IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 7.301

Volume 3, Issue 3, January 2023

Study of Physiochemical Properties of Experimental Soil and Effect of Integrated Nutrient Management on Physical and Chemical Properties of Soil while harvesting of *Phaseolus Vulgaris*

Andhale Atmaram Vitthal[1] and ShakuntalaParmeshowar Chate[2]

Assistant professor, Modern Education Society's Nowrosjee Wadia College, Pune, Maharashtra, India[1]

Extension Officer (Agri), Zilla, Parishad, Pune, Maharashtra, India[2]

atmabiotech@gmail.com[1]

Abstract: *As world population increases as day by day and to fulfill the need of food commodities, it is need to be applying the integral practices to enhance the soil fertility by improving the physical and chemical properties. In present study was done on, 'Effect of Integrated Nutrient Management on Physical and Chemical Properties of Soil'. A field experiment was conducted in rabi 2005-2006 on experimental farm of department of ACSS, MAU, Parbhani to study, "Integrated nutrient management for* ***Phaseolus Vulgaris*** *(Rajma).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 @ 5 tonnes ha^{-1} only was applied. Maximum water holding capacity was where 5 tonnes of vermicompost ha^{-1} with biofertilizers were applied. Maximum water holding capacity may be due to high organic carbon content resulting in soil aggregation. While these characters of soil were recorded minimum when only inorganic fertilizers were applied. The minimum porosity i.e., 48.60 per cent was recorded where 150% RDF of NPK/ha was applied through inorganic fertilizers. Soil pH and EC where highest only inorganic fertilizers were applied. The lowest pH and EC were recorded due to use of vermicompost only. The per cent organic carbon was highest in the soil where only vermicompost was applied only, whereas the lowest organic carbon was observed due to application of inorganic fertilizers.*

Keywords: Phaseolus Vulgaris, Bulk density, pH, EC**.**

I. INTRODUCTION

Looking to economic 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. FYM contains 0.5 per cent N, 0.2 per cent P_2O_5 and 0.5 per cent K_2O (Yawalkar, 1975). Vermicompost application to the soil drastically improves the soil fertility, improves pH, increases water holding capacity, and enhances infiltration, enhancing its exportability (Bhawalkar and Bhawalkar, 1991). It contains 1.60 per cent N, 2.20 per cent P_2O_5 and 0.65 per cent K_2O (Thompson, 1993).

As world population increases as day by day and to fulfill the need of food commodities, it is need to be applying the integral practices to enhance the soil fertility by improving the physical and chemical properties. In present study was done on, 'Effect of Integrated Nutrient Management on Physical and Chemical Properties of Soil'.

II. MATERIALS AND METHODS

A field experiment was carried out to study "Integrated nutrient management for Rajma (French bean). "The nutrient sources were organic manures, inorganic fertilizers, micronutrients and bio-fertilizers". 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 (MS), India. Weekly weather data during crop growth for the year 2005 at Parbhani were recorded.

2.1 Experimental Soils

Soils and their mineralogy-The major soils of the district are derived from "Deccan Trap" rock (Basalt) which is rich in iron, lime and magnesium (Gajbe*et al.,* 1976). As per Challa*et al.* (1995) aluminum and basalt are dominant in these soils and most suitable for the cultivation of sorghum, soybean and cotton. On the basis of morphology, soils are identical to that of Parbhani series (Typic-haplusterts) as classified by Malewar (1976). The primary mineral studies carried out by Maniyar*et al.* (1981) revealed that Parbhani soils constitute bulk of iron ores along with augite, epidote, chlorite hornblende, tourmaline, pyrite, pyroxines, feldspar, quartz and muscovite. X-ray diffraction studies indicated that these soils are dominant in montmorillonite clay. Chlorite and illite were moderate in few soils while in other they were presented in traces (Malewar and Randhawa, 1977; 1978 and Maniyar*et al.,* 1981).

