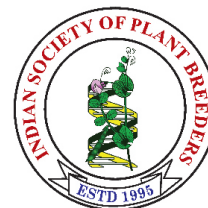


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Research Note

Influence of pollen on physicochemical characteristics of selected guava (*Psidium guajava L.*) genotypes

Praveena Jannila¹, Aditi Chakraborty^{2*}, Nilesh Bhowmick³, Amarendra Nath Dey⁴, Arup Sarkar⁵ and Manoj Kanti Debnath⁶

^{1, 2&3} Department of Pomology and Post Harvest Technology,

⁴ Department of Forestry,

⁵ Department of Genetics and Plant Breeding,

⁶ Department of Agricultural Statistics, Uttar Banga Krishi Viswa vidyalaya, Pundibari, West Bengal, India.

E-Mail: aditi.chatterjee10@gmail.com

Abstract

An experiment was conducted to determine the influence of pollen on physicochemical characteristics including fruit weight, fruit length, fruit diameter, the number of seeds/fruit, seed weight, total soluble solids, acidity, reducing sugar, total sugar and vitamin C of selected guava (*Psidium guajava L.*) genotypes at UBKV, under the Terai zone of West Bengal. Three types of crosses viz., restricted crossing, restricted selfing and open pollination were made by utilizing one Red Fleshed genotype as pollen donor plant and five white fleshed genotypes as fruit giving plant. Among the five guava genotypes L-49 recorded the best results in all type of cross and Doodh Khaja showed a very poor effect on crossing. Under Self pollination L-49 and Baruipur showed the best results and Pant Prabhat showed a poor result due to effect of pollen. Fruits obtained from restricted cross pollination were the best for fruit quality parameters namely TSS, Vitamin C and Total sugars. Hence it was inferred that planting of Red Fleshed genotype as polliniser in a mixed guava orchard may be utilized as a strategy for the improvement of horticultural traits in guava.

Keywords

Guava, pollen, physicochemical characters, polliniser

Guava (*Psidium guajava L.*) is cultivated in India since, early 17th century and due to its wider adaptability in diverse soils and agro-climatic regions, low cost of the cultivation, prolific bearing and being highly remunerative with fruit nutritive values, it has gained more popularity among the fruit growers. It is one of the most important tropical and subtropical fruits of India, belonging to Myrtaceae family is generally believed to have originated in Central America or Mexico. It is considered to be one of the most exquisite and nutritionally valuable crops and is aptly called "Apple of tropics" and "Poor man's apple".

In India, this crop has been confined to the state of Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh and West Bengal. Though it is successfully grown all over the country, Uttar Pradesh (16.5%), Bihar (10.2%), Madhya Pradesh (22.9%) and Maharashtra are the leading guava growing states. The total area under guava is 262 thousand hectares and

production is 3648 thousand tones in India (National Horticulture Board, 2017), with a productivity of 8 MT/ha. The fruit is an excellent source of vitamin C and pectin but has low energy (66 cal /100gm), protein (1%) content and has 17% of dry matter and 83% of moisture. The fruit is also rich in minerals like Phosphorus (24-37mg/100gm), Calcium (14-30 mg/100gm) and Iron (0.6-1.4mg/100gm) as well as vitamins like Niacin, Pantothenic acid, Thiamine, Riboflavin and vitamin A.

Antioxidant compounds in pink and red pulp guava accessions have the potential for a greater beneficial contribution to the human diet than white pulp guava (Santos, 2012). Guava fruits are used for both eating fresh and also for processing. Guava has excelled most of the other fruits in respect of its productivity, hardiness, adaptability and Vitamin C content. But the cultivation is seriously threatened by wilt due to *Fusarium* sp. a soil born fungus and many physiological disorders including

fruit cracking, bacterial canker, etc. which hamper the fruit quality. Hence, the first priority in guava cultivation is to develop a high yielding cultivars with improved eating quality and processing quality.

