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# Effect of three levels of zinc, iron and boron on flowering and yield of custard apple (*Annona sqamosa* L.)

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**Abstract:** The present investigation entitled "Effect of foliar sprays of zinc, iron and boron on flowering, yield and quality of custard apple (*Annona squamosa*L.) cv. Sindhan" was carried out at during the *Kharif*season of the year 2012-13. The result of the present investigation revealed that the combination effect of zinc, iron and boron that treatment T7 (0.5% Zinc sulphate + 0.5% Ferrous sulphate + 0.3% Borax)were gave significant effect on the yield attributes i.e. highest number of flowers per shoot (26.57%), fruit set (20.30%), maximum fruit retention (87.75%),minimum flower drop (79.70%) and fruit drop (12.25%),fruit yield (20.06 kg/tree and 5571 kg/ha),same as physical parameters i.e.maximum fruit weight (173.56g), girth of fruit (7.33cm), fruit length (6.86cm), and pulp weight (93.53g).As well as improved quality parameters like total soluble solids (16.29%), reducing sugars (14.29%) and non-reducing sugars (2.73%).

**Key words**: Custard apple, Yield, Quality and Micronutrients

## Introduction

Custard apple (*Annona squamosa*Linn.) belongs to the family Annonaceae. It is native of tropical America. It is known by several vernacular names such as sugar apple, sweet sop, *sitaphal*and *sharifa*in different parts of the country. Custard apple thrives well in tropical and warmer sub-tropics parts of the India. Custard apple is generally used as table fruit, known for its pleasant distinctive texture of pulp, sub-acid and aromatic flavor. Unripe fruits are directly baked on fire and eaten. The pulp contains 73.3% moisture; 1.6% protein; 0.3% fat; 0.7% mineral matter and 23.9 % carbohydrates. Its calorific value ranges from 822 to 1050 k cal. per kg as compared to 741 k cal. in mango (Singh, 1992). It is good source of vitamin A and C. Jelly jam and other products are also possible from Custard apple for short duration. Custard apple seed powder and extract has insecticidal properties (Pandey and Verma, 1977). Due to presence of annonaine leaves, stem and other parts of the plants are bitter hence not attacked by goats or cattle. The root is drastic purgative and the leaves are used as poultice to include suppuration. The custard apple is considered as a crop for a wasteland and successfully grown in sandy, rocky, gravel, heavy and even in sandy loam soils (Singh, 1992).

Micronutrients like Fe, Zn, B, Cu, Mn, Mo and Cl play a vital role in plants. Foliar application of micronutrients is more successful than soil application. Iron is required for the synthesis of enzymes responsible for chlorophyll synthesis. Boron is involved in the transportation of carbohydrates in plant. It is essential forcell division and development. Zinc is required to obtain good fruit set and size. Its role inflowering is due to synthesis of tryptophan which is a precursor of auxin and promotesflowering. It also helps in the process of translocation of metabolites to the bud itself or to thesite of bud development (Edward raja, 2009). Therefore, the present study was carried out with an aim to assessthe effect of foliar sprays of zinc, iron and boron on flowering, yield and quality of custard apple. Main objectives of experiment were effect of micronutrient on flowering, fruit retention, yield, quality and economic feasibility of custard apple.

## Materials and Methods

The present investigation was conducted at Madhadi Baug Farm, Department of Horticulture, Junagadh Agricultural University, Junagadh during the year 2012-2013. The present study was conducted on thirteen years oldcustard apple plants cultivar 'Sindhan'. All the plants selected were uniform in growth andsize which planted at the distance 6 m × 6 m. All the plants were subjected to uniformapplication of cultural practices like irrigation, manures, fertilizers and plant protectionmeasures *etc.*The experiment was laid out in Randomized Block Design with eight treatmentsand three replications. The observations were volume of fruit, fruit weight, fruit girth, fruit length, peel weight, TSS ( $Brix^0$ ), ascorbic acid (mg/10ml of juice), reducing sugars, non-reducing sugars, total sugars and acidity recorded in laboratory conditions.

