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Effect of integrated nutrient management on quality of chilli (*Capsicum annuum* L.)

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Abstract
India is the largest producer, consumer and exporter of chilli. The imbalance and continuous use of chemical fertilizers has detrimental effect on soil physical, chemical and biological properties thereby affecting the quality of the crop, besides causing environmental pollution Therefore, there is an urgent need to limit the usage of chemical fertilizers and the usage of organics should be increased which is needed to check the yield and quality levels. Keeping this in view, the present investigation was undertaken during the summer season of 2019-20 at the Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana to evaluate the effect of integrated nutrient management on quality of chilli. The Seed material of chilli *cv.* “Kashi Anmol” was grown with thirteen different treatment combinations. The experimental results revealed that the application of Recommended NPK + Vermicompost @ 2 t/ha + Azotobacter (T_3) which was at par with treatment T_5 (50% NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + Azotobacter) and T_4 (Recommended NPK + FYM @ 12.5 t/ ha + Azotobacter) and performed superiorly over the other treatments with remarkably higher values for all the quality attributes including total soluble solids (%), ascorbic acid (mg/100g) and NPK uptake by the plant (g/plant). Therefore, to reduce the use of chemical fertilizers with maintaining sustainability of soil fertility and for enhancing the quality, the chilli crop may be supplied with 50% Recommended NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + Azotobacter as per treatment (T_5).

Keywords: *Azotobacter*, chilli, Kashi Anmol, Vermicompost, FYM, NPK and yield

1. Introduction
Chilli (*Capsicum annuum* L.) is an important commercial vegetable cum spice crop grown in almost all parts of tropical and subtropical areas of India. Chilli is an annual sub-herb belongs to the family Solanaceae and originated from South and Central America where it was domesticated nearly 7000 BC. There are 30 species in the genus *Capsicum*, from which only five are cultivated: *Capsicum annuum* L., *C. Frutescens* L., *C. Chinense* Jacq, *C. pubescens* R. & P. and *C. Baccatum* L. (Votava and Bosland, 2002, Wang and Bosland, 2006 and Ince *et al.*, 2010) [13, 14, 2]. Chillies are cholesterol free and low in sodium, rich in vitamin A, vitamin C, vitamin E, a good source of potassium and folic acid. Fresh green chilli peppers contain more vitamin C than citrus fruits and fresh red chilli has more vitamin A than carrot. Chilli has a lot of culinary advantages. It has many chemicals including steam-volatile oils, fatty oils, capsaicinoids, carotenoids, vitamins, proteins, fibres and mineral elements (Votava and Bosland, 2002) [13]. *Capsicum* fruits may serve as a source of natural bactericidal agents to be used in food and medicinal systems. India is the largest producer, consumer and exporter of chilli. It was grown over an area of 366 thousand hectares with an annual production of 3737 thousand metric tons (Anonymous, 2018) [1]. Use of organic manures and biofertilizers such as vermicompost and nitrogen fixing bacteria has led to a remarkable cut down in application of chemical fertilizers and has resulted in high quality products free of harmful agrochemicals for human safety (Migahed *et al.*, 2004; Khalid *et al.*, 2005) [5, 4]. Therefore, the aforesaid consequences have opened the way to grow crop like chilli using organic and inorganic manures along with biofertilizers. The integrated nutrient management (INM) approach, therefore, could be a rational approach to increase the quality of chilli crop.

2. Material and Methods
The experiment was carried out at the Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, Haryana during the period 2019-20. The soil of the experimental field was non-saline, sandy loam in texture, medium in organic carbon, low

