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INFLUENCE OF DIFFERENT ORGANIC MULCHING MATERIALS ON SOIL FERTILITY AND PERFORMANCE OF OKRA IN NEW ALLUVIAL ZONE OF WEST BENGAL

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ABSTRACT

A Field experiments was conducted to evaluate the effect of different types of organic mulches on soil physico-chemical properties and productivity of okra crop in an intensely cultivated new alluvial gangetic soils (sandy-loam) of Nadia, West Bengal taxonomically classified as Typic Hapludalf of West Bengal in the year 2010-11 during pre-kharif season (March-June). The aim of the present study was to improve in crop performance by identifying suitable mulching practices during the growing season. Five treatment combinations with four replications were arranged in randomized block design. *i.e.* T_1: Vermicompost (2 t ha^{-1}, 3mm thick), T_2: straw (4 t ha^{-1}, 5 mm thick), T_3: saw dust (2 t ha^{-1}, 3mm thick) T_4: cow dung (2 t ha^{-1}, 3mm thick), T_5: control. It can be concluded that among the mulching materials, treatment receiving straw mulch (T2) gives best result regarding soil physical properties which directly influences greater soil moisture content but vermicompost (T1) gives highest yield (5.4 t ha^{-1}) followed by cowdung i.e. T4 (4.95 t ha^{-1}), straw mulch *i.e.* T2 (4.4 t ha^{-1}), saw dust i.e. T3 (3.98 t ha^{-1}).

INTRODUCTION

Over the past three decades or so, internationally, rapid strides have been made to evolve and spread resource conservation technologies which enhance conservation of water and nutrients. Conservation technologies which have its roots in universal principles of providing permanent soil cover (through crop residues, cover crops etc.) is now considered the principal road to sustainable agriculture, is a major step toward transition to sustainable agriculture. Thus a conservation technology like mulching practices is the most suitable and important in this regard especially in the rainfed / dry land agro ecosystem. Mulching is one of the simplest and most beneficial conservation practices that can use as a protective layer of a material that is spread on top of the soil. Mulches can either be organic—such as vermicompost, grass clippings, straw, saw dust, and similar materials or inorganic plastic. Organic mulches also improve the physico-chemical condition of the soil (Lal, 1974; Kar and Kumar, 2007, Kumar *et al*., 2016). As these mulches slowly decompose, they provide organic matter which helps greater organic carbon, source of plant nutrients and thereby improve plant growth and yield (Sharma *et al*., 2003; Singh *et al*., 2007; Pal *et al*., 2015). While inorganic mulches have their place in certain field, they lack the soil improving properties of organic mulches. In tropical and subtropical regions, although much organic matter is produced, it decays very rapidly whatever organic matter is added to the soil will be decomposed (over 90% in a year). Keeping this view, an attempt has been made in the present investigation on vegetables crops such as okra to study the effect of different types of mulching on crop performance, soil moisture status and physico-chemical properties in soil.

MATERIALS AND METHODS

The field experiment was conducted at the Kalyani 'C'-Block Farm, Bidhan Chandra Krishi Viswavidyalaya, Nadia district of West Bengal (22°76'N, 88°21'E and elevation of 9.75 m above MSL) and having tropical humid climate with Okra (*Abelmoschus esculentus*) during rainfed Pre-Kharif season (March-June) of 2010-11. The experimental site encompasses new alluvial zone, belong to the Order Inceptisol, Great Group Haplaquepts, Sub Group Typic Eutrochrept, with sandy loam texture, initial soil properties were slightly alkaline in reaction pH 7.7,bulk density-1.36 Mg m^{-3}, porosity 48.42%, electrical conductivity 0.22 dSm^{-1}, organic carbon- 0.55 % with available nitrogen (Subbiah and Asija, 1956), phosphorus (Olsen *et al*., 1954) and potassium (Brown & Wranckle, 1988) was 284.32, 44.68 and 261.34 kg ha^{-1} respectively. The experiment was laid down with 5m x 4 m plot size, in randomized block design with four replications, and 5 treatment combinations (different source of mulching materials) i.e. T1: Vermicompost (2 t ha^{-1}, 3mm thick), T2: straw (4 t ha^{-1}, 5mm thick), T3: saw dust (2 t ha^{-1}, 3mm thick), T4: cow dung (2 t ha^{-1}, 3mm thick), T5 as control (uncovered). The experimental

field was thoroughly prepared by 2 ploughing and 2 harrowing in to make the soil loose and friable. Overnight soaked seeds okra (Pusa Mukhamali) was sown in 50cm × 50 cm spacing. After 5 days of emergence of seedling, different treatments of mulching were applied. The crop was raised in purely rainfed condition and other standard agronomic practices were remaining same for all treatments. Parameters like plant height, soil moisture content were recorded at different crop growth stages (15, 20, 30, 36 and 44 DAS). After harvesting composite soil samples from each treatment was collected and prepared. Soil physico-chemical properties like bulk density, water holding capacity (Piper, 1966), Mean Weight Diameter (MWD) of water stable aggregates (Kemper and Rosenau, 1986) and soil organic carbon (Walkley *et al*., 1934) was employed as indicator of soil structural status and soil reaction pH (Jackson, 1973); Available N, P and K which regulate various physical, chemical and biological processes were measured and statistically analyzed applying the technique of analysis of variance (ANOVA) prescribed for the design to test the significance at 5% probability levels (Gomez *et al*., 1984).

