Effect of Organic and Conventional Nutrient Management on Growth and Yield of Broad Leaf Mustard *(Brassica juncea* var. *rugosa)*

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An experiment was conducted to evaluate the effect of organic and conventional nutrient management on growth and yield of Broad Leaf Mustard (Brassica juncea var. rugosa) in field at Dakshinkali Municipality-2, Kathmandu, Nepal during the year 2016-2018. The experiment was laid out in a Randomized Complete Block Design. There were 13 treatments viz. T_1 {(24 ton/ha. Farm Yard Manure (FYM)}, T_2 (6 ton/ha. Vermicompost), T_3 (4 ton/ha. Poultry Manure), T_4 (12 ton/ha Compost), T_5 (½ NPK + 3 ton/ha. Vermicompost), T_6 (¾ NPK + 1.5 ton/ ha. Vermicompost), T_7 (½ NPK+12 ton/ha. FYM), T_8 (¾ NPK +6 ton/ha. FYM), T_9 (½ NPK + 2 ton/ha. Poultry Manure), T_{10} (¾ NPK + 1 ton/ha. Poultry Manure), T_{11} (½ NPK + 6 ton/ha. Compost), T_{12} (¾ NPK + 3 ton/ha. Compost) and T_{13} (Control) with three replications. In the study, maximum plant height, number of leaves/plant, leaf size, plant canopy volume, yield per plant, yield per plot and yield per hectare were observed with the treatment combination of ¾ NPK + 1.5 ton/ ha. Vermicompost (T6).

Keywords: *Leafy vegetable, organic fertilizer, Vermicompost, yield*

Introduction

Broad Leaf Mustard (BLM), *Brassica juncea var. rugosa.*, belonging to family Cruciferae, is one the most popular, highly commercial and most widely grown leafy vegetables in Nepal. It can be found in Central to Eastern Asia. It is commonly known as 'Rayo' in Nepal. It is adapted widely and can be grown from terai to higher hills. It is one of the rich sources of several vitamins and minerals. Cooler climatic condition is most suitable for its cultivation. It is mainly grown as winter season crop in terai whereas it is mainly grown as summer season crop in the higher hills. In cooler conditions the quality of the leaves become better as compared to warmer conditions. Although it can be grown in wide range of soil, loamy soil with higher organic matter content and good water holding capacity is preferred (Parajuli, 2015).

In Nepal, BLM is mainly produced for local consumption selling at local markets. Specially, it is highly popular in urban and peri urban areas of Nepal. BLM is also consumed in the form of fermented product locally known as Gundruk which is most popular and favorite Nepali dish. Different varieties of BLM have been released and registered viz, Marpha Broad Leaf, Khumal Broad Leaf, Khumal Red Leaf, Tangkhuwa, Mike Giant and Red Giant in Nepal (MoAD, 2016). In Nepal, it is cultivated in an area of 13,191 ha of land with production of 1,60,761 MT and average yield of 12.19 MT/ha (VDD, 2015/16).

The productivity of the leafy vegetable crops is very low in Nepal as compared to other countries. One of the most important factors to enhance productivity is use of fertilizers. However, with the indiscriminate use of increased level of chemical fertilizers, there has been deterioration in the physical properties of soil along with drastic decline in inherent fertilizing capacity of the soil there by posing a serious threat to long term sustainability of crop

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production and its quality. Organic manure, although poor source of nutrients, improves physical properties of soil and increases organic matter and humus content of soil which in turn increases the water holding capacity of the soil (Arancon et al. 2003). For example, it has been reported that the use of vermicompost increased growth, yield and quality in several crops (Arancon et al. 2003). Keeping this in view, the present study was carried out to evaluate the effect of sole application of various kinds of organic manures generally used in Nepal and their combinations with commonly used chemical fertilizers conventionally on growth, yield and quality parameters of BLM. This would also help to find judicious combination of different sources and doses both of organic manures and chemical fertilizers to sustain the production and productivity of BLM as well as soil fertility status.

Materials and Methods

The present study was carried out in a field at Dakshinkali Municipality-2, Kathmandu, Nepal during the year 2016-2018.There were 13 treatment combinations (Table 1). The experiment was laid out in a Randomized Complete Block Design with three replications. 'Marpha Broad Leaf' was the variety selected for the experiment. Area of the experimental plot size was 2.0 × 2.5 m^2. Total number of plants per plot was 36.

