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Research Article

Supporting MATERIALS FACILITATE GROWTH and YIELD of *Lagenaria Siceraria*

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Abstract

Improving the cultivation system of bottle gourd is the most important feature for achieving higher yield and quality fruits. In order to evaluate the yield potential of bottle gourd with various cultivation systems, the experiment was carried out at the research field of the Department of Horticulture of Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur. The experiment consisted of four treatments of different supporting materials of cultivation viz. on the soil surface, horizontal scaffold (2.5 ft), horizontal scaffold (4 ft), and vertical scaffold (5.6 ft) with three replications. Different scaffolding systems enhanced plant growth, including fruit length, weight, and preferred fruit shape and color. Photosynthesis capacity was also enhanced by the supporting materials that reflected the plant's fruit yield. It also positively influenced the days' requirement of the first male and female flowering and the number of male flowers. The plant grown on a vertical scaffold enhanced the plant growth, such as the number of female flowers per plant and the number of fruit set per plant, and spent less time for the first fruit setting (60.33 days). The vertical scaffold also showed rapid harvesting time (66.67 days) and the highest number of fruits per plant (11.00). Furthermore, the economic analysis showed that the vertical scaffold cultivation system is profitable for bottle gourd cultivation.

Keywords: Scaffold; Bottle Gourd; Cucurbits; Fruit Yield and Quality; Cultivation Technology

Abbreviations

BCR: Benefit Cost Ratio; DAT: Days After Transplanting

Introduction

Bottle gourd (*Lagenaria siceraria*), a climbing vine of the gourd family Cucurbitaceae. It is vigorous growth, quick-growing annuals with hairy stems, long forked tendrils, and a musky odor, and one of the most giants produced cucurbits vegetables in the world. Probably bottle gourd originated in Africa and spread all over the world [1]. Nowadays, it is grown in many countries including Bangladesh, India, Malaysia, Japan, Thailand, Sri Lanka, Indonesia, Philippines, China, Hong Kong, Tropical Africa, Colombia, and Brazil [2]. The well-known growing areas of bottle gourd in Bangladesh are Rangpur, Joypurhat, Mymensingh, Chittagong and Narayanganj.

It is probably the first domesticated winter vegetable, providing food, nutrition, medicine, container, and musical instrument while its seeds are used for oil and protein sources [2-4]. The delicate shoots and leaves are used as delicious vegetables, and fleshy large young fruits are edible with good nutritional benefits and usually cooked as a vegetable, easier cooking quality, reasonable market price, and year-round availability. The demand is increasing day by day. Bottle gourd is a ubiquitous vegetable in Bangladesh and is particularly popular among rural people. It is reported as an easily digestible vegetable that keeps the body cool, prevents constipation, and has an anti-cancer effect in human breast cancer cells [5,3]. Folate of bottle gourd helps to reduce the incidence of neural tube defects in the newborns when taken by anticipant mothers during their early months of pregnancy.

Bottle gourd is most widely grown and consumed in Bangladesh, preferred mainly for its nutritional value, such as vitamins, minerals, antioxidants, and anti-cancer properties [6]. Fresh bottle gourd is a moderate source of vitamin C (100 g of raw fruit provides 10 mg or about 17% of RDA). Vitamin C, one of the powerful natural antioxidants that helps the human body scavenge harmful free radicals, is one of the reasons for cancer development. The edible portion of bottle gourd fruit contains moisture 96.3%, potassium 3320.0 mg and magnesium 162.33 mg [7]. Each 100 g bottle gourd contains energy 63 Kj, carbohydrate 3.69 g, fiber 1.2 g, fat 0.02 g, protein 0.6 g, vitamin-B1 0.029 mg (thiamine), vitamin-B2 0.02 mg (riboflavin), vitamin-B3 0.39 mg (niacin), vitamin-B5 0.144 mg (pantothenic acid), vitamin-B6 0.038 mg (pyridoxine), vitamin-C 8.5 mg, mineral 24 mg, calcium 24 mg, Iron 0.25 mg, Zinc 0.45 mg, phosphorus 11 mg, sodium 2 mg [8]. It is one vegetable recommended by dieticians in weight control programs. Other people also consume gourd as soup as it contains mostly 92% of water [8].

