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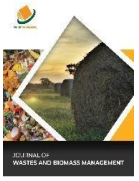

RESEARCH ARTICLE

EFFECT OF FOLIAR APPLICATION OF VERMIWASH ON GROWTH AND QUALITY OF BRINJAL

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ABSTRACT

The experiment was conducted at Regional Agricultural Research Station (RARS), Jamalpur, Bangladesh during the period of 2019-2020 and 2020-2021 to investigate the effect of vermiwash on growth, yield and quality of brinjal and to find out suitable foliar dose of vermiwash for optimizing the yield of brinjal. There were five treatments comprising T_1= Chemical fertilizer (CF) + foliar spray of distilled water (control), T_2 = CF + foliar spray of 10% vermiwash, T_3 = CF + foliar spray of 20% vermiwash, T_4 = CF + foliar spray of 30% vermiwash and T_5= CF + foliar spray of 40% vermiwash. Results revealed that, vermiwash treated brinjal plants showed better growth and yield parameters than the control plants. The highest average brinjal fruit yield (29.99 t ha^{-1}) was found in T_3 treatment i.e., foliar spray of 20% concentration of vermiwash and the lowest (26.35 t ha^{-1}) came from control. On the other hand, nutritional quality (moisture content, TSS, β carotene and nutrient content) were seen to be higher in vermiwash treated treatment compared to control treatment. The study suggests that, 20% concentration of vermiwash could be used as effective foliar spray for eco-friendly and higher yield of brinjal.

KEYWORDS

Chemical fertilizer, Foliar spray, Vermiwash, Yield, Quality and Brinjal

1. INTRODUCTION

Increased use of chemical fertilizers over a long period of time ultimately destroys the fertility of soil. Hazardous effect of chemical fertilizer can be reducing by the use of organic fertilizers. The new approaches to the use of organic amendments in farming have proven to be effective means of improving soil structure, enhancing soil fertility and increasing crop yields. Vermicomposting is a novel eco-friendly and cost-effective technology of decomposing organic matter and producing organic manure that was the best in all aspects including the nutrient level. Application of vermicompost favourably affects soil PH, microbial population and soil enzyme activities (Shweta and Singh, 2006). The vermicomposting technology can also be utilized for generating a bioliquid termed as vermiwash (Ismail, 1997).

Vermiwash is a brownish-red liquid extract collected during vermicomposting of organic waste. Vermiwash can also serve as a valuable foliar spray, because it is a combination of earthworm mucous discharges, nutrients, microorganisms and plant growth promoting materials (Gopal et al., 2010) composed of excretory products and mucus secretions from earthworms and micronutrients from the organic molecules in the soil. These nutrients are absorbed and then transported to the leaves, shoots, and other parts of a plant (Ansari and Sukhraj, 2010). Various experimental results have shown that application of vermiwash improves plant health, yield and nutritional quality (Naidu et al., 2013).

Studies have shown that vermiwash contains plant growth-promoting substances (humic, fulvic and other organic acids); auxin-like substances and cytokinin-like substances. Vermiwash foliar spray is more advantageous from economical and environmental perspectives owing to the absence of nutrient leaching, which is often encountered when performing soil amendments. Even though much work has been done on vermicomposting, very few reports are available related to vermiwash and its impact and concentration of the foliar spray on the plant growth. The main objective of the present investigation was carried out the influence of vermiwash on growth and yield parameters of brinjal plants.

2. MATERIALS AND METHODS

The experiment was started in 2019-20 period at the soil science field of RARS under Jamalpur district in Bangladesh. The site is located at Sonalata series under AEZ- 8, 24°56′11′′N latitude and 89°55′54′′E longitude and an altitude of 16.46m. The soil of the experimental site was silt clay loam in texture. Before initiation the experiment, the soil samples were collected from a depth of 0-15 cm for each replication and analyzed following standard methods (Table 1). Nutrient status of initial soil is presented in Table 1.

