

## Effect of biofertilizers on horticultural and yield traits in french bean var. Contender under dry temperate conditions of Kinnaur district of Himachal Pradesh

Seema Thakur<sup>1\*</sup>, Rajesh Thakur<sup>1</sup> and Devinder Kumar Mehta<sup>3</sup>

<sup>1</sup>Krishi Vigyan Kendra, Kandaghat, Solan (H.P.), INDIA

<sup>2</sup>Department of Vegetable Science, Dr. Y. S Parmar University of Horticulture and Forestry, Nauni, Solan (H.P.), INDIA

\*Corresponding author. E-mail: thakurseema76@gmail.com

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**Abstract:** Kinnaur district is known as the dry temperate zone of Himachal Pradesh and is known for off season and quality production of vegetables. In this district of Himachal Pradesh, Natural farming is mostly done with the minimum use of chemical fertilizers. Farmers are unaware of the judicious use of farm yard manure, and biofertilizers due to which yield of the french bean is very low (50-70 q/ha). French bean is one of the most important vegetables intercropped with apple in Kinnaur District. An experiment was conducted during the summer season of 2011 at the Experimental Farm of Vegetable Research Station, Kalpa, Kinnaur, Himachal Pradesh to study the effect of Rhizobium and Phosphorus Solubilizing Bacteria (PSB) on the horticultural and yield traits in french bean var. Contender. Six treatments comprising seed treatments (with and without Rhizobium), seed treatment (with and without PSB) along with the combination of 60 % dose of recommended quantity of Calcium Ammonium Nitrate and 75 % dose of recommended quantity of Single Super Phosphate and organic matter were evaluated in a Randomized Complete Block Design (RCBD) with three replications. The results revealed that T<sub>5</sub> treatment, i.e. Rhizobium+ PSB+ Organic matter resulted in more number of pods per plant (20), pod length (18 cm) and pod yield/ha (140 q/ha).

**Keywords:** Biofertilizers, French Bean, Kinnaur, Pod yield, Yield

### INTRODUCTION

French bean (*Phaseolus vulgaris* L.), a short duration leguminous vegetable crop is known by various names viz., rajma, rajmah, haricot bean, kidney bean, snap bean, navy bean, field bean, dry bean and pole bean. It is grown for its mature dry seeds as well as for immature tender green pods. French bean is a rich source of protein (17.5 to 28.7% in dry seeds, about 1.0 - 2.5% in green pods), carbohydrates (61.4%), mineral content (3.2 - 5.0%), crude fibre (4.2-6.3%), crude fat (1.2-2.0%) and vitamins A and C. (Messina, 1999).

Kinnaur district of Himachal Pradesh is situated in North and Northeast part of state representing high hills temperate zone. There is only one cropping season from April-November and no crops can be grown from November-March as the land is covered with snow and area reels under sub-zero temperature. French bean (*Phaseolus vulgaris* L.) is one of the most important vegetables intercropped with apple in Kinnaur district of Himachal Pradesh. In Kinnaur district, natural farming is mostly practiced with the minimum use of chemical fertilizers and farmers are unaware of the judicious use of farm yard manure and rhizobium inoculation due to which yield of the french

bean is low (50-70 q/ha). The Organic manures, apart from supplying macro and micronutrients are also known to improve the physical, chemical and biological properties of the soils (Drinkwater *et al.*, 1995). French bean responds well to organic manures and results in improved quality and sustained production. The modern day intense crop requires the use of chemical fertilizers, but the prices of inorganic fertilizers have not only increased the cost of crop production but also decreased soil fertility thereby causing environmental pollution.

There is a need to integrate both the use of organics and inorganics for getting the best quality product, which in turn is expected to substantially reduce the cost of cultivation through minimized use of inorganic fertilizers (Tiwari, 2002). It has been revealed from the long term experiments on the fertilizer application that Farm Yard Manure along with the chemical fertilizers results in yield improvement and maintenance of soil fertility (Swarup, 1998). The integrated farming system is an agricultural system conceived so far as to have the least impact on the environment. The use of organic soil amendments has been associated with desirable soil properties including higher plant available water

