Potential for Transmission and Spread of *Sclerotinia minor* by Infected Peanut Seed and Debris

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ABSTRACT

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Peanut samples were collected from plots of peanut cultivar Florunner with nearly 100% incidence of Sclerotinia blight caused by *Sclerotinia minor*. Three methods of harvesting and handling were compared for seed infection and debris contamination by *S. minor*. Seed processed by hand and by hand and machine showed infection levels of 25.4 and 8.9%, respectively. Significantly more seed infection was detected in damaged pods than in undamaged pods. Seed processed by machines showed 1.4% infection; however, seed from combine-culled pods showed 22.7% infection. In culture, infected seed frequently developed into masses of sclerotia, and in some cases, sclerotia were found between the cotyledons of decomposing seed. Infected seed lots planted in the greenhouse and in the field did not show infection with *S. minor*.

Sclerotinia blight of peanut (*Arachis hypogaea* L.), caused by *Sclerotinia minor* Jagger, was first observed in Virginia in 1971 and in North Carolina in 1972 (5). In Oklahoma, *S. minor* and *S. sclerotiorum* (Lib.) de Bary on peanut were first observed in 1972 and 1974, respectively (11,12). By 1979, Sclerotinia blight was reported from seven of the 23 peanut-producing counties in Oklahoma and from 12 counties by 1983 (Bryan, Caddo, Hughes, Atoka, Lincoln, Grady, Pottawatomie, Love, Marshall, Garvin, Kiowa, and Beckham). The disease also was reported from Texas in 1981 and from Louisiana in 1982 (9,10). Within about 10 yr, Sclerotinia blight has become the most important disease of peanut in Virginia and a major disease in Oklahoma (10).

The continued spread of the pathogen in peanut-producing areas raises questions concerning inoculum sources and dissemination. The host range of the genus *Sclerotinia* is extensive, and transmission of the fungus by infected or infested seed has been reported for several hosts (1,7,8). Perhaps the greatest potential for long-distance dissemination of *Sclerotinia* spp. is by infected seed or seed contaminated with sclerotia (1). *S. minor* was carried by 1.3–3% of the seed in small lots of hand-shelled Virginia-type peanuts (4). Information is needed on the possible transmission of *S. minor* in southwestern U.S. commercial seed stock, some of which might be produced in blight-infested fields. The object of this study was to determine the amount of seed infection associated with heavily infested areas in the field, the effect of different methods of harvesting and handling on recovery of infected seed, and the relation of infected seed lots to field transmission. A preliminary report has been published (13).

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MATERIALS AND METHODS

Peanut cultivar Florunner, susceptible to Sclerotinia blight and commonly grown in Oklahoma, was planted at four or five viable seed per foot in a field heavily infested with *S. minor*. The field was irrigated as needed and cultivated; the peanuts were dug after 156 days. Replicated single-row plots 9.2 m long were selected from areas with nearly 100% incidence of Sclerotinia blight, and three methods of harvesting and handling were compared for seed infection and debris contamination.

Hand method. Plants were carefully hand-dug to minimize the number of pods left in the ground. All pods 1.5 cm or longer were hand-picked, dried on a greenhouse bench at 28 ± 2 C, and later hand-shelled for seed.

Hand and machine method. Plants were hand-dug, wind-rowed, field-dried, and threshed with a small plot thresher (Marushin Seisaksho Company, Ltd., H 385 Yachimata-mashi, Chiba-ken, Japan). Pods were separated by the thresher into sound, mature, and cull pods (normally discarded) and later hand-shelled for seed.

Machine method. Plants were dug with a Paulk digger-inverter (United Farm Tools, Inc., Tonkawa, OK), wind-rowed, field-dried, and threshed with a Lilliston 1500 field combine (Lilliston Corporation, Albany, GA). Pods were separated into sound, mature, and cull pods, and later machine-shelled for seed (Hattaway Sheller, Paul Hattaway Company, Cordele, GA).

