Archives of Current Research International

Volume 25, Issue 6, Page 510-523, 2025; Article no.ACRI.137457
ISSN: 2454-7077

Impact of Different Growing Media and Stem Cutting on the Growth and Yield of Bindu Lau (*Lagenaria siceraria* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/acri/2025/v25i61296

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://pr.sdiarticle5.com/review-history/137457

Original Research Article

Received: 08/04/2025
Accepted: 10/06/2025
Published: 24/06/2025

ABSTRACT

This study evaluated the influence of growing media and stem-cutting techniques on the growth, yield, and economic viability of Bindu Lau (*Lagenaria siceraria* L.). A Randomized Complete Block Design (RCBD) with three replications tested two factors: Factor A (growing media: M_1

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Cite as: *Islam, Ummeh Salma Binte, Tahmina Mostarin, Khaleda Khatun, Khadijatul Cobra Karishma, Israt Jahan Kakoli, Suma Akter Labonno, Md. Jiad-Ur Rahaman, Md. Riad Mahmud, Mithila Farjana, Afra Nawar, Rabeya Tahshin Moon, Tasnia Thanim Mathin, and Manas Kirtania. 2025. "Impact of Different Growing Media and Stem Cutting on the Growth and Yield of Bindu Lau (Lagenaria Siceraria L.)". Archives of Current Research International 25 (6):510-23. https://doi.org/10.9734/acri/2025/v25i61296.*

[Soil:FYM:Sand], M_2 [Soil:Vermicompost:Sand], M_3 [Soil:Kitchen Compost:Sand]) and Factor B (stem cuttings: P_0 [control], P_1 [pruning up to 90cm + top cutting], P_2 [pruning up to 120cm + top cutting]). Among nine treatment combinations, M_2 (vermicompost-based media) outperformed others, yielding 48.55 female flowers, 11.74 harvested branches, 40.44 fruits/plant, and 33.07 t/ha. P_2 (120cm pruning + top cutting) maximized productivity with 50.22 female flowers, 42.22 fruits/plant, and 35.36 t/ha. The synergistic M_2P_2 combination achieved peak performance: 52.67 female flowers, 44.33 fruits/plant, and 37.17 t/ha yield, alongside the highest net income (737,382 Tk) and benefit-cost ratio (BCR: 2.28). Conversely, M_1P_0 (control) recorded the lowest outputs. Findings conclusively recommend M_2P_2 as the optimal strategy for enhancing Bindu Lau yield, growth, and profitability.

Keywords: Bindu lau; growing media; vermicompost; pruning; top cutting; yield; benefit-cost ratio (BCR).

1. INTRODUCTION

Bindu Lau a hybrid variety of *(Lagenaria siceraria* L) also referred as the bottle gourd, it is among of the most important vegetables cultivated globally. It is a part of the family Cucurbitaceae and is indigenous to wild species in southern Africa. The cultivated variant is also known by the names white flowered gourd, calabash gourd, birdhouse gourd, and bottle gourd. It is commonly referred to as lau in Bangladesh. It is cultivated throughout the tropics and subtropics of the world. Bottle gourd is one of the most popular and important vegetable crops cultivated in Bangladesh during the winter and summer seasons, which is also one of the most widely eaten vegetable. In 2021–2022, 284000 tons of bottle gourds were produced in Bangladesh (BBS, Statistical Year Book Bangladesh 2022). The yield of vegetables in our country is not satisfactory in comparison to our requirement (Samad *et al*., 2019). Producing high-quality horticulture crops relies on using the right growing media. In order to ensure that seedlings have access to sufficient nutrients, the suggested media is often used as a foundational medium supplement to existing soil. The goal is to increase the media's porosity by the addition of organic matter, such as vermicompost and farm yard manure. Huge volume of agriculture and homestead waste produced annually in Bangladesh and through recycling they can become an organic source for agriculture. This waste can be effectively used to prepare growing media for horticultural plants.

Farm Yard Manure (FYM) is a significant fertilizer source that aids in the accumulation of organic matter in soil. It is a composite of agricultural byproducts, including animal and plant waste, which is created via the process of decomposition. FYM stimulate subsurface biomass of microbes and transfer chemicals and nutrients gradually (Singh *et al*, 2024). Vermicomposting is a promising method of transforming unwanted and virtually supplies of organic wastes into usable substrates (Hashi *et al*., 2023 and Hammad *et al*, 2011). Vermicompost is composed of coarsely split materials that resemble peat and possess characteristics such as significant porosity, air circulation, irrigation, and retention of water (Malo *et al*., 2022 and Che *et al.,* 2020). Kitchen waste compost enhances various physicochemical as well as biological characteristics of the soil, including its structure, capability to retain water, along with microorganism community (Liu *et al*., 2023; Cooperband, 2000 and Peng *et al.*, 2022). Using of proper growing media could contribute in root development by providing a stable base, retain water as well as nutrients, let oxygen into the root system, and facilitate gas transfer with the surrounding environment (Jeong *et al*., 2021). In order to improve the output of bottle gourd, the method of stem cutting has been used in bottle gourd farming. The stem cutting approach has been demonstrated to be very successful in the Cucurbitaceae family, which has a higher frequency of male flowers and sterile branches. The fruits produced from stem cuttings exhibit exceptional size and quality, resulting in a significant boost in selling price. Successful stem cuttings will help in vigorous growth and development and more female flower ratio (Mardhiana *et al*., 2017). Pinching technique for top shooting where the apical meristem is pruned while the plant is in its early stages. This procedure also promotes the development of secondary and tertiary branches and enhances the equilibrium between both reproductive and vegetative development in order to increase output (Patel *et al.,* 2017). This strategy is simple and cost-effective in comparison to other

treatments such as plant growth regulators (PGRs) and chemical applications, which aim to maintain a balance between vegetative and reproductive development. (Naafe *et al*., 2022). In view of wide spectrum effectiveness of different growing media and stem cutting the present experiment aimed to identify the effect of different growing media on growth and yield of bindu lau and find out the impact of stem cutting on growth and yield of bindu lau. And determine the combined effects of different growing media as well as stem cutting on growth and yield of bindu lau.

