

INFLUENCE OF 3G CUTTINGS IN BOTTLE GOURD (*Lagenaria siceraria*) FOR GROWTH, YIELD AND FRUIT QUALITY

Article type: Original research article

Comment [1]: where are the closing quotes?

Abstract

The field experiment entitled “Influence of 3G cutting in Botte gourd (*Lagenaria siceraria*) for growth, yield and fruit quality” was conducted during *kharif* 2022 at Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj, (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with ten treatments including control which were replicated thrice. The experiment results revealed that the treatment T1 gave better results than other treatments *viz*, maximum number of female flowers (27.65), vine length (6.91m), number of fruits per plant (6.66), yield per plot (5.95kg), yield per hectare (29.74 t/ha), TSS (3.60°Brix) and B:C ratio (3.6) were recorded significantly higher compared to other treatments.

Comment [2]: Botte or Bottle? See in the paper title.

KEY WORDS: *Bottle gourd, 3G cutting, Growth, Yield and Fruit Quality.*

1. INTRODUCTION

Bottle gourd (*Lagenaria siceraria*) is a major vegetable crop belonging to the family Cucurbitaceae. It is widely grown in tropical regions, particularly in areas without forests. With a rich history as one of the oldest cultivated plants, it has been used by humans for over 14,000 years. The bottle gourd has various names such as birdhouse gourd, trumpet gourd, calabash gourd, and white pumpkin, and is known by different names in different regions. The bottle gourd is a climbing or trailing herb that produces fruits in the shape of a bottle, oval, or dumbbell. It is believed to have originated in Africa and spread to different parts of the world, including India, China, Indonesia, and even New Zealand. Archaeological evidence shows its usage in Egypt, Mexico, and Peru dating back to ancient times. To further enhance production, the technique of 3G cutting has been introduced in bottle gourd cultivation. 3G cutting involves the removal of primary and secondary branches, promoting the growth of tertiary branches. These third-generation branches tend to produce a higher number of female flowers, resulting in improved fruit set and higher overall production. By increasing the number of

female flowers, the 3G cutting technique contributes to increased crop yield and addresses land scarcity issues. The role of 3G cutting is to increase the number of female flowers in a plant. After applying this cutting technique, the number of female flowers increases and becomes equal to or greater than the number of male flowers in a crop. This ultimately leads to higher crop production. As the number of female flowers in plants increases, more fruits develop, resulting in a significant increase in overall production. The 3G cutting technique has been particularly effective in the Cucurbitaceae family, which tends to produce a higher number of male flowers than female flowers. This technique helps balance the male-to-female flower ratio. In India, the total area under bottle gourd cultivation is approximately 185 thousand hectares, with an annual production of 3072 thousand MT. However, in Jammu and Kashmir, it is grown over an area of 1.60 thousand hectares, with a production of 36.17 thousand MT. The adoption of 3G cutting has shown promising results in increasing production drastically, allowing for large amounts of harvest in small areas and addressing the issue of land scarcity. The size and quality of fruits obtained through 3G cuttings are of very high quality, leading to increased market value. In conclusion, bottle gourd is a versatile vegetable crop with a long history of cultivation. It is valued for its nutritional benefits and medicinal properties. Through techniques like 3G cutting, farmers can maximize production and achieve higher yields per plant.

2. MATERIALS AND METHODS

The experiment was conducted during the year 2022 in Departmental research field of Department of Horticulture and Sciences, Prayagraj. The area is situated on the south of Prayagraj on the right bank of Yamuna at Rewa Road at a distance of about 6 km from Prayagraj city. It is situated at 25.08°N latitude and 81.05°E longitudes on elevation of 98 meters from the sea level. This region has sub-tropical climate with extreme of summer and winter the temperature falls down to as low as 1°C-2°C during winter season especially in the month of December and January. The mercury rises up to 46°C-48°C during summer the average rain fall in this area is around 1013.4mm annually with maximum concentration during July to September with few showers and drizzles in winter also the soil type was sandy loam in nature with pH varies from 7.0-8.0 and low in organic carbon, nitrogen and phosphorus.

