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Influence of pinching and plant growth regulators on morphological and physiological characters of cucumber (*Cucumis sativus* L.)

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Abstract

The possibility of altering the plant frame and physiological aspects during the development of cucumber plant for productivity enhancement and better growth was analyzed using various pinching and PGRs treatments on cucumber cv. Gujarat cucumber-1 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, NAU, Navsari. The experiment was arranged over 15 treatment combinations comprising of 3 levels of pinching (P₀: no pinching, P₁: pinching at 4th node and P₂: pinching at 6th node) and 5 levels of PGRs (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 treatment and the PGRs application significantly influenced the morphological characters such as the length of vine, number of primary branches, number of nodes, internodal distance. All the pinching treatments had significantly influenced the total leaf area and leaf area index of cucumber, while the PGRs failed to have any profound effect on these physiological characters, but significantly enhanced the morphological characters. The interaction effect between pinching and PGRs was found non significant for both the morphological and physiological characters.

Keywords: cucumber, pinching, cycocel, ethrel, nodes, internodes, leaf area index

Introduction

Vegetables are so common in human diet that a meal without a vegetable is supposed to be incomplete in any part of the world. They provide a diverse range of tastes, aroma, textures, colours and nutritional attributes, to the food we eat and thus satisfying a myriad of personal preferences by adding and supplementing the quality component to the food. Cucurbitaceae is the largest group of summer vegetable crops and is notable for its comparatively larger number of species of cultivated plants with good adaptive differentiation and large morphological distinctness. Cucumber (*Cucumis sativus* L.) also known as 'khira', is a portentous cucurbitaceous vegetable. It is the second most widely cultivated cucurbit after watermelon. Immature fruits of cucumber are mainly eaten as salad or pickle. Cucumbers are rich sources of conventional antioxidants and nutrients including vitamin K and C, beta carotene, manganese and pantothenic acid. They are considered to be good sources of phytonutrients like cucurbitacins, lignans and flavonoids. Pinching is a form of pruning that encourages secondary and tertiary sprouts on the plant and thereby increases the number of secondary branches. Pinching maintains a proper balance between the vegetative and reproductive growth to maximize production. Ethrel is a versatile ethylene releasing agent, which upon metabolism by the plant, is converted to ethylene, which is a potent regulator of plant growth and ripeness. Ethrel slows down the cell division and cell elongation in meristematic tissue of shoot and regulates the plant height without change in the morphology and physiology of the plant (Hilli *et al.*, 2010). Cycocel (CCC) is a plant growth regulator which is anti-gibberellins in nature. It inhibits cell elongation, resulting in thicker stalks, which are sturdier. 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 cucumber.

Material and Methods

A field study was conducted 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 15 treatment combinations comprising of 3 levels of pinching (P_0 : no pinching, P_1 : pinching at 4th node and P_2 : pinching at 6th node) and 5 levels of PGRs (G_0 : control, G_1 : CCC @ 200 ppm, G_2 : CCC @ 400 ppm, G_3 : ethrel @ 300 ppm and G_4 : ethrel @ 600 ppm) laid out in a Randomized Block Design (Factorial concept) with three replications. The pinching operation was done on main vine at 4th and 6th node stage. It was carried out by using secateurs to remove upper growing portion of vine. CCC (cycocel) and Ethrel were applied as a 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 physiological characters.

Results and Discussion

Morphological characters

The morphological characters differed significantly with respect to pinching. The minimum length of vine (142.47 cm) at final harvesting and maximum number of primary branches (7.66) per vine at final harvesting were recorded in P_2 (Pinching at 6th node). 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) [11] who mentioned that pinching of vines decreases the vine length due to reduced accumulation of photo assimilates at the tips and increases number of branches. They also stated 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 plant becomes more active physiologically and thus increasing the number of branches and number of leaves. Similar results were reported by Pimpini and Gianquinto (1988) [11], Mangal and Sindhu (1981) and Yadava and Mangal (1979) [16].

The maximum number of nodes (112.48) and lowest internodal distance (8.88 cm) were observed in pinching treatment P_2 (pinching at 6th node of the vine). The possible reason for this 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) and Patel and Arora (1983) [10].

