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# Effect of plant growth regulators on flowering, fruit set and yield of custard apple (*Annona squamosa* L.)

**Mahorkar KD, Naglot UM, Navsare RI and Chavhan PM**

**Abstract**
The present investigation entitled "Effect of plant growth regulators on flowering, fruit set and yield of custard apple (*Annona squamosa* L.)" was carried out on located farmers field at Malegaon Tal. Badnapur, Dist-Jalna during the year 2016- 2017. The experiment was laid out in Randomized Block Design with ten treatments of plant growth regulators which were replicated three times. The results revealed that, maximum number of flower per shoot (28.11) was found with spraying of NAA @ 100 ppm ($T_3$). While, the highest percentage of fruit set (70.13 %), lowest percentage of fruit drop (15.78 %), maximum number of fruits per plant (59.83), fruit weight (186.35 g.), maximum fruit yield (11.18 kg/plant) and the maximum fruit yield (44.72 qt/ha) was recorded in treatment of $GA_3$ @ 75 ppm ($T_5$), significantly the minimum days (111.00 days) required for flowering to harvesting was recorded in treatment of Ethrel @ 300 ppm ($T_9$).

**Keywords:** Custard apple, GA3, NAA, Etherel, flowering and fruit set

## Introduction
Custard apple (*Annona squamosa* L.) is very important fruit, which belongs to family Annonaceae. It's native is tropical America. It is also known by several vernacular names such as sugar apple, sweet sop, *sitaphal* and *sharifa* in different part of the country. Custard apple thrives well in tropical and warmer sub-tropics parts of India. All Annonaceous fruits are indigenous to tropical America. Custard apple is now grown in Brazil, Australia, Myanmar, Egypt, Mexico, South Africa, India and Shri Lanka. In India, custard apple is very popular in Deccan plateau and grown commercially on smaller scale in Maharashtra, Andhra Pradesh, Madhya Pradesh, Bihar, Uttar Pradesh, Tamil Nadu, Assam, Orissa and Gujarat.

The custard apple fruity is mostly used as a dessert fruit for its delicious taste and nutritive values. The proximate composition, mineral and sugar contents of the seed and juice of the fruit of *Annona cherimoya* (Custard apple) were determined using standard methods while the physico-chemical properties and chemical composition of the seed oil and juice respectively were also evaluated using standard methods. The protein content of the seed is 17.36% while it is 4.48% for juice. The fat content of the seed and juice are 29.39% and 1.56% respectively, while the values for crude fibre are 32.46% and 7.53%, respectively. There are comparable carbohydrate contents of 10.32% and 10.52% for the seed the juice respectively. The food energy of the seed is 375.23 kcal while it is 74.04 kcal for the juice. The seed contains substantial amount of calcium. Sodium, potassium and magnesium which are better than the values obtained for the juice. The juice given higher values of sugar than seed. The invert sugar of the juice is 161.27 while it is 17.40 for the seed. The fructose content of the juice is 167.27 while it is 17.45 for the seed. The juice contains 268.13 hydrated maltose while the seed contains 26.21. The physic-chemical properties of the oil extracted from the seed has specific gravity of 0.740, acid value of 11.04, peroxide value of 24.04 and saponification value of 52.11. The juice proves to be a good source of vitamins A and C with the values 16.63 µg/100g R.E. and 43.38 µg/100g respectively. The juice contains fixed acidity of 0.023% and volatile acidity of 0.004%. The total solid of the juice is 27.25% while the soluble solid is 10.00%. The analyses showed that *Annona cherimoya* fruit is a potential food source. (Amoo *et al.* 2008) [1].

The area and production of custard apple in Maharashtra is (9,424 Ha), (65,968 Mt) respectively which is 64.45 percent of total area and 64.49 percent of total production in India

(Hiwale S. 2015) [4]. The productivity of custard apple in Maharashtra is 2.87 production/Ha. (Anonymous 2015). Custard apple is one of the important fruit crop of India. It is easy to cultivate due to hardy in nature. However, flower drop, poor fruit setting and fruit retention are serious problems. Furthermore, the number of seeds in fruit is also unfavorable for consumption. Hence, it is urgent need to overcome the problems.

It has however claimed that fruit yield and quality can be increased by hand pollination, but is considered to be time consuming and costly. Attempt made to substitute hand pollination, by growth regulators viz. $GA_3$, NAA and IAA to enhance the fruit set and improved the production of custard apple by quantitatively and qualitatively. The efficient pollination, fertilization and proper fruit development is prerequisite. For quality production one way to achieve this by hand pollination but it is time consuming and costly due to non-availability of skill labors. Therefore, it is very urgent need to substitute hand pollination by growth regulators to enhance the flowering, fruit set, yield and quality of custard apple.