2. MATERIALS AND METHODS

2.1 Experimental Site and Experimental Framework

A study was conducted at Sher-e-Bangla Agricultural University's Horticultural Farm, Dhaka (23°41'N, 90°22'E; 8.6 m elevation) during the rabi season. The soil, classified as Tejgaon (Modhupur Tract, AEZ-28), was sandy loam (27% sand, 43% silt, 30% clay) with pH 5.47–5.63 and 0.83% organic matter. The experiment tested two factors: Factor-A (Growing Media), M_1= Soil: FYM: Sand (1:2:1), M_2= Soil: Vermicompost: Sand (1:2:1), M_3= Soil: Kitchen Compost: Sand (1:2:1); Factor-B (Stem Cutting), P_0= Control, P_1= Removal of all branches up to 90 cm + Top shoot cutting, P_2= Removal of all branches up to 120 cm + Top shoot cutting. Using a Randomized Complete Block Design (RCBD) with three replications, the 360 m² area was divided into three blocks (1 m apart), each containing nine 4 m × 2 m plots (0.5 m apart). Each plot housed two plants spaced 2 m × 2 m.

2.2 Planting Materials

The seeds of Bindu Lau variety were gathered from Naomi International Seed Company in Siddique Bazar, Gulistan, Dhaka.

2.3 Growing Media Application

The farm yard manures, vermicompost and kitchen compost for Bindu Lau were calculated and applied as the recommended doses. As per experiment requirement no extra inorganic fertilizers were added to the soil during pits preparation. Amount of FYM @ 40t/ha, Vermicompost @ 25t/ha and kitchen compost @ 40t/ha was calculated coordinating the recommended NPK dose for bottle gourd production so that nutrients like nitrogen, phosphorus, potassium etc. can be supplied by only these organic fertilizers. There were two pits prepared for each plot. In M_1 treatment FYM @ 2kg/pit, and in M_2 and M_3 treatment Vermicompost @1.35kg/pit and Kitchen compost @ 2kg/pit was applied as per calculation. Maa Agro, an innovative farm based in Khulna, supplied all of the manures and composts.

2.4 Application of Stem Cutting Treatment

Top shoot cutting and the removal of lateral branches from the main stem was performed in accordance with the treatments. The branches were eliminated when they became noticeable from the main stalk and measured two to three centimeters in length. The pruning was performed in accordance with the experimental procedures. In case of P_0 treatment no branches were remove. In P_1 and P_2, treatment all branches were removed up to 90 cm and 120 cm of plant height. Top shoot of the vine also trimmed at 25 DAT, 40 DAT and 50 DAT according to requirements for promoting apical dominance for better secondary and tertiary bud growth.

2.5 Seedling Producing and Transplanting

On October 17, 2022, seeds were sown in plastic bags filled with a same quantity of well decomposed manure, sand as well as soil. Throughout the seedling growing phase, they received frequent watering. The seeds underwent full germination during a period of five to ten days. After six days of emergence, just one seedling was allowed to grow in each plastic bag. After 22 days of germination, the seedlings of Bindu Lau that were in good condition and had consistent growth were moved to the designated pits in each plot of the study field, 08th November 2022.

2.6 Pest Control

The Bindu Lau is highly susceptible to pests and diseases. Pest control measures include applying 2 ml/l of Cypermethrin 10 EC (Ripcord) to combat fruit borers, flies, and beetles. Aphid infestations are managed by manually sprinkling ash powder on leaves, while powdery mildew is treated with S-dust (sulcox) @ 5 gm/l. To address fruit fly damage during reproductive

stages, pheromone traps are installed at 1 per 10 meters. Regular field inspections ensure prompt removal of diseased leaves or fruits.

2.7 Statistical Analysis

Statistical analysis of the collected data was conducted using Statistics-10 software. Mean values for all parameters were calculated, and analysis of variance (ANOVA) was performed using the 'F' test. Treatment means were compared using Duncan's Multiple Range Test (DMRT) at a 5% significance level.

3. RESULTS AND DISCUSSION

The findings have been discussed and presented and the following headings provide potential explanations.

3.1 Number of Leaves Per Plant

Number of leaves per plant exhibited notable variations in correlation with various growing media (Table 1) at 20 DAT and 60 DAT. At 20 DAT the highest no. of leaves per plant (9.11) was obtained from M_3 treatment (Soil: Vermicompost: Sand). the lowest no. of leaves per plant (7.74) was identified from M_1 treatment (Soil: FYM: Sand), At 60 DAT the highest no. of leaves was obtained from M_3 treatment (38.89) and the lowest no. of leaves was identified from M_1 treatment (29.00).

Number of leaves per plant of Bindu Lau showed significant differences in relation to different stem cutting varied significantly at 20 and 60 DAT (Table 1). At 20 DAT, the highest no. of leaves per plant (8.72) was obtained from P_2 (Removal of all branches up to 120cm + Top shoot cutting) treatment and the lowest no. of leaves per plant (7.97) was noticed from P_0 (control) treatment. At 60 DAT the highest no. of leaves per plant (36.23) was performed by P_1 (Removal of all branches up to 90cm + Top shoot cutting) treatment while P_0 (control) treatment gave the lowest no. of leaves per plant (31.89). Cutting off the stems allows more sunshine to reach the leaves and lessens nutrient competition. When compared to the control, stem pruning on the main stem increased the no. of leaves by 16.19%. The findings are supported by Mardhiana *et al.* (2017).

