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Effect of Inmon Yield, Soil Properties and Nutrient Uptake of Tomato

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Abstract: *A field experiment was conducted at experimental Farm at Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during* kharif *season using tomato crop with variety Phula Raja (RTH-2). The experiment was laid out in Randomized Block Design with seven treatments T_1: RDF through chemical fertilizer, T_2: 50 per cent RDF + 25 t/ha vermicompost, T_3: 50 per cent RDF + 2.5 t ha^{-1} vermicompost + 2 sprays of vermiwash (1:2 treatment), T_4: 2.5 t ha^{-1} vermicompost + 2 sprays of cow urine + seeding treatment with Azotobacter + PSB vermicompost + (1:2), T_5: 5 t ha^{-1} vermicompost + 2 sprays of vermiwash (1:2 treatment), T_6: 5 t ha^{-1} vermicompost + 1 sprays of vermicash (1:2 treatment) 1 spray of cow urine + organic booster i.e. fermented slurry, T_7: 5 t ha^{-1} vermicompost + 2 sprays of EM culture. The recommended dose of fertilizer applied was 100:50:50 kg NPK ha^{-1}. Azotobacter and PSB were applied @ 250 g 10 kg^{-1} seed with 100 and 50 per cent RDF. Significantly highest total tomato yield (228.38 q ha^{-1}) was recorded in treatment T_3: 50 per cent RDF + 2.5 t ha^{-1} vermicompost + 2 sprays of vermiwash was applied, followed by treatment T6 (170.28 q ha^{-1}) where 5 t ha^{-1} vermicompost + 1 sprays of vermiwash + 1 spray of cow urine + organic booster (fermented slurry) was applied followed by treatment T_2 (156.79). The total nitrogen uptake by tomato plant enhanced due to application of organic manure in combination with inorganic fertilizer. The highest uptake was recorded in treatment T_3 (9.44 kg/ha).The P uptake by tomato plant was highest in treatment T_3 (7.00 kg/ha).Potassium uptake was maximum (7.79 kg/ha) with 50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash and it varied from 1.81 (T_4) to 7.79 (T_7) kg/ha with mean value 4.43 kg/ha.*

Key words: *Nutrient uptake, organic nutrition, yield, chilli, vermicompost, vermiwash, cowdung urine slurry, EM culture.*

INTRODUCTION

Organic farming is a philosophical approach to life, live and let live, survive together. The importance of organic farming in agriculture is known, since ancient times and finds mention in ancient Hindu religious scriptures (Rig Veda, 1, 161, 10, 2500-1500 BC; Atharva Veda II 8.3). However, in modern time, it was started with establishment of International Federation and Organic Agriculture Movement (IFOAM) on 5th November 1972 in France. Since then the organic agriculture movement spread throughout the world.Organic farming means farming in the spirit of organic relationship. The organic philosophy is to feed the soil rather than crops to maintain soil health, and it means of giving back to the nature, what has been taken from it.Organic agriculture is a production systems seeks to significantly reduce or avoid entirely the use of chemical fertilizers and pesticides, growth regulators and other agriculture chemicals. It is structured to minimize the need for off farm agricultural inputs. Many of the principles involved in traditional agriculture have now become the basis of organic farming. The system relies on crop rotation, organic manures and biofertilizers for nutrient supply, pest control system including biopesticides and biocontrol methodologies for insect control, innovative crop husbandry for disease control and maintaining soil productivity. An organic farming believes that, if the soil is healthy the plant has to be healthy and the plant is healthy, pest disease attack is meager. So maintaining soil health is key factor in organic farming.

Organic farming relates to management system, which promotes and improves the health of agro-ecosystem related to biodiversity, nutrient biocycles and soil microbial and biochemical activities. Hence, there is a vital need for revolution through organic farming to ensure food security and environment safety.Market share of organic foods in most of the developed countries are around two per cent of total food sales. Export preferences of organic vegetable offer great scope to a country like India, which has

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included the skill of growing organically since time immemorial.

