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Effect of integrated nutrient management on yield & growth performance of French bean (*Phaseolus Vulgaris* L.) under subtropical conditions of Garhwal Hills

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Abstract
The investigation was conducted at Horticulture research centre of Department of Horticulture, H.N.B. Garhwal University, Srinagar (India) during season, 2014-2015, on sandy loam soil, ph having 5.3 to 5.5 to study of integrated nutrient management viz., Rhizobium culture, FYM and along with inorganic fertilizers in French bean under irrigated condition with an objective to study growth and yield without degrading soil quality by using various nu trient compositions. In this investigation, Investigation treatment (T_8)(100 % RDF+Rhizobium Culture+Humic Acid) recorded the highest in all observations this may be due to high composition of Nitrogen in inorganic fertilizers which supplement to the plant's vegetative phase. Thus it may be concluded that Rhizobium culture was found useful than any other type of treatments under irrigated condition of Srinagar valley.

Keywords: rhizobium culture, humic acid FYM, N:P:K, yield of French bean

Introduction
French bean (*Phaseolus vulgaris* L) is one of the most important leguminous vegetables in India. It is a nutritious vegetable and can be grown in all types of soils ranging from light sandy loam to clay soils but it cannot withstand water-logging. The highest yield is obtained in soils with a PH between 5.3 and 6.0. The use of chemical fertilizers boosted the agricultural products and the farming communities are using the same indiscriminately in such areas where irrigation facility exists with an eye on two to three crops in a year. This has drained the soil and resulted in the loss of soil productivity. So to obtain maximum return farmers need to apply high quantity of fertilizers and due to this culture the rate of use of fertilizers are increasing day by day, which means unlimited draining of soil. In spite of the importance for urgent step-up, very little attention has been paid so far to nutrient management in various soil and climatic conditions. The preparation and use of organic manures as a nutrient management may provide a hygiene and useful way of disposal and utilization of waste which would otherwise have created a healthy environment. Sankhyan *et al*. (2001) [5] reported the increase in soil moisture due to mulching and significant increase in productivity of maize due to application of FYM. Kumaran (2001) [2], reported the application of FYM+ fertilizer produced higher number of matured pods per plant, pod weight per plant, number of kernels perpod, test weight, pod yield and haulm yield of groundnut. But use of fertilizer alone recorded lower pod yield. Veerabhadraiah *et al*. (2006) [9-10] showed improved soil properties due to application of either FYM or compost or vermicompost. Yadav and Vijayakumari (2003) [11] found better yield in vermicompost treatment. Same observation was also reported by Rameshwar (2006) [4]. Guu *et al*. (1995) [1] reported pod yield with fertilizer and manure application. Keeping the views of the above aspects the present research work was, therefore, undertaken to find out the response of French bean to Rhizobium culture, farmyard manure, N:P:K (Chemical fertilizer) and their different combination treatments under irrigated condition of Srinagar valley of Uttarakhand, India.

Materials and Methods
The experiment was conducted in year 2014-15 in Horticulture Research Center and Department of Horticulture, H.N.B. Garhwal University, Srinagar, Uttarakhand (India) during

September to February season of the year 20014-2015.Pant Anupama was selected.

11 Treatments using different recommended dose of fertilizer (NPK::30:60:50), rhizobium culture, and humic acid were applied on each genotype. The sowing was done in rainy season Using RBD. The sowing spacing of 45 X 10 cm in 3 X 2 M^2 with total area of 198 M^2 for each genotype was done. Five plants form each plot were selected from each treatment to calculate days to germination, plant height(cm), Number of nodules per plant, Number of pods per plant, Fresh pod yield per bed and number of grain per pod.

Table 1: The experiment comprised of the following treatments.

