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Evaluation of vermicompost use for cabbage production in two selected areas of Bangladesh

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Abstract

Vermicompost has various positive effects on soil, particularly soil fertility and productivity. Two experiments were conducted at farmer's field of Mymensingh and Jamalpur to observe the effect of vermicompost on cabbage production during rabi season 2019. There were seven compost treatments viz: T_1: RCF (N_{150} P_{40} K_{100} S_{16} Kg ha^{-1}), T_2: 85% RCF, T_3: 70% RCF, T_4: 85% RCF + 3 t ha^{-1} vermicompost (VC), T_5: 85% RCF + 1 t ha^{-1} VC, T_6: 70% RCF + 3 t ha^{-1} VC and T_7: 70% RCF + 1 t ha^{-1} VC. The experiments were laid out in a RCBD (Randomized Complete Block Design) with three replications. The average fresh yield at Mymensingh ranged from 36.5 to 61.6 t ha^{-1} with the highest yield of 61.6 t ha^{-1} from treatment T_4 (85% RCF + 3 t ha^{-1} VC). At Jamalpur, the average yield ranged from 33.5 to 55.2 t ha^{-1} and the highest yield of 55.2 t ha^{-1} was recorded from treatment T_4 (85% RCF + 3 t ha^{-1} VC). The lowest yield was obtained from treatment T_3 in both the location. The percent fresh yield increased over control (T_1), was 22.70 and 20.78 in Mymensingh and Jamalpur, respectively. The highest gross margin is Tk. 829007/-, which is obtained from treatment T_4 (85% RCF + 3 t ha^{-1} VC). The highest MBCR 2.76 (average of two locations) was obtained from the same treatment T_4 (85% RCF + 3 t ha^{-1} VC). Result indicated that application of vermicompost along with 85% recommended dose of chemical fertilizer is more profitable than application of chemical composts only.

Key words: Vermicompost, cabbage, production, Bangladesh

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Introduction

The main way of increasing production of any crop depends on the soil conditions and improved production technology. Indiscriminate use of inorganic fertilizer is believed to cause deterioration of soil texture, structure and reduced microbial activity. It also pollutes ground water and finally decreases soil fertility and crop production. On the other hand, the use of vermicompost improves texture, structure, humus, color, aeration, water holding capacity and microbial activity of the soil. All these in return increase production and reduce environmental pollution. It is true that sustainable production of crops cannot be maintained by using only chemical fertilizer and similarly it is not possible to obtain higher crop yield by using organic manure alone (Bair, 1990). Productivity of soils of Bangladesh is declining due to depletion of organic matter caused by high cropping intensity. Karim et al. (1994) stated that the soil organic matter in Bangladesh has been depleted by 9 to 45% during the period from 1969 to 1990. An

agricultural soil should have 3-5% organic matter but the organic matter content of most of the soils is below 1.5% and in many cases it is less than 1% (BARC, 2005). Application of organic manure in the cultivation is, therefore, important for ensuring satisfactory production. In Bangladesh, cow dung, mustard oil cake, poultry manure etc. is used as organic composts. The application of organic manure increase crop production significantly (Saleque *et al.* 2004). Incorporation of organic manure into soil has been shown to increase organic carbon, total nitrogen and crop yield (Chakraboty *et al*. 2001). Due to lack of knowledge and problem of preservation of organic manure, our farmers are habituated in the use of inorganic fertilizer compared to those of organic manure. Vermicompost is completely a compost fertilizer. It improves soil water holding capacity and increases soil organic matter. It encourages microbial activities and improves soil health. The vermicompost is environmentally safe and economic which also enhances drought resistance to soil. Hence, an improvement and maintenance of a good supply of organic matter is essential for sustenance of soil fertility and crop productivity. Recently private companies have formulated different organic fertilizers. These initiatives will help to supply proportionately the deficient nutrients in the soils.