Each of the three methods involved four replicates, and after hand-picking or threshing, all harvested pods were stored in an unheated building for about 120 days until the seed had reached a stabilized moisture content of about 7.5%. Pods from each of the replicates to be hand-shelled were divided into two groups of 250 g each. Each group was subdivided into visibly damaged and undamaged pods. Fifty damaged pods and 50 undamaged pods were randomly selected, surface-disinfested with 0.5% NaOCl for 2 min, and dried overnight at room temperature. Pods were opened and seed aseptically transferred to potato-dextrose agar amended with 100 μg/ml of streptomycin sulfate (PDAS). Both shell halves were plated separately on PDAS and incubated at 25 ± 2 C in darkness for 10–12 days and under continuous fluorescent light (500 lux) for an additional 10–12 days. Plates were then examined for the presence of *S. minor*.

Cull pods expelled from the small plot thresher or from the field combine were collected and divided into mature and immature pods. Pods were surface-disinfested as described, and seed from mature pods and their respective shells were plated aseptically on PDAS. Immature pods were plated whole.

Machine-shelled seed of each replicate were divided into samples of large seed

(seed held on a 19/64 [7.54-mm] screen) and small seed (seed held on a 17/64 [6.75-mm] screen). Any seeds of obvious poor quality in these samples were discarded to obtain seed somewhat comparable to good-quality commercial seed. Each seed-size sample was washed in running tap water for about 2 min, placed in 0.5% NaOCl for 10–15 sec, and plated on PDAS. Plates then were incubated and examined for the presence of *S. minor*. Seed from a Sclerotinia blight-free field source were also plated.

Greenhouse test. Cull pods from the small plot thresher were hand-shelled, and seeds were separated into two samples on the basis of what appeared to be the best and the poorest seed. Each sample was divided into four replicates; the seeds were treated with maneb plus captan (Granox PFM 30 + 30) at the rate of 170.4 g/45.5 kg, and each seed was planted in a 11.3-cm plastic pot filled with a mixture of soil, sand, and peat (1:1:1, v/v).

Field test. Six peanut entries not previously exposed to Sclerotinia blight were grown in a field nursery infested with *S. minor* at Stillwater, OK, for evaluation of resistance to Sclerotinia blight. Entries Toalson, Florunner, B798736, and B804475 were provided by Olin Smith, Texas A&M University. Florunner Hybrid 14 was provided by James Kirby, Oklahoma State University, and Virginia Bunch 81 was obtained from Terry Coffelt, Tidewater Research Station, Suffolk, VA. Seed samples collected at harvest were divided; part were plated on PDAS for *S. minor* infection and the remainder were planted the next season in replicated field plots believed free of *Sclerotinia* spp.

RESULTS AND DISCUSSION

Each of the three methods of harvesting and handling produced different percentages of recovery of *S. minor* from seed (Table 1). In the hand harvest and shelling method, about 1,600 seeds and 800 shells were plated and examined; *S. minor* was recovered from 33.3% of the seeds from damaged pods. This was higher ($P = 0.01$) than the 17.5% recovery in seed from undamaged pods. *S. minor* was isolated from about 90% of all shells plated; however, only about 30% of the infected pods contained infected seed. By the small plot thresher method, about 2,100 seeds and 1,050 shells were plated and examined. Seed from the cull pods that would normally be discarded in the field carried 11.3% infection. *S. minor* was isolated only once out of 270 immature cull pods. *S. minor* was recovered from 1.4% of the seed when harvesting and handling was entirely by machine, and no difference occurred between samples of large and small seed. However, 22.7 and 18% of the seed and shells, respectively, from combine-culled pods carried the fungus. *S. minor* was not recovered from seed obtained from the Sclerotinia blight-free field.

High levels of seed infected with *S. minor* occurred in fields severely infested with Sclerotinia blight. However, since most of the infected seed and infected pod debris is removed by machine processing, even less transmission of *S. minor* might result from combining and shelling operations in which as much debris as possible is removed. In this study, a Hattaway sheller/cleaner was used, the results of which may differ from larger commercial shellers.

Individual peanut seed lots might carry as much as 1.4% *S. minor* infection. However, the dilution factor from mixing clean and infected seed is likely to be very high so that the probability of an individual seed being infected is low and the seed lot would contain only trace amounts. Trace amounts, however, would be important in introducing the pathogen into new areas. Once introduced, the disease may increase rapidly in prevalence and severity, since as much as 22% of the cull pods from infected plants can contribute to inoculum carryover. Also, some infected seed can develop into masses of sclerotia and the decomposing seed may contain a large sclerotium. To what extent seed infection affects seed germination is not known, but some infected seed did not germinate when plated in the laboratory.