Tomato (*Lycopersicon esculentum* Mill.) is largest grown vegetable crop and known as protective food. It is grown on an area of 540000 hectares with 760000 metric tonnes of production in 2005 with productivity of 14074 kg/ha. It was originated in Persian and Mexican region. It is important commercial and dietary vegetable crop after potato and sweat potato cultivated in all ranges of soil types, under different agro-climatic conditions excepts at high altitude, tomatoes tops list of canned vegetable and used as soup, salad, ketch-up, puree, sauces, etc. besides supplying important vitamin C, A, B and vitamin B_2. That is why the French call it as the apple of love and Germans as the apple of paradise. Tomato is also rich in medicinal value and is used in cancer of mouth, sour mouth, etc. The pulp and juice is digestible mild appetizer and promoter of gastric secretion and blood purifier. Green tomatoes are used for pickles, chutneys etc. Hence, the organic cultivation of tomato holds a great promise both in domestic as well as export market. Organically produced tomatoes are considered tasty and can be consumed as raw fruit. So some farmers have started organic farming by trial and error methods. To make it more viable and economically feasible, a strong research backup is needed. Very little research work on effect of organic inputs on growth, yield and quality has been carried out particularly in crop like tomato, giving the beneficial effect (Subbiah *et al*., 1982 and Moral and Navarro, 1996; Sendur Kumaran, 1998). In a view of this fact study in this direction of having organic sources of nutrition like vermicompost, vermiwash ,cow urine, cow dung urine slurry, E.M. culture, Azotobacter, PSB, etc. need to be undertaken. Therefore, an experiment entitled "Effect of INM on yield, soil properties and nutrient uptake of tomato".

MATERIAL AND METHODS

The field experiment was conducted at Experimental Field at Department of Soil Science and Agriculture Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during *kharif* season using tomato crop. Topography of experimental plot was fairly leveled. The experiment was carried with the purpose to investigate the effect of organic vis-à-vis chemical and integrated nutrient management (INM) mode of nutrition on yield and quality of tomato and also on soil properties. The major soils of Parbhani district are derived from "Deccan trap" (basalt rock) which are rich in iron, lime and magnesium (Gajbe *et al*., 1976) on the basis of morphology, soil depth and texture, experimental soil is identical to that of Parbhani series Typic Haplustert (Vertisol) as classified by Malewar (1998). On the basis of X-ray analysis, Malewar and Randhawa (1976) identified clay mineral assemblage as montmorillonite followed by moderate amount of kaolinite and traces of illite. The soil sample was analysed for its chemical, biological and physical properties.

The experiment was laid out in randomized block design. There are seven treatments and three replications. The details of treatments are T_1: RDF through chemical fertilizer, T_2: 50 per cent RDF + 25 t/ha vermicompost, T_3: 50 per cent RDF + 2.5 t ha^{-1} vermicompost + 2 sprays of vermiwash (1:2 treatment), T_4: 2.5 t ha^{-1} vermicompost + 2 sprays of cow urine + seeding treatment with Azotobacter + PSB vermicompost + (1:2), T_5: 5 t ha^{-1} vermicompost + 2 sprays of vermiwash (1:2 treatment), T_6: 5 t ha^{-1} vermicompost + 1 sprays of vermicash (1:2 treatment) 1 spray of cow urine + organic booster i.e. fermented slurry, T_7: 5 t ha^{-1} vermicompost + 2 sprays of EM culture.

Seeds of Phule Raja (RTH-2) were obtained from Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri. Raised beds of 0.60 x 1.0 x 0.15 m (L x B x n) size were prepared. The upper layer of raised bed was mixed with vermicompost. The seeds were sown in rows by maintaining 10 cm spacing between the two plants on 26th June, 2006, watering was done regularly by rose can and two sprayings of vermiwash was given after 15 days with weekly interval in order to boost general vigour of seedlings. Raised beds were kept clean by weeding regularly. Five week old seedlings were transplanted on 2nd August, 2006 on the main field.The area for experiment was ploughed deeply by iron plough and was harrowed to bring the soil to good tilth. The field was divided into twenty one plots of size 3.6 mts x 2.7 mts by using the measuring tape, rope and pegs.Five week old uniform and healthy seedlings were selected and transplanted on main field. Before transplantation seedlings were treated with biofertilizers like *Azatobacter* and phosphorus solubilzing bacteria (PSB) as per the treatments. Before transplanting light irrigation was given to seed bed to avoid damage to roots during uprooting from the raised beds. Seedlings were planted on one side of ridge in plots. Light irrigation was given immediately after transplanting and continued till the seedlings were established. Gap filling wherever required was done with healthy seedlings in order to maintain ideal plant population per plot (i.e. 36 plants/plot).Vermicompost was used @ 5 t/ha containing 0.92 % N, 0.60% P and 0.83 % K and sprays like vermiwash was used @ 1 lit/m^2, cow urine @ 1 lit/m^2, cow dung urine slurry @ 1 lit/m^2 containing 0.38% N,0.42% P and 5.10% K and EM culture @ 1 lit/m^2 were used for spraying in various treatments. The seedling before transplanting were treated with the biofertilizer such as *Azatobacter* and phosphorus solubilizing bacteria (PSB) as per the treatments.

