Int.J.Curr.Microbiol.App.Sci (2018) *7*(8): 2543-2549

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 08 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.708.260

Effect of Gibberellic Acid and Assisted Pollination on Fruit Characters of Custard Apple *cv.* Arka Sahan

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Keywords

Gibberellic acid, Assisted pollination, Pulp recovery, Seed content

Article Info

Accepted:
15 July 2018
Available Online:
10 August 2018

A B S T R A C T

Arka Sahan is one of important variety of custard apple. It is popular because of its exhalent flavour and taste. The present experiment was carried out mainly to enhance fruit weight, pulp recovery and reduce the seed. The study under taken in Regional Horticultural Research and Extension Station, University of Horticultural Sciences campus, Bengaluru. The study revealed that the combination of GA_3 1000 ppm + assisted pollination recorded maximum increment in fruit weight (409.13g), pulp weight (307.90g), Pulp recovery (75.21 %), Pulp: Peel ratio (4.63) and Pulp: seed ratio (23.12). The study also recorded lowest Peel content (12.25 %) and Seed content (3.24 %) in the treatment GA_3 1000 ppm + Hand pollination. Among different treatment the combination of GA_3 1000 ppm + assisted pollination shows best result in custard apple *cv.* Arka sahan.

Introduction

Custard apple is one of the important minor fruit crop grown across the tropical and subtropical tracts of India. These fruit crop possesses unique pleasant flavour, mild aroma and sweet taste have a universal acceptance.

Annona fruits have considerable importance in human nutrition, medicinal and cultural events (Thakur and Singh, 1967). The most important among them is custard apple (*Annona squamosa* L.). Arka Sahan one of the popular variety of custard apple. The demand for Arka Sahan fruit is increasing, as it fetches higher price than several other varieties because of its exquisite quality and taste, but Arka Sahan require artificial pollination because difficulty involving natural pollination is due to the protogynous dichogamy phenomenon; that is, although custard apple trees have hermaphrodite flowers, self-pollination is nearly impossible because the stigma becomes receptive or viable long before the pollen is released (Campbell and Phillips, 1994). Arka Sahan fruits develop normally with the

uniformity desired by the consumer market when they are pollinated artificially. However, these fruits have relatively high costs associated with labour (Janick and Paul, 2006). Studies have shown that seedless ness in many species may be promoted through the application of gibberellins, auxins and cytokinins, without requiring pollination. Considering the above aspects, an investigation was carried out with an objective of increase in pulp recovery and reduce number of seed.

Materials and Methods

The present study was conducted at Regional Horticultural Research and Extension Centre, College of Horticulture, University of Horticultural Sciences, GKVK campus, Bengaluru in a randomized complete block design, five year old uniform plant was selected. For the current experiment were experimented mainly for the better results of fruit characters by treating custard apple with assisted pollination alone and combination of various treatments of Gibberellic acid (500 ppm, 1000 ppm, 1500 ppm and 2000 ppm). The control treatment was plain water sprayed without assisted pollination and Gibberellic acid.

Preparation of GA_3 solution and spraying details

Based on the treatment details, GA_3 solutions of different concentration were prepared by weighing required gram of GA_3, dissolved in little quantity of Ethanol and make up volume to 1000 ml by using distil water. Spraying details of the study is as fallows for treatments with hand pollination, the sprays was taken at 1^{st}, 3^{rd} and 5^{th} week after pollination whereas, for treatments with no artificial pollination, the sprays was given at the time of anthesis followed by 1st, 3rd and 5th week after anthesis.