The experiment was laid out in a randomized complete block design (RCBD) with 3 replications. The unit plot size was 2.5m x 2.3m and the variety was BARI begun-8. The 30 days old brinjal seedlings were transplanted on 12 November, 2019 in a spacing of 100cm x 70cm. Recommended doses of chemical fertilizer for brinjal were calculated on the basis of soil test values according to fertilizer recommendation guide.

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Table 1: Initial soil nutrient status of the experimental soils

Location	pH	OM (%)	Ca	Mg	K	Total N%	P	S	B	Cu	Fe	Mn	Zn
			meq 100g^{-1}				µg g^{-1}						
RARS, Jamalpur	7.1	0.86	6.0	1.9	0.092	0.053	8.7	7.5	0.35	2.6	25	4.0	1.22
Critical level	-	-	2.0	0.5	0.12	-	10	10	0.20	0.2	4	1	0.6

Treatments were as follows:

4 levels of vermiwash rate (v/v) with control

T_1 = CF + foliar spray of distilled water (control)
T_2 = CF + foliar spray of 10% vermiwash
T_3 = CF + foliar spray of 20% vermiwash
T_4 = CF + foliar spray of 30% vermiwash
T_5 = CF + foliar spray of 40% vermiwash

Blanket dose: N_{140} $P_{35}K_{85}S_{15}Zn_2B_1$ Kg ha^{-1} (Fertilizer Recommendation Guide -2018)

2.1 Preparation of vermiwash

Vermiwash preparation unit: Vermiwash preparation unit was prepared according to the procedure suggested by using a plastic container having capacity of 230 liter (97cm height ×186cm diameter) (Ismail, 1997). In brief, a tap was fixed on the lower side of the container and a bucket was placed near the container. The bottom of the container had a 15-cm layer of broken pebbles, followed by a 15-cm layer of coarse sand. Above this layer air-dried mixed waste (vegetable waste: paddy straw: water hyacinth; 1:1:1) at a height of 30 cm and cowdung at a height of 30 cm were put into the container as substrate and one thousand earthworms (*Eisenia fetida*) were introduced into the substrate. An appropriate level of moisture (60%) was maintained in the container by slowly sprinkling five liters of distilled water from the top at regular intervals. During the vermiwash preparation, the temperature and pH inside the container ranged from 29–32°C and 7.0–7.3 respectively.

2.2 Collection of Vermiwash

After 16 to 20 days of preparation, the brown-colored watery extract of vermiwash was allowed to drain out from the container. Everyday about 3-4 L of vermiwash was collected, stored at 4°C and used for foliar spray on test crop.

Table 2: Chemical composition of vermiwash

Colour	pH	OC (%)	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	S (%)	B (%)	Zn (%)	Cu (%)	Fe (%)	Mn (%)
Gray	9.22	16.2	0.01	0.10	0.64	0.25	0.13	0.67	0.020	0.004	0.012	0.015	0.006

2.3 Application of Vermiwash

The treatments were of 4 levels of vermiwash rate (10%, 20%, 30%, 40% v/v). Plants were sprayed 3 times (at flowering, at fruiting and 30 days after first fruiting).Foliar sprays were applied using hand operated compressed air sprayer at the rate of 10 litre /plot.Time of foliar sprays was 4 P.M. Brinjal plant did not receive any irrigation two days before and after the foliar spray.

Table 3: Various concentrations of vermiwash and distilled water

Treatment	Concentration of vermiwash and distilled water
Control	10 L distilled water
T_2 (10% vermiwash)	1 L vermiwash + 9 L distilled water
T_3 (20% vermiwash)	2 L vermiwash + 8 L distilled water
T_4 (30% vermiwash)	3 L vermiwash + 7 L distilled water
T_5 (40% vermiwash)	4 L vermiwash + 6 L distilled water

Other intercultural operations were done as per requirement.Nogos 50 EC was used to control brinjal fruit and shoot borer. The crop harvesting continued during the month of February to April, 2021. Data on yield and yield contributing characters were recorded from ten plants selected randomly for each plot. Data on vegetative and fruit characters were recorded and analyzed statistically using statistical software STAR which was developed by IRRI. Least significant differences (LSD) were used for means separation at 5% probability level.