The present experiment was carried out during 2016-2018 in the Instructional Farm of Department of Pomology and Post Harvest Technology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar and West Bengal. The area lies in the Terai agro-climatic zone of West Bengal at 26°19'86" N latitude and 89°23'53" E longitude (measured with GPS Garmin-72). Altitude of the area is 80 m above the mean sea level. The soil is generally sandy loam in texture, acidic in reaction (pH 4.0-6.8), high in raw humus content, low in water retention capacity, medium to high in total nitrogen content with a low rate of nitrogen mineralization, medium to high in phosphorus status, low to medium in potash content. The climate of this zone is subtropical humid with distinct features of high humidity and high rainfall. The range of maximum and minimum temperature of the area is 24°C-32° C and 7°C-8° C respectively.

In the present investigation, Red fleshed Guava was treated as pollinator for the varieties L-49, Allahabad Safeda, Pant Prabhat, Doodh Khaja and Baruiapur. The investigation was carried out by using three types of pollination systems namely, Restricted cross pollination, Restricted self pollination and Open cross pollination. For making crosses in hybridization programme, the female flowers were emasculated (removal of anthers of a flower) at calyx split stage, at least one hour before anthesis. During emasculation, the left hand was used to hold the flower at base, and the anthers were removed by inserting forceps between the sepals to grip the base of the anthers and/or petals, which were then removed by a firm but

steady pull. The stigma should remain intact and not to be injured during the emasculation process. Immediately after emasculation the flowers were bagged (with butter paper bags) to prevent random cross pollination. Small perforations were made on the butter paper for better aeration. The flower was pollinated within 2 hours after emasculation with freshly collected pollen and re-bagged. The flowers were tagged immediately after bagging. Bags were removed after 5-6 days of pollination. In case of selfing, pollen of same flower or from the flowers of same variety was used. In case of open pollination, pollination could be from any source.

The experimental data were analyzed as per the procedure for Randomized Block Design (RBD) with four replications of each combination of crossing programme. All the physical and chemical parameters were evaluated by variance analysis (one way classified data) using SAS software.

The data pertaining to the mean performance of six open pollinated guava genotypes with their physicochemical characters were analyzed as given in "Table 1". In the open pollination, the highest fruit weight, fruit length and fruit diameter was observed in Pant Prabhat (133.37 g, 4.75 cm and 4.95 cm respectively), whereas the lowest values were observed in Red Fleshed (59.62 g, 3.17 cm and 3.2 cm respectively) for the same characters. In case of self pollination, the highest fruit weight, fruit length and fruit diameter was observed in L-49 (114.62g, 4.22 cm and 4.27 cm respectively) and the lowest value was found in Red Fleshed (53.62 g, 3.17 cm and 2.80 cm respectively). In cross pollination, the highest values for the above said characters were observed in L-49 (125.00g, 4.45 cm and 4.82 cm respectively) and lowest in Allahabad Safeda (50.25g, 3.02 cm and 2.92cm respectively).

Table 1. Physical properties of guava genotypes with various modes of pollination

GENOTYPE	CHARACTER OF FRUIT														
	Weight (g)			Length (cm)			Diameter (cm)			Seed count			Seed weight (g)		
	Op	Sp	Cp	Op	Sp	Cp	Op	Sp	Cp	Op	Sp	Cp	Op	Sp	Cp
L-49	120.75 ^{ab}	114.62a	125.00a	4.22ab	4.22a	4.450a	3.92a	4.27a	4.82a	273.25ab	271.75a	226.25a	0.88d	0.80d	0.93b
BARUIPUR	105.62b	73.00c	84.87b	3.72ab	3.37b	3.475b	3.87a	3.07b	3.45b	209.25bc	142.00b	185.25a	0.81e	0.81d	0.87d
ALLAHABAD SAFEDA	113.12ab	87.50abc	50.25c	3.97ab	3.22b	3.025b	4.07a	3.17b	2.92b	220.50bc	271.50a	149.00a	0.96c	0.91b	0.96a
DOODH KHAJA	113.00ab	88.75abc	64.37bc	4.57a	3.25b	3.250b	4.62a	3.12b	3.07b	319.50ab	153.75b	144.00a	1.16a	0.98a	0.91c
PANT PRABHAT	133.37a	94.75ab	89.25b	4.75a	3.60b	3.600b	4.95a	3.27b	3.50b	375.00a	212.50ab	177.00a	1.10b	0.91b	0.91c
RED FLESHED	59.62c	53.62c		3.17b	3.17b		3.20a	2.80b		114.25c	105.75b		0.80 f	0.83c	
SEM(±)	7.63	11.28	9.17	0.40	0.19	0.19	4.78	0.17	0.20	34.28	34.19	32.85	0.00	0.003	0.003
CD at 5%	23.00	34.00	28.28	1.19	0.57	0.60	NS	0.54	0.62	103.34	103.06	NS	0.00	0.010	0.010

