

## Results of Interspecific Cross Pollinations Between *Solanum melongena* L. and *S. incanum* L. in Egg-Plant Breeding

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(Received 13 August 1981; after revision 2 November 1981)

Cytomorphology of *Solanum incanum* and two varieties of egg-plant, namely, Pusa Purple Long (PPL) and Giant of Banaras (GB) was studied together with their hybrids ( $F_1$ ). The hybrids were fertile with mostly normal meiosis indicating a close genetic relationship of *S. incanum* with the varieties of egg-plant. The cytological data of the hybrids indicated the potential ability of the parents to produce a few transgressive hybrids of some important agricultural features in  $F_2$  generation. The interpretation of cytological data, in the light of available literature suggests that the varieties of egg-plant used in present investigation are primarily differentiated from *S. incanum* by certain genetic factors.

The plants of  $F_4$  progeny were morphologically homogeneous and resistant; under field conditions, to wilt and fruit borer. If the breeding features of the subsequent progenies are satisfactory, they may be of much value in egg-plant cultivation.

**Key Words:** *Solanum incanum* L., *Solanum melongena* L., Interspecific pollinations, Transgressive hybrids, genetic factors.

### Introduction

Extensive investigations were made by the author and his co-workers on floral biology (Rao 1979), cytogenetics and development of improved pest-resistant egg-plant germplasm and varieties (Reayat Khan et al. 1978, Rao & Shamim Baksh 1979, Rao et al. 1979, Rao & Anil Kumar 1980). The present paper deals with the results of interspecific cross pollinations between *Solanum melongena* and *S. incanum*, and their significance in egg-plant breeding.

### Materials and Methods

*Solanum incanum* L. and two varieties of

*S. melongena* L., namely, Pusa Purple Long (PPL) and Giant of Banaras (GB) were used in present investigation. The seedlings of 8 to 10 cm tall were transplanted in experimental plots in rows, the distance between rows and between seedlings in rows being 90 cm.

Several long-, medium- and short-styled flowers of PPL and GB were pollinated with fresh pollen of *S. incanum*. Meiosis was studied in squashes of pollen mother cells fixed in Carnoy's fluid and made permanent with butyl alcohol (Swaminathan et al. 1954, Bhaduri & Ghosh 1954). Pollen fertility was determined as stainability in acetocarmine.

The parents and hybrids were tested against

*Fusarium oxysporum* (causes wilt) and *Leucinodes arbonalis* (brinjal fruit borer). The former was cultured on autoclaved maize grain in Earleymeyer flasks of 500 ml capacity and was reared at 25°C. The cultures were ready for use after about 10 to 15 days. The larvae of the latter were obtained from cultures maintained by the Department of Zoology, Aligarh Muslim University, Aligarh, India.

The fungal pathogen was mixed thoroughly well with autoclaved garden soil. The inoculated soil was filled in sterilized earthen pots. Some seeds were sown, as controls, on autoclaved garden soil. The percentage of seed germination was graded as follows:

- Germination less than 20% : very poor
- Germination more than 20%  
but less than 50% : Poor
- Germination between 50-75% : Moderate
- Germination above 75% : High

For testing the resistance of fruits against the brinjal fruit borer, 20 fresh and healthy fruits were collected at edible stage and were placed immediately on wooden trays of size 120 cm × 120 cm. The larvae were placed at a distance of 60 cm from the fruits. The degree of resistance of fruits against the fruit borer was graded as follows:

- Damage to the extent of  
0-25% of fruit size : Resistant  
(Negligible)
- Damage between 25-50% : Moderately  
(Moderate) resistant
- Damage more than 50% : Susceptible  
(Severe)

### Observations

*Morphological characters of the parents:* Detailed morphological features of *S. incanum*, PPL and GB are given in table 1.

Three kinds of flowers were recognized in

PPL and GB: long-styled (the style protruded above the anther tips), medium-styled (the length of style was equal to that of anther) and short-styled (the style was very small or rudimentary). *S. incanum* showed only long- and medium-styled flowers, but most of the flowers were long-styled. The long- and medium-styled flowers set fruit, whereas the short-styled flowers did not set fruit either on selfing or cross pollination. In hybridization only long-styled flowers were used.

*Results of hybridization:* Fifty long-styled flowers of each of PPL and GB were pollinated with fresh pollen of *S. incanum*. In the cross PPL × *S. incanum*, 16 seedlings were obtained with a total number of 2576 seeds, the germination percentage was 38.30. In the cross GB × *S. incanum*, 5 mature fruits were obtained with a total number of 705 seeds, the germination percentage being 14.70.

*Morphology of the hybrids* (table 1): The F<sub>1</sub> hybrids were erect, spiny, vigorous in growth, profusely branched and bushy in habit. The hybrids flowered profusely. The hybrids of the cross PPL × *S. incanum* produced several oval purplish green fruits with viable seeds. The hybrids of the cross GB × *S. incanum* produced large number of small, round-oval, green fruits with thick flesh and viable seeds. The hybrids of both the crosses were diploids with n=12 chromosomes and exhibited resistance, under field conditions, to wilt and brinjal fruit borer.

