CARIBBEAN FOOD CROPS SOCIETY

SOCIETE CARAIBE POUR LES PLANTES ALIMENTAIRES

25

Twenty fifth
Annual Meeting 1989

25e CONGRES ANNUEL

Guadeloupe

Vol. XXV

CONTROL OF SCLEROTIUM ROLFSII BY SOIL ORGANIC AMENDMENT : DYNAMIC OF THE SUPPRESSION WITH SOME SOLID RESIDUES

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ABSTRACT

The dynamic of *Sclerotium rolfsii* suppression in soil amended with bagasse (B) and banana senescent leaves and bunch rachis fiber (BSL and BRF, respectively) was studied in a pot experiment conducted in climatic chamber. The residues were incorporated in a ferralitic soil at the dose of 1 % (w:w). The evolution of viable (germinating) *sclerotia* populations (PVS) and soil infectivity due to the pathogen (SI) during time followed the typical distribution curve proposed by BAKER (1981). Soil amendments which may be immediately suppressive for *S. rolfsii* (in the case of BSL) did not induce any control later on, as for as SI was concerned. The situation was different for the PVS : BRF left a more important residual *sclerotium* population in the soil than B or BSL. The managment of solid organic residues as soil amendments management to control *S. rolfsii* is also discussed.

RESUME

LA LUTTE CONTRE *SCLEROTIUM ROLFSII* PAR AMENDEMENT ORGANIQUE DU SOL : DYNAMIQUE DE LA SUPPRESSION AVEC QUELQUES RESIDUS SOLIDES

La dynamique de la suppression de *Sclerotium rolfisii* avec la bagasse (B) ainsi que les feuilles sénescentes et la fibre de rachis de Bananier (FSB et FRB, respectivement) a été étudiée dans une expérimentation en pots conduite en chambre climatique. Les résidus ont été incorporés dans une terre ferralitique à la dose de 1 % (en poids). L'évolution au cours du temps des populations de sclérotes germants (PSG) et du potentiel infectieux du sol dû à la présence de ce champignon (PI)est conforme à la courbe théorique de distribution proposée par BAKER (1981). L'amendement du

sol qui peut être d'emblée suppressif pour *S. rolfsii* (cas de FSB, par exemple), n'apporte, cependant, aucune amélioration à terme en matière de contrôle, si l'on se réfère au PI. La situation est différente lorque l'on considère les PSG : FRB laisse dans la terre une population de sclérotes résiduels plus importante que B ou FSB. La gestion des résidus organiques solides en amendement du sol pour contrôler *S. rolfsii* est discutée.

INTRODUCTION

The introduction in soil of organic residues results in physical, chemical and biological changes of the telluric environment. These changes may conduct to the suppression of some soilborne plant pathogens. They may also vary with time as the residues decompose. Thus, a mesure at one time of disease incidence due to *Sclerotium rolfsii* in an amended soil, although useful for a screening of many residues (TORIBIO, 1984), might be however insufficient to conclude that a given organic material is really effective. The present study was then conducted in order to follow the suppressiveness during time of different residues for *S. rolfsii* after their incorporation in soil, and to know if the control obtained was ephemeral or durable.

MATERIAL AND METHODS

The experiment was conducted in an environmental chamber with pots containing a ferralitic soil.

Soil amendments and conditions of incubation

Banana senescent leaves (BSL), banana bunch rachis (mainly fiber, BRF) and sugarcane bagasse (B) were choisen in this study. Before use, these residues were grinded in a Jeffco crusher-grinder (Jeffress Bro. Ltd. 351 Melton Road, Northgate Brisbane, Q'ld, Australia) then screened to get small pieces (≤ 5 mm).
Each residue was incorporated in the soil at the dose of 1 % (w:w). The unamended (check) or the amended soil was distributed in 7.4 x 7.4 x 7.4 cm plastic pots (200 g soil/pot). Fifteen *S. rolfsii sclerotia* produced on Bread fruit (*Artocarpus altilis* (Park.) Forst.) leaves were introduced at the soil surface (0-1 cm depth) and the soil was moistened to field capacity with deionized water. The pots were incubated in an environmental chamber (temperatures of 30± 2°C, lighting of 12 hours with 3 mod. Mazda Maf 400 w RV 88 lamps situated at 1.5 m above) The same day (DO) and at regular periods of 7 days, until 42 days (D7, D14..., D42, respectively), 12

