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## Effect of foliar spray of different PGRs on growth parameters, flowering, fruiting and fruit maturity of strawberry (*Fragaria x ananassa* Duch.) cv. Sabrina under net tunnel

**Sarita Paikra, Hemant Kumar Panigrahi, GL Sharma and Sangeeta Chandrakar**

### Abstract

The experiment was conducted at Research Farm of Centre of Excellence on Protected Cultivation and Precision Farming under net tunnel, College of Agriculture, IGKV, and Raipur (C.G.) during the year 2017-18. The experiment was conducted with eleven treatments and three replications in Randomized Block Design (RBD). The experiment consisted of eleven different concentrations of plant growth regulators namely NAA (10, 20, 30, 40 and 50 ppm) and GA<sub>3</sub> (25, 50, 75, 100 and 125 ppm) were applied singly along with recommended dose of fertilizers. Amongst the different treatments of plant growth regulators, the treatment T<sub>4</sub> (RDF + GA<sub>3</sub> 100 ppm) recorded the maximum vegetative growth *i.e.* Plant height (8.91, 28.42, 31.59 and 33.78 cm), the maximum plant spread in E-W direction (12.96, 22.74, 26.99 and 32.99 cm) and the maximum plant spread in N-S direction (13.96, 22.84, 27.99 and 34.02 cm) at 30, 60, 90 and 120 DAP, respectively. Similarly the maximum numbers of leaves (9.91, 19.73, 27.60 and 34.20) and maximum number of runners per plant were also recorded under the same treatment, while the minimum was recorded under the treatment T<sub>0</sub> (RDF + water spray).

**Keywords:** Strawberry, NAA, GA<sub>3</sub>, growth parameters, flowering, fruiting and fruit maturity

### Introduction

Strawberry (*Fragaria × ananassa* Duch.) is known as one of the most attractive, nutritious, delicious and refreshing fruit of the world. It belongs to family rosaceae and the most of cultivated varieties are monoecious octaploid (2n=56) hybrid of two largely dioecious, octaploid species, *Fragaria chiloensis* Duch. and *Fragaria virginiana* Duch.. The fruit is widely appreciated for its characteristics aroma, bright red colour, delicate flavour and sweetness.

Strawberry is a temperate fruit and cultivated in plains as well as in the hills but the fruit quality is found excellent in hills. In India, it is mainly grown in Maharashtra and in hills of Himachal Pradesh, J & K and Uttarakhand. The total area under strawberry in world is 242371 ha with production of 4308 million tons (Anon, 2011) [1]. Presently in India strawberry is grown in 1000 ha area with production of 5000 million tons (Anon, 2016) [2].

Strawberries are an excellent source of vitamin 'C' and ellagic acid. Strawberries can reduce the risk of developing cancer by 50 per cent due to higher levels of vitamin-C can increase the flow of blood and oxygen to the muscles by 7 per cent due to nitrates. Vitamin C is a well-known immunity booster, as well as a powerful, fast-working antioxidant. Strawberry fruits are reported to have antioxidant (lutein and zeaxanthins), anticancer due to high fruit polyphenolic content, especially anthocyanins – the type of polyphenols quantitatively most important in strawberry fruits – as well as flavonoids, phenolic acids and vitamin 'C' (Meyers *et al.*, 2003; Olsson *et al.*, 2004 and Cordenunsi *et al.*, 2005) [5, 7, 3].

The plant growth regulators like naphthalene acetic acid (NAA) and gibberellic acid (GA<sub>3</sub>) have been found important to alter the growth of strawberry plant. Gibberellic acid plays an important role in increasing the plant growth, flowering, fruiting and fruit maturity of strawberry fruit.