holding capacity, cation exchange capacity, lower bulk density and can foster beneficial microorganisms (Doran, 1995). Benefits of compost amendments to soil include soil aggregation, pH stabilization and faster infiltration rate due to enhanced soil aggregation (Stamatiadis *et al.*, 1999). French bean is affected by the inadequate availability of nutrients in the soil; it requires a large quantity of phosphorus for optimum growth and yield. To enhance the plants capacity to utilize such nutrients effectively including in the soil, PSB and VAM inoculation have been considered to be effective. Researchers in the few decades established that PSB Treatment could improve plant growth through increased uptake of phosphorus, especially in the soils of low fertility (Ramana *et al.*, 2010; 2011). Organic manures are eco-friendly, cheap source of nutrients and are potentially sound for supplying nutrients which can reduce dependence on chemical fertilizers (Datt *et al.*, 2013). Organic resources are largely biological in origin, and they have several nutrients in their composition, which on decomposition are released into the soil (Kumar *et al.*, 2014). Organic sources of the plant nutrients have been reported to improve nutritional quality, protein content and mineral content in crops as compared to those with inorganic sources (Bhadoria *et al.*, 2002). In recent days, more importance has been given to sustainable agriculture, since the modern agriculture over the last several years depended heavily on chemical fertilizers which are cost intensive and have an adverse effect on soil fertility and the environment. Therefore, there is a need to popularize these environmental safe, ecofriendly and cost effective organic manures. The use of biofertilizers has currently attained a special significance in crop production, and tremendous success has been achieved in several crops. Hence the present study was carried with the integrated use of chemical fertilizers along with farm yard manure, Rhizobium culture and Phosphate solubilizing bacteria in variety Contender of the french bean.

## MATERIALS AND METHODS

The present investigations were carried out on French bean variety contender in 2011 at the experimental farm of Vegetable Research Station, Kalpa, Kinnaur

(H.P). The experiment was planted in a Randomized Complete Block Design (RCBD) with four replications. Plot size was kept 3x3 m. Five treatments viz., T<sub>1</sub>: Recommended dose of fertilizers of NPK, T<sub>2</sub>: 60 % N+ Rhizobium treated seeds, T<sub>3</sub>: 75% P+ PSB treated seeds, T<sub>4</sub>: T<sub>2</sub>+T<sub>3</sub>, T<sub>5</sub>: Rhizobium treated seeds+ PSB treated seeds + FYM. All the FYM doses and chemical fertilizers were applied at the time of sowing. Rhizobium culture and PSB culture was applied to the seeds of french bean var. Contender @20 g/kg of seed. The soil was sandy loam having pH 6.4 with organic carbon. The plant height was measured from the lowest cotyledonary node to the growing tip, and the mean of five plants was taken and expressed in centimeters. The number of pods was counted from five randomly selected plants and mean was worked out. The length was measured for all the pods present in the five tagged plants, and average pod length was worked out. Different treatments were also screened for diseases viz., Angular leaf spot and Anthracnose. Disease incidence was calculated on per plant basis by using the following formula :

$$\text{Disease Incidence (\%)} = \frac{\text{Number of diseased pods}}{\text{Total number of pods}} \times 100 \quad \dots \text{Eq.1}$$

## RESULTS AND DISCUSSION

The analysis of variance was carried out for seven characters. The F- value revealed highly significant differences for all the characters viz., Days taken from sowing to marketable maturity, Plant height (cm), Number of pods/plant, Pod length (cm), Pod yield/ha (q/ha), Diseases incidence of Angular leaf spot (%) and Disease incidence of Anthracnose (%). The mean values obtained for these traits have been presented in Table1.

Results revealed that T<sub>5</sub> (*Rhizobium* + PSB + FYM) treatment recorded lowest days (40 days) to marketable maturity. These findings are in line with those reported by Singh *et al.*, (2009). Maximum plant height (48.42 cm) was observed in T<sub>5</sub> treatment which was statistically at par with T<sub>4</sub> treatment (47.66 cm). Seed inoculation with *Rhizobium* significantly increased plant height which was also supported by the findings of Rana *et al.* (2006) and Mfilinge *et al.* (2014). It can be due to the beneficial effect of seed treatment with

**Table 1.** Mean performance of five plants of the French bean variety Contender for different horticultural and yield traits.

