

Numbers and Distribution of Sclerotia of *Macrophomina phaseolina* in the Soils of South Carolina

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ABSTRACT

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Each of 692 soil samples from 46 counties contained sclerotia of *Macrophomina phaseolina*. The number of sclerotia varied among fields and ranged from 6 to 168, with an average of 75 per gram of soil. Twenty-seven counties (59%) were below the average, while 10 counties (22%) were above the average (76-100 sclerotia per gram). The number of sclerotia in nine counties (19%) varied between 100 and 168 per gram. There appeared to be no definite pattern of sclerotial distribution in the state. Adjacent counties showed great disparity in population densities.

Charcoal rot, caused by *Macrophomina phaseolina* (Tassi) Goid. is a ubiquitous soilborne disease of more than 300 plant species (5). The wide host range includes such plants as clover, cotton, coffee, conifer, tea, citrus, asparagus, bean, lima bean, scarlet runner bean, mung bean, sweet potato, sweet corn, cowpea, soybean, potato, and tomato (3).

Techniques have been described and studies made in many states to determine the densities of sclerotia in soil (2,6-10). However, no record of assaying for sclerotial numbers or distribution of propagules could be found for South Carolina.

The ability of *M. phaseolina* to attack many host plants makes it possible for the buildup of propagules to be of economic importance. A major increase of inoculum enhances the potential of the organism to produce virulent strains. In part, this may be due to increased opportunities for change through a greater number of nuclear divisions, but it may act as a deterrent to change as well, because of "reduced" selective pressure. This study was undertaken to determine the density of sclerotia in randomly selected soils of South Carolina with no available record of cropping histories.

MATERIALS AND METHODS

The 692 residual soil samples obtained from the soil testing laboratory of the South Carolina Agricultural Experiment Station, Clemson University, represented all 46 counties of the state, in the spring of 1978. Initially, these soil samples were received for analysis from farmers

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throughout the state.

South Carolina was divided into three sections, viz., Coastal Plains (eastern), Midlands (central), and Piedmont (western) consisting of 10, 18, and 18 counties, respectively. Sclerotial populations were counted in 2-48 field samples per county for a total of 692 samples. Soil types for the three sections were 67, 87, and 78% clay for the Coastal Plains, Midlands, and Piedmont, respectively. Sandy and sandy-mixed types were present in smaller quantities.

Soil samples were air-dried and prepared for sclerotial counts by grinding each in a Wiley Mill fitted with a 370- μ m (40-mesh) screen. A 1 g air-dried soil sample was plated on a selective medium developed by Meyer et al (7). In extensive preliminary tests, chloroneb-mercuric chloride-rose bengal agar (CMRA) was not sufficiently selective in isolating *M. phaseolina* from these soils because contamination was excessive. Selectivity was enhanced when chloroneb was increased from 115 to 250 mg/L and the modified medium (MCMRA) was adjusted to pH 6.5 with 50% lactic acid.

Samples were plated on MCMRA by using the micromound technique (2). Inoculated plates were incubated for 1 wk at 32 C. The number of sclerotia per gram of soil was determined by counting the number of colonies that developed on the agar.

RESULTS

Sclerotia were present in all 46 counties. The number of sclerotia per gram of soil varied greatly from field to field. The lowest (6/g) and highest (168/g) levels were in McCormick and Allendale counties, respectively, with an average of 75 for all counties. McCormick is in the Piedmont and Allendale is in the Midlands bordering on the Coastal Plains.

Soil samples from 27 counties (59%)

had fewer sclerotia than the state average of 75. Soil samples from 10 counties (22%) were above average, and the number of sclerotia per gram of soil in nine counties (19%) ranged from 100 to 168, which was markedly greater than the state average.

The sclerotial population densities in the Coastal Plains, Midlands, and Piedmont sections averaged 74, 72, and 78/g, respectively. No pattern of distribution was apparent: Adjacent counties showed great disparity in populations. Intracounty and inter-county population variations showed a similar trend to variations among sections.

DISCUSSION

Sclerotia of *M. phaseolina* were isolated from the stems of beans (*Phaseolus vulgaris* L.) grown in South Carolina as early as 1927 (1). The presence of *M. phaseolina* was expected based on its distribution in tropical and subtropical countries and in Kansas and Maryland as reported by Chupp and Sherf (3).

Sclerotial population densities for South Carolina soils did not vary markedly from those reported for other states where similar studies have been made on *M. phaseolina*.

The number of sclerotia recovered by a selective medium and a wet-sieving method for direct isolation of *M. phaseolina* (8) from naturally infested soils ranged from none to more than 1,000/g of soil. A selective medium was developed to isolate sclerotia of *M. phaseolina* from air-dried soil samples in Illinois (6), and more than 100 propagules per gram of soil were recovered by the use of this medium. Bristow and Wyllie (2) developed a technique to quantitatively estimate low inoculum densities of *M. phaseolina* in a naturally infested Missouri soil. The inoculum density of the air-dried soil ranged from 37 to 156 propagules per gram of soil by this technique. Watanabe et al (10) developed a differential flotation technique for isolating sclerotia of *M. phaseolina* from soil. The average number of viable microsclerotia isolated per gram of soil in three nonfumigated plots was 35, 17, and 17 respectively.

Meyer et al (7) recovered *M. phaseoli* (*phaseolina* (Tassi.) Goid.) on CMRA from all soils tested in Illinois regardless

of cropping history. The number of propagules per gram of oven-dried soil by cropping history was: soybean, 108; corn, 31; wheat, 24; and alfalfa, 15. The incidence and severity of *M. phaseolina* infection of soybeans have increased in Missouri (4,9) and Jabalpur, India (7), in recent years. Monocropping, alternate cropping with a susceptible host, and introduction of soybeans into areas where it was not previously grown are contributing factors in the increase in disease severity (4).

The observed variation of *M. phaseolina* from section to section of South Carolina was probably fortuitous. The high and low sclerotial levels in all three sections of the state might be attributed to sample size or cropping histories. Several of the host plants probably were grown in each section on a yearly basis.

At present, *M. phaseolina* is thought to be of economic importance in soybean production in South Carolina. The extent

of damage it causes is difficult to determine, however, because of the presence of other soilborne pathogens.

Follow-up studies are in progress to determine if a buildup of sclerotia has occurred in South Carolina soils since the initiation of this study in 1978. The influence of cropping histories and specific soil types will be included.

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