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Response of Chilli Cultivars Todifferent Integrated Nutrient Management Practices

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Abstract

The experiment was undertaken to study the effect of integrated nutrient management on the vegetative growth and yield of four chilli cultivars. The experiment was conducted at Lovely Professional University, Phagwara, Punjab, India during August 2018 - May 2019. The experiment was laid in a Split Plot Design with three replications. The main plot included different combinations of organic and inorganic fertilizers i.e. 100% RDF (T1), 75% RDF + 25% vermicompost (T2), 75% RDF + 25% vermicompost + VAM (T3), 75% RDF + 25% vermicompost + humic acid (T4) and 75% RDF + 25% vermicompost + Azotobacter(T5) and sub plot consisted four varieties of chilli i.e. VS455 (V1), SS841 (V2), Punjab Tej (V3) and Teja (V4). The study revealed that integrated use of 75% RDF + 25% vermicompost + VAM was found to give highest yield (94.16 q/ha) as compared to other treatments. The treatment also had positive effect on yield and yield contributing characters *viz*. number of fruits plant^{-1} (305.9), average fruit weight (5.76 g) and fruit yield (94.16 q/ha).

Keywords: Chilli, integrated nutrient management, split plot design, vermicompost, VAM

Introduction

Chilli (*Capsicum annuum* L.) (2n=24) a member of the nightshade family i.e. solanaceae is valued for its diverse commercial uses worldwide. Andhra Pradesh (26%) followed by Karnataka (12.40%), Maharashtra(3.55%), Gujarat (3.53%), Odisha (4.82%), West Bengal (4.80%), and Tamil Nadu (3.22%) are the major chilli producing states of India contributing around 83% of the total area under cultivation and 90% of overall production(Velayutham, 2015). Chilli is the largest grown spice item exported from India and it also occupies first position in terms of prices. Adequate and balanced fertilizer management in association with manures is very much essential to exploit the full yield potential of Chilli. After the green revolution, increase in production was achieved at the cost of soil health. It

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has been proved that indiscriminate use of inorganic fertilizers results in decrease in soil fertility and increase in soil acidity with depletion of organic humus content in addition to poor crop quality. For sustainable agriculture, organic manures can be used to meet the nutrient requirement of the crop as these not only enhance the physical, chemical and biological properties of soil (Kapse*et al.*, 2017, Heitkamp *et al.*, 2011)but also improves the moisture holding capacity of soil. Use of organic manures alone can't fulfill the crop nutrients requirement. The integrated supply and use of plant nutrients from chemical fertilizers and organic manures has shown to produce higher crop yields as compared to when they are applied alone. Inclusion of organic manures with inorganic sources of nutrient is essential. Use of judicious combinations of organic and inorganic fertilizer sources is essential not only to maintain the soil health but also to sustain the productivity (Maleware*et al.*,1998).Adoption of organic farming practice alone may not address the food and nutritional requirement of our country as evident from several cases. Hence the blend of organic farming practices and modern agriculture needs to be developed. In this regard, INM practices appear to be most promising technologies which can address the problem faced by the farmers. There is a need to assess the impact of different nutrient management practices (organic farming, INM and chemical farming) on the performance of chilli genotypes. Integrated nutrient management is a technically sound, economically viable, socially acceptable, practically feasible and ecologically sound system of production (Chaubey*et al.*, 2004).

Materials and Methods

The experiment was conducted from August 2018 to May 2019 at the Agriculture Research Farm of the School of Agriculture, Lovely Professional University, Phagwara, Punjab in a Split Plot Design with three replications. The main plot included five treatments viz. T1- 100% RDF, T2- 75% RDF + 25% Vermicompost, T3- 75% RDF + 25% Vermicompost + VAM, T4- 75% RDF + 25% Vermicompost + Humic acid and T5- 75% RDF + 25% Vermicompost + Azotobacterand the sub plot included four different varieties viz. VS455, SS841, Punjab Tej and Teja. The plot size of each treatment was 18 m^2accomodating ten plants of each variety. Seedlings were planted on the ridges by maintaining a spacing of 75 cm x 60 cm. Vermicompost was applied at the rate of 10 q/ha at the time of land preparation. Required quantities of nutrients for each plot were calculated and applied by using Urea, DAP and MOP. The recommended doses of N, P_2O_5 and K_2O

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were 120, 60 and 50 kg per ha respectively. Bio-fertilizers were applied @ 1 g/m^2as per the dose mentioned on the package.Five plants from each variety in each treatment and all the replications were randomly tagged for recording different characters viz. plant height (cm),number of primary branches per plant, canopy spread (cm^2), average fruit weight (g), number of fruits $plant^{-1}$ and fruit yield per hectare (q). The data were subjected to analysis using the formula for split plot design as described by Gomez and Gomez (1984)keeping combinations of fertilizers as main plot and varieties as sub-plot.

