International Journal of Plant & Soil Science

34(20): 320-325, 2022; Article no.IJPSS.88465
ISSN: 2320-7035

Effect of Different Growth Regulators on Plant Growth and Yield of Bottle Gourd (*Lagenaria siceraria* L.) cv. Arka Bahar

Anna Sabu [a*φ], Anita Kerketta [a#] and Samir E. Topno [a#]

[a] *Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj-211007 (UP), 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/2022/v34i2031158

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/88465

Original Research Article

Received 09 April 2022
Accepted 18 June 2022
Published 21 June 2022

ABSTRACT

An experiment was conducted during 2021 to study the effect of different growth regulators on bottle gourd cv. Arka Bahar during kharif season with three growth regulators at different concentrations: Ethrel (100ppm, 200ppm, 300ppm), NAA (150 ppm, 200ppm, 250ppm) and GA_3 (50ppm, 100ppm, 150ppm).Water was used as control. The growth regulators were sprayed at two and four leaf stage. All the treatments were replicated three times in a randomized block design keeping the plot size 2m×2m. Plant growth regulators treatments rendered their significant effect on almost all the growth, flowering and yield of bottle gourd. The treatment T_9 GA_3 150 ppm was found maximum in increasing the vine length (9.01m) whereas T_3 Ethrel 200 ppm was found most effective in terms of days to first appearance of male (40.89 days) and female flower (45.44 days), node number to first male (8.11) and female flower (10.11), number of male (16.33) and female flowers (11.33) per vine, fruit diameter (8.67 cm), fruit length (39.84 cm), fruit weight (1064.28 g), number of fruits per plant (10.11), fruit yield per plant (8.72 kg), fruit yield per hectare(29.01 t/ha) The significantly higher gross return (Rs 348120/ha), Net profit (Rs 269898/ha) and B: C ratio (4.45) was also recorded under ethrel 200 ppm (T_3). Overall results revealed that application of ethrel 200 ppm proved to be better for different growth and yield traits in bottle gourd.

[φ] *M.Sc. Scholar,*
[#] *Assistant Professor,*
**Corresponding author: E-mail: annasabu12345@gmail.com;*

Keywords: Bottle gourd; Ethrel; growth regulators; GA_3; NAA; yield.

1. INTRODUCTION

Bottle gourd (*Lagenaria siceraria* L.) is an important vegetable crop belonging to the cucurbitaceae family having a chromosome number 2n=22.It is commonly known as *calabash gourd, white flower gourd plant, Lauki, kadu, ghiya* or *doodhi.* It is grown extensively in India, might have originated in Tropical Africa. It is a vegetable with a good source of carbohydrates, vitamin A, vitamin C and minerals [1]. It has pan-tropical distribution with regional economic importance and is used as a vegetable, container, musical instrument while its seeds are used for oil and protein [2]. Bottle gourd has relatively high nutritional value. The fruit contain moisture (96.3%), carbohydrates (2.9) protein (0.2%), fat (0.5%), mineral matter (0.5%) and 11 mg of vitamin C (Ascorbic acid) per 100g fresh weight and a good source of glucose and fructose [3]. This vegetable has been conventionally utilised for medicinal purposes like cardio tonic, cardio protective, aphrodisiac, diuretic, and antidote to certain poisons (Belhekar et al*.,* 2008). The plant extract is used as a cathartic and seeds are used in dropsy. In addition, the seeds and the seed oil is edible. It has anti-hyperlipidemic activity [4].

Plant growth regulators are important due to their direct effect on male and female flower production; better fruit set, and ultimately on yield (Bose et al*.,* 1999). Ethrel is an important growth regulator which is used for more production of female flowers due to its property of better development of gynoecium, fruit ripening, stress induction, lateral cell expansion [5]. It stimulates flower opening, adventitious root senescence; activate enzymes in respiration, inducing branching. NAA is a growth promoter stimulates cell division, cell elongation of shoot, photosynthesis, RNA synthesis, enhances leaf are index, leaf chlorophyll content [6]. GA_3 enhances more cell division, cell wall elongation, cell wall plasticity and permeability of cell membranes, induced parthenocarpy and modify yield contributing characters of plant [7]. Therefore the uses of plant growth regulators like NAA, Ethrel and GA_3 in bottle gourd may become an important tool for increasing flowers as well as timely harvest [8]. Keeping this in view, the experiment was undertaken to study the effect of different growth regulators (Ethrel, NAA, GA_3) on plant growth and yield of bottle gourd and to evaluate the suitable dose along with economic feasibility of different treatments.

