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Impact of Vine Management on Yield and Quality Parameters of Pumpkin (*Cucurbita moschata*)

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Authors' contributions

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

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ABSTRACT

The present study was conducted at the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali with an aim to study the effect of vine management on yield, yield attributing factors and quality parameters (which included nutritional factors such as vitamin A, vitamin C) of pumpkin. The treatments were: T_1 (Trimming of growing tip of the primary vine at 8^{th} node stage), T_2 (Trimming of

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growing tip of the primary vine at 10th node stage), T_3 (Trimming of growing tip of the primary vine at 12th node stage), T_4(Trimming of growing tip of the secondary vine at 6th node stage), T_5(Trimming of growing tip of the secondary vine at 8th node stage), T_6 (Removal of all tertiary vines), T_7 (Retention of two tertiary vines) and T_8(control without pruning). T_3 further recorded the minimum days to appearance of first male (49.17 days), female (58.15 days) flowers, fruit set to harvest duration (51.43 days) and crop duration (110.55 days) while T_8 recorded the maximum days. Significant variation was observed in the yield parameters where T_3 recorded the maximum number of fruits (6.27),fruit weight (2.47 kg), fruit yield per plant (15.47 kg) and yield per hectare (27.88 t/ha). Fruit characters such as fruit length, fruit diameter and number of seeds revealed no significant differences among the different treatments but with respect to quality parameters pruning revealed significant differences in terms of vitamin A and ascorbic acid content. The experiment thus concluded that the treatment T3 (Trimming of growing tip of the primary vine at 12th node stage) produced the highest yield with higher B: C ratio of 2.52 and it can be recommended to the farmers of Assam in order to maximize the production and productivity of pumpkin.

Keywords: Trimming; nodes; fruit set; vitamin A; ascorbic acid; benefit-cost ratio.

1. INTRODUCTION

The three species of the diverse genus *Cucurbita* L. (pumpkin, squash, gourd) with the highest agro-economic significance are *C. maxima* Duchesne, *C. moschata* Duchesne, and *C.pepo* L. The three are commonly grown for food, feed, and adornment. They are renowned for their excellent fruit polymorphism in terms of size, shape, and color. Currently, the average annual production in Europe and the rest of the world is 3.38 and 23.70 million tonnes, respectively; this represents a growth of roughly 66 and 100% when compared to the final decade of the previous century [1-4]. For the same time period globally, the higher total production is mostly due to an increase in harvested area (78%), followed by an increase in yield (13%). In contrast, the increased yield (37%) and expanded crop area (24%) are to blame for the rise in European pumpkin production. Both the seeds and the flesh of the pumpkin fruit are excellent sources of nutrients; the seeds are a particularly good source of lipids, proteins, and minerals, and the flesh is rich in carotenoids, carbohydrates, flavonoids, minerals, amino acids, and phenolic compounds. The flesh has very low calorie content (about 20 kcal/100 g).

A key factor affecting the success of Cucurbitaceous crops is the quantity of vines per plant [5]. On the other hand, fruit size, mass, and yield are all strongly influenced by the number of fruits per vine [6]. In light of this, it is crucial to give the cucurbit management factors proper considerations. Cucurbits can be controlled for the quantity of vines per plant and fruits per vine using a variety of techniques, including fruit and vine trimming [7]. Pruning is a specialized horticulture technique that involves removing specific plant sections to encourage flowering and subsequent fruiting. As a result, the output increases while improving consumer- required characteristics such fruit size and attractiveness [8]. According to Anwar et al [9], pruning's primary goal is to encourage a balance between vegetative growth and fruit load. Cucumber and butternut have both been shown to produce more when pruned [10,11]. In order to synchronize the harvesting period and produce homogeneous fruits, pruning is a frequent practice in the watermelon industry [4. Pruning has an effect on a plant's ability to bear or produce fruit, which affect show well the plant functions. The plant's capacity to produce fruits is established and enhanced. By driving or directing the sap flow towards the section of the plant that bears fruit, pruning causes the plant or vine to forcefully produce fruits of greater quality. The pruning technique and its uses in pumpkin are quite uncommon since farmers have little understanding and inadequate information.

