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# To study the effect of plant growth regulators and urea on flowering, fruiting and yield of custard apple (*Annona squamosa* L.) cv. Sindhan

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**Abstract**

The experiment was laid out in Randomized Block Design (RBD) with three replications at Horticulture Instructional Farm, Department of Horticulture, C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Dist. Banaskantha, Gujarat during the year 2005 and 2006. The experiment involved fourteen treatments comprising of three levels each of NAA and $GA_3$ (50 ppm, 100 ppm and 150 ppm) alone and their combinations with 2 % Urea, 2 % Urea alone and Control. Seventeen years old custard apple plants of uniform growth and size were selected. Plants were planted at distance of 6 m x 6 m. The experimental findings revealed the effectiveness of plant growth regulators and urea on flowering, fruiting and yield of custard apple as compared to control. The result indicated that the significantly minimum number of days was taken for flowering and fruit ripening were recorded with combined application of NAA 150 ppm + Urea 2 % during both the years and in pooled data. The combined application of $GA_3$ 50 ppm + Urea 2 % treatment recorded significantly maximum hermaphrodite flower, more rate of fruit development, fruit size (7.31 cm and 7.75 cm), number of pickings of fruit (6.42), average number of fruits per tree (194.38), average fruit weight (216.93 g), fruit yield per tree (40.26 Kg), fruit yield per hectare (11182.49 Kg) and less number of rudimentary flowers during both the years and in pooled data.

***Key words:*** *Custard apple, Plant Growth Regulators, flowering, fruiting.*

## Introduction

Custard apple have greenish yellow flowers arise at an extra axillary position, usually in clusters and rarely solitary. Six petals are in two whorls, the outer petals are thick, linear and rounded at the apex while inner ones are minute, ovate or obovate and keeled on the outside. The flower has numerous stamens and carpels. The fruit is composed of loosely cohering carpels forming a squamose or tuberculated surface. It bear hermaphrodite flowers either singly or in cluster on current season's growth and rarely on old wood (Nakasone and Paull, 1998). Flowers have thick sepals and petals, numerous ovaries, short styles, sessile stigmas, one or more ovules in each cell, small embryo and carpels united into a large fleshy fruit. The flowering period of custard apple is very long commencing from March – April continue up to July – August. Flower beings to appear in spring, yet no fruit set occurs during the entire spring and summer. It commences only in the rainy season, leaving little period for the on set of winter season. The setting of fruits early in the season is important because, immature fruit instead of developing become inedible in winter season and turn into stone (Hayes, 1957). Enough flowers are born but the poor fruit set causes low yield. Only one to eight per cent fruit set has been reported under natural conditions. Custard apple fruits usually mature in about four months from the time of anthesis. Fruits reached half their final size after the end of the initial rapid growth phase thereafter intermediate resting phase of four weeks and attain the full size and mature during the final growth phase. The skin colour turns to light green which was due to gradual decline in chlorophyll *a* and chlorophyll *b* concentrations during the last seven weeks of development. The harvesting of custard apple continues up to December, the peak period being October and November. The light green fruit colour, yellowish white colour between carpels and initiatin of cracking of the skin between the carpels are three maturity indices adopted in custard apple.

Auxin promotes elongation and growth of stem and roots and enlargement of many fruits by stimulating cell wall to stretch in more than one direction. Auxin promotes cell division in vascular combination in the growing season through movement of IAA from the developing shoot buds. $GA_3$ is most thoroughly studied gibberellin. The major sites of gibberellin production in plants are embryos, roots and young leaves near the shoot tip, immature fruits, seeds and tissues are good source. Nitrogen is chief promoter of plant growth. It imparts green colour to leaves and stem and enable them for efficient photosynthesis. Nitrogen is constituent of amino acids and it is important for the synthesis of several proteins.

