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EFFECT OF CROP LOAD MANAGEMENT ON GROWTH YIELD AND QUALITY 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 parameters recorded maximum chlorophyll content (μmol /cm^2), yield kg/plant, yield (t/ha), fruit length (cm), fruit width (cm), fruit weight (g), pulp weight (g), seed weight (g), rind weight (g), pulp: seed ratio, pulp: rind ratio. While the minimum yield kg/ plant and yield t/ha was found in the treatment (T_1) Crop load up to 40 fruits per plant.

Key words : Crop Load Management, Growth, Yield, Quality, Custard apple.

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, Annona's 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). 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 × 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 plants 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).

Chlorophyll content (µmol / cm²)

The Chlorophyll content of fully mature leaf was measured by three randomly selected leaves from each treatment and measured with the help of Spectrophotometer and expressed in (µmol / cm²).

Yield kg per plant (Kg)

Yield was recorded after weighing fully mature fruits at each harvest, it was totalled and expressed in kilograms per plant.

Yield per hectare (t/ha)

The total weight of fruits was taken at each harvesting for each observational plant. The total harvesting from each plant was done to get total weight of fruit harvested during the season in kilogram per tree and it was converted to tones.

Fruit length (cm)

The length of each fruit from stalk end to style was measured with the help of measuring tape and after computing mean, it was recorded as average length of fruit in diameter.

Fruit width (cm)

The width of each fruit was measured with the help of measuring tape at maximum thickness and after computing mean, it was recorded as average diameter of fruit in centimeter, the fruit size expressed in centimeter.

Fruit weight (g)

Individual fruit was weighed on electronic weighing balance and the average weight was expressed in grams.

Pulp weight (g)

The pulp was separated from fruits, by separating seed and outer cover of fruit. The weight of pulp taken separately from each fruit.

Rind weight (g)

The rind was separated from fruits, by separating seed and pulp of fruit. The weight of rind was taken separately from each fruit.

Seed weight (g)

The seeds were separated from fruits, by separating pulp and outer cover of fruit. The weight of seed taken separately from each fruit.

Pulp: seed ratio

The pulp: seed ratio was calculated by using the following formula

$$\text{Pulp : seed ratio} = \frac{\text{Weight of pulp}}{\text{Weight of seed}}$$

Pulp: Rind ratio

The pulp to rind ratio was calculated by using the following formula

$$\text{Pulp : rind ratio} = \frac{\text{Weight of pulp}}{\text{Weight of rind}}$$

Results and Discussion

Growth parameter

Effect of crop load management on chlorophyll content

The data depicted in Table 1 revealed that the maximum chlorophyll content was recorded in treatment T_1 (78.40) (Crop load up to 40 fruits per plant) it was at par with treatment T_2 (Crop load up to 50 fruits per plant) (76.00) followed by treatment T_3 (Crop load up to 60 fruits per plant) (71.30), However minimum Chlorophyll Content (67.56) was recorded in (control) T_7 treatment. Amount of chlorophyll in leaf tissue is influenced by nutrient availability, crop load intensity and environmental stress such as drought, salinity, cold and heat. Chlorophyll fluorescence depends on a Crop load range (Urban *et al.*, 2003) in mango.

Yield and quality attributing parameters

Effect of crop load management on yield kg per plant

The data depicted in Table 1 revealed that highest yield per plant was found in treatment T_6 of crop load up to 90 fruits per plant (23.88 kg) which is superior than all other treatments followed by the treatment T_5 of crop load up to 80 fruits per plant (22.13 kg), while the lowest fruit yield per plant was recorded in treatment T_7 of control (11.06 kg). Reduction in yield due decrease in number of fruits per tree. Similar findings were given by

Seed weight **Rind weight** **Pulp weight**

Plate 1 : Showing measurement of Seed , Rind and Pulp weight.

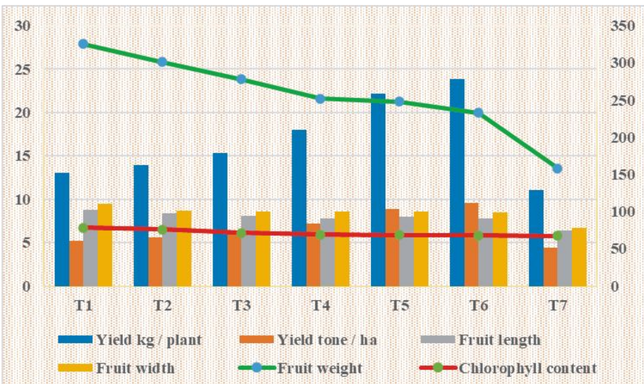

Fig. 1 : Effect of crop load management on chlorophyll content, yield kg per plant, yield per hectare, fruit length, fruit width and fruit weight.

