



Effect of Mulching on Plant Growth, Yield and Quality of French Bean (*Phaseolus vulgaris* L.) cv. ArkaKomal

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

An experiment on the "Effect of mulching on plant growth, yield and quality of French bean (*Phaseolus vulgaris* L.) cv. Arkakomal" was conducted during November 2021 to January 2022, in Central Horticulture Research Farm, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P) India. The results of the present investigation, regarding that cultivation of French bean with different mulching material found as the best option for higher productivity whereas the treatment with Saw dust mulch that is Treatment T₆ showed the best results in terms of Days to seed germination (8.6 DAS), Plant height at 30DAS (14.8 cm), 60 DAS (2.6.6 cm), 90 DAS (32.0 cm), Number of branches plant⁻¹ at 30 DAS (4.9), 60 DAS (9.0), 90DAS (10.3), Days to first flowering (35.7 DAS), Days to 50% Flowering (41.9 DAS), Days to first picking (55.5 DAS), Leaf Length (8.8 cm), Leaf breadth (6.6 cm), Number of pods plant⁻¹

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¹ (21.1), Pod weight (13.5 g), Pod length (15.7 cm), Pod diameter (1.8 cm), Pod yield plant⁻¹ (857 g), Pod yield ha⁻¹ (5.7 t), Number of seeds pod⁻¹ (8.2), TSS (6.2 °Brix). Hence the Treatment 6 (Saw dust mulch) was best suited for the farmers in terms of growth, yield, quality and net returns.

Keywords: French bean; mulching media; growth; yield; quality.

1. INTRODUCTION

French bean (*Phaseolus vulgaris* L.) is one of the most important vegetable crops. It belongs to the family Leguminosae and sub family Papilionaceae, which originated in the central and South America. It is widely cultivated in the temperate and subtropical regions and also in many parts of the tropics. It is extensively grown, commercially and also in the home garden. In our country it is known as "Farashisheem". Production of French bean depends on many factors such as quality of seed, variety, fertilizers, Mulch materials and proper management practices. "Mulch is a general term for a protective ground cover that can include manure, wood chips, seaweed, leaves, straw, grasses, sands, stones (boulders), synthetic plastics, and other natural products. While the term mulching may be defined as a practice of covering the surface of soil with these materials to reduce evaporation, and also to moderate wide fluctuations in diurnal soil temperatures, especially in the root zone environment [1-3]. It controls external evaporability and also reduces energy supply to the evaporating site by cutting off solar radiation falling on the ground. Its main function is limited to controlling first stage of drying which helps in improved moisture status, reduced soil temperature" [4], besides checking seedling mortality and improving crop stand. It also suppresses weed flora and reduces weed competition with crop for water and nutrients making them available in greater quantities for crop plants. Besides the above, mulching helps in increasing downward movement of water. Growing any crop in the open field can suffer moisture loss, reduces yield by weeds competition and their growing intensity that further causes for diseases and pest infestation [5,6]. That makes decrease in overall growth, yield and quality of crop if not taken care. The use of mulching can save the crop from all this problem and also include conservation of soil moisture, reducing weed growth, reducing disease & pest infestation of the field. Mulches of organic materials will be incorporated naturally into the soil by the activity of earthworms and other microorganisms present in soil and provide nutrients to the soil. The effectiveness of

mulches in conserving moisture has generally been found to be higher under more frequency of rainfall, drought conditions and also during early period of plant growth when canopy cover remains scanty. Mulches whether organic or synthetic type used in vegetable production are helpful in controlling weed population, reducing the impact of falling rain drops and reducing soil erosion, regulation of soil temperature and conservation of soil moisture. Different kinds of mulch play important role in conserving soil moisture. The yield of French bean may be increased by mulching. Considering the above facts.

2. MATERIALS AND METHODS

A field experiment was conducted during November 2021 to January 2022. At Central Horticulture Research Field of Horticulture Department, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The experiment entitled "Effect of mulching on plant growth, yield and quality of French bean (*Phaseolus vulgaris* L.) cv. Arkakomal." was conducted in Zaid season adapting Randomized block design (RBD) consisting of 9 treatments and three replications. The treatments are T₀ (No Mulch), T₁ (Paddy Straw), T₂ (Dry Grass), T₃ (Coconut Husk), T₄ (Banana Leaves), T₅ (Newspaper Mulch), T₆ (Saw Dust Mulch), T₇ (Black Plastic Mulch), T₈ (Silver Plastic Mulch).

3. RESULTS AND DISCUSSION

The results revealed that French bean had the following performance.

