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Effect of growth regulators application and canopy management on seed production in cucumber

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Abstract

In Cucumber (*Cucumis sativus* L.) higher sex ratio and vigorous vegetative growth in open pollinated varieties results in poor crop yield. This study was aimed to determine the “effect of growth regulators application and canopy management in cucumber seed production”. The experiment was conducted in the Experimental Farm, Department of Horticulture, AAU, Jorhat using Randomized Block Design with 3 replications and 12 treatment combinations of growth regulator application (Ethrel 100 ppm, Ethrel 200 ppm, NAA 100 ppm and NAA 200 ppm) and pruning (retention of 3 laterals, 5 laterals, and control) operations. The seeds of cucumber var. Long Green were sown at 3 m x 2 m spacing and growth regulators were applied at 2-4 leaf stage. The results revealed that the treatment combination of Ethrel 200 ppm and allowing 5 laterals per plant produced the maximum fruits (13.10), seeds per fruit (439.56), seed yield (148.45 g/plant) and total seed yield (2.37 q/ha) while Ethrel 100 ppm without pruning recorded minimum fruits per plant (9.98), seeds per fruit (392.70), seed yield (100.67 g/plant), total seed yield (1.65 q/ha). The minimum sex ratio (10.97) was observed in plants subjected to Ethrel 200 ppm spray with retention of 3 laterals followed by Ethrel 200 ppm and 5 laterals (11.19). Seed germination on storage over time was also showed a significant result with the application of growth regulator spray and canopy management. Computation of production economics revealed Ethrel 200 ppm spray with 5 lateral branches per plant to give the highest B: C ratio (1.87) for seed production in cucumber.

Keywords: Cucumber, growth regulators, seed yield, production economics

Introduction

Cucumber (*Cucumis sativus* L.) is grown extensively throughout India for its tender edible fruits. Total cucumber production in India during 2019-2020 was 1638'000 MT (Agricultural statistics 2020) [1] It is mainly a monoecious, annual, climbing vine having hairy stems with triangular ovate leaves. The yellow colour flower with 5 petals is unisexual, includes staminate, pistillate and hermaphrodite flowers. In cucurbits, the external application of growth hormones has enormous effect on male and female flower expression, controls the vegetative growth, improves plant population per unit area, improve fruit set, and ultimately increase the yield if applied at the 2-4 leaf stage, repress or progression of either male and female flower is possible. The growth of cucumber is very fast and luxuriant, needs pruning of leaves, branches and flower buds to get quality crop yield. A dense vegetative growth hampers the light penetration and shading effect results in pale colouration of fruits. To get quality crop and good seed yield, excess leaves are pruned off and sufficient number of leaves is retained on the plant for adequate rates of photosynthesis leading to increased vine length, vegetative shoots, fruit set and fruit size. Therefore, the research work was initiated in cucumber using plant growth regulators and canopy management practices to increase the crop productivity and seed yield per unit area.

Materials and Methods

The experiment was conducted during 2017-2019 at Experimental Farm, Department of Horticulture, Assam Agricultural University to study the “Effect of growth regulator application and canopy management on seed production in cucumber”. Cucumber var. Long Green was planted in an area of 216 m² in the month of March at spacing of 3 m x 2 m. The experiment comprising of 12 treatment combinations of growth regulators (NAA 100 ppm, NAA 200 ppm Ethrel 100 ppm and Ethrel 200ppm) and canopy management (retention of 3 laterals, 5 laterals, and control) practices was laid out in Randomized Block Design with 3 replications.

The growth hormones were applied at 2-4 leaf stage to study the effect on fruit and seed yield of cucumber.

Discussion

Plant growth chemicals regulate physiological processes in plants and influences growth and yield of plants. In the experiment while assessing the effect of individual factors it revealed that growth regulator sprays had significant influence of sex expression in cucumber plants. Application

of Ethrel 200 ppm brought down the sex ratio to 10.57 which, however, was not statistically superior to NAA 100 ppm treatment (Table 1). Number of fruits and seed yield per plant was also recorded higher in these treatments leading to higher total seed yield. Pruning of lateral branches did not bring about any significant change on days to flowering and sex ratio. However, fruit production and seed yield per plant were the highest in plants with 5 lateral branches leading to the highest total seed yield (2.19q).

