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Influence of the process of integrated management of nutrients on the overall growth and yield of Capsicum plants

Satyavart Rana
Department of Horticulture,
Doon (P.G) College of Agriculture Science and Technology, Dehradun-248007, Uttarakhand, India
E-mail: Satyamrana881@gmail.com

Abstract
To investigate the impact of integrated nutrient management on the development and production of capsicum cv. Santa, a field experiment was carried out between 2022 and 2023 at the Experimental Farm of Doon (P.G) College of Agriculture Sciences and Technology, Dehradun . The fruit yield (32 18 t/ha) of the treatments using 100% chemical fertilisers, such as RDF, was noticeably lower than that of organic manures (vermicompost and farm yard manure), treated with chemical fertilisers (RDF).The treatments using RDF and basal applications of vermicompost outperformed those using RDF and basal applications of farmyard manures in terms of yield performance. Additionally, it can be shown that the split application of organic manures as top dressing produced much lower yields than the basal treatment. The best results were seen in terms of growth, including plant height (65 21cm), number of leaves (104 47), number of branches per plant (11 14), leaf area (108 32cm^2), yield (52 5t/ha), and is significantly different from all other treatments.

Keywords: Growth, Yield, Capsicum, Fertilizers

Introduction
Capsicum (Capsicum annum cv grossum) also known as Simla Mirch, is a costly vegetable that is rich in vitamins A and C. It is grown in coastal agricultural environments under ideal agroclimatic conditions in the mid hills of the summer and in the plains during winter. However, the cultivation of capsicum in Dehradun coastal regions has just lately begun. Capsicum has a high nutrients need, and Dehradun uses relatively little fertiliser. Chemical fertilisers in addition to the culture of bioinoculants with organic manures are now recognised as being of utmost importance for achieving sustainable productivity of capsicum. They also provide a favourable environment for plant growth while also enhancing the physical, chemical, and biological properties of soil. (Patiram 1996). Bioinoculants (BI), Azotobacter Azospinllum, and PSB treatment considerably improves the yield compared to control, and application of 75% inorganic NP with BI greatly enhances fruit production compared to 100% NP application (Pattnavak and Haik 2003). The research focuses on the combined use of inorgnaic fertilizers and organic bioinoculants for the production of capsicum in Dehradun coastal habitats. The impact of strategic nutrient management on the growth and yield of capsicum (Capsicum annum cv grossum) Santa under east and southeast coastal plain zones of Dehradun must be studied.

Material and Methods
A field experiment was carried out at the Experimental Farm of Doon (P.G) College of Agriculture science and Technology, Dehradun, Uttarakhand from October 2022 to February 2023. The field's geographic coordinates are 29° 58' N latitude and 77° 34' E longitude, and it is 640 mts. above mean sea level. The experimental sites soil is a sandy loam with a pH of 6.2 and reasonable quantities of accessible P_2O_2, and K_2O as 180 20 and 120 kg ha^1, respectively. The test was set up using a randomized block

design with many replications. The heat sources included T_1- Control and T_2- Full NPK (based on a soil test). T_3- Full NPK + FYM (10t/ha) basal T_4-Full NPK-Vermicompost (5t/ha) basal T_5- Full NPK+FYM (5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing. T_6- NPK+FYM(5t/ha) basal + Vermicompost (1 25t/ha) 1st top dressing- Vermicompost (1 25t/ha) 2nd top dressing. T_7- Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing. T_8- Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (1 25t/ha) 1st top dressing+ Vermicompost (1 25t/ha) 2nd top dressing . T_9- 75% NP-Full K - Bioinoculants & FYM.

The manures were incorporated into the corresponding plots by applying a basal P K dose 25 days prior to planting, a half dose of N were at the time of field preparation, and a final dose of N was applied 50 days after planting. When the seedlings reached a height of 10–12 cm in November, they were transferred onto the main field. Plant to plant and row to row distances were kept at 50 and 60 cm, respectively. After 30 60 90 and 120 days of planting, the number of leaves and branches on each plant were counted. When the green fruit output reached marketable maturity, it was removed from the plant 150gm and the green fruit 150gm stalks were first dried in the shade before being chopped and again dried in an oven at 67°C ± 23°C and then finely milled to a homogeneous powder. The available N (Alkalme permanganate technique), available P (Biays 1 method by coloniunetei), and available K (flame photometrically) were estimated from these powdered materials after latex digestion.

