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ASSESSMENT OF GROWTH AND BIOMASS PRODUCTION OF A MEDICINAL PLANT *BRYOPHYLLUM* SALISB. AS INFLUENCED BY DIFFERENT ORGANIC MANURES

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Abstract

A pot experiment was carried out to evaluate the influence of various organic manures on the growth performance and biomass production of *Bryophyllum pinnatum*. Nine kinds of organic manures, such as ACI, BGF-1, bone meal, Green life, Kazi, Majim, mustard cake, Payel and Shebok composts were applied individually at the rate of 15 ton/ha. Highest height (45.25 cm), leaf number (102.67 no./plant), leaf area (82.43 cm^2/plant), number of branches (27.00 no./plant), girth (6.75 cm/plant), total fresh weight (334.02 g/plant) and total dry weight (86.09 g/plant) were recorded in mustard cake compost treatment at harvest. Results showed that the best growth performance and biomass production both were achieved by mustard cake compost treatment.

Introduction

Bryophyllum pinnatum, known as the air plant, cathedral bells, life plant, miracle leaf, and Goethe plant is a succulent plant native to Madagascar, which is a popular houseplant and has become naturalized in tropical and subtropical areas. It is also called "Leaf of Life" and "Wonder of the World". In West Bengal, it is known as 'Pathorkuchi'. It is cultivated as an ornamental plant in gardens. This plant grows up to 1 - 2 m in height and thrives at less fertile well-drained sandy soils. *Bryophyllum pinnatum* has been used as a medicinal plant for the traditional treatment of hypertension(1). The juice of the leaves is used for kidney stones and also plays an important role in curing diabetes. The leaves of *Bryophyllum pinnatum* also used against headaches and as a remedy for fever in many areas of the world.

Application of organic manures helps to maintain soil microbial population, soil fertility as well as enhance the quality of other properties of soil and the agricultural products(2). Organic manure has multiple benefits due to the balanced supply of nutrients, including micronutrients, increased soil nutrient availability due to increased soil microbial activity, the decomposition of harmful elements, soil structure improvements and root development, and increased soil water availability. Organic manure that

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is produced from animal and plant byproducts has been utilized in the agricultural fields to overcome environmental contamination and plant productivity reductions which results from the constant use of chemical fertilizers. Use of organic manures in the agricultural fields helps to recycle the waste materials from the livestock and agriculture industry which prevents environmental contamination and helps to reduce treatment costs as well as the cost of waste management. At the same time, it promotes soil improvements and agricultural productivity. On the other hand, simultaneous use of chemical fertilizers can result in a number of problems, such as nutrient loss, surface water and groundwater contamination, soil acidification or basification, reductions in useful microbial communities, and increased sensitivity to harmful insects[3]. Organic manures that had been used for this experiment had pH between 6 and 8.5 and moisture percentage between 10 and 25.

The objective of this study was to investigate the effects of different organic manure treatments on the growth and biomass production of *Bryophyllum pinnatum* as very little information was found about the cultivation of *Bryophyllum pinnatum* under the climatic condition of Bangladesh.

Materials and Methods

Surface soil sample (0 - 15 cm) was collected from Dhamrai, Savar. The sample was air-dried, ground and sieved through 2 mm sieve. Soil had a pH of 7.54 (1 : 2.5 w/v H_2O)[4], organic carbon 0.156%[5], organic matter 0.27%[4], available nitrogen 0.016% (Kjeldahl extraction)[4], available phosphorus 0.042% (blue color method using ascorbic acid)[6], exchangeable potassium 0.030%[7], available sulfur 0.0048% (Turbidimetric method)[8], sand 4.66%, silt 68.33% and clay 27.01%, textural class - silt loam[9], moisture content was 12.32% and field capacity was 32.3%[10]. The concentrations of total iron (2310 mg/kg), manganese (421 mg/kg), zinc (75 mg/kg) and copper (26 mg/kg) were determined using an atomic absorption spectrophotometer (VARIAN AA240).

A pot experiment (Fig. 1) was carried out in the net house of the Department of Soil, Water and Environment, University of Dhaka. Seven kilograms of air-dried soil was placed in 10 kg capacity pot providing a drainage system at the bottom. Nine types of organic manures manufactured by different companies were collected from the local market. The manures were ACI, BGF-1, bonemeal, Green life, Kazi, Majim, mustard cake, Payel and Shebok. The manures were properly mixed separately at the rate of 15 ton/ha with soil. To make a cent per cent organic experiment no basal doses of N, P and K were applied. Ten treatments with three replications were made. Pots were arranged in a completely randomized design (CRD). Three weeks old seedlings of *Bryophyllum pinnatum* were collected from Horticulture Centre, Asadgate, Dhaka and one seedling was transplanted per pot. The pots were watered thrice a week in the morning. Plant

height, the number of leaf and leaf area per plant were recorded at 15 days interval up to 120 days.

