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Back-Crossing of Superior Hybrids 'Sonpari' and 'Neelphonso' with 'Alphonso' Mango *(Mangifera indica L.)*

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ABSTRACT

The study was carried out during 2012-13 cropping season to find out the ability of Alphonso pollen with its two newly developed superior hybrids Sonpari (Alphonso x Baneshan) and Neelphonso (Neelam x Alphonso) as female parents in hybridization programme. To further incorporate the desirable traits of Alphonso into these hybrids back crossing was done with Alphonso as donor parent. The results revealed that fruit set was 88.91% in crossed Sonpari x Alphonso and 78.43% in crossed Neelphonso x Alphonso. Fruit retention percentage reduced drastically from fruit set stage till 14 days after pea stage (DAPS) but attained almost steady percentage from 35 DAPS onward till harvesting. The fruit retention percentage at harvest was higher in the crossed fruits of Sonpari x Alphonso (3.13%) compared to Neelphonso x Alphonso (0.94%). Combination of Sonpari x Alphonso produced higher fruit length (13.4 cm) and fruit width (9.9 cm) than crossed fruits of Neelphonso x Alphonso with fruit length (10.8 cm) and fruit width (5.7 cm). Similarly, fruit weight of hybrid fruits derived from crossed Sonpari x Alphonso (512.4 g) was higher compared to that of Neelphonso x Alphonso (235.2 g). Based on this experiment, pollens of Alphonso showed good compatibility with both Sonpari and Neelphonso and therefore, may be utilized as pollen source for pollination in these two newly developed hybrid varieties in mango breeding programme.

Keywords:

Fruit set, hybrids, hybridization, pollen

INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the Anacardiaceae family, originated in the Indo-Burma region, is one of the most important tropical fruit tree in the world (Mukherjee 1958). It has been under cultivation in the Indian subcontinent for the last four thousand years or so (Candolle 1904). This crop occupied an area of about 2.2 mha and production of 15.2 MT in India, which account for 50% of the world production (Anonymous 2011). In India, more than one thousand varieties of mango are available. However, only about 30 cultivars are of commercial importance (Chadha and Pal 1986) and majority of these cultivars possess narrow adaptability and show eco-geographical preferences for growth and yield (Yadav and Rajan 1993). Among these cultivars, Alphonso is one of

the major commercial cultivars in India. The major appealing trait of this cultivar is its 'unique flavour'; besides, good appearance. However, the limitation with this cultivar is the occurrence of spongy tissue which hamper the economics of production, as well backfoot the mango industry in the export world. In addition, this cultivar is an alternate bearer, which produced very little or no yield in some years. Therefore, to incorporate the desirable traits and eliminate the undesirable ones of this cultivar, Alphonso was used as one of the parent in hybridization programme at Agriculture Experimental Station (AES), Paria, Navsari Agricultural University (NAU), Gujarat. This programme has resulted into evolving of two new superior hybrid varieties, which were released in 1986 as Neelphonso and Sonpari in 2000 obtained from the cross Neelam x Alphonso and Alphonso x Baneshan, respectively (Anonymous 2012). Therefore, to incorporate the desirable traits of Alphonso lacking in its hybrids, breeding programme through back crossing was initiated for further improvement of Neelphonso and Sonpari. In addition, this is the first report on using Alphonso as pollen donor for female parents, Sonpari and Neelphonso.

The present study addresses the compatibility issue of Alphonso as male parent with two half-sib hybrid varieties Sonpari and Neelphonso as female parents under the hypothetical assumption that Alphonso variety may be used as pollen source for crossing to further transfer its desirable traits to the two improved half-sib varieties. In addition, the information obtained in this study may be further utilized in mango hybridization programme.

