Indian J. Hort. 71(3), September 2014: 412-414

Short communication

Effect of self-, open- and cross-pollination with Sensation on fruit set in mango cultivar Amrapali

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ABSTRACT

An attempt was made to study the pollen-pistil interactions in mango cv. Amrapali as a result of self-, open- and cross-pollination with cv. Sensation. It was observed that self-pollination in Amrapali resulted in rapid decline in fruit retention than open- and cross-pollination (Amrapali × Sensation) during 20 days after pollination (DAP). Out of 1,133 self-pollinated flowers, only three fruits (0.26%) were observed after 25 days of pollination. In contrast, cross-pollination with Sensation (637 flowers) resulted in 32 fruits (5.02%) after 25 days of pollination. It was also evident that regardless of pollination method, flower and fruit drop were more pronounced during first 20 days after pollination. Results of the present investigation clearly indicate that 'Amrapali' does not favour self-pollination. However, cross-pollination results in substantial fruit set.

Key words: Cross-pollination, fruit set, mango, open-pollination, self-pollination.

Mango hybridization work is being carried out at various research stations in India. Among which Indian Agricultural Research Institute (IARI), New Delhi is notable and being credited with the development of some commercially important mango hybrids such as 'Mallika', 'Amrapali', 'Pusa Arunima', 'Pusa Pratibha', 'Pusa Shreshth', 'Pusa Peetamber' and 'Pusa Lalima' with desirable traits for domestic as well as overseas markets (Singh *et al*., 11). With the improved technique of mango hybridization and the report of self-incompatibility in mango, it would be possible to evolve a larger number of hybrids having desirable horticultural traits (Singh *et al*., 12). The self-incompatibility phenomenon was unknown in mango until it was not discovered in the north Indian mango cultivar Dushehari, which lead to the development of caging technique of pollination in mango (Sharma and Singh, 10; Iyer, 5). Embryological studies have shown that in mango pollen tubes grow down the style and effect fertilization but the development of zygote is blocked, leading to a sporophytic type of self-incompatibility (Mukherjee *et al*., 7). In recent past, a number of improved mango hybrids have been developed at IARI, New Delhi by hybridizing parents, which are known to have self-incompatible parent in their ancestry. The mango hybrid cultivars 'Amrapali' (Dushehari × Neelum) chosen for the present investigation has self-incompatible 'Dushehari' in its parentage. A very high fruit drop at different phases of fruit growth has also been reported in many of the commercial cultivars, and self-sterility had been suspected. However, very few attempts have been made to study the varietal situation in this regard. The present study was, therefore undertaken to investigate pollen-pistil interactions in 'Amrapali' as a result of self-, open- and cross-pollination with 'Sensation'.

Fully grown healthy grafted 'Amrapali' plants, free from diseases and insect-pests were selected from the orchards of the Division of Fruits and Horticultural Technology, IARI, New Delhi. All the trees received uniform recommended cultural management practices. For self- and cross-pollination with 'Sensation', hand-pollination was attempted using the technique described by Mukherjee *et al*. (7). Panicles directly arising from secondary or tertiary branches were selected. These panicles were bagged on the preceding day of pollination with finely perforated alkathane bags (45 x 30 cm) of 100 gauge thickness. The next morning, 10-12 freshly opened perfect flowers located on middle of each panicle were retained for pollination and all other unopened buds and flowers were removed. After selection of hermaphrodite flowers, the panicles were then rebagged. Pollens from 'Amrapali' and 'Sensation' were collected from freshly opened flowers from panicles bagged previous day. The collected stocks of opened flowers were kept in separate petri dish under partial shade to dehisce anther. After pollen dehiscence, bags from panicles of female parent ('Amrapali') were removed and hand-pollination was done on stigma of the flower with the desired pollen. The pollinated panicle was immediately rebagged and labelled properly. The bags were removed after 48 hrs and fruit-set was recorded at different intervals. Similarly, a set of 30 panicles per tree were allowed

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for open-pollination and observations on fruit-set was recorded. The number of male and hermaphrodite flowers per panicle was counted on 20 panicles of similar size and age in 'Amrapali'. The average number of hermaphrodite flowers per panicles was taken as number of initial flowers to calculate the fruit set in case of open-pollination. Fruit retention was calculated by observing the number of fruitlets that developed in response to self-, open- and cross-pollination with 'Sensation' at different intervals such as 10, 15, 20 and 25 days after pollination (DAP). Fruitlet retention at marble size (25 DAP) was taken as final set. The experiment was laid out in RBD with five replications. ANOVA was calculated to separate the means. The data on percentage of fruit set were angular transformed before analysis. The weather data recorded during March-April months indicates that average maximum temperature in March month was 29.2°C and in April month it was 35.5°C. The average minimum temperature was 13.0°C during March and 17.8°C in April. The average maximum relative humidity recorded was 92.1% in March and 68.7% in April. However, the average minimum relative humidity was 42.3% in March and 33.1% in April. The rainfall recorded during March and April month was negligible (0.07 mm). Whereas, wind speed was 0.9 and 3.5 km per h during March and April months, respectively (Source- Division of Physics, IARI, New Delhi).