Table 1: Effect of INM on Plant Height

Tr No.	Treatments	Plant Height (cm)			
		30 DAT	60 DAT	90 DAT	120 DAT
T1	Control	23 7	23 44	27 68	28 63
T2	Full NPK	26 7	27 13	32 46	32 19
T3	Full NPK + FYM (10t/ha) basal	28 17	31 6	37 45	39 56
T4	Full NPK-Vermicompost (5t/ha) basal	30 34	35 12	41 25	43 26
T5	Full NPK+FYM (5t/ha) l Vermicompost (2 5t/ha) 1st top dressir	32 77	33 47	30 80	42 13
T6	NPK+FYM(5t/ha) basal + Vermicompost (1 25t/ha) 1st top dressing- Vermicompost (1 25t/ha) 2nd top dressing	31 8	30 19	43 52	43 56
T7	Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing	32 47	43 53	47 15	49 52
T8	Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (1 25t/ha) 1st top dressing+ Vermicompost (1 25t/ha) 2nd top dressing	32 77	47 45	51 50	52 89
T9	75% NP-Full K-Bioinoculants & FYM	36 54	47 38	54 85	65 21
	CD at 5%	0 18	2 80	2 08	3 49

Table 2: Effect of INM on Number of Leaves

Tr No.	Treatments	Number of Leaves			
		30 DAT	60 DAT	90 DAT	120 DAT
T1	Control	18 41	36 41	52 91	59 67
T2	Full NPK	28 34	51 68	68 29	75 28
T3	Full NPK + FYM (10t/ha) basal	28 9	53 27	72 46	80 5
T4	Full NPK-Vermicompost (5t/ha) basal	31 46	60 64	80 17	78 14
T5	Full NPK+FYM (5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing	30 13	58 44	78 73	86 7
T6	NPK+FYM(5t/ha) basal + Vermicompost (1 25t/ha) 1st top dressing- Vermicompost (1 25t/ha) 2nd top dressing	32 16	61 78	83 54	94 12
T7	Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing	30 62	67 42	85 32	95 45
T8	Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (1 25t/ha) 1st top dressing+ Vermicompost (1 25t/ha) 2nd top dressing	33 89	68 73	87 14	101 81
T9	75% NP-Full K-Bioinoculants & FYM	32 45	70 62	92 8	104 47
	CD at 5%	1 67	4 49	11 27	9 72

Table 3: Effect of INM on Number of Branches

Tr No.	Treatments	Number of Branches			
		30 DAT	60 DAT	90 DAT	120 DAT
T1	Control	1 37	3 06	4 28	5 78
T2	Full NPK	2 26	3 6	5 28	6 58
T3	Full NPK + FYM (10t/ha) basal	4 51	3 8	5 59	7 19
T4	Full NPK-Vermicompost (5t/ha) basal	3 04	7 5	5 98	8 13
T5	Full NPK+FYM (5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing	2 62	7 1	5 75	7 65
T6	NPK+FYM(5t/ha) basal + Vermicompost (1 25t/ha) 1st top dressing- Vermicompost (1 25t/ha) 2nd top dressing	1 14	4 8	6 42	8 64
T7	Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing	3 70	5 6	7 09	9 23

T8	Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (1 25t/ha) 1st top dressing+ Vermicompost (1 25t/ha) 2nd top dressing	4 69	7 3	7 81	9 51
T9	75% NP-Full K-Bioinoculants & FYM	5 9	7 8	8 82	11 14
	CD at 5%	0 11	0 15	0 17	0 24

Table 4: Effect of INM on Leaf Area Yield and Total Nutrient concentrations in plants and fruits

Tr No.	**Treatments**			**Plants (%)**			**Fruits (%)**		
		Leaf Area	**Yield**	**N**	**P**	**K**	**N**	**P**	**K**
T1	Control	80 78	18 7	0 93	0 36	2 05	1 43	0 45	1 47
T2	Full NPK	78 45	30 8	1 08	0 41	3 47	2 12	0 71	2 54
T3	Full NPK + FYM (10t/ha) basal	88 61	36 5	1 42	0 42	3 56	2 36	0 75	3 19
T4	Full NPK-Vermicompost (5t/ha) basal	94 37	38 7	2 12	0 48	4 31	2 73	0 83	3 73
T5	Full NPK+FYM (5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing	93 39	32 9	1 83	0 43	3 69	2 54	0 79	3 36
T6	NPK+FYM(5t/ha) basal + Vermicompost (1 25t/ha) 1st top dressing- Vermicompost (1 25t/ha) 2nd top dressing	96 98	39 9	2 26	0 49	4 42	2 87	0 87	3 85
T7	Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (2 5t/ha) 1st top dressing	101 42	39 7	2 48	0 54	4 53	2 92	0 89	3 96
T8	Full NPK- Vermicompost (2 5t/ha) basal+ Vermicompost (1 25t/ha) 1st top dressing+ Vermicompost (1 25t/ha) 2nd top dressing	108 32	38 5	2 67	0 65	4 84	3 14	0 91	4 08
T9	75% NP-Full K-Bioinoculants & FYM	104 26	52 5	2 98	0 91	5 35	3 32	0 95	4 97
	CD at 5%	0 57	3 47	0 20	0 01	0 13	0 02	0 03	0 17

