*Original Research Article*

# Studies on Performance of Custard Apple (*Annona squamosa*) Cultivars and Varieties Under Rainfed Vertisol Condition of Tamil Nadu


## ABSTRACT

A study was conducted in block vertisol region of Southern part of Tamil Nadu with the view to find out suitable custard apple cultivars for the region. Twelve years ole five cultivars viz., Mammoth, Raydurg, Arka Sahan, Balanagar, and APK (Ca)1 were undertaken for this study, which were planted at the spacing of 6 m x 6 m following randomized block design having three replications with ten trees in each replication. Results of three consecutive years of study clearly indicated that, the variety Arka Sahan showed increased tree ht. (6.28 m), number of primary branches (4.10), number of secondary branches (9.0), plant spread E-W (4.94 m) and plant spread N-S (4.77 m). The variety Mammoth recorded enhanced stem girth (85.67cm). Among the five custard apple varieties evaluated, Arka Sahan recorded the enhanced individual fruit wt. (214.12g), less number of seeds / fruit (8.88), pulp weight (60.76g) and TSS (30.32 °Brix). The variety Raydurg showed less rind weight of 41.89 / fruit. The variety Balanagar recorded the increased number of fruits/tree (250.36), yield / tree (22.79kg) and yield /ha (6.15 tonnes/ha) followed by APK 1 showed number of fruits / tree (204.45), yield /tree (21.20 kg) and yield /ha (5.72 tonnes/ha). TSS ranged from 21.67 to 30.32 °Brix. Considering overall performance, the cultivars Balanagar and APK (Ca) 1 are recommended for commercial cultivation in black vertisol region of Southern part of Tamil Nadu or in similar agro-climatic condition. The cultivar Arka Sahan showed enhanced growth and vegetative characters but special care (Artificial hand pollination) should be taken for fruit setting and retention.



**Keywords:** Custard apple, Vertisol, varieties, evaluation, Arid zone fruits,

## INTRODUCTION

Custard apple (*Annona squamosa* L.) is a tropical and subtropical fruit tree belongs to Annonaceae family (Nakasone and Mariguele, 1998) and it has 40 to 50 genera and 119 species, of which only six species are of commercial importance (Popenoe, 1974 and Geurts, 1981). It is popularly called as Sitaphal in India and Tamil Nadu, is commercially cultivated in dry treats of Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu, Bihar, Madhya Pradesh etc. The fruit prized a high demand due to its delicious taste and nutritive values (Priyanka Nandi et al., 2018). Fruits have also high demand in the industry for preparation of ice-cream and others due to richness in carbohydrates (Maurya and Singh, 2006; Nath et al.,2008). The custard apple is considered as a crop of wasteland and can successfully be grown in sandy, rocky, gravel, heavy and even in saline soil (Vijay Singh Meena et. al., 2022). The custard apple can successfully be grown in tropical, sub-tropical, arid and semi-arid region and best performed where there is less rainfall. It is established fact that successful cultivation of any crop mainly depends on suitable cultivar/s in an area or region and selection or recommendation of such cultivar/s require through scientific investigation. In different parts of India suitable or selected cultivars are grown (Girwani et al.,2011; Bhatnagar, 2012; Rymbai et al., 2014 ; Ghosh, 2017). In West Bengal practically the red laterite zone, where rainfall is less as compared to other parts of the state, no such varietal recommendation is available. Thus a study was undertaken towards this direction.

## MATERIALS AND METHODS

The experiment was conducted during 2017 to 2020 with the existing cultivars and varieties available at Regional Research Station (RRS), Tamil Nadu Agricultural University, Aruppukottai, Virudhunagar District under dry vertisols conditions. This research station is located at Aruppukottai, Virudhunagar District of Tamil Nadu. The altitude is 102 m above mean sea-level with a Latitude of $9^0$33' North and Longitude of $78^0$05' East. The center is coming under semi-arid climatic conditions. The annual average rainfall is 770mm. The soil type is vertisols (Black clay loam soil underlying canker nodules). Soil depth ranged between 0.6 to 1.2 m and received maximum rainfall during North – East Monsoon (Fig. 1).