2.2 Experimental Details

Physico-chemical properties of soil studied before the experimental conductions (Table 1). The field experiment was conducted in *rabi* 2005-2006 with nine treatments and three replications in Randomised Block Design. The recommended dose of fertilizer for rajma was 120:60:60 kg NPK ha^{-1}. The treatments in which micronutrients are included, they were applied as 25 kg $ZnSO_4$ and 25 kg $FeSO_4$ per hectare. In treatments where nutrients were applied through organic manures, vermicompost was applied before sowing @ 2.5 or 5.0 t ha^{-1}. The treatments where biofertilizers are included *Rhizobium* and phosphote solubilizing bacteria 250 g each were inoculated per 100 kg of rajma seed. Seed was coated with *Rhizobium phaseoli* and phosphate solubilizing bacteria *Pseudomonas striata* before sowing.

2.3 Composition of vermicompost applied in the experiment

Particulars	N (%)	P (%)	K (%)	Fe (mg kg^{-1})	Zn (mg kg^{-1})
Vermicompost	0.92	0.60	0.83	960	31

2.4 Nutrient Sources

(1). Inorganic fertilizer: through urea (46%0, through single super phosphate, through murate of photas (60% $K_2 0$).
(2) Micro-nutrient: through $ZnSO_4$, through $FeSO_4$.
(3). Organic fertilizers: Vermicomost applied as par tretement.
(4).Bio-fertilizers: a). *Rhizobium phaseoli* b) phosphate solubilizing bactria- *Psedomonas striata*

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.

2.5 Laboratory Studies

A) 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).

Bulk Density = Weight of oven dry soil/ Volume of soil (solids + pores)

c) Pore space: The total porosity was calculated from an expression relating porosity with bulk density and particle density as under.

DOI: 10.48175/IJARSCT-8137

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Impact Factor: 7.301
Volume 3, Issue 3, January 2023

$$Porosity\% = 1 - \left(\frac{Bulk\ density}{Particle\ density} \times 100 \right)$$

d) Maximum water holding capacity: The maximum W.H.C. was estimated by keen Reczkawski Box method.
e)Field capacity, f) Permanent wilting point, g) Available water capacity

Chemical Properties of Soil

1. **Soil reaction:** The pH of soil sample was determined in 1:2.5 soils: water suspension using glass electrode pH meter (Jackson, 1973).
2. **Electrical conductivity:** It was estimated in (1:2.5) soil: water suspension using digital conductivity meter (Jackson, 1973).
3. **Organic carbon:** It was determined by Walkley and Blacks rapid titration method (Black, 1965).

Details of Field Experiments

1.	Number of treatments	09
2.	Number of replications	03
3.	Design of experiment	RBD
4.	Gross plot size	4.5m X 3.6 m
5.	Net plot size	3.3 X 3.0m
6.	Spacing (row to row and plant to plant)	30cm X 15cm
7.	Total No.of plots	27.
8.	Method of sowing	Dibbling
9.	Variety of crop	Arakakomal

Treatment Details:

Symbols	Treatment
T_1	Recommended dose of fertilizer (RDF) i.e. 120:60:60 kg NPK/ha.
T_2	RDF + Rhizobium (*Rhizobium* strain for Rajma will be used i.e. *Rhizobium phaseoli* + PSB (Phosphate solubalizing bacteria).
T_3	RDF + Zn (through 25 kg $ZnSO_4$) + Fe (through 25 kg $FeSO_4$) + *Rhizobium* + PSB
T_4	150% RDF i.e. 180:90:90 NPK kg ha^{-1} + Zn + Fe + *Rhizobium* + PSB
T_5	2.5 t ha^{-1} vermicompost + 50% N through urea at sowing time.
T_6	2.5 t ha^{-1} vermicompost + 50% N through urea + Zn + Fe at sowing + Rhizobium + PSB.
T_7	2.5 t ha^{-1} vermicompost at sowing + 50% N through urea at flowering stage.
T_8	As per soil test NPK application at sowing.
T_9	Vermicompost 5 t ha^{-1} at sowing + *Rhizobium* + PSB

III. OBSERVATIONS, RESULT AND DISCUSSIONS AND CONCLUSION:

Observations as shown in below tables,

Table: 1 (Table 2), Physical physico-chemical and chemical properties of experimental soils

