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Screening of interspecific hybrids and their parents for resistance to phomopsis blight in brinjal

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Abstract

The present investigation was conducted to screen two commercial cultivars Pant Rituraj, Pant Samrat and wild relatives *viz. Solanum gilo, S. aethiopicum* and *S. khasianum*; and their interspecific hybrids against phomopsis blight. Highly significant mean squares for resistance to leaf, stem and shoot; and fruit infestation activities indicate the presence of sufficient natural variation among 20 brinjal genotypes which could be exploited in resistant breeding. For leaf infestation, stem infestation and fruit infestation either *S. gilo* or *S. khasianum* had highest value of plant showing resistance rated as highly resistant. Among the F_1 hybrids Pant Rituraj × *S. gilo*, *S. gilo* × *S. melongena, S. aethiopicum* × Pant Samrat, *S. aethiopicum* × *S. gilo*, *S. gilo* × Pant Samrat were identified as highly resistant.Among the F_1 hybrids, crosses involving *S. gilo* as one of the parent showed high level of resistance against phomopsis blight. Successful gene transfer from these wild relatives is possible through back cross except from *S. khasianum* which needs the support of biotechnological tools.

Keywords: Brinjal, wild relatives, interspecific hybrids, phomopsis blight, resistance

Introduction

Solanum melongena L., the eggplant, also known as aubergine, brinjal or guinea squash is widely cultivated in India and other tropical and subtropical part of the globe. It occupies prime position among the vegetables. Brinjal being native to India is one of the most common vegetable crops of the country and it is also known as poor men's vegetable. It is cultivated for its immature fruits which are used as cooked vegetable in various Indian food preparations. In the areas experiencing high temperature and humidity during rainy season, the production of brinjal suffers immensely due to the attack of disease and insect pests. It has got a high potentiality both in production and productivity in India where a substantial loss of the crop is due to the attack of different insect pest and diseases caused by different fungus, bacteria and mycoplasma like organisms. Among the diseases threatening the cultivation of brinjal, Phomopsis leaf blight and fruit rot are the most serious disease as this can affect at any stage of its development and lead to complete loss of the crop. The phomopsis blight caused by the fungi *Phomopsis vexans* is most serious and destructive disease of brinjal. The disease was first reported from Gujarat in 1914 and since then from many part of India, its infestation as seedling blight, leaf spot and fruit rot is reported (Rangaswami, 1979). The pathogen usually soil as well as seed borne and therefore it is very difficult to manage the disease by chemical control method alone. Chemical management of the disease also leaves behind the many toxic residues in the soil affecting the consumers health. To overcome the problems posed by phomopsis blight in commercial cultivation of egg plant, the wild relative can be used as a source of resistance to this disease in resistant breeding. Thus, studies on interspecific hybridization in relation to the pest and disease resistance are of great significance. It may be necessary to incorporate the resistant gene(s) for phomopsis blight from related *Solanum* species through interspecific hybridization. In view of above fact, there is need for searching of inherent durable resistance in brinjal cultivars, so that same cultivars could be used for growing as well as breeding purpose for further improvement. The present study was conducted to screen the parent species and their interspecific hybrids to find out durable resistance against *Phomopsis vexans*.

Materials and Methods

The present experiment was conducted for consecutive two years at the Vegetable Research Centre of the G. B.

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Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand. In first year seed of interspecific hybrids was produced followed by disease screening in the second year. The experimental material for the present study comprised of five selected genotypes which include two cultivars of *Solanum melongena* and three wild relatives of eggplant namely *S. melongena* cv. Pant Rituraj (PR), *S. melongena* cv. Pant Samrat (PS), *Solanum gilo* (Sg), *Solanum khasianum* (Sk) and *Solanum aethiopicum* (Sa); and their viable interspecific hybrids PR × PS, PR × Sg, PR × Sa, Sg × PR, Sa × PR, Sa × PS, Sa × Sk, Sg × Sa, Sa × Sg, Sg × PS. All the interspecific hybrids along with the parents were grown with three replications and all the recommended package of practices were followed to grow a successful crop.

Field screening for resistant to phomopsis blight was done as per the method adopted by Kalda et al. 1976. The plant population were screened for disease reaction separately for leaf, stem and fruit infection. The visual disease rating was presented in the Table 1. For working out percentage of plants showing resistance, the rating 0 and 1 were considered as resistant and 2 and 3 as susceptible in case of leaf as well as stem infection. The percentage of plants show resistance for leaf and stem infection were than equated to rating index in the manner 0 to 30 percent = 3; 30 to 60 percent =2; 61 to 80=1; 81 to 100 percent =0.The data in respect to screening of phomopsis blight were statistically analyzed for computing analysis of variance, GCV, PCV and heritability.