Half dose of nitrogen and full dose of phosphorus and potash were applied at the time of transplanting and remaining 50% of nitrogen was applied 30 days after transplanting as per the treatments. Vermicompost and cow dung urine slurry were applied after one and two week of transplanting respectively, while first spray of vermiwash, cow urine and EM culture was given at the time of flowering and second at the time of fruit formation. Five plants were selected from each plot as observational plants and were labelled. The observations in respect of growth characters were recorded at an interval of 15 days starting from 30 days after transplanting (DAT) from observational plants.Fifteen fruits from these five observational plants from each treatment were picked at 90 DAT randomly from all three replications, mixed thoroughly and analyzed for various quality parameters.

Soil samples were collected before transplanting, at the time of flowering and after harvest of crop. The samples were air dried, ground with wooden pestle and morter and passed through 2 mm sieve for analysis.

The plant sample of tomato from all the treatment plots were uprooted and were cleaned by rubbing with cloth followed by rinsing with detergent and then by 0.02 N HCl and deionized water. They were air dried and subsequently oven dried at 70^{o}C for 12 hours and were ground in an electrically operated stainless steel blades grinder upto maximum fineness. The ground sample were stored in polythene bags with proper labeling for chemical analysis. Results were analysed statistically as per the methods given in "Statistical Methods for Agricultural Workers" by Panse and Sukhatme (1961).

RESULTS AND DISCUSSION

Effect of nutrient management treatment on yield of tomato

In order to record biometric observations and yield of tomato, five plants were marked in each plot. The tomato fruits were harvested in ten picking at an interval of 8 day and average total yield par plant was then calculated and accordingly on the basis of total plant population per ha the total yield was calculated, analysed, statistically and data is presented in Table 1. The total tomato fruit yield as influenced by different nutrient management treatment was found to be ranging from 101.88 to 228.38 q/ha with mean value of 149.74. q/ha. Similarly after harvest of tomato the dry matter yield par plot was recorded and on that basis total dry matter yield per ha was calculated. The data pertaining to dry matter yield per ha is ranging from 5.25 to 19.24 q/ha with a mean value 11.7 q/ha.

Results are presented in Table 1 indicates that yield of tomato was significantly influenced by different treatments. Significantly highest total tomato yield (228.38 q/ha) was recorded in treatment T_3 where 50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash was applied, followed by treatment T_6 (170.28 q/ha) where 5 t/ha vermicompost + 1 spray of vermiwash + 1 spray of cow urine + organic booster (fermented slurry) was applied followed by treatment T_2 (156.79).

Table 1
Effect of nutrient management treatments on total yield and dry matter yield (q/ha) of tomato

Treatment	*Total yield*	*Dry matter yield*
T_1 : RDF Through Chemical Fertilizer	113.20	7.88
T_2 : 50% RDF + 2.5 t/ha. Vermicompost	156.79	11.67
T_3 : 50% RFD + 2.5 t/ha. Vermicompost + 2 Sprays of Vermiwash (1 : 2 roportion)	228.38	19.24
T_4 : 2.5 t/ha. Vermicompost + 2 Sprays of Cow Urine + Seed Treatment of *Azotobactor* + PSB through Soil.	101.88	5.25
T_5 : 5 t/ha. Vermicompost + 2 Sprays of Vermiwash	135.80	10.73
T_6 : 5 t/ha. Vermicompost + 1 Spray of Vermiwash + 1 Spray of cow urine + 1 Spray of Cow Urine + Organic Booster	170.28	18.09
T_7 : 5 t/ha. Vermicompost + 2 Sprays of EM Culture	141.89	9.04
Mean	149.74	11.7
SE ±	6.8	0.28
CD at 5%	21.04	0.86

