

Original Research Article

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Jute Agro Textile as a Mulching Tool for Improving Yield of Green Gram

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ABSTRACT

Keywords

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The present research work has been carried out to understand the effect of different strength of jute agro textiles on yield and moisture use efficiency of green gram (*Vigna radiata* L.) grown for two successive years 2016 and 2017 during the pre-kharif season from last week of February to 2nd week of May at the farmer's field in the Kamalpur village, Chatna block, Bankura, West Bengal. The experiment was conducted with five treatments viz. T₁ – 1000 GSM, T₂ – 800 GSM, T₃ – 600 GSM, T₄ – 400 GSM jute agro textiles and T₅ – farmer's practices where GSM = g/m². Results showed that, the yield is increased with each treatment, attaining the highest value of 6.74 q/ha in T₁ which is 185.6 % more than control. The moisture use efficiency of the crop, was increased significantly by 70.27% (on an average) due to the treatments over control. Though the best results were obtained in T₁, but the increment occurred in a declining pattern from T₂ to T₁ i.e. further increase in strength after T₂ was not proved to be efficient.

Introduction

India is the largest producer and consumer of pulse in the world, accounting for 25 percent of global production and 15 percent consumption (Saraswati *et al.*, 2004). Green gram (*Vigna radiata* L.) belongs to the family Leguminosae and sub family Papilionaceae, is being grown as one of the principal pulse crop since ages in the country.

The annual world production area of mungbean is about 5.5 million hectare. India is the primary greengram producer and contributes about 75% of the world's production (Taunk *et al.*, 2012). It is one of the major Kharif pulse crops in India covering

34.4 lakh hectare of area in the country with total production of 14 lakh tonnes and productivity of 415.70 kilogram per hectare (Anonymous, 2015). It is highly nutritious pulse crop having nearly 24 to 25% protein in seed.

To increase the production capacity of this highly proteinaceous crop many agronomic measures are adopted among which mulching is proved to be more efficient. Mulching usually involves placing a layer of organic or inorganic material on the soil surface around the desired crop to modify the growing micro-environment for improving crop productivity. Materials such as wheat straw, rice straw or husk, grass, weeds, leaves, leaf mold, animal

manures, compost, sawdust and woodchips are usually used as organic mulches and that of plastic or polyethylene film, sand, gravel, pebbles, etc. are used as inorganic mulches (Khurshid *et al.*, 2006; Seyfi and Rashidi, 2007; Quilty and Cattle, 2011). Mulching with synthetic (polyethylene film) or organic (crop residue) materials has been widely practiced for production of commercial widely spaced crops and vegetables including tomato, lettuce and others (Albert *et al.*, 2010). Geotextiles or agrotextiles mulches, permeable fabrics made from polypropylene or bio-degradable materials like jute and other fabrics, are most effective in modifying soil environment, suppressing weed and increasing crop yield (Manna *et al.*, 2018). In this context, jute agro textile, made from 100% natural bust fibre has the same potential to improve crop yield as well as soil fertility and productivity status. Application of jute agro textile mulches increased the yield of capsicum and pointed gourd (Saha *et al.*, 2006) and that of sweetlime and turmeric (Nag *et al.*, 2008) compared to control where no mulching materials were used.

Most of the earlier researchers have studied the impact of various mulches and their many beneficial effects, but hardly anybody attempted to study the beneficial aspects of different strength of jute agro textiles specially in increasing yield of green gram and their moisture use efficiency on Alfisols of West Bengal, India where mean annual rainfall is less (~1250 mm) and soil productivity is also less due to its light texture, acidic in nature, low fertility status and low water holding capacity.

On this background, a field experiment was undertaken to explore, in details, the effects of jute agrotextile mulches on growth and productivity of green gram (*Vigna radiata* L.) in Alfisols or lateritic soil of West Bengal, India.

