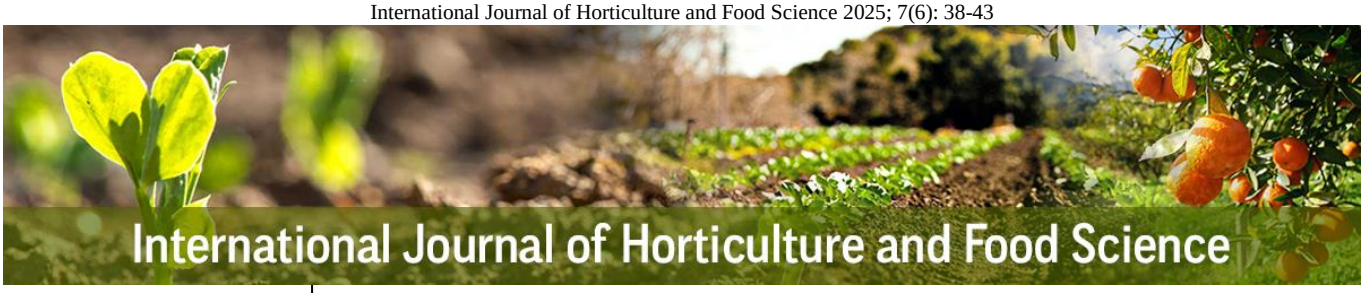

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Effect of assisted pollination on reproductive and fruit quality in custard apple cv. Arka Sahan

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Abstract
A research was conducted at the horticulture research farm, Career Point University, Kota during the session 2024-2025. The experiment consisted of ten treatments combination comprising different pollination time and pollinaizers of different custard apple verities. The experiment design was used of Randomized Block Design with three replications. As regard to reproductive parameters, plants with 1st Pollination of Arka Sahan with Balanagar (T_1) had minimum (7.43) number of days taken to fruit set while maximum fruit set (55.90%) and maximum fruit retention (84.66%) was recorded in 2nd Pollination of Arka Sahan with Raydurg (T_4). In physical parameters, treatment 1st Pollination of Arka Sahan with Balanagar, (T_1) produced maximum number of fruit weight (328.46 g), fruit diameter (9.25 cm) and minimum number of areoles (64.24). Better quality parameters *viz.* maximum pulp weight (251.22 g), pulp per cent (76.41%), highest pulp: seed ratio (24.80), highest rind weight (65.12 g), higher seed length (12.28 mm), maximum seed width (10.01 mm) and minimum seed weight (3.66 g) was recorded under 1st Pollination of Arka Sahan with Balanagar (T_1).

Keywords: Arka Sahan, Pulp, seed, quality, weight

Introduction
Custard apple (*Annona squamosa* L.) also known as sugar apple belongs to the family *Annona*ceae. There are a number of related species of *Annona* which produce edible fruits and used for fresh utilization worldwide. These are (Pritchard and Edwards, 2015), Custard apple (*Annona squamosa L.*), Cherimoya (*A. cherimola* Mill.), Soursop (*A. muricata L.)*, Ramphal (*A. reticulata L.*) and Atemoya (*A. atemoya* Hort.). Among these, custard apple is most choicest and popular crop in the market. Custard apple performs well under dry land conditions and adverse situations where other crops do not perform properly with respect to growth, yield and quality. Custard apple tree is small, more or less shrub or tree, in winter it sheds the leaves.

Custard apple is mainly grown in Maharashtra, Andhra Pradesh, Gujarat, and some pockets of Rajasthan in wild form. Its leaves are used in manufacturing of bio-pesticides. The tree displays yellow proclaim shaped flowers that produce a pleasant sweet smell, with just a small number of flowers setting fruit. Flowers are bisexual, distinctly protogynous. In custard apple some commercial cultivars such as Balanagar, Phule Janki, Arka Sahan, APK-Ca1 *etc.* are popular. All the varieties have large number of seeds except Arka Sahan which, occasionally, becomes a limiting factor in its quality. Therefore, developing a variety with less seed has been prime objective of breeding programmes in custard apple. Among these, Arka Sahan is fulfilling that criteria but again pollination is major drawback self-incompatibility, dichogamy and poor pollination arethe major problems in many fruits like apple, apricot, datepalm, custard apple etc.

