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Effect of leaf to fruit ratio on growth, yield and quality of custard apple cv. GJCA-1

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Abstract

The objective of this study was to determine the effect of leaf to fruit ratio on growth, yield and quality of custard apple. The research conducted at FRS, Madhadi baug, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat). The treatments were imposed in the second week of August (When fruit attain marble size). The treatments comprised of eight level viz., T₁: (Leaf: fruit, 4:1), T₂: (Leaf: fruit, 6:1), T₃: (Leaf: fruit, 8:1), T₄: (Leaf: fruit, 10:1), T₅: (Leaf: fruit, 12:1), T₆: (Leaf: fruit, 14:1), T₇: (Leaf: fruit, 16:1), T₈: Control. The experiment was laid out in Randomized Block Design (RBD) with three replications. Among different treatments, T₆ (Leaf: fruit, 14:1) increased leaf area, chlorophyll content, leaf carbohydrates, fruit weight, fruit length, fruit width, fruit volume, yield (Kg/plant) and yield (T/ha), T₃ (Leaf: fruit, 8:1) increased pulp weight, pulp: seed ratio and pulp: rind ratio and T₅ (Leaf: fruit, 12: 1) increased total sugar, reducing sugar and non-reducing sugar.

Keywords: Custard apple, leaf to fruit ratio

Introduction

In India, custard apple is the most importance fruit of the Annonaceous. The Annonaceous fruits originated in Tropical America and are widely distributed in tropics and sub tropics. Among annonaceous fruits, custard apples are the most favourite in India. Its plants come up unattended in parts of Andhra Pradesh, Assam, Bihar, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Rajasthan and Tamil-Nadu as a scrub or hedge plant. of late, custard apple has gained commercial significance and exclusive orchards are emerging in Maharashtra, Andhra Pradesh and Gujarat (Kumar *et al.*, 2018) ^[3]. The total area under cultivation of custard apple in India is around 45,000 ha and production is 3, 90,000 tones (Singh *et al.*, 2021) ^[15]. In Gujarat, the production is 73,050 tones, provide share approximately 18.97%. (Anonym, 2022) ^[2]. In Gujarat, it is systematically cultivated in Bhavnagar, Baroda, Sabarkantha, Panchmahal and Junagadh districts. Photosynthesis is a process in which light energy is capture by chlorophyll in leaves and used to synthesize reduced carbon compounds from carbon dioxide and water and produces carbohydrates. These carbohydrates used for growth and development of plants. The carbohydrates translocated from leaves to reserve organs, these translocated carbohydrates are the most important for growth and development of sink organs i.e., fruits. It is useful to study source sink relationship for better understanding of crop physiology and the influence of yield limiting factors on crop production. Within a tree, reproductive organs such as fruits complete for assimilate with each other (Dejong *et al.*, 1987) ^[5]. In fruit trees, crop load affects fruit size and has a large effect on dry matter production and partitioning. Variation in fruit growth depends on source-sink relationship that include assimilate availability and partitioning. Assimilate availability is usually represented by the leaf to fruit ratio, which can increase fruit size. In order to obtain the acceptable fruit size, there must be requirement of an adequate leaf to fruit ratio which supply the photosynthetic carbon products especially during the cell division stage of fruit growth.

Materials and Methods

The experiment was conducted at FRS, Madhadi baug, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat) during the year 2021-22. The treatments comprised of eight level viz., T₁: (Leaf: fruit, 4:1), T₂: (Leaf: fruit, 6:1), T₃: (Leaf: fruit, 8:1),

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T₄: (Leaf: fruit, 10:1), T₅: (Leaf: fruit, 12:1), T₆: (Leaf: fruit, 14:1), T₇: (Leaf: fruit, 16:1), T₈: Control. The experiment was laid out in Randomized Block Design (RBD) with three replications. Observations on leaf area, chlorophyll content carbohydrates, fruit weight, fruit length, fruit width, fruit volume, pulp weight, pulp: seed ratio, pulp: rind ratio, yield (Kg/plant), yield (T/ha), total sugar, reducing sugar and non-reducing sugar. Statistical analysis was done by using method of analysis of variance (ANOVA) for Randomized block design by Panse and Sukhatme (1985) [12].