The investigation was carried out during 2017 to 2020 with the existing twelve years old grafted custard apple varieties viz., Mammoth, Raydurg, Arka Sahan, Balanagar, and APK (Ca) 1 available at Regional Research Station, Tamil Nadu Agricultural University, Aruppukottai, Virudhunagar District, Tamil Nadu under dry vertisols conditions. The cultivars were planted at 6m x 6m spacing in a randomized black design having three replications and ten plants in each replication. The altitude is 102 m above mean sea-level with a Latitude of $9^0$33' North and Longitude of $78^0$05' East. The center is coming under semi-arid climatic conditions. The annual average rainfall is 770mm. The soil type is vertisols (Black clay loam soil underlying canker nodules). Soil depth ranged between 0.6 to 1.2 m and received maximum rainfall during North – East Monsoon. Fruits yield was recorded

at harvest. The physico-chemical characteristics of fruits were noted from 5 matured fruits, collected from each plant separately following standard procedure **(A.O.A.C., 1990).**

## RESULTS AND DISCUSSION

### Tree Height (m), Number Branches Tree$^{-1}$ (No.) and Tree Girth (cm)

Significantly increased tree height was observed in the cultivar Arka Sahan (6.28 m) followed by Raydurg (3.63 m) and Mammoth (3.32 m). Reduced tree height was recorded in APK (Ca) 1 (2.98 m). The enhanced number of primary and secondary branches per tree were observed in Arka Sahan (4.10 and 9.0) followed by Raydurg (3.55 and 8.0). The least number of primary and secondary branches were recorded in APK (Ca) 1 (2.84 and 7.33) (Table 1). Increased tree girth was observed in Mammoth (85.67 cm) followed by Arka Sahan (55.31 cm) and Raydurg (52.23 cm). The decreased tree girth was noticed in APK (Ca) 1 (35.24 cm).

### Number of Seeds Fruit$^{-1}$ (No.) and Rind Weight Fruit$^{-1}$ (gm)

Increased seed content was observed in the cultivar Balanagar (40.63 no. fruit$^{-1}$) followed by Raydurg (37.85 no. fruit$^{-1}$) and minimum number of seeds in Arka Sahan (8.88 no. fruit$^{-1}$) and Mammoth (30.77 no. fruit$^{-1}$) (Table 2). Greater rind content (55.67 gm fruit$^{-1}$) was recorded from Arka Sahan followed by Balanagar (51.11 gm fruit$^{-1}$) and Roydurg (41.89 no. fruit$^{-1}$) closely followed by APK (Ca) 1 (43.45 no. fruit$^{-}$ ) (Table 2). Usually lesser number of seeds per fruit and less rind weight are preferred for table and processing purpose. Data indicated that the number of seeds per fruits increases as the fruit size increases but, it was not likely be always true. Minimum number of seeds per fruit might be due to higher pulp per cent. The results are in conformity with Shete et al. (1991), Jalikop and Kumar (2000), Mathakar (2005) and Kumar (2015) in custard apple.

### Individual Fruit Weight (gm)

The parameter, fruit weight in custard apple is very important feature for commercial cultivation. In commercial cultivation, both growers and consumers preference is always towards the larger size fruits. In the present study, the cultivar Arka Sahan significantly produced largest fruit weight (214.12 g ) followed by Balanagar (162.66 g in weight). Lowest fruit weight (134.11g) was recorded from the cultivar Mammoth (Table 2). This variation in fruit weight may be due to higher canopy spread which contribute to the accumulation of higher photosynthates in fruit to attain optimum fruit size. The variation in fruit weight is correlated with the length and breadth of the fruit which helps in attaining the good fruit size. Beside this, the age, vigour of plant and eco-physiological conditions may also influence the fruit weight. Similar results

were also reported by Ghosh et al. (2001), Dikshit et al. (2008), Kad et al. (2016) in custard apple, Patil (2004) and Mohar et al. (2011) in sweet orange.

