Resistance to *Athelia rolfsii* and Web Blotch in the U.S. Mini-core Collection

R.S. Bennett* and K.D. Chamberlin[1]

ABSTRACT

Athelia rolfsii (=*Sclerotium rolfsii*) is a soil-borne fungus that causes the disease commonly known as southern blight, southern stem rot, stem rot, and white mold. Despite the fact that *A. rolfsii* is one of the most destructive pathogens of peanut, the U.S. germplasm collection has not been evaluated for resistance to this pathogen. Therefore, 71 of the 112 accessions comprising the U.S. peanut mini-core collection were evaluated in the field for resistance to southern blight in 2016 to 2018 in Oklahoma. Moderate to low levels of southern blight were observed, but four accessions—CC125, CC208, CC559, and CC650—had low levels of disease in 2017 and 2018, the most favourable years for *A. rolfsii*. Ratings for web blotch, a yield-limiting foliar disease in some production areas caused by *Didymella arachidicola*, were also taken in 2017 and 2018, when outbreaks occurred. Five entries—CC287, CC155, CC149, CC812, and CC559—had between 10% and 20% disease in 2018, a year when over half of the mini-core accessions exhibited between 50% and 93% disease. Because cultivated peanut in the U.S. has a narrow genetic base, these results will be useful to breeders seeking additional sources of resistance to *A. rolfsii* and web blotch.

Key Words: Germplasm, phenotyping, *Phoma arachidicola*, pod rot, *Sclerotium rolfsii,* Southern blight, stem rot, web blotch, white mold

Germplasm collections are valuable sources of desirable traits such as disease resistance (Hoisington *et al*., 1999; McCouch *et al*., 2013), but much work remains in characterizing the collections for useful traits. Considering the 10,065 peanut accessions currently maintained by the National Plant Germplasm System (NPGS) (USDA-ARS, 2019) and the 15,622 accessions held by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT Genebank, 2019), relatively few have been used by breeders (Isleib *et al*., 2001). Despite this, the impact of the few utilized plant introductions (PI) on the United States peanut industry is significant. For example, PI 203396—an accession of Brazilian origin with resistance to late leaf spot, southern blight, and tomato spotted wilt virus (TSWV)—is in the pedigrees of many cultivars including Florida-07, Georgia-12Y, Georgia Green, Southern Runner, and Tifguard (Isleib *et al*., 2001; Holbrook *et al*., 2008; Gorbet and Tillman, 2009; Branch, 2013).

For the USDA-NPGS peanut collection, disease phenotyping efforts have focused on the more manageable core (Holbrook *et al*., 1993) and mini-core (Holbrook and Dong, 2005) subsets. To date, all or parts of the core collection have been evaluated for resistance to late leaf spot (Anderson *et al*., 1993; Holbrook and Anderson, 1995), TSWV (Anderson *et al*., 1996), Rhizoctonia limb rot ((Franke *et al*., 1999), peanut root-knot nematode (Holbrook *et al*., 2000), Sclerotinia blight (Damicone *et al*., 2010; Bennett *et al*., 2018), pepper spot (Damicone *et al*., 2010), and web blotch (Damicone *et al*., 2010). One notable omission from this list of diseases is southern blight, caused by *Athelia rolfsii* (Curzi) C.C. Tu & Kimbr. (= *Sclerotium rolfsii* Sacc.; Xu *et al*., 2010). Southern blight (also called southern stem rot, stem rot, and white mold) is considered to be one the most economically damaging pathogens of peanut in the U.S. (Backman and Brenneman, 1997).

Many studies have screened peanuts in the field for resistance to *A. rolfsii*, but most have evaluated breeding lines and cultivars (Branch and Csinos, 1987; Shew *et al*., 1987; Grichar and Smith, 1992; Besler *et al*., 1997; Gorbet *et al*., 2004; Branch and Brenneman, 2009). The most comprehensive screening by far was conducted in India, where Mehan *et al*. (1995) evaluated 859 germplasm accessions, breeding lines, and interspecific hybrid derivatives over several years for southern blight and pod rot resistance. However, while 16 highly resistant interspecific hybrids and breeding lines were identified, this study only named a fraction of the entries that were evaluated. Bera *et al*. (2016) also screened 25 wild *Arachis* accessions and 178 F3 progenies for southern blight in India. One accession each of *A. appresipila* (ICG 8945) and *A. pusilla* (DGR 12047) and three F3 lines had less than 15% mortality when screened in pots or in the field.

