# Effects of Mechanical Injury, Fungi, and Soil Temperature on Peanut Seed Decay in Soil

D. K. Bell

Associate Professor of Plant Pathology, University of Georgia College of Agriculture Experiment Stations, Coastal Plain Station, Tifton 31794.

Appreciation is expressed to E. K. Sobers, D. R. Sumner, and H. D. Wells for assistance in preparing the manuscript.

Accepted for publication 23 September 1973.

ABSTRACT

Sound and mechanically damaged peanut seed were planted in nontreated and autoclaved field soil infested with nine species of fungi. Three soil temp regimes were maintained (29 C for 20 days, 24 C for 10 days raised to 29 C for 10 days, and 18 C for 10 days raised to 29 C for 10 days). Stands were significantly reduced in all treatments with damaged seed. *Cylindrocladium crotalariae* reduced stands more in nontreated, than in autoclaved, soil. The reverse occurred with *Pythium myriotylum* and *Sclerotium rolfsii*. All other fungi were similarly virulent within seed damage categories in both soils. The fungi tended to maintain similar relationships in effects on stand at the 29 and 24 to 29 C regimes; however, the relationship changed at 18 to 29 C. Seedling emergence was delayed due to the initially low soil temp in the latter regime. *Sclerotium rolfsii* was the most destructive fungus at the two higher temp, but was less so at 18 to 29 C.

Phytopathology 64:241-243

*Additional key words: Arachis hypogaea, Cylindrocladium crotalariae, Pythium myriotylum, Sclerotium rolfsii.*

Seed peanuts (*Arachis hypogaea* L.) represent a large cost to peanut growers with price often more dependent on type (Spanish, Runner, Virginia), cultivar, and available supply than on quality. Peanut seed may be infested with numerous pathogenic organisms which can reduce seed quality (4, 5). Commercial peanut seed may be mechanically damaged during digging, combining, transporting, shelling, and planting. Such seed grown in axenic culture were much more susceptible to decay by numerous seed- and soilborne fungi than were nondamaged seed from the same source (2).

Peanuts are usually planted in Georgia from mid-April to mid-May with soil temp at normal planting depth (ca. 8 cm) ranging ca. 18-29 C. Temp influences seedling emergence rate and the activity of seed- and soilborne pathogens (1).

The objectives of this research were to determine the effects of nine fungi on the decay of both sound and mechanically damaged peanut seed in nontreated and autoclaved soils at three temp regimes.

MATERIALS AND METHODS. – *Seed.* – Nonopened pods of high quality (avg 98% germination) seed of cultivar 'Starr' (Spanish-type) were obtained from a commercial source. Sound seed were obtained by handopening the pods and discarding any seed with visible damage. Mechanically damaged seed were obtained by opening pods from the same source with a commercial peanut shelling machine and discarding seed without visible damage. Damaged seed had small nicks and gouged areas in the surface of the cotyledons which comprised up to, but not more than, ca. 10% of the surface area of the seed. No seed were used in which an entire portion of the cotyledon was missing. Both sound and damaged seed were fumigated with vapor from liquid methylmercury dicyandimide (Panogen 15) under vacuum (1).

*Fungi.* – The following fungi were used because of frequent association with various parts of the peanut plant: *Aspergillus flavus* Lk.; *A. niger* van Tiegh.; *Cylindrocladium crotalariae* (Loos) Bell & Sob.; *Pythium myriotylum* Drechs.; *Rhizoctonia solani* Kuhn; *Rhizopus arrhizus* Fischer; R. *oryzae* Went & Prin.-Geerl.; *R. stolonifer* (Ehrenb. ex Fr.) Vuill.; and *Sclerotium rolfsii* Sacc. *Cylindrocladium crotalariae* was isolated from a necrotic peanut hypocotyl, *P. myriotylum* and *R. solani* from decayed peanut pods, and *S. rolfsii* from a necrotic peanut stem. All others were isolated from peanut seed.

