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Research Paper

Impact of Vermicompost based Integrated Nutrient Management on Soil Properties for Productivity Enhancement of Broccoli (*Brassica oleracea* var. Italica) under Rain Fed Condition of Northeast India

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Abstract: A study was conducted at Ri-Bhoi District of Meghalaya to evaluate the impact of vermicompost based integrated nutrient management on soil nutrient dynamics and its effect on productivity enhancement of Broccoli (*Brassica oleracea* var. Italica). The experiment was conducted at 2 selected villages of Ri-Bhoi District with 3 treatments viz., 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:: 50:20:10 kg/ha) with 5 replications following randomized block design during the year 2017-18. From the results it is revealed that Vermicompost @ 1.0 t/ha + 50% RDF showed significant increase in yield and B.C ratio followed by Vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching & pod initiation stage and Farmers practice. Moreover, improved soil nutrient status was achieved in T1 followed by T2 and T3 in the soil after the harvest of the crop as compared to the initial stage of soil before the implementation of Treatments.

Keywords: *Front Line Demonstration, Vermi-compost, INM, Broccoli.*

Introduction:

Northeast India is famous for its sonic beauty with vast and varied landscape along with diversified flora and fauna. Although the Agriculture is the backbone of socio-economic development of this region the productivity of crops is very low as because of the favorability to the traditional methods of cultivations by the Farmers along with some other factors (Bordoloi, 2021 a and Arunachalam *et al*., 2003). In Meghalaya, Agriculture is the major source of income for maximum of the people for their livelihood. But due to the improper soil fertility management coupled with other challenges prevailing in North-eastern Hilly Region of India, the farmers are getting very low yield from the agricultural sector (Kumar *et. al*., 2012, Sanjay-Swami, 2020, Bordoloi and Islam, 2020). Moreover, due to the high rainfall soil acidity is also found high which is also associated with low productivity of crop (Lyngdoh *et al*., 2020, Bordoloi 2021, b and Bordoloi 2021 c).

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The preferences of cultivation of vegetable crops among the farmers of Meghalaya is increasing gradually as because of its high price achieved in local market as well as from supply to the nearby States. Moreover, organic matter application is mostly preferred by the farmers of Meghalaya for crop cultivation (Bordoloi, 2021 d and Bordoloi, 2021 e). But for commercialization of high value vegetable crops, the modernization of Agriculture with sound scientific knowledge of crop production is required (Sanjay-Swami and Singh, 2019, Bordoloi, 2020 and Bordoloi, 2021 f). The integrated use of balanced organic and inorganic fertilizer improves the soil physical environment that is suitable for achieving higher productivity of crop in intensive cropping system of North-eastern hilly region of India (Saha *et al*., 2010, Bordoloi *et al*., 2020 and Das *et al*., 2018). Some studies show the good results in terms of crop productivity and soil nutrient status by the application of vermicompost along with reduced dose of chemical fertilizers (Bordoloi, 2021 a). A study was conducted at Ri-Bhoi District of Meghalaya in the year 2017-18 to evaluate the impact of vermicompost based integrated nutrient management on soil nutrient dynamics and its effect on productivity enhancement of Broccoli (*Brassica oleracea* var. Italica).

Materials and Methods:

A study was conducted at Ri-Bhoi District of Meghalaya in 2 selected villages to study the impact of vermicompost based integrated nutrient management on productivity enhancement of Broccoli (*Brassica oleracea* var. italica) and its effect on soil nutrient status. The Ri-Bhoi District is 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 falls between the altitudes of 833 to 890 amsl. The area under each FLD was 0.4 ha with a total area of 2 ha. The experiment was conducted by following 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:: 50:20:10 kg/ha) with 5 replications following randomized block design during the year 2017-18. All the participating farmers were trained on all aspects of Broccoli production and soil fertility management before implementing the FLDs at their field. To study the impact of FLD, data from each experimental plot were collected and analyzed. The soil fertility statuses were estimated by soil analysis of composite soil sample from each plot before transplanting and after harvesting of crop. The soil of the experimental site was sandy loam and acidic in reaction. 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.

To study the impact of FLD, data from FLDs and Farmers' Practices were collected and analyzed. The extension gap, technology gap and technology index along with benefit cost ratio were calculated using the formula as suggested by Samui *et al.*, (2000) as follows

Technology Gap = Potential yield – Demonstration Yield (q/ha)

Extension Gap = Demonstration Yield – Farmers Yield (q/ha)

Technology Index = Potential Yield – Demonstration Yield/ Potential Yield x 100

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Results and Discussion:

Crop Yield and Economics Analysis

From the results it is revealed that Vermicompost @ 1.0 t/ha + 50% RDF showed significant increase in fruit yield and B:C ratio followed by Vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching & pod initiation stage and Farmers practice. 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 1. The highest B:C ratio was recorded in the T1 *i.e*. 3.4 followed by Treatment 2 *i.e.* 2.98 and Treatment 3 *i.e.* 2.47 (Farmers practice). The recorded results were obtained may be due to higher yield obtained under the experimental plot compared to Farmers practice. The suitable B:C ratio reveals the economic viability of the FLD and convinced the farmers to adopt the Technology.

