prediction in 3 central districts of Madhya Pradesh (Vidisha, Ashoknagar and Guna) for *rabi* 2022 season, leveraging machine learning techniques and remotely sensed data. To achieve accurate predictions, a dataset spanning the years 2018 to 2021 was compiled, including various spectral vegetation indices, biophysical, edaphic, and meteorological variables. The dataset included a wheat crop map generated using spectral indices (NDVI, LSWI) and SAR backscatter VH and VV polarization. Additionally, biophysical parameters like FAPAR, edaphic factors such as root zone soil moisture, and meteorological data, including temperature and rainfall, were extracted at the halka administrative level. Crop phenology phases were derived from NDVI data, and crop growth phase-specific features were extracted. A comparative ML approach was employed, to compare the efficacy of the Random Forest (RF) and Linear Regression (LR) algorithms. The integration of crop-specific statistics and phenological information based feature engineering allowed for an improved understanding of the factors influencing wheat crop yields and enhanced model predictive capabilities. Training and testing data was split for validating accuracy in 80:20 ratio. For RF, hyper parameters like n_estimators (number of trees), max_depth (maximum number of levels in each decision tree), maximum features considered for each tree were optimized at 200, 20 and 2, respectively. The predicted wheat yield data demonstrated significant agreement with CCE yield data, indicating the efficacy of both the ML algorithms. RF model (RMSE=644 kg/ha, R^2=0.61) performed better than the LR model (RMSE=758 kg/ha, R^2=0.52). Thus, these algorithms demonstrate potential as reliable tools for crop yield forecasting, scalable to other areas through alternative ML algorithms, facilitating informed agricultural planning and resource allocation. This research intersects remote sensing, machine learning, and agriculture, providing a valuable methodology for predicting wheat crop yields in Madhya Pradesh. The findings emphasize the approach's potential to enhance decision-making processes for farmers, policymakers, and stakeholders, improving regional agricultural outcomes.

Key words: Machine learning, Crop, Wheat, Madhya Pradesh

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Estimation of Soil Moisture Content using Laboratory Spectral Data

Rajeev Ranjan[1]*, Rabi N. Sahoo[1], Nishant K. Sinha[2] and Rejith R.G.[1]

[1]ICAR-Indian Agricultural Research Institute, New Delhi-110012
[2]ICAR-Indian Institute of Soil Science, Bhopal-462038, Madhya Pradesh
**Corresponding author: rajeev4571@gmail.com*

Soil moisture content (SMC) is an important environmental element, that influences plant water availability and atmospheric parameters. Remote sensing is considered an effective tool for monitoring soil parameters over large areas and is more cost-effective than *in situ* measurements. In the present study, an operational framework for retrieving soil moisture was developed using spectral reflection data in the 350-2500 nm range. The soil samples were collected from four states in India, namely Delhi, Madhya Pradesh, Bihar and Jharkhand. 31 topsoil samples were collected and taken to the laboratory for measuring soil moisture and reflectance measurements. Soil reflectance spectra were measured in the laboratory using an ASD spectroradiometer at various soil moisture levels. The pre-processed spectral data were resampled to 10 nm. The inverted Gaussian function was used to fit soil spectra and two absorption features of the spectra absorption depth (AD) and absorption area (AA) are calculated as functions of soil moisture content. The continuum-removed reflectance (CR-reflectance) was calculated using ENVI's DISPEC software package. The AD and AA near 1400 and 1900 nm show an important correlative relationship with soil moisture. Since the soil moisture is more sensitive to the SWIR than in visible and NIR, two absorption features near 1400 and 1900 nm are selected for the present study. The deeper absorption features near 1400 and 1900 nm can be attributed to O-H stretches and H-O-H bending fundamental sand overtone. These spectral wavelengths are strongly absorbed by water and show strong spectral contrast. The R^2 values obtained for AA1900, AD1900, AA1400, and AD 1400 correlated with soil moisture are 0.87, 0.80, 0.88, and 0.88 respectively. Four One-variable linear regressive models were developed for predicting soil moisture. The R^2 of the four prediction models developed using AA1900, AD1900, AA1400, and AD 1400 are 0.95, 0.89, 0.96, and 0.95 respectively. The prediction results are satisfactory. Accurate prediction accuracies suggest the use of the present method for estimating the SMC.

Key words: Soil moisture content, Spectral reflectance, Spectral indices, Absorption feature, Regression

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Modelling and Optimization of Irrigation Strategies for Enhancing Maize Productivity under North Bihar Conditions

Shreya Nivesh*, Rakesh N., Koushik Banerjee, Ajay Kumar Singh, Vikas Paradkar, Geeta, Haritha Mohan M., Jadhav Amol Kailas and Neela Madhav Patnaik

ICAR-Mahatma Gandhi Integrated Farming Research Institute,
Motihari (East Chamaparan)-845429, Bihar
**Corresponding author: shreya.nivesh@icar.gov.in, shreyanivesh@gmail.com*

India is highly susceptible and risk-prone to climate change than many other countries in the world. Humid subtropical regions play significant role in advancing food security under changing climate. In this article an attempt has been made to study the effects of five irrigation methods and three irrigation levels on the growth, yield, and productivity of rabi maize through a field experiment conducted in East-Champaran district of Bihar during the winter season of 2021-2022 in a split plot design. To conduct a detailed analysis of crop response, measurement of various growth parameters, yield components, biomass distribution, and other different factors were made comprehensively. Results showed significant effects of irrigation method and irrigation level on grain yield with irrigation method 5^{th} and 4^{th} indicating highest average grain yields of maize. The irrigation level-II (ET_c value of 80%) resulted in a maximum average grain yield compared to irrigation level-I & irrigation level-III. Among all replications, strong positive correlations were observed between grain yield, root weight, and cob weight. The outcomes of the study show that, alternate furrow irrigation at a depth of 15 cm and an irrigation level with 80% ET_c can significantly improve rabi maize under humid subtropical climatic conditions.

Key words: Rabi maize, North-Bihar, Grain yield, Crop modeling, Water use efficiency

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Prospects of Internet of Things (IoT) and Big Data analytics in Smart Farming in India

Rakesh N.*, Shreya Nivesh, A.K. Singh, Geeta and Jadhav Amol Kailas

ICAR-Mahatma Gandhi Integrated Farming Research Institute, Piprakothi-845429, Motihari (East Champaran), Bihar
**Corresponding author: rakesh.n1@icar.gov.in*

The increasing global population, projected to reach 9.1 billion by 2050, poses a significant challenge to agriculture in meeting the potential demands for food. Traditional farming methods yield low results, prompting a shift towards modern science and technology and emphasizing the need for innovation. The advent of the Internet of Things (IoT) and Big Data Analytics has revolutionized various industries, including agriculture. The relevance of IoT in agriculture becomes evident as it plays an immense role in satellite mapping, aiding in monitoring crop growth through geo-tagging, while e-markets facilitate virtual trading with physical markets in the background. Products and livestock traceability, climate sensing stations, agriculture drones, and smart farming demonstrate the versatility of IoT in addressing various agricultural challenges. Big Data analytics is often a complex process of examining big data to uncover information such as hidden patterns, correlations, market trends, and customer preferences. Big Data analytics, coupled with IoT, emerges as a game-changer in agriculture, optimizing farming practices by playing an immense role in feeding a growing population, promoting ethical pesticide use, optimizing farm equipment, and strengthening the supply chain. However, challenges such as data security, real-time data processing, remote monitoring, and data reliability must be addressed for successful implementation. IoT leads to automation, efficiency, and precision in farming. Despite being in its infancy, IoT-based smart farming shows immense potential to revolutionize food production. Policymakers need to look for Its endless possibilities, coupled with innovations like big data, indicate a future where farmers increasingly rely on sophisticated and affordable technology.

