Original Research Article

Effect of Gibberellic acid and Naphthalene acetic acid on growth and yield of Cucumber (*Cucumis sativus* L.) in Prayagraj agro climatic conditions

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ABSTRACT

An experiment was conducted on effect of gibberellic acid and Naphthalene acetic acid to determine the best suitable concentrations on growth and yield of cucumber at Horticulture Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during mid-March 2021. Total Nine treatments were tried and replicated three times in a Randomized Block Design. Treatments include two growth regulators having concentrations of GA_3 (15, 25, 35, 45 ppm) and NAA (75,100,125,150 ppm) and Control (Water spray) were spayed at two leaf stage and four-leaf stages. The application of plant growth regulators significantly affects the vegetative as well as reproductive attributes of the crop. Application of 25 ppm GA_3 at 2, 4 leaf stage was found most effective in terms of Vine length at 20, 40, 60 days (39.12, 91.02, 180.32 cm) Days to first appearance of male flowers in 50% plants (32.86 days) , No. of fruits per plant (12.20) Average fruit yield per plant (1870.37 g) fruit weight (153.33g) Days to first appearance of female flowers in 50% plants (38.93 in 35 ppm GA_3), Days to first harvest (50.6 days in 35 ppm GA_3) , length of the fruit(14.66 cm in 15 ppm GA_3) ,fruit diameter (4.28 cm in 15 ppm GA_3), Average yield (18.77 t/ha in 25 ppm GA_3)

Keywords: *Cucumber, GA_3 ,NAA, Growth, yield.*

1. INTRODUCTION

Cucumber (*Cucumis sativus* L.) belongs to the family Cucurbitaceae with monoecious nature having 2n=14 as chromosome number is an important warm season vegetable crop (Bailey et al., 1969) It is cross pollinated and propagated by seed. *Cucumis hardwckii* is progenitor of present cultivating cucumber. The fruit of cucumber is said to have cooling effect, prevent constipation and check jaundice and indigestion. During 2020-2021 productivity of cucumber was about 1,18,000 ha with an annual production of 1.665 mt was recorded (DAC & FW – Year? This font isn't in references). In cucumber staminate flowers are much more than pistillate flowers so application of optimum concentration of PGR at correct stage of plant growth modifies the morphology and physiology of plant by inhibiting or by stimulating the enzymes which regulate the metabolism of plants in altering the sequence of flowering. Plant growth regulators can be used flexibly for the fine tuning of crops that grow uncontrollable and unpredictable environmental conditions (Rademacher, 2016).GA_3 and NAA are the two important plant growth regulators that alter the growth and yield contributing characters of cucumber. Exogenous application of GA_3 at three leaf stage and tendril initiation stage helps in enhancing vine length, branches, promoting and better fruit setting while NAA which is a synthetic form of auxin helps in enhancement in vegetative growth, fruit and seed yield (Nagamani 2015).Increasing length of main axis and number of branches (Hadvani,2010).Application of auxins, gibberellins, growth retardants shifts towards femaleness in sex expression (Chowdary et al 1959) Inadequate data was observed PGR's on growth, yield of cucumber.Therefore an experiment was conducted to determine the best concentration of gibberellic acid and naphthalene acetic acid on growth and yield of cucumber.

2. material and methods

The field experiment was conducted at Horticulture Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during mid-March 2021. The University is about 7 km away from Prayagraj city and it is geographically situated at 25.5^0 N latitude, 81.08^0 E longitudes. The altitude of this location is about 98 meter above the mean sea level.The soil of the experimental field was sandy loam with pH of 6.8. Recommended package of cultural practices were adopted at last ploughing FYM- 2.0 kg/m^2 and half dose of nitrogen, full dose of P_2O_5 and K_2O were applied as basal and the remaining half nitrogen was applied at 30 days after sowing 100:60:60 kg/ha was applied in the form of Urea, Single super phosphate and Muriate of potash. The field experiment was carried out as a randomized block design with three replications.Two seeds per pit were sown with a spacing of 1.5 x 0.6 m in march 2021. GA_3 (15,25,35,45ppm) and NAA(75,100,125,150ppm) solutions, control (water spray) were prepared from the respective stock solutions with distilled water.The solutions were sprayed at 2 and 4 leaf stage with hand sprayer early in the morning. Irrigation ,weeding, hoeing and plant protection measures were employed as per the need of the crop. For each treatment of a replication five plants were selected and observations were recorded on various parameters of growth, and yield of the crop as per the planned schedule .The recorded data was analyzed statistically by ANOVA.