Significant variation was noticed due to the combined effect of different growing media and stem cutting on no. of leaves per plant of Bindu Lau at, 20 DAT and 60 DAT (Table 2). At 20 DAT, the highest no. of leaves per plant (9.68) was recorded from M_2P_2 treatment combination and lowest no. of leaves per plant was noticed in M_1P_0 (7.23) treatment combination which is equivalent to M_1P_1 treatment combinations. At 60 DAT the highest no. of leaves per plant (41.67) was noticed from treatment combination M_2P_2 and lowest no. of leaves per plant (26.00) was noticed from M_1P_0 treatment combination. The current study's results suggest that a combination of varied growing media and stem cuttings may have improved growing conditions, which in turn may have increased the no. of leaves produced by each plant. Vermicompost promoted the greater number of leaves, which contributes to Bindu Lau's increased leaf count.

3.2 Leaf Length (cm)

Variation on leaf length at 20,40 and 60 DAT varied significantly due to different growing media (Table 1). Results revealed that at 20 DAT maximum leaf length (14.39 cm) was noticed from M_2 (Soil: Vermicompost: Sand) treatment which was statistically identical to M_3 (Soil: Kitchen Compost: Sand) treatment and minimum leaf length (13.23 cm) was noticed from M_1 (Soil: FYM: Sand) treatment. At 40 DAT, the highest leaf length (17.31 cm) was recorded from M_2 (Soil: Vermicompost: Sand) treatment and lowest leaf length (15.51 cm) was noticed from M_1 (Soil: FYM: Sand) treatment. At 60 DAT, the highest leaf length (19.23 cm) was recorded from M_2 (Soil: Vermicompost: Sand) treatment and the lowest (17.94 cm) was noticed from M_1 (Soil: FYM: Sand) treatment.

Significant influence was noticed in terms of leaf length of Bindu Lau influenced by different stem cutting techniques at 20,40 and 60 DAT (Table 1). Findings revealed that at 20 DAT maximum leaf length (14.85 cm) was noticed from P_2 (Removal of all branches up to 120cm + Top shoot cutting) treatment and minimum leaf length (13.06 cm) was noticed from P_0 (control) treatment. At 40 DAT, the highest leaf length (17.68 cm) was recorded from treatment P_2 (Removal of all branches up to 120cm + Top shoot cutting) and lowest leaf length (14.25 cm) was noticed from P_0 (control) treatment. And finally, at 60 DAT, the highest leaf length (20.79 cm) was recorded from treatment P_2 (Removal of all branches up to 120cm + Top shoot cutting) and the lowest (16.66 cm) was noticed from P_0 (control) treatment.

Significant variation was noticed due to the combined effect of different growing media and stem cutting on leaf length of Bindu Lau at, 20,40 and 60 DAT (Table 2). At 20 DAT, the highest leaf length (15.62 cm) was recorded from M_2P_2 treatment combination which is followed by to M_3P_2 treatment combinations and lowest leaf length was noticed in M_1P_0 (12.05 cm) treatment combination. At 40 DAT the highest leaf length (18.92 cm) was noticed from treatment combination M_2P_2 and lowest leaf length (13.17 cm) was noticed from M_1P_0 treatment combination. And finally, at 60 DAT, the highest leaf length (21.48 cm) was recorded from treatment M_2P_2 and the lowest (15.86 cm) was noticed from M_1P_0 treatment. The recent noticed results suggest that a combination of varied growing media and stem cuttings may have improved growing conditions, which in turn may have increased the attributes of leaves produced by each plant. Vermicompost increased the leaf length, which contributes to Bindu Lau's increased leaf count.

3.3 Number of Branches Per Plant at Harvest

The use of different growing media resulted in a considerable difference in the no. of branches per plant (Fig. 1). At harvest (110 DAT), the highest (11.74) no. of branches was estimated from M_2 (Soil: Vermicompost: Sand) treatment and the lowest (9.46) no. of branches was estimated from M_1 (Soil: FYM: Sand) treatment. The results indicated that the application of vermicompost containing growing media maximizes the branching no. compared to other growing media. Significant differences in the no. of primary and secondary branches per plant were seen when alternative stem cutting procedures were applied (Fig. 2). At the time of harvest (110 DAT), the highest no. of branches (12.62) was obtained from P_2 treatment (removal of all branches up to 120 cm + top shoot cutting) and the lowest no. of branches (7.08) was identified from P_0 (control) treatment. The outcome also showed that a large increase in branch count can be achieved by early stem trimming. Pruning of all the side branches at certain lengths were discovered to improve the no. of branches/plant of Cucurbitaceae family in the current investigations. This result is supported by the findings of Khan *et al.* (2023). The combined effect of different growing media and stem cutting resulted in a wide range of variability in the no. of primary branches per plant at harvest (Table 2). At harvest the highest no. of branches per plant (14.50) was discovered in the M_2P_1 treatment combination, whereas the lowest no. of branches per plant (6.34) was identified in the M_2P_0 treatment combination. Suitable growing media with proper pruning techniques are important in a variety of ways. Photosynthesis, respiration, energy storage, transport, and cell division are all physiological processes that will considerably improve plant auxiliary stalk or branching. Increased branch number was caused by factors such as glucose translocation hindrance, greater auxin levels, and starch hydrolysis.

