Using the Soil-Tray Technique to Predict the Incidence of Sclerotium Rot in Sugar Beets

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ABSTRACT

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Regression equations were developed to relate populations of viable sclerotia in field soil and in truck tare soil to the percentage of sugar beet roots infected by *Sclerotium rolfsii*. By analyzing truck tare soil, the sugar beet processor can recommend appropriate rotations when loss thresholds are exceeded. Alternatively, the processor can analyze field soil to determine whether sugar beets can be planted safely the following season.

Additional key words: *Beta vulgaris*, crop losses, soil sampling

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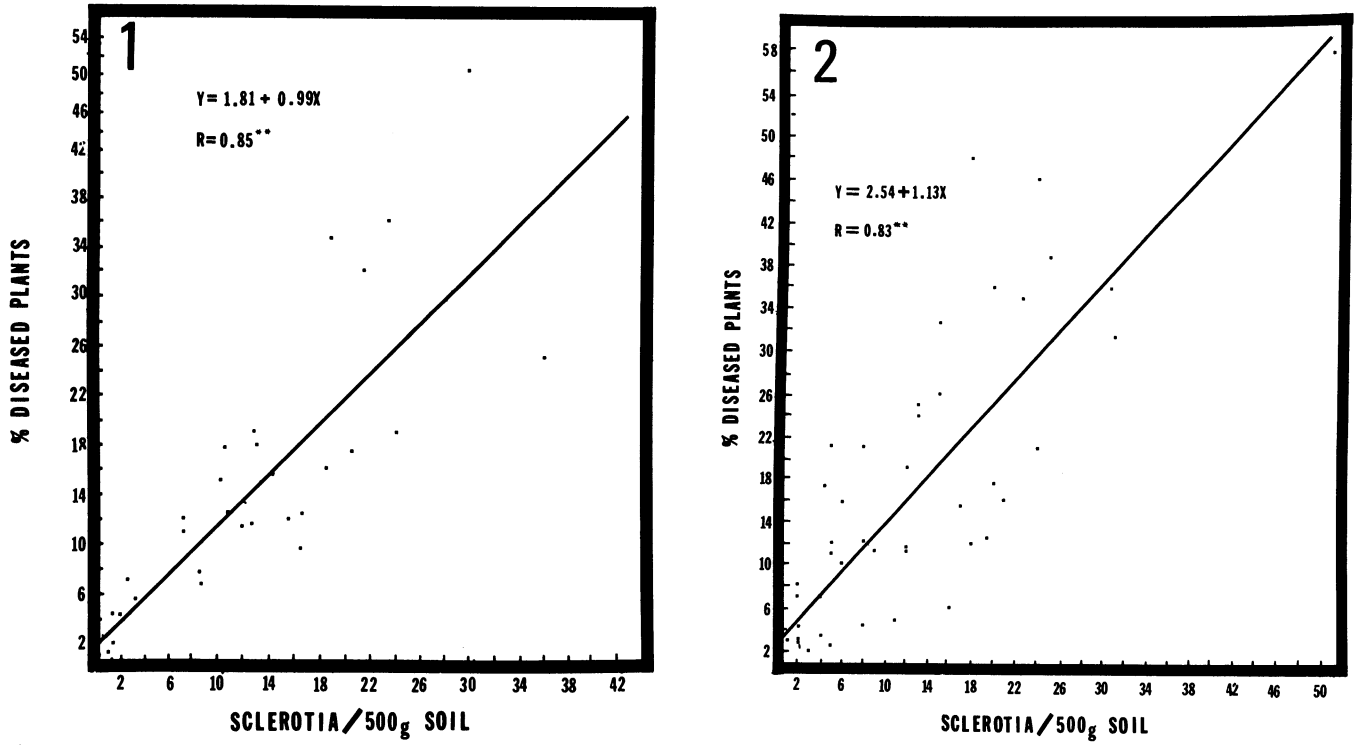
Sclerotium rot of sugar beet (*Beta vulgaris* L.), caused by *Sclerotium rolfsii* Sacc., is especially severe in countries with mild climates (2). In Uruguay, losses frequently exceed 60% of the farmer's crop and often result in early closing of sugar beet processing plants. Monoculture or poor choices of rotation crops have aggravated this situation.

