ORIGINAL RESEARCH ARTICLE

INFLUENCE OF MULCHING AND ORGANIC MANURE ON THE GROWTH AND POD YIELD OF FRENCH BEAN (*Phaseolus vulgaris* L.)

ABSTRACT

An experiment was conducted at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka during November 2020 to March 2021 to study the influence of mulching and organic manure on the growth and pod yield of french bean (*Phaseolus vulgaris* L.). French bean variety BARI Jharsheem-2 was used as planting material in this study. The experiment consisted of two factors: Factor-A: mulch materials (4 levels): M_0 = No mulches, M_1 = Black polythene, M_2 = Rice straw and M_3 = Water hyacinth; Factor-B: T_0 = No organic manure, T_1 = Kitchen compost (5 t ha^{-1}), T_2 = Vermicompost (7 t ha^{-1}) and T_3 = Kitchen compost + Vermicompost (2.5 t ha^{-1} +3.5 t ha^{-1}). In the trial, the M_1 (Black Polythene Mulch) treatment outperformed the M_0 (No Mulch) treatment in terms of effectiveness. Higher pod yields per hectare were produced by the organic manure T_3 (Kitchen compost + Vermicompost) than by the control T_0 (no organic manure). The investigation's top treatment combination was identified as M_1T_3 (black polythene mulch and kitchen compost + vermicompost), which had a 17.55 tha^{-1} yield potential. At the interaction level between mulching and organic manure, a significant association between the yield and yield components was found.

Keywords: French bean**,** Water hyacinth, Vermicompost, Black polythene mulch, Pearson's correlation

INTRODUCTION

French bean (*Phaseolus vulgaris* L.) is an important vegetable crop belonging to the family Fabaceae and grown throughout the world. It is originated from Central and South America (Swiader *et al*., 1992). It is also grown in Europe, Italy, Africa, India, Peru, Mexico, Bangladesh etc. It has others name such as bush bean, kidney bean, snap bean, raj bean, common bean, basic bean, navy bean, haricot bean, pole bean, wax bean, string bean and bonchi (Salunkhe *et al*., 1987). In our country it is known as "Jhar Sheem" (Rashid, 1993). The green pods and mature seeds are used as cooked vegetable in our country. Seeds are also used as pulse in Sylhet, Moulovibazar, Sunamgonj, Habigonj, Brahmmanbaria, Coxsbazar, Chittagong, Feni etc. It is widely cultivated in many parts of the tropical, subtropical and throughout the temperate regions (Pursglove, 1987). But it is more suitable as a winter (rabi) crop in the India subcontinent area. Recently cultivation of french bean is gaining popularity in Bangladesh mainly because of its demand as a commodity for export. Hortex Foundation and BRAC are trying to extent the production area, because french bean is now an exportable vegetable among others (Kashem and Kamal, 2001). The green pod is nutritionally rich which contains on an average of 1.7 % protein, 4.5 % carbohydrate, 1.8% fiber, calcium 50 mg, magnesium 29 mg, phosphorous 28 mg, and iron 1.7 mg per 100 g of pod (Shanmugavelu, 1989). Production of french bean depends on many factors such as quality seed, variety, inorganic fertilizers, organic fertilizers, mulch materials and various management practices etc. Mulching is a

desirable cultural management practice which is reported to improve soil moisture, physical conditions by enhancing biological activity of the soil fauna and increases soil fertility (Mann and Chakor, 1989; Lal, 1989). In artificial mulching soil surface is covered with crop residues or plant species and generally practiced in the production of horticultural crops (Wilhoit *et al*., 1990). Mulching may be natural or artificial. In artificial mulching, soil surface is covered with crop residues or plant species or polythene sheets and these are generally practiced in the field of horticultural crop production. Lots of research work have been carried out in many countries with the use of natural mulches (Yavari *et al*., 2008), synthetic films and also hiodegradablc films of' organic origin (Scarascia-Mugnozza *et al*., 2006). Organic matter content of most of the Bangladesh soils is very low, the majority being below the critical level (1.5%) (BARC, 2005). Organic manure contains nutrient elements that can support crop production and enhance the chemical and physical properties of soil. Organic manure contains the essential nutrients such as nitrogen, phosphorus and potassium for growth and development of plants and improves the soil health (Alves *et al.*, 2000). The uptake of nutrient is higher with composted poultry manure. The added organic manure not only acts as a source of nutrient but also plays a vital role in transforming the inorganic fertilizer into their available form (Amanullah *et al*., 2007). Soil organic matter such as cowdung, poultry manure and vermicompost improves the tilt and structure of soil. It improves the ability of soil to hold water and plant nutrients. In Bangladesh, French bean is a newly introduced vegetable as well as pulse crop which is highly nutritious and can meet the demand of increasing population. Several works have been done on French bean but there is a limited works on the combining effect of mulching and organic manure on French bean. Therefore the present study was carried out with the following objectives: to select the suitable mulch material on growth and yield of French bean, to study the response of different organic manure on growth and yield of French bean and to assess the combined effect of mulching and organic manure on growth and yield of French bean.

