



EFFECT OF DIFFERENT CONCENTRATION OF GA 0.45 % SL ON FRUITING AND QUALITY ATTRIBUTES OF APPLE CV RED DELICIOUS

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Abstract

Field experiments were conducted at Regional Horticultural Research & Training Station, Sharbo (Himachal Pradesh), to determine the effect of different concentration of GA 0.45 % SL on fruit size, weight, yield and TSS of the apple cv. Red Delicious. The experiment was comprised of five GA 0.45 % SL treatments viz., T₁: 1.5 ml/L; T₂: 2.0 ml/L; T₃: 2.5 ml/L; T₄: 3.5 ml/L; T₅: Control (Untreated), laid out in randomized block design with three replications. The Gibberellic acid 0.45 % SL was applied to all the selected trees at three stages viz., i) at silver tip stage ii) fruit setting stage and iii) at walnut stage. The plants selected for the trials were uniform in size and vigor and received uniform dose of fertilizers as per university recommendations and the plant protection measure was similar in all the treatments. The data revealed that application of Gibberellic acid 0.45 % SL @ 2.5 ml/L (T₃) exhibited maximum fruit length (72.89 mm), fruit breadth (74.24 mm), fruit weight (199 g), fruit yield (65.23 kg/plant) and TSS content (12.0°B) recorded significantly higher over the foliar application of other treatments and control. The application of Gibberellic acid 0.45 % SL at the rate of 2.5 ml /liter was most effective in enhancement of fruit size, fruit shape, fruit weight, fruit yield and TSS content in apple cultivar Red Delicious.

Key words : Gibberellic acid, Fruit size, Fruit weight, TSS, Red Delicious.

Introduction

Apple is a main fruit crop of Himachal Pradesh and in recent years, it has emerged as the leading remunerative cash crop amongst fruit crops. It alone accounts for 49 percent of total area under fruit crops and 74 percent of the total fruit production. The area under apple has increased from 97438 hectares in 2008-09 to 112634 hectares on 2017-18 (Anonymous, 2019). The fruit crop contributes more than 3313 crore towards the gross domestic product. The apple production level has gradually touched to 368603 MT (Anonymous, 2019). The production of apple has been gradually increased but void of export quality fruit production, it is still a great concern for the farming community of this state to produce quality

apple in coming years. At present, these Delicious group cultivars mainly Red Delicious, Royal Delicious and Starking Delicious constitute nearly 80 % of apple trees. In order to improve the production and quality of fruits to meet the export standards, the horticulture sector is therefore constantly seeking for new practices to integrate in the management of the cultivation systems. Several factors like inadequate pollinizer proportion, reduction in natural population of pollinating agents, inadequate winter chilling, occurrence of spring frost etc. attributed as the main factors leading to poor fruit set. The use of plant growth regulators has assumed an integral part of modern fruit production to improve the quality and production of fruits, and it has resulted in outstanding achievements in a number of fruit crops with regard to improvements in yield and quality (Jain and Dashora, 2011). Because of