2. MATERIALS AND METHODS

The experiment was conducted at Experimental Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) during 2021 during Kharif season in India.

The experiment material consist of Arka Bahar variety of bottle gourd, which is released from Indian Institute of Horticultural Research, Karnataka. The soil of the experiment field was alkaline, sandy loam and pH of 7.2. The pit was dug with 30×30×30 cm^3 and applied dose of FYM is 20 tonnes/ha and N, P, K is 120 kg, 60kg and 60kg/ha respectively. The experiment was laid out in randomized block design with three replications consisting of 10 treatments having one control (water spray), three levels of each Ethrel (100, 200 and 300ppm), NAA (150,200 and 250 ppm) and GA_3 (50, 100 and 150 ppm). The plot size was 2m×2m with 2m×1.5m spacing rows and plants. Two successive sprays of growth regulators were done at 2, 4 leaf stages on the crop plants in all treatments during the morning hours of the day. Statistical analysis of variance was performed on the data collected throughout the experiment. The observation were recorded for vine length (m), days to appearance of first male and female flower, node number to first male and female flower, total number of male and female flower per vine, fruit diameter (cm), fruit length (cm), fruit weight (g), no of fruits per vine, fruit yield per plant(kg), fruit yield per hectare (t/ha). The significance of the treatments was determined using the ‘F’ test at a level of significance of 5%.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The data on growth parameters in different treatment combinations was recorded (Table 1). Vine length was increased significantly by plant growth regulator application compared to control in the analysis of data. The maximum vine length was recorded in T_{10} GA_3 150 ppm (9.01m) being significantly superior while minimum to the T_1 control (5.83m). Growth regulators significantly reduced the number of days for appearance of first male flower in T_3 Ethrel 200 ppm (40.89 days). T_3 Ethrel 200 ppm (45.44 days) significantly reduced the number of days for appearance of first female flower. Node number of first male flower was significantly reduced by growth regulators and the lowest was in Ethrel 200 ppm (8.11). Similarly, Ethrel 200 ppm significantly decreased the node number of first female flower (10.11). The analysis data of number of male and female flowers per vine showed the significant results. The minimum number of male flowers per vine recorded followed by in T_3 ethrel 200 ppm (16.33) and the maximum in T_1 Control (32.44). The maximum number of female flowers per vine recorded followed by in T_3 ethrel 200 ppm (11.33) and the minimum in T_1 Control (7.00).

The increased vine length in GA_3 and NAA was due to mechanism in stimulating auxin production, cell division, cell elongation, increases plant height and extending growth of shoots that enhance the vegetative growth of plant [9]. Komal et al*.,* (2019) showed that GA_3 was most effective in increasing the length of vine. Ethrel might have reduced the growth of vine length and induction of dwarfism which might due to the decrease in level of gibberelin as also reported by Arora et al. [10].

Ethrel helps in stimulating the initiation of flowers and stimulates the flower opening. Randhir Kumar et al*.,* (2019) caused the reduction of days for the first male flower appearance which was also in the agreement with those of Baruas and Das et al*.,* (1997) in bottle gourd. The increase of starch and carbohydrate due to the ethrel application resulted in earliest production of female flowers. Abdul Majid Ansari et al*.* [11] revealed that the application of ethrel 100 ppm reduced the minimum days to appearance of female flower in bottle gourd. Similar results were found in the findings of Sidhu et al., [12]. Application of ethrel caused reduction of Node number of first male flower. Similar results also reported by Sidhu et al*.* [12 in Muskmelon and Node number of first female flower Similar results also reported by Chowdhary et al*.* [13] in bottle gourd.