2. MATERIALS AND METHODS

The study was carried out at the Instructional Cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali (26.7° N latitude, 90.5° E longitude, and at 105 m above MSL) from October 2021 to April 2022.

Eight treatments, each with three replications, were used in the experiment. These treatments included T1 (trimming the growing tip of the primary vine at the eighth node stage), T2 (trimming the growing tip of the primary vine at the tenth node stage), T3 (trimming the growing tip of the primary vine at the twelve node stage), T4 (trimming the growing tip of the secondary vine at the sixth node stage), T5 (Trimming of growing tip of the secondary vine at 8th node stage), T6 (Removal of all tertiary vines), T7 (Retention of two tertiary vines) and T8 (control without pruning) by utilizing a pumpkin of the same kind. Using secateurs, pruning was carried out when the plants reached their pruning stage in accordance with the various treatments. To prevent damaging the node, the pruning was done above the node. Standard agricultural techniques were followed to assure a robust crop stand, beginning with the full preparation of the experimental plot through thorough ploughing, followed by harrowing and leveling. The entire plot was then divided into 24 plots, each with 8 plots, in 3 replications. Each plot/bed was constructed with a 9 m x 4.5 m dimensions in mind. Then 30 cm3-sized trenches were dug and filled with a mixture of top soil and cow manure. In the trenches, seeds were planted with 3 m x 1.5 m spacing. Each pit was initially seeded with two to three seeds, and then thinning was done in order to keep the healthiest plant in each pit.

Yield attributing factors such as days to appearance of first male and female flowers, duration from fruit set to harvest, crop duration, number of fruits per plant and fruit weight, fruit yield per plant, fruit yield per plant was studied. Also quality factors such as vitamin A, ascorbic acid content were examined to study the effect of different pruning treatments.

For estimation of Vitamin A, Beta carotene was used as a means of determination. The procedure was as follows: After being crushed with a pestle and mortar, 5 ml of fruit juice were collected in a separating funnel. Following that, 10 ml of petroleum ether and 10 ml of acetone were added to the 5 ml of juice and properly mixed. After mixing, a distinct layer was formed on the lower surface, which was discarded. Only the upper layer was kept and gathered, and volume make-up was completed by adding 100 ml of petroleum ether to it. 5 ml of fruit juice was extracted using a separating funnel. The optical density (O.D.) at 452 nm was then recorded using a spectrophotometer using petroleum ether as the blank. Vitamin A was then estimated using the following formula and represented in international units (I.U.).

Vitamin A was estimated by using the formula

$$\beta\text{ carotene } (\mu g/100g) = \frac{\text{O.D13.9x10x100}}{\text{Wtofthesample 560x1000}}$$

$$\text{VitaminA} = \frac{\text{Beta carotene}\left(\frac{\mu g}{100g}\right)}{0.6}$$

For estimation of Ascorbic acid content: 10 g of fruit sample was obtained, and the volume make-up was done with 4% oxalic acid before filtering. The ascorbic acid concentration was calculated using the visual titration method using 2, 6 dichlorophenol indophenol dye and expressed in mg per 100 g in a 100 ml volumetric flask. Ten milliliters of the filtrate were obtained and titrated against the standard dye that had been made using two and a half dichlorophenol and indophenol. The filtrate's end point is identified when it turns pink.

$$\text{Ascorbic acid (mg/100g)} = \frac{\text{TitrevaluexDyefactor Volumemadeup}}{\text{Weight ofthe sample takenforestimationx Aliquotofsampletakenforestimation}} \text{X100}$$

*Dye factor =0.5/Titre value

Analysis of variance was used to compare from laboratory tests and observations collected during field experiments. The approach outlined by Panse and Sukhatme [12] was used to calculate the corresponding "F" values in order to establish the significance or non-significant o f the variation attributable to treatments. By computing critical difference (CD at 5%) estimations, the importance of the difference between the mean values of the treatment's parameters was examined.

3. RESULTS AND DISCUSSION

3.1 Effect of Vine Management on Yield Attributing Factors

3.1.1 Days for appearance of first male flower (Table 1)

The initial male flower appearance showed a notable variance with various pruning techniques. The treatment T8 had the longest time to produce the first male bloom, measuring 57.47 days, followed by T7, taking 54.42 days. However, under T3, the minimum number of days required for the first male flower to appear was noted to be 49.17 days.

