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Study of fruit set, yield and fruit drop in different varieties of sapota (*Manilkara zapota* L.)

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Abstract
The present investigation was conducted at Fruit Research Station, Jambuvadi, College of Horticulture, Junagadh Agricultural University, Junagadh (Gujarat). The experiment was carried out in Randomized Block Design with eight treatments and three replications. The treatments comprised of different varieties *viz.*, Zumakhiya (V_1), Kalipatti (V_2), Pilipatti (V_3), Culcutti special (V_4), Mohongootee (V_5), Bhuripatti (V_6), Murabba (V_7) and Cricket ball (V_8). It was observed that, highest percentage fruit set, minimum fruit drop percentage and highest fruit yield were observed in the variety Kalipatti while more number of fruits per tree was observed in variety Zumakhiya and maximum fruit weight was found in variety Cricket ball.

Keywords: Sapota, fruit set, yield, fruit drop, varieties

Introduction
Sapota is an economically important species of the Sapotaceae family native to Tropical America especially the southern Mexico. Commonly known as Chikku, Sapota plum, Sapodilla or Prickly pear. Sapota is next only to mango, banana, citrus, apple and guava in India. It is cultivated over an area of 83000 hectares in India with annual production of 1003 MT which is cultivated on commercial scale in the states of Karnataka, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, West Bengal, Punjab and Kerala (NHB, 2020) [7].

Fruit is energy rich with high total soluble solids (20-22%) and good source of digestible sugar with appreciable amount of protein (0.40-0.70 g), fat (1.10 g), fiber and minerals like calcium (28 mg), phosphorous (27 mg) per 100 g of pulp. Fruit is highly astringent when unripe due to presence of the polyphenol like leucodelphinidin and leucocyanidin (Gopalan *et al.*, 1977) [3].

Tree is medium sized evergreen with milky sap grows to a height of 20 m. Flowers are dull white, axillary, solitary about 1 cm in diameter and pedunculous on short pedicels. Calyx, consists of 6 sepals is arranged in 2 whorls of 3 sepals which are gamopetalous. Corolla is imbricate consists of 6 pale white petals, which form a bell shaped tube. Androecium consists of 12 stamen arranged in two whorls with petaloid staminodes. Anthers are small and pointed towards tip and gynoecium composed of 4-5 fused carpels, the style is bifid, stigma is capitate with 10-12 celled superior ovary. The fruit is a fleshy berry, variable in shape like round, globose, conical and oval and size of 5 to 8 cm length, 3.5 to 7.0 cm diameter and 75 to 150 g weight with specific gravity of 1.022. The skin (rind) is rusty brown, somewhat scurfy giving the fruit a striking resemblance to an Irish potato. The flesh is yellowish brown or red, translucent, soft with granular texture. Fruit is with 1 to 5 seeds, endospermic and vary from none to twelve or many in number depending on season, weighing 0.6 to 1.0 g and are hard, black and shining embedded in pulp around central axis (Chundawat, 1998) [1].

Under tropical condition, sapota bears flowers in different flushes, *viz*., "*Ambe bahar"* (March-April), "*Mrig bahar"* (July-August) and "*Hasth bahar"* (October-November). The studies on various aspects *viz.*, fruit set, fruit drop and yield in different varieties are essential to initiate a successful breeding programme. An existence of variability gives an opportunity and imparts for research to sapota breeders. Variability in variety provides an opportunity and opened a new vista for the export of good quality sapota to abroad and more reliably in favour of the growers. Keeping this in view some important sapota varieties grown in the horticultural belt of Gujarat were explored to study the fruit set and yield parameters to access the genetic variability among them.

Materials and Methods

The present investigation was carried out at Fruit Research Station, Jambuvadi, College of Horticulture, Junagadh Agricultural University, Junagadh during *kharif* 2022. The experimental design employed was a Randomized Block Design (RBD) with eight treatments comprising of eight important sapota varieties *viz*., Zumakhiya (V_1), Kalipatti(V_2), Pilipatti (V_3), Culcutti special (V_4), Mohongootee (V_5), Bhuripatti (V_6), Murabba (V_7) and Cricket ball (V_8) *i.e*., each tree per treatment with three replications. The main objective of the experiment was to study the floral biology of different varieties of sapota. The parameters include days to flower bud, number of flower buds per shoot, time of anthesis, anther dehiscence and stigma receptivity (hrs.), duration of dehiscence, intensity of stigma receptivity, pollen germination (%) and pollen viability (%). Observations were taken visually by tagging the required number of flower buds in each tree. Statistical analysis of data of various characters was carried out as per Randomized Block Design (RBD). Analysis of variance was worked out using standard statistical procedures as described by Panse and Sukhatme (1985) [8].

