LONGIVITY OF SCLEROTIA AND RESPONSE OF *Sclerotium oryzae*, THE CAUSAL ORGANISM OF RICE STEM ROT TO CHEMICAL

Maung Maung Myint, Hla Than, Yu Yu Min and Thet Yi Khaing
Department of Plant Pathology, Yezin Agricultural University, Yezin

Abstract

Variability of sclerotia of *Sclerotium oryzae*, the causal organism of rice stem rot, kept under laboratory condition significantly decreased with their ages. A small number of viable sclerotia (4.4%) were, however, recovered 2 years after isolation. Of two fungicides tested in vitro against mycelial growth of *S. oryza*, Terraclor was more effective than Rovral. ED_{50} values were 6.6 and 20.7 p.p.m (a. i.) for the former and the latter. Among the three herbicides assessed in vitro, Satunil, with an ED_{50} of 4.8 p.p.m.(a. i.), was the most toxic to radial growth of *S. oryzae*. Sunrice and Sofit were also toxic with ED_{50} of 16.6 and 54.6 p.p.m. (a. i.).

Introduction

Stem rot of rice caused by *Sclerotium oryzae* has been reported in rice growing countries in Europe, Africa, South America and Asia. Estimated losses due to rice stem rot range from 18 to 80% of yield (Mew and Misra, 1994). In Myanmar, rice stem rot has been reported since 1911 (Mya Thaung and Soe Myint, 1979). Rhind (1924) also reported the disease to be widely distributed in Myanmar, where losses were great.

The sclerotia of *S. oryzae* can survive the winter and other unfavorable conditions for a long time (Ou, 1972). Tullis and Cralley (1941) stated that viability of sclerotia varied with different conditions of storage. Information available on this subject, however, was limited on the media under laboratory condition.

Study on the effect of soil-applied pesticides on soil-borne fungi has been limited to fungicides and soil fumigants. Fungicides have been tried in Japan but are not generally recommended (Ou, 1972). Herbicides can affect soil-borne pathogens (Mercado, 1979). *In vitro* studies concerning the effects of herbicides on other plant pathogenic fungi are numerous (Bozarth & Tweedy, 1971; Chappel & Miller, 1956; Ercegovich *et al.*, 1973, Katan & Eshel, 1973).

Knowledge of the longevity of sclerotia and inhibitory action by chemicals on growth of *S. oryzae* would contribute to basic understanding of this destructive pathogen and could influence the development strategies for its control. The present investigation was, thus, carried out at the Department of Plant Pathology, Yezin Agricultural University, from 1998 to year 2000 with the following objectives:

1. To determine the longevity of *S. oryzae*,
2. To assess the inhibition of different fungicides and herbicides *in vitro* against mycelial growth of *S. oryzae*.

Materials and Methods

1. Longivity of Sclerotia of *S. oryzae*

The sclerotia from the infected rice plants of CMS 25A (male sterility) collected form the field of Rice Division, CARI, Yezin were placed onto potato dextrose agar slants in December 1998. Subcultures were made monthly to get the different month-old sclerotia. In this study 1,6,12,18 and 24 month-old sclerotia were used.

Five sclerotia of the same age were placed onto 9cm diameter PDA plates at the same distance of 3cm from each other. It was meant that one sclerotium was put at the center of a plate and four sclerotia were placed at the points with equal distance from the center of the plate on the circumference of circle of radius 3cm. The plates were then incubated under laboratory condition for 3 days. Each treatment consisted of 3 plates. The experiment was arranged in completely randomized design with 3 replications.

2. *In vitro* effect of fungicides on mycelial growth of *S. oryzae*

Terraclor 75 Wp (PCNB) and Rovral 50 WP (Iprodione) were used with different concentrations of 0.1, 1, 10, 100 and 1000 p.p.m. (a.i.). Fifteen ml of PDA incorporated with different concentrations of each fungicide was poured in to 9cm plates and left to cool overnight. Five mm diameter disc cut from the edge of 5 days old mycelial growth of *S. oryzae* was placed at the center of PDA plate in an inverted position and incubated at room temperature in the dark. The experiment was carried out in triplicate. Control plates consisted of the media without fungicide.

Three days after incubation, diameter of the linear growth of *S. oryzae* was measured. Percentage inhibition of growth in each treatment was calculated using the following relationship (Horsfall, 1956).

$$\% \text{ Inhibition} = \frac{(ru - rt)}{ru} \times 100$$

whereas, ru = diameter of mycelial growth on untreated agar

rt = diameter of mycelial growth on treated agar

The amount of chemical required for 50% inhibition of fungal growth (ED_{50}) was calculated from regression lines plotting percentage inhibition on a probit scale versus log concentration of chemical.

