

Review Article

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Effect of Gibberellic Acid Application on the Growth, Vigour, Flowering, Fruiting and Quality of Strawberry: A Review

Aditee Sharma* and Ankush Godara

School of Agriculture, Lovely Professional University, Punjab, India

*Corresponding author

ABSTRACT

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Strawberry is a very unique berry fruit. It is mainly cultivated in subtropical and temperate area. Strawberry is a non climacteric fruit. It is rich in vitamin c and iron. It is law-growing herbaceous plant which arise basal leaves. PGR play a key role in yield and size of the fruit. GA₃ has stimulate the effect on the fruit of strawberry ripening , testimonial by a reduce the activity of respiration and detain the synthesis of anthocyanin and breakdown of chlorophyll gibberellic acid influence the growth , and fruiting etc. Gibberellic acid is a growth promoting hormone which is mainly found in fungi and plants. It involves over-coming dormancy in seed and buds. Gibberellins translocates easily in the plant in both direction. It is used commercially in increasing fruit size, stimulating seed germination and seed growth.

Introduction

Strawberry is a delightful, delicious and healthy fruit. Strawberry fruit has individual and good aroma. They are very sweet flavor. It has cultivated in the very unique place. It is a manmade hybrid. Strawberry botanically known as *Fragaria x ananasa Duch.* Belongs to Rosaceae family with octaploid chromosome no 56(2n=8x) and Order Rosales. it is originated from France (Nathewet *et al.*, 2010). It is fast growing crop and also it is short day plant crop. It is suitable for kitchen garden. Rich in vitamin - C and Iron (Morgan, 2005). It is an vital flavor due to Ethyl butanoate and Ethyl hexanoate. Strawberry is a good source of folic acid.

Cultivation of strawberry in the region of HP, UP, Maharashtra, West Bengal, Haryana, Punjab and Rajasthan. They have also grown in the subtropical area of J\$K. They are grown in the region of Himalaya. In India they are exported in 400-500 tonn. The total cultivated area is 0.21 ‘000 ha. 1.61 ‘000 MT is a total production area in the year 2013-2014 (NHB 2014).In world, strawberry cover 9.2 lakh hectare area (73 countries) and annual production of strawberry is estimate 45.9 lakh hectare.

A growth regulator, plant growth regulator is natural or synthetic chemical that influence the growth and development. Plant hormone is natural substance that act to control plant

activities chemical messenger in a one part of plant and the transported to the other parts, where they initiated the response. They have five type of plant growth regulators: Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid. Effect of PGRs has been investigated extensively in strawberry. They control the plant growth or increase the strawberry yield, reported by (Dwivedi *et al.*, 1999).

Gibberellic acid have a regulatory function are produce the shoot apex primary in the leaf primodial and root system stimulates stem growth dramatically and also stimulates cell division, cell elongation and enzyme secretion. It involves over-coming dormancy in seed and buds. Gibberellins translocates easily in the plant in both direction. It is used commercially in increasing fruit size, stimulating seed germination and seed growth (Kumar *et al.*, 2012).

Gibberellic acid is a growth promoting hormone which is mainly found in fungi and plants. It can be commercially synthesized using microorganisms. GA promotes growth endogenously and has direct effect on cell elongation, fruit set, germination, flowering and fruit development. In this review major work done on studying the effects of gibberellic acid on the growth and development of strawberry is listed. The some researchers evaluated the effect of gibberellic acid at varied concentrations individually and with addition to other growth promoters and evaluated various parameters such as flowering, fruiting, yield, quality of strawberry and the work of these researchers are discussed in this review (Khunte *et al.*, (2014)).

