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Integrated nutrient management in chilli (*Capsicum annum* L.) in lateritic soil of Konkan region of Maharashtra

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Abstract
A field experiment was conducted at Vegetable Improvement Scheme, Pangari Block, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (Maharashtra) during *Rabi season* 2014-2015. The field experiment was laid out in Randomized Block Design comprising of thirteen treatments replicated thrice. It was observed that the substitution of N through poultry manure to the extent of 50 percent (and remaining 50 percent through urea) was observed to be the best treatment amongst different combinations of organic manures with urea. It produced highest yield (Green, dry matter of green chilli pod and stover) of chilli and weight of fruit per plant. The NPK uptake by pod and stover was also recorded maximum in combined application of poultry manure with urea. Maximum uptake of N (36.08 kg ha^{-1}) and P (3.40 kg ha^{-1}) was recorded with treatment T_8 i.e. application of 50% N through poultry manure and 50% N through urea while the maximum uptake of K (74.58 kg ha^{-1}) was recorded with treatment T_9 i.e. application of 75% N through poultry manure and 25% N through urea. The data regarding micronutrients uptake was found to be non-significant except total Mn and Zn uptake. The maximum total uptake (chilli pod + stover) of Fe (637.95 g ha^{-1}), Zn (1041.31 g ha^{-1}), and Cu (1259.12 g ha^{-1}) was recorded in the treatment T_9 receiving 75% N through poultry manure and 25% N through urea while the maximum Mn uptake (2434.36 g ha^{-1}) was observed in treatment T_8. The combined use of organics (farmyard manure, vermicompost, poultry manure and groundnut cake) along with the inorganic fertilizers increased nutrient use efficiency of crop. Integrated use of organic manures along with chemical fertilizers not only produced highest and sustainable crop yields but also enhanced the efficiency of added fertilizers.

Keywords: Integrated nutrient management, chilli, uptake, lateritic soil

Introduction
Chilli (*Capsicum annum* L.) is one of the most important commercial crops of India which belongs to family Solanaceae. It is also called as hot pepper, red pepper, cayenne pepper, capsicum, etc. Most of the cultivated varieties in India belong to the species Capsicum annum. It is grown almost throughout the country. India is the largest producer of chillies in the world and earns valuable foreign exchange for the country (Venkateshalu, 2009) [16]. Chillies are excellent source of vitamin A, C and E with minerals like molybdenum, magnesium, potassium and copper. It is an essential ingredient of Indian curry, which is characterized by tempting colour and exciting pungency. It is predominantly popular for its green pungent fruits, which is used for culinary purpose. It is used in salads, chutney, sauces, pickles and it is a main ingredient of Indian diet in every home. The nutritive value of chilli is important for human diet. Particularly chilli needs heavy manuring for sound plant growth and high yield. 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 poultry manures, FYM, vermicompost and groundnut cake 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. chilli can be grown in many types of soils, well-drained loamy soils rich in organic matter are best suited for its cultivation. There is an atmost need to produce more crop yield which has led to the tendency of using more and more chemical fertilizers. Due to this it has resulted in to deterioration of productive soil. Kukereja *et al.*, (1991) [7] stated that mineral fertilizers decrease both the biological activities in the soil and aggregate

stability. The intensive use of chemical inputs has not only polluted the soil, water and environment causing their slow degradation but also affected the life of human being. Thus, the importance of organic manure in present agriculture is increasing day by day, because of its utility not only improving the physical, chemical and biological properties of soil but also maintaining the soil health without pollution. From nutrient point of view, the role of organic matter is very meagre. However its value lies more in its action as a soil ameliorant corrective for physical condition and parameter of biological activity to enhance the productivity. The nutritional requirement of chilli crop is partially fulfilled by slow release of nutrients from organic manure but its use alone is not sufficient. Therefore, there is also a need to supplement it with chemical nutrients. The supplementary and complementary use of organic manures and inorganic chemical fertilizers augment the efficiency both the substances to maintain a high level of soil productivity (Thakuria *et al.*, 1991) [14].

