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Effect of inorganic fertilizers, organic manure alone and in combination with or without biofertilizers on physical properties of soil at harvest of Rajma

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ABSTRACT

A field experiment was conducted in rabi 2005-2006 on experimental farm of Department of Agriculture Chemistry and Soil Science, College of Agriculture, Parbhani. The field experiment was carried out to study, "Integrated nutrient management for Rajma". Nutrient sources were inorganic fertilizers (NPK and micronutriets). Organic manure and biofertilizers. The effect of these nutrient sources along and in combination was studied on nutrient availability at harvest in soil and other physico-chemical properties of soil, growth attributes, yield, and uptake of nutrients and quality parameters of Rajma.

Keywords: *Phaseolus vulgaris*, Physical properties of soil, Organic manure, Bio-fertilizers

INTRODUCTION

French bean (*Phaseolus vulgaris* L. Halics) is an important pod vegetable and short duration crop. It belongs to the family leguminaceae. It is popularly known as field bean, green bean, kidney bean, dry bean, common bean, garden bean, snap bean etc. French been is an important source of dietic protein for more than 500 million persons in latin America and other countries. Rajma is quite nutritious containing 20.69 to 25.81 per cent crude protein 1.72 per cent fat and 72.42 per cent carbohydrates beside this 5.89 mg of iron 20.02 to 9.62 mg of methionine per 100 gm of protein 381 mg calcium, 425 mg phosphorus per 100 gm of edible parts. Ali and Khushwanta (19.87) reported that Rajama contain 3.84 mg zinc per 10 gm.

In Maharashtra, Pune, Satara, Ahemadnagar, Sangli, Nashik and Solapur are the leading district for growing french bean (Sravanghevda) in *rabi*season. Similarly in Mahabaleshwar and Ratnagiri region, it is grown as a *kharif* crop. It provides direct economic returns in form of pod used as a vegetable and grain for human beings as well as fodder for animals. In India french bean is grown on an area of 42.68 ha and producing 24778 tonnes with productivity 5-8 t/ha (Anonymous, 2003).

Looking for economical condition of farmer and cost of fertilizers, it is essential to adopt new techniques and management practices as integrated nutrient management. The combined use of organic and inorganic manures not only increases the crop yield but also improves the physical and biological properties of soil. Use of organic manures with optimum rate of fertilizers under intensive farming system increased the turnover of nutrients in the soil plant system (Nambiar, 1989). The organic manures such as FYM and vermicompost are not just source of nutrients but also have profound effect on physical properties resulting in a better soil structure, greater water retention in soil and more favorable environment for root growth and better infiltration of water.

MATERIAL AND METHODS

The experiment was conducted in *rabi* season of 2005-2006 at experiment farm of Department of Agricultural Chemistry and Soil Science, College of Agriculture, Parbhani.

Collection of soil samples

Collection and preparation of soil samples for chemical analysis

Representative surface soil sample (0 to 15 cm) was collected before sowing i.e. prior to application of manures and fertilizers. Surface soil samples were also collected at 7 days after harvesting of the crop. These samples were air dried in shade then crushed and sieve through 2 mm sieve and were stored in brown paper bags.

Collection of soil samples for physical properties

Core samples (0-15 cm depths) were collected from each plot and were dried in shade. The undisturbed soil samples were used for some physical properties.

Laboratory studies:

Soil analysis

Physical properties of soil

a) Particle size analysis

It was carried out by adopting International Pipette method as described by Piper (1950) using NaOH as dispersing agent.

b) Bulk density

It was determined by Core method given by Piper (1950).

$$\text{Bulk Density} = \frac{\text{Weight of oven dry soil}}{\text{Volume of soil (solids + pores)}}$$

Pore space

The total porosity was calculated from an expression relating porosity with bulk density and particle density as under.

$$\text{Porosity \%} = \left(1 - \frac{\text{Bulk density}}{\text{Particle density}} \text{ X100}\right)$$

d) Maximum water holding capacity

The maximum W.H.C. was estimated by keen Reczkawski Box method.

RESULTS AND DISCUSSION:

Physical properties as bulk density, per cent porosity and maximum water holding capacity of soils before application of the treatments and at harvest of the crop were studied. The results obtained are given in Table 1.