Table 1: The visual disease rating for phomopsis blight in brinjal

For leaf infestation	
Rating index	Infestation
0	No visual symptoms on the leaf
1	The lowest leaf showing symptoms of the disease
2	About 60 percent of total foliage showing disease symptom
3	>60 percent of foliage showing disease symptom
For stem and shoot infestation	
Rating index	Infestation
0	No visual symptom on stem
1	Stem showing symptom but otherwise growing normal
2	Stem partially dead
3	Entire stem permanently wilted and dead
For fruit infestation	
% infestation	Rating index
0-20	Resistant (R)
20-40	Moderately resistant (MR)
40-60	Susceptible (S)
>60	Highly susceptible (HS)

Results and Discussion

Large numbers of improved varieties have been developed by various organizations but most of them are susceptible to major insect-pest like shoot and fruit borer (*Lencinodes orboralis* Guen) and jassid (*Amrasca bigutula bigutula*) and diseases like phomopsis blight and bacterial wilt. These pests were responsible for yield losses up to 90 per cent which is most alarming. In this context resistant breeding involving interspecific gene transfer has wide scope for improvement of eggplant. Results of this study revealed crossability relationship of *Solanum melongena, S. gilo, S. khasianum, S. aethiopicum*, morphological variation of the interspecific hybrids from their parents and resistance to major pest and diseases. The mean square (Table 2) showed that resistance to leaf infestation, stem and shoot infestation and fruit infestation due to phomopsis blight in five parents and ten interspecific hybrids of brinjal

Table 2: Analysis of variance for leaf infestation, stem and shoot infestation and fruit infestation due to phomopsis blight in parents and interspecific hybrids of brinjal

Source of variation	d.f	Mean Square		
		LI	SI	FI
Replication	2	0.66	0.52	4.84
Treatment	14	100.12**	96.31**	104.29**
Error	28	0.40	0.19	1.45

***P* <0.01; LI: leaf infestation; SI: Stem and shoot infestation; FI: Fruit infestation

varied significantly. Highly significant mean squares for resistance to leaf, stem and shoot; and fruit infestation activities indicate the presence of sufficient natural variation among 20 brinjal genotypes which could be exploited in resistant breeding.

Screening against leaf infestation due to phomopsis blight: The relative incidence of *Phomopsis* blight on leaf is given in Table 3.The screening against leaf infestation due phomopsis blight revealed that among the parents *S. melongena* cv. Pant Rituraj had least value of plants showing resistance i.e. 6.65 per cent only followed by *S. melongena* cv. Pant Samrat (41.90%) and *S. aethiopicum* (45.95%) and were rated as susceptible genotypes. Among the susceptible genotypes value of *S. melongena* cv. Pant Rituraj varied significantly with the value of other genotypes. While *S. gilo* had highest value of plant showing resistance followed by *S. khasianum* and was rated as highly resistant.

Among the F_1 hybrids *S. melongena* cv. Pant Rituraj × *S. gilo* (84.5%), *S. gilo* × *S. melongena* cv. Pant Rituraj (72.35%), *S. aethiopicum* × *S. melongena* cv. Pant

Table 3: Percentage of plant showing resistance to leaf infestation due to phomopsis blight

Genotype	Means No. of plant	Mean No. of plant showing resistance	% of plant showing resistance	Rating index	Reaction
PR	20	1.33	6.65	3	S
PS	20	8.38	41.90	2	S
Sa	20	9.19	45.95	2	S
Sk	20	19.01	95.05	0	R
Sg	20	19.46	97.30	0	R
PR × PS	20	3.66	18.3	3	S
PR × Sg	20	16.90	84.5	0	R
PR × Sa	20	3.21	16.05	3	S
Sg × PR	20	14.47	72.35	1	R
Sa × PR	20	8.81	44.05	2	S
Sa × PS	20	12.68	63.40	1	R
Sa × Sk	20	10.64	53.2	2	S
Sg × Sa	20	8.99	44.95	2	S
Sa × Sg	20	13.14	65.70	1	R
Sg × PS	20	18.08	90.40	0	R

PS: *S. melongena* cv. Pant Samrat; PR: *S. melongena* cv. Pant Rituraj; Sa: *S. aethiopicum;* Sg: *S. gilo;* Sk: *S. khasianum*

Table 4: Percentage of plant showing resistance stem infestation due to phomopsis blight