### Materials and Methods

The present investigation was carried out during the year 2017-18 at the Research Farm of

Centre of Excellence on Protected Cultivation and Precision Farming under net tunnel, College of Agriculture, IGKV, Raipur (C.G.). Raipur is situated near the central part of Chhattisgarh and lies at 21°25' N latitude and 81° 63' E longitude at an altitude of 298.15 meter above the mean sea level. Healthy tissue cultured saplings of strawberry cv. Sabrina transplanted in uniform plots with 30cm x 30cm planting spacing after bed preparation. The experiment was carried out in Randomized Block Design consisted 11 treatments and each replicated thrice. The treatments consisted eleven different concentrations of plant growth regulators along with recommended dose of fertilizers viz., T<sub>0</sub>: RDF + Control (water spray), T<sub>1</sub>: RDF + Gibberellic acid 25 ppm, T<sub>2</sub>: RDF + Gibberellic acid 50 ppm, T<sub>3</sub>: RDF + Gibberellic acid 75 ppm, T<sub>4</sub>: RDF + Gibberellic acid 100 ppm, T<sub>5</sub>: RDF + Gibberellic acid 125 ppm, T<sub>6</sub>: RDF + Naphthalene acetic acid 10 ppm, T<sub>7</sub>: RDF + Naphthalene acetic acid 20 ppm, T<sub>8</sub>: RDF + Naphthalene acetic acid 30 ppm, T<sub>9</sub>: RDF + Naphthalene acetic acid 40 ppm, T<sub>10</sub>: RDF + Naphthalene acetic acid 50 ppm. Naphthalene acetic acid and gibberellic acid applied at 30 and 45 days after planting on strawberry cv. Sabrina. The required quantity of gibberellic acid and naphthalene acetic acid was measured by measuring cylinder and dissolved in a small quantity of absolute ethyl alcohol and NH<sub>4</sub>OH, respectively and then the final volume was made up to one litre with distilled water. The stock solution of the chemicals was diluted with tap water for preparing the required strength of the foliar spray. The chemicals were sprayed on plant thoroughly with the help of knap sack sprayer

## Results and discussion

### Plant Height (cm)

Amongst the different treatments of plant growth regulators T<sub>4</sub> (RDF + Gibberellic acid 100 ppm) recorded maximum plant height (8.91, 28.42, 31.59 and 33.78 cm) at 30, 60, 90 & 120 DAP respectively. The maximum plant height was observed under the treatment T<sub>4</sub>, which was recorded statistically at par with T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> at 90 and 120 DAP. However the minimum plant height (8.38, 15.49, 18.65 and 21.53 cm) were registered at 30, 60, 90 and 120 DAP respectively under T<sub>0</sub> (RDF + Control). The present results were in close agreement with the findings of Kumar and Tripathi (2009) and Tiwari *et al.* (2017) [15] in strawberry.

### Plant spread (cm) in East-West direction

The maximum plant spread (12.96, 22.74, 26.99 and 32.99 cm) at 30, 60, 90 and 120 DAP respectively in E-W direction were recorded under the superiority of treatment T<sub>4</sub> (RDF + Gibberellic acid 100 ppm) while, the minimum (12.20, 17.51, 19.37 and 21.59 cm) at 30, 60, 90 and 120 DAP respectively was recorded under the treatment T<sub>0</sub> (RDF + Control). In present investigation maximum plant spread was recorded under the treatment T<sub>4</sub>, which was recorded statistically at par with T<sub>3</sub>, T<sub>5</sub> and T<sub>10</sub> at 90 and 120 DAP. These above findings are also similar with the findings of Singh and Asrey (2006) [14] in strawberry.

### Plant Spread (cm) in North-South direction

The maximum plant spread (13.96, 22.84, 27.99 and 34.02 cm) 30, 60, 90 and 120 DAP respectively in N-S direction were recorded under the superiority of treatment T<sub>4</sub> (RDF + Gibberellic acid 100 ppm) while, the minimum (13.20, 17.41, 20.41 and 22.59 cm) at 30, 60, 90 and 120 DAP respectively

was recorded under the treatment T<sub>0</sub> (RDF + Control). The treatment T<sub>4</sub> was recorded significantly superior from rest of the treatments. These findings are in agreement with the reports of Paroussi *et al.* (2002) [9] and Sharma and Singh (2009) [12].

