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EFFECT OF EXOGENOUS APPLICATION OF PLANT GROWTH REGULATORS ON GROWTH AND FLOWERING ATTRIBUTES OF BOTTLE GOURD (*LAGENARIA SICERARIA* L.)

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ABSTRACT

An experiment was carried out on “Effect of Exogenous Application of Plant Growth Regulators on Growth, Yield and Quality of Bottle Gourd (*Lagenaria siceraria* L.)” at Experimental Field, Department of Horticulture, College of Agriculture, Indore, (M.P.), India during *kharif* season 2023-2024. The experiment was laid out in randomized block design with thirteen treatments and three replications. The treatments consist of two growth regulators viz., Ethrel (250 ppm and 500 ppm) and Salicylic Acid (0.5 mM and 1.0 mM) sprayed at three different growth stages viz., 2-4 leaf stage, vine initiation stage and flowering stage. The results indicated significant variability among the treatments for various growth and flowering traits. Ethrel @ 500 ppm at vine initiation significantly reduced the growth parameters like vine length and length of internodes and significantly increased number of branches and number of leaves. Furthermore, the minimum number of days taken to first flowering and 50% flowering was recorded in Ethrel (250 ppm) at vine initiation stage and Ethrel (500 ppm) at vine initiation was found superior in reducing the days taken to first picking as well as narrowing the sex ratio.

Key words: Bottle gourd, Ethrel, Salicylic Acid, PGRs

Introduction

Bottle gourd (*Lagenaria siceraria* L.), a significant vegetable crop from the Cucurbitaceae family, possesses a chromosome number of $2n = 22$. Commonly referred to as calabash gourd, white-flowered gourd, lauki, ghiya, or doodhi, it is widely cultivated across India and is believed to have originated in tropical Africa. In India, leading states for bottle gourd cultivation include Bihar, Uttar Pradesh, Madhya Pradesh, Haryana, Chhattisgarh, and West Bengal. As per the Department of Agriculture and Farmers Welfare (2021–22), bottle gourd was grown over an area of 0.192 million hectares, yielding 3.17 million tons with an average productivity of 16.51 tons per hectare. Within Madhya Pradesh, districts like Satna, Sidhi, Rewa, and Jabalpur are known for extensive bottle gourd farming. According to the HAPIS GOI Final Advanced

Estimate (2022–23), the crop occupied 0.028 million hectares in the state, with a total production of 0.512 million tons, and an average yield of 18.28 tons per hectare, which exceeds the national average. Bottle gourd is a day-neutral, monoecious, and highly cross-pollinated plant. Its monoecious characteristic means that male and female flowers appear separately but on the same plant (Desai *et al.*, 2011). The crop is pan-tropically distributed, holding regional economic value and used for various purposes as a vegetable, for crafting musical instruments, and for oil and protein extraction from its seeds (Kubde *et al.*, 2010). The tender fruits are commonly cooked or used in making sweets and pickles. Nutritionally, bottle gourd is rich in carbohydrates, vitamin A, vitamin C, and essential minerals, making it a valuable dietary component (Hill *et al.*, 2008).

Table 1: Influence of plant growth regulators on growth attributes in bottle gourd.

Treatments		Vine length (cm)			Number of leaves			LOI	NBV	
		30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP		45 DAP	60 DAP
T ₀	Control	142.20	319.20	464.60	9.73	30.53	87.47	15.13	6.27	9.87
T ₁	Salicylic acid (0.5 mM) at 2-4 leaf stage	120.00	298.40	432.20	9.60	35.27	88.13	14.80	4.40	9.73
T ₂	Salicylic acid (0.5 mM) at vine initiation	125.67	305.80	419.93	9.73	25.33	75.47	14.60	4.73	10.53
T ₃	Salicylic acid (0.5 mM) at flowering stage	128.33	260.27	362.33	9.80	28.40	80.33	14.53	4.60	10.03
T ₄	Salicylic acid (1.0 mM) at 2-4 leaf stage	128.73	229.13	326.07	9.00	25.20	66.47	14.07	4.20	9.60
T ₅	Salicylic acid (1.0 mM) at vine initiation	134.60	285.60	364.53	10.13	32.00	70.60	14.73	5.33	11.03
T ₆	Salicylic acid (1.0 mM) at flowering stage	129.53	278.53	370.53	9.47	30.00	74.47	14.33	6.33	10.20
T ₇	Ethrel (250 ppm) at 2-4 leaf stage	127.27	260.20	359.53	9.80	30.20	71.47	13.00	6.07	11.07
T ₈	Ethrel (250 ppm) at vine initiation	118.20	232.67	342.93	10.80	41.27	88.27	13.20	7.53	11.67
T ₉	Ethrel (250 ppm) at flowering stage	115.80	238.47	394.87	9.27	26.40	79.07	14.00	6.33	10.80
T ₁₀	Ethrel (500 ppm) at 2-4 leaf stage	115.87	245.87	404.40	9.67	29.40	80.07	12.53	6.10	11.27
T ₁₁	Ethrel (500 ppm) at vine initiation	112.13	222.20	318.13	10.93	43.00	90.80	10.47	7.87	12.47
T ₁₂	Ethrel (500 ppm) at flowering stage	129.60	281.20	384.47	9.93	31.87	86.33	13.20	6.03	10.47
SEm±		2.84	8.59	22.57	0.31	2.21	4.50	0.45	0.34	0.351
C.D. (at 5%)		8.28	25.06	65.87	0.91	6.46	13.13	1.30	1.01	1.026
LOI: Length of internode (cm); NBV: Number of branches/vine										