Arka Sahan is an inter-specific hybrid which has been developed (Jalikop and Kumar, 2007) [14] by crossing between Island Gem (*Annona cherimola* x *Annona squamosa* Hort.) x Mammoth (*Annona squamosa* L.). Arka Sahan fruits approach to harvest in September-October and mature fruits take about 6-7 days to ripe (Shivakumar *et al*., 2018) [23]. The skin has light green colour with large, flat eyes. The fruit pulp has creamy colour, pleasant aroma with less no of seeds (9/100 g).

Hand pollination is an effective approach which helps not only in good fruit set but also produces big size, attractive uniform shape fruits with no loss in edible attributes. Thus, fruit yield can be significantly increased by artificial pollination. Fruits developing from hand pollination generally command premium price in the market Jalikop and Kumar, 2007 [14], Campos *et al.*, 2004 [7], Melo *et al.*, 2004 [16], Matsuda and Higuchi, 2019 [15]. Hand pollination increases fruit set by around 44 to 60 per cent.

Materials and Methods

Location: Kota district is located at 25.18° N to 75.83° E Latitude in South Eastern Rajasthan. It covers an area of 221.36 km^2. Agro-climatically, the district falls in Zone V, known as Humid South Eastern Plain. The average rainfall in the region is 660.6. mm. Maximum temperature range in the summer is 40 to 48°C and minimum 1.0-2.6°C during winter.

Experimental Details: The present experiment was conducted at the Horticulture research farm, School of Agricultural Sciences, Career Point University, Kota (Rajasthan) during the year 2024-25. The experimental design used for the study was Randomized Block Design, which helps in reducing prejudice and obtaining reliable results by randomly assigning treatments to dissimilar blocks. The treatments comprising of different pollination time and pollinaizers of diverse custard apple varities *viz.* (Un-assisted, natural pollination (T_0), 1st Pollination of Arka Sahan with Balanagar (T_1), 1st Pollination of Arka Sahan with Raydurg (T_2), 1st Pollination of Arka Sahan with APK-Ca 1 (T_3), 2nd Pollination of Arka Sahan with Raydurg (T_4), 2nd Pollination of Arka Sahan with APK-Ca 1 (T_5), 2nd Pollination of Arka Sahan with African (T_6), 3rd Pollination of Arka Sahan with Raydurg (T_7), 3rd Pollination of Arka Sahan with Balanagar (T_8), 3rd Pollination of Arka Sahan with APK-Ca 1 (T_9). So that total ten treatments combination was made.

Pollination Technique: Pollen grains were collected from previously opened flowers from Balanagar, Raydurg and APK-Ca 1. Pollen was collected in a paper cup by shaking the flowers in inverted position. After collecting sufficient pollen grains, the cup was firmly placed in worker's shirt's pocket so that pollen could be dropped easily. Selected female flowers (Flowers about to open) of Arka Sahan were opened and pollen grains smeared on stigma with the help of paint brush No. 2. After pollinating, flowers were date-wise tagged with different colour tags. In second and third time pollination, remaining flowers were pollinated with same methodology. Successful pollination indicated dried stigma after 3-4 days of pollination. During pollination at different time interval 130 flowers in each pollination were attempted for pollination.