### Number of leaves per plant

The maximum number of leaves per plant (9.91, 19.73, 27.60 and 34.20) at 30, 60, 90 and 120 DAP respectively was recorded under the treatment T<sub>4</sub> (RDF + Gibberellic acid 100 ppm), while the minimum number of leaves per plant (9.20, 12.67, 19.73 and 24.27) at 30, 60, 90 and 120 DAP respectively was observed under the treatment T<sub>0</sub> (RDF + Control). The maximum number of leaves per plant was observed under the treatment T<sub>4</sub>, which was found non-significant difference with T<sub>10</sub> at 60, 90 and 120 DAP, whereas in further analysis the treatment T<sub>4</sub> recorded statistically at par with T<sub>3</sub>, T<sub>5</sub>, T<sub>6</sub>, and T<sub>2</sub> at 120 DAP. These findings are in agreement with the reports of Paroussi *et al.* (2002) [9], Kumar and Tripathi (2009) and Sharma and Singh (2009) [12] in strawberry.

### Days to 1<sup>st</sup> flowering

Plants treated with RDF + Gibberellic acid 100 ppm (T<sub>4</sub>) took minimum days to flowering (41.01 days) followed by treatment T<sub>3</sub> (RDF + Gibberellic acid 75 ppm). The maximum days to first flowering (52.89 days) was recorded under the treatment T<sub>0</sub> (RDF + Control). The treatments T<sub>2</sub>, T<sub>5</sub>, T<sub>7</sub> & T<sub>3</sub> and T<sub>1</sub>, T<sub>9</sub>, T<sub>8</sub> & T<sub>10</sub> and T<sub>2</sub>, T<sub>5</sub>, T<sub>7</sub> & T<sub>6</sub> having respective days to first flowering 42.21, 41.78, 44.33 & 41.56 and 45.58, 46.97, 48.44 & 46.15 and 42.21, 41.78, 44.33 & 44.90 days were found non-significant differences with each other. These results are in agreement with the findings of Prasad *et al.* (2013) [10], Saima *et al.* (2014) [11] and Palei *et al.* (2016) [8] recorded earliest flowering with the application of GA<sub>3</sub> 100 ppm in strawberry crop.

### Number of flowers per plant

The maximum number of flowers per plant (38.10) was recorded under the treatment T<sub>3</sub> (RDF + Gibberellic acid 75 ppm) followed by T<sub>5</sub> (32.33), while the minimum number of flowers per plant (24.40) was observed under the treatment T<sub>0</sub> (RDF + Control). The treatments T<sub>4</sub>, T<sub>10</sub>, T<sub>5</sub> & T<sub>7</sub> and T<sub>8</sub>, T<sub>6</sub>, T<sub>2</sub>, T<sub>9</sub>, T<sub>1</sub>, T<sub>4</sub> & T<sub>10</sub> and T<sub>8</sub>, T<sub>2</sub>, T<sub>9</sub>, T<sub>4</sub> & T<sub>10</sub> having respective number of flowers per plant 30.28, 29.05, 32.33 & 31.07 and 27.18, 26.89, 28.56, 28.22, 25.75, 30.28 & 29.05 and 27.18, 28.56, 28.22, 30.28 & 29.05 were found non-significant differences with each other at 5 % level of significance. Similar observations were reported by Tripathi and Shukla (2010) [16] in strawberry.

### Days to 1<sup>st</sup> fruiting

Number of days taken to 1<sup>st</sup> fruiting (49.52 days) was recorded minimum under the treatment T<sub>4</sub> (RDF + Gibberellic acid 100 ppm) followed by the treatment T<sub>3</sub> (49.92 days), whereas maximum number of days to 1<sup>st</sup> fruiting (59.52 days) was recorded under the treatment T<sub>0</sub> (RDF + Control). The treatments T<sub>2</sub>, T<sub>3</sub>, T<sub>7</sub>, T<sub>9</sub> and T<sub>10</sub> having respective days to first fruiting 51.66, 49.92, 57.57, 56.53 and 56.90 showed significant differences with each other the under present investigation. This result corroborates with the results of Mikhteleva and Petrovskaya (1975) [6] and Saima *et al.* (2014) [11] in strawberry crop.

