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Effect of crop load management on biochemical parameters of custard apple (*Annona squamosa*) cv. Balanagar

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Abstract
An experiment was carried out at Horticulture farm, College of Agriculture, Dhule to evaluate the "Effect of Crop Load Management on Growth Yield and Quality of Custard Apple (*Annona squamosa*) cv. Balanagar" from June, 2024 to November, 2024 under Randomized Block Design (RBD) with three replications and seven treatments. The treatment (T_1) Crop load up to 40 fruits per plant recorded maximum pH, TSS, TSS: Acidity ratio, reducing sugar (%), non reducing sugar, total sugar (%) of pulp. While maximum titrable acidity was found in treatment T_7 (control).

Keywords: Custard Apple (*Annona squamosa*), Balanagar (Cultivar), crop load management

Introduction
The custard apple (*Annona squamosa* L.) is a vital dry land fruit crop in India, commonly referred to as Sitaphal or Sharifa. As a member of the Annonaceae family, it possesses a chromosome number of 2n=14. Due to its adaptability to various environmental conditions, annonas have successfully spread worldwide. Commercial custard apple cultivation actively takes place in India, the West Indies, Florida, Mexico, Brazil, Malaysia, Thailand, the Philippines, and Egypt.

The primary Indian states for custard apple cultivation are Andhra Pradesh, Uttar Pradesh, Maharashtra, Bihar, and Assam. In Maharashtra, over 7,000 hectares of land are dedicated to custard apple cultivation, yielding 1,30,880 tonnes of fruits (NHB 2024 https://www.nhb.gov.in). This fruit is primarily grown in Vidharbha, Western Maharashtra and Marathwada and North Maharashtra. In Maharashtra mainly research efforts have focused on the districts of Nagpur, Pune, Solapur, Dhule, Ahmednagar, Aurangabad, and Beed.

Crop load management has emerged as a cutting-edge production system, offering immense potential for enhancing productivity, yield efficiency and profitability while minimizing risks (Peifer *et al*., 2018) [6]. By reducing crop load, the leaf area per fruit ratio within individual trees increases, thereby improving the carbon supply per fruit. This, in turn, enhances fruit size and quality, making crop load management an indispensable tool in fruit production. When flowers are abundant and fruit set is high, thinning becomes necessary to achieve regular bearing and larger fruit sizes. To address this issue, flower and fruit thinning have become essential practices for regulating crop load and enhancing fruit quality at harvest. The number of fruits remaining on a tree directly impacts yield, whereas fruit size and quality determine fruit value.

Materials and Methods
The experiment carried out at Horticulture farm, College of Agriculture, Dhule on Effect of Crop Load Management on Growth yield and quality of Custard Apple (*Annona squamosa*) cv. Balanagar, during the year of 2024 - 2025. The experiment was conducted on 14 years old tree of custard apple cv. Balanagar spaced at 5 m x 5 m. Healthy trees of uniform growth and vigour was selected for the experiment. The soil of experimental plot was medium with 1.5 m deep with good drainage and has well levelled topography. The present research programme was laid out in Randomized Block Design (RBD) consisting seven treatments of

crop load on plant replicated thrice. Three plant were selected under each treatment. Fruit thinning was done when fruit was aonla size. The treatment consists of (T_1) Crop load up to 40 fruits per plant, (T_2) Crop load up to 50 fruits per plant, (T_3) Crop load up to 60 fruits per plant, (T_4) Crop load up to 70 fruits per plant, (T_5) Crop load up to 80 fruits per plant, (T_6) Crop load up to 90 fruits per plant and (T_1) Control (No thinning of fruits).

Results and Discussion

Effect of crop load management on pH of pulp

The data depicted in Table 1 revealed that the maximum pH of pulp was recorded in treatment T_1 (5.15) (Crop load up to 40 fruits per plant)) at par with treatment T_2 (Crop load up to 50 fruits per plant) (5.10), treatment T_3 Crop load up to 60 fruits per plant (5.09) followed by treatment T_5 (Crop load up to 80 fruits per plant (4.90). However, minimum pH (4.61) was recorded in treatment T_7 (control). The fruit acidity decreased with a concomitant decrease in pH as the fruit advances in maturity. The results are in accordance with the findings of Thakur and Chandel (2004) [8] in kiwi fruit and Abeer and Mohsen (2010) [1] in peach.

