Response of Early, Medium, and Late Maturing Peanut Breeding Lines to Field Epidemics of Tomato Spotted Wilt

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ABSTRACT

Epidemics of tomato spotted wilt, caused by tomato spotted wilt *Tospovirus* (TSWV), were monitored in field plots of runner-type peanut (*Arachis hypogaea* L.) cultivars Georgia Green and Georgia Runner and numerous breeding lines from four different breeding programs as part of efforts toward characterizing breeding lines with potential for release as cultivars. Breeding lines were divided into early, medium and late maturity groups. The tests were conducted near Attapulgus, GA and Marianna, FL in 1997 and in Tifton, GA and Marianna, FL in 1998. Epidemics in some early and medium maturing breeding lines, including some genotypes with high oleic acid oil chemistry, were comparable to those in Georgia Green, the cultivar most frequently used in the southeastern U.S. for suppression of spotted wilt epidemics. No early maturing breeding lines had lower spotted wilt final intensity ratings or higher yields than Georgia Green. However, spotted wilt intensity ratings in some late maturing lines and a smaller number of medium maturing lines were significantly lower than those of Georgia Green. Several of those lines also produced greater pod yields than Georgia Green. Results from these experiments indicated that there is potential for improving management of spotted wilt though development of cultivars that suppress spotted wilt epidemics more than currently available cultivars. There was no indication that differences in spotted wilt ratings corresponded to differences in numbers of thrips adults or larvae.

Key Words: Epidemiology, groundnut, multiple pathogen resistance, thrips, TSWV, vectors.

Peanut (*Arachis hypogaea* L.) cultivars that suppress epidemics of spotted wilt, caused by tomato spotted wilt *Tospovirus* (TSWV), are the most important tools in an integrated, multi-factor package for minimizing the risk of yield losses to tomato spotted wilt of peanut in the southeastern United States (3). Other cultural and chemical means of suppressing spotted wilt complement the use of these cultivars, but do not provide sufficient control of spotted wilt when used alone (3). Due largely to its high yield potential even in the presence of spotted

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wilt, Georgia Green has become the predominant cultivar grown in Alabama, Florida, and Georgia. The cultivars Southern Runner (2, 5), ViruGard (16), and Florida MDR-98 (7) have effects on spotted wilt epidemics similar to those of Georgia Green, and all provide moderate levels of suppression of spotted wilt. None of the cultivars released to date has a high level of resistance, and all available cultivars may suffer significant damage during extreme epidemics. The mechanism responsible for differences in incidence and severity of spotted wilt among peanut cultivars and breeding lines in the field has not been elucidated. Mechanical inoculation studies have not corroborated results of the field evaluations. Pereia (14) and Hoffman *et al.* (12) reported similar susceptible responses of Southern Runner and Florunner cultivars to mechanical inoculation with TSWV; whereas in field studies, incidence of spotted wilt in Southern Runner has been reported to be approximately half that of Florunner (2, 5). Therefore, use of the term resistance in this paper refers only to reduced incidence or severity of spotted wilt in the field, with no implication of mechanisms involved or of resistance to mechanical inoculation with TSWV.

TSWV is vectored by thrips. Two species that are confirmed vectors of TSWV, tobacco thrips (*Frankliniella fusca* Hinds) and western flower thrips (*F. occidentalis* Pergande), occur on peanut in the U.S. (18). There has been no indication in previous studies that reduced incidence and severity of spotted wilt in advanced breeding lines or cultivars has been due to lack of preference by thrips or reduced suitability for thrips reproduction (5, 6, 7, 8). Nonetheless, screening for resistance to thrips continues to be a substantial part of our genotype characterization efforts.

