INTERNATIONAL JOURNAL OF PLANT PROTECTION / VOLUME 6 | ISSUE 1 | APRIL, 2013 | 15-21

IJPP

RESEARCH ARTICLE

Studies on pre- and post emergence damping off on chilli caused by *Pythium ultimum*

■ S. N. ZAGADE*[1], G. D. DESHPANDE[1], D. B. GAWADE[2] AND S. V. PAWAR[1]

[1]Department of Plant Pathology, College of Agriculture (M.A.U.), PARBHANI (M.S.) INDIA
[2]Department of Plant Pathology, Division of Crop Protection, V.S.I., PUNE (M.S.) INDIA

ARITCLE INFO

Received : 17.11.2011
Revised : 25.12.2012
Accepted : 10.01.2013

Key Words :
Damping off,
Pythium ultimum

*Corresponding author:
shrizagade@gmail.com

ABSTRACT

Chilli crop is attacked by more than dozen diseases of fungal, bacterial and viral nature leading to great loss to cultivators. Among those diseases, damping off of chilli incited by *Pythium* spp. is responsible for 90 per cent mortality either as pre or post-emergence damping off in nurseries and field conditions. Results indicated that the pre-emergence damping off was responded with significantly lowest seed rot found in PATH-34 (42.4 %) and this variety was at par with PATH-32 (60.3 %), PATH-24 (60.3%), PATH-9 (61.1%), PATH-7 (60.02%), PATH-6 (65.00 %) and PATH-26 (65.0%). Significantly highest seed mortality was noted in 58 entries where number of rotten seeds ranged from 69.6 to 96.7 per cent. Significantly higher germination in sick soil was PATH-34 (28.63 %), PATH-9 (16.41%), PATH-24 (15.61%), PATH-32 (15.61 %), PATH-6 (11.71 %), PATH-7 (11.71%) and PATH-26 (11.71%). While 58 entries have significantly less germination in sick soil. However, the post-emergence damping off the genotypes PATH-6 (22.86%), PATH-9 (22.86%) and PATH-34 (22.86%) were resistant (R) reaction with seedling mortality and the moderately resistant (MR) reaction of seedling mortality were PATH-24 (40.16%), PATH-32 (40.06%), PATH-30 (36.17%) and PATH-07 (31.46%). The 12 germplasm lines expressed moderately susceptible (MS) reaction having post-emergence mortality from 40.2 to 56.8 (%). The 18 germplasm lines expressed susceptible reaction (S) having 56.9 to 73.4 (%) post emergence mortality. The highly susceptible reaction (HS) was expressed by 28 entries having post-emergence mortality from 73.5 to 90 (%).

How to view point the article : Zagade, S.N., Deshpande, G.D., Gawade, D.B. and Pawar, S.V. (2013). Studies on pre- and post emergence damping off on chilli caused by *Pythium ultimum*. *Internat. J. Plant Protec*., **6**(1) : 15-21.

INTRODUCTION

Chilli (*Capsicum annuum* L.) also known as red pepper is the member of family Solanaceae. Two species of chilli are under cultivation. The *Capsicum annuum* L. is small in size, more pungent types. Whereas, the *Capsicum frutescence* L. is somewhat larger, mild to moderately pungent types and referred as 'Dhobli Mirchi' and is used mostly as green vegetable. The pungency is due to the active principle capsicin contained in the skin and septa of the fruit. Chillis are valued principally for their high pungency and for their colour. Chilli forms an indispensable culinary spice in several parts of the world. It is also used in beverages and in the preparation of medicines. India is the largest producer, consumer and exporter of chillies in the world. The important states growing chilli are Andhra Pradesh, Maharashtra, Orissa, West Bengal, Karnataka, Rajasthan and Tamil Nadu. As per the latest statistics, India produced 1.24 million tonnes of dry chilli from an area of 0.077 million hectares (Anonymous, 2009).