**Treatment details:** $T_1$: Zinc sulphate (0.5 %); $T_2$ Ferrous sulphate (0.5 %); $T_3$: Borax (0.3 %); $T_4$: Zinc sulphate (0.5 %)+

Ferrous sulphate (0.5 %); $T_5$: Zinc sulphate (0.5 %)+ Borax (0.3%); $T_6$: Ferrous sulphate (0.5 %)+ Borax (0.3 %); $T_7$: Zinc sulphate (0.5 %) + Ferrous sulphate (0.5 %) + Borax (0.3 %); $T_8$: Control (water spray)

## Results and Discussion

The appropriate reasons with observed variation recorded during the course of presentstudy are explained. Relevant supporting studies have been quoted and the results reported by other researcher have also been contradicted with the findings of the present study. The results presented in table-1. revealed that the effect of foliar sprays of differentmicronutrients either separately or in combination showed a significant effect on flowering parameters. The application of treatment $T_7$produced maximum number of flowers (26.57) per shoot. This indicated the positive combined effect of micronutrients on flowering. Zinc enhanced the synthesis of auxin in plants. Iron is credited with a definite role in the synthesis of chlorophyll molecule (Pandey and Sinha, 2008). Boron regulates metabolism involved in translocation of carbohydrates, cell wall development and RNA synthesis (Brown *et al.,* 1995). The minimum flower drop (79.70%) and maximum fruit set (20.30%) (Table-1.) were observed in treatment T7.That might be due to higher availability of photosynthates and boron is also associated with hormone metabolism which promotes synthesis of auxin, essential for fruit set (Shukla, 2010 and Yadav *et al.* 2011). The maximum fruit retention (87.75%) was observed in treatment T7 (Table-1). That might be due to cumulative effect of micronutrients involved directly in various physiological process and enzymatic activities (Shukla, 2011). The minimum fruit drop (12.25%) was observed in treatment T7 (Table-1). Reduction in fruit drop by spray of borax can be due to the indirect action of boron in auxin synthesis that delayed formation of abscission layer during early stage of fruit development (Shukla and Kumar, 2010 and Yadav *et al.,* 2011).

The combined sprays of zinc, iron and boron significantly influenced the physicalcharacteristics of custard apple fruit. The maximum girth of fruit (6.67cm) was found in treatment T7 (Table-2). This might be due to cumulative effect of micronutrients.The enlargement of fruit size is caused by drawing of photosynthesis to the fruit as aconcequence of intensification of the sink; it helps in cell division and elongation process. It is in the conformity with the observation of Yadav *et al.* (2011). The treatment T7 (Table -2) notedthe highest fruit length (6.86 cm). The maximum length of fruit with these nutrients might be due to their involvement in cell division, cell expansion and increase volume of intercellularspaces in mesocarpic cells. It could also be due to higher mobilization of food and minerals from other parts of plants towords the developing fruit that are extremely active metabolic sink (Pandey *et al.,*1990). The maximum fruit weight (173.56g) was found in treatment T7(Table-2). Might be the highest fruit weight has direct correlation with accumulation of more photosynthates for which boron play key role (Shukla, 2011), optimal concentration of iron required to maintain optimal growth and suitable cell enlargement and cell division. The treatment T7 (Table-2) *i.e.* combined application of zinc, iron and boron gave maximumpulp weight (93.53g). This might be due to rapid synthesis of metabolites particularly carbohydrate and their translocation to fruits causing relatively greater pulp content (Sharma and Chakrabarty, 2003).

**Table-1:** Effect of foliar sprays of zinc, iron and boron on flowering parameters of custard apple

| Treatments | No. of flowers /shoot | Flower drop (%) | Fruit Set (%) | Fruit retention (%) | Fruit drop (%) |
|---|---|---|---|---|---|
| $T_1$ | 18.43 | 83.57 | 16.43 | 79.35 | 20.65 |
| $T_2$ | 20.83 | 84.50 | 15.50 | 73.02 | 26.98 |
| $T_3$ | 21.67 | 83.67 | 16.33 | 82.65 | 17.35 |
| $T_4$ | 21.57 | 82.33 | 17.67 | 82.72 | 17.28 |
| $T_5$ | 23.33 | 83.70 | 16.30 | 80.59 | 19.41 |
| $T_6$ | 25.00 | 82.03 | 17.97 | 84.42 | 15.58 |
| $T_7$ | 26.57 | 79.70 | 20.30 | 87.75 | 12.25 |
| $T_8$ | 17.60 | 86.90 | 13.10 | 66.39 | 33.61 |
| S.Em.± | 1.44 | 0.44 | 0.44 | 1.32 | 1.32 |
| C.D. at 5% | 4.38 | 1.32 | 1.32 | 4.01 | 4.01 |
| C.V. % | 11.43 | 0.91 | 4.52 | 2.88 | 11.22 |

