**Effect of Plant Growth Regulators on yield and profitability of Custard apple: An economic Prospective**

ABSTRACT

In India, custard apple is traditionally known as “sitaphal” especially in Southern states. Commercial cultivation of custard apples is distributed in Andhra Pradesh and parts of Maharashtra. The experiment was framed to determine the influence of growth regulators (effective concentration of GA3 and NAA) on yield parameters and Economics. The results from the study show that foliar application of growth regulators was more effective on growth and yield parameters. The treatment with a combination of GA3 50 + NAA 20 ppm and 25 ppm of GA3 + 10 ppm of NAA, before flowering and a second spray after one month gives higher yields. The results revealed that, the highest B: C ratio 7.98 was found in Treatment T8 followed by T7 (7.11). Foliar application of GA3 50+NAA 20 ppm before flowering and after one month of flowering positively influenced yield, profit and returns from the investment

**Keywords:** Crop management, Custard apple, GA3, NAA, Fruit quality and Profitability

## I. INTRODUCTION

Custard apple (*Annona Squamosa*), traditionally known as “sitaphal”, is one of the decidedly consumable fruits in southern states and is tarnished for its great nutritive potential. The custard apple fruit has many medicinal values and is a rich source of vitamin C, carbohydrates, proteins, fats, etc. (Mahorkar et.al 2020). It was originated from tropical America to India and found in vastly humid areas of the country. Some of the major contributing states are Andhra Pradesh, Maharashtra, Madhya Pradesh, Karnataka, Rajasthan, etc.

The custard apple crop is scattered across the entire globe due to its acclimatization to different climatic conditions. The crop is most suitable for light and sandy soils with the proper drainage system (Zapota et.al 2020). The most suitable seasons for the blossoming of flower and fruit setting are preferably autumn and spring (Kumar T. S 2021 and Singh D.D 2021). Extreme temperatures obstruct the flower and fruit setting. The main advantage of growing custard apples is less infestation of pests and disease attacks. Custard apples can be consumed as a ripened fruit or in processed form.

Custard apple is one of the fruit crops grown in the Rayalaseema region as solo or inter-crop. The crop is grown as intercrop, border crop, or mixed crop depending on the landholding of the farmers. Some of the main cropping patterns for growing custard apples are Mango+ Custard Apple, Coconut + Custard apple, Jack fruit + Custard apple, Guava + Custard Apple.

The main reason for growing custard apples as an intern or mixed crop is farmers get a higher income from the two crops and better utilization of resources and cost minimization ultimately reflect on profit throughout the year (Suman M & Jain M. C 2021 and Bista D et.al 2022). The main objective of this experiment was to analyze the influence of different levels of plant growth regulators on flowering and fruit quality and yield parameters.

## II. MATERIALS AND METHODS

The present study was conducted in the College of Agricultural Sciences and Applied Research, Bharatiya Engineering, Science and Technology Innovation University, Sri Satya Sai, Andhra Pradesh in 2024. The experiment was conducted in an 8-year-old orchard maintained with a spacing of 4X4 meters. A random block design was deployed for the experiment with 10 treatments and three replications (Table 1). Data were recorded weekly for the growth and yield parameters and operations were collected immediately after the operation. Statistical tools like mean, S.D, and C.V were employed for analyzing the yield data. To determine the profitability of the crop under different treatments, the cost of cultivation and benefit-cost ratio were used.

Standard Deviation formula:

$$\boldsymbol{\sigma} = \sqrt{\frac{\sum(\mathbf{Xi}-\boldsymbol{\mu})\mathbf{2}}{N}}$$

$\boldsymbol{\sigma}$ = population standard deviation

N= size of the population

Xi= each value from the population

μ = the population mean

Coefficient of variation: CV = $\frac{\textbf{Standard deviation}}{\textbf{Mean}} \times 100$

BCR indicates returns perrupee of investment. BCR is worked out by dividing the discounted net cash flows by initialinvestment.