3. Results

3.1 Effect of vermiwash on plant growth and yield of brinjal

The effect of vermiwash application on plant growth and yield of brinjal were presented in Table 4.A notably increases in various yield attributes of brinjal was recorded after the foliar application. The highest plant height (118.47 cm) was observed in T_3 treatment and the lowest plant height (98.58 cm) was obtained from untreated (control) treatment. Fruit length and fruit diameter were increased from 14.36 cm (control) to 20.38 cm (20% vermiwash) and 2.43 cm (control) to 3.04 cm (20% vermiwash), respectively. Brinjal plant treated with 20% concentrations of vermiwash led to a statistically significant increase fruit no. (23.61) and individual fruit weight (139.26 g) in comparison with the control.

Among all the concentrations of vermiwash tested, 20% vermiwash exhibited the maximum increase in brinjal fruit yield (30.95 t ha^{-1}) in 2019-2020 and (29.03 t ha^{-1}) in 2020-2021. T_4 treatment (30% vermiwash) produced second highest brinjal yield (27.53 t ha^{-1}) which were statistically at par with T_2 (10% vermiwash) (27.34 t ha^{-1}). Obviously, control plot (T_1) showed the lowest yield (25.44 t ha^{-1}). The highest average brinjal yield (29.99 t ha^{-1}) was observed in T_3 treatment (20% vermiwash) which was 13.81% higher over control. These results agreed with earlier, Meghvansi et al. (2012) reported that application of 20 % vermiwash significantly improved the vegetative and yield attributes of both Okra and Naga chilli.

Similarly, some researcher also found an auxin-like effect of earthworm worked humic substances on cell growth and nitrogen metabolism in Daucus carota (Muscolo et al., 1999). Parallel to these observations, reported that the diluted extracts improved plant growth and increased radish yields significantly by up to 20% (Buckerfield et al., 1999). However, a 30% concentration of vermiwash led to a decrease in the marketable weight of brinjal in our study. It is postulated that occurrence of inhibition of growth at higher vermicompost substitution rates might be attributed to higher electrical conductivity and excessive nutrient levels (Buckerfield et al., 1999). Excessive nutrient levels can cause a micronutrient imbalance in the soil, which may have a negative influence on the crop.

3.2 Effect of vermiwash application on nutritional quality of brinjal

The effects of vermiwash application on some nutritional composition of brinjal were presented in Table 5. Moisture content was varying from 85.91% to 92.45 % in different treatment. The total soluble solid (TSS) was influenced by the application of different concentrations of vermiwash. The highest TSS content (5.28 ^{0}Brix) was obtained from T_3 (20% vermiwash) treatment and the lowest TSS (4.81 ^{0}Brix) was found in control treatment. β – carotene levels were higher in vermiwash treated brinjal than control brinjal. K was found higher (149.97 mg100g^{-1}) in T_3 treatment and lower (137.38 mg100g^{-1}) inuntreated treatment. Ca (30.92 mg100g^{-1}) and Fe (1.47 mg100g^{-1}) were also higher in vermiwash treated treatment and lower from control treatment. These results are in conformity with who concluded on the observation of better nutritional value of organic produce owing to greater activation of plant defense mechanism (without pesticide) with active soil life of interacting plants and microbes, balanced mineral in take without excess of nutrients from fertilizer (Lundegardh, 2003).