Bottle gourd is widely cultivated throughout the country during the winter season. September to February is the congenial period for bottle gourd cultivation in Bangladesh. In the 2018-19 fiscal year, around 26.7 million tons of vegetables were produced across Bangladesh, and the total vegetable (winter season) production area was 221.26 thousand hectares of land with a total production of 2.46 million tons [9]. In Bangladesh, cucurbits occupy 66% of the land under vegetable production and contribute 11% of total vegetable production [9]. Cucurbits include bottle gourd, sweet gourd, cucumber, squash, bitter gourd, watermelon etc. The average yield of bottle gourd in Bangladesh is only 12.43 tons/ha, which is very low compared to other bottle gourd-producing countries [9]. Now, bottle gourd is grown around the year. They are grown in homesteads for family consumption and larger plots for commercial purposes.

The agro-ecological condition and as the winter vegetables are relatively short duration crops, farmers can take advantage of a quick harvest and thereby can increase their farm income and improve nutritional status [10]. Besides local demand, there is an excellent scope to export vegetables to the Middle East and some European countries. Due to pleasant weather, low labor cost, high demand, and popularity, bottle gourd is cultivating commercially and at village farm households. Several factors are responsible for this yield. Bottle gourd can be grown by direct sowing or transplanting 15 to 20 days old seedlings. Bottle gourd is cultivated in our country following a traditional system in which the vines are allowed to spread on the soil surface in a commercial scale and on the horizontal scaffold in a household scale. In recent years, improving the cultivation system of bottle gourd using different scaffolds is getting popular. So far, there is no comparative study in Bangladesh on which cultivation system is more economical and profitable for the growers. Therefore, in this study, yield performance of bottle gourd using various supporting materials in the cultivation system has been evaluated.

Materials and Methods

The experiment was conducted at the Department of Horticulture and Horticulture lab, Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Gazipur-1706, Bangladesh, during the period from September 2018 to February 2019. There were four treatments in the experiment viz. T0 - On the soil surface, T1 - Horizontal scaffold (2.5 ft), T2 - Horizontal scaffold (4 ft), T3 - Vertical scaffold (5.6 ft). The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. The field with good tilth was divided into 12 plots, each of which was 6.0 m × 2.5 m maintaining plot to plot and row to row distance of 0.5 m. Sixteen-day-old seedlings of bottle gourd variety BARI lau 3 were transplanted in the main field on 29 September 2018. In each plot having three plants and total 36 plants were accommodated in the experimental plot. Chemical fertilizer @ 150 kg urea, 125 kg Triple Super Phosphate (TSP), 100 kg Muriate of Potash (MOP), 15 tons cow dung per hectare were applied [11]. Half of the cow dung and the entire amount of TSP were applied during final land preparation. One week before planting, the remaining cow dung and 1/3 of MOP were applied during pit preparation. The entire urea and rest MOP were applied as top dressing after 15 days. Intercultural operations like thinning and gap filling, weeding and mulching, staking, trellis, irrigation and after-care, pesticide application were done as and when necessary for better growth and development of plants. The parameters included in the study were number of branches per plant, length of the plant (m), the weight of whole plant (kg), days required for first male and female flowering, number of male and female flowers per plant, days required for first fruit setting and harvesting, number of fruit set per plant, fruit length (cm), breadth (cm), shape and color, number of fruit harvested per plant/per plot/per hectare, fruit yield per plant (kg)/per hectare (ton) and finally economics analysis.

Data were analyzed by using Analysis of Variance (ANOVA) and treatment means were compared using Least Significant Difference (LSD) at 5% level of probability.

Results and Discussion

Different supporting materials are influenced the bottle gourd parameters in various degrees (Table 1). The maximum number of branches (24.67) per plant was recorded in T0 treatment, and the minimum number of branches (18.17) per plant was recorded in T2 treatment. The highest length of the plant (15.31 m) was recorded in T0 treatment and the lowest (11.33 m) was found in T2. The plants were grown on the soil produced a higher number of branches. In its continuity, we found T0 treatment showed the longest length of plants. After final harvesting, the weight of each plant was measured. Horizontal scaffold, 4 ft showed the highest value (3.29 kg), and the lowest value (2.18 kg) was found in T0.