Materials and Methods

Experimental site

The present study was carried out at the farmer's field in the Kamalpur village, Chatna block, Bankura, West Bengal under the soil order Alfisols, lies between 22.08' N L and 87.21' E L, the general elevation ranges from 200 to 500 m above mean sea level with the mean annual rainfall of 1247 mm. The soils are characterized by slightly acidic, low clay and organic matter content and dominants by kaolinitic and illitic type of clay mineral with the presence of small modules of iron concretions which make it beyond the optimum productivity level (Fig. 1).

Methodology

The variety named sona moog of green gram was sown on last week of February of each consecutive years and grown during the pre-kharif or summer season of 2016 and 2017. Five treatments i.e. T₁ -1000 GSM, T₂ -800 GSM, T₃- 600 GSM, T₄- 400 GSM jute agro textiles and T₅-farmer's practices (control) along with NPK dose of 20-40-20 kg/ha were used for the production of green gram where GSM = gram per meter square. The area of each plot was 20 sq.m with spacing of 30 cm X 10 cm. Before seeding @ 15 kg/ha, seed treatment was done by Rhizobium culture (1 pack/bigha) and with Diathem M-45 (3 gm/kg). The other recommended package of practices was adopted for growing the crop. Various strength of jute agro textiles were laid before sowing the crop. All the treatments were replicated four times in Randomized Block Design. All the yield attributes and physiological parameters were recorded and moisture use efficiency was calculated by the relationship as MUE (kg/mm/ha) = Total yield (kg/ha) / Total water use (mm). The obtained data were subjected to statistical investigation following the analysis of variance techniques

by using software packaging of MS Excel and OPSTAT. Statistical significance between means of individual treatments was assessed using Fisher's Least Significant Difference (LSD) at 1% level of probability (Gomez and Gomez. 1984).

Results and Discussion

Yield and yield attributes

The results of pooled data on yield and yield attributes of green gram grown in 2016 and 2017 during summer season with only one sprinkler irrigation during pod initiation on 1st year and flowering initiation on 2nd year showed variation with the application of various kinds of jute agro textiles (Table 1). The yields of green gram significantly increases with the application of each treatment and response over control were 4.38 q/ha (185.6%), 3.76 q/ha (159.32%), 2.48 q/ha (105.08%) and 2.18 q/ha (92.37%) respectively in 1000, 800, 600, 400 GSM jute agro textiles (Figure 2). Though the highest yield was observed in 1000 GSM but in case of percentage comparison between treatments 800 GSM showed more efficient result as 54.24% increment occurred in T₂ from T₃ than T₁ from T₂ (26.28% increment). Similarly the no. of pods per plant, no. of grains per pod and 1000 grain weight were also found highest in T₁ compared to the other treatments. Result further reveals that green gram yield is positively and significantly correlated with number of pod/plant ($r = 0.960$), number of grain/pod ($r = 0.992$), 1000 grain weight ($r = 0.932$), water use efficiency ($r = 0.996$) and crop growth rate ($r = 0.951$) at 1% level of significance (Table 4). The above findings were supported by Paza (2007).

Physiological parameter of green gram

The results of the number of branch/ plant, plant height, dry matter production and crop

growth rate influencing yield and growth of green gram crop due to application of various JAT are presented in (Table 2). Plant height and no of branches per plant had increased upto 32.58 cm and 9.51 from 26.74 cm and 5.27 respectively. The results also found that response of dry matter production over control due to each treatment were 136.95 g/m² (39.59%), 116.23 g/m² (33.6%), 49.79 g/m² (14.39%), and 19.91 g/m² (5.75%) in T₁, T₂, T₃, T₄ respectively. The total dry matter weight of green gram significantly increased with the application of different types of JAT over control but response is highest in T₂ from T₃ (66.44%) than T₁ from T₂ (20.72%). The response of crop growth rate over control due to each treatment were 1.98 g/day/m² (37.85%), 1.72 g/day/m² (32.88%), 0.81 g/day/m² (15.48%), and 0.4 g/day/m² (7.64%) g/day/m² in T₁, T₂, T₃, T₄ respectively. Again the crop growth rate is found to be highest in T₂ from T₃ (17.4%) than T₁ from T₂ (4.97%). According to it, the best result is found in case of treatment 800 GSM as it shows a declining trend of increment after this treatment.

