Original Research Article

Improving Fruit Set in Custard Apple (Annona squamosa L.) by using Growth Regulators

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Abstract

Custard apple (Annona squamosa L.) is gaining popularity as dryland fruit crop in Maharashtra. But poor set is the limiting factor in the expansion of area under this crop. To circumvent this problem, the investigation was undertaken at Research Farm, Department of Horticulture, College of Agriculture, Dhule by using different growth regulators viz., NAA (15 ppm), GA (50 ppm), CPPU (1 and 2 ppm), Brassinosteroid (1 and 2 ppm), Potassium monohydrogen phosphate (0.5 and 1.0%), Potassium dihydrogen phosphate (0.5 and 1.0 %) and Boric acid (1 and 2 %). Three sprays of each treatment were given at monthly interval starting from April. The experimental results indicated that, though CPPU @ 2 ppm recorded highest number of flowers per shoot (32.83) followed by NAA @ 15 ppm (32.11 flowers per shoot), the highest fruit set (21.06%), fruit retention (70.59%), number of fruits per plant (60.0 fruits/plant) and yield (9.43 kg/plant) was registered by the spray treatment of NAA @ 15 ppm. Fruit weight and days to fruit harvesting were not influenced by the growth regulators studied. Further, it was observed that none of the growth regulators studied did not influence the physico-chemical characters of the fruit. Thus, the sprays of CPPU and NAA at flowering stage and spray of NAA from fruit set to harvest found to be beneficial in improving fruit set and fruit yield in custard apple.

Keywords
Growth regulators, Custard apple, Fruit set, Fruit retention, Yield

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Introduction

Custard apple (Annona squamosa L.) is proving boon to the arid zones of Maharashtra because of their wider adaptability, comparatively freeness from pests and diseases, hardy nature and escape from stray and grazing animals. However, low fruit set is a major constraint in expanding its commercial cultivation (Hays, 1957). Plant growth regulators have become important tool in the production of various fruit crops. Growth regulators as a means for enhancing flowering, fruit set; control of fruit drop, fruit size, yield and fruit quality have become important in agriculture (Guirguis, et al. 2010). However, research work on this aspect in custard apple is very sporadic. Moreover, new growth regulators like CPPU, Brassinosteroids are available in markets which are widely used in grapes, but, their suitability in the custard apple needs to be assessed. Being hardy crop, the cultivation of custard is increasing in North Maharashtra, the present study undertaken to generate data from farmers’ point of view.
Materials and Methods

The present investigation was carried out on seven year old Custard apple cv. Balanagar during 2014-15 at Research Farm, Department of Horticulture, College of Agriculture, Dhule (Maharastra). The experiment was laid out in Randomized Block Design with thirteen treatments (Table 1) which were replicated three times and each treatment comprised of a unit of 2 plants. Three sprays of each treatment were given at monthly interval starting from April. The observations on fruit set, fruit retention, fruit weight, fruit yield and quality parameters namely pulp weight, TSS, total sugar’s and acidity were recorded.

The percentage fruit set was calculated by using following formula-

\[
\text{Fruit set} \, (\%) = \left( \frac{\text{Total number of fruits set}}{\text{Total number of flowers per shoot}} \right) \times 100
\]

Fruit retention was recorded at the time of harvesting when the fruits attained appropriate maturity and the percentage was worked out as follows-

\[
\text{Fruit retention} \, (\%) = \left( \frac{\text{Total number of fruits carried to maturity}}{\text{Total number of fruits set}} \right) \times 100
\]

The data in respect of number of fruits at each picking was recorded and then summed up to get average number of fruits per plant. Fruits were randomly selected from each treatment and were brought to laboratory and the weight of fruits was recorded on the electronics weighing balance and weight was expressed in grams. Yields per plant was worked out by multiplying number of fruits and weight of the fruits harvested. The weight of pulp was measured on electronics weighing balance. Total soluble solids (T.S.S.) were recorded by hand refractometer (Erma Tokyo A032). The total sugars were worked out as per the method advocated by Ranganna (1985) and expressed as percentage. Acidity was worked out by simple method of titration of homogenized pulp against 0.1 N NaOH, using phenolphthalein as an indicator as per the method advocated by Ranganna (1985) and expressed as percentage. The data so generated were subjected to statistical analysis as per the method given by Panse and Sukhatme (1995).

