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Studies on flowering behavior of different genotypes of custard apple

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Abstract
The present investigation was carried out to studies on floral biology of different genotypes of custard apple (*Annona squamosal* L.) during *Kharif* season. The results of the study indicated that, floral biololgy studied among different Genotypes/Selections and Cultivars maximum, flowers per shoot (6.84), days required to full bloom (60.92), time of anthesis (5.35 a.m.), were recorded foremost in Sindhan while minimum days to flowering (26.66) was observed in GJCA-1 and Selection-7 took least time for dehiscence (10.33 a.m.). However there was negligible variation observed in case of number of petals per flower in all genotypes.

Keywords: Flowering in custard apple, floral biology

Introduction
Custard apple (*Annona squamosa* L.) is an arid fruit crop belonging to the Annonaceae family and hardy in nature requires dry climate with mild winter. It can grow successfully upto 100 m above the mean sea level. This family contains over 2000 members spread throughout the world. The other important features of annonaceous fruits are their wider adaptability to soil and climatic conditions and free from pests and diseases. Due to their hardy nature and escape from animal damage, they have become naturalized in many tropical and subtropical parts of the world along with a tremendous scope for further expansion. It is widely distributed through-out tropical South America and also grown commercially in Africa, Australia, China, India, Mexico, Southern United States, Philippine and Thailand. In Gujarat, it is cultivated in Junagadh and Bhavnagar district of saurastra region. Local cultivar Sindhan is most popular in Saurastra region among the growers. Area under custard apple is also increasing in other district like Ahmadabad, Sabarkantha, Banashkantha, Gandhinagar, Anand and Patan. The floral biology study has been carried out in various parts of the world but there is still scope to study more genotypes. An existence of variability in variety provides an opportunity and opened a new vista for the export of good quality custard apple to abroad and more reliably in favour of the growers. Variability gives an opportunity and imparts for research to custard apple breeders.

Materials and Methods
Present investigation Studies on floral biology of different genotypes of custard apple (*Annona squamosal* L.) was carried out on 23 to 25 years old trees having uniform growth with spaced at 6 m x 6 m at Fruit Research Station, Madhadi Baugh, Department of Horticulture, College of Agriculture, Junagadh Agricultural University, Junagadh during *kharif* 2017. The experiment was laid out in Randomized Block Design (RBD) with three replications and eight different treatments. The treatment comprised of different Genotypes/Selections and Cultivars viz., Selection-7, Selection-11, Selection-15, Selection-20, Selection-21, Selection-22, GJCA-1 and Sindhan. All the cultural operations like weeding, interculturing and irrigation were adapted uniformly to all experimental plants. Observations of various flowering attributing characters Viz; days to flowering, number of flowers/shoot, days required to full bloom stage, time of anthesis, dehiscence and no. of petals per flower were recorded. The statistical analysis was done by standard statistical method suggested by Panse and Sukhatme, (1985) [5].

Results and Discussion
Days to flowering
There was much variation in number of days taken for flower bud to attain full bloom stage in different genotypes of custard apple. In the present study, the Selection-11 had taken 33.10 days to flowering, whereas the GJCA-1 took 26.66 days. These variations may be due to the different genetic makeup of the individual.

These results are in conformity with Lenka *et al.* (1996) [4] revealed that the chiku crop requires 55.30-60 days from flower bud initiation to anthesis. Srivastava and Singh (2000) [9] reported that flowering duration was longest (29 days) in Bael.

Number of flowers /shoot

Among the data regarding number of flowers per shoot higher number of flowers per shoot was observed on Sindhan (6.84) and minimum number of flowers per shoot was observed in Selection-20 (4.74). These results are more or less in conformity Janick and Paull (2008) [2] with flowers are axillary, pendant, single or in clusters of two to five on leafy shoots in *Annona squamosal* L. Sao Jose *et al.* (2014) [7] reported that studies in India showed that flower bud of custard were strongly affected by the lack of nitrogen.

Days required to full bloom stage

The maximum days required to full bloom stage was recorded in Sindhan (60.92). While, the minimum days to full bloom stage was recorded in Selection-7 (51.96). These results are in accordance with the results of Kumari *et al.* (2016) [3] most of ber the cultivars were in full bloom in the 3rd week of September, however cultivar Sanaur-4 was first to come into full bloom (12th September) followed by Gola (13th September). Ranjari Selection-2 was the last to come into full bloom (24th September).