Many advanced peanut breeding lines from the Univ. of Florida, Univ. of Georgia, USDA-ARS (Tifton, GA), and AgraTech Seeds (Ashburn, GA) breeding programs have been observed to have lower incidences of spotted wilt than the susceptible cultivar Georgia Runner in preliminary field experiments. Several of the lines included in these tests have high levels of oleic acid (> 80% of the oil composition). Lines with high levels of oleic acid content have shown greater oxidative stability (13) and, therefore, should have better shelf life potential than lines with typical levels of oleic acid. Peanuts with high levels of oleic acid also show some promise for beneficial health effects in humans and animals that consume them (9). High oleic acid cultivars SunOleic 95R, SunOleic 97R, and FlavoRunner 458 are susceptible to damage by TSWV in the field (3). Development of high oleic acid cultivars that are less prone to damage by spotted wilt will be essential if this trait is to be utilized to its potential in the southeastern U.S.

For the purposes of these experiments, the genotypes were grouped according to maturity groups based on estimates of time to maturity in previous field evaluations. All genotypes were compared to the medium maturing cultivars Georgia Green and Georgia Runner for spotted wilt reaction and yield under field conditions. Cultivars with higher levels of resistance to TSWV than are currently available could greatly reduce risks to spotted wilt. This report represents evaluation results of ongoing efforts to develop runner- and virginia-type peanut cultivars with greater levels of resistance to TSWV.

Materials and Methods

Field Test Designs. Tests were conducted at the Univ. of Georgia Attapulgus Res. Farm, Attapulgus, (Decatur Co.) GA in 1997, the Univ. of Georgia Coastal Plain Exp. Sta., Tifton, (Tift Co.) GA in 1998, and the North Florida Res. and Educ. Center, Marianna, (Jackson Co.) FL in 1997 and 1998. Soil type was Dothan loamy sand (pH 5.8) for fields at Attapulgus, Tifton sandy loam (pH 5.8) for fields at Tifton, and Orangeburg loamy sand (pH 6.0) for fields in Florida. Thrips and TSWV were endemic at all locations, and neither virus nor vector was artificially introduced into plots. Three separate tests were conducted in each location in each year. Randomized complete block designs with six replications were used in all tests. The three tests represented groupings of peanut genotypes into early (*ca.*120-135 d to maturity), medium (*ca.* 135-145 d to maturity), and late (*ca.* 150-160 d to maturity).

Planting dates were 1 April 1997 and 13 April 1998 in Georgia, 2 April 1997 and 15-16 April 1998 in Florida. No in-furrow insecticide or nematicide was applied in any test. Seeding rate was 12.3 seed/m of row for all tests in both years. Plants in each plot were counted 14-21 d after planting (DAP) in each year to determine initial plant populations. Plant stands in all plots were thinned to five plants/m of row in 1997. Plant stands were not thinned in 1998, and established stands averaged 9.3 plants/m of row. Plant populations used in both tests were lower than recommended for commercial production to promote higher incidence of spotted wilt (3, 10). Plots were two rows, 6.1 m long with row spacings of 0.9 m. In 1997, plots in Georgia were bordered on both sides by susceptible cultivar Tamrun 88 to increase overall incidence of spotted wilt in all entries (1). Each plot in Florida in both years and in Georgia in 1998 was bordered on one side by Tamrun 88.

Genotypes Evaluated. Genotypes for the early, medium and late maturity classes are listed in Tables 1, 2, and 3, respectively. Entries included breeding lines from Univ. of Georgia, Univ. of Florida, USDA-ARS (Tifton, GA), and AgraTech Seeds (Ashburn, GA) breeding programs. All tests included the medium maturing cultivars Georgia Green (moderately resistant) and Georgia Runner (susceptible). The late maturity test also included new runner-type cultivar C-99R (formerly known as F84/9B-4-2-1-1-2-b2-B) (11).

Thrips Sampling. Two samples were taken from each plot for comparison of thrips populations among entries. Ten partially unfolded quadrifoliolate terminal leaves were collected from each plot on two occasions between 14 and 28 DAP. Terminal leaves were collected and processed as previously described by Chamberlin *et al.* (4).