Chilli crop is attacked by more than dozen diseases of fungal, bacterial and viral nature leading to great loss to cultivators. Among these diseases, damping off of chilli incited by *Pythium* spp. is responsible for 90 per cent mortality either as pre or post-emergence damping off in nurseries and fields

(Sowmini, 1961). *Pythium* damping off is very common problem in fields and greenhouse, where the organism kills newly emerged seedlings (Jarvis, 1992). Many *Pythium* species, along with their close relatives, *Phytophthora* spp. are plant pathogens of economic importance in agriculture. *Pythium* spp. tend to be very generalistic and unspecific in their host-range. They infect a large range of hosts (Owen-Going, 2002), while *Phytophthora* spp. are generally more host-specific. In chilli crop, two species of *Pythium* have been reported. *i.e* *Pythium ultimum* and *Pythium aphanidermatum* *P. ultimum* occurs relatively in higher frequency in dry areas.

MATERIALS AND METHODS

Pre-emergence damping off in sick soil :

This experiment was planned in split plot design with two main treatments *i.e.* I_0 = Uninoculated control and I_1 = Inoculation through sick soil and Sub treatments = 65 germplasm lines *viz.,* PATH 1 to PATH 65 with four replications. For preparation of inoculum in the form of sick soil, the normal surface soil was collected randomly from 15 spots, it was thoroughly mixed, sieved through screen and the sorghum flour was added @ 25 g/kg soil, so as to boost the organic carbon level of soil, for providing nutrition to pathogen. Then the soil was sterilized at 15-pound pressure per inch^2 for 1 hr consequently for two times an interval of 24 hrs. Then the plastic containers with drainage hole of 1 cm diameter at the bottom were filled with sterilized amended soil. Inoculum disc (5 mm) of the reisolate (RI_1) was slotted with cork borer and was transferred to sterile soil in plastic container. For incubation, these plastic containers were transferred to plastic trays containing sterile water at the bottom (1 cm height) and trays were covered with plastic sheet so to create the humidity for 4 days. After 4 days of incubation the seeds of each germplasm lines were sown @ 4 seeds/ container. Four replications of the inoculated containers were maintained for each germplasm line. In the same way for uninoculated absolute control the sterilized soil was used. The observations on the pre-emergence damping off seed rot (%) and germination (%) were noted 14 days after sowing. The data on pre-emergence damping off and germination (%) were subjected to statistical analysis.

Post-emergence damping off in sick soil :

Post emergence damping off is also important component of the disease and this experiment was planned in split plot design with three main treatments *i.e.* T_0 = Absolute control, T_1 = Abiotic stress (stagnation + amendment of organic carbon) and T_2: Inoculation through sick soil and Sub treatments = 65 germplasm lines *viz.,* PATH 1 to PATH 65 with four replications. The details of main treatments are as below:

T_0: Absolute control :

Sterile soil was used and there was no amendment of sorghum flour in the soil as well as there was no inoculation of pathogen. Therefore, this treatment was called as absolute control.

T_1: Relative control :

It was maintained with stagnation by 1 cm of sterile water at the bottom of the trays and soil amendment with sorghum flour @ 25 g/kg soil and followed by sterilization of amended soil for 1 hour at 15 pound pressure psi consequently for two times at 24 hr interval.

T_2: Inoculation through sick soil :

For filling the plastic containers of 125 ml of capacity with drainage hole of 1 cm diameter, the sterilized sorghum flour amended soil was used. Then these plastic containers were inoculated with *Pythium ultimum* (5 mm inoculum disc) and these were incubated in trays with sterile water of 1 cm height at the bottom. These were covered with plastic sheet. After 4 days of incubation, 12 days old seedlings of germplasm lines were transplanted in sick soil @ 4 seedlings/container/ replication. In the same way, in T_0 and T_1 treatments seedlings were transplanted @ 4 seedlings / container / replication. The observations on seedling mortality were recorded after 3 to 5 days of transplanting. The data were subjected to statistical analysis.

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussions have been presented under following sub heads:

Pre-emergence damping off in sick soil :

The resistant variety is the most cost effective and cheap input in vegetable production like chilli, so as to identify the source of resistance to pre-emergence damping off. For I_0 control; soil was sterilized and watered with sterile water. For the preparation of sick soil (I_1) the soil was added with 25 g of sorghum flour per kg of soil and then it was sterilized and transferred to plastic container of 130 ml capacity with drainage hole of 1 cm diameter. Each plastic container was inoculated with 5 mm inoculum disc of pathogen. Then these plastic containers were transferred to stagnant tray having 1 cm column of sterile water at the bottom. These trays were covered with polythene sheet so as to maintain maximum humidity. After inoculation the containers were incubated for 4 days. These containers were then sown with 4 seeds per container. The observations on seed rot and seed germination were recorded replication wise and were subjected to statistical analysis.

