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Studies on Yield and Quality Improvement of Chilli through Organic nutrition

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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 chilli crop with variety Pusa Jwala. The experiment was laid out in Randomized Block Design with seven treatments T_1: NPK (80:40:50 kg ha^{-1}) through chemical fertilizer T_2: 50 per cent RDF + 2.5 t ha^{-1} 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 application (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 Vermiwash (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 80:40:50 kg NPK ha^{-1}.* Azotobacter *and PSB were applied @ 250g 10 kg ha^{-1} seed with 100 and 50 per cent RDF, significantly highest total chilli yield (86.85 q ha^{-1}) was recorded in treatment T_3, where 50 per cent RDF + 2.5 t ha^{-1} vermicompost + 2 sprays of Vermiwash was applied, followed by treatment T_6 (81.43 q ha^{-1}) where 5 t ha^{-1} vermicompost + 1 spray of Vermiwash + 1 spray of cow urine + organic booster (fermented slurry) was applied followed by treatment T_2 (74.68). The quality parameters like ascorbic acid content, physiological weight loss and rotting percentage in chilli were significantly highest in treatment T_3. However, integrated plant nutrient management system (IPNS) in chilli crop help to increase the crop yield significantly and also improve the quality of chilli crop.*

Key Words*: Organic nutrition, yield, quality, chilli, vermicompost, vermiwash, cowdung urine slurry etc.*

INTRODUCTION

Chilli (*Capsicum annuum* L.) is one of the important vegetable and commercial spice crop grown throughout tropical and temperate regions of the world. At present, India is the second world's largest producer of chilli, which contributes about one fourth of the world's production. Chilli occupies 102.9 thousand hectares of area in Maharashtra and produces 48.1 thousand tonnes chilli per annum (Anonymous, 2005). Production of chilli in India is dominated by Andhra Pradesh, which accounts for almost 49 per cent of the total production while Karnataka, the second largest producer contributes 11 per cent followed by Orissa (7 per cent), Maharashtra (6 per cent), Madhya Pradesh (4 per cent), Tamil Nadu, Uttar Pradesh and others account for the rest. Nasik, Ahmednagar, Solapur, Aurangabad, Nanded and Amravati are major chilli producing districts of Maharashtra (Peter, 1999). Productivity of chilli in State including Marathwada is below the national average. The production of chilli can be significantly raised by developing high yielding varieties and adopting good management practices which include use of manures and fertilizers to meet the nutrient requirement of crop at various growth stages. The soils are exploited by using high yielding fertilizer responsive hybrids, super seed material and indiscriminate use of chemical input like fertilizers and pesticides.

Organic agriculture is an ecological production management system that promote and enhances biodiversity, biological cycles and soil biological activity. Organic farming is a system that excludes the use of synthetic fertilizers, pesticides and growth regulators. It is based on minimal use of off-farm inputs and management practices that restore, maintain and enhance ecological harmony. Organic is a lebelling term which denotes products produced under the requirements of the organic food production act. Vegetable responds to addition of nutrients through neem cakes, FYM, green manuring and chemical fertilizers (Sharma and Rana, 1993). Particularly chilli needs heavy manuring for sound

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plant growth and high yield. The use of judicious combination of organic and inorganic fertilizers source is essential not only to maintain the soil health but also sustain productivity (Malewar *et al.*, 1998). Application of organic sources in chilli crop enhanced plant growth and production. Similarly, fruit quality was improved and pest incidence was also reduced. The replacement of inorganic fertilizers by organic manures like vermicompost is found to be promising in alone or in combination with inorganic sources. This practice enables to curtail the expenditure on inorganic fertilizers and chemical pesticides. Thus, there is a wide scope to use organic manures in vegetable farming and the benefits in respect of healthy produce, human and soil health. Organic chilli cultivation offers one of the most sustainable farming system with recurring benefits to not only long term soil health but provides lasting stability in production by imparting better resistance to various biotic and abiotic stresses.

The importance of organic manure in vegetable cultivation is a well established fact. But the availability of the cattle manure, the major source of organic manure is very much limited. Under this situation the nutrient rich vermicompost produced by the activity of earthworms on biowastes and in situ application of worms in the field along with biowastes can be tried as an alternate source of organic manure and a partial substitute for costly inorganic fertilizers. Use of organic sources of nutrient is a alternative to produce chilli, with least toxic effect besides the advantage of restoring soil health. The recycling of waste through earthworm increases the quality and contents of nutrient resulting in improvement of soil fertility, organic matter content, physical and biological properties of soil.

