Int.J.Curr.Microbiol.App.Sci (2018) *7*(8): 2536-2542

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.2018.708.259

Influence of Gibberellic Acid and Assisted Pollination on Morphometric Characters of Custard Apple cv. Arka Sahan

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Keywords

Gibberellic acid, Assisted pollination, Fruit set and Morphometric

Article Info

Accepted:
15 July 2018
Available Online:
10 August 2018

A B S T R A C T

Custard Apple is one such arid fruit crop grown across various parts of Southern India serves as the fruit of poor man. Custard apple cv. Arka Sahan is an improved hybrid obtained out of Island Gem (*Annona atemoya* Hort.) x Mammoth (*Annona squamosa* L.). The present study was under taken mainly to enhance the fruit characters by subjecting it to assisted pollination and various combinations of Gibberellic acid. Among the treatments the combination of GA_3 1000 ppm + assisted pollination recorded maximum increment in reproductive parameters such as fruit set (98.23 %), fruit retention (98.16 %) and Time taken for maturity (133.33 days). The fruit characters like fruit weight (409.13 g), fruit length (8.95 cm), fruit width (8.71 cm), pedicel length (6.59 cm), pedicel weight (3.32 g), pulp weight (307.90 g) and peel weight (66.78 g) were also had significant results from the same treatment combination. So it is GA_3 1000 ppm + assisted pollination combination proved to be the best treatment for enhancing the reproductive traits.

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 is one of the popular variety of custard apple gaining popularity among the custard apple growing regions. 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 the fruit setting in many species may be promoted through the application of gibberellins, auxins and cytokinins, without requiring pollination. In this context an experiment was conducted at Regional Horticultural Research and Extension Centre, College of Horticulture, GKVK campus, Bengaluru with a objective of enhancing reproductive traits of custard apple *cv*. Arka Sahan.

Materials and Methods

The present study was conducted at already established Arka Sahan orchard where all plants were of uniform 5 years old.

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 quantity 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 1st, 3rd and 5th 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 morphological characters *viz*., fruit weight (g), pulp weight (g) and peel weight (g) was recorded using electronic weighing balance. Other parameters like fruit length and diameter were noted using the verniercalipers, volume of fruit was recorded by water displacement method and weights was recorded using electronic weigh balance. While reproductive parameters were calculated by following formulas:

$$\text{Fruit setting (\%)} = \frac{\text{Number of set fruits}}{\text{Number of flowers pollinated}} \times 100$$

$$\text{Fruit retention (\%)} = \frac{\text{Number of fruits at harvest time}}{\text{Initial fruit set}} \times 100$$

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

Observations on various fruit characters were recorded and significant results were analysed and discussed as follows.

Fruit set (%)

The result obtained from the study shows statistically significant to fruit set (Table 1). The results revealed that the highest fruit set (98.23 %) was observed from GA_3 1000 ppm + Hand pollination which was on par with GA_3 2000 ppm + Hand pollination and GA_3 1500 ppm + Hand pollination (96.63 and 95.30 %, respectively), while lowest fruit set (5.37 %) was observed in Control. It may be due to double effect of Gibberellic acid and assisted pollination.

As it is known that Gibberellic acid treated flowers can set fruits without natural pollination. In addition to this we have made an hand pollination this benefitted the flowers to have good fruit set. These results are in confirmation with the earlier works of Chaudhari *et al.,* (2016), Bhoye (2010) and Revar (2010) in custard apple and Jawed *et al.,* (2015) in guava.

Fruit retention (%)

The highest fruit retention (98.16 %) was reported from GA_3 1000 ppm + Hand pollination which was on par with GA_3 2000 ppm + Hand pollination and GA_3 1500 ppm + Hand pollination (97.25 and 96.10 %, respectively), while lowest fruit retention (10.20 %) was observed in GA_3 2000 ppm.

This result is due to GA_3 might have been raised endogenous auxin synthesis which prevents the formation of abscission layer leading to diminished fruit drop rate and attributed to increase in fruit retention level.

These results may also confirm the effect on pollen parent on the counter parent. The above reports were in agreement with those of Lal *et al.,* (2013), Sharma and Tiwari (2015) in guava and Chaudhary *et al.,* (2016) in custard apple.

Time taken for maturity (days)

The data regarding time taken for maturity has been presented in Table 1. The results revealed that time taken for fruit maturity was found to be statistically non-significant.

Fruit weight (g)

The effect of Gibberellic acid and assisted pollination on fruit weight found to be statistically significant among the various treatments (Table 2). 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.

Fruit length (cm)

The results obtained in this regard were significant with highest fruit length (8.95 cm) recorded in GA_3 1000 ppm + Hand pollination which was on par with treatments GA_3 1500 ppm + Hand pollination, GA_3 500 ppm + Hand pollination and GA_3 2000 ppm + Hand pollination (8.52, 8.00 and 7.92 cm, respectively). The lowest fruit length (5.79 cm) was obtained from Control.

