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Application of Different Geotextile in Soil to Improve the Soil Health in Humid and Hot Sub Humid Region of West Bengal, India

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ABSTRACT

Geotextiles a natural product at eco-friendly and biodegradable in nature, act as useful ameliorative to climate the soil related constrains of crop production. Biodeterioration of cellulose fiber results from the reduction at die polymerization leading to loss textile strength. It also helps to protect the most vital natural resources of soil and water from various degradation processes by erosion of soil and runoff water. It plays a vital role in increasing moisture holding capacity in soil, improving water uptake and drainage capacity. Application of suitable ameliorative thus necessitates for improving various soil conditions towards increasing the crop productivity. The experiment was conducted with five treatments combinations viz. T1 -non woven jute geotextile, T2 - non woven dry grasses geotextile, T3 - non woven coco coir geotextile ,T4 - non woven banana leaf fibre geotextile and T5 - farmers practices (i.e. control). All geotextile materials @ 10 ton /ha were spread on the soil after final land preparation and before seedling or planting of vegetables. Application of different Geotextile treatments improves the physical and chemical environments in soil thus favouring better soil conditions and nutrient availabilities towards better growth and yield of vegetables.

Introduction

Jute agro geo-textiles as surface cover materials have various potentials for maintaining soil quality and protecting the soil against any form of degradation. Naturally occurring jute agro 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 (Yong *et al.*, 2000; 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 (Bhattacharya *et al.*, 2010). Natural geotextiles degrades to form organic mulch and held in weak establishment of vegetation. Jute geotextile degrades in 1 to 2 years, dry grasses, coco coir geotextile and Banana leaf fiber, geotextile degrades 1 to 2 to 3 years (Adhikary *et al.,* 2019).

Geotextile application in soil location specific so in addition to the characteristics of geotextiles, identification and application of geotextiles depends on soil types, soil compaction, moisture content, liquid limits, plasticity index, bulk density, soil pH, iron/ calcium content, clay / silt and sand composition, land sloping and hydrolic action (Adhikary *et al.,* 2019).Geotextiles used for re-vegetation and soil stabilization and wherever the upper layer of the soil has to be preserved from wind and water erosion and conserved soil moisture during the establishment of a vegetation cover.

Materials and Methods

In order to investigate the application of different geotextile treatment on soil to improve the soil health in humid and hot sub humid region, experiment was carried out during 2015 – 2016 at Gokna village near Baduria North 24 Parganas West Bengal. The land is situated at 22º71' N latitude, 88 º 75' E longitudes with and altitude at 5 m above the mean sea level. The climate is subtropical moist sub humid with mean annual temperature of 36.4^0 C to 14.4^0 C and mean annual rainfall of 1503mm (KrishiVigyan Kendra, Ashoknagar). The initial soil test conducted before doing the experiment showed in (Table No -1) and treatment details also described on (Table No-2).

Results and Discussion

Effect different geotextile after one year changes of soil physical and chemical properties presented in this section.

Physical properties of soil

The result of changes of various physical properties in soil due to application of various non- woven geotextile are presented in (Table 3) .The data reveals that variations of bulk density, porosity and water holding capacity in soil were detected due to variation of treatment combinations. The result shows minimum bulk density under jute geotextile treatment than the other treatment.

Bulk density showed to change with the following order. Jute geotextile (1.20g/cc)< Dry grasses geotextile (1.23gm/cc) < Coco coir geotextile (1.25g/cc) < Banana leaf fibre geotextile (1.27g/cc) < control (1.28g/cc). The reduction of B.D. over control due to each treatment were 0.08 (6.25%), 0.05 (3.65%), 0.03 (2.08%), 0.01 (1.04%) respectively for jute fibre, Dry grasses, coco-coir and banana leaf fibre.

The results of porosity showed reverse trend of bulk density as it increases due to application of each treatments over control. Highest values are observed in the soil treated with jute geotextiles in every year (Table 3). Porosity showed to change with the following order Jute geotextile (56.46 %) >Dry grasses(55.56 %)> Coco coir geotextile (51.76 %)> Banana leaf fibre geotextile (51.16 %) >control (49.9 %). Increase porosity over control in each treatment was 6.57 (13.16%), 5.67 (11.36%), 1.87 (3.74 %), 1.27 (2.54%) respectively. The above results supported by Nag *et al.,* (2008).

The water holding capacity in soil also shows to vary significantly with the variation of various geotextiles application. At each of the geotextiles treatment the values of water holding capacity found to increase over control. Highest values are observed in the soil treated with jute geotextiles plots (Table 3).

Increase of water holding capacity over control due to each treatment were jute geotextile (58.4%) >Dry grasses(57.8%) > Coco coir geotextile (56.6%) > Banana leaf fibre geotextile (55.2%) > control (54.3%) increase of the value over control were 18.38%, 14.56%, 7.7% and 3.75% respectively for jute, Dry grasses, coco coir and banana leaf fibre geotextile.

Similar results also evidence by Booth *et al.*, (2005) lowering bulk density and increasing the porosity and water holding capacity by the application of palm leaf geotextile for maintain of soil quality and soil conservation. Soil aggregation is an important parameter of soil structure linked with various major functions in relation to soil management system. Stabilization of soil aggregates is often used as a measurement of soil structure, which mediates many important biological, chemical and physical processes in soil. Changes of some of such indicates like mean weight diameter, geometric mean diameter, water stability aggregates, percent aggregates stability and structural coefficient under the influence of geotextiles are presented in (Table 4).

The results found that all the soil structure and the stability of aggregation showed much variation due to variation of different treatments. Increases of MWD and GMD due to application of geotextiles are clearly shows improvement of soil structure. Biswas *et al.*, (1970) reported that the nature of organic matter played an important role in the development soil structure owing to differential nature of by products produced during the process of decomposition.

