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Full Length Research Article

Influences of Plant Growth Regulators on Growth and Yield of Summer Squash (*Cucurbita pepo* L.)

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Abstract

The investigation was carried out to "Study the influences of plant growth regulators on growth and yield of summer squash (*Cucurbita pepo* L.)" at farmer field at Sorakalnatham, Natrampalli taluk, Tirupattur district, (Tamil Nadu) during 2022. The experiment was laid out in randomized block design with thirteen treatments replicated thrice. The treatments viz., Naphthalene acetic acid @ 50ppm, Naphthalene acetic acid @ 100ppm, Naphthalene acetic acid @ 150ppm, Gibberellic acid @ 50ppm, Gibberellic acid @ 100ppm, Gibberellic acid @ 150ppm, Ethrel @ 150ppm, Ethrel @ 200ppm, Ethrel @ 250ppm, Malichydrazide @ 150ppm, Malichydrazide @ 200ppm, Malichydrazide @ 250ppm, Control (water spray). The results indicated that the maximum values for growth attributes viz., plant height (61.25 cm), number of primary branches/plant (2.85), leaf area (395.78 cm^2) and yield components like number of female flower per plant (12.49), sex ratio (0.89), number of fruits per plant (11.19), fruit set percent (89.79%), fruit length (42 cm), single fruit weight (2.32 kg), fruits yield per plant (25.96 kg) and minimum number of male flower per plant (13.98) were recorded in the foliar application of plant growth regulator NAA @ 100 ppm. This was followed by the foliar application of plant growth regulators ethrel @ 150 ppm. Significant differences were observed with the use of growth regulators on growth and yield traits of summer squash.

Key words: *Cucurbita pepo* L., Ethrel, Naphthalene acetic acid, Growth, Yield

The most crucial vegetable crop is summer squash (*Cucurbita pepo* L.). It originates from the cucurbitaceous family. It grows during the summer in tropical and subtropical environments. In addition to being used as food for humans, it is notable because of its usage as a medicinal plant due to its high zinc and antioxidant content. The blossoms of this plant are produced on the same plant, both male and female. It often produces fewer female flowers and more male flowers. A base-mounted unripe fruit serves as a presentation for female flowers. In this crop, environmental factors including photoperiod, temperature, and others influence sex expression in addition to genetic reasons [2]. Typically, there are fewer male flowers and more female flowers in the spring. Typically, plants with lengthy photoperiods and high temperatures have more male blooms and fewer female flowers. Its fruit output will diminish as a result of this issue. Consequently, the change of sex expression in this crop has been accomplished by the plant growth regulator. It can alter sex expression, enhance fruit set, and eventually boost crop production. It's likely that in these plants, growth hormones and sex expression are related. By using exogenous substances like NAA, GA_3, ethrel, and MH, sex modification shifts toward femaleness in sex expression while decreasing the quantity of male flowers and increasing the development of female blooms on lateral branches. As a result, they stimulate the female flower production on lateral branches, increasing the yield and quality in the end. Exogenous GA_3 administration improves other phytohormone balance, stomatal conductance, water usage effectiveness, photosynthetic activity, and ion uptake. In order to lessen the severe impacts of environmental stress, GA_3 also increases osmoprotectant and antioxidant capacity while reducing lipid peroxidation. The goal of the current fulfillment was to look for practical growth regulators that would increase the yield potential of summer squash. Growth regulators are currently employed in horticulture and are seen to be very essential treatments because they often affect fruit yield. The goal of the current study was to as certain how plant growth regulators affected the growth and yield of summer squash.

