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Influence of pinching and plant growth regulators on morphological and sex expression of bottle gourd (*Lagenaria siceraria* L.)

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Abstract

A field experiment was conducted for evaluating effect of pinching and PGRs on morphological and sex expression of bottle gourd cv. ABG - 1. The experiment had 2 levels of pinching (no pinching and pinching at 6th node) and 5 levels of PGRs (control, CCC @ 200 ppm, CCC @ 400 ppm, ethrel @ 300 ppm and ethrel @ 600 ppm) laid out in a RBD (Factorial). The pinching treatment significantly influence on morphological characters and sex expressions viz., length of vine, number of primary branches, number of nodes, internodal distance, female flowers, male flowers and sex ratio. Ethrel @600 ppm profoundly influenced the morphological attributes such as vine length, number of nodes and internodal distance. Floral characters viz, maximum number of female flower, minimum male flowers and lowest sex ratio were recorded in ethrel @600 ppm. The interaction effect was found non-significant for all the characters studied.

Keywords: pinching, cycocel, ethrel, sex expression

Introduction

Vegetables are increasingly becoming important as produce for domestic and export markets. They have a great potential to improve the nutrition and thereby health of consumers as most are good sources of vitamins, minerals and proteins needed for the proper functioning and development of the human body. Cucurbitaceous is one of the largest families in vegetable kingdom consisting of largest number of edible type species. Among gourds, bottle gourd [*Lagenaria siceraria* L. $2n = 2x = 22$] commonly known as *lauki*, *kadu*, *ghiya* or *doodhi* 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. Pinching is a form of pruning that encourages secondary and tertiary sprouts on the plant. Pinching is mostly done when the plants are quite small. Pinching maintains a proper balance between the vegetative and reproductive growth to maximize production. Exogenous application of PGRs can alter the sex ratio and sequence, if applied at 2 or 4 true leaf stage, which is the critical stage for suppression or promotion of either sex in cucurbits. Ethrel is the substances that slow down the cell division and cell elongation in meristematic tissue of shoot and regulated the plant height without change in the morphology and physiology of the plant (Hilli *et al.*, 2010)^[8]. Cycocel (CCC) is a plant growth regulator which is anti-gibberelic in nature. It inhibits cell elongation, resulting in thicker stalks, which are more sturdier and is also having the effects like enhancement in numbers of female flowers per vine, low male: female ratio in the cucurbitaceous plants, lesser vine length and also reduces the days to first female flowering which is an essential attribute to high yield and earliness. The effect of pinching and such growth regulators has been a topic of great interest from years, to a number of researchers in India and abroad. However, there is insufficient information regarding the effect of pinching and growth regulators on plant characteristics in bottle gourd.

Material and Methods

A field study was undertaken during summer season of 2016 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari, Gujarat. The experiment was arranged over 10 treatment combinations comprising of 2 levels of pinching (P₀: no pinching and P₁: pinching at 6th node) and 5 levels of plant growth regulators (G₀: control, G₁: CCC @ 200 ppm, G₂: CCC @ 400 ppm,

G₃: ethrel @ 300 ppm and G₄: ethrel @ 600 ppm) laid out in a Randomized Block Design (Factorial concept) with three replications. The pinching operation was done on main vine at 6th node stage. It was carried out by using secateur to remove upper growing portion of vine. CCC (Chlormequat) and Ethrel were applied as foliar application till run-off, with the help of hand sprayer during evening hours. Five tagged vine from each plot were selected for recording observations of morphological and sex expression.

Results and Discussion

Morphological characters

The length of vine differed significantly with respect to pinching at all the four stages of growth (Table 1). The minimum length of vine was recorded 139.73, 198.60, 224.80 and 240.80 cm at 60, 90, 120 days after sowing and at final harvesting, respectively in treatment P₁ (pinching at 6th node). Maximum number of primary branches 6.03, 8.71, 9.37 and 9.67 per vine at 60, 90, 120 DAS and at final harvesting were recorded in P₁ (Pinching at 6th node), respectively. Reduction of the vine length and increase in the number of primary branches per vine can be better explained in the lights of Anand *et al.* (2014) [1] who stated that pinching of vines decrease the vine length due to reduced accumulation of photo assimilates at the tips and increased number of branches. They also mentioned that the increase in number of branches due to pinching can be attributed to diversion of concentrations of auxins from the tips of the lower part of the plant and thereby the plants becomes more active physiologically and thus increasing the number of branches and number of leaves.