**Days to maturity**

The days to maturity of fruit (61.33 days) was observed minimum under the treatments T<sub>4</sub> (RDF + Gibberellic acid 100 ppm) followed by the treatments T<sub>6</sub>, T<sub>1</sub> and T<sub>10</sub> having respective days to maturity 63.53, 64.64 and 65.61, while the maximum days to maturity (52.89 days) was recorded under the treatment T<sub>0</sub> (RDF + Control). Singh and Singh (2009) [12, 13] in strawberry also reported similar results showing to minimize the days of fruit maturity.

**Number of runners per plant**

The maximum number of runners per plant (5.23) was produced by T<sub>4</sub> (RDF + Gibberellic acid 100 ppm) which was found at par with the treatments T<sub>1</sub>, T<sub>2</sub>, T<sub>6</sub> and T<sub>5</sub> having respective number of runners per plant of 4.27, 3.03, 4.03 and 3.99 and minimum number of runners (2.58) was recorded under control. These results are in conformity with the result of Kumar and Tripathi (2009) [13] who reported that GA<sub>3</sub> application increases number of runners per plant in strawberry plant.

**Table 1:** Effect of foliar spray of different PGRs on plant spread in E-W and N-S direction of strawberry (*Fragaria x ananassa* Duch.) cv. Sabrina under net tunnel.

Treatments	Plant spread (cm) in E-W direction				Plant spread (cm) in N-S direction			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
T <sub>0</sub> -RDF + Control (Water spray)	12.20	17.51	19.37	21.59	13.20	17.41	20.41	22.59
T <sub>1</sub> -RDF + Gibberellic acid 25 ppm	12.48	18.25	19.59	23.37	13.48	18.41	20.61	24.39
T <sub>2</sub> -RDF + Gibberellic acid 50 ppm	12.55	18.85	20.03	23.70	13.55	18.73	21.14	24.75
T <sub>3</sub> -RDF + Gibberellic acid 75 ppm	12.68	21.61	26.70	31.03	13.68	21.65	27.33	32.04
T <sub>4</sub> -RDF + Gibberellic acid 100 ppm	12.96	22.74	26.99	32.99	13.96	22.84	27.99	34.02
T <sub>5</sub> -RDF + Gibberellic acid 125 ppm	12.59	19.47	26.37	29.70	13.59	19.19	27.42	30.67
T <sub>6</sub> -RDF + Naphthalene acetic acid 10 ppm	12.66	18.01	25.17	28.50	13.66	18.17	26.19	29.55
T <sub>7</sub> -RDF + Naphthalene acetic acid 20 ppm	12.45	19.00	25.07	28.40	13.45	18.99	26.09	29.48
T <sub>8</sub> -RDF + Naphthalene acetic acid 30 ppm	12.71	19.18	23.20	27.80	13.71	19.16	24.24	28.70
T <sub>9</sub> -RDF + Naphthalene acetic acid 40 ppm	12.75	19.99	24.93	28.60	13.75	19.99	25.95	29.63
T <sub>10</sub> -RDF + Naphthalene acetic acid 50 ppm	12.54	20.07	26.33	30.33	13.27	20.05	27.34	30.87
SE(m)±	0.20	1.86	2.82	2.24	0.18	0.08	0.07	0.14
C.D. at 5%	NS	0.63	0.95	0.76	NS	0.24	0.22	0.43

1. DAP – Days after planting
2. RDF – Recommended dose of fertilizers

**Table 2:** Effect of foliar spray on different PGRs on plant height and number of leaves per plant of strawberry (*Fragaria x ananassa* Duch.) cv. Sabrina under net tunnel.

