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Efficient use of jute agro textiles as soil conditioner to increase tomato productivity

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ABSTRACT

A field experiment was conducted at the Central Research Farm under Bidhan Chandra Krishi Viswavidyalaya, Gayespur, Nadia district of West Bengal which is situated at 22^0 582 N L, 88^0 302 E L, with an altitude of 10.9 m above the mean sea level with a slope of 0 to 1% which is topographically medium in class to investigate the effect of various strength (gram per meter square) of jute agro textiles on yield and changes of soil properties of tomato. Five treatment combinations viz. T_1–800 GSM jute agro textiles , T_2 - 600 GSM jute agro textiles , T_3- 400 GSM jute agro textiles , T_4– 200 GSM jute agro textiles and T_5-Control (farmer's practice) were spread before transplanting of tomato seedlings along with the levels of N-P-K at 20- 40-40kg ha^{-1} in randomise block design with four réplications. Initial and final soil samples were analyzed for relevant physical and chemical properties by following standard methods .The yields of tomato were39.80 t ha^{-1}, 42.69 t ha^{-1}, 37.08 t ha^{-1}, 30.84 t $ha^{-1}$and 24.77 t ha^{-1}in the plots of Jute agro textiles 800 GSM, 600 GSM, 400 GSM, 200 GSM and control (farmer's practice) respectively. Significantly highest ($P<0.05$) fruit yield was recorded in plots of jute agro textiles 600 GSM. Response of fruit yield of tomato over control due to each treatment were 15.03 t ha^{-1} (60.68%), 17.92 t ha^{-1} (72.34%), 12.31 t ha^{-1} (49.70%) and 6.06 t ha^{-1} (24.47%) in respectively plots of jute agro textiles 800 GSM, 600 GSM, 400 GSM, 200 GSM. The yield of tomato significantly increased ($P<0.05$) with the application of each of the different types of treatments over control (farmer's practice). The result showed the decreased bulk density and increased porosity under all treatments also improved the moisture retention capacity in soil. They also helped to improve moisture use efficiency. Better aggregation and their stabilization as well as tomato yield occurred with applied T_2- 600 GSM jute agro textile treatments.

Keywords: Bulk density, jute agro textiles, porosity and moisture use efficiency

Tomato, (*Lycopersicon esculentum*)) is a dietary source of vitamins especially A and C, minerals and fiber, which are important for human nutrition and health. Also, tomatoes are the richest source of lycopene, flavonoids and phenolic acids which protects human beings from cancer, human inflammatory and cardiovascular diseases. In India it is grown in about 0.46 M ha area with 7.28 Mt production with 15.9 Mt ha^{-1} productivity. The major tomato producing states of the country are Bihar, Karnataka, Uttar Pradesh, Orissa, Andhra Pradesh, Maharashtra, Madhya Pradesh and West Bengal. In West Bengal, tomato is grown over an area of 43,600 ha with the production of 0.59 Mt with productivity of 13.6 Mt ha^{-1} but nowadays productivity decreases. However, the productivity of the crop gradually decreases due to declining soil fertility status and inadequate availability of water as well as non-availability of good quality seeds.

Naturally occurring jute geo textiles are eco-friendly and biodegradable products which act as surface cover materials and useful ameliorative to eliminate soil related constraints to crop production byYong *et al*. (2000) and Pain *et al*. (2013). It also helps to protect the most vital natural resources against various degradation processes and promotes vegetative cover through accelerated seed germination and seedling emergence of Bhattacharya *et al.* (2010). Adequate information on the efficiencies of jute agro textiles as soil conditioners towards improving crop productivity is lacking. Viewed the above consideration, the present study was undertaken to compare the efficiencies of different strength (gram per meter square) of jute agro textiles on soil quality changes and improvement of tomato yield.

MATERIALS AND METHODS

The present investigation had been carried out at the Central Research Farm under Bidhan Chandra Krishi Viswavidyalaya, Gayespur, Nadia district of West Bengal which is situated at 22^0 582 N L, 88^0 302 E L, with an altitude of 10.9 m above the mean sea level having average rainfall of 1500 to 1600 mm $year^{-1}$ with variation of temperatures between 10^0 to 38^0 C. The soils of the area are characterized by acidic in nature, low in organic carbon and medium in fertility status in an Inceptisols. The experiment was conducted with following treatments:

$T_{1:}$ Jute agro textiles (800gsm) + NPK @ 20:40:40(kg ha^{-1}), $T_{2:}$ Jute agro textiles (600gsm) + NPK @ 20 :40 :40 (kg ha^{-1}), T_3 : Jute agro textiles (400gsm) + NPK @

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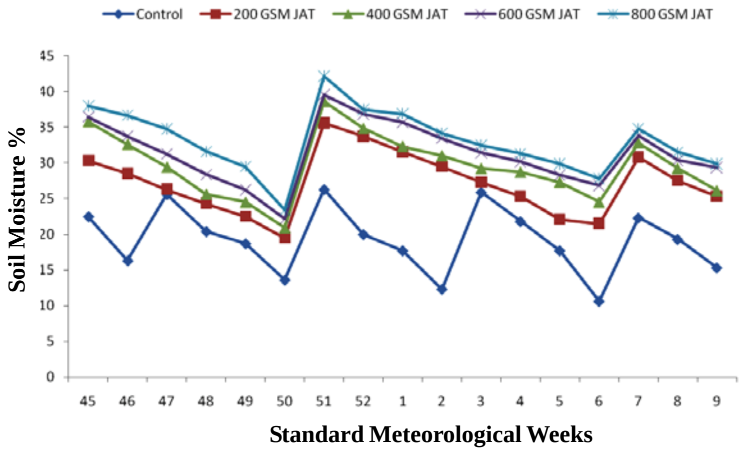

Fig. 1 : Effect of various jute agro textiles management on changes of soil moisture.