Effect of crop load management on TSS of pulp:

The data presented in Table 1 it was observed that significantly maximum TSS (23.53 ^{0}Brix) was found in treatment T_1 (Crop load up to 40 fruits per plant) at par with treatment T_2 (Crop load up to 50 fruits per plant) (22.89 ^{0}Brix), treatment T_3 (Crop load up to 60 fruits per plant) (22.49 ^{0}Brix). while the minimum TSS of pulp (21.36 ^{0}Brix) was recorded in treatment T_7 (control). Improvement in total soluble solids might be attributed due to reduced crop load due to thinning of young fruitlets, which resulted in more synthesis, transport and accumulation of sugars in the remaining fruits. The results are in close conformity with Rab *et al*. (2012) [7] in apricot and Bular *et al.* (2008) [2] in pear.

Effect of crop load management on titrable acidity (%) of pulp

The data from Table 1 revealed that, maximum titrable acidity (0.31%) was found in T_7 treatment followed by treatment T_6 (Crop load up to 90 fruits per plant) (0.26%). However, minimum titrable acidity (0.22%) was recorded in treatment T_1 (Crop load up to 40 fruits per plant). The fruit acidity decreased with a concomitant decrease in pH as the fruit advances in maturity. Thinning seems to delay the maturation process by slowing down decrease in acidity of guava fruits. The results are in accordance with the findings of Thakur and Chandel (2004) [8] in kiwi fruit.

Effect of crop load management on TSS: Acidity ratio of pulp

The data from Table 1 showed that, the effect of crop load management on TSS: Acidity ratio was found to be significantly maximum in treatment T_1 (106.95) (Crop load up to 40 fruits per plant) followed by treatment T_2 (Crop load up to 50 fruits per plant) (95.27). However, minimum TSS: acidity ratio (71.20) was recorded in treatment T_7 (control). Improvement in total soluble solids might be attributed due to reduced crop load due to thinning of young fruitlets, which resulted in more synthesis, transport and accumulation of sugars in the remaining fruits. Which leads to increase in TSS: Acidity ratio of pulp. Similar results were founded by Jadhav *et al.* (2022) [3].

Effect of crop load management on reducing sugar (%) of pulp

The data from Table 1 showed that, the effect of crop load management on reducing sugar (%) was found to be maximum in treatment T_1 (18.68%) (Crop load up to 40 fruits per plant) followed by treatment T_2 (18.18%) (Crop load up to 50 fruits per plant) However, minimum reducing sugar (16.60%) was recorded in treatment T_7 (17.80%) (control). Improvement in reducing sugars might be attributed due to reduced crop load due to thinning of young fruitlets, which resulted in more synthesis, transport and accumulation of sugars in the remaining fruits. The results are in close conformity with Mishra *et al.* (2020) [4] in guava.

Effect of crop load management on non reducing sugar of pulp

The data presented in Table 1 showed that, the effect of crop load management on non-reducing sugar (%) was found to be maximum in treatment T_1 (2.82%) at par with treatment T_2 (2.14%) (Crop load up to 50 fruits per plant) and followed by treatment T_3 (1.90%) (Crop load up to 60 fruits per plant) However, minimum non-reducing sugar (1.57%) was recorded in treatment T_7 (control). Improvement in non-reducing sugars might be attributed to reduced crop load due to thinning of young fruitlets, which resulted in more synthesis, transport and accumulation of sugars in the remaining fruits. The results are in close conformity with Mishra *et al*. (2020) [4] in guava, Rab *et al.* (2012) [7] in apricot.

Effect of crop load management on total sugar (%) of pulp

The data depicted in Table 1 and shown in Fig. 2. it was found that, the effect of crop load management on total sugar (%) was found to be significantly maximum in treatment T_1 (21.50%) (Crop load up to 40 fruits per plant) at par with treatment T_2 (20.33%) (Crop load up to 50 fruits per plant) followed by treatment T_5 (Crop load up to 80 fruits per plant) (18.94%). However, minimum total sugar (18.21%) was recorded in treatment T_7 (control). Improvement in total sugars might be attributed to reduced crop load due to thinning of young fruitlets, which resulted in more synthesis, transport and accumulation of sugars in the remaining fruits. The results are in close conformity with Mishra *et al*. (2020) [4] in guava, Rab *et al.* (2012) [7] in apricot.

Conclusion

On the basis of the present investigation on effect of crop load management on custard apple cv. Balanagar, it can be concluded that, maximum TSS, TSS: Acidity ratio, reducing sugar, non -reducing sugar and total sugar was found in treatment T_1 (Crop load up to 40 fruits per plant) with minimum Titrable acidity.