MATERIALS AND METHODS

The present study was carried out at Horticultural Farm in Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh to study the response of different mulches and organic manure on the growth and yield of French bean (*Phaseolus vulgaris* L.) during the period November, 2020 to March, 2021. In this experiment french bean variety of BARI Jharsheem-2 was used in the experiment as a planting material. Two factors were used in the experiment four levels of mulches (M) *viz.* M_0 = No mulches, M_1 = Black polythene, M_2 = Rice straw and M_3 = Water hyacinth and four levels of organic manure (T) *viz.* T_0 = No organic manure, T_1 = Kitchen compost (5 t ha^{-1}) , T_2 = Vermicompost (7 t ha^{-1}) and T_3= Kitchen compost+Vermicompost (2.5 t ha^{-1}+3.5 t ha^{-1}). At the time of first ploughing, kitchen compost and vermicompost was applied as per treatmenet. The experimental area was fertilized as follow (Table 1).

Table 1: Fertilizer management

Fertilizers	Doses ha^{-1}		Nutrients	Sources
Vermicompost	T_2	7 t	N_{140kg} P_{110kg} K_{70kg}	Nature
	T_3	3.5 t	N_{70kg} P_{55kg} K_{35kg}	Nature
Kitchen compost	T_1	5 t	N_{120kg} P_{90kg} K_{60kg}	Nature
	T_3	2.5 t	N_{60kg} P_{45kg} K_{30kg}	Nature

Mulching materials are set up after final land preparation and before seed sowing of specific mulch material as treatment wise on the plot. The experiment consisted of 16 treatment combinations and was laid out in Randomized Complete Block Design (RCBD) with 3 replications. The unit plot size was 2 m x 1.5 m (3.00 m^2). Plant to plant distance was 25 cm x 15 cm. The distance between block to block was 0.5 m and distance between plot to plot was 0.5 m. Various intercultural operations, such as gap filling, weeding, thinning, stalking, irrigation, pest and disease control etc. were done for better growth and development of the seedlings. Five healthy plants were randomly selected in each plot as per treatment of each unit of plot to avoid border effect and data were recorded on yield and yield contributing characters of French bean. The data collected on different parameters were statistically analyzed to obtain the level of significance using the Statistx 10 computer package program. Analysis of variance was done following two factors randomized complete block design. The mean differences among the treatments were compared by Least Significant Difference (LSD) test at 5% level of significance.

RESULTS AND DISCUSSION

Different mulching materials significantly influenced the morphological performance of french bean (Table 2). The highest plant height (56.04 cm) was produced from M_1 (Black polythene) treatment and the shortest (54.48 cm) plant was produced in M_0 (no mulch) treatment. Similar trends was also observed in case of no. of leaves per plant, leaf length (cm), leaf breadth (cm), no. of branch $plant^{-1}$, days to first flowering, no. of flowers $plant^{-1}$, fresh weight of shoot $plant^{-1}$ (g), plant dry matter (%). Mulching was found to be more effective during the early stage of plant growth. The present result also agrees well with Subhan (1988), Choudhary, (2016), Islam (2020) and Barge *et al*., (2022). Different organic manure significantly influenced the morphological performance of french bean (Table 2). T_3 (Kitchen compost + Vermicompost) showed the best performance in case of plant height (cm), no. of leaves per plant, leaf length (cm), leaf breadth (cm), no. of branch $plant^{-1}$, days to first flowering, no. of flowers $plant^{-1}$, fresh weight of shoot $plant^{-1}$ (g), plant dry matter (%) among the treatment combinations. Rahman *et al*., (2012) and Thriveni *et al*., (2015) observed similar trend of results.