The beneficial effects of combined application of chemical fertilizers with organic manures viz., farmyard manure, vermicompost, poultry manure, oil cakes and many more of such materials are universally known. Application of organic manures in general improves the availability of micronutrients like zinc, iron, manganese and copper. It is found that integrated nutrient management with FYM, vermicompost, poultry manures and oil cakes showed a significant positive response on chillies (Pariari and Khan, 2013) [11]. Particularly chilli needs heavy manuring for better plant growth and high yield. Use of judicious combinations of organic and inorganic fertilizer sources is essential not only to maintain the soil health but also sustain the productivity (Malewar *et al.,* 1998) [8]. Integrated use of organic manures along with chemical fertilizers not only produced highest and sustainable crop yields but also enhanced the efficiency of added fertilizers. Hence, in light of the available information, the present investigation entitled "Effect of different sources of organic manures and their combination on yield and nutrient uptake by chilli (*Capsicum annum* L.) in lateritic soil of Konkan"

Materials and Methods

The present investigation pertaining to the studies on the "Effect of different sources of organic manures and their combination on yield and nutrient uptake by chilli (*Capsicum annum* L.) Cv. Konkan Kirti in lateritic soils of Konkan" was conducted during 2014-2015 at Vegetable Improvement Scheme, Pangari Block, Wakawali. The analytical work was done in the research laboratory of the Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dapoli. The selection of site was done on the basis of suitability of land for the cultivation of chilli where, the facilities of irrigation water and protection from cattle's were available. Chilli (*Capsicum annuum* L.) var. Konkan Kirti was taken as a test crop during Rabi season of the year 2014 - 2015 with a spacing 60 X 45 cm. There were thirteen treatment combinations in three replications and the details are as follows: Treatments comprised of T_1 [25% N through FYM + 75% N through Urea], T_2 [50% N through FYM + 50% N through Urea], T_3 [75% N through FYM + 25% N through Urea], T_4 [25% N through Vermicompost + 75% N Urea], T_5 [50% N through Vermicompost + 50% N through Urea], T_6 [75% N through Vermicompost + 25% N through Urea], T_7 [25% through N Poultry manure + 75% N through Urea], T_8 [50% through N Poultry manure + 50% N through Urea], T_9 [75% N through Poultry manure + 75% N through Urea], T_{10} [25% N through Groundnut cake + 75% N through Urea], T_{11} [50% N through Groundnut cake + 50% N through Urea], T_{12} [75% N through Groundnut cake + 25% N through Urea] and T_{13} [Absolute control].

Organic manures, viz. Farm yard manure, Vermicompost, Poultry manure and groundnut cake was applied on the basis of nitrogen content only, and applied at the time of field preparation. Half dose of N and recommended dose of P and K was applied at the time of transplanting and half dose of N was applied at 30 days after transplanting. Observation on weight of fruit (g plant-1) was recorded from five selected plants in the plot area at each picking time and average was workout. Pods were harvested at maturity i.e. green matured chilli and the pod yield obtained after each harvesting and stover yield after uprooting of crop was recorded with fresh as well as dry stover yield. Treatment wise plant samples were collected as mentioned earlier at 30, 60 DAT and at harvest stages. The samples were first washed with tap water and with deionized water and then were air dried and preserved in the brown paper bags labeled with permanent marker. These representative samples were dried in oven at a temperature of 60 ± 5°C and ground in Willey type grinding machine and stored in polythene bags for analysis. The plant samples after digestion were analyzed for nutrients content by following standard procedure and nutrient uptake was computed. Nitrogen was estimated by Kjeldahl's digestion and distillation method, phosphorus by Vanadomolybdate method, potassium by Flame Photometer method and micronutrients by Atomic absorption spectrophotometer method (Bhargava and Raghupathi, 1993). The experimental data was analyzed statistically by the technique of analysis of variance as applicable to randomized block design given by Panse and Sukhatme (1967).

Results and Discussion

Effect on chilli pod and Stover yield

The data pertaining pod and stover yield of chilli as influenced by different treatments are presented in Table 1. The application of different sources of organic manures and their combination on chilli significantly influenced the yield of green chilli as well as stover.