Table 1. Treatments of the experiment

Treatments	Doses and Sources of Nutrients
T_1	24 ton/ha. Farm Yard Manure (FYM)
T_2	6 ton/ha. Vermicompost
T_3	4 ton/ha. Poultry Manure
T_4	12 ton/ha. Compost
T_5	½ NPK + 3 ton/ha. Vermicompost
T_6	¾ NPK + 1.5 ton/ ha. Vermicompost
T_7	½ NPK + 12 ton/ha. FYM
T_8	¾ NPK + 6 ton/ha. FYM
T_9	½ NPK + 2 ton/ha. Poultry Manure.
T_{10}	¾ NPK + 1 ton/ha. Poultry Manure
T_{11}	½ NPK + 6 ton/ha. Compost
T_{12}	¾ NPK + 3 ton/ha. Compost
T_{13}	Control (No nutrient application)

Note: NPK were supplied through chemical fertilizers viz. Urea, Diammonium Phosphate and Murate of Potash. Recommended doses of NPK for Broad Leaf Mustard: $N:P_2O_5:K_2O$:: 120: 80:60 kg ha^{-1} (Singh and Bhandari, 2015)

The plant height was measured from the ground level to the apical tip of the plant. The observation was recorded at the end of the growth period for each treatment. Effective leaves were counted and then mean was calculated. Photosynthetically active green leaves were considered as effective. Senescent leaves were excluded in the counting. The leaf length and width were measured from their one margin to other. The observation was recorded at the end of the growth period for each treatment. The volume of the plant was calculated by using the formula given by Westwood (1993).

i. For a plant which is taller than its width: Volume = $4/3\pi ab^2$

ii. For a plant which is wider than its height: Volume = $4/3\pi a^2 b$

Where; $\pi = 3.1428$

$a = 1/2$ of the major axis

$b = 1/2$ of the minor axis

The observations on yield were recorded at the time of harvesting. Broad leaf mustard was harvested 3 times to simulate farmers' practices. After harvesting from each plot it was weighed and expressed in kg per plot and calculated in kg per hectare.

The statistical analysis of the data was carried out as per method described by Cochran and Cox (1963). Data were systematically arranged on the basis of various observed parameters. Micro-soft Excel and Genstat (developed by VSN International Ltd.) were used for the analysis of variance and other data analysis. The treatment effects were tested at 5 percent level of significance.

Results and Discussion

Effect on Growth of BLM

The highest plant height (38.14 cm) was observed from the treatment T_6 (¾ NPK + 1.5 ton/ ha. vermicompost). The least height (29.50cm) was observed in T_{13} (Control) (Table 2). This might be due to that vermicompost supplies micronutrients such as zinc, copper, manganese and iron in optimum range to the plant (Nandhakumar, 1997). In agreement to this finding Bongkyoon (2004) reported that the plant height of potato was higher in the plots where vermicompost and NPK were supplied. Further, Alam (2005) stated that combined application of organic manure and inorganic fertilizers gave the highest plant height in carrot plant. Findings of the present study on plant height are in agreement with the findings of Azad (2000) in cabbage.

The number of leaves per plant was recorded the highest (14.00) in treatment T_6 (¾ NPK + 1.5 ton/ ha. vermicompost) where as it was the least (10.33) in T_{13} (Control) (Table 2). The better performance of conjunctive use of inorganic and organic fertilizers than sole applications might be due to solubilization of the nutrients by mixing of vermicompost with chemical fertilizers leading to increased uptake of NPK. In support of this, Bahadur and Singh (2004) also reported that application of organic manures combined with recommended dose of inorganic fertilizers showed superior performance in plant growth of tomato crop.

Likewise, the highest leaf size of BLM was 949.37cm^2 in the treatment T_6 (¾ NPK + 1.5 ton/ ha. Vermicompost) and the least (522.56 cm^2) in control (T_{13}) (Table 3).

Regarding canopy of BLM plant, it was the highest (0.0663m^3) in the treatment T_6 (¾ NPK + 1.5 ton/ha. vermicompost) and the least (0.0300 m^3) was in T_{13} (Control) (Table 3).