MATERIALS AND METHODS

Experimental plants

Three mango varieties including Alphonso as pollen donor and two half-sib hybrids, *viz.*, Neelphonso (Neelam x Alphonso) and Sonpari (Alphonso x Baneshan) developed by the NAU were used as female parents for hybridization. Three fully grown healthy grafted trees, free from diseases and insect-pests of the three mango varieties were selected in the orchards of Division of Fruit Science, RHRS, ASPEE College of Horticulture & Forestry, NAU, Navsari. These selected trees were maintained uniformly as per recommended cultural and management practices of the University. Description of the two newly developed hybrids used as parents are given below;

Neelphonso: It is a moderate regular and late bearing tendency hybrid. Harvesting period is during end of July when no other commercial cultivars are available, thus offering good market price. Fruit size is medium (200g) with apricot yellow peel colour and orange yellow pulp at ripening. Fruits are free from spongy tissue disorder and are moderate resistant against fruit fly (Anonymous, 2012).

Sonpari: A heavy yielder and regular in bearing. Fruits are obliquely oval in shape like its male parent Baneshan, big in size (360–550 g). Peel colour is smooth and turning attractive golden yellow colour on ripening. Pulp content is 75 – 77% and taste is excellent and resembles to that of its female parent Alphonso and very good for table purpose with excellent keeping quality (Anonymous, 2012).

Hybridization procedures

The hybridization technique attempted was controlled hand pollination (Mukherjee *et al.*, 1961; Dutta *et al.*, 2013). Healthy panicles directly arising from secondary or tertiary branches were selected. These panicles were bagged in afternoon of the preceding day of pollination with finely perforated alkathane bags (8″ x 5″) of 100 gauge thickness, after removing all opened flowers. The next morning, 10-12 freshly opened perfect flowers located on middle of each panicle were retained for pollination and all other unopened buds were removed. After selection of hermaphrodite flowers, the panicles were then rebagged. Pollens were collected from freshly opened flowers of the same parent from panicles bagged earlier. The collected stock of opened flowers was kept in separate petri-dish under shade to dehisce anther. After pollen dehiscence, bags from panicles of female parent were removed and hand-pollination was done on stigma of the flower. The pollinated panicle was immediately rebagged and labelled properly. The bags were removed after 72 hrs and fruit set was recorded at different intervals.

Observations

Observations on number of fruit set was recorded at seven days after pollination and fruit set percentage was calculated by dividing the number of fruit set by total number of pollinated flowers and multiplied by 100. Fruit retention percentage was recorded at weekly intervals from pea stage onward and calculated by dividing the number of fruit retained after every seven days by the total number of fruit retained at pea stage. Similarly, physical characteristics of crossed fruits were recorded using electric balance (Adiar Dutt-1620C) for fruit weight (g) and vernier calliper (Mitutoya Digimatic Calliper, Code No. 500-147) for fruit length (cm) and width (cm).

RESULTS AND DISCUSSION

Pollination and fruit set

Pertaining to table 1, the average number of flowers pollinated per panicle was 7.05 and 6.87 in Sonpari x Alphonso and Neelphonso x Alphonso respectively. In both years, fruit set percentage of combination Sonpari x Alphonso was higher than cross Neelphonso x Alphonso. In the combination Sonpari x Alphonso, an average of 69.0 pollinated flowers set fruits out of average 80 total flower pollinated which recorded 88.91% of fruit set. While, in the cross Neelphonso x Alphonso, an average of 45 pollinated flower set fruits out of the 58 total pollinated flowers, which gave 78.43% of fruit set. The result obtained in both the combinations showed higher fruit set percentage than 16.1% in Amrapali x Tommy Atkin (Pinto *et al.*, 2004) and 29.3% on open-pollinated Amrapali (Pandey and Kumar, 2006). This indicated that high fruit set percentage in Sonpari and Neelphonso can be obtained, when Alphonso was used as pollen source. However, the difference in fruit setting percentage between Sonpari and Neelphonso might be due to the role of the genetic background under a particular set of environment conditions (Shu, 2009).