*Cytology of the parents and hybrids:* In *S. incanum*, PPL and GB the meiosis was normal with 12 bivalents at diakinesis and metaphase I (figures 1-3). In the former, at metaphase I, the mean number of chiasmata, per bivalent, was 1.78, while in PPL and GB it was 1.16 and 1.48, respectively.

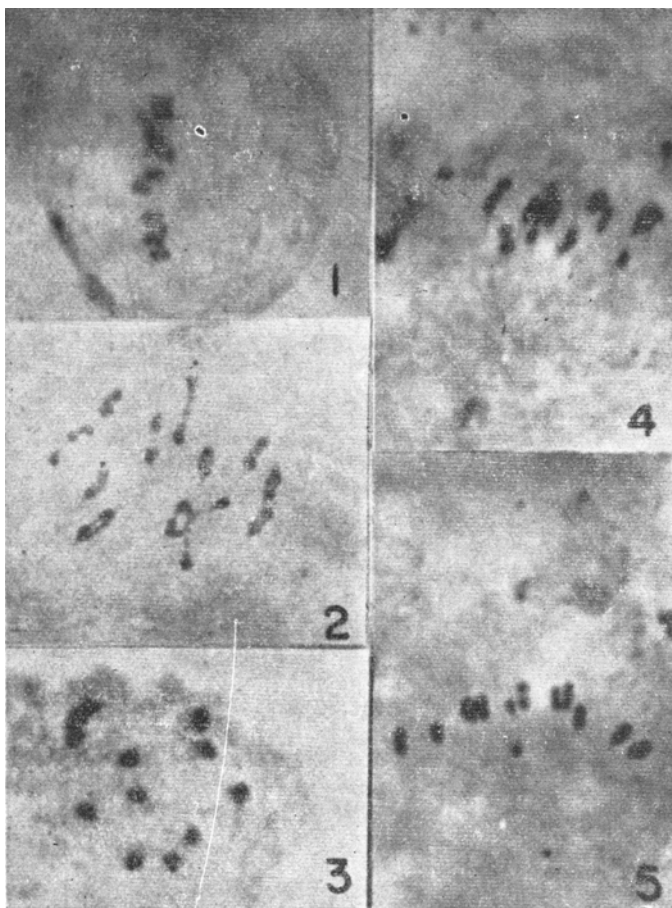
No meiotic aberrations were observed in F<sub>1</sub> hybrids of the cross PPL × *S. incanum* and GB × *S. incanum*. There were no bridges or fragments at metaphase I (figures 4 & 5). In hybrids of the former and latter crosses,

**Table 1** Comparison of morphological characters of Pusa Purple Long (PPL), Giant of Banaras (GB), *S. incanum* and  $F_1$  hybrids

Character	PPL	GB	<i>S. incanum</i>	PPL × <i>S. incanum</i>	GB × <i>S. incanum</i>
Habit	Prostrate and sparsely spiny	Erect and spineless	Erect and spiny	Semi-erect and spiny	Erect and spiny
Plant height (cm)	67.00	47.00	85.00	71.00	105.00
Leaf	Sparsely spiny and dark green	Spineless and dark green	Spiny and dark green	Spiny and dark green	Spiny and dark green
Flower	Solitary or in clusters of 2 or 3 each	Solitary or in clusters of 2 or 3 each	Solitary or in clusters of 2 or 3 each	Solitary or in clusters of 2-8	Solitary or in clusters of 2-6
Fruits per plant	13	8	43	28	102
Fruit nature	Solitary. Occasionally in clusters of 2 or 3 each	Solitary	Solitary or in clusters of 2 or 3 each	Solitary or in clusters of 2 or 3 each	Solitary or in clusters of 2-4
Fruit shape	Long and cylindrical	Round	Round-oval	Oval	Round-oval
Fruit colour	Purple when young and yellow when ripe	Light green when young and yellow when ripe	Green when young and yellow when ripe	Purplish green when young and light orange red when ripe	Green when young and light orange red when ripe
Fruit weight (gm)	81.00	662.00	14.50	67.00	68.20
Pollen fertility (%)	92.00	80.50	79.00	50.70	43.30
Seeds per fruit	317	872	47	93	139
Chromosome number (n)	12	12	12	12	12

at metaphase I, the mean pairing of chromosomes recorded, per cell, was  $11.59_{II} + 0.81_I$  and  $11.56_{II} + 0.88_I$ , respectively. In hybrids of the cross PPL × *S. incanum*, the mean frequency of chiasmata, per bivalent, was 1.08 while in hybrids of the cross GB × *S. incanum* it was 1.05.

*Study of F<sub>2</sub> progeny:* From F<sub>2</sub> progeny of the cross PPL × *S. incanum*, one semi-erect, spiny plant with as many as 38 small, oval, green fruits was selected. The fruits were solitary or in pairs. The plant was resistant, under field conditions, to wilt and brinjal fruit borer.