[1]Research Plant Pathologist and Research Biologist, USDA-ARS, Wheat, Peanuts and Other Field Crops Research Unit, Stillwater, OK 74075.

*Corresponding author's E-mail: rebecca.bennett@usda.gov

The objective of the current study was to conduct field trials to evaluate a 71-accession subset of the U.S. mini-core collection (Bennett *et al.*, 2018) to address the lack of information regarding sources of resistance to *A. rolfsii* in the U.S. germplasm collection. In the second and third years of evaluation, disease ratings were taken for web blotch caused by *Didymella arachidicola* (Khokhr.) Tomilin (=*Phoma arachidicola* Marasas, Pauer & Boerema; Chen *et al.*, 2015), and pod rot ratings were also taken in the last year of the study.

Materials and Methods

Seventy-one accessions of the U.S. peanut mini-core collection were evaluated at Oklahoma State University's Caddo Research Station at Fort Cobb in 2016 to 2018. The *A. rolfsii*-susceptible, runner cultivar Georgia-06G (Branch, 2007), rated 20 by Peanut Rx (Kemerait *et al.*, 2018) was used as a positive control. Runner cultivars Georgia-03L (Branch, 2004) and Georgia-07W (Branch and Brenneman, 2008), rated 10 and 15, respectively by Peanut Rx, served as resistant controls.

Field plots were in either Pond Creek fine sandy loam (fine-silty, mixed, superactive, thermic Pachic Argiustolls) or Binger fine sandy loam (fine-loamy, mixed, active, thermic Udic Rhodustalfs). A randomized complete block design with three replications (blocks) were used, and individual plots consisted of two 4.6-m-long rows with 0.9-m beds. Seeds were planted at a density of five per 0.3 m. Plots were planted on 12 May 2016, 3 June 2017, and 18 May 2018. Herbicide and fertilizer treatments were applied following Extension recommendations. Applications of azoxystrobin, chlorothalonil, chlorothalonil and difenoconazole, cyproconazole, and fluazinam were applied during the three seasons to manage other diseases such as leaf spots and Sclerotinia blight. Plots were dug 142 d after planting in 2016 (30 September), 139 d after planting in 2017 (19 October), and 152 d after planting in 2018 (16 October). Air temperature and rainfall were recorded by the Oklahoma Mesonet weather station at the Oklahoma Agricultural Experiment Station Caddo Research Station in Fort Cobb, OK (McPherson *et al.*, 2007). The field plots were within 290 m of the weather station.

Plots were inoculated with *A. rolfsii* on 8 August 2016, 7 July 2017, and 17 July 2018. In 2016, 35 ml of oat groats colonized by *A. rolfsii* isolate Ar-15-1 were distributed along the interior of the plant canopy of each row. The oat inoculum was produced by soaking 600 ml of oat groats in 350 ml of reverse osmosis water in a stainless-steel tray (42 cm-long x 25 cm-wide x 6.4 cm-deep) for 4 hours. The tray was then covered with two layers of aluminium foil before autoclaving for 60 min at 121 C and 172 kPa on two consecutive days. After cooling to room temperature, the sterilized oats were inoculated with eight, 7.2-mm-diam. mycelial plugs, taken from the colony margins of a 3-day-old culture grown on potato dextrose agar. The inoculated oats were incubated at 27 C for 10 days, after which the grains were colonized by *A. rolfsii*. The trays were placed in a greenhouse set at approximately 29 C, the foil cover was removed, and the colonized oats were stirred daily until completely dry. In 2017 and 2018, 0.15 g of sclerotia (approximately 225 individual sclerotia) mixed with 0.15 g of sand to serve as a carrier were used to inoculate plots instead of colonized oats. Sclerotia were produced on peanut leaves and stems of U.S. peanut core collection accessions CC38 (PI 493581), CC41 (PI 493631), CC68 (PI 493880), CC384 (PI 155107), and CC787 (PI 429420). These accessions were chosen because they were found to be highly susceptible to *A. rolfsii* in growth chamber inoculation experiments (Bennett, in press). Half-size flatware racks (50.2-cm long x 25.4-cm wide x 10.2-cm deep, Cambro HFR258151, WebstaurantStore, Lancaster, PA) were lined with a damp cotton towel. Five mycelial plugs, produced as for the oat inoculum, were each placed on moist cosmetic cotton rounds along the middle of the racks. Eight-week-old plants, grown in 11-cm-diam. pots (ca. 600 ml), were cut at the soil line. Stems and leaves were cut into approximately 50-cm segments and were placed on the flatware rack, covering the mycelial plugs. Trays were placed in a growth chamber (PGR15; Controlled Environments Ltd., Winnipeg, MB) set at 28.5 C. Reverse osmosis water was applied to the trays for 5 sec, every 5 min, at a flow rate of 160 cm3 min–1 with misting system (Orbit Irrigation, North Salt Lake City, UT). After 1 or 2 weeks, when the peanut vegetation was covered with *A. rolfsii* mycelium, the mister was turned off. Numerous sclerotia formed as the plant material and towels slowly dried over 2 to 5 days. Sclerotia were separated from the dried vegetation by hand.

