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STUDIES ON IMPACT OF GROWTH REGULATORS ON PERFORMANCE OF STRAWBERRY (*FRAGARIA* × *ANANASSA* DUCH.) VARIETY CHANDLER UNDER POLYHOUSE CONDITION

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Abstract

The experiment was undertaken with 10 treatments viz., T_1: Control; T_2: 50 ppm GA_3; T_3: 75 ppm GA_3; T_4: 100 ppm GA_3; T_5: 50 ppm NAA; T_6: 75 ppm NAA; T_7: 100 ppm NAA; T_8: 50 ppm GA_3 +50 ppm NAA; T_9: 50 ppm GA_3 + 75 ppm NAA; T_{10}: 50 ppm GA_3 + 100 ppm NAA. Each treatment was replicated thrice in randomized block design (RBD). Maximum plant height (23.82cm), number of runner per plant (10.96), number of flower per plant (46.39), number of fruit per plant (39.42), yield per plant (618.50g), length of fruit (4.25cm), diameter of fruit (3.71cm), fruit weight (15.68g), fruit volume (18.32ml) and TSS (7.60^{0}B) was recorded T_2. The maximum leaf area (124.37cm^2) was recorded in T_7. The maximum fruit set (85.50%) observed in T_9. The highest number of leaves per plant (40.50) and ascorbic acid (64.25mg/100gm) was recorded in T_3. Thus, it can be concluded that an appropriate combination of GA_3 and NAA may be significantly improve the overall plant growth, flowering,, fruit yield and physico-chemical quality of strawberry variety Chandler under protected condition.

Key words : Plant growth regulator (PGRs), quality, yield, strawberry.

Introduction

The strawberry, a manually transformed hybrid fruit crop, belong to the family rosaceae. Presently, it is cultivated nearly about 75 countries throughout the world (Vishal *et al*., 2016). Strawberry fruits contains vitamin A (60 UI/100g of edible portion), vitamin C (30-120mg/100g of edible portion), 5.0% total sugar, 0.90%-1.85% acids, fibre content, pectin (0.55%) and water (90%) (Sharma, 2002). The positive effect of exogenously applied growth regulators on the overall vegetative growth, flowering, yield and physico-chemical quality attributes of strawberry has been reported by Vishal *et al.* (2016). NAA and GA_3 are most frequently used PGRs in strawberry production (Palei *et al.*, 2016). Naphthalene acetic acid (NAA) is a synthetic auxin, mainly involved in production of quality fruits in terms of total sugars, ascorbic acid content and it reduces the titrable acidity percentage in strawberry fruits (Vishal *et al*., 2016). Gibberellic acid (GA_3) is a growth promoter, improves plant height, leaf area index, leaves number, runner production when exogenously applied to strawberry plants. Gibberellic acid induced advanced flowering and harvesting of berries in strawberry crop. It also increases fruit set percentage and fruits count per plant (Reid, 1983; Sharma and Singh, 2009). Hence, present investigation was carried out to find out optimum concentration of GA_3 and NAA increasing fruit yield and quality attributes of strawberry cv. Chandler grown under the polyhouse condition.

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Materials and Methods

The study was performed at Research Farm, Lovely Professional University, Phagwara, Punjab to find out the most suitable PGRs and their optimum concentration and combination for increasing the fruit yield and quality attributes of strawberry cultivar Chandler grown under poly-house condition. The experiment site is located at 31.25° latitude and 75.70° longitude along with altitude of 232m above mean sea level. The experiment was undertaken with 10 treatments and 3 replication in RBD. The treatments of growth regulators *viz.,* T_1: Control; T_2: 50 ppm GA_3; T_3: 75 ppm GA_3; T_4: 100 ppm GA_3; T_5: 50 ppm NAA; T_6: 75 ppm NAA; T_7: 100 ppm NAA; T_8: 50 ppm GA_3 +50 ppm NAA; T_9: 50 ppm GA_3 + 75 ppm NAA;

T_{10}: 50 ppm GA_3+ 100 ppm NAA were applied. A single spray of growth regulators was applied to the plants 6 week after planting. Plant height was measured by scale and expressed in centimetre. Leaf area was measured by leaf area meter and expressed in centimetre square. Fruit length and fruit diameter was measured with Vernier caliperand expressed in centimetre. Fruit weight was measured by weighing balance and average weight expressed in gram. Fruit yield per plant was calculated by multiplication of number of fruit per plant with average weight of fruit, and expressed in gram per plant. Quality parameter viz., TSS, titratable acidity and ascorbic acid was measured as per protocol of A.O.A.C. (2000). Data recorded from the study were analyzed as per procedure by Gomez and Gomez (1984) and tabulated.