Disease Evaluation. Spotted wilt intensity was evaluated in each plot using a disease intensity rating that represents a combination of incidence and severity as previously described (7). The number of 0.3-m portions of row containing severely stunted, chlorotic, wilted or dead plants was counted for each plot four times in 1997 and five times in 1998 at 14- to 21-d intervals during the season. The number of 0.3-m portions of linear row severely affected by spotted wilt was converted to a percentage of row length for comparison of genotypes. Disease intensity ratings over time were used to calculate area under the disease progress curve (AUDPC) for each plot as described by Shaner and Finney (15). Final disease intensity ratings and AUDPC values were used for genotype comparison.

All tests were maintained as recommended for commercial production. Chlorothalonil (Bravo 720) or tebuconazole (Folicur 3.6 F) was applied as a foliar spray at 7- to 14-d intervals for control of fungal diseases. Plots were dug and inverted at approximate maturity for each group based on hull scrape evaluation maturity index (19) and/or visual maturity estimates. In 1997, all plots in the early maturity test except Georgia Runner and Georgia Green were dug on 22 Aug. at Attapulgus and 18 Aug. at Marianna. All plots in the medium maturity test and plots of Georgia Green and Georgia Runner in the early maturity test and late maturity test were dug on 4 Sept. at Attapulgus and on 25 Aug. at Marianna. The remaining plots in the late maturity test were dug on 9 Sept. at Attapulgus and 5 Sept. at Marianna. In 1998, all plots in the early maturity test except Georgia Runner and Georgia Green were dug on 28 Aug. at both locations. All plots in the medium maturity test and plots of Georgia Green and Georgia Runner in the early maturity test and late maturity test were dug on 11 Sept. at Tifton and on 7 Sept. at Marianna. The remaining plots in the late maturity test were dug on 24 Sept. at Tifton and 14 Sept. at Marianna. Inverted plants were dried in wind-rows for 3-7 d. Pods were harvested mechanically and pod yields were determined for each plot.

Statistical Analysis. All data were subjected to analysis of variance. Data were analyzed across locations, but within years (17). Fisher's protected LSD values were calculated for comparison of genotypes. Differences described below are significant at $P \leq 0.05$ unless otherwise indicated.

Results

Thrips Populations. There were few significant differences among breeding lines in any test for populations of *F. fusca* or *F. occidentalis* adults or for larvae of *Frankliniella* spp. In 1997 there were no entries in any test that had fewer adults of either species or larvae than susceptible Georgia Runner (data not shown). For the second sample in the 1998 early maturity test at Marianna, all entries except F89/OL14-6-1-1-2-b2-B had fewer adults of *F. fusca* (14.5 thrips/10 terminals or fewer) than the 21.8 thrips/10 terminals (LSD = 6.8) for Georgia Runner. No other entry in any test in 1998 had fewer adults of *F. fusca* or *F. occidentalis* than Georgia Runner. In the medium maturity test at Tifton in 1998, fewer larvae of *Frankliniella* spp. were found on F90/7-1-5-1-b2-B, F88/OL3-HO6-2-1-1-b2-B, FSunr BC2-F2-42-1-1-1-1-b2-B, and GA 942010 than than the 114.0 larvae/10 terminals (LSD = 38.5) found on Georgia Runner at the first sample, whereas only F93Q8 had fewer larvae than Georgia Runner (36.8 vs. 61.3, LSD = 23.0) at the second sample. For the first thrips sample in the late maturity test at Marianna in 1998, entries F84/9B-4-2-1-1-2-b2-B, F 86/45B-10-1-2-2-2-b2-B, F 84/9B-4-2-1-1-1-b2-B, and F86/43-1-1-1-1-1-b2-B, had fewer larvae than the 236 larvae/10 terminals (LSD = 66.0) on Georgia Runner. No other entries had fewer larvae than Georgia Runner. Considering the lack of consistent genotype effects and previous reports of similar trends (5, 6, 7, 8), complete thrips population data are not included in this paper.

