Effect of plant growth regulators on yield and quality of cucumber (*Cucumis sativus* L.)

Abstract

The study investigated the effect of plant growth regulators (PGRs) on the yield and quality of cucumber (*Cucumis sativus* L.) to explore its production potential conducted during the summer season of 2020 at the College farm, College of Horticulture, SardarkrushinagarDantiwada Agricultural University, Jagudan. The experiment followed a randomized block design (RBD) with three replications and ten treatments which including different concentration of gibberellic acid (GA_3), Naphthalene acetic acid (NAA) and ethrel*viz*., T_1: Control (Water spray), T_2: NAA at 50 ppm, T_3: NAA at 75 ppm, T_4: NAA at 100 ppm, T_5: GA3 at 20 ppm, T_6: GA3 at 40 ppm, T_7: GA_3 at 60 ppm, T_8: Ethrel at 100 ppm, T_9: Ethrel at 200 ppm, and T_{10}: Ethrel at 300 ppm were applied at the 2-4 true leaf stages. Treatment T_{10} (Ethrel @ 300 ppm) exhibited the highest number of fruits per vine (14.13), while T_4 (NAA @ 100 ppm) showed the maximum number of pickings (8.59). GA_3 @ 40 ppm (T_6) recorded the highest fruit yield per vine (1.87 kg), Fruit yield per plot (28.29 kg) and Fruit yield per hectare (251.50 q). Additionally, Treatment T_6 produced fruits with the longest length (30.34 cm) and widest diameter (3.91 cm). These findings demonstrate the potential of PGRs particularlyEthrel and $GA_3$to significantly impact on cucumber yield and quality.

Key words:PGRs, GA_3, NAA, Ethrel, Cucumber, Fruit yield

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1. Introduction

Vegetable growing is the most remunerative enterprise as it is adopted on small and marginal holding with high production in short duration. Being a source of farm income, it creates impact on the agricultural development and economy of the country. Vegetables are cheaper sources of minerals, vitamins and with high caloric values. There is an increasing demand of vegetables both for domestic and for export, which can earn valuable foreign exchange for India. Cucurbits is the largest group of summer vegetable crops and is notable for its comparatively larger number of species of cultivated plants (Nayak *et al.*, 2017).

Cucumber (*Cucumissativus* 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 huge demand and consumer inclination both in domestic and 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, lignin and flavonoids. Cucumber (*Cucumis sativus* L.) is one of the most prized vegetable because of its varied usefulness, excellent flavour, texture and medicinal value. It is a summer vegetable grown generally in open field conditions. But it is also grown as a forcing crop under green house conditions in the off season owing to its increasing demand for varied purposes (Mehdi *et al.*, 2012).

Plant growth regulators, also known as phytohormones, are chemical molecules that influence all aspects of plant growth and development. Auxin, cytokinins, gibberellins,

abscisicacid, and ethylene are the five primary classical phytohormones that include more than 20 different kinds of PGRs (Gosai *et al.,* 2020). Plant growth regulators are known to be modifying growth and sex expression, improve fruit set and ultimately increases yield in a number of cucurbits. The modification and shift of sex from male in to female in monoecious cucurbits by the exogenous application of various growth regulating chemicals has been a topic of great interest to number of investigators in India and abroad. Exogenous application of plant growth regulators can alter the sequence of male and female flowers, if applied at 2nd or 4th leaf stages, the critical stage at which suppression or promotion of either sexes is possible. Hence, by proper manipulation the sequence of flowering with the application of exogenous plant growth regulators, the yield of cucurbits can be increased. Certain growth regulating chemicals *viz.*, NAA, GA_3 and Ethrel have been reported to influence sex suppression of male flower (Rafeekhar*et al.,* 2001) in cucumber. The growth regulators specially, NAA and ethrel suppress the male flower and increase female flower appearance there by finally increase the yield.