Total water use and moisture use efficiency of green gram

Periodical soil moisture content in percentage due to variations of different geotextile treatment in soils growing with green gram was monitored by weekly basis, the results of which are presented in figure 5. Consistent variations have been observed in the soil moisture content under different treatment. Highest moisture percentage was found in 1000 GSM and lowest values were found in the control plots The total moisture use by plant i.e. water use pattern are found to follow in the order: T₁ (264.87 mm) > T₂ (259.94 mm) > T₃ (250.7 mm) > T₄ (248.01 mm) > control (185.41 mm) (Table 3). The total water use by plant and yield were significantly and positively correlated and the R² value is 0.882 according to linear trend line (Figure 4).

Table.1 Effect of different jute agro textiles on yield and yield component of green gram.
(Mean of two years)

Treatments	No. of pod/ plant	No. of grain/pod	1000 Grain weight (g)	Yield (Q/ha)
T ₁ - 1000 GSM	38.25	9.59	37.20	6.74
T ₂ - 800 GSM	36.06	8.96	36.84	6.12
T ₃ - 600 GSM	34.13	7.81	35.35	4.84
T ₄ - 400 GSM	32.67	7.26	34.94	4.54
T ₅ - control	28.68	5.84	26.78	2.36
SE (m) ±	0.019	0.15	0.028	0.008
C.D. at 5 %	0.064	0.496	0.091	0.025

Table.2 Effect of different jute agro textiles on physiological parameters of green gram
(Mean of two years)

Treatments	No. of Branch	Plant height (cm)	Dry matter production (g/m ²)	Crop growth rate (g/day/m ²)
T ₁ - 1000 GSM	9.51	32.58	482.87	7.21
T ₂ - 800 GSM	8.79	31.65	462.15	6.95
T ₃ - 600 GSM	7.66	29.77	395.71	6.04
T ₄ - 400 GSM	6.78	28.68	365.83	5.63
T ₅ - control	5.27	26.74	345.92	5.23
SE (m) ±	0.006	0.011	1.577	0.007
C.D. at 5 %	0.019	0.038	5.224	0.023

Table.3 Effect of different jute agro textiles on total water use and moisture use efficiency of
green gram (Mean of two years)

Treatments	Total Water Use (mm)	Moisture Use Efficiency (Kg/ ha-mm)
T ₁ - 1000 GSM	264.87	2.54
T ₂ - 800 GSM	259.94	2.35
T ₃ - 600 GSM	250.70	1.93
T ₄ - 400 GSM	248.01	1.83
T ₅ - control	185.41	1.27
SE (m) ±	0.77	0.006
C.D. at 5 %	2.54	0.021

Table.4 Correlation metrics involving yield and yield attributes characters of green gram (Mean of two years)

Correlations	No. of pod/plant	No. of grain/pod	1000 Grain weight (g)	WUE (kg/ha-mm)	Crop growth rate (g/day/m ²)	Yield (Q/ha)
No. of pod/plant	1					
No. of grain/pod	0.950**	1				
1000 Grain weight(g)	0.951**	0.886**	1			
Water use efficiency (kg/ha-mm)	0.942**	0.998**	0.896**	1		
Crop growth rate (g/day/m ²)	0.899**	0.978**	0.789 ^{NS}	0.971**	1	
Yield (Q/ha)	0.960**	0.992**	0.932**	0.996**	0.951**	1