## Materials and methods

The experiment involved three levels each of higher concentration of NAA and $GA_3$ (50, 100 and 150 ppm) with urea and without urea 2 % were taken to find out their influence on flowering of custard apple at Horticulture Instructional Farm, Department of Horticulture, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Dist: Banaskantha, Gujarat during crop season of the year 2005 and 2006. Seventeen year old custard apple orchard uniform in growth and size which were planted at the distance of 6 x 6 meters. All the plants were subjected to uniform application of cultural practices like irrigation, weeding and fertilizer etc. Sindhan variety of custard apple was taken under investigation as this variety is promising one and most of cultivators of North Gujarat regions are growing extensively. The experimental field was loamy sand in texture and good drainage property. Randomized Block Design (RBD) was adopted with three replication and two plant in each replication. Farm Yard Manure was applied at the rate of 50 Kg to each plants uniformly, while chemical fertilizers were applied at the rate of 250 g : 125 g : 125 g NPK/plant/year. Three irrigation were given during experimentation.

Three level of NAA and $GA_3$ were sprayed singly and combined with urea and thus fourteen number of treatment combinations were $T_1$ – NAA 50 ppm, $T_2$ – NAA 100 ppm, $T_3$ – NAA 150 ppm, $T_4$ – $GA_3$ 50 ppm, $T_5$ – $GA_3$ 100 ppm, $T_6$ – $GA_3$ 150 ppm, $T_7$ – Urea 2 %, $T_8$ – NAA 50 ppm + Urea 2 %, $T_9$ – NAA 100 ppm + Urea 2 %, $T_{10}$ – NAA 150 ppm + Urea 2 %, $T_{11}$ – $GA_3$ 50 ppm + Urea 2 %, $T_{12}$ – $GA_3$ 100 ppm + Urea 2 %, $T_{13}$ – $GA_3$ 150 ppm + Urea 2 %, $T_{14}$ – Control.

## Result and discuss

### Effect of NAA and NAA with urea

The foliar application of NAA with 2 % Urea and NAA alone with all its concentration gave most promising results by decreasing the number of days taken to flowering after spray in custard apple during both the year of experimentation. The number of days taken for flowering significantly decreased by NAA 150 ppm with 2 % urea followed by NAA 150 ppm during the years of experimentation. The application of NAA can be accelerate to synthesis and promote to auxins which preventing the formation of abscission layer possibly through the inhibition of enzymatic activity such as pectinase, cellulose and polygalactauronase. This findings are in conformity with the results of Singh A. R. (1971) in Mango and Khan *et al.* (1974) in Litchi.

The higher concentration of NAA with 2 % urea and NAA alone were found beneficial for reduction in time taken to fruit ripening. The significantly minimum time for fruit ripening was recorded under the treatment NAA 150 ppm + Urea 2 % ($T_{10}$) and the maximum under $GA_3$ 150 ppm during both the years and pooled data of two years. The results of present study are in accordance with the finding of Maurya *et al.* (1973) in Mango and Khan *et al.* (1974) in Litchi.

The higher concentration of NAA 150 ppm with 2 % urea and NAA alone recorded more percentage of hermaphrodite flowers during both the years and in pooled of two years. It might be due to the fact that auxin prevents abscission and facilitates the ovary to remain attached with the shoot. The flower drop was thus reduced due to NAA application as compared to other application. The increased fruit set due to NAA could be attributed to the fact that auxin is involved in the growth of a ovary into fruit and its adequate quantity is necessary for fruit to set. Similar results due to application of NAA were reported by Singh *et al.* (1991) in Mango and Bhati and Yadav (2003) in Ber.

The per cent rudimentary flowers decreased with all the levels of NAA and NAA with 2 % urea in custard apple. The minimum rudimentary flower were recorded under NAA 150 ppm + Urea 2 % ($T_{10}$). It might be due to the reason that NAA spray was probably might have forced profuse flowering. It seems to have helped to increase the fruit set either by improving pollen germination or by helping the growth of pollen tubes and thus, facilitates timely fertilization before the stigma looses its receptivity or the style becomes non-functional.

The maximum fruit diameter was recorded under higher concentration of NAA with 2 % urea and NAA alone. The maximum fruit diameter was obtained under NAA 150 ppm + Urea 2 % ($T_{10}$). NAA is a synthetic auxin and auxins are known for their growth promoting activity in plant tissue through RNA and protein synthesis. The results are in agreement with those of Sharma *et al.* (1987), Banker and Prashad (1990) and Singh *et al.* (2001) in Ber.