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its diverse effects, it is possible to use certain growth regulating chemicals at particular stages of fruit growth and development to exhibit maximum effects. Occasionally, they needed to be supplement exogenously for additional stimulus for plants, which require quick responses for increased growth, fruit set and yield (Singh and Singh, 2009). Gibberellins (GA) are natural growth hormones which play primary role in stimulating auxin reaction that helps in controlling growth as well has direct effect on Internode elongation, flowering, fruiting, quality and yield. Gibberellic acid is known to enhance the plant growth through cell elongation (Turner, 1963). Fruit growth is stimulated by gibberellins due to an increase in cell division (increasing the number of cells per fruit) and cell elongation (increasing cell size). Gibberellins stimulate pollen germination and pollen tube growth, and exogenous application of gibberellins to flower can result in fruit set. It has been demonstrated that GA enhanced diphenols and hence reduced the activity of IAA oxidase, resulting in high auxin level. The use of plant growth regulators like GA₃ by many researchers have shown reduced flower drop, high flower retention, increased yield and fruit quality in various fruit species such as citrus, apple, mango and guava (El-Shewy, 1999; Iqbal *et al.*, 2009). Watanabe *et al.*, (2008), in their study on apple observed 60% fruit set in GA₃ treated 'Ohrin' cultivar and about 7% in 'Fuji'. Moreover, GA₃ + 2,4-DP + CPPU treated 'Ohrin' apple showed the highest fruit set percent. These researches have put the corner stones for the fruit production through chemical means even under the unfavorable conditions. As apple trees bloom during a cool period and suffer from self-incompatibility, any factor that can improve pollination, pollen germination and pollen tube growth or extend the effective pollination period, such as the application of plant bio-regulators, should be beneficial for fruit production. Considering all of these facts, a pressing need exists to lay out a field experiment to explore the effectiveness of GA sprays in improving the apple fruit yield.

Materials and Methods

The present investigation was undertaken in the Regional Horticultural Research & Training Station of Dr Y S Parmar UH&F Nauni Solan, Himachal Pradesh. The experiment carried out with randomized block design with four replications considering stages of after fruit set stage and walnut stage of fruit development. The experiment was comprised of five GA 0.45 % SL treatments *viz.*, T1: 1.5 ml/L ; T2: 2.0 ml/L; T3– 2.5 ml/L; T4– 3.5 ml/L; T5– Control (Untreated), laid out in randomized block design with three replications. The Gibberellic acid 0.45 % SL was applied to all the selected

trees at three stages *viz.* i) at silver tip stage ii) fruit setting stage and iii) at walnut stage. The plants selected for the trials were uniform in size and vigor and received uniform dose of fertilizers as per university recommendations and the plant protection measure was similar in all the treatments. The fruit samples collected during September washed and kept for analysis. Fruit length and breadth measured with Vernier calliper and fruit weight recorded in a sensitive weighing balance. Total soluble solids measured with the help of refractometer and total acidity estimated by using standard methods and procedures given by A.O.A.C. (1970). The data obtained were tabulated and analyzed subjected to the Analysis of Variance (ANOVA) procedure of Statistical Analysis System (SAS).

Results and Discussion

The effect of different concentrations of Gibberellic acid 0.45 % SL showed significant effect on fruit size, weight, yield and TSS content of apple cv. Red Delicious during the study. Table 1 revealed that application of Gibberellic acid 0.45 % SL exhibited significant effect on fruit length, fruit breadth and fruit weight of apple cv. Red Delicious. The maximum fruit length (72.89 mm) and fruit breadth (74.24 mm) was observed in treatment T3 (Gibberellic acid 0.45 % SL @ 2.5 ml/L) which was closely followed by treatment T4 (Gibberellic acid 0.45 % SL @ 3 ml/L). The minimum fruit length (65.48 mm) and fruit breadth (66.00 mm) was observed in untreated control. The exogenous application of GA₃ increased the cell size of the fruit by the proliferation of the sink demand, resulting in enhanced phloem unloading and carbon assimilate metabolism in the fruit and a greater supply of assimilates and photosynthates to the fruits (Zhang *et al.*, 2007, Ahmed *et al.*, 2012). In addition, GA improved the internal physiology of the developing fruits in terms of a better supply of nutrients and other compounds that are vital for their proper growth and development, which resulted in improved size and ultimately a greater yield (Pandey, 1999).

The data recorded table 1 on the fruit weight reveals that highest fruit weight (199 g) was recorded in treatment T₃ (Gibberellic acid 0.45 % SL @ 2.5 ml/L) which was significantly superior to rest of the treatments. The lowest fruit weight (182 g) recorded in treatment T₅ (control). Similarly, application of Gibberellic acid 0.45 % SL @ 2 ml/L (T₂) and 3ml/L (T₄) also resulted in the significant increase in the fruit weight in comparison to untreated control. The increase in fruit weight with application of GA may be due to increased plant and leaf growth, which might have enhanced the photosynthetic activity and

Table 1: Effect of different concentration of GA 0.45 % SL on fruit size, weight yield and TSS of the Red Delicious apple.

