International Journal of Plant & Soil Science

Volume 35, Issue 15, Page 407-415, 2023; Article no.IJPSS.101551
ISSN: 2320-7035

Influence of 3G Cuttings in Bottle Gourd (*Lagenaria siceraria*) for Growth, Yield and Fruit Quality

Pathan Nagul Khan [a++*], Vijay Bahadur [b#], V. M. Prasad [b†], Tarence Thomas [c‡], Anita Kerketta [b^] and Shashi Tiwari [d^]

[a] Department of Horticulture (Vegetable Science), Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh, 211007, India.
[b] Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh-211007, India.
[c] Department of Soil Science and Agricultural Chemistry, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh-211007, India.
[d] Department of Plant Pathology, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh-211007, India.

Authors' contributions

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

Article Information

DOI: 10.9734/IJPSS/2023/v35i153121

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://www.sdiarticle5.com/review-history/101551

Original Research Article

Received: 11/04/2023
Accepted: 14/06/2023
Published: 17/06/2023

[++] M.Sc. Scholar;
[#] Associate Professor & Head;
[†] Professor;
[‡] Professor & Head;
[^] Assistant Professor;
**Corresponding author: E-mail: nagulakhan6@gmail.com;*

ABSTRACT

The field experiment entitled “Influence of 3G cutting in Bottle 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 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 (Primary branch cutting 25% of the length + secondary branch cutting 25% of the length) 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 (5.95 kg), yield per hectare (29.74 t/ha), TSS (3.60^{o}Brix) and B:C ratio (3.6) were recorded significantly higher compared to other treatments.

Keywords: 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 [1]. 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. 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. 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.

2. MATERIALS AND METHODS

The experiment was conducted during the year 2022-23 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 250.8ºN latitude and 810.50ºE 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 1ºC-2ºC during winter season especially in the month of

Table 1. List of treatments

S. No	Treatment name	Notation
1	No cutting	T_0
2	Primary branch cutting 25% of the length + secondary branch cutting 25% of the length	T_1
3	Primary branch cutting 25% of the length + secondary branch cutting 50% of the length	T_2
4	Primary branch cutting 25% of the length + secondary branch cutting 75% of the length	T_3
5	Primary branch cutting 50% of the length + secondary branch cutting 25% of the length	T_4
6	Primary branch cutting 50% of the length + secondary branch cutting 50% of the length	T_5
7	Primary branch cutting 50% of the length + secondary branch cutting 75% of the length	T_6
8	Primary branch cutting 75% of the length + secondary branch cutting 25% of the length	T_7
9	Primary branch cutting 75% of the length + secondary branch cutting 50% of the length	T_8
10	Primary branch cutting 75% of the length + secondary branch cutting 75% of the length	T_9

December and January. The mercury rises up to 46ºC-48ºC during summer the average rain fall in this area is around 1013.4nm 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.

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.

