

**Effect of temperature, moisture and soil amendment
on the survival ability of hyphae of *Phytophthora
colocasiae* in soil**

SITANSU PAN AND S. K. GHOSH

*Department of Plant Pathology
Bidhan Chandra Krishi Viswavidyalaya
Mohanpur 741 252, West Bengal*

Effect of temperature, moisture and soil amendment on the survival ability of hyphae of *Phytophthora colocasiae* was studied in natural and sterilised soil. In general the hyphae survived for longer duration (30 days) in sterilised soil compared to natural soil (5 days). At temperature above 20°C and soil moisture >55 and <75% its hyphae were short lived and completely disappeared within 5 days of their burial in natural soil. The different soil amendments used (@ 0.5% w/w) apparently had no effect on the survival ability of hyphae either in sterilised or in natural soil. However, glucose, fructose and glucose + L-asparagine supported to some extent growth the organism in hyphal form in natural soil.

Key words : Survival ability, natural soil, sterilised soil, hyphae, *Phytophthora colocasiae*

INTRODUCTION

Phytophthora colocasiae Racib. the incitant of leaf blight and corm rot of taro (*Colocasia esculenta* (L.) Schott) is a corm and soil borne organism (Gomez, 1925; Narula and Mehrotra, 1984). Being a soil borne organism, its survival ability in soil is sure to be governed by various biotic and abiotic factors of the soil as has been reported for other species of this organism (Sneh and McIntosh, 1974). In general the fungal mycelia are short lived in soil. Reports in favour (Chattopadhyay and Mustafee, 1977; Samaddar and Setua, 1979) and against

(Krober, 1980) this generalised statement are plenty. Gist (1975) and Meyer and Schonbeck (1975) observed that the survival ability of mycelia of *P. cactorum* differed with change in soil moisture and temperature.

The present investigation was undertaken with a view to study the effect of temperature, moisture and amendments on the survival ability of hyphae of *P. colocasiae* in soil.

MATERIALS AND METHODS

Effect of temperature and moisture

The survival ability of hyphae of *P. colocasiae* in soil was studied under laboratory condition using sandy loam soil (pH: 6.7 and mhc: 45%). The organism was grown at $28 \pm 1^\circ\text{C}$ for 6 days in 250 ml Erlenmeyer flasks containing 50 ml of sterilised oat-broth medium. The mycelial mat was harvested, thoroughly washed with distilled water, chopped into pieces and was added to natural or autoclaved air dried soil in petri plates. The plates containing infested soil were immediately adjusted to different moisture levels (35, 45, 55 & 75%). The petri plates containing infested soil at a specific moisture status were incubated at different temperature (5, 10, 20, 25, 30 & 35°C). The degree of hyphal lysis was assessed on a 0-10 scale (Rana and Gupta, 1983; a modification of Ko and Lockwood, 1970) under the high power (x 45) of a compound microscope over a period of 30 days.

Effect of soil amendments

Air dried soil was fortified with different amendments like glucose, fructose, xylose, L-asparagine, ammonium nitrate, ammonium sulphate and glucose + L-asparagine @ 0.5% (w/w). The amended soils were adjusted to two different moisture levels (55 and 75%) and were packed in 10 cm diameter petri plates. The soil in petri plates was infested with the chopped hyphae as before and were incubated at $25 \pm 1^\circ\text{C}$ in B. O. D. incubator. Parallel controls were run with unamended soil. Observations were made as earlier.

RESULTS AND DISCUSSION

The results showed that in sterilised soil (Table 1) the hyphal morphology remained unchanged upto 6th day at the highest incubation temperature (35°C) and soil moisture (75%) and upto 20 days at the lowest incubation temperature (5°C) and soil moisture (35%). In addition, the speed of sequential changes in hyphal morphology was much less in sterilised soil than in natural soil. Where as in natural soil (Table 2), at temperature above 20°C and soil moisture $>55\%$ and $<75\%$, the hyphae were short lived and lysis of hyphae started within 48 hr

Table 1. Effect of soil temperature and moisture on survival ability of hyphae of *P. colocasiae* in sterilised soil

Temperature (°C)	Soil moisture (%)	Degree of hyphal lysis* (days after incubation)								
		1-6	7	8	9	10	15	20	25	30
5	35	0	0	0	0	0	0	0	1	1
	45	0	0	0	0	0	0	1	1	2
	55	0	0	0	0	0	0	1	2	2
	75	0	0	0	0	0	0	1	2	3
10	35	0	0	0	0	0	0	1	1	2
	45	0	0	0	0	0	1	1	2	3
	55	0	0	0	0	0	1	2	2	3
	75	0	0	0	0	0	1	2	2	3
20	35	0	0	0	0	0	0	1	1	2
	45	0	0	0	0	1	1	2	2	3
	55	0	0	0	0	1	2	2	3	3
	75	0	0	0	1	1	2	3	3	4
25	35	0	0	0	0	0	1	1	2	2
	45	0	0	0	0	1	1	2	2	3
	55	0	0	0	1	1	2	2	3	4
	75	0	0	1	1	2	2	3	3	4
30	35	0	0	0	1	1	1	2	2	3
	45	0	0	0	1	1	2	2	3	4
	55	0	0	1	1	2	3	3	4	5
	75	0	0	1	2	2	3	4	4	5
35	35	0	0	0	1	1	2	2	3	3
	45	0	0	0	1	2	2	3	4	5
	55	0	0	0	1	2	3	4	4	5
	75	0	1	1	2	2	3	4	5	6