**Number of Fruits Tree$^{-1}$ (No.)**

Significantly enhanced number of fruits per tree was recorded in Balanagar (250.36 fruits tree$^{-1}$) followed by APL (Ca)1 (204.45 fruits tree$^{-1}$) and Roydurg (184.68 fruits tree$^{-1}$). The reduced number of fruits per tree was recorded in Arka Sahan (11.56 fruits tree$^{-1}$). Similar results were noticed by Varu and Barad (2011). Usually lesser number of seeds per fruit preferred for table and processing purpose. Data indicated that the number of seeds per fruits increases as the fruit size increases but, it was not likely be always true. Minimum number of seeds per fruit might be due to higher pulp per cent. The results are in conformity with Shete et al. (1991), Jalikop and Kumar (2000), Mathakar (2005) and Kumar (2015) in custard apple

**Fruit yield per tree (kg)**

Significant variation was observed in pooled mean. It is a most important parameter for evaluating any kinds of varieties. Highly significant differences were observed for fruit yield per tree. In the year 2017, recorded fruit yield per tree range between 4.04 to 20.10 kg. During 2018, recorded the fruit yield per tree range between 5.31 to 21.37 kg, During 2019, showed the fruit yield per tree ranged between 6.73 to 22.79 kg. In the year 2020, fruit yield per tree range between 6.12 to 22.50 kg. The pooled data (2017-2020) indicated that, the variety Balanagar continuously recorded increased fruit yield per tree of 21.69 kg followed by APK 1 (19.22 kg), Raydurg (16.87 kg) and Mammoth (12.89 kg) and The decreased fruit yield was observed in Arka Sahan (5.55 kg).

**Fruit yield per hectare (t)**

Highly significant differences were observed for fruit yield per ha. It is an essential parameter for valuing any kinds of varieties. In the year 2017, recorded fruit yield per ha range between 1.09 to 5.43 t. During 2018, recorded the fruit yield per ha range between 1.43 to 5.76 t, During 2019, showed the fruit yield per ha ranged between 1.82 to 6.15 t. In the year 2020, fruit yield per ha range between 1.65 to 6.07 t. The pooled data (2017-2020) indicated that, the variety Balanagar continuously recorded increased fruit yield per ha of 5.85 followed by APK 1 (5.19 t), Raydurg (4.55 t) and Mammoth (3.48 t) and The decreased fruit yield was observed in Arka Sahan (1.49 t). Arka Sahan is a promising hybrid from Indian Institute of Horticultural Research, Bangalore, showed decreased yield at this condition mainly due to lack of artificial hand pollination (Jalikop and Sampath Kumar, 2000). The unsatisfactory performance of few cultivars in the studied area was mainly due to varied agro-climatic condition. Besides, fruit set and its retention are greatly affected by climatic variation and tree physiological factors

(Rymbai, et al., 2014). Some genotypes produce less yield even after more number of fruits per plant, this might be due to lesser accumulation of photosynthetic products in custard apple fruit, as it also reported by Dubey, (2000) in sweet orange. These findings are in line with the earlier reports of Kaur et al. (2014) in mango. Yield being the polygenic and complex character is determined by various vegetative and reproductive characters as also reported by Shete et al. (1991) in custard apple.

**Fruit Quality**

Among the cultivars tested for TSS content of the fruit, Arka Sahan recorded significantly highest TSS content (30.32 °Brix) followed by Balanagar (23.53 °Brix) and APK (Ca)1 (23.10 °Brix). Minimum TSS content observed in Mammoth (20.67 °Brix). The variation in quality parameters among the cultivars may be due to their genetic nature which determine the capability to absorb nutrients from 'source' and their metabolism for synthesis of sugars and other products for the sink. It was important to note that fruit quality in respect of TSS was improved in most of the cultivars as compared to the different land races of custard apple, reported by Bahatnagar et al.(2012)

## CONCLUSION

In this experiment five popularly cultivating custard apple cultivars were evaluated for various growth, yield and quality parameters. Among the cultivars evaluated, the cultivar Balanagar followed by APK (Ca) 1 were performed well under black vertisol region of Southern Tamil Nadu. The cultivars Balanagar and APK (Ca) 1 are recommended for commercial cultivation under black vertisol region of Southern Tamil Nadu and similar other regions. The cultivar Arka Sahan also suitable for commercial cultivation, provided with artificial hand pollination (Pollen source from Balanagar or APK (Ca) 1).