Table 1: Effect of different sources of organic manures and their combination on yield of chilli.

T. No.	Treatment Details	Yield (q ha^{-1})			Weight of fruit (g plant^{-1})
		Green pod yield	Dry matter yield of green pods	Stover yield	
T_1	25% N(FYM) + 75% N(Urea)	99.05	8.88	15.03	267.44
T_2	50% N(FYM) + 50% N(Urea)	100.56	9.81	10.96	271.50
T_3	75% N(FYM) + 25% N(Urea)	114.27	9.71	12.13	308.54
T_4	25% N(VC) + 75% N(Urea)	101.91	8.72	12.36	275.15
T_5	50% N(VC) + 50% N(Urea)	110.42	10.16	11.23	298.13
T_6	75% N(VC) + 25% N(Urea)	110.86	10.27	9.25	299.32
T_7	25% N(PM) + 75% N(Urea)	114.10	10.40	11.86	308.08
T_8	50% N(PM) + 50% N(Urea)	128.01	11.22	15.28	345.63
T_9	75% N(PM) + 25% N(Urea)	111.28	9.24	12.99	300.47
T_{10}	25% N(GC) + 75% N(Urea)	107.30	9.49	10.91	289.71
T_{11}	50% N(GC) + 50% N(Urea)	105.48	9.68	12.15	284.80
T_{12}	75% N(GC) + 25% N(Urea)	109.53	11.08	9.50	295.72
T_{13}	Absolute control	73.65	5.73	8.13	198.87
	SE ±	6.14	0.86	1.23	16.57
	C.D.(P=0.05)	17.91	2.52	3.60	48.37

Highest green pod yield of chilli (128.01 q ha^{-1}) was recorded in the treatment T8 receiving 50% N through Poultry manure and 50 percent N through urea. Maximum dry matter of green pod yield (11.22 q ha^{-1}) was recorded in treatment T8 receiving 50% N through poultry manure and 50 percent N through urea. Numerically higher stover yield (15.28 q ha^{-1}) was obtained by treatment T8 receiving 50% N through Poultry manure and 50 percent N through urea. The treatment not receiving any fertilizer or manure T_{13} i.e. control was less effective by recording minimum green pod yield, dry matter of green pod yield and stover yield. Range of the yield recorded here was similar with the results obtained by Mujumdar *et al.* (2000) [10], Kasture (2001) [5] and Kokare (2013) [6]

Weight of fruit (g plant^{-1})

The data pertaining on the yield contributing characters i.e. weight of fruit per plant is given in Table 1.which reveals that weight of fruit per plant were significantly influenced due to application of various sources of manures and their combination. The fresh fruit weight was remarkably maximum (345.63 g plant^{-1}) in treatment T_8 receiving 50% N through poultry manure and 50 percent N through urea, which was found to be significantly higher over other treatments except treatments T_3, T_5, T_6, T_7 and T_9 which was found at par with T8. Minimum fruit weight (198.87 g plant^{-1}) was recorded in treatment T_{13} (Absolute control). The results of the present study are in agreement with those reported by Masud *et al.* (2009) [9] who reported that the maximum weight of fruit (g plant^{-1}) was recorded in plots receiving 100 percent STB (Soil test base) + 2.5 ton poultry manure ha^{-1}.

Effect on uptake of nutrient by chilli

The data pertaining to the uptake of nutrients by chilli pod, stover and total nutrient uptake by chilli crop as influenced by different treatments due to application of different sources of organic manures and their combination on chilli are presented in Table 2.