Sr. No.	Particulars	Observed values
I	**Physical properties**	
1)	Particle size analysis (%)	
a.	Coarse sand	21.15
b.	Fine sand	14.20
c.	Silt	26.15
d.	**1) Clay**	52.50
2)	**2) Textural class**	Clay
3)	**3) Depth (cm)**	140
4)	**4) Bulk density (Mg m3)**	1.28
5)	**5) Porosity (%)**	51.69
6)	**6) Soil moisture studies (%)**	
a.	**7) Maximum water holding capacity**	56.32
b.	**8) Field capacity (F.C.)**	34.00
c.	**9) Permanent wilting point**	17.00
d.	**10) Available water capacity**	17.00
II	11) **Chemical properties**	
a.	**12) pH (1:2.5 soil : water)**	7.70
b.	**13) Electrical conductivity (dSm-1)**	0.26
c.	**14) Organic carbon (%)**	0.56
d.	**15) Available nitrogen (kg/ha)**	241.00
e.	**16) Available phosphorus (kg/ha)**	18.70
f.	**17) Available potassium (kg/ha)**	364.00
g.	**18) Fe++ (ppm) in DTPAN**	3.40
h.	**19) Zn (ppm) in DTPAN**	0.68

Table 2: (Table 3) Effect of inorganic, organic nutrient sources and biofertilizers on physical properties of soil at harvest of *Phaseolus Vulgaris*

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 = 1.28 (mg m^{-3}); **Porosity** =51.69 (%); **Maximum water holding capacity** = 56.32 (%)

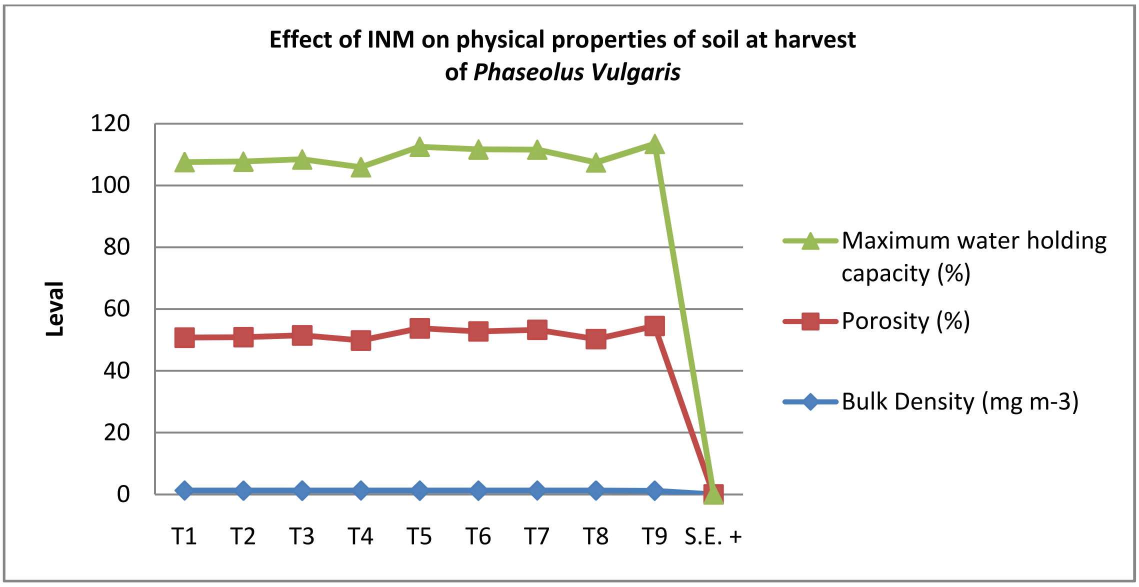

Figure 2

Table 3: (Table 4)Effect of integrated nutrient management (inorganic, organic, bio-fertilizers and their combinations) on chemical properties of soil at harvest of *Phaseolus Vulgaris*