**Table 1: Evaluation of morphological and quality characters in varieties of custard apple (2017 – 2020)**

| Varieties | Tree height (m) | No. of Branches | | Tree Girth (cm) | Plant Spread (m) | | No. of seeds / Fruit | Rind wt / fruit (g) | Pulp wt / fruit (g) | Individual fruit weight (g) | No. of fruits / tree | TSS (°Brix) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No. of primary of branches | No. of secondary branches | | E-W | N-S | | | | | | |
| Mammoth | 3.32 | 3.37 | 7.67 | 85.67 | 3.47 | 3.18 | 30.77 | 47.11 | 42.90 | 134.11 | 147.64 | 20.67 |
| Raydurg | 3.63 | 3.55 | 8.00 | 52.23 | 4.10 | 3.93 | 37.85 | 41.89 | 51.12 | 149.55 | 184.68 | 21.97 |
| Arka Sahan | 6.28 | 4.10 | 9.00 | 55.31 | 4.94 | 4.77 | 8.88 | 55.67 | 60.76 | 214.12 | 11.56 | 30.32 |
| Balanagar | 3.22 | 3.22 | 7.50 | 37.14 | 3.10 | 2.97 | 40.63 | 51.11 | 58.23 | 162.66 | 250.36 | 23.53 |
| APK 1 (Ca) | 2.98 | 2.84 | 7.33 | 35.24 | 2.83 | 2.73 | 35.11 | 43.45 | 46.23 | 155.33 | 204.45 | 23.10 |
| **SEd** | **0.302** | **0.007** | **0.011** | **4.989** | **0.610** | **0.541** | **0.174** | **0.076** | **0.103** | **0.415** | **1.246** | **1.471** |
| **CD (P=0.05)** | **0.606** | **0.014** | **0.021** | **9.981** | **1.224** | **1.085** | **0.349** | **0.155** | **0.209** | **0.834** | **2.496** | **2.946** |

**Table 2 : Evaluation of yield per tree and overall yield per ha. in varieties of custard apple (2017 – 2020)**

| Varieties | Yield / tree (kg) | | | | Pooled | Yield / ha. (t) | | | | Pooled |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | 2018 | 2019 | 2020 | | 2017 | 2018 | 2019 | 2020 | |
| Mammoth | 10.69 | 11.98 | 13.40 | 15.48 | 12.89 | 2.89 | 3.23 | 3.62 | 4.18 | 3.48 |
| Raydurg | 12.14 | 15.39 | 20.18 | 19.75 | 16.87 | 3.28 | 4.16 | 5.45 | 5.33 | 4.55 |
| Arka Sahan | 4.02 | 05.31 | 06.73 | 06.12 | 05.55 | 1.09 | 1.43 | 1.82 | 1.65 | 1.49 |
| Balanagar | 20.08 | 21.37 | 22.79 | 22.50 | 21.69 | 5.43 | 5.76 | 6.15 | 6.07 | 5.85 |
| APK 1 (Ca) | 14.26 | 19.78 | 21.20 | 21.62 | 19.22 | 3.86 | 5.34 | 5.72 | 5.84 | 5.19 |
| **SEd** | **0.25** | **0.30** | **0.15** | **0.31** | **0.24** | **0.04** | **0.05** | **0.04** | **0.07** | **0.08** |
| **CD (P=0.05)** | **0.56** | **0.67** | **0.33** | **0.69** | **0.54** | **0.09** | **0.11** | **0.09** | **0.16** | **0.17** |

**Fig. 1: Evaluation of Fruit yield per tree and overall fruit yield per ha. (2017 – 2020), Regional Research Station, Aruppukottai, Tamil Nadu, India**