Table 1: Effect of PGR sprays and canopy management on seed production of cucumber

Treatments	Days to flowering	Sex ratio	Number of fruits/ plants	Seeds/ fruit	Seed yield (g/pl)	Total seed Yield (q/ha)
Growth Regulator spray						
G ₁ Ethrel 100 ppm	52.11	12.59	10.36	405.82	110.65	1.80
G ₂ Ethrel 200 ppm	51.22	10.57	12.29	432.63	138.83	2.24
G ₃ NAA 100 ppm	47.00	11.43	12.57	417.40	133.23	2.17
G ₄ NAA 200 ppm	49.78	13.09	10.84	404.07	113.03	1.89
SEd (+)	2.60	0.70	0.41	10.72	5.28	0.08
CD (5%)	NS	1.45	0.85	NS	10.95	0.17
Canopy management						
C ₁ 3 lateral branches	49.50	11.37	11.55	412.97	124.76	2.03
C ₂ 5 lateral branches	51.75	11.80	12.27	419.55	134.79	2.19
C ₃ Control (No pruning)	48.83	12.59	10.73	412.42	112.25	1.85
SEd (+)	2.25	0.61	0.35	9.28	4.57	0.07
CD (5%)	NS	NS	0.73	NS	9.49	0.15

Interaction effects revealed that the treatment combinations did not have any effect on days to flowering (Table 2, Fig 1). However, early flowering (47.92 days) was recorded in T₉ (NAA 100 ppm with all laterals). Minimum sex ratio (10.97) was observed in T₄ (Ethrel 200 ppm with 3 laterals), followed by 11.19 in T₅ (Ethrel 200 ppm with 5 laterals). Ethylene governs the development of leaves, flowers, and fruits (Khan 2005^[3]; Konings and Jackson 1979^[4]; Pierik *et al.*, 2006^[5]). The number of fruits per plant as influenced by plant growth regulators and canopy management showed significantly higher number of fruits (13.10) in T₅ (Ethrel 200 ppm with 5 laterals) than other treatments except for T₇ and T₈ while the minimum was recorded in T₁₂ (NAA 200 ppm with all laterals). The observation was in close conformity with the findings of Suthar *et al.*, 2007^[9]. Increase in fruit number in treated plants may further be attributed to the reason that plants remain physiologically more active to build up sufficient assimilates for the developing flowers and fruits (Vasantkumar and Sreekumar, 1981^[10]). Pruning allows more light penetration and increases photosynthetic rate to improve vegetative growth of plants hence increase fruit numbers

(Preece and Read, 2005)^[6]. The maximum seed number per fruit (439.56) was recorded in Ethrel 200 ppm with 5 laterals (T₅) as against the lowest in treatment T₃ (392.70). Yadava and Sreenath, 1975^[11]; Saleh and Abdul, 1980^[8] strongly convinced that plant growth regulators which helps in increasing the photosynthetic activity and eventually more accumulation of assimilates in plant organs leads to more seed per fruit. The maximum seed yield per plant (148.45 g) was obtained from the plants treated with Ethrel 200 ppm with retention of 5 laterals and minimum seed yield per plant (1.65 g) was obtained in plants applied with Ethrel 100 ppm without pruning. The analysis of variance revealed that there was a wide difference in total seed yield of cucumber due to different plant growth regulators application. The highest seed yield per hectare (2.37 q/ha) was obtained in plants treated with Ethrel 200 ppm with 5 laterals (T₅), followed by NAA 100 ppm with 5 laterals. The maximum B:C ratio (2.87) was obtained in Ethrel 200 ppm spray retaining 5 laterals followed by NAA 100 ppm with 5 laterals (T₈). Similar findings were also reported by (Raji *et al.*, 2015)^[7].

Table 2: Interaction effect of PGR sprays and canopy management on seed production of cucumber

Treatments	Days to flowering	Sex ratio	Fruits/ plant	Seeds/ fruit	Seed yield (g/pl)	Total seed Yield (q/ha)	B: C Ratio
T ₁ (Ethrel100 + 3 laterals)	50.80	11.98	9.98	407.76	107.56	1.74	2.39
T ₂ (Ethrel100 + 5 laterals)	51.93	12.20	11.11	417.01	123.70	2.03	2.61
T ₃ (Ethrel100 + all laterals)	50.47	12.59	9.98	392.70	100.67	1.65	2.31
T ₄ (Ethrel200 + 3 laterals)	50.36	10.97	12.06	426.67	138.87	2.24	2.78
T ₅ (Ethrel200 + 5 laterals)	51.49	11.19	13.10	439.56	148.45	2.37	2.87
T ₆ (Ethrel200 + all laterals)	50.02	11.58	11.72	431.66	129.17	2.11	2.67
T ₇ (N100 + 3 laterals)	48.25	11.40	13.03	413.77	138.59	2.24	2.81
T ₈ (N100 + 5 laterals)	49.38	11.62	13.05	413.91	141.36	2.29	2.84
T ₉ (N100 + all laterals)	47.92	12.01	11.62	424.51	119.73	1.97	2.59
T ₁₀ (N200 + 3 laterals)	49.64	12.23	11.10	403.66	114.03	1.89	2.52
T ₁₁ (N200 + 5 laterals)	50.77	12.45	11.82	407.73	125.64	2.09	2.68
T ₁₂ (N200 + all laterals)	49.31	12.84	9.59	400.82	99.42	1.68	2.35
SEd (+)	2.60	0.70	0.71	18.57	9.15	0.14	-
CD (5%)	NS	1.45	1.46	NS	18.97	0.29	-