Number of nodes and internodal distance were differed significantly in pinching treatment. The maximum number of nodes (164.10) and lowest internodal distance (8.17 cm) were observed in pinching treatment P₁ (pinching at 6th node of the vine). The possible reason for increase in number of nodes and reduced internodal distance can be explained as the number of nodes and internodal distance has direct relationship with increased number of branches, due to

removal of apical portion, which neutralises the effect of apical dominance and thereby promoting laterals on application of pinching treatments. These results are in accordance with those reported by Dalal *et al.* (2006) [4].

The treatment G₄ (ethrel @ 600 ppm) recorded the minimum length of vine (150.83, 207.50, 239.33 and 253.83 cm) at 60, 90, 120 DAS and at final harvesting respectively, which was remained at par with G₃ (ethrel @ 300 ppm). This reduction in length of vine can be attributed to the ethrel suppressing the apical growth of the plant and plant polar auxin transport. These results are in conformity with Singh and Chaudhary (1989) and Arora *et al.* (1982) in summer squash. In case of number of primary branches per vine at final harvesting, G₂ (CCC @ 400 ppm) produced maximum number of primary branches per vine (5.91, 8.43, 9.06 and 9.27) at 60, 90, 120 DAS and at final harvesting respectively, which was remained at par with G₄ (ethrel @ 600 ppm) and G₁ (CCC @ 200 ppm). This may be due to the fact that CCC acts as an anti-mitotic agent, suppressing the apical growth of the main axis and thereby increasing the number of primary branches per vine. The present finding concurs with the result of Thappa *et al.* (2011) [14] in cucumber and Chovatia *et al.* (2010) [3] in bitter melon. The response of different growth regulators on number of nodes and internodal distance at final harvesting was differed significantly. The number of nodes per vine at final harvesting was noted maximum (164.21) in G₄ (ethrel @ 600 ppm) which was at par with G₃ (ethrel @ 300 ppm) and G₂ (CCC @ 400 ppm), likewise the lowest internodal distance (8.72 cm) was observed in G₄ (ethrel @ 600 ppm) that remained at par with G₃ (ethrel @ 300 ppm). This result can be attributed to the reason that application of ethrel inhibits both the cell division and cell elongation in the meristematic shoots resulting in production of shorter shoots and leaves with minimum effect on physiology and morphology of the plant, as reported by Thappa *et al.* (2011) [14] and Rajala and Peltonen (2001) [10].

Table 1: Effect of pinching and plant growth regulators on morphological characters of bottle gourd

	Length of vine (cm)				Number of primary branches				Number of node on stem	Internodal distance (cm)
	60 DAS	90 DAS	120 DAS	Final harvest	60 DAS	90 DAS	120 DAS	Final harvest		
Factor A: Pinching (P)										
No pinching (P ₀)	250.33	309.00	342.07	360.67	4.86	7.07	7.53	7.74	144.11	11.43
Pinching at 6 th node (P ₁)	139.73	198.60	224.80	240.80	6.03	8.71	9.37	9.67	164.10	8.17
S.Em±	4.84	5.39	6.15	6.70	0.18	0.16	0.19	0.18	2.94	0.24
C.D. at 5 %	14.38	16.00	18.26	19.92	0.35	0.49	0.55	0.52	8.75	0.73
Factor B: Plant growth regulators (G)										
Control (G ₀)	233.00	291.00	319.83	340.00	5.05	7.30	7.77	8.01	144.42	10.75
Cycocel @ 200 ppm (G ₁)	221.00	280.50	310.67	327.67	5.42	7.94	8.49	8.79	148.28	10.36
Cycocel @ 400 ppm (G ₂)	199.50	260.00	287.33	305.50	5.91	8.43	9.06	9.27	154.10	9.89
Ethrel @ 300 ppm (G ₃)	170.83	230.00	260.00	276.67	5.25	7.60	8.08	8.38	159.52	9.31
Ethrel @ 600 ppm (G ₄)	150.83	207.50	239.33	253.83	5.60	8.20	8.86	9.09	164.21	8.72
S.Em±	7.66	8.52	9.72	10.60	0.19	0.26	0.29	0.28	4.66	0.39
C.D. at 5 %	22.74	25.30	28.87	31.49	0.55	0.77	0.87	0.83	13.83	1.15
Interaction P*G										
S.Em±	10.83	12.04	13.74	14.99	0.26	0.36	0.41	0.39	6.58	0.55
C.D. at 5 %	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV %	9.61	8.22	8.40	8.63	8.30	8.05	8.48	7.82	7.40	9.65

