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Hybridization Studies Between Pomegranate Cultivars and Wild Germplasm Accessions

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Abstract Bacterial blight of pomegranate is a highly devastating disease recording 60 to 80% yield loss in India. Most of the improved commercial cultivars of pomegranate are facing the risk of genetic vulnerability in the absence of resistant germplasm. The search for resistant varieties forms the basis for a successful management of this disease in the future globally. In the present study five cultivars namely Ganesh, G-137, Kandhari Kabuli, Bhagwa, Mridula and two wild pomegranate (*Daru*) germplasm accessions namely NT-1 and MH-1 were used for hybridization studies. Amongst all the cross combinations attempted the highest (79.09%) fruit set was observed in Bhagwa × NT-1 and minimum fruit set was recorded in MH-1 × G-137 (57.76%). Fruit retention ranged from 10.34 to 30.90% whereas seed germination ranged from 0.00 to 19.43% in all cross combinations.

Keywords Genetic vulnerability, Hybridization, Bacterial blight, Germination.

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Introduction

Pomegranate (*Punica granatum* L.) a member of family Punicaceae, is a favorite table fruit of the tropical and subtropical regions. The fruit was domesticated around 2000 BC [1]. It is very much liked for its cool refreshing juice and valued for its medicinal properties. The clonal degeneration of adapted varietal lot, absence of varieties suited to local climatic conditions and devastating outbreak of bacterial blight necessitates the breeding of varieties resistant to the same. Bacterial blight of pomegranate caused by *Xanthomonas axonopodis* pv. *punicae* has become an increasingly serious threat for pomegranate growers in the Indian subcontinent resulting in heavy economic losses [2]. So far, there is no known gene source present imparting resistance to this disease except wild pomegranate *Daru* and dwarf ornamental pomegranate variety *Nana* which are hardy in nature and does not exhibit any symptoms of the disease [3]. The search for resistant varieties forms the basis for a successful management of this disease in the future globally.

Materials and Methods

The present investigation was carried out in pomegranate block of the department of fruit science, Dr Y S Parmar University of Horticulture and Forestry, Solan (H P). The cultivars undertaken for study were Ganesh, G-137, Mridula, Kandhari Kabuli, Bhagwa and wild pomegranate germplasm accessions (NT-1 and MH-1).

For emasculation /crossing, about to open

Table 1. Fruit set and fruit retention under artificial cross pollination. * Figures in parentheses are arc sine transformed values, ** Figures in parentheses are square root transformed values.

Cross combination	Fruit set (%)*	Fruit retention (%)**
Ganesh × MH-1	72.99 (58.72)	27.45 (5.23)
Ganseh × NT-1	73.14 (58.83)	26.64 (5.16)
Mridula × MH-1	65.86 (54.25)	18.53 (4.30)
Mridula × NT-1	66.03 (54.36)	26.22 (5.12)
Bhagwa × MH-1	76.47 (61.01)	26.89 (5.18)
Bhagwa × NT-1	79.09 (62.80)	29.42 (5.42)
G-137 × MH-1	67.72 (55.42)	20.03 (4.47)
G-137 × NT-1	68.83 (56.08)	24.08 (4.91)
Kandhari Kabuli × MH-1	76.95 (61.40)	30.09 (5.48)
Kandhari Kabuli × NT-1	77.51 (61.70)	29.56 (5.44)
MH-I × Ganesh	61.37 (51.58)	15.16 (3.89)
NT-1 × Ganesh	74.35 (59.99)	17.62 (4.20)
MH-1 × Mridula	65.66 (54.14)	10.34 (3.21)
NT-1 × Mridula	61.56 (51.69)	17.23 (4.15)
MH-1 × Bhagwa	69.81 (56.77)	27.56 (5.25)
NT-1 × Bhagwa	72.87 (58.85)	29.08 (5.39)
MH-1 × G-137	57.76 (49.52)	14.53 (3.81)
NT-1 × G-137	59.38 (50.47)	13.52 (3.67)
MH-1 × Kadhari Kabuli	62.50 (52.25)	24.87 (4.99)
NT-1 × Kandhari Kabuli	64.75 (53.60)	22.95 (4.79)
$CD_{0.05}$	4.06	0.32

healthy flower buds which were marked by the appearance of cracks at the apex of bud were selected and emasculated with the help of forceps. The emasculated flowers showing stigma receptivity (shiny appearance and showing signs of wetness) were pollinated with desired pollen parent in each cultivar. The following cross combinations involving Ganesh × NT-1, Ganesh × MH-1, G-137 ×NT-1, G-137 ×MH-1, Mridula ×NT-1, Mridula ×MH-1, Kandhari Hansi × NT-1, Kandhari Hansi × MH-1, Bhagwa × NT-1, Bhagwa × MH-1 and their reciprocals were attempted. The number of fruits setting in each cross combination was recorded after six weeks of pollination and percentage was worked out.

$$\text{Fruit Set (\%)} = \frac{\text{Number of fruits developed}}{\text{Total number of flowers}} \times 100$$

The fruits retained on the plant were recorded, one week before harvesting of fruits.

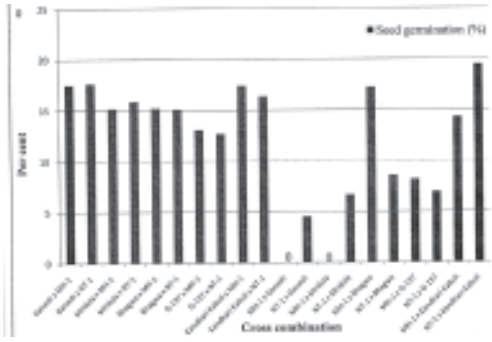

Fig. 1. Hybrid seed/ seedlings obtained from different cross combinations in pomegranate.

After harvest the freshly extracted seeds from each cross combination were sown in pots for subsequent raising of hybrid seedlings. The germination percentage was recorded after 15 days of sowing of seeds by using following formula :

$$\text{Seed germination (\%)} = \frac{\text{Total number of seeds}}{\text{Seeds germinated}} \times 100$$

The hybrid seedlings were transplanted and lined out in nursery beds when they attained a height of 4-6 inches : The data were analyzed in randomized block design (Fruit set and fruit retention) as per the procedures given by Panse and Sukhatme [4].

Results and Discussion

All the pomegranate cultivars and wild germplasm accessions in which hybridization was done were found to be cross compatible. Fruit set in different cross combinations ranged from 57.76 to 79.09% (Table 1). The fruit set through artificial cross pollination varies with different cross cobinations. However, Sharma and Bist [5] reported maximum fruit set up to 90% by artificial cross pollination in different cultivars. Fruit retention varied from 10.34 to 30.09% (Table 1). This significant variation was observed due to adverse climatic conditions resulting in fruit cracking and attack of bacterial blight disease during the hybridization program. Kumar [6] achieved similar results while attempting inter-vari-

etal crosses in pomegranate with fruit retention ranging from 8.14 to 29.60%.

Seed germination in different cross conbinations ranged from 0.00 to 19.43% (Fig.1). Jalikop [7] observed that seed germination ranged from 0.12 to 38.82% of hybrid seeds obtained from different cross combinations. The results obtained in the present study are a step forward to evolve bacterial leaf blight resistant genotypes in pomegranate. Considerable success has been achieved via attempting crosses as evident from moderate to high fruit set and moderate hybrid seed germination. Thus,bearing in mind the risk of genetic vulnerability of commercial cultivars in the absence of resistant germplasm, there is an absolute need to continue further work in respect of raising, screening and evaluation of the resultant hybrid progeny to select promising genotypes.

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