**Table-2:** Effect of foliar sprays of zinc, iron and boron on physical parameters of custard apple

| Treatments | Girth of fruit (cm) | Length of fruit (cm) | Average fruit wt. (g) | Pulp wt. (g) |
|---|---|---|---|---|
| $T_1$ | 5.89 | 6.26 | 133.52 | 61.58 |
| $T_2$ | 5.56 | 6.00 | 139.70 | 57.89 |
| $T_3$ | 5.26 | 5.97 | 135.10 | 63.97 |
| $T_4$ | 5.14 | 6.24 | 124.46 | 67.43 |
| $T_5$ | 5.44 | 5.20 | 147.17 | 76.90 |
| $T_6$ | 6.34 | 6.54 | 163.74 | 86.02 |
| $T_7$ | 6.67 | 6.86 | 173.56 | 93.53 |
| $T_8$ | 5.36 | 5.37 | 117.98 | 54.01 |
| S.Em.± | 0.27 | 0.28 | 6.09 | 2.56 |
| C.D. at 5% | 0.83 | 0.87 | 18.48 | 7.78 |
| C.V. % | 8.34 | 8.24 | 7.43 | 6.33 |

**Table-3:** Effect of foliar sprays of zinc, iron and boron on yield and quality parameters of custard apple

| Treatments | Yield of fruit kg /plant | Yield of fruit kg /hectare | TSS ($^0$Brix) | Reducing sugar (%) | Non-reducing sugar (%) |
|---|---|---|---|---|---|
| $T_1$ | 14.00 | 3889 | 15.83 | 13.46 | 2.54 |
| $T_2$ | 13.82 | 3840 | 15.89 | 13.48 | 2.38 |
| $T_3$ | 15.56 | 4321 | 15.92 | 13.50 | 2.34 |
| $T_4$ | 15.83 | 4398 | 15.96 | 13.66 | 2.45 |
| $T_5$ | 13.83 | 3843 | 15.93 | 13.61 | 2.48 |
| $T_6$ | 18.17 | 5046 | 16.13 | 13.63 | 2.60 |
| $T_7$ | 20.06 | 5571 | 16.29 | 14.29 | 2.73 |
| $T_8$ | 12.50 | 3472 | 13.60 | 13.60 | 2.28 |
| S.Em.± | 1.29 | 130 | 0.44 | 0.12 | 0.08 |
| C.D. at 5 % | 3.93 | 393 | 1.35 | 0.39 | 0.25 |
| C.V. % | 14.51 | 14.52 | 4.94 | 1.63 | 5.86 |

The results revealed that effect of foliar sprays of different micronutrients separatelyand in combination significantly influenced the yield of custard apple (Table-3). The application of treatment T7 gave the maximum yield (20.06 kg/tree and 5571 kg/ha). The cumulative effect of micronutrients might have helped to increase the fruit size and fruit weight so simultaneously increased in fruit yield (Khan *et al.,* 2009) and (Sharma and Belsare, 2011). The result

presented in table-3 indicated that the biochemical parameters of custardapple fruit were significantly increased due to difference levels of zinc, iron and boron. Treatment T7 gave maximum TSS (16.29). This might be due to its converting complex substances into simple sugar, which enhances the metabolic activity in fruits and resulted in increased TSS of fruit (Yaseen and Ahemad, 2010). As well as observed the highest reducing sugar (14.29%) was recorded by treatment T7. This might be due to that ferrous sulphate promoted hydrolysis of starch in to sugars (Balakrishanan2001). The treatment T7 (Table-3)gavethe highest non-reducing sugar (2.73%). Micronutrients have a definite and significant effect on quality in terms of ascorbic acid, reducing acidity and improving TSS in number of fruit crops (Edward Raja, 2009) and (Dutta and Banik, 2000).

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