International Journal of Advanced Research in Engineering Technology & Science
ISSN: 2349-2819
Email: editor@ijarets.org Volume-10 Issue-3 March-2023 www.ijarets.org

Investigations on the Impact of Plant Growth Regulators on Strawberry Yield and Growth under Protected Cultivation

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Abstract:

In the years 2021–2022, the Department of Horticulture at Glocal University in Saharanpur, Uttar Pradesh, conducted an experiment named "Studies on the Effect of Plant Growth Regulators on Growth and Yield of Strawberry) Under Protected Cultivation." The results of the study demonstrated how well strawberry plants reacted to the administration of plant growth regulators. In terms of vegetative development, plant height, spread, number of leaves per plant, days till first flowering, and fruiting, GA3 at 100 ppm produced the greatest results. Fruit length, weight, diameter, total soluble solid, total sugar, and acidity were all at their best when GA3 75 ppm was present.

Keyword: PGRs, Growth, Quality Fruit, Strawberry, Yield.

INTRODUCTION

The strawberry (Fragaria x ananassa Duch.) is an attractive Rosaceae fruit crop. This fruit is extremely valued in the international marketplace due to its appealing red color, pleasant aroma, and excellent nutritional content in terms of vitamins (A and C) and minerals (Fe and K). Strawberry fruits, in addition to being consumed fresh, are used to make jam and jelly because of the large content of pectin present (Rathod et al., 2021). Fragaria x ananassa Duch., the current cultivated strawberry, is a cross between two predominantly dioecious octoploid species, Fragaria cheloensis Duch and Fragaria varginiana Duch. Strawberry'schromosomal no is 2n=2x=56. The species is octaploid. It's a short-lived (3-5 years), perennial, robust, stoloniferous herb that grows to a height of 10-20 cm and a spreading of 30-50 cm. The genuine strawberry fruit is an achene, a little, dry seed that is loosely linked to the swelling ovary wall. The strawberry's flesh is actually the ovary wall, which has many fruits/seeds on its surface. Because the roots are shallow, plants require regular watering but not standing water (Vishal et al., 2016). Strawberry usually grows in temperate zones, and itis classified as a short-day plant based on its behaviour and eco system. Strawberry is a temperate plant that can be grown in both farmlands and mountains, but the fruit results are better on the hills. For best progress and growth, the strawberry needed a day temperature of 22°C and a night temperature of 7°C to 13°C. Frost and winter injuries decreased yield. Strawberry might cultivate in particular land, extending from thick clay to light sand and gravel. Strawberry plants, on the other hand, grow on sandy loam soil with a pH of 5.5 to 6.5.It is a heavy conveyor crop that produces more (Yadav et al., 2018)

It is one of the few fruit trees that yield fast and easy and substantial returns per unit area on total income, as the fruit is ready for harvesting within six months after sowing. Strawberry appears to be particularly responding to the

implementation of plant growth regulators in addition to growth, production, and quality, according to research (Kumar et al., 2012). In India, strawberry fruit crop is still grown in open areas using a paddy straw mulching strategyby poor or marginal farmers, and it accounts for a large part of the national annual strawberrycultivable land. According to scientific findings, the strawberry plant responded positively to the application of a growth regulator (Sharma and Sharma, 2004). Because of their suitability for treatment at a lower cost, naphthalene acetic acid (NAA) and gibberellins (GA_3) havebeen widely investigated in present agricultural systems. In many fruits, the role of these plant growth regulators has been explored (Bist et al., 2018). Premature flowering, enhanced flowering time, collecting, and yield have all been observed with the use of GA_3 in strawberries. It boosts fruit output and quality, promotes cell elongation and expansion, helps to improve vegetative growth, reduces the period to maturity, and boosts fruit set (Sharma and Singh, 2009). In strawberry fruits, NAA promotes growth parameters, slows ripening, and enhances anthocyanin accumulation. It furthermore enhances the blooming period and improve fruit output and quality (Mir et al., 2004).

RESEARCH METHODS

The experiment was conducted during 2021-2022 at experimental filed of department of horticulture, Glocal University, Saharanpur Uttar Pradesh to experiment the influence of plant growth regulators on growth, yield, and quality of strawberry. The practical was carryout in a randomized block design with seven treatments consisted of control (no application of plant growth regulators), GA_3 (75, 100 ppm), NAA (75, 100 ppm), and CEPA (1000, 2000 ppm). All the treatment was replicated thrice. All the runners are equal and vigour transplanted during morning hours at a 30cm x 40cm. Daily watering was done forfirst week with drip irrigation and gap filling was done after first week of transplanted. After the transplant, the plant growth regulators were sprayed at 45, 60, and 75 days. In each replication, the observation was noted in three randomly selected plants. According to A.O.A.C (1990), the quality of the fruits was tested during harvest using a standard method and procedure, and the results were statistically analyzed.

RESEARCH FINDINGS AND DISCUSSION

For this experiment, growth and flowering criteria including plant height, spread, number of leaves, number of flowers, number of days until first fruit, and the number of runners were chosen. The results of the current experiment make it evident that the application of the PGRs NAA, GA_3, and CEPA had a major impact on the growth and flowering parameters. The maximum plant height (22.01 cm), plant spread (W-E) (24.16cm), plant spread (N-S) (23.49cm), no of leaves (22.97), days taken to first flower (41.04) no of flower (33.52), and days taken to first fruit (50.2) was recorded with treatment T_2 followed by treatment T_1 whereas minimum result was observed in control T_0. When no of runners found best in treatment T_1. The number of fruits, flowers, and fruit productivity all significantly increased after GA_3 application, according to their observations of plant height, leaf count, leaf area, and fruit productivity. The evidence of (Qureshi et al., 2013), who also discovered that the application of GA_3 greatly improves plant height, leaf area, fruit setting percentage, and the number of runners is consistent with the study's findings as well.

