



PROSPECTS AND POTENTIAL OF CUSTARD APPLE IN RAJASTHAN

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ABSTRACT : Rajasthan state of India holds promise in availability of germplasm of custard apple belonging to genus *Annona* in Mewar and Hadoti regions comprising of Udaipur, Chittorgarh, Baran and Jhalawar districts. Custard apple exists in the form of landraces. The tribal people harvest them and sale in the local markets. There exists a lot of scope to identify best one amongst wild germplasm available in plenty. Selection may be made against early bearing, synchronous maturity of sexes, poor fruit setting, freeness from mummification, soft and mealy texture, fruit size, shelf life besides ravages to pests and diseases. Horticultural interventions are the need of hour to really harvest the food and nutritional values of the fruit. There is a great need to preserve existing biodiversity of custard apple in the state with sustainable efforts being needed to enhance production, accelerate research and develop capabilities to make custard apple as profitable farming enterprise amongst fruit growers of the Rajasthan state.

Keywords : Custard apple, landraces, germplasm, morphological traits, quality.

Custard apple (*Annona squamosa* L.) is one of the most delicious and sweet arid fruits known mostly for its dessert and confectionery values. Custard apples are native to South America. It belongs to the family Annonaceae. The pleasant flavour and wild aroma have a universal liking about this fruit. Being rich in carbohydrate (23.0g/100g) and possessing pleasant flavour custard apple fruits are utilized for ice cream making as reported by Maurya and Singh (5) and Nath *et al.* (6). The fruit is reported to have moisture 70.5g, protein 1.6g, fat 0.4g, minerals 0.9g, fibre 3.1g, calcium 17.0mg, phosphorous 47.0 mg, iron 1.5 mg, thiamine 0.07 mg, riboflavin 0.17 mg, niacin 1.30 mg, Vitamin C 37.0 mg and energy 104 Kcal reported in the findings of Gopalan *et al.* (4) as well as by Singh (7). Rajasthan state of India is blessed with natural biodiversity of the crop and its wild land races are found distributed all along as a natural stand over an acreage of approximately 673 hectares in the Aravalli range of forest scattered across Udaipur, Chittorgarh, Kota, Baran and Jhalawar districts. Custard apple is generally found growing spontaneously in wild forests, scrub jungles, rocky slopes as a semi-wild fruit in Rajasthan. Custard apple exhibits a typical intermediate phenological behaviour between temperate and evergreen types being deciduous under North Indian and evergreen in Central and Southern India. Custard apple being very hardy, survives well under drought, salinity and marginal soil conditions.

Custard apples are mostly grown as rainfed crop. It grows very well even on shallow soils at the mercy of nature. Its flowering coincides with maximum moisture availability during rainy period makes it quite at home under stress conditions. Shedding off leaves during stress conditions is another associated escape mechanism which offers ample scope for cultivation of custard apple in arid regions. There is no well organized orcharding of this crop. In Rajasthan where more than 57% area covering 61% of total area under desert in country is desert as reported by Chandra (2) attributing curse of nature in form of scorching sun shine, soil salinity, alkalinity, dry aquifer etc. Under such situation, there is a need to popularize custard apple so that its amenability to fit well under stress environment can be befittingly utilized. Keeping these points in view, a survey work was conducted in Udaipur, Baran, Chittorgarh and Jhalawar districts to assess the fruit quality of wild land races of Custard apple during November-December, 2010 to explore the quality status of germplasm under natural conditions so as to draw inferences as regard to the existing quality attributes of the crop with a view to have an account of its further improvement.

MATERIALS AND METHODS

The area falls under Zone VI A of Rajasthan. The region receives on an average 800 mm rainfall and average temperature lies in the range of 10 to 48°C. However, the maximum temperatures during summer cross the mark beyond 45°C and that the minimum

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temperature during winter falls to 2°C. A survey of habitat of wild custard apple was made in different locations in Udaipur, Baran, Chittorgarh, Kota and Jhalawar districts during November-December, 2010. From each location, twelve fruits were collected by random sampling of physiologically mature fruits from three trees under each site. Thus total 182 fruit samples were collected from seven locations of all the four districts as per details given below :

1. Junakhera, Jhalawar
2. Nahargarh, Baran
3. Chittorgarh Fort, Chittorgarh
4. Deola, Udaipur
5. Kotra, Udaipur
6. Kelwara, Rajsamand
7. Dara, Kota

The collected fruits were analyzed for physico-chemical attributes for further quality analysis. Average of fruits as well as pulp was taken using electronic balance. TSS content was directly measured through "Zeiss" hand refractometer (0-32) on percentage basis at 20°C room temperature. The pulp was separated manually from the individual seeds and pulp weight/fruit was recorded. The number of seeds/fruit was calculated and seed weight/fruit was also recorded. The acidity of fruits was determined by titrating aliquot of fruit juice against standard N/10 NaOH solution as per the method suggested by AOAC (1).