Key words: Satellite mapping, Supply chain management, Livestock traceability, Smart farming, Internet protocol

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Analysis of Rainfall Patterns and Feasibility of Rainwater Harvesting for Greenhouse Cultivation

Vinutha B.B.[1]* and Thimmegowda M.N.[2]

[1]Department of Agronomy, College of Agriculture, [2]AICRP on Agrometeorology, University of Agricultural Sciences, GKVK, Bengaluru-560065, Karnataka
**Corresponding author: vinuthabb95@gmail.com*

To comprehensively assess rainfall pattern, rainwater collection efficiency, storage and its effective use with sensor-based irrigation for different vegetable crops under protected cultivation, a factorial-RCBD experiment was conducted at AICRP for Dryland Agriculture during kharif 2021-22 and 2022-23. The study comprised of four irrigation levels *viz.*, 75, 50, 25% ASM with surface irrigation as check and four vegetable crops viz., broccoli, capsicum, cherry tomato and pole bean totalled to 16 treatments replicated thrice. The total annual rainfall for the year 2021 and 2022 was 1328.4 mm and 1477.4 mm, respectively, which exceeded the long-term average of 921.0 mm by 44.23 per cent during 2021 and 60.41 per cent during 2022. The monthly rainfall in 2021 was higher in November (367.4 mm) and lower in March (0.0 mm), while in 2022, October had the higher rainfall (361.0 mm) and February had the lower (0.0 mm). During 2021, the actual rainwater collection fell short of the estimated collection by 235.9 m^3 and in 2022, the actual volume captured fell short by 277.4 m^3, indicating a 11.83 and 12.5 per cent gap between potential and realized collection, respectively. The observed storage levels varied from a minimum of 105.77 m^3 in March 2023 to a peak of 662.38 m^3 in November 2022, representing a variation of 556.61 m^3. In 0-30 DAT, surface irrigation used 123.39 mm, while the 75, 50 and 25% ASM treatments required only 52.92, 59.06 and 66.08 mm, respectively across broccoli, capsicum, pole beans and cherry tomato, representing reductions of 57.11, 52.14 and 46.45 per cent water, respectively. The water requirement increased progressively with decreasing ASM level for broccoli/ pole beans: 329.23 mm at 75% ASM, 380.12 mm at 50% ASM, 426.31 mm at 25% ASM and 635.67 mm at surface irrigation; capsicum/cherry tomato: 499.12 mm at 75% ASM, 552.63 mm at 50% ASM, 603.21 mm at 25% ASM and 907.89 mm at surface irrigation.

Key words: Broccoli, Capsicum, Cherry tomato, Pole beans, Irrigation

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Land Use and Land Cover Mapping using Remote Sensing and GIS: A case study in Owk watershed of Nandyal District, Andhra Pradesh

M. Prabhavathi[1]*, K. Kannan[2], B.S. Naik[1], M.N. Ramesha[1], Ravi Dupdal[1], Ravi, K.N.[1], B.K. Rao[1] and M. Madhu[3]

[1]ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Ballari-583104, Karnataka
[2]ICAR-Sugarcane Breeding Institute, Coimbatore-641007, Tamil Nadu
[3]ICAR-Indian Institute of Soil and Water Conservation, Dehradun-284003, Uttarakhand
**Corresponding author: prabha21may@gmail.com*

Land use and land cover mapping using satellite imagery has attracted significant attention across globe. Classification of land use and land cover is an advantage of remote sensing technology which provides all information about land surface. Classification algorithms such as maximum likelihood, random forest, subject vector machine (SVM), iso cluster technique are some of the algorithms generally used for land use land cover mapping. The study area includes 10 km surrounding of proposed upper owk reservoir lies in 77° 55' 0.926" - 78° 15' 39.211" E longitude and 15° 5' 55.662" -15° 18' 51.0048" N latitude. Total geographical area of the study area is 562 sq. km and slope varies from 0 to 90.9 %. The lower Owk reservoir is constructed across Paleru river near Owk village of Owk Mandal, Nandyal district, Andhra Pradesh. There are 34 micro watersheds falling under 10 km radius of the reservoir and all the watersheds are draining into the Paleru river. The aim of the study is to analyze LULC pattern using satellite imagery and GIS for the Owk watershed in Nandyal district in the state of Andhra Pradesh using a Landsat 8 satellite imagery and SVM model, a powerful supervised algorithm. Agriculture is the major land use practiced in 37.5% area followed by barren land (39.5%). Scrub and degraded forest contribute17% of the area while water body contributes 1.9% area. Mine spoil is a serious concern in the watershed which occupies 0.91 ha and expanding. The over-all accuracy of the classified map is 77.0% with producer's and user's accuracy as 84.5 % and 74.2% respectively. Kappa statistics for the classified map are calculated as 71.5 %. The classified map provides useful information for developing recommendations to enhance sustainability and foster resilience.

Key words: Land use, Land cover, SVM, Satellite imagery, Kappa statistics

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A Study on Varying Water Demand under Different Scenarios using Water Evaluation and Planning System (WEAP) Model in Dhasan River Basin of Madhya Pradesh

Shreya Nivesh[1]*, Rakesh N.[1], Pradeep Singh Kashyap[2] and Ajay Kumar Singh[1]

[1]ICAR-Mahatma Gandhi Integrated Farming Research Institute, Piprakothi-845429, Motihari (East Chamaparan), Bihar
[2]Department of Soil & Water Conservation Engineering, College of Technology, G.B. Pant University of Agriculture and Technology, Pantnagar-263145, Uttarakhand
**Corresponding author: shreya.nivesh@icar.gov.in*

The present study aimed at allocation and management of demand, supply and streamflow of Dhasan river basin, Madhya Pradesh using Water Evaluation and Planning System (WEAP) Model. Study attempts to develop an integrated water resource management plan for the Dhasan river basin by employing a scenario analysis approach to analyse trends in water use and anticipated demand between 2015 and 2050, simulating five possible scenarios as external driving factors. For model, 2015 was selected as a base year. Reference scenarios was established from the current accounts year or base year to simulate likely evaluation of the system without intervention for the period 2016 to 2050 covering about 35 years. The Rainfall-Runoff Methodused for water allocation planning in study area. The results of the projections demonstrated that, by 2050, increasing population growth will increase water demand dramatically posing threats to the environment and water security for humans and livestock. Additionally, It is also revealed that demand on water resources in the Dhasan river basin would increase in the future.Several suggestions have been recommended to assist policymakers in planning sustainable water management practices for meeting demands of water resources in the future through widespread implementation of improved irrigation technologies, improved farming practices on farms and implementing water conservation and harvesting structures that could significantly reduce the quantum of unmet demands and shortfalls in the study area.