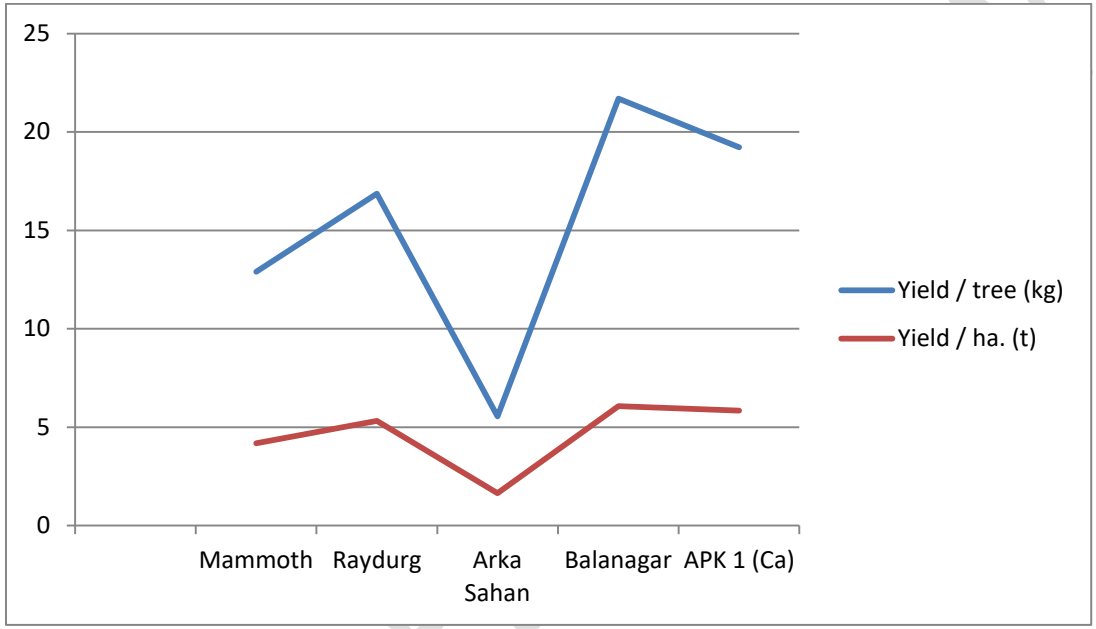
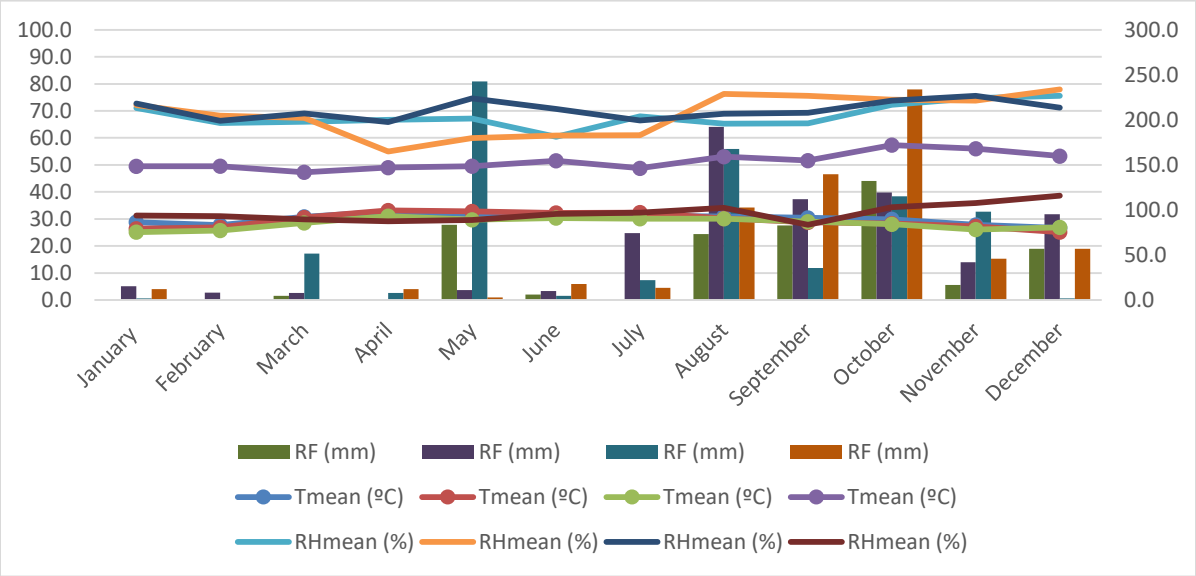


**Fig. 2 :** Weather data recorded during 2017-2020 at Regional Research Station, Aruppukottai, Tamil Nadu, India



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