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SHORT COMMUNICATION

Effect of Pollen Grain and Pollination Period on Fruit Set in Litchi (*Litchi chinensis* Sonn.)

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Abstract The effective pollination period (EPP) was studied in three litchi cultivars. viz. Shahi, China and Bedana, with the objective of evaluating the best time of pollination for all cultivars involved in hybridization. The pollen grains of the previous season stored at low temperature (−20 °C) along with fresh pollen grains collected during the current season were used in the present study for pollination. Results revealed that the EPP reported in Shahi, China and Bedana were 6–7 AM, 6–8 AM and 7–9 AM, respectively. Though maximum fruit set was obtained in Shahi × Bedana and China × Bedana using fresh pollen grains (0.24 to 0.81%), an appreciable amount of fruit set was also obtained from the old stored pollen grains (0.23 to 0.52%).

Keywords Effective pollination period · Hybridization · Pollen grain · Temperature · Flowers

Litchi (*Litchi chinensis* Sonn.), a member of the family Sapindaceae, possesses three types of flowers, namely male, hermaphrodite functional female and pseudo-hermaphrodite male flowers, which generally open sequentially in succession [1]. However, litchi is a highly cross-pollinated and good fruit set can be ensured only if pollen from male flowers is transferred to the stigma of female flower. Storage of pollen at low temperature has been standardized in a number of plant species, such as dogwood, protea, mango and almond [2–5]. Different approaches have been adopted for evaluating pollen quality; however, limited attempt has been made under in vivo condition and none in litchi. In the present study, an in vivo approach which involves placing the pollen grains on the stigmas of emasculated flowers while remaining intact with the plant was attempted. In litchi, the period of stigma receptivity is very short and lasted only for a few hours. Knowing the right time for pollination as well as the time of stigma receptivity is crucial for the success of the hybridization programme. The effective pollination period (EPP) denoting the period of highest stigma receptivity in different cultivars was assessed. Therefore, this experiment was conducted with the objective of determining the effective pollination period in litchi and the per cent fruit set based on one-year-old stored and fresh pollen grains.

A hybridization experiment was conducted to develop hybrids and to find out effective pollination period (EPP) in litchi for two consecutive years in 2014 and 2015. Three parents, viz. Shahi, China and Bedana, were crossed with each other in all combinations in three replications. In order to assess the viability of pollen grains stored for a longer duration, litchi pollen of M2 flowers of the previous year stored under low temperature (−20 °C) was utilized in the hybridization. Two days before the anticipated anthesis of female flowers, litchi panicles were bagged to avoid possible chance of cross-contamination by pollen grains. On the day of hybridization, bags were removed and flowers were emasculated and pollinated by dipping a small brush into petri plates containing pollen grains. The pollinated flowers were re-bagged, and the per cent fruit set was recorded at weekly interval till harvesting.

In the present study, fruit set was recorded after one week of pollination in different sets of crosses (Fig. 1). In

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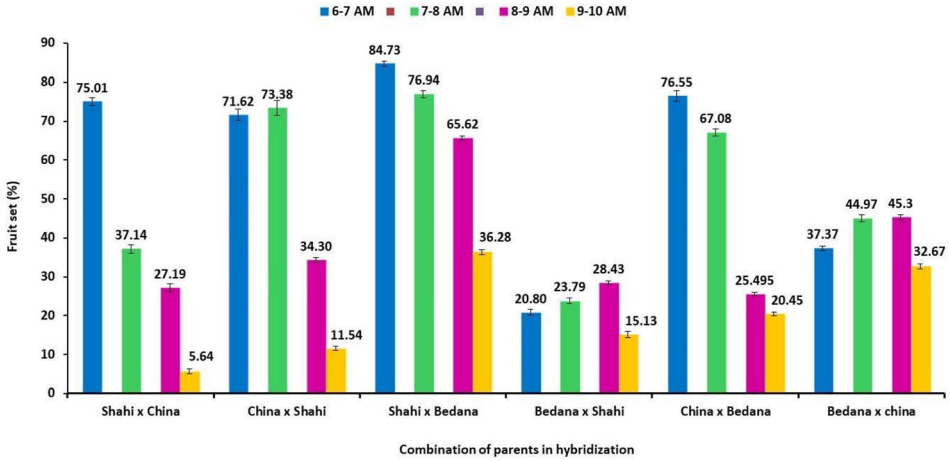

Fig. 1 Effect of time of pollination on fruit set in different parentages in litchi

crosses where Shahi was used as female parent, the maximum success of fruit set was recorded in pollination attempted during 6–7 AM. In Shahi × China cross, the maximum fruit set was recorded during 6–7 AM (75.01%), followed by 37.14% during 7–8 AM. Similarly, in Shahi × Bedana cross, the maximum fruit set (84.73%) was noted during 6–7 AM. It was observed that fruit set percentage decreased progressively from 6 to 10 AM. Temperature has important role on viability and receptivity of stigma which ensure fruit set. High temperature has detrimental effect on pollen viability, and gynoecium normality [6, 7] and higher fruit set during 6–7 AM might be due to low temperature.

In crosses involving Shahi as the maternal parents, irrespective of the pollen donors, the period between 6–7 AM is most crucial for carrying out pollination, which also denotes period of highest stigma receptivity. Hence, 6–7 AM is considered as effective pollination period in Shahi.