in available nitrogen, high in available phosphorus and rich in available potassium.. The experiment was conducted in Randomized Block Design (RBD) having 13 treatments - (T_1) FYM @ 12.5 t/ha + Azotobacter, (T_2) Vermicompost @ 2 t/ha + Azotobacter, (T_3) Recommended NPK + Vermicompost @ 2 t/ha + Azotobacter, (T_4) Recommended NPK + FYM @ 12.5 t/ ha + Azotobacter, (T_5) 50% NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + Azotobacter, (T_6) 50% NPK + Azotobacter, (T_7) 50% NPK + Vermicompost @ 2 t/ha + Azotobacter, (T_8) 50% NPK + FYM @ 12.5 t/ha + Azotobacter, (T_9) FYM @ 25 t/ha, (T_{10}) Azotobacter (500 g/ha), (T_{11}) Recommended NPK (62.5: 30: 30) kg/ha, (T_{12}) Vermicompost @ 4 t/ha and (T_{13}) Control with three replications. Seed material comprised of an improved population developed from recurrent selection from a Sri Lankan introduction of chilli i.e Kashi Anmol, the seedlings were transplanted with a spacing of 50 cm x 45 cm in different plots of size 3.0 m × 2.0 m. The manures and fertilizers were applied to the plots as per the treatment combinations. The quantity of organic manures *viz.*, farm yard manure and vermicompost were applied in the soil before sowing to accomplish the recommended dose of nitrogen (62.5 kg/ha). While, inorganic fertilizer (Urea) was applied in two splits at the time of sowing and after one month for the treatments where nitrogen was supplied through inorganic source. Inoculant of Azotobacter (nitrogen fixing bacteria) was mixed with minimum quantity of water and individual seedlings were dipped for about 15-20 minutes and transplanted in the main field immediately. The quantity of biofertilizer culture was used at the rate of 500g/ha. The recommended dose of phospohorous (30 kg/ha) was applied through diammonium phosphate (DAP) in all the treatments at the time of transplanting. The recommended dose of potassium (30kg/ha) was supplied through murate of potash (MOP) in all the treatments at the time of sowing. Quality attributes *viz.* total soluble solids (%), ascorbic acid (mg/100g) and NPK uptake by the plant (g/plant) were recorded after harvesting. TSS was measured by extracting the juice from the fruits of randomly selected plants and a few drops of juice were poured over designated platform of the refrectometer and the readings were recorded from the scale. Ascorbic acid content was measured from the fruits selected from five randomly plants which were blended until smooth. Then 20 g of blended sample was weighed and put into 100 ml volumetric flask, added 50 ml of metaphosphoric acid solution, mixed well and then the metaphosphoric acid solution was added to the marking line and the mixture was homogenized. 5 ml of metaphosphoric acid solution was added and titrated with the 2,6-dichloroindophenol solution until the steady pink color appeared. According to Horwitz (2003), ascorbic acid levels were calculated with the formula (equation 2):

$$L = \frac{(V_{ST}-V_{BT})\times E\times V_{VF}\times 100}{V_A\times W_S}$$

Explanation

L = levels of vitamin C (mg/100 g)
V_{ST} = volume of sample titration (ml)
V_{BT} = volume of blank titration (ml)
E = equality (mg/ml)
V_{VF} = volume of volumetric flask (ml)
V_A = volume of aliquot (ml)
W_S = weight of sample (g)

The NPK uptake by the plant was measured from the samples of leaves collected at the harvest stage and the oven dried at 65^0 C and then fine ground and digested wet. At 550^0C the plant material was ashed and the residues were dissolved in 3.3% HCL. Then after the digestion the concentration of N was analysed by Kjeldahl apparatus, the content of Phosphorus was determined by spectrophotometer and the concentration of Potassium was analysed using a flame photometer (Ortas *et al.*1999) [6].

2.1 Statistical analysis of data

The data obtained from experiment conducted in RBD was analyzed as per standard method suggested by Panse and Sukhatme (1985) [7]. The critical difference (CD) values were calculated at 5 per cent probability level whenever ‘F’ test was significant.

The standard error of differences (SEd), Standard error of means (SEm), Critical difference (CD) and coefficient of variation (CV) were calculated as follow:

$$SE(m) = \sqrt{\frac{EMS}{r}}$$

$$SE(d) = \sqrt{2\left(\frac{EMS}{r}\right)}$$

$$CD(5\%) = SEd \times t\ value\ at\ error\ d.f.$$

$$CV(\%) = \frac{\sqrt{EMS}}{\overline{X}} \times 100$$

Where,
r = number of replication
$\overline{X}$ = overall mean (grand total /n)

3. Results and Discussion

3.1 Quality attributes

The perusal of data related to quality attributes of chilli presented in Table 1 depicts that various treatments of nutrient combination has significantly increased all the quality attributes *viz.*, total soluble solids (%), ascorbic acid (mg/100g) and NPK uptake by the plant (g/plant) as compared to the control.