2. Material and Methods

2.1 Location and weather condition

The study titled "Effect of plant growth regulators on yield and quality of cucumber (*Cucumissativus* L.)" aimed to assess cucumber production potential. Conducted at the College farm of SardarkrushinagarDantiwada Agricultural University in Jagudan during the summer of 2020 in an open field, Jagudan is situated approximately 10 km from Mehsana and 60 km from Ahmedabad representing the North Gujarat Agro-Climatic Region (AES-IV).Jagudan experiences a subtropical climate with distinct seasons. The region encounters a warm and humid monsoon from mid-June to early September with most rainfall in July and August. Winters, lasting from October to February, are cool and dry, reaching minimum temperatures in December and January. The temperature gradually rises from the end of February peaking in May, which along with April constitutes the hottest period of the year. Over the past 15 years, Jagudan has received an average annual rainfall of 688 mm, concentrated in about 28 rainy days.

2.2 Experimental detail

The study followed a RBD with three replications. Three plant growth regulators (PGRs) were utilized such as gibberellic acid (GA_3), Naphthalene acetic acid (NAA) and ethrel. Sprays of each PGR were administered at the 2-4 true leaf stages which resulting in a total of ten treatments for the field trial. The experiment includes treatments *viz.*, T_1: Control (Water spray), T_2: NAA at 50 ppm, T_3: NAA at 75 ppm, T_4: NAA at 100 ppm, T_5: GA3 at 20 ppm, T_6: GA3 at 40 ppm, T_7: GA_3 at 60 ppm, T_8: Ethrel at 100 ppm, T_9: Ethrel at 200 ppm, and T_{10}: Ethrel at 300 ppm.

2.3 Preparation of spray solution

For the preparation of foliar spray solutions, the required quantity of GA_3, NAA and Ethrel were weighed separately. GA_3 and NAA were prepared by dissolving desired quantity of NAA and GA_3 in small amount of NAOH and volume was made to 1 liter by adding distilled

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water to obtain 225 ppm NAA and 120 ppm GA_3. Then desired concentration of NAA (50 ppm, 75 ppm, 100 ppm) and GA_3 (20 ppm, 40 ppm, 60 ppm) were prepared by dilution method. Ethrel was dissolved in water and final volume made up to 1.0 liter by adding distilled water. Then a desired concentration of Ethrel (100 ppm, 200 ppm, 300 ppm) was prepared by dilution method. Foliar application of each treatment was given at 2^{nd} and 4^{th} true leaf stage during the morning. Both the surface of leaves and apical meristems were fully moistened. Spraying was done with 'Plastic hand sprayer'

2.4Statistical analysis and Observations

The data of all yield and quality parameters are collected from five tagged plant and count average of five tagged plant, after that mean data was statistically analysis by technique as described by Panse and Sukhatme (1985). The Randomized Block Design (RBD) was used for experimental analysis of variance.

3. Results and Discussions

3.1 Yield parameters

3.1.1 Number of fruit per vine

The maximum number of fruit per vine (14.13)in treatment T_{10} (Ethrel @ 300 ppm).This may be due to the fact that ethrel suppressed the number of male flowers and promoted number of female flower thereby, increased number of fruits per vine. The present finding is in accordance with Mehdi *et al.* (2012) and Nayak *et al.* (2017) in cucumber.

3.1.2Number of picking

In treatment T_4 (NAA @ 100 ppm), the maximum number of pickings (8.59), indicating a notable outcome. This aligns with the research conducted by Nayak *et al*. (2017) in cucumber, emphasizing the consistency of these findings across different studies. The enhanced frequency of pickings in this treatment suggests the potential effectiveness of NAA in influencing the harvest schedule, offering valuable insights for optimizing cucumber cultivation practices.

3.1.3Fruit yield (per vine, plot and hectare)

The application of GA_3 at 40 ppm (T_6) resulted in the highest recorded fruit yield per vine at (1.87 kg) as well as the maximum fruit yield per plot (28.29 kg) and per hectare (251.50 q). The notable increase in fruit yield in the GA_3 treatment can be attributed to the positive impact of GA_3 on various factors, including enhanced fruit set percentage, increased fruit weight, and improvements in the length and diameter of the fruits. These combined effects ultimately contributed to the highest overall yield. These outcomes closely align with the findings of Dostogir*et al*. (2006) and Birdar*et al.* (2014) in bitter gourd, as well as with Farhana (2015), Baqi *et al.* (2018) and Kadi *et al*. (2018) in cucumber. Additionally, the consistency of these results extends to the study by Hidaytullah*et al.* (2012) in bottle gourd.