Treatments	No. of branches plant^{-1}	Length of the plant (m)	Weight of the plant (kg)
T_0	24.67 ± 1.96	15.31 ± 0.58	2.18 ± 0.04
T_1	21.33 ± 1.01	12.17 ± 2.24	3.05 ± 0.41
T_2	18.17 ± 2.46	11.33 ± 0.35	3.29 ± 0.43
T_3	23.50 ± 1.73	13.31 ± 1.10	2.87 ± 0.46
CV%	5.07	9.05	3.69

Table 1: Growth characteristics of bottle gourd under different treatment combinations.
T_0-On soil surface, T_1-Horizontal scaffold (2.5 ft), T_2-Horizontal scaffold (4 ft), T_3-Vertical scaffold, means followed by same letter (s) in a column do not differ significantly at 5% level by DMRT, DAT- Days After Transplanting.

It was observed that the different reproductive parameters such as Days required for first male and female flowering, number of male and female flowers per plant (Table 2), days required for first fruit setting and first fruit harvesting, number of fruit set per plant (Table 3), were influenced by the different treatment combinations. The earliest (37.67 days) male flower initiation was observed in T1 while it was delayed (44.00 days) in T0 followed by T3 (39.67 days) and T2 (38.00 days). In case of female flowering, the earliest (50.00 days) was observed in T2 while it was delayed (53.67 days) in T0 followed by T1 (50.67 days), T3 (50.33 days).

Treatments	Days to first male flowering	Days to first female flowering	Number of male flowers plant^{-1}			Number of female flowers plant^{-1}		
			60 DAT	75 DAT	90 DAT	60 DAT	75 DAT	90 DAT
T_0	44.00 ± 1.15^a	53.67 ± 1.45^a	18.83 ± 1.20	19.50 ± 4.31	17.17 ± 1.76	8.00 ± 2.18	12.67 ± 3.17^a	20.00 ± 6.56^a
T_1	37.67 ± 1.20^c	50.67 ± 0.67^b	16.67 ± 3.22	15.17 ± 6.12	18.67 ± 2.52	7.83 ± 3.09	12.33 ± 1.86^a	18.33 ± 1.86^{ab}
T_2	38.00 ± 1.15^c	50.00 ± 0.58^b	12.50 ± 2.57	13.00 ± 3.33	17.17 ± 1.86	8.17 ± 2.89	12.50 ± 2.31^a	20.33 ± 2.20^{ab}
T_3	39.67 ± 0.88^b	50.33 ± 0.33^b	17.00 ± 5.92	19.17 ± 1.59	16.17 ± 1.88	9.33 ± 3.69	15.17 ± 1.26^b	24.17 ± 1.30^b
CV%	4.11	3.07	9.14	7.68	3.31	5.07	4.11	3.66

Table 2: Days to flower initiation and number of both male and female flowers per plant in different treatments at different days after transplanting.
T_0-On soil surface, T_1-Horizontal scaffold (2.5 ft), T_2-Horizontal scaffold (4 ft), T_3-Vertical scaffold, means followed by same letter (s) in a column do not differ significantly al 5% level by DMRT, DAT- Days After Transplanting.

Treatments	Days to first fruit setting	Days to first fruit harvesting	Number of fruit set $plant^{-1}$		
			60DAT	75DAT	90DAT
T_0	64.00 ± 0.58^{a}	70.33 ± 0.33^{a}	9.5 ± 2.08	9.83 ± 2.62	10.83 ± 2.59
T_1	61.33 ± 0.88^{ab}	67.67 ± 0.67^{b}	11 ± 0.76	11.67 ± 0.93	12 ± 1.26
T_2	61.67 ± 0.88^{ab}	68.00± 0.58^{b}	10.5 ± 0.28	11.5 ± 0.50	12 ± 0.58
T_3	60.33 ± 0.88^{b}	66.67 ± 0.88^{b}	10 ± 1.00	11 ± 0.87	11.5 ± 1.15
CV%	2.37	1.68	2.01	1.66	2.08

Table 3: Days to first fruit setting, fruit harvesting and number of fruit set per plant at different days after transplanting in different treatments.

T_0-On soil surface, T_1-Horizontal scaffold (2.5 ft), T_2-Horizontal scaffold (4 ft), T_3-Vertical scaffold, means followed by same letter (s) in a column do not differ significantly al 5% level by DMRT.

