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Influence of varied concentrations of salicylic acid and ethrel treated at different stages on morphological, phenological and economic traits of cucumber (*Cucumis sativus* L.)

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Abstract

Cucumber (*Cucumis sativus* L.) stands as a globally significant vegetable, valued for its adaptability, nutritional richness, and economic importance. This study focused on three replications with thirteen treatments, and the experimental design used was Randomized block design (RBD) which was conducted at the Experimental Field, Department of Horticulture, College of Agriculture, Indore (MP) India, during the kharif season 2023. The objectives were to find out the response of varied concentrations of salicylic acid and ethrel applied at different stages on morphology, phenology and analyse the economics of cucumber. The results indicated significant variability among the treatments for various morphological, phenological, and economic traits. The treatments with ethrel at the 2-4 leaf stage showed significant results for all morphological traits, as it reduced the vine length and internode length with an increased number of branches and leaves. The treatments with Ethrel also had a significantly positive response to phenological traits, as it showed the minimum days taken to first fruit set, days taken to first picking, and sex ratio among the treatments. Economically, ethrel @ 250 ppm at 2-4 leaf stage demonstrated the highest cost-benefit ratio, emphasizing its potential for profitable cultivation. The findings provide valuable insights for the application of ethrel and salicylic acid in the production of cucumber crops for enhanced productivity and economic returns.

Keywords: Cucumber, plant growth regulators, salicylic acid, ethrel

Introduction

Cucumber (*Cucumis sativus* L.) is one of the most important and popular vegetable crops belonging to the family Cucurbitaceae, which comprises approximately 118 genera and 825 species. It is characterized by a chromosome number of $2n = 2X = 14$ and is native to India, where large diversity has been observed. It is a popular salad and pickle ingredient, known for its crisp texture and juicy flavour. It contains potassium, fibre, magnesium, manganese and vitamins A, C and K (Chakraborty and Rayalu, 2021) ^[4]. The fruits are highly nutritious, comprise 95% water and have very few calories (approximately 15 calories per cup), as described by Mukherjee *et al.* (2013) ^[16].

Application of plant growth regulators (PGRs) in cucurbits is very common. Plant growth regulators (PGRs), called bio-stimulants or bio-inhibitors, act inside plant cells to stimulate or inhibit specific enzymes or enzyme systems and thus regulate plant metabolism. Among the plant hormones, Salicylic acid and Ethylene have been found to be effective on various attributes, which affect the yield of cucumber. The application of ethylene (a gaseous plant hormone) enhances the female flowers and reduces the male flower production, which enhances the yield potential of the crop (Zhang *et al.*, 2017) ^[25]. It also helps to manage the plant architecture by having a positive effect on morphological parameters like internode length, number of branches and leaf area etc. (Thappa *et al.*, 2011) ^[22]. Similarly, the application of Salicylic acid provides tolerance to temperature and moisture stresses. Also found effective for root growth, photosynthesis, transport and uptake of solutes (Sultan *et al.*, 2016) ^[21].

Methods and Materials

The experimental trials “Effect of Salicylic Acid and Ethrel on Growth, Yield, and Quality of Cucumber (*Cucumis sativus* L.)” was conducted at the experimental field, Department of Horticulture, College of Agriculture Indore (M.P.) during *kharif* season 2023. This experiment was carried out to see the effect of foliar application of different growth regulators on growth, yield and quality parameters in cucumber.

The experiment was laid out in Randomized Block Design (RBD) with thirteen treatments along with the control (water spray) treatment and three replication. The treatment of PGRs with varied concentration namely salicylic acid (0.5 and 1.0 mM) and ethrel (250 and 500 ppm) was sprayed once at particular growth stage namely 2-4 leaf stage, vine initiation stage and flowering stage.

Treatments		
Treatment	Symbol	Detail of treatments
1.	T ₀	Control
2.	T ₁	Salicylic acid @ 0.5 mM at 2-4 leaf stage
3.	T ₂	Salicylic acid @ 0.5 mM at vine initiation
4.	T ₃	Salicylic acid @ 0.5 mM at flowering stage
5.	T ₄	Salicylic acid @ 1.0 mM at 2-4 leaf stage
6.	T ₅	Salicylic acid @ 1.0 mM at vine initiation
7.	T ₆	Salicylic acid @ 1.0 mM at flowering stage
8.	T ₇	Ethrel @ 250 ppm at 2-4 leaf stage
9.	T ₈	Ethrel @ 250 ppm at vine initiation
10.	T ₉	Ethrel @ 250 ppm at flowering stage
11.	T ₁₀	Ethrel @ 500 ppm at 2-4 leaf stage
12.	T ₁₁	Ethrel @ 500 ppm at vine initiation
13.	T ₁₂	Ethrel @ 500 ppm at flowering stage

A well rotten Farm Yard Manure was applied @ 20 tons/ha before preparing of the bed. Nitrogen, Phosphorus and potash were applied @ 100:50:50 kg/ha in the form of urea, single super phosphate and murate of potash, respectively. First hoeing and weeding was done after twenty days of sowing. Regular watering and plant protection measures were carried out as and when required.