pregerminated Lentil (*Lens esculenta* Moench.) seeds were sown in each pot of a first set of pots for the determination of disease incidence as (percentage of dead seedlings). A second set of pots without plants was used to detect the viable (germinating) *sclerotia* according to a method previously described (TORIBIO, 1977) : and slighty modified : the upper soil fraction in each pot (about 100 g) which was contaminated with the *sclerotia* was dried overnight in the labotory (Temperature of 20 ± 2°C), relative humidity of 65-75 %), distributed in thin layer in five 90 mm diameter Petri dishes, remoistened to field capacity with distilled water, and placed under plastic bags in a incubator at 30°C. The other fraction of soil in the pots (botton fraction) was used for different chemical analysis (total C, total N, N-NO3) and for the determination of soil microflore, pH and conductivity by standard procedures. For each period of incubation , 5 pots were considered, and the experiment was repeated twice.

RESULTS

Evolution during time of disease incidence due to *S. rolfsii* in the unamended or amended soil are represented by figure 1. At DO, only the residue BSL reduced significantly disease incidence. At the same time, the soil amended with B and BRF induced significantly more disease than the unamended soil. Later on, there was a rapid decrease of the percentage of dead seedlings followed by a stabilization phase where the amended soil had the same comportment than the unamended one. This last phase occured at about 21 days of incubation.

Populations of viable *sclerotia* (PVS) of *S. rolfsii* in the soil amended with BSL were identical to those in the check unamended soil. However,when the residues were B and BRF, the PVS increased between DO and D7, passing from 10 to 28 and 74 *sclerotia*/100 g soil for B and BRF, respectively (Fig. 2). They decreased after to reach, comparatively to the check soil the same number or a significantly higher number of *sclerotia* as for as B or BRF, respectively, were considered. Finally, at the end of the incubation period of 42 days, the number of *sclerotia* was reduced by 64 % in the unamended soil or in the soil amended with B, and by 92 % in the soil amended with BSL ; it increased by 33 % when the amendment BRF was used.

DISCUSSION

Evolution of PVS and disease incidence due to *S. rolfsii* followed a curve typical of the survival curve illustrated by BAKER (1981) who precises that "all sections may not be present in a given situation". Thus, in our study, only

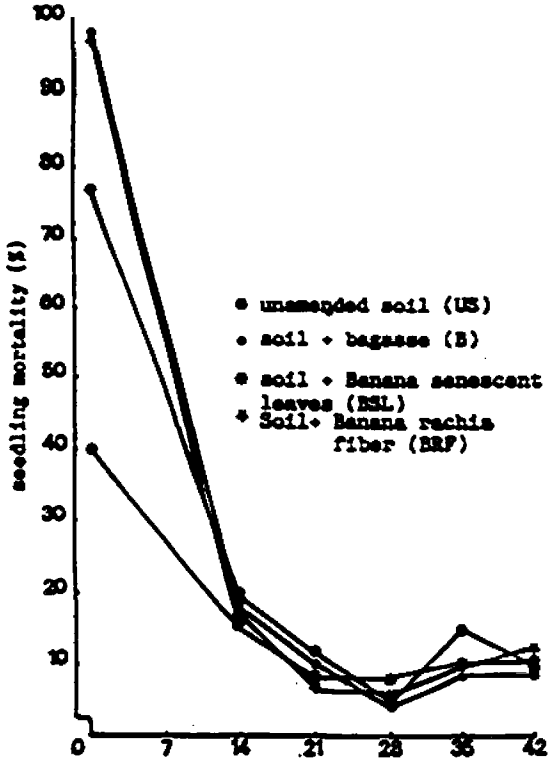

Fig.1 Evolution of soil infectivity due to *Sclerotium rolfsii* in unamend or amended soil. The soil was used at the dose of 1% (w:w). The percentage of dead Lentil (*Lens esculenta* Moench.) seedlings was determined from 5 pots with 12 seedlings each during 15 days in a climatic room at 30+/- 2°C. The curves were elaborated from results of 2 assays.

