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Vermicompost and Integrated Nutrient Management Approach for Yield Enhancement of Capsicum (*Capsicum annuum* L.) under Hill Agro Ecosystem of Meghalaya, North East India

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ABSTRACT

The present study was carried out at farmers' field of Ri-Bhoi district of Meghalaya to test the effect of integrated nutrient management with vermi-compost for yield improvement of capsicum (*Capsicum annuum* L.) and its effect on soil nutrient status. The experiment was conducted by using 3 treatments: T1: Vermicompost @ 1.0 t/ha + 50% RDF (RDF: N: P_2O_5: K_2O::120: 80: 60 kg/ha), T2: Vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching & pod initiation stage, T3: Farmers' practice (imbalance fertilizer with N: P_2O_5: K_2O:: 40:25:15 kg/ha) with 5 replications following randomized block design during 2016 and 2017. From the results it was revealed that Vermicompost @ 1.0 t/ha + 50% RDF showed significant increase in fruit yield *i.e.*, 132 q/ ha and B.C ratio of 2.98 followed by Vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching and pod initiation stage (108 q/ha yield, B.C ratio 2.25) and farmers' practice (86 q/ha yield, B.C ratio 2.10). Moreover, improved soil nutrient status was achieved in T1 followed by T2 and T3. There was an increase of 123.16 % in organic carbon, 123.76 % nitrogen, 131 % available phosphorus and 169.07 % potassium recorded in the soil after the harvest of the crop as compared to initial stage of soil before the implementation of Treatment 1.

Key Words: On Farm Testing, Vermi-compost, INM, Capsicum.

INTRODUCTION

North East India is the region of amazing natural beauty with wonderful hills and valleys and the integration of different culture and tradition. Meghalaya is one of the Hilly State of North East India. It receives heavy rainfall almost all round the year and its suitable agro-climatic conditions prevailing in the area makes Meghalaya favourable for the cultivation of vegetables throughout the year (Bordoloi, 2021a). The cultivation of capsicum crop is gradually rising in the hilly areas of North Eastern region. The cultivation of capsicum is being commercialized and it is spread to almost all the parts of the Meghalaya because of its good price achieved from the neighbouring states too. The productivity of capsicum crop is less in this area due to improper soil nutrient management as well as other intercultural operations. Furthermore, farmers of this hilly region use the chemical fertilizer and pesticides in very low quantity and prefers to grow the crop by putting the locally available manure only due to unawareness of modern technology (Bujarbaruah, 2004, Sanjay-Swami, 2020). The farmers get lower yield of crop due to improper soil fertility management in Meghalaya (Bordoloi, 2021b, Sanjay-Swami, 2019).

The productivity of crops and soil nutrient status can be increased through integrated use of inorganic fertilizers and organic manure in the hill agro ecosystem of Meghalaya (Bordoloi and Islam, 2020, Sanjay-Swami and Singh, 2020). The organic carbon, available nitrogen, phosphorus and potassium status of soil can be increased through integrated application of inorganic fertilizers and organic manure (Baishya *et al*, 2015). Due to the occurrence of heavy rainfall in this area, the high

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soil acidity is experiencing in this region which also affects the crop productivity (Bordoloi, 2020; Bordoloi, 2021c; Sanjay-Swami *et al*, 2020). Vermicompost can be utilized successfully to improve the soil physical and chemical properties and for productivity enhancement of crops (Kumar *et al,* 2020; Rajkhowa and Kumar, 2013; Rajkhowa *et al*, 2019; Bordoloi, 2021d). Moreover, capsicum crop requires a high amount of nutrients and therefore integrated nutrient management approach is very much effective for improvement of soil health and productivity of capsicum. So, considering the above in view the present study was carried out during 2016 and 2017 at five different farmers' field of Ri-Bhoi district of Meghalaya to test the effect of integrated nutrient management with vermi-compost in yield improvement and economics of capsicum (*Capsicum annuum* L.) along with soil nutrient status.

MATERIALS AND METHODS

The Ri-Bhoi district lies between the North Latitudes 25.15/ and 26.15/ and East Longitudes 91.45/ and 92.15/. The total area of Ri-Bhoi district is 2378 sq. km with a total population of 2, 58,840 (Anonymous, 2011). The area falls under humid subtropical with an average rainfall of 1000mm to 2500 mm. The study area covers three villages namely Khweng, Kdonghulu and Kyrdem and falls between the altitudes of 823 to 898 amsl. The total area covers for the on farm testing was 0.5 ha. The soil of the experimental site was found to be sandy loam and acidic in reaction. The variety taken for the experiment was California wonder. The experiment was conducted by following 3 treatments like T1: Vermicompost @ 1.0 t/ha + 50% RDF (RDF: N: P_2O_5: K_2O::120: 80: 60 kg/ha), T2: Vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching & pod initiation stage, T3: Farmers practice (imbalance fertilizer with N: P_2O_5: K_2O:: 40:25:15 kg/ha) with 5 replications following randomized block design. The chemical properties of vermi-compost used in the experiment are presented in the **Table 1**. The farmers were trained in vermi-composting technology, capsicum cultivation and about soil fertility management. The data related to yield parameters and soil fertility status were collected from all the plots before and after the implementation of the programme. The economics of the experiment was also analyzed for proper conclusion of the experiment.