BCR=discounted netcash flow÷ initialinvestment

Table 1: Details of experiment treatments and replication

| Sl. No | Treatment | Chemicals |
|---|---|---|
| 1 | T1 | GA3 25 ppm |
| 2 | T2 | T2 : GA3 50 ppm |
| 3 | T3 | T3 : GA3 75 ppm |
| 4 | T4 | T4 : NAA 10 ppm |
| 5 | T5 | T5 : NAA 20 ppm |
| 6 | T6 | T6 : NAA 30 ppm |
| 7 | T7 | T7 : GA3 25+NAA 10 ppm |
| 8 | T8 | T8 : GA3 50 +NAA 20 ppm |
| 9 | T9 | T9 : GA3 75+NAA 30 ppm |
| 10 | T10 | T10: control (water spray) |

## III. RESULTS AND DISCUSSION

### III.1. Influence on yield attributes

The results (Table 2) from the experiment revealed that the flowering and yield of custard apples were significantly influenced by foliar application of plant growth regulators. The foliar application treatment T8 (GA3 50 +NAA 20 ppm) recorded the superlative results among all the treatments. In the T8 treatment, the maximum number of fruits per plant was around 65, and the average weight of the fruits was around 220 grams. The highest fruit yield per plant and Ha was also noticed in the T8 with 12.66 kg. Succeeding best results were noticed in treatment T7 (GA3 25+NAA 10 ppm) with 9.72 tonnes. In T7, the number of fruits per plant was around 63, the average fruit weight was around 210 grams, average yield per plant and Ha were 10.58 Kg and 8.56 Tonne respectively. The findings were in line with Vamshi et. al (2023), Singh S (2021) and Dobhalet.al(2022).

Table 2: Influence of growth regulators on yield parameters of custard apple

| Treatments | No. of fruits per plant | Average fruit weight (g) | Yield per plant (kg) | Yield per Ha (Tonnes) |
|---|---|---|---|---|
| T1 | 46.40 | 170.20 | 7.14 | 5.71 |
| T2 | 53.00 | 194.65 | 9.89 | 7.21 |

| | | | | |
|---|---|---|---|---|
| T3 | 48.05 | 188.06 | 7.28 | 6.28 |
| T4 | 59.13 | 195.24 | 9.20 | 6.90 |
| T5 | 61.06 | 199.46 | 10.72 | 8.32 |
| T6 | 57.09 | 206.09 | 10.03 | 7.90 |
| T7 | 62.92 | 210.80 | 10.58 | 8.56 |
| T8 | 64.89 | 218.56 | 12.66 | 9.72 |
| T9 | 49.29 | 189.01 | 8.21 | 6.60 |
| T10 | 40.20 | 177.60 | 6.38 | 5.20 |
| SEm+ | 2.56 | 4.65 | 0.62 | 0.44 |
| S. D | 8.10 | 14.72 | 1.95 | 1.39 |
| C. V | 6.69 | 13.25 | 4.72 | 5.20 |

The main reason might be due to regulating the growth and influencing different developmental processes which include stem elongation, germination, flowering, enzyme induction, etc. Due to the effect of gibberellic acid cell enlargement, cell division leads to an increase in the number and size of fruits which ultimately results in higher fruit yield. Application of NAA resulted in enhancing the photosynthesis phenomena, rate of fruit setting increase, and chances of fruit dropping reduces ultimately reflected in terms of yield parameters. These findings follow the results obtained by Darshan devi (2022) in aonla, Kajal et.al (2023) in mango, Kothapu 2023, Mahendraand Das (2024) in custard apple.

III.2. Effect of plant growth regulators on the economics of custard apple

Cost of cultivation refers to the total expenses incurred in cultivating a crop in a unit area, usually calculated for an Acre or Hectare. The cost of cultivation is worked out by input and operation together with their percentage of the total. The results revealed from (Table 3) the experiment that, the highest cost of cultivation per hectare was recorded in T9 (Rs. 33141) and T6 (Rs. 32075) followed by T7 (Rs. 32009). This is due to expenditure made towards the purchase of chemicals and labour costs of foliar application (Meshram et.al 2022). The highest gross returns (Rs. 279000) were recorded in Treatment T8. On the other hand, the lowest cost of cultivation of Rs. 30077 was recorded in treatment T10. In T10 treatment only the application of water does not fletching any cost.