*Inoculum production.* – Medium for growing inoculum was prepared by mixing 1:10:2 (w/w/v) ground annual ryegrass (*Lolium multiflorum* Lam.) seed, Tifton loamy sand (80% sand, 5% silt, and 15% clay) passed through a 2-mm-mesh screen, and water. The medium was placed in Fernbach flasks, plugged with cotton, and autoclaved 1 h at 121 C on two successive days. Flasks of medium were seeded with individual fungi, shaken daily, and held at 27 C for 14 days.

*Potting soil and inoculation.* – Nontreated soil was Tifton loamy sand obtained from an abandoned crop site which had no crop of peanuts in its history, but currently was overgrown with various common grasses. Soil to be autoclaved was obtained from the same location, but heated to 121 C for 40 min. Soil was infested with fungi by blending 1 part inoculum with 9 parts (v/v) Tifton loamy sand.

*Soil temperature regimes.* – The following soil temp regimes were maintained in environmental cabinets (Sherer-Gillett Model CEL-37-14) under alternating 12 h of 8611.4 lux daylight fluorescent light at plant ht and 12-h darkness: 29 ± 1 C for 20 days, and 24 ± 1 C for 10 days raised to 29 ± 1 C for 10 days, and 18 ± 1 C for 10 days raised to 29 ± 1 C for 10 days.

TABLE 1. Effects of soil temp, mechanically sound or damaged seed, and fungi on peanut seedling emergence 20 days after planting

| Treatments | | Seedling emergence 29 C Mean Stand | 24-29 C Mean Stand | 18-29 C Mean Stand |
|---|---|---|---|---|
| Seed[y] | | | | |
| | Sound | 3.9 | 4.1 | 3.1 |
| | Damaged | 0.6 | 0.3 | 0.1 |
| | LSD ($P$=0.05) | 0.21 | 0.20 | 0.24 |
| Fungi[z] | | | | |
| | Control | 3.3 c | 2.8 c | 2.6 c |
| | *Aspergillus flavus* | 2.9 d | 2.7 c | 0.7 f |
| | *Aspergillus niger* | 2.8 d | 2.8 c | 0.6 f |
| | *Rhizopus stolonifer* | 2.3 e | 2.5 cd | 2.2 d |
| | *Rhizoctonia solani* | 2.3 e | 2.4 de | 2.1 d |
| | *Cylindrocladium crotalariae* | 2.3 e | 2.0 f | 0.8 f |
| | *Pythium myriotylum* | 2.1 ef | 1.9 f | 1.7 e |
| | *Rhizopus oryzae* | 2.1 ef | 2.2 ef | 1.9 de |
| | *Rhizopus arrhizus* | 1.8 f | 1.9 f | 1.9 de |
| | *Sclerotium rolfsii* | 0.6 g | 1.2 g | 1.6 e |

[y]Mean of nontreated and autoclaved soil and nine fungi plus control with five seeds/replicate.
[z]Mean of nontreated and autoclaved soil plus sound and damaged seed with five seeds/replicate. Means not followed by the same letter in each column differ significantly ($P$ = 0.05) by Duncan's multiple range test.

*Experimental design.*—A split-splitplot design with 10 replications was used at each temp with soils as whole plots, seed categories as sub-plots, and fungi as sub-subplots. Each sub-subplot contained five seeds in a 10-cm diam clay pot. Temperatures were not replicated. All seed were planted with the radicle tip downward. After seeds were planted the soil was kept moist by overhead sprinkling as needed.

*Stand counts and analyses.*—Stand counts were made 10 and 20 days after planting. Data were analyzed for each temp regime using a least squares analysis of variance. Duncan's multiple range test (3) was used for fungi and to test interactions.

Except at 18 to 29 C, where emergence was delayed and not complete on first reading due to low soil temp, counts at 10 and 20 days were not significantly different; therefore, only data from 20-day counts is presented.