Southern blight disease evaluations were taken twice each year on the following dates: 22 August and 19 September in 2016, 11 and 28 September in 2017, and 24 August and 18 September in 2018. Disease incidence was measured by counting the number of 6-inch sections within each plot that had symptoms of southern blight. More disease was observed each year on the second disease rating, so only last rating date was analyzed. Incidence of web blotch was taken on 28 September 2017 and on

Table 1. Monthly air temperature and rainfall in 2016-2018 at the Caddo Research Station, Fort Cobb, OK, from Oklahoma Mesonet (McPherson et al., 2007).

	Mean Daily Air Temperature (°C)						Rainfall (mm)					
Month[a]	2016		2017		2018		2016		2017		2018	
May	20.1	—	—	—	25.3	—	65.0	—	—	—	21.6	—
June	25.8	(0)	25.4	(-0.6)	27.2	(+1.1)	162.1	(+61.2)	61.0	(-49.5)	95.3	(-12.2)
July[b]	28.1	(+0.6)	27.8	(+0.6)	27.8	(N/A)	77.2	(+13.7)	70.6	(+3.3)	102.4	(+33.3)
August[b]	26.4	(N/A)	24.8	(-2.2)	24.8	(N/A)	35.8	(-44.5)	179.3	(+102.4)	40.9	(-46.2)
September[b]	22.5	(N/A)	22.3	(0)	21.7	(-0.6)	149.4	(+106.4)	83.3	(+31.5)	185.7	(+132.6)
October	—	—	16.7	—	16.1	—	—	—	102.1	—	116.6	—

[a]Mean daily temperature and rainfall for May are from the planting date (12 May 2016, 18 May 2018). 2017 plots were planted on 3 June. Departure from 15-year averages, as calculated by Oklahoma Mesonet, in parentheses. Plots were dug on 30 September 2016, 19 October 2017, and 16 October 2018.

[b]Departure from 15-year averages not available due to incomplete weather station records. Also, data not presented from months when plants were present in the field for only part of the month due to planting and harvest dates.

10 October 2018 by visually estimating the percentage of leaflets in each plot with symptoms. In 2017, plots with approximately an incidence of 5% or less of web blotch were recorded as 0%. In 2018, web blotch severity, or the percentage of leaf area in remaining leaves with symptoms, and percentage of defoliation were also estimated. In addition, plots were rated for pod rot in 2018 by estimating the percentage of pods with symptoms of pod rot within three hours after digging.

Data were analyzed using one-way ANOVA in PROC GLIMMIX of SAS Version 9.4 (SAS Institute, Cary, NC) using a split plot design, with year as the whole plot and entry as the subplot. Replication (block) was included as a random factor. The SLICE option of the LSMEANS statement was used to examine differences within entries among years. The Type I error rate for pairwise comparisons of breeding lines and cultivars was controlled at $\alpha = 0.05$ using the ADJUST-TUKEY option. Correlation between years for incidence of southern blight and web blotch, as well as between web blotch incidence, severity, and defoliation, were conducted using PROC CORR.

Results and Discussion

Over the duration of the experiment, temperatures were generally close to the 15-year average for Fort Cobb except for August 2017 when it was 2.2 C cooler (Table 1). For rainfall, the most notable deviations from 15-year averages were September 2016 and 2018, and August 2017. In these months, two to three times the 15-year average rainfall occurred (Table 1).