Sanjeevan Gosai et al*.* [14] observed that Ethrel was found effective in decreasing the number of male or staminate flowers per vine. Similar results were also observed by Ghani et al. [15] in bitter gourd (*Momordica charantia*). Sexual differentiation is controlled by endogenous levels of auxin which are altered by the ethrel, which developed flowering primordia and during flowering act as anti-gibberellin substance. This anti-gibberellin effect suppressed staminate flowers and promotes more pistillate flowers and ethrel was found most effective in increasing flowers per vine in the experiment showed by Patel A N et al*.,* (2017). Similar results were also observed by Sulochanamma et al*.* [16] in muskmelon (*Cucumis melo*).

3.2 Yield Parameters

The exogenous application of plant growth regulators at 2 and 4 leaf stages significantly affected the yield characters of bottle gourd as shown in table 2. The maximum fruit diameter (8.67cm) was found in ethrel 200 ppm (T_3) which is significantly at par with by T_2 ethrel 100 ppm (8.32 cm) and the minimum was in control (6.43cm). Length of the fruit increased significantly with plant growth regulator maximum (39.84 cm) long fruits with the application of ethrel 200 ppm (T_3) and the shortest length was in control (29.44 cm). The maximum fruit weight was increased significantly by the application of ethrel and the minimum fruit weight was in control (605.13).The analysis data of number of fruits per plant showed the significant results. The maximum number of fruits per plant recorded followed by in T_3 ethrel 200 ppm (10.11) and the minimum in T_1 Control (6.22). The data revealed that fruit yield of bottle gourd per plant was significantly increased by various treatments. The maximum Fruit yield per plant (kg) recorded in followed by in T_3 ethrel 200 ppm (8.72kg) and the minimum in T_1 Control (4.67 kg). The data of total fruit yield hectare (t/ha) varied from 15.56 t/ha to29.01 t/ha. The maximum fruit yield per hectare (t/ha) recorded T_3 ethrel 200 ppm (29.01 t/ha) followed by T_2 ethrel 100 ppm (26.49 t/ha) and the minimum in T_1 Control (15.56 t/ha).

The length of the fruit with the application of ethrel might be due to cell enlargement as well as activation of metabolic activity of fruit. Length of fruit significantly with ethrel which was revealed by B M Chowdhary et al*.* [13. This was in accordance with the Prasad et al*.* [17] in bottle gourd. Prakash Mahala et al*.* [18] ethrel applied at the 2,4 leaf stage on bottle gourd in significantly higher fruit weight was found in ethrel. The increase in fruit weight by the application of ethrel is due to the plant remained physiologically more active to build up sufficient food stock for developing flowers and fruits, ultimately leading to higher fruit weight [19-22].

Table 1. Effect of different growth regulators on growth traits of Bottle gourd (*Lagenaria siceraria* L.) cv Arka Bahar

Treatments	Treatment combinations	Vine length (m)	Days to first appearance of male flower	Days to first appearance of female flower	Node number to first male flower	Node number to first female flower	Number of male flowers per vine	Number of female flowers per vine
T_1	Control	5.83	50.78	55.44	12.44	15.22	32.44	7.00
T_2	Ethrel 100 ppm	6.32	41.33	47.11	8.44	11.14	18.33	10.22
T_3	Ethrel 200 ppm	6.82	40.89	45.44	8.11	10.11	16.33	11.33
T_4	Ethrel 300 ppm	7.52	42.22	47.56	8.67	11.56	20.22	9.11
T_5	NAA 150 ppm	7.26	48.89	54.56	9.22	14.33	31.33	7.67
T_6	NAA 200 ppm	7.96	43.78	52.44	11.22	12.56	24.89	7.89
T_7	NAA 250 ppm	8.08	44.67	53.56	10.11	13.11	25.78	9.00
T_8	GA_3 50 ppm	8.16	46.22	52.89	10.67	13.22	29.11	7.22
T_9	GA_3 100 ppm	8.64	44.56	51.22	9.89	12.44	27.22	8.00
T_{10}	GA_3 150 ppm	9.01	42.33	52.22	11.56	13.67	22.67	8.11
	S.Ed. (±)	**0.19**	**0.63**	**0.83**	**0.20**	**0.32**	**0.37**	**0.32**
	C.D (P=0.05)	**0.40**	**1.31**	**1.74**	**0.42**	**0.68**	**0.78**	**0.67**
	C.V.	**3.08**	**1.72**	**1.98**	**3.24**	**3.10**	**1.82**	**4.58**