Table 1 : Effect of inorganic, organic nutrient sources and biofertilizers on physical properties of soil

Treatments	Bulk Density (mg m^{-3})	Porosity (%)	Maximum water holding capacity (%)
T_1	1.26	49.45	56.85
T_2	1.25	49.60	56.85
T_3	1.24	50.20	57.00
T_4	1.29	48.50	56.12
T_5	1.24	52.50	58.81
T_6	1.24	51.50	58.92
T_7	1.26	52.00	58.31
T_8	1.28	49.00	57.15
T_9	1.23	53.25	58.96
S.E. ±	0.04	0.009	0.03
CD at 5%	NS	0.02	NS

Initial values of bulk density, porosity (%) and maximum water holding capacity (%) at sowing were as below :

Bulk density.28 (mg m^{-3})
Porosity 51.69 (%)
Maximum water holding capacity 56.32 (%

Effect on bulk density (mg m^{-3})

The data from Table 1 indicated that higher bulk density was observed when NPK was applied to soil only through inorganic fertilizers. High dose of NPK (180:90:90 kg/ha i.e. 150% RDF) application through inorganic fertilizers recorded highest bulk density i.e. 1.29 mg m^{-3} in T_4 treatment, which was highest among all the treatments. It was followed by T_8, T_7, T_1 and T_2 treatments. The treatments where 2-5 t vermicompost and 50% N through urea either at sowing or at flowering with or without micronutrients and biofertilizers recorded decreased the bulk density as compared to T_1 and T_2 treatments. The lowest bulk density was observed in treatment T_9 i.e. 1.23 mg m^{-3} where only 5 t vermicompost per hectare was applied. However, the differences in bulk density among all the treatments were non-significant. Palaniappan (1975) has also reported that the humic substances penetrate the interlameller spaces of clay minerals and influence the interaction of clay with other soil constituents. Similar observations were recorded by Mishra and Sharma (1997), Bellakki*et al*. (1998), Babhulkar*et al*. (2000).

Effect on percent porosity

The data from Table 1 showed that, higher porosity was observed when 5 t of vermicompost only per hectare was applied as organic manure. The highest porosity in this treatment recorded as 53.25 per cent which was highest among all the treatments. The treatments where 2.5 t vermicompost per hectare and 50% N through urea either at sowing or at flowering with or without micronutrients and biofertilizers recorded comparatively more porosity as compared to NPK application as per soil test values 100% RDF and 150% RDF through inorganic fertilizer sources. The lowest porosity i.e. (48.50%) was observed in T_4 treatment where 150% RDF i.e. 180:90:90 kg/ha NPK was applied only through inorganic fertilizers.

The data from Table 1 indicated that per cent porosity was maximum (53.25%) due to T_9 treatment where only 5 tonnes vermicompost per hectare was applied with biofertilizers. Similar observations were reported by Palaniappan (1995) who noted that addition of organic matter improved soil aggregation and thereby more porosity of soil. Venkateshrlu (1989) also showed that, the combined application of FYM and inorganic fertilizers increased the pore space in soil. Bhatia and Shukla (1982) observed that continuous addition of organic manures, resulted in soil aggregation and favourable change in total porosity of soils. Similar findings were recorded by Sarkar *et al*. (1989).

The minimum porosity i.e. 48.60 per cent was recorded where 150% RDF of NPK/ha was applied through inorganic fertilizers. Minimum porosity due to deterioration of soil structure by use of inorganic fertilizers was shown by Biswas *et al*. (1971). Similar results were found by Gattani*et al*. (1996). They reported that continuous use of NPK fertilizers decreased the porosity due to absence of organic matter. Sarkar *et al*. (1989) found that, the continuous use of inorganic fertilizers decreased the porosity of soil.

Effect on per cent maximum water holding capacity

The highest water holding capacity was recorded i.e. 58.96 per cent in T_9 treatment followed by T_7, T_6 and T_5. The treatment 2.5 t vermicompost per hectare and 50% N through urea either at sowing or at flowering with micronutrients and biofertilizers recorded comparatively more water holding capacity as compared to 100% RDF. The lowest maximum water holding capacity i.e. 56.12 per cent was observed in T_4 treatment where 150% RDF was applied followed by T_8 treatment where NPK was applied as per soil test through inorganic source. It was also observed that differences in per cent maximum water holding capacity due to different treatments were non-significant.

Bhatnagar*et al*. (1992) noted that higher water holding capacity of soil was ascribed due to the improvement in structural condition of the soil, brought about mainly by the application of FYM. Similar results were found by Bellakki*et al*. (1998), Babulkar*et al*. (2000).

Water holding capacity was lowest (56.12%) in T_4 treatment where was applied. Similar results were found by Biswas *et al*. (1971). They reported that application of inorganic fertilizers lowered down water holding capacity due to deterioration of soil structure. Gattani*et al*. (1996) also found that the continuous use of N, P, K i.e. inorganic fertilizers caused hard pan and hence decreased the water holding capacity. Sarkar *et al*. (1989) found that continuous use of inorganic fertilizers with fixed rotation decreased the water holding capacity of soil.

CONCLUSION

Lowest bulk density of soil was observed due to application of only vermicompost. Wherever the highest

bulk density was observed when only inorganic fertilizers were applied. Maximum water holding capacity of soil and porosity was recorded where vermicompost at 5 tonnes ha^{-1} only was applied. While these characters of soil were recorded minimum when only inorganic fertilizers were applied.

Conflicts of interest: The authors stated that no conflicts of interest.

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