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Evidence of Self-Compatibility in Indigenous Almond (*Prunus dulcis* (Miller) D. A. Webb.) Selections from India

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Abstract

Fruit set studies following bagging and hand self pollination were conducted to determine the pollination behaviour of indigenous almond selections. The mean fruit set percentage recorded 40 and 70 days after bagging varied from 12.02 (Badamjor Spillo No.2C) to 47.04 (Gaur Almond) and 4.96 (Badamjor Spillo No.2C) to 24.81 [Local Selection-II (Gaura)], respectively. Six selections resulted in more than 20 per cent fruit set after 70 days of bagging. The mean per cent unit fruit set resulting from hand self pollination ranged from 13.99 (Badamjor Spillo No.2C) to 78.27 (Telangi Selection) recorded after 40 days while it varied from 6.27 (Badamjor Spillo No.2C) to 53.78 (Telangi Selection) when recorded after 70 days of hand self pollination. High fruit sets (more than 20 per cent) after 70 days of hand self pollination in as many as sixteen selections indicates the presence of self-compatibility in indigenous almonds. Positive correlations were observed between different fruit set obtained through bagging and hand self pollination and between different dates after pollination.

Introduction

Cultivated almond {*Prunus dulcis* (Miller) D. A. Webb.} is a self-incompatible species and requires outcrossing to set fruits and obtain optimum yields. To overcome the interplanting of appropriate pollinizers, self-fruitful almond cultivars are being developed the world over (2, 9). In India, almond trees of seedling origin are growing in groups without any provision of pollinizers and pollinators. In order to determine the pollination behaviour of almond selections made from native tree populations of seedling origin, the present study was envisaged. Controlled fruit set studies after both unassisted and hand self-pollination were conducted to assess the existence of self-compatibility.

Material and Methods

The present investigations were carried out in the Almond Collection Block of the Department of Fruit Breeding and Genetic Resources, University of Horticulture & Forestry, Nauni-Solan (HP), India located at 1275 meters above mean sea level lying near 31°N latitude and 77° E longitude. The experimental material included 16-18 year old bearing trees of eighteen indigenous almond selections budded on wild peach rootstock.

Unassisted self pollination (Bagging)

In each selection, four branches bearing 100-150 flowers each on a tree were covered with insect proof selfing bags. Only unopened, healthy flowers in 'popcorn' or 'balloon' stage were included and bagged Already opened, immature and damaged flowers were removed prior to bagging, counting and labeling.

Hand self pollination

In each selection, on four different branches of the tree, around 500 healthy undamaged flower buds at balloon stage were emasculated and bagged overnight to allow the stigmas to become receptive. The following day, the emasculated flowers were pollinated by fresh pollen prepared from the same tree.

Standard methods of pollen collection, emasculation and pollination were followed as suggested by Kester and Griggs (5).

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Observations

The initial and final fruit set percentage was calculated by counting the number of fruits setting after 40 days (5) and 70 days (11) of self pollination, respectively The number of fruits following bagging/hand self pollination was recorded as ratio of developing nuts to the total number of flowers bagged or hand pollinated. On the basis of the extent of fruit set after 70 days of hand self pollination, selections with more than 20 per cent fruit set were categorized as self-compatible, those with 10 to less than 20 per cent as partially self-compatible (10-20%) and those with less than 10 per cent were categorised as self-incompatible.

Standard error (SE) of mean, interval estimation of mean i.e., the confidence interval and correlations were estimated following the methods of Panse and Sukhatme (6).

Results

Mean fruit set (%) through unassisted self pollination (bagging)

The mean fruit set upon unassisted self pollination recorded 40 days after bagging ranged from 12.02 in Badamjor Spillo No.2C to 47.04 per cent in Gaura Almond (Table 1). Four selections, Badamjor Spillo No.2C, JKS-38, Telangi Selection and Tree No.14 resulted in less than 20 per cent fruit set. The corresponding values recorded 70 days after bagging were minimum (4.96%) in Badamjor Spillo No.2C and maximum (24.81%) in Local Selection II (Gaura). Gaura Almond, JKS-238, Kashmiri Seedling, Local Selection-II (Gaura), Ribba Selection and Spillo No.7 resulted in more than 20 per cent fruit set even at 70 days after bagging (Table 1).

