

Change of Edaphic Properties of Soil through the Application of Organic Mulch

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ABSTRACT

Rice straw is used as organic mulch to regulate the hydrothermal regime of the soil. It is also used for moisture conservation, soil temperature moderation, and weed suppression. Attempts were made to study the physico-chemical properties of soil through a series of experiments at four different locations of lateritic sandy loam soil of India under straw mulch. Straw mulches suppressed the soil temperature and it does not allow the radiant energy to contact the soil directly. The radiation interception due to shading and evaporative cooling were responsible for lower soil temperature under straw mulch. During experimentation it was observed that straw mulch improves the soil properties because rice straw contains about 0.6% N, 0.10% each P and S, 1.5% K, 5% Si, and 40% C. It increases the content of organic C, N and available P, K, and Si. It was concluded that rice straw might be used as a nutrient source in crop production and acts as *mulch-cum manure*.

Introduction

Mulches of various kinds have been used to modify hydrothermal regimes in the crop root zone (Chaudhary *et al.*, 1985; Khan, 1998). The nature and magnitude of the effect on hydrothermal regime and crop growth have been found to depend upon the nature of the mulch, climatic environment and the crops (Choudhary and Chopra, 1983). In India, straw mulching has been practiced for moisture conservation, soil temperature moderation and weed suppression. Irrigation requirements are reduced and water storage efficiency was increased up to 66-80 per cent by the use of straw mulch (Greb *et al.*, 1970). Straw mulches suppressed the soil temperature and it does not allow the radiant energy to contact the soil directly. The radiation interception due to shading and evaporative cooling were responsible for lower soil temperature under straw mulch (Khan *et al.*, 2000).

During experimentation it was observed that straw mulch acts as mulch-cum-manure and improves the soil properties because rice straw contains about 0.6% N, 0.10% each P and S, 1.5% K, 5% Si, and 40% C. It increases the content of organic C, N and available P, K, and Si. Gonnamperuma (1984) reported an increase of (0.4 ton/ha) rice yield due to straw mulch. Composted straw frequently results in yield more than twice (Tanaka, 1978). Though important agronomic

benefit of rice straw on improved soil fertility was reported, regrettably, there are little analysis of the farm management and economic aspects of rice straw as a nutrient source in crop production and its use as *mulch-cum-manure*.

This study was restricted to the use of rice straw as mulch and after harvest, the experimental soil was analyzed to study whether there is an improvement in physicochemical properties of soil.

Materials and Methods

The field studies were carried out at four different locations of India in laterite sandy loam soil of coastal field belt of Bay of Bengal (Kharagpur, Gangeswar and Bhubaneswar) and in the plateau region of Bihar (Ranchi). Peanut (*Arachis hypogea* L.) crop was grown at Kharagpur and Bhubaneswar. Pointed gourd (*Trichosanthes dioica* L.) was grown at Gangeswar, and Soyabean (*Glycine max.*) was grown at Ranchi. At all the four locations paddy straw @ 8 tones/hectare was used as mulch and after the harvest of the crop, the physico-chemical properties of the experimental soil analyzed by standard international methods.

Result and Discussion

The physico-chemical properties of the soils as altered by organic (straw) mulch at four locations are presented in Table 1. The application of straw

Table 1. Physico-chemical properties of soil as altered by organic (straw) mulch at four different locations of India

Sl.No.	Physico-chemical properties of soil	Kharagpur soil	Gangeswar (Cuttack) soil	Ranchi soil	Bhubaneswar soil
1.	pH	05.50	05.54	05.60	05.41
2.	Electrical conductivity, μ mhos/cm	60.38	62.49	68.17	70.90
3.	Redox potential, mV	84.16	86.83	83.41	87.00
4.	Bulk density, $g\ cm^{-3}$	01.48	01.50	01.51	01.53
5.	Aeration (non-capillary) porosity, %	20.80	18.60	17.65	16.95
6.	Organic matter, per cent	00.42	00.44	00.45	00.44
7.	Available Nitrogen, Kg/ha	236.00	244.00	246.00	230.00
8.	Available Potassium, Kg/ha	170.00	173.00	171.00	180.00
9.	Available Phosphorus, Kg/ha	014.22	014.90	015.11	013.62

mulch has shown slight improvement in the pH rise. The organic matter content of the soil was improved. Robinson (1951) has also reported an increase of organic matter content due to straw mulch. The electrical conductivity of the soil was also increased. The application of straw mulch increased the available nitrogen, available potassium and available phosphorus content. The extra N probably came from nitrogen fixation stimulated by straw mulch acting as an energy source for heterotrophs and as a carbon di oxide supplement to surface phototrophs (Ponnamperuma, 1984). Medcalf (1956) reported increased availability of potassium and phosphorus due to mulching. Rice straw contains 1.1 to 3.7 per cent K which are water-soluble and is readily available to crop through soil (Amarasiri and Wickremasinghe, 1977). The increase in availability of phosphorus of the soil may be due to reduced activity of iron and aluminum in soil and less fixation of phosphorus by iron and aluminum. Availability of phosphorus increases due to stable complexes of organic acids with iron and aluminum from added organic matter through paddy (rice) straw, which reduces fixation (Brady 1997).

The rising cost of fertilizers and the need to conserve plant nutrients by recycling them focus attention on organic materials as sources of fertilizer elements. Ponnamperuma (1984) reported

that 5 tones straw contains about 2 tones C which can be an indirect source of N that provide a substrate for microbial metabolism, including sugar, starches, celluloses, hemicelluloses, pectins, lignins, fats and proteins. These compounds constitute about 40 per cent (as C) of the dry matter of straw. Straw incorporation stimulates both heterotrophic and phototrophic N fixation in flooded soils (Matsuguchi, 1979). Rice straw application also increases the efficiency of chemical fertilizers in both temperate and tropical countries (Ponnamperuma, 1984).

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