Table 1: Effect of crop load management on pH, TSS, Titrable acidity, TSS: Acidity ratio, reducing sugar, non -reducing sugar and total sugar of custard apple

Treatments	pH	TSS	Titrable acidity	TSS: Acidity ratio	Reducing sugar	Non -reducing sugar	Total sugar
T_1	5.15	23.53	0.220	106.95	18.68	2.82	21.50
T_2	5.10	22.89	0.240	95.27	18.18	2.14	20.33
T_3	5.09	22.49	0.250	93.70	17.80	1.90	19.66
T_4	4.95	21.85	0.253	87.40	17.50	1.72	19.23
T_5	4.90	21.66	0.263	83.15	17.30	1.63	18.94
T_6	4.65	21.62	0.267	80.22	17.00	1.58	18.60
T_7	4.61	21.36	0.310	71.20	16.60	1.57	18.21
SE m. ±	0.18	0.38	0.010	1.49	0.15	0.25	0.48
CD at 5%	0.26	1.17	0.031	4.61	0.46	0.77	1.50

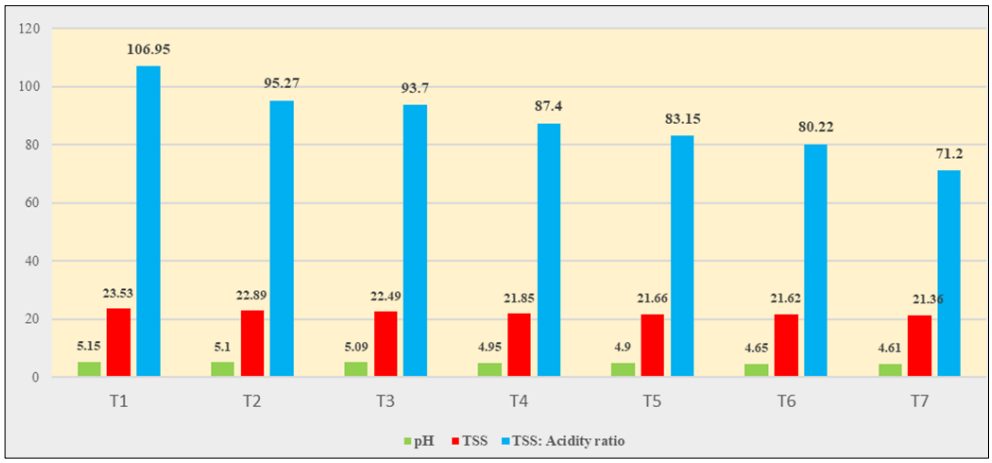

Fig 1: Effect of crop load management on pH, TSS, TSS: Acidity ratio, of custard apple

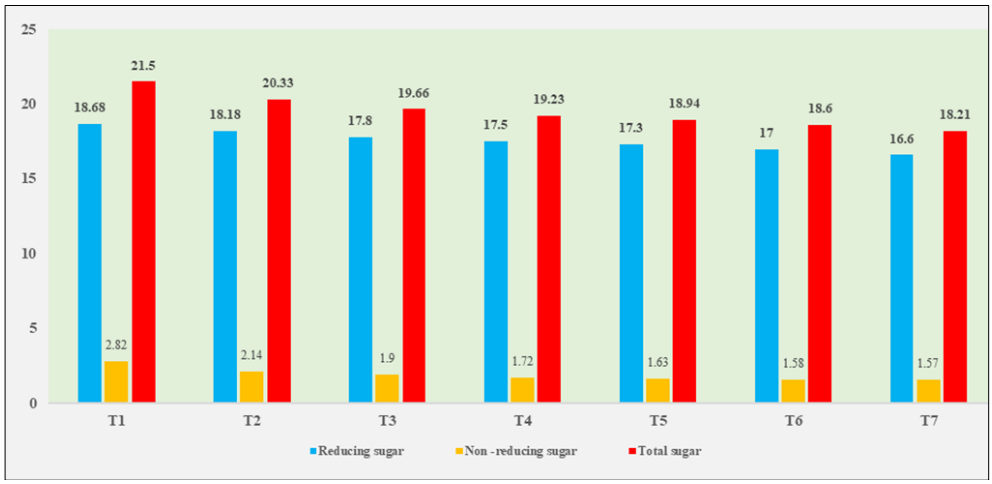

Fig 2: Effect of crop load management on reducing sugar, non -reducing sugar and total sugar of custard apple

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