www.hortflorajournal.com
HortFlora Research Spectrum, 3(2): 162-165 (June 2014) ISSN : 2250-2823

EFFECT OF MULCHING ON PHYSIOLOGICAL GROWTH DETERMINANTS OF PRODUCTIVITY IN FRENCH BEAN (*Phaseolus vulgaris* L.)

B.V.G. Prasad[1], S. Chakravorty[1], B.K. Saren[2] and D. Panda[2]

[1]*Department of Crop Improvement, Horticulture and Agriculture Botany (CIHAB),*

[2]*Department of ASEPAN,*

Institute of Agriculture, Visva-Bharati, Sriniketan-731236, West Bengal, India.

**E-mail: prasadbvg@sify.com*

ABSTRACT: The present investigation was undertaken at Horticulture Farm, Institute of Agriculture, Visva-Bharati University, West Bengal (India) during winter (*rabi*) season from December 2012-March 2013 to study the effect of mulching on physiological growth parameters of French bean. The results of plant growth analysis revealed that highest plant height (60.71cm), leaf area index (6.29), dry matter accumulation (826.23 g m^{-2}), crop growth rate (14.49 g m^{-2} day^{-1}) and relative growth rate (1.26 $g^{-1}day^{-1}$) were observed under paddy straw mulch @ 10 t ha^{-1}.

Keywords : *French bean, mulching, physiological growth, productivity.*

French bean is considered one of the important legume family members because of the high percentage of protein (pod contains 1.7% protein, and dry seed contains 21.1% protein per 100 g of edible part) and other desirable agronomic characteristics. In red lateritic belts of West Bengal there is a good scope of cultivation of French bean, but reduced rainfall and less availability of water from other resources are the limiting factors. Hence, adoption of water conservation techniques like mulching with cheap and locally available material may be helpful for better production. Mulching is a desirable cultural management practice which reported to improve soil moisture, soil fertility and physical condition by enhancing biological activity of the soil fauna (Mann and Chakope, 3; Tyagi and Sharma, 8. Pod yield is a complex character and the physiological inbuilt of plant contribute effectively towards yield. Higher pod yield is always an important criterion for the farmer and it initially depends on growth attributing characters. Therefore, study of different physiological growth parameters at different growth stages under different types and quantity of mulches will help to understand the response towards yield. Considering the above mentioned aspect, the present study was undertaken to evaluate the effect of mulching on physiological growth determinants of productivity in French bean.

MATERIALS AND METHODS

The field experiment was carried out on French bean at the Horticulture Farm, Institute of Agriculture, Visva-Bharati University,West Bengal, India during *rabi* season, December 2012-March 2013. The experiment was laid out in the randomized block design consisting of ten treatments i.e., Paddy straw mulch, rice husk mulch and saw dust mulch each of @ 5, 7.5, 10 t ha^{-1} and no mulch treatment with three replications. The unit plot size was 2m x 1m with 15 cm x 15cm spacing accommodating 84 plants $plot^{-1}$. The land was manured and fertilized with well rotten farm yard manure (FYM), recommended dose of N, P_2O_5 and K_2O @ 12 t ha^{-1}, 100, 80 and 60kg ha^{-1}, respectively. The N, P_2O_5 and K_2O were applied in the form of urea, single super phosphate (SSP) and murate of potash (MOP), respectively. Mulches were uniformly applied in between rows just after sowing of seeds. Measured quantity of life saving irrigation was applied to each plot uniformly and other recommended package of practices was followed to raise a good crop. During the crop growth and development, periodic data was recorded for, plant height, leaf area index (LAI), dry matter accumulation (DMA), crop growth rate (CGR) and relative growth rate (RGR). Data was statistically analyzed by the analysis of variance method (Panse and Sukhatme, 6) and the significance of variance were tested by Error Mean Square using Fisher Snedecor 'F' test of probability at 0.05 level of significance.