Pollen source and collection

Three different pollen source viz. Balanagar, Raydurg and APKCa-1 were selected. Pollen source were collected from fully open flower of previous day. The pollination was been done three times separately as per the following time schedule:-

- 10-15 July (1st Pollination)
- 16-20 July (2nd Pollination)
- 25-30 July (3rd Pollination)

Measurement of the reproductive parameters

The number of days taken to first fruit set was observed when the ovary showed swelled mark and it attained the size equal to fly head. The percentage of fruit set was observed after 25 days of pollination. The data on fruit set was calculated on the basis of total flower converted into well-developed healthy fruit. The percentage of fruit set was calculated by using the following formula:

Fruit set (%) = (Number of fruits set / Total number of flowers) × 100

Data on the fruit retention were observed under each treatment at the time of fruit harvesting. The per cent of fruit retention was calculated by using the subsequent formula:

Fruit retention (%) = [(Total number of fruits – Total fruit dropped) / Total number of fruits] × 100

Determination of the quality parameters

The fruits weight from each tagged plant be taken on every date of harvest by the help of electronic weight balance and the mean was uttered as weight of fruit in gram. Fruit diameter for same fruits was measured by the help of digital Vernier caliper and expressed in cm. Areoles on the fruit surface were counted by hand by putting number on that. Total counted numbers were expressed as areoles. Pulp from the ripened fruits scooped out with a spatula. Seeds were separated and weight of pulp was taken with the help of electronic balance. Mean pulp weight was expressed in gram per fruit. Rind of fruit from five fruits of each treatment was weighed with the help of electronic balance and mean rind weight of fruits was calculated and observed as rind weight in gram. Number of seeds per fruit was calculated by counting the seeds of five randomly selected fruits from every treatment and the average was recorded as number of seeds per fruit in number. Seeds from every sampled fruits were separated from the pulp. Seed length was measured by digital Vernier caliper and presented in mm. Seed width was measured by digital Vernier caliper and expressed in millimeter (mm). Weight of seed in fruits of every treatment was weighed with the help of electronic balance and mean seed weight of fruits was computed and observed as seed weight and expressed in gram (g). Stony fruits were calculated on per plant basis. Total stony converted fruits were calculated and articulate in percentage.

Pulp percent calculated by dividing pulp weight by fruit weight

Pulp (%) = (Pulp weight / Weight of fruit) × 100

The pulp to seed ratio was computed by dividing sum weight of pulp of fruit by total weight of seeds of fruit

Pulp to Seed Ratio = (Weight of pulp / Weight of seeds) × 100

The pulp to rind ratio was calculated by dividing total weight of pulp of fruit by total weight of rind of fruit.

Pulp to Rind Ratio = (Weight of pulp / Weight of rind) × 100

The rind ratio was calculated by dividing total weight of rind of fruit by total weight of fruit

Rind (%) = (Weight of rind / Weight of fruit) × 100

Results

Reproductive parameters

The number of days taken to fruit set was significantly influenced by different treatments. Data are presented in Table 1 was observed that significantly minimum (7.43) number of days was taken for fruit set in Arka Sahan with Balanagar (T_1) and maximum (10.03) in un-assisted, natural pollination (control). Observations indicate that fruit set percent was significantly influenced by sources of pollen and time of pollination (Table 1). Pollination with Balanagar was observed better for enhanced fruit setting. Significantly maximum fruit set (55.90%) was recorded in T_4 (Arka Sahan with Raydurg) while minimum (11.17%) was recorded with un-assisted, natural pollination (control). Fruit retention is an important parameter to determine final yield. In our result, we got a clear cut conclusion that the treatment T_4 exhibited maximum fruit retention (84.66%) whereas the minimum fruit retention was recorded in T_0 (un-assisted, natural pollination), (47.14%).

Physical quality parameters

The data in respect to the fruit weight (g) from different treatments at different interval of time plants were showed in Table 2. From the data, it has been observed that source of pollen as well as time significantly increased the fruit weight (g) as compare to natural pollination. In this study, treatment Arka Sahan with Balanagar (T_1) had highest fruit weight (328.46 g) while, T_0 had the minimum (80.80 g) fruit weight. Moreover, a treatment T_3, T_6 and T_8 were statistically at par each further in weight of the fruits but was significantly lesser than other treatments. The perusal of the data reveals that application of assisted pollination had significantly affected on fruit diameter (cm). The maximum (9.25 cm) fruit diameter was recorded in T_1 while, the minimum (4.41 cm) was recorded in T_0 (control). In present study, data shows that application of assisted pollination had significantly affected on number of areoles per fruit. The lower (64.24) number of areoles per fruit was recorded in T_1 while, the highest (81.24) was observed in T_0 (Un-assisted, natural pollination).