Result and Discussions

Among the different treatments, maximum leaf area (87.78 cm²) was observed in T₆ (Leaf: fruit, 14:1). It might be due to optimum number of leaves which produce more assimilates, its accumulation in leaf tissue enhance the leaf area. Similar results were found by Eliwa (2003) [7] in peach, Katekar and Bharad (2020) [10] and Rathod *et al.* (2020) [14] in custard apple, Singh (2010) [16] in nectarine. Maximum chlorophyll content (52.83 SPAD) was observed in T₆ (Leaf: fruit, 16:1). It might be increase due to leaf expansion and plant with dense leaves had lower chlorophyll contents compared to the ones with less dense leaf. Similar results were found by Rathod *et al.* (2020) [14] and Katekar and Bharad (2020) [10] in custard apple. Maximum carbohydrate (0.84%) was observed in T₆ (Leaf: fruit, 14:1) which is at par with T₅. It might be due to optimum number of leaves which produce more assimilates, its accumulation in leaf tissue enhance the leaf carbohydrates. Similar results were found by Eliwa (2003) [7] in peach, Rathod *et al.* (2020) [14] and Katekar and Bharad (2020) [10] in custard apple.

Maximum fruit weight (178.33 g) was observed in T₆ (Leaf: fruit, 14:1). It might be due to the increase in the optimum number of leaves per fruit thereby increasing the availability of photosynthates and lesser nutritional competition among the developing fruits, thus improving the fruit weight. These results get support from Casierri *et al.* (2007) [4] who reported fruit with 30 to 45 leaves produced larger fruit. These results are in agreement with those reached by Hussein *et al.* (1977) [8], Ibrahim and Ibrahim (2021) [9] in date palm and Arvind *et al.* (2018) [3] in the guava. Deshmukh *et al.* (2012) [6] reported that increase in LFR improved the fruit weight in Flordasun peach. They recorded the highest fruit weight with 45:1 followed by 35:1 and 55:1 leaf to fruit ratio. Maximum fruit volume (151.57 ml) was observed in T₆ (Leaf: fruit, 14:1). Increase in fruit volume might be due to the increase in the optimum number of leaves per fruit thereby increasing the availability of photosynthates and lesser nutritional competition among the developing fruits, thus improving the fruit volume. The practice of thinning, although increasing the size of fruit, would reduce the total crop per tree. This gives the percentage increase in the volume of the fruit in relation to the percentage of increase in leaf area. Similar results were

found by Arvind *et al.* (2018) [3] in the guava, Rathod *et al.* (2020) [14] and Katekar and Bharad (2020) [10] in custard apple. Maximum fruit size (78.31 mm × 79.40 mm) was observed in T₆ (Leaf: fruit, 14:1). It might be due to the increase in the optimum number of leaves per fruit 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. Similar results were found by Arvind *et al.* (2018) [3] in the guava, Casierri *et al.* (2007) [4] and Patel *et al.* (2014) [13] in peach. Deshmukh *et al.* (2012) [6] reported that increase in LFR improved the fruit length and width in Flordasun peach. They recorded the highest fruit length with 45:1 followed by 35:1 and 55:1 leaf to fruit ratio.

Maximum pulp weight (79.33 g) was recorded in T₃ (Leaf: fruit, 8:1). The increase in pulp weight could be attributed to increase in fruit size which resulted in higher proportionate pulp weight. Similar results were found by Casierri *et al.* (2007) [4] and Patel *et al.* (2014) [13] in peach. Rathod *et al.* (2020) [14] in custard apple. Highest pulp: seed ratio (18.58) was noted in T₃ (Leaf: fruit, 8:1). The increase in pulp: seed ratio could be attributed to increase in fruit size which resulted in higher proportionate pulp weight and there is non significantly influence with seed weight. Similar results were found by Casierri *et al.* (2007) [4] and Patel *et al.* (2014) [13] in peach. Highest pulp: rind ratio (1.29) was noted in T₃ (Leaf: fruit, 8:1). The increase in pulp: rind ratio could be attributed to increase in fruit size which resulted in higher proportionate pulp weight and there is non significantly influence with rind weight. Similar result was found by Rathod *et al.* (2020) [14] in custard apple.