Treatments	pH	EC (dSm^{-1})	% organic carbon
T_1	7.66	0.30	0.64
T_2	7.63	0.31	0.71
T_3	7.70	0.32	0.73
T_4	7.66	0.33	0.76
T_5	7.56	0.29	0.78
T_6	7.63	0.30	0.82
T_7	7.62	0.28	0.80
T_8	7.76	0.30	0.74
T_9	7.55	0.28	0.91
S.E. +	0.09	0.07	0.08
CD at 5%	NS	NS	0.25

Initial values of pH, EC and per cent organic carbon in soil at sowing were as below:
pH =7.70 ;**EC (dSm^{-1})**= 0.26; **Percent organic carbon** =0.56

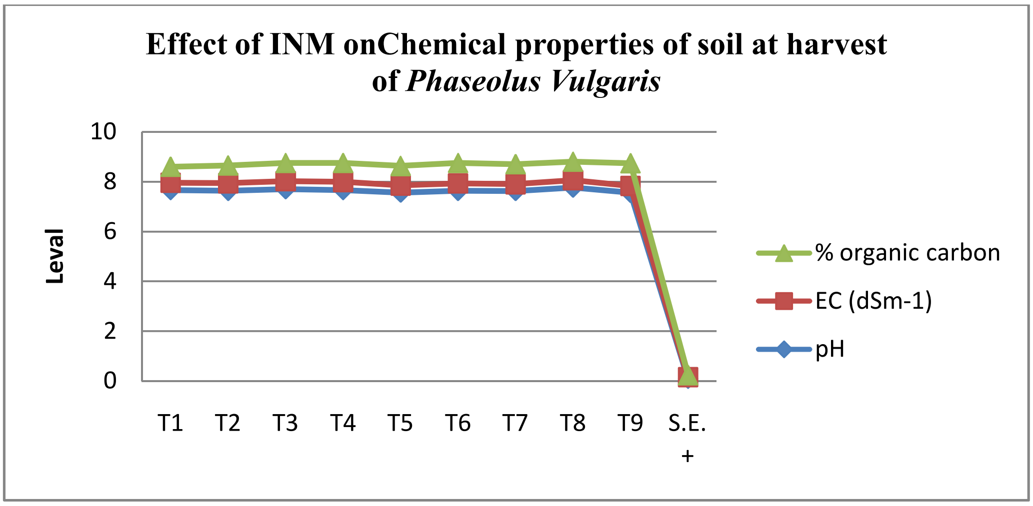

Figure 3

IV. RESULT AND DISCUSSIONS

Effect of inorganic fertilizers, organic manure alone and in combination with or without biofertilizers on physical properties of soil at harvest of rajma: 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 2 and fig. 2.

Effect on Bulk Density (mg m^{-3}): The data from Table 3 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.

Effect on percent Porosity: The data from Table 3 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.

Effect on percent 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.

Effect of integrated nutrient management (inorganic, organic, biofertilizers and their combination) on chemical properties of soils at harvest of rajma (Table 3 and fig. 3):

Effect of Soil pH: Results on soil pH given in table 3 indicated that it was lowest (7.55) in treatment T_9 where only vermicompost and biofertilizers were applied. The highest soil pH i.e. 7.76 was observed in T_8 treatment where the nutrients were applied only through inorganic fertilizers. Use of inorganic nutrient sources (NPK and micronutrient) with and without biofertilizers had no major effect on soil pH. There were no statistical differences in soil pH due to these treatments alone or in combinations of inorganic fertilizers (with and without micronutrient) and organic manure with and without biofertilizers. Application of only organic manure as vermicompost @ 5 tonnes/ha slightly decreased the soil pH as compared to other treatments where inorganic fertilizers were used.