Results and Discussion

Fruit set, fruit retention, yield and yield attributes

The data with respect to fruit set, fruit retention, yield and yield attributes is presented in Table 1.

Fruit set (%)

Results presented in Table 1 revealed that plant growth regulators under study significantly influenced fruit set. Significantly highest fruit set percentage was observed in the treatment T1 i.e. NAA @ 15 ppm which recorded 21.06 % fruit set. The findings are in agreement with those obtained by Sundarajan (1968); Durate (1976); Keskar et al. (1986) and Kulkarni et al., (1995) in custard apple.

Beneficial role of NAA in improving fruit set was also reported by Ghosh et al., (2009 a) in pomegranate cv. Ruby; and Kaseem et al., (2011) in ber. It is well known that auxins play an important role in control of fruit abscission (Osborne, 1989). Beneficial role of NAA in increasing fruit set may be explained from the fact that, auxins play significant role in fruit set due to their strong mobilization activity (Crane, 1969), which helps to maintain ongoing physiological and biochemical process of inhibition of abscission (Tomaszewska and Tomaszewska, 1970).
Fruit retention (%) 

The highest fruit retention percentage was recorded in the treatment T1 i.e. NAA 15 ppm (70.59%) which was significantly superior over rest of the treatments. Similar results were reported by Kulkarni (1991) in custard apple. The response of NAA in increasing fruit retention confirms the earlier findings of Improvement in fruit retention due to application of NAA has also been reported by Bal et al., (1982) and Kaseem et al., (2011) in ber; Ghosh et al., (2009 a) in pomegranate and Saraswathi et al., (2003) in mandraians (C. reticulate, Blanco). The NAA being auxin compound might have reduced the cellulose activity and the abscission process which would have resulted in increased fruit retention. (Randhava and Chadha (1994)).

Number of fruits per plant

The highest number of fruits per plant was recorded in the treatment T1 i.e. NAA 15 ppm which recorded 60 fruits per plant which was significantly superior over rest of the treatments. Present findings are in harmony with the findings of Kulkarni et al., (1996). Patel et. al. (2010) in custard apple; Ghosh et al., (2009 a) in pomegranate; Kaseem et. al. (2011) in ber and Nkansah et al., (2012) in Keitt mangoes also reported the increase in number of fruits per plant due to the application of NAA. The increase in number of fruits per plant in the present investigation might be due to the corresponding significant increase in the fruit set and fruit retention percentage.

Table 1: Effect of different plant growth regulators on fruit set (%), number of fruits per plant, fruit weight (g) and yield per plant (kg)
Table 2: Effect of different plant growth regulators on pulp weight (g), Total Soluble Solids (T.S.S.) (%), acidity (%) and total sugars (%)

| Treatment No. | Treatments details            | Pulp weight (g) | T.S.S. (%) | Acidity (%) | Total Sugars (%) |
|---------------|-------------------------------|-----------------|------------|-------------|------------------|
| T1            | NAA (15 ppm)                  | 70.87           | 18.35      | 0.185       | 17.28            |
| T2            | GA (50 ppm)                   | 72.74           | 18.36      | 0.186       | 18.21            |
| T3            | CPPU (1 ppm)                  | 78.59           | 18.91      | 0.180       | 17.72            |
| T4            | CPPU (2 ppm)                  | 64.22           | 18.93      | 0.187       | 17.22            |
| T5            | Brassinosteroid (1 ppm)       | 82.66           | 18.98      | 0.185       | 18.45            |
| T6            | Brassinosteroid (2 ppm)       | 72.61           | 18.45      | 0.184       | 18.14            |
| T7            | Potassium monohydrogen phosphate (0.5 %) | 67.40       | 17.88      | 0.190       | 17.74            |
| T8            | Potassium monohydrogen phosphate (1 %) | 77.64      | 18.61      | 0.188       | 18.02            |
| T9            | Potassium dihydrogen phosphate (0.5 %) | 69.69       | 19.37      | 0.183       | 17.67            |
| T10           | Potassium dihydrogen phosphate (1.0 %) | 71.04       | 18.50      | 0.185       | 17.66            |
| T11           | Boric acid (1.0 %)            | 72.93           | 19.08      | 0.188       | 18.42            |
| T12           | Boric acid (2.0 %)            | 75.40           | 18.86      | 0.187       | 17.85            |
| T13           | Control                       | 79.39           | 18.48      | 0.187       | 17.51            |
|               | S. E. ±                       | 4.32            | 0.28       | 0.00303     | 0.33             |
|               | C. D. 0.5%                    | N. S.           | N. S.      | N. S.       | N.S.             |