Ramteke *et al*. (2022) in custard apple. Sdoodee *et al.* (2008), reported that the highest yield was found in high crop load in mangosteen trees.

Effect of crop load management on yield per hectare

The data depicted in Table 1 revealed that significantly highest fruit yield per hectare was obtained in treatment T_6 of crop load up to 90 fruits per plant (9.55 t/ha) which is superior than all other treatments at par with treatment T_5 of crop load up to 80 fruits per plant (8.85 t/ha) followed by the treatment T_4 of crop load up to 70 fruits per plant (7.19 t/ha), while the lowest fruit yield per hectare was recorded in treatment T_7 of control (4.42 t/ha). Results are in congruent with Lakpathi *et al*. (2013) in guava , Sdoodee *et al*. (2008) reported that, moderate crop load of mangosteen plants provided high yield with high percentage of large fruits. Although the highest yield was found in high crop load plants, most of the fruits were small.

Effect of crop load management on fruit length

The data depicted in Table 1 revealed that maximum fruit length was found in treatment T_1 crop load up to 40 fruits per plant (8.80 cm) followed by treatment T_2 crop load up to 50 fruits per plant (8.35 cm). However, minimum fruit length (6.44 cm) was recorded in treatment T_7 (control). The increase in fruit length might be due to the reduction in the number of fruits per plant thereby increasing the size of the cell and cell elongation which resulted in maximum accumulation of the food materials in the developing fruits, thus improving the fruit size. These results are in collaboration with the findings of Jadhav *et al.* (2022) in custard apple, Arora and Chanana (2001) and Casierra *et al.* (2007) in peach.

Effect of crop load management on fruit width

The data depicted in Table 1 revealed that maximum fruit width was found in treatment T_1 crop load up to 40 fruits per plant (9.49 cm) followed by treatment T_2 crop load up to 50 fruits per plant (8.66 cm). However, minimum fruit width (6.66 cm) was recorded in treatment T_7 (control). Increase in the fruit size could be attributed to increase in leaf to fruit ratio as a result of thinning, thus increasing the availability of photosynthates and nutrients to the remaining fruits thereby increasing the width of individual fruits. The results are in accordance with the finding of Jadhav *et al.* (2022) in custard apple and Davarynejad *et al.* (2008) in sour cherry .

Effect of crop load management on fruit weight

The data depicted in Table 1 revealed that maximum fruit weight was found in treatment T_1 crop load up to 40 fruits per plant (325.29 g) at par with treatment T_2 crop load up to 50 fruits per plant (301.00 g) followed by treatment T_3 crop load up to 60 fruits per plant (277.66 g) However, minimum fruit weight (158.10 g) was recorded in treatment T_7 (control). This might be due to the reduction in the number of fruits per plant thereby increasing the leaf to fruit ratio which resulted in increased availability of photosynthates and lesser nutritional competition among the developing fruits, thus improving the fruit weight. These results are supported by the findings of Islam *et al.* (1992) and Sharifuzzaman (1996) in guava and Kousar *et al.* (2016) .

Table 1 : Effect of crop load management on chlorophyll content, yield kg per plant, yield per hectare, fruit length, fruit width and fruit weight.

Treatments	Chlorophyll content	Yield kg / plant	Yield tone / ha	Fruit length	Fruit width	Fruit weight
T_1	78.40	13.05	5.22	8.80	9.49	325.29
T_2	76.00	13.94	5.57	8.35	8.66	301.00
T_3	71.30	15.34	6.13	8.07	8.57	277.66
T_4	68.90	17.99	7.19	7.82	8.57	252.14
T_5	68.35	22.13	8.85	7.99	8.55	247.91
T_6	68.20	23.88	9.55	7.82	8.45	233.05
T_7	67.56	11.06	4.427	6.44	6.66	158.10
SE m. ±	1.278	0.89	0.451	0.306	0.299	8.091
CD at 5%	3.939	2.75	1.388	0.942	0.921	24.932

Table 2 : Effect of crop load management on pulp weight, rind weight, seed weight, pulp: seed ratio and pulp: rind ratio.

