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Efficacy of pinching and plant growth regulators in enhancing yield characters of cucumber (*Cucumis sativus* L.)

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Abstract
Cucumber is a portentous cucurbitaceous vegetable, valued for its nutritive cum medicinal properties. Its production potential relies upon numerous factors, and can easily be augmented by manipulating them, therefore a field experiment was conducted with the objective of evaluating the effect of pinching and PGRs on yield characters of cucumber cv. Gujarat Cucumber-1 using various pinching and PGRs treatments. 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 treatment and the PGRs application individually significantly influenced the yield parameters such as the average length of fruit, number of fruits per vine, yield per vine and yield per hectare, but both failed to manifest any evident effect on the average fruit weight. Pinching at 6th node and higher doses of both ethrel and CCC had significantly enhanced most of the yield characters. The interaction effect of pinching and PGRs failed to exhibit any significant effect for all the characters studied.

Keywords: cucumber, pinching, cycocel, ethrel, yield

Introduction
Vegetables have inordinate potential to improve the nutrition and thereby health of consumers as most of them are good sources of vitamins, minerals and provides a diverse range of tastes, aroma, textures, colours and nutritional attributes, to the food we eat and thus satisfying a myriad of personal preferences. 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, these are mostly climbers and trailers, are rarely woody or arborescent. Cucumber (*Cucumis sativus* L.) also known as *'khira'*, is a creeping vine bearing cucumiform fruits, which are used as vegetables. It is the second most widely cultivated cucurbit after watermelon, it has a huge demand and consumer inclination both in domestic as well as export markets. 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. 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 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) [3]. 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.

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

The response towards individual application of pinching and plant growth regulators treatment to various yield characters *viz.*, average length of fruit, number of fruits per vine and yield per hectare were found significant. The data reveals that average length of fruit has been significantly affected by the pinching treatments. The maximum average length of fruit (23.34 cm) among the pinching treated plants was observed in P_2 (pinching at 6th node), which was at par with P_1 (pinching at 4th node), whereas the data pertaining to the average fruit weight depicted no significant effect for average fruit weight for pinching. The possible reason for the increase of average length of fruit in pinching treatment is reduction in the vine length by pinching and thereby diversion of the photo-assimilates, leading to accelerated cell division and cell elongation in the growing portion which ensured maximum length of fruits. This result is in agreement with that of Mir (2007) in cucumber. The highest number of fruits per vine (14.25) among pinched plants and control was observed in P_2 (pinching at 6th node). Yield per vine was also significantly influenced by the pinching treatment, maximum yield per vine (3.15 kg) was noted in P_2 and thus the highest yield per hectare (21023.27 kg) for pinched plants was observed in P_2 (Pinching at 6th node). The possible reason behind these can be the increased number of female flowers and branches. These results are in accordance with Eve *et al.* (2016), Pimpini and Gianquinto (1988) and Riley (1998) who also indicated that increased number of branches has the tendency to stimulate the production of female flowers. The more the female flowers the higher will be the fruits produced per plant.

The maximum average length of fruit (23.39 cm) was noted in G_4 (ethrel @ 600 ppm), which was at par with G_3 (ethrel @ 300 ppm) and G_1 (CCC @ 200 ppm), but both the growth regulators failed to exert any significant effect on the average fruit weight. The probable reason for the increase in the length of fruit after the application of ethrel may be attributed to higher respiration and photosynthesis in treated plants as compared to control. This may be due to greater accumulation of carbohydrates, owing to photosynthesis which resulted into increased length of fruit. This result is in conformity with reports on ethrel by Chovatia *et al*. (2010) in bittergourd, and Mir (2007) in cucumber. Highest number of fruits per vine (14.33) was recorded in G_4 (ethrel @ 600 ppm) and was statistically at par with G_3 (ethrel @ 300 ppm). The maximum yield per vine (3.18 kg) was observed in G_4 (ethrel @ 600 ppm) which remained statistically at par with G_3 and thus the highest yield per hectare (21223.28 kg) was also noted in G_4 (ethrel @ 600 ppm) which was at par with G_3 (ethrel 300 ppm). A sensible explanation for these results is that, ethrel suppresses the number of male flowers and promotes the number of female flowers there by increasing the number of fruits and ultimately promoting yield. These results are in consonance with the findings of Mahala *et al.* (2014) in bottle gourd, Thappa *et al.* (2011) in cucumber, Mehdi *et al.* (2012) in cucumber, Kooner *et al.* (2000) in bottle gourd, Sharma *et al.* (1988) in bottle gourd, Sadiq *et al.* (1990) in cucumber and Kshirsagar *et al.* (1995) in cucumber. The interaction effect of pinching and plant growth regulators failed to exhibit any significant effect on the yield characters of cucumber.

Conclusion

The present study revealed that the individual effect of pinching and plant growth regulators application had notably manifested evident results, showing enhancement on the yield parameters in cucumber such as the average length of fruit, number of fruits per vine, yield per vine and yield per hectare, on the contrary, both failed to possess any significant effect on the average fruit weight.

From the above enumeration this can be concluded that pinching at 6th node or foliar application of ethrel both at 600 ppm and 300 ppm reflects good result with respect to most of the yield characters in cucumber as compared to CCC. Both pinching and PGRs treatments are reluctant to exhibit any significant variation due to interaction between pinching and plant growth regulators at varying levels.

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Table 1: Influence of pinching and plant growth regulators on average length of fruit (cm) and average fruit weight of cucumber cv. Gujarat Cucumber -1.