Electrical Conductivity: Results on soluble salt concentration in soil at harvest affected due to application of inorganic fertilizers (including or excluding micronutrient fertilizers), organic manure as vermicompost and its levels, biofertilizers and combination of these sources were studied. The rajma crop was grown and the results are presented in Table 4, which are expressed as electrical conductivity (dSm^{-1}). The results indicated that, electrical conductivity was highest (0.33) when 150% NPK as inorganic source with micronutrient fertilizers was applied to soil. The electrical conductivity (dSm^{-1}) was followed in other treatments where RDF of NPK through inorganic fertilizers + micronutrients and with biofertilizers or only inorganic NPK sources (RDF) was applied. The results also showed that in treatment T_8 where NPK were applied through inorganic sources according to soil test values also had higher electrical conductivity. The results clearly indicated that, soluble salt concentration was comparatively lower in the treatments where the nutrients were applied through organic (with or without inorganic and biofertilizers). The lowest salt concentration (EC 0.28 dSm^{-1}) was recorded from the soils where organic manure as vermicompost only was applied. It was also seen from the Table 3, that the electrical conductivity of soil due to all the treatments was increased as compared to its initial value (0.26 dSm^{-1}) before sowing of the crop. However, the data also indicated that the differences in the electrical conductivity due to these nutrient sources were non-significant.

Organic carbon content in soil: The organic carbon content in soil (Table 3) showed that it was improved more or less due to application of all the nutrient sources. The results further showed that organic carbon content in soil was increased due to the treatments where organic manure as vermicompost was applied either 5 tonnes/ha or 2.5 tonnes/ha. It was also observed that organic carbon content in soil was comparatively less and that got improved due to the treatments where only inorganic fertilizers with or without biofertilizers were used. Micronutrient application as well as biofertilizers had no significant effect on organic carbon content in soil. The highest per cent organic carbon content (0.91%) in soil was found in treatment T_9 followed by T_6, T_7 and T_5 treatments where 2.5 tonnes of vermicompost was applied with 50% N of RDF through urea. However, differences in per cent organic carbon content in soil due to 5 tonnes/ha and 2.5 tonnes/ ha were at par. The lowest per cent organic carbon content was found to be 0.64 in soil, where only RDF of NPK through inorganic fertilizers was applied, which was slightly improved due to addition of biofertilizers as well as micronutrients and 150% RDF. However, all the treatments were statistically at par except the difference in T_9 and T_1 were significant.

4.1 Discussions

A. Effect of inorganic and organic nutrient sources with or without biofertilizers on physical properties of soil at harvest of Rajma: Physical properties of soil as bulk density, per cent porosity and maximum water holding capacity were studied and the results presented in Table 3 are discussed below.

Bulk Density: The data pertaining to bulk density presented in Table 3 indicated that, bulk density was lowest i.e. 1.23 mg m^{-3} in T_9 treatment where only 5 tonnes vermicompost per hectare and biofertilizers were applied. Vermicompost might have combined with mineral constituents of the soil modifying and lowering the bulk density of soil P.Santhy (1999). 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. Similarly Arvind (1987) also explained that organic additions improved the aggregate formation of soil and lowered down the bulk density. Similar observations were recorded by Mishra and Sharma (1997), Bellakki*et al*. (1998), Babhulkar*et al*. (2000) and Hangarge*et al*. (2002).

Highest bulk density 1.29 mgm^{-3} was recorded T_4 treatment where only inorganic nutrient sources (150% RDF) were used. Biswas *et al*. (1971) reported that inorganic fertilizers increased bulk density due to deterioration of soil structure. Gattani*et al*. (1976) also found that use of N, P, K fertilizers alone and their combinations caused a hard pan of soil and resulted in increase in bulk density. Sarkar *et al*. (1989) found that, the continuous use of inorganic fertilizers with fixed rotation increased bulk density. Wandile *et al*. (2005) recorded that application of N; P with micronutrients had no significant effect on bulk density of soil.

Percent Porosity: The data from Table 3 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 Shulka (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 Mahimairaja*et al*. (1986), Patanik*et al*. (1989), Sarkar *et al*. (1989) and Wandile *et al*. (2005).

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.

Maximum Water Holding Capacity: The data (Table 3) indicated that maximum water holding capacity was where 5 tonnes of vermicompost ha^{-1} with biofertilizers were applied. Maximum water holding capacity may be due to high organic carbon content resulting in soil aggregation. The presence of polysaccharides in organic matter might have improved soil aggregates by binding clay particles and increasing the water holding capacity of soil. 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), Santhy*et al*. (1999), Babulkar*et al*. (2000) and Wandile *et al*. (2005).