Floral characters

Number of female flowers, male flowers per vine and sex ratio were differed significantly with application of pinching. Maximum number of female flowers per vine (36.70), maximum number of male flowers per vine (127.00) and

lowest sex ratio (3.57:1) were observed in P₁ (pinching at 6th node). The possible reason for this is the translocation of stored materials and narrowing of C: N ratio which increased the metabolic activity and increased number of branches. The synthesis of certain bioregulators would also have influenced

number of female flowers and their induction at lower nodes as compared to male flowers. This is in conformity with the results reported by Anand *et al.* (2014)^[1] in bottle gourd and Gosselin and Guillaume (1990) in cucumber.

Plant growth regulators treatments were found significant on sex expression of bottle gourd (Table 2). The minimum number of male flowers (109.46) was recorded in CCC @ 400 ppm (G₂) which was remained at par with G₄ (ethrel @ 600 ppm). The action of CCC in increasing the female flowers and reducing the male flowers in bottle gourd might be due to the fact that CCC reduces the catabolic activities inside the plant and act in the same way as that of low temperature and short days. It also reduced the transpiration and other activities and thereby increasing female flowers and reduced the male flowers and ultimately registering the lowest sex ratio. The

maximum number of female flowers (38.43) were recorded in G₄ (ethrel @ 600 ppm) followed by G₂ (CCC @ 400 ppm) and G₃ (ethrel @ 300 ppm) and in accordance to this the sex ratio was lowest (2.97:1) in G₄ (ethrel @ 600 ppm) followed by G₂ (CCC @ 400 ppm). This may be due to the reason that the sexual differentiation is controlled by endogenous levels of auxins 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 number of pistillate flowers, and thus registers lower sex ratio. Also, the increased number of branches has enhanced the number of female flowers per vine. Similar results were also observed by Ghani *et al.* (2013)^[5] in bitter gourd and Sulochanamma (2001)^[12] in musk melon.

Table 2: Effect of pinching and plant growth regulators on sex expression of bottle gourd

Treatments	Number of male flowers	Number of female flowers	Sex ratio
Factor A: Pinching (P)			
No pinching (P ₀)	109.69	29.89	3.78
Pinching at 6 th node (P ₁)	127.00	36.70	3.57
S.Em±	2.14	0.87	0.07
C.D. at 5 %	6.36	2.59	0.20
Factor B: Plant growth regulators (G)			
Control (G ₀)	126.49	25.29	5.03
Cycocel @ 200 ppm (G ₁)	120.26	32.12	3.77
Cycocel @ 400 ppm (G ₂)	109.46	36.29	3.02
Ethrel @ 300 ppm (G ₃)	122.39	34.37	3.58
Ethrel @ 600 ppm (G ₄)	113.15	38.43	2.97
S.Em±	3.38	1.38	0.10
C.D. at 5%	10.05	4.10	0.31
Interaction P*G			
S.Em±	4.79	1.95	0.15
C.D. at 5 %	NS	NS	NS
CV %	7.00	10.15	6.96

Conclusion

The results of the study inferred that the individual effect of pinching and plant growth regulators application had significantly influenced the morphological and floral parameters.

Individually, they have noticeably reduced the vine length, increased the number of primary branches per vine, maximised number of nodes, shortened there in ternodal distance, performed early female flowering, reduced the ratio of male and female flowers and increased the number of female flowers in bottle gourd.

From the above enumeration, pinching at 6th node or foliar application of ethrel @ 600 ppm was found good result with respect to growth and sex expression of bottle gourd.

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