RDF (NPK)	T_1
100% RDF+ Rhizobium culture	T_2
100% RDF+Humic Acid	T_3
75% RDF+ Rhizobium culture	T_4
75% RDF+Humic Acid	T_5
50% RDF+ Rhizobium culture	T_6
50% RDF+Humic Acid	T_7
100% RDF+ Rhizobium culture +Humic Acid	T_8
75% RDF+ Rhizobium culture +Humic Acid	T_9
50% RDF+ Rhizobium culture +Humic Acid	T_{10}
Control	T_0

Result

In all the observation aspects of growth the maximum value was recorded under Treatment T_8, and T_9 but minimum value was found variable in different treatment and different observation was aspect. The result of the present study indicated that among the 11 different treatment the treatment combination of T_8(100%RDF+Rhizobium culture+Humic acid), Treatment T_9(75%RDF+Rhizobium culture+Humic acid) and treatment T_{10} (50%RDF+Rhizobium culture+Humic acid) recorded significant improvement various growth parameters which., Days to Germination, Plant height (cm), Number of Nodules per plant, Number of pods per plant, Fresh pod yield per bed and Number of grains per pod. The germination of the seed depicts the yield of the crop a data present in table 2 showed that 50% of germination of the seed of different treatments took 8.00 to 14.00 days, recording non significant different among various treatment for germination that days taken to full germination was significantly influenced by various treatment whereas minimum days of germination was recorded in treatment T8(8 days) and whereas maximum days of germination was observed in treatment T0(14 days). The maximum Yield per bed was observed in treatment T_8 followed by T_9 and T_{10} (6.3,5.70,5.40)kg. whereas minimum pod yield was observed in treatment T_0 and T_1 (2.200.3.200)kg. The maximum plant height was observed in treatment T_8, T_9 and T_{10} (44.00,40.50,39.00)cm whereas minimum plant height was observed in treatment T_1 and T_0 (26.50,28.00)cm. and again measured Maximum number of Nodules per plant was obtained in Treatment T8,T9 and T10(15.00,14.60,13.40) whereas minimum was obtained in T7 and T0 (6.00,6.20). In case, Maximum Number of pods per plant was obtained in Treatment T_8, T_9 and T_{10} (55,49,43) whereas minimum was obtained in treatment T_0 and T_7 (30,39). Maximum number of grain per pod was observed in case of treatment T8, T9 and T10 (6.8,6.0,5.8) whereas minimum number of grain per pod was observed in treatment T1 and T0 respectively. The improvement in growth and yield parameters in the treatment combination (T8) might be due to combination application of Rhizobium culture and humic acid, FYM and N.P.K that influence the physical, chemical and biological properties of soil through supplying macro and micro nutraings leading to better plant growth and development we support the finding of meelu (1996) [12] patidar and Mali (2004) [13], Singh *at el* (2009) [8] and Sharma *at el* (2011).

Table 2: Performance of different treatments for yield attributing characters.

Treatment	Days to Germination	Plant height (cm)	No. of Nodules/ plant	No. of Pods/ plant	Fresh pod yield/bed (kg)	No. of grain/pod
T_1	10	26.50	6.60	49.00	3.200	3.40
T_2	12	31.00	8.00	40.00	4.790	4.60
T_3	10	34.00	7.40	42.00	4.000	4.00
T_4	12	34.50	7.80	42.00	4.300	4.00
T_5	13	28.75	6.60	41.00	3.900	3.80
T_6	11	31.50	6.20	42.00	3.900	4.60
T_7	13	29.50	6.00	39.00	3.800	3.60
T_8	8	44.00	15.00	55.00	6.370	6.80
T_9	12	40.50	14.60	49.00	5.700	6.00
T_{10}	12	39.00	13.40	43.00	5.400	5.80
T_0	14	28.00	6.20	30.00	2.200	3.60
Range	8-14	26.50-44.00	6.00-15.00	30.00-55.00	2.200-6.370	3.40-6.80
CD 5%	NS	6.20	1.50	7.5	0.50	1.20

Conclusion

The findings of the present investigation clearly reveals among the different treatments utilized to investigate the effect of integrated nutrient management on yield & growth performance of french bean (*Phaseolus Vulgaris* L.), T_8 (100 % RDF + Rhizobium cuture + Humic Acid) showed superior performance for days to germination, plant height (cm), number of nodule/plant, number of pods /plant, fresh pod yield per bed (kg) and number of grain/pod followed by treatment T_9 and T_{10} (75 % RDF + Rhizobium cuture + Humic Acid) and (50 % RDF + Rhizobium cuture + Humic Acid). Thus they may be utilized as an effective integrated nutrient management strategy in French bean especially under subtropical conditions of garhwal hills.

Conflict of Interest

We the Authors declare no conflict of Interest.

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