Chemical properties of soil

The effects of various geotextiles which change the chemical properties and nutrient availabilities in soils are presented in (Table 5). The various chemical properties are pH, organic carbon and availabilities of nutrients like nitrogen, phosphorus and potassium contents in soils. Soil pH and EC values decreases with the application of jute, Dry grasses, coco coir and banana leaf fibre geotextile more than the control plot.

Lowest value of pH (7.6) and EC (2.25mmhos/cm) were found in non-woven jute geotextile and highest value i.e 7.9 and 3.78mmhos/cm are found in the control plot. As well as available nitrogen, phosphorus and potassium content are also increase by application of geotextile. The highest value observed by application of jute geotextile is nitrogen 96.75 kg/ha, phosphorus 33.28 kg/ha and potassium 262.94 kg / ha respectively. The above results collaborate with the observation reported by Rajagopal and Ramakrishna, (1997) for the increasing availabilities of nutrients with the application of various geotextiles.

The value of organic carbon gradually increase by application of treatments following order i.e. jute geotextile 1.37>Dry grasses geotextile 1.27> coco coir geotextile 1.24> banana leaves geotextile 1.13> control 1.02. Increases of organic carbon content found highest in the plot under jute geotextile (34.31%) over the control.

The above results are in agreement with the observation as reported by Rajagopal and Ramakrishna (1997) who observed improvement of organic carbon content in soil by the application of geotextile. Similar options are also available from the results of Sudhier and Siddaramappa (1995) and Varalashmi *et al.*, (2005) Manna (2005),Dutta and Chakraborty (1995) and Adhikary *et al.*, (2016) also observed increase of organic carbon content in NPK over NP due to significant important of active fraction of soil organic crabon.

Table.1 Initial soil parameter of the experimental plot

Sl. No.	Particulars	Values
A)	**Physical properties**	
1	Bulk density (gm/cc)	1.28
2	Porosity (%)	49.9
3	Particle size distribution (%)	
	Sand	16.1
	Silt	33.7
	Clay	49.9
4.	Water holding capacity (%)	51.6
5	**Soil aggregates**	
a)	Mean weight diameter (mm)	0.665
b)	Structural coefficient	0.601
c)	GMD (mm)	0.418
d)	WAS> 0.25%	58.70
e)	WAS < 0.25%	40.26
B)	**Chemical Properties**	
1.	Soil pH (1 : 2.5 soil suspension)	7.9
2.	EC (mmhos/cm)	3.8
3.	Organic carbon (%)	0.95
4.	Available nitrogen (kg/ha)	22.10
5.	Available phosphorus (kg/ha)	20.19
6.	Available potassium (kg/ha)	165.30

Table.2 Experimental Details

Treatment Details	**T_1 : Non woven jute fibre geotextile (5 ton+ NPK @ 60 :40 :40 kg/ha)**
	T_2 : Non woven dry grasses fibre geotextile.(5 ton+ NPK @ 60 :40 :40 kg/ha)
	T_3 : Non woven coco coir geotextile. (5 ton+ NPK @ 60 :40 :40 kg/ha)
	T_4: Non woven banana leaf fibre geotextile. (5 ton+ NPK @ 60 :40 :40 kg/ha)
	T_5: Control (farmer practice). (NPK @ 60 :40 :40 kg/ha)
Plot size:	36 sq m.
Design:	RBD
Replication:	3
Date of planting	January 2nd 2015

Table.3 Physical Properties of Soil

Treatment	Bulk density(g/cc)	Porosity (%)	Water holding capacity (%)
Jute	1.20	56.47	60.97
Dry grasses	1.23	55.57	59.00
Coco coir	1.25	51.77	55.47
Banana leaf fibre	1.27	51.17	53.43
Control	1.28	49.90	51.50
SEm(±)	0.01	0.24	0.31
CD at 5%	0.02	0.78	1.02

Table.4 Soil Structure

Treatment	MWD (mm)	Structural coefficient	GMD (mm)	WAS >0.25 %	WAS<0.25%
Jute	1.960	0.976	0.813	85.757	16.453
Dry grasses	1.741	0.971	0.764	80.690	17.780
Coco coir	1.351	0.893	0.678	74.743	25.807
Banana leaf fibre	1.140	0.883	0.667	69.653	31.070
Control	0.752	0.646	0.474	62.200	39.820
SEm(±)	0.010	0.000	0.010	0.240	0.240
CD at 5%	0.050	0.000	0.020	0.770	0.770

Table.5 Chemical Properties of Soil

Treatment	pH	EC (mmhos/cm)	Organic carbon (%)	Available Nitrogen (Kg/ha)	Available phosphorus (Kg/ha)	Available Potassium (Kg/ha)
Jute	7.67	2.25	1.37	96.75	33.28	262.94
Dry grasses	7.63	2.91	1.27	85.19	31.05	247.38
Coco coir	7.57	3.15	1.24	80.52	34.25	218.04
Banana leaf fibre	7.47	3.49	1.13	75.45	29.97	212.29
Control	7.90	3.78	1.02	26.99	24.80	159.44
SEm(±)	0.06	0.04	0.02	1.01	0.30	1.96
CD at 5%	0.20	0.13	0.08	3.28	0.98	6.38

The results of present study thus lead to suggest that application of each of geotextiles increased growth and yield of vegetables. It also helps to improve physical and chemical properties in soil particularly the structural status in soil and also enhanced the water use efficiency and crop growth rate by the crops.

Besides, each at the applied geotextile facilitates to increase soil organic carbon and build up soil fertility. Among the various geotextiles used for the study jute geotextile found to be more effective for improving soil properties and building up soil fertility.

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