Cucurbit crop yields are significantly influenced by the ratio and timing of male and female flower development. Generally, male flowers emerge on the lower nodes, while female flowers tend to appear later on the plant. However, cucurbits often produce a higher number of male flowers compared to female or hermaphrodite flowers, which can lead to lower yields and delayed harvests. In addition, environmental stresses such as high temperatures and drought conditions further limit productivity. The use of Plant Growth Regulators (PGRs) such as Ethrel and Salicylic Acid offers a promising approach to improving yield and mitigating the adverse effects of abiotic stresses.

Plant Growth Regulators (PGRs) play a crucial role in regulating numerous physiological and biochemical processes in plants. They are especially important because of their significant influence on flowering, fruit development, and overall crop yield. Applying PGRs externally can help boost fruit production by reducing the formation of male (staminate) flowers on the main stem and promoting the development of female (pistillate) flowers on the lateral branches (Mahida *et al.*, 2015).

Materials and Methods

A field experiment on Bottle gourd was conducted at Research Farm of Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Department of Horticulture, College of Agriculture Indore, during kharif season 2023-2024. The spacing between row to row 1 m and plant to plant 1 m were maintained. The experiment was laid out in randomized block design with thirteen treatments and

three replications. The treatments consist of two growth regulators viz., Ethrel (250 ppm and 500 ppm) and Salicylic Acid (0.5 mM and 1.0 mM) sprayed at three different growth stages viz., 2-4 leaf stage, vine initiation stage and flowering stage. The treatments consists of T₀ (Control), T₁ (Salicylic acid @ 0.5 mM at 2-4 leaf stage), T₂ (Salicylic acid @ 0.5 mM at vine initiation), T₃ (Salicylic acid @ 0.5 mM at flowering stage), T₄ (Salicylic acid @ 1.0 mM at 2-4 leaf stage), T₅ (Salicylic acid @ 1.0 mM at vine initiation), T₆ (Salicylic acid @ 1.0 mM at flowering stage), T₇ (Ethrel @ 250 ppm at 2-4 leaf stage), T₈ (Ethrel @ 250 ppm at vine initiation), T₉ (Ethrel @ 250 ppm at flowering stage), T₁₀ (Ethrel @ 500 ppm at 2-4 leaf stage), T₁₁ (Ethrel @ 500 ppm at vine initiation) and T₁₂ (Ethrel @ 500 ppm at flowering stage). The required amounts of plant growth regulators (PGRs) were applied to the corresponding plots, following the specified treatment schedules and at the correct growth stages. Plants were randomly chosen and tagged in each treatment to record the observations of growth and flowering characteristics.

Results and Discussion

Growth parameters

Data showed in Table 1 indicated that the growth parameters like vine length, intermodal distance, number of branches and number of leaves were significantly influenced by the exogenous application of plant growth regulators. The maximum vine length at 30, 45, and 60 i.e. 142.20, 319.20 and 464.60 cm respectively and the length of internodes i.e. 15.13 cm were recorded in T₀

Table 2: Influence of plant growth regulators on flowering attributes in bottle gourd.