In crosses where China was used as female parent, the maximum success of fruit set was found in pollination made during 6–8 AM. In China × Shahi crosses, 71.62% fruit set during 6–7 AM and 73.38% fruit set during 7–8 AM were found. Similarly, in China × Bedana crosses, 76.55% fruit set during 6–7 AM and 67.08% fruit set during 7–8 AM were observed. Thus, irrespective of male parents, 6–8 AM can be considered as the effective pollination period in China. In crosses where Bedana was used as female parent, the maximum success of fruit set was found in pollination made during 8–9 AM. In Bedana × Shahi crosses, fruit set per cent was 20.80 at 6–7 AM, 23.79 at 7–8 AM and 28.43 at 8–9 AM, while in Bedana × China, fruit set per cent was 37.37 at 6–7 AM, 44.97 at 7–8 AM and 45.30 at 8–9 AM. Thus, effective pollination period in Bedana lies between 7–9 AM. Low temperature (27–30 °C) in the morning (6–9 AM) resulted in high fruit set, whereas high temperature (> 30 °C) 9 AM resulted in low fruit set. Fruit set decreased as temperature increased [8]. The suitable time for hybridization in the morning might be due to low temperature and high humidity leading to less desiccation of flowers. Similar observations were made by other workers in apricot [9] and olive [10].

The maximum success of fruit set indicated the effective pollination and effective pollination period varied among parents of litchi used in hybridization (Fig. 2).

In the present study, it was observed that fruit set per cent during first week ranged from 20.26–84.53% and 19.46–90.69% in crosses involving fresh and old pollen grains, respectively. In crosses involving fresh pollen, the maximum per cent fruit set was obtained in China × Bedana (84.53), while in crosses involving old pollen grains, the maximum fruit set was obtained in China × Shahi (90.69%). With the onset of fruit maturity, fruit set declines markedly to 0.23–2.01% in all parentages involving fresh pollen grains and old pollen grains. The maximum fruit set per cent at harvest period involving fresh pollen grains was 0.81% in China × Shahi followed by 0.50% in Shahi × Bedana, whereas maximum fruit set in crosses involving stored old pollen grains was 0.52% in Shahi × Bedana followed by 0.46% in China × Shahi (Table 1). In the present study, fruit set per cent obtained based on stored old pollen was comparable to that of fresh pollen. This revealed that litchi pollen viability can be maintained for 1 year or more when stored at −20 °C which corroborates with the finding of other [11].

In the present study, it was revealed fruit set per cent in crosses involving stored old pollen was comparable to that in crosses involving fresh pollen grains. The final fruit set varies from 0.24 to 0.81% when fresh pollen was used and 0.23 to 0.52% when one-year-old pollen was used. The effective pollination period giving maximum percentage of fruit set is 6–7 AM for Shahi cultivar, 6–8 AM for China cultivar and 7–9 AM for Bedana cultivar. This study will

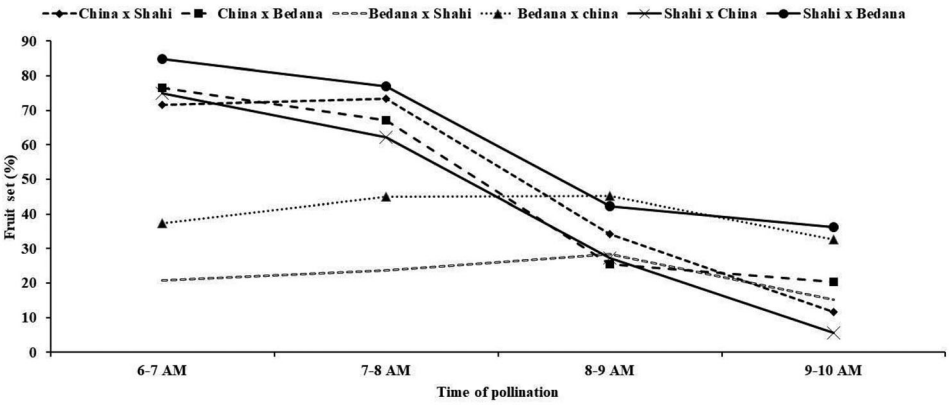

Fig. 2 EPP in litchi cultivars as indicated by success of fruit set per cent

Table 1 Fruit set per cent at different weeks as influenced by age of pollen and parentage

Parentages		Weeks					
		1st	2nd	3rd	4th	5th	6th
Fresh pollen grains	Bedana × Shahi	20.26	2.31	0.6	0.34	0.34	0.26
	Shahi × Bedana	20.87	1.11	0.86	0.50	0.50	0.50
	Bedana × China	51.75	6.45	2.84	0.28	0.28	0.28
	Shahi × China	46.24	8.65	3.27	0.24	0.24	0.24
	China × Bedana	84.53	6.64	0.64	0.43	0.43	0.43
	China × Shahi	84.16	7.52	1.39	0.81	0.81	0.81
Old pollen grains	Bedana × Shahi	19.46	3.12	0.62	0.25	0.25	0.25
	Shahi × Bedana	83.82	28.76	0.56	0.52	0.52	0.52
	Bedana × China	57.94	2.99	2.05	0.46	0.26	0.26
	Shahi × China	31.68	9.22	0.46	0.26	0.23	0.23
	China × Bedana	85.45	13.42	0.27	0.27	0.27	0.27
	China × Shahi	90.69	15.62	0.85	0.46	0.46	0.46
	C.D.	2.105	0.688	0.072	0.046	0.02	0.021
	SE(m)	0.725	0.237	0.025	0.016	0.007	0.007
	C.V.	2.366	4.814	3.741	5.097	2.38	2.566

be useful to determine the right time for carrying out pollination based on receptivity of parents.

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