In general, moderate to low levels of southern blight were observed in this experiment relative to similar experiments conducted in the Southeast, where greater than 50% disease incidence has been observed in Georgia-06G over multiple years (Branch and Brenneman, 2009). In this experiment, southern blight was most severe in 2017, with nearly 50% disease incidence in Georgia-06G, but significantly less disease was observed in 2016 and 2018 (Table 2). The above-average rainfall received in August 2017 likely resulted in conditions more favourable for *A. rolfsii*. Analysis of southern blight incidence indicated significant effects of entry ($F = 6.99$; df = 73, 438; $P < 0.01$) and year ($F = 34.84$; df = 2, 4; $P < 0.01$), as well as a significant entry*year interaction ($F = 3.03$; df = 146, 438; $P < 0.01$). Entries differed in incidence of southern blight in 2016 ($F = 3.08$; df = 73, 146; $P < 0.01$), 2017 ($F = 6.02$; df = 73, 146; $P < 0.01$), and 2018 ($F = 2.85$; df = 73, 146; $P < 0.01$). In 2017, the best year for disease, there were three entries with over 50% disease incidence, 17 entries with 25 to 48%, 28 entries with 10 to 24%, 18 entries with 5 to 9%, and five entries with less than 5% disease incidence. As indicated by the significant entry* year interaction, disease incidence within entries varied with year, and results from 2017 and 2018 had the best correlation among years ($r = 0.56$, $P < 0.01$). CC38, CC33, and CC202, the three most susceptible entries in 2017, were among the top third and quarter most diseased entries in 2016 and 2018, respectively. Similarly, the five of the six most resistant entries in 2017—CC559, CC208, CC125, and CC650—were among the bottom quarter of least diseased entries in 2017. The resistant cultivar Georgia-07W was among the more resistant entries, and Georgia-03L had numerically, albeit not statistically, more disease than Georgia-07W in 2017 and 2018. A couple entries were notably inconsistent among years. CC808, which was among the most resistant entries in 2017 (4%), had moderate disease in 2016 and 2018 (11% and 21%, respectively). In addition, CC47 had the most

Table 2. Incidence of southern blight (caused by *Athelia rolfsii*) in 71 accessions of the U.S. peanut mini-core in Fort Cobb, OK field trials from 2016-2018.

