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RESEARCH ARTICLE

Estimation of *Pythium* population in different soil types, with different moisture levels

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SUMMARY

In the experiment on interaction of soil type, moisture levels and varieties, it was confirmed that in heavy soils maximum seed rot was induced. High moisture level also induced significantly higher seed rot. Varieties also differed in their susceptibility. Heavy soils, water logging conditions and high genetic susceptibility caused significantly highest seed rot. All soil types at high moisture level (M_1) caused significantly highest seed rot in susceptible genotype.

Key Words : *Pythium ultimum,* Population density

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Tomato is the important 'protective foods' both because of its special nutritive value and also because of its widespread production. It is the world's largest vegetable crop after potato and sweet potato but it tops the list of canned vegetables. Tomatoes are used for soup, salad, pickles, ketchup, sauces and for many other purposes. According to an estimate of FAO an area of over 80000 hectares was under tomato in 1978 with an annual production of nearly 7,40000 tonnes.

The best soil for tomato is rich loam, with little sand in the upper layer and good clay in the sub soil good texture of the soil is of primary importance.

The tomatoes are prone to a number of diseases. Damping off disease is an important disease in tomato. The seedlings are mostly attacked in the nursery bed at the ground level as a result they topple over. Causal organism may be *Pythium* spp. *Rhizoctonia* sp. or *Phytopthora* spp.

Different species of *Pythium viz.*, *P. aphanidermatum, P. debaryanum, P. butteri* and *P. ultimum* Trow have been recorded on tomato. Repeated isolations of tomato seedlings and rotten seeds yielded consistently the pathogen of *P. ultimum* Trow. As pre and post emergence damping off is noticed throughout Maharashtra and is a major obstacle in the supply of quality seedlings as required in the peak demand period of transplanting. Therefore, it is important to investigate the effect of interaction between different soil type, different moisture level and different varieties of tomato on the population of *Pythium ultimum.*

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MATERIALS AND METHODS

For assessment of relation of soil type, moisture level and variety with the incidence of pre-emergence damping off; an experiment was conducted at Department of Plant Pathology, College of Agriculture, Latur in 2006. The soil samples of various soil types were collected from Latur district. The experiment was conducted in factorial design was planned with 4 replications. Each pot was representing a replication and in each pot 4 seeds were sown. The details of treatment of each factor are given below.

Factor – I Soil type : 6 treatments :

S_0 - No soil (Hydroponics)
S_1 - Soils (From low lying area)
S_2 - Soils (heavy)

S_3 - Soils (medium)
S_4 - Soils (light)
S_5 - Sand + FYM (50 : 50)

Factor – II Moisture level - 2 treatments :

M_0 - Normal moisture level
M_1 - High moisture level

Factor – III – Varieties : 2 treatments :

V_1 - AVT-2
V_2 - DT-II

After sowing observations on germination (%) and rotton seed (%) were noted after 10 days of seedling. For the treatment of M_1 (High moisture level), the plastic pots were kept in trays having 1-2 cm layer of sterile water and trays were covered with polythene sheet for creation of maximum humidity and retention of high moisture level. Isolations were also made from rotten seeds and they were recorded in observations.

This experiment was conducted in Factorial Design. The factors under study were as below :

– Factor-I :Six different soil types from S_0 to S_5
– Factor-II :Two moisture levels from M_0 to M_1
– Factor-III :Two different varieties from V_1 to V_2

Total treatments of (S x M x V = 6 x 2 x 2 = 24) 24 were replicated twice.

Six different soil types were collected and filled in small

Sr. No.	I Factor	I Factor Code	II Factor	II Factor Code	III Factor	III Factor code	Treat-ment code	No. of repli-cation
1.	No soil (hydroponic	S_0	Normal moisture	M_0	AVT-2	V_1	$S_0M_0V_1$	2
	culture)				DT-II	V_2	$S_0M_0V_2$	2
			High moisture	M_1	AVT-2	V_1	$S_0M_1V_1$	2
					DT-II	V_2	$S_0M_1V_2$	2
2.	Soil from low lying area /	S_1	Normal moisture	M_0	AVT-2	V_1	$S_1M_0V_1$	2
	stagnated areas				DT-II	V_2	$S_1M_0V_2$	2
			High moisture	M_1	AVT-2	V_1	$S_1M_1V_1$	2
					DT-II	V_2	$S_1M_1V_2$	2
3.	Heavy soils	S_2	Normal moisture	M_0	AVT-2	V_1	$S_2M_0V_1$	2
					DT-II	V_2	$S_2M_0V_2$	2
			High moisture	M_1	AVT-2	V_1	$S_2M_1V_1$	2
					DT-II	V_2	$S_2M_1V_2$	2
4.	Medium soils	S_3	Normal moisture	M_0	AVT-2	V_1	$S_3M_0V_1$	2
					DT-II	V_2	$S_3M_0V_2$	2
			High moisture	M_1	AVT-2	V_1	$S_3M_1V_1$	2
					DT-II	V_2	$S_3M_1V_2$	2
5.	Light soils	S_4	Normal moisture	M_0	AVT-2	V_1	$S_4M_0V_1$	2
					DT-II	V_2	$S_4M_0V_2$	2
			High moisture	M_1	AVT-2	V_1	$S_4M_1V_1$	2
					DT-II	V_2	$S_4M_1V_2$	2
6.	Sand + FYM (50:50)	S_5	Normal moisture	M_0	AVT-2	V_1	$S_5M_0V_1$	2
					DT-II	V_2	$S_5M_0V_2$	2
			High moisture	M_1	AVT-2	V_1	$S_5M_1V_1$	2
					DT-II	V_2	$S_5M_1V_2$	2