Nitrogen uptake

The data in respect of the nitrogen uptake by chilli plant due to the effect of application of different sources of organic manures and their combination is presented in Table 1. It is observed from the data that the uptake of nitrogen in the stover ranged from 9.13 to 18.38 kg ha^{-1} due to effect of various treatments and it was found statistically significant. The maximum uptake (18.38 kg ha^{-1}) was recorded by the treatment T_9 receiving 75% N through poultry manure and 25% N through urea, which was found to be significantly higher over the treatments T_6, T_{12} and T_{13} but at par with all other treatment. Minimum uptake (9.13 kg ha^{-1}) was recorded at treatment absolute control. The uptake of nitrogen by the chilli pod increased from 6.89 to 18.35 kg ha^{-1} due to effect of various treatments and it was found to be statistically significant. Among the various treatments the maximum uptake of nitrogen was recorded in treatment T8 (18.35 kg ha^{-1}) with application of 50% N through poultry manure and 50% N through urea, which was significantly higher over rest of other treatments except treatment T_6, T_7, and T_{11} with which it was found to be at par. Minimum uptake (6.89 kg ha-1) was recorded in treatment absolute control. Total nitrogen uptake was seen to be in the range from 16.02 to 36.08 kg ha^{-1} due to effect of different treatments. The maximum uptake (36.08 kg ha^{-1}) was recorded with treatment T8 i.e. application of 50% N through poultry manure and 50% N through urea, which was significantly higher over other treatments and treatment T_1, T_3, T_4, T_7, T_9 and T_{11} was found to be at par. Ranges of total nitrogen uptake by chilli at harvest quoted here are in agreement with Kasture (2001) [5] and Kokare (2013) [6] in chilli and Kadam *et al.* (2005) in tomato. Significant increase in total nitrogen uptake by Chilli with application of organic manures in combination with inorganic fertilizer over control may be due to continuous availability of nitrogen as well as increase in the yield by application of different treatments.

Table 2: Effect of different sources of organic manures and their combination on uptake of macronutrients

Tr. No.	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
	Stover	Pod	Total	Stover	Pod	Total	Stover	Pod	Total
T_1	17.46	12.08	29.54	1.35	1.23	2.59	48.46	20.97	69.42
T_2	14.01	11.84	25.85	1.12	1.60	2.72	28.68	23.84	52.52
T_3	15.01	13.49	28.50	1.41	1.35	2.76	33.71	22.72	54.95
T_4	15.22	13.64	28.86	1.38	1.47	2.85	43.36	24.85	65.09
T_5	14.65	8.82	23.46	1.42	1.67	3.09	44.55	28.56	70.55
T_6	11.91	14.40	26.30	1.12	1.71	2.82	41.54	25.11	65.62
T_7	15.53	14.37	29.89	1.39	1.44	2.83	47.58	22.97	70.55
T_8	17.73	18.35	36.08	1.43	1.97	3.40	44.06	34.89	69.00
T_9	18.38	11.76	30.13	1.39	1.50	2.89	51.11	23.47	74.58
T_{10}	14.78	12.14	26.92	1.02	1.40	2.42	38.19	25.47	63.66
T_{11}	14.69	15.36	30.05	1.16	1.22	2.38	36.52	22.71	57.96
T_{12}	12.46	13.51	25.97	0.99	1.86	2.85	26.02	26.77	52.79
T_{13}	9.13	6.89	16.02	0.45	0.71	1.16	16.99	11.03	28.02
SE ±	1.57	1.57	2.36	0.15	0.13	0.25	5.21	2.13	6.46
C.D. (P=0.05)	4.57	4.57	6.90	0.44	0.40	0.73	15.20	6.23	18.45

Phosphorus uptake

The data in respect of the phosphorus uptake by chilli plant due to the effect of application of different sources of organic manures and their combination is presented in Table 2. It is observed from the data that the uptake of phosphorus in the stover ranged from 0.45 to 1.43 kg ha^{-1} due to effect of various treatments and it was found to be statistically significant. The maximum uptake (1.43 kg ha^{-1}) was recorded by the treatment T_8 receiving 50% N through poultry manure and 50% N through urea, which was found to be at par with rest of the treatments except T_{13} (absolute control). Minimum uptake (0.45 kg ha^{-1}) was recorded in treatment T_{13}. The uptake of phosphorus by the chilli pod ranged from 0.71 to 1.97 kg ha^{-1} due to effect of various treatments and it was found to be statistically significant. Among the various treatments the maximum uptake of phosphorus was recorded in treatment T_8 (1.97 kg ha^{-1}) with application of 50% N through poultry manure and 50% N through urea, which was significantly higher over rest of other treatments except treatment T_2, T_5, T_6 and T_{12} which was found to be at par. Minimum uptake (0.71 kg ha^{-1}) was recorded at treatment absolute control.