Gap Analysis

The data of extension gap, technology gap and the technology index received after the implementation of the technology had reveals the feasibility of the demonstrated technology at the farmers' field and the suitability of the technology in the Hill agro-ecosystem of North Eastern India. The extension gap in the T1 *i.e.* 54.9 q/ha emphasized the need to train the farmers through demonstration and training for adoption of improved technology to reverse the trend of wide extension gap (Table 1). Technology gap of 37.5 q/ha reveals the farmer's cooperation in carrying out new demonstration with good results. The technology index of 18.75 showed the feasibility of the demonstrated technology at the farmers' field and suitability of the Technology in the region. Similar results also recorded by Bordoloi, (2021 g) and Kumar *et al.*, (2015).

Soil Fertility Status

Soil samples were collected before the implementation of the FLD's and after the harvesting of the Broccoli crop. The improved soil nutrient status was achieved in T1 followed by T2 and T3 in the soil after the harvest of the crop as compared to the initial stage of soil before the implementation of Treatments. From Table 2 it is reveals that the soil is 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) in T1 followed by T2 and T3. From the results of the experiment it is seen that the application of T1: Vermicompost @ 1.0 t/ha + 50% RDF (RDF: N: P_2O_5: K_2O ::120: 80: 60 kg/ha) significantly increase the nutrient content i.e. as compare to T2: Vermicompost@ 2.0 t /ha + Lime @ 500kg/ha + 2% urea spray at branching & pod initiation stage and T3: Farmers practice (imbalance fertilizer with N: P_2O_5: K_2O:: 50:20:10 kg/ha). So, the integrated use of Vermicompost along with reduce rate of NPK fertilizer can be effectively used for increased the productivity of Broccoli crop and for sustaining the soil nutrient status for increase the farmers' income. Similar results are also achieved by Bordoloi, (2020) and Maier *et al*., (2002) in the earlier studies. It indicates that applications of organic sources with inorganic sources found more effective in building up soil fertility status.

Conclusion

Soil fertility management is the important parameters to increase the productivity of the crop as well for sustainable agriculture. Imbalanced fertilizer application along with soil acidity decreases the availability of most of the plant nutrients and also affects adversely in important microbiological processes. The technology used for the experiments were to provide the essential nutrients to the crop in an

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integrated manner to make the soil productive and profitable on a long-term sustainable basis. So, it is required to popularize the technology locally for large scale dissemination among the Farmers. Further research is required for more reduction of chemical fertilizers with replacement of organic products for increase the productivity of Broccoli crop and for maintaining the sustainable agriculture in Northeast Region of India.

Figure 1: Implementation of FLD programme in the Farmers Field

Table: 1. Effect of INM on Yield and Economics of Broccoli in Hill Agro ecosystem of North-eastern India

Treatments	Avg. yield (q/ha)	% increase/ change in avg. yield over local	Gross Cost (Rs/ha)/ (Rs./unit)	Gross Return (Rs/ha) / (Rs./ unit)	Net Return (Rs/ha)/ (Rs./Unit)	B:C Ratio (GR/GC)	Technology gap (q/ha)	Extension gap (q/ha)	Technology Index
T1	162.5	143.05	95,600	325,000	229,400	3.4	37.5	54.9	18.75
T2	138.0	130.38	92,450	276,000	183,550	2.98	62	30.4	31
T3	107.6		86,540	214,000	127,460	2.47	92.4		
P<0.05	1.09								
%= % increase in yield over control									

Table: 2. Effect of INM on soil fertility status in Hill Agro ecosystem of North North-eastern India

Treatments	pH		Organic Carbon (kg/ha)			Available Nitrogen (kg/ha)			Available Phosphorus (kg/ha)			Available potassium (kg/ha)		
	Before	After	Before	After	% Increased	Before	After	% Increased	Before	After	% Increased	Before	After	% Increased
T1	4.43	5.03	1.11	1.22	109.91	286.51	366.43	127,89	18.65	26.23	140.64	109.23	155.66	142.50
T2	4.42	5.16	1.02	1.14	111.77	281.33	329.42	117.09	17.65	22.21	125.83	106.58	123.21	115.60
T3	4.54	4.86	1.05	1.12	106.67	287.32	303.43	105.61	18.55	21.11	113.80	108.08	115.55	106.91
P<0.05		0.08		0.07			6.21			2.86			1.65	
%= % increase in yield over control														

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