Result and Discussion

Growth, flowering and yield parameters

Growth, flowering and yield parameters *viz*. plant height, leaves count, leaf are, runner count, flower count per plant, fruit set, fruit count per plant, yield per plant were selected for the study. It is clear from the present investigation that the growth, flowering and yield parameters were significantly affected with the treatment of plant growth regulator (PGRs) *viz*. NAA and GA_3 (table 1). The maximum plant height (23.82cm), number of flower (46.39) per plant, number of fruit (39.42) per plant and yield (618.50g) per plant was recorded with treatment T_2, followed by treatment T_9 and minimum was recorded in treatment T_1 *viz*. plant height (13.47cm), number of flower per plant (27.66), number of fruit per plant (20.30) and yield per plant (214.75g). The highest number of leaves (40.49) was recorded in T_3, followed by T_2 whereas minimum number of leaves (14.87) in T_1. The maximum leaf area (124.37cm^2) was recorded in T_7 followed by T_5, maximum number of runner per plant (10.69) was in T_2 followed by T_3 and maximum fruit set (85.50%) was in T_9. While, minimum leaf area (95.36 cm^2), number of runner per plant (4.05) and fruit set (72.46%) was recorded with T_1. These results are in accord with the results of Uddin *et al*. (2012). They observed that GA_3 application resulted significant improvement in growth parameters (plant height, leaves count, leaf area) fruit count, flower count and fruit productivity. The foregoing results of the study are also similar with the findings of Qureshi *et al*. (2013) who also found that the application of GA_3 significantly increase plant height, leaf area, fruit setting percentage and number of runners. Techawongstein (1989) also reported that the application of NAA on strawberry increase in vegetative growth.

Physico-chemical quality parameters of fruits

Selected physico-chemical quality parameter *viz*. physical (length, width, weight and volume) and chemical (T.S.S., titratable acidity and ascorbic acid) showed that foliar application of PGRs have noticeable significant effect. Data presented in table 2 showed maximum fruit length (4.25cm) and fruit width (3.71cm) in T2, followed by treatment T_9. However, minimum maximum fruit length (2.88cm) and fruit width (2.15cm) was recorded with T_1. Uddin *et al*. (2012) also reported higher fruit length and diameter of fruit in strawberry plants when treated with GA_3 as compared to control. Mir *et al*. (2004) reported increase in fruit length: diameter ratio

Table 1 : Effect of GA_3 and NAA on growth, flowering and yield parameters of strawberry cv. Chandler.

Treatments	Growth and yield parameters							
	Plant height (cm)	Number of Leaves	Leaf area (cm^2)	Number of runner/ plant	Number of flower/ plant	Fruit set (%)	Number of fruit/ plant	Yield/ plant (g)
T_1: Control	13.47	14.87	95.36	4.05	27.66	72.46	20.30	214.75
T_2: 50 ppm GA_3	23.82	36.93	110.09	10.69	46.39	84.95	39.42	618.50
T_3: 75 ppm GA_3	16.04	40.49	101.76	10.45	33.94	79.04	26.83	373.10
T_4: 100 ppm GA_3	15.85	29.74	110.56	6.33	33.45	79.39	26.53	326.79
T_5: 50 ppm NAA	13.64	34.43	124.32	7.22	37.88	81.73	30.96	448.96
T_6: 75 ppm NAA	14.91	16.16	121.32	8.92	33.43	79.16	26.45	298.34
T_7: 100 ppm NAA	22.68	16.12	124.37	6.53	38.31	84.19	32.23	487.92
T_8: 50 ppm GA_3 +50 ppm NAA	17.49	35.08	121.67	6.38	37.98	82.85	31.46	474.02
T_9: 50 ppm GA_3 + 75 ppm NAA	23.29	36.32	120.34	6.54	45.90	85.50	39.26	604.90
T_{10}:50 ppm GA_3 + 100ppm NAA	16.35	27.36	121.32	8.14	36.31	81.13	29.46	423.04
S.E±	0.40	0.83	0.43	0.76	0.62	1.65	0.53	1.07
C.D at 5%	1.20	2.49	1.30	2.28	1.86	4.96	1.57	3.20

Table 2 : Effect of GA_3 and NAA on physico-chemical parameters of strawberry cv. Chandler.