Fig. 2: Photograph. 1.15 days aged tomato crop with jute agro textiles.

Fig. 3:Three months aged tomato crop with fruits.

20 :40 :40 (kg ha^{-1}), T_4: Jute agro textiles (200gsm) + NPK @ 20 :40 :40 (kg ha^{-1}), T_5: Control (farmer practice) + NPK @ 20:40:40 (kg ha^{-1}), (gsm= gram per square meter).

The above treatments were replicated four times in randomise block design with growing Tomato, (var. - Pusa Ruby) as test crop. The field experiment was carried out during November to February, 2014-15 and 2015-16 .The area of each plots were maintained by 36 sq.m with spacing of 75 cm between row to row and 75 cm between plants to plants. Each year tomato crop was harvested during February. All jute agro textiles (of different strength) laid on soil before seedling transfer into main field. Soil sample were collected from 0-15 cm depth and moisture content at 7 days interval from entire growth period were determined by gravimetric method by Black (1965). Bulk density, porosity and size distribution of aggregates in soil was evaluated by the methods as proposed by Piper (1966). The pH, organic carbon, availabilities of phosphorous and potassium were determined by the standard procedure of Jackson (1965). Cost benefit ratios was calculated by the ratio of total economic return (Rs) and total cost (Rs). Moisture use efficiency was calculated by the relationship as: MUE (Kg ha^{-1}mm^{-1}) = Total yield (kg ha^{-1})/Consumptive use of water (mm). Necessary statistical analysis was worked out to interpret the effects of treatments as suggested by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Tomato yield

The results of effects of different strength of jute agro textiles on yields of tomato are presented in table 1. Response of tomato yield over control due to treatments were 15.03 t ha^{-1} (60.68%), 17.92 t ha^{-1} (72.34%), 12.31 t ha^{-1} (49.70%) and 6.06 t ha^{-1} (24.47%) respectively in 800 gsm, 600 gsm, 400 gsm and 200 gsm jute agro textiles. The significantly highest ($P<0.05$) tomato yield was observed in 600 gsm jute agro textiles. The benefit cost ratio of tomato crop was maximum on 600 gsm jute agro textiles also. The results revealed that the maximum tomato yield was under 600 gsm jute agro textiles probably due to proper root growth towards uninterrupted availability of nutrients through continuous supply of moisture and air. The above results are supported by Paza (2007).

Table 1: Effect of different strength of jute agro textiles on tomato yield, moisture use efficiency and benefit cost ratio (B: C).

Treatment	Yield (t ha^{-1})	MUE (Kg ha^{-1} mm^{-1})	Benefit Cost ratio (B : C)
Jute agro textiles (800gsm)	39.80	72.96	2.4:1
Jute agro textiles (600gsm)	42.69	77.05	2.6:1
Jute agro textiles (400gsm)	37.08	68.66	2.2:1
Jute agro textiles (200gsm)	30.83	58.00	2.2:1
Control (farmer practice)	24.77	54.68	1.5:1
SEm (±)	0.24	0.48	
LSD (0.05)	0.70	1.40	

Table 2: Effect of different strength of jute agro textiles on soil physical and chemical properties

Treatment	Bulk density (g cc^{-1})	Porosity (%)	Organic carbon (%)	Available nitrogen (Kg ha^{-1})	Available phosphorus (Kg ha^{-1})	Available potassium (Kg ha^{-1})
Jute agro textiles (800 gsm)	1.29	51.7	0.67	73.6	24.8	246.1
Jute agro textiles (600 gsm)	1.27	52.4	0.69	79.4	25	310.5
Jute agro textiles (400 gsm)	1.3	50.8	0.62	71.3	23.2	176.3
Jute agro textiles (200 gsm)	1.3	50.5	0.61	71.1	23	176.1
Control (farmer practice)	1.32	50.09	0.45	43	10.6	153
SEm(±)	**0.032**	**0.42**	**0.025**	**1.19**	**0.626**	**0.136**
LSD(0.05)	**0.078**	**1.47**	**0.074**	**2.92**	**1.53**	**0.334**

Table 3: Effect of different strength of jute agro textiles on the changes of indices on soil structure and there stabilization.