Table 2: Effect of mulching and organic manure on the morphological performance of French bean

Treatments Mulching	Plant height (cm)	No. of leaves per plant	Leaf length (cm)	Leaf breadth (cm)	No. of branch $plant^{-1}$	Days to first flowering	No. of flowers $plant^{-1}$	Fresh weight of shoot $plant^{-1}$ (g)	Plant dry matter (%)
M_0	54.48 d	16.20 d	9.38 d	7.49 d	13.26 d	43.45 a	20.57 d	50.49 d	18.34 d
M_1	56.04 a	18.54 a	10.90 a	8.76 a	14.80 a	40.67 d	25.12 a	55.47 a	19.91 a
M_2	55.13 c	17.80 c	9.92 c	8.54 b	14.11 c	42.87 b	23.35 c	51.87 c	19.10 c
M_3	55.47 b	18.281 b	10.44 b	8.39 c	14.34 b	42.17 c	23.86 b	52.85 b	19.68 b
CV%	7.5	2.46	4.36	2.94	5.71	3.06	3.79	2.58	6.26
Organic manure									
T_0	53.08 d	15.52 d	9.21 d	7.35 d	12.69 d	43.50 a	20.04 d	42.12 d	15.89 d
T_1	54.50c	16.97 c	9.89 c	7.97 c	13.55 c	42.36 b	21.75 c	50.61 c	18.18 c
T_2	56.38 b	18.35 b	10.55 b	8.42 b	14.47 b	41.82 c	24.30 b	56.65 b	20.84 b
T_3	57.17 a	19.98 a	10.98 a	9.42 a	15.81 a	41.46 d	26.82 a	61.30 a	22.11 a
CV%	7.5	2.46	4.36	2.94	5.71	3.06	3.79	2.58	6.26

Combined effect of different mulch materials and organic manure on the morphological performance of French bean was found statistically significant (Table 3). The interaction effect of M_1T_3 (black polythene mulch and Kitchen compost + Vermicompost) showed the highest performance in case of all the parameters of

morphological performance of French bean and M_0T_0 (no mulch and no organic manure) showed the lowest performance.

Table 3: Interaction effect of mulching and organic manure on the morphological performance of French bean

Interaction Mulching x Organic manure	Plant height (cm)	No. of leaves per plant	Leaf length (cm)	Leaf breadth (cm)	No. of branch plant^{-1}	Days to first flowering	No. of flowers plant^{-1}	Fresh weight of shoot plant^{-1} (g)	Plant dry matter (%)
M_0T_0	52.12 g	14.15 i	8.11 j	6.46 i	10.97 h	44.31 a	17.47 m	40.53 l	15.63 m
M_0T_1	53.55 f	15.26 h	8.81 i	6.93 h	13.20 g	43.29 bc	19.17 k	48.70 i	17.78 i
M_0T_2	56.04 c	17.20 e	9.94 f	7.33 g	14.09 de	43.22 c	21.2 j	54.18 f	19.52 f
M_0T_3	56.22 c	18.19 d	10.66 de	9.22 bc	14.78 c	42.99 cd	24.44 e	58.57 d	20.41 e
M_1T_0	53.41 f	15.93 g	9.64 g	8.05 f	13.81 ef	42.70 de	22.83 fg	42.85 j	16.15 j
M_1T_1	54.27 e	17.22 e	10.75 cd	8.18 f	14.19 de	41.21 h	23.38 f	52.33 g	18.68 g
M_1T_2	57.36 b	19.52c	11.28 b	8.88 d	14.72 c	39.73 i	25.37 d	61.21 c	21.02 d
M_1T_3	59.13 a	21.49 a	11.92 a	9.91 a	16.51 a	39.03 j	28.90 a	65.48 a	23.77 a
M_2T_0	52.18 g	16.53 f	9.14 h	7.48 g	12.91 g	43.68 b	21.64 ij	43.18 j	15.77 l
M_2T_1	55.10 d	17.26 e	9.95 f	8.48 e	13.16 g	42.80 d	22.01 hi	50.38 h	17.72 i
M_2T_2	56.10 c	17.37 e	10.14 f	9.04 cd	14.21 d	42.66 de	23.34 f	55.68 e	20.44 e
M_2T_3	57.16 b	20.03 b	10.43 e	9.16 bc	16.17 a	42.34 ef	26.42 c	58.26 d	22.46 b
M_3T_0	54.61 e	15.46 h	9.96 f	7.42 g	13.08 g	43.33 bc	18.22 l	41.93 k	16.02 k
M_3T_1	55.07 d	18.14 d	10.04 f	8.30 ef	13.66 f	42.16 f	22.41 gh	51.02 h	18.53 h
M_3T_2	56.03 c	19.31 c	10.85 cd	8.45 e	14.86 c	41.68 g	27.28 b	55.54 e	22.39 b
M_3T_3	56.15 c	20.22 b	4.36	2.94	5.71	3.06	3.79	62.89 b	21.78 c
CV%	7.5	2.46	4.36	2.94	5.71	3.06	3.79	2.58	6.26