The plants were harvested as root, stem and leaf. The roots were washed with tap water and finally with distilled water to remove any adhering particles on the root surface. Samples were air-dried in the room temperature and finally oven-dried at 65°C for 48 hrs in the laboratory. The dry weight of the samples was recorded and the samples were ground with a mechanical grinder and stored in the plastic containers for further chemical analysis. Results were statistically analyzed using Microsoft Excel 2013, IBM SPSS and Software Minitab 19.

Fig. 1 *Bryophyllum pinnatum* plants: **A.** general view of the pot experiment; **B.** *Bryophyllum pinnatum* plant grown in mustard cake treatment at harvest.

Results and Discussion

Plant growth was observed in terms of plant height (Table 1), leaf number (Table 2), leaf area (Table 3), branch/plant and girth (Table 4), biomass production of leaf, stem, and root (Table 5). Height values of 15, 30, 45, 60, 75, 90, 105 and 120 days increased significantly ($p \leq 0.05$) (Table 1). During the experiment, the maximum plant height (45.25 cm) was observed in mustard cake at 120 days of growth. But a remarkable height

(37.50 cm) was observed in bone meal at 120 days of transplanting. The minimum plant height (9.75 cm) was recorded in control at 120 days of growth. Nutrient availability from organic sources is due to microbial action and improved physical condition of soil. Due to rich in protein, mustard cake gave the highest growth on plants. The results of this experiment are in agreement with some other work[11].

Table 1. Effects of different organic manures on the height (cm) of *Bryophyllum pinnatum.*

Treatments	Days after transplanting							
(15 ton/ha)	15	30	45	60	75	90	105	120
Control	1.67^{b}	2.83^{b}	4.50^{b}	5.25^{bc}	6.00^{b}	6. 67^{b}	8.17^{b}	9.75^{f}
ACI	1.83^{ab}	3.67^{ab}	4.83^{b}	5.75^{bc}	11.50^{ab}	12.33^{ab}	15.33^{ab}	21.50^{cde}
BGF-1	2.33^{ab}	4.50^{ab}	6.67^{ab}	7.50^{bc}	11.83^{ab}	13.00^{ab}	16.33^{ab}	29.00^{bc}
Bone meal	4.00^{a}	8.33^{a}	9.17^{ab}	9.75^{ab}	15.33^{a}	16. 67^{a}	26.33^{a}	37.50^{ab}
Green life	4.00^{a}	6.33^{ab}	8.00^{ab}	8.50^{abc}	13.77^{ab}	14.83^{ab}	18.00^{ab}	22.50^{cd}
Kazi	1.80^{b}	4.33^{ab}	4.50^{b}	4.75^{c}	7.90^{b}	9.17^{ab}	12.00^{ab}	19.50^{de}
Majim	2.00^{ab}	4.33^{ab}	5.83^{b}	5.75^{bc}	10.23^{ab}	11.17^{ab}	13.00^{ab}	18.00^{def}
Mustard cake	3.03^{ab}	8.33^{ab}	11.17^{a}	13.00^{a}	16.37^{ab}	18.17^{a}	30. 33^{a}	45.25^{a}
Payel	2.50^{ab}	4.17^{ab}	5.17^{b}	6.00^{bc}	7.67^{ab}	9.00^{ab}	10.00^{b}	12.50^{ef}
Shebok	2.17^{ab}	3.50^{b}	6.00^{ab}	7.10^{bc}	8.33^{ab}	9.67^{ab}	11.67^{ab}	15.50^{def}
LSD at 5%	0.78	1.28	1.28	1.08	2.63	2.87	3.61	2.15

Data bearing different superscripts within the same column differ significantly at 5% level.

Number of leaves per plant has a direct bearing effect on the growth of crops. As shown in Table 2 the number of leaves per plant varied significantly ($p \leq 0.05$). Highest number of leaves per plant (102.67) was produced by mustard cake (15 ton/ha) treatment. The minimum values of leaf number (26.00) were recorded in control on the day of harvesting. It is visible that the number of leaves during harvest is higher than the number of leaves at day 15, this is because of the fact that the number of leaves were increasing day by day with the length and growth of the plant. Similar findings was reported by Robertson[12].