Comment [3]: For the Material and Methods chapter, photos and sketches of the experimental field are needed, to visualize the distribution of plants in the field and the plots assigned to various treatments.

Comment [4]: In modern works, the location of the experimental field is done on GIS maps. I recommend introducing such a map or a classical one. See map in Fig. 1.

Comment [5]: 25° 8' N and 81° 50' E ??? See fig. 1.

Comment [6]: 1013.4 mm ?

The experiment aimed to assess the impact of 3G cutting on the growth, yield, and fruit quality of Bottle gourd (*Lagenaria siceraria*) during the Kharif season. A randomized block design (RBD) was employed, consisting of 10 treatments replicated three times. The treatments were allocated randomly within each replication. The Bottle gourd plants were cultivated in plots measuring 2m x 2m, resulting in a total plot size of 20m x 6m. The spacing between plants was set at 200cm, while the distance between rows was 60cm. The experimental field covered a gross area of 184m², with a net area of 120m². A total of 180 plants were distributed in the field, with six plants in each plot. The row-to-row distance was 3m. The experiment was conducted at the Horticulture Research Farm, Department of Horticulture, SHUATS, located in Prayagraj, Uttar Pradesh. The 10 treatments were assigned notation codes and included different combinations of primary and secondary branch cutting percentages. Treatment T0 involved no cutting, while T1 to T9 comprised varying degrees of primary (25%, 50%, or 75%) and secondary (25%, 50%, or 75%) branch cutting. The experimental field layout was organized according to the randomized block design, ensuring a comprehensive evaluation of the treatments and their effects on Bottle gourd cultivation.

Comment [7]: It is recommended to insert comparative photos of plants with different treatments in intermediate stages of growth and mandatory before harvesting.

Comment [8]: 184 m² ?

Comment [9]: 120 m² ?

Table 1.0 List of treatments

S. No	Treatment name	Notation
1	No cutting	T0
2	Primary branch cutting 25% of the length + secondary branch cutting 25% of the length	T1
3	Primary branch cutting 25% of the length + secondary branch cutting 50% of the length	T2
4	Primary branch cutting 25% of the length + secondary branch cutting 75% of the length	T3
5	Primary branch cutting 50% of the length + secondary branch cutting 25% of the length	T4
6	Primary branch cutting 50% of the length + secondary branch cutting 50% of the length	T5
7	Primary branch cutting 50% of the length + secondary branch cutting 75% of the length	T6
8	Primary branch cutting 75% of the length + secondary branch cutting 25% of the length	T7

Comment [10]: Why not Table 1?

Comment [11]: The tables are not cited in the text of the manuscript.

9	Primary branch cutting 75% of the length + secondary branch cutting 50% of the length	T8
10	Primary branch cutting 75% of the length + secondary branch cutting 75% of the length	T9

3. RESULTS AND DISCUSSION

The study investigated the impact of 3G cutting on the growth, yield, quality, and economic parameters of bottle gourd. The results showed that T1 (Primary branch cutting 25% + secondary branch cutting 25%) had the most favourable outcomes across various parameters. T1 exhibited enhanced growth, with longer vines, increased branch development, and faster flower emergence. It also showed superior yield characteristics, including a higher number of fruits per plant, larger fruit size, and higher fruit yield per plant and per hectare. Moreover, T1 demonstrated improved quality attributes, such as higher vitamin C content and total soluble solids. Economically, T1 resulted in higher gross and net returns per hectare and a favourable benefit-cost ratio. These findings highlight the positive influence of 3G cutting on bottle gourd cultivation, emphasizing the importance of optimizing pruning treatments and growth regulator application for maximizing growth, yield, and economic profitability.