plastic containers having hole of 1 mm diameter at bottom. Each soil type was incubated at two moisture levels. After incubation four seedlings of each variety *viz.*, ATV-2 and DT-II were transferred to each plastic containers.

RESULTS AND DISCUSSION

The observations on germination percentage were recorded after 7 days and which are given in Table 1.

From Table 1 it can be concluded that sterile water allowed maximum germination. Significantly least germination was noted in mixture of FYM + Sand (50:50). In general the ATV-2 had significantly higher germination per cent over DT-II at all the moisture levels tested. Amongst the different soil type tested significantly highest germination was given by medium soil type which was at par with sterile hydroponic culture.

FYM + sand mixture has given significantly lowest germination per cent indicating FYM as major source of *Pythium* inoculum. Cultivar DT-II has given significantly less germination over ATV-2 (Table 2).

In low lying areas the ratio of avirulent to virulent population was almost 3:1. In heavy soil the ratio of avirulent to virulent is 1:1 in light soil or in the sand + FYM mixture the ratio of avirulent to virulent population is 1:3.

Minimum virulent population in soil was 10 per cent of the total population and the maximum avirulent population in soil was 90 per cent depending upon the soil type stagnation level and variety seeded. The minimum damping off due to virulent population may be 10% $\pm$ 2 %. With congenial soil condition highest stagnation and susceptible varieties. Pre-emergence damping off due to virulent population may be upto 90 % $\pm$ 2 per cent.

Table 1 : Germination (%) in different soil types at two moisture levels in two verities

Sr. No	Treatment key	Treatment	Germination (%)			
			Original value	$\sqrt{X+1}$ Trans-formation	$(\sqrt{X+1})^2$ Value	Acrsin value
1.	$S_0V_1M_1$	No soil ATV-2 Stagnated	16/16	10.05	100.00	89.98
2.	$S_0V_1M_0$	No soil ATV-2 Non stagnated	16/16	10.05	100.00	89.98
3.	$S_0V_2M_1$	No Soil DT-II Stagnated	16/16	10.05	100.00	89.98
4.	$S_0V_2M_0$	No Soil DT-II Non stagnated	16/16	10.05	100.00	89.98
5.	$S_1V_1M_1$	Soil low laying area ATV-2 Stagnated	16/16	10.05	100.00	89.98
6.	$S_1V_1M_0$	Soil low laying area ATV-2 Non stagnated	14/16	9.38	88.50	69.70
7.	$S_1V_2M_1$	Soil low laying area DT-II Stagnated	6/16	5.48	38.40	23.90
8.	$S_1V_2M_0$	Soil low laying area DT-II Non stagnated	6/16	5.48	38.20	23.70
9.	$S_2V_1M_1$	Heavy soil ATV-2 Stagnated	16/16	10.05	100.00	89.9
10.	$S_2V_1M_0$	Heavy soil ATV-2 Non stagnated	10/16	7.75	63.40	46.20
11.	$S_2V_2M_1$	Heavy Soil DT-II Stagnated	5/16	5.60	32.10	18.90
12.	$S_2V_2M_0$	Heavy Soil DT-II Non stagnated	7/16	6.51	44.67	27.50
13.	$S_3V_1M_1$	Medium soil ATV-2 Stagnated	16/16	10.05	100.00	89.90
14.	$S_3V_1M_0$	Medium soil ATV-2 Non stagnated	16/16	10.05	100.00	89.90
15.	$S_3V_2M_1$	Medium Soil DT-II Stagnated	7/16	6.51	57.30	26.60
16.	$S_3V_2M_0$	Medium Soil DT-II Non stagnated	7/16	6.51	44.60	27.50
17.	$S_4V_1M_1$	Light soil ATV-2 Stagnated	16/16	10.05	100.00	89.90
18.	$S_4V_1M_0$	Light soil ATV-2 Non stagnated	12/16	8.65	75.90	65.00
19.	$S_4V_2M_1$	Light Soil DT-II Stagnated	11/16	8.26	69.70	50.10
20.	$S_4V_2M_0$	Light Soil DT-II Non stagnated	3/16	4.06	19.60	11.40
21.	$S_5V_1M_1$	Sand + FYM ATV-2 Stagnated	0/16	1.00	1.00	0.50
22.	$S_5V_1M_0$	Sand + FYM ATV-2 Non stagnated	3/16	4.06	19.50	12.50
23.	$S_5V_2M_1$	Sand + FYM DT-II Stagnated	0/16	1.00	1.00	0.50
24.	$S_5V_2M_0$	Sand + FYM DT-II Non stagnated	0/16	1.00	1.00	0.50