Table 2. Effect of growth regulators on yield traits of Bottle gourd (*Lagenaria siceraria* L.) cv Arka Bahar

Treatments	Treatment combinations	Fruit diameter (cm)	Fruit length (cm)	Fruit weight (g)	No of fruits per plant	Fruit yield per plant (kg)	Fruit yield (t/ha)
T_1	Control	6.43	29.44	605.13	6.22	4.67	15.56
T_2	Ethrel 100 ppm	8.32	36.42	941.11	9.22	7.95	26.49
T_3	Ethrel 200 ppm	8.67	39.84	1064.28	10.11	8.72	29.01
T_4	Ethrel 300 ppm	7.89	30.38	853.11	8.56	7.73	23.55
T_5	NAA 150 ppm	7.49	32.60	811.11	7.22	6.31	20.28
T_6	NAA 200 ppm	7.27	31.61	779.56	6.78	6.09	21.03
T_7	NAA 250 ppm	6.96	33.46	785.33	7.00	5.58	18.59
T_8	GA_3 50 ppm	7.23	32.87	614.44	7.44	5.20	17.46
T_9	GA_3 100 ppm	6.64	31.53	807.00	7.67	6.05	20.14
T_{10}	GA_3 150 ppm	7.47	33.91	834.89	7.56	6.74	22.46
	S.Ed. (±)	**0.12**	**0.78**	**31.42**	**0.30**	**0.17**	**0.59**
	C.D (P=0.05)	**0.26**	**1.64**	**66.01**	**0.62**	**0.37**	**1.24**
	C.V.	**2.01**	**2.88**	**4.75**	**4.66**	**3.53**	**3.35**

These findings are in close consonance with those of Sanjeevan et al*.,* (2020) in cucumber (*Cucumber sativus*). The increase the number of fruits per vine in ethrel was due to better fruit set because of more number of female flowers. Similar results were reported by Mandai et al*.,* (1990) in bottle gourd. The increase in the yield of fruit per plant in ethrel and these findings were in consonance with Parmar et al*.,* (2003) in sponge gourd (*Luffa aegyptica*).