Leaf area is a measure of size of assimilatory system of plant and is a product of leaf length and width. It is also one of the major characteristics influencing plant productivity and is an important determinant of dry matter production. Application of different organic manures significantly ($p \leq 0.05$) influenced leaf area in Table 3. Data at harvest showed that the highest leaf area (82.43 cm^2) was recorded in mustard cake treatment. The second highest leaf area (77.15 cm^2) was found in bone meal treatment. The lowest

value of leaf area (27.70 cm^2) was observed in control. Result is in agreement with the work of Makinde[13].

Table 2. Effects of different organic manures on the leaf number per plant of *Bryophyllum pinnatum.*

Treatments (15 ton/ha)	Days after transplanting							
	15	30	45	60	75	90	105	120
Control	4.00^{b}	5.67^{b}	8.50^{c}	10.50^{c}	12.33^{b}	17.00^{b}	21.00^{b}	26.00^{d}
ACI	6.67^{ab}	8.83^{ab}	10.50^{abc}	13.00^{c}	20.33^{b}	30.33^{b}	46.00^{ab}	68.67^{bc}
BGF-1	7.00^{ab}	9.00^{ab}	11.00^{abc}	13.50^{c}	20.00^{b}	32.33^{b}	49.33^{ab}	76.33^{bc}
Bone meal	9.00^{a}	13.00^{a}	14.50^{a}	20.50^{ab}	33.67^{ab}	43.00^{ab}	77.00^{a}	93.33^{ab}
Green life	9.33^{a}	9.67^{ab}	12.00^{abc}	14.00^{bc}	27.33^{b}	38.67^{b}	62.33^{ab}	71.00^{bc}
Kazi	6.67^{ab}	7.67^{ab}	11.00^{abc}	9.50^{c}	15. 67^{b}	28.33^{b}	41.67^{ab}	69.00^{c}
Majim	6.33^{ab}	6.33^{b}	10.50^{abc}	13.00^{c}	17. 33^{b}	28.00^{b}	46.00^{ab}	65.33^{c}
Mustard cake	7.00^{ab}	11.00^{ab}	15.50^{ab}	22.50^{a}	51.33^{a}	59.67^{a}	85.00^{a}	102.67^{a}
Payel	5.33^{ab}	7.33^{b}	9.50^{abc}	11.38^{c}	17.33^{b}	28.33^{b}	41.33^{ab}	49.00^{cd}
Shebok	5.33^{ab}	7.50^{ab}	8.50^{bc}	11.25^{c}	19.33^{b}	29.33^{b}	44.67^{ab}	54.67^{c}
LSD at 5%	1.15	2.09	1.23	1.30	7.56	7.00	10.15	11.78

Data bearing different superscripts within the same column differ significantly at 5% level.

Table 3. Effects of different organic manures on the leaf area (cm^2/plant) of *Bryophyllum pinnatum.*

Treatments (15 ton/ha)	Days after transplanting							
	15	30	45	60	75	90	105	120
Control	1.88^{e}	5.07^{e}	8.83^{d}	12.49^{d}	15.70^{e}	18.13^{g}	22.10^{d}	27.70^{h}
ACI	9.39^{bcde}	16.45^{bc}	23.49^{bc}	29.15^{b}	32.00^{d}	40.78^{e}	47.63^{c}	55.24^{ef}
BGF-1	12.31^{abc}	15.24^{bcd}	30.23^{ab}	43.30^{a}	47.25^{bc}	53.61^{b}	59.68^{abc}	65.72^{d}
Bone Meal	17.29^{a}	25.76^{ab}	32.34^{a}	47.50^{a}	54.60^{ab}	62.20^{a}	68.95^{ab}	77.15^{b}
Green life	13.78^{ab}	17.75^{abc}	30.34^{ab}	42.28^{a}	44.91^{c}	47.27^{cd}	55.58^{bc}	59.20^{e}
Kazi	10.51^{abcd}	11.44^{cde}	16.82^{cd}	21.78^{bc}	31.19^{d}	43.12^{de}	52.62^{bc}	69.80^{cd}
Majim	9.23^{bcde}	12.46^{cde}	29.10^{ab}	45.31^{a}	46.04^{c}	51.70^{bc}	56.05^{bc}	71.98^{c}
Mustard cake	10.91^{abc}	21.28^{a}	37.31^{a}	50.50^{a}	56.05^{a}	67.30^{a}	75.45^{a}	82.43^{a}
Payel	5.24^{cde}	8.08^{de}	12.17^{d}	18.12^{cd}	21.74^{de}	34.71^{f}	42.50^{c}	47.28^{g}
Shebok	2.93^{de}	11.24^{cde}	15.35^{cd}	20.61^{cd}	24.58^{e}	31.40^{f}	46.50^{c}	52.18^{f}
LSD at 5%	1.97	2.09	2.17	2.12	2.33	1.35	4.92	1.18

Data bearing different superscripts within the same column differ significantly at 5% level.

