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Effect of Soil pH and Soil type on the germinability of phialospores of *Gliocladium virens* Millers, Giddens and Foster

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ABSTRACT

Phialospores of four isolates of *Gliocladium virens viz.*, 15 GV_1, 26GV_1, 1AGV_2 and 1AGV 6 responded differentially to soil fungistasis in different soils of West Bengal according to the properties of soils explored. The pH of soil appeared to be the cardinal factor. The effect of soil fungistasis was more pronounced in alkaline soil followed by neutral soil but gradually decreased due to reduction of soil pH to acidic level. Fungistasis was more in unsterilized soil compared to sterilised one.

KEY WORDS : *Gliocladium virens*, phialospore, fungistasis, soil pH, soil type

Soil fungistasis often determines the survival of many soil-borne microorganisms. Phialospores of *Trichoderma* spp. have been reported to be sensitive (Lockwood, 1977 ; Steiner and Lockwood, 1969; Emmaty and Green, 1966) to relatively insensitive (Mitchel and Dix, 1975) to this property of soil. Sensitivity to fungistasis was more pronounced in alkaline and neutral soils than acidic soils (Danielson and Davey, 1973) and fungi with small spores have been claimed to suffer much from this static effect of soil. These spores germinate slowly and usually require exogenous sources of nutrients for germination (Lockwood, 1977). These information with the spores of *G.virens* appeared to be fragmentary. The present experiment was therefore aimed towards the study of germination behaviour of phialospores of four isolates of *G.virens* collected from various localities of West Bengal with different cropping histories.

MATERIALS AND METHODS

Representative and composite soil samples (0-15 cm depth) were collected from each of the field. The samples were air-dried, powdered, sieved and analysed for pH (1:2.5, Soil : Water), organic carbon (wet oxidation) and total 'N' (Kjeldahl) following the procedures as described by Jackson (1973).

The germinability of phialospores of *G.virens* on natural and sterilised soil was determined at a fixed moisture (50% moisture holding capacity) and temperature (30^0C) of soil by agar block method. Both natural and sterilised soils at 50% moisture holding capacity were compacted in small (50 mm dia) Petri plates and the surface was smoothened with a flat spatula. Sterilised and thin (2 mm) 2% water-agar blocks (10.0 mm diameter) were placed on to the top of these smooth soil surface and allowed to activate overnight at 10^0C. The next day, spore suspension at 20-25 spores/ microscopic vision was pipetted (one drop/block) onto the surface of each agar block. The experiment thus arranged were reincubated at 30^0C for 24 hours. The agar blocks were subsequently removed carefully from the soil surface, stained with 10% aniline blue in lactophenol and placed on a clean glass slide with a drop of lactophenol. The germination of phialospore of *G.virens* was recorded at 15 x 20 X magnification of a compound microscope. The observations were recorded at random from six different microscopic fields from two separate determinations.

RESULTS AND DISCUSSION

The soil samples collected from the different agro-eco systems of West Bengal varied with regards to the different properties like pH, organic carbon, total nitrogen and soil types (Table 1). While majority of the soil samples had pH range between neutral (Ca. 7.0) to moderately alkaline (Ca. 8.0), a few (Soil sample N0.1,2,3) had acidic pH (5.5-5.6). Similarly, soils of various agro-eco systems varied with regard to their available total nitrogen and organic carbon. While some of them (Sample No.11) contained high nitrogen (Ca. 0.46%) probably due to use of high dosage of nitrogen fertilizers, others had high percentage of organic carbon (Ca. 2.1%) as was found in soil samples from mixed vegetable plots at Dhapa (Sample No.6,7) a dumping ground for city garbage for several years. Some soils were acutely deficit in organic carbon eg. Kalyani, Arambag and Simurali. Besides, they also varied in soil type ranging from tarai, laterite, alluvium including muck soil.

Irrespective of isolates and soil types, the per cent germination of phialospores was higher in sterilised soil compared to natural one (Table 2). Maximum germination of phialospores was recorded in acid soil (ca. 45-69%) followed by alkaline (Ca. 0-47%) and neutral soil (ca. 2-18%). Singur soil (pH 8.2) was however an exception wherein the germination of phialospores was Ca. 92%. Among the four isolates *viz.*, 15 GV_1, 26GV_1, 1AGV_2 and 1AGV_6 of *G.virens*, maximum germination of phialospores was recorded with 15GV_1 (Ca. 22.44) and the least in 1AGV_6 (Ca.15.81), the others being intermediate. In unsterilized acid soils, other than Jalpaiguri soil (pH 5.5) in which the spores failed to germinate due to reason(s) not explored in this experiment the germination of phialospores varied between 3-9%. Similarly, in unsterilised soils with pH ranging between neutral to alkaline (7.2-8.6), the phialospore germination was nil except in soils collected from Dhapa and Kalyani. Significant variation in spore germination was also noted in soils with almost similar pH (5.5) but with different soil type. Thus in this experiment, the germinability of phialospores varied not only with respect to isolates of *G.virens* but also with soil type and the soil pH.