Entry[a]	PI No.	2016[b]		2017[b]		2018[b]	
Georgia-06G	—	25.6	a	47.8	a-d	16.7	a-c
Georgia-03L	—	9.4	a-e	12.8	d-j	4.4	bc
Georgia-07W	—	6.1	a-e	6.7	h-j	2.8	c
38	493581	12.2	a-e	60.6	a	38.3	ab
33	493547	10.0	a-e	55.0	ab	21.7	a-c
202	331297	15.6	a-e	52.2	a-c	25.0	a-c
605	475918	7.2	a-e	48.3	a-d	35.6	a-c
53	493729	11.7	a-e	47.2	a-e	6.7	bc
488	356004	5.0	b-e	44.4	a-f	27.8	a-c
249	343384	18.3	a-e	43.9	a-g	30.6	a-c
41	493631	6.1	a-e	41.7	a-h	21.1	a-c
516	288146	7.8	a-e	41.7	a-h	15.0	a-c
787	429420	3.9	c-e	41.7	a-h	8.9	bc
112	497517	2.2	de	38.3	a-i	33.9	a-c
149	502040	8.3	a-e	36.7	a-j	16.1	a-c
296	399581	16.1	a-e	35.6	a-j	17.2	a-c
12	493329	4.4	c-e	34.4	a-j	27.2	a-c
16	493356	5.0	b-e	31.1	a-j	32.2	a-c
68	493880	1.1	e	31.1	a-j	8.3	bc
87	475863	6.7	a-e	31.1	a-j	16.7	a-c
189	339960	4.4	c-e	30.6	a-j	20.0	a-c
408	262038	5.6	b-e	28.3	a-j	12.8	a-c
508	259617	6.7	a-e	25.6	a-j	23.3	a-c
47	493693	11.7	a-e	23.9	a-j	44.4	a
223	290620	21.1	a-d	21.1	b-j	16.7	a-c
588	403813	5.6	b-e	20.0	b-j	15.6	a-c
119	496448	4.4	c-e	19.4	b-j	24.4	a-c
775	482120	9.4	a-e	18.9	b-j	27.8	a-c
740	407667	6.7	a-e	18.3	b-j	18.9	a-c
381	313129	17.2	a-e	18.3	b-j	16.1	a-c
342	298854	24.4	ab	17.2	c-j	25.0	a-c
227	290566	13.3	a-e	16.7	c-j	17.8	a-c
287	355271	17.8	a-e	15.6	c-j	21.1	a-c
580	268586	3.3	c-e	15.6	c-j	12.2	a-c
157	502120	10.0	a-e	15.0	d-j	1.1	c
446	270905	3.9	c-e	15.0	d-j	18.3	a-c
760	471952	7.2	a-e	15.0	d-j	6.1	bc
75	493938	13.3	a-e	13.9	d-j	6.1	bc
388	162655	6.1	a-e	13.9	d-j	23.9	a-c
755	482189	6.7	a-e	13.9	d-j	11.7	a-c
310	337406	7.2	a-e	13.3	d-j	19.4	a-c
82	494034	16.7	a-e	12.8	d-j	31.7	a-c
277	259851	8.3	a-e	12.2	d-j	4.4	bc
805	355268	16.7	a-e	12.2	d-j	14.4	a-c
477	268806	3.9	c-e	11.7	d-j	9.4	bc
802	196622	2.2	de	11.7	d-j	13.3	a-c
406	152146	7.8	a-e	10.6	e-j	9.4	bc
673	481795	11.1	a-e	10.6	e-j	12.2	a-c
221	290560	7.2	a-e	10.0	f-j	7.2	bc
246	343398	22.2	a-c	10.0	f-j	23.3	a-c
481	268755	10.6	a-e	10.0	f-j	2.2	c
155	502111	8.9	a-e	9.4	f-j	13.3	a-c
266	200441	7.8	a-e	8.3	f-j	2.8	c
80	494018	11.7	a-e	7.8	f-j	16.7	a-c
529	319768	2.2	de	7.8	f-j	1.7	c
535	296558	0.6	e	7.8	f-j	4.4	bc
725	240560	8.9	a-e	7.8	f-j	6.1	bc

Table 2. Continued.

Entry[a]	PI No.	2016[b]		2017[b]		2018[b]	
781	471954	6.1	a-e	7.8	f-j	9.4	bc
384	155107	8.9	a-e	7.2	g-j	8.3	bc
546	259836	4.4	c-e	7.2	g-j	8.3	bc
798	461434	8.3	a-e	7.2	g-j	2.8	c
338	268696	3.3	c-e	7.2	g-j	13.9	a-c
431	337293	5.6	b-e	6.7	h-j	9.4	bc
230	290594	12.2	a-e	6.1	h-j	15.6	a-c
553	157542	6.1	a-e	6.1	h-j	15.0	a-c
703	476432	2.8	c-e	6.1	h-j	4.4	bc
579	271019	2.2	de	5.6	h-j	10.0	a-c
233	290536	17.2	a-e	5.0	h-j	9.4	bc
812	323268	19.4	a-e	5.0	h-j	11.7	a-c
650	478819	6.1	a-e	4.4	ij	3.3	c
125	504614	4.4	c-e	2.8	ij	6.7	bc
808	337399	10.6	a-e	2.8	ij	21.1	a-c
208	274193	3.9	c-e	1.7	ij	5.6	bc
559	158854	7.2	a-e	1.1	j	4.4	bc

[a]Mini-core accessions sorted from least to most resistant to *A. rolfsii* in 2017, the year with the most disease. Numbers with the same lowercase letter within columns are not significantly different (P < 0.05). Numbered entries are core collection numbers (Holbrook et al., 1993).

[b]Ratings were conducted on 19 September 2016, 28 September 2017, and 18 September 2018.

southern blight of any entry in 2018 (44%) but had intermediate levels of disease in 2017 (24%). Finally, CC157 (2%) and CC481 (1%) were among the most resistant entries in 2018 but were only moderately resistant in 2017 (15% and 10%, respectively). Possible explanations for inconsistency between years could be genetically mixed entries, since these accessions were from the non-purified mini-core (Chen *et al.*, 2014), in addition to uneven distribution of inoculum despite manual application of sclerotia.