MATERIALS AND METHODS

The experiment was conducted at farmer's field at Sorakalnatham, Natrampalli taluk, Tirupattur district (Tamil Nadu) during 2022. The experimental field is situated at 12° 35' N latitude and 78° 30' E longitude, at an altitude of 195.75 meters above mean sea level. The weather at Sorakalnatham

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colder during winter and hotter in summer with average maximum temperature 35°C, average minimum temperature 16°C and average relative humidity 85 per cent. The soil was sandy clay loam. The varieties chosen for the crop were squash long green. The experiment was laid out in a randomized block design with three replications and thirteen treatments replicated thrice. The treatments viz., Naphthalene acetic acid @ 50ppm, Naphthalene acetic acid @ 100ppm, Naphthalene acetic acid @ 150ppm, Gibberellic acid @ 50ppm, Gibberellic acid @ 100ppm, Gibberellic acid @ 150ppm, Ethrel @ 150ppm, Ethrel @ 200ppm, Ethrel @ 250ppm, Malichydrazide @ 150ppm, Malichydrazide @ 200ppm, Malichydrazide @ 250ppm, Control (water spray). The entire dose of phosphorus and potassium and half dose of nitrogen were applied basally and rest of the nitrogen is top dressed about four weeks after seed sowing. Seeds are sown at a depth of 2-3 cm with spacing of 2 × 1 m. Two sprays of growth regulators were done at 2 - 4 leaf stages. Irrigation was given immediately after sowing with care. Life irrigation was given on third day after sowing. Subsequent irrigations were given at 3-4 days interval as per the crop requirement and weather. In summer squash, tender and still have a shiny or glossy appearance fruits were harvested. Observations were taken on the five randomly selected plants in each plot in respect to growth characters viz., plant height, Number of primary branches plant^{-1}, leaf area and floral, yield characters viz., Number of male flower plant^{-1}, Number of female flower plant^{-1}, sex ratio, fruit set per cent, Number of fruit plant^{-1}, Fruit length, single fruit weight, and Fruit yield plant^{-1}. The data statistically analyzed using the methods suggested by [5]. The percentage of fruit set was estimated fruit set per cent was calculated from the number of fruits to the number of female flowers produced plant^{-1} as follows:

Fruit set per cent = No. of fruits plant^{-1} / No. of female flower plant^{-1} × 100 [2]

Sex ratio

It was calculated according to the following equation:

Sex ratio = No. of female flowers/ No. of male flower [6]

RESULTS AND DISCUSSION

Growth attributes

The results (Table 1) revealed that there was significant difference between the treatments. The maximum values for the growth parameters viz., plant height (61.25 cm), number of primary branches plant^{-1} (2.85) and leaf area (395.78 cm^2) were recorded in the summer squash which received the foliar application of (T_2) NAA @ 100 ppm. This treatment was followed by the treatment T_7 ethrel @ 150 ppm and found to be significant with the best treatment. The minimum values of growth parameters were recorded in control (T_{13}) which was on par with the treatments T_6, T_3, T_8 and T_9. The greatest summer squash plant height is a result of their stimulation of plant development through cell elongation and quick cell division in apical portions of the plant. The growth of intact plants is promoted by NAA, according to various reports. The maximum number of primary branches arising from the plant's height and the quantity of primary branches that are created in the plant are directly proportional to one another, i.e., an increase in plant height causes an increase in the number of primary branches, and vice versa. Due to the application of NAA and the increased number of primary branches on the main branches of summer squash, the major outcome may be the result of reversible effects on plant mitosis. Leaves plays an important role in different metabolic activity occurred in plant like photosynthesis, respiration, transpiration and translocation of nutrients. The maximum leaf area caused by low concentrations of Naphthalene acetic acid (NAA) increased the area of the leaf blades, whereas larger concentrations entirely prevented and stopped the growth of the leaves. For better conversion of the complex starches into simple sugars to provide energy for growth, additional NAA availability in the seed may have increased the level of amylase in the aleurone tissue of the seed. Leaf area increased with increasing time to a maximum, coinciding with maximum top growth [1], [3].