Table 3: Effect of plant growth regulators on the profitability of custard apple (Per Ha)

| **Treatments** | **Cost of cultivation** | **Gross Returns** | **Net Return** | **B:C ratio** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| T1 | 30725 | 171400 | 140675 | 4.58 |
| T2 | 31418 | 224800 | 193382 | 6.16 |
| T3 | 32108 | 183890 | 151782 | 4.73 |
| T4 | 30380 | 205490 | 175110 | 5.76 |
| T5 | 30756 | 249800 | 219044 | 7.12 |
| T6 | 32075 | 246800 | 214725 | 6.69 |
| T7 | 32009 | 259700 | 227691 | 7.11 |
| T8 | 31078 | 279000 | 247922 | 7.98 |
| T9 | 33141 | 195880 | 162739 | 4.91 |
| T10 | 30077 | 154800 | 124723 | 4.15 |

By calculating the net returns from the investment, the farmer or investor has an idea of particular enterprise is profitable or not. The money you make from an investment after you subtract all the expenses you had to pay to make that investment. It's like getting paid for doing a job, but first, you have to take out the money you spent on tools or transportation. The highest net returns were realized in treatment T8 with a profit of Rs. 247922 followed by T7 (Rs. 227691). In these two treatments, all the yield parameters like the number of fruits per plant, average weight, yield per plant, and overall yield per hectare were recorded as highest. Due to because of quantity and quality wise fruit yield was decent (Parthama et.al 2023). The lowest net returns (Rs. 124723) were realized from the plants treated with the water T10 (control).

Benefit Cost Ratio (BCR) is one of the indicators that will show the relationship between two variables i,e relative cost and returns of a project, which is expressed in qualitative or monetary terms. BCR specifies expected returns per rupee of investment. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value to a firm and its investors. The results from the experiment show that B: C ratio of 7.98 was observed in T8 and followed by T7 (7.11). Foliar application of GA3 25+NAA 10 ppm before flowering after one month of flowering positively influenced yield, profit and returns from the investment. Since the custard apple crop does not have as much of a resource requirement and cost-effective crop, the investment returns were high even in control conditions. The variation in benefit: cost ratio due to the foliar application of different growth regulators in custard apples was also reported by Kumar et.al 2023 and Rathod et.al 2024.

## IV. CONCLUSION

The findings from the experiment indicate that the application of PGRs can significantly advantage in custard apple cultivation and the fruit industry as a whole. PGRs have been shown to enhance custard apple yield at GA3 50 +NAA 20 ppm and two foliar applications (at flowering and fruit set stage) result in improved flowering, fruit set, and reduced premature fruit drop. Additionally, PGRs have a direct impact on fruit quality, larger fruit sizes, increased fruit weight, and improved TSS (Total soluble sugars) content. These quality enrichments upsurge consumer preferences and satisfaction. With improvement in the marketability of custard apples, farmers have the potential to command higher prices in the market. Perhaps one of the most significant advantages of PGR use in custard apple cultivation is the extension of fruit shelf life.

Moreover, foliar application of PGRs can result in cost savings for custard apple growers, making custard apple cultivation more economically viable. While the existing literature is largely positive about the impact of PGRs on custard apple crops, it is essential to acknowledge the need for ongoing research to optimize PGR application methods, dosage, and timing for different custard apple cultivars and growing conditions. Additionally, further investigations into the specific mechanisms by which PGRs influence custard apple plants are necessary to unlock the full potential of PGRs in custard apple cultivation. In sum, the evidence from this review strongly suggests that the controlled use of PGRs holds great promise for custard apple growers and the fruit industry, offering the potential for increased productivity, improved fruit quality, sustainable practices, and economic benefits. Continued research and practical application of PGRs in custard apple farming will be instrumental in realizing these advantages and further elevating the position of custard apples as a desirable and profitable crop.

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