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# Effect of Integrated Phosphorus Management on Drymatter Production, Secondary and Micronutrient uptake of French bean (*Phaseolus vulgaris* L.) in *Alfisols* of Tirupati

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**ABSTRACT**

A field experiment was conducted in *rabi* season of 2006, to study the effect of integrated use of inorganic fertilizers coupled with organic manures and phosphate solubilizing bacteria on drymatter production, uptake of Ca, Mg, S, Fe, Mn, Zn and Cu in French bean at different growth stages of the crop in alfisols (*Typic Haplustalf*) of Tirupati. The results revealed that applications of 80 per cent of recommended dose of fertilizers along with 20 per cent phosphorous through poultry manure and phosphate solubilizing bacteria @ 25 kg ha$^{-1}$ recorded highest uptake of Ca, Mg, S, Fe, Mn, Zn and Cu at different growth stages of crop.

**Key words :** Drymatter, Integrated, Phosphorus, Micronutrient.

French bean is an important legume vegetable crop in the world, it is grown both as green vegetable and seed purpose. Dry beans furnish a large portion of protein, which needs for low and middle class families. In India it is being cultivated more than 1.48 lakh hectares with an annual production of 4.2 lakh metric tonnes (CMIE, 2004).

Continuous and indiscriminate use of high analysis fertilizers has resulted in several problems such as acidity, alkalinity, micronutrient deficiencies and soil and ground water pollution (Chhonker, 1995). The high cost of fertilizers and unstable crop production call for substituting part of the inorganic fertilizers by locally available low cost organic sources *viz.,* poultry manure, farmyard manure and vermicompost, biofertilizers etc. in an integrated manner for sustainable crop production to maintain soil health. The supplementary and complementary use of organic manures and inorganic chemical fertilizers coupled with biofertilizers (Phosphorus solubilizing bacteria) augment the efficiency of both the substances to maintain a high level of soil productivity . However, due to paucity of organic sources and their inability to meet total nutrient requirement in sustaining high level productivity to meet the demands of fast growing population of country and to safeguard the soil health, their integrated use with chemical fertilizers and biofertilizers is essential. Keeping this in view, the present investigation was conducted to monitor the effect of integrated phosphorus management on dry matter production, pod yield, quality and N, P, K uptake of French bean.

## MATERIAL AND METHODS

A field experiment was conducted during *rabi* season of 2006-07 on *Alfisols* (*Typic Haplustalf*) at Dryland Farm of Sri Venkateswara Agricultural College, Tirupati. The experimental soil was sandy loam having pH 7.72 (neutral), organic C (0.52%), alkaline $KMNO_4$ extractable N 225.79 kg ha$^{-1}$ (low), Olsen's P 23.27 kg ha$^{-1}$ (medium) $NH_4$ OAC extractable K 224 kg ha$^{-1}$ (medium) and DTPA extractable Fe 29.7 mg kg$^{-1}$, Mn 14.3 mg kg$^{-1}$, Zn 2.03 mg kg$^{-1}$ and Cu 5.9 mg kg$^{-1}$. The experiment was laid out with three replications in a randomized block design with 8 treatments {control (RDF)20-50-50 kg ha$^{-1}$ of N, $P_2O_5$ $K_2O$ respectively, RDF + phosphobacteria @ 2.5 kg ha$^{-1}$, 75% RDF + Phosphobacteria @ 2.5 kg ha$^{-1}$, 50% RDF + phosphobacteria @ 2.5 kg ha$^{-1}$, 80% RDF + 20% P through poultry manure, 80% RDF + 20% P through vermicompost, 80% RDF + 20% P though poultry manure + phosphobacteria @ 2.5 kg ha$^{-1}$, 80% RDF + 20% P through vermicompost + phosphobacteria @ 2.5 kg ha$^{-1}$}. The N, P and K were applied as basal in the form of urea, single superphosphate and muriate of potash, respectively. The FYM, poultry manure and vermicompost contained 0.5, 0.3 and 0.5 per cent, 3.0, 2.5 and 1.5 per cent, 1.2, 1.0 and 0.5 per cent N, P and K respectively. The organic sources were applied along with biofertilizers i.e. phosphobacteria @ 2.5 kg ha$^{-1}$ at the time of field preparation. The locally popular variety of French bean (Selection-9) seeds were sown with a spacing of 50 x 30 cm and all the cultural practices were followed to raise a good crop .The drymatter