Result and Discussion

Fruit set (%)

The data presented in the Table 1 and graphically illustrated in Fig 1 revealed that the percentage of fruit set was found significant in different varieties of sapota. Among all the varieties maximum fruit set percentage was recorded in variety Kalipatti V_2 (34.13%). Whereas, the minimum percentage of fruit set was recorded in variety Cricket ball V_8 (11.21%) (Table 1). Variations in the fruit set among the different varieties were thought to be due to variation in the pollen germination. The sterility of pollen affected by the rain is also one of the factors restricting setting of the fruits. The present investigation is in confirmation with the results obtained by Relekar *et al*. (1991) [9] who observed that the maximum percentage of fruit set was recorded in variety Kalipatti (40.24%) in the month of August. Similarly Gunaki *et al.* (1999) [4] reported that the highest fruit set obtained during July-August flush (13.23- 35.15%).

Fruit drop (%)

The data presented in the Table 1 and graphically illustrated in Fig 1 revealed that the percentage of fruit drop was found significant in different varieties of sapota. Among all the varieties significantly the minimum percentage of fruit drop was recorded in variety Kalipatti V_2 (65.87%) which was statistically at par with the variety Culcutti special V_4 (71.19%) and variety Pilipatti V_3 (73.45%). Whereas, the maximum percentage of fruit drop was recorded in variety Cricket ball V_8 (90.79%). Heavy fruit drop of small fruits might collectively due to climatic factors, poor pollination and physiological disturbances. These findings are in agreement with the results obtained by Relekar *et al.* (1991) [9] who observed that only 36 percent of the fruits were retained to maturity and remaining were dropped in variety Kalipatti. Similarly Lakshminarayana and Subramanyam (1970) [5] reported that presence of collar-like grooves at the insertion zone of the pedicel was pronounced in the drooping type which later abscised and the cells in the abscission zone were poorly differentiated.

Number of fruits per tree

The data pertaining of number of fruits per tree is presented in Table 1 revealed that number of fruits per tree was found significant in different varieties of sapota. Among all the varieties significantly the maximum number of fruits per tree was obtained in variety Zumakhiya V_1 (1197.37).Whereas, the minimum number of fruits per tree was recorded in variety Murabba V_7 (412.67). This result is in line with results of Mone (1989) [6] reported that variation in number of fruits per tree in different varieties of sapota and the number of fruits obtained in 15 year old tree of variety Gavarayya was 1218.75 per tree. Similar results obtained by Gunaki *et al.* (1999) [4], Saraswathy *et al*. (2010) [10] and Shirol *et al.* (2019) [11].

Fruit yield (kg/tree)

The data regarding fruit yield is presented in Table 1 and graphically depicted in Fig. 2 revealed that fruit yield was found significant in different varieties of sapota. The highest fruit yield was recorded in variety V_2 Kalipatti (99.30 kg/tree). Whereas, the lowest fruit yield was obtained in variety V_7 Murabba (63.56 kg/tree). It might be due to minimum fruit drop and maximum fruit set percentage in variety Kalipatti. Similar results have been found by Relekar *et al.* (1991) [9] reported that an average yield of 80.92 kg per tree per annum in 13 year old sapota trees of cv. Kalipatti. Mone *et al.* (1989) [6] also reported that the highest yield was obtained in cv. Kalipatti (150.84 kg/tree/year) under Dharwad condition. Higher yield of Kalipatti compared to present investigation might be due to differences in the climatic conditions between two regions. Chundawat and Bhuva (1982) [2] reported that the yield per tree varied with cultivar, its age and management practices.

Fruit weight (g)

As evident from the data given in Table 1 and Fig 2 revealed that highly significant differences were observed with respect to fruit weight in different varieties of sapota. The highest fruit weight was recorded in variety Cricket ball V_8 (152.31 g) and the lowest fruit weight was observed in variety Zumakhiya V_8 (69.11 g). The results showed a wide variability in the weight of fruits of different varieties due to its varietal character. Similar results have been reported by Chundawat and Bhuva (1982) [2] that maximum average fruit weight in variety Cricket ball (142.20 g) and lowest in variety Zumakhiya (57.47 g).

Table 1: Effect of fruit set (%), fruit drop (%), number of fruits/tree, fruit yield (kg/tree) and fruit weight (g) in different varieties of sapota

Varietal code	Varieties	Fruit set (%)	Fruit drop (%)	Number of fruits/tree	Fruit weight (g)	Fruit yield (kg/tree)
V_1	Zumakhiya	23.98	80.35	1197.37	69.11	82.74
V_2	Kalipatti	34.13	65.87	845.67	117.42	99.30
V_3	Pilipatti	25.59	73.45	950.66	89.86	85.43
V_4	Culcutti special	29.14	71.19	829.33	85.89	71.23
V_5	Mohongootee	27.89	78.45	745.34	105.35	78.52
V_6	Bhuripatti	29.58	76.11	580.33	127.56	74.03
V_7	Murabba	18.61	83.75	412.67	137.06	56.57
V_8	Cricket ball	11.21	90.79	438.32	152.31	66.76
S. Em. ±		1.294	3.348	34.024	3.038	3.038
C.D. at 5%		3.93	10.15	103.21	9.21	9.21
C.V.%		9.05	7.48	7.86	4.76	6.85