## Material and Methods

The present investigation on the effect of plant growth regulators on flowering, fruit set, yield and quality of custard apple (*Annona squamosa* L.) were carried out on the four years old trees having uniform growth with spaced at 5 m X 5 m at farmers field Malegaon Tal. Badnapur, Dist-Jalna during the year 2016-2017. The experiment was conducted in Randomized Block Design with three replications with total ten treatments. Custard apple trees were sprayed with different plant growth regulators *viz.,* NAA (50, 75 and 100 ppm), $GA_3$ (50, 75 and 100 ppm), Ethrel (100, 200 and 300 ppm) and control. The plant growth regulators were sprayed two times i.e. first spray given at flowering stage and second at fruit set stage. All the cultural operations like weeding, inter culturing and irrigation were adapted uniformly to all experimental plants. Observations of various fruit attribute characters and fruit yield were recorded. Results thus, obtained were subjected to statistical analysis.

### 1 Number of flowers per shoot

For recording the flowers per shoot, the four shoots of all the directions were marked and tagged on observational plants. The numbers of flowers borne on each shoots were counted and after computing the mean it was recorded as a number of flowers per shoot.

### 2 Fruit Set (%)

For recording the fruit set on observational plants the number of flowers born on each tagged shoots and number of set fruit on same shoot were counted after computing the mean it was recorded as fruit set in percentage.

Fruit set (%) = [Total number of fruits/ Total number of flowers] × 100

### 3 Fruit drop (%)

The fruit drop of observational plant was calculated in percentage by using flower per shoot, fruit set and final retention of fruit on plant and records as fruit drop. Sharma and Tiwari (2015) [9].

$$\text{Fruit drop (\%)} = \frac{(\text{Total number of fruit set} - \text{No. of fruits at harvest time})}{[\text{Total no. of fruit set}]} \text{ X } 100$$

### 4 Days required for flowering to harvesting

For recording days required for flowering to harvesting, the dates of flowering and harvesting of fruits was recorded. After computing mean it was recorded as a days required for flowering to harvesting.

### 5 Number of fruits per plant

The fruits harvested from each plant were counted at each harvest. The total number of fruits of all picking were calculated and recorded fruits harvested per plant.

### 6 Fruit weight (g)

The fruit weight of selected fruits was recorded with the help of electronic balance and mean of fruit weight was calculated and recorded as fruit weight in gram.

## Result and Discussion

### Number of flowers per shoot

The result regarding number of flowers per shoot are presented in Table 1. The data revealed that, there were significant differences with respect to number of flowers per shoot as affected by different plant growth regulator treatments under study. Maximum number of flowers per shoot (28.11) were recorded in treatment of NAA @ 100 ppm ($T_3$) which was significantly superior over control and statistically at par with the treatments of $GA_3$ @ 75 ppm (27.09) ($T_5$), NAA @ 75 ppm (26.58) ($T_2$), NAA @ 50 ppm (25.80) ($T_4$), and $GA_3$ @ 100 ppm (24.16) ($T_6$), while minimum number of flowers per shoot (18.64) was recorded in control ($T_{10}$). It might be due to plants remain physiologically more active to build up sufficient food stock for the developing flowers and fruits production, ultimately resulted into flower set. The above results were in agreement with those of Chaudhari *et al.* (2016) [3] in custard apple.

### Fruit Set (%)

The result regarding fruit set per cent are presented in Table 1. The data clearly indicated that the highest fruit set (70.13%) was recorded in treatment of $GA_3$ @ 75 ppm (T5), which was statistically at par with treatment of NAA @ 100 ppm (64.63%) ($T_3$) and found significant over rest of the treatments. Significantly lowest fruit set (32.18%) was recorded in control ($T_{10}$). It might be due to the fact that substances like gibberellins induces cell division, cell elongation, cell enlargement and ultimately leads to better growth of fruit. The above results were in agreement with those of Chaudhari *et al.* (2016) [3], Bhoye (2010) [2] and Revar (2010) [8] in custard apple.