Table 1 Influences of plant growth regulators on growth parameters in summer squash

Treatments	Plant height (cm)	No. of primary branches	Leaf area (cm^2)
T_1: NAA @ 50 ppm	45.49	1.85	360.99
T_2: NAA @ 100 ppm	61.25	2.85	395.78
T_3: NAA @ 150 ppm	42.53	1.76	355.05
T_4: GA_3 @ 50 ppm	52.83	2.29	375.21
T_5: GA_3 @ 100 ppm	50.13	2.05	368.43
T_6: GA_3 @ 150 ppm	43.09	1.80	357.23
T_7: Ethrel @ 150 ppm	57.30	2.52	381.08
T_8: Ethrel @ 200 ppm	41.35	1.70	347.60
T_9: Ethrel @ 250 ppm	41.79	1.73	352.11
T_{10}: MH @ 150 ppm	54.95	2.40	378.49
T_{11}: MH @ 200 ppm	52.39	2.17	371.06
T_{12}: MH @ 250 ppm	47.87	1.92	364.37
T_{13}: Control	40.72	1.67	344.08
S.Ed	1.23	0.07	6.93
CD(p=0.05)	2.45	0.14	13.85

Floral and yield attributes

The data recorded on floral and yield attributes of summer squash are presented in (Table 2). Foliar application of NAA @ 100 ppm had excelled other treatments by recording the highest values for number of female flower plant^{-1} (12.49), sex ratio (0.89), number of fruits plant^{-1} (11.19), fruit set % (89.79), fruit length (42 cm), single fruit weight (2.32 kg), fruit yield plant^{-1} (25.96 kg) and lowest number of male flower plant^{-1} (13.98). This was followed by the treatment which received foliar application of the treatment ethrel @ 150 ppm and found to be significant with the best treatment. The highest proportion of female flowers in the best treatment may be caused by an increase in auxin substance metabolization in plants and a reduction in sugar, which changes membrane permeability. The plant's predisposition toward femaleness was induced by the auxin, which like Naphthalene acetic acid (NAA) delayed flowering with lower dosages compared to larger doses of NAA. The quantity of female flowers on plant $^{-1}$ increased noticeably with each rise in NAA doses, it was also reported. It might be due to NAA induces femaleness in cucurbits and regulate the metabolic activities in plants. The present study found that the growth promoters (NAA) lowered the commencement of male flowers at the optimum doses, which may be because they are at an optimal level known to slow down the metabolization of photosynthates. As a result, there were less male flowers. The highest sex ratio caused by NAA dosages may have been caused by the inhibition of staminate blooms and the promotion of more pistillate flowers [4]. The use of NAA may be related to the fact that these compounds are said to improve the functionality and compatibility of female organs while also decreasing embryo abortion in plants. The most fruit possible per plant the large improvement in fruit development may be attributable to growth regulators, which stimulate plant metabolism. This, in turn, enhances the reproductive phase and increases the production of pistillate flowers, which leads to a greater number of fruits plant^{-1}. The maximum fruit length can be explained by the fact that the only purpose of fertilized ovules or seeds in relation to fruit growth is to synthesis one or more hormones that start and sustain a metabolic gradient and allow for the transport of food from different plant sections to the fruits. Because of the plant's increased metabolic activity, which also improved the reproductive phase, fruit development has significantly improved. It is possible to explain an increase in fruit output in treated plants to the fact that plants continue to grow physiologically more active in order to accumulate enough food for the developing flowers and fruits, which ultimately results in a larger yield. Auxin-directed mobilization of metabolites from source to sink responds to an increase in carbohydrate metabolism and carbohydrate buildup [8]. However, at low and medium concentrations, these treatments resulted in significantly maximum values over control [6-7].

Table 2 Influences of plant growth regulators on yield parameters in summer squash