Table 1. Effect of different growing media and stem cutting on number of leaves per plant and leaf length at different days after transplanting of Bindu Lau

Growing media	No. of leaves per plant		Leaf length (cm)		
	20 DAT	20 DAT	20 DAT	40 DAT	60 DAT
M_1	7.74 c	29.00 c	13.23 b	15.51 c	17.94 c
M_2	8.17 b	34.11 b	14.39 a	17.31 a	19.23 a
M_3	9.11 a	38.89 a	14.21 a	16.09 b	18.58 b
LSD (0.05)	0.2546	1.3379	0.7473	0.5145	0.4767
CV%	7.28	9.29	4.70	7.45	3.84
Stem cutting					
P_0	7.97 c	31.89 c	13.06 c	14.25 c	16.66 c
P_1	8.72 a	36.23 a	13.92 b	16.98 b	18.31 b
P_2	8.33 b	33.89 b	14.85 a	17.68 a	20.79 a
LSD (0.05)	0.2546	1.3379	0.7473	0.5145	0.4767
CV%	7.28	9.29	4.70	7.45	3.84

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where, M_1: Soil: FYM: Sand; M_2: Soil: Vermicompost: Sand; M_3: Soil: Kitchen Compost: Sand; P_0: Control; P_1: Removal of all branches up to 90cm + Top shoot cutting P_2: Removal of all branches up to 120cm + Top shoot cutting

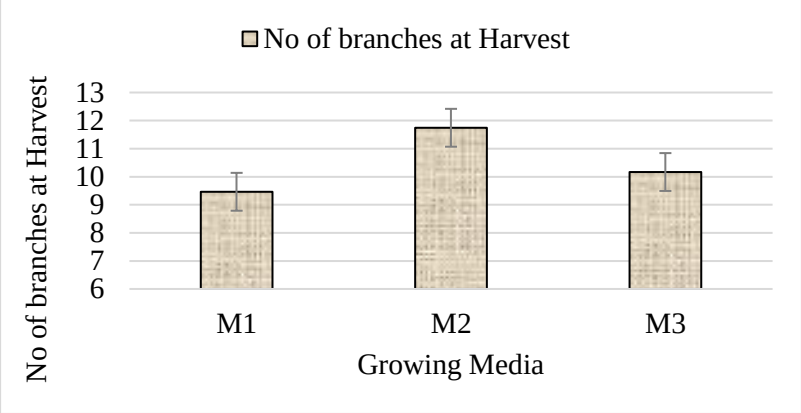

Fig. 1. Effect of different growing media on number of branches per plant at harvest of Bindu Lau

Here, M_1: Soil: FYM: Sand; M_2: Soil: Vermicompost: Sand; M_3: Soil: Kitchen Compost: Sand); where FYM @ 40t/ha, Vermicompost @ 25t/ha, Kitchen compost @ 40t/ha

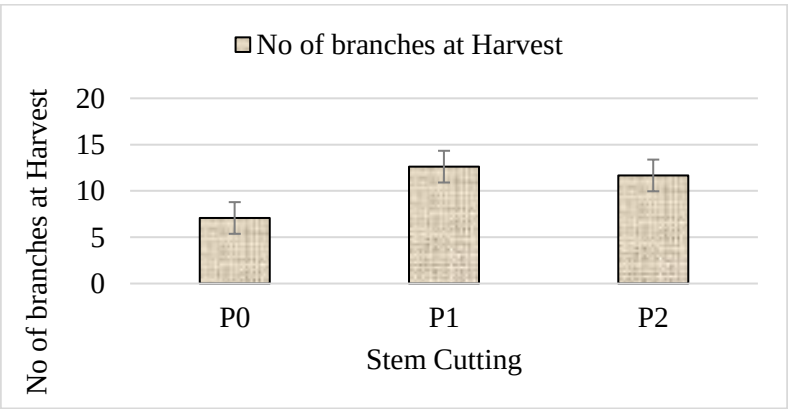

Fig. 2. Effect of different stem cutting on number of branches per plant at harvest of Bindu Lau

Where P_0: Control; P_1: Removal of all branches up to 90cm + Top shoot cutting P_2: Removal of all branches up to 120cm + Top shoot cutting

Table 2. Combined effect of different growing media and stem cutting techniques on number of leaves per plant, leaf length at different days after transplanting and number of branches at harvest of Bindu Lau

Treatment combinations	No. of leaves per plant		leaf length (cm)			No. of branches at harvest
	20 DAT	20 DAT	20 DAT	40 DAT	60 DAT	
M_1P_0	7.23 f	7.23 f	12.05 d	13.17 g	15.86 e	6.34 f
M_1P_1	7.67 ef	7.67 ef	13.64 bc	16.73 cd	17.48 d	12.20 bc
M_1P_2	9.00 b	9.00 b	14.00 bc	16.63 cd	20.48 b	9.85 d
M_2P_0	8.05 de	8.07 de	13.58 c	15.28 e	17.36 d	7.57 e
M_2P_1	8.50 c	8.50 c	13.98 bc	17.71 b	18.85 c	14.50 a
M_2P_2	9.68 a	9.68 a	15.62 a	18.92 a	21.48 a	13.17 b
M_3P_0	8.03 de	8.00 de	13.55 c	14.29 f	16.74 d	7.33 ef
M_3P_1	8.33 cd	8.35 cd	14.15 bc	16.49 d	18.59 c	11.17 c
M_3P_2	8.67 bc	8.67 bc	14.93 ab	17.50 bc	20.41 b	12.00 c
LSD (0.05)	0.4409	0.4409	1.2944	0.8912	0.8257	1.151
CV%	7.28	7.28	4.70	7.45	3.84	3.94

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where, M_1: Soil: FYM: Sand; M_2: Soil: Vermicompost: Sand; M_3: Soil: Kitchen Compost: Sand, where P_0: Control; P_1: Removal of all branches up to 90cm + Top shoot cutting P_2: Removal of all branches up to 120cm + Top shoot cutting

3.4 Days Required to First Male Flowering

There is substantial influence of different growing media on the no. of days necessary for the appearance of first male flower of Bindu Lau (Table 3. Maximum days to first male flowering (19.06) were noticed in M_2 (Soil: Vermicompost: Sand) treatment, whilst minimum days to first male flower appearance (17.02) were noticed in M_1 (Soil: FYM: Sand) treatment. The data on days necessary for the first male flowering was shown to be relevant in terms of different stem cutting techniques on Bindu Lau (Table 3). The results revealed that the P_2 (Removal of all branches up to 120cm + Top shoot cutting) treatment required the maximum days (19.29) to first male flowering, but the P_0 (control) treatment required the lowest days (16.02) to first male flowering. Significant variation in days to first male flowering was seen on Bindu Lau when varied growing media and stem cutting were used (Table 4). The M_2P_2 treatment combination required the maximum days (20.70) to first male flowering, while the M_1P_0 treatment combination required the lowest days (15.02) to first male flowering.