3.1.1 Total soluble solids (%)

According to the data, the treatment combination of recommended NPK + Vermicompost @ 2 t/ha + Azotobacter (T_3) has the maximum total soluble solids in the fruits (14.10%) and treatment combination of 50% NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + Azotobacter (T_5) was statistically at par (13.58%) followed by T_4 (Recommended NPK + FYM @ 12.5 t/ha + Azotobacter) with 13.11% and the minimum TSS was recorded under control T_{13} (7.37%).

3.1.2 Ascorbic acid (mg/100g)

The similar trend was observed in the ascorbic acid content in the fruits as the maximum ascorbic acid content (130 mg/100g) was found with the treatment combination of recommended NPK + Vermicompost @ 2 t/ha + Azotobacter (T_3) followed by 125.79 mg/100g with the treatment combination of 50% NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + Azotobacter (T_5) and recommended NPK + FYM @ 12.5 t/ha + Azotobacter (T_4) that is 124.45 mg/100g while the minimum ascorbic acid (99.70 mg/100g) was recorded under the control treatment.

3.1.3 NPK uptake by plant plant (g/plant)

According to the data recorded, maximum nitrogen (0.97 g), phosphorus (0.13 g) and potassium (1.13 g) uptake was recorded under the treatment combination of recommended NPK + Vermicompost @ 2 t/ha + Azotobacter (T_3) followed by the treatment combination of recommended NPK + FYM @ 12.5 t/ha + Azotobacter (T_4) and then treatment combination of 50% NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + Azotobacter (T_5) which were statistically at par while the minimum uptake for nitrogent, phposphorus and potassium was observed under treatment T_{13} (control) that is 0.74 g, 0.07 g and 0.91 g per plant respectively. The results associated with the quality attributes that is total soluble solids (%), ascorbic acid (mg/100g) and NPK uptake by the plant (g/plant) indicated that there was a significant and positive effect of different combinations of organic and inorganic nutrient sources. A remarkable increase in the total soluble solids is noticed in the different treatments having combination of organic and inorganic nutrient sources. The findings of of Umesha *et al*. (2011) [12] in makoi (solonum nigrum), Patil *et al*. (2004) [8] in tomato and Thimma (2006) [11] in chilli confirmed the results of the present investigation. Similarly the increase in the ascorbic acid in the chilli fruits has been noticed with the various treatment combinations of nutrient doses under INM. The considerable rise in the ascorbic acid in the fruits may be due to the continuous and adequate supply of nutrients through inorganic sources and fixation of nitrogen in ample amount by *Azotobacter*. It may also be due to physiological influence of organics in combination of inorganic source of nutrients on the various enzyme activities and also the close relationship existed between carbohydrate metabolism and formation of ascorbic acid. The results of the present investigation are in resemblance with the findings of Jayanthi *et al.* (2014) [3], Patil *et al.* (2004) [8] and Sharu *et al.* (2001) [10] in chilli crop where the rise in the levels of ascorbic acid reported which are associated with the supply of inorganic nutrient sources.

It was revealed that there is a positive and appreciable effect of INM on the nutrient uptake capacity of the plant. This may be due to conjunction of organics and inorganic sources along with nitrogen fixating biofertilizer, which reduced the loss of nitrates through leaching from the soil, provide better availaibility of phosphorus in rhizosphere, which created a balancing effect on the supply of nitrogen, phosphorus and potash to the plants. This led to increased uptake of the nutrients by the plants with countinous supply and in available form throughout the growth period of the crop. The findings of the present investigation are conformed by the findings of Jayanthi *et al*. (2014) [3] in chilli crop and Poul *et al*. (2004) [9] in tomato crop where the nutrient uptake by the plant is increased with the supply of organic manures with inorganic sources.