The number of branch per plant and the girth of the stem measured from 3 cm above the soil surface at 40 days interval are shown in Table 4. Branch number was the highest (27.00 no./plant) with the application of mustard cake. The minimum values for branch number per plant were recorded in the control. Branch number per plant varied significantly ($p \leq 0.05$) at 40, 80 and 120 days, mentioned in Table 4. The girth value was maximum (6.75 cm) in mustard cake treatment. The girth values varied significantly ($p \leq 0.05$) at 40 and 80 and 120 days, respectively. The minimum value of the girth of the stem (3.00 cm) was recorded in control.

Table 4. Effects of different organic manures on the number of branch per plant and girth (cm) of *Bryophyllum pinnatum*.

Treatments (15 ton/ha)	Days after transplanting (Branch/plant)			Days after transplanting (Girth)		
	40	80	120	40	80	120
Control	1.00^{d}	1.50^{b}	2.50^{d}	1.04^{e}	2.10^{de}	3.00^{e}
ACI	6.50^{abcd}	9.50^{ab}	16.00^{abcd}	2.10^{cd}	3.10^{cd}	4.35^{c}
BGF-1	5.50^{bcd}	8.50^{ab}	22.00^{abc}	2.35^{bcd}	3.50^{bc}	4.50^{c}
Bone meal	8.50^{abc}	18.50^{a}	24.00^{ab}	3.35^{ab}	4.50^{b}	5.75^{b}
Green life	9.50^{ab}	13.50^{ab}	17.50^{abc}	1.95^{cde}	2.90^{cde}	4.00^{cd}
Kazi	4.00^{bcd}	9.00^{ab}	18.50^{abc}	2.10^{cd}	2.40^{cde}	3.50^{de}
Majim	6.00^{bcd}	11.00^{ab}	21.00^{abc}	2.40^{bc}	3.35^{c}	4.45^{c}
Mustard cake	12.00^{a}	19.50^{a}	27.00^{a}	4.00^{a}	5.85^{a}	6.75^{a}
Payel	3.50^{cd}	6.50^{ab}	11.00^{cd}	1.35^{de}	1.90^{e}	3.15^{e}
Shebok	5.00^{bcd}	7.50^{ab}	14.50^{bcd}	1.65^{cde}	2.10^{de}	3.75^{d}
LSD at 5%	1.45	3.45	2.93	0.26	0.28	0.14

Data bearing different superscripts within the same column differ significantly at 5% level.

The yields of fresh and dry weights of leaf, stem and root are presented in Table 5. The values for leaf, stem and root varied significantly ($p \leq 0.05$) for both fresh and dry weights in most of the treatments. The highest yields were achieved in mustard cake. The fresh yields of leaf, stem and root were 233.14, 71.01 and 34.75 g/plant at harvest. The dry weights were 49.76, 21.14 and 15.19 g/plant at harvest. The minimum values for fresh weights were 26.41, 1.67 and 8.75 g/plant and for dry weights were 6.28, 2.52 and 5.05 g/plant for leaf, stem and root, respectively found in control. It is observed that fungal inoculation with mustard cake increased the plant yield[14].

Table 5. Effects of different organic manures on the fresh and dry weights of *Bryophyllum pinnatum.*

