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Influence of plant growth regulators (PGRs) on growth parameters and sex ratio in cucumber (*Cucumis sativus* L.)

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Abstract
An experiment was conducted during 2018-19 at JNKVV College of Agriculture, Tikamgarh (M.P.) to study the Influence of plant growth regulators (PGRs) on growth parameters and sex ratio in cucumber (*Cucumis sativus* L.)" cv. Kumud f_1 hybrid. Total nine treatments of the growth regulators *viz*, GA_3 50, 100, 200ppm, NAA 50, 100, 200 ppm, Ethrel 100, 200 ppm and control were applied in Randomized Block Design with replicates three. Foliar applications of all treatments were given at 2-true leaf to 4-leaf stages during the morning period. Out of these treatments GA_3 @ 200 ppm had maximum effect on growth parameters *viz*., vine length (132.44 cm), number of branches (6.81), number of nodes (22.67), and number of leaves (57.67). Sex ratio was recorded minimum in the treatment Ethrel @ 200 ppm (1.73:1).

Keywords: Plant growth regulators, GA_3, NAA, and Ethrel Growth parameter and sex ratio in Cucumber

Introduction
Cucurbitaceae is one of the largest families in vegetable kingdom consisting of largest number of edible type species. One of the valuable plant among them is cucumber (*Cucumis sativus* L.) while is most important cross pollinated and popular vegetable having chromosome no. 2n=14. Cucumber is commonly a monoecious, annual, trailing or climbing vine (Bailey, 1969) having hirsute or scabrous stems with triangular ovate leaves with shallow and acute sinuses. Unbranched lateral tendrils developed at the leaf axils. As the lateral branches are developed, flower clusters appear at leaf axils (Ahmed *et al.* 2004) [1].

The fruit of cucumber is said to have cooling effect, prevent constipation, checks jaundice and indigestion. Besides, the seed of cucumber is used in Ayurvedic preparations while raw fruits are being used in cosmetic preparations. The fruits are highly nutritive and have very high water content and very low calories. The fruit is used as a vegetable or salad. It is rich in minerals, thiamine, niacin and vitamin C. (0.38 g, 0.3 mg, 0.2 mg and 78 mg, respectively per 100 g of edible fruit). Fruits consist about 80 percent of edible portion which contains 95% water, 0.7% protein, 0.1% fat, 3.4% carbohydrates, 0.4% fiber and 0.4% ash (Aykroyd, 1963) [3].

The effects of plant growth regulators in cucumber exhibits a fascinating range of floral morphology, including staminate, pistillate and hermaphrodite flowers occurring in various arrangements and yielding several types of sexual expression. Furthermore, these types are affected greatly by environmental factors as well as hormones in the plant system. Growth regulators have tremendous effects on sex expression and flowering in cucumber crop leading to either suppression of male flowers or an increase in the number of female flowers (Al-Masoum and Al-Masri 1999) [2] without imposing any deleterious effect on the environment and human health. Exogenous application of plant growth regulators can alter the sex ratio and sequence, if applied at the two and four leaf stage, which is the critical stage at which the suppression or promotion of either sex is possible (Hossain, *et al*., 2006).

The plant growth regulators *viz*, GA_3, NAA, Ethrel etc. have been reported to influence the sex expression in various cucurbits leading to either suppression of male flower or an increase in number of female flower. Similar results have been reported by Choudhury and Singh (1970) [6] in cucumber. Sidhu *et al.* (1982) in muskmelon, Arora *et al.* (1987) [4] in ridge gourd. The growth regulators suppress the number of male flower on lateral branches and there by ultimately increase the yield. However, scanting information is available regarding the effect of growth regulators on the growth, flowering, sex expression and yield of cucumber.

Materials and Methods

The experimental trials comprises the details about the material used and the methods adopted during the course of investigation entitled "Influence of plant growth regulators (PGRs) on growth parameters and sex ratio in cucumber (*Cucumis sativus* L.)" cv. Kumud f_1 hybrid was carried out in *summer season* of 2019. The present field experiment investigation was carried out during *summer* 2019 at Research Area, Department of Horticulture, J.N.K.V.V., College of Agriculture, Tikamgarh (M.P.).

The experiment was laid out in Randomized Block Design (RBD) with three replications. The experiment comprised of nine with the combinations of plant growth regulators, namely Gibberellic acid (GA_3), Naphthalene acetic acid (NAA) and Ethrel these used at different concentrations. Foliar applications of all treatments were given at 2-true leaf to 4-leaf stages during the morning period. Both the surfaces of leaves and apical meristem were fully moistened. There were nine pits in every plot. The length and breadth of each pit was 30 cm and 30 cm respectively. There was 20 cm depth in pits and 45 cm distance from the border of the plots. The pits were prepared with necessary manures and fertilizers on 8th February 2019. The seeds were sown directly in the pit on 10th February 2019. 2 to 3 seeds were sown in each pit at 2 to 3 cm depth when the seedlings attained 10-15 cm height and become hard enough then one healthy seedling was selected to remain in each pit and others were thinned out.