The observations on various fruit characters were recorded in five randomly selected fruit per replication in each treatment. Fruit character like Fruit weight (g), Pulp weight (g), Peel weight (g) and seed weight (g) was recorded using electronic weighing balance. Other parameters like number of seed per fruit is counted manually and average of five fruit is taken in each treatment while pulp recovery (%), peel content (%) and seed content (%) were calculated by following formulas:

$$\text{Pulp recovery (\%)} = \frac{\text{Pulp weight}}{\text{Fruit weight}} \times 100$$

$$\text{Peel content (\%)} = \frac{\text{Peel weight}}{\text{Fruit weight}} \times 100$$

$$\text{Seed content (\%)} = \frac{\text{Seed weight}}{\text{Fruit weight}} \times 100$$

Statistical analysis

The data on various parameters during the course of investigation were statistically analyzed, applying the technique of analysis of variance suggested by Panse and Sukhatme, (1985). Wherever, the treatment differences were found significant, (F-test) critical difference was worked out at five per cent probability level. The treatment differences that were not significant were denoted by "NS".

Results and Discussion

Fruit weight (g)

The effect of Gibberellic acid and assisted pollination on fruit weight found to be statistically significant among the various treatments (Table 1). From the obtained results it was observed that the maximum fruit

weight (409.13 g) in GA_3 1000 ppm + Hand pollination which was on par with GA_3 1500 ppm + Hand pollination (362.68 g). Whereas, the minimum fruit weight (181.81 g) was recorded from Control which was on par with GA_3 500 ppm (220.60 g). The fruit weight here may be directly attributed by the exogenous supply of Gibberellic acid, where it increases the cell division and cell elongation.

The foliar application of growth regulators which helps in active polar transport, promote cell multiplication and enlargement of cells and more accumulation of food materials like sugars and water in expanded cells. The similar results were also recorded by Chaudhary *et al.,* (2014), Patel *et al.,* (2010) in custard apple and Katiyar *et al.,* (2008), Garasiya *et al.,* (2013) in guava.

Pulp weight (g)

The data regarding pulp weight has been presented in Table 1. As evident from the data, significant differences were observed among the treatments. The highest pulp weight (307.90 g) was found from GA_3 1000 ppm + Hand pollination which were on par with GA_3 1500 ppm + Hand pollination (273.58 g). Whereas, the lowest pulp weight (128.49 g) was observed in Control which was on par with GA_3 500 ppm (122.59 g).

The increase in pulp weight may also be due to increased berry weight coupled with induced cell division and assimilate mobilization in the developing berries as reported by Rizk *et al.,* (2011) in grapes, similarly Ramezani and Shekafandeh (2009) reported that the increase in pulp weight in olive might be due to application of GA_3 which helps in increasing the fruit mesocarp could be interpreted through its action on sink demand by enhancement of phloem unloading or the metabolism of carbon assimilates in fruit.

Peel weight (g)

From the analysed data it was observed that the minimum peel weight from the treatment Control (38.63 g) which was followed by GA_3 500 ppm and GA_3 1500 ppm (49.74 and 50.91 g, respectively).

The maximum peel weight (66.78 g) was observed from the treatment combination of GA_3 1000 ppm + Hand pollination which was on par with GA_3 500 ppm + Hand pollination, GA_3 1500 ppm + Hand pollination, and GA_3 2000 ppm + Hand pollination (65.15, 64.38 and 61.97 g respectively) as represented in Table 1.

The increase in peel weight in other treatment is may be due to more cell division by GA_3, thereby increasing the cell density per unit volume (Bhat *et al.,* 2012). The findings are in close conformity with earlier reports (Peng *et al.,* 2004 and Gomes *et al.,* 2006).

Pulp recovery (%)

The obtained data regarding pulp recovery were found to be statistically significant among the various treatments.

The highest pulp recovery (75.21 %) was obtained from GA_3 1000 ppm + Hand pollination which was on par with GA_3 1500 ppm + Hand pollination, GA_3 500 ppm + Hand pollination and GA_3 2000 ppm + Hand pollination (72.40, 71.24 and 70.65 % respectively).

Meanwhile, the lowest pulp recovery (57.60 %) in (Control) which was on par with GA_3 500 ppm (53.96 %).The increase in the pulp content mainly dependent on the exogenous supply of Gibberellic acid than hand pollination because the Gibberellic acid increases the overall fruit weight due to increase in the mesophyll cells of the fruit.