Results and Discussion

The analysis of variance as presented in Table 1 and Table 2 showed significant differences among fertilizers, varieties and their interaction for growth and yield parameters. Among the various treatments, T1 (100% RDF) exhibited the maximum value of plant height (70.52 cm) which was statistically superior over the other treatments while, the lowest value of plant height (49.38 cm) was observed in T4 (75% RDF + 25% Vermicompost + Humic acid).Among the different varieties, V3 (Punjab Tej) resulted in maximum plant height (63.71 cm) which was at par with V4 (62.82 cm) while, the minimum plant height (60.22 cm) was observed in V1 (SS445).Interaction among the five fertilizer combinations and the four varieties showed that the maximum plant height (88.73 cm) was observed in T1V4 i.e. Teja variety grown under 100% RDF which was at par with T1V3 (85.90 cm) and T1V2 (85.83 cm) while, the minimum plant height (21.63 cm) was obtained in T1V1.These results might be due to faster release of nutrients by the application of recommended dose of fertilizers, especially nitrogen which enhanced chlorophyll synthesis and led to increase in carbohydrate synthesis, which in turn resulted in higher vegetative growth. Treatment T1 exhibited maximum plant height as compared to the other treatments, possibly due to the optimum availability of required nutrients which facilitated production of better root and shoot biomass resulting in increased internodal length and thus maximum plant height. Similar result has been reported by Pervez *et al.* (2004).

Among the various treatments the maximum number of primary branches per plant (9.22) were obtained in T5 (75% RDF + 25% vermicompost + Azotobacter) which was statistically significant over the other treatments while, the minimum number of primary branches (6.53) were observed in T3 (75% RDF + 25% vermicompost + VAM). Among the different varieties, V3 (Punjab Tej) resulted in maximum number of primary

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branches (7.98) which was at par with V4 (7.74) while, the minimum number of primary branches (7.13) were observed in V2 (SS841).Interaction among the five fertilizer combinations and the four varieties showed that the maximum number of primary branches per plant (9.60) were observed in T2V3 which was statistically at par with T5V3 (9.53), T4V1 (9.46), T5V4 (9.36) and T5V1 (9.33) while, the minimum number of primary branches per plant (4.46) were obtained in T2V2. These results might be due to the application of vermicompost and Azotobacter which induced the release of phytohormones such as auxins, cytokinins and gibberellins and led to rapid meristematic activity in plants. Similar results have been reported by Bade at el (2017).

The maximum canopy spread (55.02 cm^2) was obtained in T4 which was statistically at par with T2 (54.39 cm^2), T1 (53.29 cm^2) and T3 (52.83 cm^2) while, the minimum canopy spread (46.08 cm^2) was observed in T5 (75% RDF + 25% vermicompost + Azotobacter).Among the different varieties, V4 (Teja) resulted in maximum canopy spread (54.54 cm^2) which was at par with V3 (53.56 cm^2) while the minimum canopy spread (49.24 cm^2) was observed in V1 (VS455).Interaction among the fertilizers and varieties showed that the maximum canopy spread (60.76 cm^2) was observed in T2V4 which was statistically at par with T2V3 (57.26 cm^2), while the minimum canopy spread (36.46 cm^2) was observed in T5V1. Addition of vermicompost along with humic acid might have resulted in maximum canopy spread under this treatment which influenced the proliferation of secondaryroots and thus enhanced the absorption of nutrients. It allowed mycorrhizal fungi to flourish and easily colonize plant roots by providing nutrients. Maximum availability of nutrients might have resulted in more vegetative growth.