3.1 Influence of 3G cutting in Bottle Gourd for Growth and floral Parameters:

The study investigated the impact of 3G cutting on various growth parameters of bottle gourd. Vine length measurements revealed that the control group (T0) had the longest vines (6.91m), followed by T1 (6.84m), T2 (6.44m), and T4 (6.14m) (Mir et al., 2019). T9 exhibited the shortest vine length (4.59m), suggesting that 3G cutting stress might impede normal plant growth. Analysis of second-generation branches indicated that T1 had the highest branch count (6.47), followed by T2 (6.34) and T0 (6.13), while T9 had the lowest count (3.13). Pruning treatments, combined with factors like minimum spacing and early vine pruning, stimulated branch development (Zafari et al., 2019). The study also examined third-generation branches, finding that T1 had the highest count (11.67), followed by T2 (10.61) and T0 (10.19), with T9 exhibiting the lowest count (3.81) (Ratnamala et al., 2014; Singh and Singh, 2011; Devi et al., 2016). Factors such as carbohydrate translocation hindrance, higher auxin levels, and starch hydrolysis contributed to increased branch numbers. Regarding flower emergence, T1 had the shortest duration to first male flower emergence (38.19 days),

followed by T2 (39.37 days) and T0 (39.86 days), while T9 had the longest (43.74 days). Pruning treatments and growth regulator usage contributed to faster flowering response (Ratnamala *et al.*, 2014; Singh and Singh, 2011). In terms of first female flower emergence, T1 had the shortest duration (41.48 days), closely followed by T2 (42.39 days) and T0 (42.91 days), with T9 having the longest duration (52.57 days). The shorter duration in T1 suggested enhanced nutrient utilization through growth regulators, resulting in earlier flower emergence. The study recorded the number of male and female flowers as well. T1 had the highest number of male flowers (86.43), followed by T0 (84.36), while T2 had the lowest (63.19). For female flowers, T1 had significantly the highest number (27.65), followed by T2 (19.75), with T0 exhibiting the lowest count (13.39). The involvement of auxin and growth of third-generation branches in the 3G cutting treatment likely contributed to the increased number of male and female flowers. Regarding the sex ratio, T1 had the significantly lowest ratio (3.13), followed by T2 (3.20), while T0 had the highest ratio (6.30). These findings indicated that the 3G cutting treatment exhibited a lower male to female flower ratio compared to the no pruning and no fertilizer treatment. The study also recorded the number of days to first fruit setting and first fruit picking. T1 had significantly the shortest duration to first fruit setting (45.43 days) and first fruit picking (53.41 days), followed by T2, T0, and T4, which showed similar results. The longest durations were observed in T9. Specific pruning treatments and other factors promoted earlier fruit development. In conclusion, 3G cutting had both positive and negative effects on the growth parameters of bottle gourd. Pruning treatments stimulated branch and flower development, leading to earlier fruit development. Further research is needed to optimize pruning treatments and growth regulator application for maximizing bottle gourd growth.

3.2 Influence of 3G cutting in Bottle gourd on Yield and Quality parameters:

The influence of 3G cuttings on yield parameters in bottle gourd was investigated, and T1 (Primary branch cutting 25% + secondary branch cutting 25%) demonstrated superior performance across various parameters. T1 had the highest number of fruits per plant, significantly higher fruit weight, larger fruit diameter, longer fruit length, and higher fruit yield per plant and per hectare. T2 also performed well in most parameters, while T9 consistently had the lowest values. In terms of fruit production, T1 exhibited the highest number of fruits per plant, followed by T2 and T0, while T9 had the lowest number of fruits per plant. Additionally, T1 had significantly higher fruit weight (893.73g) compared to T2