Fruit weight

Although, fruit weight of custard apple in the present investigation was not influenced by application of growth regulators, numerically the highest fruit weight (180.0 g) was noticed in the treatment T5 i.e. application of 1 ppm brassinosteroid. However Kulkarni (1996) in Custard apple and Saraswathy et al., (2003) in mandrian reported that growth regulators especially NAA and 2,4-D did not affect fruit weight.

Fruit yield

The highest yield per plant was recorded in the treatment T1 i.e. NAA 15 ppm (9.43 kg/plant) which were at par with the treatments and T3 i.e. CPPU 1 ppm (8.88 kg/plant), T5 i.e. Brassinosteroid 1 ppm (8.23 kg/plant) , T4 i.e. CPPU 2 ppm (8.11 kg/plant) and T2 i.e. GA 50 ppm (7.92 kg/plant). Results are in close agreement with Kulkarni et al., (1996). Parallel results were also obtained by Patel et al., (2010) in custard apple due to the application of 20 ppm NAA. The increase in the yield might be due the increased number of fruits per plant which directly corresponds to the increased fruit set and fruit retention.

Fruit quality characters

The data with respect to pulp weight (g), Total Soluble Solids (T.S.S.) (%), acidity (%) and total sugars (%) is presented in Table 2.

Pulp weight (g)

Pulp weight was not affected by the applications of growth regulators under study. However, numerically the highest pulp weight (82.66 g) was recorded in the treatment T5 i.e. application of 1 ppm brassinosteroid. Findings of Kulkarni (1991) in Custard apple suggested that growth regulators did not influence pulp weight.

TSS (%)

Results revealed that growth substances studied did not affect T.S.S. However, numerically the highest T.S.S. was registered in T9 i.e. potassium dihydrogen phosphate (19.37%). The results are in accordance with
those obtained by Keskar et al., (1986) and
Kulkarni (1991) in custard apple. Han and Lee (2004) while working on Kyoho grape
reported that T.S.S. was not influenced by the
application of GA₃, CPPU and ABA.

**Total sugars (%)**

The significant differences were not observed
with respect to total sugar content of the fruits
due to the application of various plant growth
regulators. However, numerically the highest
total sugar was registered in the treatment T₃
i.e. (Brassinosteroid @ 1 ppm) and it was
18.45 per cent. Lowest Total Sugar (%) was
recorded in the treatment T₄ i.e. @ CPPU 2
ppm and it was 17.22 per cent. The present
findings of non- influence of total sugars by
growth regulators corroborate with Kulkarni
et al., (1996) in custard apple and Hesami and
Abdi (2010) in date palm.

**Acidity (%)**

The acidity (%) of fruits did not differ
significantly due to the application of various
plant growth regulators studied. However,
numerically the lowest acidity was found in
the treatment T₃ i.e. CPPU 1 ppm and it was
0.180 %. Highest percentage of acidity % of
0.190 % was recorded in T₇ i.e. Potassium
monohydrogen phosphate 0.5%. Non-
influence of acidity due to growth regulators
confirms the findings of Kulkarni et al.,
(1996) in custard apple; Saraswathi et al.,
(2003) in mandarin; Hesami and Abdi (2010)
in date palm and Faissal and Aal (2007) in pear.

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