Disease Intensity and Yield. Spotted wilt epidemics were severe in all tests and locations. Genotype × location interaction effects were significant for spotted wilt final intensity ratings and yield in 1997 in the early maturity test (Table 1), for AUDPC values in both years in the medium maturity test (Table 2), and for yield in both years in the late maturity test (Table 3). Therefore, data in those cases were analyzed and are presented independently for each location within the respective year. In all other cases, pooled analysis was used within each year, and comparisons were made across locations. Genotype effects were significant for all variables in all tests except yield among the early maturing genotypes at both locations in 1997 (Table 1).

In general, performance of the early maturing genotypes based on all variables measured was weakest among the three maturity classes. No early maturing genotype in either year had final spotted wilt ratings or AUDPC values lower than those of Georgia Green (Table 1). In 1997, only two breeding lines had final spotted wilt ratings less than Georgia Runner in both locations. Across locations, six breeding lines had AUDPC values lower than those of Georgia Runner, and AUDPC for five of those genotypes did not differ from those of Georgia Green. Yields were low and variability was high within the early maturity tests at both locations.

In 1998, all early maturing genotypes except ANDRU 93 and F89/OL14-1-3-2-2-2-b3-B had spotted wilt ratings lower than that of Georgia Runner, and all entries had AUDPC values and yield better than those of Georgia Runner. Three genotypes had both final spotted wilt ratings and AUDPC values similar to those of Georgia Green, and four genotypes had yields that did not differ significantly from that of Georgia Green.

Across both locations in 1997, all medium maturing entries had lower final spotted wilt ratings and higher yields than Georgia Runner (Table 2). No genotype had final incidence ratings or AUDPC lower than those of Georgia Green, but yields in F87/6-9-1-1-1-b2-B were higher than all entries except GA 942007.

In 1998, all medium maturing breeding lines except F93Q8 had final spotted wilt ratings lower than Georgia Runner, and several lines had spotted wilt ratings that were lower than those of Georgia Green (Table 2). All but four genotypes had yields higher than those of Georgia Runner, and most had yields comparable to or greater than those of Georgia Green. The breeding line F90/7-3-5-1 had spotted wilt ratings of 11.7%, compared to 59.2% for Georgia Green, and had mean pod yield that exceeded that of Georgia Green by almost 2000 kg/ha.

Based on comparisons to the standard cultivars used in all tests, intensity of spotted wilt was lower among late maturing genotypes in general than in genotypes in the other two maturity classes. Several genotypes had lower spotted wilt ratings and higher yields than Georgia Green, with some having spotted wilt ratings less than half those of Georgia Green (Table 3). Across both locations in 1998, C11-2-39 had AUDPC values and spotted wilt ratings significantly lower than all except four entries, and had spotted wilt ratings of 11.9% compared to 57.9% in the Georgia Green standard.

Discussion

Suppression of epidemics of spotted wilt similar to or better than that achieved with Georgia Green was observed in found runner-type and virginia-type breeding lines in medium and late maturing classes. Furthermore, this paper is the first report of breeding lines with

Table 1. Area under the disease progress curve (AUDPC), final intensity of tomato spotted wilt, and pod yield of early maturing peanut genotypes at Attapulgus, GA in 1997, Tifton, GA in 1998, and Marianna, FL in 1997 and 1998.