Table 2. Effect of Organic and Conventional Nutrient Management on Plant height and Number of leaves per plant of Broad Leaf Mustard

Treatments		Plant Height (cm)	Number of leaves per plant
T_1	24 ton/ha. Farm Yard Manure (FYM)	32.60	11.67
T_2	6 ton/ha. Vermicompost	36.18	13.50
T_3	4 ton/ha. Poultry manure	34.61	12.17
T_4	12 ton/ha Compost	32.94	11.83
T_5	½ NPK + 3 ton/ha.Vermicompost	37.33	13.83
T_6	¾ NPK + 1.5 ton/ ha. Vermicompost	38.14	14.33
T_7	½ NPK + 12 ton/ha. FYM	33.79	11.67
T_8	¾ NPK +6 ton/ha. FYM	35.50	12.33
T_9	½ NPK + 2 ton/ha. Poultry Manure.	37.10	12.00
T_{10}	¾ NPK + 1 ton/ha. Poultry Manure	35.10	12.00
T_{11}	½ NPK + 6 ton/ha. Compost	33.25	12.50
T_{12}	¾ NPK + 3 ton/ha. Compost	35.54	12.17
T_{13}	Control (No nutrient application)	29.50	10.33
LSD (0.05)		3.896	0.7287
P-Value		0.009	<.001
CV%		6.7	3.5
SEM		1.335	0.2496

Table 3. Effect of Organic and Conventional Nutrient Management on Leaf Size and Plant Canopy Volume of Broad Leaf Mustard

Treatments		Leaf Size (cm^2)	Plant Canopy Volume (m^3)
T_1	24 ton/ha. Farm Yard Manure (FYM)	610.33	0.0457
T_2	6 ton/ha. Vermicompost	831.46	0.0570
T_3	4 ton/ha. Poultry manure	719.25	0.0520
T_4	12 ton/ha Compost	788.50	0.0443
T_5	½ NPK + 3 ton/ha. Vermicompost	920.21	0.0630
T_6	¾ NPK + 1.5 ton/ ha. Vermicompost	949.37	0.0663
T_7	½ NPK + 12 ton/ha. FYM	643.17	0.0473
T_8	¾ NPK +6 ton/ha. FYM	676.12	0.0497
T_9	½ NPK + 2 ton/ha. Poultry Manure.	745.91	0.0513
T_{10}	¾ NPK + 1 ton/ha. Poultry Manure	758.12	0.0540
T_{11}	½ NPK + 6 ton/ha. Compost	792.75	0.0463
T_{12}	¾ NPK + 3 ton/ha. Compost	808.78	0.0510
T_{13}	Control (No nutrient application)	522.56	0.0300
LSD (0.05)		80.92	0.005690
P-Value		<.001	<.001
CV% (between treatments)		6.4	6.7
SEM		27.72	0.001949

Effects of the treatments on yield parameters of Broad Leaf Mustard

The highest yield per plant (0.327 Kg/plant) was obtained with the application of treatment T_6 (¾ NPK + 1.5 ton/ha. vermicompost) while the least was recorded in control treatment (T_{13}) with 0.194 kg/plant (Table 4). Similarly, the highest yield per plot (11.77 kg/plot) was obtained with the application of T_6 (¾ NPK + 1.5 ton/ha. Vermicompost) while the least yield per plot of 6.993 kg/plot was recorded in T_{13} (Control) (Table 4).

Likewise, the highest yield/ha (24.22 t/ha) was obtained with the application of treatment T_6 (¾ NPK + 1.5 ton/ ha. vermicompost) while the lowest yield (14.39 t/ha) was recorded in the treatment T_{13} (Control) (Table 4). This shows the positive synergistic effect of the combined application of vermicompost with chemical fertilizers on yield related parameters through increased uptake of the nutrient elements by the crop plant. These results are in line with the findings in broccoli (*Brassica oleracea* L. var *italica*) by Sharma (2000) in which he found that integrated application of organic and inorganic fertilizers significantly increased the head yield over inorganic fertilizers alone and also over the control. Higher yields with the application of vermicompost in combination of recommended dose of NPK was also reported in cabbage by Ranjit (2010). Present investigation revealed that partial substitution of the recommended dose of inorganic fertilizers through vermicompost was more effective compared to higher levels of vermicompost (T_2). It also showed that vermicompost is better organic fertilizer over other sources of organic manures in terms of yield of BLM.