3.2 Quality parameters

3.2.1Length of fruit (cm) and Diameter of fruit (cm)

The data indicates a significant increase in both the length (30.34 cm) and diameter (3.91 cm) of fruits, with treatment T_6 (GA_3@ 40 ppm) demonstrating the highest values. The observed

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Comment [B12]: The maximum number of fruits per vine (14.13) was recorded from the application of 300ppm Ethrel.

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enhancement in fruit dimensions in response to GA_3 aligns with the findings of Ghani *et al.* (2013) and Vadigeri*et al.* (2001). These studies propose that the increase in fruit length and diameter may be attributed to the activation of cell division and elongation, coupled with an elevation in metabolic activity induced by GA_3. This outcome resonates with the results reported by Sondarva*et al.* (2016) in ridge gourd and by Singh and Choudhary (1989) and Pawar *et al.* (2019) in cucumber, highlighting the consistent influence of GA_3 on fruit morphology across various plant species.

3.2.2 Total Soluble Solid (°Brix)

For the measurement of TSS values, fruits were cut in to small pieces and mixed thoroughly to make a homogenous extract. Then readings were recorded with the help of digital hand refractometer (° Brix).Total soluble solid in fruit affected by different treatments was found not significant among various treatments but application of GA_3 40 ppm showed maximum (5.73 °Brix) total soluble solid in fruit. The results supported by the findings of Kadi *et al.* (2018) in cucumber.

Table 1: Effect of plant growth regulators on yield parameters of cucumber (*Cucumis sativus* L.)

Treatments No.	Treatment	Number of fruit per vine	Number of pickings	Fruit yield per vine (kg)	Fruit yield per plot (kg)	Fruit yield per hectare (q)
T_1	Control (Water spray)	8.15	5.97	1.22	17.64	156.82
T_2	NAA @ 50 ppm	10.01	6.72	1.35	19.79	175.90
T_3	NAA @ 75 ppm	10.63	6.79	1.43	20.24	179.73
T_4	NAA @ 100 ppm	12.62	8.59	1.62	21.63	192.25
T_5	GA_3 @ 20 ppm	11.80	7.39	1.41	22.46	199.65
T_6	GA_3 @ 40 ppm	12.39	7.12	1.87	28.29	251.50
T_7	GA_3 @ 60 ppm	11.09	6.83	1.47	24.01	213.27
T_8	Ethrel @ 100 ppm	10.99	6.59	1.44	21.60	192.01
T_9	Ethrel @ 200 ppm	12.03	7.39	1.50	23.39	207.90
T_{10}	Ethrel @ 300 ppm	14.13	7.79	1.63	25.34	225.23
S.Em. ±		0.457	0.346	0.080	0.080	1.050
C.D. at 5 %		1.36	1.03	0.22	0.22	3.12
C.V. %		6.96	8.41	8.68	8.68	8.10

Table 2: Effect of plant growth regulators on quality parameters of cucumber (*Cucumis sativus* L.)

Treatments No.	Treatment	Length of fruit (cm)	Diameter of fruit (cm)	TSS (°Brix)

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T_1	**Control (Water spray)**	23.31	2.90	5.07
T_2	**NAA @ 50 ppm**	26.45	3.17	5.13
T_3	**NAA @ 75 ppm**	26.35	3.05	5.16
T_4	**NAA @ 100 ppm**	27.49	3.24	5.27
T_5	**GA_3 @ 20 ppm**	27.66	2.92	5.23
T_6	**GA_3 @ 40 ppm**	30.34	3.91	5.73
T_7	**GA_3 @ 60 ppm**	28.25	3.41	5.44
T_8	**Ethrel @ 100 ppm**	24.69	3.23	5.42
T_9	**Ethrel @ 200 ppm**	25.81	3.38	5.44
T_{10}	**Ethrel @ 300 ppm**	25.55	3.42	5.44
S.Em. ±		0.679	0.113	0.172
C.D. at 5 %		2.02	0.34	NS
C.V. %		4.42	6.02	5.60