Genotype	Market[a] type	AUDPC[b] GA	AUDPC FL	AUDPC Mean	Final intensity rating[c] GA	Final intensity rating FL	Final intensity rating Mean	Yield GA	Yield FL	Yield Mean
		----- % disease days -----			------------- % -------------			----------- kg/ha -----------		
1997										
Georgia Green	R	1725	1193	1459	58.8	31.4	-	1450	2225	-
Georgia Runner	R	2512	1739	2126	87.1	46.0	-	1308	1963	-
ANDRU 93	R	2369	1561	1965	83.8	42.9	-	1309	2091	-
GA 942001	R	1760	1471	1616	71.3	38.5	-	1498	1911	-
F88/1B-OLBC-6-1-3-1-b2-B	R	1849	1560	1704	67.9	42.7	-	1443	2582	-
F88/1B-OLBC$_1$-6-1-1-2-b2-B	R	1773	1096	1435	60.0	30.2	-	1396	2964	-
F88/1B-OLBC$_1$-7-1-3-1-b3-B	R	2059	1810	1934	62.9	49.1	-	1695	2414	-
F89/OL14-11-1-1-1-b2-B	R	1996	1649	1823	67.3	42.3	-	1071	2291	-
F89/OL14-6-1-1-b2-B	R	1865	1407	1636	65.2	37.7	-	1803	2589	-
F90/OL41-8-2-2-b2-B	R	1944	1292	1618	72.1	33.1	-	1145	2638	-
F90/OL43-7-2-1-b2-B	V	2177	1948	2062	72.5	50.6	-	1187	2411	-
F90/OL61-HO2-1-1-b2-B	R	2347	1438	1892	77.7	34.8	-	1051	2458	-
LSD (P ≤ 0.05)		-	-	266[d]	13.4[e]	11.3[e]	-	NS[e]	NS[e]	-
1998										
Georgia Green	R	2126	1463	1795	45.4	54.6	50.0	4396	4102	4249
Georgia Runner	R	3849	3143	3496	75.0	86.3	80.6	2949	2229	2588
ANDRU 93	R	3010	2637	2823	67.1	77.0	72.1	3941	3666	3803
GA 942001	R	2703	1873	2288	53.8	70.4	62.1	3567	3483	3525
F89/OL14-1-3-2-2-2-b3-B	R	2721	2189	2455	67.1	75.8	71.5	3540	3186	3363
F89/OL14-2-4-2-6-1-b2-B	R	2444	1720	2082	55.8	63.8	59.8	3843	3492	3668
F89/OL14-6-1-1-2-b2-B	R	2307	1663	1985	57.5	61.3	59.4	4082	3789	3936
F89/OL14-11-1-1-1-b2-B	R	3235	2007	2620	61.3	63.3	62.3	4109	3513	3811
F90/OL41-8-2-2-b2-B	R	2567	1895	2231	55.0	60.0	57.5	3399	3071	3234
F90/OL61-HO2-1-1-b2-B	R	3063	1956	2509	52.9	60.4	56.7	3773	4211	3992
LSD (P ≤ 0.05)		-	-	502[d]	-	-	11.1[d]	-	-	449[d]

[a]Runner market types indicated with an 'R' and virginia market types with a 'V'.

[b]Percentage disease days calculated as an index of intensity ratings of the percentage of the row severely affected by spotted wilt over four evaluations in 1997 and five evaluations in 1998.

[c]Percentage of the total row length with plants severely affected by spotted wilt.

[d]Genotype × location interaction effects were not significant (P > 0.05). Therefore, data from the two locations were pooled for genotype comparisons, and means across locations are listed.

[e]Genotype × location interaction effects were significant (P ≤ 0.05). Therefore, data were analyzed independently for each location, and means across locations are not listed. NS indicates no significant (P > 0.05) genotype effect.

spotted wilt intensity consistently significantly lower than that of Georgia Green, the standard moderately resistant cultivar grown in the southeastern U.S. Several late maturing lines from the crosses F84/47 and F86/43 from Florida and the line C11-2-39 from the USDA had much lower intensity ratings of spotted wilt than Georgia Green. Greater suppression of spotted wilt than in Georgia Green was observed more frequently in late maturing genotypes than in early and medium maturing lines in these tests. However, impedance of spotted wilt epidemics in the medium maturing line F90/7-3-5-1 compared to Georgia Green appeared to be similar to that of the best of the late maturing genotypes. Although none of the early maturing lines evaluated in this study has a high level of resistance to TSWV, some exhibited moderate suppressive effects on spotted wilt epidemics that approached the level of Georgia Green.