The mature fruit size and weight was increased with concentration of NAA, amongst them NAA 150 ppm with 2 % urea and NAA alone were found to be the superior. An increase in fruit size (length and width) is caused mainly by cell division and cell elongation. Hence,

probably auxins positively help in fruit growth and increased fruit size as well as weight. Ultimately, increased fruit yield which is due to increase in yield contributing factors such as fruit set, weight and size. The findings are supported by Bankar and Prashad (1990), Singh *et al.* (2001) and Bhati and Yadav (2003) in Ber.

**Effect of $GA_3$ and $GA_3$ with urea**

Among the various treatments, the data on number of days taken for flowering after first spray were significantly influenced by all the concentrations of $GA_3$ and the combination of $GA_3$ with 2 % urea. It was found that the application of $GA_3$ 50 ppm + 2 % urea ($T_{11}$) took significantly more number of days for flowering during both the years. The more days of flowering duration increased the more number of fruit set due to stimulation of endogenous NAA. So, the hermaphrodite flowers forced to set as fruit which ultimately increases the number of fruit per tree. Similar results were obtained by Khan *et al.* (1974) in Litchi, Kumar *et al.* (1975) in Lime and Ahmad and Zargar (2005) in Grape.

The lower concentration of $GA_3$ with 2 % Urea and $GA_3$ alone were found beneficial for percent hermaphrodite flowers forced to set as fruit which ultimately increases the number of fruit per tree and reduction in percent rudimentary flowers during both the years. $GA_3$ 50 ppm + Urea 2 % ($T_{11}$) treatment give significantly maximum percent hermaphrodite flowers and minimum percent rudimentary flowers during both the years and in pooled data.

The rate of fruit development was significantly increased over control with the application of $GA_3$ alone with all concentrations during experimental year. The significantly highest fruit development was observed under $GA_3$ 50 ppm + Urea 2 % ($T_{11}$) during both the years of experimentation. It might be due to the growth of fruit is largely a result of cell division and cell elongation. Gibberellin's is known for its important role in cell elongation and cell division therefore, is responsible for an increase in fruit development. The findings are supported by results of Banker and Prashad (1990) in Ber, Sharma *et al.* (2005) in Litchi and Kaur *et al.* (2000) in Kinnow Mandarin.

The data indicated that the significantly maximum fruit length and width were obtained under treatment $GA_3$ 50 ppm + Urea 2 %. The superiority of $GA_3$ over NAA treatments might be due to the fact the increase in fruit size (length and width) is chiefly because of increase in the volume of cells in the mesocarp and only partially due to cell division. The exogenous application of gibberellins might have stimulated cell division and cell elongation. Consequently, rate of growth and development of fruit was enhanced resulting in larger size of fruits. The findings are in agreement with Ray *et al.* (1991) in Litchi and Rani and Brahmachari (2004) in Kinnow mandarin.

All the treatments significantly increased number of pickings of custard apple cv. Sindhan. However, the significant increase in number of pickings was recorded with all the levels of $GA_3$. The treatment of $GA_3$ 50 ppm + Urea 2 % recorded significantly more pickings during both the year of experimentation. It might be due to the fact that gibberellins has an effect on cell elongation which ultimately results in bigger size of fruit and increasing flowering period and more number of fruit set and required more days of maturity. The findings are in conformity with results of Chundawat and Singh (1980) in Phalsa and Parmar and Chundawat (1984) in Banana.

The application of $GA_3$ with 2 % urea and $GA_3$ alone with all concentrations significantly increased number of fruits carried up to maturity which were also statistically superior over the control. The exogenous application of gibberellins in the present experiment might have kept the protein synthesis in an active state and allowed the fruit to continue growth for longer period and thus delayed the maturity. This prolonged growth in gibberellin's treatment has also resulted in bigger sized fruits. These results are in consonance with those already reported on the effect of NAA by earlier workers such as Chundawat and Singh (1980) in Phalsa, Parmar and Chundawat (1984) in Banana and Ahmad and Zargar (2005) in Grape.