RESULTS AND DISCUSSION

Growth and development in plant are a consequence of excellent coordination of several processes operating at different stages of the plant. Besides many other ways of maximization of growth rate and economic productivity the manipulation of

Received : 25-05-2014 *Accepted : 17-06-2014*

microclimatic conditions is one of the main tools towards the maximum realization of yield potential. This can be achieved through nutrient management, irrigation, cultural practices and plant protection measures (Naidu *et al.,* (5).

Plant height

Plant heights of French bean at different growth stages were remarkably influenced by the different types and quantity of mulches (Table 1). It increased during 35 DAS to 95 DAS but the rate of increase in plant height was highest from 35 DAS to 65 DAS. At every growth stage the best response was observed with the maximum quantity of mulches of all kinds. At 35, 65 and 95 DAS paddy straw mulch @ 10 t ha^{-1} (T_3) recorded significantly higher plant height (39.50 cm, 58.59 cm and 60.71cm, respectively) closely followed by treatment with saw dust mulch @ 10 t ha^{-1} (38.12cm, 58.42cm and 59.09cm, respectively). Thus improved growth of the plants in T_3 treatment indicated the increased plant height. This might be due to more availability of water and nutrients through better water conservation. These results are in agreement with the findings of Mozumder *et al.* (4). The treatment of no mulch (T_{10}) recorded the lowest plant height at 35, 65 and 95 DAS (30cm, 48.4cm and 51.31cm, respectively). Moreover, reduced plant growth, smaller leaves and short internodes were observed in the no mulch plots might have been due to more evaporation loss of water and low consumptive use.

Leaf area Index

Leaf Area Index has been proposed by Watson (1947) as the best measure of the capacity of a crop for producing dry matter, this he called its productive capital. It is an important parameter which determines the photosynthetic capacity of a crop. Leaf area index (LAI) of French bean at different growth stages were remarkably influenced by the different types and quantity of mulches (Table 1). It increased steadily up to 65 DAS and thereafter declined rapidly as the crop progressed towards advanced stage *i.e.* 95 DAS. Moreover, the plants showed higher leaf area index when plots were mulched with increased quantity of mulching materials of different types. At 35, 65 and 95 DAS paddy straw mulch @ 10 ha^{-1} (T_3) recorded significantly higher leaf area index (3.50, 6.29 and 3.57, respectively) followed by treatment saw dust mulch @ 10 t ha^{-1} (2.58, 5.62 and 2.73, respectively). Thus increased leaf area index under T_3 treatment might be due to availability of adequate moisture through better soil-moisture conservation by mulching. This might have resulted better growth of the plants as observed with more number of leaves per plant which ultimately found to be beneficial for high leaf area index. The crop under no mulch plots registered lowest leaf area index (1.72, 3.45 and 1.16, respectively) in all the growth stages. In this no mulch treatment, less number of leaves with reduced leaf blade in terms of both length and width of the leaf were observed. Similar findings were reported by Haqqani *et al.* (2) in Mung bean.

Dry matter accumulation

Total dry matter accumulation of the plant altered significantly among the treatments at all stages of crop growth (Table 1). Treatment T_3 (paddy straw mulch @ 10 t ha^{-1}) recorded significantly higher dry matter (337.24, 826.23 and 601.86 g m^{-2}, respectively) at 35, 65 and 95 DAS, respectively which was followed by T_6 (rice husk mulch @ 10 t ha^{-1}) and T_9 (saw dust mulch @ 10 t ha^{-1}) at all the growth stages. During the entire growth period no mulched plots recorded the lowest dry matter accumulation (303.03, 661.63 and 423.22 g/ m^{-2}, respectively). The highest dry matter accumulation under paddy straw mulch @ 10 tha^{-1} might be due to availability of sufficient soil-moisture for prolonged period for increased plant growth, higher leaf area index, fresh and dry weight of leaves, stems and pods in the mulched plots. The results are in accordance with the findings of Stopes *et al.* (7) in legumes.