The shortest duration for the emergence of the initial male (49.17 days) and female (58.15 days) flowers was noted for treatment T3, which involved trimming the primary vine's developing tip at the 12th node stage. This is in line with a bell pepper experiment conducted by Awalin et al [13], in which it was observed that the plants with pruning began to flower three days earlier than the plants without pruning. Comparing bottle gourd plants with and without pinching at the third node stage [14] showed similar results.

3.1.2 Days for appearance of first female flower (Table 1)

Out of the eight distinct pruning treatments, treatment T3 took the fewest days (58.15days) to produce female flowers, followed by treatment T4 (59.35days). Treatment T8 took the longest (69.16) days to produce the first female flowers. The reduction in apical development that encouraged more lateral branches may have contributed to the early appearance of female flowers in the treatment T3. This is consistent with findings from Arora and Malik [15] study on ridge gourd,which showed that early development off emale flowers was observe donplant spruned tosix principal vines. When plants were clipped on the main stem [16] observed that the cucumbers produced the most blooms and the bud break occurred earlier. Moreover, pepper plants showed a decrease in the length of time it took for female flowers to develop after pruning [17].

3.1.3 Duration from fruit set to harvest (Table1)

Significant variations in fruit set to harvest duration were found through pruning. The treatment T8 required the greatest time (58.95 days) from fruit set to harvest, followed by T1 (56.46 days) and T5 (55.43days), while T3 (51.43days) took the least time. When plants were clipped [18] found that the maximum number of female flowers and the minimum number of male flowers in long melons were recorded. According to Kumar and Singh [19], unpruned plants had the longest fruit set to harvest time. This confirms the current investigation's findings, which showed that treatment T3 (trimming the primary vine's growing tip at the 12th node stage) took the shortest amount of time (51.43 days) to harvest fruit, and treatment T8 (control without pruning) took the longest (58.95) days.

3.2 Crop Duration (Table 1)

The eight different pruning treatments demonstrated significant variations in the length of the crop.T3 had the shortest crop duration, measuring 110.55 days, followed by T4 (113.38 days) and T2 (116.59 days). Treatment T8 had the highest crop duration, measuring 127.96 days. Significant differences between the various pruning procedures were seen in the crop duration from the current study. T3 recorded the shortest crop duration (110.55 days), while T8 which involved no pruning at all recorded the longest (127.96) days. One of the reason of short crop duration of T3 might be because of flowering of both male and female flowers early. Pruning has been shown to be able to regulate fruiting and flowering, according to study published by Mnzava [20]. The crop duration data in this study is consistent with tomato results that were published, where plants that were cut to a single stem showed the bare minimum number of days needed for the first harvest as compared to the plants without being pruned [21,22].

3.3 Effect of Vine Management on Quality Parameters

3.3.1 Vitamin A content (Table2)

The study examined the effects of various pruning procedures on the concentration of vitamin A. T1 had the highest recorded vitamin A content at 2216.49 IU, followed by T3 at 2150.85 IU and T7 at 2144.07 IU as shown in Table 2. T8 had the lowest recorded vitamin A content at 1921.58 IU. Significant variations in vitamin A content were found in relation to trimming techniques. T1 (trimming the primary vine's developing tip at the eighth node stage) had the highest vitamin A content (2216.49IU), whereas T8 (control without pruning) had the lowest (1921.58IU).In a comparable manner Rahmanet al [23] found that sweet potatoes with up to five secondary vines pruned had higher β-carotene content. Additionally, Gupta et al [24] found considerable variations in the vitamin A concentration of pointed gourds grown using various pruning techniques.

3.3.2 Ascorbic acid content (Table2)

Significant differences were observed in the ascorbic acid content between the various pruning treatments. T2 had the highest ascorbic acid content (7.42 mg/100g), followed by T6 (6.55 mg/100g). T8 had the lowest ascorbic acid content (5.40mg/100g), statistically comparable to T5 (5.51 mg/100g) and T1 (5.71 mg/100g).