Results (Table 1 and 2) indicated that the seven entries responded significantly and lowest seed rot was found in PATH-34 (42.4 %) and this variety was at par with PATH-32 (60.3 %), PATH-24 (60.3%), PATH-9 (61.1%), PATH-7 (60.02%), PATH-6 (65.00 %). Significantly highest seed mortality was

Table 1: Screening of germplasm lines against pre- emergence damping off

GPL	Seed rot (%)			GPL	Seed rot (%)			GPL	Seed rot (%)			Main treat. (Inoculation)	
	I_0	I_1	Mean		I_0	I_1	Mean		I_0	I_1	Mean	S.E.±	C.D. 0.05
Path-1	46.29	79.85	63.07	Path-23	50.19	89.98	70.09	Path-45	34.07	89.98	62.03		
Path-2	59.59	69.72	64.66	Path-24	50.19	60.32	55.26	Path-46	26.76	89.98	58.37		
Path-3	31.46	89.98	60.72	Path-25	67.63	79.85	73.74	Path-47	59.59	89.98	74.79		
Path-4	36.16	79.85	58.01	Path-26	40.05	65.02	52.54	Path-48	40.05	89.98	65.02		
Path-5	42.39	79.85	61.12	Path-27	23.66	89.98	56.82	Path-49	44.75	89.98	67.37		
Path-6	46.29	65.02	55.66	Path-28	23.93	89.98	56.96	Path-50	11.71	89.98	50.85		
Path-7	37.69	65.02	51.36	Path-29	75.15	89.98	82.57	Path-51	26.76	89.98	58.37		
Path-8	40.86	89.98	65.42	Path-30	44.75	75.15	59.95	Path-52	37.69	89.98	63.84		
Path-9	54.89	61.12	58.01	Path-31	59.59	89.98	74.79	Path-53	22.86	89.98	56.42		
Path-10	49.45	89.98	69.72	Path-32	50.19	60.32	55.26	Path-54	15.34	89.98	52.66		
Path-11	31.46	89.98	60.72	Path-33	50.19	79.85	65.02	Path-55	50.99	89.98	70.49		
Path-12	54.89	79.85	67.37	Path-34	50.19	42.39	46.29	Path-56	23.93	89.98	56.96		
Path-13	52.52	89.98	71.25	Path-35	23.93	89.98	56.96	Path-57	79.85	89.98	84.92		
Path-14	54.89	89.98	72.44	Path-36	28.63	89.98	59.31	Path-58	69.72	89.98	79.85		
Path-15	35.35	89.98	62.67	Path-37	69.72	89.98	79.85	Path-59	60.32	89.98	75.15		
Path-16	22.86	79.85	51.36	Path-38	54.89	89.98	72.44	Path-60	69.72	89.98	79.85		
Path-17	37.69	89.98	63.84	Path-39	50.19	89.98	70.09	Path-61	40.05	89.98	65.02		
Path-18	41.59	89.98	65.79	Path-40	31.46	89.98	60.72	Path-62	31.46	89.98	60.72		
Path-19	56.42	89.94	73.18	Path-41	15.34	89.98	52.66	Path-63	28.63	89.98	59.31		
Path-20	59.59	75.15	67.37	Path-42	31.46	89.98	60.72	Path-64	27.56	89.98	58.77		
Path-21	41.59	89.98	65.79	Path-43	27.56	89.98	58.77	Path-65	27.56	89.98	58.77		
Path-22	23.66	79.85	51.76	Path-44	44.75	89.98	67.37	-------	-------	-------	-------		
Mean	42.32	84.72	63.52	Mean	42.32	84.72	63.52	Mean	42.32	84.72	63.52	1.58	7.14*
S.E. ±			6.9				6.9				6.9		
C.D.(0.05)			19.19*				19.19*				19.19*		

Interaction: I x GPL (Inoculation x Germ plasm lines)

S.E.± 9.75

C.D. (0.05) 27.13

* GPL : Germplasm line, I_0 : Control, I_2 : Inoculated

Table 2: Categorization of germplasm lines on the basis of seed rot percentage in sick soil