3. *In vitro* effect of herbicide on mycelial growth of *S. oryzae*

Five mm diameter mycelial disc of *S. oryzae* was placed at the center of each 9cm plate containing PDA incorporated with different concentrations (1, 5, 10, 50, 100 and 500 p.p.m. (a.i.) of Sofit (Pretilachlor 300 EC) , Sunrice (Ethoxy sulfuron 15 WDG) and Satunil (Thiobencarb + Propenil 60% EC). The plated were then incubated at room temperature in the dark. Calculation for radial growth inhibition was similar to that described above.

Results

Viability of different month-old sclerotia was significantly decreased with its age. Viability of 1 month–old sclerotia was the best whereas that of 24 month-old sclerotia the lowest. A small number of viable sclerotia (4.4%) were, however, recovered two years after isolation (Table 1, Fig.1). The viability and age of sclerotia were found to be negatively correlated (Fig.2).

Table 2 showed percentage ingibition of mycelial growth of *S.oryzae* for each fungicide at different concentrations. Probit-log dose plots for effect of fungicide on mycelial growth were shown in Fig.3. Terraclor and Rovral were toxic against mycelial growth of *S. oryzae* with ED50 values of 6.6 and 20.7 p.p.m. (a.i.). Terraclor was, therefore, more effective than Rovral (Table 3 and Fig.4).

The inhibition of radial growth of *S.oryzae* for each herbicide at different concentrations was summarized in Table 4. Figure 5 showed regression lines plotting percentage inhibition on a probit scale versus log concentration of herbicides. Among the herbicides evaluated in vitro, Satunil has the highest inhibitory effect to mycelial growth of *S. oryzae* with an ED50 of 4.8 p.p.m (a.i.). Sunrice and Sofit were also toxic with ED_{50} of 16.6 and 54.6 p.p.m. (a.i.) (Table 5 and Fig 6).

Discussion

The present investigation revealed that sclerotia of *S. oryzae* remained viable for at least two years in test tubes under laboratory condition. The result obtained from the present study was in general agreement with those of other investigation. Park and Bertus (1932) showed that sclerotia remained viable in an air-dry incubator for period of 3 years at 20°C ; submerged in tap water at 20°C for 2 years. Rotation periods of 4 to 6 years apparently would not eliminate rice stem rot because sclerotia of *S.oryzae* can remain viable for at least 6 years in uncultivated soil (Tullis and Cralley, 1941).

Both fungicides tested in this study were inhibitory to aycelial growth of *S.oryzae* in vitro. Terraclor 75 WP is labeled for use to control a variety of soil-borne diseases on ornamentals such as bulb and crown rot of tulip and lilies caused by *S. rolfsii* (Anon, 1998a). Rovral is also recommended to control garlic white rot caused by *S. cepivorum*. LD_{95} for activity *in vitro* of *S. cepivorum* and *S. rolfsii* are 3-4 and 100μg/ml (p.p.m.) (Anon, 1998 b).

Inhibition of mycelial growth and sclerotia formation of other sclerotium forming fungi such as *S. rolfsii* (Ercegovich *et al.*1973) and *Sclerotinia sclerotiorum* (Cerkaukas *et al.*, 1986) by some herbicides have been reported. Mercado (1979) also described that some herbicides can decrease disease incidence of peanut stem rot and tomato damping-off caused by *S. rolfsii*. In this study all herbicides tested were toxic *in vitro* with low ED_{50} values to mycelial growth of *S. oryzae*. Sofit, Sunrice and Satunil were effective in controlling weeds in wet-seeded rice (Mar Mar Kyu and Myint Myint Win, 2000).

It can be concluded that the rice stem rot fungus, *S. oryzae*, can remain viable for at least 2 years in dry condition under laboratory condition. Rotation periods of 2 years seemed impracticable as a control measure. Some fungicides and herbicides were highly inhibitory *in vitro* against mycelial growth of *S. oryzae*. More research should, therefore, be carried out in natural agroecosystem to confirm the in vitro results obtained from the in vitro results obtained from the present studies.

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Table 1 Viability of sclerotia of *Sclerotium oryzae*

Age of sclerotia (month)	Viability (%)
1	100.0 a
6	82.7 b
12	42.3 c
18	16.2 d
24	4.4 e
CV	16.2%

Means followed by the same letter are not significantly different at 5% level of probability by DMRT.