Table 1.Influence of integrated phosphorus sources on calcium, magnesium, sulphur and micronutrient uptake by French bean at 55 and 65 DAS.

| S. No | Treatments | Dry Matter (kg ha$^{-1}$ ) | | Uptake (kg ha$^{-1}$) | | | | | | Uptake (g ha$^{-1}$) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Ca | | Mg | | S | | Fe | | Mn | | Zn | | Cu | |
| | | 55 DAS | 65 DAS | 55 DAS | 65 DAS | 55 DAS | 65 DAS | 55 DAS | 65 DAS | 55 DAS | 65 DAS | 55 DAS | 65 DAS | 55 DAS | 65 DAS | 55 DAS | 65 DAS |
| 1 | Control (RDF) | 588.81 | 549.97 | 9.33 | 8.37 | 3.51 | 2.72 | 5.33 | 4.98 | 101.04 | 90.41 | 35.76 | 32.97 | 10.93 | 9.63 | 18.35 | 15.04 |
| 2 | RDF+P.B. @2.5kg ha$^{-1}$ | 608.60 | 562.31 | 10.03 | 8.85 | 3.77 | 2.93 | 5.61 | 5.16 | 104.60 | 92.81 | 37.04 | 33.85 | 11.33 | 9.90 | 19.03 | 15.47 |
| 3 | 75%RDF+P.B. @2.5kg ha$^{-1}$ | 573.73 | 531.73 | 8.86 | 7.77 | 3.25 | 2.54 | 5.09 | 4.73 | 95.54 | 86.77 | 34.04 | 29.84 | 10.02 | 8.96 | 17.40 | 14.15 |
| 4 | 50%RDF+P.B. @2.5kg ha$^{-1}$ | 562.11 | 518.32 | 8.50 | 7.47 | 3.10 | 2.39 | 4.87 | 4.53 | 92.82 | 83.83 | 32.85 | 29.25 | 9.44 | 8.33 | 16.72 | 13.31 |
| 5 | 80%RDF+20% P (PM) | 601.08 | 542.19 | 9.56 | 8.33 | 3.60 | 2.68 | 5.44 | 4.92 | 104.33 | 90.48 | 38.03 | 32.97 | 11.38 | 9.98 | 19.12 | 15.36 |
| 6 | 80%RDF+20% P (VC) | 597.88 | 541.25 | 9.50 | 8.28 | 3.56 | 2.68 | 5.39 | 4.87 | 103.61 | 89.69 | 34.45 | 30.66 | 11.26 | 9.83 | 18.95 | 15.26 |
| 7 | 80%RDF+20%P (PM)+P.B.@2.5kg ha$^{-1}$ | 632.63 | 604.23 | 10.59 | 9.70 | 4.13 | 3.31 | 5.99 | 5.65 | 109.94 | 102.16 | 41.32 | 38.75 | 13.41 | 11.92 | 21.79 | 19.25 |
| 8 | 80%RDF+20%P (VC)+P.B.@2.5kg ha$^{-1}$ | 627.07 | 602.10 | 10.25 | 9.51 | 3.9 | 3.16 | 5.79 | 5.52 | 107.96 | 100.95 | 39.53 | 37.53 | 11.95 | 10.96 | 20.27 | 17.66 |
| | S.Em± | 1.04 | 0.78 | 0.04 | 0.03 | 0.01 | 0.01 | 0.02 | 0.01 | 0.18 | 0.14 | 1.19 | 1.18 | 0.05 | 0.04 | 0.07 | 0.10 |
| | C.D.(0.05) | 3.16 | 2.37 | 0.13 | 0.09 | 0.04 | 0.03 | 0.07 | 0.03 | 0.55 | 0.43 | 3.62 | 3.59 | 0.16 | 0.12 | 0.22 | 0.31 |