Key words: Water Evaluation and Planning System (WEAP), Dhasan river basin, Bundelkhand region, Supply delivered, Current accounts year, Water demand

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Sensor Based Real Time Water Measurement and Irrigation Scheduling System for Increasing Water Use Efficiency

B. Krishna Rao[1]*, S. Annapurna[2], K. Sunitha[2], N. Subhasree[2] and M. Madhu[3]

[1]ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Ballari-583104, Karnataka
[2]Water & Land Management Training & Research Institute, Hyderabad-500030, Telangana
[3]ICAR-Indian Indian Institute of Soil & Water Conservation, Dehradun-284003, Uttarakhand
**Corresponding author: b_krishnarao@rediffmail.com*

In India, irrigation systems are supply based systems with a fixed schedule, where watering schedule involves specific run-times and days with the controller executing as per schedule regardless of the season or weather conditions. But it should be demand based systems with a focus on climate, crop stage and weather conditions. Sensor based real time water level measurement system was developed and evaluated for scheduling irrigations in paddy other irrigated dry crops. These systems give daily water depth, soil moisture information of paddy and id crops fields respectively through messages through wireless network. Based on the messages received irrigations were scheduled. The sensor based irrigation scheduling reduced the number of irrigations from 14 to 10 in paddy, water quantity from 4316 to 3120 m3/ha and energy consumption from 157 to 116 kwh. The sensor based system enhanced the water productivity from 1.26 kg/m^3 to 1.98 kg/m^3 in kharif season. The sensor based irrigations reduced the number of irrigations from 44 to 31, water quantity from 8948 to 4316m3/ha, energy consumed from 650 to 451kwh. The sensor based system enhanced the water productivity from 0.4 kg/m^3 to 0.67 kg/$m^{3.}$ This system saved 30% water and 31% energy in rabi season.

Key words: Real time, Water measurement, Ultrasonic sensors, Water productivity

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Back Yard Poultry Farming as a Source of Livelihood in SCSP Village

P.K. Pankaj, Shailesh Borkar, T.V. Prasad* Anshida Beevi C.N., Jagariti Rohit, Ashish Dhimate and V.K. Singh

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: t.prasad@icar.gov.in*

Livestock and poultry farming play a crucial role in enhancing both the nutritional security and profitability of the agricultural sector in India. In recent times, the poultry sub-sector, particularly backyard poultry, has experienced a growth rate over 40%. This indicates the significant potential and opportunities for this type of farming in rural areas. Backyard poultry production involves raising a small number of native birds, often between 2 and 100, with limited feeding and resources. In Mancherial district, where the Scheduled Caste Sub Plan is being implemented in various villages of Kotapally mandal, Vanaraja chicks were provided to over 200 people in the year 2020. These households received instruction on poultry rearing procedures to overcome production limitations in backyard poultry. Due to its enhanced quality, the chicks were also provided with chick feed to facilitate their initial raising. The implementation of a 10-chick per family model, with a 10% mortality rate, was introduced due to the excessively high mortality rate (56%) observed in the 25-chick per family model. This high mortality rate indicates a low carrying capacity for the farmers in question. The farmers achieved a dual benefit from backyard poultry production, obtaining an average of 67.0±5.0 eggs per bird and a live body weight of 1.94±0.21 kg after 6 months. The birds and eggs were evaluated for their opportunity cost, resulting in a net profit of Rs. 4,234 per household per year. In addition, after one-year, mature birds were utilized for domestic consumption, providing adequate protein for a family consisting of two adults and one youngster. Backyard poultry farming, utilizing improved varieties, offers a dual benefit of addressing food security concerns for impoverished villages, a good option for landless farmers and generating profitable livelihood opportunities in rural India.

Key words: Vanaraja, Backyard poultry, SC farmers, Food security

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Enhancing the Productivity of Rainfed Crops at Agricultural Landscape Level: Land Management Unit Approach

G. Ravindra Chary*, M.S. Shirahatti, S.B. Patil, R.A. Nandagavi, B. Narsimlu, K.A. Gopinath, K.B. Sridhar and Nayab Rasool

ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
**Corresponding author: gcravindra@gmail.com*

Rainfed agriculture is challenged with biophysical and socioeconomic constraints. Further, climate /rainfall variability impacts are evident in production and productivity of rainfed production systems. Agricultural landscapes at microwatershed level are characterized with diverse soil types. The performance of crop/variety will vary on various soil types in a microwatershed, though the rainfall amount and distribution is same, due to intrinsic soil properties. At microwatershed level, soil resource mapping and delineating the soils in to homogeneous land management units helps in allocating the land parcels to specific land utilization types. Land management unit (LMU) is a homogeneous block of land that responds in a similar way under similar management. At Koulagi watershed, Vijayapura district, Northern dry zone of Karnataka, the soil resource mapping was done at cadastral level. The soils were further delineated into Soil Conservation Units (SCUs) based on soil physical properties and Soil Quallity Units (SQUs) based on soil chemical properties. Further, in GIS environment, the SCUs and SQUs were delineated in to Land Management Units (LMUs). Rainfed crops viz. pigeonpea, sorghum and chickpea were evaluated for their performance on various LMUs. Though the rainfall amount and distribution was same in various years, the rainfed crops performed differently. There was significant yield difference among the LMUs indicating the influence of land, LMU /soil characteristics on performance of crops. The yield of varieties of sorghum on similar LMUs (LMU I, LMU III, LMU V and LMU VII) was different due to crop duration. This suggest that there is a need to allocate LMUs to specific rainfed crop(s) and or varieties for enhancing the yield at agricultural landscape level. In rainfed production systems with LMU approach at microwatershed level will help in better agricultural land use planning.