Fruit retention percentage

The fruit retention percentage of both the crosses showed a drastically decrease from fruit setting stage till 14 days after pea stage (DAPS; 10.6% in Sonpari x Alphonso and 8.77% in Neelphonso x Alphonso), thereafter, the decrease in fruit retention percentage slowed down and remained almost steady from 35 DAPS onward till harvesting (Fig. 1). It was interesting to note that the

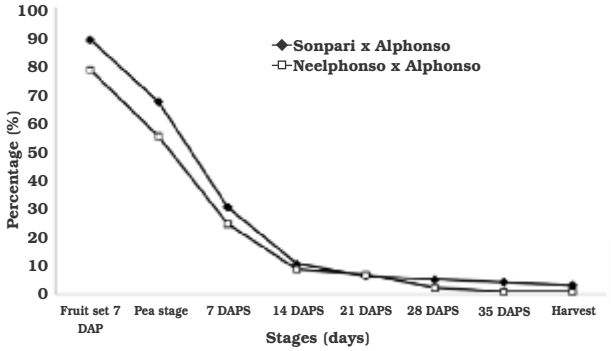

Fig. 1. Retention percentage of hybrid fruits from crosses Sonpari x Alphonso and Neelphonso x Alphonso of mango at various stages.

fruit retention percentage of Sonpari x Alphonso throughout the entire stage of fruit growth was always higher than that of Neelphonso x Alphonso, excepting at 21 DAPS (6.32% in Sonpari x Alphonso and 6.88% in Neelphonso x Alphonso). The rapid decrease in fruit retention percentage between fruit set stage to 14 days after pea stage seems to be due to low relative humidity and comparatively high

Table 1: Pollinated flowers and fruit set in the crosses Sonpari x Alphonso and Neelphonso x Alphonso of mango

	Total pollinated flowers			Pollinated flowers per panicle			Number of fruit set at 7 DAP			Fruit set at 7 DAP (%)		
Parentage	**2012**	**2013**	**Mean**	**2012**	**2013**	**Mean**	**2012**	**2013**	**Mean**	**2012**	**2013**	Mean
Sonpari x Alphonso	110	50	80	7.33	6.77	7.05	90.00	48.00	69.00	81.82	96.00	88.91
Neelphonso x Alphonso	71	45	58	7.38	6.36	6.87	53.00	37.00	45.00	74.65	82.22	78.43

DAP, days after pollination

evaporation (Fig. 4; table II).

The fruit retention percentage at harvest was higher in the crossed fruits of Sonpari x Alphonso (3.13%) compared to Neelphonso x Alphonso (0.94%). The fruit retention percentage at harvest in both the crosses was in accordance with Pinto *et al.* (2004) who reported the range of 0.5 – 3.3% fruit retention at harvest when Amrapali was used one of the parents. The result indicated that Alphonso showed a good genetic compatibility with Sonpari and Neelphonso when used as a male parent.

Physical parameters of crossed fruits

Among fruits of the two crosses (Fig. 2), crossed fruits obtained from Sonpari x Alphonso produced higher fruit length (13.4 cm) and fruit

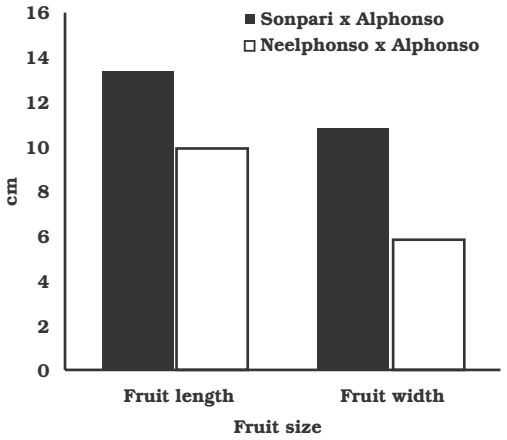

Fig. 2. Fruit size of hybrid fruits from crosses Sonpari x Alphonso and Neelphonso x Alphonso of mango at ripening stage.

width (9.9 cm) than hybrid fruits of Neelphonso x Alphonso with fruit length (10.8 cm) and fruit width (5.7 cm). Similarly, fruit weight of hybrid fruits derived from crossed Sonpari x Alphonso (512 g) was higher compared to that of Neelphonso x Alphonso (235 g) (Fig. 3).

Relationship between number of fruits retention and weather parameters

The relationship among number of fruits at various stages and weather parameters was observed. Based on figure 5, a drastic reduction in number of fruits from fruit set stage at 7 days after pollination (DAP) upto 14 DAPS was coincidence with weather parameters.

