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SCLEROTIA OF *RHIZOCTONIA SOLANI*, THEIR PRODUCTION ON INFECTED RICE PLANTS AND THEIR POPULATION IN DIFFERENT SOIL TYPES

PEMBENTUKAN SKLEROTIA R. SOLANI *PADA TANAMAN DAN JERAMI SAKIT DAN POPULASINYA PADA TIPE TANAH YANG BERBEDA*

Suparyono
Research Institute for Rice, Jl. Raya IX, Sukamandi, Subang 41256.
I. Suwanto
Faculty of Agriculture, Univ. of Tanjungpura, Pontianak.
H. Utami
Former Undergraduate Student, Faculty of Agriculture, Soedirman University, Purwokerto.
Sudir
Research Institute for Rice, Jl. Raya IX, Sukamandi, Subang 41256

ABSTRACT

Production of sclerotia of *Rhizoctonia solani* on infected rice plants and their population in different soil types were evaluated during the year of 1992/1993 and 1993/1994. The production of sclerotia was estimated on 20 diseased rice plants and plant debris (rice straw) placed on soil surface, in 10 cm depth, and in 20 cm depth. The population of sclerotia in the soil was estimated by separating the sclerotia from soil samples collected from different soil previously planted with different crops. Data indicated that during the rainy season of 1992/1993, the mean sclerotia produced were 14.85 and 10.95 per hill on the variety of IR64 and non-IR64, respectively. While during the dry season of 1993 the mean sclerotia produced on these varieties were 7.50 and 7.25 per hill. On both varieties, the production of sclerotia was positively correlated with disease severity of sheath blight, as indicated by the correlation coefficient of 0.90 and 0.70, for the variety of IR64 and non-IR64, respectively. Their close relationship was estimated by the model of $Y=-29.00+1.16x$ ($R^2=0.82$) and $Y=-2.94+0.35x$ ($R^2=0.45$), for the variety of IR64 and non-IR64, respectively. The production of sclerotia on the infected rice straw was significantly affected by the soil depth where the diseased straw were kept. On the straw of IR64, the sclerotia produced were 7.00, 5.25, and 1.25, when the straw were kept in the depth of 0, 10, and 20 cm, respectively. While on the straw of non-IR64 variety, the sclerotia produced were 7.75, 5.25, and 0.50, when the straw were kept in the depth of 0, 10, and 20 cm, respectively. Highest number of sclerotia was observed in Ultisol soil previously planted with corn, while the smallest was in Ultisol previously planted with mungbean.

Key words: Sclerotia production, *Rhizoctonia solani*, rice, population trend, soil type.

INTISARI

Pembentukan sklerotia R. solani *pada tanaman dan jerami sakit dan populasinya pada tipe tanah yang berbeda telah dipelajari pada tahun 1992 sampi 1994. Pembentukan sklerotia dipelajari pada 20 tanaman padi IR64 dan bukan-IR64 sakit di lapangan dan pada jerami yang disimpan di permukaan tanah, pada kedalaman 10 dan 20 cm. Populasi sklerotia dalam tanah dievaluasi melalui metode pemisahan sklerotia dari contoh-contoh tanah yang diambil dari beberapa ekosistem yang sebelumnya ditanami tanaman yang berbeda. Hasil penelitian menunjukkan bahwa pada musim hujan 1992/1993, rata-rata produksi sklerotia adalah 14,85 dan 10,95 per rumpun, berturut-turut pada varietas IR64 dan bukan-IR64. Pada musim kemarau 1993, produksi sklerotia pada kedua varietas berturut-turut sebesar 7,50 dan 7,25 per rumpun. Pada kedua varietas, produksi sklerotia berkorelasi positif dengan keparahan* *hawar pelepah, seperti terlihat dari koefisien korelasinya yang besarnya 0,90 dan 0,70 berturut-turut untuk IR64 dan bukan-IR64. Kedekatan hubungan dapat dilihat dari persamaan regresi Y=-29,00+1,16x (R^2=0,82) dan Y=-2,94+0,35x (R^2=0,45), berturut-turut pada varietas IR64 dan bukan-IR64. Pada jerami IR64, produksi sklerotia adalah 7,00; 5,25; dan 1,25, berturut-turut kalau jerami disimpan di atas tanah, pada kedalaman 10, dan 20 cm. Sedang pada jerami bukan-IR64, produksi sklerotia adalah 7,75; 5,25; dan 0,50, untuk penyimpanan yang sama. Jumlah sklerotia terbanyak ditemukan pada tanah Ultisol yang sebelumnya ditanami jagung dan terendah pada tanah yang sama yang sebelumnya ditanami kacang hijau.*