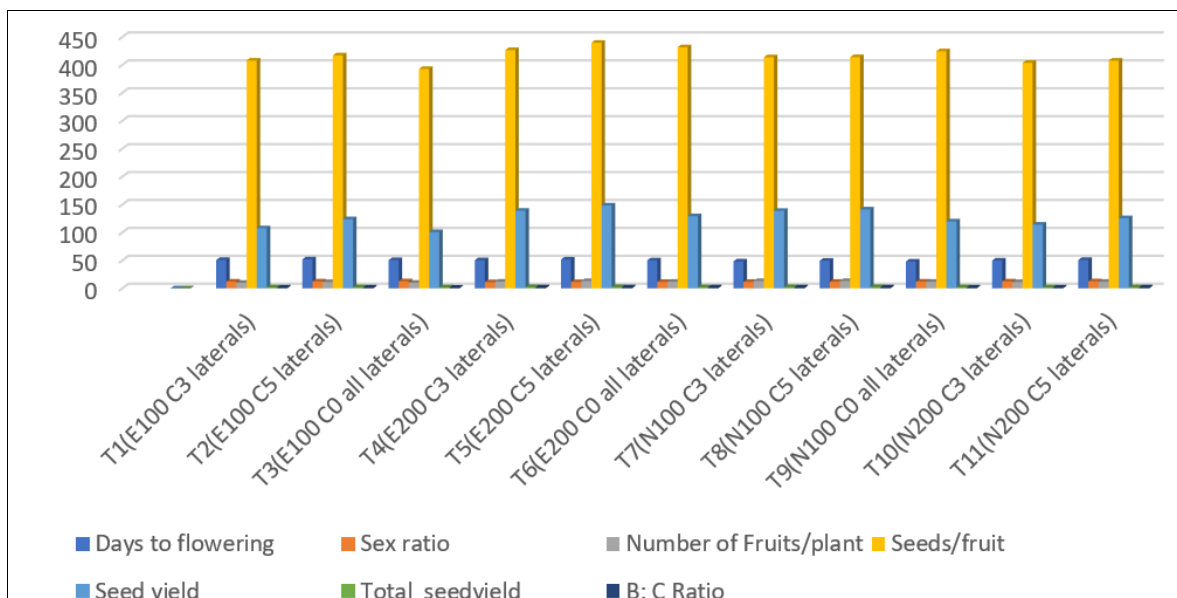


Fig 1: Interaction effect of PGR sprays and canopy management on seed production of cucumber

Test weight of seeds was neither affected by growth regulators nor does pruning practice, although application of NAA 200 ppm across the period of stages showed significant variation in seed germination percentage and canopy management showed best in retaining 5 laterals at 3 months after harvest, 6 months after harvest and at harvest (Table 3). The combined effect (Table 4, Fig 2) of NAA 100 ppm and retaining 5 lateral branches have exhibited non-significant

differences in test weight and seed germination percentage at 6 months after harvest except for seed germination percentage at 3 months after harvest was recorded highest (88.33 %). This finding was in line with the results of Guney *et al.*, 2016-^[2] which demonstrated that auxin hormone increases the germination percentage in *Lilium martagon* seeds. Lowest percentage of germination was obtained in plants treated with NAA without pruning (T3), followed by T12 and T9.

Table 3: Effect of PGR sprays and canopy management on seed quality of cucumber

Treatments	Test weight (g)	Seed germination (%)		
		at harvest	3 MAH	6MAH
Growth Regulator spray				
G ₁ Ethrel 100 ppm	27.9	87.1	83.3	77.7
G ₂ Ethrel 200 ppm	28.1	89.3	86.4	78.3
G ₃ NAA 100 ppm	27.5	90.3	87.3	78.3
G ₄ NAA 200 ppm	27.7	88.4	84.3	78.0
SEd (+)	0.20	0.94	1.02	1.33
CD (5%)	NS	2.04	2.11	NS
Canopy management				
C ₁ 3 lateral branches	27.9	89.0	86.0	79.6
C ₂ 5 lateral branches	28.0	89.4	86.2	79.8
C ₃ Control (No pruning)	27.5	87.5	83.9	74.9
SEd (+)	0.20	0.85	0.88	1.16
CD (5%)	NS	1.77	1.82	2.40

