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*Orignal Article*

# Assessment of Integrated Nutrient Management in French bean (Phaseolus vulgaris L.) under Sub tropical Conditions of Uttarakhand

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**Abstract**

Present experiment was carried out at Horticulture Research Block, School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand to study the effect of integrated nutrient management on growth and yield of French bean cultivar Pant Anupma under subtropical conditions of Dehradun. Treatments included twelve combinations viz. $T_1$ (Without any organic, inorganic or biofertilizer application), $T_2$ (50% RDF i,e 15:25:15 Kg NPK/ha, respectively), $T_3$ (75% RDF i,e 22.5:37.5:22.5 Kg NPK/ha, respectively), $T_4$ (100% RDF i,e 30:50:30 Kg NPK/ha, respectively), $T_5$ (FYM @ 5 ton/ha), $T_6$ (VC @ 2.4 ton/ha)), $T_7$ (Biofertilizer viz., Rhizobium + PSB @ 20g/kg seed),$T_8$ (50% FYM + 50% VC + Biofertilizer), $T_9$ (50% RDF + 50% FYM), $T_{10}$ (50% RDF + 50% VC), $T_{11}$ (50% RDF+ Biofertilizer) and $T_{12}$ (50% RDF + 50% FYM + 50% VC + Bio-fertilizer). The experiment was laid out in Randomized Block Design with three replications. Results revealed that the yield attributes and yield increased significantly over control and highest pods/plant (13.40), seeds/pod (5.00), pod length (11.01 cm), 100-seed weight (g) and seed yield (1386.67 kg/ha) were recorded with application of 100% RDF but showed no significant difference with treatment $T_{12}$ (50% RDF + 50% FYM + 50% VC + Biofertilizer). Among growth and quality parameters, highest plant height (33.50 cm), primary branches (4.80, secondary branches (4.40), LAI (5.77), total dry weight (22.00), protein content (21.20%) and protein yield (294.01 kg/ha) were also recorded with application of 100% RDF and lowest in control.

**Keywords**: French bean, Organic, Inorganic, Biofertilizers, Yield attributes, Protein content

## Introduction

French bean (Phaseolus vulgaris L.) is commonly known by various names viz. common bean, kidney bean, haricot bean, snap bean etc. in English and in Hindi it is called as Farash bean or Rajma. It is an important leguminous vegetable crop which is consumed as vegetable when pods are immature, delicate, tender, soft and green; and also as it is one of the most precious and highly relished pulse crop of North India with a high yield potential of 18-20 q/ha (Zahida et al. 2016). Pods are valuable source of protein, vitamins as well as minerals. It is a short duration crop and can be grown in all types of soils ranging from light sandy loam to clay soils but it cannot withstand water-logging. French bean being a fertilizer responsive crop it responds well to nutrition. With population explosion, the demand for the crop has increased significantly leading to the extensive use of chemical fertilizers without any consideration for people health as well as soil health and quality, which is a critical factor for realizing sustainability in yield. 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. Besides this the residual effects of chemical fertilizers on our environment, underground water, soil microbes and the crop products etc. are matter of great concern. Greater use of chemical fertilizers not only puts a heavy financial burden to the farmers but also gradually decreases the production and thereby, jeopardizes the sustenance of the basic ecological system. Lesser use of the organic manures has also rendered soils deficient in macro and micro nutrients (Acharya and Mandal, 2002). 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 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). Thus, for increasing the yield and quality of French bean, besides other factors, an adequate quantity of nutrients from organic and inorganic sources is pre-requisite. Keeping the views of the above aspects the present research work was planned to study the effect of integrated nutrient management on growth, yield and quality of French bean under sub tropical conditions of Uttarakhand.