RESULTS AND DISCUSSION

Different observations on soil moisture status, different growth parameters, yield attributes of Okra and some physico-chemical properties of soil were recorded for the experiment. Plant heights, soil moisture content at different periods along with yields are furnished in the Tables 1. The highest plant height in all the respective treatments is attained at 44 DAS. Plant height significantly varies with the variation in mulching. The effect of straw mulch and vermicompost register dominant effect on the plant height especially at 30, 36 and 44 DAS. This result is corroborated with the findings of Roy *et al*., 2010.

Periodic soil moisture content at different growth stages (15, 20, 30 and 44 DAS) due to variation of applied treatments in soil growing with okra as a test crop were monitored during the crop growing stages, the result of which are presented in Fig. 1. Without mulching treatment showed less moisture content throughout the cropping period. This is solely due to fact that faster and bulk rate of evapo-transpiration occurs from the uncovered soil as compared to that of mulched soils. The lowest range of soil moisture was found at first observation i.e. 15 DAM and that of highest value was associated with final observation i.e. 44 DAM with respect to all the treatments. From the observation data gained at different days after mulching viz. 15, 20, 30 and 40 DAM, it was found that the 3rd treatment i.e. sawdust mulching has the best and pronounced effect throughout the growth periods as compared to that of the other mulching materials in conserving the soil moisture due to the fact that the sawdust mulch can retain much more moisture as compared to the other soil mulching agents (similar finding observed by Isalm *et al*., 2007)). This will in turn enhance a better nutrient availability to the plants. The figure depicts the sawdust mulch performs the better results compare to others treatments (Sinkevicien *et al*., 2009).

Changes of soil physico-chemical properties as influenced by different type of mulching materials were showed in Table 2. Bulk density, water holding capacity, mean weight diameter (mm), pH, EC and organic carbon, available nitrogen, available phosphorus and available potassium were estimated. Result of the study reveals that the treatments of mulching have pronounced effect on bulk density. It was found that the lowest bulk density 1.23 Mg m^{-3} was achieved with vermicompost whereas the highest bulk density was found in control plot (1.34 gm/cc). Mean weight diameter designates the degree of aggregation of the soil particles. The highest mean weight diameter was achieved with treatment receiving straw mulch (0.88 mm) followed by vermicompost (0.85 mm), cowdung (0.84 mm), saw dust (0.82 mm) and control (0.76 mm) respectively. The increase in mean weight diameter is due to fact that organic specially straw act as a chelating agent to bind soil particles thus helps in aggregation and increases

Table 1: Effect of mulching on plant height, soil moisture content and yield of okra

Treatments	Plant height(cm)					Soil Moisture content (%)					Mean Yield of Okra	
	15 DAS	20 DAS	30 DAS	36 DAS	44 DAS	15 DAS	20 DAS	30 DAS	36 DAS	44 DAS	Number of fruits(t/ha)	Green Weight of fruits/ha
Vermicompost,T_1	6.40	7.23	12.25	17.99	26.50	9.15	9.15	17.09	18.15	11.04	475000	5.4
Strawmulch,T_2	6.67	6.83	10.75	17.08	26.69	10.04	10.04	16.96	17.27	10.98	380000	4.4
Sawdust,T_3	5.83	4.50	8.00	13.17	19.25	9.12	9.12	21.01	22.34	15.67	330000	3.98
Cowdung,T_4	6.03	6.00	10.00	16.67	24.73	9.29	9.29	15.08	18.41	11.43	437500	4.95
Control,T_5	5.13	4.92	6.53	11.30	14.67	8.87	8.87	11.63	14.11	8.99	310000	3.59
$CD_{(0.05)}$	1.27	1.25	1.54	3.61	7.17	NS	2.39	2.76	2.69	1.60	11126.67	0.22

Table 2: Changes of soil physico-chemical properties as influenced by different type of mulching materials

Treatment	B.D. (Mgm^{-3})	WHC(%)	MWD (mm)	pH	EC (mSm^{-1})	OC (%)	Av N ($kgha^{-1}$)	Av P ($kgha^{-1}$)	Av K ($kgha^{-1}$)
T_1	1.23	36.3	0.85	7.31	0.2	0.69	308	58	287
T_2	1.28	37.2	0.88	7.58	0.2	0.68	294	50	281
T_3	1.30	38.2	0.82	7.87	0.3	0.63	286	48	272
T_4	1.28	37.1	0.84	7.68	0.2	0.65	298	54	284
T_5	1.34	36.5	0.76	7.72	0.2	0.58	284	45	263
$C.D_{(0.05)}$	0.008	0.920	0.04	0.34	0.01	0.031	13.24	2.39	12.56