### Fruit Drop (%)

The result regarding fruit drop per cent are presented in Table 1. The data clearly indicated that the minimum fruit drop (15.78%) was observed in treatment of $GA_3$ @ 75 ppm ($T_5$). which was significantly superior over control. The second best treatment of NAA @ 100 ppm (20.63%) ($T_3$), which was statistically at par with the treatment of $GA_3$ @ 50 ppm (23.12%) ($T_4$). In remaining treatments also the percentage of fruit drop significantly less over control. Significantly maximum percentage of fruit drop (39.66%) was recorded in control ($T_{10}$). This action of GA3 might have raised auxin level leading to diminished drop rate and attributed to its reduction in fruit drop which prevents the formation of abscission layer. The above results were in agreement with those of Lal *et al.* (2013) [6], Sharma and Tiwari (2015) [9] in guava.

**Number of fruits per plant**

There was significant difference in respect of number of fruits per plant affected by various plant growth regulator treatments in custard apple, as can be seen from the data presented in Table 1. Maximum number of fruits per plant (59.83) were recorded in treatment of GA3 @ 75 ppm (T5), which was significantly superior over control. It was followed by treatment of NAA @ 100 ppm (55.83) ($T_3$). Minimum number of fruits per plant (30.00) were recorded in control ($T_{10}$). The increase in number of fruits per plant may be due to the fact that GA3 increased the number of fruits per shoot and promoted the fruit retention, there by increased number of fruits in treated plant may be attributed to reason that substances like gibberellins induces cell division, cell elongation, cell enlargement and ultimately leads to better growth of fruit. The above results were in agreement with those of Patel *et al.* (2009), Chaudhari *et al.* (2016) [3] in custard apple.

**Fruit Weight (g)**

The results regarding fruit weight are presented in Table 1. The maximum fruit weight (186.35 g) were recorded in treatment of $GA_3$ @ 75 ppm ($T_5$), which was statistically at par with the treatments of $GA_3$ @ 50 ppm (179.53 g) ($T_4$), NAA @ 100 ppm (178.07 g) ($T_3$), $GA_3$ @ 100 ppm (176.19 g) ($T_6$) and NAA @ 75 ppm (170.17 g) ($T_2$), which were significantly superior over control and rest of the treatments. Minimum fruit weight (138.77 g) was recorded in control ($T_{10}$). The reason for increase in fruit weight may be due to increase in volume of mesocarp cells. The results are in agreement with the findings reported by Chaudhari *et al.* (2016) [3], Patel *et al.* (2010) [7] in custard apple.

**Table 1:** Effect of plant growth regulators on flowering, fruit set and yield of custard apple

| S. No | Treatments | No. of flowers/shoot | Fruit set (%) | Fruit drop (%) | Number of fruits per plant | Fruit weight (g) | Yield (kg/tree) | Yield (qt/ ha) | Days required for flowering to harvesting |
|---|---|---|---|---|---|---|---|---|---|
| 1 | NAA 50 ppm | 23.25 | 45.46 (27.03) | 29.04 (16.88) | 38.16 | 165.17 | 6.38 | 25.52 | 114.16 |
| 2 | NAA 75 ppm | 26.58 | 54.47 (33.02) | 24.03 (13.90) | 48.00 | 170.17 | 8.22 | 32.88 | 113.77 |
| 3 | NAA100 ppm | 28.11 | 64.63 (40.31) | 20.63 (11.91) | 55.83 | 178.07 | 9.98 | 39.92 | 113.10 |
| 4 | $GA_3$ 50 ppm | 25.80 | 60.50 (37.26) | 23.12 (13.36) | 51.16 | 179.53 | 9.23 | 36.92 | 115.92 |
| 5 | $GA_3$ 75 ppm | 27.09 | 70.13 (44.81) | 15.78 (9.07) | 59.83 | 186.35 | 11.18 | 44.72 | 115.66 |
| 6 | $GA_3$ 100 ppm | 24.16 | 49.66 (29.78) | 27.50 (15.96) | 38.16 | 176.19 | 6.81 | 27.24 | 115.10 |
| 7 | Ethrel 100 ppm | 21.16 | 52.93 (31.99) | 26.78 (15.53) | 42.00 | 145.26 | 6.16 | 24.64 | 112.10 |
| 8 | Ethrel 200 ppm | 20.91 | 44.23 (26.28) | 32.43 (18.92) | 34.83 | 144.10 | 5.10 | 20.40 | 111.70 |
| 9 | Ethrel 300 ppm | 20.10 | 38.80 (22.83) | 35.12 (20.56) | 34.16 | 143.09 | 4.91 | 19.60 | 111.00 |
| 10 | Control | 18.64 | 32.18 (18.77) | 39.66 (23.36) | 30.00 | 138.77 | 4.18 | 16.72 | 116.50 |
| | SE± | 1.37 | 2.02 | 0.79 | 2.77 | 6.57 | 0.60 | 2.22 | 0.79 |
| | CD at 5% | 4.09 | 6.07 | 2.37 | 8.25 | 19.54 | 1.79 | 6.62 | 2.36 |

Note-Figures in parenthesis denote the arc sign transformations value.