Category	Seed rot (%) (Arc sin)	Number of entries	Name of the entries
I	42.4-69.5	7	Path-34 (42.4), Path-09 (61.1), Path-24 (60.3), Path-32 (60.3), Path-06 (65.0), Path-07 (65.0), Path-26 (65.0)
II	69.6-96.7	58	Path-20 (75.2), Path-30 (75.1), Path-02 (69.7), Path-01 (80.0), Path-04 (80.0), Path-05 (79.9), Path-12 (79.9), Path-16 (80.0), Path-22 (79.6), Path-25 (79.9), Path-33 (79.9), Path-03 (90.0), Path-08 (90.0), Path-10 (90.0), Path-11 (90.0), Path-13 (90.0), Path-14 (90.0), Path-15 (90.0), Path-17 (90.0), Path-18 (90.0), Path-19 (89.9), Path-21 (90.0), Path-23 (90.0), Path-27 (90.0), Path-28 (90.0), Path-29 (90.0), Path-31 (90.0), Path-35 (90.0), Path-36 (90.0), Path-37 (90.0), Path-38 (90.0), Path-39 (90.0), Path-40 (90.0), Path-41 (90.0), Path-42 (90.0), Path-43 (90.0), Path-44 (90.0), Path-45 (90.0), Path-46 (90.0), Path-47 (90.0), Path-48 (90.0), Path-49 (90.0), Path-50 (90.0), Path-51 (90.0), Path-52 (90.0), Path-53 (90.0), Path-54 (90.0), Path-55 (90.0), Path-56 (90.0), Path-57 (90.0), Path-58 (90.0), Path-59 (90.0), Path-60 (90.0), Path-61 (90.0), Path-62 (90.0), Path-63 (90.0), Path-64 (90.0), Path-65 (90.0)
SE ±	9.75		For Interaction: I x V
C.D. 0.05	27.13		For Interaction: I x V

noted in 58 entries where number of rotten seeds ranged from 69.6 to 96.7 per cent. It can be concluded that (Table 3 and 4) the significantly higher germination in sick soil was found in PATH-34 (28.63 %), PATH-9 (16.41%), PATH-24 (15.61%), PATH-32 (15.61 %), PATH-6 (11.71 %), PATH-7 (11.71%) and PATH-26 (11.71%). While 58 entries had significantly less germination in sick soil. In present investigation, I x GPL interaction (Inoculation x Germplasm line) was also significant. Similar trend was also observed in respect of germination. Dahiphale (2006) and Chavan (2007) screened popular varieties of tomato. Rasal (2008) also screened popular varieties of brinjal against *P. ultimum* and found that Sel-5 variety was resistant. Zagade (2007) also screened popular varieties of chilli and noted that varieties DCL-1 and Maina were resistant. The resistance to *Pythium arrhenomes* has also been reported by Subramainiam (1936) in sugarcane. Resistance has also been recorded in case of sorghum against *P. arrhenomos* (Wanger, 1936). The monogenic resistance against *Pythium* has been recorded in case of soybean and pea (Brown and Kennedy, 1965).

Post-emergence damping off :

Post emergence damping off is an important component of the damping off disease. In order to know the host resistance to post-emergence damping off, the main treatment of absolute control (T_0) was maintained by transplanting the seedlings in sterilized soil. The plastic container in absolute control (T_0) was watered with sterile water. In T_1 treatment, sterilized soil