Table 2 Percent inhibition of mycelial growth of *Sclerotium oryzae* at different concentration of fungicides

Concentration (p.p.m) (a.i)	Growth inhibition (%) by	
	Rovral	Terraclor
0.1	0	0
1	17.9	9.9
10	35.5	82.7
100	82.3	89.7
1000	80.2	90.9

Table 3 ED_{50} values of fungicides for inhibition of mycelial growth of *Sclerotium oryzae*

Fungicides	ED_{50} (p.p.m.) (a.i.)
Rovral	20.7
Terraclor	6.6

Table 4 Percent inhibition of mycelial growth of *Sclerotium oryzae* at different concentrations of herbicides

Concentration (p.p.m.) (a.i.)	Growth inhibition (%) by		
	Sofit	Sunrice	Satunil
1	0	15.7	19.5
5	0	24.1	33.6
10	6.0	41.1	74.4
50	63.6	59.0	95.3
100	77.4	78.4	100.0
500	87.3	95.4	100.0

Table 5 ED_{50} values of herbicides for inhibition of mycelial growth of *Sclerotium oryzae*

Herbicide	ED_{50} (p.p.m.) (a.i.)
Satunil	4.8
Sunrice	16.6
Sofit	54.6

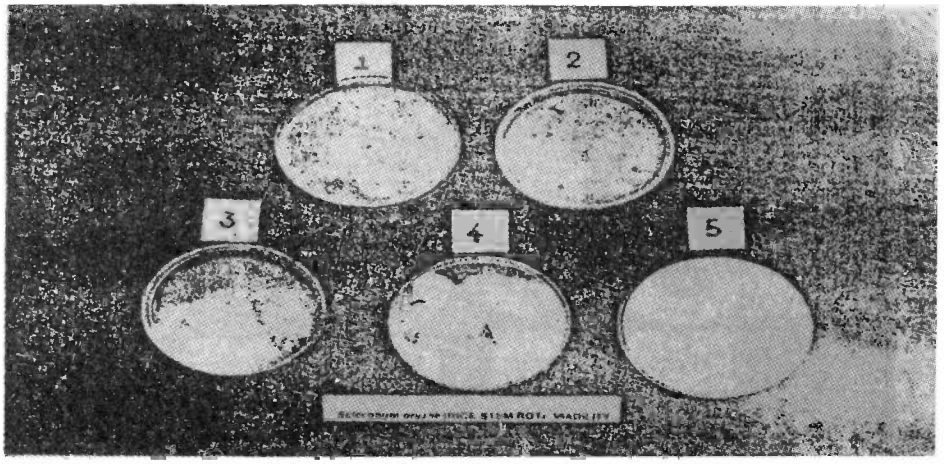

Fig.1 Mycelial growth of different month-old sclerotia of *S. oryzae* (1-24m; 2-18m; 3-12m; 4-6m; 5-1m) showing its viability

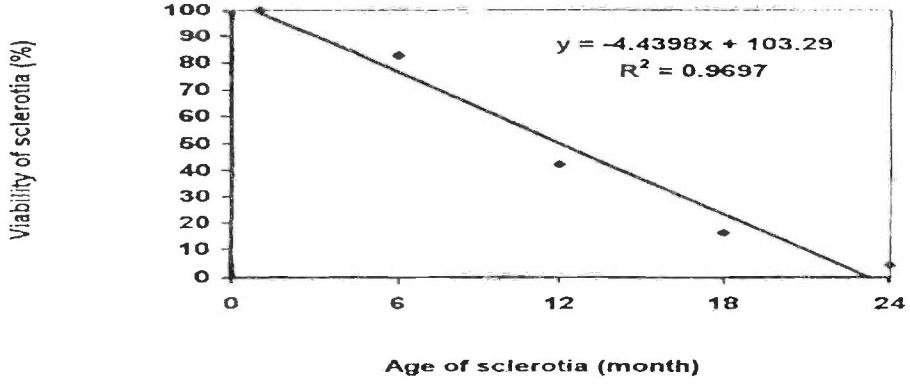

Fig 2. Relationship between viability and age of sclerotia of *S. oryzae*

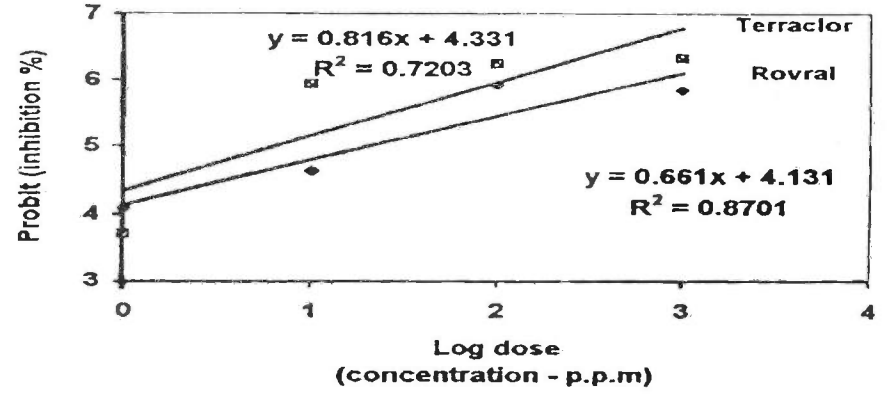

Fig 3. Probit-log dose plots for effect of fungicides on growth of *S. oryzae in vitro*