** Correlation is significant at the 0.01 level (2-tailed).

Fig.1 Field view of green gram growing in summer season



Fig.2 Response of yield (Q/ha) over control in green gram

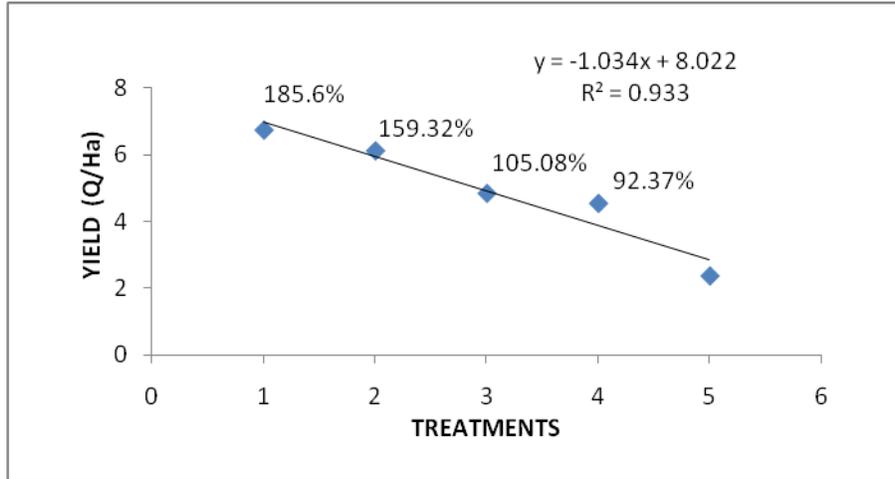


Fig.3 Response of moisture use efficiency (kg/ha-mm) over control in green gram

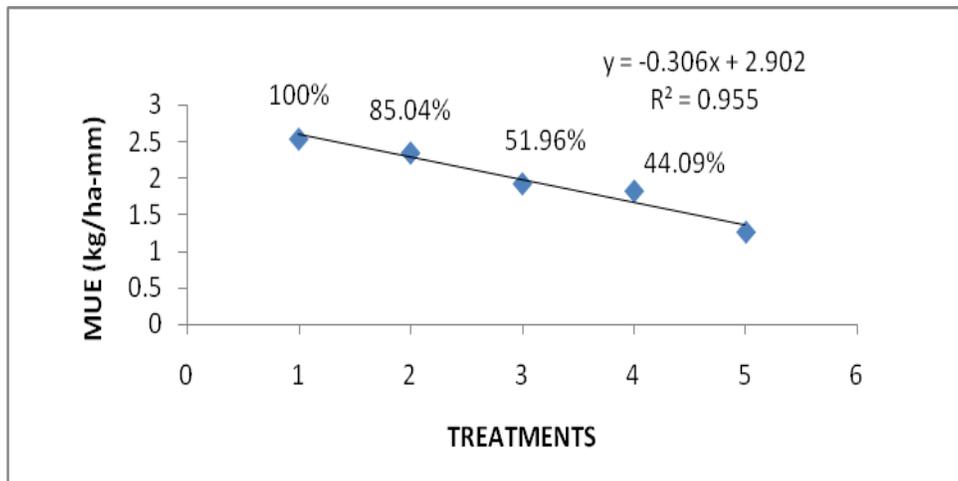


Fig.4 Relationship of yield (Q/ha) and total water use (mm)