Treatments	Pulp weight	Rind weight	Seed weight (g) per fruit	Pulp:seed ratio	Pulp: rind ratio
T_1	168.883	130.250	23.79	7.21	1.29
T_2	151.160	120.663	22.36	6.76	1.25
T_3	133.857	118.527	21.95	6.12	1.20
T_4	130.397	116.110	21.58	6.10	1.16
T_5	126.570	113.827	21.29	5.94	1.11
T_6	122.737	110.182	20.95	5.85 ‘	1.10
T_7	73.007	70.233	17.23	4.19	1.01
SE m. ±	5.505	4.297	0.896	0.45	0.04
CD at 5%	16.963	13.240	2.760	1.39	0.14

Effect of crop load management on pulp weight

The data depicted in Table 2 revealed that significantly maximum fruit pulp weight was recorded in treatment T_1 crop load up to 40 fruits per plant (168.88 g) followed by treatment T_2 (Crop load up to 50 fruits per plant) (151.16 g). However, minimum fruit pulp weight (73.00 g) was recorded in treatment T_7 (control). The increase in pulp weight could be attributed to increase in fruit size which resulted in higher proportionate pulp weight. The present findings are in close conformity with the findings of Mishra *et al.* (2020) in guava.

Effect of crop load management on rind weight

The data depicted in Table 2 revealed that significantly maximum rind weight was recorded in treatment T_1 crop load up to 40 fruits per plant (130.25 g) it was at par with treatment T_2 (Crop load up to 50 fruits per plant) (120.66 g) and treatment T_3(Crop load up to 60 fruits per plant) (118.52 g). However, minimum fruit rind weight (70.23 g) was recorded in treatment T_7 (control) rind weight of fruit increases due to accumulation of more cells. Similar findings were given by Ramteke *et al.* (2022) in custard apple and Mishra *et al.* (2020) in guava.

Effect of Crop load management on seed weight (g) per fruit

The data depicted in Table 2 revealed that significantly maximum seed weight was recorded in treatment T_1 crop load up to 40 fruits per plant (23.79 g) at par with treatment T_2 (Crop load up to 50 fruits per plant) (22.36 g) and treatment T_3(Crop load up to 60 fruits per plant) (21.95 g). However, minimum seed weight (17.23 g) was recorded in treatment T_7 (control) The increase in pulp weight, stone weight, stone size and pulp: stone ratio could be attributed to increase in fruit size which resulted in higher proportionate pulp weight and increased marginal stone weight. The present findings are in close conformity with the findings of Casierra *et al.* (2007) in peach and Hegazi (2008) in Date palm.

Effect of crop load management on pulp: seed ratio

The data depicted in Table 2 revealed that maximum pulp: seed ratio was recorded in treatment T_1 crop load up to 40 fruits per plant. (7.21)) it was at par with treatment T_2 (Crop load up to 50 fruits per plant) (6.76) and treatment T_3 (Crop load up to 60 fruits per plant) (6.12) and followed by treatment T_4 (Crop load up to treatment 70 fruits per plant) (6.10). However, minimum pulp : seed ratio(4.19) was recorded in treatment T_7 (control). The increase in pulp: seed ratio could be attributed to increase in fruit size which resulted in higher proportionate pulp weight. Similar results were found by Casierra *et al*. (2007) and Patel *et al.* (2014) in peach.

Effect of crop load management on pulp: rind ratio

The data depicted in Table 2 revealed that the maximum pulp : rind Ratio was found in treatment T_1 (Crop load up to 40 fruits per plant) (1.29) it was at par with treatment T_2 (Crop load up to 50 fruits per plant) (1.25) and followed by treatment T_3 (Crop load up to 60 fruits per plant) (1. 20). However, minimum pulp : rind Ratio (1.01) was recorded in treatment T_7 (control). The increase in pulp: rind ratio could be attributed to increase in fruit size which resulted in higher proportionate pulp weight. Similar result was found by Rathod *et al.* (2020) in custard apple.

Conclusion

It was observed in the present investigation that most of the physical parameters *i.e.*, fruit length, fruit width, fruit weight, pulp weight, seed weight, rind weight, pulp :seed ratio and pulp :rind ratio was influenced by treatment T_1 crop load up to 40 fruits per plant. while the yield attributing characters i.e., yield kg per plant and yield per hectare was influenced by treatment T_6 crop load up to 90 fruits per plants.

