Survival of Colletotrichum coccodes in Soil

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ABSTRACT

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By using a selective medium, the survival of conidia and sclerotia of *Colletotrichum coccodes* was studied in an artificially infested soil incubated either moist or dry at 4 C or 25 C for 52 weeks. Survival also was studied in soils incubated at 25 C in which the moisture level was continuously varied. When sclerotia were used as an inoculum, a decrease in populations was detected after 52 weeks in dry or moist soil incubated at 4 C or 25 C or in soil incubated at 25 C where moisture varied. Conidia populations were reduced in the first week by 89-96% in dry soil and 28-45% in moist soil with the less rapid population decline in the soil incubated at 4 C. After 52 weeks, conidia populations were reduced by 96-99% in all treatments.

Additional key words: tomato anthracnose.

Tomato anthracnose, caused by *Colletotrichum coccodes* (Wallr.) Hughes, is a major disease of canning tomato fruit in the north central and north eastern sections of the United States. Despite repeated applications of fungicides, losses of 5-15% often occur. Kendrick and Walker (10) concluded that summer fruit infection arose primarily from sclerotium-infested tomato debris overwintering in soil. *Colletotrichum coccodes* forms sclerotia on infected tomato fruit (9) and is closely related to *C. atramentarium,* a root pathogen of tomato (3) and potato (6) that survives in soil as sclerotia (2). These observations suggest that sclerotia of *C. coccodes* may be important in survival as is the case with many soil-borne fungi whose sclerotia survive for long periods in soil (4).

Data given in the above reports on *Colletotrichum* were gathered by means of plant bioassays (10) or techniques such as propagule-infested tapes or agar films (2) which could be removed from soil after varying incubation periods and spores then assayed for their viability. The recent development of a selective medium (7) for isolation of *C. coccodes* from soil permits a more accurate estimation of sclerotia survival potential and would better enable comparisons between conidia and sclerotia survival.

MATERIALS AND METHODS

Nonsterile Wooster silt loam was collected, air dried and passed through a 2-mm screen just prior to the initiation of the study. Moisture content of the soil is expressed as Pw (5) which is the percent moisture on an oven-dry weight basis (105 C). Field capacity of the soil measured at −0.3 bars was 26 Pw; permanent wilt point at −15 bars was 6.5 Pw.

Sclerotia were collected from 1- to 2-month-old cultures grown on potato-dextrose agar (PDA) covered with uncoated cellophane. Sclerotia were scraped off the cellophane, ground in a Waring Blendor with water and fine-mesh sand, and then washed through 250- and 150-μm sieves. Sclerotia were collected on a 125-μm sieve, air dried and stored at 4 C until used. Conidia were harvested from 4-day-old V-8 agar plates (1). Sclerotia or conidia were thoroughly mixed with air-dried soil at a concentration of 845 sclerotia/g or 180 conidia/g of soil (oven-dry basis). One hundred gram aliquots of infested soil were either: (i) moistened to 15 Pw and stored at 4 C or 25 C in plastic bags, (ii) stored air dry (1.5 Pw) in plastic bags at 4 and 25 C, or (iii) moistened to 15 Pw and stored in covered petri dishes (140 × 20 mm) at 25 C. The samples in petri dishes were allowed to dry to 1.5 Pw and were then remoistened to 15 Pw. The drying period; i.e., from 15 to 1.5 Pw, was approximately 14 days. Samples were repeatedly air dried and remoistened 25 times during the 52-week test.

Populations of conidia and sclerotia were monitored by using a selective medium (7) at various times during the 52-week incubation period. Soil suspensions were prepared by mixing infested soil and distilled water in an Omni-Mixer at approximately 4,000 rpm for 1 minute. Final soil dilutions were agitated by a magnetic stirrer in a beaker, and 1-ml amounts were removed and spread on the selective medium. Each treatment consisted of three replications and each replication of six plates. Colonies were counted after 15-20 days of incubation at 24 C.

RESULTS AND DISCUSSION

When sclerotia were used as inoculum, no decrease in population was detected during 52 weeks (Table 1). In moist soil and in the varying moisture soil treatments, temporary population increases occurred. These

TABLE 1. Survival of *Colletotrichum coccodes* sclerotia and conidia in Wooster silt loam at different temperatures and moistures

Inoculum	Incubation treatment	Population[a] after incubation of: 1 week	2 weeks	4 weeks	8 weeks	16 weeks	32 weeks	52 weeks
Sclerotia	Moist[b] at 4 C	840	1030	913	1173	1200	1220	1140
	Moist at 25 C	1100	1620	1327	1193	1033	1070	920
	Dry[c] at 4 C	960	900	1167	1080	1200	910	1106
	Dry at 25 C	940	870	833	1105	1086	1201	893
	Varying moisture[d] at 25 C	890	2580	2600	1767	1233	1230	1133
Conidia	Moist at 4 C	130	125	140	43	20	4	6
	Moist at 25 C	100	40	47	2	4	3	4
	Dry at 4 C	20	30	33	14	8	10	9
	Dry at 25 C	7	26	13	4	6	3	3
	Varying moisture at 25 C	90	70	84	6	10	4	8

[a]Each value is the average of six plates from each of three subsamples. Initial sclerotia population was 845/g soil. Initial conidia population was 180/g soil.
[b]Moist soil was at 15% moisture by weight.
[c]Dry soil was at 1.5% moisture by weight.
[d]Soil was repeatedly air dried from 15% to 1.5% moisture. After each drying period, soil was remoistened to 15% moisture. The time period of each drying cycle was approximately 14 days.

increases may have been due to conidia produced from germinating sclerotia. Sclerotia of *C. coccodes* germinate and sporulate in natural soil when small amounts of glucose; i.e., 10 μg/gram dry wt soil, are added (J. D. Farley, *unpublished*). Nutrient increases in natural soil when soil moisture fluctuates have been reported (8).

It was impossible to distinguish if colonies developing on the selective medium arose from conidia or sclerotia. Thus, the propagules assayed from moist soil could have been germinated sclerotia, conidia or ungerminated sclerotia. As germination of sclerotia probably did not occur in dry soil or in soil incubated at 4 C, propagules assayed from these treatments were likely sclerotia.

The evidence that *C. coccodes* is capable of surviving at least one year under different environmental conditions supports the conclusions of others (2, 10), that the organism can survive for long periods and that the sclerotium is apparently the structure which provides this capacity. As there was no reduction in population even after one year, the survival capacity of *C. coccodes* is probably much longer than one year. With the sclerotium survival capacity indicated in this study, it is doubtful that a 1- or 2-year rotation with nonsuscept crops would be successful in significantly reducing inoculum.

Conidia of *C. coccodes,* like those of *C. atramentarium* (2), are short lived in soil. They were particularly sensitive to dry conditions; populations were reduced 90-95% within one week (Table 1). Although a large percentage of the conidia died within 1 to 4 weeks, small numbers could be recovered from all the treatments throughout the 52 weeks.

Survival in field soil probably takes place in intimate association with tomato fruit residue. *Colletotrichum coccodes* has been recovered from overwintered tomato skins collected from May through August (7). Attempts to use artificially infested tomato skins in this study were unsuccessful due to large saprophytic fungal population build-up in tomato skin-amended soil.

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