Significant variation was observed in yield and yield contributing characters of french bean due to application of different mulching materials (Table 4). Among the treatment combinations M_1 (Black polythene) showed the best performance in terms of all the yield and yield contributing characters of french bean and M_0 (no mulch) showed the worst performance. In case of different organic manure application also significant variation was observed in yield and yield contributing characters of french bean (Table 4). T_3 (Kitchen compost + Vermicompost) showed the highest performance in terms of in yield and yield contributing characters of french bean among the treatment combinations. Mohamed (2002), Ali and Gaur (2007) and Ravneet and Sarabjeet (2009) support the result of present experiment.

Table 4: Effect of mulching and organic manure on the yield and yield contributing characters of French bean

Treatments Mulching	No. of pod plant^{-1}	Length of green pod (cm)	Diameter of green pod (cm)	No. of seed pod^{-1}	1000 seed weight (g)	Yield ha^{-1} (t)	Seed Germination (%)
M_0	16.55 d	11.71 d	1.10	6.85 d	905.44 c	12.71 d	87.25 d
M_1	20.74 a	13.63 a	1.24	7.89 a	994.21 a	14.70 a	92.92 a
M_2	18.83 c	12.60 c	1.17	7.26 c	929.39 b	13.92 c	89.33 c
M_3	20.27 b	12.86 b	1.21	7.67 b	935.77 b	14.08 b	91.58 b
CV%	4.94	3.23	6.19	4.20	4.16	3.57	7.96
Organic manure							
T_0	15.54 d	11.13 d	1.11	5.86 d	875.70 d	11.702 d	86.17 d
T_1	18.31 c	12.43 c	1.17	6.81 c	914.90 c	12.84 c	89.00 c
T_2	20.81 b	13.33 b	1.21	8.04 b	965.70 b	15.10 b	92.00 b
T_3	21.72 a	13.91 a	1.24	8.94 a	1008.40a	15.77 a	93.92 a
CV%	4.94	3.23	6.19	4.20	4.16	3.57	7.96

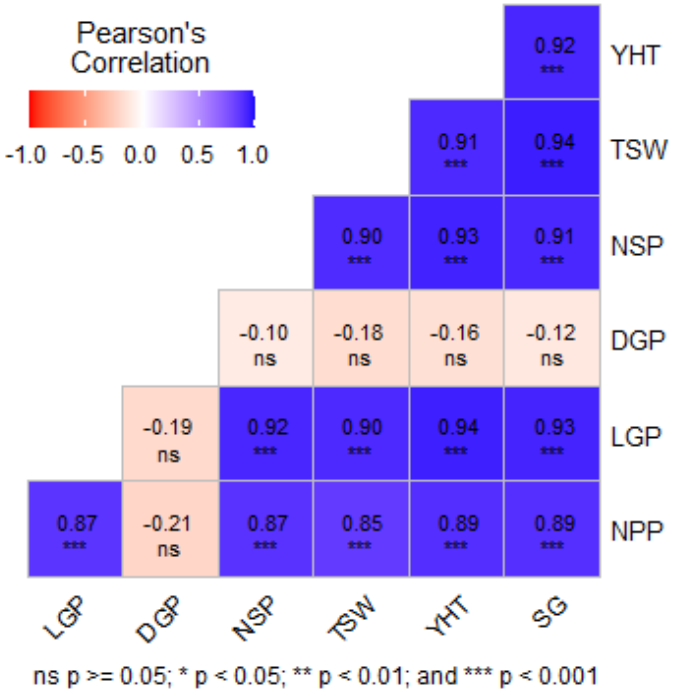
Combined effect of different mulch materials and organic manure on the yield and yield contributing characters of French bean was found statistically significant (Table 5). The interaction effect of M_1T_3 (black polythene mulch and Kitchen compost + Vermicompost) showed the highest performance in case of all the parameters of

yield and yield contributing characters of French bean and M_0T_0 (no mulch and no organic manure) showed the lowest performance.