Table.1 Effect of gibberellic acid and assisted pollination on Pulp and Peel quantity of custard apple *cv.* Arka Sahan

Treatments	Fruit weight (g)	Pulp weight (g)	Peel weight (g)	Pulp recovery (%)	Peel content (%)	Pulp: Peel ratio
T_1: Hand pollination	274.49	171.31	59.58	63.91	16.38	2.84
T_2: GA_3 500ppm	220.60	122.59	49.74	53.96	15.78	2.44
T_3: GA_3 1000ppm	262.60	157.49	51.82	62.67	14.11	3.01
T_4: GA_3 1500ppm	260.83	168.67	50.91	65.44	13.88	3.32
T_5: GA_3 2000ppm	278.72	193.46	50.76	68.56	13.09	3.78
T_6: GA_3 500ppm + Hand pollination	346.54	218.24	65.15	71.24	14.50	3.33
T_7: GA_3 1000ppm + Hand pollination	409.13	307.90	66.78	75.21	12.25	4.63
T_8: GA_3 1500ppm + Hand pollination	362.68	273.58	64.38	72.40	13.18	4.21
T_9: GA_3 2000ppm + Hand pollination	343.16	251.65	61.97	70.65	15.26	4.02
T_{10}: Control	181.81	128.49	38.63	57.60	13.96	3.32
S. Em. ±	16.67	11.86	3.22	3.23	0.36	0.23
CD @ 5%	49.53	35.23	9.57	9.59	1.06	0.68

Table.2 Effect of gibberellic acid and assisted pollination on seed characteristics of custard apple *cv.* Arka Sahan

Treatments	Number of seeds per fruit	Seed weight per fruit(g)	Seed content (%)	Pulp: seed ratio
T_1: Hand pollination	35.33	18.24	6.64	9.52
T_2: GA_3 500ppm	31.60	16.23	7.34	7.38
T_3: GA_3 1000ppm	31.93	16.63	6.33	9.45
T_4: GA_3 1500ppm	30.20	15.92	6.17	10.39
T_5: GA_3 2000ppm	30.27	16.04	5.72	12.13
T_6: GA_3 500ppm + Hand pollination	33.80	16.65	4.73	13.15
T_7: GA_3 1000ppm + Hand pollination	27.80	13.30	3.24	23.12
T_8: GA_3 1500ppm + Hand pollination	32.40	15.40	4.23	17.51
T_9: GA_3 2000ppm + Hand pollination	31.20	16.08	4.65	15.53
T_{10}: Control	15.07	9.40	5.18	13.47
S. Em. ±	1.81	0.80	0.41	0.81
CD @ 5%	5.46	2.38	1.22	2.40

The similar conformational statements were also being given by Zhang *et al.*, (2007) that the increase in fruit size in pear in response to exogenously applied GA_3 and this has been associated with an increase in cell size of the mesocarp and increased sink demand by the enhancement of phloem unloading or metabolism of carbon assimilates in fruit.

Peel content (%)

The analysed data on peel content (%) are presented in Table 1 and observed significant differences among the treatments. The data revealed that the lowest peel percentage (12.25 %) from GA_3 1000 ppm + Hand pollination which was on par with GA_3 1500

ppm + Hand pollination (13.18 %). Whereas, the highest pulp percentage (16.38 %) was observed in Hand pollination which was on par with GA_3 500 ppm (15.78 %).

Pulp: Peel ratio

The highest pulp: peel ratio (4.63) was obtained in GA_3 1000 ppm + Hand pollination which was on par with GA_3 1500 ppm + Hand pollination and GA_3 2000 ppm + Hand pollination (4.21 and 4.02 respectively).

The lowest pulp: peel (2.44) was recorded in GA_3 500 which was on par with Hand pollination and GA_3 1000 (2.84 and 3.01 respectively). This result due to the combined application of growth regulators which will increase the pulp ratio by cell division and cell elongation.

Number of seeds per fruit

The number of seeds per fruit was found to be significant among various treatments and presented in Table 2. The lowest number of seeds per fruit (15.07) was recorded from Control which was followed by GA_3 1000 ppm + Hand pollination, GA_3 1500 ppm and GA_3 2000 ppm (27.80, 30.20 and 30.27 respectively).