RESULTS AND DISCUSSION

Morphological Characters

A significant variation in morphological characters of fruits was observed in the land races of custard apple collected from study area (Table 1). Variations in shape (round and cordate), fruit colour (yellowish green, light green, pale green), pulp colour (pale white, creamy white) and areole shape (rounded, rounded and fused, mammiform) of fruits were observed. The areoles were prominent and the rind was leathery in the landraces collected from Dara and Baran Germplasm. The areoles are rounded and smooth in Baran and Kota Germplasm and faintly demarcated. Among the seven landraces, the landraces from Baran site had an attractive rind colour. The pulp colour varied from pale white to creamy white. Jhalawar, Baran and Kota landraces had pale white colour while the landraces from Chittorgarh, Udaipur and Rajsamand had a creamy white colour. The maturity of fruits

coincided with first week of November to first week of December. The importance of variation in *Annonas* in breeding programme has been elucidated by Cliff (3).

Physical Characters

The physical parameters determine the quality of fruit and there was significant variation among germplasm in physical parameters (Fig.1). The fruit weight ranged from minimal 89.50 g in germplasm collected from Chittorgarh to maximal 149.75 g in those collected from Baran. The fruit weight is a genetically controlled character and varied significantly in different landraces and illustrated in Fig.1. The pulp weight ranged minimal 21.50g in germplasm from Chittorgarh and maximal 47.00g in those collected from Baran Germplasm. The minimal seed weight 11.50g was observed in Jhalawar Germplasm and maximal 13.25g in those collected from Deola and Udaipur Germplasm. The seed number per fruit varied from 35.25 to 42.00.

Quality related traits

The chemical constituents of the fruit; mainly total soluble solids (TSS), acidity showed variations among the different landraces elucidated in Fig.1. The TSS ranged from 16.12 to 18.07 °brix. It was maximal in landraces collected from Kelwara and Rajsamand Germplasm (18.07 °brix) followed by those from Baran site (17.87 °brix). There was no significant variation in titratable acidity. The shelf life of fruits ranged from 5 to 6 days at ambient temperature. The maximum shelf life of fruit was observed in the fruits of germplasm brought from Baran and Dara, Kota site (6 days) which might be due to thin leathery rind in Baran and Dara Germplasm. The utility of rigid cell wall in containing cell contents intact has been highlighted by Wills *et al.* (8).

Strategies for growing environment

Flowering

Custard apples flowers during summer over a period of 2-3 months from April to July in Northern India. There is no fruit set reported during spring under North Indian conditions during spring and summer and fruit set only occurs during rainy season. The flowering pattern is strongly associated with the vegetative growth of the trees and flowering intensity is dependent upon new season on small laterals similar to guava. The poor fruit set in custard apples is due to dichogamy phenomena in which the stamens mature and shed their pollen at a different time than the pistils are receptive. Therefore, the fruit set in Custard apple can be increased by hand pollination. Closer planting is also preferred for better pollination and fruit set. There

Table1 : Morphological characteristics of custard apple land races.

S.No.	Locations	Time of fruit harvest	Fruit shape	Fruit colour	Areole shape	Depth of furrow	Pulp colour
1.	Junakhera, Jhalawar	November	Round	Yellowish green	Rounded	Shallow	Pale white
2.	Nahargarh, Baran	November	Cordate	Yellowish green	Rounded & fused	Shallow	Pale white
3.	Chittorgarh	November	Cordate	Light green	Rounded	Shallow	Creamy white
4.	Deola, Udaipur	November	Round	Light green	Rounded	Shallow	Creamy white
5.	Kotra, Udaipur	November	Round	Pale green	Rounded	Shallow	Creamy white
6.	Kelwara, Rajsamand	November	Round	Pale green	Rounded	Shallow	Creamy white
7.	Dara, Kota	November	Round	Light green	Rounded	Shallow	Creamy white

exists a strong competition between new developing vegetative flushes and growing fruitlets and it creates a strong sink effect on competing fruitlets, which causes internal fruit quality problems such as brown pulp and woodiness. There is a need to apply calcium through