Treatment T_3 is significantly superior among all other treatments and treatment T_6 and T_2 were at par with each other. The lowest yield was recorded in treatment T_4 (101.88 q/ha) where 2.5 t/ha vermicompost + 2 sprays of cow urine + seedling treatment *Azotobacter* + PSB soil application which could be because of under nutrition of crop. On the contrary in treatment T_2 where 50 per cent of RDF was applied in addition to 2.5 t/ha vermicompost and use of vermiwash might have ensured adequate supply of plant nutrient throughout plant growth period. Thus integration of chemical and organic source of plant nutrient goes a longway a enhancing yield levels. The treatment T_6 where 5 t/ha vermicompost, cow urine and drenching with fermented mixture of cowdung urine (organic booster) which could be mutually beneficial in activating soil microflora and thereby enhancing nutrient availability therefore among organic treatments alone the treatment T_6 could be the next best option. Similar results were found by Quatirucci and Canali (1998). They reported that mixture of organic and mineral fertilizer gave the highest total yield of tomato crop. The reason for increased yield by application of NPK with FYM could be attributed to solubilization effect of plant nutrient by the addition of FYM leading to increased uptake of NPK as reported the Subbiah *et al.* (1982). Similar results are also given by Bombatkar (1995), Moral and Nevano (1996) Nathkuamr and Veeraraguvanthatham (1998) in brinjal, Singh and Kohli (1999) in tomato, Shiyou *et al.* (1999) in tomato. Renuka and Ravi Sankar (2001) in tomato, Sharma and Arya (2001) Yadav Pavan (2004) in okra and Pradeep Kumar (2004) in tomato.

Effect of nutrient management treatment on dry matter yield of tomato (q/ha)

The data on dry matter yield of tomato is also presented in Table 1. The results indicated that the application of different organic sources significantly influenced dry matter yield of tomato crop under various treatments. The dry matter yield was also highest (19.24 q/ha) in treatment T_3 where 50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash followed by treatment T_6 (18.09 q/ha), where 5 t/ha vermicompost + 1 spray of vermiwash + 1 spray of cow urine + organic booster fermented slurry followed by treatment T_2 (11.67 q/ha). The treatment T_3 was significantly superior over all other treatments. The lowest dry matter yield was recorded in treatment T_4 (5.25 q/ha) where 2.5 t/ha vermicompost + 2 sprays of cow urine + seedling treatment with *Azotobacter* + PSB soil application. It is observed that the dry matter yield was more when organics combined with inorganic fertilizers. The similar results were obtained by Morva *et al.* (1998).

Effect of nutrient management treatments on soil pH, EC and $CaCO_3$

The data pertaining to effect of nutrient management treatment on physico- chemical properties of soil is presented in Table 2. The soil pH, EC and $CaCo_3$ was ranged from 7.82 to 7.90, 0.48 to 0.70 dsm^{-1} and 7.63 to 8.23 percent with mean value of 7.85, 0.57 dsm^{-1} and 7.76 percent respectively.

Table 2
Effect of nutrient management treatments on pH, EC and $CaCO_3$ content of soil

Treatments	*pH*	*EC (dSm^{-1})*	*$CaCO_3$ (%)*
T_1	7.83	0.45	7.53
T_2	7.83	0.59	7.80
T_3	7.90	0.70	8.23
T_4	7.82	0.48	7.63
T_5	7.89	0.64	7.86
T_6	7.89	0.64	7.86
T_7	7.82	0.52	7.46
Mean	7.85	0.57	7.76
SE $\pm$	0.02	0.02	0.19
CD at 5%	0.07	0.06	0.60

Initial value of pH 8.20, EC 0.22 dSm^{-1} and $CaCO_3$ 8.5 per cent.

Soil pH

Soil pH is an important soil characteristics which control nutrient availability and their uptake by crops. The result on pH of the soil revealed that soil pH was influenced by addition of organic manures along with inorganic fertilizers. The soil pH values recorded at initial and after harvest of crop all noted in Table 2. The initial soil pH value is 8.20 and after harvest it is ranges from 7.82 to 7.90 although the difference among them are non significant.