Seed samples from six peanut entries harvested from a field severely infested with *S. minor* demonstrated 2.1–16.8% infected seed when plated on PDAS (Table 2). Florunner (highly susceptible) had the highest level of infected seed, Virginia Bunch 81 (released because of resistance to Sclerotinia blight) had a low level, and B804475 had the lowest level (2.1%).

Of 382 plants produced from seed obtained from cull pods, which previously had shown 11.3% infection, none was infected by *S. minor* after 158 days of growth in a greenhouse maintained to favor disease development. Check plants were also free of *S. minor* infection. Some seed failed to germinate, but there was no evidence that germination failure was due to seed infection. Even though one of the six peanut entries (Florunner) planted in a *Sclerotinia*-free field was known to carry as much as 16% *S. minor* infection, no transmission to new growth was detected in the field. However, Sclerotinia blight was severe in nearby fields.

Although infected seed sources produced no infected plants in the greenhouse or field, this study demonstrated that as much as 33% of the peanut seed and 90% of the shells may be infected in areas of a field severely infested with *S. minor*.

Table 1. Effect of harvesting and shelling methods on recovery of *Sclerotinia minor* from Florunner peanut seed

Source or size of seed	Percent recovery by method		
	Entirely by hand	By hand and small plot thresher	Entirely by machine
From damaged pods	33.3**[a]	13.7**	...
From undamaged pods	17.5	4.0	...
From cull pods	...	11.3[b]	22.7[c]
Large and small	...	...	1.4[d]

[a] Seed from damaged pods had significantly more infection than from undamaged pods (** = $P = 0.01$).
[b] Cull pods blown out of the small plot thresher.
[c] Cull pods that would normally be blown out of a field combine and distributed in the field.
[d] Average percent infection of large and small seed.

Table 2. Mean percentage of infected seed plated on PDAS[a] from six peanut entries harvested from a field severely infested with *Sclerotinia minor*

Entries	No. of infected seeds from eight samples of 50 pods each								Total no. of infected seeds over no. uninfected	Mean percent infected seed
	1	2	3	4	5	6	7	8		
B804475	0/106	0/109	7/110	4/112	2/102	0/107	5/94	0/102	18/842	2.1
Toalson	6/100	0/98	7/94	2/94	1/96	0/101	2/89	4/94	22/766	2.8
B798736	2/101	0/96	6/89	0/49	2/99	0/95	7/91	2/40	19/660	2.8
Virginia Bunch 81[b]	0/91	9/86	0/86	5/88	...	...	...	...	14/351	3.9
Flohybrid 14[b]	0/96	10/96	...	...	...	...	...	...	10/192	5.2
Florunner	6/91	21/97	12/89	18/89	10/96	17/97	15/89	26/96	125/744	16.8

[a] Potato-dextrose agar amended with 100 μg/ml of streptomycin sulfate.
[b] Insufficient seed for eight samples.

Throughout our study, dislodged sclerotia could be found where infected plant material was handled. Harvesting and sacking operations undoubtedly play an important role in returning and spreading infested and infected residue throughout a field. Since infected residue may be used for hay, movement of infected hay may be a major source of local spread of *S. minor*. The possibility exists that long-distance spread of the pathogen could result from infected seed. Infected seed, whether it germinates or not, could be responsible for introducing the pathogen into new areas. However, discovery of a pathogen need not be from recent seed introduction. *Sclerotinia* spp. have a wide host range, and *S. minor* may have been present in low incidence until changes in the environment or farming practices permitted its development. For example, *S. minor* and *S. sclerotiorum* were found on soybeans in Virginia for the first time in 1978 (3); in Oklahoma in 1982, alfalfa developed Sclerotinia blight when it followed peanuts with Sclerotinia blight (2). Recent changes in environment appear less responsible because other species of *Sclerotinia* have been present in Oklahoma for many years (6,14).

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