A regular watering and plant protection measures were carried out as and when required. The crop was grown with FYM 50 and 100% recommended of fertilizers were applied following ring method of application at the rate of 150:75:75 kg NPK per hectare in the form of Urea, Di ammonium phosphate and Muriate of potash, respectively.

First hoeing and weeding was done after twenty days of sowing and second weeding was repeated after twenty five days of first weeding in all the treatments to keep plots weed free. After sowing, crop was protected from insect pest and diseases by fungicide and insecticide. The fungicide use for plant protection was carbendazim 12% + mencozeb 63% @ 2g/1kg of seed treatment disease control. Insecticide chloropyriphos 50% + cypermethrin 5% EC and dimethoate 30 EC were sprayed for control Red pumpkin beetles, fruit fly and aphids etc. No disease incidence was observed during the experiment.

Results and Discussion

The data on various observations recorded during experimentation were subjected to statistical analysis in Randomized Block Design in order to find out the significance of different treatments by using the analysis of variance. The results have been integrated along with the corresponding tables and figures.

Growth parameters

It is clear from the table 1 and depicted in Figure 1 that the maximum vine length (valued 132.44 cm) in treatment GA_3 @ 200ppm and while minimum was recorded in treatment control (valued 118.67 cm). Gibberellins promote stem elongation which might be due to that GA_3 could be involved in cell enlargement, intermodal elongation, stimulate RNA and protein synthesis and there by leading to enhanced growth and development. Hormonal action for enhancing cell division and cell elongation in growing portion of plants might be due to increased uptake of nutrients by increased photo synthetic activity, enhancement in the mobilization of photosynthesis and change in the membrane permeability (Pandita *et al.*, 1980) [14]. The similar finding was also recorded by Geeta *et al.* (2010) [7] at 60 DAS the maximum vine length (147.4 cm) was recorded in Gibberellic acid (20 ppm). Hilli *et al.* (2010) [9]. In general the number of branches per, nodes per plant and plant leaf number per plant were maximum in the treatment GA_3 @ 200 ppm (valued 6.81, 22.67 and 57.67, respectively) and while minimum was recorded in the treatment control (valued 4.78, 17.56 and 47.45, respectively). Increase in the number of branches, nodes and plant leaf number might be due to its additional availability of GA_3. It has been observed in the present study that the application of plant growth regulators had profound influence on assimilatory surface area and its associated characters. This could be attributed to the stimulatory effect of the plant growth regulators on cell division and cell enlargement, which lead to enhanced leaf area and hence influenced the growth and development (Geeta *et al.*, 2010) [10]. the number of branches, nodes and leaves formation is associated with the length of plant. The vine length is directly proportionate to the number of branches, nodes and leaves i.e., the more will be vine length the greater will be branches, nodes and leaves number. Suggested that maximum number of branches @ GA_3 (4.60) has been recorded. Similar finding were also given by Kadi *et al.* (2018) [10] the treatment with GA_3@ 100 ppm was recorded the maximum in Growth parameters *viz* number of branches (17.00). number of nodes on main vine as compared with the control However, the highest the number of nodes (34.29) on main vine was recorded in (GA_3 @ 60 ppm) confirmed by the result of Chaurasiya *et al.* (2015). who reported that maximum number of leaves (18.00) by @ GA_3 60 mg / L where as Geeta *et al.* (2014) [8] find out that GA_3 @ 20ppm recorded maximum number of leaves 46.00 at 40 DAS.

Sex ratio

It is clear from the Table 2 and depicted in the Figure 2 in showed that sex ratio was maximum in the treatment Control (valued 2.64:1) and while minimum was recorded in the treatment Ethrel @ 200 ppm (valued 1.73:1). It determines the sex ratio and sequence of flowering. Mia *et al.* (2014) [12] it could be attributed to the suppression in number of male flowers and promoted in more number of female flower flowers. There was a significant decrease in sex ratio recorded in all treatments than control and ethrel 150 ppm (7.19) proved as one of the best treatment in this respected finding of Kshirsagar *et al.* (1995) [11] Chaurasiya *et al.* (2015) and Patel *et al.* (2017) [13].