Little web blotch was observed in 2016 (data not shown), but 2017 had moderate levels of disease and considerable disease was observed in 2018 (Table 3). Incidence of web blotch was greatest in 2018, perhaps because disease evaluations were taken nearly two weeks later than in 2017. In the combined year analysis, significant effects were observed for year ($F = 258.93$; df = 1, 4; P < 0.01) and entry ($F = 22.66$; df = 73, 292; P < 0.01), as well as for the year*entry interaction ($F = 3.73$; df = 73, 292; P < 0.01). Despite the significant interaction, which indicated that web blotch incidence within entries depended upon year, there was a correlation between the two years in disease incidence ($r = 0.76$, P < 0.01). Statistical differences among entries in disease incidence were also observed within each year ($F = 20.96$ in 2017 and 11.14 in 2018; df = 73, 146; P < 0.01; Table 3). The Georgia cultivars were among the most resistant entries in both years and had low estimates for severity and defoliation. In 2018, incidence of web blotch greater than 75% was observed in 23 entries, 50-73% in 14 entries, 27-47% in 22 entries, and 25% or less in 12 entries (Table 3). Five entries—CC287, CC155, CC149, CC812, and CC559—had between 10% and 20% disease. The 23 most susceptible entries in 2018 were also among the most diseased in 2017. In 2018, there were significant differences among entries in web blotch severity ($F = 9.52$; df = 73, 146; P < 0.01) and defoliation ($F = 7.36$; df = 73, 146; P < 0.01). Strong correlations were also observed between disease incidence and severity ($r = 0.89$, P < 0.01), disease incidence and defoliation ($r = 0.76$, P < 0.01), and severity and defoliation ($r = 0.93$, P < 0.01). Three entries—CC33, CC208, and CC481—were also evaluated for web blotch by Damicone *et al.* at Fort Cobb in 2003 (2010). In that study, moderate to low levels of web blotch were observed, with the most susceptible entry, CC357, having 37.5% disease incidence. In 2003, CC33 and CC208 had 6.2% web blotch and CC481 had 30%, similar to what was observed in this study in 2017. While leaves with web blotch symptoms are not uncommon, severe outbreaks of web blotch do not occur regularly at Fort Cobb. Web blotch has been considered a minor disease in Oklahoma (Damicone *et al.*, 2010).

Moderate levels of pod rot were observed in 2016, but disease ratings were not taken. Ratings were not taken in 2017 because the entire 2017 experiment was left in the ground in an attempt to increase soilborne inoculum for other pod rot experiments. Moderate levels of pod rot were

Table 3. Web blotch and pod rot in 71 accessions of the U.S. peanut mini-core in Fort Cobb, OK field trials (2017-2018).