Table 5: Interaction effect of mulching and organic manure on the yield and yield contributing characters of French bean

Interaction Mulching x Organic manure	No. of pod plant^{-1}	Length of green pod (cm)	Diameter of green pod (cm)	No. of seed pod^{-1}	1000 seed weight (g)	Yield ha^{-1} (t)	Seed Germination (%)
M_0T_0	14.52 l	10.41 j	1.05	5.18 j	849.70 k	11.37 j	83.67 j
M_0T_1	16.44 j	11.91 h	1.11	6.87 f	873.90 ij	12.05 h	85.67 i
M_0T_2	17.58 hi	12.14 gh	1.12	7.41 e	923.40 g	13.64 e	88.67 h
M_0T_3	17.63 hi	12.40 g	1.14	7.93 d	974.80 de	13.80 e	91.00 fg
M_1T_0	15.23 k	12.28 gh	1.17	6.12 hi	911.90 gh	11.66 i	88.33 h
M_1T_1	17.88 gh	12.91 f	1.20	6.90 f	964.60 ef	13.65 e	92.00 def
M_1T_2	24.48 b	14.16 c	1.25	8.61 c	1016.80 b	15.95 b	94.67 bc
M_1T_3	25.35 a	15.16 a	1.33	9.92 a	1083.60 a	17.55 a	96.67 a
M_2T_0	17.20 i	10.69 j	1.07	5.76 i	862.40 jk	11.65 i	85.33 i
M_2T_1	18.49 fg	12.94 f	1.16	6.86 f	909.10 h	13.28 f	88.00 h
M_2T_2	19.06 f	13.23 ef	1.21	7.71 de	960.60 f	15.21 d	91.33 efg
M_2T_3	20.56 e	13.52 de	1.26	8.70 c	985.50 cd	15.54 c	92.67 de
M_3T_0	15.19 k	11.15 i	1.15	6.39 gh	878.90 i	12.01 h	87.33 h
M_3T_1	20.44 e	11.95 h	1.22	6.62 fg	912.10 gh	12.37 g	90.33 g
M_3T_2	22.11 d	13.78 cd	1.24	8.45 c	962.20 ef	15.61 c	93.33 cd
M_3T_3	23.35 c	14.56 b	1.25	9.21 b	989.80 c	16.2 b	95.33 ab
CV%	4.94	3.23	6.19	4.20	4.16	3.57	7.96

Pearson Correlation statistics is a widely applicable evaluation method that effectively shows the relationship between two variables. The current study raveled the correlation association at interaction level on yield and yield contributing characters of French bean (Fig. 1). No. of pod plant^{-1} showed strongly significant and positive correlation association with seed germination (%) (0.89), yield ha^{-1} (t) (0.89), 1000 seed weight (g) (0.85), no. of seed pod^{-1} (0.87) and length of green pod (cm) (0.87) but showed non-significant and negative correlation association with diameter of green pod (cm) (-0.21). Length of green pod (cm) showed the similar trend. Diameter of green pod (cm) showed non-significant and negative correlation association with seed germination (%) (-0.12), yield ha^{-1} (t) (-0.16), 1000 seed weight (g) (-0.18), no. of seed pod^{-1} (-0.10). No. of seed pod^{-1} showed strongly significant and positive correlation association with seed germination (%) (0.91), yield ha^{-1} (t) (0.93) and 1000 seed weight (g) (0.90). Thousand seed weight (g) showed strongly significant and positive correlation association with seed germination (%) (0.94) and yield ha^{-1} (t) (0.91). Mishra *et al*. (2008) observed similar trend of results.



Here, NPP-No. of pod plant^{-1}, LGP-Length of green pod (cm), DGP-Diameter of green pod (cm), NSP- No. of seed pod^{-1}, TSW-1000 seed weight (g), YHT-Yield ha^{-1} (t), SG-Seed germination (%)

Fig. 1: Correlation coefficients for yield and yield contributing characters of French bean.

CONCLUSION

The goals of the current study were to choose the best mulch for French bean growth and yield, examine the effects of various types of organic manure on French bean growth and yield, and determine the combined impact of mulching and organic manure on French bean growth and yield. In the experiment M_1 (Black polythene mulch) treatment was more effective than without mulch M_0 (no mulch) treatment. The organic manure T_3 (Kitchen compost + Vermicompost) gave higher pod yield per hectare than without organic manure T_0 (no organic manure). During the investigation, the best treatment combination was obtained from M_1T_3 (black polythene mulch and Kitchen compost + Vermicompost) treatment combination having yield potentiality of 17.55 tha^{-1}. Significant correlation was observed among the yield and yield components at mulching and organic manure interaction level.

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