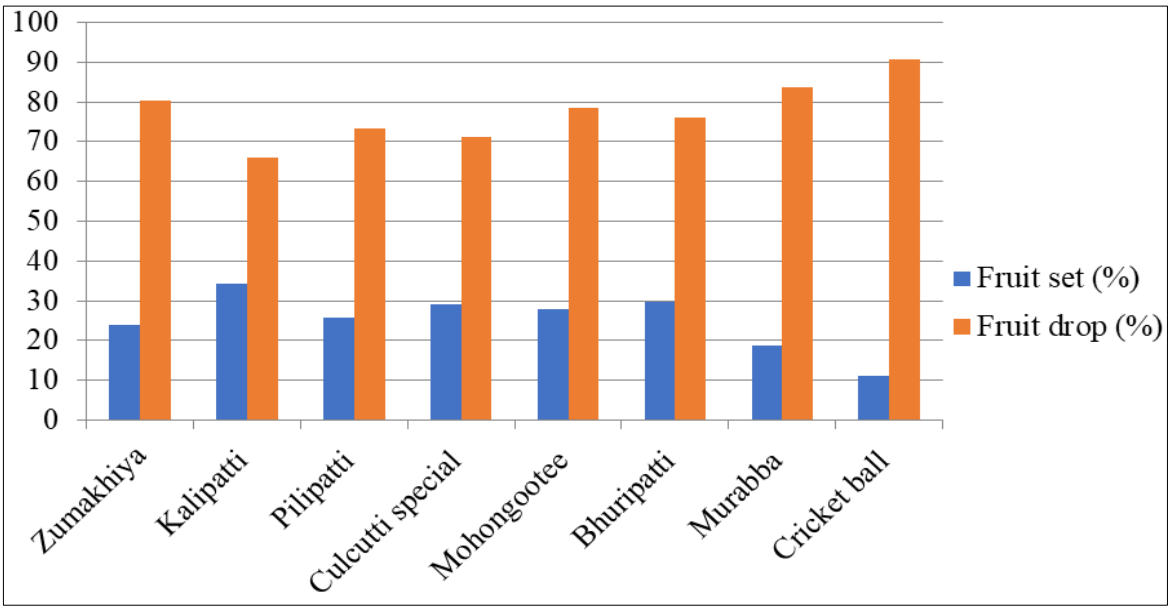

Fig 1: Effect of fruit set and fruit drop (%) in different varieties of sapota

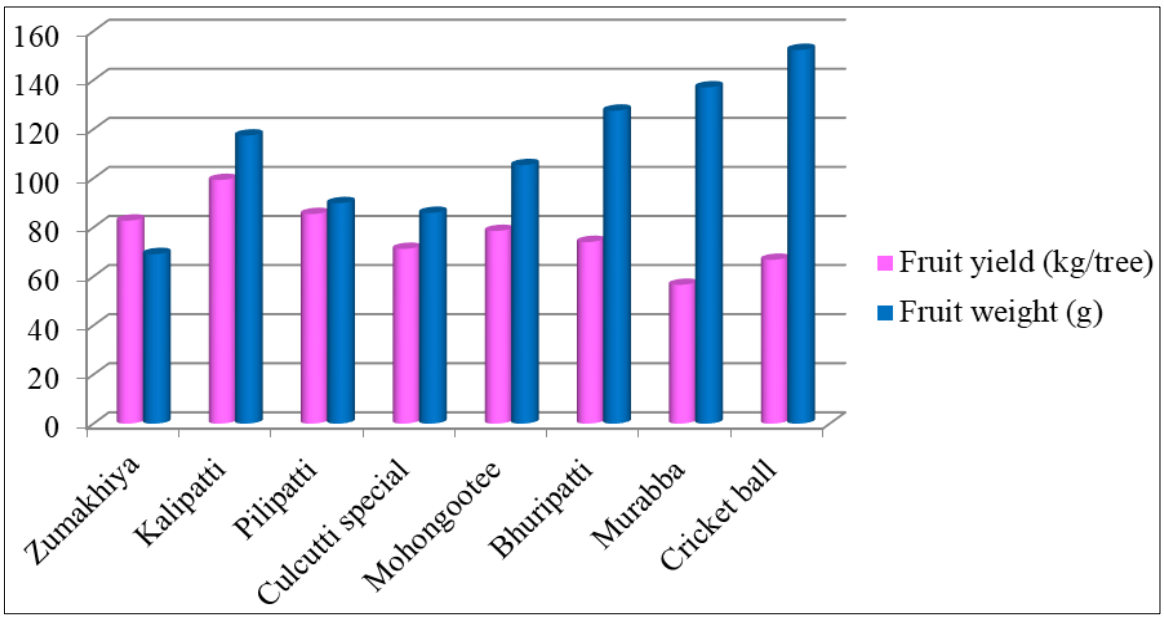

Fig 2: Effect of fruit yield (kg/tree) and fruit weight (g) in different varieties of sapota

Conclusion

On the basis of the result obtained from this present study, it could be concluded that highest percentage fruit set, minimum fruit drop percentage and highest fruit yield were observed in the variety Kalipatti while more number of fruits per tree was observed in variety Zumakhiya and maximum fruit weight was found in variety Cricket ball. Therefore, the variety Kalipatti was observed to be having better fruit set and yield parameters.

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