and T0, with T9 recording the lowest fruit weight (708.93g). T1 also demonstrated significantly larger fruit diameter (6.72), followed by T2 (6.24), while T2 had the smallest fruit diameter (5.30). Furthermore, T1 had the significantly longest fruit length (39.20cm), followed by T2 (36.60cm), while T2 exhibited the shortest fruit length (30.73cm). In terms of yield, T1 achieved the highest fruit yield per plant (5.95kg), followed by T2, while T9 had the lowest fruit yield (3.50kg). T1 also achieved the significantly highest fruit yield per hectare (29.74t), followed by T2, with T9 having the lowest fruit yield (17.49t). These remarkable outcomes in T1 can be attributed to the effect of 3G cutting, which stimulates processes such as cell separation, enlargement, protein synthesis, and an optimal concentration of auxin. These factors contribute to accelerated root and lateral shoot growth, increased leaf and flower production, enhanced fruit set, and improved vegetative growth, ultimately resulting in higher yields. The findings of this study align with previous research conducted by Devi et al. (2016), Chaurasiya et al. (2020), Chapagain *et al.* (2022), Shivaraj *et al.* (2018), and Mardhiana *et al.* (2017) in terms of the number of fruits per plant, fruit weight, fruit diameter, fruit length, and yield per plant and per hectare. These studies also support the notion that 3G cuttings positively impact various yield parameters in bottle gourd. Furthermore, the influence of 3G cuttings on quality parameters in bottle gourd was also examined. T1 exhibited the highest Vitamin C content (11.95 mg/100 g) and total soluble solids (TSS) of 3.60 oBrix, followed by T2 (Vitamin C: 11.82 mg/100 g, TSS: 3.23 oBrix), with T0 (Vitamin C: 11.76 mg/100 g, TSS: 3.11 oBrix) being statistically similar. T9 consistently displayed the lowest values for Vitamin C (11.02 mg/100 g) and TSS (1.98 oBrix). The enhanced availability of essential nutrients, particularly nitrogen and potassium, through the application of 3G cuttings likely contributed to these improvements in quality parameters. Similar findings have been reported in previous studies by Singh *et al.* (2021), Ali *et al.* (2016).

3.3 Influence of 3G cuttings on Economic Analysis in Bottle gourd

The study evaluated the economics of bottle gourd cultivation with the application of 3G cutting. The results showed that the total cost of cultivation was INR 1,22,643, which included expenses for agronomical practices, protection measures, land rent, labor, and machinery.

In terms of gross returns per hectare, T1 demonstrated the highest value of INR 4,46,065.23, indicating that the implementation of 3G cutting had a positive impact on yield. T2 followed

closely with gross returns of INR 4,20,571.87. These findings suggest that the pruning treatments and growth regulator usage in T1 and T2 contributed to improved production.

Net returns per hectare, which take into account the total cost of cultivation, showed a similar trend. T1 achieved the highest net returns of INR 3,23,422.43, followed by T2 with INR 2,97,929.07. This indicates that despite the expenses associated with 3G cutting, the resulting increase in yield and market value outweighed the costs. On the other hand, T9 exhibited the lowest gross and net returns, suggesting that the 3G cutting treatment in this group may not have been as effective in terms of economic outcomes. Further analysis and investigation are required to identify the specific factors that led to the lower returns in T9. The benefit-cost ratio, which compares the benefits derived from cultivation to the costs incurred, was highest in T1 with a ratio of 3.6, followed by T2 with a ratio of 3.4. These values indicate that for every unit of cost invested, T1 and T2 generated significant returns. In contrast, T9 had the lowest benefit-cost ratio of 2.1, indicating a lower profitability compared to the other treatment groups.

Overall, the findings suggest that 3G cutting, as implemented in T1 and T2, has the potential to enhance the economics of bottle gourd cultivation. The pruning treatments and growth regulator application likely contributed to increased yields and improved market value. However, further research is needed to optimize the implementation of 3G cutting and maximize the economic benefits in bottle gourd cultivation.

4. Conclusion

It is from the present investigation concluded that treatment T1 (Primary branch cutting 25% + secondary branch cutting 25%) was recorded maximum number of female flowers (27.65), number of male flowers (86.43), number of fruits per plant (6.66), yield per plot (5.95kg), yield per hectare (29.74 t/ha), TSS (3.60°Brix) and B:C ratio (3.6).