	Average length of fruit (cm)	Average fruit weight (g)
Factor A: Pinching (P)		
No Pinching (P_0)	21.65	150.80
Pinching at 4th node (P_1)	22.43	153.80
Pinching at 6th node (P_2)	23.34	156.80
S.Em±	0.4007	2.456
C. D. at 5%	1.161	NS
Factor B: Plant growth regulators (G)		
Control (G_0)	21.13	148.93
Cycocel @ 200 ppm (G_1)	22.85	152.83
Cycocel @ 400 ppm (G_2)	21.85	155.47
Ethrel @ 300 ppm (G_3)	23.15	154.77
Ethrel @ 600 ppm (G_4)	23.39	157.00
S.Em±	0.517	3.171
C. D. at 5%	1.499	NS
Interaction P*G		
S.Em±	0.896	5.492
C. D. at 5%	NS	NS
CV%	6.906	6.185

Table 2: Influence of pinching and plant growth regulators on number of fruits per vine and yield per vine (kg) of cucumber cv. Gujarat Cucumber -1

	Number of fruits per vine	Yield per vine (kg)
Factor A: Pinching (P)		
No Pinching (P_0)	12.25	2.58
Pinching at 4th node (P_1)	13.24	2.87
Pinching at 6th node (P_2)	14.25	3.15
S.Em±	0.288	0.070
C. D. at 5%	0.834	0.204
Factor B: Plant growth regulators (G)		
Control (G_0)	11.62	2.38
Cycocel @ 200 ppm (G_1)	13.11	2.84
Cycocel @ 400 ppm (G_2)	13.17	2.89
Ethrel @ 300 ppm (G_3)	14.01	3.04
Ethrel @ 600 ppm (G_4)	14.33	3.18
S.Em±	0.372	0.091
C. D. at 5%	1.077	0.263
Interaction P*G		
S.Em±	0.644	0.157
C. D. at 5%	NS	NS
CV%	8.417	9.507

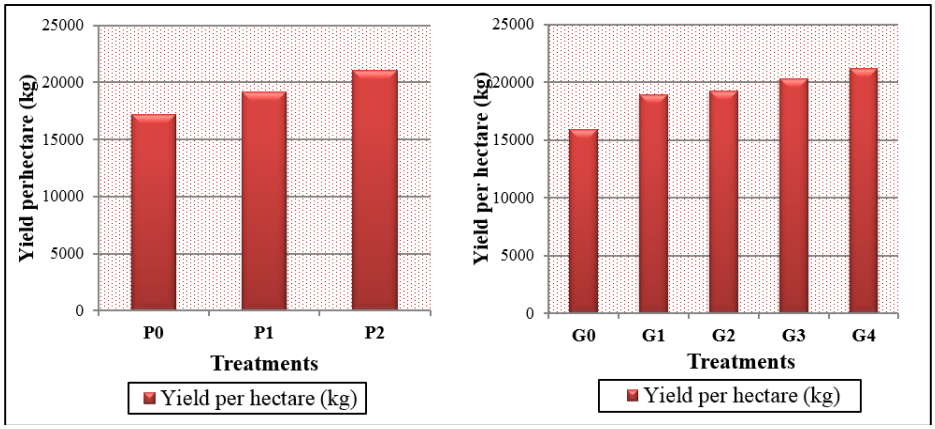

Fig 1: Influence of pinching and plant growth regulators on yield per hectare (kg/ha) of cucumber cv. Gujarat Cucumber -1.

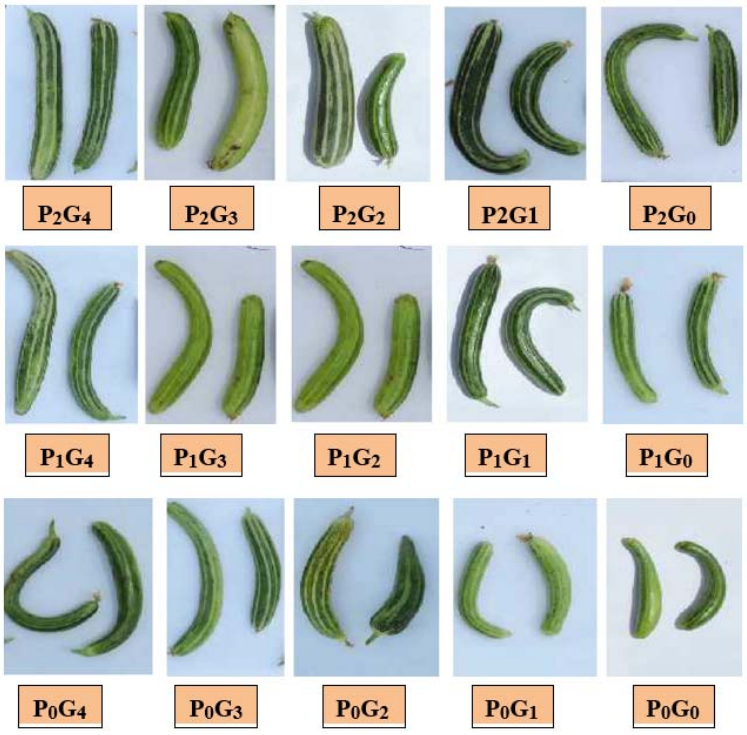

Fig 2: Effect of pinching and growth regulators on cucumber fruits in cv. Gujarat Cucumber-1

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