Materials and Methods

***Experiment site and design*:** Field experiments were conducted at Farmer's field of Mymensingh and Jamalpur to observe the effect of the vermicompost on the cabbage production during October 2018 to February 2019. The experiments comprised of seven treatments viz: (T_1 = recommended chemical fertilizer (RCF) @ N_{150} P_{40} K_{100} S_{16}, T_2 = 85% RCF, T_3 = 70% RCF, T_4 = 85% RCF + 3 t ha^{-1} vermicompost (VC), T_5 = 85% RCF +1 t ha^{-1} vermicompost, T_6 = 70% RCF + 3 t ha^{-1} (VC) and T_7 = 70% RCF +1 t ha^{-1} (VC)). The experiments were laid out in a RCBD (Randomized Complete Block Design) with three replications. The unit plot size of the experiment was 5m×4m. The lands were prepared properly as per crop requirement before setting up of the experiments. Vermicompost was applied before final land preparation. Applications of composts were made as per treatments. One-third urea and all TSP, MP and Gypsum were applied during final land preparation and thoroughly incorporated into the soil. The rest urea fertilizer was applied in two equal splits. Both of these installments were applied as broadcast and incorporated with soil. Nutrient content of applied vermicompost was 7.5 pH, 16.2% OM, 0.94% N, 0.6% P, 1.6% K and 0.58% S. Weeding, spraying and irrigation were done whenever necessary. The fresh cabbage was harvested at maturity.

***Chemical analysis*:** The initial soil status of the experimental sites is shown in Table 1. The initial soils of the experimental fields were collected and analyzed following standard methods (pH, organic matter, nitrogen, phosphorus, potassium and sulphur). Soil pH was measured with a glass electrode pH meter, the soil-water ratio being 1:2.5 as described by Jackson (1962).

Table 1. Initial soil status of the experimental sites.

Locations	pH	OM (%)	Nitrogen (%)	Phosphorus (ppm)	Potassium (meq%)	Sulphur (ppm)
Mymensingh	6.8	1.23	0.12	14.8	0.21	18.8
Jamalpur	7.1	1.30	0.11	15.9	0.23	16.2

Organic carbon content of soil was determined following wet oxidation method (Page *et al.,* 1982). Total N content in soil was determined by Kjeldahl method. Available P content was extracted from soil with 0.5M $NaHCO_3$ solution at a pH 8.5 (Olsen *et al.*, 1954). Exchangeable K content of soil was determined

by extraction with 1M NH_4OAc, pH 7.0 solution followed by measurement of extractable K by flame photometer (Page *et al.*, 1982). Available S content was determined by extracting soil sample with $CaCl_2$ (0.15%) solution as described by Page *et al.* (1982). The S content in the extract was determined turbidimetrically and the turbid was measured by spectrophotometer at 420 nm wave length.

***Data analysis*:** The analysis of variance for various crop characters as well as yield was done following the principle of F-statistics. Mean comparisons of the treatments were adjudged by the Duncan's Multiple Range Test (Gomez and Gomez, 1984). Treatment details of vermicompost for cabbage production are mentioned as follows (Table 2).

Table 2. Treatments detail of vermicompost for cabbage production.

Treatments	Detail
T_1	RCF (N_{150} P_{40} K_{100} S_{16})
T_2	85% RCF
T_3	70% RCF
T_4	85% RCF + 3 t ha^{-1} VC
T_5	85% RCF + 1 t ha^{-1} VC
T_6	70% RCF + 3 t ha^{-1} VC
T_7	70% RCF + 1 t ha^{-1} VC

Results and Discussion

Fresh yield of cabbage for different treatments at both the locations are presented in Table 3. In both of the locations, yield was increased significantly due to the treatments. All the vermicompost treated plots produced higher yield over chemical fertilizer treated plot except T_7 (70% RCF +1 t ha^{-1} VC) because 1 ton vermicompost cannot recover nutrient elements that of 30% chemical fertilizer, which was reduced. The average yield at Mymensingh ranged from 36.5 to 61.6 t ha^{-1} with the highest yield of 61.6 t ha^{-1} from treatment T_4 (85% RCF + 3 t ha^{-1} VC) followed by treatment T_5 (85% RCF + 1 t ha^{-1} VC) which produced 54.6 t ha^{-1}. The lowest yield (36.5 t ha^{-1}) was obtained from treatment T_3 (70% RCF). The highest percent increase in fresh yield over T_1, was 22.70 at Mymensingh.