Table -1: Effect of Plant growth regulators on vegetative growth and flowering of strawberry.

Treatment	Plant height (cm)	Plant spread (cm) (W-E)	Plant spread (cm) (N-S)	No of leaves	Days taken to 1st flowering	No of flower	Days taken 1st fruit	No of runners
T0: Control	15.45	19.5825	20.275	18.4775	54.2	28.12	60.05	5.46
T1: GA3 75 ppm	21.125	22.425	23.09	20.8525	42.2	34.7	52.43	11.03
T2: GA3 100 ppm	22.01	24.1625	23.49	22.9775	41.04	33.52	50.2	9.12
T3: NAA 75 ppm	18.38	21.5	22.28	20.6875	44.85	32.8	54.22	10.1
T4: NAA 100 ppm	18.7375	21.9675	22.76	20.35	43.28	33.1	53.22	9.72
T5: CEPA 1000 ppm	17.0475	20.43	20.525	20.015	46.03	31.25	55.12	7.21
T6: CEPA 2000 ppm	17.4225	21.2075	20.5675	19.5675	47.3	30.2	56.38	6.31
C.D at 5%	1.79	2.078	2.098	1.97	4.407	3.070	5.256	0.824

Effect on Fruiting and Yield of Strawberry

The strawberry fruiting was adversely affected by the plant growth regulator treatments. The plant absorbs foliar spray of 75 ppm GA3 produce maximum no of fruit (28.1), fruit length (4.81 cm), fruit weight (14.35 gm), fruit diameter (4.01 cm), fruit set (83.86 %), and yield were recorded in treatment T1 followed by treatment T2. When minimum observation was found in control T0. In foliar spray with GA3, additional biomass may be able to generateextra metabolites during photosynthesis, which eventually sank into the producing fruits and generated berry with the most weight. In strawberries, the use of GA3 has been observed to boost berry weight (Sharma and Singh, 2009). A higher number of marketable fruits were produced as a result of the exogenous application of GA3, which also indirectly affected the auxin metabolism and increased the fruit yield. It has also been previously documented that applying GA3 increases fruit yield in strawberry (Rathod et al., 2021).

Table -2: Effect of plant growth regulators on yield attributing and yield of strawberry.

Treatment	No offruits	Fruitlength (cm)	Fruit weight (gm)	Fruit diameter (cm)	Fruit set (%)	Yield per plant (gm)
T0: Control	19.02	2.83	10.32	2.12	67.63869	196.286
T1: GA3 75 ppm	28.1	4.81	14.35	4.01	83.86167	417.585
T2: GA3 100 ppm	26.82	4.01	13.88	3.45	80.01193	372.262
T3: NAA 75 ppm	25.43	3.8	13.26	2.98	77.53049	337.202

T4: NAA 100 ppm	26.2	3.26	12.96	2.76	79.15408	339.552
T5: CEPA 1000 ppm	23.18	3.1	11.38	2.43	74.176	263.788
T6: CEPA 2000 ppm	22.11	3.01	10.81	2.21	73.21192	245.928
C.D at 5%	2.349	0.343	1.198	0.279	7.344	30.224

Effect on Fruit Quality of Strawberry

In terms of strawberry quality, the results reported in Table 3 demonstrated that the use of growth regulators altered the quality features of the strawberry fruit. The plant absorbs foliar spray of 75 ppm GA3 produce maximum Total soluble solid (8.44 ^{0}B), Acidity (0.52%), Ascorbic acid (65.47mg), Total sugar (9.48 %), Reducing sugar (5.1%), non-reducing sugar (4.38%) were recorded in treatment T1. When minimum result show in control T0. Gibberellicacid was applied to fruits, which massively improved total soluble solids and decreased titratable acidity. With foliar treatment of 75 ppm GA3, the highest total soluble solid was recorded. However, in the current investigation, the control group had the lowest levels of total soluble solids. These results support those of Prasad et al. (2013), who demonstrated that GA3 concentrations responded favourably to a strawberry quality measure.

Table-3: Effect of plant growth regulators on quality of strawberry.

Treatment	**Total soluble solid (^{0}B)**	**Acidity(%)**	**Ascorbic acid (mg/100 g)**	**Total sugar (%)**	**Reducing sugar (%)**	**Non-reducing sugar (%)**
T0: Control	6.9	0.79	52.69	6.03	3.9	2.13
T1: GA3 75 ppm	8.44	0.52	65.47	9.48	5.1	4.38
T2: GA3 100 ppm	7.91	0.54	63.11	8.35	4.31	4.04
T3: NAA 75 ppm	7.49	0.71	59.84	8.1	4.12	3.98
T4: NAA 100 ppm	8.01	0.68	57.14	8.89	4.72	4.17
T5: CEPA 1000 ppm	7.32	0.76	55.54	7.8	4.03	3.77
T6: CEPA 2000 ppm	7.1	0.71	54.22	7.2	3.98	3.22
C.D at 5%	0.730	0.070	5.609	0.764	0.417	0.356

CONCLUSION

Strawberry was improved by applying 75 ppm and 100 ppm GA3 before blooming, according to the data analyzed for

this study. Overall growth of the plant, fruit set, flowering, fruit size, yield, and quality. These findings may be used to evaluate the effects of PGR on different cultivars of strawberries cultivated in protected areas in the future.

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