Key words: Rainfed, Crop, Landscape, Land management

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Navigating Change: Exploring Tree Preferences, Crop Responses, and Farmer Perceptions of Windbreak Systems in Arid Western Rajasthan

Renjith P.S.[1#*], Sheetal K.R.[1], Birbal[2], Subbulakshmi V.[2] and P.C. Moharana[3]

[1]*ICAR-Central Arid Zone Research Institute, Regional Research Station, Bhuj-370105, Gujarat*
[2]*ICAR-Central Arid Zone Research Institute, Regional Research Station, Bikaner-334004, Rajasthan*
[3]*ICAR-Central Arid Zone Research Institute, Jodhpur-342003, Rajasthan*
[#]*ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Udhakamandalam-643006, Tamil Nadu*
**Corresponding author: Renjith.PS@icar.gov.in*

Technologies that enhance the feasibility of cropping and improve landscape manageability, particularly in challenging terrains like arid zones, hold significant ecological and economic importance. Windbreaks, comprising single or multiple trees and/or shrub combinations, stand out as one of the leading eco-friendly strategies to combat wind erosion, stabilise sand dunes, and tackle associated challenges prevalent in arid regions, which encompass 12% of India and over half of Rajasthan. Conducted in the Bikaner district of Rajasthan, the study aimed to identify existing windbreaks, assess farmers' perceptions of the benefits and drawbacks associated with adopting and retaining windbreaks in their fields, and investigate their impact on crops through an exploratory survey. The decision to establish windbreaks was influenced by irrigation conditions, with 96% of plantations in irrigated regions strategically positioned along farm boundaries. The preferred configuration was predominantly single-row, featuring a variety of tree species including shisham (*Dalbergia sisoo*), neem (*Azadirachta indica*), ber (*Zizyphus* sp.), gonda (*Cordia myxa*), ardu (*Ailanthus* sp.), khejri (*Prosopis cineraria*), rohida (*Tecomella undulata*), acacia (Acacia sp.), and Eucalyptus sp. Notably, shisham emerged as the predominant species, offering lumber as an additional income source after 15-20 years. The age trend analysis indicated a shift from fast-growing trees like *Acacia tortilis*, used for immediate solutions for sand dune stabilisation and afforestation, to sustainable options such as shisham and ber, aligning with farmers' needs for field protection and economic returns. Crop production was influenced by windbreaks, exhibiting varied impacts dependent on tree species, distance from the tree line, in addition to other factors. Overall, the yield was noted to be very low up to the same distance as the height of the tree (i.e., 1H), attributed to shading, moisture competition, and bird damage. Neem showed a higher negative effect on crops, while *gonda* caused the least losses. The study revealed farmers highly value windbreak benefits, including crop protection from extreme weather, shading effects, and control of soil erosion. However, challenges in retaining windbreaks involve moisture competition with crops and increased bird damage to crops. The findings underscore the intricate balance between ecological interventions and agricultural productivity in arid regions, offering insights for sustainable farming practices in similar climates.

Key words: Arid zone, Crop yield, Windbreak

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Remote Sensing Technology for Diagnosis and Management of Abiotic Stresses in Crops

Vinay Kumar Sehgal*

Division of Agricultural Physics,
ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Email: vk.sehgal@icar.gov.in*

Abiotic stresses experienced by crops range from water deficit, water logging, extreme temperatures, soil salinity, nutrient deficiency, etc. which limit their growth and development leading to lower crop productivity. This invited paper presents technology-based diagnosis, monitoring and management of abiotic stresses in crops, ranging from field to regional scale. The technological approaches range from imaging techniques acquired from hand-held devices, to drones to satellites. Many of these techniques comes under the ambit of smart-digital agriculture. The advances in data analytics like machine learning, the connectivity provided by wireless/mobile networks, the advances in high end computing at cheaper prices are the enabling backend technologies which work in tandem with sensors and images to provide for accurate diagnosis, monitoring the status and suggesting/ triggering management options. Water deficit stress is the foremost abiotic stress and measurements of soil moisture and evapotranspiration are good estimators of water deficit. The remote sensing based optical and thermal based indices can directly monitor plant water status, soil moisture and combined with physical model can provide the diagnosis of water stress and can be integrated into an automated irrigation system. Examples of field to regional scale water deficit stress and its management will be presented. Among the nutrient deficiency, nitrogen is the most important and also the major limiting factor for agriculture productivity. A system of N application in wheat (timing and dose) has been developed by combining satellite remote sensing with crop simulation model and demonstrated which showed higher N efficiency and lower GHG emission. Besides, imaging sensors have been used for plant phenotyping shown to screen crop varieties simultaneously performing under multiple stresses, like, nitrogen and water deficit. The paper will present examples and their scientific basis along with future directions in which technological solutions are expected for diagnosis and management of abiotic stresses.

Key words: Water deficit, Drought, Nitrogen, Crop, Resource efficiency, Resource management

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Elevated Temperature and CO_2 Alter the Growth, Biomass and Yield Responses of Maize (*Zea mays* L.) Genotypes

P. Sathish[1]*, M. Vanaja[1], B. Sarkar[1], N. Jyothi Lakshmi[1], G. Vijay Kumar[2], Ch. Mohan[1], A. Sushma[1] and M. Srinivasa Rao[1]

[1]ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]Department of Genetics, University College of Science, Osmania University, Hyderabad-500007, Telangana
**Corresponding author: p.sathish2@icar.gov.in*

The production of agricultural crops is expected to be impacted by increasing of atmospheric carbon dioxide (CO_2) concentration and global warming. In general, enhanced CO2 (eCO_2) stimulates photosynthesis and increases yield in C3 crops but this positive effect may be less pronounced in C4 crops like maize. In the present study, four maize (*Zea mays* L.) genotypes *viz*. M-22, M-24, DTL-4-1 and Harsha were assessed for phenological, physio-biochemical, biomass and yield responses at elevated temperature (eT +3.0 ± 0.5°C), combination of eT with elevated CO2 (eT+CO_2 550 ± 50ppm) under Free Air Temperature Elevation (FATE) facility and compared with ambient control (aT). The results showed that at both eT, eT+eCO_2 increased anthesis silking interval (ASI) with M-24 while, impact was less with M-22, DTL- 4-1 and Harsha. Under eT condition, the photosynthetic rate (Anet), stomatal conductance (gs), transpiration rate (Tr), WUE, RWC and cell membrane stability index (CMSI) of four maize genotypes decreased and recovered to some extent with eT+eCO_2. With the presence of eCO_2, WUE was improved due to increased Anet and reduced Tr at eT+eCO_2. The impact of eT was evident by increased proline and MDA content, and it was reduced under eCO_2.This suggest that increased CO_2 concentration can minimizes the ill effects of eT even with C4 crops like maize. Among the genotypes, DTL-4-1, M-22 and Harsha recorded less reduction of grain yield under eT and the presence of eCO_2 enabled them to produce better grain yield due to improved the kernel number and its filling. The reduction in reproductive biomass was higher than vegetative biomass with eT, while eT+eCO_2 condition improved more of reproductive biomass than vegetative biomass. Although, maize is sensitive to high temperature, it was observed that the elevated CO_2 ameliorated the ill effects of eT due to altered its biochemical and physiological functions.