In case of open pollinated fruits, the highest seeds/fruit was observed in Pant Prabhat (375.00) followed by Doodh Khaja (319.50) and the lowest in Red Fleshed (114.25) followed by Baruipur (209.25). In case of self pollinated fruits, the highest seeds/ fruit were observed in L-49 (271.75) and the lowest in Red Fleshed (105.75). Moreover, in cross pollinated fruits, the highest seeds/ fruit was observed in L-49(226.25) and the lowest in Doodh Khaja (144.00). Total number of seeds present in open pollinated fruits was more as compared to cross pollinated fruits, which is a negative effect of pollen on fruit character but less number of seeds is a good physical property of the fruit; so this can be a positive effect of pollen.

The highest seed weight in open pollinated fruits was found in Doodh Khaja (1.16g) followed by Pant Prabhat (1.10 g) and the lowest in case of Red Fleshed (0.80g) followed by Baruipur (0.81 g). In case of self

pollinated fruits, the highest seed weight was found in Pant Prabhat (0.98g) and the lowest in case of L-49 (0.80g). Highest seed weight for cross pollinated was found in Allahabad Safeda (0.96), and the lowest in case of Baruipur (0.87). For the character seed weight, all the genotypes differed significantly from each other.

Chemical properties of guava fruits obtained from different modes of crossing were significantly different (**Table 2**). The highest total soluble solid was found in L-49 (9.60^o Brix) and the lowest in case of Doodh Khaja (7.72^o Brix). In case of self pollination, the highest total soluble solid was found in Red Fleshed (10.25^o Brix) and the lowest in case of Baruipur (8.75^o Brix). In addition to this the total soluble solid for cross pollinated guava genotypes was found highest in Baruipur (11.37^oBrix) and the lowest in case of Pant Prabhat (9.17^oBrix).

Table 2. Chemical properties of guava genotypes with various modes of pollination

GENOTYPE	CHARACTER OF FRUIT														
	TSS(^o Brix)			Total Acidity (%)			Reducing sugar(%)			Total sugar(%)			Vitamin-C (mg/100g)		
	Op	Sp	Cp	Op	Sp	Cp	Op	Sp	Cp	Op	Sp	Cp	Op	Sp	Cp
L-49	9.60a	9.52a	10.20ab	0.30abc	0.33a	0.30b	4.53ab	4.63a	4.33c	6.49b	6.69a	6.70a	117.76abc	134.43b	145.15a
BARUIPUR	8.85ab	8.75a	11.37a	0.28bc	0.30a	0.30b	4.48b	4.48b	4.56a	6.40cd	6.69a	6.70a	119.62ab	144.34a	139.20ab
ALLAHABAD SAFEDA	8.47bc	10.00a	10.97a	0.27c	0.35a	0.36a	4.45b	4.51ab	4.45b	6.38cd	6.42b	6.36b	115.07bc	141.10ab	132.65b
DOODH KHAJA	7.72c	9.60a	10.02ab	0.33ab	0.33a	0.30b	4.42b	4.61a	4.46b	6.67a	6.66a	6.74a	114.28bc	135.35ab	140.95ab
PANT PRABHAT	8.90ab	9.10a	9.17a	0.35a	0.30a	0.32ab	4.59a	4.55ab	4.421b	6.45bc	6.70a	6.64a	125.25a	144.03a	130.70b
RED FLESHED	8.07bc	10.25a		0.32abc	0.30a		4.29c	4.33c		6.33d	6.65a		110.07c	118.45a	
SEM(±)	0.33	0.50	0.36	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.06	0.05	2.78	2.95	2.75
CD at 5%	1.02	NS	1.14	NS	NS	NS	0.09	0.11	0.08	0.06	NS	0.18	8.47	8.98	8.58

Values having same superscription are statistically non significant at 5% level of significance.