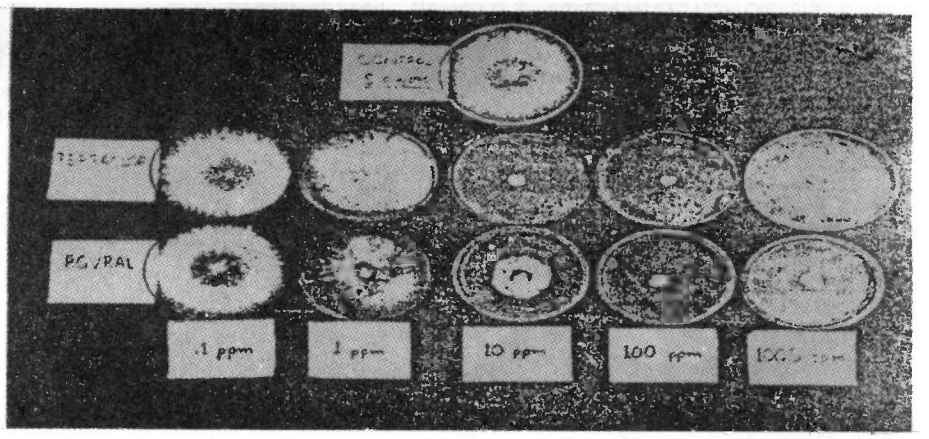

Fig. 4 Mycelial growth of *S. oryzae* on PDA media incorporated with different concentrations of Terraclor and Rovral

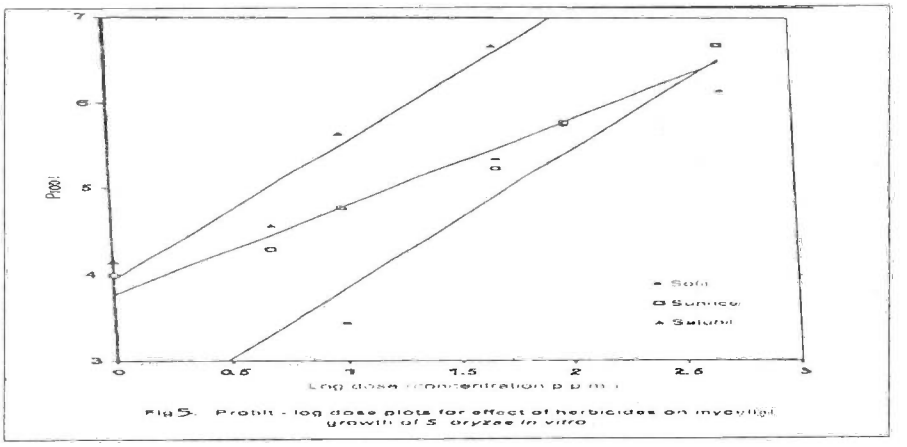

Fig 5. Probit - log dose plots for effect of herbicides on mycelial growth of *S. oryzae* in vitro

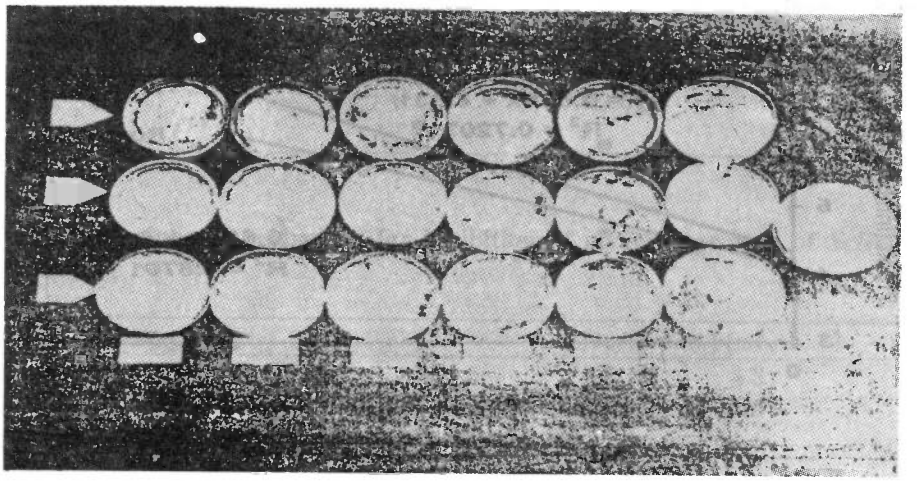

Fig. 6 Mycelial growth of *S. oryzae* on PDA media incorporated with different concentrations of Satunil, Sofit and Sunrice