Electrical conductivity of soil

The electrical conductivity of soil is directly related to the soil reaction which control the fertility gradient of soil. The initial values of EC of soil is 0.22 dSm-1 and increase at harvest stage as noted in Table 2 could be attributed to availability of more nutrient ions which are electrolyte as well.

Calcium carbonate ($CaCO_3$)

Calcium carbonate ranged from 7.63 to 8.23 per cent and the initial value is 8.5 per cent are presented in

Table 2. However these values are found to be almost at par with each other except T_2 and T_3. But there seems some decline in free $CaCO_3$ over initial with the application of organic sources of plant nutrients. The lower pH, Ec and $CaCO_3$ values were noted in the treatment receiving only organic manure i.e. vermicompost, cow urine and biofertilizers. This decrease in pH and EC with application of organic manure may be attributed due to the release of organic acids as a result of decomposition due to organics. Similarly, Bellakki and Badanur (1997) also found to be decreased in calcium carbonate content at the soil with the addition organic matter. The reason assigned may be due to release of organic acids during the decomposition of organic material which might have reacted with calcium releasing CO_2 (Dutta *et al*., 2003). They reported that the vital activity of earthworm changes the pH of the soil medium, one of an important consequence of the passage of soil and plant residues through the tracts of earthworm and production of acids during the process of decomposition of organic matter. Basak *et al*. (1990) studied the effect of earthworm on soil fertility and observed that the soil pH raised from the acidic to near neutral and EC was lowered.

Effect of nutrient management treatment on organic carbon content in soil

The data pertaining to effect of nutrient management treatment on organic carbon content in soil was ranged from 0.51 to 0.70 percent at flowering with mean value of 0.58 percent and after harvest it was range from 0.40 to 0.75 per cent with mean value of 0.60 percent respectively.

Table 3
Effect of nutrient management treatments on organic carbon content (%) of soil

Treatment	*At flowering*	*After harvest*
T_1	0.44	0.47
T_2	0.63	0.65
T_3	0.70	0.75
T_4	0.51	0.40
T_5	0.61	0.64
T_6	0.68	0.74
T_7	0.54	0.58
Mean	0.58	0.60
SE $\pm$	0.005	0.01
CD at 5%	0.01	0.04

Initial value of organic carbon 0.38 per cent.

The data indicating organic carbon content in surface soil at flowering and harvest stage as influenced due to application of organic and inorganic nutrient sources alone and in combination are given in Table 3. The results indicated that at flowering and at harvest carbon content in soil was significantly increased due to treatments receiving organic manures as well as inorganic fertilizers as compared to initial (0.38%). The treatment with combination of both the fertilizers i.e. organic manures and inorganic fertilizers recorded higher organic carbon content than treatment receiving inorganic fertilizers alone.

At flowering and at harvest stage treatment T_3 showed significantly higher value of organic carbon (0.70 and 0.75 respectively) which was treated with 50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash followed by treatment T_6 (0.68 and 0.74 respectively). The lowest organic carbon content (0.51 and 0.40, respectively) was recorded at both the stages in treatment T_4, where only organic fertilizers were added.

The data in Table 3 indicated that application of compost as well as inorganic fertilizers either alone or in combination increased significantly organic carbon content in soil. The highest organic carbon content was recorded treatment T_3 (50% RDF + vermicompost + vermiwash). This was followed by treatment T_6 where various organic sources of plant nutrient were used and both these treatment were almost at par with each other both at flowering as well as harvest stage. The relatively higher values of organic carbon could be attribute to relatively higher production of biomass both above and below ground. Application of inorganic fertilizers alone slightly increased organic carbon over the initial value i.e. 0.44 and 0.47 respectively. Bellakki and Badanur (1997) observed that organic carbon content at surface and subsurface soil was increased significantly with the incorporation of FYM and sunhemp either alone or in combination with inorganic fertilizers as compared with the organic carbon due to recommended dose at fertilizers and control. They also attributed this due to the addition of organic materials as a source of organic carbon and also due to better root growth and more plant residues addition after harvest. Ravankar *et al*. (2003) noticed that organic carbon status of the soil was significantly improved by application of 100% NPK + 10 tonnes FYM/ha over the control. Continuous use of FYM helped in maintaining and improving physical properties and organic carbon content of the soil (Gattani *et al*. (1976) whereas Munna and Hajana (1996) found that the organic carbon increased due to application of cow dung urine slurry @ 5 t/ha + 50 kg P_2O_5/ha over inorganic and organic amended soil. Babhulkar *et al*. (2000) reported that worms increased organic carbon in casts because of selective feeding on non humidified material within the soil matrix and secretion of muco polysaccharides in their gut.