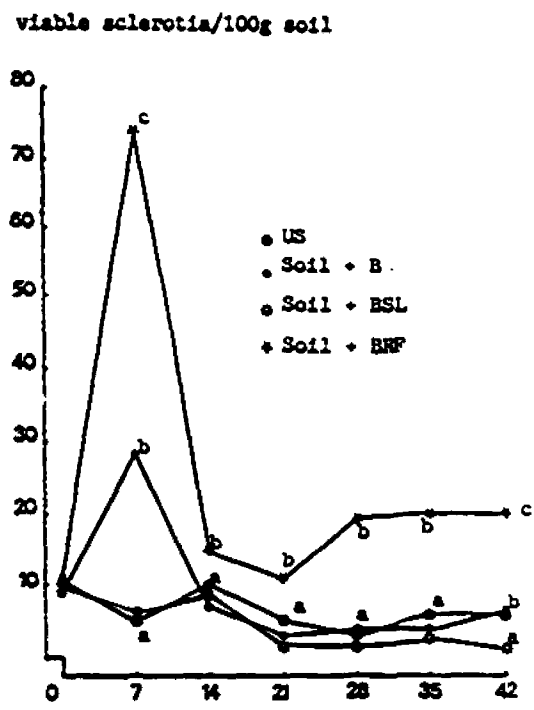

Fig.2. Evolution of *S.rolfsii* viable sclerotia populations in the unamended or amended soil. The soil was inoculated with 15 sclerotia.The residues were used at the dose of 1% (w:w).Viable sclerotia were counetd in 100g soil samples. The soil was dried, distributed in thin layers in petri dishes, remoistened with distilled water and incubated at 30°C during 48h. At each date,5 soil samples were analysed for a given treatment ; the same letter means no significant difference between the values (p=0.05, Newman-Keuls test after square root transformation of data : $X' = \sqrt{X+0,5}$). The curves were elaborated from results of 2 assays.

two phases were observed for the disease incidence. The first phase represented a rapid decline of seedling mortality between DO and D14 . The second phase illustrated stabilization of disease incidence to a constant level, whether the soil was amended or not. This information suggests that amending the soil with organic residues does not nessarily increase damages caused by *S. rolfsii* as too often considered. It may be, however, important to wait a certain time between the day of incorporation of amendment in soil and the day of sowing a susceptible host. Two to 3 weeks were found adequate for the ferralitic (oxisol) soil under study. For sandy and sandy-loam soils however, longer delays have been proposed (GAUTAM & KOLTE, 1979 ; MATHUR & SINHA, 1970 ; MEHROTRA & CALUDIUS, 1972 ; NARGUND et al., 1983). This indicates that the soil nature has an influence on suppressiveness of organic amendments to *D. rolfsii.*

Evolution of the PVS was more consistent with the ideal curve of Baker, especially if the soil was amended with B and BRF. The phase of inoculum increase supports the idea of BOYLE (1961) on the use, by *S. rolfsii*, of nutrients from the decomposing residues. The level of this increase probably had some influence on the number of long term surviving *sclerotia* in soil. In fact, for the same level of seedling mortality, the residue B left in the soil the same amount of *sclerotia* than the unamended soil ; whereas BRF left significantly more. *sclerotia*. The soil amended with BRF contained theoretically - and at any time during the experiment - enough slerotia to kill much more Lentil seedlings than really observed. HIGGINS, cited by BOYLE (1961) did not observe damages of *S. rolfsii* even though *sclerotia* were present in large numbers in some peanut fields We also frequently finf numerous *sclerotia* on wet substrates and soil, without severe attacks of the fungus on bean, tomato, and aroids (*Anthurium, Colocasia* spp. and *Xanthosoma* spp.) crops. These facts suggest that the long term survival of *sclerotia* is associated with soil fungistasis. This fungistasis seems not to be related with soil pH, conductivity, N-NH4, and N-NO3, C/N ratio, or a particular increase in microbial populations in the telluric environment. It disappeared easily, however after drying then remoistening the soil, or amending the wet soil again with another amount of residue. As *sclerotia* of *S. rolfsii* are not likely to be influenced by a nutritional type fungistasis (LOCWOOD, 1977), it is more probable that the germination of these propagules is directly or indirectly under the influence of volatil compounds in amended or unamended soils.

In any case, since long term survival of a great number of *sclerotia* in the soil represents a risk for the following crop,only organic residues that generate less or an equal number of *sclerotia* than the level obtained in unamended soil should be used. In order to compare different soil amendments for suppressiveness to *S. rolfsii*, it seems necessary to perform at least two

detections of viable *sclerotia* in soil : one, the day of amendment operation, and the other, about 3 weeks later.

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