Genotype	Means No. of plant	Mean No. of plant showing resistance	% of plant showing resistance	Rating index	Reaction
PR	20	3.70	18.50	3	S
PS	20	11.62	58.1	2	S
Sa	20	11.80	59.00	2	S
Sk	20	19.63	98.15	0	R
Sg	20	19.53	97.65	0	R
PR × PS	20	6.24	31.20	2	S
PR × Sg	20	18.53	92.65	0	R
PR × Sa	20	2.63	13.15	3	S
Sg × PR	20	17.91	89.55	0	R
Sa × PR	20	10.13	50.65	2	S
Sa × PS	20	14.61	73.05	1	R
Sa × Sk	20	9.46	47.3	2	S
Sg × Sa	20	10.24	51.20	2	S
Sa × Sg	20	14.13	70.65	1	R
Sg × PS	20	18.93	94.65	0	R

PS: *S. melongena* cv. Pant Samrat; PR: *S. melongena* cv. Pant Rituraj; Sa: *S. aethiopicum;* Sg: *S. gilo;* Sk: *S. khasianum*

Samrat (63.40%), *S. aethiopicum* × *S. gilo* (65.70%), *S. gilo* × *S. melongena* cv. Pant Samrat (90.40%) were identified as highly resistant while all other F_1 hybrids grouped under susceptible genotypes. In susceptible genotypes the value of plant showing resistance ranged from 16.05 per cent in *S. melongena* cv. Pant Rituraj × *S. aethiopicum* to 53.20 per cent in *S. aethiopicum* × *S. khasianum*. These results were encouraged by the findings of Kalda et al. (1976); Pandey et al. (2002); and Sugha et al. (2002).

Screening against stem infestation due to phomopsis blight: The results of the screening against stem infestation due to phomopsis blight (Table 4) revealed that *S. melongena* cv. Pant Rituraj had least value of plant showing resistance to stem infestation due to phomopsis blight i.e. only 18.50 per cent plants showed resistance to stem infestation followed by *S. melongena* cv. Pant Samrat (58.1%), *S. aethiopicum* (59.00%). These genotypes were scored as susceptible parents. While *S. khasianum* had highest value of plant showing resistance to stem infestation i.e. 98.15 per cent followed by *S. gilo* (97.65%) which were grouped under highly resistance genotypes. Among the F_1 hybrids *S. melongena* cv. Pant Rituraj × *S. gilo* (92.65%), *S. gilo* × *S. melongena* cv. Pant Rituraj (89.55%), *S. aethiopicum* × *S. melongena* cv. Pant Samrat (73.05%), *S. aethiopicum* × *S. gilo* (70.65), *S. gilo* × *S. melongena* cv. Pant Samrat (94.65%) were evaluated as resistant F_1 hybrids. The value of plant showing resistance in susceptible F_1 hybrids ranged from 13.15 per cent in *S. melongena* cv. Pant Rituraj × *S. aethiopicum* to 51.20 per cent in *S. gilo* × *S. aethiopicum*. This report was also encouraged by Kalda et al. 1976; Pandey et al. 2002; and Singh et al. 2002.

Screening against fruit infestation by phomopsis blight : The screening against fruit infestation due to phomopsis blight revealed highest value of fruit infestation (Table 5) in *S. melongena* cv. Pant Rituraj (59.84%) followed by *S. melongena* cv. Pant Samrat (44.14%) and *S. aethiopicum* (41.64%). These genotypes were categorized as susceptible genotypes. While *S. khasianum* showed high level of resistance with 1.18 per cent fruit infestation followed by *S. gilo* (3.225). Among the F_1 hybrids *S. melongena* cv. Pant Rituraj × *S. aethiopicum* showed high level of susceptibility with 62.61 per cent fruit infestation. It is due to spreading plant habit and fruits touch the soil. *S. melongena* cv. Pant Rituraj × *S. melongena* cv. Pant Samrat (44.46%), *S. aethiopicum* × *S. melongena* cv. Pant Rituraj (54.86%), *S. aethiopicum* × *S. melongena* cv. Pant Samrat (46.31%) were reported as susceptible F_1 hybrids. While other F_1 hybrids were grouped under moderately resistant genotypes. The value of moderately resistant genotypes ranged from 22.86 per cent in *S. melongena* cv. Pant Rituraj × *S. gilo* to 28.39 per cent in *S. aethiopicum* × *S. gilo.* Kalda et al. (1976) and Vadivel and Bapu (1989) also reported similar types of findings.