Treatment	Fruit size (mm)		Fruit weight(g)	Yield (kg/plant)	Total soluble solids (TSS ° B)
	Fruit length	Fruit breadth			
T ₁	67.85	70.63	187.00	60.62	10.00
T ₂	68.11	70.68	192.00	62.41	11.00
T ₃	72.89	74.24	199.00	65.23	12.00
T ₄	72.65	72.63	196.00	64.17	11.00
T ₅	65.48	66.00	182.00	57.24	10.00
CD _{0.05}	0.91	0.90	1.79.00	1.81	0.89

resulted in more accumulation of photo-synthates. The present findings regarding the increase in fruit size and fruit weight with application of gibberellic acid are in consonance with results of Banday *et al.*, (2005), Singh and Singh (2006), Tripathi and Shukla (2006) and Uddin *et al.*, (2012), who also reported increased fruit size and fruit weight with application of gibberellic acid in fruit crops. The observations for fruit yield showed significant variation among different treatments under present study. The perusal of data, reveals that the maximum fruit yield (65.23 kg/plant) was recorded in plants treated with Gibberellic acid 0.45 % SL @ 2.5 ml/L, followed by T₄ (Gibberellic acid 0.45 % SL @ 3 ml/L). While, the minimum fruit yield (57.24 kg/plant) recorded in untreated control. The increase in yield with gibberellic acid might be due to an increase in flower number, better fruit setting percentage and the production of a higher number of fruits with maximum fruit weight in addition to better vegetative growth. In addition, GA may have affected the auxin metabolism, which may have indirectly aided in fruit enlargement and thus the production of fruits in higher number, which ultimately increases yield/plant and yield/ha (Kappel and Mac Donald, 2007, Singh and Singh, 2006). Exogenous application of gibberellins have been reported to promote pollen germination and increase pollen tube length in vitro in apricot (Bolat and Pirlak, 1999). The active components of Promalin (GA₄+7 + 6-BA) operate as growth promoters at cellular level and improve the development of fruitlets immediately after flowering (Vilardell *et al.*, 2008). Gibberellins either from fruit seed or exogenously applied, have been found to intensify organ ability to function as nutrient sink and also can increase the biosynthesis of IAA in plant tissue which delays the formation of the separation layer and thus enhances fruit retention. Further findings have also indicated that foliar sprays of gibberellic acid resulted in higher fruit retention (Wally *et al.*, 1999).

The quality parameter, total soluble solids of fruits also studied under the course of study. It is evident from the data that application of Gibberellic acid 0.45 % SL

exhibited significant effect on TSS content of fruits. The maximum TSS content (12.00 °B) was observed in treatment T₃ (Gibberellic acid 0.45 % SL @ 2.5 ml/L) which was statistically at par with treatments T₂ (Gibberellic acid 0.45 % SL @ 2.0 ml/L) and T₄ (Gibberellic acid 0.45 % SL @ 3.5 ml/L). The minimum TSS content (10.00 °B) was recorded in untreated control (T₅) and treatment T₁ (Gibberellic acid 0.45 % SL @ 1.5 ml/L). The increase in TSS may be the result of a higher accumulation of metabolites and a quick conversion of starch into soluble sugars during the fruit development in response to growth regulators (Agrawal and Dikshit, 2010).

Conclusion

Growth hormones like GA play a very important role in fruit production by influencing various physiological processes. On the basis of the results obtained in present investigation, it is inferred that the foliar spray of Gibberellic acid 0.45 % SL at the rate of 2.5 ml/liter was most effective in enhancement of fruit size, fruit shape, fruit weight, fruit yield and TSS content in apple cultivar Red Delicious.

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