At Jamalpur, the average yield ranged from 33.5 to 55.2 t ha^{-1} and the highest yield of 55.2 t ha^{-1} was also recorded from treatment T_4 (85% RCF + 3 t ha^{-1} VC) followed by treatment T_5 (85% RCF +1 t ha^{-1} VC) which was produced 49.1 t ha^{-1}. The lowest yield (33.5 t ha^{-1}) was obtained by the treatment T_3 (70% RCF). The highest percent increase in fresh yield over T_1, was 20.78. From the different treatments of vermicompost with recommended chemical compost packages, the results demonstrated that the highest cabbage yield was obtained from the treatment T_4 (85% RCF + 3 t ha^{-1} VC). Haque et al. (2020) also found that 85% chemical fertilizer with 4 t ha^{-1} VC increased plant height, number of pods $plant^{-1}$ seed and straw yields of mustard in different location of Bangladesh compare to only 100% chemical fertilizer application. Ali et al. (2018) reported highest head yield of cabbage from VC application with chemical fertilizer. Our finding is also in agreement with Alam et al. (2017).

***Economic analysis*:** The estimated gross return, variable cost, gross margin and marginal benefit cost ratio (MBCR) are presented in Table 4. The integration of chemical and vermicompost increased the gross margin in all the treatments. The highest gross margin was Tk. 829007/-, which was obtained from treatment T_4 (85% RCF + 3 t ha^{-1} VC) followed by treatment T_5 (85% RCF + 1 t ha^{-1} VC). The highest MBCR 2.76 (average of two locations) was obtained from treatment T_4 and the second highest MBCR 1.90 was found from treatment T_5 (85% RCF + 1 t ha^{-1} VC). Result indicated that application of vermicompost along with 85% recommended dose of chemical fertilizer is more profitable than application of chemical composts only.

Table 3. Effect of vermicompost on cabbage production (t ha^{-1}) at Mymensingh and Jamalpur.

Treatments	Cabbage yield (t ha^{-1})		Yield increased over control (T_1) (%)	
	Mymensingh	Jamalpur	Mymensingh	Jamalpur
T_1 : RCF (N_{150} P_{40} K_{100} S_{16})	50.2bc	45.7bc	-	-
T_2: 85% RCF	45.3d	39.3cd	-	-
T_3: 70% RCF	36.5e	33.5e	-	-
T_4 : 85% RCF + 3 t ha^{-1} VC	61.6a	55.2a	22.70	20.78
T_5: 85% RCF + 1 t ha^{-1} VC	54.6b	49.1b	8.76	7.43
T_6: 70% RCF + 3 t ha^{-1} VC	51.3bc	45.8bc	2.19	0.21
T_7: 70% RCF + 1 t ha^{-1} VC	47.4cd	40.1c	-	-
CV (%)	11.47	10.32	-	-

Figure in a column, having common letter (s) do not differ significantly at 5% level of probability.

Table 4. Cost benefit ratio of vermicompost on cabbage (average of two locations).

Treatments	Yield (t/ha)	Gross return (Tk./ha/yr.)	Variable cost (Tk./ha/yr.)	Gross Margin (Tk./ha/yr.)	MBCR
T_1 : RCF (N_{150} P_{40} K_{100} S_{16})	48.0	719250/-	19907/-	699343/-	-
T_2: 85% RCF	42.3	634500/-	16993/-	617507/-	-
T_3: 70% RCF	35.0	525000/-	14877/-	510123/-	-
T_4 : 85% RCF + 3 t ha^{-1} VC	58.4	876000/-	46993/-	829007/-	2.76
T_5: 85% RCF + 1 t ha^{-1} VC	51.9	777750/-	26993/-	750757/-	1.90
T_6: 70% RCF + 3 t ha^{-1} VC	48.6	728250/-	44877/-	683373/-	-
T_7: 70% RCF + 1 t ha^{-1} VC	43.8	656250/-	24877/-	631373/-	-

*Cabbage = Tk 15 kg^{-1}, Urea= Tk 16 kg^{-1}, TSP= Tk 22 kg^{-1}, MP= Tk 15 kg^{-1}, Gypsum= Tk 10 kg^{-1}, Vermicompost = Tk 10 kg^{-1}.

Conclusion

In both the locations, treatment T_4 (85% RCF + 3 t ha^{-1} VC) has produced the highest yield. The highest marginal benefit cost ratio was obtained from treatment T_4 as well and this treatment is found economically cost effective. From the result it might be concluded that treatment T_4 (85% RCF + 3 t ha^{-1} VC) is best treatment for cabbage production. There is ample scope of increasing the yield of cabbage through the use of vermicompost.

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