Effect of organic and inorganic mode of nutrition on nutrient uptake by tomato crop

The data pertaining to effect of nutrient management treatment on concentration and uptake of nitrogen phosphorus and potassium is presented in Table 4. The concentration of nitrogen phosphorus and potassium was ranged from 0.450 to 0.491, 0.319 to 0.364 and 0.345 to 0.405 percent with mean value of 0.469 percent, 0.339 percent and 0.370 percent respectively. The uptake of nitrogen phosphorus and potassium was ranged from 2.36 to 9.44 kg/ha, 1.67 to 7.00 kg/ha and 1.81 to 7.79 kg/ha with mean value of 5.55 kg/ha, 4.03 kg/ha and 4.43 kg/ha respectively.

Concentration and uptake of nitrogen

The data on uptake of nitrogen are presented in Table 4 which revealed that the treatment T_3 (50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash) resulted into highest concentration and uptake of nitrogen i.e. 0.491 per cent and 9.44 kg/ha respectively. The treatment T_3 was significantly superior over rest of the treatment. The treatment T_6 (5 t/ha vermicompost + 1 spray of vermiwash + 1 spray of cow urine + organic booster fermented slurry) showed next higher concentration (0.484 per cent) and uptake (8.75 kg/ha), respectively followed by treatment T_2 concentration (0.478 per cent) and uptake (5.57 kg/ha), T_5, T_7 and T_1. While treatment T_4 recorded the minimum concentration (0.450 per cent) and uptake (2.36 kg/ha) respectively which was treated with 2.5 t/ha vermicompost + 2 sprays of cow urine + seedling treatment with *Azotobacter* + PSB soil application. Obviously this could attribute to under nutrition of crop. However, the treatment T_3 found significantly superior over rest of the treatment in respect to concentration and total uptake of nitrogen. Treatment T_6 was ranked next to treatment T_3. The treatment showed their significance in following order : $T_3 > T_6 > T_2 > T_5 > T_7 > T_1$ and T_4.

Concentration and uptake of phosphorus

The effect of different treatments on concentration and uptake of phosphorus is presented in Table 4. The treatment T_3 (50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash) indicated maximum gain in P concentration (0.364 per cent) and P uptake (7.00 kg/ha) and found to be highly significant over all other

Table 4
Effect of nutrient management treatments on concentration and uptake of nitrogen, phosphorus and potassium after harvest of tomato

Treatment	*Nitrogen*		*Phosphorus*		*Potassium*	
	Conc. (%)	*Uptake (kg/ha)*	*Conc. (%)*	*Uptake (kg/ha)*	*Conc. (%)*	*Uptake (kg/ha)*
T_1	0.454	3.57	0.325	2.56	0.348	2.74
T_2	0.478	5.57	0.347	4.04	0.378	4.41
T_3	0.491	9.44	0.364	7.00	0.405	7.79
T_4	0.450	2.36	0.319	1.67	0.345	1.81
T_5	0.470	5.04	0.340	3.64	0.367	3.93
T_6	0.484	8.75	0.351	6.34	0.394	7.12
T_7	0.460	4.15	0.330	2.98	0.359	3.24
Mean	0.469	5.55	0.339	4.03	0.37	4.43
SE $\pm$	0.001	0.10	0.0009	0.11	0.001	0.12
CD	0.004	0.32	0.002	0.35	0.003	0.37

treatments. The treatment T_6 (5 t/ha vermicompost + 1 spray of vermiwash + 1 spray of cow urine + organic booster fermented slurry) was ranked second in P concentration (0.351 per cent) and P uptake (6.34 kg/ha) of phosphorus followed by treatment T_2 with P concentration (0.347 per cent) and with P uptake (4.04 kg/ha) respectively. The lowest P concentration (0.319 per cent0 and P uptake (1.67 kg/ha) was recorded in treatment T_4 (2.5 t/ha vermicompost + 2 sprays of cow urine + seedling treatment with *Azotobacter* + PSB soil application. However, the treatment T_3 found significantly superior over rest of treatment in respect of P concentration and total uptake of phosphorus.