3.5 Days Required to First Female Flowering

The days required to first female flowering showed significant difference for different growing media (Table 3). Due to application of growing media, the maximum days required to first female flowering (21.56) was recorded in M_1 (Soil: FYM: Sand) treatment which is equivalent to M_3 treatment while the minimum day to first female flower appearance (20.21) was recorded in M_2 (Soil: Vermicompost: Sand) treatment which is statistically equivalent to M_3 (Soil: Kitchen Compost: Sand) treatment. Application of different stem cutting on Bindu Lau showed significant effect on days to first female flowering (Table 3). The maximum days required to first female flowering (22.51) was noticed in P_0 (control) treatment while the minimum days to first female flowering (19.43) was recorded in P_2 (Removal of all branches up to 120cm + Top shoot cutting) treatment. The early emergence of female flowers in pinched plants could be related to alterations in auxin and cytokinin concentrations in the plant. According to Patel *et al.* (2017) pinching causes more cytokinin's to concentrate in lower areas of the body. plants, which stimulates lateral growth branches. Furthermore, pinching has been prohibited carbon nitrogen balance documented ratio in plants, which stimulates flowering in plants. The combination of different growing media and stem cutting considerably altered the days to first female flower appearance (Table 4). It was determined that the highest amount of days required to flower the first female (23.50) occurred from the M_1P_0 treatment combination, whilst the lowest amount of days required to flower the first female (18.3) obtained from the M_2P_2 treatment combination.

3.6 Number of Male Flowers Per Plant

The data on the no. of male flowers per plant was noticed to be significant for varied growing media applied to Bindu Lau (Table 3). The M_1 (Soil: FYM: Sand) treatment produced the maximum male flowers per plant (69.33), whereas the M_2 (Soil: Vermicompost: Sand) treatment produced the lowest (66.78). This could be because nutrients level present in different growing media aided in the correct development of the Bindu Lau's reproductive system. The quantity of male flowers per plant was significantly affected by the stem cutting techniques applied to Bindu Lau (Table 3). The treatment P_0 (control) produced the maximum male flowers (72.89), which is statistically significant when compared to the other treatments, whereas the P_2 (Removal of all branches up to 120cm + Top shoot cutting) treatment produced the lowest (65.00) male flower per plant. In terms of the quantity of male flowers per plant, the combined effect of different growing media and stem cutting indicated a statistically significant variance (Table 4). The highest no. of male flowers per plant (74.00) was obtained from the M_1P_0 treatment combination, whereas the lowest no. of male flowers per plant (63.67) was obtained from the M_2P_2 treatment combination, which is statistically equivalent to the M_2P_1 treatment combination.

3.7 Number of Female Flowers Per Plant

The data on the no. of female flowers per plant was noticed to be significant for varied growing media applied to Bindu Lau (Fig. 3). The M_2 (Soil: Vermicompost: Sand) treatment produced the maximum female flowers per plant (48.55), whereas the M_1 (Soil: FYM: Sand) treatment produced the lowest (44.45). The quantity of female flowers per plant was significantly affected by the stem cutting techniques applied to Bindu Lau (Fig. 4). The P_2 (Removal of all branches up to 120cm + Top shoot cutting) treatment produced the highest female flowers

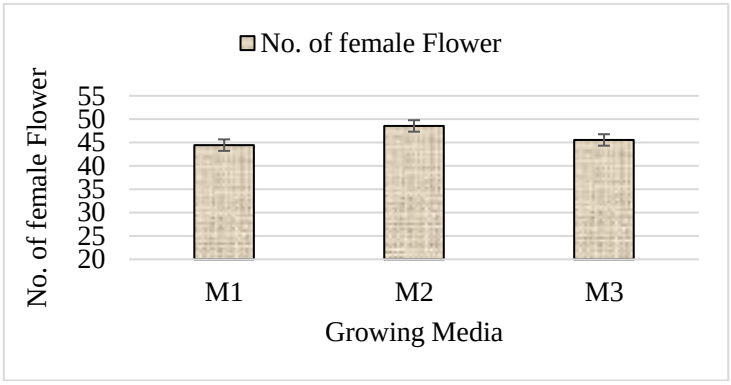

Fig. 3. Effect of different growing media on number of female flowers per plant of Bindu Lau
(M_1: Soil: FYM: Sand; M_2: Soil: Vermicompost: Sand; M_3: Soil: Kitchen Compost: Sand); where FYM @ 40t/ha, Vermicompost @ 25t/ha, Kitchen compost @ 40t/ha

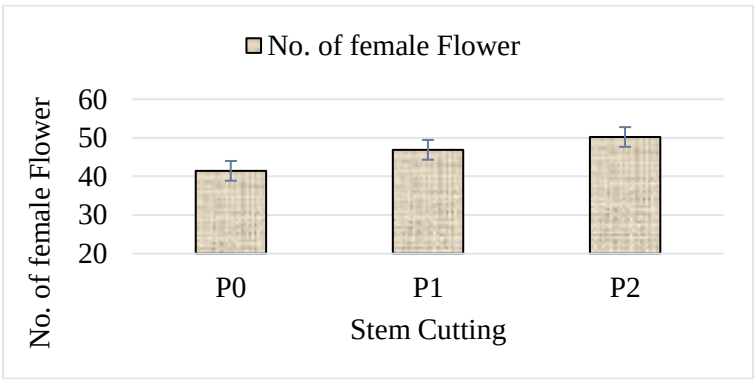

Fig. 4. Effect of different stem cutting on number of female flowers per plant of Bindu Lau
(P_0: Control; P_1: Removal of all branches up to 90cm + Top shoot cutting P_2: Removal of all branches up to 120cm + Top shoot cutting)