Crop growth rate [g m^{-2}. day^{-1}]

The crop growth rate was very high between 35 and 65 DAS of the plant growth but it gradually decreased between 65 and 95 DAS (Table 1). The highest crop growth rate (14.79 g.m^{-2} day^{-1}) during 35-65 DAS was recorded with the treatment T3 (paddy straw mulch @ 10 t ha^{-1}) which was closely followed by T_9 (14.38 g. m^{-2}. day^{-1}) and T_2 (14.17 g. m^{-2}. day^{-1}), respectively. Similarly, maximum crop growth rate (8.74 g. m^{-2}. day^{-1}) was recorded under paddy straw mulch @ 10 t ha^{-1} (T_3) during 65-95 days. Minimum crop growth rate (10.47 and 6.17 g. m^{-2}. day^{-1}, respectively) was, however, recorded in no mulched plots at 35-65 DAS and 65-95 DAS, respectively.

At the initial growth phase sufficient growth and development of vegetative parts is desirable for supporting reproductive stage of the plant for optimum yield which declines with the maturity of the plant.The above mentioned result indicated the similar trend in French bean. The beneficial effect of mulching is evident in the plots mulched with high quantity of

mulches but the most significant effects were observed in paddy straw mulch @ 10 t ha^{-1}. Moreover, the experimental findings are in agreement with findings of Ghassemi-golezani *et al.* (1).

Relative Growth Rate [g. g^{-1} day^{-1}]

The result indicated (Table 1) very high relative growth rate between 35 and 65 DAS of the plant growth which decreased gradually with the advancement of age of the plant i.e. between 65 and 95 DAS .The highest relative growth rate (1.26 g. g^{-1} day^{-1}) during 35-65 DAS was recorded in the treatment (T_3) with paddy straw mulch @ 10 t ha^{-1} which is at par with T_6 (1.21 g. g^{-1}. day^{-1}). Similar trend was recorded in the advanced stage of crop growth during 65-95 days and maximum relative growth rate (0.68 g. g^{-1}. day^{-1}) was recorded with T_3, though, at par with T_6 and T_9. Minimum relative growth rate (0.98 and 0.42 g. $g^{-1}day^{-1}$) was, however, recorded in no mulched plots at 35 DAS and 95 DAS, respectively.

Generally, RGR always decreases as the biomass of a plant increases. This may be due to the top leaves of a plant begun to shade lower leaves and soil nutrients can become limiting. Overall, respiration scales with total biomass, but photosynthesis only scales with photosynthetic biomass and as a result biomass accumulates more slowly as total biomass increases. The beneficial effects of mulching are evident in the plots mulched with high quantity of mulches but the most significant effects were observed in paddy straw mulch @ 10 t ha^{-1}. Moreover, the results coincide with the findings of Ghassemi-golezani *et al.* (1).

CONCLUSION

It may be concluded from this experiment that the application of paddy straw mulch @ 10 t ha^{-1} is the best treatment which significantly increased the physiological and functional determinants of productivity.

Table: 1: Effect of mulching on physiological growth determinants of productivity in French bean.