3.1 Growth Parameters

Growth parameters of French bean were presented in Table 1. It is clear from the Table 1 that the significant results shows that the minimum days to germination was observed in, treatment T₆ (8.6) whereas maximum days to germination in, treatment T₀ (11.8). The maximum plant height was observed in, treatment T₆ (32.0) at 90 DAS. Whereas minimum plant height in

Table 1. Effect of different mulching on growth of French bean

Notation	Treatments	Days to first seed germination	Plant height (cm)			No. of branches / plant			Days to 50% flowering	Days to first picking	Leaf length	Leaf breadth
			30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS				
T ₀	No Mulch	11.8	10.5	17.4	26.8	2.8	6.9	8.3	48.4	61.1	7.4	5.2
T ₁	Paddy Straw	9.9	11.6	20.6	28.4	3.4	7.5	8.9	45.1	58.1	8.1	5.9
T ₂	Dry Grass	10.4	11.4	20.4	28.2	3.3	7.4	8.7	45.9	58.6	7.9	5.9
T ₃	Coconut Husk	9.0	14.0	25.3	30.6	4.4	8.5	9.8	42.1	55.8	8.8	6.4
T ₄	Banana Leaves	9.1	13.2	24.6	29.7	4.1	8.2	9.6	43.0	56.5	8.5	6.4
T ₅	Newspaper Mulch	9.4	12.7	21.3	28.5	3.6	7.8	9.1	43.7	57.7	8.3	6.2
T ₆	Saw Dust Mulch	8.6	14.8	26.6	32.0	4.9	9.0	10.3	41.9	55.5	8.8	6.6
T ₇	Black Plastic Mulch	11.2	10.6	18.0	27.3	2.9	7.0	8.4	47.4	60.2	7.5	5.3
T ₈	Silver Plastic Mulch	10.6	11.2	19.6	27.8	3.0	7.1	8.5	46.4	59.0	7.9	5.6
F-test		S	S	S	S	S	S	S	S	S	S	S
SEd±		0.11	0.01	0.01	0.01	0.11	0.15	0.15	0.32	0.38	0.22	0.22
CD (0.05)		0.33	0.03	0.03	0.03	0.34	0.44	0.44	0.96	1.15	0.65	0.66

Table 2. Effect of different mulching on yield of French bean

Notation	Treatments	Number of Pods/Plant	Pod Weight (g)	Pod Length (cm)	Pod Diameter (cm)	Yield / Plant (g)	Yield / ha. (t)	Number of Seeds / Pods
T ₀	No Mulch (Control)	14.2	9.7	13.1	0.7	411	2.7	5.5
T ₁	Paddy Straw	17.1	11.3	14.6	1.1	580	3.9	7.2
T ₂	Dry Grass	16.5	10.9	14.2	1.0	540	3.6	7.0
T ₃	Coconut Husk	19.6	13.3	15.6	1.7	783	5.2	7.9
T ₄	Banana Leaves	18.6	12.8	15.5	1.3	712	4.7	7.7
T ₅	Newspaper Mulch	17.3	11.9	15.1	1.2	615	4.1	7.4
T ₆	Saw Dust Mulch	21.1	13.5	15.7	1.8	857	5.7	8.2
T ₇	Black Plastic Mulch	14.5	10.0	13.3	0.8	436	2.9	6.2
T ₈	Silver Plastic Mulch	15.6	10.3	13.5	0.9	485	3.2	6.8
F-test		S	S	S	S	S	S	S
SEd±		0.419	0.189	0.263	0.018	0.00	0.01	0.05
CD (0.05)		1.257	0.565	0.788	0.053	0.004	0.025	0.16
CV%		4.234	2.839	3.137	2.567	1.071	1.071	1.29

Table 3. Effect of different mulching on quality and economics of French bean

Notation	Treatments	TSS	Net return (INR/ha.)	Benefit Cost ratio
T ₀	No Mulch (Control)	5.2	70713	1.1
T ₁	Paddy Straw	5.7	122112	1.7
T ₂	Dry Grass	5.6	108738	1.5
T ₃	Coconut Husk	6.1	188908	2.6
T ₄	Banana Leaves	5.9	167362	2.4
T ₅	Newspaper Mulch	5.8	132696	1.8
T ₆	Saw Dust Mulch	6.2	216436	3.1
T ₇	Black Plastic Mulch	5.4	71130	1.0
T ₈	Silver Plastic Mulch	5.5	87467	1.2
F-test		S	-	-
SEd±		0.01	-	-
CD (0.05)		0.03	-	-