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.

B. Effect of integrated nutrient management (Inorganic, organic, biofertilizers and their combinations) on chemical properties of soil at harvest of Rajma Chemical properties of soil such as pH, electrical conductivity (dsm^{-1}) and per cent organic carbon of soil at harvest of Rajma were studied and the results presented in table 4 are discussed below.

Soil pH: The data on table 4 indicated that application of inorganic fertilizers with or without micronutrients, organic manures and biofertilizers (including and excluding) had non-significant effect on soil pH. Soil pH was lowest 7.55 due to T_9 treatment where only 5 tonnes vermicompost ha^{-1} with biofertilizers was applied. Similar results were found by Narkhede and Ghungre (1987). They found significant decrease in pH with long term use of manuring. Rana *et al*. (1998) observed that application of *Rhizobium* improved soil pH.Katkar*et al*. (2002) reported that effect on soil pH due to various treatments of organic and inorganic fertilizers was not consistent.

The highest pH i.e. 7.75 was observed in T_8 treatment where applications of inorganic fertilizers as per soil test were applied. Santhy*et al*. (1999) observed that the continuous addition of varying quantities and combination of NPK + FYM did not alter the soil pH appreciably. This was due to the fact that the quantity and nature of fertilizers being applied are such that they don't alter the soil pH appreciably.

Effect on electrical conductivity (dsm^{-1}) of soil : The data from Table 4 presented on electrical conductivity (dsm^{-1}) indicated that application of inorganic fertilizers with or without micronutrients, organic manures and biofertilizers (including or excluding) had nonsignificant effect.The electrical conductivity was increased to 0.33 dsm^{-1} in T_4 treatment where 150% RDF of NPK was applied through inorganic fertilizers. Similar results were found by Katkar*et al*. (2000) who reported that the treatments in which only inorganic fertilizers were applied showed slight increase in electrical conductivity of soil.

Lowest electrical conductivity recorded was 0.28 dsm^{-1} in T_9 treatment, where only 5 tonnes vermicompost/ha was applied. This can be ascribed to the fact that the use of organic manures increases the soil microflora altering EC of the soil by reducing salt content. Similar findings were recorded by Bharambe*et al*. (2001). Santhy*et al*. (1999) noted that a slight increase in salt content was observed with the application of100% NPK + FYM and a considerable increase with the application of inorganic fertilizers alone at different levels and at various combinations. Raghuwanshi*et al*. (1988), Bharadwaj and Omanwar (1994) did not find any change in electrical conductivity with long term effect of manures and fertilizers.

Percent organic carbon content in soil: The data presented in Table 4 indicated that highest organic carbon content in soil was observed due to T_9 treatment where only 5 tonnes vermicompost ha^{-1} with biofertilizers was applied. Increase in per cent organic carbon due to addition of organic matter which might have stimulated the growth and activities of microbes and may also be due to better root penetration. It was also noted that the organic sources retained higher residual organic carbon in soil and there was further addition in organic matter due to residues after harvest of Rajma crop. Similar observations were recorded by Kanwar and Parihar (1982) they recorded an increase in organic carbon content in the soil due to long term application of manures and fertilizers. Continuous use of FYM helped in maintaining and improving organic carbon content in soil.

Similar results were observed by Bharadwaj *et al*. (1994), Sudhir and Siddaramappa (1995), Bellakki*et al*. (1997), Bhoyar and Ingale (1998), Babulkar*et al*. (2000), Tiwari *et al*. (2002) and Veralakshmi*et al*. (2005).

V. 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 @ 5 tonnes ha^{-1} only was applied.Maximum water holding capacity was where 5 tonnes of vermicompost ha^{-1} with biofertilizers were applied. Maximum water holding capacity may be due to high organic carbon content resulting in soil aggregation. While these characters of soil were recorded minimum when only inorganic fertilizers were applied. The minimum porosity i.e. 48.60 per cent was recorded where 150% RDF of NPK/ha was applied through inorganic fertilizers.