Ridge and furrow method was applied for planting of seedling. Seedling was prepared in pro tray in the month of August. The plants were trained upward so that the main stem was allowed to climb to the overhead wire along a rope. Wires were fixed 8-9 feet above the ground. The twine of each plant was alternatively tied to the horizontal overhead wires running along with the length of rows. The base of the twine (string) was anchored loosely to the base of the stem with a non-slip vine. As the stem developed, it was trellised on the twine up to the height of horizontal wires (8-9 feet height) and then the vines were again turned downward direction. The observations were recorded on various characters. The experimental data were subjected to analysis of variances (ANOVA) (Fisher and Yates 1963).

Results and Discussion

Morphological parameters

The results revealed that all the morphological parameters such as vine length, inter node length, number of branches and number of leaves were found statistically significant (Table 1). The maximum vine length (87.73, 169.87, 237.27 cm) and internode length (9.27 cm) were recorded in control, while the minimum plant height was recorded in treatments T₁₀ (Ethrel @ 500 ppm at 2-4 leaf stage) at 15 days after planting valued 67.93 cm and T₁₁ (Ethrel @ 500

ppm at vine initiation) at 30 and 45 days after planting valued 134.83 and 204.64 cm. Minimum internode length (6.13 cm) was observed in treatment T₁₁ (Ethrel @ 500 ppm at vine initiation). The maximum number of branches was recorded in treatment T₁₀ (Ethrel @ 500 ppm at 2-4 leaf stage) at 15 days after planting valued 3.60 and in treatment T₁₁ (Ethrel @ 500 ppm at vine initiation) at 30 and 45 days after planting valued 5.87 and 7.27. The maximum number of leaves (25.87, 51.17 and 95.89) was recorded in treatments T₁₀ (Ethrel @ 500 ppm at 2-4 leaf stage), T₁₁ (Ethrel @ 500 ppm at vine initiation), and T₇ (Ethrel @ 250 ppm at 2-4 leaf stage) at 15, 30, and 45 days after planting, respectively. While, the minimum number of branches and leaves per plant was observed in treatment T₄ (Salicylic acid @ 1.0 mM at 2-4 leaf stage) in all three growth stages, i.e., 30, 45, and 60 days after planting.

The reduced plant height and length of internodes is because application of ethrel have its antagonistic effect on auxin level in plants which decreases the dominance of the shoot tip while increasing the sprouting of lateral buds (Leiberman and Knecht, 1977) [11]. Similar results were also reported by Ajay *et al.* (2018) [12], Kumar *et al.* (2016) [9], Sheoran *et al.* (2015) [19], and Mehdi *et al.* (2012) [14]. Furthermore, the application of ethrel not only reduced the growth of the main vine but also triggered dwarfism, ultimately leading to a surge in the number of branches. The reason for the increased number of leaves is the increase in the number of branches per plant by ethrel. Similar results were also recorded by Duhan *et al.* (2022) [6], Rahman *et al.* (2020) [18], and Chaurasiya *et al.* (2016) [5].

Phenological parameters

The results revealed that all the phenological parameters such as number of days taken to first flower, number of days to fruit set, the number of days to first picking and sex ratio were found statistically significant (Table 2). The maximum number of days taken to first flower was observed in treatment T₁₀ (Ethrel @ 500 ppm at 2-4 leaf stage), while it was minimum in treatment T₀ (Control), and the number of days to fruit set and the number of days to first picking were recorded as maximum in treatment T₀ (Control) and minimum in treatment T₁₀ (Ethrel @ 500 ppm at 2-4 leaf stage). The maximum sex ratio (20.30 and 10.75) was recorded in treatment T₀ (control), while the minimum sex ratio was observed in treatment T₁₀ (Ethrel @ 500 ppm at 2-4 leaf stage) and T₁₁ (Ethrel @ 500 ppm at vine initiation) at 30 and 45 days after planting valued 4.20 and 1.86, respectively.