The data also showed general superiority of $GA_3$ over NAA as revealed by significantly higher fruit weight under $GA_3$ 50 ppm + Urea 2 % as compared to the respective NAA treatments. It is well established that gibberellins bring about certain metabolic changes which are reflected through increased weight of fruit. The fruit weight was major yield attributing parameters which was significantly increased with the application of $GA_3$ with 2 % urea and treatment of $GA_3$ alone in the present studies. $GA_3$ 50 ppm + 2 % Urea gave significantly maximum fruit weight as compared to control and all the other treatments during both the year of experimentation and in pooled of two years. The similar results were recorded by Ahmad and Zargar (2005) in Grape and Sharma *et al.* (2005) in Litchi.

In this investigation, $GA_3$ with 2 % urea as well as alone produced significantly the highest fruit yield per tree of custard apple than other treatments during both the year of experimentation. The highest yield of custard apple was obtained from $GA_3$ 50 ppm + Urea 2 % in comparison to other treatments and also in control. Gibberellins play a important role in cell elongation and cell division. Therefore, it is responsible for increase in fruit size (length and width) as well as fruit weight. An increase in yield would be attributable to the reduction in flower drop and also better fruit growth, which was contributed to an overall increase in yield. The results are in conformity with the findings of Parmar and Chundawat (1984) in Banana.

**Table 1.** Effect of plant growth regulators and urea on number of days taken for flowering after first spray and days taken to fruit ripening of custard apple cv. Sindhan

| Treatment | Number of days taken for flowering after first spray | | | Days taken to fruit ripening | | |
|---|---|---|---|---|---|---|
| | Year-2005 | Year-2006 | Pooled | Year-2005 | Year-2006 | Pooled |
| $T_1$ | 75.45 | 73.78 | 74.61 | 78.81 | 80.21 | 79.51 |
| $T_2$ | 71.55 | 67.50 | 69.53 | 77.45 | 78.06 | 77.76 |
| $T_3$ | 68.15 | 65.15 | 66.65 | 75.63 | 76.14 | 75.89 |
| $T_4$ | 80.06 | 77.75 | 78.91 | 85.81 | 86.68 | 86.25 |
| $T_5$ | 83.77 | 81.08 | 82.43 | 89.43 | 90.32 | 89.87 |
| $T_6$ | 84.59 | 81.40 | 82.99 | 90.68 | 91.03 | 90.85 |
| $T_7$ | 77.01 | 75.72 | 76.37 | 84.12 | 84.98 | 84.55 |
| $T_8$ | 74.25 | 70.95 | 72.60 | 79.30 | 79.42 | 79.36 |
| $T_9$ | 72.87 | 68.53 | 70.70 | 76.58 | 77.14 | 76.86 |
| $T_{10}$ | 66.48 | 63.50 | 64.99 | 73.32 | 74.05 | 73.69 |
| $T_{11}$ | 78.79 | 77.30 | 78.05 | 85.18 | 85.79 | 85.49 |
| $T_{12}$ | 81.44 | 78.99 | 80.22 | 86.45 | 87.30 | 86.88 |
| $T_{13}$ | 82.47 | 80.92 | 81.69 | 87.66 | 88.59 | 88.13 |
| $T_{14}$ | 77.76 | 76.28 | 77.02 | 84.34 | 85.01 | 84.68 |
| S. Em ± | 3.64 | 4.12 | 2.47 | 3.67 | 3.72 | 2.34 |
| C. D. at 5 % | 10.58 | 11.98 | 6.98 | 10.67 | 10.81 | 6.63 |
| Year x Treatment (Y x T) Interaction: | | | | | | |
| S. Em. + | - | - | 3.89 | - | - | 3.69 |
| C. D. at 5 % | - | - | NS | - | - | NS |
| C. V. % | 8.21 | 9.62 | 8.92 | 7.71 | 7.74 | 7.72 |

