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EFFECT OF FOLIAR APPLICATION OF NANO UREA ON YIELD, QUALITY AND ECONOMICS OF CUSTARD APPLE (*ANNONA SQUAMOSA* L.) CV. SINDHAN

A.H. Hirpara[1], B.M. Nandre[2*], P.A. Sable[3], Anjinayya[1] and H.B. Kher[3]
[1]Department of Fruit Science, College of Horticulture, SDAU, Jagudan, Gujarat, India
[2]Department of Horticulture, C.P. College of Agriculture, SDAU, Sardarkrushinagar, Gujarat, India
[3]Department of Vegetable Science, College of Horticulture, SDAU, Jagudan, Gujarat, India
*Corresponding author E-mail: bmnandre@gmail.com
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ABSTRACT

The field experiment was conducted at the College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana (Gujarat) from June to December 2024. The experiment was laid out in Randomized Block Design with ten treatments and three replications. The results of study revealed that, a combination of 100% RDN through urea and three foliar spray of 0.5% nano urea at 1st week of June, July and August enhanced yield, quality and economics as compared to control. In respect of yield parameters, the results indicated that, maximum number of fruits per tree (95.69), weight of fruit (204.07 g), diameter of fruit (7.50 cm), maximum weight of pulp (89.01g), maximum pulp: seed ratio (4.26 %) and weight of peel (94.13 g), yield per tree (18.27 kg) and yield per hectare (5.06 t) were recorded in the treatment T_4 i.e. 100 per cent RDN + 0.5 per cent Nano urea. Data in respect of quality parameters clearly reveals that, maximum TSS (25.64 °Brix), total sugar (22.26%), reducing sugar (18.98%), non-reducing sugar (3.28%) were recorded in the same treatment (T_4). It is evident from the data of economics, maximum gross returns (202400 /ha), net returns (119302/ha) and Benefit Cost Ratio (2.44) was also recorded in the treatment T_4.
Keywords **:** Custard apple, nano urea, yield, quality and economics.

Introduction

Custard apple is the most ancient dry land fruit crop in India valued for its adaptability to arid climates. It is originated from tropical region of America and it is introduced to India by the Portuguese and quickly acclimatized. It is widely distributed throughout the tropics and subtropics. It belongs to the family Annonaceae, comprises 40 genera and 120 species out of that only five are edible. *Annona squamosa* is the most valued species of custard apple known as *Sitaphal* also called as a poor man's fruit as well as food. Custard apple trees are drought-resistant and can grow in dry regions, requires well-drained soil. In India, custard apple is cultivated in the area 62,000 ha with a production of 829,000 t (Anon., 2024-25). Gujarat is a key producer and districts Bhavnagar, Ahmedabad and Junagadh are contributing significantly. The state covers 7903 ha area with production 81137 t and a productivity of 10.27 t/ ha. Nutrient management, especially nitrogen, phosphorus and potassium are essential for healthy growth and fruit quality. Nitrogen supports protein, chlorophyll, and nucleic acid synthesis, but many Indian soils especially sandy ones are deficient in it. Recently, urea is used most extensively as a source of nitrogen in agriculture because of its high N content and compatibility with other nutrients, but only 45-50% of nitrogen is used defectively in modern agriculture because of high N loss as well as low use efficiency and it forces the farmers to use more nitrogen fertilizers in order to get more yield, which also increases the cost of cultivation also responsible for an adverse impact on the environment (Sonkar *et al.*, 2024). Nano-based agricultural products, such as nanofertilizers, offer innovative solutions to enhance crop performance and minimizing environmental

impacts (Lal, 2008). Foliar application of nitrogen through nano urea is an efficient solution due to its fast absorption, low phytotoxicity and targeted delivery. Nano urea, developed by Indian Farmers Fertiliser Cooperative Limited (IFFCO) contains 4% nitrogen with particles sized 20–50 nm. It enhances nitrogen use efficiency (>80%), boosts photosynthesis and promotes plant growth (Kumar *et al*., 2021). As compared to conventional urea, it reduces fertilizer usage, nitrogen loss and environmental pollution, making it a sustainable and precise option for improving custard apple yield and quality in dryland farming. Therefore, this experiment was conducted with the aim to find out effect of foliar application of nano urea on yield, quality and economics of custard apple (*Annona squamosa* L.) CV. Sindhan.