Table 3: Screening of germ plasm lines against pre- emergence damping off

GPL	Germination (%)			GPL	Germination (%)			GPL	Germination (%)			Maint treat. (Inoculation)	
	I_0	I_1	Mean		I_0	I_1	Mean		I_0	I_1	Mean	S.E. ±	C.D. 0.05
Path-1	23.94*	4.19	14.07	Path-23	19.24	0.57	9.91	Path-45	42.66*	0.57	21.62		
Path-2	11.44	7.82	9.63	Path-24	19.24	15.61	17.43	Path-46	35.35*	0.57	17.96		
Path-3	31.46*	0.57	16.02	Path-25	22.92	4.19	13.56	Path-47	11.44	0.57	6.01		
Path-4	27.56*	4.19	15.88	Path-26	22.86	11.71	17.29	Path-48	22.86*	0.57	11.72		
Path-5	28.63*	4.19	16.41	Path-27	40.86*	0.57	20.72	Path-49	18.96	0.57	9.77		
Path-6	23.93	11.71	17.82	Path-28	46.29*	0.57	23.43	Path-50	65.02*	0.57	32.80		
Path-7	32.53*	11.71	22.12	Path-29	8.09	0.57	4.33	Path-51	35.35	0.57	17.96		
Path-8	23.66*	0.57	12.12	Path-30	18.96	8.09	13.53	Path-52	32.53*	0.57	16.55		
Path-9	15.34	16.41	15.88	Path-31	11.44	0.57	6.01	Path-53	40.05*	0.57	20.31		
Path-10	15.06	0.57	7.82	Path-32	19.24	15.61	17.43	Path-54	54.89*	0.57	27.73		
Path-11	31.46*	0.57	16.02	Path-33	19.24	4.19	11.72	Path-55	20.04	0.57	10.31		
Path-12	15.34	4.19	9.77	Path-34	19.24	28.63*	23.94	Path-56	46.29*	0.57	23.43		
Path-13	25.01*	0.57	12.79	Path-35	46.29*	0.57	23.43	Path-57	4.19	0.57	2.38		
Path-14	15.34	0.57	7.96	Path-36	42.39*	0.57	21.48	Path-58	7.82	0.57	4.20		
Path-15	26.76*	0.57	13.67	Path-37	7.82	0.57	4.20	Path-59	15.61	0.57	8.09		
Path-16	40.05*	4.19	22.12	Path-38	15.34	0.57	7.96	Path-60	7.82	0.57	4.20		
Path-17	32.53*	0.57	16.55	Path-39	19.24	0.57	9.91	Path-61	22.86*	0.57	11.72		
Path-18	27.83*	0.57	14.20	Path-40	31.46*	0.57	16.02	Path-62	31.46*	0.57	16.02		
Path-19	20.31*	0.57	10.44	Path-41	54.89*	0.57	27.73	Path-63	42.39*	0.57	21.48		
Path-20	11.44	8.09	9.77	Path-42	31.46*	0.57	16.02	Path-64	36.16*	0.57	18.37		
Path-21	27.83*	0.57	14.20	Path-43	36.16*	0.57	18.37	Path-65	36.16*	0.57	18.37		
Path-22	40.86*	4.19	22.53	Path-44	18.96	0.57	9.77	-------	------	-------	-------		
Mean	26.92	3.011	14.97	Mean	26.92	3.011	14.97	Mean	26.92	3.011	14.97	1.48	6.69*
SE ±			5.0				5.0				5.0		
C.D.(0.05)			13.9				13.9				13.9		

Interaction: I x GPL (Inoculation x Germ plasm lines)

S.E. ± 7.08

C.D. (0.05) 19.7*

* GPL: Germplasm line, I_0: Control, I_1: Inoculated

was used and favourable abiotic factors were provided, which included stagnation with sterile water and amendment of sorghum flour to raise organic carbon level. The sorghum flour was added @ of 25 g/kg of soil. After amendment of sorghum flour, the soil was sterilized at 15 lb pressure per inch^2 for 1 hr. So as to have perfect penetration of heat in soil during sterilization, the soil was sterilized in cottony or gunny bag. After sterilization, the soil was transferred to plastic container for T_1 treatment. In case of T_0 treatment the soil was sterilized at 15 lb pressure inch^2 for 1 hour but it was without sorghum flour. In T_2 treatment, all favourable abiotic factors added. All the plastic containers having drainage hole of 1 cm diameter at bottom were transferred to trays having 1 cm column of sterile water. Then these plastic containers for T_2 main treatment were inoculated with 5 mm inoculum disc of *Pythium ultimum* Trow. After inoculation, the trays were covered with polythene sheet so as to provide maximum humidity for the development of the inoculum in soil. After 5 days of incubation under humid condition, 8 days old seedlings of each germplasm line grown on sterile soil were transplanted to plastic containers. Observation on seedlings mortality was noted on 4th day of transplanting. Observation of post-emergence damping off expressed under T_0, T_1 and T_2 treatments in different germplasm line were recorded.