**Table 2.** Effect of plant growth regulators and urea on percent hermaphrodite flowers and rudimentary flowers of custard apple cv. Sindhan

| Treatment | Percent hermaphrodite flowers | | | Percent rudimentary flowers | | |
|---|---|---|---|---|---|---|
| | Year-2005 | Year-2006 | Pooled | Year-2005 | Year-2006 | Pooled |
| $T_1$ | 14.54 | 16.69 | 15.61 | 85.46 | 83.31 | 84.39 |
| $T_2$ | 15.26 | 17.89 | 16.58 | 84.74 | 82.11 | 83.42 |
| $T_3$ | 16.51 | 19.07 | 17.79 | 83.49 | 80.93 | 82.21 |
| $T_4$ | 27.79 | 31.10 | 29.44 | 72.21 | 68.90 | 70.56 |
| $T_5$ | 25.46 | 27.92 | 26.69 | 74.54 | 72.08 | 73.31 |
| $T_6$ | 19.38 | 22.22 | 20.80 | 80.62 | 77.78 | 79.20 |
| $T_7$ | 12.25 | 14.93 | 13.59 | 87.75 | 85.07 | 86.41 |
| $T_8$ | 13.68 | 16.07 | 14.88 | 86.32 | 83.93 | 85.13 |
| $T_9$ | 16.86 | 19.99 | 18.43 | 83.14 | 80.01 | 81.57 |
| $T_{10}$ | 17.59 | 21.02 | 19.30 | 82.41 | 78.98 | 80.70 |
| $T_{11}$ | 29.27 | 33.79 | 31.53 | 70.73 | 66.21 | 68.47 |
| $T_{12}$ | 23.85 | 25.84 | 24.84 | 76.15 | 74.61 | 75.16 |
| $T_{13}$ | 20.48 | 23.92 | 22.20 | 79.52 | 76.08 | 77.80 |
| $T_{14}$ | 11.56 | 12.97 | 12.26 | 88.44 | 87.03 | 87.74 |
| S. Em + | 3.77 | 4.21 | 2.54 | 3.77 | 4.21 | 2.54 |
| C. D. at 5 % | 10.98 | 12.25 | 7.17 | 10.97 | 12.25 | 7.20 |
| Year x Treatment (Y x T) Interaction: | | | | | | |
| S. Em. ± | - | - | 4.00 | - | - | 4.00 |
| C. D. at 5 % | - | - | NS | - | - | NS |
| C. V. % | 34.61 | 33.68 | 34.16 | 8.06 | 9.32 | 8.69 |

**Table 3** . Effect of plant growth regulators and urea on rate of fruit development (diameter) of custard apple cv. Sindhan

| Treatment | Rate of fruit development (diameter) (cm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 30 days | | | 60 days | | | At time of harvesting | | |
| | Year 2005 | Year 2006 | Pooled | Year 2005 | Year 2006 | Pooled | Year 2005 | Year 2006 | Pooled |
| $T_1$ | 4.83 | 4.79 | 4.81 | 5.56 | 5.52 | 5.54 | 6.76 | 6.73 | 6.75 |
| $T_2$ | 4.93 | 4.89 | 4.91 | 5.62 | 5.60 | 5.61 | 6.88 | 6.87 | 6.87 |
| $T_3$ | 5.08 | 5.05 | 5.07 | 5.77 | 5.73 | 5.75 | 6.99 | 6.99 | 6.99 |
| $T_4$ | 5.72 | 5.71 | 5.71 | 6.71 | 6.68 | 6.70 | 7.71 | 7.61 | 7.66 |
| $T_5$ | 5.60 | 5.56 | 5.58 | 6.61 | 6.56 | 6.58 | 7.38 | 7.34 | 7.36 |
| $T_6$ | 5.32 | 5.30 | 5.31 | 6.26 | 6.20 | 6.23 | 7.30 | 7.26 | 7.28 |
| $T_7$ | 4.61 | 4.57 | 4.59 | 5.45 | 5.42 | 5.43 | 6.57 | 6.55 | 6.56 |
| $T_8$ | 4.71 | 4.67 | 4.69 | 5.51 | 5.48 | 5.49 | 6.69 | 6.66 | 6.68 |
| $T_9$ | 5.17 | 5.13 | 5.15 | 5.89 | 5.88 | 5.89 | 7.17 | 7.14 | 7.15 |
| $T_{10}$ | 5.24 | 5.22 | 5.23 | 6.11 | 6.08 | 6.10 | 7.23 | 7.20 | 7.21 |
| $T_{11}$ | 5.91 | 5.89 | 5.90 | 6.78 | 6.74 | 6.76 | 7.77 | 7.73 | 7.75 |
| $T_{12}$ | 5.58 | 5.54 | 5.56 | 6.51 | 6.46 | 6.48 | 7.58 | 7.55 | 7.57 |
| $T_{13}$ | 5.34 | 5.32 | 5.33 | 6.37 | 6.32 | 6.35 | 7.49 | 7.37 | 7.43 |
| $T_{14}$ | 4.51 | 4.47 | 4.49 | 5.39 | 5.31 | 5.35 | 6.55 | 6.53 | 6.54 |
| S. Em ± | 0.22 | 0.22 | 0.14 | 0.22 | 0.22 | 0.14 | 0.27 | 0.26 | 0.17 |
| C. D. at 5 % | 0.65 | 0.64 | 0.40 | 0.64 | 0.64 | 0.39 | 0.78 | 0.76 | 0.48 |
| Year x Treatment (Y x T) Interaction: | | | | | | | | | |
| S. Em. + | - | - | 0.22 | - | - | 0.22 | - | - | 0.27 |
| C. D. at 5 % | - | - | NS | - | - | NS | - | - | NS |
| C. V. % | 7.45 | 7.40 | 7.43 | 6.28 | 6.35 | 6.31 | 6.54 | 6.35 | 6.45 |