Materials and Methods

The present investigation titled "Effect of foliar application of nano urea on yield, quality and economics of custard apple (*Annona squamosa* L.) CV. Sindhan" was conducted on 13 years old orchard at the College of Horticulture, Sardarkrushinagar Dantiwada Agricultural University, Jagudan, Dist. Mehsana (Gujarat) from June to December 2024. Spacing of custard apple orchard was 6 m × 6m. The experiment was laid out in Randomized Block Design with ten treatments and three replications. The treatment details are T_1 (100% RDF Control), T_2 (100% RDN + 0.3% Nano urea), T_3 (100% RDN + 0.4% Nano urea), T_4 (100% RDN + 0.5% Nano urea), T_5 (75% RDN + 0.3% Nano urea), T_6 (75% RDN + 0.4% Nano urea), T_7 (75% RDN + 0.5% Nano urea), T_8 (50% RDN + 0.3% Nano urea), T_9 (50% RDN + 0.4% Nano urea) and T_{10} (50% RDN + 0.5% Nano urea). Basal dose of fertilizers was applied in the 1st week of June. The entire dose of Farm Yard Manure (FYM), recommended dose of nitrogen, phosphorus and potassium were applied @250, 125 and 125 g per tree through urea, single super phosphate and muriate of potash, respectively. Fertilizers were applied at a depth of 15 cm with ring method one meter away from the main trunk of the tree. Prior to fertilization, mechanical weeding was done to clean the area. Foliar spray of nano urea was done three times at 1st week of June, July and August, accordingly. Observations were recorded on yield and quality parameters. The collected data were subjected to statistical analysis following the method outline by Panse and Sukhatme (1978). The gross realization in terms of rupees per hectare was worked out on the basis of the yield of custard apple for each treatment and the price of the produce prevailing in the market. The cost of cultivation of each treatment was calculated considering the current rate of agricultural operations and market price of inputs involved. The total cost of cultivation was subtracted from the gross realization to obtain net return per hectare for each treatment. For this, benefit cost ratio (BCR) was worked out using the following formula.

$$\text{BCR} = \frac{\text{Gross realization (Rs./ha)}}{\text{Total cost of cultivation (Rs./ha)}}$$

Results and Discussion

Yield parameters

Data in respect of yield parameters reveals that, number of fruits per tree, weight of fruit (g), diameter of fruit (cm), weight of pulp (g), pulp:seed ratio (%), weight of peel (g), yield per tree (kg) and yield per hectare (t) were significantly influenced by application of nano urea as depicted in Table 1. The maximum number of fruits per tree (95.69), maximum weight of fruit (204.07 g), maximum diameter of fruit (7.50 cm), maximum yield per tree (18.27 kg) and yield per hectare (5.06 t) was recorded in treatment T_4 i.e. 100% RDN + 0.5% nano urea. The results are partially consistent with the findings of Singh *et al*., 2023 in guava, Ganvit *et al*. (2024) in custard apple, Bhatti *et al*. (2023) in guava, Parsana *et al*. (2023) in custard apple, Butani *et al*. (2020) in custard apple, Varu *et al*. (2020) in papaya and Davarpanah *et al*., 2017 in pomegranate, Hafeez *et al*. (2015) in wheat, Tarafdar *et al*. (2014) in pearl millet, Xia *et al*., 2009 and Cheng *et al*., 2007 in apple. Tarafdar *et al*., 2014 and Hafeez *et al*., 2015 reported that, nano fertilizers are quickly absorbed by the tree and translocated at a faster rate, which resulted in higher rate of photosynthesis and more dry matter accumulation. The reason for increase in number of fruits per tree can be physiological and metabolic functions of nitrogen in the process of flowering and fruiting. The role of nitrogen is crucial in supplying carbohydrates that is necessary at various stages of plant such as flower bud growth, initiation and development of flower, lifespan of ovule and effective pollination and fertilization. Sonkar *et al*. (2024) also stated in strawberry, that the behaviour of increasing the number of fruits, fruit weight and fruit yield might be application of an additional dose of nitrogen to the plants in combination with nano-urea because of nitrogen is an important component of enzyme, vitamins, and chlorophyll molecules and is involved in nucleic acid, amino acid synthesis and protein production which is important for cell growth and development. The results obtained were in conformity with the findings of Reddy and Gaoyal (2020) in strawberry who reported an increased

number of fruits and average fruit weight with an increase in levels of nitrogen. These result are also in accordance with the findings of Bhavana *et al*. (2025) in mango, Ghosal *et al*. (2024) in litchi , Singh *et al*. (2023) in guava and Etehadnejad and Aboutalebi (2014) in apple. Data in respect of weight of pulp, pulp:seed ratio and weight of peel reveals that, maximum weight of pulp (89.01g), maximum pulp:seed ratio (4.26 %) and weight of peel (94.13 g) was recorded in the treatment T_4 (Al-mobark, 2014). The increase in pulp weight may result from fertilizer application during cell division, which raises osmotic pressure enhancing nutrient and water uptake into the fruit. The maximum pulp:seed ratio and weight of peel might be due the fact increases in mineral concentrations in cells after fertilization can increase turgor pressure and stimulate water absorption reported by Kumar *et al*., 2014. Maximum yield per tree and per hectare might be due to foliar nitrogen application which boosts yield by supporting key metabolic roles in flowering and fruit set aiding bud growth, flower development, pollination and fertility. These results are in accordance with the findings of Bhavana *et al*., 2025 in mango, Ghosal *et al*., 2024 in litchi, Bhatti *et al*., 2023, Singh *et al*., 2023 in guava, Etehadnejad and Aboutalebi, 2014 in apple and Stiles, 1999.