Thus, the experiment was planned to study the relative efficiency of vermicompost along with other organics on yield and quality of chilli.

MATERIALS AND METHOD

A field experiment was conducted at Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during Kharif season using chilli as test crop on "Studies on yield and quality improvement of chilli through organic nutrition. Parbhani is situated at 19^0 16' North Latitude and 70^0 47' East Latitude at an altitude of 409 meters (MSL). This area falls under assured rainfall zone. The annual average precipitation is 830 mm. Most of the rain received during June to September from South West monsoon. A field experiment was conducted with seven treatments replicated three times. Details of treatments are T_1-NPK (80:40:50 kg/ha) through chemical fertilizers, T_2- 50% RDF + 2.5 t/ha vermicompst, T_3 - 50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash, T_4 - 2.5 t/ha vermicompost + 2 sprays of cow urine + seedling treatment of Azotobacter + PSB soil application, T_5- 5 t /ha vermicompost + 2 sprays of vermiwash, T_6- 5 t/ha vermicompost + 1 sprays of vermiwash + 1 spray of cow urine + CDUS (fermented slurry), T_7 - 5 t / ha vermicompost + 2 sprays of EM culture. Chilli cultivar Pusa Jwala was used. Recommended dose of inorganic fertilizer viz., N, P, K (80:40:50 kg/ha) were applied through urea, SSP and Muriate of potash containing 46% N, 16% P_2O_5 and 60% K_2O respectively. Vermicompost was used @ 5 t/ha (0.92% N, 0.60% P and 0.83% K) and other organics like vermiwash was used @ 1 lit/m^2, cow urine @ 1 lit/m^2, cow dung urine slurry @ 1 lit/m^2, (0.38 % N, 0.42 % P and 5.1% K) and E.M. culture @ 1 lit/m^2 were used during application of various treatments . Seedling treatment of Azotobacter and PSB as per treatments were given at the time of transplanting as per the recommended procedure. Nitrogen was applied in two splits i.e. 50% N at the time of transplanting and remaining 50% N was applied at 30 days after transplanting of crop. Recommended dose of P and K were applied at the time of transplanting of crop. Recommended dose of P and K were applied at the time of transplanting as a basal dose. Vermicompost was applied one week after transplanting. Cow dung urine slurry was applied 15 days after transplanting. Cow dung urine slurry was applied 15 days after transplanting. One spray of vermiwash, cow urine and E M culture was given at the time of flowering and second spray of vermiwash, cow urine and EM culture was given at the time of fruit formation. Soil samples were collected before transplanting of chilli crop and after harvested of chilli crop. These samples were air dried, ground with pestle and morter and passed through 2 mm sieve for general analysis. Height of plant was measured from the ground level to the tip of plant. It was recorded for observational five plants in each plot at 30 days interval from the date of transplanting till the harvested and average height was then calculated for each treatment. The total number of branches of five observational plants in each plot were recorded at 30 days interval from the date of transplanting till the harvested and average number of branches were taken for each treatment.

The total green mature fruit yield (g/plant) were harvested from five observational plants in each plot at each picking. The mean number of fruits harvested per plant was determined. Accordingly total green chilli yield (q/ha) was calculated with sum of three pickings. Dry matter of chilli in g per plant at harvest was recorded. For quality parameters like ascorbic acid content 10g g of fruit sample (i.e. two fruits from each observational plant of each plot and mixed plot wise) were taken at second picking for estimation of ascorbic acid content by 2, 6-dichlorophenol indophenols visual titration method (A.O.A.C., 1990) and it was expressed in mg / 100 g. The weights of chill fruit were recorded at each picking and the loss in weight was worked out. The percentage was calculated separately for each treatment on initial weight basis. The rotted chilli fruits were separated and weighed and per cent loss due to rotting was determined. The statistical analysis of data collected was done by standard procedure described by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

An experiment was conducted to "study the yield and quality improvement of chilli through organic nutrition" during the kharif season at Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Soil samples were analysed before and after harvest of the crop for chemical and biological properties. Similarly, biometric observations were recorded at various stages of the crop. The yield was recorded plotwise and expressed on hectare basis. The results of the experiment are subjected for statistical analysis and are presented under following heads.