Table 1: Effect of integrated nutrient management on quality attributes of chilli

		Total soluble solids (%)	Ascorbic acid (mg/100g)	Nitrogen (g/plant)	Phosphorus (g/plant)	Potassium (g/plant)
T_1	FYM @ 12.5 t/ha + *Azotobacter*	9.87	111.42	0.83	0.10	0.98
T_2	Vermicompost @ 2 t/ha + *Azotobacter*	10.38	113.55	0.84	0.10	0.98
T_3	Recommended NPK + Vermicompost @ 2 t/ha + *Azotobacter*	14.10	130.00	0.97	0.13	1.13
T_4	Recommended NPK + FYM @ 12.5 t/ ha + *Azotobacter*	13.11	124.45	0.96	0.12	1.11
T_5	50% NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + *Azotobacter*	13.58	125.79	0.95	0.12	1.11
T_6	50% NPK + *Azotobacter*	11.04	115.18	0.84	0.10	1.00
T_7	50% NPK + Vermicompost @ 2 t/ha + *Azotobacter*	12.22	119.16	0.93	0.12	1.09
T_8	50% NPK + FYM @ 12.5 t/ha + *Azotobacter*	11.67	116.49	0.88	0.10	1.03
T_9	FYM @ 25 t/ha	9.28	110.08	0.81	0.09	0.95
T_{10}	*Azotobacter* (500 g/ha)	8.96	101.28	0.80	0.09	0.92
T_{11}	Recommended NPK (62.5: 30: 30) kg/ha	12.81	122.78	0.90	0.11	1.09
T_{12}	Vermicompost @ 4 t/ha	9.75	111.32	0.82	0.09	0.97
T_{13}	Control	7.37	99.70	0.74	0.07	0.91
SE (m)		0.32	1.45	0.15	0.01	0.15
C.D. (P= 0.05)		0.56	2.49	0.25	0.02	0.27

Table 2: Effect of integrated nutrient management on yield attributes of chilli

Treatments		Fruit length (cm)	Fruit girth (cm)	Average fruit weight (g)	Number of fruits per plant
T_1	FYM @ 12.5 t/ha + *Azotobacter*	7.11	2.74	2.42	61.96
T_2	Vermicompost @ 2 t/ha + *Azotobacter*	7.20	2.78	2.46	65.33
T_3	Recommended NPK + Vermicompost @ 2 t/ha + *Azotobacter*	8.58	3.28	3.80	75.83
T_4	Recommended NPK + FYM @ 12.5 t/ ha + *Azotobacter*	7.99	3.18	3.54	71.23
T_5	50% NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + *Azotobacter*	7.84	3.02	3.42	73.10
T_6	50% NPK + *Azotobacter*	6.48	2.81	2.55	64.33
T_7	50% NPK + Vermicompost @ 2 t/ha + *Azotobacter*	7.90	3.11	2.94	70.00
T_8	50% NPK + FYM @ 12.5 t/ha + *Azotobacter*	7.56	2.97	2.79	66.00
T_9	FYM @ 25 t/ha	6.84	2.56	2.31	57.27
T_{10}	*Azotobacter* (500 g/ha)	6.12	2.51	2.18	50.68
T_{11}	Recommended NPK (62.5: 30: 30) kg/ha	7.98	3.16	3.20	70.33
T_{12}	Vermicompost @ 4 t/ha	7.09	2.73	2.38	62.17
T_{13}	Control	5.63	2.47	1.94	50.33
SE (m)		0.66	0.10	0.19	1.91
C.D. (P= 0.05)		1.13	0.18	0.42	3.26

Table 3: Effect of integrated nutrient management on yield per plot (kg) and yield (q/ha) of chilli