At 60 and 75 days after transplanting, there was a variation found in the number of male flowers per plant. The maximum number of male flowers (18.83 and 19.50) per plant was recorded in T0 Treatment and the minimum number (12.50 and 13.00) per plant was recorded in T2 treatment, respectively. At 90 days after transplanting, the higher number of male flowers (18.67) was recorded in T2 treatment and the lowest (16.17) was found in T3 treatment.

The maximum number of female flowers (9.33) per plant was recorded at 60 days after transplanting and (15.17) per plant was recorded 75 days after transplanting both in T3 Treatment. The minimum number of female flowers (7.83) per plant at 60 days after transplanting and (12.33) per plant at 75 days after transplanting were recorded both in T1 treatment. At 90 days after transplant, the maximum number of female flowers (24.17) was also found in T3 treatment and the minimum number (18.33) was in T1 treatment also.

T3 treatment was appeared first fruiting and harvesting in 60.33 and 66.67 days after transplanting, which was almost similar in T1 and T2 treatments. Furthermore, more days (64.00 and 70.33) are required in T0 treatment. The variation in the number of fruit set per plant was observed at 60 to 75 days after transplanting. The maximum number of fruit set (11.00) per plant was recorded at 60 days after transplanting and (11.67) per plant was recorded 75 days after transplanting both in T1 Treatment. The minimum number of fruit set (9.50) per plant at 60 days after transplanting and (9.83) per plant at 75 days after transplanting were found both in T0 Treatment. At 90 days after transplant, the maximum number of fruit set (12.00) per plant was in both T1 and T2 treatments, and the minimum number (10.83) was in T0 treatment.

A variation was found in some fruit characteristics such as fruit length, breadth, shape, and color (Table 4) in the different treatments of bottle gourd cultivation. The highest value (34.58) was recorded in T1 treatment and the lowest (31.28) was found in T0 treatment. The fruit breadth is correlated to the fruit length. The plant grown on the soil produced the highest value (34.77) and the lowest value (32.25) was recorded in T1 treatment.

Treatments	Fruit length (cm)	Fruit breadth (cm)	Fruit shape	Fruit color
T_0	31.28 ± 0.81^{b}	34.77 ± 0.83	Rough skin and shorter	Whitish one side
T_1	34.58 ± 0.61^{a}	32.25 ± 0.47	Smooth skin and medium	Light or Deep green
T_2	34.53 ± 1.33^{a}	33.47 ± 1.52	Smooth skin and longer	Light or Deep green
T_3	33.53 ± 0.34^{ab}	32.84 ± 1.19	Smooth skin and medium	Bright color
CV%	4.67	5.88		

Table 4: Fruit length, breadth, shape and color of bottle gourd grown in different treatments.

T_0-On soil surface, T_1-Horizontal scaffold (2.5 ft), T_2-Horizontal scaffold (4 ft), T_3-Vertical scaffold, means followed by same letter (s) in a column do not differ significantly al 5% level by DMRT.

Treatments	Number of harvested fruits plant^{-1}	Number of harvested fruits plot^{-1}	Number of harvested fruits ha^{-1}	Fruit yield (kg plant^{-1})	Fruit yield (t ha^{-1})
T_0	9.33 ± 0.88^{a}	31.33 ± 0.88^{a}	18667 ± 1.76^{a}	21.17 ± 3.20^{a}	42.34 ± 6.40^{a}
T_1	10.5 ± 0.44^{ab}	35.67 ± 0.88^{ab}	21000 ± 1.15^{ab}	25.23 ± 1.96^{ab}	50.45 ± 3.92^{b}
T_2	10.83 ± 0.44^{ab}	34.18 ± 1.17^{ab}	21667 ± 0.88^{ab}	27.17 ± 1.40^{b}	55.08 ± 3.05^{b}
T_3	11 ± 0.76^{b}	35.83 ± 1.17^{b}	22000 ± 1.53^{b}	24.96 ± 1.12^{ab}	49.92 ± 2.24^{b}
CV%	1.40	2.71	6.71	3.50	9.08

Table 5: The number of harvested fruit and fruit yield plant^{-1}, plot^{-1} and hectare^{-1} in different treatments.
T_0-On soil surface, T_1-Horizontal scaffold (2.5 ft), T_2-Horizontal scaffold (4 ft), T_3-Vertical scaffold, means followed by same letter (s) in a column do not differ significantly al 5% level by DMRT.