Treatment	Days taken from sowing to marketable maturity	Plant height (cm)	No. of pods/plant	Pod length (cm)	Pod yield/ha (Q/ha)	Diseases incidence of Angular leaf spot (%)	Disease incidence of Anthracnose (%)
T <sub>1</sub>	50	40.29	12.90	10.71	80.55	40	38
T <sub>2</sub>	45	43.23	12.92	11.51	100.37	25	27
T <sub>3</sub>	43	43.04	13.57	10.82	102.88	20	24
T <sub>4</sub>	44	47.66	16.57	13.36	120.32	28	20
T <sub>5</sub>	40	48.42	20.00	18.00	140.00	15	10
CD <sub>0.05</sub>	2.96	0.750	0.80	1.75	6.57	5.6	4.9

T<sub>1</sub>: Recommended dose of fertilizers of NPK, T<sub>2</sub>: 60 % N+ Rhizobium treated seeds, T<sub>3</sub>: 75% P+ PSB treated seeds, T<sub>4</sub>: T<sub>2</sub>+T<sub>3</sub>, T<sub>5</sub>: Rhizobium treated seeds + PSB + FYM

Rhizobium and PSB strains in enhancing the nutrient supply to the plants (Chandra *et al.*, 1987). The highest number of pods per plant (20.00) and maximum pod length (18.00 cm) was also recorded in T<sub>5</sub> treatment. Gangwar and Dubey (2012) and Ramanna *et al.* (2010) also reported similar results and concluded that combined inoculation of *Rhizobium* and PSB significantly increased the number of pods per plant, seed yield, straw yield, net monetary returns and pod length in cluster bean. T<sub>5</sub> treatment also maintained its superiority for pod yield/ha (140 q/ha). Similar results for increase in yield components and seed yield by *Rhizobium* inoculation was reported by Bindra *et al.*, 2008 and Datt *et al.* (2013). The maximum number of pods/plant, number of seeds/pods, 100-seed weight, seed yield/plant, crop yield, and protein and oil content were observed when higher levels of P and FYM were supplied. Better results were obtained with Rhizobium + PSB compared to Rhizobium or PSB supplied individually (Ramanna *et al.* (2010). Yield response can be attributed to increased number of pods per plant and pod length. Seed inoculation resulted in greater yield attributes. This may be attributed to increased nodulation and nitrogen fixation, more solubilisation of natural phosphorus and production of secondary metabolites by the bacteria (Thakur *et al.*, 1998 and Rudresh *et al.*, 2005). Different treatments were also screened for the incidence of Angular leaf spot and Anthracnose under field conditions of vegetable Research Station, Kalpa. Disease incidence of both Angular leaf spot (15 %) and Anthracnose diseases (10 %) was found lowest in T<sub>5</sub> treatment (Rhizobium + PSB + organic matter). Rhizobium microorganisms mediate soil processes such as exudation of soluble compounds, storage and releases of nutrients and water, nutrient mobilization and nitrogen fixation, nitrification, denitrification and sulfur reduction (Khan *et al.*, 1999).

## Conclusion

The results of the experiment revealed that T<sub>5</sub> (*Rhizobium* + PSB + FYM) treatment recorded lowest days to marketable maturity (40 days) along with maximum plant height (48.42 cm), number of pods per plant (20.00 cm), pod length (18.00 cm) and pod yield per plant (140.00 q/ha). The incidence of Angular leaf spot (15 %) and Anthracnose (10%) was also lowest in T<sub>5</sub> treatment which concluded that increased nodulation and nitrogen fixation along with the solubilisation of natural phosphorus and production of secondary metabolites were the main factors which increased the yield and quality of the French bean variety Contender.