The data on number of flowers used in self-, open and cross-pollination and fruit set at different intervals are presented in Table 1 and Figure 1. Out of 1,133 self-pollinated flowers of 'Amrapali', 512 fruitlets were observed on 10 DAP. Whereas, 'Amrapali' × 'Sensation' cross showed 464 fruits from 637 crossed flowers on 10 DAP. Similarly, 486 fruits were observed in case of open-pollination. On 15 DAP, number of fruits reduced to 33 in self-pollination. However, it was 228 and 247 in cases of 'Amrapali' × 'Sensation' cross- and open-pollination, respectively. On 20 DAP, only four fruitlets were retained under self-pollination but substantial fruit set was found in cross- and open-pollination (48 and 83, respectively). At marble stage (25 DAP), only three fruitlets were observed in self-pollination, However, it was 32 and 54 fruitlets in 'Amrapali' × 'Sensation' cross and under open-pollination, respectively (Table 1).

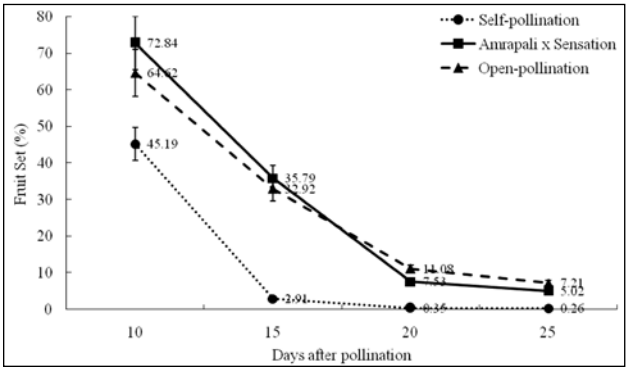

Fig. 1. Fruit set (%) under self-, open- and cross-pollination in 'Amrapali' with 'Sensation'. LSD ($p < 0.05$) for pollination method = 2.9, fruit set at different intervals = 3.6 and interaction of pollination method and fruit set at different intervals = 5.9. Vertical bars indicate ± SE.

The data on fruit set percentage (Fig. 1) clearly indicate that irrespective of pollination methods, significant decrease in fruit set was evident during 20 DAP. However, self-pollination in 'Amrapali' showed sharp decline in fruit retention during first 15 days after pollination. In case of self-pollinated 'Amrapali' the substantial fruit set (45.1%) was observed on 10 DAP. Which reduced to 2.91% on 15 DAP and to 0.26 on 25 DAP. In contrary, 'Amrapali' × 'Sensation' cross showed 72.8% fruit set on 10 DAP, which decreased to 35.8% on 15 DAP and to 5.02% on 25 DAP. Open-pollination in 'Amrapali' showed almost similar trend as it was noticed in 'Amrapali' × 'Sensation' cross and had 64.6% fruit set on 10 DAP and 7.21% on 25 DAP.

Failure of selfed flowers to set fruit was more pronounced in 'Amrapali' than open-pollination and cross-pollination with 'Sensation'. The negligible fruit-set and fruit retention in self-pollinated 'Amrapali' indicated that it does not favour self-pollination and is self-incompatible. Self-incompatibility in other cultivars of mango has also been reported (Singh *et al*., 12; Mukherjee *et al*., 7; Sharma and Singh, 10;

Table 1. Effect of self-, open- and cross-pollination with Sensation on fruit retention in mango cultivar Amrapali.