Effect of organic sources of nutrients on height (cm) of chilli at various stages

The data recorded on plant height during experimentation period (Table 1) indicated that vermicompost and other organics singly and in combination with chemical sources of plant nutrients influenced the plant height significantly during their growth period. At the time of transplanting, 30, 60, 90 and 120 days after transplanting plant height was ranged between 15.06 to 17.06 cm, 31.36 to 35.06 cm, 36.53 to 41.60 cm, 40.26 to 41.26 cm and 42.06 to 44.20 cm with the mean value of 15.85 cm, 33.69 cm, 39.34 cm, 41.95 cm and 43.28 cm respectively.

Table 1
Effect of organic sources of nutrients on height (cm) of chili at various stages

Treatment	*At the time of transplanting*	*Days after transplanting*			
		30	*60*	*90*	*120*
T_1	16.00	33.73	39.33	40.26	42.06
T_2	16.60	35.06	41.60	42.40	43.53
T_3	17.06	34.33	40.66	42.33	43.43
T_4	15.40	34.26	39.80	42.73	44.20
T_5	15.26	31.36	38.20	42.26	43.33
T_6	15.60	33.66	36.53	41.26	42.60
T_7	15.06	33.46	39.26	42.46	43.86
Mean	15.85	33.69	39.34	41.95	43.28
SE +	0.30	0.85	0.50	0.50	0.92
CD at 5%	0.93	2.62	1.54	1.55	N.S

At 30 and 60 days after transplanting an application of 50 % RDF + 2.5 t/ha vermicompost (T_2) found to give maximum height and was at par with T_3 where application of 50 % RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash was made and significantly superior over T_5 at 30 days after transplanting and T_5, T_6 and T_7 at 60 days after transplanting.

However, the differences in height among the treatment were narrowed down beyond 60 days and almost all the treatments were at par. The non significant differences among the different treatments at 120 days after transplanting could be because of the fact that chilli plants have stopped growing vegetatively and have entered into reproductive phase thereby narrowing the differences in height of plants.

The use of vermicompost @ 2.5 t/ha along with 50% NPK (T_2) was better to enhance the chilli height may be because of better nutrition with the integration of organic and chemical sources of plant nutrients. This finding is on lines as reported by Sharma and Bhalla (1995) who carried out the studies on the integrated nutrient management for okra.

Effect of organic sources of nutrients on branching in chilli at various stages

The data presented in Table 2 indicated that branching in chilli was significantly influenced with use of organic sources. At the time of transplanting non significant variations were recorded in branching with mean value of 4.15. However at 30, 60, 90, and 120 days after transplanting, branching was ranged between 7.06 to 10.6, 14.60 to 16.46, 15.13 to 17.60 and 19.13 to 21.73 with the mean value of 8.78, 15.50, 16.22 and 20.34 respectively. At 120 days after transplanting application of vermicosmpost @ 2.5 t/ha + 2 sprays of cow urine + seedling treatment of Azotobacter + PSB soil application (T_4) was found to be superior over other treatments and was at par to the treatment T_7 (Vermicompost @ 5 t/ha + 2 sprays of E.M. culture).

Table 2
Effect of organic sources of nutrients on number of branches of chilli

Treatment	*At the time of transplanting*	*Days after transplanting*			
		30	*60*	*90*	*120*
T_1	4.33	9.2	14.60	15.13	19.13
T_2	4.46	10.6	15.73	16.53	20.66
T_3	4.40	10.6	15.53	16.33	20.53
T_4	4.13	8.46	16.46	17.60	21.73
T_5	3.8	7.06	15.46	16.00	19.46
T_6	4.06	8.20	14.66	15.33	19.33
T_7	3.93	7.40	16.06	16.66	21.60
Mean	4.15	8.78	15.50	16.22	20.34
SE±	0.23	0.41	0.28	0.38	0.48
CD at 5%	NS	1.26	0.86	1.18	1.50

Vermicompost works better when supported with other organics like cow-dung urine slurry and inorganic fertilizers. This type of findings was also recorded by Sharma and Bhalla (1995).