Although the fruit shape and color are genetic characters, growing environments and management practices influence these characters. The color whitish one-side fruit was found in the T0 treatment in four cultivation methods. In other treatments in T1, T2, T3 where proving different supporting materials produced the light green to deep green with the white spot. The shape of the fruit in T0 treatment where plant grown directly on soil is not smooth among the other treatments.

The number of fruits harvested per plant varied slightly and the maximum number of fruits per plant (11.00) was recorded in T3 treatment and the minimum number of fruits per plant (9.33) was recorded in T0 treatment. The highest number of fruits per plot (35.83) was found in T3 treatment and the lowest number of fruits per plot (31.33) was also recorded in T0 treatment.

The different supporting materials also affected fruit yield per plant of bottle gourd. The highest fruit yield per plant (27.17) was found in T2 treatment, and the lowest fruit yield per plant (21.17) was found in T0 treatment.

It was found that the highest number of harvested fruits per hectare (22,000) in T3 treatment and among the treatments the highest fruit yield was found in T2 treatment (55.08 t ha-1) and the lowest number of harvested fruits per hectare and fruit yield per hectare were found both in T0 treatment when plants grown on soil (18667 and 42.34 t ha-1).

The economic analysis showed that the fruit yield in scaffold was more profitable than fruit yield, where the plant is grown directly on the soil without using any scaffold (Figure 1 and 2). The total cost of production of T0 treatment was Tk. 1.47 lac per hectare and the other treatments it was Tk. 1.71 lac in T1, Tk. 1.86 lac in T2 and Tk. 1.56 lac in T3. The corresponding gross incomes were Tk. 3.38 lac, Tk. 4.27 lac, Tk. 4.65 lac and Tk. 4.23 lac, respectively. The estimated net income in 2.5 ft horizontal scaffold was Tk. 2.53 lac in 4 ft horizontal scaffold was Tk. 2.79 lac, in vertical scaffold was Tk. 2.67 lac, and on the soil surface was Tk. 1.91 lac.

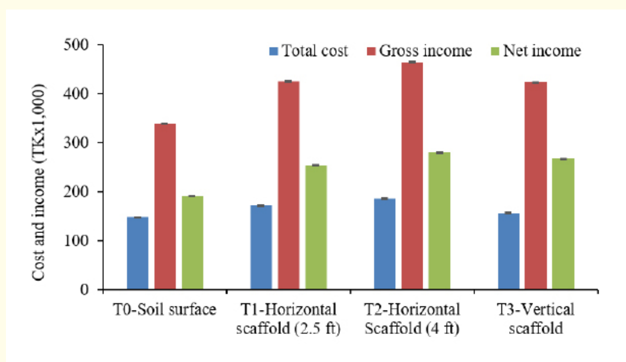

Figure 1: Economic analysis of different cultivation system of bottle gourd in relation to fruit production (mean ± SEM, LSD ≤ 0.05).

The benefit-cost ratio (BCR) is crucial for choosing the best crop production method. BCR was highest in T3 treatment (2.71) than the other two scaffold treatments. In contrast, horizontal scaffold, 2.5 ft showed 2.47 and horizontal scaffold, 4 ft 2.50 BCR, respectively. The lowest BCR was 2.29 found in the T0 treatment.

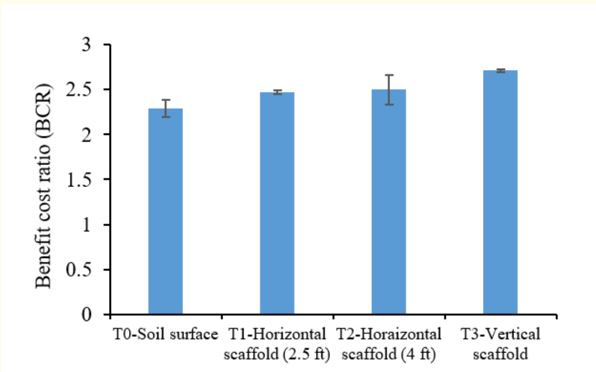

Figure 2: Benefit cost ratio of different cultivation system of bottle gourd in relation to fruit production (mean ± SEM, LSD ≤ 0.05).