Of the early and medium maturing genotypes found to have moderate levels of field resistance to TSWV, some have high oleic fatty acid oil composition (greater than 80% oleic fatty acid). Early maturing genotype F90/OL61-HO2 from the Univ. of Florida, and medium maturing genotypes GA 942007 from the Univ. of Georgia, F90/OL41-15-3-1-b3-B3 from the Univ. of Florida,

Table 2. Area under the disease progress curve (AUDPC), final intensity of tomato spotted wilt, and pod yield of medium maturing peanut genotypes at Attapulgus, GA in 1997, Tifton, GA in 1998, and Marianna, FL in 1997 and 1998.

	Market[a]	AUDPC[b]			Final intensity rating[c]			Yield		
Genotype	type	GA	FL	Mean	GA	FL	Mean	GA	FL	Mean
		----- % disease days -----			--------------- % ---------------			------------ kg/ha ------------		
1997										
Georgia Green	R	1799	1383	-	51.9	48.9	50.4	2013	2464	2239
Georgia Runner	R	2359	2223	-	78.3	78.1	78.2	1166	1356	1261
ViruGard	R	1681	1391	-	48.8	44.4	46.6	1796	1945	1871
GA 942007	V	1378	1641	-	37.1	60.0	48.5	2589	2399	2494
GA 942009	R	2096	1267	-	60.4	43.3	51.9	2447	2895	2671
GA 942010	R	1833	1506	-	55.8	51.5	53.6	2230	2332	2281
F87/6-9-1-1-1-b2-B	R	1838	1407	-	55.8	45.4	50.6	2895	2977	2936
FSunr. BC$_5$F$_3$-29-5	R	2285	2084	-	66.0	67.9	67.0	1979	1948	1964
LSD ($P \leq 0.05$)		385[e]	337[e]	-	-	-	8.3[d]	-	-	516[d]
1998										
Georgia Green	R	2441	2288	-	48.8	59.2	53.9	3940	4035	3988
Georgia Runner	R	3655	4203	-	80.8	80.4	80.6	3360	3236	3298
GA 942007	V	1947	1473	-	27.5	54.2	40.8	4786	4228	4507
GA 942009	R	2397	2697	-	61.3	79.2	70.2	3848	4353	4101
GA 942010	R	2497	2476	-	60.0	79.6	69.8	4315	4049	4182
F88/48-SSB1-B2-B3-B4-7-b2-B	R	978	1818	-	41.3	33.3	37.3	4699	4894	4797
F88/OL3-HO6-2-1-1-b2-B	R	1362	2191	-	32.1	35.4	33.8	4938	3998	4468
F90/7-1-5-1-b2-B	R	1281	2035	-	35.0	33.8	34.4	5529	4946	5237
F90/7-3-5-1-b2-B	R	616	767	-	10.8	12.5	11.7	6158	5682	5920
F90/OL41-6-3-1-b2-B	R	1787	2939	-	56.3	51.6	53.9	4201	4807	4505
F90/OL41-15-3-1-b3-B	R	1634	2538	-	54.6	55.4	55.0	4304	4846	4575
F92/OL19-3-3-3-b2-B	R	1693	1905	-	44.6	55.8	50.2	4716	4117	4416
F93Q8	R	3402	4379	-	74.6	78.3	76.5	2612	3142	2877
FSunr BC2-F2-42-1-1-1-1-b2-B	R	2530	3579	-	61.3	76.7	68.9	3518	3829	3674
C155-31	R	1651	2473	-	52.5	60.4	56.5	4396	4879	4638
C156-47	R	1262	1531	-	34.2	46.3	40.2	4244	3823	4033
C135-125	R	2915	3117	-	54.6	68.8	61.7	4217	4135	4176
C155-25	R	2961	3035	-	63.8	74.2	68.9	3561	3564	3563
AT 97-2556	R	1708	2139	-	64.2	66.7	65.4	3696	3799	3748
AT 97-7856	V	1480	2221	-	55.0	53.3	54.1	5388	4458	4923
LSD ($P \leq 0.05$)		788[e]	564[e]	-	-	-	9.5[d]	-	-	559[d]

[a]Runner market types indicated with an 'R' and virginia market types with a 'V'.