Kata kunci: Produksi sklerotia, populasi sklerotia, Rhizoctonia solani, *padi, tipe tanah.*

INTRODUCTION

Sheath blight caused by *Rhizoctonia solani* Kühn, is one of the most important diseases of rice in the tropics (Ou, 1985). The fungus affects many different crops at different plant growth stages. In leguminous crops, such as soybean and mungbean, this pathogen along with some other pathogens (i.e. *Sclerotium, Fusarium*, and *Pythium*), causes disease called damping-off. In rice, the pathogen normally attacks the plant at about tillering stage. While the disease normally occurs on the leaf sheath, the disease may reach upper leaves of the rice plants under humid condition. Under such level of disease development, the disease may cause considerable yield losses. When rice varieties of early and late maturing varieties were inoculated with *R. solani* at different plant growth stage, Suparyono *et al.* (1992) observed differences in yield losses.

No control measures against *R. solani* are adopted by the farmers so far, and no resistant varieties to the disease are available, which might be due to the wide range of host of the pathogen. No fungicide are specifically used by the farmers against the pathogen, although several reports indicated that application of fungicides decreased disease severity and increased rice yield (Arunyanart *et al.*, 1986). Control measure through cultural practices requires information on the sources and role of initial inoculum of the pathogen. Information on the production and number of sclerotia either on the infected rice plants or on plant debris would be very helpful in understanding the disease development in a particular ecosystem.

The objectives of this study were to evaluate the production of sclerotia of *R. solani* on infected rice plants and on plant debris, and the influence of soil types on the population of the sclerotia.

MATERIALS AND METHODS

Production of sclerotia on infected rice plants and straw. Observations were done in the farmer's field planted with IR64 and non-IR64 (such as Cisadane, Ciliwung, and Muncul). Twenty-one old seedlings of each variety were transplanted at the planting space of 20x20 cm. The crops were fertilized with nitrogen and phosphorous at the rate of 250 and 100 kg/ha, for urea and P_2O_5, respectively. Split application of urea was done 100 kg as basal fertilizer (application at one day before transplanting), and the rests were applied at maximum tillering and panicle initiation growth stages. All P_2O_5 fertilizers were applied as basal fertilizers. The rice crops were hand-weeded twice, at early tillering and maximum tillering growth stages. To manage stem borer (*Tryporyza innotata*), Furadan was applied once at maximum tillering growth stage, at the rate of 20 kg/ha.

A total of 50 rice plants of each variety were tagged for observation. The tagged plants were observed for disease development, starting from the first appearance of symptom up to the production of sclerotia. The disease incidence was expressed as the number of infected hills, while disease severity was evaluated by the relative lesion height (RLH) developed by Ahn *et al.* (1986). On diseased plants, sclerotia were observed and collected every 7 days, starting from the first symptom appearance until the rice plants were harvested. Straw of the diseased plants were kept on the surface of the soil, buried at the soil depth of 10 and 20 cm. The production of sclerotia were recorded every week, starting at 15 days after the placement of the straw until the buried straw were totally degraded.

Population of sclerotia in different agroecosystem. Soil samples were collected from four different locations, namely : (1) Sukamandi, soil type Ultisol, previously planted with rice, mungbean or corn; (2) Sleman, Regosol, previously planted with rice or corn; (3) Bantul, Grumusol, previously planted with peanut or corn; and (4) Jakenan, Latosol, previously planted with rice or corn, followed by a fallow period. The locations were selected primarily based on the soil types and the previous crops planted. Regardless of the size, the selected fields were divided into three parts in about equal size, and were designated as plots from where the soil samples were obtained. In each location, such procedures were done in three sub-locations and designated as replication. From each plot in the selected location, samples were collected along both diagonals. A total of 45 samples were collected per replication. Samples were collected from 5-10 cm depth, with a total of 2 kg per sample. In the laboratory, soil samples were processed by the wet sieving method using a 20 mesh screen (Kim and Kim, 1987). Observation was done under binocular microscope. The suspected sclerotia were plated in Petridishes containing PDA medium. The growing sclerotia were identified based on the characteristic of the mycelium. The population of the sclerotia was estimated based on the weight of the soil samples observed.