3. results and discussion

germination parameters

The seeds were not treated with the growth regulators and the experimental results revealed that there is no significant difference with respect to days taken to germination it can be affected by various environmental factors such as the difference between day and night temperature, soil moisture, light, pH of the soil in cucumber. The statistically analysed data was presented in Table no.1.

Growth parameters

Application of growth regulators has significant effect on vegetative growth as well as reproductive attributes (Mahala *et al.,* 2010).In the experiment the results revealed that the vine length increased significantly with the application of GA_3 25 ppm (39.12,91.02,180.32 cm) which was at par with GA_3 15 ppm (34.9,89.76,178.84 cm) followed by NAA 75 ppm (35.03,86.16,176.72 cm) and minimum was recorded (29.8,73.21,162.5 cm) under control at 20 ,40 ,60 days after sowing(Chovatia *et al*.,2010 ; Sure *et al*.,2012) GA_3 increases the rate of photosynthesis, efficiency of utilization of photosynthates which results in rapid cell elongation and cell division, stimulates RNA and protein synthesis which ensures in increasing the vine length. These finding are in the confirmity with earlier findings (Ajay *et al.,*2018).The data indicated in Table no 1: shows that days to first appearance of male flowers in 50 % plants of cucumber were significantly influenced by the various doses of NAA ,GA_3 as compared to control(Acharya *et al.,*2020). Minimum days taken to first appearance of male flowers in 50% plants were recorded in GA_3 25ppm (32.86) which is at par with GA_3 15ppm (33.4) where as maximum was recorded in control-water spray (39). This might be due to reducing the sugars there by inducing metabolic activity of cell which induces early flowering (Kadi *et al*., 2018). Minimum days to first appearance of female flowers in 50% plants were recorded in GA_3 35 ppm (38.93 days) which is par at GA_3 25 ppm (39.9) where as maximum days under control-water spray(46.2). This might be due to effect of GA_3 which alters the sexual differentiation in potentially male buds to female buds that enhances female flower formation earlier. The similar results of the study are in agreement with were Rahman *et al*.,(2018) ;Dixit *et al.*, (2001) The statistically analysed data was presented in Table no. 1.

Table no. 1 Effect of Gibberellic acid and Naphthalene acetic acid on days to germination, vine length, Days to first appearance of male flowers in 50% plants and first appearance of female flowers in 50% plants.

Notation	Treatment	Days to germination	Vine length(cm)			Days to 1st appearance of male Flowers in 50% plants	Days to 1st appearance of female flowers in 50% plants
			20 DAS	40 DAS	60 DAS		
T_1	Control	4	29.89	73.21	162.75	39.93	46.26
T_2	GA_3 15 ppm	5	34.96	89.76	178.84	33.40	41.06
T_3	GA_3 25 ppm	4	39.12	91.02	180.32	32.86	39.93
T_4	GA_3 35 ppm	5	33.02	82.31	172.79	34.13	38.93
T_5	GA_3 45 ppm	5	32.48	79.88	170.16	36.05	44.86
T_6	NAA 75 ppm	4	35.03	86.16	176.72	37.06	45.80
T_7	NAA100 ppm	5	34.14	85.13	175.94	33.86	42.13
T_8	NAA125 ppm	5	33.28	84.15	173.79	35.26	43.73
T_9	NAA150 ppm	4	30.79	77.80	166.75	44.33	44.33
F-Test		NS	S	S	S	S	S
SE(d) ±		0.150	0.812	1.231	1.072	0.285	0.579
$CD_{0.05}$		-	1.735	2.631	2.292	0.608	1.238

S-significant ; NS-Non significant; DAS-days after sowing

Fig 1: Effect of Gibbereillic acid and Naphthalene acetic acid on vine length of cucumber

Fig 2: Effect of Gibberellic acid and Naphthalene acetic acid on Days to first appearance of male and female flowers in 50% of the plants and Harvesting of cucumber