[b]Percentage disease days calculated as an index of intensity ratings of the percentage of the row severely affected by spotted wilt over four evaluations in 1997 and five evaluations in 1998.

[c]Percentage of the total row length with plants severely affected by spotted wilt.

[d]Genotype × location interaction effects were not significant ($P > 0.05$). Therefore, data from the two locations were pooled for genotype comparisons, and means across locations are listed.

[e]Genotype × location interaction effects were significant ($P \leq 0.05$). Therefore, data were analyzed independently for each location, and means across locations are not listed.

and AT-7856 from AgraTech Seeds are lines high in oleic fatty acids. Previously, field resistance to TSWV at levels similar to that in Georgia Green has been reported for mid-oleic cultivars Florida MDR-98 (7) and ViruGard (16). However, breeding lines and cultivars such as SunOleic 95R and SunOleic 97R with high oleic acid levels have been notoriously susceptible to TSWV (3). This is the first report of a moderate level of field resistance to TSWV in high oleic acid breeding lines.

As with previous reports on cultivars and breeding lines from the southeastern U.S., there was no indication in any of the tests that differences in spotted wilt intensity was due to corresponding differences in numbers of thrips adults or larvae (5, 6, 7, 8). None of the lines evaluated in this study had consistent effects on adult thrips or larvae compared to Georgia Runner.

Table 3. Area under the disease progress curve (AUDPC), final intensity of tomato spotted wilt, and pod yield of late maturing peanut genotypes at Attapulgus, GA in 1997, Tifton, GA in 1998, and Marianna, FL in 1997 and 1998.

Genotype	Market[a] type	AUDPC[b] GA	AUDPC[b] FL	AUDPC[b] Mean	Final intensity rating[c] GA	Final intensity rating[c] FL	Final intensity rating[c] Mean	Yield GA	Yield FL
		---------% disease days---------			---------------- % ----------------			----kg/ha ----	
1997									
Georgia Green	R	1469	1526	1497	44.6	46.5	45.3	1939	3799
Georgia Runner	R	2437	2675	2550	85.4	87.1	86.3	1349	1969
C-99R (F84/9B-4-2-1-1-2-b2-B)	R	1345	837	1091	34.6	25.4	30.0	3084	5134
F84/9B-4-2-1-1-1-b2-B	R	1129	1108	1119	30.5	29.6	30.0	3270	5108
F84/23-11-2-1-1-1-1-	R	933	857	895	28.3	23.9	26.1	2738	4353
F84/28-5-4-1-2-1-2-	R	1123	1426	1275	30.4	39.1	34.8	3126	4005
F84/28-5-4-2-2-b3-B	R	1547	1419	1483	51.0	41.0	46.0	2253	4344
F84/47-10-1-1-2-b2-B	V	1042	789	915	32.3	20.0	26.1	2549	5899
F86/43-1-1-1-1-1-b2-B	R	985	561	773	27.7	13.5	20.6	3036	4432
F86/43-1-2-1-2-1-b2-B	R	1066	914	990	39.2	24.6	31.9	3017	4634
F86/43-5-1-2-1-1-	R	1253	1407	1330	40.8	38.8	39.8	3158	3928
F86/45A-12-1-1-b2-B	V	1130	952	1041	32.3	24.8	28.5	2936	4082
F86/45B-10-1-2-2-2-b2-B	V	1440	1560	1500	48.1	41.9	45.0	2001	4061
F87/8-2-1-1-b2-B	V	1080	1048	1065	35.4	32.3	33.9	2562	5089
LSD ($P \leq 0.05$)		-	-	269[d]	-	-	7.4[d]	481[e]	682[e]
1998									
Georgia Green	R	1976	2026	2001	50.8	65.0	57.9	4570	3699
Georgia Runner	R	4383	3509	3946	81.7	89.6	85.6	2943	2645
C-99R (F84/9B-4-2-1-1-2-b2-B)	R	1902	1322	1612	28.3	36.3	32.3	6028	5181
F84/9B-4-2-1-1-1-b2-B	R	1376	1029	1203	22.9	33.3	28.1	6575	5070
F84/47-10-1-1-1-1-b3-B	V	737	1047	892	13.3	29.0	16.7	6591	5493
F84/47-10-1-1-2-b2-B	V	1135	843	989	15.0	25.8	20.4	7275	6015
F86/43-1-1-1-1-1-b2-B	R	1138	866	1002	21.7	25.8	23.8	6103	4619
F86/43-1-1-1-2-1-b2-B	R	802	721	761	12.5	19.5	16.0	6640	4354
F86/43-1-2-1-2-1-b2-B	R	793	947	870	13.3	24.1	18.8	6586	4849
F86/45B-10-1-2-2-2-b2-B	V	3045	2675	2860	65.8	76.3	71.0	5280	2755
F88/25-6-2-2-1-2-b3-B	V	2090	1831	1961	38.3	40.8	39.6	4328	3624
F89/OL28-HO1-7-4-1-2-b3-B	R	1141	1488	1315	23.3	35.4	29.4	6364	4655
F89/OL28-HO1-7-5-1-1-b2-B	R	2048	1919	1983	43.3	55.0	49.2	4510	2801
C11-2-39	R	751	438	595	11.7	12.1	11.9	5610	3756
C12-1-15	R	1889	2003	1946	37.9	64.2	51.0	4760	3476
C12-1-16	R	3524	3171	3347	72.9	79.2	76.0	4158	3124
LSD ($P \leq 0.05$)		-	-	449[d]	-	-	9.2[d]	615[e]	567[e]