**Materials and Methods**

The experiment was conducted during kharif season 2018 at Horticulture Research Block, School of Agricultural Sciences, Shri Guru Ram Rai University, Dehradun, Uttarakhand, India located at 29o58' N and 77o34' E and at an altitude of 610 m above msl, to study the effect of integrated nutrient management on growth, yield and quality of French bean cv. Pant Anupma. The experiment was laid out in a Randomized Block Design having 12 treatments (Table-1), comprising different combinations of inorganic fertilizers, organic manure and biofertilizers viz., $T_1$ (Without any organic, inorganic or biofertilizer application), $T_2$ (50% RDF i,e 15:25:15 Kg NPK/ha, respectively), $T_3$ (75% RDF i,e 22.5:37.5:22.5 Kg NPK/ha, respectively), $T_4$ (100% RDF i,e 30:50:30 Kg NPK/ ha, respectively), $T_5$ (FYM @ 5 ton/ha), $T_6$ (VC @ 2.4 ton/ha)), $T_7$ (Biofertilizer viz., Rhizobium + PSB @ 20g/kg seed), $T_8$ (50% FYM + 50% VC + Biofertilizer), $T_9$ (50% RDF + 50% FYM), $T_{10}$ (50% RDF + 50% VC), $T_{11}$ (50% RDF+ Biofertilizer) and $T_{12}$ (50% RDF + 50% FYM + 50% VC + Bio-fertilizer) and was replicated thrice. The climate of the experimental site is sub-tropical characterized by moderately hot summers and cold winters. Rainfall received during the growing season (April to July) was 118.6 mm. The mean weekly maximum and minimum temperatures during the growing seasons varied from 7.2 to 19.52oC and 19.68 to 33.48oC respectively, whereas mean minimum relative humidity 42.78 to 66.78% and mean maximum relative humidity was 71.44 to 88.78 per cent. Recommended doses of NPK fertilizers (100% as per soil test) applied to French bean were N: $P_2O_5$: $K_2O$ @ 30:50:30 kg/ ha. The 100% NPK was applied as basal at the time of sowing. The recommended dose of Rhizobium (20 g/kg seed) or PSB as per treatment was first mixed in clean water to make thick slurry and seed was then inoculated as per treatments with the biofertilizer. Organic manures (farm yard manure and vermicompost) were incorporated according to the treatments at the time of field preparation and mixed thoroughly. French bean cv. Pant Anupma was sown @ 80 kg/ha at 30cm × 15cm spacing. All other intercultural operations were followed as per standard recommendations. The grain and straw yield of French bean were recorded and observation on growth and yield attributers were recorded from five randomly selected tagged plants from each plot at 60 days after sowing (DAS). Protein estimation was done in laboratory and protein yield was calculated as per following standard formula.

$$\text{Protein yield (kg/ha} = \frac{\text{Seed yield (kg/ha)} \times \text{Protein content (\%)}}{100}$$

The experimental data were analyzed as per the standard procedure for Analysis of Variance (ANOVA) as described by Gomez and Gomez (1984). The significance of treatments were tested by 'F' test (Variance ratio) and Standard error of mean (SEm±) was computed in all treatments. The difference in the treatment mean was tested by using critical difference (CD) at 5% level of probability.

Table 1: Organic and Inorganic Treatment Combinations

| Abbreviation Used | Treatment Details | Treatment Combinations |
|---|---|---|
| $T_1$ | Control | Without any organic, inorganic or biofertilizer application |
| $T_2$ | 50% RDF | 15 N: 25 $P_2O_5$:15 $K_2O$ kg/ha |
| $T_3$ | 75% RDF | 22.5 N: 37.5 $P_2O_5$:22.5 $K_2O$ kg/ha |
| $T_4$ | 100% RDF | 30 N: 50 $P_2O_5$: 30 $K_2O$ kg/ha |
| $T_5$ | FYM | 5 ton/ha |
| $T_6$ | Vermicompost | 2.4 ton/ha |
| $T_7$ | Biofertilizers (Rhizobium+PSB) | 20 g/kg seed |
| $T_8$ | 50% FYM+ 50%VC + Biofertilizers | 2.5 ton/ha + 1.2 ton/ha + 20 g/kg seed |
| $T_9$ | 50% RDF + 50% FYM | 15 N: 25 $P_2O_5$: 15 $K_2O$ kg/ha + 2.5 ton/ha |
| $T_{10}$ | 50% RDF + 50% VC | 15 N: 25 $P_2O_5$ :15 $K_2O$ kg/ha + 1.2 kg/ha |
| $T_{11}$ | 50% RDF + Biofertilizers | 15 N: 25 $P_2O_5$:15 $K_2O$ kg/ha + 20 g/kg seed |
| $T_{12}$ | 50%RDF + 50% FYM + 50%VC + Biofertilizers | 15 N: 25 $P_2O_5$: 15 $K_2O$ kg/ha +2.5 ton/ha + 1.2 ton ton/ha + 20 g/kg seed |

## Results and Discussion

### *Growth Attributes*

Results shows that the various growth parameters (Table-2) increased significantly with the application of various organic and inorganic fertilizers over control except germination percentage. It was observed that the increase in the inorganic fertilization dose (RDF) increases the all growth attributes as compared to control. Among all treatments the application of 100% RDF ($T_4$) recorded highest plant height (35.50 cm), primary branches (5.20), secondary branches (4.80), leaf area index (5.86) and total dry weight (22.20 g) and remained statistically at par with the treatment $T_{12}$ (50%RDF + 50% FYM + 50%VC + Biofertilizer) and were significantly superior over control ($T_1$) at 60 DAS whereas as the minimum plant height (23.00 cm), primary branches (2.80), secondary branches (3.20), leaf area index (1.21) and total dry weight (11.83 g) was recorded in control ($T_1$). Similar observations were also recorded by Jagdale et al., (2015). The increase in growth attributes in treatment $T_4$ might have been due to more and quick supply of NPK with heavy application