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 and floral parameters of bottle gourd statistically analysed and presented in Table 2. The Vine length measurements revealed that the control group (T_0) had the longest vines (6.91m), followed by T_1 (6.84m), T_2 (6.44m), and T_4 (6.14m) [2]. T_9 exhibited the shortest vine length (4.59m), suggesting that 3G cutting stress might impede normal plant growth. Analysis of second-generation branches indicated that T_1 had the highest branch count (6.47), followed by T_2 (6.34) and T_0 (6.13), while T_9 had the lowest count (3.13). Pruning treatments, combined with factors like minimum spacing and early vine pruning, stimulated branch development [3]. The study also examined third-generation branches, finding that T_1 had the highest count (11.67), followed by T_2 (10.61) and T_0 (10.19), with T9 exhibiting the lowest count (3.81) [4-7]. Factors such as carbohydrate translocation hindrance, higher auxin levels, and starch hydrolysis contributed to increased branch numbers. Regarding flower emergence, T_1 had the shortest duration to first male flower emergence (38.19 days), followed by T_2 (39.37 days) and T_0 (39.86 days), while T_9 had the longest (43.74 days). Pruning treatments and growth regulator usage contributed to faster flowering response [4,5]. In terms of first female flower emergence, T_1 had the shortest duration (41.48 days), closely followed by T_2 (42.39 days) and T_0 (42.91 days), with T9 having the longest duration (52.57 days). The shorter duration in T_1 suggested enhanced nutrient utilization through growth regulators, resulting in earlier flower emergence. The study recorded the number of male and female flowers as well. T_1 had the highest number of male flowers (86.43), followed by T_0 (84.36), while T_2 had the lowest (63.19). For female flowers, T_1 had significantly the highest number (27.65), followed by T_2 (19.75), with T_0 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, T_1 had the significantly lowest ratio (3.13), followed by T_2 (3.20), while T_0 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. T_1 had significantly the shortest duration to first fruit setting (45.43 days) and first fruit picking (53.41 days), followed by T_2, T_0, and T_4, 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 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, statistically analysed and presented in Table 3. T_1 (Primary branch cutting 25% of the length + secondary branch cutting 25% of the length) demonstrated superior performance across various parameters. T_1 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. T_2 also performed well in most parameters, while T_9 consistently had the lowest values. In terms of fruit production, T_1 exhibited the highest number of fruits per plant, followed by T_2 and T_0, while T_9 had the lowest number of fruits per plant. Additionally, T1 had significantly higher fruit weight (893.73g) compared to T_2 and T_0, with T9 recording the lowest fruit weight (708.93g). T_1 also demonstrated significantly larger fruit diameter (6.72), followed by T_2 (6.24), while T_2 had the smallest fruit diameter (5.30). Furthermore, T_1 had the significantly longest fruit length (39.20cm), followed by T_2 (36.60cm), while T_2 exhibited the shortest fruit length (30.73cm). In terms of yield, T1 achieved the highest fruit yield per plant (5.95kg), followed by T_2, while T_9 had the lowest fruit yield (3.50kg). T_1 also achieved the significantly highest fruit yield per hectare (29.74t), followed by T_2, with T_9 having the lowest fruit yield (17.49t). These remarkable outcomes in T_1 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

Table 2. Influence of 3G cutting on Various Growth and Floral Traits in Bottle gourd

S. No	Treatment	Vine length (m)	No of 2nd Generation branches	No of 3nd Generation branches	No. of days to 1st male flower emergence	No. of days to 1st female flower emergence	No. of Male flowers	No. of female flowers	Sex Ratio	Days to 1st fruit setting	Days to 1st 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 @5%	0.24	0.21	0.47	1.79	1.41	3.57	0.72	0.13	2.21	2.53
	CV	2.46	2.38	3.54	2.52	1.78	3.05	2.34	1.81	2.54	2.65