Mean fruit set (%) through hand self pollination

The mean fruit set percentage recorded 40 days after hand self pollination was lowest (13.99) in Badamjor Spillo No.2C and highest (78.27) in Spillo No.7 (Table 1). Except for Badamjor Spillo No.2C, all other selections resulted in more than 20 per cent fruit set. The fruit set recorded at 70 days after hand self pollination was again lowest (6.29%) and highest (53.78%) in Badamjor Spillo No.2C and Spillo No.7, respectively. Except for Badamjor Spillo No.2C and Tree No.16, all other selections recorded more than 20 per cent fruit set after 70 days of hand self pollination (Table 1).

Correlations

High and positive correlations (Table 2) were observed between fruit set attained through bagging and hand self pollination after 40 days ($r = 0.6599$) and after 70 days ($r = 0.7372$). Similarly positive and high correlations were recorded between fruit set after 40 and 70 days of bagging ($r = 0.9114$) and hand self pollination ($r = 0.8954$).

Relative fruit set ratio

The relative fruit set (bagging/hand self-pollination) ratio was lowest (0.37) in Tree No.101 and highest (0.91) in Gaura Almond on the basis of observations recorded 40 days after bagging/hand self pollination (Table 3). Whereas, on the basis of fruit set recorded at 70 days after bagging/hand self pollination, the relative fruit set ratio was minimum (0.38) in Telangi Selection and maximum (0.88) in Gaura Almond and Tree No.16, respectively.

Discussion

The various almond selections studied, differed considerably with regard to their ability to set fruits upon bagging and hand self-pollination. Unlike the previous practices of determining fruit set percentage 40 days after pollination (5), the criteria for establishing self-compatibility in almond selections in the present study, is per cent fruit set 70 days after pollination as suggested by Weinbaum et al. (11). By this time, the development crop of abortive fruits ceases. Based upon fruit set recorded 70 days after hand self pollination, most of the indigenous selections exceeded the level of 20 per cent. Exceptions are Badamjor Spillo No.2C and Tree No.16 (Table 1). Accordingly, these have been

Table 1. Mean fruit set (%) through bagging and hand self pollination in almond selections.

Selections	Mean fruit set (%) [$\bar{X}$ ± SE]*				Remarks**
	After 40 days		After 70 days		
	Bagging	Hand self pollination	Bagging	Hand self pollination	
Badamjor Spillo No. 2C	12.02±4.47	13.99±4.48	4.96±2.25	6.29±2.85	SI
Telangi Selection	15.31±4.53	36.76±2.65	9.18±2.93	24.26±3.24	SC
Tree No.14	16.92±4.94	33.71±2.36	11.92±4.38	21.28±3.22	SC
JKS-38	17.04±4.44	40.08±1.05	12.12±4.38	21.93±3.48	SC
Tree No.2	20.29±3.47	32.07±2.49	14.49±4.41	20.75±3.27	SC
Spillo No.3	21.04±3.48	42.10±1.18	15.86±4.46	23.62±3.49	SC
Local Selection-I (White)	21.18±3.81	37.81±3.57	14.11±3.34	23.99±3.03	SC
Tree No.106	22.07±3.48	34.22±2.38	17.10±4.74	20.57±3.25	SC
JKS-184	22.86±3.94	47.20±1.78	14.26±4.94	20.45±3.47	SC
Tree No.16	23.09±3.49	33.27±2.35	13.93±4.40	15.84±4.52	PSC
Tree No.101	24.96±3.45	68.10±1.85	15.96±4.43	31.90±2.39	SC
JKS-168	29.80±3.53	45.95±1.58	19.26±4.94	25.61±3.51	SC
Local Selection-II (Gaura)	34.96±2.49	72.19±2.52	24.81±4.14	36.19±2.56	SC
Spillo No.7	35.41±2.50	78.27±2.84	21.01±3.47	53.78±0.38	SC
Ribba Selection	37.59±2.90	77.96±2.84	23.52±3.28	37.59±2.57	SC
JKS-238	44.92±1.58	53.28±0.58	23.26±3.49	31.57±2.47	SC
Kashmiri Seedling	45.97±1.50	52.58±0.58	21.41±3.49	39.18±2.57	SC
Gaura Almond	47.04±1.16	51.48±0.58	24.07±3.25	27.40±3.55	SC