Total phosphorus uptake was seen to be in the range of 1.16 to 3.40 kg ha^{-1} due to effect of different treatments. The maximum uptake (3.40 kg ha^{-1}) was recorded with treatment T_8 i.e. application of 50% N through poultry manure and 50% N through urea, which was significantly higher over other treatments except treatments T_1, T_{10}, T_{11} and T_{13}. Similar results of total phosphorus uptake was found by Kasture (2001) [5] and Kokare (2013) [6] in chilli. Overall, results indicate that the highest uptake of phosphorus was observed in treatments receiving combined application of organic manure with inorganic fertilizer. Vasanthi and kumaraswamy (2000) noted the positive effect of organic manure on uptake of Phosphorus by the crop, which may attributed to the chelation of micronutrients and Ca and Mg preventing them from fixing P in insoluble compounds.

Potassium uptake

The data in respect of the Potassium uptake by chilli plant due to the effect of application of different sources of organic manures and their combination is presented in Table 2. It can be observed from the data that the uptake of potassium in the stover ranged from 16.99 to 51.11 kg ha^{-1} due to effect of various treatments and it was found statistically significant. The maximum uptake (51.11 kg ha^{-1}) was recorded by the treatment T_9 receiving 75% N through poultry manure and 25% N through urea, which was found to be significantly higher over other treatments, except treatment T_2, T_3, T_{12} and T_{13}. Minimum uptake (16.99 kg ha^{-1}) was recorded by treatment T_{13} (absolute control). The uptake of potassium by the chilli pod ranged in between 11.03 to 34.89 kg ha^{-1} due to effect of various treatments and it was found to be statistically significant. Among the various treatments the maximum uptake of potassium was recorded in treatment T_8 (34.89 kg ha^{-1}) with application of 50% N through poultry manure and 50% N through urea, which was significantly superior over rest of all the treatments. The minimum uptake (11.03 kg ha^{-1}) was recorded at treatment T_{13}. Total uptake of potassium was observed to be in the range of 28.02 to 74.58 kg ha^{-1} due to effect of different treatments. The maximum uptake (74.58 kg ha^{-1}) was recorded with treatment T_9 i.e. application of 75% N through poultry manure and 25% N through urea, which was significantly higher over other treatments, except treatments T_2, T_3, T_{12} and T_{13}. A similar result of total phosphorus uptake was found by Kasture (2001) [5] and Kokare (2013) [6] in chilli. The results indicated that K uptake increased with the age of the crop. Organic manure with fertilizers treated plots showed more potassium uptake with increased addition of K through organic manures. Bhandari *et al*. (1992) [1] noted that K uptake in all fertilizers and manurial treatment increased significantly over control plot. This may be due to more availability of these nutrient from added fertilizers and to the solubilizing action on K of organic acid produced during degradation of organic acids.

Iron uptake

The data in respect of the iron uptake by chilli plant due to the application of different sources of organic manures and their combination on chilli is presented in Table 3. It is observed from the data that the uptake of Fe in the stover ranged from 255.47 to 474.87 g ha^{-1} due to effect of various treatments, which was found to be non-significant. The maximum uptake (474.87 g ha^{-1}) was recorded at treatment T_9 receiving 75% N through poultry manure and 25% N through urea. Minimum uptake (255.47g ha^{-1}) was recorded at treatment T_{13} (absolute control). The uptake of Fe by the chilli pod ranged in between 65.32 to 229.77 g ha^{-1} due to effect of various treatments. It significantly increased under different treatments over control. Among the various treatments the maximum (229.77 g ha^{-1}) uptake of Fe was recorded with treatment T_8 receiving 50% N through poultry manure and 50% N through urea, which was significantly superior over the rest of all treatments except T_5 (194.68 g ha^{-1}) and T_6 (189.84 g ha^{-1}), with which