Discussion

The bottle gourd plant grown directly on the soil most nodes of the branches is attached directly to the soil and collect nutrients. This facility of the soil surface grown plants encourages vegetative growth. The physiology of plants says that available nutrients from the soil and increased photosynthetic activity enhance vegetative growth [12]. Therefore, it was found that higher vegetative growth in the soil surface grown bottle gourd plants. The plants grown on the scaffold are deprived of available nutrients thus showed a smaller number of branches but on the vertical scaffold, the plants were more exposed to sunlight and received a better environment for photosynthesis. These findings were supported by the results of Akoroda., *et al*. [13], FAO [14], and Hussain [15] in cucumber. They reported that the staking method exposes leaves for adequate light reception and photosynthetic activities promote better aeration. Similarly, according to the results of Hilli., *et al*. [16] in ridge gourd and Nweke., *et al*. [17] in cucumber, the agronomic practice of staking had a significant difference in the growth of ridge gourd (*Luffa acutangula* L. Roxb) and cucumber.

The plant grown on the soil is susceptible to stem rot diseases. Since the supporting materials prevent stem contact with soils, thus decreasing soil-borne diseases and pathogens. The present findings supported the results of Akoroda., *et al*. [13]. They reported that the staking method reduces the proportion of unmarketable yield by preventing diseases and fruit rot in the plants grown directly on the soil.

Because in the T0 treatment the plants crept on the soil, its vegetative growth became higher than the reproductive growth. In general, the higher the vegetative growth, the lower the reproductive growth of cucurbits. In the T1, T2 and T3 treatments (used different scaffolds) it's needed fewer days and almost the same days for the first female flower initiation than both flower initiation times in T0 treatment (44.00 and 53.67 days). It may also be due to the effect of sunlight and the consumption of more nutrients [18]. As in the T1, T2 and T3 treatments, the plants were more exposed to sunlight than the T0 treatment. High nutrition such as nitrogen under high-temperature conditions promotes male flowers, but the number of female flowers or perfect flowers per vine reduces, resulting in a low fruit set.

The cucurbits, in general, produce more male flowers than the female flower. There were no significant differences in the number of male flowers in this study. However, scaffold grown plants (T3) was produced a higher number of female flowers than the plants grown on the soil surface (T0). The availability of sunlight might have increased the photosynthetic activity, and good aeration might be influenced to the production of more female flowers in the vertical scaffold. The results were corroborated with Ara., *et al*. [19] and Singh., *et al*. [20] in cucumber.

Frist fruiting, harvesting and fruit setting may be due to enough sunlight good air circulation that increases more pollination by influencing the different pollinators and enhancing the plants' photosynthesis activity and carbohydrate accumulation to the fruits. As in the T0 treatments, the plants crept on the soil where the vegetative growth was higher than the reproductive growth and also the different soil borne pathogens as the flowers (both male and female) were nearly to the soil surface and for this delay fruit setting was occurred and finally delay fruit harvesting was done. These results were in close conformity with the findings of Hussain [15] and Waseem., *et al*. [21] and Jilani., *et al*. [22] in cucumber.

Since due to the high activity of pollinators and pleasant temperature, fertilization of more ovules in scaffold has occurred and does not allow the fruit to the contact of ground that's preventing them from being infected by pathogens and decreasing the number of rotten eggs or diseased fruits. These results agreed with the report of Patil*., et al.* [17] in bottle gourd cv. Pusa Hybrid 3 and Hilli., *et al*. [16] in ridge gourd and Jilani., *et al*. [22] in cucumber.

The highest fruit length in T1 treatment may be due to the gravitational force, and it's almost similar to the T2 treatment. As the length of the fruit is lowest in T0 treatment, its breadth is increased. In T1 treatment, the length of the fruit is highest, so its breadth is decreased. These results were in conformation with the result of Chukwudi and Agbo [23] in pumpkin and Hussain [15] and Waseem., *et al*. [21] in cucumber. From the consumer's point of view, we know that medium fruit length is preferable in our country and for export purposes. We can see that the vertical scaffold system produced medium-length fruit (33.53 cm).

As the fruit was directly attached to the ground till the edible stage, one side of the fruit directly attached became whitish. This whitish color was not preferable for the consumers and for exporting purposes instead of deep green to bright colored fruits [24,25]. As in the other treatments, the fruits are grown in the hanging condition till the edible stage for that smooth elongate medium or longer shape fruits were produced. The smooth medium shape fruits are preferable for the markets that cannot produce in the plant grown directly on the soil [26,27].