Key words: Temperature, Biomass, Maize

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Impact of Sensor-Based Irrigation on Crop Growth and Yield in Protected Cultivation of Vegetable Crops under Reduced Runoff Farming

Vinutha B.B.[1]* and Thimmegowda M.N.[2]

[1]Department of Agronomy, College of Agriculture, [2]AICRP on Agrometeorology, University of Agricultural Sciences, GKVK, Bengaluru-560065, Karnataka
**Corresponding author: vinuthabb0@gmail.com*

A greenhouse experiment was conducted during kharif 2021-22 and 2022-23 at AICRP for Dryland Agriculture, UAS, Bangalore, to examine the effectiveness of sensor-based irrigation on the growth, yield and economics of high value vegetable crops, namely broccoli, capsicum, cherry tomato and pole bean under protective cultivation. The experiment was laid out in factorial- RCBD design with 16 treatments comprising four irrigation level *viz.*, 75, 50, 25% available soil moisture (ASM) and surface irrigation as check. The results revealed that sensor-based irrigation schedule at 75% ASM recorded higher growth parameters *viz.*, plant height, leaf area, leaf area index and total dry matter of broccoli (70.27 cm, 4778.24 cm^2, 5.31 and 111.95 g $plant^{-1}$, respectively), capsicum (130.46 cm, 5090.74 cm^2, 2.51 and 110.41 g $plant^{-1}$, respectively) and pole bean (194.26 cm, 196.81 cm^2, 0.22 and 113.26 g $plant^{-1}$, respectively) and cherry tomato (211.73 cm, 4095.07 cm^2, 2.02 and 186.11 g $plant^{-1}$, respectively) at 120 DAT/P compared to 25% ASM. Further, the higher mean yield of broccoli (26.05 t/ha), capsicum (48.59 t/ha), pole bean (37.08 t/ha) and cherry tomato (42.02 t/ha) was recorded for irrigation scheduled at 75% ASM compared to 25% ASM (18.71, 40.81, 26.48 and 35.44 t/ha, respectively). The maximum net returns for broccoli (Rs. 6,55,899 ha^{-1}), capsicum (Rs. 9,69,689 ha^{-1}), pole bean (Rs. 11,07,535 ha^{-1}) and cherry tomato (Rs. 5,79,865 ha^{-1}) was with irrigation schedule of 75 % ASM, which is attributed to higher yield and lesser cost of production. Among crops, pole bean was emerged as the most remunerative crop with higher B:C ratio (3.95) followed by cherry tomato (3.05), capsicum (2.99) and broccoli (2.47). it is concluded that, irrigation with 75 % ASM is superior for growth, yield and economics of high value vegetables under protected cultivation.

Key words: Broccoli, Capsicum, Cherry tomato, Pole beans, Irrigation and reduced runoff farming

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Unleashing Vegetables Potential: Optimization of Smart Irrigation in Greenhouse cultivation for Higher Yield and Sustainable Water Use

Vinutha B.B.[1]* and Thimmegowda M.N.[2]

[1]Department of Agronomy, College of Agriculture, [2]AICRP on Agrometeorology, University of Agricultural Sciences, GKVK, Bengaluru-560065, Karnataka
**Corresponding author: vinuthabb0@gmail.com*

A greenhouse experiment was conducted during kharif 2021-22 and 2022-23 at AICRP for Dryland Agriculture, UAS, Bangalore. the main objective of the study was to optimize irrigation levels (75%, 50%, and 25% ASM) against a conventional surface irrigation method for four high-value vegetable crops (broccoli, capsicum, cherry tomato and pole bean) grown under protected cultivation. The experiment was laid out in factorial- RCBD design with 16 treatments and replicated thrice. Scheduling irrigation at 75% ASM resulted in significantly early flowering (65.11, 28.62 and 50.51 DAT, respectively), minimum days for 50% flowering (77.58, 35.62 and 60.50 DAT, respectively), minimum days for first harvest (83.60, 42.80 and 68.01 DAT, respectively) and longer harvesting period (35.20, 59.34 and 84.21 days, respectively) compared to surface irrigation. However, scheduling irrigation at 25% ASM resulted in delayed flowering (73.95, 34.10 and 62.87 DAT, respectively), minimum days for 50% flowering (86.68, 41.53 and 73.83 DAT, respectively), minimum days for first harvest (89.82, 47.42 and 90.95 DAT, respectively) and shorter harvesting period (30.24, 56.00 and 72.08 days, respectively) for broccoli, capsicum and cherry tomato. Similarly, scheduling irrigation at 75 % ASM recorded significantly higher plant physiological parameters such as SPAD value (52.01 54.40 58.88 and 54.26 respectively) and relative water content (83.77, 83.05, 79.09 and 75.61%, respectively) at 30, 60, 90 and 120 DAT/P while, 25% ASM recorded lower SPAD values (44.44, 45.10, 55.44 and 51.10, respectively) and relative water content (80.91, 81.65, 74.70 and 73.19%, respectively).

Key words: RWC, Sensor based irrigation, Protected vegetable cultivation, SPAD

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Energy Evaluation of Maize as Affected by Different Dates of Sowing and Nitrogen Levels in Temperate Condition

Ayman Azad[1]*, Bilal Lone[2], Sarath Chandran M.A.[1], Jeevanand K.P.[1] and Deepti Verma[1]

[1]*Central Dryland Agriculture for Dryland Agriculture, Hyderabad-500059, Telangana*
[2]*Sher-e-Kashmir University of Agricultural Sciences and Technology, Srinagar-190025, Jammu & Kashmir*
**Corresponding author: aymanazad07@gmail.com*

In every production setup, the concept of energy assessment and effectiveness relates to the consumption and yield of energy. Energy efficacy is linked to the proportion of energy consumed to energy yielded in food setups. If the energy yield surpasses the consumption, the operation is deemed effective; if the consumption surpasses the yield, the operation is considered ineffective. For this study we selected the composite variety of maize Suwan-1 because of its broad adaptation, yield stability, and resistance to downy mildew that have led to its use in breeding programs throughout the developing world, either as a resource material or for direct release. CIMMYT and its collaborators have drawn on Suwan-1 as a source of desirable traits. The experiment was laid out in factorial Randomized Block Design with two factors including 3 sowing dates (S_1=17th Standard Meteorological Week, S_2 = 20th SMW and S_3 = 22nd SMW) and 4 nitrogen levels (N_1 = 90 kg/ha, N_2 = 120 kg/ha, N_3 = 150 kg/ha and N_4 = 180 kg/ha). Employing a standard, all consumption and yield factors were converted into mega joules (MJ), and subsequently, the energy consumption and energy yield for all treatment permutations were assessed. Calculations were performed using various treatment combinations to calculate energy input/output for maize growing on 1 hectare of land. Total energy utilized for maize cultivation on 1 hectare of land = energy utilized in total all the operations carried out on crop duration from sowing to harvest. As far as energy output were also observed to follow the same trend as of net profit and B.C ratio with sowing date on 28th April (S_1) and 150 kg N ha^{-1} (N_3) (104652.7 and 120041 MJ) this may be the fact of having higher grain yield in this treatment followed by treatment 180 kg N ha^{-1} (N_4) (103286.7 and 118819 MJ). Least values of energy output, were recorded when sowing was carried out on 28th May that too with 90 kg N ha^{-1} (N_1). On the basis of generalization of the results obtained from the present investigation, it was concluded that under agro-climatic conditions of Kashmir valley the treatment combination of S_1 and nitrogen level of N_3 gave the highest energy output of 104652.7 and 120041 MJ for year 2020 and 2021 respectively.