## REFERENCES

- Bhadoria P.B.S., Prakash Y.S., Anitva R and Rakshit, A (2002). Importance of organic manures in improving quality of rice and okra. *Environment and Ecology* 20 (3) 628-633.
- Bindra, A. D., Dubey, Y. P. and Rana, M. C. (2008). Complementary effect of bio-fertilizers and nitrogen levels on seed crop of French bean (*Phaseolus vulgaris* L.) under dry temperate conditions of Himachal Pradesh. *Himachal Journal of Agricultural Research*, 34(1):15-17
- Chandra, R., Rajput, C.B.S., Singh, K.P. and Singh, S. J.P. (1987). A note of the effect of nitrogen, phosphorus and rhizobium culture on growth and yield of French bean. *Haryana Journal of Horticultural Sciences*, 16(1):145-147
- Datt, N., Dubey, Y.P. and Chaudhary, R. (2013). Studies on the impact of organic, inorganic and integrated use of nutrients on symbiotic parameters, yield, quality of French bean (*Phaseolus vulgaris* L.) vis-a vis soil properties of an acid alfisol. *African Journal of Agricultural Research*. 8(22): 2645-2654.
- Doran, J (1995). Building soil quality. In: Proceedings of the 1995 Conservation Workshop on Opportunities and Challenges in Sustainable Agriculture. Red Deer, Alta, Canada, Alberta Tillage Conservation Society and Alberta Agriculture Conservation, development Branch. pp. 151-158.
- Drinkwater, L.E., Letourneau, D.K., Workneh F., Van Bruggen, A.H.C and Shennan C (1995). Fundamental differences between conventional and organic tomato agroecosystems in California. *Ecol. Appl.* 5:1098-1112.
- Gangwar, S. and Dubey, M. (2012). Chickpea (*Cicer arietinum* L.) root nodulation and yield as affected by micronutrients application and rhizobium inoculation. *Crop Res.* 44 (1&2): 37-41.
- Khan, S., Mol, Zaidi, A., and Lakhchaura, B.D. (1999). Nodule occupancy determination and Rhizobium strain quantification by immunoblot assay. *Indian J. Exp. Biol.*, 37: 813-817.
- Messina, M.L. 1999. Legumes and soybeans: overview of their nutritional profiles and health effects. *Am. J. Clin. Nutr.* 70(suppl.):439S-450S
- Mfilinge, A., Mtei, K. and Ndakidemu, P. (2014). Effect of rhizobium inoculation and supplementation with P and K on growth, leaf chlorophyll content and nitrogen fixation of bush bean varieties. *American Journal of Research Communication*. 2 (10):49-87.
- Ramana, V., Ramakrishna, M., Purushotham, K. and Reddy, K. Balakrishna (2010). Effect of biofertilizers on growth, yield attributes and yield of French bean (*Phaseolus vulgaris*). *Legume Res.* 33 (3):178-183.
- Ramana, V., Ramakrishna, M., Purushotham, K. and Reddy, K. Balakrishna (2011). Effect of biofertilizer on growth, yield and quality of french bean. *Veg. Sci.* 38 (1): 35-38.
- Rana, M. C., Datt, N and Singh, Man (2006). Effect of Rhizobium culture in combination with organic and chemical fertilizers on rajmash under dry temperate conditions of Himachal Pradesh. *Indian Journal of Agricultural sciences*. 76(3): 151-153.
- Rudresh, D.L., Shivaprakash, M.K. and Prasad, R.D. (2005). Effect of combined application of Rhizobium, phosphate solubilizing bacterium and Trichoderma spp. on growth, nutrient uptake and yield of chickpea (*Cicer arietinum* L.). *Applied Soil Ecol.* 28: 139-146.
- Singh, Anjani K., Singh, S.B. and Singh, Vineeta (2009).

- Influence of nitrogen doses on growth and green pod yield parameters of french bean varieties during kharif season under subtropical area of Jammu region. *Legume Res.* 32 (2): 142-144.
- Stamatiadis, S., Werner, M. and Buchnam, M. (1999). Field assessment of soil quality as affected by compost and fertilizer application in a broccoli field (SanBenito County, California). *Appl. Soil Ecol.* 12:217-225.
- Swarup, A. (1998). Emerging soil fertility management issues for sustainable crop productivity in irrigated systems. In: Swarup A, Reddy Damodar, Prasad RN (Ed). Long term Soil Fertility Management through Integrated Plant Nutrient Supply pp 54-67. Indian Institute of Soil Science, Bhopal, India.
- Thakur, R.N., Arya, P.S. and Thakur, S K. (1999). Response of French bean (*Phaseolus vulgaris* varieties to fertilizers levels, Rhizobium inoculation and their residual effect on onion (*Allium cepa* in the mid hills of North Western Himalaya). *Indian Journal of Agronomy.* 69 (60):416-18.
- Tiwari, K. N. (2002). Nutrient management for sustainable agriculture. *J. Indian Soc. Soil Sci.*, 50(4):374-397.