Results indicated that (Table 5 and 6) the mortality ranged from 8 per cent to 32.8 per cent. Significantly lowest mortality was expressed in PATH-6 (8 %) and significantly highest mortality was noted in PATH-48 (32 %). The interaction inoculation x Germplasm line (I x GPL) was also significant. The interaction inoculation x Germplasm line (I x GPL) revealed that three germplasm lines responded with significantly highest resistance to post-emergence mortality. These were PATH-6, PATH-9 and PATH-34 with only 22.9 per cent post emergence mortality. In screening, 4 entries responded with moderately resistant (MR) reaction with seedling mortality from 23.6 to 40.1 (%). The 12 germplasm lines expressed

Table 4 : Classification of germplasm lines on the basis of germination (%) in sick soil

Category	(%) Germination (Arc sin)	Resistance category	Number of entries	Name of the entry with germination (%) in bracket
I	28.63-8.93	R	7	Path-34 (28.63), Path-09 (16.41), Path-24 (15.61), Path-32 (15.61), Path-06 (11.71), Path-07 (11.71), Path-26 (11.71)
II	< 8.94	S	58	Path-20 (8.09), Path-30 (8.09), Path-02 (7.82), Path-01 (4.19), Path-04 (4.19), Path-05 (4.19), Path-12 (4.19), Path-16 (4.19), Path-22 (4.19), Path-25 (4.19), Path-33 (4.19), Path-03 (0.57), Path-08 (0.57), Path-10 (0.57), Path-11 (0.57), Path-13 (0.57), Path-14 (0.57), Path-15 (0.57), Path-17 (0.57), Path-18 (0.57), Path-19 (0.57), Path-21 (0.57), Path-23 (0.57), Path-27 (0.57), Path-28 (0.57), Path-29 (0.57), Path-31 (0.57), Path-35 (0.57), Path-36 (0.57), Path-37 (0.57), Path-38 (0.57), Path-39 (0.57), Path-40 (0.57), Path-41 (0.57), Path-42 (0.57), Path-43 (0.57), Path-44 (0.57), Path-45 (0.57), Path-46 (0.57), Path-47 (0.57), Path-48 (0.57), Path-49 (0.57), Path-50 (0.57), Path-51 (0.57), Path-52 (0.57), Path-53 (0.57), Path-54 (0.57), Path-55 (0.57), Path-56 (0.57), Path-57 (0.57), Path-58 (0.57), Path-59 (0.57), Path-60 (0.57), Path-61 (0.57), Path-62 (0.57), Path-63 (0.57), Path-64 (0.57), Path-65 (0.57)
S.E. ±	7.08		For Interaction: I x GPL	
C.D. 0.05	19.68		For Interaction: I x GPL	