Concentration and uptake of potassium

The data on the effect of different nutrient management treatments on concentration and uptake of potassium are presented in Table 4.The data showed that the treatment T_3 (50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash) contributed higher K concentration (0.405 per cent and K uptake (7.79 kg/ha). The treatment T_3 was significantly superior over all other treatments. The treatment T_6 (5 t/ha vermicompost + 1 spray of vermiwash + 1 spray of cow urine + organic booster fermented slurry) showed next higher K concentration (0.394 per cent) and K uptake (7.12 kg/ha) followed by treatment T_2, T_5, T_7 and T_1. The lowest K concentration (0.345 per cent) and K uptake (1.81 kg/ha) was recorded in treatment T_4. However, the treatment T_3 found significantly superior over rest of the treatments in respect to concentration and total uptake of potassium.

At a glance, it was found that uptake of NPK were significantly influenced by different nutrient management practices indicating the highest uptake of NPK in treatment receiving 50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermicompost (T_3) i.e. INM. This might be due to synergistic effect of organic and chemical source of plant nutrients and its role in improving nutrient availability of soil, which might have reflected on biological yield and ultimately concentration and uptake of major nutrients. The next best treatment is the T_6 although it is solely organic treatment but combines different sources including vermicompost, vermiwash, cow urine and organic booster, which might have played significant role in mobilizing soil nutrients as well besides being a sources of nutrients its self. Similarly, impact of vermicompost on the uptake of nutrient was also reported by Bangar and Jatkar (1995). Moreover, Jadhav *et al*. (2002) also reported that the application of organic manures in combination with NPK fertilizers had the highest total N, P and K uptake. Nitrogenous compounds are slowly broken down there by increasing its availability in the form of ammonical nitrate N supply remains throughout crop growth. Goyal *et al*. (1992) found that higher nitrogen uptake with the addition of FYM was observed, due to higher availability of nitrogen by microbial biomass.

Kale *et al*. (1992) observed that N uptake at from vermicompost plot was significantly more i.e. 17.40 mg N/g over control plot 4.98 mg N/g. Acharya *et al*. (1998) studied the uptake of K in tomato reported that application of K along with organic matter increase K uptake. Harikrishna *et al*. (2002) indicated the effect of integrated nutrient management on nutrient uptake of tomato and found that the highest K uptake was observed at 50% flowering of tomato.

CONCLUSION

By and large the integrated nutrient management treatment involving 50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash (T_3) was found to give highest tomato fruit yield per hectare with better fruit quality parameters and favorable effects on soil characteristics including microbial abundance. The next best option is to use organic mode of nutrition i.e. use 5t/ha vermicompost + 1 spray of vermiwash + 1 spray of cow urine + use of organic booster fermented cow dung urine slurry through soil application as in case of treatment (T_6).

REFERENCES

Acharya, G.P., tripathi, B.P. and Bhattarai, S.P. (1998), Working paper. Lumle Agricultural Research centre, 3-14.

Babhulkar, P.S., Wandile, R.M., Badole, W.P. and Balpande, S.S. (2000), Residual effect of long term application of FYM and fertilizers on soil properties (Vertsils) and yield of soybean. *J. Indian Soc. Soil Sci*., **48**(1): 89-92.

Bangar, A.R. and Jatkar, H.S. (1995), Effect of vermicompost on growth, nutrient uptake and yield of maize. Abst. State Level Seminar on Integrated Nutrient management for sustainable agriculture, ISSS/ Rahuri Chapter, Rahuri, Oct. 708, 1995-96.

Bellaki, M.A. and Badanur, V.P. (1997), Long term effect of integrated nutrient management on properties of Vertisol under dryland agriculture. *J. Indian Soc. Soil Sci*., **45**(3): 438-442.

