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Effect of soil Moisture and soil Amendment on Survival of Solerotia of *Rhizoctonia oryzae-sativae*

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Sclerotia of *Rhizoctonia oryzae-sativae* (Saw.) Mord., the stem and root rot pathogen of rice survived over 300 days in soil at 50% WHC under laboratory conditions. In sun dry soil (3% moisture) viability of the sclerotia declined rapidly to zero in between 135-150 days. However they remained viable for 225-240 days in soil at saturation moisture. The effective survival period of the sclerotia in soils at 3 (sun dry), 50 and 100% WHC were 119, 269 and 158 days, respectively. This might be a resu t of the removal of sclerotial moisture by clay colloids and the biological activity of soil microbes. Among the different soil amendments used the pathogen effectively survived for 240, 264, 300 and 300 days in soils amended with urea (0.011%), ammonium sulphate (0.025%), single super phosphate (0.03%) and muriate of potash (0.01%), respectively. The release of ammonia during decomposition of urea in alkaline pH probably affected sclerotial viability directly leading to higher activity of urea over ammonium nitrogen.

Key words : Effective survival period, Desiccation, Ammonia, *Rhizoctonia oryzae-sativae*

INTRODCUTION

Sclerotia represent a means of dormant survival and serve also as a very efficient means of conserving mycelial nutrients (Christias and Lockwood, 1973). The stem and root rot of rice incited by *Rhizoctonia oryzae-sative* (Saw.) Mord., a wide spread disease of the crop in South-East Asia, particularly in Eastern India (Mukherjee *et al.*, 1980) perpetuates from one crop season to the next through the sclerotia (Mordue, 1974). Survival of sclerotia of the pathogen under different soil moisture regimes and soil amendments have been studied here to provide a basis for manipulation of cultural practices directed towards management of the

disease, the informations in this area about the pathogen in particular being scanty.

MATERIALS AND METHODS

Pathogen

The sclerotia of the pathogen, *Rhizoctonia oryzae-sativae* were multiplied in sterilized rice straw for 15 days 30 ± 1°C. For harvesting the sclerotia, the pathogen cultures were placed in folds of blotter paper, air dried and the sclerotia were hand picked. They were washed repeatedly in distilled water, centrifuged, sterilized with 0.5% sodium hypochlorite solution and blotted dry. The average sclerotial count per gram of freshly harvested mature sclerotia was 2248.

Soils

The soils used were collected from a rice field located at the Experimental Farm, BCKV, Mohanpur ; sun dried, finely grinded and passed through 100 mesh sieve. The pH of the test soil was found to be 6.42 (Smiley and Cook, 1972) and the water holding capacity (WHC) as 51.43% Keen and Raczokowski, 1921). The moisture content of the sun dry soil was equal to its 3% WHC. Two hundred fifty gram soil was taken in 250 ml polythene beaker to which added 2.5 g sclerotia and mixed thoroughly.

Adjustment of soil moisture levels

The moisture content of the soils in the first experiment were adjusted to 3 (sun dry), 25, 50, 75 and 100% WHC by adding requisite amount of distilled water. The beakers were weighed separately and the open mouth was covered with punched alluminium foil. The loss in moisture was readjusted through addition of distilled water when the beakers were weighed every alternate day. All the treatments were replicated thrice.

Soil amendments

In the second experiment, the soils were amended with two nitrogenous and one each of phosphatic and potassic fertilixer. The amendments used were ammonium sulphate (0.025%), urea (0.011%), single super phosphate (0.03%), and muriate of potash (0.01%). The soils were adjusted to 50% WHC.

Recovery and viability of the sclerotia

The sclerotia were recovered by wet sieving (Gangopadhya and Das, 1975) at 15 days interval for 300 days. The initial mean percentage recovery of sclerotia per gram of soil samples (sun dry) was found to be 93.83%. The sclerotia that floated on the surface in 1% saline water were collected in a 100 mesh sieve, rinsed well in distilled water, surface sterilized and plated on 1% dextrose-rose bengal-agar medium. The percentage germination of sclorotia were recorded.

RESULTS AND DISCUSSION

Effect of soil moisture levels

The population of viable sclerotia declined as a function of moisture levels with increase in time ; the rate of decrease was most rapid from 15-75 days and decelerated thereafter (Table 1). It remained viable for more than 300 days at 50% WHC while it survived in between 285-300 days in soils held at 25% and 75% WHC, 225-240 days at 100% WHC. The sclerotial viability decreased to zero between 135-150 days at 3% WHC.

The inoculated soils initially contained 20-25 sclerotia per gram of soil samples. Nath (1985) estimated that a minimum of 2-3 sclerotia/g soil were critically required for a successful infection to occur. The effective survival period i. e., the time required for reduction of sclerotial population to this critical level was determined to be 119, 158, 219, 265 and 269 days when the soils were held at 3, 100, 25, 75 and 50% WHC.

The results showed that survival of sclerotia of *R. oryzae-sativae* was best favoured around 50% WHC and it lost viability rapidly in sun dry soil (3% WHC). That the pathogen survived over a wide range of soil moisture (10-97%) for 240 days at 25-28°C has been reported earlier (Inagaki *et al.*, 1987). The ultra structure of the sclerotia revealed that the sclerotial cells were not differentiated into rind and medulla. It is thought probable that such sclerotia provide little resistance to desiccation unlike the sclerotia of many other fungi that are extremely resistant to desiccation (Coley-Smith and Cooke, 1971). The apparent reduction of viability in sun dry soil may be due to the removal of sclerotial moisture by clay colloids. The biological activity of soil microbes including the pathogen itself under different temperature-moisture interaction may also contribute to decline in sclerotial viability.