Table 1 : Effect of foliar application of nano urea on yield parameters of custard apple

Treatments	Number of fruits per tree	Weight of fruit(g)	Diameter of fruit (cm)	Weight of pulp(g)	Pulp: Seed ratio (%)	Weight of peel(g)	Yield (kg/tree)	Yield (t/ha)
T_1	75.82	169.62	6.35	67.33	2.79	78.17	12.42	3.44
T_2	86.63	186.11	6.83	78.60	3.57	85.52	14.63	4.05
T_3	88.50	195.98	7.39	84.50	3.90	89.85	17.17	4.76
T_4	95.69	204.07	7.50	89.01	4.26	94.13	18.27	5.06
T_5	79.91	181.35	6.71	74.33	3.17	83.56	13.67	3.79
T_6	82.71	188.11	6.74	79.14	3.29	84.88	14.34	3.97
T_7	86.68	190.63	7.34	81.41	3.45	85.74	16.19	4.48
T_8	77.45	173.02	6.62	69.77	3.08	80.60	13.79	3.82
T_9	80.94	180.81	6.70	75.67	3.31	82.31	13.66	3.78
T_{10}	85.77	183.15	6.75	75.93	3.33	84.42	14.02	3.88
S. Em.±	3.64	6.38	0.20	3.44	0.23	2.62	0.97	0.27
C.D. at 5%	10.83	18.97	0.59	10.23	0.67	7.78	2.88	0.80
C.V.%	7.51	5.97	5.02	7.69	11.41	5.34	11.33	11.33

Quality parameters

Data regarding the quality parameters was significantly affected by the different treatments as depicted in Table 2. From the data it is clear that, maximum total soluble solids (25.64 °Brix), total sugar (22.26%), reducing sugar (18.98%), non-reducing sugar (3.28%) were recorded in the treatment T_4 i.e. 100% RDN + 0.5% nano urea. Nitrogen enhances chloroplast function, CO_2 assimilation and enzyme activity, boosting photosynthesis and carbohydrate accumulation thus increasing TSS and total sugar. These results are in accordance with the findings of Sharma *et al*., 2014 and Stiles, 1999. According to Osman and Rahman, 2010 nano nitrogen may increase leaf area, enhancing photosynthesis and carbohydrate production, which speeds up starch conversion and sugar translocation to fruits. In respect of quality parameters, the effect of treatments on ascorbic acid and acidity was found non-significant. This result is in accordance with the findings of Singh *et al.,* 2025 in strawberry, Ghosal *et al*., 2024 in litchi, Kumar *et al*., 2023 in mango and Mirji *et al*., 2023 in sapota.

Table 2 : Effect of foliar application of nano urea on quality characters of custard apple

Treatments	Total Soluble Solids(^{O}Brix)	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)
T_1	20.89	19.39	16.61	2.78
T_2	23.36	21.22	18.27	2.95
T_3	24.38	21.62	18.52	3.10
T_4	25.64	22.26	18.98	3.28
T_5	22.61	20.45	17.51	2.94
T_6	22.82	21.21	18.24	2.97
T_7	24.05	21.33	18.28	3.05
T_8	21.75	20.26	17.45	2.82

T_9	22.48	20.48	17.64	2.84
T_{10}	23.18	20.73	17.72	2.85
S.Em.±	0.74	0.44	0.41	0.08
C.D. at 5%	2.21	1.31	1.21	0.24
C.V. %	5.57	3.66	3.95	4.82

Economics

It is evident from the data in Table 3 that, maximum gross returns (202400 Rs./ha), net returns (119302 Rs./ha) and Benefit Cost Ratio (2.44) was recorded in treatment T_4 i.e. 100 per cent RDN + 0.5 per cent Nano urea as compared to other treatments.

Table 3 : Effect of foliar application of nano urea on economics

Treatments	Yield (t/ha)	Total cost (Rs./ha)	Gross returns (Rs./ha)	Net returns (Rs./ha)	Benefit: Cost Ratio
T_1	3.44	78191	137600	59408	1.76
T2	4.05	81602	162000	80397	1.99
T3	4.76	82350	190400	108049	2.31
T4	5.06	83098	202400	119302	2.44
T5	3.79	81376	151600	70224	1.86
T6	3.97	82124	158800	76676	1.93
T7	4.48	82872	179200	96328	2.16
T8	3.82	81150	152800	71649	1.88
T9	3.78	81898	151200	69301	1.85
T10	3.88	82646	155200	72553	1.88

*Selling price Rs. 40/ kg

Conclusion

The study concluded that, application of 10 kg FYM, 250:125:125 g NPK/ plant as basal and three foliar spray of 0.5% nano urea at 1st week of June, July and August found superior for custard apple cultivation by enhancing yield and quality parameters as well as beneficial in respect of economics.

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