The close review of data reveals that application of assisted pollination brought perceptible variation in pulp weight (g) have been recorded in Table 3. The observation of the data reveals that effect assisted pollination increases the pulp weight (g) significantly over the control. Among different treatments, Arka Sahan with Balanagar (T_1) exhibited maximum pulp weight (251.22 g). Lower Pulp weight (50.90 g) was recorded in Un-assisted, natural pollination. From the data it was found that assisted pollination and time affected the pulp per cent significantly. The maximum pulp per cent (76.41%) was recorded in treatment T_1 while, the minimum (61.47%) was recorded in the T_0. From the mean value of data, it was found that assisted pollination did not affect the pulp: seed ratio significantly. Treatment T_1 was statistically at par with T_2. Value wise T_1 had the highest pulp: seed ratio (24.80) while, the lowest was recorded in T_0 (13.57). Average value of rind weight (g) as influenced by assisted pollination and time of pollination have been recorded. Rind weight of fruit is a major physical property which affects the shelf life and pulp percent. It was evident that pollination time and source significantly affected the weight of rind. Rind weight is directly proportionate to fruit weight. The Arka Sahan with Balanagar (T_1) had the highest rind weight (65.12 g) while, the lowest was recorded in T_0 (25.09 g). Weight of rind was converted into total percent *i.e.* rind percent. From the analyzed data, it was reported that minimum rind (18.47%) was found in treatment 2nd Pollination of Arka Sahan with Raydurg (T_4) while, maximum (31.05%) was recorded in the T_0 (control). The analyzed data belonging to the pulp: rind ratio have been presented in Table 3. The observation of the data expose that effect of application of assisted pollination increased the pulp: rind ratio significantly over the control. The pulp: rind ratio was recorded maximum (3.86) in treatment 1st Pollination of Arka Sahan with Raydurg (T_2) while; minimum (2.03) was recorded in the T_0.

In our case we have calculated the no of seeds per fruit and mean value of data have been presented in Table 4. Here, the data evident that effect pollination increased the No. of seeds/fruit significantly in excess of the natural pollination *i.e.* T_0 (Un-assisted, natural pollination). The numbers of seeds are openly correlated with size of fruits and no of areoles. The No. of seeds/fruit was observed minimum (9.77) in treatment T_0 while maximum (27.77) was observed in the T_1 (control). The data related to seed length (mm) as influenced by assisted pollination effect have been analyzed and presented (Table 4). A keen observation of the data reveals that, assisted pollination showed a scattered pattern unlike the seed numbers. Treatment T_1 had higher seed length (12.28 mm) but non-significant with T_2 whereas it was minimum (10.00 mm) in T_0 (Un-assisted, natural pollination). It is evident from the data that, assisted pollination had significantly affected the seed width (mm). The T_1 had the maximum (10.01 mm) seed width (mm) whereas, the minimum (3.67 mm) seed width (mm) recorded in T_0 as compare to other treatments. It has been reported maximum seed weight (10.08 g) was recorded in T_1 while, minimum seed weight (3.66 g) in T_0 (Un-assisted, natural pollination). Our data suggested that likewise seed width, seed weight also influenced by assisted pollination and time of pollination. In custard apple conversion of fruit into stony is common problem but in present study there were no stone fruits observed.