Figures 1-5

From  $F_2$  progeny of the cross GB  $\times$  *S. incanum*, one erect, spiny plant with 36 solitary, small, round, green fruits was selected. The plant was resistant, under field conditions, to wilt and brinjal fruit borer.

*Study of  $F_3$  progeny:* The  $F_3$  seedlings were raised from seeds of the selected plants and were tested against wilt (table 2). The survival of seedlings of the crosses PPL  $\times$  *S. incanum* and GB  $\times$  *S. incanum* was moderate (50-75%) in soil inoculated with *F. oxysporum*, but their survival was high (above 75%) in autoclaved soil. The seedlings of moderate resistance were transplanted in experimental plots and

**Table 2** Comparison of resistance of seedlings of Pusa Purple Long, Giant of Banaras, *S. incanum* and hybrids ( $F_3$ ) against *F. oxysporum*

Material	Autoclaved soil		Autoclaved soil with <i>F. oxysporum</i>	
	Seeds sown	Survival percentage of seedlings	Seeds sown	Survival percentage of seedlings
PPL	100	86	100	16
GB	100	92	100	28
<i>S. incanum</i>	100	80	100	57
PPL $\times$ <i>S. incanum</i> ( $F_3$ )	100	98	100	52
GB $\times$ <i>S. incanum</i> ( $F_3$ )	100	86	100	50

their fruits were tested against brinjal fruit borer. The observations indicate that the fruits of *S. incanum* and F<sub>3</sub> plants were moderately resistant to fruit borer, while the fruits of PPL and GB were susceptible (table 3).

Promising selections were made from plants which exhibited resistance, under experimental as well as field conditions, to wilt and brinjal fruit borer. From F<sub>3</sub> progeny of the cross PPL × *S. incanum*, one semi-erect, spiny plant with 38 small, oval, green fruits was selected. The fruits were solitary or in pairs. From F<sub>3</sub> progeny of the cross GB × *S. incanum*, one erect, spiny plant with solitary, round green fruits was selected.

*Study of F<sub>4</sub> progeny:* The F<sub>4</sub> progeny of each selection was morphologically homogeneous, vigorous in growth and profusely branched, and was resistant, under field conditions, to wilt and brinjal fruit borer. The F<sub>4</sub> plants of the cross PPL × *S. incanum* were tall, erect, spiny and profusely branched with solitary, small, oval, green fruits. The average number of fruits/plant was 20, whereas in PPL it was 13. The fruits of the hybrids reached edible stage about 20 days earlier than the fruits of PPL. The F<sub>4</sub> plants of the cross GB × *S. incanum* were tall, erect

and spiny with solitary, small, round, light green fruits. The average number of fruits/plant was 20, while in GB it was 8. The fruits of the hybrids matured to edible stage about 15 days earlier than the fruits of GB.

**Discussion**

The ready crossability and production of fertile hybrids with normal meiosis between *S. incanum* and PPL, and GB indicate close phyletic relationship between the two taxa. At diakinesis and metaphase I, the occurrence of 12 bivalents in several pollen mother cells of the hybrids may suggest the close identity of genomes of the parents. The absence of multivalents in parents and hybrids may indicate allosyndetic pairing of chromosomes.

In hybrids, the occasional occurrence of univalents at metaphase I and low percentage of pollen fertility, as compared to that of the parents, may be due to either the differences in genetic constitution or cryptic structural differences between the parental chromosomes, which may be too small to be detected cytologically, or the combined effects of both the factors. Small structural differences between chromosomes could conceivably co-exist with high degree of regular meiotic pairing (Stebbins 1947).

**Table 3** Comparison of resistance of fruits of Pusa Purple Long, Giant of Banaras, *S. incanum* and F<sub>3</sub> plants against *Leucinodes arbonalis*

Material	Fruits tested	Larvae used	Distance between larvae and fruits (cm)	Average time taken by larvae			Fruits infected	Extent of damage of fruits		
				reach fruits	begin penetration	complete penetration		Negligible	moderate	Severe
PPL	20	50	60	20	5	45	20	—	—	20
GB	20	50	60	5	9	30	20	—	—	20
<i>S. incanum</i>	20	50	60	10	10	28	20	20	—	—
PPL × <i>S. incanum</i>	20	50	60	10	15	71	20	3	13	—
GB × <i>S. incanum</i>	20	50	60	8	14	48	16	6	10	—

It may also be noted that marked evidence of structural differentiation is not to be expected in species with small chromosomes and a few chiasmata. It is suggested that *S. incanum* and the varieties of *S. melongena*, namely, PPL and GB are primarily differentiated from each other by certain genetic factors.

In  $F_1$  hybrids the occurrence of as high as 1.05 chiasmata/bivalent, may indicate the potential ability of the parents to produce new recombinants. This is further corroborated

by occurrence of a few transgressive hybrids of some important agricultural features in  $F_2$  generation.

Since the  $F_4$  plants of each of the two crosses were morphologically homogeneous and of high yielding nature, and were resistant, under field conditions, to fruit rot and brinjal fruit-borer, if the breeding features of the transgressive hybrids are satisfactory, they may be of much potential value in egg-plant cultivation.

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