Table.1 Effect of gibberellic acid and assisted pollination on fruit set, fruit retention and time taken for maturity in custard apple *cv*. Arka Sahan

Treatments	Fruit set (%)	Fruit retention (%)	Time taken for maturity (Days)
T_1: Hand pollination	91.91	91.67	134.00
T_2: GA_3 500ppm	63.53	11.83	136.67
T_3: GA_3 1000ppm	86.77	18.02	135.00
T_4: GA_3 1500ppm	73.19	13.69	133.00
T_5: GA_3 2000ppm	50.63	10.20	133.33
T_6: GA_3 500ppm + Hand pollination	94.20	96.24	133.33
T_7: GA_3 1000ppm + Hand pollination	98.23	98.16	133.33
T_8: GA_3 1500ppm + Hand pollination	95.30	96.10	132.33
T_9: GA_3 2000ppm + Hand pollination	96.63	97.25	134.00
T_{10}: Control	5.37	87.31	137.33
S. Em. ±	2.76	1.78	-
CD @ 5%	8.21	5.29	NS

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

Treatments	Fruit weight (g)	Fruit length (cm)	Fruit width (cm)	Pedicel length (cm)	Pedicel weight (g)	Pulp weight (g)	Peel weight (g)
T_1: Hand pollination	274.49	7.28	7.97	5.23	2.05	171.31	59.58
T_2: GA_3 500ppm	220.60	7.00	6.58	4.35	1.34	122.59	49.74
T_3: GA_3 1000ppm	262.60	7.38	7.07	5.07	1.77	157.49	51.82
T_4: GA_3 1500ppm	260.83	7.00	6.52	5.46	1.73	168.67	50.91
T_5: GA_3 2000ppm	278.72	7.49	6.76	5.33	2.08	193.46	50.76
T_6: GA_3 500ppm + Hand pollination	346.54	8.00	7.75	5.50	2.69	218.24	65.15
T_7: GA_3 1000ppm + Hand pollination	409.13	8.95	8.71	6.59	3.32	307.90	66.78
T_8: GA_3 1500ppm + Hand pollination	362.68	8.52	8.29	5.69	2.86	273.58	64.38
T_9: GA_3 2000ppm + Hand pollination	343.16	7.92	7.55	5.62	2.74	251.65	61.97
T_{10}: Control	181.81	5.79	4.93	3.49	1.12	128.49	38.63
S. Em. ±	16.67	0.48	0.45	0.35	0.16	11.86	3.22
CD @ 5%	49.53	1.43	1.33	1.04	0.49	35.23	9.57

Dimovska *et al.*, (2014) reported that application of GA_3 significantly promoted the berry elongation in Thompson Seedless, mainly due to its effect on distal than proximal parenchymatous tissues of berry. Gibberellic acid promote growth by

increasing plasticity of the cell wall followed by the hydrolysis of starch into sugars which reduces the cell water potential, resulting in the entry of water into the cell and causing elongation (Richard, 2006) in grapes.

Fruit width (cm)

Among the results observed (Table 2) that the maximum fruit width (8.71 cm) from GA_3 1000 ppm + Hand pollination which was on par with GA_3 1500 ppm + Hand pollination, Hand pollination, GA_3 500 ppm + Hand pollination and GA_3 2000 ppm + Hand pollination (8.2, 7.97, 7.75 and 7.55 cm respectively). The minimum fruit width (4.93 cm) was reported to be from Control followed by GA_3 1500 ppm (6.52 cm). The increase in fruit width has direct impact of Gibberellic acid than assisted pollination.These results are in close conformity with the findings of Shailendra and Dikshit (2010) in guava, Katiyar *et al.,* (2008) in guava *cv*. Sardar. Further Nguyen (2013) reported that the increase of fruit size in apple response to growth regulators application may indicate their ability to stimulate carbohydrate translocation to the fruit in combination with their effect on increasing cell wall elasticity.

Pedicel length (cm)

From the obtained data it was observed that the highest pedicel length (6.59 cm) was 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 (5.69 and 5.62 cm respectively). The minimum pedicel length (3.49 cm) was reported to be from Control which was on par with GA_3 500 ppm (4.35 cm). Gibberellins play a vital role in increase in the pedicel length. The cell elongation in turn stimulated by Gibberellins. These results are in confirmation with the statements of Hyung *et al.,* (2008), Morris (1987), Taleb (2010) and Dimovska *et al.,* (2014) who reported the effect of gibberellins on bunch length of grapes. Increase in cluster length could be mainly due to increase in the length of rachis cell promoted by gibberellin.

Pedicel weight (g)

Pedicel weight of custard apple *cv*. Arka Sahan significantly differed among the various treatments and the data on mean pedicel weight are presented in Table 2. The highest pedicel weight (3.32 g) was recorded from GA_3 1000 ppm + Hand pollination which was on par with GA_3 1500 ppm+ Hand pollination (2.86 g). Whereas, the lowest pedicel weight (1.12 g) was observed from Control which was on par with GA_3 1500 ppm (1.77 g). This result is due to higher cell multiplication attributed by increase in the phloem cell formations at the pedicel region. The results are substantiated by the opinions of Weaver and Cune (1958) it is possibly under a direct hormonal control because of the promotional effect of auxin, cytokinin and GA_3 on cell division and enlargement.

Pulp weight (g)

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 treatments 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). This is because 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).

Out of present experiment it 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 assisted pollination is found to be most essential for enhancing the yield of custard apple *cv*. Arka Sahan and the gibberellic acid 1000 ppm gives superficial increase in fruit morphometric characters.

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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 Sreekanth, H. S. 2018. Influence of Gibberellic Acid and Assisted Pollination on Morphometric Characters of Custard Apple *cv*. Arka Sahan. *Int.J.Curr.Microbiol.App.Sci.* 7(08): 2536-2542. doi: https://doi.org/10.20546/ijcmas.2018.708.259