Table 3: Correlation matrix between green yield of okra and soil physico chemical properties

Treatments	Yield	B.D.	WHC	MWD	pH	EC	OC	Avai lable N	Avai lable P	Avai lable K
Yield	1									
B.D.	-0.940	1								
WHC	-0.198	0.230	1							
MWD	0.816	-0.759	0.150	1						
pH	-0.696	0.790	0.746	-0.460	1					
EC	-0.319	0.197	0.857	-0.125	0.640	1				
OC	0.915	-0.928	-0.075	0.942	-0.694	-0.204	1			
Available N	0.936	-0.947	-0.485	0.634	-0.880	-0.461	0.833	1		
Available P	0.953	-0.950	-0.356	0.625	-0.778	-0.329	0.815	0.981	1	
Available K	0.997	-0.931	-0.158	0.854	-0.675	-0.308	0.932	0.914	0.929	1

P (0.05) = 0.8783 and P(0.01) = 0.9587

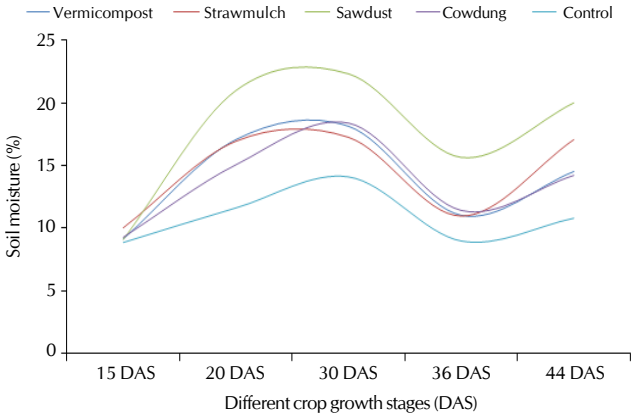

Figure 1: Effects of various mulching treatments on soil moisture content at different growth stages of okra crop

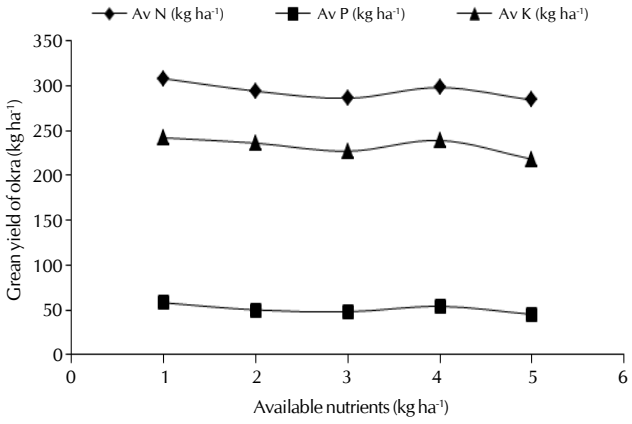

Figure 2: Effects of various organic mulching on available N, available P and available K in soil

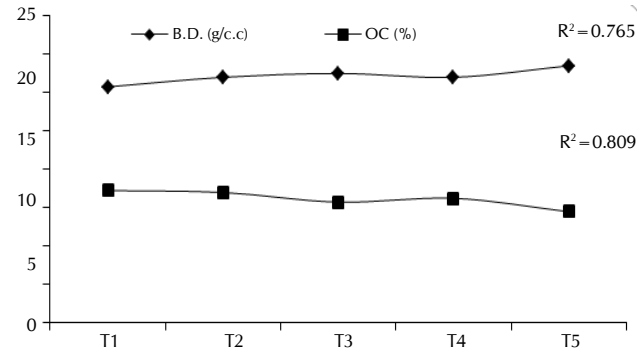

Figure 3: Effects of various organic mulching on soil bulk density and organic carbon content

mean weight diameter (Six *et al*., 2000; Bandyopadhayay *et al*., 2010).

The magnitude of yield is determined by number of fruits per hectare. Significant variations in fruit yields and number of fruits per plot were found with the variation in mulching treatment applied. The total number of fruits produced by the effect of mulching were 547500, 380000, 330000, 437500 and 310000 and yield were 5.40, 4.40, 3.98, 4.95 and 3.59 tonnes/ha for the treatments T_1, T_2, T_3, T_4 and T_5 respectively. The highest value was obtained for the treatment vermicompost (T_1). Critical examination of the data reveals that mulching causes green fruits yield response of 50.42% at vermicompost, 22.56% at straw mulch, 10.86% at sawdust and 37.88% at cowdung over control. In all cases the increase in yield were attributed to the increase in number of fruits. The similar findings has also found by Islam *et al*. (2007).Green weight of okra exhibits significant positive relationship with available nitrogen (r = 0.981), available phosphorus (r = 0.996), available K (r = 0.952) in soil (Table 3) and variability with bulk density, organic carbon, available N, available P and available K in soil are 76.9%, 80.9%, 51.4%, 52.5% and 46.5% respectively (Fig. 2 and Fig. 3).

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