Table 1: Growth parameters

Treatments	Vine length (cm)	No. of branches	No. of nodes	No. of leaves
T_1 - GA_3 (50 ppm)	125.56	5.89	19.78	52.56
T_2 - GA_3 (100 ppm)	130.89	6.44	20.89	55.78
T_3 - GA_3 (200 ppm)	132.44	6.81	22.67	57.67
T_4 - NAA (50 ppm)	123.67	5.56	19.33	51.33
T_5 - NAA (100 ppm)	127.45	6.11	20.56	53.56

T_6 - NAA (200 ppm)	129.80	6.33	21.44	54.55
T_7 – Ethrel (100 ppm)	121.56	5.48	19.11	49.44
T_8 - Ethrel (200 ppm)	123.44	5.67	19.78	50.89
T_9 – Control	118.67	4.78	17.56	47.45
S.Em±	1.68	0.40	0.71	1.18
CD at 5% Level	5.03	1.22	2.15	3.54

Table 2: Sex Ratio

Treatments	No. of male flower/plant	No. of female flower/plant	Sex ratio
T_1 - GA_3 (50 ppm)	36.17	15.67	2.31
T_2 - GA_3 (100 ppm)	35.00	17.55	1.99
T_3 - GA_3 (200 ppm)	34.78	19.83	1.76
T_4 - NAA (50 ppm)	35.67	15.11	2.36
T_5 - NAA (100 ppm)	33.22	16.33	2.07
T_6 - NAA (200 ppm)	36.56	16.89	2.17
T_7 – Ethrel (100 ppm)	37.66	17.55	2.15
T_8 - Ethrel (200 ppm)	37.33	21.55	1.73
T_9 – Control	39.17	14.89	2.64
S.Em±	0.78	0.62	0.10
CD at 5% Level	2.34	1.86	0.30

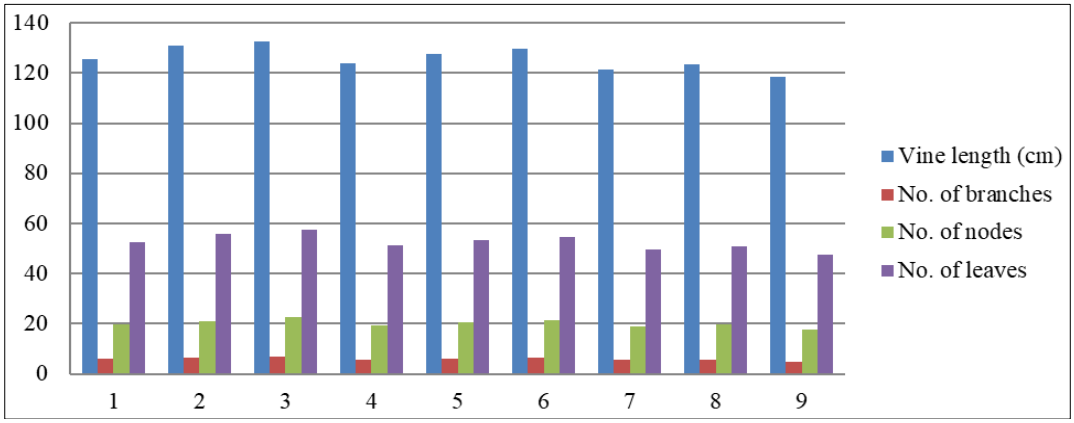

Fig 1: Growth parameters

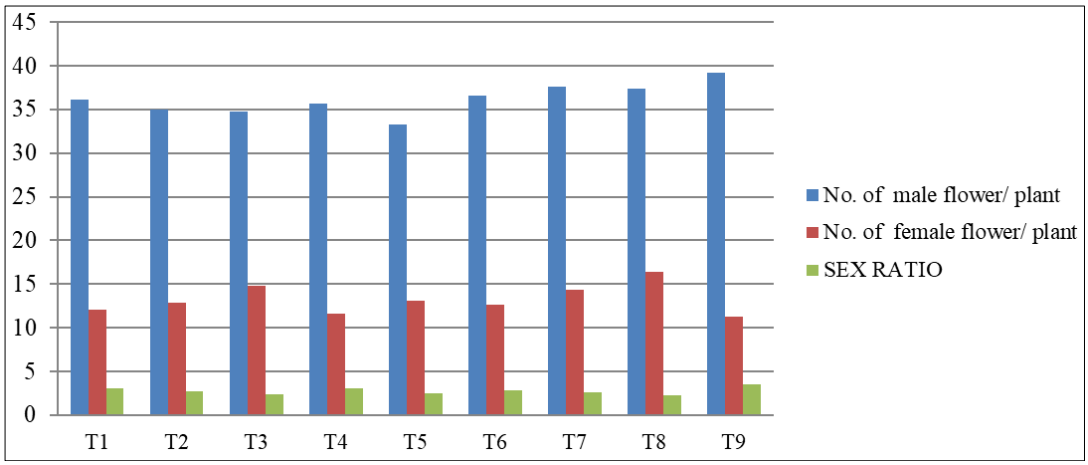

Fig 2: Sex Ratio

Conclusion

Findings obtained from this experiment shows that GA_3 @ 200 ppm was found the best for yield and yield attributes in Cucumber. The confirmation required further studies. Results revealed that the application of plant growth regulators significantly increased the growth parameters *viz.*, vine length, number of branches per plant, number of nodes per plants, number of leaves per plant, the growth foliar application of plant growth regulators GA_3 @ 200 ppm play most significant role in these characters followed by NAA @ 200 ppm. Ethrel @ 200 ppm can be used for minimizing sex ratio which is desirable while maximum sex ratio was recorded under Control.

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