Table 4: Effect of vermiwash application on yield and yield components of brinjal, 2020-2021

Treat.	Plant height	Fruit length	Fruit dia.	Fruit no. plant^{-1}	Individual fruit weight (g)	brinjal yield (t ha^{-1})		Average yield (t ha^{-1})	% increase over control
	(cm)					2019-20	2020-21		
T_1	98.58 d	14.36 d	2.43 c	15.63 d	117.14 d	27.26 c	25.44 d	26.35	-
T_2	113.45 bc	16.46 c	2.73 b	19.93 b	131.34 b	28.69 b	27.34 bc	28.01	6.29
T_3	118.47 a	20.38 a	3.04 a	23.61 a	139.26 a	30.95 a	29.03 a	29.99	13.81
T_4	115.96 ab	18.44 b	2.92 a	23.10 a	130.97 b	29.49 b	27.53 b	28.51	8.19
T_5	112.36 c	17.62 bc	2.74 b	16.70 c	125. 60 c	27.34 c	26.64 c	26.99	2.42
CV%	5.34	7.17	7.28	8.79	9.57	9.87	10.04	-	-
LSD (0.05)	3.09	1.69	0.11	0.67	1.39	1.08	0.87	-	-

Means in a column followed by same letter(s) do not differ significantly at 5% level by LSD
Note: T_1 = control, T_2 = 10% vermiwash, T_3 = 20% vermiwash, T_4= 30% vermiwash, T_5 = 40% vermiwash

Table 5: Nutritional quality of brinjal as influence by vermiwash application, 2020-2021

Treatment	Moisture (%)	TSS (^{0}Brix)	β – carotene (µg 100g^{-1})	K (mg100g^{-1})	Ca (mg100g^{-1})	Fe (mg100g^{-1})
T_1= control	85.91	4.81	9.35	137.38	27.55	1.29
T_2= 10% vermiwash	90.34	5.26	10.67	148.41	30.13	1.42
T_3 = 20% vermiwash	92.45	5.28	12.10	149.97	30.92	1.47
T_4 = 30% vermiwash	91.31	5.28	12.07	149.01	28.11	1.33
T_5 = 40% vermiwash	91.27	5.26	11.13	148.93	28.43	1.37

Note: T_1 = control, T_2 = 10% vermiwash, T_3 = 20% vermiwash, T_4= 30% vermiwash, T_5 = 40% vermiwash

3.3 Economic analysis

The economic performance of brinjal as influenced by vermiwash application showed in Table 6. The highest gross return (TK 449850 ha^{-1}), gross margin (TK 301350 ha^{-1}) and BCR (3.02) were recorded from T_3 (20% vermiwash application) treatment. The lowest gross return (TK 395250 ha^{-1}) came from control treatment. Among the treatment, the lowest gross margin (TK 250350 ha^{-1}) and BCR (2.62) were recorded from T_5 (40% vermiwash application) treatment. T_5 treatment demonstrated poor performance mainly due to low yield and high cost of production as the vermiwash concentration was high. From economic point of view, 20% concentration of vermiwash application would be the best for high yield and economic return.

Table 6: Cost and return analysis of brinjal as influence by vermiwash application, 2020-2021

Treatments	Average brinjal yield (t ha^{-1})	Gross return (TK ha^{-1})	Total variable cost	Gross margin	BCR
T_1= control	26.35	395250	142500	252750	2.77
T_2 = 10% vermiwash	28.01	420150	145000	274650	2.89
T_3 = 20% vermiwash	29.99	449850	148500	301350	3.02
T_4 = 30% vermiwash	28.51	427650	151500	276150	2.82
T_5 = 40% vermiwash	26.99	404850	154500	250350	2.62

Note: Input: Unit price **(**Tk.Kg^{-1}**):** Urea=16, TSP=22, DAP=16, MoP= 15, Gypsum = 6, Zinc sulphate = 120 and Boric acid = 150, vermiwash=10Tk/

Output: Price range of brinjal 10.00 to 25.00 Tk Kg^{-1}, average price 15.00 Tk Kg^{-1}

4. Conclusion

Finally results revealed that, brinjal plant responded well to foliar application of vermiwash. The foliar sprays of 20% concentration of vermiwash with recommended dose of chemical fertilizers (T_3) was found to be the most effective in increasing brinjal yield and improved nutritional quality. From economic point of view, this treatment was suitable and economically viable. So, it can be concluded that, foliar application of vermiwash can be used as a potent input in organic farming for both crop yield and quality

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