Table 1. Effect of vine management on yield attributing factors

Treatment	Days to First Appearance of Male Flower	Days to First Appearance Female Flower	Duration from Fruit Set to Harvest	Total Crop Duration
T_1	50.91	61.07	56.46	119.39
T_2	52.44	62.24	53.55	116.59
T_3	49.17	58.15	51.43	110.55
T_4	50.98	59.35	52.42	113.38
T_5	52.05	61.50	55.43	117.42
T6	53.03	64.53	52.56	120.47
T_7	54.42	66.29	54.29	122.33
T_8	57.47	69.16	58.95	127.96
SEd±	**0.49**	**0.33**	**0.46**	**0.39**
C.D(P=0.05)	**1.06**	**0.71**	**0.98**	**0.85**

T1: Trimming of growing tip of the primary vine at 8th node stage, T2: Trimming of growing tip of the primary vine at 10th node stage, T3: Trimming of growing tip of the primary vine at 12th node stage, T4: Trimming of growing tip of the secondary vine at 6th node stage, T5: Trimming of growing tip of the secondary vine at 8th node stage, T6: Removal of all tertiary vines, T7: Retention of two tertiary vines and T8: Control without pruning

Table 2. Effect of vine management on quality parameters, fruit yield per plant (kg) and fruit yield per hectare (t/ha)

	Quality Parameters		Fruit Yield	Fruit Yield
Treatments	**Vitamin A content (IU)**	**Ascorbic Acid Content (mg/100g)**	**(kg/Plant)**	**(t/ha)**
T_1	2216.49	5.71	13.40	24.19
T_2	1984.59	7.43	11.85	21.36
T_3	2150.85	5.77	15.47	27.88
T_4	1965.77	6.42	12.61	22.78
T_5	1987.35	5.51	11.16	20.18
T_6	2067.96	6.55	11.10	20.05
T_7	2144.07	5.75	10.28	18.55
T_8	1921.58	5.40	8.57	15.48
SEd±	**0.81**	**0.23**	0.03	0.02
C.D(P=0.05)	**1.70**	**0.50**	**0.06**	0.05

T1: Trimming of growing tip of the primary vine at 8th node stage, T2: Trimming of growing tip of the primary vine at 10th node stage, T3: Trimming of growing tip of the primary vine at 12th node stage, T4: Trimming of growing tip of the secondary vine at 6th node stage, T5: Trimming of growing tip of the secondary vine at 8th node stage, T6: Removal of all tertiary vines, T7: Retention of two tertiary vines and T8: Control without pruning

Several researchers have observed that pruning treatments positively boosted the level of ascorbic acid (vitamin C). When comparing trimmed plants to unpruned plants [25] found that the pruned plants had the highest levels of vitamin C. Comparably, sweet pepper plants that were trimmed to a single branch had higher levels of ascorbic acid [26]. The aforementioned results pertain to the current study, wherein the pruning treatments had an impact on the ascorbic acid concentration. The greater morpho-physiological characteristics brought about by pruning may be the cause of the higher ascorbic acid concentration observed under the pruning therapy. Additionally Razzak et al [27] found that when stem clipping was done, cherry tomatoes had a greater ascorbic content.

3.4 Effect of Vine Management on Fruit Yield Per Plant and Per Hectare

3.4.1 Effect of vine management on number and weight of fruits (Fig.1)

Regarding the quantity of fruits produced per plant, it was revealed that there were significant variations among the treatments. Following T1 (6.12) and T4 (5.41), treatment T3 (6.27) produced the highest amount of fruits per plant, while treatment T8 (4.18) produced the lowest fruits per plant. Between the various pruning methods, there were notable variations in the weight of each individual fruit. The lowest fruit weight (2.05 kg) was recorded by T8, which was comparable to T6 (2.16 kg), while the largest fruit weight (2.47 kg) was recorded by T3, which was comparable to T7 (2.37 kg) and T4 (2.33 kg).

With the most secondary vines produced, treatment T3 (trimming of the growing tip of the primary vine at 12th node stage) may have produced more female flowers on the secondary vines, which in turn may have produced more fruits. Various factors, such as fruit size and quantity, affect a larger yield [18]. This aligns with the findings obtained from the current study. While T8 (control without pruning) recorded the lowest fruit weight (2.05 kg), which proves that there is some effect of pruning on fruit weight. Fruit size and quantity are correlated with morpho physiological factors. Pruning increased the number of branches, leaves, and LAI, which may have increased photosynthetic activity and the accumulation of assimilates, which in turn increased the number and weight of fruits [28].