		Web Blotch[b]								Pod Rot[c]	
		Incidence				Severity		Defoliation			
Entry[a]	PI No.	2017		2018		2018		2018		2018	
Georgia-06G	—	0.0	l	26.7	j-q	3.7	g-i	0.0	f	8.3	a
Georgia-03L	—	0.0	l	6.7	q	1.0	i	0.0	f	28.3	a
Georgia-07W	—	0.0	l	18.3	m-q	2.3	hi	0.0	f	30.0	a
446	270905	20.0	f-l	93.3	a	43.3	a-d	31.7	b-f	19.3	a
808	337399	50.0	a-d	92.7	ab	60.0	a	65.0	ab	30.0	a
673	481795	50.0	a-d	91.7	ab	40.0	a-e	41.7	a-f	10.0	a
221	290560	53.3	a-c	90.0	a-c	36.7	a-f	53.3	a-d	11.7	a
775	482120	46.7	a-e	90.0	a-c	43.3	a-d	20.0	c-f	15.7	a
384	155107	20.0	f-l	90.0	a-c	40.0	a-e	40.0	a-f	26.7	a
477	268806	60.0	a	88.3	a-d	43.3	a-d	35.0	b-f	15.0	a
553	157542	56.7	ab	88.3	a-d	50.0	a-c	65.0	ab	16.7	a
338	268696	50.0	a-d	88.3	a-d	30.0	a-i	18.3	c-f	14.3	a
579	271019	36.7	a-g	88.3	a-d	50.0	a-c	60.0	a-c	7.3	a
406	152146	50.0	a-d	86.7	a-e	43.3	a-d	40.0	a-f	3.7	a
588	403813	46.7	a-e	86.7	a-e	31.7	a-i	13.3	d-f	15.0	a
481	268755	33.3	b-h	86.7	a-e	50.0	a-c	53.3	a-d	11.7	a
725	240560	10.0	h-l	86.7	a-e	53.3	ab	78.3	a	8.3	a
388	162655	46.7	a-e	83.3	a-f	28.3	a-i	21.7	c-f	20.0	a
740	407667	43.3	a-f	83.3	a-f	33.3	a-h	18.3	c-f	21.7	a
119	496448	26.7	d-k	83.3	a-f	35.0	a-g	33.3	b-f	18.0	a
546	259836	23.3	e-l	83.3	a-f	23.3	b-i	15.0	d-f	18.3	a
266	200441	13.3	g-l	80.0	a-f	28.3	a-i	21.7	c-f	29.0	a
310	337406	30.0	c-i	78.3	a-h	21.7	b-i	23.3	b-f	17.7	a
703	476432	13.3	g-l	78.3	a-h	18.3	c-i	6.7	ef	20.3	a
249	343384	28.3	c-i	76.7	a-i	35.0	a-g	48.3	a-e	16.7	a
82	494034	20.0	f-l	76.7	a-i	25.0	b-i	10.0	ef	4.3	a
431	337293	3.3	kl	73.3	a-j	21.7	b-i	16.7	d-f	18.3	a
798	461434	10.0	h-l	70.0	a-k	13.3	d-i	3.3	f	31.7	a
580	268586	10.0	h-l	70.0	a-k	26.7	b-i	23.3	b-f	45.0	a
80	494018	0.0	l	69.3	a-l	23.3	b-i	20.0	c-f	12.0	a
38	493581	50.0	a-d	65.0	a-m	21.7	b-i	15.0	d-f	20.0	a
227	290566	10.0	h-l	65.0	a-m	15.0	d-i	5.0	f	20.0	a
33	493547	3.3	kl	63.3	a-n	25.0	b-i	18.3	c-f	15.0	a
296	399581	0.0	l	63.3	a-n	6.7	f-i	0.0	f	15.3	a
125	504614	6.7	i-l	61.7	a-n	13.3	d-i	11.7	d-f	28.3	a
650	478819	6.7	i-l	60.0	a-o	5.0	f-i	0.0	f	18.3	a
535	296558	0.0	l	60.0	a-o	20.0	c-i	18.3	c-f	8.7	a
233	290536	0.0	l	58.3	a-o	11.7	d-i	5.0	f	10.0	a
246	343398	3.3	kl	56.7	a-p	5.0	f-i	0.0	f	35.7	a
488	356004	33.3	b-h	53.3	a-q	5.0	f-i	1.7	f	9.3	a
41	493631	13.3	g-l	46.7	a-q	3.7	g-i	0.0	f	36.7	a
760	471952	10.0	h-l	46.7	a-q	6.7	f-i	6.7	ef	10.0	a
802	196622	0.0	l	46.7	a-q	5.0	f-i	5.0	f	8.3	a
529	319768	0.0	l	46.7	a-q	6.7	f-i	5.0	f	23.3	a
68	493880	6.7	i-l	45.0	b-q	5.0	f-i	0.0	f	9.7	a
53	493729	0.0	l	45.0	b-q	8.3	e-i	8.3	ef	11.0	a
157	502120	10.0	h-l	43.3	c-q	6.7	f-i	3.3	f	21.7	a
230	290594	1.7	l	43.3	c-q	5.0	f-i	6.7	ef	30.0	a
12	493329	3.3	kl	41.7	c-q	6.7	f-i	3.3	f	31.0	a
47	493693	5.0	j-l	40.0	e-q	5.3	f-i	0.0	f	18.3	a
508	259617	0.0	l	40.0	e-q	6.7	f-i	0.0	f	25.0	a
342	298854	0.0	l	40.0	e-q	12.0	d-i	3.3	f	46.7	a
781	471954	0.0	l	38.3	f-q	3.7	g-i	1.7	f	27.0	a
189	339960	0.0	l	38.3	f-q	5.0	f-i	8.3	ef	8.3	a
75	493938	0.0	l	36.7	f-q	5.0	f-i	0.0	f	16.7	a

Table 3. Continued.