Effect of gibberellic acid in strawberry flowering and yield

The impact of GA₃ application in different concentrations (0,5,10,15 ppm) on strawberry

cv. Camarosa at second and fourth week of January. The GA₃ was applied exogenously on the strawberry plant. The study revealed that the application of gibberellic acid resulted in early flowering without reduction in yield and quality of fruit. The results were best seen at 10 ppm concentration of GA₃ exceed the elongation axillary shoot and decrease formation of callus. Specifically, it was observed that under low concentration of GA₃ (1.0, 2.0 mg d/m³) axillary shoots (mainly crown shoots) were elongated and under high concentration of GA (5.0, 10.0 mg d/m³) there was stimulation in development of runners (Ahsen *et al.*, (2002)). A study was conducted Rzeszow University, Poland where they developed in vitro shoot cultures of strawberry under the influence of higher doses of gibberellic acid and growth and development of strawberry was evaluated. The doses of GA were 1.0, 2.0, 5.0, 10.0 mg d/m³. It was generally observed by (Wojciech *et al.*, 2009).

The effects of gibberellic acid and chilling treatment on the vegetative growth and vigour of strawberry plants. Elsanta cultivar of strawberry was used in the research and plants for chilling treatment were kept in polybags in cold storage room at 3 degree Celsius at 2, 4, 6, 8 and 10 week and observation were recorded. To compare whether GA can mimic the effects of chilling treatment, another batch of plantlets were sprayed with GA at varied concentrations. It was observed that gibberellic acid increases the vegetative growth but simultaneously the length of inflorescence and therefore the shape of fruit become abnormal. Also, at 50 ppm concentration of GA the abnormalities were least. This research is conducted by (Tehranifar and Battey, 1997).

The spray of gibberellic acid GA₃ @ 75 ppm has decrease the weight of strawberry berry and also affect on the fruit set, but

increase the total yield and total number of fruit and there is no wrong impact on the quality parameter of fruit and also number of yield was increase this is observed by (Sharma and Singh 2009). Singh and Singh (2009) is confirm that the cultivar of strawberry treated with gibberellic acid and chemical fertilizer GA₃ @100 ppm. The Application of GA₃ mixed with auxin and increases the yield of strawberry variety Camarosa (Roussos *et al.*, 2009). However, the Application of GA₃ @75 ppm the number of flower and fruit yield is increased therefore it is confirm by the (Uddin *et al.*, (2012).

Effect of GA₃ on growth and yield of strawberry

It has been reported that the Application of GA₃ has influence on the plant growth model, that stimulate good plant length height, leaf length which is harmonize with cell elongation intercalary meristem that is further associated with cell division (Sauter and Kende, 1992). The cell growth is not modulate with the gibberellins that stimulate with auxin synthesis verify by the Ockerse and Galston (1967).

It was observed that there is stem elongation induced by gibberellin which include the early expansion with different kinetic which is followed by long and mid term expansion due to enhancing the action of IAA, but increase in endogenous level of auxin was not seen. Many authors are considered that the GA₃ work as a growth promoter and also explain that the impact of abundant concentration of GA₃ on various growth parameter such as plant height, leaf length, shape of leaf, bunch of plant and production of runner etc, (Barralt and Davies (1977)). The applied over the 2 week of flowering the application of GA₄ + 7 at 15 ppm and Promalin (1.8% of GA₄ + 7 and 1.8% of 6-Benzyladenine) @ 6ppm for growth of plant

and area of leaf under protected cultivation of strawberry cultivar. This is recommended by (Thakur *et al.*, 2017).

The 4 concentration of GA₃ i.e. @50, 100, 150 and 200 ppm at the stage of 4 leaf and the subsequent time of a week then notice that the extend the length of petiole and there is no effect on the size and number of leaf and the branches of plant and reduce the production of fruit (Luangprasert (1994)). The gibberellin effect on the growth of vegetative part of the strawberry and also promote the growth of the strawberry. Concentration of GA₃ @ 80ppm is good for the vegetative growth and runner production of strawberry is confirmed by (Rajesh *et al.*, 2012). The growth of runner production is increase and it is also related with inhibitory effect on flowering also stimulates the expansion of parenchymatous and epidermal cell reported by Akath and Singh (2009).