Table 2: Influence of organic and inorganic fertilizers on growth parameters of French Bean cv. Pant Anupma

| Treatments | Germination percentage | Plant Height (cm) | No. of Primary Branches | No. of Secondary Branches | LAI | Total dry Weight |
|---|---|---|---|---|---|---|
| T1 | 81.00 | 23.00 | 2.80 | 3.20 | 1.21 | 11.83 |
| T2 | 84.00 | 27.50 | 3.40 | 3.60 | 2.12 | 18.50 |
| T3 | 82.67 | 32.00 | 4.40 | 4.00 | 5.06 | 22.00 |
| T4 | 85.82 | 35.50 | 5.20 | 4.80 | 5.86 | 22.20 |
| T5 | 85.55 | 30.00 | 3.80 | 3.80 | 3.37 | 20.27 |
| T6 | 85.00 | 30.90 | 3.80 | 3.80 | 3.99 | 20.40 |
| T7 | 88.44 | 29.30 | 3.67 | 3.60 | 2.77 | 20.01 |
| T8 | 87.50 | 28.37 | 3.60 | 3.60 | 2.70 | 19.13 |
| T9 | 86.00 | 31.60 | 4.00 | 4.00 | 4.32 | 20.60 |
| T10 | 86.44 | 31.60 | 4.40 | 4.20 | 4.66 | 20.70 |
| T11 | 88.50 | 31.39 | 4.20 | 3.80 | 4.14 | 20.60 |
| T12 | 88.00 | 32.50 | 4.80 | 4.53 | 5.42 | 22.00 |
| SEm± | 1.88 | 1.00 | 0.11 | 0.11 | 0.17 | 0.55 |
| CD (p≤0.05) | NS | 3.28 | 0.31 | 0.33 | 0.50 | 1.63 |

of inorganic fertilization which increases the photosynthetic activity, cell division, cell elongation and differentiation etc. resulting in higher growth attributes as compared to other treatments. The increase in growth attributes at higher fertility levels is similar with the observations of Shubashree et al., (2011) and El-Bassiony et al., (2010). Further, the increased growth with substitution of 50% RDF by organic manures along with biofertilizers ($T_{12}$) might be due to the fact that the organic manures releases nutrients slowly, increases nutrient use efficiency, biological fixation and also increases availability of micro-nutrients as reported by Nawalgatti et al., (2009) and Shubasshree et al., (2011).

### *Yield and Yield Attributes*

The data presented in Table-3 indicates significantly higher yield attributes viz. pods/ plant at 60 DAS (13.64), pods/plant at harvest (14.26), seeds/pod (5.40), pod length (12.14cm) and 100-seed weight (40.36 g) were recorded with the application of $T_4$ (100% RDF i.e. 30:50:30 Kg NPK/ ha, respectively) without showing any significant difference with the treatment involving application of 50% RDF along with 50% FYM + 50% VC + 20 g biofertilizers/Kg seed ($T_{12}$). The minimum yield attributes viz. pods/plant at 60 DAS (5.18), pods/ plant at harvest (6.60), seeds/pod (1.96), pod length (5.80 cm) and 100-seed weight (26.67 g) were recorded in control ($T_1$). The maximum seed yield of (1434.26 Kg/ha) was recorded with treatment $T_4$ (100% RDF i.e. 30:50:30 Kg NPK/ha, respectively) whereas minimum seed yield (586.20 Kg/ha) was recorded with treatment control ($T_1$) where no any organic, inorganic fertilizer or biofertilizer was applied. However, no any statistical difference was recorded between seed yield (1434.26 Kg/ha) with the treatment $T_4$ i.e. 100% RDF and seed yield (1320.16 kg/ha) with the treatment $T_{12}$ (50% RDF + 50% FYM + 50% VC + biofertilizer). The seed yield of treatments $T_3$ (75% RDF), $T_9$ (50% RDF + 50% FYM, $T_{10}$ (50% RDF +50% VC) and $T_{11}$ (50% RDF + biofertilizers) were at par with each other. In case of stover yield, maximum stover yield (1298.00 kg/ ha) was recorded with 75% RDF ($T_3$) which was remained statistically at par with the stover yield (1267.00 kg/ha) of treatments $T_{12}$ (50% RDF + 50% FYM + 50% VC + biofertilizer) and stover yield (1274.00 kg/ha) of treatments $T_4$ (100% RDF). These results show similarity with Abd El-Mawgoud et al., (2015) and Dhanjal et al., (2011).