Table 4. Effect of Organic and Conventional Nutrient Management on Yield parameters of Broad Leaf Mustard

Treatments		Yield per plant (Kg)	Yield per Plot (Kg)	Yield per Ha. (ton/ha.)
T_1	24 ton/ha. Farm Yard Manure (FYM)	0.281	10.113	20.814
T_2	6 ton/ha. Vermicompost	0.308	11.083	22.814
T_3	4 ton/ha. Poultry Manure	0.285	10.243	21.086
T_4	12 ton/ha.Compost	0.289	10.400	21.407
T_5	½ NPK + 3 ton/ha. Vermicompost	0.318	11.443	23.555
T_6	¾ NPK + 1.5 ton/ ha. Vermicompost	0.327	11.770	24.222
T_7	½ NPK + 12 ton/ha. FYM	0.293	10.530	21.679
T_8	¾ NPK +6 ton/ha. FYM	0.297	10.687	22.000
T_9	½ NPK + 2 ton/ha. PoultryManure.	0.295	10.617	21.849
T_{10}	¾ NPK + 1 ton/ha. Poultry Manure	0.300	10.807	22.246
T_{11}	½ NPK + 6 ton/ha. Compost	0.289	10.410	21.431
T_{12}	¾ NPK + 3 ton/ha. Compost	0.294	10.580	21.777
T_{13}	Control (No nutrient application)	0.194	6.993	14.39467
LSD (0.05)		0.02109	0.7593	1.562
P-Value		<.001	<.001	<.001
CV% (between treatments)		4.3	4.3	4.3
SEM		0.00723	0.2601	0.535

Conclusion

It is concluded that the investigation on effect of organic and conventional nutrient management on growth and yield parameters of Broad Leaf Mustard (*Brassica juncea* var. *rugosa*) showed that the combined application of ¾ NPK +1.5 t/ha Vermicompost (Treatment T_6) was most effective for improving the plant height, number of leaves/plant, leaf size, plant canopy volume, yield per plant, yield per plot and average yield of BLM. It is advised to apply ¾ of recommended dose of NPK with 1.5 ton/ha Vermicompost for higher green leaf yield of broad leaf mustard.

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References

Alam, M.N. 2005. Effect of vermicompost and NPKS fertilizers on growth, yield and yield components of carrot (cv. New Kuroda). Bangladesh Journal of Environmental Science. 11(2): 398-403.

Arancon, N.Q., C.A. Edwrads, P. Bierman, J.B. Metzger, S. Lee, C.O. Welch, A.J. Morgan, R.P. Blackshaw, K.R. Butt, J. Freaderickson, J.E. Morgan, J.G. Pierce and J.M. Weeks .2003. Effects of vermcompost on growth and marketable fruits of field gown tomatoes, peppers and strawberries. Pedobiologia.47(5-6): 731-735.

Azad, A.K. 2000. Effects of plant spacing, source of nutrients and mulching on growth and yield of cabbage. M.Sc. Thesis. Department of Horticulture. Bangladesh Agriculture University Mymensingh,15-40.

Bahadur, A., Singh, J. & Singh, K.P. 2004. Response of cabbage to organic manures and biofertilizers. Indian Journal of Horticulture. 61(3): 278-279.

Bongkyoon, K. 2004. Effect of vermicompost on growth of fall-cropping potato in volcanic ash soil. Korean Journal of crop Science. 49(4): 305-308.

Cochran, G.C. and Cox, G.M.1963. Experimental Design. Asian Publication House Bombay.p. 611

MoAD .2016. Agriculture Diary, Agriculture Information and Communication Centre, Hariharbhawan, Lalitpur.

Nandhakumar,S. 1997. Studies on the effect of integrated nutrient management on growth , yield and quality of brinjal (*Solanum melongena* L.) Cv. PLTL. South Indian Horticulture . 47 (1-6): 42-48

Parajuli, A. 2015. Cultivation and Management practices of leafy vegetable in Nepal. Wordpress.com

Ranjit, C. 2010. Physiological Attributes of cabbage (Brassica oleracea) as influenced by different sources of nutrients under Eastern Himalayan Region. Research Journal of Agricultural Sciences.1(4): 318-321.

Sharma, K.C. 2000. Influence of integrated nutrient management on yield and economics in broccoli (*Brassica oleracea* L. *varitalica*) plant under cold temperate conditions. Journal of Vegetation Science.27 (1), 62-63.

Singh, K.P., & Bhandari, R. (2015) Vegetable Crop Production Technology, Vol.1st, Samiksha Publication, Kathmandu

Westwood, M.N. 1993. Temperate-zone pomology. Physiology and Culture. 3rd ed. Timber Press Inc.Portland, Oregon, pp.523