Treatments	Plant height (cm)				Number of leaves per plant			
	30 DAP	60 DAP	90 DAP	120 DAP	30 DAP	60 DAP	90 DAP	120 DAP
T <sub>0</sub> -RDF + Control (Water spray)	8.38	15.49	18.65	21.53	9.20	12.67	19.73	24.27
T <sub>1</sub> -RDF + Gibberellic acid 25 ppm	8.60	20.48	28.15	30.41	9.48	18.47	25.67	30.00
T <sub>2</sub> -RDF + Gibberellic acid 50 ppm	8.74	22.89	27.26	29.90	9.55	16.53	25.47	31.07
T <sub>3</sub> -RDF + Gibberellic acid 75 ppm	8.73	20.01	27.50	29.79	9.68	16.87	25.27	33.00
T <sub>4</sub> -RDF + Gibberellic acid 100 ppm	8.91	28.42	31.59	33.78	9.91	19.73	27.60	34.20
T <sub>5</sub> -RDF + Gibberellic acid 125 ppm	8.81	16.59	26.57	29.07	9.59	16.40	24.07	33.20
T <sub>6</sub> -RDF + Naphthalene acetic acid 10 ppm	8.63	18.66	24.89	27.21	9.60	17.87	25.47	33.53
T <sub>7</sub> -RDF + Naphthalene acetic acid 20 ppm	8.74	17.20	22.50	25.27	9.69	19.27	26.27	28.87
T <sub>8</sub> -RDF + Naphthalene acetic acid 30 ppm	8.89	16.91	21.25	23.83	9.42	19.00	26.53	30.20
T <sub>9</sub> -RDF + Naphthalene acetic acid 40 ppm	8.62	19.88	21.18	23.89	9.88	18.87	26.80	30.87
T <sub>10</sub> -RDF + Naphthalene acetic acid 50 ppm	8.66	19.27	21.20	23.79	9.80	18.80	27.47	33.33
SE(m)±	0.149	0.29	1.58	1.61	0.22	0.49	0.79	1.06
C.D. at 5%	NS	0.86	4.70	4.79	NS	1.45	2.35	3.15

1. DAP – Days after planting
2. RDF – Recommended dose of fertilizers

**Table 3:** Effect of foliar spray of different PGRs on days to 1<sup>st</sup> flowering, number of flowers per plant, days to 1<sup>st</sup> fruiting, days to maturity and number of runners per plant of strawberry (*Fragaria x ananassa* Duch.) cv. Sabrina under net tunnel.

Treatments	Days to 1 <sup>st</sup> flowering	Number of flowers per plant	Days to 1 <sup>st</sup> fruiting	Days to maturity	Number of runners per plant
T <sub>0</sub> -RDF + Control (Water spray)	52.89	24.40	59.52	71.80	2.58
T <sub>1</sub> -RDF + Gibberellic acid 25 ppm	45.58	25.75	55.44	64.64	4.27
T <sub>2</sub> -RDF + Gibberellic acid 50 ppm	42.21	28.56	51.66	67.89	4.03
T <sub>3</sub> -RDF + Gibberellic acid 75 ppm	41.56	38.10	49.92	70.10	3.80
T <sub>4</sub> -RDF + Gibberellic acid 100 ppm	41.01	30.28	49.52	61.33	5.23
T <sub>5</sub> -RDF + Gibberellic acid 125 ppm	41.78	32.33	53.87	67.33	3.99
T <sub>6</sub> -RDF + Naphthalene acetic acid 10 ppm	44.90	26.89	53.88	63.53	4.03
T <sub>7</sub> -RDF + Naphthalene acetic acid 20 ppm	44.33	31.07	57.57	65.78	3.63
T <sub>8</sub> -RDF + Naphthalene acetic acid 30 ppm	48.44	27.18	55.77	68.58	3.40
T <sub>9</sub> -RDF + Naphthalene acetic acid 40 ppm	46.97	28.22	56.53	66.38	2.90
T <sub>10</sub> -RDF + Naphthalene acetic acid 50 ppm	46.15	29.05	56.90	65.61	3.00
SE(m) ±	1.09	1.09	0.13	1.49	0.46
C.D. at 5%	3.23	3.23	0.39	4.42	1.36

1. DAP – Days after planting
2. RDF – Recommended dose of fertilizers

## Conclusion

Plant growth regulators (RDF + Gibberellic acid 100 ppm) treated plants gave highest results in terms of growth parameters *i.e.* plant height, plant spread, number of leaves per plant and number of runners per plant as compared to control at all the stages of observations. Flowering parameters *i.e.* number of flower per plants, days to 1<sup>st</sup> flowering and fruiting as well as days to maturity was increased considerably with the application of same treatment. Hence the application of gibberellic acid @ 100 ppm is recommended for better plant growth and fruiting in strawberry under Chhattisgarh region.

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