Table 1. Chemical properties of vermi-compost used in the present investigation

Property	Value (%)
Organic Carbon	10.3
Nitrogen	2.75
Phosphorus	1.88
Potassium	1.98
Calcium	1.29
Sulphur	0.35
Magnesium	0.38

Table 1. Yield of Capsicum and Economics under the Agro-ecosystem of Meghalaya.

Treatment	Av. Yield (q/ha)	Per cent	Avg. Gross cost (Rs/ha)	Avg. Gross return (Rs/ha)	Avg. Net income (Rs/ha)	BCR
T 1	132	153.49	88444	264000	175556	2.98
T 2	108	125.58	96086	216,000	119914	2.25
T 3	86	FP	82000	172,000	90000	2.10
CD (pd" 0.05)	7.13					
%= % increase in yield over control						

RESULTS AND DISCUSSION

Crop Yield and Economics Analysis

It was revealed that the application of vermicompost @ 1.0 t/ha + 50% RDF (RDF: N: P_2O_5: K_2O:120: 80: 60 kg/ha gave significantly higher yield (at 5% level of significance) of capsicum followed by vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching and pod initiation stage and farmers' practice. There was a 153.49 per cent yield improvement in T1 compared to T3 and 125.58 per cent yield improvement in T1 compared to T3 i.e., farmers' practice where they used imbalanced Fertilizers. Similar results of yield improvement on rabi onion by application INM were achieved by Dhillon and Singh (2019).

The input and output cost of products exist during the period of demonstrations were taken for calculating the cost of cultivation, net return and benefit cost ration show in Table 2. The highest B.C ratio was recorded in the T1 i.e. Vermicompost @ 1.0 t/ha + 50% RDF (RDF: N: P_2O_5: K_2O::120: 80: 60 kg/ha (2.98) followed by T 2 i.e. Vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching & pod initiation stage (2.25) and T3 i.e. farmers' practice (imbalance fertilizer with N: P_2O_5: K_2O:: 40:25:15 kg/ha) (2.10). The average net income (Rs/ha) was recorded Rs. 175556/- in T1 which is higher as compare to T2 (Rs. 119914/-) and T3 (Rs. 90000/-). The recorded results were obtained may be due to higher yield obtained under the experimental plot compare to farmers' practice. Similar results of improvement of BC ratio and net income of capsicum by the application INM was also recorded by Shabir *et al* (2017). The suitable BC ratio reveals the economic viability of the OFT and convinced the farmers to adopt the Technology.

Soil Fertility Status

Soil sample were collected before the implementation of the treatments to the farmers field and after the harvesting of the crop. The soil fertility status was significantly increased with the application of organic and inorganic combination of fertilizer from initial to final stage of the crop during both the years of experimentation. It revealed that the soil was acidic in nature with high organic carbon content. The soil pH, organic carbon, available nitrogen, available phosphorus and available potassium status of soil after harvest of the crop significantly increased (at 5% level of significance) due to application of the treatment. From the results of the experiment it is seen that application of T1 (Vermicompost @ 1.0 t/ha + 50% RDF (RDF: N: P_2O_5: K_2O::120: 80: 60 kg/ha) significantly increased the nutrient content followed by T2 (Vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching and pod initiation stage) and T3 i.e. farmers' practice. A total of 123.16 % increased in organic carbon, 123.76 % nitrogen, 131 % increased available phosphorus and 169.07 % increased in potassium were recorded in the soil after the harvest of the crop as compare to initial stage of soil. The increased amount of NPK in soil by application of INM in rice in Meghalaya was recorded by Bordoloi and Islam (2020). So, the integrated use of vermicompost along with reduced rate of NPK fertilizer can be effectively used for increase the productivity of capsicum crop and for sustaining the soil nutrient status for increase the farmers' income. It indicates that applications of organic sources with inorganic sources were found more effective in building up soil fertility status as compared to farmers' practice and can successfully use for maintain and improve the soil fertility.

CONCLUSION

Vermicompost is a suitable method to recycle of crop waste available in the Ri-Bhoi district and it is an appropriate organic fertilizer for yield improvement of crop as well as for improving the soil nutrient status. The technology used for the experiments were to make less productive soils into productive and profitable for income generation on a long-term sustainable basis. So, it is needed to popularize the technology locally for adoption by the farmers and spread the technology to

different part of the region for profit maximization and for management of soil health in commercial cultivation of capsicum crop. As the farmers of this region prefer the organic cultivation of crop, so, further research is required for more reduction of chemical fertilizers for increase the productivity of capsicum crop and reducing the cost of cultivation as well as for environmental sustainability.

Table 2. Effect of Vermi-Compost Based INM on Soil Nutrient Status.

Treatment	pH		Organic C (kg/ha)		%	Available N (kg/ha)		%	Available P (kg/ha)		%	Available K (kg/ha)		%
T 1		5.84		5.34	0.95	1.17	123.16	311.56	385.6	123.76	49.21	64.35	131.00	41.96	70.94	169.07
T 2		5.86		5.14	0.93	1.09	117.2	314.76	365.4	116.09	46.43	59.35	127.83	44.42	68.14	153.40
T 3		5.96		5.94	0.93	1.02	1.10	309.43	315.8	1.02	48.67	54.35	1.12	42.43	57.22	134.86
CD (pd" 0.05)			0.06			0.09			8.86			2.45			1.43	

%= % increase

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