(50.22), which is statistically significant when in contrast to the other treatments, whereas the P_0 (control) treatment produced the lowest (41.44) female flower per plant. This could be as a result of training improving the reproductive growth of the cucumber plant. Furthermore, Kumar *et al.* (2017) noticed that training cucumbers produces more female flowers. In terms of no. of female flowers per plant, the combined effect of different growing media and stem cutting indicated a statistically significant variance (Table 4). The highest no. of female flowers per plant (52.67) was obtained from the M_2P_2 treatment combination, whereas the lowest no. of female flowers per plant (40.00) was obtained from the M_1P_0 treatment combination. Anand *et al.* (2014) showed that lateral branches were more efficient at producing female flowers, and vines with a higher number of female flowers would yield a greater quantity of fruits.

3.8 Days to First Fruit Harvest

The days required to first fruit harvest showed significant difference for different growing media (Table 3). Due to application of growing media, the maximum days required to first fruit harvest (61.78) was recorded in M_1 (Soil: FYM: Sand) treatment while the minimum day to first fruit harvest (59.12) was recorded in M_2 (Soil: Vermicompost: Sand) treatment. Equivalent findings were also reported by Shah *et al.* (2020), who noted that applying organic manure can enhanced the development and growth of plant, transferred all necessary macro- and micronutrients by plant to facilitate earlier harvesting and fruiting. Application of different stem cutting on Bindu Lau showed significant effect on days to first fruit harvest (Table 3). The maximum days required to first fruit harvest (67.35) was noticed in P_0 (control) treatment while the minimum days to first fruit harvest (55.56) was recorded in P_2 (Removal of all branches up to 120cm + Top shoot cutting) treatment. The findings showed that the maximum no. of days needed to first fruit harvest was using particular pruning procedures was less than that of the control, ensuring a higher yield of Bindu Lau. Early fruit development was aided by

certain pruning techniques as well as additional variables and it boosted branch and flower development. Khan *et al.* (2023) emphasized the supported outcome. The combination of different growing media and stem cutting considerably altered the days to first fruit harvest (Table 4). It was determined that the highest number of days required to first fruit harvest (69.33) occurred from the M_1P_0 treatment combination, whilst the lowest number of days required to first fruit harvest (52.67) obtained from the M_2P_2 treatment combination. The results on the no. of days required for first fruit harvest obtained from the current investigation demonstrated that higher doses of vermicompost combination with pruning of side branches up to 120 cm ensure the earlier fruit harvest.

3.9 Fruit Length

Bindu Lau fruit length changed statistically significantly according to different growing media (Table 3). The M_2 (Soil: Vermicompost: Sand) treatment produced the largest fruit length (17.49 cm) which is statistically equal (17.24 cm) to the M_3 treatment (Soil: Kitchen Compost)., while the M_1 (Soil: FYM: Sand) produced the smallest fruit length (16.41 cm). According to Rahman and Akter (2020) When inorganic sources of nutrients are used along with kitchen waste compost and vermicompost, it promotes plant growth by increasing glucose synthesis. The substantial flow of assimilates to the sink in this condition may have contributed to the increased fruit length. Fruit length variability was noticed to be statistically significant for different stem cutting techniques (Table 3). Where P_2 treatment (Removal of all branches up to 120cm + Top shoot cutting) produced the largest fruit length (18.09 cm) and P_0 (control) treatment produced the smallest fruit length (15.82 cm). Bindu Lau fruit length was shown to be considerably different when different growing media and stem cutting were combined (Table 3). The M_2P_2 treatment combination produced the largest fruit length (18.73 cm), which was statistically equivalent to the (18.16 cm) M_3P_2 treatment combinations and the M_1P_0 treatment combination produced the smallest fruit length (15.21 cm). Experimental results indicated that a higher rate of vermicompost containing growing media integration with different level of pruning application produce increased fruit length compared to a FYM or Kitchen compost containing growing media and no pruning association. Bindu Lau fruit breadth was shown to be considerably different when different growing media and stem cutting were combined (Table 4). The M_2P_2 treatment combination produced the largest fruit breadth (11.53 cm), which was statistically equivalent to the (11.23 cm) M_3P_2 treatment combinations and the M_1P_0 treatment combination produced the smallest fruit breadth (9.88 cm). Experimental results indicated that a higher rate of vermicompost containing growing media integration with different level of pruning techniques application produce increased fruit breadth compared to a FYM or Kitchen compost containing growing media and no pruning association.

3.10 Individual Fruit Weight (gm)

Bindu Lau fruit weight changed statistically significantly according to different growing media (Table 3). The M_2 (Soil: Vermicompost: Sand) treatment produced the largest fruit weight (666.67 g) while the M_1 (Soil: FYM: Sand) produced the smallest fruit weight (623.33 g). As stated by Kharga *et al.* (2019), the cause for increased fruit weight could be due to the simple availability of nutrients to plants via inorganic fertilizers, improved soil solubilization of organic manures ultimately leading to production and distribution of adequate quantity of photosynthates from the leaves to the reproductive organs. Fruit weight variability was noticed to be statistically significant for different stem cutting techniques (Table 3). Where P_2 treatment (Removal of all branches up to 120cm + Top shoot cutting) produced the largest fruit weight (677.44 g). The P_0 (control) treatment produced the smallest fruit weight (598.67 g). The findings are consistent with the results of Mardhiana *et al.* (2017), who showed that pruning eliminated unproductive parts, resulting in a wide allocation of resources assimilation of photosynthetic process to improve cell enlargement. Bindu Lau fruit weight was shown to be considerably different when different growing media and stem cutting were combined (Table 4). The M_2P_2 treatment combination produced the largest fruit weight (700.67 g), which was statistically equivalent to the (686.33 g) M_2P_1 treatment combinations and the M_1P_0 treatment combination produced the smallest fruit weight (587.33 g). Experimental results indicated that a higher rate of vermicompost containing growing media integration with different level of pruning techniques application produce increased fruit weight compared to a FYM or Kitchen compost containing growing media and no pruning association.