**Table 4** . Effect of plat growth regulators and urea on fruit size and number of pickings of custard apple cv. Sindhan

| Treatment | Fruit length (cm) | | | Fruit width (cm) | | | Number of pickings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Year 2005 | Year 2006 | Pooled | Year 2005 | Year 2006 | Pooled | Year 2005 | Year 2006 | Pooled |
| $T_1$ | 6.39 | 6.36 | 6.37 | 6.76 | 6.73 | 6.75 | 5.17 | 4.83 | 5.00 |
| $T_2$ | 6.48 | 6.45 | 6.47 | 6.88 | 6.87 | 6.87 | 5.33 | 5.00 | 5.17 |
| $T_3$ | 6.57 | 6.54 | 6.56 | 6.99 | 6.99 | 6.99 | 5.33 | 5.00 | 5.17 |
| $T_4$ | 7.16 | 7.13 | 7.14 | 7.71 | 7.61 | 7.66 | 6.33 | 6.17 | 6.25 |
| $T_5$ | 7.07 | 7.02 | 7.04 | 7.38 | 7.34 | 7.36 | 6.17 | 5.83 | 6.00 |
| $T_6$ | 6.80 | 6.76 | 6.78 | 7.30 | 7.26 | 7.28 | 5.67 | 5.67 | 5.67 |
| $T_7$ | 6.26 | 6.22 | 6.24 | 6.57 | 6.55 | 6.56 | 5.00 | 4.67 | 4.83 |
| $T_8$ | 6.30 | 6.27 | 6.29 | 6.69 | 6.66 | 6.68 | 5.17 | 4.83 | 5.00 |
| $T_9$ | 6.65 | 6.62 | 6.64 | 7.17 | 7.14 | 7.15 | 5.50 | 5.33 | 5.42 |
| $T_{10}$ | 6.72 | 6.71 | 6.72 | 7.23 | 7.20 | 7.21 | 5.50 | 5.50 | 5.50 |
| $T_{11}$ | 7.33 | 7.29 | 7.31 | 7.77 | 7.73 | 7.75 | 6.50 | 6.33 | 6.42 |
| $T_{12}$ | 6.97 | 6.94 | 6.96 | 7.58 | 7.55 | 7.57 | 6.00 | 5.83 | 5.92 |
| $T_{13}$ | 6.86 | 6.81 | 6.84 | 7.49 | 7.37 | 7.43 | 5.83 | 5.50 | 5.67 |
| $T_{14}$ | 6.16 | 6.14 | 6.15 | 6.55 | 6.53 | 6.54 | 4.83 | 4.50 | 4.67 |
| S. Em + | 0.24 | 0.24 | 0.15 | 0.27 | 0.26 | 0.17 | 0.35 | 0.39 | 0.24 |
| C.D. at 5 % | 0.71 | 0.69 | 0.43 | 0.78 | 0.76 | 0.48 | 1.02 | 1.13 | 0.67 |
| Y x T Interaction | | | | | | | | | |
| S. Em. ± | - | - | 0.24 | - | - | 0.27 | - | - | 0.37 |
| C.D. at 5 % | - | - | NS | - | - | NS | - | - | NS |
| C. V. % | 6.32 | 6.14 | 6.23 | 6.54 | 6.35 | 6.45 | 10.82 | 12.59 | 11.70 |