Estimation of genetic component for phomopsis blight resistance: The percentage of plant showing resistance to leaf infestation due to phomopsis blight also showed high genetic variability (Table 6) which ranged from 1.33 to 19.46 per cent with a mean value of 11.42 per cent. The genotypic and phenotypic coefficient of variation was found 51.44 per cent and

Table 5: Percentage of fruit infestation due to phomopsis blight

Genotype	Means No. of fruit/plant	Mean No. of infested fruit/plant	% infestation	Reaction
PR	51.43	30.7	59.84	S
PS	61.90	27.33	44.14	S
Sa	114.40	47.63	41.64	S
Sk	522.93	3.01	1.18	R
Sg	52.26	1.69	3.22	R
PR × PS	38.06	16.92	44.46	S
PR × Sg	343.80	78.62	22.86	MR
PR × Sa	62.86	39.43	62.61	HS
Sg × PR	314.00	72.40	23.05	MR
Sa × PR	115.70	63.49	54.86	S
Sa × PS	42.26	19.57	46.31	S
Sa × Sk	144.13	36.68	25.45	MR
Sg × Sa	75.4	17.7	23.49	MR
Sa × Sg	58.46	16.59	28.39	MR
Sg × PS	46.13	12.76	27.66	MR

PS: *S. melongena* cv. Pant Samrat; PR: *S. melongena* cv. Pant Rituraj; Sa: *S. aethiopicum;* Sg: *S. gilo;* Sk: *S. khasianum*

51.76 per cent, respectively, with 98.78 per cent heritability. The variability observed with regard to percentage of plant showing resistance to stem infestation due to phomopsis blight ranged from 3.70 to 19.63 per cent with a mean of 12.61. The genotypic and phenotypic coefficient of variation was 44.88 and 45.02 per cent respectively with high heritability estimate of 99.39 per cent. The percentage of infested fruits per plant of the genotypes showed high level of the genotypes showed high level of genetic variability which ranged from 1.18 to 59.84 with a mean value of 33.81 per cent. The genotypic and phenotypic coefficients of this trait were 54.88 and 55.00 per cent. The heritability estimate of this trait was 99.58 per cent. Sharmin et al. 2010 and Asad et al. 2015, also reported genetic variation for phomopsis blight resistance in brinjal.

It may be concluded from the above results that wild relatives of *S. melongena* have great significant in the crop improvement. Among the wild relatives *Soloanum khasianum* though totally cross incompatible to the cultivated species *Solanum melongena* but it carries resistant gene(s) for phomopsis blight. Besides *Solanum gilo* also showed great promise for resistant to this devastating fungal disease. For successful gene transfer from *S. khasianum* needs the help of biotechnological tools like embryo culture and transgenic approaches.

Table 6: Estimation of genetic component for phomopsis blight resistance

Character	Mean	Range	Coefficient of variation (%)		Heritability (broad sence, %)
			PCV	GCV	
% of plant showing resistance against leaf infestation due to phomopsis blight	11.42	1.33-19.46	51.76	51.44	98.78
% of plant showing resistance against stem infestation due to phomopsis blight	12.61	3.70-19.63	45.02	44.88	99.39
% fruit infested due to phomosis blight	33.81	1.18-59.84	55.00	54.88	99.58

सारांश

वर्तमान परीक्षण फोमोप्सिस झुलसा के प्रति छंटनी हेतु दो व्यवसायिक प्रजातियों पंत रितुराज, पंत सम्राट तथा जंगली प्रजातियों जैसे– *सोलेनम गिलो, सोलेनम इथियोपिकम* व *सोलेनम खासिएनम* एवं अन्तःसंकरों को समाहित किया गया। उच्च सार्थकता मध्यम पत्ती, तना व प्रोह के प्रति रोगरोधिता तथा फल संक्रमण को प्रक्रिया से स्पष्ट हुआ कि बैंगन की 20 प्रभेदों में उच्च प्राकृतिक विविधता है जिनका उपयोग रोगरोधी प्रजनन में किया जा सकता हैं। पत्ती, तना तथा फल संक्रमण या *सोलेनम गिलो* अथवा *सोलेनम खासिएनमी* रोधिता प्रदर्शन मूल्य ज्यादा होने के कारण उच्च रोगरोधी की श्रेणी में रखा गया। संकरों में पंत रितुराज x पंत सम्राट, *सोलेनम इनियोपिकम* x *सोलेनम गिलो, सोलेनम गिलो* x पंत सम्राट की पहचान उच्च रोग रोधिता के लिए पायी गयी। *सोलेनम गिलो* जिन संकरों में पितृ के रूप में सम्मिलित था, फोमोप्सिस झुलसा के प्रति उच्च रोगरोधिता मूल्य पाया गया। इन जंगली सम्बन्धियों से सफलतापूर्वक जीन स्थानान्तरण पश्च–संकरण से सम्भव है, केवल *सोलेनम खासिएनम* को छोड़कर जिनमें जैव–प्रौद्योगिकी के सहारे की आवश्यकता होगी।

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