Key words: Energy, Maize, Nitrogen levels, Sowing date

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Decoding Climatic Extremes: The Unraveling Impact of 2015 and 2023 Floods with El Niño in Tamil Nadu

Fawaz Parapurath*

Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Email: faazzz96here@gmail.com*

Rainfall is one of the major climatic elements that affects farmer's livelihood and plays a major role in the environment and socioeconomic conditions of Tamil Nadu. The northeast monsoon season, occurring from October to December, witnesses the most substantial rainfall activity in this region, peaking during the 45th-49th standard meteorological week (5th November to 9th December) of the year. However, studies on rainfall trends reveal considerable variability over the past decades, and it is well-acknowledged that the El Niño Southern Oscillation (ENSO) is the dominant factor influencing climate variability on seasonal to inter-annual scales. The years 2015 and 2023 were the strong and moderate El Niño years that observed devastating floods in the districts of Tamil Nadu, mainly Chennai. This study reveals that the flood events in Tamil Nadu are coinciding with the El Niño episodes. The results infer that the rainfall received in the strong El Niño year (2015) exceeded normal years by 947.1 mm and 353.4 mm for the month of November and December respectively. Similarly in the moderate El Niño year (2023) the rainfall exceeded by 364.6 mm and 190.8 mm with respect to normal years. The number of rainy days during strong and moderate El Niño years were 25 and 21, while normal years experienced at most 10 rainy days from 5th November to 9th December. Comparing the floods of 2015 and 2023, 2015 witnessed higher rainfall events with more rainy days, resulting in significant infrastructural damage and crop losses (actual rainfall deviation of + 746 mm in comparison with 2023) because the strength of ENSO was more (strong) whereas 2023 recorded less rainfall events and rainy days in comparison with 2015 because the ENSO strength was moderate. But the later stage of northeast monsoon in 2023 was accelerated with disastrous winds and torrential rainfall due to the cyclone Michaung. Over the last decade, the Arabian Sea and Bay of Bengal have experienced a substantial increase in the frequency of cyclonic events, especially during the pre-monsoon and post-monsoon periods. The sea surface temperature (SST) is the well-observed environmental factor that affects Tropical Cyclone (TC) intensity and it is expected to respond to anthropogenic climate change. Therefore, in the near future, El Niño years are projected to contribute highly intensified rainfall along with disastrous cyclonic events, leading to flood like situations in susceptible districts of Tamil Nadu, including Chennai, Cuddalore, Kancheepuram, Kanyakumari, Tenkasi, Thiruvallur, Thoothukudi, Tirunelveli, Ramanathapuram, and Virudhunagar. Since these districts are the major foodgrain cultivators of Tamil Nadu, significant devastation will be experienced in the agricultural sector, particularly in the Rabi season, during El Niño years. Therefore, early forewarning of extreme weather events is crucial to reduce crop loss, and the adoption of climate-resilient agricultural technologies, including disaster mitigation techniques, is imperative across all districts.

Key words: Decoding, Climatic, Floods, El Niño, Tamil Nadu

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IoT Based Smart Irrigation System for Dryland Agriculture in Kashmir Valley

Latief Ahmad*, Sameera Qayoom, Faisul Ur Rasool, S.A. Dar and Zahoor A. Dar

Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Shalimar, Sringar-190025, Jammu & Kashmir
**Corresponding author: drlatief@skuastkashmir.ac.in*

The Kashmir Valley, renowned for its picturesque landscapes, faces persistent challenges in water resource management, particularly in its dryland regions. Addressing these challenges requires innovative approaches that integrate technology with traditional agricultural practices. The study focused on implementing a Smart Irrigation System enabled by the Internet of Things (IoT) in the dryland regions of the Kashmir Valley. The system leverages IoT sensors, weather data, soil moisture sensors, and predictive analytics to optimize water usage and enhance agricultural productivity in dryland areas. By continuously monitoring environmental conditions and soil moisture levels in real-time, the system can precisely regulate irrigation schedules, ensuring that crops receive adequate water while minimizing wastage. Additionally, the integration of IoT devices enables remote monitoring and control of irrigation systems, providing farmers with greater flexibility and convenience in managing their fields. The study aims to assess the effectiveness of the Smart Irrigation System in improving water efficiency, crop yields, and overall farm profitability in the dryland regions of the Kashmir Valley. It evaluated the system's performance under varying climatic conditions and crop types, considering factors such as water savings, energy consumption, and environmental sustainability. Through this research, we anticipate contributing to the sustainable development of agriculture in the Kashmir Valley by introducing innovative solutions to address water scarcity challenges in dryland regions. The implementation of Smart Irrigation Systems enabled by IoT holds great promise for enhancing water management practices, mitigating drought risks, and promoting resilient agricultural systems in the region.

Key words: Smart irrigation, IoT (Internet of Things), Dryland agriculture and Kashmir valley

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Enhancing Growth and Yield of *Rabi* Sorghum (*Sorghum bicolor* L. Moench) through Nano-DAP Foliar Application

Girish R. Satannavar* and Bandiwaddar T.T.

Department of Agronomy, College of Agriculture,
University of Agricultural Sciences, Dharwad-580005, Karnataka
**Corresponding author: girishsatannavar111@gmail.com*

A field study was undertaken during *Rabi* season of 2022-23 to know the impact of Nano-DAP foliar application on the growth and yield of *rabi* sorghum (*Sorghum bicolor* L. Moench) at AICRP on Sorghum, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The experiment was laid out in split-plot design with three replications, consisting of two main plots (Fertilizer levels), six subplots (Foliar nutrition) and a control (only RDF). The study revealed that among fertilizer levels, application of 100 % RDF recorded significantly higher plant height (201.70 cm), panicle length (17.56 cm), grain weight panicle^{-1} (78.7 g), grain yield (36.34 q ha^{-1}), stover yield (8.98 t ha^{-1}), total nutrient uptake (N-111.62, P-33.69, K-103.91 kg ha^{-1}), net returns (¹ 88640 ha^{-1}) and B-C ratio (3.03) over 75% RDF. Among foliar nutrition, foliar spray of Nano-DAP @ 2 ml l^{-1} at PI (Panicle Initiation) and FL (Flag Leaf) stages recorded significantly higher plant height (202.15 cm), grain weight panicle^{-1} (77.3 g), grain yield (37.16 q ha^{-1}), stover yield (9.20 t ha^{-1}), total nutrient uptake (N-111.25, P-33.65, K-103.09 kg ha^{-1}), net returns (¹ 89777 ha^{-1}) and B-C ratio (3.01) compared to other foliar sprays. Among interaction, application of 100% RDF + foliar spray of Nano-DAP @ 2 ml l^{-1} at PI and FL stages recorded significantly higher plant height (207.43 cm), grain weight panicle^{-1} (86.25 g), grain yield (39.56 q ha^{-1}), stover yield (9.94 t ha^{-1}), total nutrient uptake (N-116.23, P-36.74, K-107.06 kg ha^{-1}), net returns (¹ 98650 ha^{-1}) and B-C ratio (3.15) compared to other treatments. Thus, foliar application of Nano-DAP @ 2 ml l^{-1} at panicle initiation and flag leaf stages along with RDF can be recommended to obtain higher yield and profit in *rabi* sorghum than with RDF alone.