The increase in yield attributes might have been due to increased availability of NPK, higher total dry matter production and more vegetative growth resulting in better growth and development of yield attributes and also the higher seed yield with application of heavy inorganic fertilization. Similar observation was also recorded by Veeresh (2013). Further, higher seed yield and stover yield by application of inorganic fertilizers in combination with organic manures might has been due to its greater availability and uptake of more macro and micro nutrients resulting in higher rate of photosynthesis, cell and tissue differentiation and also due to translocation of assimilates and photosynthates etc. leading to higher seed and

Table 3: Influence of Organic and Inorganic Fertilizers on Yield Attributes, Yield and Quality of French Bean cv. Pant Anupma

| Treatments | Pods/ plant at 60 DAS | Pods/ Plant at Harvest | Seeds/ pod | Pod Length (cm) | 100-Seed Weight | Seed Yield (Kg/ha) | Stover Yield (Kg/ha) | Harvest Index (%) | Seed Protein (%) | Protein Yield (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| T1 | 5.18 | 6.60 | 1.96 | 5.80 | 26.67 | 586.20 | 680.33 | 44.16 | 17.70 | 95.22 |
| T2 | 8.20 | 9.60 | 2.60 | 7.07 | 32.00 | 890.00 | 841.3 | 51.64 | 18.20 | 161.98 |
| T3 | 11.33 | 12.60 | 4.40 | 9.80 | 37.00 | 1180.00 | 1298.00 | 48.76 | 20.80 | 245.1 |
| T4 | 13.64 | 14.26 | 5.40 | 12.14 | 40.36 | 1434.26 | 1274.00 | 53.06 | 21.28 | 296.02 |
| T5 | 10.20 | 10.80 | 3.20 | 7.53 | 34.80 | 977.00 | 928.00 | 51.23 | 18.46 | 180.34 |
| T6 | 10.13 | 11.20 | 3.40 | 7.80 | 35.00 | 1002.00 | 949.00 | 51.37 | 18.48 | 185.34 |
| T7 | 10.13 | 10.73 | 3.00 | 7.33 | 34.60 | 952.00 | 883.6 | 51.95 | 18.36 | 174.79 |
| T8 | 8.93 | 10.40 | 2.80 | 7.20 | 34.30 | 912.00 | 920.00 | 50.01 | 18.30 | 166.89 |
| T9 | 10.47 | 11.60 | 4.00 | 8.77 | 36.20 | 1152.00 | 985.00 | 51.72 | 18.60 | 195.65 |
| T10 | 10.80 | 11.60 | 3.73 | 9.20 | 36.33 | 1173.00 | 1053.33 | 51.41 | 18.90 | 210.41 |
| T11 | 10.27 | 11.40 | 3.60 | 8.13 | 35.50 | 1145.00 | 973.00 | 50.90 | 18.50 | 193.33 |
| T12 | 11.67 | 12.80 | 4.53 | 9.93 | 37.60 | 1320.16 | 1267.00 | 50.74 | 19.70 | 250.60 |
| SEm± | 0.42 | 0.55 | 0.28 | 0.57 | 1.28 | 51.49 | 32.23 | 1.61 | 0.076 | 10.17 |
| CD (p≤0.05) | 1.25 | 1.62 | 0.82 | 1.69 | 3.79 | 152.00 | 95.15 | NS | 0.223 | 29.71 |

stover yield. Similar finding was also reported by Sen et al., (2012). The result on harvest index indicated that there were no significant differences among the treatments. These observations are in agreement with the results of Thirumalia and Abdul Khalak (1998).

The data on seed protein percentage indicated significantly higher protein percentage (21.28 %) with application of 100% RDF ($T_4$), showings 19.14% increase over control while the minimum protein percentage (17.70%) was recorded with control ($T_1$). Similar observations were also reported in terms of protein yield, with significantly higher protein yield (296.02 kg ha-1) with application of 100% RDF than all the treatments, showing 19.14 percent increase over control. This might have been due to the increased nitrogen availability and uptake in case of heavy fertilization and nitrogen being an essential component of seed protein. These results are in agreement with Gupta et al., 1998 and Abdel-Mawgoud et al., (2015).

## Conclusion

From the present investigation it was concluded that in context of sustainable agriculture, the growth, yield and quality may be improved and enhanced by integrated use of organic and inorganic fertilizers under sub-tropical conditions of Uttarakhand and the nutrient management of French bean may involve substitution of 50% RDF through 50% FYM (2.5 ton FYM/ha) + 50%VC (1.5 ton VC/ha) + Biofertilizer (20 g biofertilizer/kg seed).

Hence, the integrated nutrient management practice is required for sustaining the desired crop productivity by optimizing the benefits from all the sources of plant nutrients in an integrated approach.

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