Treatments	MWD (mm)	Structural coefficient	GMD (mm)	WSA >0.25 %	WSA <0.25%
Jute agro textiles (800gsm)	1.872	0.812	0.705	82.38	17.62
Jute agro textiles (600gsm)	2.970	0.831	0.705	83.99	16.01
Jute agro textiles (400gsm)	0.743	0.702	0.462	71.70	28.24
Jute agro textiles (200gsm)	0.742	0.700	0.459	71.70	28.30
Control (farmer practice)	0.706	0.514	0.426	58.47	41.53
SEm (±)	**0.03**	**0.01**	**0.03**	**0.99**	**0.99**
LSD(0.05)	**0.10**	**0.03**	**0.12**	**3.43**	**3.43**

Physical and chemical properties of soil

The results of the effects of different strength of jute agro textiles on the changes of physical and chemical properties of soil are presented in table 2. Bulk density of soil were decreased by 0.03 (2.3%), 0.05 (3.8%), 0.02 (1.5%) and 0.02 (1.5%) with simultaneous increase in porosity by1.61 (3.2%), 2.3 (4.6%), 0.7 1(1.42) and 0.41(0.8%) in jute agro textile 800 gsm, 600 gsm, 400 gsm and 200 gsm respectively. The results further indicated significantly increased availability of nitrogen, phosphorous and potassium over control. The results also reveal the increment of organic carbon by 0.22(48.89%), 0.24(53.33%), 0.17(37.78%) and 0.16(35.56%) respectively in 800 gsm, 600 gsm, 400 gsm and 200 gsm jute agro textiles. The results revealed that the porosity increase aeration and root growth towards uninterrupted availability of nutrients. The above results also supported by Dutta and Chakraborty (1995).

Soil moisture use efficiencies

Soil moisture changes at 7 days interval for the entire growing period of tomato under various strength of jute agro textiles have been depictured in figure 1. Soil moisture content at every stage was higher under each of the treatment over control. It was found maximum under 800 gsm jute geo textiles than other treatments.

Results followed the following order of soil moisture contents: 800 gsm jute geo textiles > 600 gsm jute geo textiles > 400 gsm jute geo textiles > 200 gsm jute geo textiles > control at 15 cm. soil depth. The data further showed that the average moisture use efficiencies of the crop increased by 26.50 per cent due to the treatments of jute agro textiles over control, the highest 40.69 per cent of which occurred under 600 gsm jute agro textiles (Table 1).

Soil aggregation

The results of the effects of jute agro textiles on the changes of various indices of soil structure and their stabilization were presented in table 3. Results clearly revealed much variation of all the indices of soil structure and their stability due to application of various treatments. The values of mean weight diameter (MWD), geometric mean diameter (GMD), structural coefficient (SC) and water stable aggregates (WSA) were found highest in 600 gsm jute agro textiles followed by 800 gsm, 400 gsm and 200 gsm. These indicated that 600 gsm jute agro textiles could be effective ameliorative towards improving stability of soil structure.

Jute agro textiles as surface cover materials have various potentials for maintaining soil quality and protecting the soil against any form of degradation. Efficiencies of different strength of jute agro textiles on the improvements of soil properties attributing yield of tomato have been investigated in the present study. Sharp improvements of bulk density, porosity, moisture use efficiency as well as better aggregation and well stabilization of soil aggregates occurred due to application of each strength of jute agro textiles. The result thus leads to suggest that 600 gsm jute agro textiles could be effectively utilized for tomato cultivation as its beneficial effects towards highest yield and benefit cost ratio, favorable soil structure along with other soil properties and better rhizosphere of root zones to help uninterrupted availability water, nutrient and air, influencing root growth which in turn improves crop production.

REFERENCES

Black, C. A. 1965. Methyod of soil analysis. American Soc. Agron., Inc., Madison, Wisconsin, USA.

Dutta, T. and Chakraborty, T. 1995. Effect of organic manures and subabul leaf mulching under varying levels of fertility on growth and yield of potato and weed biomass. *Indian J. Agron*. **40 (1)**: 140-42

Gomez, K. A. and Gomez, A. 1984. Statistical Procedures for Agricultural Research, 2nd ed. Wiley, New York.

Hu L.Y., Wang. Z.Q., Peng, D.X. and Liao, G.S. 2000. Study on the effect of jute geotextile on ramie growth. *J. Scientia Agri. Sinica* . **33(3)** : 103-05.

Jackson, M. L. 1967. Soil chemical analysis. Prentice Hall of India Pvt.Ltd. New Delhi, India.

Nag, D., Choudhury, T. K., Debnath, S., Ganguli, P. K. and Ghosh, S. K. 2008. Efficient management of soil moisture with jute non-woven as mulch for cultivation of sweet lime and turmeric in red lateritic zone. *J Agr Eng*, New Delhi. **45** (3): 59-62

Pain, D., De, S. K., Tarafdar, P. K., Pal, A., Mahata, A. P., Adhikari, R. and Bauri, S. K. 2013. Efficient use of geotextiles as soil conditioner to increase potato productivity on inceptisols of West Bengal. *J. Soil Water Consv.* **12(2)** : 103-07

Paza, A. 2007. The fertilization of potato with cash crops and straw. *Framenta Agron.* **24**(40): 100-05.

Piper, C. S. 1966. Soil plant analysis. Asian Report, Hans Publisher, Bombay, India.