Sr No	Treatment	Vine length (m)	No of 2 nd Generation branches	No of 3 rd Generation branches	No. of days to 1 st male flower emergence	No. of days to 1 st female flower emergence	No. of Male flowers	No. of female flowers	Sex Ratio	Days to 1 st fruit setting	Days to 1 st fruit picking
1	T ₀	6.91	6.13	10.19	39.86	42.91	84.36	13.39	6.30	48.13	54.33
2	T ₁	6.84	6.47	11.67	38.19	41.48	86.43	27.65	3.13	45.43	53.41
3	T ₂	6.44	6.34	10.61	39.37	42.39	63.19	19.75	3.20	46.89	53.89
4	T ₃	5.61	5.21	6.86	41.28	46.72	67.14	17.67	3.80	50.92	55.69
5	T ₄	6.14	5.87	9.48	40.64	44.16	64.42	18.41	3.50	48.81	54.74
6	T ₅	5.74	5.52	8.67	40.91	44.83	65.77	18.27	3.60	50.67	55.26
7	T ₆	5.16	4.23	5.48	42.88	47.23	67.89	15.79	4.30	53.78	56.47
8	T ₇	5.38	4.67	6.33	42.64	49.27	68.54	16.72	4.10	51.19	57.38
9	T ₈	4.83	3.51	4.79	43.37	51.66	69.27	15.74	4.40	54.88	57.79
10	T ₉	4.59	3.13	3.81	43.74	52.57	70.87	15.41	4.60	55.27	58.37
	F-Test	S	S	S	S	S	S	S	S	S	S
	S. Ed. (±)	0.12	0.10	0.23	0.85	0.67	1.70	0.34	0.06	1.05	1.21
	CD at	0.24	0.21	0.47	1.79	1.41	3.57	0.72	0.13	2.21	2.53

	@5%										
	CV	2.46	2.38	3.54	2.52	1.78	3.05	2.34	1.81	2.54	2.65

Table 2.0 Influence of 3G cutting on Various Growth and Floral Traits in Bottle gourd

Comment [12]: Why not Table 2?

Table 3.0 Influence of 3G cutting on Various Yield and Quality Traits in Bottle gourd

Comment [13]: Why are the titles of tables 1.0, 3.0 and 4.0 written before the tables and the title of table 2.0 after the table?

S No	Treatment	No. of fruits per plant (no)	Fruit weight (gm)	Fruit diameter (cm)	fruit length (cm)	Yield per plot (Kg)	Fruit Yield per Ha (t)	Vitamin C (mg/100 g)	TSS (°Brix)
1	T ₀	6.19	851.47	5.87	34.53	5.27	26.34	11.76	3.11
2	T ₁	6.66	893.73	6.72	39.20	5.95	29.74	11.95	3.6
3	T ₂	6.45	869.53	6.24	36.60	5.61	28.04	11.82	3.23
4	T ₃	5.35	825.93	5.66	32.40	4.42	22.09	11.57	2.55
5	T ₄	5.82	847.67	5.85	33.87	4.93	24.64	11.75	2.95
6	T ₅	5.68	837.73	5.8	32.67	4.76	23.79	11.67	2.8
7	T ₆	5.20	810.8	5.47	31.33	4.21	21.06	11.41	2.32
8	T ₇	5.28	817.27	5.58	31.67	4.31	21.57	11.45	2.46
9	T ₈	5.03	792.67	5.42	31.13	3.99	19.96	11.30	2.13
10	T ₉	4.93	708.93	5.3	30.73	3.50	17.49	11.02	1.98
	F-Test	S	S	S	S	S	S	S	S
	S. Ed. (±)	0.14	18.61	0.14	0.65	0.14	0.69	0.23	0.07
	CD at @5%	0.30	39.11	0.30	1.36	0.29	1.44	0.49	0.15

Comment [14]: Why not Table 3?