Discussion

The days taken to fruit set in Arka Sahan greatly varied with pollen source and time of pollination. In our study minimum number of days taken by plants which were pollinated with Balanagar pollens. The differences in days to fruit set might be recognized to pollen germination earlier as in case of Balanagar pollen. In case of natural pollination the germination of pollen grains could be delayed due to poor viability and germination capacity of the pollen grains as observed in the previous study also by Jalikop and Kumar, (2007) [14]. Fruit set significantly affected by hand pollination and time of pollination higher number of fruit where recorded in treatment T_4. Number of fruit determines overall yield and quality of the fruit. The maximum fruit set in Balanagar pollinated plants could be due to proper fertilization and pollen tube germination in more number of flowers. Further the less number of pollen grain germination in other pollen sources and natural pollination, continuous rainfall heavy wind and other climatic factors might be

possible reasons for poor fruit set in other plants which were pollinated with Raydurg and APK CA-1 pollens. In a previous study of Kahn *et al.* (1994) reported effects of maternal and paternal parents on fruit set percentage in cherimoya. In addition to that continuous rain fall triggered dropping of the flowers just after pollination. The similar reports were observed by (Richardson and Anderson, 1995 and Melo *et al.* 2004) [16] in various species of *Annona* in which they have reported higher fruit set in stimulated pollination. The maximum fruit retention percent in Balanagar pollinated plants might be due to appropriate fertilization and pollen tube germination. Similar findings reported by Mesejo *et al.* (2008) [17] in mandarin and Vardi (2008) [25] in citrus.

Fruit weight is a vital parameter to determine overall plant yield. Fruit weight was significantly exaggerated by assisted pollination and time of pollination higher fruit weight which was recorded in treatment T_1. In a previous study similar finding may be attributed to results obtained using artificial pollination emerge to get better fruit quality this might be due to a superior distribution of pollen on all the stigmas of the female flowers more than to an supplementary involvement of pollen (Blanchet, *et al.*, 1991) [6] and improve cell division and cell magnification which leads to augment in higher fruit weight. The parallel reports were experimental by Gonzalez *et al.* (1998) [11] in kiwi fruit, Jalikop and Kumar (2007) [14] in custard apple. Fruit diameter considerably affected by assisted pollination and time of pollination. In an earlier study similar finding may be attributed to results obtained using diverse time of pollination appear to get better fruit diameter this could be due to natural thinning consequently augment cell division and cell enlargement as well as the biosynthesis of carbohydrates regarding and proteins Abdel-Galil *et al*., (2007) [1] and Elham *et al*., (2006) [9]. The similar reports were recorded by Ahmed *et al*., (2013) [2] and Gupta (2017) [12]. Fruit weight was significantly affected by assisted pollination and time of pollination higher fruit weight which was observed in treatment T_1. This might be owing to pollen source affects the growth of ovarian tissues through respect to hormones at large by growing endosperm and embryo tissues, which disperse into the ovarian tissue and apply specific effect on the fruit growth. Earlier parallel kind of results has been found by El-Makhtoun and Kader, (1993) [10]. Number of areoles per fruit significantly affected by assisted pollination and time of pollination. Least number of areoles per fruit was observed in treatment T_1. In case of custard apple areoles determine the shape of fruits. Areoles on the fruit surface are determined by different genes. Arka Sahan has bit compressed and complex areoles. Appropriate pollination imparts accurate shape. Maximum number of areoles in treatment T_1 could be owing to suitable pollination and genetic nature of pollen source cultivar. In adding up to that individual ovary may be attributed to areole development. Larger no of ovary is unswervingly correlated to number of areoles on fruit shell.