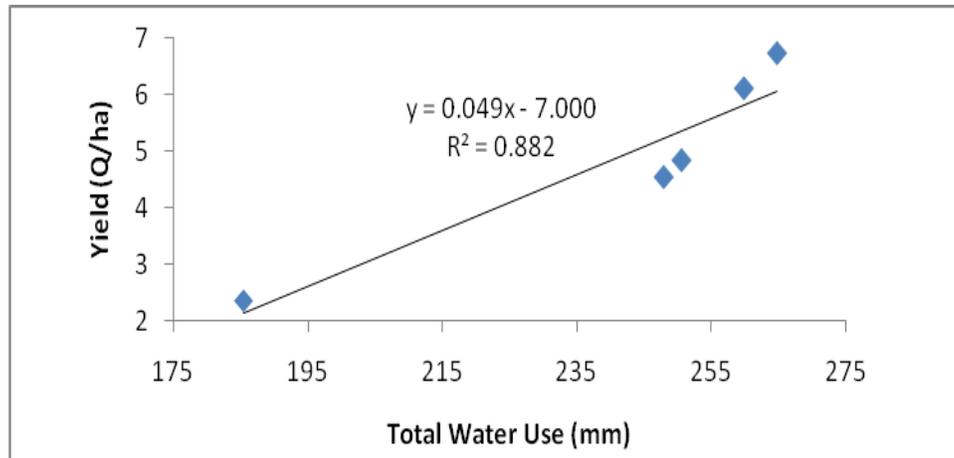
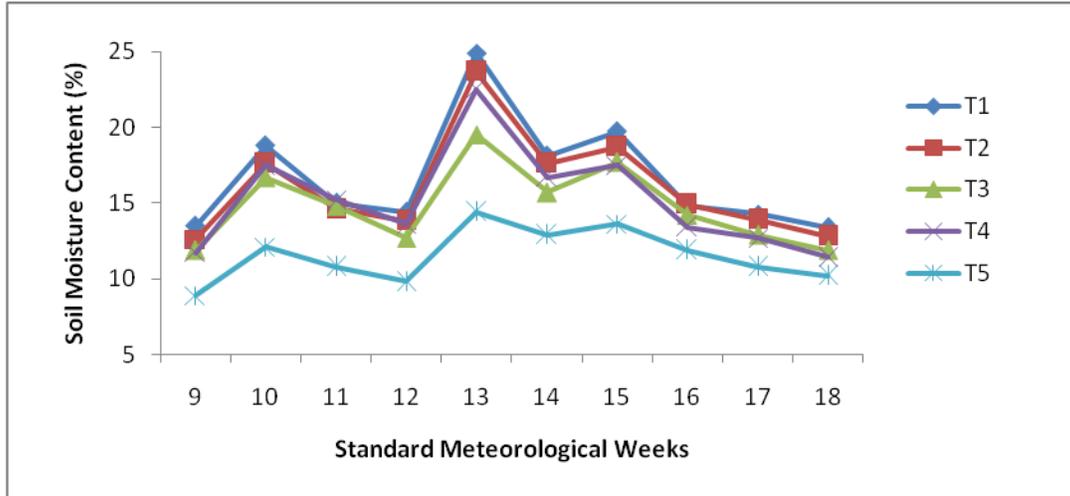


Fig.5 Effect of various jute agro textiles on changes of soil moisture pattern



The data further showed that the moisture use efficiencies (MUE) of the crop, were increased significantly over control by 1.27, 1.08, 6.6, 5.6 kg/ha/mm, generally on an average, 70.27% due to the treatments of T₁, T₂, T₃, T₄ respectively. The highest MUE was observed in treatment 1000 GSM i.e. 100% of the control plot (Figure 3). MUE is positively and significantly correlated with no. of pod/plant ($r = 0.942$), no. of grain/pod ($r = 0.998$), 1000 grain weight ($r = 0.896$), crop growth rate ($r = 0.971$) and grain yield ($r = 0.996$) at 1% level of significance (Table 4). The changes in soil moisture content due to various treatments might be attributed by lower bulk density and higher porosity of soil towards increasing moisture retention capacity of soil. The above results are supported by Nag *et al.*, (2008).

The effects of various strength of jute agro textiles on yield and yield components of green gram as well as their moisture use efficiencies have investigated in the present study. All the strength of jute agro textile is proved to be more efficient than the farmer's practice for improving the production of green gram. The increase in yield was found to be the highest in case of 1000 GSM compared to 800, 600 and 400 GSM, but the

difference in percentage increase between 600 and 800 GSM is greater than the percentage difference between 800 and 1000 GSM. That is, the percentage increase in yield shows a declining trend with the increase in GSM after the second treatment T₂. So, a further increase in GSM may results in an increase in yield, but with reduced magnitude leading to deceleration in net income which may not be economical considering the additional cost associated with it. JAT also improves the moisture use efficiency of the crop, hence can be used in areas of water scarcity. Acting as a mulching material, it improves the soil micro-environment i.e. optimum condition for favorable nutrient supply to the crop leading to higher productivity and income than regular condition. Thus the result leads to suggest that treatment T₂ - 800 GSM was found to be most effective for green gram cultivation as it not only improves the quality and quantity of crop but also the moisture use pattern leading to more moisture conserving environment for sustainable and economic development in agriculture.

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