*$\bar{X}$ = mean; SE = standard error.
**SI = Self-incompatible; SC = Self-compatible; PSC = Partially self-compatible.

grouped as self-compatible (> 20 per cent), partially self-compatible (10-20 per cent) and self- incompatible (< 10 per cent). Since 25-40 per cent fruit set is considered optimal for commercial production of almond (5), the observed range (4.96-24.81) of fruit set percentage after 70 days of bagging seems to be horticulturally inadequate in comparison to that obtained through hand self pollination (Table 1). Likewise, 15-26 per cent fruit set upon bagging observed in self-compatible al-

Table 2. Correlation between fruit set obtained through bagging and hand self pollination and between different dates after pollination.

Attribute	Fruit set after 40 days of bagging	Fruit set after 70 days of bagging	Fruit set after 40 days of hand self pollination	Fruit set after 70 days of hand self pollination
Fruit set after 40 days of bagging	1.0000			
Fruit set after 70 days of bagging	0.9114*	1.0000		
Fruit set after 40 days of hand self pollination	0.6599*	0.7797*	1.0000	
Fruit set after 70 days of hand self pollination	0.6844*	0.7372*	0.8954*	1.0000

*Significant at 0.05 level of significance.

Table 3. Relative fruit set (bagging/hand self pollination) ratio in almond selections.

Selections/Cultivars	Relative fruit set ratio	
	After 40 days	After 70 days
Badamjor Spillo No. 2C	0.86	0.79
Telangi Selection	0.42	0.38
Tree No.14	0.50	0.56
JKS-38	0.43	0.55
Tree No.2	0.63	0.70
Spillo No.3	0.50	0.67
Local Selection-I (White)	0.56	0.59
Tree No.106	0.64	0.83
JKS-184	0.48	0.71
Tree No.16	0.69	0.88
Tree No.101	0.37	0.50
JKS-168	0.65	0.75
Local Selection-II (Gaura)	0.48	0.69
Spillo No.7	0.45	0.39
Ribba Selection	0.48	0.63
JKS-238	0.87	0.74
Kashmiri Seedling	0.87	0.55
Gaura Almond	0.91	0.88

mond cultivars native to Apulia, Italy (1, 2, 7), has been considered as biological interesting but horticulturally inadequate. But this can improve cropping consistency in mixed blocks.

The perusal of data on relative fruit set presented in Table 3 reveals that all the indigenous selections set higher number of fruits through hand self pollination than through bagging. Although some workers in the past have obtained the similar results (3, 4) yet others recorded higher fruit set from unassisted self pollination (bagging) as compared to hand self pollination (9). Vasilakakis and Porlingis (10), on the other hand, reported nearly similar fruit set from caged branches and hand self-pollination. However, correlations worked out in the present study indicates that fruit set obtained through bagging and hand self pollination after 40 and 70 days are associated with each other positively and significantly (Table 2). Thus, it may be possible to select for self-compatibility on the basis of fruit set recorded after 40 days of bagging or/and hand self pollination.

The data presented here indicate the self-compatible nature of as many as sixteen indigenous selections. However, it is suggested that these be tested for their field performance in solid blocks for future recommendations, to evaluate their potential for natural self-pollination in the absence of pollinizers and honeybees. Unlike peaches, self-compatibility is independent of natural self-pollination in almonds.

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