Treatments	No. of female flower plant^{-1}	No. of male flower plant^{-1}	Sex ratio	No. of fruits plant^{-1}	Fruit set %	Fruit length (cm)	Single fruit weight (kg)	Fruit yield plant^{-1} (kg)
T_1: NAA @ 50 ppm	10.30	16.01	0.64	8.52	82.72	34.88	1.71	15.56
T_2: NAA @ 100 ppm	12.49	13.98	0.89	11.19	89.79	42.00	2.32	25.96
T_3: NAA @ 150 ppm	10.04	16.35	0.61	8.01	79.68	34.07	1.55	13.31
T_4: GA_3 @ 50 ppm	11.29	15.09	0.75	9.90	87.69	38.17	1.97	20.50
T_5: GA_3 @ 100 ppm	10.90	15.52	0.70	9.29	85.23	37.01	1.83	18.02
T_6: GA_3 @ 150 ppm	10.12	16.19	0.63	8.12	80.24	34.41	1.60	14.29
T_7: Ethrel @ 150 ppm	11.91	14.68	0.81	10.63	88.85	40.61	2.14	22.74
T_8: Ethrel @ 200 ppm	9.63	16.70	0.58	7.62	79.13	33.51	1.51	11.51
T_9: Ethrel @ 250 ppm	9.91	16.54	0.60	7.85	79.21	33.86	1.53	12.05
T_{10}: MH @ 150 ppm	11.58	14.90	0.78	10.22	88.26	39.43	2.03	21.74
T_{11}: MH @ 200 ppm	11.04	15.29	0.72	9.62	87.14	38.08	1.90	19.27
T_{12}: MH @ 250 ppm	10.54	15.79	0.67	8.94	84.82	35.96	1.76	16.73
T_{13}: Control	9.57	16.73	0.57	7.57	79.10	33.11	1.49	11.27
S.Ed	0.34	0.28	0.02	0.22	1.79	0.67	0.06	0.65
CD(p=0.05)	0.67	0.56	0.04	0.44	3.59	1.34	0.12	1.30

CONCLUSION

Plant growth regulators had a favorable impact up to a point where some characters could be controlled. On NAA @ 100 ppm, followed by ethrel @ 150 ppm, several plant growth regulators displayed a statistically significant variance. It can be concluded that foliar application of NAA @100ppm ppm twice at 2 and 4 true leaf stage was found to be superior for growth and yield parameters like plant height, number of primary branches plant^{-1}, leaf area, number of female flowers plant^{-1}, number of male flowers plant^{-1}, sex ratio, number of fruit plant^{-1}, fruit set %, fruit length, and fruit yield plant^{-1}. Summer squash plants left untreated (the control) showed lower growth and yield metrics.

LITERATURE CITED

1. Dalai S, Singh MK, Singh KV, Kumar M, Malik S, Kumar V. 2015. Effect of foliar application of GA_3 and NAA on growth, flowering, yield and yield attributes of cucumber (*Cucumis sativus* L.). *Ann. Hortic.* 8(2): 181-194.
2. Dobhal A, Pant SC, Chandola JC, Panwar A, Kumar V. 2022. Effect of plant growth regulator on growth, yield, quality and economic of summer squash (*Cucurbita pepo* L. Var. Pattypan) in Mid Hills of Uttarakhand. *Int. Jr. Plant Soil Science* 34(24): 855-862.
3. Kadi AS, Asati KP, Barche S, Tulasigeri RG. 2019. Effect of different plant growth regulators on growth, yield and quality parameters in cucumber (*Cucumis sativus* L.) under polyhouse condition. *Int. Jr. Cur. Microbiol. Appl. Sci.* 7(4): 3339-3352.
4. Khatoon R, Moniruzzaman M, Moniruzzaman M. 2019. Effect of foliar spray of GA_3 and NAA on sex expression and yield of bitter gourd. *Bangladesh Jr. Agric. Sciences* 44(2): 281-290.
5. Panse VG, Sukhatme PV. 1978. *Statistical Methods for Agricultural Workers*. Indian Council of Agricultural Research, New Delhi, Third Edition.
6. Shafeek MR, Helmy YI, Ahmed AA, Ghoname AA. 2016. Effect of foliar application of growth regulators (GA_3 and Ethrel) on growth, sex expression and yield of summer squash plants (*Cucurbita pepo* L.) under plastic house condition. *Int. Jr. Chemtech. Research* 9(6): 70-76.
7. Sinojiya AG, Kacha HL, Jethaloja BP, Giriraj J. 2015. Effect of plant growth regulators on growth, flowering, yield and quality of watermelon (*Citrullus lanatus* Thunb.) cv Shine Beauty. *Environ. Ecology* 33(4A): 1774-1778.
8. Sravika B, Kiranpatro TSKK, Ushakumari K, Emmanuel N, Suneetha S. 2021. Effect of growth regulators on yield and quality parameters of summer squash (*Cucurbita pepo* L.). *Pharma Innovation.* 10(8): 708-711.