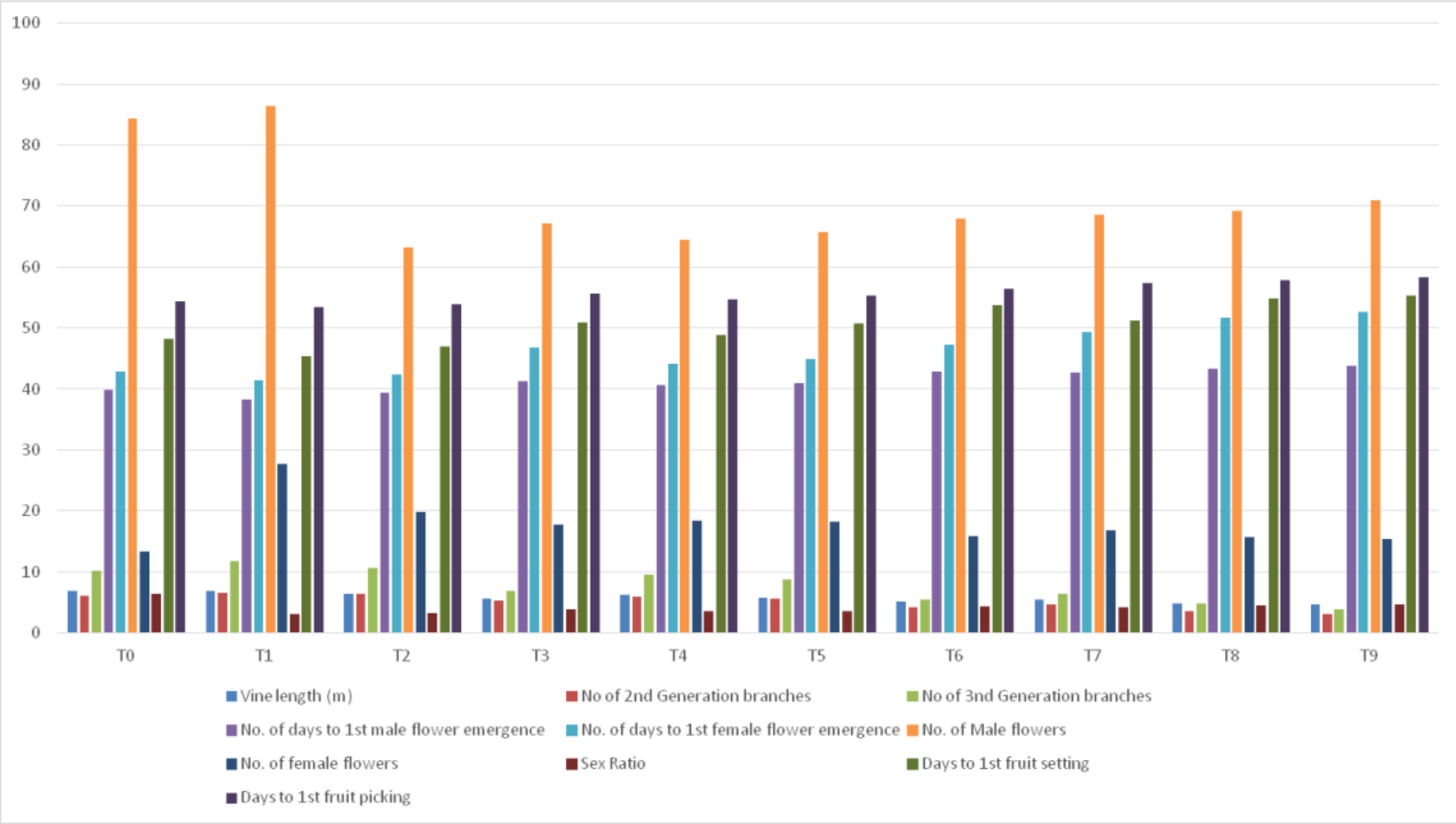

Fig. 1. Influence of 3G cutting on Various Growth and Floral Traits in Bottle gourd

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

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 (^{o}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
	CV	3.06	2.76	2.98	2.38	3.58	3.58	2.48	3.13

Table 4. Influence of 3G cutting on benefit cost ratio of bottle gourd

Treatments	Fruit Yield (q/ha)	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	Benefit Cost ratio
T_0	263.39	122643	395089.95	272447.15	3.2
T_1	297.38	122643	446065.23	323422.43	3.6
T_2	280.38	122643	420571.87	297929.07	3.4
T_3	220.90	122643	331356.06	208713.26	2.7
T_4	246.40	122643	369596.76	246953.96	3.0
T_5	237.89	122643	356832.78	234189.98	2.9
T_6	210.55	122643	315827.35	193184.55	2.6
T_7	215.69	122643	323527.95	200885.15	2.6
T_8	199.62	122643	299435.33	176792.53	2.4
T_9	174.92	122643	262377.48	139734.68	2.1

yields. The findings of this study align with previous research conducted by Devi et al. [6], Chaurasiya et al. [8], Chapagain et al. [9], Shivaraj et al. [10], and Mardhiana et al. [11] 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. T_1 exhibited the highest Vitamin C content (11.95 mg/100 g) and total soluble solids (TSS) of 3.60 oBrix, followed by T_2 (Vitamin C: 11.82 mg/100 g, TSS: 3.23 oBrix), with T_0 (Vitamin C: 11.76 mg/100 g, TSS: 3.11 oBrix) being statistically similar. T_9 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. [12], Ali et al. [13].