4. CONCLUSION

Based on the present investigation it was concluded among the 10 treatments, the treatment T_3 i.e. application of Ethrel 200 ppm at 2,4 leaf stage was the most beneficial in terms of days to first appearance of male and female flower, node number to first male and female flower, number of male and female flowers per vine, fruit diameter, fruit length , fruit weight , number of fruits per plant, fruit yield per plant, fruit yield per hectare for application in kharif season bottle gourd cultivation for better yield.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hilli JS, Vyakaranahal VS, Biradar DP. Influence of growth regulators and stages of spray on seed quality of Ridge gourd (*Luffa acutangula L*.). Karnataka Journal of Agriculture Science. 2008;21(2):194-197.
2. Kubde MS, Khadabadi SS, Farooqui IA, Deore SL. In-vitro anthelmintic activity of Colocasia esculenta. Der Pharmacia Lettre. 2010;2(2):82-5.
3. Thamburaj S, Singh N. Cucurbitaceous vegetables. Textbook of Vegetables: Tuber Crops and Spices, ICAR Publication, New Delhi. 2005;271-4.
4. Mohale DS, Dewani AP, Saoji AN, Khadse CD. Antihyperlipidemic activity of isolated constituents from the fruits of Lagenaria siceraria in albino rats. International Journal of Green Pharmacy (IJGP). 2008;2(2).
5. Taiz L, Zeiger E. Photosynthesis: physiological and ecological considerations. Plant Physiol. 2002;9:172-4.
6. Kore VN, Khade HP, Nawale RN, Patil RS. Effect of growth regulators on growth, flowering and yield of bottle gourd variety Samrat under Konkan conditions. Journal Soils Crops. 2013;13:18-21.
7. Deepanshu, Pradeep Kumar Singh. Effect of plant growth regulators on quality, yield and growth of bottle gourd (*Lagenaria siceraria*) Ecology, Environment and Conservation. 2017;23(4):2206-2209.
8. Sharma NK, Arora SK. Effect of plant growth substances on growth, yield, flowering, sex expression and fruit yield of bottle gourd. Haryana Journal University of Journal Reasearch. 1998;18(4):291-297.
9. Misra HP, Fridovich I. The role of superoxide anion in the autoxidation of epinephrine and a simple assay for superoxide dismutase. Journal of Biological chemistry. 1972;247(10):3170-5.
10. Arora SK, Pandita ML, Sindhu AS. Effect of maleic hydrazide on vegetative growth, flowering and fruiting of bottle gourd. Scientia Horticulture. 1982;17(3):211-215.
11. Ansari AM, Chowdhary BM. Effect of boron and plant growth regulators on bottle gourd [*Lagenaria siceraria*.]. Journal of Pharmacognosy and Phytochemistry. 2018;1:202-206.
12. Sidhu PS, Gilkes RJ, Cornell RM, Posner AM, Quirk JP. Dissolution of iron oxides and oxyhydroxides in hydrochloric and perchloric acids. Clays and Clay Minerals. 1981;29(4):269-76.
13. Chowdhary B, Babel YS. Studies on sex expression, sex ratio and fruit set as affected by different plant regulator sprays in bottle gourd. Horticulture Science. 1969; 1:61-71.
14. Gosai S, Adhikari S, Khanal S, Bahadur P. Effects of plant growth regulators on growth, flowering, fruiting and fruit yield of cucumber (*Cucumis sativus* L.) Archives of Agriculture and Environmental Science. 2020;5(3):268-274.
15. Ghani MA, Amjad M, Iqbal Q, Nawaz A, Ahmad T. Efficacy of plant growth regulators on sex expression, earliness and yield components in bitter gourd. Pakistan J0urnal of Life Social Science. 2013;11(3):218- 224.
16. Sulochanamma BN. Effect of ethrel on sex expression in muskmelon (*Cucumis melo*) An International Journal of Life Sciences. 2001;29:91-93.
17. Prasad TK, Anderson MD, Stewart CR. Acclimation, hydrogen peroxide, and abscisic acid protect mitochondria against

irreversible chilling injury in maize seedlings. Plant Physiology. 1994;105(2): 619-27.

18. Mahala P, Chowdhary MR. Yadhav TV. Effect of plant growth regulators on growth, yield, quality and economics of bottle gourd. Annuals of agri-bio research. 2014;19(1):137-139.
19. Kumari K, Kant K, Ranjan A, Kumari S, Kumar M, Kumari K. Effect of plant growth regulators on yield and economics of bottle gourd (*Lagenaria siceraria* Standl). Journal of Pharmacognosy and Phytochemistry. 2020;9(2):2068-2070.
20. Mahmood HT, Farooq M, Khokhar MA, Hussain SL. Plant growth regulators affecting sex expression of bottle gourd (*Lagenaria siceraria* Molina) plants Pakistan J. Agric. Res. 2012;25L1.
21. Baruah GK, Das S. Effect of plant growth regulators on growth, flowering and yield of bottle gourd at different sowing dates. Annals of Agricultural Research. 1997;8 (3):371–4.
22. Acharya SK, Thakar C, Brahmbhatt, Joshi, N. Effect of plant growth regulators on cucurbits. Journal of Pharmacognosy and Phytochemistry 2020; 9(4):540-544.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/88465