In T0 treatment, the vines were allowed to spread on the ground, which affected the production of shorter (9.33) fruits than in other treatments. In the case of this treatment, decay of more fruits occurred due to being highly prone to the damage of soil-born insects. The plant is grown in horizontal scaffold both in 2.5 ft and 4 ft where the fruits grown in the hanging condition and no protection around the fruits also increases fruit fly infestation. On the other hand, the plants are grown on the vertical scaffold where the fruit is grown in hanging condition, but one side is covered with the leaves and the plant's branches. The benefits of vertically scaffold grown plants decreased the infestation of the fruit fly. So, the number of rotten or diseased fruits was significantly lower in T3 treatment than the other three growing plants, and eventually the number of harvested fruits was increased. Thus, the vertical scaffold was better among the other treatments. The results were corroborated with Hilli., *et al*. [16] in ridge gourd and Chukwudi and Agbo [23].

Fruit yield per plant is the multiplication of fruit weight and fruit number per plant. As the weight of the fruit is highest in T2 treatment but the number of fruits per plant was lower for this after the multiplication of these two, the yield per plant became highest (27.17 kg) in T2 treatment. It might be occurred due to the proper utilization of nutrition, sunlight, and air circulations. These results were in close conformity with the experimental findings in strawberries by Heidari and Mohammad [28]. That means cultivation on soil showed the lowest yield performance. However, the vertical scaffold showed the highest number of fruits per hectare (22,000) and the fruit yield (49.92 t ha-1). It was found here that the harvested fruit in the T3 treatment was highest among the other three treatments.

BCR shows the relationship between the relative costs and benefits expressed in monetary or qualitative terms. The results inferred that vertical scaffold is more economically profitable than the other treatments. These results were supported by Patil*., et al.* [7] results in bottle gourd cv. Pusa Hybrid 3.

Conclusion

Among the different treatments used in this study, plant grown on the soil surface-enhanced number of branches, plant length, fruit breadth, but scaffold supported plant enhanced whole plant weight, fruit length, fruit weight, preferable fruit shape, and fruit color. Days required for first male and female flowering, number of male flowers were influenced positively by the different scaffolding system and among the treatments plant grown on vertical scaffold enhanced the plant growth parameters such as number of female flowers per plant, number of fruit set per plant and took less time for first fruit setting (60.33 days). Among the different scaffolds used in this study, vertical scaffold showed rapid harvesting time and more fruits per plant. The scaffolding system also had a positive effect on fruit yield per plant. The BCR analysis also supported that vertical scaffold cultivation is profitable and viable for bottle gourd cultivation.

Conflict of Interest

The author declares no conflict of interest.

Bibliography

1. Mubarak I and Janat M. “Bottle gourd (*Lagenaria siceraria* L.) crop response to different planting densities under both drip and wide-spaced furrow irrigation methods”. *Journal of Agricultural Science* 32 (2021): 79-85.

2. Ahuja S and Ahuja U. “Bottle Gourd - History, Uses, and Folklore”. *Asian Agri-History* 15 (2011): 283-302.

3. Ahmad I., *et al*. “Nutritional and medicinal potential of *Lagenaria siceraria”*. *International Journal of Vegetable Science* 17 (2011): 157-170.

4. Milind P and Satbir K. “Is bottle gourd a natural guard?” *International Research Journal of Pharmacy* 2 (2011): 13-17.

5. Ku J M., *et al*. “Cucurbitacin D exhibits its anti-cancer effect in human breast cancer cells by inhibiting Stat3 and Akt signaling”. *European Journal of Inflammation* 16 (2018): 1-9.

6. Umar S., *et al*. “Nitrate management approaches in leafy vegetables Nitrate in leafy vegetable”. Toxicity and safety measures. New Delhi: IK International Publishing House Pvt Ltd (2013): 166-181.

7. Patil K., *et al*. “Influence of vertical trailing on seed yield and quality during seed production of bottle gourd (*Legenaria siceraria)* CV Pusa hybrid-3”. *Seed Research* 40 (2013): 139-144.

8. United States Department of Agriculture (USDA). Basic Report 75122 Vegetables, “USDA National nutrient database for standard reference release”. 23, The National Agricultural Library, United States Department of Agriculture, Washington, DC (2014).

9. Bangladesh Bureau of Statistics (BBS). Planning Division, Ministry of Planning, Government of the Peoples Republic of Bangladesh, Dhaka (2019): 144.