Treatments	Physico-chemical parameters						
	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Fruit volume (ml)	Total soluble solid (^{0}B)	Titratable acidity (%)	Ascorbic acid (mg/100g)
T_1: Control	2.88	2.15	10.71	9.64	5.33	0.30	57.82
T_2: 50 ppm GA_3	4.25	3.71	15.68	18.32	7.60	0.19	64.16
T_3: 75 ppm GA_3	3.51	2.94	13.91	11.19	5.46	0.21	64.25
T_4: 100 ppm GA_3	3.23	2.77	12.31	10.53	7.28	0.19	59.49
T_5: 50 ppm NAA	3.77	3.16	14.51	13.93	7.53	0.23	60.34
T_6: 75 ppm NAA	3.14	2.40	11.28	10.41	6.95	0.23	61.69
T_7: 100 ppm NAA	3.92	3.27	15.12	16.76	7.50	0.40	51.94
T_8: 50 ppm GA_3 +50 ppm NAA	3.79	3.17	15.06	14.94	6.46	0.28	53.96
T_9: 50 ppm GA_3 + 75 ppm NAA	3.99	3.37	15.47	17.01	6.73	0.21	60.65
T_{10}:50 ppm GA_3 + 100ppm NAA	3.58	3.12	14.35	12.75	5.79	0.32	60.86
S.E±	0.17	0.12	0.63	0.58	0.51	0.04	1.31
C.D at 5%	0.53	0.38	1.90	1.75	1.53	NA	3.94

with NAA application on strawberry cv. Sweet Charlie. The maximum fruit weight (15.68g) and fruit volume (18.32ml) was observed in T2, followed by treatment T_9 whereas minimum fruit weight (10.71g) and fruit volume (9.64ml) was recorded with the treatment T_1. These findings are similar with the findings of Al-Madhagi *et al*. (2012). They reported that the application of GA3 increased the fruit weight in strawberry cultivar Camarosa. Manju and Rawat (2015) also observed higher fruit weight with the spray of bio regulator (NAA). Nor *et al.* (2014) also reported higher fruit volume with the foliar application GA_3 treatment in strawberry.

Observation of data as revealed in table 2 indicated that the foliar application of GA_3 and NAA affect significantly on total soluble solid and ascorbic acid whereas effect was non-significantly for titratbale acidity. Treatment (T_2) resulted maximum TSS (7.60^{0}B) followed by treatments T_5, T_7 and T_4 while minimum TSS (5.33^{0}B) was recorded in T_1. The minimum titratable acidity (0.19%) was recorded in treatment T_2 followed by T_4 while maximum titratable acidity (0.40%) was recorded in treatment T_7- The maximum ascorbic acid (64.25mg/100gm) was recorded in treatment T_3 followed by treatments T_2 while minimum ascorbic acid (51.94mg/100gm) in treatment T_7. These finding corroborate the results of Prasad *et al*. (2013) who reported positive response of GA_3 concentrations on the quality parameter of strawberry. They observed that GA_3 application resulted significant increase in TSS, acidity and ascorbic acid. These results are also similar with the findings of Kumar *et al*. (2012) who also reported that the application of GA_3 has significantly increase TSS, ascorbic acid. Khunte *et al.,* (2014) reported that PGRs did not have significant effect on titratable acidity.

Conclusion

On the basis of analysed data of present study, it is come to conclusion that the application of 50 ppm GA_3 and 50ppm GA_3 + 75ppm NAA applied before flowering, increased overall vegetative growth, flowering, fruit set, fruit size, yield and fruit quality of strawberry cv. Chandler. These findings could be further used to evaluate the effect of PGR on different strawberry cultivars grown under protected cultivation.

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