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. statistically analysed and presented in Table 4. The results showed that the total cost of cultivation was INR 122643, 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 446065.23, indicating that the implementation of 3G cutting had a positive impact on yield. T2 followed closely with gross returns of INR 420571.87. 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 323422.43, followed by T2 with INR 297929.07. 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 T_9. The benefit-cost ratio, which compares the benefits derived from cultivation to the costs incurred, was highest in T_1 with a ratio of 3.6, followed by T_2 with a ratio of 3.4. These values indicate that for every unit of cost invested, T_1 and T_2 generated significant returns. In contrast, T_9 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 T_1 and T_2, 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 [14].

4. CONCLUSION

It is from the present investigation concluded that treatment T1 (Primary branch cutting 25% + secondary branch cutting25%) 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^{o}Brix) and B:C ratio (3.6).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Harika M, Gasti VD, Shantappa T, Mulge R, Shirol AM, Mastiholi AB, Kulkarni MS. Evaluation of bottle gourd genotypes (*Lagenaria siceraria* (Mol.) Standl.) for various horticultural characters. Karnataka Journal of Agricultural Sciences. 2012; 25(2):241-244.
2. Mir AA, Sadat MA, Amin MR, Islam MN. Pruning: A mechanical stress inducing method to improve growth and yield of bangaldeshi local cucumber variety “Baromashi”. International Journal of Business, Social and Scientific Research. 2019;7(4):31-35.
3. Zafari, M., Pawar, C., Surve, N.R. 2019. Studies on the effect of spacing and

pruning on growth parameters of bottle gourd (Lagenaria siceraria) Var. Samrat under Konkan agro-climatic condition. Int. J. Chemical studies.7(5): 1039-1045.

4. Ratnamala M, Prasannakumar B, Swami DV, Salomi Sumitha DR. Effect of auxins and type of cutting on propagation of phalsa (*Grewia subinaequalis* DC.) under shade net condition. Green Farming. 2014;5(3):419-423.
5. Singh N, Singh BP. Effect of different concentrations of indole butyric acid (IBA) on sprouting, rooting and callusing potential of bougainvillea stem cuttings. The Asian J Hort. 2011;6(1): 229-230.
6. Devi J, Bakshi P, Wali VK, Kour K, Sharma N. 2016. Role of auxin and dates of planting on growth of cutting raised plantlets of Phalsa (*Grewia asiatica* L.). The Bioscan. 2016;11(1):535-537.
7. Ndereyimana A, Waweru BW, Kagiraneza B, Niyokuri AN, Rukundo P, Hagenimana G. Effect of vine and fruit pruning on yield attributes of two watermelon (*Citrus lanatus*) cultivars. Adv. Hort. Sci. 2021; 35(3):269-275.
8. Chaurasiya DK, Kumar M, Sahni S, Singh S. 3G Cutting: A Wonderful Technique to Redouble the Production of Cucurbits. Biotica Research Today. 2020;2(12): 1308-1310.
9. Chapagain U, Bhandari S, Shreshtha YM, Bista S, Dahal J. Effect of Pruning and Fertilizers on Growth, Flowering and Yield of Cucumber (*Cucumissativus* L.) under Protected Structure in Panchthar, Nepal. Int. J. Appl. Sci. Biotechnol. 2022;10(3): 171-181.
10. Shivaraj D, Lakshminarayana D, Prasanth P, Ramesh T. Studies on the effect of pruning on Cucumber cv. Malini grown under protected conditions. Int. J. Curr. Microbiol. App. Sci. 2018;7 (3):2019-2023.
11. Mardhiana, Pradana AP, Adiwena M, Kartina, Santoso D, Wijaya R, Maliki A.. Effects of pruning on growth and yield of cucumber (*Cucumis sativus*) mercy variety in the acid soil of North Kalimantan, Indonesia; 2017.
12. Singh V, Kumar S, Sahu, MP, Patel R. 3G cutting Technique for increasing yield in the crops of Cucurbitaceae family. Krishi Science. 2021;2(6):22-24.
13. Ali MR, Halim, GMA, Mehraj H. Stages of vine pruning for vine production of bottle gourd varieties and lines in summer season. J. Biosci. Agri. Res. 2016;9(1):792
14. Kandasamy RE, Arivazhagan, Bharathi SS. Evaluation of growth and yield characters in bottle gourd (*Lagenaria siceraria* (Mol) Standl). Journal of Pharmacognosy and Phytochemistry. 2019;8(3):4653-4655.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/101551