Treatments	Plant height (cm)			Leaf area index (LAI)			Dry matter accumulation (DMA)[$g.m^{-1}.day^{-1}$]			Crop growth rate(CGR) [$g\ m^{-2}.\ day^{-1}$]		Relative growth rate (RGR) [$g.g^{-1}day^{-1}$]	
	35 DAS	65 DAS	95 DAS	35 DAS	65 DAS	95 DAS	35 DAS	65 DAS	95 DAS	35-65 DAS	65-95 DAS	35-65 DAS	65-95 DAS
T_1-Paddy straw mulch@ 5t/ha	35.57	52.54	54.36	2.12	4.55	1.46	309.81	727.53	470.82	12.15	7.53	1.05	0.47
T_2-Paddy straw mulch@7.5t/ha	36.57	54.26	56.36	2.47	4.48	2.09	322.23	759.41	506.38	14.17	7.79	1.10	0.63
T_3-Paddy straw mulch @10t/ha	39.50	59.89	60.71	3.50	6.29	3.57	337.24	826.23	601.86	14.79	8.74	1.26	0.68
T_4-Rice husk mulch @ 5t/ha	35.63	55.69	57.14	2.26	4.65	1.81	304.64	728.39	483.28	12.55	7.47	1.04	0.55
T_5-Rice husk mulch@7.5t/ha	36.78	54.20	56.03	2.46	4.74	1.92	320.84	753.95	517.72	13.47	6.32	1.13	0.63
T_6-Rice husk mulch@ 10t/ha	37.66	56.55	57.56	2.49	6.15	2.90	331.10	803.14	558.74	14.04	8.36	1.21	0.67
T_7-Sawdust mulch @ 5t/ha	35.18	54.28	55.58	2.43	4.71	1.38	308.70	739.96	463.96	12.68	7.37	0.98	0.44
T_8-Sawdust mulch @ 7.5t/ha	36.90	49.74	52.76	2.47	4.09	2.10	321.15	745.49	524.44	13.40	7.48	1.12	0.47
T_9-Sawdust mulch @ 10t/ha	38.12	58.42	59.09	2.58	5.62	2.73	325.24	783.39	543.06	14.38	8.12	1.2	0.66
T_{10}-No mulch	30.00	48.54	51.31	1.72	3.45	1.16	303.03	61.63	423.22	10.47	6.17	0.98	0.42
CD (P-0.05)	2.94	5.05	4.89	0.74	0.72	0.87	21.10	53.83	76.47	2.3	0.44	0.17	0.06

REFERENCES

1. Ghassemi-golezanik, S., Ganehpoor, A., Dabbagh Mohammadi, N. (2009). Effect of water limitation on growth and grain filling of Faba bean cultivars. *J. Food Agri. and Envir.,* **7**(3&4): 442-447.
2. Haqqani and Pandey, K. (1994). Response of Mung bean to water stress and irrigation at various growth stages and plant densities. *Plant and Crop Growth Parameters*; **71**(4): 281-288.
3. Mann, J. S. and Chakope, I. S. (1989). Effect of trash mulch and weed control on rain fed sugercane ratoon. *Indian J. Agron.,* **34**(3): 279-282.
4. Mozumder, S.N., Moniruzzaman, M., Islam, M. R. and Alam S. N. (2002). Effect of planting time and spacing on the yield performance of bush bean (*Phaseolus vulgaris* L.). *Bangladesh J. Argil. Res.*; **34**(1) : 105-111.
5. Naidu,A.K.,Tiwari,J.P.,Diwadi,S.K.,and Saxena, S.K.(2000). Effect of various levels of N,P,K on physiological growth determinants of productivity in garlic (*Allium sativum* L.). *Veg. Sci.* **27**(2) : 165-167.
6. Panse, V. G and Sukhatme, P. V. (1978). *Statistical Methods for Agriculture Workers*. ICAR New Delhi, 97-123.
7. Stopes, C., Millington, S. and Wood Ward, L. (1989). Dry matter and nitrogen accumulation in legumes under green manures. *Agri., Ecosyst. and Environ,;* **57**: 189-196.
8. Tyagi, S.K. and Sharma, M.L. (2013). Effect of plastic mulch on growth, yield and economics of water melon [*Citrullus lanatus* (Thumb.) Matsun and Nakai] under Nimar Plains of Madhya Pradesh. *HortFlora Res. Spectrum,* **2** (3) :215-219.

❑

Citation : Prasad, B.V.G., Chakravorty, S., Saren, B.K. and Panda, D. (2014). Effect of mulching on physiological growth determinants of productivity in French bean (*Phaseolus vulgaris* L.). *HortFlora Res. Spectrum,* **3**(2) : 162-165