The highest number of seeds per fruit (35.33) was reported from Hand pollination which was on par with GA_3 1500 ppm + Hand pollination and GA_3 1000 ppm (32.40 and 31.93 respectively).This reduction in number of seeds per fruit might be attributed to the natural pollination where by the pollen of the mother parent fertilized its own flowers. As evident from our experimental results the naturally pollinated fruit does not exceed 15.07 seeds per fruit. This is in confirmation with the results of Jalikop (2010), who also reported the lower number of seeds upon natural pollination.

Seed weight per fruit (g)

The results showed significant differences among the treatments. The observed data revealed that the lowest seed weight per fruit (9.40 g) from Control followed by GA_3 1000 ppm + Hand pollination and GA_3 1500 ppm + Hand pollination (13.30 g and 15.40 g). The highest seed weight per fruit (18.24 g) was observed in Hand pollination which was on par with GA_3 2000 and GA_3 1500 (16.65 g and 16.04 g). From the above observation it is clear that as the total number of seeds decreases proportionately the seed weight per fruit also decreases. The similar results were also made by Jalikop, (2010), who report the minimum seed weight from the naturally pollinated fruits.

Seed content (%)

The data related to seed content (%) are presented in the Table 2. The results showed significant differences among the treatments. The GA_3 1000 ppm + Hand pollination has recorded minimum (3.24 %) seed content followed by GA_3 1500 ppm + Hand pollination and GA_3 2000 ppm + Hand pollination (4.23 % and 4.65 %). The highest seed content (7.34 %) was observed from GA_3 500 ppm which was on par with Hand pollination and GA_3 1000 ppm (6.64 % and 6.33 %). This might be due to exogenous supply of Gibberellic acid which imparts parthenocarpy in treated fruits. Such instances of reduced seed number due to GA_3 or other growth regulators were reported earlier by Dass and Randhawa (1968), Patil *et al.,* (2010) in sapota and Bhat *et al.,* (2012) in grapes. Paleg (1960) reported that exogenous application of growth regulators like GA_3 and other may induce amylolytic activity in isolated endosperm which resulted in the formation and release of reducing sugars. This amylolytic splitting of the nutrients of the endosperm as well as the nucellus could

deprive the developing embryo of the metabolites required for its further growth and differentiation and thus resulting in its abortion.

Pulp: seed ratio

The maximum pulp to seed ratio (23.12) was observed in GA_3 1000 ppm + Hand pollination followed by GA_3 1500 ppm + Hand pollination and GA_3 2000 ppm + Hand pollination (17.51 and 15.53). The minimum pulp to seed ratio (7.38) was recorded from GA_3 500 ppm. This might be due to the combined application of growth regulators which will increase the pulp ratio by cell division and cell elongation and it will also play important role in reducing seed number in the fruit when applied after fertilization. The similar results were also reported by Santos *et al.,* (2016) that fruits artificially pollinated and treated with three and two GA_3 applications after anthesis showed a remarkable reduction in seed ratios, with no dose effect.

The present experiment is evident that Gibberellic acid alone cannot have a significant enhancement in the fruit characters development of Arka Sahan, it is the combined effect of artificial pollination and gibberellic acid. Among the observed results we can conclude that the exogenous application of GA_3 1000ppm and assisted pollination was found to best in increment in fruit character and also reduces the seed in custard apple *cv*. Arka Sahan.

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How to cite this article:

Shivakumar, A.P., Venkata Rao, M.K. Honnabyraiah, T. Sakthivel, S.V. Patil, K.R. Vasudeva, J. Dinakara Adiga and Srikanth, H. S. 2018. Effect of Gibberellic Acid and Assisted Pollination on Fruit Characters of Custard Apple *cv*. Arka Sahan. *Int.J.Curr.Microbiol.App.Sci.* 7(08): 2543-2549. doi: https://doi.org/10.20546/ijcmas.2018.708.260