Pulp percent considerably exaggerated by assisted pollination and time of pollination. In present study higher pulp per cent was also recorded in T_1. The better fruit size and volume of fruit accredited to high pulp percent. Maximum pulp weight resulting maximum percentage of pulp. Hand pollination enhanced fruit quality parameters in kiwi fruits as cribbed by improved distribution of pollen on stigma than the normal pollination (Blanchet *et al*. 1991) [6]. Pulp: seed ratio considerably affected by assisted pollination and time of pollination superior Pulp: seed ratio which was observed in treatment T_1. The highest pulp: seed ratio in Balanagar pollinated plants might be due to appropriate fertilization and pollen tube germination which show the way to drastically improved Pulp: Seed ratio as evaluate to the control. In previous study similar finding by Awad and Al-Qurashi (2012) [4], Rezazadeh *et al.* (2013) [20] in date palm. Pulp: rind ratio notably affected by assisted pollination and time of pollination higher Pulp: rind ratio which was recorded in treatment T_2. Reason being less peel thickness and average pulp weight was higher in treatment T_2. The higher loosening of the pulp might be a possible reason for high pulp rind ratio. Shivakumar *et al*. (2018) [23] reported combined role of growth regulators after artificial pollination which increases pulp ratio by cell division and cell elongation. Rind weight was notably affected by assisted pollination and time of pollination. Though, rind weight is not desirable in higher side but having keen importance in determining shelf life. Higher rind weight was recorded in treatment T_1 as compare to other. This is as supplementary cell division and increasing the cell density per unit volume (Bhat *et al*., 2012) [5]. In adding up to that, mineralogy, leaf shoot ratio and cell wall structuring complex also play equal role in rind development. Previous studies by Peng *et al*., (2004) [18] and Shivkumar *et al.* (2018) [23] support our findings. Rind percent also expresses the total contributory part of rind in total fruit. Higher weight of rind could impart higher rind percent in T_1. Besides, better fruit size and volume due to appropriate pollination and fertilization may influence the ratio of rind. Being green in colour, photosynthates are also equally responsible.

Higher seed in fruits may responsible for taste and quality but not desirable in custard apple. Here, no. of seed per fruit was considerably affected by assisted pollination and time of pollination. In our study, fruits for T_1 observed higher number of seeds. Ovule development as a fertilization progression leads to last seed enlargement. Being an aggregate fruit, multiple ovaries renovate into areoles. Each areole contains approximately seeds. Number of pollen grains, improvement of ovule may be a possible reason of seed development. In earlier study parallel findings recommended that elevated seed number in the fruits emerging from *A. squamosa* pollens can have triggered rapid fruit development. It is well documented that developing seeds and their association with hormones (mostly auxin) also responsible (Dag and Mizrahi, 2005) [8]. Higuchia *et al.* (1998) [13] also reported that warm temperature and short viability of pollen resulting a symmetrical and small size fruits, which may produce little seeds. Seed length which was recorded maximum in treatment T_1. Reason behind, seed length is physiology and hormone distribution at the time of seed development. Also justified that high pollen densities produces higher number of seed and heavier fruit size which could result bigger size of seed. Similar finding were reported by Al-Muhtaseb and Ghnaim, (2006) [3] in date palm. Seed weight significantly affected by hand pollination and time of pollination higher seed weight which was recorded in treatment T_1.This might be due to the pollen resource affects the growth of ovarian tissues by means to hormones released by growing endosperm and embryo tissues, which circulate into the ovarian tissue and apply specific result on the fruit growth

(Shafique *et al.*, 2011) [22]. Earlier parallel discover of results have been originate by El-Makhtoun and Kader, (1993) [10] in date palm.

There are no stone fruit found during entire study period. However, reason for stony fruits are still unknown but some researchers reported that Ca content, moisture deficient and temperature are possible reasons.

Conclusion

It can be concluded that reproductive characteristics and fruit quality of Arka Sahan custard apple considerably exaggerated by assisted pollination and time of pollination. In present study, maximum fruit set and fruit retention and was obtained maximum in treatment T4 where 2nd Pollination of Arka Sahan with Raydurg in second week of July.