Table 4: Interaction effect of PGR sprays and canopy management on seed quality of cucumber 011

Treatments	Test weight (g)	Seed germination (%)		
		at harvest	3 MAH	6MAH
T ₁ (Ethrel100 + 3 laterals)	2.78	87.3	84.33	78.00
T ₂ (Ethrel100 + 5 laterals)	2.83	87.7	83.66	79.33
T ₃ (Ethrel100 + all laterals)	2.75	86.3	83.66	77.33
T ₄ (Ethrel200 + 3 laterals)	2.78	89.3	86.66	79.33
T ₅ (Ethrel200 + all laterals)	2.78	91.0	88.00	79.33
T ₆ (Ethrel200 + all laterals)	2.80	87.7	87.33	77.66
T ₇ (N100 + 3 laterals)	2.78	91.0	88.00	80.00
T ₈ (N100 + 5 laterals)	2.84	91.33	88.33	81.33
T ₉ (N100 + all laterals)	2.69	88.66	85.66	76.66
T ₁₀ (N200 + 3 laterals)	2.74	88.33	85.00	81.00
T ₁₁ (N200 + 5 laterals)	2.79	89.66	84.66	79.00
T ₁₂ (N200 + all laterals)	2.77	87.33	83.33	78.33
SEd (+)	0.03	1.70	2.25	2.30
CD (5%)	NS	NS	4.67	NS

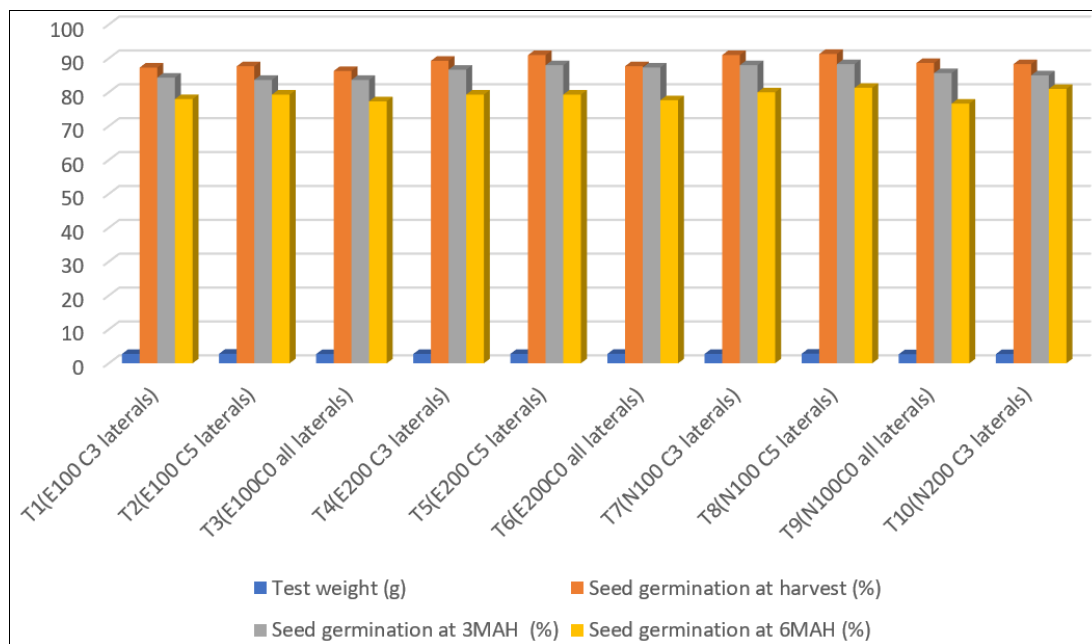


Fig 2: Interaction effect of PGR sprays and canopy management on seed quality of cucumber

Conclusion

It was revealed that for higher seed production spraying Ethrel 200 ppm or NAA 100 ppm at 2-4 leaves stage gives better result while among the pruning practices 5 lateral branches should be retained per plant. Combined application of Ethrel 200 ppm and retaining 5 laterals produces the maximum fruits per plant (13.10), seeds per fruit (439.56), seed yield per plant (148.45 g/plant), total seed yield (2.37 q/ha) whereas, the germination percentage of stored seeds was recorded highest in T8 (88.33%) at 3 months after harvesting. Maximum benefit cost ratio (2.87) was obtained in the treatment T5.

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