**Table 5.** Effect of plat growth regulators and urea on number of fruits per tree and average fruit weight (g) of custard apple cv. Sindhan

| Treatment | Number of fruits per tree | | | Average fruit weight (g) | | |
|---|---|---|---|---|---|---|
| | Year 2005 | Year 2006 | Pooled | Year 2005 | Year 2006 | Pooled |
| $T_1$ | 147.77 | 144.10 | 145.94 | 189.48 | 182.58 | 186.03 |
| $T_2$ | 150.29 | 146.73 | 148.51 | 193.24 | 186.48 | 189.86 |
| $T_3$ | 155.87 | 152.50 | 154.19 | 194.44 | 188.94 | 191.69 |
| $T_4$ | 191.91 | 187.11 | 189.51 | 214.59 | 210.11 | 212.35 |
| $T_5$ | 186.41 | 180.04 | 183.23 | 213.38 | 210.03 | 211.71 |
| $T_6$ | 167.46 | 163.08 | 165.27 | 199.65 | 195.16 | 197.41 |
| $T_7$ | 142.27 | 138.99 | 140.63 | 183.81 | 178.99 | 181.40 |
| $T_8$ | 145.21 | 142.60 | 143.90 | 187.08 | 180.33 | 183.71 |
| $T_9$ | 158.52 | 154.07 | 156.30 | 195.59 | 180.14 | 192.36 |
| $T_{10}$ | 162.10 | 157.70 | 159.90 | 198.52 | 190.79 | 194.65 |
| $T_{11}$ | 196.73 | 192.02 | 194.38 | 218.82 | 215.03 | 216.93 |
| $T_{12}$ | 182.41 | 177.43 | 179.92 | 208.97 | 204.83 | 206.90 |
| $T_{13}$ | 174.79 | 170.28 | 172.54 | 201.47 | 196.56 | 199.02 |
| $T_{14}$ | 140.15 | 136.59 | 138.37 | 182.63 | 178.83 | 180.73 |
| S. Em + | 6.26 | 5.82 | 3.83 | 6.75 | 7.79 | 4.62 |
| C.D. at 5 % | 18.19 | 16.93 | 10.86 | 19.63 | 22.63 | 13.11 |
| Y x T Interaction | | | | | | |
| S. Em. ± | - | - | 6.04 | - | - | 7.29 |
| C.D. at 5 % | - | - | NS | - | - | NS |
| C. V. % | 6.59 | 6.29 | 6.45 | 5.89 | 6.97 | 6.44 |

**Table 6.** Effect of plat growth regulators and urea on fruit yield per tree (kg) and fruit yield per hectare (kg) of custard apple cv. Sindhan