Acidic pH was reported to favour growth and germination of *T.harzianum in vitro* (Chet, 1987) as also the sensitivity to fungistasis was more pronounced in neutral or alkaline soil than in acidic soil (Papavizas, 1985). Schippers *et al.* (1982) presented evidence to show that

Table 1. Soils with some of their properties used in the experiment

Source of soil	Cropping History	*pH of soil	* Organic Carbon	* Total Nitrogen	Soil Type
Jalpaiguri (1)	Jute	5.5	1.72	0.18	Tarai
Jhargram (2)	Vegetable	5.6	0.22	0.04	Red Laterite
Arambag (3)	Brinjal	5.6	0.28	0.14	Old Alluvium
Kalyani (4)	Fallow	7.2	0.17	0.02	New Alluvium
Kalinarayanpur (5)	Tuberose	7.5	0.45	0.07	New Alluvium
Dhapa (6)	Mixed Vegetables	7.6	2.1	0.30	Muck soil
Dhapa (7)	Mixed Vegetables	7.7	2.14	0.24	Muck soil
Simurali (8)	Betelvine (Deshi)	7.8	0.42	0.05	New Alluvium
Basirhat (9)	Betelvine (Deshi)	8.0	0.6	0.10	Old Alluvium
Basirhat (10)	Betelvine (Deshi)	8.1	0.6	0.11	Old Alluvium
Singur (11)	Brinjal	8.2	0.43	0.46	Old Alluvium
Simurali (12)	Betelvine (Deshi)	8.4	0.39	0.07	New Alluvium
Kalyani (13)	Vegetable	8.6	0.37	0.07	New Alluvium

Figure in the parentheses indicates sample number of the soil
* An average of three separate determinations

Table 2. Germinability of phialospores of *Gliocladium virens* in natural (NS) and sterilized (SS) soils with different pH at fixed temperature and soil moisture

Source[a] of soil	pH[a] of soil	*Mean per cent germination of ** Phialospores of *G.virens* isolates							
		15 GV_1		26 GV_1		IA GV_2		IA GV_6	
		NS	SS	NS	SS	NS	SS	NS	SS
1	5.5	0.0 (4.05)	52.79 (46.6)	0.0 (4.05)	50.79 (45.45)	0.0 (4.05)	47.88 (43.78)	0.0 (4.05)	45.88 (42.64)
2	5.6	9.88 (18.32)	69.75 (53.63)	6.38 (14.63)	55.61 (48.22)	7.50 (15.91)	56.45 (48.70)	3.88 (11.36)	46.09 (42.76)
3	5.6	8.88 (17.34)	50.43 (45.25)	5.86 (14.0)	48.17 (43.95)	3.33 (10.51)	47.89 (43.79)	3.54 (10.84)	45.13 (42.20)
4	7.2	0.0 (4.05)	18.02 (25.12)	0.0 (4.05)	5.88 (14.03)	0.0 (4.05)	3.48 (10.75)	0.0 (4.05)	2.51 (9.11)
5	7.5	0.0 (4.05)	0.68 (4.73)	0.0 (4.03)	1.33 (6.62)	0.0 (4.05)	1.39 (7.24)	0.0 (4.05)	1.59 (7.24)
6	7.6	4.97 (12.88)	41.29 (39.98)	3.82 (11.27)	20.80 (27.13)	2.63 (9.33)	10.80 (19.18)	2.71 (9.47)	13.41 (21.48)
7	7.7	0.0 (4.05)	12.9 (21.04)	0.0 (4.05)	11.38 (19.71)	0.0 (4.05)	9.57 (18.02)	0.0 (4.05)	8.09 (16.49)
8	7.8	0.0 (4.05)	31.81 (34.33)	0.0 (4.05)	12.07 (20.33)	0.0 (4.05)	7.14 (10.5)	0.0 (4.05)	8.06 (16.49)
9	8.0	0.0 (4.05)	26.86 (31.22)	0.0 (4.05)	16.67 (24.09)	0.0 (4.05)	12.48 (20.69)	0.0 (4.05)	9.27 (17.73)
10	8.1	0.0 (4.05)	35.43 (36.53)	0.0 (4.05)	15.44 (23.14)	0.0 (4.05)	11.84 (20.12)	0.0 (4.05)	12.83 (20.99)
11	8.2	0.0 (4.05)	92.98 (74.41)	0.0 (4.05)	26.57 (31.02)	0.0 (4.05)	27.70 (31.76)	0.0 (4.05)	24.39 (29.59)
12	8.4	0.0 (4.05)	28.80 (32.46)	0.0 (4.05)	27.7 (31.76)	0.0 (4.05)	28.70 (32.39)	0.0 (4.05)	30.76 (33.68)
13	8.6	0.68 (4.73)	47.48 (43.55)	0.0 (4.05)	32.57 (34.8)	2.34 (8.8)	37.49 (37.75)	1.33 (6.62)	32.58 (34.8)

	S.Em±	CD(P=0.05)		S.Em±	CD(P=0.05)
Soil source	0.98	2.72	Isolate x soil condition	0.77	2.13
Type of isolate	0.54	1.50	Source of soil x type of isolate x soil condition	2.77	7.68
Soil condition	0.38	1.05			
Soil source x type of isolate	1.96	5.43			
Soil source x Soil condition	1.38	3.83			

a. Have been arranged in order of Table No.1; Figures in parentheses represent angular transformed values corresponding to percentages.
* An average of six observations from two separate determinations.
** 9 day old phialospores were used.

ammonia was fungistatic to germination of conidia of *Trichoderma* and *Gliocladium* in alkaline soil and the inhibitory effect decreased with decreasing soil pH (Jackson, 1958). Similarly, the growth and germination of conidia of *G.virens* was optimum at pH ranging from 4 to 4.5 and retarded at pH 7.0 or above (Kang et al., 1989). It has been postulated that under acidic conditions the extent of fungistasis may be lessened because of suppression of activities of bacteria and actinomycetes (Lockwood, 1977).

In the present investigation, acid soil favoured more germination of phialospores than neutral and alkaline soils. Germination was also always higher in sterilised soil surface than the natural soil. Thus it appeared that fungistasis is both abiotic (pH - oriented) and biotic in origin. Higher germination percentage in a few alkaline soils in this investigation may be due to high energy carbon and nitrogen sources that helped in partial annulment of soil fungistasis (Emmatty and Green, 1966).

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