3.4.2 Effect of vine management on Fruit yield per plant and per hectare (Table 2)

The fruit production per plant showed significant differences across the pruning treatments; T3 had the highest output (15.47 kg), followed by T1 (13.40 kg) and T4 (12.61 kg), while T8 had the lowest yield (8.57 kg).

Significant variations were found between the levels of pruning treatments, as shown by the results in Table 2. T3 recorded the highest yield (27.88t/ha), followed by T1 (24.19t/ha) and T4 (22.78t/ha), while T8 recorded the lowest yield (15.48t/ha). Additionally, a yield increase of 80.10% was noted from T3 over T8.

The current study showed that, in comparison to the control, trimming helped to increase the overall yield percentage. Table 2 makes it evident that the treatment T3 (trimming of the primary vine at 12 node stage) produced a yield increase of 80.10% in comparison to treatment T8 (control without pruning). It is possible that the pruned plants produced the maximum yield because they produced more and larger fruits. This is consistent with Razzak et al [28] findings with cucumber. By allowing proper light exposure, pruning raised the rate of photosynthesis and, in turn, the source to sink ratio, which raised the marketable output. Research showed that plants with pruning experienced greater fruit yields than those with no pruning Palada and Chang [29] for bitter gourd, and Hesami et al [30] for tomatoes. According to reports by Paksoy and Akella [31], pruning increased the amount of eggplant that could be sold by reducing the number of waste fruits. When plants were trimmed to four stems in greenhouse-cultivated sweet pepper, the fruit yield was highest compared to unpruned plants [32]. Similar results were found by Laxman and Mukherjee [33] in chilli and Shetty and Manohar [34] in capsicum.

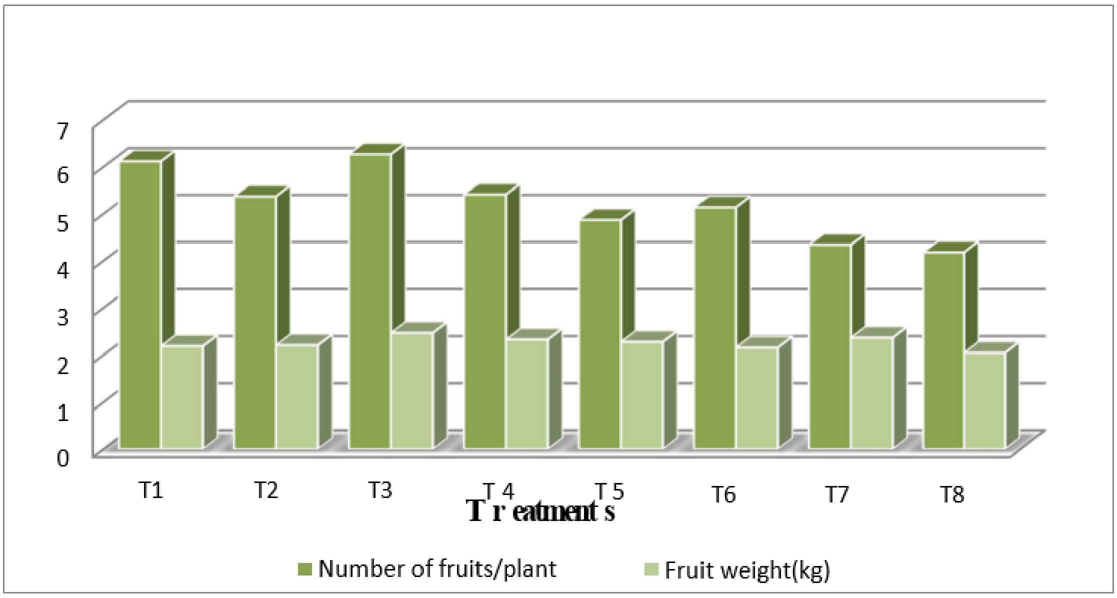

Fig. 1. Effect of vine management on number and weight of fruits

4. CONCLUSION

From the study conducted on different pruning treatments it was revealed that it had a significant effect in terms of yield attributing, quality and yield parameters of pumpkin. The treatment T3 was revealed to be best among the different pruning treatments.

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 manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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