		Web Blotch[b]								Pod Rot[c]	
		Incidence				Severity		Defoliation			
Entry[a]	PI No.	2017		2018		2018		2018		2018	
787	429420	0.0	l	33.3	g-q	5.0	f-i	1.7	f	18.7	a
202	331297	0.0	l	31.7	h-q	3.7	g-i	1.7	f	28.3	a
208	274193	0.0	l	30.0	i-q	3.7	g-i	0.0	f	6.7	a
381	313129	0.0	l	30.0	i-q	3.7	g-i	0.7	f	8.0	a
408	262038	0.0	l	30.0	i-q	3.7	g-i	0.0	f	10.3	a
16	493356	3.3	kl	26.7	j-q	2.3	hi	0.0	f	12.3	a
605	475918	0.0	l	26.7	j-q	3.7	g-i	0.0	f	37.7	a
805	355268	0.0	l	25.0	k-q	3.7	g-i	0.0	f	10.7	a
516	288146	0.0	l	23.3	k-q	2.3	hi	0.0	f	2.7	a
112	497517	3.3	kl	21.7	l-q	3.7	g-i	0.0	f	18.3	a
87	475863	0.0	l	21.7	l-q	3.7	g-i	0.0	f	36.7	a
755	482189	10.0	h-l	20.0	m-q	1.0	i	0.0	f	6.7	a
277	259851	0.0	l	20.0	m-q	2.3	hi	0.0	f	35.7	a
223	290620	0.0	l	20.0	m-q	2.3	hi	0.0	f	11.7	a
559	158854	0.0	l	16.7	n-q	1.0	i	0.0	f	35.3	a
812	323268	0.0	l	16.7	n-q	2.3	hi	0.0	f	23.3	a
149	502040	0.0	l	16.7	n-q	2.3	hi	0.0	f	11.7	a
155	502111	0.0	l	13.3	o-q	3.7	g-i	0.0	f	14.0	a
287	355271	0.0	l	10.0	pq	2.3	hi	0.0	f	25.0	a

[a]Mini-core accessions sorted from least to most resistant to web blotch in 2018. Numbers with the same lowercase letter within columns are not significantly different ($P < 0.05$). Numbered entries are core collection numbers (Holbrook et al., 1993).

[b]Web blotch ratings were conducted on 28 September 2017 and 10 October 2018. In 2017 entries with less than 5% web blotch incidence were rated as 0%.

[c]Pod rot evaluations were made within 3 hours after digging on 16 October.

observed in 2018, but differences among entries were not statistically significant after correcting for Type I error rate resulting from multiple comparisons (Table 3). There were eight entries with between 35% to 47% pod rot, 19 entries between 20% and 32%, 17 entries between 11% and 20%, and 18 entries with less than 11%. Among the cultivars, Georgia-06G had the least pod rot at 8% and Georgia-03L and Georgia-07W had 28% and 30%, respectively. More years of data are needed to definitively identify resistant accessions in the mini-core, but the data presented here provide a starting point. The need for host resistance to Pythium pod rot has increased with the European Union recently reducing the maximum residue limit for phosphite fungicides to 2 mg/kg (European Union Pesticides Database - European Commission, 2019).

The high levels of southern blight reported in Georgia (Branch and Brenneman, 2009, 2015) were not obtained in this study. However, these results identify *A. rolfsii*-susceptible accessions within the U.S. mini-core, in addition to promising resistant candidates for further testing in environments more conducive to southern blight. Of the four most resistant accessions identified in this study (CC559, CC208, CC125, and CC650), CC125 and CC650 are also highly resistant to Sclerotinia blight (Bennett *et al.*, 2018). CC650 has also demonstrated high levels of resistance to *A. rolfsii* in growth chamber assays (Bennett, in press.) The current study identified susceptible and resistant accessions to web blotch. Web blotch first appeared in the U.S. in southern Texas in 1972 and has since spread to other peanut production regions throughout the country (Taber *et al.*, 1984). Web blotch has been reported from most other peanut-producing countries and is one of the important diseases of peanut in southern Africa (Cole and Liddell, 1997). The study by Damicone *et al.* (2010), which evaluated 62 accessions from the core collection, and this study are the only reports to date regarding web blotch resistance in the U.S. germplasm collection. Peanut breeders may find these disease-resistant accessions useful for introducing new sources of resistance to *A. rolfsii* and web blotch into their breeding programs.

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