Table 1: Effect of different treatments on days taken to fruit set, fruit set (%) and fruit retention (%) of custard apple (*Annona squamosa* L.*)* cv. Arka Sahan

Treatments	Days taken to fruit set	Fruit set (%)	Fruit retention (%)
T_0	10.03	11.17	47.14
T_1	7.43	39.61	80.47
T_2	8.03	35.99	68.43
T_3	9.46	36.67	58.47
T_4	7.91	55.90	84.66
T_5	8.87	49.72	70.51
T_6	9.63	40.03	62.54
T_7	8.43	53.21	82.77
T_8	9.17	48.88	69.65
T_9	9.79	32.46	60.87
S.E.M (±)	0.14	1.00	0.40
CD 5%	0.43	2.98	1.22

Table 2: Effect of different treatments on fruit weight (g), fruit diameter (cm), and no. of areoles of custard apple (*Annona squamosa* L.*)* cv. Arka Sahan

Treatments	Fruit weight (g)	Fruit diameter (cm)	No of areoles per fruit
T_0	80.80	4.41	81.24
T_1	328.46	9.25	64.24
T_2	305.80	8.81	67.73
T_3	199.46	8.20	71.91
T_4	267.80	8.37	73.24
T_5	239.80	7.37	75.92
T_6	207.13	6.55	80.06
T_7	258.80	8.05	75.04
T_8	208.13	7.27	77.5
T_9	200.46	6.62	79.24
S.E.M (±)	3.30	0.12	1.19
CD 5%	9.92	0.37	3.45

Table 3: Effect of different treatments on pulp weight (g), pulp (%), pulp: seed ratio, rind weight (g), rind (%) and pulp: rind ratio of custard apple (*Annona squamosa* L.*)* cv. Arka Sahan

Treatments	Pulp weight (g)	Pulp (%)	Pulp: seed ratio	Rind weight (g)	Rind (%)	Pulp: rind ratio
T_0	50.90	61.47	13.57	25.09	31.05	2.03
T_1	251.22	76.41	24.80	65.12	19.83	3.86
T_2	234.89	76.11	24.78	59.79	19.55	3.93
T_3	143.55	71.35	20.51	47.46	23.79	3.02
T_4	197.22	73.19	21.66	49.46	18.47	3.99
T_5	175.22	72.56	21.45	54.46	22.71	3.22
T_6	152.22	72.90	20.13	45.79	22.11	3.32
T_7	195.55	75.09	24.79	53.46	20.66	3.66
T_8	151.22	72.07	19.18	47.46	22.80	3.19
T_9	145.72	72.08	19.69	46.12	23.01	3.16
S.E.M (±)	2.25	0.15	0.14	1.00	0.51	0.02
CD 5%	6.52	0.45	0.40	2.04	1.04	0.06

Table 4: Effect of different treatments on no. of seeds/fruit, seed length (mm), seed width (mm) and seed weight (g) of custard apple (*Annonas quamosa* L.) cv. Arka Sahan

Treatments	No of seeds/ fruit	Seed length (mm)	Seed width (mm)	Seed weight (g)
T_0	9.77	10.00	3.67	3.66
T_1	27.77	12.28	10.01	10.08
T_2	27.44	11.85	9.31	9.43
T_3	20.44	10.49	7.68	6.94
T_4	26.77	11.32	8.74	9.05
T_5	22.44	11.22	8.17	8.11
T_6	20.77	11.16	7.35	7.50
T_7	25.03	11.55	8.13	7.84
T_8	23.77	11.42	7.62	7.82
T_9	21.77	10.68	6.94	7.34
S.E.M (±)	0.40	0.17	0.22	0.15
CD 5%	1.21	0.50	0.67	0.46

Fruit value characteristics like fruit weight, fruit diameter, minimum no of areoles per fruit, maximum pulp weight, pulp percent and pulp: seed ratio were found to be best in treatment 1st Pollination of Arka Sahan with Balanagar, (T_1).

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Declaration of Competing Interest

No interests to declare.

Authors' contributions Statements

Gunjan Sharma contributed to data compilation, data investigation and writing, Mahaveer Suman contributed to conceptualization, research supervision and writing, Gunnjeet Kaur contributed to writing, Deva Ram Meghawal, contributed to data analysis and writing.

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