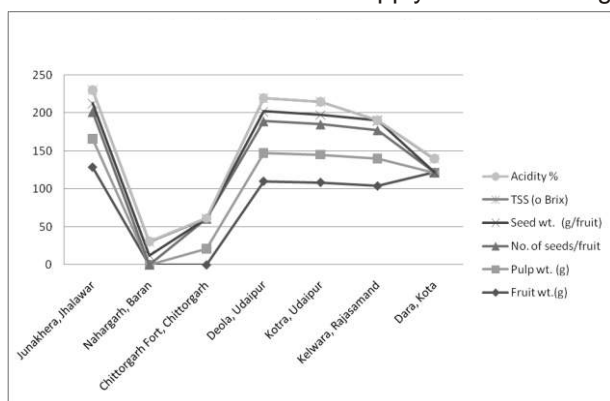


Fig. 1 : Variations in physico-chemical attributes of natural landraces of custard apple in Rajasthan.

foliar sprays to check internal fruit quality problems.

Temperature

There is a significant role of temperature affecting the timing and span of flowering, fruit growth, ripening on fruit quality attributes. Temperatures of 25-30°C during July are favourable for good fruit set. Beyond temperature range of 30°C, there is excessive vegetative growth and fewer flowers as well as excessive drying of flowers. Temperatures above 35°C are conducive to growth of vegetative flushes and there is reduced fruit set and concomitant increase in vegetative biomass with a reduced fruit set. Low temperatures especially below 10°C encountered especially at the later stages of fruit development causes skin discoloration and fruit splitting in custard apples. Custard apples are highly sensitive to frost at

low temperatures of 5°C or less are there in the winter season. Overhead intermittent misting for maintaining relative humidity and windbreaks should be erected around new custard apple plantations for ensuring suitable microclimate for enhancing pollination.

Relative humidity

For ensuring good fruit set and good fruit shape, the range of relative humidity must be within 70 to 85% under north Indian conditions. Poor fruit set is observed if relative humidity remains less than 30% during flowering season. During summers heat stress (days with temperatures above 40°C) adversely affects fruit set. Fruit burning can be noticed by high loads of radiation. A high diurnal temperature range maximum enhances the chances of pollination and fruit set in custard apple. Very low humidity at the time of flower initiation causes pollination failure and desiccation of pollens and ultimately fruit set failure. Fruit set is better when humidity is high.

Assimilation Physiology

Custard apple has similar rates of Pn as compared to temperate fruits *i.e.* 10 to 16 $\mu\text{mol m}^{-2}\text{s}^{-1}$. Trees compensate for increasing fruit loads by increasing Pn by about 25%. Pn and gs of Annona species are highly positively related to increasing relative humidity of atmosphere. High photosynthetic rate coupled with high relative humidity is a key factor in the improvement of fruit set and to aid movement of pollinating insects.

Soil

Custard apple prefers well drained loamy soils; however it grows over wide pH range of 7.0 to 8.5 under different type of soils. There should not be water

logging conditions for long time as it hampers aeration and rhizosphere health.

Post Harvest temperature range

One of the key factors to avoid blackening of custard apple fruits under cool storage conditions is temperature optima of 10°C and during transit journey to different locations.

Conclusion

Existence of variability in custard apple germplasm indicates ample scope for improvement of annonas landraces found adapted under sub mountainous tracts of Aravalli hills. There is a natural gene sanctuary in the Aravalli mountain tracts of Rajasthan. However with deteriorating nature and degrading natural ecosphere genetic erosion is very rampant so also floral diversity of custard apple is under hard pressure of eco-catastrophe. Both in-situ and ex-situ conservations are the need of the hour. They will pave the way for further breeding and improvement against various morphological and physico-chemical attributes like fruits shape, size, colour, pulp colour, time of harvesting, fruit weight, pulp weight, seed size, less number of seeds, high pulp: stone ratio, sugar, acidity etc. It is essential from the view point of hastening diversity of orcharding and also in product range based on custard apple fruits.

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