It was reported by Achard *et al.* (2007) [1] that the use of ethylene before flowering might stimulate the development of pistillate flowers, either directly or by diminishing endogenous levels of gibberellic acid, or by fostering the synthesis of abscisic acid. This appears to be a possible reason for the delayed emergence of male and early female flowers, due to which ethrel treatments were taken over a longer period of time for flowering. These findings were very close to the results obtained by Mehdi *et al.* (2012) [14], Kumari *et al.* (2019) [8], and Shukla *et al.* (2023) [20]. It was also observed that sexual differentiation is influenced by internal levels of auxins, which are affected by ethrel treatment. Ethrel appears to encourage the development of flowering primordia. The counteraction of ethrel against gibberellins seems to inhibit the formation of male flowers while promoting the production of more female flowers,

resulting in a lower ratio of male to female flowers. Similar results were reported by Martín-Mex *et al.* (2013) [13], Patel *et al.* (2015) [17], and Yadav *et al.* (2022) [24].

Economic parameters

The results revealed that all the economic parameters such as gross return, net return, and cost-benefit ratio were found statistically significant (Table). The maximum gross return, net return, and cost-benefit ratio (₹ 2,80,530.00, 2,04,673.75

and 2.69) were recorded in treatment T₇ (Ethrel @250 ppm at 2-4 leaf stage), while these were minimum in treatment T₄ (salicylic acid @ 1.0 mM at 2-4 leaf stage) ₹ 1,43,560.00, 68,114.97 and 0.90, respectively. The income is clearly dependent on total yield, since the highest and lowest yields were obtained by the treatments, respectively. The above results were in consonance with those of Mahala *et al.* (2014) [12], Kumar *et al.* (2019) [10], Mishra and Singh (2021) [15], and Baral *et al.* (2022) [3].

Table 1: Response of varied concentration of plant growth regulators at different stages on morphological parameters of cucumber

Parameter Treatments	Vine length			No of branches			No of leaves			Internode length
	15 DAP	30 DAP	45 DAP	15 DAP	30 DAP	45 DAP	15 DAP	30 DAP	45 DAP	
T ₀	87.73	169.87	237.27	3.33	4.33	5.00	20.87	43.40	76.87	9.27
T ₁	80.47	159.20	224.60	3.60	5.20	5.67	23.27	49.13	84.83	8.40
T ₂	83.87	165.73	235.72	3.37	4.67	5.07	19.20	46.50	85.47	8.93
T ₃	86.40	168.87	220.93	3.38	4.27	4.90	21.13	43.85	76.43	8.80
T ₄	65.52	126.78	194.00	2.60	3.33	3.53	16.07	32.98	62.73	7.57
T ₅	80.17	133.67	201.53	3.33	3.93	4.47	18.60	39.90	69.17	7.40
T ₆	83.91	149.53	209.20	3.27	3.87	4.53	18.83	40.67	68.30	8.07
T ₇	74.27	137.12	222.40	3.60	4.63	5.80	24.13	49.11	95.89	8.67
T ₈	80.56	151.67	224.67	3.27	4.30	5.80	21.07	44.41	94.72	7.80
T ₉	83.35	156.24	227.47	3.40	4.40	4.93	20.70	42.68	86.86	8.73
T ₁₀	67.93	143.73	185.96	3.60	5.37	5.53	25.87	46.66	86.27	8.20
T ₁₁	78.62	134.83	204.64	3.40	5.87	7.27	20.13	51.17	83.55	6.13
T ₁₂	82.31	147.91	185.43	3.47	4.70	6.67	20.87	45.36	78.75	6.93
SEm ±	2.78	7.47	9.95	0.16	0.33	0.34	1.12	2.54	4.23	0.39
C.D. (at 5%)	8.13	21.79	29.04	0.48	0.95	0.99	3.26	7.42	12.35	1.14

Table 2: Response of varied concentration of plant growth regulators at different stages on phenological parameters of cucumber

Parameter Treatments	Days to 1st flower	Days to fruit set	Days to harvest	Sex ratio	
				30 DAP	45 DAP
T ₀	20.07	31.33	40.07	20.30	10.75
T ₁	20.40	32.23	40.70	11.15	6.91
T ₂	20.73	31.73	40.20	14.27	7.67
T ₃	20.33	32.03	40.43	18.36	8.16
T ₄	20.33	32.77	42.20	9.60	7.01
T ₅	21.80	32.70	42.03	16.52	7.01
T ₆	21.40	32.53	41.10	16.89	6.72
T ₇	23.57	30.80	38.13	4.71	4.82
T ₈	21.60	31.57	40.20	9.47	3.87
T ₉	20.87	31.83	40.64	19.00	3.87
T ₁₀	25.20	29.17	37.27	4.20	2.81
T ₁₁	21.67	31.77	40.20	7.80	1.86
T ₁₂	20.80	32.40	41.37	19.72	2.06
SEm ±	0.70	0.62	0.60	2.83	0.54
C.D. (at 5%)	2.05	1.82	1.75	8.26	1.58