3.11 Yield (t/ha)

The effect of different growing media was shown to have a significant impact on the amount of Bindu Lau produced per plant (Table 3). The highest fruit yield per plant (13.23 kg) came from the M_2 treatment (Soil: Vermicompost: Sand), while the lowest fruit yield per plant (11.59 kg) came from the M_1 treatment (Soil: FYM: Sand). More fruits per plant is inevitably related with a larger fruit production per plant. Variations in stem cutting intensity were noticed to have a significant effect on the yield of Bindu Lau fruits per plant (Table 3). In contrast, the P_0 treatment (control) resulted in the lowest fruit yield per plant (9.79 kg), while the P2 treatment (Removal of all branches up to 120cm + Top shoot cutting) provided the highest fruit yield per plant (14.14 kg). Bindu Lau yield per plant was shown to be considerably different when different growing media and stem cutting were combined (Table 3). The M_2P_2 treatment combination produced the highest yield per plant (14.87 kg), which was statistically equivalent to the (14.58 kg) M_2P_1 treatment combinations and the M_1P_0 treatment combination produced the lowest yield per plant (9.21 kg). Different growing media showed a notable variation in Bindu Lau fruit yield per hectare (Table 4). The M_2 treatment (Soil: Vermicompost: Sand) generated the maximum yield per hectare (33.04 ton), while the M_1 (Soil: FYM: Sand) generated the least fruit yield per hectare (28.89 ton). The study revealed that growing media consisting vermicompost give maximum productivity per hectare. Different levels of stem cutting resulted in considerable differences in total Bindu Lau yield per hectare (Table 3). The P_2 treatment (Removal of all branches up to 120cm + Top shoot cutting) produced the highest yield per hectare (35.36 ton). In comparison to other treatments, P_0 (control) had the lowest yield per hectare (24.47 ton). The combined effect of different growing media and stem cutting resulted in a statistically considerable variation in total Bindu Lau yield per hectare (Table 4). The M_2P_2 treatment combination produced the highest yield per hectare (37.17 ton) which was statistically equivalent to the M_2P_1 treatment (36.44 ton) combinations. On the other hand, the M_1P_0 treatment combination yielded the lowest yield per hectare (23.03 ton). Shah *et al*. (2020) reported equivalent results, according to him plant development was enhanced when inorganic sources of nutrients were combined with organic sources, such as vermicompost, chicken manure, or farmyard manure increased production of carbohydrates, which resulted in maximum crop's fruit production. The 1:2:1 Soil:Vermicompost:Sand media optimizes bottle gourd growth by providing high nutrient availability (via vermicompost) while ensuring superior drainage and aeration (from sand), preventing root diseases. Balanced media promotes vigorous root development, nutrient uptake, and reduces abiotic stress, directly enhancing fruit yield (Gazi *et al*., 2024 and Mohite *et al*., 2024).

3.12 Gross Return

The combined effect of different growing media and stem cutting techniques resulted in a variation in gross return (Table 5). The M_2P_2 treatment combination resulted the highest gross return (1314075 BDT./ha), while the M_3P_2 treatment combination resulted the second highest (1238925 BDT. /ha). The M_1P_0 treatment combination resulted the lowest gross return (801375 BDT. /ha).

3.13 Net Return

In terms of net return, different treatment combinations produced a wide variety of net returns. The combination of M_2P_2 produced the highest net return (73738 BDT. /ha), while the combination of M_3P_2 produced the second highest net return (633967 BDT /ha). Table 5 shows that the M_1P_0 treatment combination had the lowest net return (227457 BDT /ha).

3.14 Benefit Cost Ratio

The combination of different plant growing media and stem cutting techniques for benefit cost ratio was different in all treatment combination (Table 5). The M_2P_2 treatment combination had the highest benefit cost ratio (2.28), and the M_3P_2 treatment combination had the second highest benefit cost ratio (2.05). The M_1P_0 treatment combination had the lowest benefit-cost ratio (1.40). From a financial perspective, the ongoing results showed that the M_2P_2 treatment combination was more financially profitable than the other treatment combinations.

Table 3. Combined effect of different growing media and stem cutting techniques on number of branches at harvest, number of days required to first male flower, days required to first female flower, no. of male flowers, no. of female flowers, on number of days required to first fruit harvest, no. of fruits harvested per plot, fruit length, individual fruit weight and yield per (t/ha) of Bindu Lau

Growing media	Days required to first male flower	Days required to first female flower	No. of male flowers per plant	Day required to first fruit harvest	No. of fruits harvested per plot	Fruit length (cm)	Individual fruit weight (gm)	Yield per (t/ha)
M_1	17.02 c	21.56 a	69.33 a	61.78 a	36.89 c	16.41 b	623.33 c	28.99 c
M_2	19.06 a	20.21 b	66.78 c	59.12 c	40.44 a	17.49 a	666.67 a	33.07 a
M_3	17.78 b	20.84 ab	67.56 b	60.67 b	37.56 b	17.24 a	646.78 b	30.67 b
LSD (0.05)	0.4139	0.8091	0.4262	0.8943	0.6603	0.5345	12.803	0.961
CV%	5.74	6.29	4.26	7.90	8.44	7.79	5.25	6.02
Stem cutting								
P_0	16.02 c	22.51 a	72.89 a	67.35 a	33.33 c	15.82 c	598.67 c	24.47 c
P_1	18.55 b	20.67 b	65.78 b	58.67 b	39.33 b	17.23 b	660.67 b	32.91 b
P_2	19.29 a	19.43 c	65.00 c	55.56 c	42.22 a	18.09 a	677.44 a	35.36 a
LSD (0.05)	0.4139	0.8091	0.4262	0.8943	0.6603	0.5345	12.803	0.961
CV%	5.74	6.29	4.26	7.90	8.44	7.79	5.25	6.02