The maximum average fruit weight was obtained in T3 (5.76 g) which was statistically significant over the other treatments while the minimum average fruit weight was observed in T5 (4.30 g). Among the different varieties, V3 (Punjab Tej) resulted in maximum average fruit weight (5.19 g) which was at par with V4 (Teja) (5.09 g) while the minimum average fruit weight was observed in V1 (VS455) i.e. 4.80 g.Interaction among the five fertilizer combinations and the four varieties showed that the maximum average fruit weight (6.32 g) was observed in T3V4 i.e. Teja variety grown under 75% RDF + 25% vermicompost + VAM) which was statistically significant over the other treatments while the minimum average fruit weight (3.58 g)

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was obtained in T1V1 i.e. VS455 variety grown under 100%RDF.Addition of vermicompost might have helped to maintain the soil organic carbon content and total nitrogen at a higher level and provided balanced C:N ratio which resulted in greater release and uptake of plant nutrients throughout the growth period. Again, inoculation with biofertilizers has further improved the efficacy of vermicompost based treatment. It resulted in the translocation of more amount of photosynthates to the developing fruits due to better availability and utilization of nutrients in vermicompost based treatments which may be the possible reason for higher fruit weight in chilli. Dange*et al.* (2002) also reported the similar findings. It was also found that integrated nutrient management with FYM, vermicompost, poultry manures and oil cakes showed a significant positive response on chilli(Pariari and Khan, 2013).

Among the various treatments, the maximum number of fruits plant^{-1} (305.9) were obtained in T3 which was statistically at par with T5 (301.2) whereas, the minimum number of fruits plant^{-1} (244.4) were observed in T4 (75% RDF + 25% vermicompost + Humic acid).Among the different varieties, V2 (SS851) resulted in maximum number of fruits plant^{-1}(305.2) which was at par with V1 (VS455) (294.7) while the minimum number of fruits plant^{-1} (233.1) were observed in V4 (Teja).Interaction among the five fertilizer combinations and the four varieties showed that the maximum number of fruits plant^{-1} (570.6) were observed in T5V1 which was statistically at par with T2V3 (546.3) and T1V2 (546.3) whereas, the minimum number of fruits plant^{-1} (73.3) were observed in T4V4.Highest value of total number of fruits plant^{-1} obtained in T3, which included 75% RDF + 25% vermicompost + VAM might be due to higher chlorophyll index. Chowdhury *et al.*(2014)also reported higher value of total number of fruits plant^{-1} in chilli (295.8).

The maximum fruit yield (94.16 q/ha) was obtained in T3 (75% RDF + 25% vermicompost+ VAM) which was statistically significant over the other treatments while, the minimum fruit yield (64.09 q/ha) was observed in T4 (75% RDF + 25% vermicompost +humic acid).Among the different varieties, V1 (VS455) resulted in maximum fruit yield (87.76 q/ha) which was at par with V2 (82.01 q/ha) while, the minimum fruit yield (62.99 q/ha) was observed in V3 (Teja).Interaction among the five fertilizer combinations and the four varieties showed that the maximum fruit yield (129.70 q/ha) was observed in T3V4 which was statistically at par with T5V1 (123.92

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q/ha), T2V3 (123.70 q/ha), T1V2 (120.06 q/ha) and T3V2 (119.11 q/ha) while, the minimum fruit yield (26.66 q/ha) was observed in T3V3.The significant improvement and increment in yield might be due to the addition of vermicompost along with VAM which led to the enhanced uptake of nutrients from soil and increased the rate of photosynthesis which further increased the vegetative growth and thus resulted in more accumulation of photosynthates with an ultimate increase in yield. Similar range of yield was also recorded by Mujumdar *et al.*(2000), Kasture (2001) and Kokare (2013).

Conclusion

On the basis of results obtained from the present investigation it was observed that application of 75% RDF + 25% vermicompost + VAMincreased the plant growth positivelyand produced higher fruit yield(94.16 q/ha). The cultivars VS455 and SS841 showed better response in terms of growth and yield when 75% RDF, 25% vermicompost and VAM was done, so, it may be a better option for the farmers having adequate resources.