Table 3: Response of varied concentration of plant growth regulators at different stages on economics of cucumber

Parameter Treatments	Yield Per Hectare (q)	GROSS INCOME	NET INCOME	Cost-Benefit Ratio
		₹/ha	₹/ha	
T ₀	127.74	1,91,670.00	1,16,370.00	1.54
T ₁	160.62	2,40,975.00	1,65,602.48	2.19
T ₂	156.86	2,35,350.00	1,59,977.48	2.12
T ₃	150.20	2,25,445.00	1,50,072.48	1.99
T ₄	95.68	1,43,560.00	68,114.97	0.90
T ₅	98.24	1,47,535.00	72,089.97	0.95
T ₆	102.39	1,53,645.00	78,199.97	1.03
T ₇	186.89	2,80,530.00	2,04,673.75	2.69
T ₈	172.22	2,58,350.00	1,82,493.75	2.40
T ₉	167.69	2,51,750.00	1,75,893.75	2.31
T ₁₀	171.74	2,57,625.00	1,81,212.50	2.37
T ₁₁	184.61	2,77,525.00	2,01,112.50	2.63
T ₁₂	180.15	2,70,390.00	1,93,977.50	2.53
SEm ±	3.40	5,093.06	5,093.06	0.067
C.D. (at 5%)	9.91	14,865.59	14,865.59	0.195

Conclusion

The results indicate that the application of PGRs like ethrel significantly affected the morphological parameters and reduced the vine length and internode length, while increasing the number of branches and leaves. Phenological parameters like days taken to 1st flower, fruit set, harvesting, and sex ratio were significantly affected when treated with salicylic acid and ethrel. Ethrel 250 ppm at 2-4 leaf stage was beneficial in terms of economic parameters like CBR, gross return, and net return. Over all, ethrel 250 ppm at 2-4 leaf stage was the best treatment, and salicylic acid 1.0 mM at 2-4 leaf stage was the worst treatment in terms of morphological, phenological and economic parameters. It was observed that low concentrations (ethrel 250 ppm and salicylic acid 0.5 mM) gave significantly positive results for most of the parameters.

Scope for further work

- Further research is needed for the identification of the mode of action and effect of salicylic acid on the growth and development of cucumber.
- It is also required to study the interactions between the PGRs and their different concentrations.
- It is necessary to investigate the proper concentration and stage of application of salicylic acid as there is limited resources available in previous studies.
- To validate the findings, it is advisable to replicate the experiment over a span of 3–4 years at various locations, ensuring greater precision.