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where, M_1: Soil: FYM: Sand; M_2: Soil: Vermicompost: Sand; M_3: Soil: Kitchen Compost: Sand, where P_0: Control; P_1: Removal of all branches up to 90cm + Top shoot cutting P_2: Removal of all branches up to 120cm + Top shoot cutting

Table 4. Combined effect of different growing media and stem cutting techniques on number of branches at harvest, number of days required to first male flower, days required to first female flower, no. of male flowers, no. of female flowers, on number of days required to first fruit harvest, no. of fruits harvested per plot, fruit length, individual fruit weight and yield per (t/ha) of Bindu Lau

Treatment combinations	Days required to first male flower	Days required to first female flower	No. of male flowers per plant	No. of female flowers	Number of day required to first fruit harvest	No. of fruits harvested per plot	Fruit length (cm)	Individual fruit weight (gm)	Yield per (t/ha)
M_1P_0	15.02 g	23.50 a	74.00 a	40.00 f	69.33 a	32.33 f	15.21 e	587.33 f	23.03 g
M_1P_1	17.05 e	20.83 bcd	68.33 c	44.67 d	59.30 c	37.00 d	16.67 cd	628.03 d	30.15 e
M_1P_2	19.00 c	20.33 d	65.74 d	48.57 c	56.64 e	41.33 c	17.37 bc	654.67 c	33.78 cd
M_2P_0	16.70 ef	21.83 bc	72.67 b	42.62 e	66.04 b	34.00 e	16.23 d	613.02 de	25.61 f
M_2P_1	19.77 b	20.50 cd	64.00 e	50.33 b	58.67 cd	43.00 b	17.50 bc	686.33 ab	36.44 ab
M_2P_2	20.70 a	18.30 e	63.67 e	52.66 a	52.67 f	44.33 a	18.73 a	700.67 a	37.17 a
M_3P_0	16.33 f	22.20 ab	72.04 b	41.67 e	66.62 b	33.67 e	16.03 de	595.67 ef	24.76 f
M_3P_1	18.83 cd	20.67 cd	65.02 d	45.68 d	58.00 cde	38.00 d	17.53 bc	667.54 bc	32.13 d
M_3P_2	18.16 d	19.67 de	65.45 d	49.33 bc	57.33 de	41.00 c	18.16 ab	677.02 b	35.12 bc
LSD (0.05)	0.7169	1.4014	0.7382	1.5832	1.5489	1.1436	0.9258	22.175	1.664
CV%	5.74	6.29	4.26	3.07	7.90	8.44	7.79	5.25	6.02

In a column, means with similar letter (s) are not significantly different and those having dissimilar letter (s) are significantly different by LSD at 5% level of significance. Where, M_1: Soil: FYM: Sand; M_2: Soil: Vermicompost: Sand; M_3: Soil: Kitchen Compost: Sand, where P_0: Control; P_1: Removal of all branches up to 90cm + Top shoot cutting P_2: Removal of all branches up to 120cm + Top shoot cutting

Table 5. Cost and return of Bindu Lau cultivation as influenced by different growing media and stem cutting techniques

Treatment combinations	Cost of production (BDT/h)	Yield (branch number)	Return (branch) (BDT)	Yield (t/ha)	Return (Fruit) (BDT)	Gross return (BDT/ha)	Net return (BDT/ha)	BCR
M_1P_0	573918	7365	110475	23.03	690900	801375	227457	1.40
M_1P_1	596118	8586	128790	30.15	904500	1033290	437172	1.73
M_1P_2	596118	8865	132975	33.78	1013400	1146375	550257	1.92
M_2P_0	554493	9955	149325	25.61	768300	917625	363132	1.65
M_2P_1	576693	11660	174900	36.44	1093200	1104860	528167	1.91
M_2P_2	576693	13265	198975	37.17	1115100	1314075	737382	2.28
M_3P_0	582798	9579	143685	24.76	742800	886485	303687	1.52
M_3P_1	604958	10569	158535	32.13	963900	1122435	517477	1.89
M_3P_2	604958	12355	185325	35.12	1053600	1238925	633967	2.05

Note: M_1: Soil: FYM: Sand; M_2: Soil: Vermicompost: Sand; M_3: Soil: Kitchen Compost: Sand, where P_0: Control; P_1: Removal of all branches up to 90cm + Top shoot cutting P_2: Removal of all branches up to 120cm + Top shoot cutting
Price of bindu lau = 30 BDT/kilograms

4. CONCLUSION

The following conclusion may be drawn based on the findings of this study: Treatment M_2 (Soil: Vermicompost: Sand), was superior to others; vermicompost @ 25t/ha with a half amount mixture of sand and soil may be used to get desirable yield of Bindu Lau. Stem cutting or pruning had a significant effect on Bindu Lau growth and production P_2 (Removal of all branches up to 120cm + Top shoot cutting) was indicated to produce the highest yield of Bindu Lau among the several stem cutting techniques. The treatment combination M_2P_2 (Soil: Vermicompost: Sand + Removal of all branches up to 120cm + Top shoot cutting) could be used to increase the yield of fruits per plant and total yield of Bindu Lau. It may provide the maximum significant advantage to farmers. As a result, it may be recommended to farmers for Bindu Lau growing during the rabi season.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://pr.sdiarticle5.com/review-history/137457