Plant growth regulators had significant effect over morphological characters. The minimum length of vine (161.22 cm) was noted in ethrel@600 ppm (G_4) which was at par with G_3 (ethrel@300 ppm). Maximum number of primary branches (6.71) was recorded in Cycocel@400 ppm (G_2) which was at par with G_4 (ethrel@600 ppm). The number of nodes per vine at final harvesting was noted maximum (107.94) in G_4 (ethrel @ 600 ppm) which was at par with G_3 (ethrel @ 300 ppm) and G_2 (CCC @ 400 ppm) and the lowest internodal distance (9.47 cm) was observed in G_4 (ethrel @ 600 ppm) that remained at par with G_3 (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 with minimum effect on physiology and morphology of the plant, as reported by Thappa *et al.* (2011) [14], Ouzounidou *et al.* (2008) [9] and Rajala and Peltonen (2001) [12]. The interaction effect of pinching and plant growth regulators had no significant effect over the morphological characters.

Physiological characters

The maximum total leaf area (43500.08 cm²/plant) was recorded in P_2 (pinching at 6th node), which remained at par with P_1 (pinching at 4th node). Similarly the maximum leaf area index (2.90) was recorded in P_2 (pinching at 6th node) which was at par with P_1 (pinching at 4th node). The possible reason for these results is the increase in the number of branches with more number of leaves produced in the pinching treatments as compared to no pinching, which is because of the higher rate of metabolic activity and translocation of assimilates to the leaves from the other parts of vine. This result was also confirmed by Anand *et al.* (2014) [11] in bottle gourd, Choi and Jafhan (1999) [3] and Wikesjo (1971) [15] in cucumber. While Plant growth regulators failed to show any significant effect over the total leaf area and leaf area index. The interaction effect of pinching and plant growth regulators had no significant effect on physiological characters.

Conclusion

The present study revealed that the individual effect of pinching application had significantly influenced the morphological and physiological characters in cucumber whereas the interaction effect of PGRs and pinching treatments failed to show any significant results. The morphological characters were significantly influenced by different plant growth regulators treatments. While the effect of foliar application of both ethrel and CCC was not significant for the physiological characters in cucumber. Pinching treatments showed significantly better results, both for the morphological and physiological characters in cucumber.

From the above enumeration this can be concluded that pinching at 6th node or foliar application of ethrel @ 600 ppm reflects good result with respect to morphological characters of cucumber and both the pinching treatments at 6th node and 4th node manifests evident result for enhanced physiological characters in cucumber.

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Table 1: Influence of pinching and plant growth regulators on morphological characters of cucumber cv. Gujarat Cucumber -1.

	Length of vine(cm)	Number of primary branches	Number of nodes	Internodal distance(cm)
Factor A: Pinching (P)				
No Pinching (P_0)	201.33	4.66	95.77	11.22
Pinching at 4th node (P_1)	172.27	6.23	104.28	9.98
Pinching at 6th node (P_2)	142.47	7.66	112.48	8.88
S.Em±	3.022	0.113	1.281	0.191
C. D. at 5%	8.753	0.326	3.711	0.554
Factor B: Plant growth regulators (G)				

Control (G ₀)	183.44	5.61	101.12	10.50
Cycocel @ 200 ppm (G ₁)	176.89	6.19	102.47	10.28
Cycocel @ 400 ppm (G ₂)	172.78	6.71	103.30	10.21
Ethrel @ 300 ppm (G ₃)	165.78	5.92	106.05	9.68
Ethrel @ 600 ppm (G ₄)	161.22	6.48	107.94	9.47
S.Em±	3.901	0.145	1.654	0.247
C. D. at 5%	11.300	0.421	4.791	0.716
Interaction P*G				
S.Em±	6.756	0.252	2.865	0.428
C. D. at 5%	NS	NS	NS	NS
CV%	6.803	7.052	4.763	7.391

Table 2: Influence of pinching and plant growth regulators on total leaf area and leaf area index of cucumber cv. Gujarat Cucumber -1.

	Total leaf area(cm ² /plant)	Leaf area index
Factor A: Pinching (P)		
No Pinching (P ₀)	39513.89	2.63
Pinching at 4th node (P ₁)	42056.53	2.77
Pinching at 6th node (P ₂)	43500.08	2.90
S.Em±	555.691	0.046
C. D. at 5%	1609.773	0.134
Factor B: Plant growth regulators (G)		
Control (G ₀)	40802.86	2.66
Cycocel @ 200 ppm (G ₁)	41204.10	2.74
Cycocel @ 400 ppm (G ₂)	41529.12	2.77
Ethrel @ 300 ppm (G ₃)	42179.59	2.81
Ethrel @ 600 ppm (G ₄)	42735.16	2.85
S.Em±	717.394	0.060
C. D. at 5%	NS	NS
Interaction P*G		
S.Em±	1242.563	0.104
C. D. at 5%	NS	NS
CV%	5.162	6.481

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