Effect of organic sources of nutrients on yield of green chilli (q/ha) and dry matter yield (q/ha)

The total fruit yield per plant was converted into total green pod yield per hectare and also dry matter yield after harvest of third picking was observed. The relevant data was statistically analyzed and-presented in Table 3. The green chilli yield and dry matter yield of chilli were ranged from 51.83 to 86.85 q/ha and 11.99 to 16.86 q/ha with the mean value of 70.27 q/ha and 14.44 q/ha respectively. This data clearly brought out the fact that the treatment T_3 proved to be significantly superior over the rest of the treatments in green chilli and dry matter yield followed by the treatment T_6 consisting of application of 5 t/ha vermicompost + 1 spray of vermiwash + 1 spray of cow urine + use of organic booster which could be the next second highest.

Use of vermicompost alongwith organic booster with a fermented mixture of cow dung urine slurry (CDUS) is better for enhancing the yield of chilli crop considerably. Sharma and Bhalla (1995) also reported the higher yield of vegetable. Santhakumar (1993) also reported application of biogas digested slurry in combination with chemical fertilizer to crop okra.

Table 3
Effect of organic sources of nutrients on yield of chilli (q/ha) and dry matter yield (q/ha)

Treatment	*Yield of green chilli (sum of 3 picking) (q/ha)*	*Dry matter yield (q/ha)*
T_1	61.74	13.40
T_2	74.68	14.05
T_3	86.85	16.86
T_4	51.83	11.99
T_5	69.67	14.81
T_6	81.43	15.63
T_7	65.69	14.39
Mean	70.27	14.44
SE +	0.52	0.27
CD at 5%	1.62	0.85

The beneficial effect of application of organics on physical, chemical and biological properties influencing soil structure favourably for root growth which ultimately influence better plant growth and dry matter accumulation. The results revealed that vermicompost when applied combinely with some supplement may be through chemical fertilizers or through organics always fulfil the nutrient requirement of crop like chilli. Manna and Hajara (1996) also studied the comparative performance of cow dung urine slurry and inorganic fertilizer on maize and reported that the dry matter yield obtained due to application of slurry along with inorganic fertilizer was more.

Effect of organic sources of nutrients on ascorbic acid content, physiological weight loss and rotting percentage in chilli

The data presented in Table 4 on quality parameters of chlli indicated that use of organic sources along with chemical fertilizers influenced the quality parameters in chilli. The ascorbic acid content (mg/100g), physiological weight loss (%) and rotting percentage in chilli were ranged from 97.76 to 154.49 mg/100g, 27.91 to 35.66 % and 5.24 to 7.60 % with the mean value of 121.75 mg/100 g, 31.29 % and 6.57 % respectively.

Table 4
Effect of organic sources of nutrients on ascorbic acid content, physiological weight loss and rotting percentage in chilli

Treatment	*Ascorbic acid content (mg/100g)*	*Physiological weight loss (%)*	*Rotting percentage (%)*
T_1	103.97	34.42	7.72
T_2	132.80	29.33	5.72
T_3	154.49	27.91	5.14
T_4	97.76	35.66	7.60
T_5	117.37	31.23	6.26
T_6	133.21	28.28	6.13
T_7	112.65	32.20	7.43
Mean	121.75	31.29	6.57
SE +	0.19	0.90	0.08
CD at 5%	0.58	2.77	0.27

The highest ascorbic acid content (154.49 mg/100 g) in fruits was obtained in treatment T_3 (50 % RDF + vermicompost @ 2.5 t/ha + 2 sprays of vermiwash) and was superior over all the treatments followed by treatment T_6 (133.21 mg/100 g) receiving vermicompost @ 5 t/ha + 1 spray of vermiwash + 1 spray of cow urine + fermented slurry (CDUS) which was at par with treatment T_2 (132.80 mg/100 g) receiving 50 % RDF + 2.5 t/ha vermicompost. The lowest ascorbic acid content (97.76 mg/100g) in fruits was registered in treatment T_4 (vermicompost @ 2.5 t/ha + 2 sprays of cow urine + seedling treatment of *Azotobactor* + PSB soil application).

In general, the combination of organic and inorganic fertilizers increased the ascorbic acid of fruit as compared to inorganic fertilizer alone. Similar results have been reported by Tolkyndaev (1973) in tomato. The increase in ascorbic acid content might be due to balanced nutrition of crop and also due to growth promoting substances which could have accelerated synthesis of carbohydrates resulting in increase in ascorbic acid content. Similar observations were also reported by Mahendran and Kumar (1996) in cabbage and Kamili *et al.* (1999) in brinjal.