Yield Parameters

In the study the application of gibberellic acid and naphthalene acetic acid shows significant difference on yield parameters as compared to control. The results obtained in the present study shows that minimum days taken to first harvest of cucumber was recorded in GA_3 35 ppm (49.8) which was at par with GA_3 25 ppm(50.60), where as the maximum days taken to first harvest in control-water spray (55.2).The treated plants are more physiologically active translocates food to develop fruits which results in early maturity of fruits.The maximum fruit weight (153.33g) was recorded in GA_3 25 ppm followed by GA_3 15 ppm (151.11g) where as minimum was recorded in control-water spray (142.90 g). GA_3 and NAA application increases the fruit mesocarp by increasing the cell size (Jyoti *et al*., 2016 ;Hossain *et al.,* 2006)).The length of the fruit(14.66 cm) and the diameter (4.42cm) was recorded highest with application of GA_3 15ppm.This may be due to increasing the accumulation of carbohydrates and traslocation of food towards fruit. The results are similar with (kadi *et al*., 2018).The maximum number of Fruits per plant (12.2), Average yield per plant (1870.378 g) and Average yield tonnes per hectare (18.70 t/ha) was recorded in GA_3 25 ppm where as minimum (8.13,1162.3 g,11.61 t/ha) was recorded in control-water spray respectively (Das *et al.,*2001;Anayat *et al*.,2020) and similar in Dalai *et al*.,2015) The Yield which depends on multiple factors like number of fruits per plant, fruit weight, length and diameter of the fruits. GA_3 has an effect on both vegetative as well as reproductive characters, mainly female flower formation and fruit setting which ultimately increases the number of fruits, fruit weight both combinedly increased fruit yield per plant resulted in maximum Average yield per hectare.This may be due to better enzymatic activity and the synthesis of growth regulators endogenously which was similar findings of (sure *et.al.,*2012, Anayat *et al.,*2020) The statistically analysed data was presented in Table no. 2.

Table no. 2 Effect of Gibberellic acid and Naphthalene acetic acid on Days to first harvest, fruit weight, length of the fruit, fruit diameter, no. of fruits per plant, average yield per plant and average yield per hectare.

Notation	Treatment	Days to first harvest	Fruit weight (g)	Length of the fruit (cm)	Fruit diameter(cm)	No of fruits per plant	Average yield per plant (g)	Average yield (t/ha)
T_1	Control	55.20	142.90	12.36	3.96	8.13	1,162.36	11.61
T_2	GA_3 15 ppm	51.20	151.11	14.66	4.42	11.13	1,682.39	16.81
T_3	GA_3 25 ppm	50.60	153.33	14.12	4.25	12.20	1,870.37	18.70
T_4	GA_3 35 ppm	49.80	146.86	14.05	4.15	8.53	1,253.14	12.53
T_5	GA_3 45 ppm	53.33	145.67	13.88	4.11	8.20	1,194.58	11.94
T_6	NAA 75 ppm	53.86	149.72	14.23	4.28	10.73	1,606.73	16.06
T_7	NAA100 ppm	51.80	148.01	13.74	4.07	9.66	1,430.71	14.30
T_8	NAA125 ppm	52.33	147.79	14.19	4.26	9.26	1,369.56	13.69

T_9	NAA150 ppm	52.60	143.90	13.54	4.02	8.20	1,180.03	11.79
F-Test		s	s	s	s	s	s	s
SE(d) ±		0.513	1.217	0.184	0.037	0.190	29.083	0.291
$CD_{0.05}$		1.131	2.602	0.394	0.080	0.407	62.184	2.515

4. Conclusion

It is concluded that the effect of gibberellic acid and naphthalene acetic acid on growth and yield of cucumber at 2, 4 leaf stage was found superior in T_3 - GA_3 25 ppm in terms of Vine length , Days to first appearance of female flowers in 50% plants, Days to first appearance of male flowers in 50% plants, Days to first Harvest, Fruit weight in grams (g) , Length of the fruit (cm), Fruit diameter (cm), Number of Fruits per plant, Average Yield per plant(g),Average Yield (t/ha) as compared to control.

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