Key words: Growth, Sorghum, Nano-DAP, Application

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Factors Affecting the Adoption of Soil and Water Conservation Structures Implemented under the Drainage Line Treatment Scheme in Wayanad District of Kerala

Lokesh S.[1]*, P. Indira Devi[2], Anil Kuruvila[2] and Rama Rao C.A.[3]

[1]NICRA Project, [3]Section of Design and Analysis, ICAR-Central Research Institute for Dryland Agriculture, Hyderabad-500059, Telangana
[2]Department of Agricultural Economics, Kerala Agricultural University, Thrissur-680656, Kerala
**Corresponding author: lokeshs835@gmail.com*

The Wayanad District in Kerala , grapples with intricate soil and water conservation challenges, exacerbated by its unique socio-economic and environmental context. This study systematically examines the factors influencing the region's adoption and effectiveness of soil and water conservation technologies. Wayanad district was purposely selected for the study as it was one of the climate change hotspots in Kerala. The multistage random sampling method was used for the sample selection. Garret Ranking method was employed to understand the preference of the farmers for various structures implemented under the scheme and Stream Bank Stabilization, Farm ponds and check dams were most preferred based on the elevation of the farms. Ordered probit model was used for the analysing the factors affecting the preferences. The results indicated that socio-economic factors viz., age, education, knowledge on soil and erosion, family size, organizational membership and number of literates in the family have impacted the adoption decision of the respondents.

Key words: Soil, Water, Drainage, Treatment, Kerala

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Farm Level Soil Moisture estimation using Sentinel-1 C band Microwave Data

Joydeep Mukherjee*, Anuradha Sharma, V.K. Sehgal, Deb Kumar Das and Debashis Chakraborty

Division of Agricultural Physics, ICAR-Indian Agricultural Research Institute, New Delhi-110012
**Corresponding author: joydeep.icar@gmail.com*

Soil moisture studies play a crucial role as a prerequisite input for many applications. Soil moisture comprise a very small proportion of the global water resources but possess a key indicator of assessing drought or flood events. Remote sensing methods specifically the microwave region of electromagnetic spectrum is considered as the optimum tool for monitoring the soil moisture due to unique property of microwave sensitivity towards water contained. There is various method available to estimate the soil moisture such as backscatter models, change detection, interferometry approaches. Ground collection of soil parameters using random sampling approach were done over the region where soil moisture ranges from 1.70 to 31.9 vol. % and surface roughness ranges from 0.465 cm to 1.438 cm and average of 0.95cm surface roughness was used in the simulation. Semi empirical model such as modified Dubois model and traditional Dubois model were used for the calibration of the model. The backscatter coefficient values simulated from modified Dubois model by Baghdadi *et al*., 2016 and Sentinel has showed Pearson correlation coefficient of 0.45 and RMSE of 2.08 which is improved one compared to the Dubois model 1995 in which RMSE of 3.867 dB is found. Simulated backscatter coefficients obtained from the models were then compared with Sentinel1A backscatter coefficients values. Further, model optimization was performed in order to minimise the error and finally Dielectric mixing model such as Topps model was used to convert the dielectric constant into soil moisture values. The sensor parameters such as incidence angle average (31°-41°), ks=0.67cm (assume) and wavelength =5.5cm were used in the Dubois model for IARI farm whereas averaged incidence angle of 27.9°-39.3°, ks=0.802cm and wavelength of 5.5cm used as an input for central state farm Hisar.

Key words: SAR, Soil moisture, Sentinel-1, Remote sensing, Active microwave

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Assessing Crop Water Requirement of Mustard Crop under Projected Climate Change for Middle Gujarat Agroclimatic Zone

M.M. Lunagaria[1]*, N.J. Chaudhari[1], Radhika Vala[1] and S.K. Bal[2]

[1]Department of Agricultural Meteorology, BACA,
Anand Agricultural University, Anand-388110, Gujarat
[2]ICAR-Central Research Institute for Dryland Agriculture,
Hyderabad-500059, Telangana
**Corresponding author: mlunagaria@gmail.com*

Mustard, an important rabi oilseed crop is likely to face increasing water stress due to rising temperatures and frequent heatwave conditions. This study aims to assess the impact of climate change on the crop's water requirement for comprehensive understanding of the future water demands of mustard in Middle Gujarat. We employed the CROPWAT 8.0 model to estimate reference evapotranspiration (ETo) and mustard's evapotranspiration (ETc) under Baseline, SSP245 and SSP585 scenarios. The bias corrected climate projection data of BCC-CSM2-MR (Beijing Climate Center Climate System Model - Medium Resolution) were used considering projection accuracy for the Indian subcontinent. Climatic normals were computed from observatory records. Hydrological soil properties were obtained from soil science laboratory of AAU and derived from ISRIC database. The crop parameters were estimated from field experiments conducted at Anand Agricultural University, Anand. The study quantified future changes in ETo and mustard Etc under the scenarios. During baseline period (1975-2014), water requirement of the mustard in the region was found 276 mm with trend value close to zero (-0.04 mm/year). Spatial variation in the changes of water requirement is revealed in the zone. Under SSP245, the ETc showed linear increasing trend (0.21 mm/year) for future (2015-2099). Increasing water demand is likely to high under SSP585, as signifies by linear trend of 0.54 mm/year. The findings of the study will be useful to farmers, policymakers, and agricultural stakeholders to adapt and ensure water security for mustard cultivation in Middle Gujarat amidst climate change challenges.