Pollination method	No. of flowers	No. of fruits			
		10 DAP	15 DAP	20 DAP	25 DAP
Self-pollination	1,133	512	33	4	3
Amrapali × Sensation	637	464	228	48	32
Open-pollination	752	486	247	83	54
CD at 5%		NS	12.2	7.3	5.1

Degani *et al*., 2; Dag *et al*., 1; Gehrke-Velez *et al*., 3). In 'Amrapali', a self-incompatible cv. Dushehari was involved as one of the parents (Singh *et al*., 12), and the presence of self-incompatibility in this cultivar might have inherited from parent 'Dushehari'. Deagani *et al*. (2) studied the outcrossing rate in adjacent 'Maya' and 'Tommy Atkins' mango blocks and suggested existence of self-incompatibility as a reason for the predominance of outcrossed fruit in the rows adjacent to the polliniser blocks and the unexpectedly high hybrid percentage at larger distance from the polliniser block. In a similar study, Dag *et al*. (1) reported significant abscission of selfed fruitlets in mango. The phenomena of higher fruit-set in open-pollination than in self-pollination in mango is also reported by Roemer (8) and Gehrke-Velez *et al*. (3). Rapid decline in fruit set and retention upon selfing may also be attributed to degeneration of the ovule that leads to arrest of fruit growth and subsequent abscission. Sedgley and Granger (9) observed in *Eucalyptus* sp. that most self-pollinated ovules were degenerating and were either unfertilised or had undivided zygotes and free nuclear endosperm. The ovule degeneration resulted from slower pollen tube growth, low levels of pollen tube penetration and fertilisation, and that in those ovules which were fertilised, the zygote generally failed to divide. The present finding showed that there is occurrence of initial-compatibility and fertilisation as a result of self-pollination. However, at the later stage of the pollination and fertilisation process, a delayed self-incompatibility becomes evident, which evidently results in post-fertilized endosperm or/ ovule degeneration. This result in young fruitlet abortion, and subsequently the selfed fruitlets abscise. Mukherjee *et al*. (6) and Sharma and Singh (10), based on their anatomical studies also reported the post-fertilization self-incompatibility in mango, while Gehrke-Velez *et al*. (3) described this phenomenon as delayed self-incompatibility in mango.

REFERENCES

1. Dag, A., Degani, C. and Gazit, S. 2009. Gene flow in mango orchards and its impact on yield. *Acta Hort.* **820**: 347-50.
2. Degani, C., Yutko, O., El-Batsri, R. and Gazit, S. 1997. Outcrossing rate in adjacent 'Maya' and 'Tommy Atkins' mango blocks. *Scientia Hort.* **70**: 25-30.
3. Gehrke-Velez, M., Castillo-Vera, A., Ruiz-Bello, C., Moreno-Martinez, J.L. and Moreno-Basurto, G. 2012. Delayed self-incompatibility causes morphological alterations and crop reduction in 'Ataúlfo' mango (*Mangifera indica* L.). *New Zealand J. Crop Hort. Sci.* DOI:10.1080/01140671.2011.632423.
4. Guerra, M.E., Wunsch, A., Lopez-Corrales, M. and Rodrigo, J. 2011. Lack of fruit set caused by ovule degeneration in Japanese plum. *J. American Soc. Hort. Sci.* **136**: 375-81.
5. Iyer, C.P.A. 1991. Recent advances in varietal improvement in mango. *Acta Hort.* **291**: 109-32.
6. Mukherjee, S.K., Majumder, P.K. and Chatterjee, S.S. 1961. An improved technique of mango hybridization. *Indian J. Hort.* **18**: 302-4.
7. Mukherjee, S.K., Singh, R.N., Majumder, P.K. and Sharma, D.K., 1968. Present position regarding breeding of mango (*Mangifera indica* L.) in India. *Euphytica,* **17**: 462-67.
8. Roemer, M.G. 2011. Premature fruit drop in mango (*Mangifera indica* L.) in Northern Vietnam. Ph.D. thesis submitted to University Hohenheim. http://opus.ub.uni-hohenheim.de/volltexte/2011/657/pdf/Roemer.
9. Sedgley, M. and Granger, L. 1996. Embryology of *Eucalyptus spathulata* and *E. platypus* (Myrtaceae) following selfing, crossing and reciprocal interspecific pollination. *Australian J. Bot.* **44**: 661-71
10. Sharma, D.K. and Singh, R.N., 1970. Self-incompatibility in mango (*Mangifera indica* L.). *Hort. Res.* **10**: 108-18.
11. Singh, A.K., Dubey, A.K. and Srivastav, Manish, 2012. New mango varieties to enrich fruit basket. *Indian Hort.* March-April 2012, pp. 3-5.
12. Singh, R.N., Majumder, P.K. and Sharma, D.K. 1962. Self incompatibility in mango (*Mangifera indica* L.) var. Dushehari. *Curr. Sci.* **31**: 209.

Received: September, 2013; Revised: February, 2014; Accepted: June, 2014