TABLE 2. Effects of *Cylindrocladium crotalariae* on seedling emergence from mechanically sound or damaged seed in nontreated or autoclaved soil at three temp 20 days after planting

| Soil | Seed[y] | Seedling emergence 29 C | 24-29 C | 18-29 C |
|---|---|---|---|---|
| Nontreated | Sound | 1.9 c[z] | 1.7 c | 1.5 b |
| | Damaged | 1.4 c | 0.1 d | 0.0 c |
| Autoclaved | Sound | 5.0 b | 4.9 b | 1.7 b |
| | Damaged | 0.8 d | 1.4 c | 0.0 c |

[y]Mean of 10 replicates with five seeds/replicate.
[z]Means not bordered by same letter in each column differ significantly ($P$ = 0.05) by Duncan's multiple range test.

RESULTS. — Reduction in stand counts with damaged seed and differences among fungal treatments were highly significant at all temp (Table 1). The stand from damaged seed in the controls was also significantly less than from sound seed. Plants from sound seed emerged 2 to 3 days earlier at all temp in both soils infested with *R. solani* than in those infested with other fungi or in noninoculated controls. There were no significant differences in stand counts among replicates.

Soil-seed interaction was nonsignificant at 29 C, but was significant at 24-29 C, and at 18-29 C. Soil-fungus, seed-fungus, and soil-seed-fungus interactions were highly significant at all temp.

The effect of fungi on seedling emergence maintained similar relationships at 29 and 24-29 C (Table 1), but the relationship among fungi changed at 18-29 C. Occasional decayed seed were found in infested soil at the latter temp regime. Many germinating seed were also found. Fewer decayed seed were found in controls at 18-29 C, than in fungal treatments. *Sclerotium rolfsii* was the most destructive fungus, even on sound seed at the two higher temp. *Aspergillus flavus, A. niger,* and *C. crotalariae* were the most destructive at 18-29 C.

*Cylindrocladium crotalariae* was more virulent on sound seed in nontreated than in autoclaved soil at 29 and 24-29 C (Table 2); however, there was little difference at 18-29 C. *Pythium myriotylum* and *S. rolfsii* were more destructive in autoclaved, than in nontreated, soil. All other fungi were about equally virulent within seed categories in both soils.

DISCUSSION. — The reduction in stand counts in all instances with damaged seed agreed with results previously published (2). The extent of mechanical damage to the seed in these studies was probably less than that to most commercial seed.

Certain common seed- and soilborne peanut pathogens varied in relative virulence to sound or damaged peanut seed whether in autoclaved or nontreated soil. All of the fungi used in these studies, with one exception (*C. crotalariae* has not been reported as isolated from commercial seed), are known to be both seed- and soilborne. In either case, damaged seed appear to be more vulnerable to fungi than sound seed.

Holding peanut seed in soil at 24 C for 10 days did not appreciably increase stand loss; however, holding the seed in soil at 18 C for 10 days generally increased seed decay. This may be due to prolonged exposure of the seed and embryonic tissues to the soilborne pathogens before emergence.

It can be seen in Tables 1 and 2 that many of the fungi caused comparable stand losses under the same test regimes, but *S. rolfsii, C. crotalariae, P. myriotylum, A. flavus,* or *A. niger* treatments caused stand loss within certain temp regimes. These studies indicate that an effective seed protectant fungicide would have to perform effectively against a broad spectrum of fungi on both sound and damaged seed over a wide range of soil temp. Such evaluations are currently under investigation with each of the parameters included in this study.

## LITERATURE CITED

1. BELL, D. K. 1967. Pathogenicity of fungi to peanut seedlings in known fungal culture at four temperatures. Oléagineux 22:373-375.
2. BELL, D. K. 1969. Pathogenicity of fungi to sound and damaged peanut seed in known fungal culture at four temperatures. Oléagineux 24:221-223.
3. DUNCAN, D. B. 1955. Multiple range and multiple F tests. Biometrics 11:1-42.
4. GARREN, K. H., and C. R. JACKSON. 1973. Peanut diseases. Pages 429-494. *in* Peanuts – culture and usage. Am. Peanut Res. Educ. Assoc., Stillwater, Oklahoma.
5. JACKSON, C. R., and D. K. BELL. 1969. Diseases of peanut (ground nut) caused by fungi. Georgia Agric. Exp. Stn. Res. Bull. 56.