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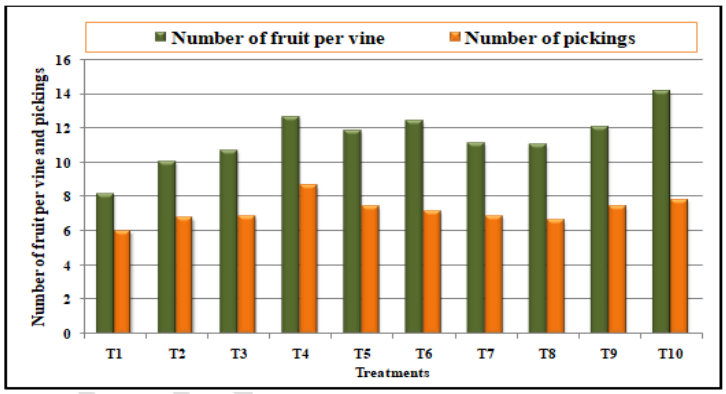
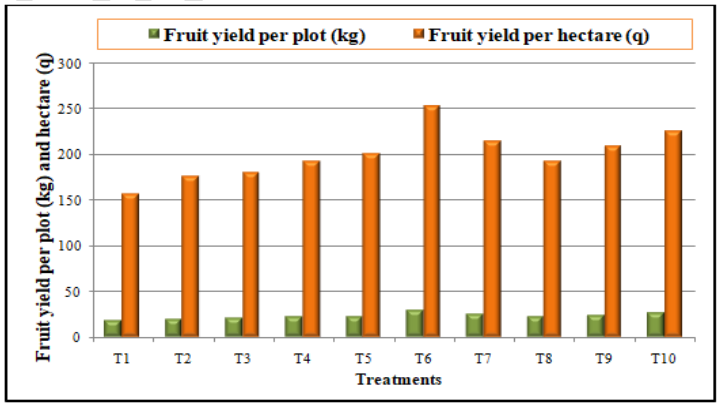
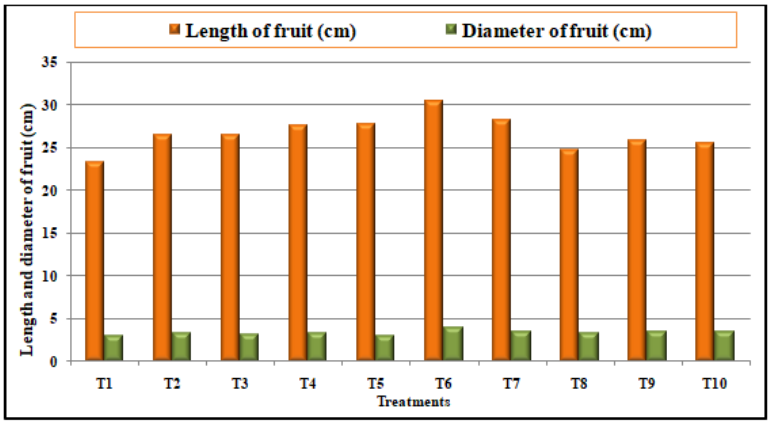


[Fig 1: Effect of plant growth regulators on number of fruit per vine and pickings]



[Fig 2: Effect of plant growth

regulators on fruit yield per plot (kg) and hectare (q)]



[Fig 3: Effect of plant growth regulators on length and diameter of fruit (cm)]

Conclusion

In conclusion, the study reveals that different treatments significantly influenced fruit yield and quality in cucumber vines. Treatment T_{10}, utilizing Ethrel at 300 ppm, exhibited the highest number of fruits per vine (14.13) and maximum pickings (8.59). However, Treatment T_6, applying GA3 at 40 ppm, showed remarkable results with the highest fruit yield per vine (1.87 kg), fruit yield per plot (28.29 kg), and fruit yield per hectare (251.50 q). Moreover, Treatment T_6 produced fruits with the longest length (30.34 cm) and widest diameter (3.91 cm), indicating its superiority in enhancing both yield and quality parameters. These findings offer valuable insights for optimizing cucumber crop production and informing growers' treatment choices.

Comment [B24]: This was due to 100ppm NAA.

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Reference

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