Time of anthesis

Variable percentage of anthesis occurred at the same time in different genotypes of custard apple. Sindhan was first to show anthesis. However, least anthesis occurred during day period from 9:00 a.m. to 6:00 p.m. The optimum time for anthesis was found during early morning with the peak period of anthesis from 5.30 a.m. to 7.30 a.m. in all the genotypes of custard apple. It was observed that time of anthesis varied from cultivar to cultivar and also governed by environmental conditions. It may be due to lower temperatures and higher humidity favoured the rate of anthesis while higher temperature and lower humidity lowered the rate of anthesis. These results are in conformity with the findings of Sahoo *et al.* (2000) [6] revealed that anthesis occurred from 02:30 a.m. hr to 18:30 p.m. hr with peak period 5:30 a.m. to 6:30 a.m.in custard apple. Thakur and Singh (1965) [10] reported that highest number of flowers opened in the morning and in the evening than at any other time during the day. Thus low temperature and high relative humidity were condusive for anthesis.

Time of dehiscence

Dehiscence commenced just after few hours of anthesis and about three to four hours were taken to complete the process. The optimum time for anther dehiscence was found from 10.00 a.m. to 2:00 p.m. with a peak period of dehiscence in most of the genotypes was between 10.00 a.m. to 12.00 p.m. It was observed that anther dehiscence was maximum in Selection-22 (11:59 a.m.) and minimum in Selection-7 (10:33 a.m.). None of the genotypes custard apple showed anther dehiscence during evening hours and early morning. These results are in conformity with the Chitkara and Singh (1979) [1] found that anther dehiscence occurred between 12 noon to 2 p.m. in Flordasun, Matchless, Peach Dwarf and Australian Dwarf, while in case of Dwarf Golden Treasure it occurred between 10 to 12 a.m. The delay in anther dehiscence during autumn flowering as compared to spring flowering season might be due to high relative humidity (71.7 %) and low temperature (21.8 ºC) prevailing during September in comparison to low relative humidity (60.3%) and high temperature (23.9 ºC) during April (2004). Seth (1962) [8] reported that in guava humidity and to some extent fluctuation of minimum temperature, greatly influenced the timing of anther dehiscence. However, of these two factors, humidity is more important as even slight variation in it at a particular temperature cause a marked difference in the time of anther dehiscence.

Number of petals per flower

The data regarding number of petals per flower was found non-significant in different genotypes of custard apple. Number of petals per flower was found same in all genotypes. No variation was observed in any treatment.

Table 1: Flowering attributes in different genotypes of custard apple

Selections	Days to flowering	No. of flowers /shoot	Days to full bloom	Time of anthesis (a.m.)	Time of dehiscence (a.m.)	No. of petals per flower
Selection-7	29.22	5.30	51.96	6.35	10.33	3.03
Selection-11	33.10	5.02	56.40	6.50	11.12	3.01
Selection-15	28.17	5.84	54.05	6.43	11.30	3.02
Selection-20	28.40	4.74	52.96	7.12	11.27	3.04
Selection-21	29.70	6.06	54.78	7.30	11.59	3.02
Selection-22	31.81	6.25	53.59	7.08	11.20	3.03
GJCA-1	26.66	6.62	55.78	5.50	10.48	3.01
Sindhan	27.03	6.84	60.92	5.35	10.50	3.00
S. Em. ±	0.92	0.18	1.60	0.24	0.28	0.02
C. D. at 5 %	2.78	0.56	4.85	0.73	0.84	NS

Conclusion

The observations recorded from the present investigation revealed that, floral biololgy studied among different Genotypes/Selections and Cultivars maximum, flowers per shoot (6.84), days required to full bloom (60.92), time of anthesis (5.35 a.m.), were recorded foremost in Sindhan while minimum days to flowering (26.66) was observed in GJCA-1 and Selection-7 took least time for dehiscence (10.33 a.m.). However there was negligible variation observed in case of number of petals per flower in all genotypes

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