Effect of soil amendments

The results of soil amendment with nitrogenous, phosphatic and potassic fertilizers on survival of sclerotia of the pathogen are presented in Table 2.

Table 1 : Effect of different soil moisture on the survival of sclerotia of *R. oryzæ-sativæ*[a]

Soil Moisture level	Percent viable sclerotia after different period of incubation (in days)																				Effective survival period (in days)
	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	
Sun dry[b] (3% WHC)	62.0	56.2	62.5	32.5	31.0	28.6	22.2	8.6	3·0	—	—	—	—	—	—	—	—	—	—	—	119
25% WHC	63.3	62.0	67.4	50.0	32.0	23.0	23.0	24.0	24.6	21.4	20.8	14.6	15.0	12.7	8.9	7.8	7.2	3.8	3.7	—	219
50% WHC	73.9	64.0	70.8	54.2	24.0	25.9	25.0	26.9	23.3	25.1	23.1	25.0	22.3	20.1	18.8	19.5	17.4	9.6	7.8	8.1	269
75% WHC	72.0	69.0	58.3	50.0	33.3	30.8	29.6	26.7	23.3	24.1	20.8	21.5	19.4	18.4	19.1	16.4	15.8	6.2	3.1	—	265
100% WHC	66.7	61.1	68.4	26.9	21.7	24.0	19.6	18.6	17.4	12.0	8.6	6.6	7.5	5.3	2.9	—	—	—	—	—	158

a Each insertion is an average of 3 replications
b WHC : Water holding capacity
c indicates no viable sclerotia were recovered

C.D. (P=0.05) = 14.31
S.Em (±) = 4.53

Table 2 : Effect of soil amendment[a] with different fertilizers on survival of *R. oryzæ-sativae* in soil at 50% WHC[b]

Fertilizers	Percent viable sclerotia after different period of incubation (in days)																				Effective survival period (in days)
	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	
0.025% A.S[d]	62.5	62.5	61.5	46.4	41.0	30.8	28.6	35.3	32.5	26.4	26.7	22.2	19.7	17.9	15.2	15.1	16.4	6.4	4.2	2.3	264
0.011% Urea	59.3	59 0	55.2	46.7	38.3	28.8	24.0	23.0	20.3	20.0	17.2	13.4	14.2	12.1	9.8	12.4	7.8	4.2	3.8	—	240
0.03%S.S.P[e]	77.3	70.4	56.0	50.0	47.8	41.4	38.8	37.8	40.0	37.7	36.7	31.6	27.7	25.9	23.2	24.5	22.6	14.4	12 2	9.8	300
0.01%M.O.P[f]	69.6	69.2	52.0	50.6	50.0	46.8	48.5	38.3	35.2	34.2	30.4	29.3	31.7	29 9	27.2	28.5	26.6	18.4	16.2	9.9	300

a Each insertion is an average of 3 replication
b WHC — Water Holding Capacity
c (—)indicates no viable sclerotia were recovered
d A.S. — Ammonium sulphate
e S.S.P. — Single Super Phosphate
f M.O.P. — Muriate of Potash

C.D. (P=0.05)=5.83
S. Em (±) =1.85

The levels of amendments were determined on the basis of recommended doses of N, P_2O_5 and K_2O for high yielding rice cultivation. The pathogen remained viable for over 300 days in soils receiving ammonium sulphate (0.024%), single super phosphate (0.03%), and muriate of potash (0.01%), the effective survival period being 264, 300 and 300 days respectively for the treatments. The sclerotial viability declined to zero between 285-300 days in soils treated with urea (0.011%) and the effective survival period was found to be 240 days.

The results showed that the amide form of nitrogen was more effective in reducing viability of the sclerotia than the ammonium form. This was followed by phosphatic and potassic fertilizers. The effect of soil amendment on sclerotial survival of this pathogen has not been worked out previously. However, some inorganic soil amendments, particularly nitrogenous compounds are known to have reduced infections caused by *Sclerotium rolfsii* (Henis and Chet, 1968). Among the many materials tested by them (1968) only ammonia affects sclerotial viability directly. The other compounds appear to act by increasing the antagonistic activity of microorganisms at the soil-sclerotia interface. In the present study, the differences in higher activity of amide nitrogen over ammonium form for reducing the viability of sclerotia may be due to the release of ammonia during decomposition of urea The pH of soil receiving urea rises as ammonium is produced and the pH in the immediate vicinity of particles of urea fertilizer may reach values in excess of 8.0 and sometimes about 9.0, although the pH only a minute distance away may be near neutrality or below. In these alkaline conditions, the product is infact ammonia and not ammonium. This phenomenon probably explains why the amide form of nitrogen is more effective than the ammonium one. The microbial transformation of phosphatic and potassic fertilizers to cell components proceeds very slowly and thereby the chances of rapid enhancement of microbes may be ruled out leading to prolonged survival in soils receiving these fertilizers.

Finally, the biological equilibrium of soil as exists in nature are rarely reproduced in vitro. Hence, the results obtained in the laboratory may have reservations for field application.

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