was at par. This might be due to the application of poultry manure followed by vermicompost which enhance the Fe uptake by plant. The lowest Fe uptake (65.32 g ha^{-1}) was observed with T_{13} (absolute control). The total uptake of iron by the chilli plant due to various treatments was seen to be non-significant. The uptake of iron ranged from 320.79 to 637.95 g ha^{-1}. The maximum uptake (637.95 g ha^{-1}) was recorded in the treatment T_9 receiving 75% N through poultry manure and 25% N through urea. Minimum uptake (320.79 g ha^{-1}) was recorded at treatment T_{13} (absolute control). Similar ranges were reported by Kokare (2013) [6]. Application of poultry manure records higher uptake than other treatment. This might be due to the complexion properties of poultry manures must have prevented precipitation and fixation of iron and keep it in available form which was reported by Talashilkar (1997) [13].

Table 3: Effect of different sources of organic manures and their combination on uptake of micronutrients

Treatment. No.	**Fe** (g ha^{-1})			**Mn** (g ha^{-1})			**Zn** (g ha^{-1})			**Cu** (g ha^{-1})		
	Stover	**Pod**	**Total**	**Stover**	**Pod**	**Total**	**Stover**	**Pod**	**Total**	**Stover**	**Pod**	**Total**
T_1	431.71	117.30	549.01	1980.82	343.07	2323.89	720.05	312.08	1032.13	524.77	324.12	848.88
T_2	332.18	148.21	480.39	1255.21	384.46	1639.66	594.39	383.37	977.76	678.57	418.35	1096.92
T_3	394.49	169.31	563.79	1472.58	362.74	1835.32	660.15	357.72	1017.87	609.00	499.66	1108.66
T_4	372.02	133.74	505.75	1341.77	360.21	1701.97	612.44	354.94	967.38	654.67	491.43	1146.10
T_5	352.38	194.68	547.06	1271.98	469.49	1741.47	482.27	384.05	866.32	307.16	654.04	961.19
T_6	316.76	189.84	506.59	1090.52	516.22	1606.74	567.76	443.50	1011.27	542.11	465.27	1007.38
T_7	381.24	160.93	542.16	1546.40	444.48	1990.88	593.46	443.57	1037.03	551.24	342.28	893.52
T_8	356.92	229.77	586.69	1991.29	461.07	2434.36	470.49	422.10	892.60	435.33	402.48	837.81
T_9	474.87	163.09	637.95	1510.37	438.35	1948.73	679.09	362.22	1041.31	699.94	559.18	1259.12
T_{10}	347.76	143.12	490.88	1168.13	341.09	1509.22	585.10	323.30	908.40	719.40	334.53	1053.93
T_{11}	369.91	152.82	522.73	1259.24	367.85	1627.09	544.71	369.22	913.93	656.22	336.90	993.12
T_{12}	284.83	161.00	445.83	1118.66	438.03	1556.69	444.11	418.24	862.35	361.85	569.97	931.82
T_{13}	255.47	65.32	320.79	701.59	192.89	894.48	220.35	191.86	412.21	346.53	196.44	542.97
S.E. ±	45.50	18.81	53.90	173.44	65.03	189.43	93.76	46.52	107.05	105.34	99.61	151.84
C.D (P=0.05)	NS	54.92	NS	506.25	NS	552.93	NS	NS	312.46	NS	NS	NS