Procedures for monitoring populations of *S. rolfsii* in soil have been known for many years, but they require processing large volumes of soil (3) and a follow-up viability check (3,4). Recently, a rapid procedure for counting populations of viable sclerotia in one operation with small amounts of soil was reported (5). We used this method, the soil-tray technique, to determine numbers of sclerotia and relate them to levels of Sclerotium rot in sugar beets and developed procedures for securing representative soil samples for analysis.

MATERIALS AND METHODS

Soil samples from randomly selected sugar beet fields in the vicinity of Mercedes, Uruguay, were collected with a probe or trowel to a depth of 10–15 cm at



Figs. 1 and 2. Relationship between number of sclerotia in tare soil (residual soil after trucks have delivered sugar beets to processing plants) **(1)** or field soil (samples collected between rows at onset of disease) **(2)** and the incidence of Sclerotium rot in the field at harvest.

20–30 locations per 10 ha. Samples were collected in January (midsummer) at randomly selected sites between rows and as far as possible from sugar beet plants to reduce the chances of inadvertently including sclerotia from current infections to ensure that almost all sclerotia detected had developed from previous years' infections. Samples from a particular field were pooled, air-dried, and sieved as described by Rodríguez-Kábana et al (5).

Disease incidence was determined in February, as the sampled fields were about to be harvested. Plants infected with *Sclerotium rolfsii* were counted in 10 m of row at 12–20 locations per 10 ha of field. The percentage of plants infected was then calculated.

After the beet roots were delivered to the factory, samples of soil residues in the bottom of the trucks (tare soil) were collected, air-dried, and sieved (as before). Five to eight trucks were sampled per field. (It should be mentioned that farmers in Uruguay discard or trim infected beet roots before delivery to the factory.)

The processed soil (500 g) was spread on absorbent paper in perforated 25 × 40 × 5 cm trays and allowed to imbibe 1% (v/v) aqueous methanol until it was evenly moist (5). The trays were placed in an enclosed chamber that provided simultaneous incubation of 40–60 trays under warm-humid conditions (relative humidity above 95%; 27–30 C). After 36–48 hr, tufts of cottony, white mycelium were counted on the upper soil surface; the trays were then inverted and colonies on the absorbent paper not coincident with colonies on the upper soil surface were counted.

For larger fields from which multiple soil samples were taken and for fields represented by soil samples from several trucks, the average number of colonies per 500 g of soil is reported. Colony numbers from field and truck samples were related to the disease level observed in the fields of origin, and data were analyzed by linear regression to establish predictive trend lines (6).

RESULTS AND DISCUSSION

Numbers of sclerotia in soil samples from both fields and trucks were correlated ($P < 0.01$) with disease incidence in the field. Linear regression trend lines allow estimation of disease by either sampling method (Figs. 1 and 2). Both figures indicate that one viable sclerotium detected per 500 g of soil was approximately equivalent to 1% disease incidence at harvest. More sclerotia (per unit of disease) were expected in truck tare soil; the practice of discarding or trimming infected roots is thought to be responsible for the low numbers actually observed.

The scatter of the data points deserves comment. Points above the regression line were frequently from fields with severe weed or foliar disease problems and/or poor nitrogen nutrition. Points below the line were from fields that generally had good fertilization and pest control. In addition, fields with a high incidence of root damage from *Rhizoctonia solani* Kuehn in the spring had higher-than-predicted levels of Sclerotium rot at harvest.

These data are from randomly sampled fields and are representative of the year and location of the study. This study was conducted during a very dry summer, and the Vertisols (4–6% organic matter) of the region cracked very deeply. The resultant oxygen penetration probably allowed sclerotia lying deep in the soil to germinate and infect surrounding sugar beets. In a more typical, wetter summer, sclerotia deep in the soil would probably not get enough oxygen to germinate and infect roots, and the relationship between number of sclerotia and incidence of disease would therefore be greater (more than one sclerotium per 1% of disease).

Our data demonstrate the usefulness of the soil-tray technique (5) for assessing populations of viable sclerotia in soil and indicate that traditional field soil samples can be used to predict disease. Leach and Davey (3) also related populations of viable sclerotia at harvest to disease in the subsequent crop.

A soil-sampling system based on soil residues in trucks delivering sugar beets (tare soil) was equally effective and eliminated the need for on-site soil sampling. This expediency, plus the ability to sample simultaneously for cyst nematodes (*Heterodera schachtii* Schm.) (1) should increase acceptance of the system. Three sugar beet processing companies in Uruguay have established laboratories that use this method to select fields with low Sclerotium rot potential.

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