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Table 1: Effect of integrated nutrient management on the growth parameters of chilli

S. No.	Treatments	Plant height (cm)					Number of primary branches per plant					Canopy spread (cm^2)				
		V1 (VS455)	V2 (SS841)	V3 (Punjab Tej)	V4 (Teja)	Mean	V1 (VS455)	V2 (SS841)	V3 (Punjab Tej)	V4 (Teja)	Mean	V1 (VS455)	V2 (SS841)	V3 (Punjab Tej)	V4 (Teja)	Mean
1	T1 (100% RDF)	21.63	85.83	85.90	88.73	70.52	4.73	8.20	8.50	7.73	7.29	43.83	56.73	56.70	55.90	53.29
2	T2 (75% RDF + 25% Vermicompost	83.00	25.80	85.13	77.40	67.83	7.53	4.46	9.60	8.60	7.50	53.60	45.93	57.26	60.76	54.39
3	T3 (75% RDF + 25% Vermicompost + VAM)	74.63	77.26	27.60	55.76	58.81	6.46	6.73	4.63	8.30	6.53	56.80	55.60	43.30	55.63	52.83
4	T4 (75% RDF + 25% Vermicompost + Humic acid)	56.96	57.93	55.73	26.90	49.38	9.46	7.60	7.66	4.70	7.35	55.53	56.13	53.73	54.70	55.02
5	T5 (75% RDF + 25% Vermicompost + Azotobacter)	64.90	54.80	64.20	65.30	62.30	9.33	8.66	9.53	9.36	9.22	36.46	45.30	56.83	45.73	46.08
	Mean	60.22	60.32	63.71	62.82		7.50	7.13	7.98	7.74		49.24	51.94	53.56	54.54	
Factors			**CD at 5%**	**SE (d)**	**SE m ±**			**CD at 5%**	**SE (d)**	**SE m ±**			**CD at 5%**	**SE (d)**	**SE m ±**	
Fertilizer combinations			1.46	0.62	0.44			0.24	0.10	0.07			2.88	1.23	0.87	
Varieties			1.29	0.63	0.44			0.22	0.10	0.07			1.55	0.75	0.53	
Interaction			2.98	1.41	0.88			0.51	0.24	0.15			3.68	1.69	1.74	

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Table 2: Effect of integrated nutrient management on the yield and yield contributing characters of chilli

S. No.	Treatments	Average fruit weight (g)					Number fruits per plant					Fruit yield (q/ha)				
		V1 (VS455)	V2 (SS841)	V3 (Punjab Tej)	V4 (Teja)	Mean	V1 (VS455)	V2 (SS841)	V3 (Punjab Tej)	V4 (Teja)	Mean	V1 (VS455)	V2 (SS841)	V3 (Punjab Tej)	V4 (Teja)	Mean
1	T1 (100% RDF)	3.58	4.43	5.50	5.53	4.76	96.0	546.3	248.0	166.3	264.1	39.11	120.06	57.40	75.63	73.05
2	T2 (75% RDF + 25% Vermicompost	4.62	4.64	5.58	5.42	5.06	244.6	81.3	568.0	167.0	265.2	79.81	43.55	123.70	79.33	81.60
3	T3 (75% RDF + 25% Vermicompost + VAM)	5.60	5.67	5.47	6.32	5.76	310.0	312.0	74.0	527.6	305.9	101.18	119.11	26.66	129.70	94.16
4	T4 (75% RDF + 25% Vermicompost + Humic acid)	5.58	5.46	5.59	3.83	5.12	252.3	377.3	274.6	73.3	244.4	94.81	71.78	54.07	35.70	64.09
5	T5 (75% RDF + 25% Vermicompost + Azotobacter)	4.61	4.42	3.83	4.36	4.30	570.6	209.3	193.6	231.3	301.2	123.92	55.55	53.11	56.00	72.14
	Mean	4.80	4.92	5.19	5.09		294.7	305.2	271.6	233.1		87.76	82.01	62.99	75.27	
Factors			**CD at 5%**	**SE (d)**	**SE m ±**			**CD at 5%**	**SE (d)**	**SE m ±**			**CD at 5%**	**SE (d)**	**SE m ±**	
Fertilizer combinations			0.20	0.08	0.06			16.9	7.2	5.1			4.84	2.07	1.46	
Varieties			0.20	0.09	0.07			17.1	8.3	5.9			5.11	2.49	1.76	
Interaction			0.46	0.22	0.12			39.2	18.7	10.2			11.69	5.57	2.92	

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