Statistical significance

Germination (%)							
0.57	4.19	7.82	8.09	11.71	15.61	16.41	28.63
S				R			

Table 5: Screening of germplasm lines against post- emergence damping off

GPL	Seedlings mortality %				GPL	Seedlings mortality %				GPL	Seedlings mortality %				Main treat.	
	T_0	T_1	T_2	Mean		T_0	T_1	T_2	Mean		T_0	T_1	T_2	Mean	S.E.	C.D. 0.05
Path 1	0.6	0.6	50.2	17.1	Path 23	4.2	0.6	79.9	28.2	Path 45	0.6	0.6	54.9	18.7		
Path 2	0.6	0.6	49.5	16.9	Path 24	0.6	0.6	40.1	13.7	Path 46	0.6	0.6	90.0	30.4		
Path 3	0.6	4.2	60.3	21.7	Path 25	0.6	4.2	79.9	28.2	Path 47	0.6	0.6	69.7	23.6		
Path 4	0.6	0.6	59.6	20.3	Path 26	4.2	0.6	4.8	3.2	Path 48	7.8	0.6	90.0	32.8		
Path 5	0.6	0.6	90.0	30.4	Path 27	0.6	4.2	90.0	31.6	Path 49	0.6	4.2	59.6	21.5		
Path 6	0.6	0.6	22.9	8.0	Path 28	0.6	0.6	69.7	23.6	Path 50	0.6	0.6	49.5	16.9		
Path 7	4.2	0.6	31.5	12.1	Path 29	4.2	0.6	90.0	31.6	Path 51	0.6	4.2	79.9	28.2		
Path 8	0.6	0.6	50.2	17.1	Path 30	0.6	4.2	36.2	13.7	Path 52	0.6	0.6	59.6	20.3		
Path 9	4.2	4.2	22.9	10.4	Path 31	0.6	0.6	79.9	27.0	Path 53	0.6	0.6	49.5	16.9		
Path 10	4.2	0.6	90.0	31.6	Path 32	0.6	0.6	40.1	13.7	Path 54	4.2	0.6	65.0	23.3		
Path 11	0.6	0.6	90.0	30.4	Path 33	0.6	0.6	90.0	30.4	Path 55	0.6	4.2	69.7	24.8		
Path 12	0.6	0.6	59.6	20.3	Path 34	0.6	4.2	22.9	9.2	Path 56	0.6	0.6	71.3	24.1		
Path 13	4.2	0.6	69.7	24.8	Path 35	0.6	0.6	79.9	27.0	Path 57	0.6	0.6	65.0	22.1		
Path 14	0.6	0.6	75.2	25.4	Path 36	0.6	0.6	90.0	30.4	Path 58	0.6	0.6	90.0	30.4		
Path 15	0.6	0.6	54.9	18.7	Path 37	0.6	4.2	69.7	24.8	Path 59	0.6	4.2	65.0	23.3		
Path 16	4.2	4.2	90.0	32.8	Path 38	4.2	0.6	59.6	21.5	Path 60	0.6	4.2	79.9	28.2		
Path 17	4.2	0.6	54.9	19.9	Path 39	0.6	0.6	90.0	30.4	Path 61	4.2	0.6	90.0	31.6		
Path 18	0.6	0.6	75.2	25.4	Path 40	0.6	0.6	90.0	30.4	Path 62	0.6	0.6	65.0	22.1		
Path 19	7.8	0.6	90.0	32.8	Path 41	4.2	0.6	79.9	28.2	Path 63	0.6	0.6	59.6	20.3		
Path 20	0.6	0.6	50.2	17.1	Path 42	4.2	4.2	79.9	29.4	Path 64	0.6	0.6	79.9	27.0		
Path 21	0.6	4.2	50.2	18.3	Path 43	0.6	0.6	79.9	27.0	Path 65	0.6	4.2	79.9	28.2		
Path 22	4.2	0.6	60.3	21.7	Path 44	0.6	0.6	46.3	15.8							
Mean	1.6	1.5	66.4	23.2	Mean	1.6	1.5	66.4	23.2	Mean	1.6	1.5	66.4	23.2	0.29	1.03*
S.E.				3.45					3.45					3.45		
C.D. (0.05)				9.58*					9.58*					9.58*		

Interaction: I x GPL (Inoculation x Germplasm lines)

S.E. 5.97

C.D. 0.05 16.60

* GPL : Germplasm line, T_0 : Absolute control, T_1 : Relative control, T_2 : Inoculation treatment

Table 6: Classification of germplasm lines as per interaction (V x I) for post emergence damping off under sick soil

Category	Seedling mortality (%)	Resistance category	No. of entry	Details of the entry (Arc sin trans.)
I	7.0-23.5	R	3	PAHH 06 (22.86%), PAHH 09 (22.86%), PAHH 34 (22.86%).
II	23.6-40.1	MR	4	PAHH 24 (40.16%), PAHH 32 (40.06%), PAHH 30 (36.17%), PAHH 07 (31.46%),
III	40.2-56.8	MS	12	PAHH 15 (54.90%), PAHH 17 (54.90%), PAHH 45 (54.90%), PAHH 01 (50.19%), PAHH 08 (50.19%), PAHH 20 (50.19%), PAHH 21 (50.19%), PAHH 02 (49.46%), PAHH 50 (49.46%), PAHH 53 (49.46%), PAHH 44 (46.30%), PAHH 26 (44.75%)
IV	56.9-73.4	S	18	PAHH 56 (71.25%), PAHH 13 (69.72%), PAHH 28 (69.72%), PAHH 37 (69.72%), PAHH 47 (69.72%), PAHH 55 (69.72%), PAHH 54 (65.03%), PAHH 57 (65.03%), PAHH 59 (65.03%), PAHH 62 (65.03%), PAHH 03 (60.32%), PAHH 22 (60.32%), PAHH 04 (59.59%), PAHH 12 (59.59%), PAHH 38 (59.59%), PAHH 49 (59.59%), PAHH 52 (59.59%), PAHH 63 (59.59%)
V	73.5-90.0	HS	28	PAHH 05 (89.98%), PAHH 10 (89.98%), PAHH 11 (89.98%), PAHH 16 (89.98%), PAHH 19 (89.98%), PAHH 27 (89.98%), PAHH 29 (89.98%), PAHH 33 (89.98%), PAHH 36 (89.98%), PAHH 39 (89.98%), PAHH 40 (89.98%), PAHH 46 (89.98%), PAHH 48 (89.98%), PAHH 58 (89.98%), PAHH 61 (89.98%), PAHH 23 (79.86%), PAHH 25 (79.86%), PAHH 31 (79.86%), PAHH 35 (79.86%), PAHH 41 (79.86%), PAHH 42 (79.86%), PAHH 43 (79.86%), PAHH 51 (79.86%), PAHH 60 (79.86%), PAHH 64 (79.86%), PAHH 65 (79.86%), PAHH 14 (75.15%), PAHH 18 (75.15%)