	M	V	M x V	S	M x S	V x S	MxVxS
S.E. $\pm$	2.1	2.1	3.0	3.7	5.3	5.3	7.5
C.D. (P=0.05)	6.0	6.0	8.5	10.4	14.7	14.7	20.8

Table 2 : Interaction S x V (soil type x varity) expressed with germination (%)

Sr. No.	Soil type	Treat. key	Germination (%)		
			ATV-2	DT-II	Mean for soil type
1.	No soil	S_0	89.9	89.9	89.9
2.	Soil from low line area	S_1	56.9	46.7	51.8
3.	Heavy soils	S_2	54.4	36.8	45.6
4.	Medium soils	S_3	58.3	58.7	58.5
5.	Light soils	S_4	70.0	38.2	54.1
6.	Sand+FYM (50:50)	S_5	57.2	65.7	61.5
Varietal mean			55.00	46.10	56.6
			Soil type	Variety	S x V interaction
S.E. ±			3.7	2.1	5.3
C.D. (P=0.05)			10.4	6.0	14.7

Table 3: Interaction S x M (soil type x moisture level) expressed with germination (%)

Treat. key	Soil type	Moisture level		
		M_1	M_0	Mean for moisture level
S_0	No soil	89.9	89.9	89.9
S_1	Soil from low line area	79.8	23.8	51.8
S_2	Heavy soils	68.1	23.2	45.6
S_3	Medium soils	89.9	27.1	58.5
S_4	Light soils	77.4	30.7	54.1
S_5	Sand+FYM (50:50)	65.7	0.5	33.1
Mean		78.4	32.5	78.4
		Soil type	Moisture	S x M interaction
S.E. ±		3.7	2.1	5.3
C.D. (P=0.05)		10.4	6.0	14.7

Table 4: Interaction M x V (moisture x varity) expressed with germination (%)

Moisture level	Varieties		
	V_1	V_2	Mean for soil type
M_1	75	62.2	68.6
M_0	34.9	30.0	32.4
Mean	54.9	46.1	50.5
	Moisture level	Variety	M x V interaction
S.E. ±	2.1	2.1	3.0
C.D. (P=0.05)	6.0	6.0	8.5

Similar observations were also noted by Agnihotri and Vartaja (1957), Bouhot (1975), Deshpande (1987), Patil (2005) and Dahiphale (2006). In case of a damping off in tomato high damping off and seed rot was recorded by Singh (1969) when seed rate was high. He further commentated that the ungerminated seeds provided a very good nutrient for enhanced growth of *Pythium* thereby increasing high incidence of pre and post emergence damping off especially in soybean.

Similar observations were recorded by Zhang *et al.* (1990)

Table 5 : Interaction M x V x S (Moisture level x Variety x Soil type) expressed as germination (%)

Treat. key	Soil type	Germination (%)					
		Variety					
		V_1			V_2		
		Moisture level			Moisture level		
		M_1	M_0	Mean	M_1	M_0	Mean
S_0	No soil	89.9	89.9	89.9	89.9	89.9	89.9
S_1	Soil from low line area	89.9	23.9	56.9	69.7	23.7	56.8
S_2	Heavy soils	89.9	18.9	54.4	46.26	27.5	36.88
S_3	Medium soils	89.9	26.6	58.2	89.9	27.5	58.7
S_4	Light soils	89.9	50.1	70.0	65.0	11.4	38.2
S_5	Sand+FYM (50:50)	0.5	0.5	0.5	12.5	0.5	6.5
Mean		75.0	34.9	19.95	62.2	30.0	46.1
		M x V x S	S x V	S x M	M x V	S	V	M
S.E. $\pm$		7.54	5.3	5.3	3.07	3.7	2.1	2.1
C.D. (P=0.05)		20.8	14.7	14.7	8.5	20.4	6.0	6.0

who stated that populations of *Pythium* spp. were affected particularly by moisture, as well as rainfall during seedling stage. High organic carbon content in heavy soil enhanced the *Pythium* population. This fact was also confirmed with present investigation.

Intra-species difference in the virulence of *Pythium ultimum* Trow was noted by Higginbotham *et al.* (2004). They also recorded that isolate 90038 among *P. ultimum* was the virulent isolate.

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