Results and Discussion

Growth Attributes and Yields

The three treatments had a substantial impact on the plant's height, number of leaves, area of branches per leaves, and yield. After 30 to 120 days of planting, there was a noticeable improvement in the growth of the plant height (Table 1) Number of Leaves (Table 2) and number of branches (Table 3). Maximum plant height (65 21cm), number of leaves (104 47), number of branches per plants (11 14), leaf area (108 32 cm^2) and yield (52 5t/ha), were determined by application of 75% NP, full K, bioinoculants, and FYM. It differs greatly from all other therapies. This might be as a result of the continual metabolism process carried out by these bioinoculants and the release of readily accessible nitrogen and phosphorus to plants. Better growth was induced by an abundance of nutrients moving from the soil to the roots and translocating to the individual portions of plants to create phytoplankton and other compounds. The combined application of 75% NP full K, bioinoculants, and FYM over control resulted in the maximum number of branches. This may be because more nutrients, particularly nitrogen, were absorbed, promoting cell division and cell elongation, which in turn increased metabolic activity. Naik and Hosaman (2003) observed a similar conclusion for chilli.

Application of organic and inorganic fertilisers coupled with bioinoculants clearly showed promise for reducing yield, according to the analysis of the data (Table 4). The maximum yield (52 5/t ha) came from a mixture of 75% NP full K, bioinoculants, and FYM, which was followed by full NPK + FYM (5 t/ha), basal + vermicompost (2 5 t/ha) (1st top dressing), and full NPK + FYM (5 t/ha). 1st top dressing Vermicompost (125 t/ha) + 2nd top dressing Vermicompost (125 t/ha) In their study of the impact of INM on capsicum output, Sharu and Meeiabai (2001) found that the use of organic fertilisers and inorganic manures resulted in considerably higher yields.

Due to differences in nutrient availability and plant nutrient utilisation, 75% NP, full K, bioinoculants, and FYM treatment resulted in the highest fruit output per hectare. Due to better NP fixation from the soil and atmosphere by FYM grown bioinoculants, it also assisted in generating a higher yield with 75% NP (Pattnayak and Naik 2003). In addition, the FYM cultured bioinoculants may have improved the efficiency of applied N and P, leading to better growth and, eventually, larger fruits with a higher yield in comparison to other foods.

N, P and K content in Plants and Fruits

Table 4 clearly shows that chemical fertilisers alone or in conjunction with organic fertilisers significantly increased the N, P, and K content in plants and capsicum. Treatment 75% NP full K, bioinoculants, and FYM helped produce plants and fruits with the highest levels of N (2 98%) and P (0 91%). 75% NP Application. The concentration of maximum in N plants and fruits generated by full K, bioinoculants, and FYM may have resulted from continuous supply of nitrogen, which led to better uptake and utilisation. It appears that nitrogen N levels from organic sources were successful in altering the amount of nitrogen in plants. The highest K concentration was found in plants (5 35%) and fruits (4 97%) when combined with bioinoculants, FYM, and 75% NP in the treatment. High concentration of N P and K in plants and fruits were detected with the the application of organic mannures and bioinoculants, which may be caused by the chelating impact of organic mannures leading to an increased nutrition supply. The results of the study do not agree with those of Roy et al. (sweet paparika) , Yadav et al. (2005) and M. okra Albasel and Bar-Yosef (1984), According to the study, using 75% NP full K in combination with bioinoculants and FYM increased capsicum production more effectively than using simply chemical fertiliser and RDF in combination with organics.

Conclusion

The three treatments had a substantial impact on the plant's height, number of leaves, area of branches per leaves, and yield. After 30 to 120 days of planting, there was a noticeable improvement in the growth of the plant height (Table 1) Number of Leaves (Table 2) and number of branches (Table 3). Maximum plant height (65 21cm), number of leaves (104 47), number of branches per plants (11 14), leaf area (108 32 cm^2) and yield (52 5t/ha), were determined by application of 75% NP, full K, bioinoculants, and FYM. The maximum yield (52 5/t ha) came from a mixture of 75% NP full K, bioinoculants, and FYM, which was followed by full NPK + FYM (5 t/ha), basal + vermicompost (2 5 t/ha) (1st top dressing), and full NPK + FYM (5 t/ha). 1st top dressing Vermicompost (125 t/ha) + 2nd top dressing Vermicompost (125 t/ha)

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