* Classification based on interaction (I x V) CD 0.05 16.6

moderately susceptible (MS) reaction having post-emergence mortality from 40.2 to 56.8 (%). The 18 germplasm lines expressed susceptible reaction (S) having 56.9 to 73.4 (%) post emergence mortality. The highly susceptible reaction (HS) was expressed by 28 entries having post-emergence mortality from 73.5 to 90 (%). Screening of soybean varieties against *Pythium ultimum* was undertaken by Zhang *et al.* (1998) and Brown and Kennedy (1965). Dahiphale (2006) and Chavan (2007) also noted Parbhani Yashashri a popular variety of tomato which has shown resistance to *P. ultimum.* Rasal (2008) has also observed Sel-5 variety of brinjal resistant to *P. ultimum*.

REFERENCES

Brown, G. E. and Kennedy, B.W. (1965). Pythium pre-emergence damping off of soybean in Minnesota. *Plant Dis. Rep*., **49** : 646.

Chavan, A.A. (2007). Studies on varietal reaction and virulency of *Pythium ultimum* Trow infecting tomato. M.Sc. (Ag.) Thesis, Marathwada Agricultural University, College of Agriculture, Latur, M.S. (INDIA).

Dahiphale, S.J. (2006). Physiological investigations on *Pythium ultimum* Trow. causing damping-off in tomato. M.Sc. (Ag.) Thesis, Marathwada Agricultural University, College of Agriculture, Latur, M.S.(INDIA).

Jorvis, W.R. (1992). *Managing disease in greenhouse crops.* APS Press, St. Poul, Minn.

Owen-Going, T.N. (2002). Etiology and epidemiology of Pythium root rot in bell pepper (*Capsicum annuum* L.) in commercial scale and small scale hydroponic system. M.Sc. Thesis, Univeristy of Guelph, Guelph, Ontario.

Rasal, S.R. (2008). Studies on damping off diseases in brinjal caused by *Pythium ultimum* Trow. M.Sc. (Ag.) Thesis, Marathwada Agricultural University, Parbhani, M.S.(INDIA).

Sowmini, R. (1961). Studies on phycomycetes in Agricultural soils with special reference to Pythiaceae. M.Sc. (Ag.) Thesis, University of Madras,Chennai, (T.N.) INDIA : 160.

Subramaniam, L.S. (1936). Some new seedling diseases of sugarcane. *Indian J. Agric. Sci.,* **6**(1) :11-16.

Wanger, F.A. (1936). Reaction of sorghums to the root, crown and shoot rot of milo. *J. Amer. Soc. Agron.,* **28** (8) : 643-654.

Zagade, S.N. (2007). Investigations on damping off of chilli with reference to predisposition, varietal screening and control measures. M.Sc. (Ag.) Thesis, Marathwada Agricultural University, Parbhani, M.S. (INDIA).

Zhang, B.Q., Chen, W.D. and Yang, X.B. (1998). Occurrence and relative abundance of *Pythium* species in long-term corn and soybean monoculture and corn/soybean rotation fields. *Mycol. Res.,* **102**: 1450-1452.

■ WEBLIOGRAPHY

Anonymous (2009). *www.karvycomodities.com*

****