[a]Runner market types indicated with an 'R' and virginia market types with a 'V'.

[b]Percentage disease days calculated as an index of intensity ratings of the percentage of the row severely affected by spotted wilt over four evaluations in 1997 and five evaluations in 1998.

[c]Percentage of the total row length with plants severely affected by spotted wilt.

[d]Genotype × location interaction effects were not significant ($P > 0.05$). Therefore, data from the two locations were pooled for genotype comparisons, and means across locations are listed.

[e]Genotype × location interaction effects were significant ($P \leq 0.05$). Therefore, data were analyzed independently for each location, and means across locations are not listed.

Low spotted wilt intensity and high yields observed in several of the late and medium maturing breeding lines indicate that these lines have potential to aid greatly in management of spotted wilt. Performance of the best of these breeding lines suggests that they might have enough resistance to sustain production even in situations with severe disease potential. Several of these lines also represent diverse sources of resistance to TSWV. Additional resistance should help reduce further the risk of losses to spotted wilt, and make management of spotted wilt less dependent upon integration of cultural and chemical factors.

These studies were conducted using early planting dates and sparse plant populations to maximize spotted wilt incidence and severity. Spotted wilt and yield response to increased plant populations may vary among breeding lines and cultivars. Investigations are in progress to determine how some of the most promising lines from these tests compare to Georgia Green in response to factors such as increased plant population, planting date, use of phorate insecticide, row patterns, and tillage systems. All of these factors are part of the recommended strategy for management of spotted wilt in the southeastern U.S. (3).

Based on this and previous studies (7), C-99R has the highest level of field resistance to TSWV currently available in any cultivar. The resistance found in this cultivar, together with its yield potential, could make it very valuable in areas where late maturing peanut cultivars can be grown. In addition, Univ. of Georgia medium maturing breeding line GA 942007 has been proposed for release as a virginia-market type peanut. Across years and locations, GA 942007 performed as well as or better than Georgia Green under high levels of spotted wilt. If released, GA 942007 would represent the highest level of spotted wilt resistance currently available in a cultivar with high oleic acid oil composition.

The potential of other breeding lines for release as commercial cultivars remains to be determined. Many of them have at least partial resistance to important fungal pathogens as well as other pathogens. Based on spotted wilt incidence and pod yields in these tests, a number of breeding lines have potential for improving management of spotted wilt compared to Georgia Green, which is the predominant cultivar currently grown in peanut producing areas of Georgia, Alabama, and Florida.

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