Data analyses. Production of sclerotia on the infected rice plants and straw were presented as the mean of sclerotia harvested. Correlation between disease severity and number of sclerotia was evaluated. Regression of disease severity as the independent variable and number of sclerotia as dependent variable was evaluated to determine their relationship. Coefficient of determination (R^2) was calculated to evaluate the variation explained by the model.

RESULTS AND DISCUSSION

Among the 50 rice plants tagged, 20 diseased rice plants in each variety were randomly selected for further studies. The sclerotia were observed and harvested therefore from those 20 diseased plants. Data indicated that sclerotia were first produced when the plants reached the ripening growth stage. During the rainy season of 1992/1993, the mean number of sclerotia produced were 14.85 and 10.95 per hill for IR64 and non-IR64, respectively. During the dry season of 1993, the respective mean number of sclerotia of those varieties were 7.50 and 7.25 per hill (Table 1).

Table 1. Mean of sclerotia of *R. solani* produced on infected plants, 1992/1993

Rice variety	Number of sclerotia *)	
	WS1992/1993	DS 1993
IR64	14.85±22.61	7.50±4.39
Non-IR64	10.95±9.63	7.25±5.69

*) Means of 20 plants observed.
WS1992/1993 = wet season of 1992/1993.
DS1993 = dry season of 1993.
Non-IR64 = rice varieties other than IR64, such as Muncul, Cisadane, and Ciliwung.

Disease severity of sheath blight correlated well with the number of sclerotia produced, with the coefficient of correlation of 0.90 and 0.70 for the IR64 and non-IR64, respectively. The production of sclerotia on infected plants increased with the severity of sheath blight, as indicated by the model $Y=-29.00+1.16x$ ($R^2=0.82$) and $Y=-2.94+0.35x$ ($R^2=0.45$) for IR64 and non-IR64, respectively (Fig. 1).

The production of sclerotia was significantly affected by the depth of placement of infected straw (Table 2). On both varieties, the highest number of sclerotia were observed when the straw were kept on the surface of the soil. The production of sclerotia decreased as the straw buried deeper in the soil.

Table 2. Means of sclerotia of *R. solani* produced by infected straw kept at different soil depth.

Soil depth (cm)	Number of sclerotia *)	
	IR64	Non-IR64
0	7.00± 2.16	7.75± 2.06
10	5.25± 4.11	5.25± 3.77
20	1.25± 1.50	0.50± 1.00

*)Means of 5 samples observed.

Different population of sclerotia of *R solani* was observed in different soil types previously planted with different crops (Table 3). The highest number of sclerotia was observed in Ultisol soil previously planted with corn, and the lowest was observed from Ultisol soil previously planted with mungbean.