Treatments (15 ton/ha)	Fresh weight (g/plant)				Dry weight (g/plant)			
	Leaf	Stem	Root	Total	Leaf	Stem	Root	Total
Control	26.41^{j}	1.67^{j}	8.75^{j}	36.83^{j}	6.28^{j}	2.52^{j}	5.05^{j}	13.85^{j}
ACI	38.77^{i}	29.05^{g}	15.35^{g}	83.17^{i}	12.50^{h}	15.01^{c}	6.56^{f}	34.07^{f}
BGF-1	106.86^{h}	49.37^{c}	13.03^{h}	169.26^{e}	20.83^{e}	6.80^{i}	5.87^{g}	33.50^{g}
Bone meal	138.66^{b}	70.65^{b}	34.75^{a}	244.06^{b}	25.05^{b}	19.36^{b}	11.21^{b}	55.62^{b}
Green life	133.27^{c}	45.58^{d}	16.96^{e}	195.81^{c}	19.12^{f}	11.64^{d}	7.65^{e}	38.41^{d}
Kazi	128.00^{d}	30.20^{e}	27.39^{c}	185.59^{d}	22.30^{d}	9.16^{e}	5.30^{h}	36.76^{e}
Majim	116.03^{e}	29.61^{f}	18.92^{d}	164.56^{f}	24.68^{c}	8.69^{g}	9.61^{c}	42.98^{c}
Mustard cake	233.14^{a}	71.01^{a}	29.87^{b}	334.02^{a}	49.76^{a}	21.14^{a}	15.19^{a}	86.09^{a}
Payel	111.73^{g}	21.90^{h}	12.00^{i}	145.63^{h}	8.71^{i}	6.98^{h}	5.10^{i}	20.79^{i}
Shebok	112.35^{f}	26.14^{i}	15.89^{f}	154.38^{g}	15.16^{g}	8.90^{f}	7.73^{d}	31.79^{h}
LSD at 5%	0.54	0.44	0.74	0.66	0.32	0.22	0.25	0.27

Data bearing different superscripts within the same column differ significantly at 5% level.

The experiment reported in this paper is primarily concerned with the growth response and both fresh and dry matter yield of *Bryophyllum pinnatum* plants influenced by different organic manure treatments. It indicated that the most effective treatment was mustard cake so far growth performance and biomass production of *Bryophyllum pinnatum*is concerned.

References

1. Lans CA 2006. Ethnomedicines used in Trinidad and Tobago for urinary problems and diabetes mellitus. J. Ethnobiol. Ethnomed. **2**: 45.
2. Jyoti B, S Tripathi, A Kumar, A Tripathi and RK Upadhyay 2016. Organic manures a convincing source for quality production of Japanese mint (*Mentha arvensis* L.). Industrial Crops and Products **83**: 603-606.
3. Chen JH 2006. The combined use of chemical and organic fertilizers and/or biofertilizer for crop growth and soil fertility. Proceedings of International Workshop on Sustained Management of the Soil-Rhizosphere System for Efficient Crop Production and Fertilizer Use **16**: 20.
4. Jackson ML 1965. *Soil Chemical Analysis*. New York, Prentice-Hall Inc. pp. 498.
5. Walkley A and IA Black 1934. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci. **37**: 29-37.

6. Olsen SR, CV Cole, FS Watanabe and LA Dean 1954. Estimation of available phosphorus in soils by extraction with sodium bicarbonate. US Dept. Agr. Circ. 939.
7. Pratt PF 1965. Potassium. *In:* C.A. Black (ed). *Methods of Soil Analysis*. Part 2. Am. Soc. Agron.Inc. Madison, Wisconsin, USA. pp. 1022-1030.
8. Bardsley CE and JD Lancaster 1965. Sulfur. *In:* C. A. Black (ed). *Methods of Soil Analysis*. Part 2. American Soc. Agron. Inc., Madison, Wisconsin, USA. pp. 1102-1114.
9. Bouyoucos GJ 1962. Hydrometer method improved for making particle-size analysis of soils. Agron. J. **54**: 464-465.
10. Gardner WH 1986. Water content. *In:* Klute, A. (ed). *Methods of Soil Analysis*. Part 1. Second Edition, American Soc. Agron. Inc., Soil Sci. Soc. Am. Inc., Madison, Wisconsin, USA. pp. 439-541.
11. Rahman MM, MN Islam, MZK Roni, O Goni and AFM Jamal Uddin 2018. Vermicompost and mustard oil cake as an alternative fertilizer for strawberry production. Int. J. Bus. Soc. Sci. Res. **6**(3): 78-84.
12. Robertson MJ 1994. Relationship between internode elongation, plant height and leaf appearance in maize. Field Crops Research **38**(3): 135-145.
13. Makinde EA 2007. Effects of an organo-mineral fertilizer application on the growth and yield of maize. J. Applied Sci. Res. **3**: 1152-1155.
14. Ibrahim S and E Mumtaz 2014. Application of agro-waste products as organic and value added biofertilizer for improving plant growth. J. Pharm. Clin. Sci. **8**: 35-41.

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