Treatments		Days taken to first flowering	Days taken to 50 % flowering	Days taken to first picking	Number of male flower	Number of female flower	Sex ratio
T ₀	Control	35.80	39.07	68.33	36.60	4.77	7.67
T ₁	Salicylic acid (0.5 mM) at 2-4 leaf stage	34.70	37.80	61.33	29.33	5.23	5.61
T ₂	Salicylic acid (0.5 mM) at vine initiation	35.47	38.93	59.33	30.73	5.47	5.62
T ₃	Salicylic acid (0.5 mM) at flowering stage	34.53	38.20	63.33	27.67	7.23	3.83
T ₄	Salicylic acid (1.0 mM) at 2-4 leaf stage	34.67	38.27	65.00	28.00	5.70	4.91
T ₅	Salicylic acid (1.0 mM) at vine initiation	34.90	38.53	63.00	27.33	5.20	5.26
T ₆	Salicylic acid (1.0 mM) at flowering stage	35.00	38.40	60.00	31.00	7.67	4.04
T ₇	Ethrel (250 ppm) at 2-4 leaf stage	34.60	38.13	64.00	24.67	7.33	3.37
T ₈	Ethrel (250 ppm) at vine initiation	32.67	35.60	57.33	27.00	6.97	3.87
T ₉	Ethrel (250 ppm) at flowering stage	34.77	37.93	62.00	29.33	6.27	4.68
T ₁₀	Ethrel (500 ppm) at 2-4 leaf stage	34.53	37.73	65.00	27.27	7.33	3.72
T ₁₁	Ethrel (500 ppm) at vine initiation	33.27	36.47	53.00	21.00	9.67	2.17
T ₁₂	Ethrel (500 ppm) at flowering stage	35.13	38.47	67.33	30.13	7.50	4.02
SEM±		0.47	0.54	1.22	2.10	0.44	0.42
C.D. (at 5%)		1.37	1.58	3.55	6.13	1.28	1.23

(control), while the minimum vine length *i.e.* 112.13, 222.20 and 318.13 cm and length of internodes *i.e.* 10.47 cm were observed in treatment T₁₁ (Ethrel @ 500 ppm at vine initiation). The reduction in vine length and length of internodes might be due to Ethrel, as it showed the anti-gibberellic property, which results in the cessation of mitotic process in the meristem of root and shoot that affects the vine length (Hayashi *et al.*, 2001). Similar results were also reported by Duhan *et al.*, (2022), Rahman *et al.*, (2020), and Dhakal *et al.*, (2019). The maximum number of branches at 45 and 60 days after planting *i.e.* 7.87 and 12.47 respectively and the number of leaves at 30, 45 and 60 days after planting *i.e.* 10.93, 43 and 90.80 respectively were recorded in treatment T₁₁ (Ethrel @ 500 ppm at vine initiation), while the minimum number of branches/plant and number of leaves were 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 positive impact of Ethrel on boosting the number of branches per vine might be due to its antagonistic effect on auxin. This results in a reduction of apical dominance and promotes the sprouting of lateral buds. 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 due to increase in the number of branches per vine by ethrel. These results are in agreement with results obtained by Duhan *et al.*, (2022), Rahman *et al.*, (2020) and Chaurasiya *et al.*, (2016).

Flowering parameters

Data showed in Table 2 indicated that the minimum number of days taken to first flowering and 50% flowering were recorded in treatment T₈ (Ethrel @ 250 ppm at vine initiation) *i.e.* 32.67 and 35.60 days respectively while the maximum number of days taken to first flowering and 50% flowering were recorded in treatment T₀ (control). The minimum number of days taken to first picking was recorded in treatment T₁₁ (Ethrel @ 500 ppm at vine initiation) *i.e.* 53 days while the maximum number of days taken to first picking was also recorded in treatment T₀ (control). Similar findings were also confirmed with the findings of Achard *et al.*, (2007) that the use of ethylene before flowering might stimulate the development of pistillate flowers, either directly or by diminishing endogenous levels of gibberellic acid and auxin, or by fostering the synthesis of abscisic acid. This appears to be a possible reason for the early emergence of female flowers and the delayed emergence of male flowers, due to which ethrel treatments were taken less number of days for flowering as well as first picking. These findings are in line with results obtained by Sabu *et al.*, (2022) in bottle gourd, Chaudhary *et al.*, (2023) in cucumber and Kumari *et al.* (2020) in bottle gourd. The maximum number of male flowers and sex ratio were recorded in treatment T₀ (control), while the maximum number of female flowers and minimum sex ratio *i.e.* 9.67 and 2.17 respectively were observed in treatment T₁₁ (Ethrel @ 500 ppm at vine initiation). The reason for the variation in sex ratio was because sexual differentiation is influenced by internal levels of auxins, which are affected by ethrel. Ethrel appears to encourage the

development of flowering primordia and, during the flowering process, acts as a substance counteracting gibberellin. This counteraction 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 also reported by Patel *et al.*, (2017) in bottle gourd, Chaudhary *et al.*, (2023) in cucumber and Chaurasiya *et al.*, (2016) in muskmelon.

Conclusion

It was concluded that the application of plant growth regulators like Ethrel @ 500 ppm at vine initiation significantly reduced the growth parameters like vine length and length of internodes and significantly increased number of branches and number of leaves. Phenological parameters like days taken to first flowering and days taken to 50% flowering was reduced by Ethrel @ 250 ppm at vine initiation, while Ethrel @ 500 ppm at vine initiation significantly reduced the days taken to first picking as well as narrowing the sex ratio.

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