Bombatkar, V. (1995), Kisna Mitra. Three Star Publication, Nagpur, pp 38.

Dutta, D., Singh, S. and Singh, H.P. (2003), Effect of nitrogen, FYM and *Azotobactor*ization of physico-chemical properties and fertility status of mollisol after harvest of maize. *Pantnagar J. Res*., **1**: 25-28.

Gattani, P.D., Jain, S.V. and Seth, S.P. (1976), Effect of continuous use of chemical fertilizers and manures on soil physical and chemical properties. *J. Indian Soc. Soil Sci*., **24**(3): 284-289.

Goyal, M.M., Hooda, I.S. and Singh, R. (1992), Organic matter microbial biomass relationship in field experiments under tropical conditions, effect of inorganic fertilization and organic amendments. *J. Soil Biol. Biochem*., **24**(1): 1081-1084.

Harikrishna, B.L., Channal, H.T., Hebsur, N.S., Dharmatti, P.R. and Sarangamath, P.A. (2002), *Karnataka J. agric. Sci*., **15**(2): 275-278.

Jackson, M.L. (1976), Soil Chemical Analysis. Prentice Hall of Indian Pvt. Ltd., New Delhi, pp 38-214.

Jadhav, M.M., Chougule, B.A., Chavan, U.D. and Adsule, R.N. (2002), Assessment of juice quality in the improved sweet sorghum varieties. *J. Maharashtra Agric. Univ*., **13**(2):233-236.

Kale, R.D., Mallesh, B.C., Kubra, B. and Bangyaraj, D.J. (1992), Influence of vermicompost application on the available macronutrients and selected microbial population in a paddy field. *Soil Biol. Biochem*., **24**(12): 1317-1320.

Kumaran, S. Natarajans, S. and Thamburaj, S. (1998), Effect of organic and inorganic fertilizer on growth yield and quality of tomato. *South Indian Hort*., **46**(3-4): 203-205.

Malewar, G.U. and Randhawa, N.S. (1978), Distribution of zinc, iron, manganese and copper in Marathwada soils. *J. Maharashtra Agric. Univ*., **3**(3): 157-159.

Manna, M.C. and Hajara, J.N. (1996), Comparative performance of cow dung slurry, microbial inoculation and inorganic fertilizers on maize. *J. Indian Soc. Soil Sci*., **44**(3): 526-528.

Moral, R. and Nevarro Pedremo, J. (1976), Tomato fruits yield and quality are affected by organic and inorganic fertilization and cadmium pollution. *J. Plant Nutri*., 1493-1498.

Nathkumar, S. and Veeraragavathatham, D. (1999), Effect of integrated nutrient management on yield and yield attributes of brinjal (*Solanum melongena*) cv. PLR 1. *South Indian Hort*., **47**(1-6): 42-48.

Panse, V.G. and P.V. Sukhatme (1961), Statistical Methods of Agricultural Workers, ICAR Pub., New Delhi.

Pradeep Kumar and Sharma, S.K. (2004), Integrated nutrient management for sustainable cabbage-tomato cropping sequence under mid hill conditions of Himachal Pradesh. *Indian J. Hort*., **61**(4): 331-334.

Quattrucci, M. and Canali, S. (1998), Thenical economic comparison of fertilizer lines in Tuscany Informatore Agrario, **54**(10): 63-66.

Ravankar, H.N., Rathod, P.K., sanap, P.A., Pothare, S.V., Jadhav, V.D. and Rathod, D.R. (2003), Dynamics of major nutrients in Vertisols under long term fertilization to sorghum-wheat sequence. *Agric. Sci. Digest*, **23**(2): 79-83.

Renuka, B. and Ravi Shankar (2001), Effect of organic manure on growth and yield of tomato. J. *South Indian Hort*., **49**: 215-210.

Sharma, K.C. and P.S. Arya (2001), Effect of N and FYM on cabbage (*Brassica oleracea* var. capitata) in dry temperature zone of Himachal Pradesh. *Indian J. Agric. Sci*., **71**(1): 60-61.

Shiyou, J.B., H.U. Duanwei and D.W. Zhu (1999), Effect of new types of mixed organic manures on yield, quality and enzyme activity of chilli and tomato. *J. Huazhong Agril. Univ*., **18**(2): 139-142.