* 0-10 represent degree of hyphal lysis

of burial in soil. Subsequent rise in incubation temperature and soil moisture accelerated the process of lysis. At the highest incubation temperature (35°C) and soil moisture (75%) the hyphae completely lysed within 5 days of burial. The rate of lysis of hyphae was minimum at 5°C and 35% soil moisture where

Table 2. Effect of soil temperature and moisture on the survival ability of hyphae of *P. colocasidae* in natural soil

Temperature (°C)	Soil moisture (%)	Degree of hyphal lysis* (days after incubation)													
		1	2	3	4	5	6	7	8	9	10	15	20	25	
5	35	0	0	0	0	0	0	0	0	0	0	2	4	5	
	45	0	0	0	0	0	0	0	0	0	0	4	4	6	
	55	0	0	0	0	0	0	0	0	0	3	5	6	7	
	75	0	0	0	0	0	0	0	0	2	4	6	7	8	
10	35	0	0	0	0	0	0	0	1	2	3	4	6	8	
	45	0	0	0	0	0	0	1	2	4	5	6	7	9	
	55	0	0	0	0	0	0	1	3	5	6	7	8	10	
	75	0	0	0	0	0	1	2	5	6	7	8	10	10	
20	35	0	0	0	0	0	2	5	7	10	10	10	10	10	
	45	0	0	1	4	6	8	9	10	10	10	10	10	10	
	55	0	1	2	5	7	9	10	10	10	10	10	10	10	
	75	0	2	4	7	8	9	10	10	10	10	10	10	10	
25	35	0	0	0	1	4	5	9	10	10	10	10	10	10	
	45	0	1	3	5	8	9	10	10	10	10	10	10	10	
	55	1	2	4	6	8	10	10	10	10	10	10	10	10	
	75	1	3	5	7	9	10	10	10	10	10	10	10	10	
30	35	1	2	2	4	6	8	9	10	10	10	10	10	10	
	45	1	3	5	8	9	10	10	10	10	10	10	10	10	
	55	2	3	5	8	9	10	10	10	10	10	10	10	10	
	75	2	4	6	9	10	10	10	10	10	10	10	10	10	
35	35	1	2	3	5	6	8	9	10	10	10	10	10	10	
	45	2	3	5	8	9	10	10	10	10	10	10	10	10	
	55	3	4	6	8	10	10	10	10	10	10	10	10	10	
	75	4	5	7	9	10	10	10	10	10	10	10	10	10	

* 0-10 represent degree of hyphal lysis

Table 3. Effect of soil amendments on the survival ability of hyphae of *P. colocasiae* in natural soil

Treatments	Soil moisture (%)	Degree of hyphal lysis *(days after incubation)					
		1	2	3	4	5	6
Glucose	55	0	1	2	5	9	10
	75	0	1	3	6	10	10
Fructose	55	0	1	2	4	8	10
	75	0	1	4	7	9	10
Xylose	55	0	1	5	9	10	10
	75	0	3	7	9	10	10
L-asparagine	55	0	2	4	9	10	10
	75	0	3	8	10	10	10
Ammonium nitrate	55	0	1	3	8	9	10
	75	0	2	5	7	10	10
Ammonium sulphate	55	0	1	2	8	9	10
	75	0	2	4	9	10	10
Glucose + L-asparagine	55	0	0	3	7	8	10
	75	0	1	3	8	9	10
Control	55	1	2	4	8	10	10
	75	2	3	5	9	10	10

* 0-10 represent degree of hyphal lysis

no deformity in hyphal morphology was noted even upto 10th day of incubation. The above results indicated that in natural soil at 30° and 35°C the rate of hyphal lysis was much faster and this did not provide much scope to trace the sequential changes occurring in hyphal morphology. Accordingly, the effect of different soil amendments on the survival ability of hyphae was studied at 25°C. An overview of the results (Table 3) showed that the different amendments used (@ 0.5% w/w) had no effect on the survival ability of hyphae of *P. colocasiae* in natural soil. The amendments neither accelerated nor decelerated the lysis of hyphae appreciably. A closer look on to the results, however, revealed that the rate of hyphal lysis was comparatively less in soil amended with glucose, fructose and in combined treatment with glucose + L-asparagine.

The phenomenon of lysis may be either hetero- or auto-lytic. The former is based mainly on the ability of microorganisms to produce wall degrading enzymes (Potgieter and Alexander, 1966; Eveleigh *et al.*, 1968) while autolysis results from stress and translocation (Ko and Lockwood, 1970). The induction of autolysis by nutrient deprivation imposed in soil by microbial activity is also significant (Lloyd and Lockwood, 1966).

In the present experiment rate of lysis of hyphae of *P. colocasiae* was much faster in natural soil compared to sterilised soil. Both the mechanisms of lysis are likely to be operative specifically at higher soil temperatures (above 20°C) and moisture (55% and above). The lysis of hyphae in sterilised soil was apparently a stress phenomenon leading to autolysis although the chances of recontamination and subsequent imposition of heterolysis could not be ruled out (cf. Mitchell and Alexander, 1963) as in the present experiment it was not possible to maintain the aseptic conditions.

In the present experiment it was observed that hyphae totally disappeared within 5 days from nature soil at higher incubation temperature and soil moisture. This was in agreement with the earlier studies on *P. cactorum* by Sneh and McIntosh (1974) Rana and Gupta (1983).

The different soil amendments used in the present investigation had apparently no effect on the hyphal survival of *P. colocasiae* but only delayed the process of lysis that too only during the initial periods. Rana and Gupta (1983) obtained no effect of soil amendments on the mycelial survival of *P. cactorum*.

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