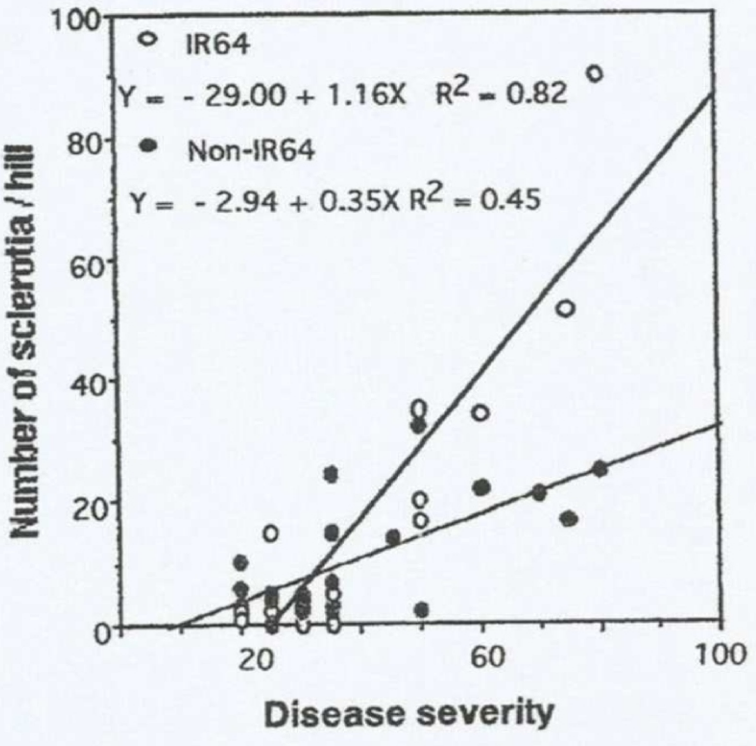

Figure 1. Regression of total sclerotia on disease severity of sheath blight for the rice variety IR64 and non-IR64.

Table 3. Means of sclerotia of *R. solani* collected from different types of soil previously planted with different crops

Previous crops	Number of sclerotia *)			
	Ultisol	Regosol	Grumusol	Latosol
Rice	1.10±0.05	1.55±0.31	n.a.	1.27±0.21
Mungbean	1.05±0.05	n.a.	n.a.	n.a.
Corn	3.72±0.07	2.73±0.15	1.50±0.20	1.18±0.27
Peanut	n.a.	n.a.	1.67±0.14	n.a.

n.a. = not available, data were not available due to the unavailability of the cropping pattern

Based upon the results of the study it was obvious that sclerotia of *R. solani* were produced by the diseased rice plants at the time while the diseased rice plants were still alive and on infected straw placed at different soil depth. The production of sclerotia was higher in shallower soil depth or on the surface of the soil. Such information would be very useful as it is related to the management of straw done by the farmers. Incorporating rice straw into the soil before planting immediately after harvest is expected to prevent the production of sclerotia, which further result in the reduction of the primary inoculum (Xo) of the pathogen. Reducing the primary inoculum is one of the recommended tactics in the management of rice diseases (Zadoks and Schein, 1979). Incorporating rice straw with soil would be beneficial for both enriching the soil with nutrients originating from the straw and decreasing the source of primary inoculum of sheath blight. It is hypothesized therefore that in order to be more beneficial to the rice production, rice straw should be well decomposed before being incorporated into the paddy field. By doing so it was expected that while maintaining the nutritional status of the soil, the tactic is useful in reducing the inoculum source of sheath blight.

Assuming that the sclerotia produced by the infected rice plants will effectively function as either secondary or primary inoculum, then the rice plants are in a high risk condition throughout the growing season. Fortunately various naturally occurring factors were observed to be able to inhibit the development of rice sheath blight. Hashiba (1992) reported that the viability of sclerotia was higher at low temperature (winter) than at high temperature (summer) under saturated atmosphere. Under such view, it is expected that the viability of sclerotia in tropical condition such as in Indonesia would be low. Under tropical condition it is unclear therefore if the sclerotia will function as the primary inoculum, especially for the wet season crops. Wet season crops in Indonesia is normally held after the land is left fallow for 2-to-3 months. During that period (July, August, and September) the average temperature is high (32°C) and the relative humidity is low.

In the soil, the sclerotia were exposed to naturally occurring antagonistic micro-organisms. These antagonistic micro-organisms decreased the viability of the sclerotia which further decreased the efficiency of the sclerotia as the source of inoculum. Bacteria isolated from healthy plants and rhizospheric soil of healthy plants from irrigated rice fields decreased the viability and the ability of the sclerotia to infect the rice plants and resulted in a better protection against rice sheath blight (Mew and Rosales, 1992; Sudir *et al.*, 1992; Suparyono, 1990)

If the sclerotia produced are viable, and the environmental condition is favorable for the development of the disease, sclerotia originated from previous infected plants may function as the primary source of inoculum for the following crops. Such hypothesis should be tested in Indonesia since tropical ecosystem is distinctly different from temperate region.

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