Where, Op-Open pollination, Sp- Self pollination, Cp-Cross pollination

In case of open pollination, the highest acidity was found in Pant Prabhat (0.35) and the lowest in Allahabad Safeda (0.27). In case of self pollination, the highest acidity was found in Allahabad Safeda (0.35). In case of cross pollination, the character total acidity was highest in Allahabad Safeda (0.36).

With respect to reducing sugar, the highest value in self pollination was obtained in Pant Prabhat (4.59) and the lowest in Red Fleshed (4.29). In case of self pollination, the highest reducing sugar was found in L-49 (4.63) and the lowest in Red Fleshed (4.33). In case of cross pollination, the highest reducing sugar was found in Baruipur (4.56) and the lowest in L-49 (4.33). In case of open pollination, the total sugar was found highest in Doodh Khaja (6.67) and the lowest in Red Fleshed(6.33).

In case of self pollination as well as cross pollination, the highest total sugar was found in Doodh Khaja (6.70 with self pollination and 6.74 with cross pollination) and the lowest in Allahabad Safeda (6.42 with self pollination and 6.36 with cross pollination). All the crossed fruits except Allahabad Safeda x Red Fleshed recorded a high total sugar content.

In case of the open pollination, the highest vitamin C was found in Pant Prabhat (125.25 mg) and the lowest was recorded in Red Fleshed (110.07mg). In case of the self pollination, the highest vitamin-C was found in Baruipur (144.34 mg) and lowest in Red Fleshed (118.45 mg). In case of cross pollination, the highest vitamin-C was found in L-49 (145.15 mg) and the lowest in Pant Prabhat (130.70).

Red Fleshed (Pollen donor) had positive effect on all the other genotypes on fruit quality. In the open pollinated fruits, TSS was observed in a range between 7.72-9.60° Brix while in cross pollinated fruits to the range was 9.17-11.37° Brix. Vitamin C observed in open pollinated fruits was 110.07 -125.25 mg/100g while in cross pollinated fruits it was higher with the highest value being 145.5 mg/100g. While there was no appreciable change in reducing sugar and total sugar content, pollen had a negative effect on fruit weight and fruit length. As in open pollinated guava genotypes fruit weight was more as compared to cross pollinated fruits. Fruit length and diameter were also observed to be more in open pollinated fruits as compared to cross pollinated fruits. Similarly, the total number of seeds present in open pollinated fruits was more as compared to cross pollinated fruits, which is a negative effect of pollen on fruit character. However, since the less number of seeds is a good quality parameter, this can be considered as a positive effect of pollen. Seed weight (100 seed weight) was more in open pollinated fruits (0.80-1.16 g) but in cross pollinated fruits it was comparatively less (0.87-0.96 g). Atawia *et al.* (2016), reported that self pollinated shaddock fruits had highest fruit weight, fruit size, pulp weight, the number of seeds per fruit, juice %, T.S.S % and Vitamin C compared with cross pollination. Vazifeshenas *et al.*, (2015) reported that pollen source influenced all qualitative traits of pomegranate with the exception of aril colour and taste that remain unaffected. Further, they also observed that cross pollination increased fruit decay. Yildiz (2017) reported the significant effect of cross pollination on fruit set and pomological characters such as fruit weight, total soluble solids, TSS: TA (total acids) ratio and the number of seeds per fruit in 'Robinson' and 'Fremont' Mandarins.

The results of this experiment demonstrated that pollen of Red Fleshed genotype had negative effect on number of seed/fruit and seed weight, which are desirable horticultural characters and had positive effect on TSS and vitamin C for more or less all the genotypes. Among the five guava genotypes, L- 49 recorded best results in all the three types of pollination. The genotype Doodh Khaja showed a very poor effect on crossing. Under self

pollination L- 49 and Baruipur showed a best result and Pant Prabhat showed a poor result due to effect of pollen. Fruits resulting from restricted cross pollination were associated with superior fruit quality parameters with respect to TSS, Vitamin C and total sugar. Hence, it may be concluded that the use of Red Fleshed genotype as polliniser in a mixed guava orchard may be a beneficial strategy for the improvement of horticultural traits.

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