| Treatment | Fruit yield per tree (kg) | | | Fruit yield per hectare (kg) | | |
|---|---|---|---|---|---|---|
| | Year 2005 | Year 2006 | Pooled | Year 2005 | Year 2006 | Pooled |
| $T_1$ | 30.34 | 30.11 | 30.22 | 8427.82 | 8363.60 | 8395.71 |
| $T_2$ | 30.86 | 30.66 | 30.76 | 8571.54 | 8515.85 | 8543.70 |
| $T_3$ | 32.00 | 31.86 | 31.93 | 8889.79 | 8851.12 | 8870.45 |
| $T_4$ | 39.40 | 39.10 | 39.25 | 10945.27 | 10859.85 | 10902.56 |
| $T_5$ | 38.27 | 37.62 | 37.95 | 10631.58 | 10449.52 | 10540.55 |
| $T_6$ | 34.38 | 34.07 | 34.23 | 9550.61 | 9464.98 | 9507.80 |
| $T_7$ | 29.21 | 29.04 | 29.13 | 8114.32 | 8067.02 | 8090.67 |
| $T_8$ | 29.81 | 29.79 | 29.80 | 8281.62 | 8276.15 | 8278.89 |
| $T_9$ | 32.55 | 32.19 | 32.37 | 9041.11 | 8942.25 | 8991.68 |
| $T_{10}$ | 33.28 | 32.95 | 33.12 | 9245.29 | 9152.73 | 9199.01 |
| $T_{11}$ | 40.39 | 40.12 | 40.26 | 11220.36 | 11144.63 | 11182.49 |
| $T_{12}$ | 37.45 | 37.07 | 37.26 | 10403.45 | 10297.65 | 10350.55 |
| $T_{13}$ | 35.89 | 35.58 | 35.73 | 9968.86 | 9882.86 | 9925.86 |
| $T_{14}$ | 28.78 | 28.54 | 28.66 | 7993.22 | 7927.34 | 7960.28 |
| S. Em + | 1.28 | 1.22 | 0.79 | 356.79 | 337.98 | 219.97 |
| C.D. at 5% | 3.73 | 3.54 | 2.25 | 1037.18 | 982.50 | 624.24 |
| Y x T Interaction | | | | | | |
| S. Em. ± | - | - | 1.25 | - | - | 347.52 |
| C.D. at 5% | - | - | NS | - | - | NS |
| C. V. % | 6.59 | 6.29 | 6.45 | 6.59 | 6.29 | 6.45 |

## Effect of urea

The treatment of 2 % urea gave superior results in respect of number of days taken to flowering after first spray, percent hermaphrodite and rudimentary flower during both the years of experimentation and in pooled of two years data. It might be due to the nitrogen application may increase the supply of some hormones to the fruit that tend to reduce abscission, probably auxins. The effect of C : N ratio on growth and fruitfulness are paralleled by its effect on abscission. The foliage is also thought to be seat of auxin production needed for many physiological activities. The findings are in conformity with findings of

Chundawat and Singh (1980) in Phalsa and Parmar and Chundawat (1984) in Banana.

The rate of fruit development increased with 2 % urea during both the years of experimentation but it failed to reach the level of significance. The foliar application of urea attributes proper supplementation of nutrients thereby it increases the efficiency of metabolic processes of the various parts of tree including fruit and provides proper development (Singh, A. R., 1977). The findings are in agreement with results of Singh *et al.* (1991) in Mango.

The treatment of 2 % urea gave superior results in respect of days taken to fruit ripening during both the years of experimentation and in pooled of two years data. The fruit carried up to the maturity in urea were higher than control during both the years but failed to reach the level of significance. The urea 2 % gave more mature fruit over control. The findings are supported by Malik *et al.* (2000) in Kinnow.

The fruit size and weight was not statistically significant with treatment of urea. The increase in fruit size and weight might be due to foliar feeding of nutrients and consequently rapid fruit development caused easy availability of nutrients to the plants. The findings are in conformity with results of Singh *et al.* (1991) in Mango.

The increasing yield with 2 % urea was recorded under present investigation during both the years and yield attributing parameters like more number of pickings, number of fruits per tree, average weight of fruit, fruit length and fruit width. An increase in the yield might be due to the fact that nitrogen is an important constituent of protoplasm and it is helpful in chlorophyll synthesis which increased photosynthetic activity of leaves and consequently the yield. Yield is also affected by reduction of flower drop and also better fruit growth. The findings are in accordance with results of Singh *et al.* (1991) in Mango and Malik *et al.* (2000) in Kinnow.

The effect of urea on number of pickings was non- significant during both the years and in pooled of two year data. It might be due to the reason that urea is a nitrogenous fertilizer and is known for its growth promoting activity in plant tissues.

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