production was recorded at different growth stages of the crop. The plant samples were analysed for total Ca, Mg, S, Fe, Mn, Zn and Cu content (Jackson, 1973 and Vogel, 1978) and nutrient uptake by plant was computed.

$$\text{Nutrient uptake } (\text{kg ha}^{-1}) = \frac{\text{Nutrient concentration (\%)} \times \text{Weight of drymatter (kg ha}^{-1})}{100}$$

## RESULTS AND DISCUSSION

Application of 80% RDF+20% P through poultry manure + Phosphobacteria @ 2.5 kg ha$^{-1}$ recorded the highest drymatter production at different growth stages of the crop (Table 1). The highest drymatter production might be due to application of phosphobacteria integrated with 80 percent RDF and poultry manure @ 20% P recommended dose which might be due to combined synergistic effect of the three components by means of ready supply of microbial activities and enhanced nutrient availability to the crop by organic manures and increased P availability through its solubilization in the soil by phosphobacteria. Similar results were also reported by Amurtheswara *et al*.(2005).

With advancement of age of the crop the uptake of Ca, Mg and S was highest at 55 DAS later it was decreased at final harvest (65 DAS). The reason for decreasing Ca, Mg and S uptake at later stages were mainly due to reduction in drymatter productions, and also dilution effect coupled with reduced supply of nutrients. In general, uptake of Ca, Mg and S was highest with $T_7$ (80% RDF + 20% P through poultry manure + PB @ 2.5 kg ha$^{-1}$) followed by $T_8$ (80% RDF + 20% P through vermicompost + PB @ 2.5 kg ha$^{-1}$) over the $T_1$ (RDF) and other treatments tried in the study and the lowest was recorded with $T_4$ (50% RDF + PB @ 2.5 kg ha$^{-1}$) at all growth stages of the crop. The increased Ca, Mg and S uptake might be due to decomposition of organic manures as well as chelating effect. The highest uptake might be due to the nutrients released by organic fertilizers during entire crop growth period of French bean and also by the solubilization of native Ca, Mg and S by the organic acids produced from the organic manures upon from their decomposition. Similar results were recorded with FYM + vermicompost (Umareddy, 1999). Application of FYM + PB to the turmeric recorded higher uptake of Ca, Mg and S (Rajasekhar reddy, 2006) and also similar results reported with Khumawat and Khangarot (2002).

The uptake of micronutrients was significantly influenced by the integrated phosphorus sources at all the growth stages of the French bean (Table 1) The plots treated with $T_7$ (80% RDF + 20% P through poultry manure + PB @ 2.5 kg ha$^{-1}$) showed highest uptake of Fe, Mn, Zn and Cu followed by $T_8$ (80% RDF + 20% P through vermicompost + PB @ 2.5 kg ha$^{-1}$) over the $T_1$ (RDF) and other treatments which were tested in the study. This might be due to the fact that organic manures (poultry manure and vermicompost) had converted the micronutrients from unavailable form to easily available form. Similar results were observed by Madhavi (1992) with poultry manure. Higher uptake of micronutrients under poultry manure treatment could be due to improved inherent nutrient supplying capacity of materials, complexing of nutrients particularly micronutrients and enhanced microbial biomass during early stages of decomposition and subsequent autolysis of cell constituents might have helped in maintaining the availability of micronutrients. Organic manures increased the availability of micronutrients by decomposition of added organic manures which in turn resulted higher concentration and uptake of nutrients in tomato (Umareddy, 1999). These results were in line with Zaki and Radwan (2006), Singh *et al*.(1979).

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