Soil pH and EC were highest only inorganic fertilizers were applied. The lowest pH and EC were recorded due to use of vermicompost only. The per cent organic carbon was highest in the soil where only vermicompost was applied only, whereas the lowest organic carbon was observed due to application of inorganic fertilizers.

REFERENCES

- **[1].** Babhulkar, R.M. (2000). Residual effect of long term application of FYM and fertilizer on soil properties and yield of soybean. J. Indian Soc. Soil.Sci., 48 : 89-92.
- **[2].** Badanur, V.P., Poleshi, C.M. and Naik, B.K. (1990). Effect of organic matter on crop yield and physical chemical properties of vertisol. *J. Indian Soc. Soil Sci*., 38 : 426-429.
- **[3].** Badiyala, D. and Verma (1990). Effect of supplemental sources and fertilizer nitrogen on physico-chemical properties of acid soils of Himachal Pradesh. *Indian J. Agron*., 35 (1 and 2) : 144-149.
- **[4].** Bellaki, M.A. and Badanux, V.P. (1997). Long term effect of integrated nutrient management on properties of vertisol under dryland agriculture. *J. Indian Soc. Soil Soc*., 45(3) : 438-442.
- **[5].** Bellakki, M.A., Badanur, V.P. and Shetty, R.A. (1998). Effect of long term integrated nutrient management on some important properties of a Vertisol. *J. Indian Soc. Soil Sci.,* 46 (2) : 176-180
- **[6].** Bhawalkar, V.U. and Bhawalkar, S.U. (1991). Vermicompost Biochemistry. Pub. Bhawalkar Earthworm Res. Institute, Pune, M.S.41.
- **[7].** Bhoyar, S.M. and Ingale, S.N. (1998). Effect of fertilizers alone and in combination with FYM on build up of organic carbon level in Vertisols. *Ann. Plant Physio.,* 12 (1) : 70-71.
- **[8].** Jackson, M.L. (1973). Soil chemical Analysis. Advance Course Dept. of Soils, Univ. of Wisconsin Madison Wisconsin, U.S.A.
- **[9].** Kanwar, J.S. and Parihar, S.S. (1982). Effect of continuous application of manure and fertilizer on some physico-chemical properties of Punjab soils. *J. Indian Soc. Soil Sci*., 10: 242-248.
- **[10].** Malewar, G.U. (1976). Placement of black soils of Marathwada in comprehensive system of soil classification. J. Maharashtra agric. Univ., 1 : 155-59.
- **[11].** Malewar, G.U. (1995). Micronutrient availability as influenced by cropping patterns in Marathwada region of Maharashtra. *J.* Maharashtra *agric. Univ*., 20(3) : 330-333.
- **[12].** Mishra, V.K. and Sharma, R>B. (1997). Effect of fertilizers along and in combination with manure on physical properties and productivity of entisol under rice based cropping system. *J. Indian Soc. Soil Sci*., 41(1) : 84-88.
- **[13].** Nambiar, K.K.M. and Abroal, I.P. (1989). Long term fertilizer experiments in India. *Fert. News*, 34 (4) : 11-20.
- **[14].** Palaniappan, R. (1975). Reported that the humic substances penetrate the interlandlar spaces of clay minerals and influence the interaction of clay with other soil constituents. Ph.D. Thesis submitted to Univ., of Madras Coimbatore.
- **[15].** Piper, C.S. (1950). Soil and Plant Analysis. Univ. of Adeladide, Australia.
- **[16].** Varlakshimi, L.R., Srinivasamurthy and Bhaskar, B. (2005). Effect of integrated use of organic manures and inorganic fertilizers on organic carbon, available N, P, and K in sustaining productivity of groundnut finger millet cropping system. *J. Indian Soc. Soil Sci*., 53(3) : 315-318.
- **[17].** Yawalkar, K.S. (1975). Manures and fertilizers 3rd Ed. Agri-Horticultural Publishing House, Nagpur-440010, India.
- **[18].** Bellakki, M.A., Badanur, V.P. and Shetty, R.A. (1998). Effect of long term integrated nutrient management on some important properties of a Vertisol. *J. Indian Soc. Soil Sci.,* 46 (2): 176-180.