Manganese uptake

From the perusal of data presented in Table 3 on the Mn uptake by chilli plants as a result of application of different sources of organic manures and their combination. It is observed that the uptake is significant in stover and total but non-significant in pod. Mn uptake by stover was significant. It ranged between 701.59 to 1991.29 g ha^{-1}. The treatment T_8 receiving 50% N through poultry manure and 50% N through urea recorded significantly highest value (1991.29 g ha^{-1}) over rest of the treatments. The treatment T_1 (1980.82 g ha^{-1}), T7 (1546.40 g ha^{-1}) and T_9 (1510.37 g ha^{-1}) were found at par with T_8. Minimum Mn uptake (701.59 g ha^{-1}) was observed in treatment T_{13} control. Mn uptake by chilli pod ranged from 192.89 to 516.22 g ha^{-1}. The maximum Mn uptake was recorded by treatment T_6 (516.22 g ha^{-1}). Minimum Mn uptake (192.89 g ha^{-1}) was observed in treatment T_{13} control. Total Mn uptake by chilli plant was seen to be in the range of 894.48 to 2434.36 g ha^{-1}.The treatment T_8 receiving 50% N through poultry manure and 50% N through urea recorded significantly highest value (2434.36 g ha^{-1}) over rest of the treatments. The treatments T_1 (2323.89 g ha^{-1}), T_7 (1990.80 g ha^{-1}) and T_9 (1948.73 g ha^{-1}), were found at par with T_8. Minimum Mn uptake (894.48 g ha^{-1}) was observed in treatment T_{13} control. Higher uptake of Mn was due to the ample of availability of Mn in soil due to the low pH acidic soils.

Zinc uptake

The data in respect of the Zinc uptake by chilli plant due to the application of different sources of organic manures and their combination on chilli is presented in Table 3. It can be seen from the data that the uptake of Zn in the stover ranged from 220.35 to 720.05 g ha^{-1} due to effect of various treatments. But it was found to be non-significant. The maximum uptake (720.05 g ha^{-1}) recorded at treatment T_1 receiving 25% N through FYM and 75% N through urea. Minimum uptake (220.35 g ha^{-1}) was recorded at treatment T_{13} (absolute control). The uptake of Zn by the chilli pod ranged from 191.86 to 443.53 g ha^{-1}due to effect of various treatments. It was found to be non-significant. Among the various treatments the maximum (443.53 g ha^{-1}) uptake of Zn was recorded with treatment T_7 receiving 25% N through poultry manure and 75% N through urea. Minimum uptake (191.86 g ha^{-1}) was recorded at treatment T_{13} (absolute control). It might be due to the application of poultry manure followed by vermicompost enhance the Zn uptake by plant. The total uptake of Zinc by the chilli plant due to various treatments ranged from 412.21 to 1041.31 g ha^{-1}. The maximum uptake (1041.31 g ha^{-1}) was recorded in the treatment T_9 receiving 75% N through poultry manure and 25% N through urea, which was found statistically at par with all the treatments except treatment T_{13}. Minimum uptake (1041.31 g ha^{-1}) was recorded at treatment T_{13} (absolute control).

Copper uptake

The data in respect of the Copper uptake by chilli plant due to the application of different sources of organic manures and their combination on chilli on copper uptake in plants is presented in Table 3. It is observed from the data that the uptake of Cu in the stover ranged from 346.53 to 719.40 g ha^{-1} due to effect of various treatments. But it was found to be non-significant. The maximum uptake (719.40 g ha^{-1}) was recorded at treatment T_{10} receiving 25% N through groundnut cake and 75% N through urea. Minimum uptake (220.35 g ha^{-1}) was recorded at treatment T_{13} (absolute control). The uptake of Cu by the chilli pod ranged in between from 196.44 to 654.04 g ha^{-1}due to effect of various treatments. It was found to be non-significant. Among the various treatments the maximum (654.04 g ha^{-1}) uptake of Cu was recorded with treatment T_5 receiving 50% N through Vermicompost and 50% N through urea and the minimum uptake (196.44 g ha^{-1}) was recorded at treatment T_{13} (absolute control). The total uptake of copper by the chilli plant due to various treatments

ranged from 542.97 to 1259.12 g ha^{-1}. The maximum uptake (1259.12 g ha^{-1}) was recorded in the treatment T_9 receiving 75% N through poultry manure and 25% N through urea. Minimum uptake (1259.12 g ha^{-1}) was recorded at treatment T_{13} (absolute control).

Conclusion

It could be concluded from the above investigation that the application of 100% RDN through different combination of poultry manure with urea (50 percent through poultry manure and 50 percent N through urea, 75 percent N through poultry manure and 25 percent N through urea) was found to be the best treatments along with recommended dose of phosphorus and potassium in increasing yield (stover and pod) of chilli, Var. Konkan Kirti as well as enhancing the efficiency of added fertilizers.

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