10. Chimonyo VGP and Modi AT. “Seed performance of selected bottle gourd (*Lagenaria siceraria* (Molina) Standl.)”. *American Journal of Experimental Agriculture* 3 (2013): 740-766.

11. Chowdhury MAH and Hassan MS. Handbook of Agricultural Technology. “Bangladesh Agricultural Research Council, Farmgate, Dhaka” (2013).

12. Yadav JP., *et al*. “Influence of various spacing and methods of trailing on growth and yield of pointed gourd (*Trichosanthes dioica* Roxb)”. *Vegetable Science* 16 (1989): 113-118.

13. Akoroda MO., *et al*. “Flowering, pollination and fruiting in Fluted Pumpkin (*Telfairia occidentalis*)”. *Scientia Horticulturae* 43 (1990): 197-206.

14. Food and Agriculture Organization (FAO). “Green beans integrated pest management An Ecological Guide Training Resource Text in Crop Development, Major Agronomic Practice, Disease and Insect Ecology, Insect Pest, Natural Enemies and Diseases of Green Bean, Rome, Italy (2007).

15. Hussain A-B JM. “Effect of Organic and Inorganic Fertilizers on Growth and Yield of Hybrid Cucumber *Cucumis sativus* L Grown under Unheated Plastic House”. *IOP Conference Series: Earth and Environmental Science* (2020): 553.

16. Hilli JS., *et al*. “Influence of method of trailing and fertilizer levels on seed yield of ridge gourd (*Luffa acutangula* L Roxb)”. *Karnataka Journal of Agricultural Sciences* 22 (2009): 47-52.

17. Nweke IA., *et al*. “The effect of staking and plant spacing on the growth and yield of cucumber (*Cucumis sativus* L)”. *Journal of Environmental Science, Toxicology and Food Technology* 3 (2013): 26-31.

18. Imnatemsu KN., *et al*. “Effect of organic and inorganic fertilizers on growth and yield of bottle gourd (L*agenaria siceraria*) under teak based agroforestry system”. *Indian Journal of Pure and Applied Biosciences* 8 (2020): 388-395.

19. Ara K., *et al*. “Seasonal and year-on-year variability in chlorophyll a and microphytoplankton assemblages for 9 years (2001-2009) in the neritic area of Sagami Bay”. *Japan Plankton and Benthos Research* 6 (2011): 158-174.

20. Singh G., *et al*. “Response of integrated nutrient management on cucumber (*Cucumis sativus* L) hybrid under polyhouse conditions”. *International Journal of Chemical Studies* 8 (2020): 1914-1916.

21. Waseem K., *et al*. “Effect of Different Nitrogen Levels on Growth and Yield of Cucumber (*Cucumis Sativus* L)”. *Journal of Agricultural Research* 46 (2008): 259-266.

22. Jilani MS., *et al*. “Effect of different levels of NPK on the growth and yield of cucumber (*Cucumis sativus*) under the plastic tunnel”. *Journal of Agriculture and Social Sciences* 5 (2009): 99-101.

23. Chukwudi UP and Agbo CU. "Effect of trellis height and cutting frequency on leaf and fruit yield of fluted pumpkin (*Telfairia occidentalis* Hook F)". *Journal of Animal and Plant Sciences* 24 (2014): 1190-1197.

24. Behera TK., *et al*. "Pusa Santushti: A New High-Yielding Bottle Gourd Variety". *International Journal of Vegetable Science* 21 (2015): 323-328.

25. Weber N., *et al*. "Influence of deficit irrigation on strawberry (*Fragaria* × *ananassa* Duch.) fruit quality". *Journal of the Science of Food Agriculture* 97 (2016): 849-857.

26. Liu L., *et al*. "Integrated analysis of molybdenum nutrition and nitrate metabolism in strawberry". *Frontiers in Plant Science* 11 (2020): 1117.

27. Akhatou I and Recamales ÁF. "Influence of Cultivar and Culture System on Nutritional and Organoleptic Quality of Strawberry". *Journal of the Science of Food and Agriculture* 94 (2014): 866-875.

28. Heidari M and Mohammad MM. "Effect of rate and time of nitrogen application on fruit yield and accumulation of nutrient elements in *Momordica charantia*". *Journal of the Saudi Society of Agricultural Sciences* 11 (2012): 129-133.