Maximum yield (8.03 kg/plant) and yield (6.69 t/ha) were recorded in T₆ (Leaf: fruit, 14:1). It might be due to more supply and better partitioning of the assimilates among the developing the fruits in these treatments might have been the cause for increasing the yield kg per plant and tonne per hectar. Similar results were found by Patel *et al.* (2014) [13] and Casierri *et al.* (2007) [4] in peach, Rathod *et al.* (2020) [14] in custard apple, Arvind *et al.* (2018) [3] in the guava and Al-Salman *et al.* (2012) [1] in date palm. Similar results were found by Al-Salman *et al.* (2012) [1] in the date palm, Arvind *et al.* (2018) [3] in the guava and Patel *et al.* (2014) [13] in peach.

*Note: Number of fruits per plant was counted by multiplying number of fruit per shoot (1 fruit/shoot) with average total number of shoots per plant (45 shoots/plant). Maximum total sugar (11.77%), reducing sugar (3.80%) and non reducing sugar (7.98%) were recorded in T₅ (Leaf: fruit, 12:1). It 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 with sufficient number of leaves. Similar results were found by Casierri *et al.* (2007) [4] and Patel *et al.* (2014) [13].

Table 1: Effect of leaf to fruit ratio on leaf area, chlorophyll content, leaf carbohydrates (%), fruit length and fruit width in custard apple

Treatment No.	Leaf area (cm ²)	Chlorophyll content (SPAD)	Leaf carbohydrates (%)	Fruit weight (g)	Fruit length (mm)	Fruit width (mm)
T ₁	65.51	45.27	0.44	146.67	55.57	73.43
T ₂	78.09	48.49	0.62	148.33	67.03	72.02
T ₃	77.95	48.99	0.75	150.00	74.84	64.32
T ₄	70.94	46.83	0.46	151.67	71.85	77.15
T ₅	83.51	49.85	0.81	166.00	74.17	75.24
T ₆	87.78	52.83	0.84	178.33	78.31	79.40
T ₇	72.43	47.55	0.47	157.33	73.55	74.32
T ₈	59.44	44.95	0.45	140.00	65.81	67.26
S. Em.±	5.35	1.52	0.01	4.53	1.97	3.00
C. D. at 5%	16.21	4.60	0.03	13.74	5.99	9.10
C. V.%	12.43	5.46	3.13	5.07	4.88	7.13

Table 2: Effect of leaf to fruit ratio on fruit volume, pulp weight, pulp: seed ratio, pulp: rind ratio, yield (kg/plant) and yield (T/ha) in custard apple

Treatment No.	Fruit volume (ml)	Pulp weight (g)	Pulp: seed ratio	Pulp: rind ratio	Yield (kg/plant)	Yield (T/ha)
T ₁	115.97	78.67	13.11	1.16	6.63	5.53
T ₂	126.80	54.33	12.75	0.66	6.67	5.56
T ₃	128.62	79.33	18.58	1.29	6.77	5.64
T ₄	128.75	49.00	10.08	0.50	6.83	5.69
T ₅	149.02	53.00	9.36	0.54	7.47	6.22
T ₆	151.57	62.00	14.45	0.57	8.03	6.69
T ₇	130.83	72.33	12.85	0.85	7.10	5.92
T ₈	111.26	58.33	11.92	0.84	6.27	5.22
S. Em.±	2.44	2.11	1.17	0.07	0.208	0.17
C. D. at 5%	7.41	6.41	3.56	0.22	0.630	0.52
C. V.%	3.25	5.78	15.78	15.72	5.159	5.16

Table 3: Effect of leaf to fruit ratio on total sugar, reducing sugar and non-reducing sugar in custard apple

Treatment No.	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)
T ₁	7.08	2.28	4.81
T ₂	7.92	2.81	5.12
T ₃	9.76	2.96	6.81
T ₄	7.24	1.71	5.53
T ₅	11.77	3.80	7.98
T ₆	8.70	2.88	5.82
T ₇	7.86	3.25	4.61
T ₈	7.77	3.56	4.91
S. Em.±	0.92	0.32	0.86
C. D. at 5%	2.78	0.97	2.60
C. V.%	18.64	19.15	26.06

Conclusion

From results obtained in the present investigation, it is concluded that maximum leaf area (cm²), chlorophyll content (SPAD), leaf carbohydrates (%), fruit weight (g), fruit length (mm), fruit width (mm), yield (Kg/plant) and yield (T/ha), obtained by maintained 14 leaves per fruit in custard apple.

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