References

1. Achard P, Baghour M, Chapple A, Hedden P, Van Der Straeten D, Genschik P, *et al.* The plant stress hormone ethylene controls floral transition via DELLA-dependent regulation of floral meristem-identity genes. *Proceedings of the National Academy of Sciences of the United States of America*. 2007;104(15):6484-6489.
2. Ajay BL, Patil PL, Khadi BM. Effect of seed treatment with micronutrients and plant growth regulators on vegetative and reproductive growth in cucumber (*Cucumis sativus* L.). *The Pharma Innovation Journal*. 2018;10(10):47-51.
3. Baral B, Shrestha M, Subedi S, Dulal PR, Joshi NR. Effect of foliar spray of ethephon doses and pruning intensities on growth, sex expression, and yield of cucumber (*Cucumis sativus* L.) in Kaski, Nepal. *Archives of Agriculture and Environmental Science*. 2022;7(3):347-354.
4. Chakraborty S, Rayalu S. Health Beneficial Effects of Cucumber. *IntechOpen*; 2021. doi:10.5772.
5. Chaurasiya J, Verma RB, Ahmad M, Adarsh A, Kumar R, Pratap T. Influence of plant growth regulators on growth, sex expression, yield and quality of muskmelon (*Cucumis melo* L.). *Ecology, Environment and Conservation*. 2016;22(Special Issue):S39-S43.
6. Duhan DS, Singh J, Panghal V, Raj H. Influence of plant growth regulators on growth, flowering and fruit yield of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. *Vegetable Science*. 2022;49(1):69-74.
7. Fischer RA, Yates F. *Statistical tables for biological, agricultural and medical research*. 6th ed. Oliver and Boyd, Edinburg and London; 1963. p. 146.
8. Kumar M, Dubey R, Jha M. Effect of plant growth regulators and thiourea on growth and yield of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] cv. Pusa Naveen. *Journal of Pharmacognosy and Phytochemistry*. 2019;8(5):1616-1617.
9. Kumar R, Singh R, Malik CP. Effect of ethephon on sex expression, yield and quality parameters of watermelon cultivars under protected cultivation. *International Journal of Agricultural Sciences*. 2016;12(2):329-333.
10. Kumari K, Kamalkant KR, Singh VK. Effect of plant growth regulators on growth and yield of bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). *International Journal of Current Microbiology and Applied Sciences*. 2019;8(7):1881-1885.
11. Leiberman M, Knecht E. Effects of Ethrel on Auxin Levels and Shoot Growth in Plants. *Journal of Plant Physiology*. 1977;45(3):123-136.
12. Mahala P, Choudhary MR, Yadav TV, Garhwal OP, Singh P. Effect of plant growth regulators on yield, quality and economics of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. *Annals of Agricultural and Biological Research*. 2014;19(1):137-139.
13. Martin-Mex R, Nexticapan-Garcez A, Larqué-Saavedra A. Potential benefits of SA in food production. In: Hayat S, Ahmad A, Nasser MN, editors. *SA Plant Growth and Development*. Springer Dordrecht Heidelberg New York London; 2013. p. 299-313. doi:10.5772.
14. Mehdi M, Ahmed N, Jabeen N, Khan SH, Afroza B. Effect of ethrel on hybrid seed production of cucumber (*Cucumis sativus* L.) under open and protected conditions. *Asian Journal of Horticulture*. 2012;7(2):558-560.
15. Mishra A, Singh D. Effect of salicylic acid, 2, 4-dichlorophenoxyacetic acid and Gibberellic acid on yield and economics of Cape gooseberry (*Physalis peruviana* L.). *Pharma Innovation*. 2021;10(10):2543-2546.
16. Mukherjee PK, Nema NK, Maity N, Sarkar BK. Phytochemical and therapeutic potential of cucumber. *Fitoterapia*. 2013;84(1):227-236.
17. Patel J, Desai B, Jadav B. Effect of salicylic acid on growth, yield and quality of cucumber (*Cucumis sativus* L.) cv. Arka Anant. *Journal of the Indian Society of Horticultural Science*. 2015;74(4):432-435.
18. Rahman A, Duhan DS, Zood PK, Raj H. Response of plant growth regulators and trace elements on growth, flowering and yield of bottle gourd cv. GH 22. *Vegetable Science*. 2020;47(1):93-98.
19. Sheoran R, Singh R, Malik CP. Effect of ethephon on sex expression and yield of cucumber cultivars under protected cultivation. *Haryana Journal of Horticulture Sciences*. 2015;29(1):7-10.
20. Shukla S, Singh R, Haribaksh RP, Srivastav A. Effect of plant growth regulators on growth, flowering and yield of ridge gourd (*Luffa acutangula* L. Roxb.) cv. Kashi Shivani. *The Pharma Innovation Journal*. 2023;12(7):823-826.
21. Sultan SME, Mohamed MF, Abd-elrahim GH, El-basyouny MSS. Growth and Yield of Cucumber Plants Derived from Seeds Pretreated with Salicylic Acid. *Journal of Biology, Chemistry, Environmental Science*. 2016;11(1):541-561.
22. Thappa M, Kumar S, Rafiq R. Influence of Plant Growth Regulators on Morphological, Floral and Yield

- Traits of Cucumber (*Cucumis sativus* L.). Kasetsart Journal (Natural Science). 2011;45:177-188.
23. Ullah H, Bano A, Khokhar KM, Mahmood T. Effect of seed soaking treatment with growth regulators on phytohormone level and sex modification in cucumber (*Cucumis sativus* L.). African Journal of Plant Science. 2011;5(10):599-608.
24. Yadav NP, Bahadur V, Singh NV, Singh G. Effect of foliar spray of brassinosteroids, salicylic acid and gibberellic acid on the fruit yield and yield traits of cucumber (*Cucumis sativus* L.) cv. Arpit. The Pharma Innovation Journal. 2022;11(12):1330-1333.
25. Zhang Y, Zhao G, Li Y, Mo N, Zhang J, Liang Y. Transcriptomic analysis implies that GA regulates sex expression via ethylene-dependent and ethylene-independent pathways in cucumber (*Cucumis sativus* L.). Frontiers in Plant Science. 2017;8:10.