Key words: Climate change, CROPWAT, Crop water requirement, Mustard, Middle Gujarat, Evapotranspiration

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Influence of Soil Temperature and Moisture on Yield of Paddy Straw Mushroom under Maize Cropping System

Devanakonda Venkata Sai Chakradhar Reddy[1]*, Ga. Dheebakaran[1], G. Thiribhuvanamala[2] and N.K. Sathyamoorthy[1]

[1]Agro Climate Research Centre, [2]Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore-641003, Tamil Nadu
**Corresponding author: devanakonda.chakri9@gmail.com*

Paddy Straw Mushroom (PSM) is the third-largest cultivated fungus in the world. It is highly valued for its delicious flavour and is known as a "warm mushroom" as it thrives well in tropical climates. PSM doesn't require any costly controlled environment for its production and can be cultivated in maize crop from 50 days after sowing. The straw mushrooms need high temperatures, about 30-35°C for the mycelia development stage and 28-30°C for the fruiting body production stage. This study aims to find the impact of bed temperature and bed relative humidity on the paddy straw mushroom yield, which varies with changes in soil temperature, soil moisture and other factors that could impact soil microclimate like plant geometry and residue management. Paddy straw mushroom beds are intercropped in maize cropping system of different spacing and residue treatments. Field experiments were conducted during summer and *kharif* 2022 at Agro Climate Research Centre, Tamil Nadu Agricultural University, Coimbatore under a Randomised Block Design (RBD) with eight treatments comprised of wide normal row (60 x 25 cm), close normal row (45 x 25 cm), wide paired row (45/75 x 25 cm) and a close paired row (30/60 x 25 cm), which were included with and without mulch. During summer, soil temperatures were typically lower in *kharif* maize than summer maize due to higher soil moisture near the soil surface, resulting in higher PSM yield under the *kharif* maize canopy. The soil microclimate variables identified as ideal for paddy straw mushroom cultivation as a maize intercrop were temperatures of around 32 and 28°C, and soil moisture of 23 and 30 per cent during summer and *kharif*, respectively. Both in summer and *kharif* seasons, the bed temperature was negatively correlated with yield having R^2 values of 0.91 and 0.72. The mulched treatments recorded significantly higher mushroom yield than non mulched plots by lowering the soil temperature and bed temperature. The study concludes that the *kharif* season maize with mulching provided optimum microclimate for a higher yield of paddy straw mushroom by increasing the soil moisture content and reducing the soil and bed temperatures.

Key words: Maize intercrop, Microclimate, Soil moisture, Soil temperature, Mushroom

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Modeling LAI of Wheat from UAV-mounted Multispectral Image using Normalized Difference Red Edge and Random Forest

Tarun Kondraju[1]*, Rabi N. Sahoo[1], Renu Pandey[2], Rajeev Ranjan[1], Rejith R.G.[1], Amrita Bhandari[1] and Joydeep Mukherjee[1]

[1]Division of Agricultural Physics, ICAR-Indian Agriculture Research Institute, New Delhi-110012
[2]Division of Plant Physiology, ICAR-Indian Agriculture Research Institute, New Delhi-110012
**Corresponding author: tarunkondraju@gmail.com*

Unmanned Aerial Vehicles (UAV) with mounted multispectral cameras have revolutionized the application of remote sensing for detailed retrieval of crop traits for monitoring crop growth precisely. The current work shows the application of a random forest machine learning algorithm in estimating the LAI of Wheat crops at the experimental field in ICAR-Indian Agriculture Research Institute (IARI), New Delhi . The multispectral Image of the field was captured with a spatial resolution of 1.5 cm and five bands falling in Blue, Green, Red, Red edge, and NIR spectra of light. The experiment assessed the impact of five different nitrogen dosages starting from zero Kg/hectare to 240 Kg/hectare of nitrogen with 60 Kg/hectare in every iteration on nineteen varieties of wheat crop. Three replications were mapping the no of plots to 285 plots. The dataset was pre-processed to extract only the crop area from the Image by masking the soil region. Normalized Difference Red Edge (NDRE) was calculated for the entire Image, and the mean NDRE values for each plot were extracted. The mean NDRE values along with the in-situ LAI measurements, were used to train and validate the model. The model estimated LAI values with an agreeable R^2 of 0.64 and Root Mean Square Error (RMSE) of 0.2. The trained model was later used to estimate the LAI from the Image, and the results were satisfactory. The study developed a Random forest-based LAI estimation method using NDRE as an input generated from UAV-borne multispectral data for the near-real-time retrieval of wheat traits. This workflow can be upscaled to farmers' fields, facilitating efficient crop monitoring and management.

Key words: UAV, Multispectral data, LAI, Random forest, Wheat

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Long Term Effect of Organic and Inorganic Plant Nutrients on Yield and Soil Fertility Status under Typical Vertisols (*Typic Chromusterts*)

V. Sanjivkumar*, M. Manikandan, S. Manoharan, G. Guru, K. Bhakiyathu Saliha and J.V.N.S. Prasad

AICRPDA Main Centre, Agricultural Research Station (TNAU), Kovilpatti-628501, Tamil Nadu
**Corresponding author: Sanjivkumar.v@tnau.ac.in*

A field experiment was conducted in the Agricultural Research Station, Kovilpatti under dryland situation from 2011-'20 to find out the long term effect of organic and inorganic nutrient application on crop yield and soil fertility status in cotton crop. This experiment was conducted in randomized block design replicated thrice under rainfed situation. The experimental soil was clay in texture and belongs to sivasubramanium Soil Series (*Typic Chromusterts*). The soil pH is non saline and alkaline in nature with available nutrient status of as low in available nitrogen, medium in available phosphorus and high in available potassium. Nine treatments *viz.,* T_1 - Control, T_2 - 100% RDF (40:20:40 NPK kg ha^{-1}), T_3- 50% RDF (20:10:20 NPK kg ha^{-1}), T_4- 50% N (crop residues), T_5 -50% N (FYM), T_6 - 50% Inorganic N+ 50% organic N (crop residues) + P & K 50% as inorganic, T_7 -50 % inorganic N+ 50% organic N (FYM) + P & K 50% as inorganic , T_8 -100% RDF + 25 kg $ZnSO_4$ ha^{-1} and T_9 - FYM @ 12.5 ha^{-1}. The results revealed that significant on a long term basis, application of 100 % RDF + 25 kg $ZnSO_4$ ha^{-1} registered higher seed cotton yield (1236 kg ha^{-1}), B:C ratio (1.74) and RWUE (2.89kg/ha mm). With regard to soil fertility status, there was a build up of soil available nitrogen from 80 to 168 kg ha^{-1} whereas decreased trend was observed in soil organic carbon from 4.3 to 3.5 g/kg. No significant diffrences were exhibited in the experimental soil in respect of the soil available zinc content registered an increased trend from 0.54 to 0.70 ppm. Hence, it can be concluded that application of 100% RDF + 25 kg $ZnSO_4$ ha^{-1} influences significantly the crop yield under vertisols.

Key words: Cotton, Crop residues, Farm yard manure, Inorganic fertilizers, Vertisols

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NURTURING DEVELOPMENT, ENSURING PROSPERITY.

For 41 years, NABARD has been at the forefront of India's Rural Development; touching almost every aspect of the vast rural economy with its Financial, Developmental and Supervisory role. As the digital future unfolds, we are once again driving the change, with a strong emphasis on AgriTech, FinTech, CleanTech and Co-op Tech; next-gen tools that will power the Nation's development through this century and beyond.

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