	CV	3.06	2.76	2.98	2.38	3.58	3.58	2.48	3.13
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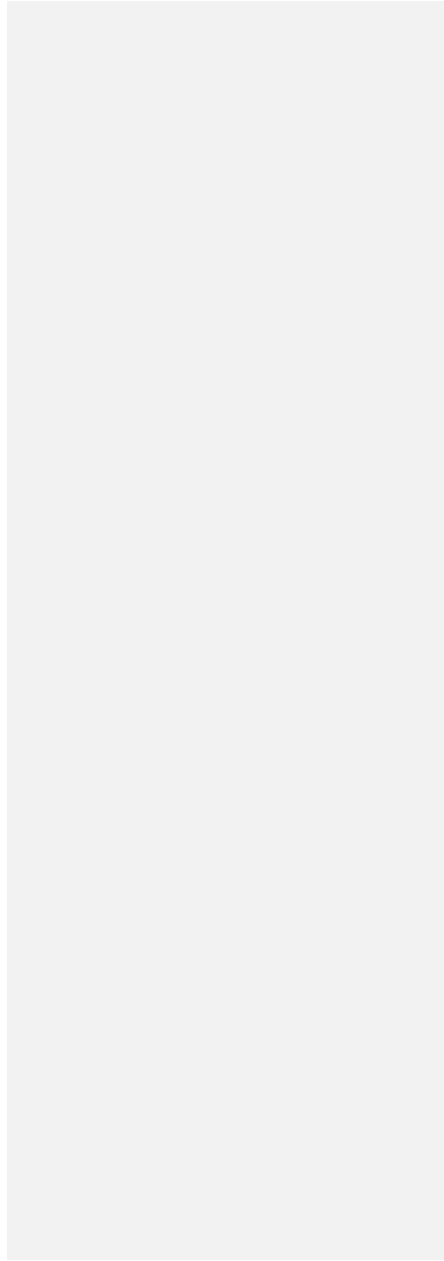


Table 4.0 Why not Influence of 3G cutting on benefit cost ratio of bottle gourd

Comment [15]: Why not Table 4?

Treatments	Fruit Yield (q/ha)	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	Benefit Cost ratio
T0	263.39	122643	395089.95	272447.15	3.2
T1	297.38	122643	446065.23	323422.43	3.6
T2	280.38	122643	420571.87	297929.07	3.4
T3	220.90	122643	331356.06	208713.26	2.7
T4	246.40	122643	369596.76	246953.96	3.0
T5	237.89	122643	356832.78	234189.98	2.9
T6	210.55	122643	315827.35	193184.55	2.6
T7	215.69	122643	323527.95	200885.15	2.6
T8	199.62	122643	299435.33	176792.53	2.4
T9	174.92	122643	262377.48	139734.68	2.1

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Reviewer's additions



Fig. 1

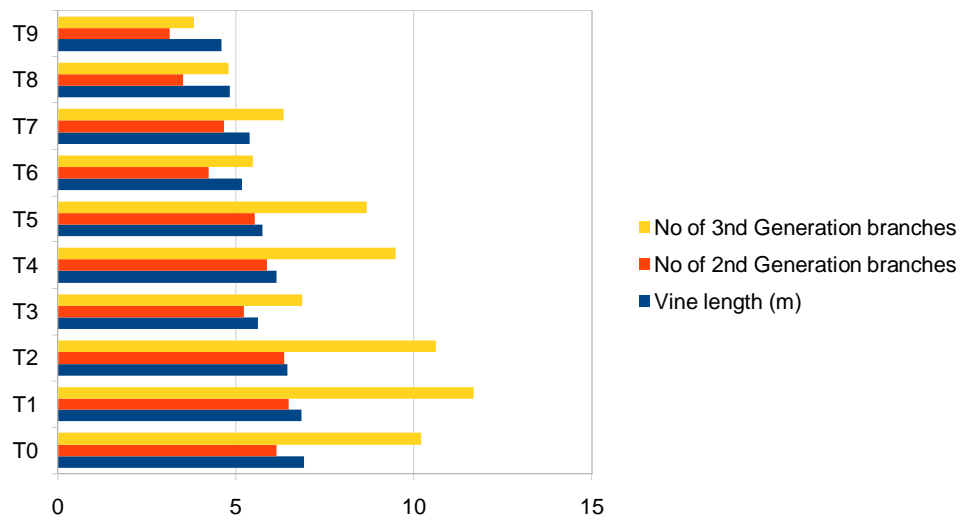


Fig. 2