Table 4. Effect of different mulching on soil fertility of French bean

Notation	Treatments	Before sowing			After harvest		
		Soil N (kg ha ⁻¹)	Soil P (kg ha ⁻¹)	Soil K (kg ha ⁻¹)	Soil N (kg ha ⁻¹)	Soil P (kg ha ⁻¹)	Soil K (kg ha ⁻¹)
T ₀	No mulch	277.23	58.21	329.25	207	42.85	316
T ₁	Paddy straw	284.56	59.29	340.98	221	46.65	325
T ₂	Dry grass	272.56	56.71	331.64	211	44.07	319
T ₃	Coconut husk	276.45	56.78	330.46	204	42.89	317
T ₄	Banana leaves	285.64	59.77	335.85	214	45.12	321
T ₅	Newspaper mulch	211	45.35	324.42	211	45.35	324.42
T ₆	Saw dust	281.35	61.2	335.44	209	43.56	318.95
T ₇	Black plastic	286.95	60.87	336.9	215	44.38	321.26
T ₈	Silver plastic	277.56	60.44	332.8	210	44.98	319.34
F-Test		S	S	S	S	S	S
SEd(±)		2.064	2.091	2.102	2.064	2.091	2.102
CD		4.02	--	--	4.02	7.18	4.25

treatment T₀ (26.8). The maximum number of branches plant⁻¹ at 90 DAS was observed in treatment T₆ (10.3) followed by, treatment T₃ (9.8). Whereas minimum Number of branches plant⁻¹ in, treatment T₀ (8.3). The minimum days to first flowering was observed in, treatment T₆ (35.7). Whereas maximum days to first flowering in, treatment T₀ (42.0). The minimum days to 50% flowering was observed in, treatment T₆ (41.9). Whereas maximum days to 50% flowering in, treatment T₀ (48.4). The minimum Days to first picking was observed in, treatment T₆ (55.5). Whereas maximum Days to first picking in, treatment T₀ (61.1). The maximum leaf length (cm) was observed in, treatment T₆ (8.8). Whereas minimum leaf length (cm) in, treatment T₀ (7.4). The maximum leaf breadth (cm) was observed in, treatment T₆ (6.6). Whereas minimum leaf breadth (cm) in, treatment T₀ (5.2). "The main function of sawdust mulch is limited to controlling first stage of drying which helps in improved moisture status, reduced soil temperature [4], besides checking seedling mortality and improving crop stand. Mulching helps in better seedling establishment by reducing the soil temperature and conserving soil water, resulting in better seedling establishment. Organic mulches may produce some phytotoxic allelochemicals, which are known to reduce the germination and seedling growth of crops".

3.2 Yield Parameters

Yield parameters of French bean were presented in Table 2. It is clear from the Table 2. That the significant results shows that the maximum number of pods plant⁻¹ was observed in, treatment T₆ (21.1). Whereas minimum number of pods plant⁻¹ in, treatment T₀ (14.2). The maximum pod weight (g) was observed in, treatment T₆ (13.5). Whereas minimum pod weight (g) in, treatment T₀ (9.7). The maximum pod length (cm) was observed in, treatment T₆ (15.7). Whereas minimum pod length (cm) in, treatment T₀ (13.1). The maximum pod diameter (cm) was observed in, treatment T₆ (1.8). Whereas minimum pod diameter (cm) in, treatment T₀ (0.7). The maximum pod yield plant⁻¹ (g) was observed in, treatment T₆ (857). Whereas minimum pod yield plant⁻¹ (g) in, treatment T₀ (410). The maximum pod yield ha⁻¹ (t) was observed in, treatment T₆ (5.7). Whereas minimum pod yield ha⁻¹ (t) in, treatment T₀ (2.7). The maximum number of seeds pod⁻¹ was observed in, treatment T₆ (8.2). Whereas minimum number of seeds pod⁻¹ in, treatment T₀ (5.5). Sawdust mulches which induce higher soil

temperature have been found to be more effective in increasing the early yields of French bean than the white and reflective plastics (Decoteau et al. 1989). The high early yields in French bean that have been regularly documented for black and clear plastic mulches is attributed to preferential partitioning of carbon to fruits rather than to foliage. However, under conditions of high ambient temperature and high solar radiation as they occur during the summer in the south-eastern United States, plants often show poor growth and low yield. Under these conditions, Sawdust mulches warm the soil to temperatures that may be deleterious to plant growth.

3.3 Quality Parameters

The maximum TSS (°Brix) was observed in, treatment T₆ (6.2). Whereas minimum TSS (°Brix) in, treatment T₀ (5.2).

"Quality parameters of French bean was presented in Table 3. It is clear from the Table 3. that the significant results shows that the concentrations of ascorbic acid, B-carotene and vitamin-A are also recorded to be appreciably higher in the French bean plants growing with Sawdust mulch as compared to the no mulch" (Awasthi et al. 2006). Similarly, it is also reported that "organic mulches significantly increased the oleoresin content in ginger over un-mulched control" [7].

4. CONCLUSION

Based on the results of the present investigation, it is concluded that cultivation of French bean with different mulching material found as the best option for higher productivity whereas the treatment T₆ (Saw dust mulch) showed the best results in terms of growth, yield, quality, net returns and B:C ratio. Hence the treatment T₆ (Saw dust mulch) was best suited for the farmers in terms of growth, yield, quality and net returns.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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