It has been reported that the reaction of chemical fertilizer or nitrogen fixing bacteria combination with plant bio-regulators on strawberry cultivar. The application of GA₃ (100ppm) has been observed that increase the height of plant, shape of leaf, number of leaf and area of leaf. Application of GA₃ applied with the mixing Azotobacter and Azospirillum during the 60 kg N/ha conducted by Singh and Singh (2009). The application of the GA₃ the (75 ppm) to increase the plant height, number of leaves and area of leaf in strawberry plant conducted by Uddin *et al.*, (2012).

The strawberry cultivar vigorous runner production in the specific year. some runner plants are treated with the application of GA₃ and keep it under the cold temperature for 25 days. The application of the concentration of (GA₄ + 7 at 15 ppm) or Promalin (GA₄+7 (1.8%) or 6-Benzyladenine (1.8%) @ 6ppm to increase the height and growth of plant it is

confirm by (Thakur *et al.*, (2017)). In strawberry cultivar to applied the application GA₃ (25, 50,75ppm), cycocel @ 300, 600, 900ppm) or triacotanol @1.25, 2.5, 5ppm) observed that the yield of strawberry fruit is maximum i.e.(376.69g/plant)and number of fruit is also increase i.e. (23.31) 1:50 length: diameter ratio of fruit was observed with the concentration of 5ppm triacotanol confirm by Sangwook *et al.*, (1996).

It has been reported that there is an increase in number of fruits per plants by the application of gibberellic acid (GA₃) @ 50 ppm in Camarosa cultivar of strawberry. (AL-Madhagin *et al.*, (2012)). similarly that maximum number of flowers (28.7/plant) maximum yield (25.9/plant) and maximum number of fruits where seen in strawberry plants which where treated with GA₃75 ppm followed by GA₃100ppm and least (21.1,248.9gm /plant, 19.6/plant respectively) in control reported by (Uddin *et al.*, 2012).

Effect of gibberlic acid in strawberry fruit ripening

The effect of gibberellic acid on post-harvest ripening of strawberry by evaluating various biochemical parameters like anthocyanin content and chlorophyll content. The strawberry plants at different growth stages were harvested and incubated with gibberellic acid. The observations indicated that gibberellic acid had an inhibitory effect on strawberry respiration and thus reducing the ripening. Also, GA₃ accounted for chlorophyll degradation and delay in the synthesis of anthocyanin due to inhibition in respiratory function (Martinez *et al.*, 1994).

Effect of gibberellic acid (GA₃) on quality of strawberry fruit

GA₃ 100ppm + vermicompost @100q/ha resulted more TSS (10.68 °Brix) in strawberry var. Douglas. It was observed that the

increase the number of fruit and also increase the juice content i.e 87.37% with the application of gibberellic acid (GA₃) @ 30ppm and also the application of gibberellic acid (GA₃) @ 90ppm the increase the ascorbic acid 64.04 and acidity also increased (Rajbhar *et al.*, 2015).

The variety sweet Charlie in strawberry in various type of plant growth regulator are effected on the different concentration of gibberellic acid (GA₃)@ 25 and 75 ppm, cycocel 300 and 600 ppm and that is also resulted that the specific gravity and ph in higher range at the application of tryptophan and the application of Cycocel @ 900ppm shows that the rich in vitamin content and the sugar level is also increase (Kumar *et al.*, (2012) i.e. 9.63° brix and it also increase the content of juice) gives highest vitamin C (55mg/100gm), total sugar (9.40%), TS (9.40%), TSS (9.63degree Brix), juice content and level of ascorbic acid in the chandler variety of straw berry . the spray of the application of GA₃ @ 75ppm twice in the month of mid November to the mid of February, this is considered that the Roussos *et al.*, (2009).

In conclusion the application of gibberellic acid applied the plant in different concentration. it influence the growth of strawberry. Gibberellic acid had different effect on respiration and thus reduce the ripening. The effect of different concentration of gibberellic acid GA₃ various parameter of growth like height of plant, leaf length, fruit size etc. application of GA₃ resulted early flowering concentration of 10ppm should be applied three times at weekly intervals starting in the autumn, when the flowers are first initiated (Smith *et al.*, 1961), fruit is also in good textured (Smith *et al.*, 1961). It enhances the cell elongation.

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