	Treatments	Yield per plot (kg)	Yield (q/ha)
T_1	FYM @ 12.5 t/ha + *Azotobacter*	3.63	60.17
T_2	Vermicompost @ 2 t/ha + *Azotobacter*	3.99	66.50
T_3	Recommended NPK + Vermicompost @ 2 t/ha + *Azotobacter*	6.42	106.63
T_4	Recommended NPK + FYM @ 12.5 t/ ha + *Azotobacter*	6.05	101.50
T_5	50% NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + *Azotobacter*	6.31	105.40
T_6	50% NPK + *Azotobacter*	3.92	65.78
T_7	50% NPK + Vermicompost @ 2 t/ha + *Azotobacter*	5.35	89.11
T_8	50% NPK + FYM @ 12.5 t/ha + *Azotobacter*	4.03	67.13
T_9	FYM @ 25 t/ha	2.94	49.22
T_{10}	*Azotobacter* (500 g/ha)	2.51	42.21
T_{11}	Recommended NPK (62.5: 30: 30) kg/ha	5.10	85.25
T_{12}	Vermicompost @ 4 t/ha	3.71	62.72
T_{13}	Control	2.46	41.56
SE (m)		0.47	5.89
C.D. (P= 0.05)		0.88	7.10

4. Conclusion

On the basis of present study it may be concluded that application of nutrients in combinations has a significant and vital effect on quality attributes of chilli and best utilize the nutrient with high uptake. It could be concluded that supply of various plant nutrients at an optimum level sustains the desired crop productivity by optimizing the benefit from all sources in an integrated manner. Therefore, to reduce the use of chemical fertilizers for maintaining sustainability of soil fertility and for higher quality, the chilli crop may be supplied with 50% Recommended NPK + FYM @ 12.5 t/ha + Vermicompost @ 2 t/ha + Azotobacter as per treatment (T_5).

5. References

1. Anonymous. Third advance estimate of area and production of horticultural crops. National Horticulture Board, Ministry of Agriculture, Government of India 2018. www.nhb.gov.in.
2. Ince AG, Karaca M, Onus AN. Genetic relationships within and between Capsicum species. Biochemical genetics 2010;48(1, 2):83-95.
3. Jayanthi L, Sekar J, Ameer Basha S, Parthasarathi K. Influence of Vermifertilizer on Soil Quality, Yield and Quality of Chilli (*Capsicum annuum* L.). International Inter disciplinary Research Journal 2014;4:204-217.
4. Khalid KA, Shafei AM. Productivity of dill (*Anethum graveolens* L.) as influenced by different organic manure rates and sources. Arab Universities of Journal of Agricultural Sciences 2005;13(3):901-913.
5. Migahed HA, Ahmed AE, Abdel Ghany BF. Effect of different bacterial strains as biofertilizer agents on growth, production and oil of *Apium graveolens* under calcareous soil. Arab Universities Journal of Agriculture Sciences 2004;12:511- 525.
6. Ortas I, Güzel N, Ibrikçi H. Determination of potassium and magnesium status of soils using different soil extraction procedures in the upper part of Mesopotamia (in the Harran Plain). Communications in soil science and plant analysis 1999;30(19-20):2607-2625.
7. Panse VG, Sukhatme. Statistical methods for agricultural workers. ICAR, New Delhi 1985.
8. Patil MB, Mohammed RG, Ghadge PM. Effect of organic and inorganic fertilizers on growth, yield and quality of tomato. J. Maharashtra Agric. Univ 2004;29(2):124-127.
9. Poul AS, More SD, Lohot VD, Bodke RG. Effect of organic and inorganic nutrient sources on growth, yield and nutrient uptake in tomato. J Soils and Crops 2004;14(1):40-45.
10. Sharu SR, Meerabai M. Effect of integrated nutrient management on yield and quality in chilli (*Capsicum annuum* L.) 2001.
11. Thimma NM. Studies on the effect of organic manures on growth, yield and quality of chilli (*Capsicum annuum* L.) under Northern Transition zone of Karnataka. M.Sc.(Agri.) Thesis, Univ. Agric. Sci. Dharwad (India). 2006.
12. Umesha K, Soumya SP, Smitha GR, Sreeramu BS. Influence of organic manures on growth, yield and quality of makoi (*Solanum nigrum* L.). Indian Journal of Horticulture 2011;68(2):235-239.
13. Votava EJ, Nabhan GP, Bosland PW. Genetic diversity and similarity revealed via molecular analysis among and within an in situ population and ex situ accessions of chiltepin (*Capsicum annuum* var. glabriusculum). Conservation Genetics 2002;3(2):123-129.
14. Wang D, Bosland PW. The genes of Capsicum. Hort Science 2006;41(5):1169-1187.