References

Arora, N.K. and Channana Y.R. (2001). Effect of hand thinning on maturity, yield and quality of peach (*Prunus persica* Batsch.) cv. Florida Prince. *J. Res., Punjab Agricult. Univ.*, **38**, 167–172.

Casierra, P.F., Rodríguez P.J.I. and Cárdenas-Hernández J. (2007). Leaf to fruit ratio affects yield, fruit growth, and fruit quality of peach (*Prunus persica* Batsch, cv. Rubidoux). *Revista Facultad Nacional de Agronomía Medellín*, **60(1)**, 3657–3669.

Davarynejad, G.H., Nyeki J., Szabo Z. and Szabo Z. (2008). Influences of hand thinning of bud and blossom on crop load, fruit characteristics and fruit growth dynamics of sour cherry cultivar. *Amer.-Eur. J. Agricult. Environ. Sci.*, **4**, 138–141.

Hegazi, A.M., El-Dengawy E.F. and Hamama M.H. (2008). Leaf/ bunch ratio for Oreabi date palm cultivar grown at the north delta of Egypt. *J. Horticult., Mansoura Univ.*, **33(1)**, 419–424.

Islam, M.M., Bhuyan M.A.J., Biswas M. and Islam M.S. (1992). Fruit size, yield and quality of guava cv. Kazi Piara as affected by fruit thinning. *South Indian Horticult.*, **40(2)**, 71–73.

Jadhav, K.P., Panchbhai D.M., Bahadure A., Patil S.R. and Ramteke N.H. (2022). Effect of severity of pruning and fruit retention on growth and harvesting of custard apple. *The Pharma Innov. J.*, **11(9)**, 1122–1126.

Kousar, Javaid, Dar K.R., Qureshi K.S., Rahila Shameem, Raja R.H.S., Kirmani S.N. and Basu Y.A. (2016). Influence of crop load and foliar nutrient sprays on growth, yield and quality of apple (*Malus* × *Domestica* Borkh.) Cv. Red Delicious. *Thebioscan*, **11(2)**, 1187-1191.

Lakpathi,G., Rajkumar M. and Chandrasekhar R. (2013). Effect of pruning intensities and fruit load on growth, yield and quality of guava (*Psidium guajava* L.) cv. Allahabad Safeda under high density planting. *Int. J. Curr. Res.*, **5(12)**, 4083–4090.

Mishra, M., Lal S. and Kumar R. (2020). Effect of fruit thinning on growth and quality of rainy season crop of guava (*Psidium guajava* L.). *J. Pharmacog. Phytochem.*, **9(5)**, 3214–3217.

National Horticulture Board (NHB) (2024). *A report on the area and production of custard apple*. Government of India.

Patel, R.K., Meitei S.B., Kumar A., Shrivastava K., Deka B.C., Deshmukh N.A. and Verma V.K. (2014). Effect of leaf and fruit thinning on yield and quality of peach cv. Floridasun. *Ecoscan*, **6**, 467–471.

Peifer, L., Ottnad S., Kunz A., Damerow L. and Blanke M. (2018). Effect of non-chemical crop load regulation on apple fruit quality, assessed by the DA-meter. *Scientia Horticulturae*, **233**, 526–531.

Ramteke, N.H., Bharad S.G., Panchbhai D.M., Nagre P.K. and Patil S.R. (2022). Effect of planting density and fruit load on flowering, fruit set and yield of custard apple. *The Pharma Innov. J.*, **12(3)**, 1894–1903**.**

Rathod, A.R., Bharad S.B., Deshmukh P.L. and Ramteke N.H. (2020). Effect of leaf to fruit ratio on growth, yield and quality of custard apple. *Int. J. Chem. Stud.*, **8(5)**, 174-178.

Sdoodee, S., Phonrong K. and Ruongying Y. (2008). Mangosteen crop load affects physiological responses, fruit yield and fruit quality. *Acta Horticulturae*, **773**, 187–194.

Sharifuzzaman, S. (1996). Effect of fruit thinning and growth regulators on the yield and quality of guava cv. Kazipira (*M.Sc. thesis*). Department of Horticulture, Bangladesh Agricultural University, Mymensingh, 73.

Urban, L., Roux X., Sinoquet H., Jaffuel S. and Jannoyer M. (2003). A biochemical model of photosynthesis for mango leaves: Evidence for the effect of fruit on photosynthetic capacity of nearby leaves. *Tree Physiology*, **23(5)**, 289–300.