Maximum physiological loss in weight chilli (35.66%) in the treatment T_4 (2.5 t/ha vermicompost + 2 sprays of cow urine + seedling treatment of *Azotobactor* + PSB soil application) followed by treatment T, (34.42%) application of full dose of NPK and T_7 (32.20%) application of 5 t/ha vermicompsot + 2 sprays of E.M. culture, which were statistically at par with each other. Similarly, the treatments T_2, T_3 and T_6 were found statistically at par with each other. Significantly lowest physiological weight loss in chilli (27.91 %) was noted in the treatment T_3 (50 % RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash). Significantly highest rotting (7.72 %) in chilli was observed in the treatment T_1 (full dose of NPK and which was statistically at par with the treatment T_4 (7.60 %) receiving vermicompost @ 2.5 /ha + 2 sprays of cow- urine + seedling treatment of *Azotobactor* + PSB soil application. Lowest rotting (5.14%) was noted in the treatment T_3 (50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash) which was statistically at par with the treatment T_2 (50% RDF + 2.5 t/ha vermicompost). The overall quality parameters were also found to be favourably influenced by treatment T_3 having integration of organic and chemical sources of plant nutrients as compared using chemical or organics alone. This could be attributed to overall adequate and balanced nutrition of crop under the integrated nutrient supply system as in case of treatment (T_3).

CONCLUSIONS

1. The screening of various organic and inorganic combination and their individual effects on yield and yield attributes, quality of produce, availability of nutrients, effect on physical and biological properties revealed that combined effect of organics with other organic sources and inorganic fertilizers proved to be better. Among the various combinations overall performance of treatment T_3 (50% RDF + 2.5 t/ha vermicompost + 2 sprays of vermiwash) was superior and followed by treatment T_6 receiving 5 t/ha vermicompost + 1 spray of vermiwash + 1 spray of cow urine + organic booster (cow dung urine slurry).
2. Integrated plant nutrient management system (IPNS) in chilli crop helped to increase the crop yield significantly and also improved the availability of nutrients, physical properties of soil including support to biological life.
3. The treatment T_6 in which application of 5 t/ha vermicompost + 1 spray of vermiwash + 1 spray

of cow urine + use of fermented cow dung urine slurry could proved to be the next best option for chilli crop.

REFERENCES

A.O.A.C. (1990), Official Method of Analysis. Ed. 12, Association of Official Analytical, Washington, D.C.

Anonymous (2005), Statewise area and production of vegetable in India.

Kamili, I.A., Zargar, M.Y. and Chattoo, M.A. (2002), Effect of microbial inoculants, chemical nitrogen and their combination on brinjal. Veg. Sci., 29(1): 87-89.

Mahendran, P.P. and Kumar, N. (1997), Effect of organic manures on cabbage cv. Hero (*Brassica oleracea* var. capitata). South Indian Hort., 45(5-6): 240-243.

Malewar, G.U., Syed Ismail and Rudraksha, G.B. (1998), Integrated nutrient management in chilli (*Capsicum annum* L.). Bulletin of Indian Inst. of Soil Sci., 2: 156-163.

Manna, M.C. and Hazra, J.N. (1996), Comparative performance of cowdung slurry microbial inoculums and inorganic fertilizer in maize. J. Indian Soc. Soil Sci., 44(3): 526-528.

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

Peter, K.V. (1999), Need for the right mix. Survey of Indian Agriculture. The Hindu : 169-173.

Santhkumar G. (1993), Biogas digested slurry – A supreme manure. Kisan World, 20(7): 10-14.

Sharma, N.K. and Bhalla, P.L. (1995), Infleunce of integrated nutrient management of growth, yield and economics in okra (*Abelmoschus esculentus*). Veg. Sci., 22(1): 1-4.

Sharma, R.P. and Rana, D.S. (1993), Nutrient management in vegetable crops. Fertilizer News, 45(4): 77-81.

Tolkynbaev, Z.H. (1973), Tomato fruit quality in relation to rates of nitrogen fertilizers in kara kalpakia Vestnik Karakalp fil AN Vzbssr, No., 2(52): 49-51.