**Effect on Yield**

There was significant difference in respect of average increased the fruit yield (kg/plant) affected by various plant growth regulator treatments in custard apple, as can be seen from the data presented in Table 1. Maximum fruit yield (11.18 kg/plant) and (44.72 qt/ha) was observed in treatment of $GA_3$ @ 75 ppm ($T_5$) while minimum fruit yield (4.18 kg/plant) and (16.72 qt/ha) was observed in control ($T_{10}$). The increased in yield under this growth regulators treatment was associated with increase in the number of fruit, low percentage of fruit drop, more fruit retention and increased fruit size and weight. The above results were in agreement with those of Lal *et al.* (2013) [6] in guava.

**Days required for flowering to harvesting**

The result regarding days required for flowering to harvesting are presented in Table 1. Minimum days required for flowering to harvesting (111.00 days) were recorded in treatment of Ethrel @ 300 ppm ($T_9$), which was significantly superior over control and statistically at par with the treatments of Ethrel @ 200 ppm (111.70 days) ($T_8$), Ethrel @ 100 ppm (112.10 days) ($T_7$) and NAA @ 100 ppm (113.10 days) ($T_3$). Maximum days required for flowering to harvesting (116.50 days) was recorded in control ($T_{10}$). The foliar application of ethrel on plant led to marked increase in rates of ethylene production in leaves, stem and apices which induces early ripening. Ethephon increases the endogenous level of ethylene in plant by autocatalytic stimulation, which has resulted in minimum days required for flowering to harvesting of fruit. Similar results were reported by Yadava (2012) [10] in gooseberry, Jain *et al*. (2007) in guava and Kacha *et al*. (2012) [5] in phalsa.

**Conclusion**

It can be concluded that two foliar applications of GA3 @ 75 ppm for custard apple trees at full bloom and fruit set stage is beneficial for getting higher yield of fruits.

**References**


1. Amoo IA, Emenike AE, Akpambang VOE. Compositional Evaluation of Annona cherimoya (custard apple) Fruit. Trends in Applied Sci. Res. 2008; 3(2):216-220.
2. Bhoye DV. Effect of $GA_3$ and NAA on fruit set, yield and quality of custard apple. M.Sc. (Hort.) Research thesis, Akola, 2010.
3. Chaudhari JC, Patel KD, Yadav L, Patel UI, Varu DK. Effect of plant growth regulators on flowering, fruit set and yield of custard apple (*Annona squamosa* L.) cv. Sindhan. Adv. in Life Sci. 2016; 5(4):1202-1204.
4. Hiwale S. Sustainable Horticulture in Semiarid Dry lands. Springer India, 2015¸135-152.
5. Kacha HL, Viradia RR, Leua HN, Jat G, Tank AK. Effect of NAA, GA3 and ehrel on yield and quality of phalsa (*Grewia asiatica* L.) under south- saurashtra condition. Asian J Hort. 2012; 7(2):242-245.
6. Lal N, Das RP, Verma LR. Effect of plant growth regulators on flowering and fruit growth of guava (*Psidium guajava* L.) cv. Allahabad safeda. Asian J Hort. 2013; 8(1):54-56.
7. Patel NM, Patil DK, Verma LR, Patel MM. Effect of cultural and chemical treatments on fruit set and fruit yield of custard apple (*Annona sqamosa* L.) cv. Sindhan. The Asian J of Hort. 2010; 5(2):498-502.
8. Revar HJ. Effect of gibberelic acid ($GA_3$) on flowering. Fruit set and yield of custard apple. Thesis submitted to

Department of Horticulture, Collage of Agriculture, JAU, Junagadh, 2010.
9. Sharma R, Tiwari R. Effect of growth regulator sprays on growth, yield and quality of guava under malwa plateau conditions. Annals of Plant and Soil Res. 2015; 17(3):287-291.
10. Yadava LP. Effect of growth retardants on floral biology, fruit set and fruit quality of Cape gooseberry (*Physalis peruviana* L.). Am. J Plant Physiol. 2012; 7(3):143-148.