During these stages, there was a wide variation between maximum and minimum temperature. The maximum (day) temperature was

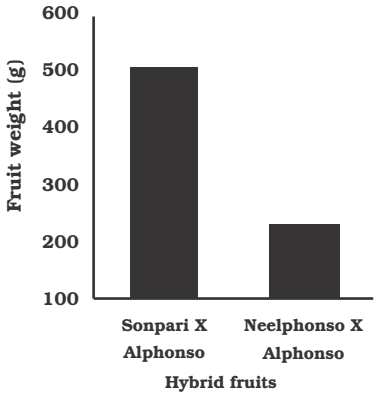

Fig. 3. Fruit weight of hybrid fruits from crosses Sonpari x Alphonso and Neelphonso x Alphonso of mango at ripening stage.

highest and night temperature was lowest between 7th March to 4th April. However, thereafter, it was interesting to note that the variation between the two was almost constant till harvest (second week June). This indicated that the gap between day and night temperatures was very high during these stages, which might have contributed to sharp reduction in fruit number.

It was also observed that both maximum and minimum relative humidity (%) was low during

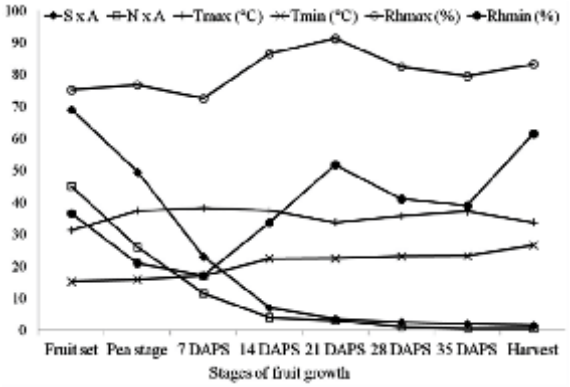

Fig. 4. Relationship between numbers of fruit retained and weather parameters at various stages of fruit growth. S x A, Sonpari x Alphonso; N x A. Neelphonso x Alphonso; Tmax, maximum temperature; Tmin, minimum temperature; Rhmax, maximum relative humudity; Rhmin, minimum relative humidity; DAPS, days after pea stage.

Table 2 : Mean of other climatic data during evaluation periods for fruit set and retention behaviours of mango hybrid fruits from crosses Sonpari x Alphonso and Neelphonso x Alphonso.

Climatic factors	A	B	C	D	E	F	G	H
Wind Speed (km/hr)	4.2	3.0	3.5	4.7	5.4	4.7	4.5	4.3
RF (mm)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3
Cloud cover	0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.2
Sun shine (hrs/day)	8.5	8.8	8.3	8.5	9.2	8.5	8.9	9.0
Evapo ration (mm/day)	5.3	6.5	7.2	6.9	6.8	6.7	6.8	6.3

DAPS, days after pea stage; A, pollination to fruit set stage; B, fruit set to pea stage; C, pea stage to 7 DAPS; D, 7 to 14 DAPS; E, 14 to 21 DAPS; F, 21 to 28 DAPS; G, 28 to 35 DAPS; H, 35 DAPS to harvest. Mean data from February to June of 2012 and 2013.

this period. However, the maximum variation between maximum (morning) and minimum (evening) RH also existed during the same period. Similarly, the variation between the two after 14 DAPS followed similar pattern with temperature variation, where fruit number also remained almost constant.

The inference between fruit drop and other weather parameters including wind speed, rain fall, cloud cover and sun shine hours could not be drawn (Table 2). This was because the orchard of the hybridization block was surrounded by several layers of fruit trees of sapota and mango, which neutralized the effect of the wind speed. Besides, the parent trees were under well maintenance with drip irrigation system that has effect on evaporation rate.

CONCLUSION

Based on our finding, it can be concluded that Alphonso can be used as parent donor of pollens to Sonpari and Neelphonso with high fruit set and retention percentage in hybridization programme. The weather parameters also showed high influence on fruit retention over a period of fruit growth and development.

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