Spotted Wilt Apparent Disease Progress in the Component Lines of Southern Runner Cultivar

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ABSTRACT

The apparent disease progress of spotted wilt, caused by tomato spotted wilt virus, was monitored in the three component lines of Southern Runner peanut (*Arachis hypogaea* L.), and in cultivars Southern Runner, Florunner and GK-7 in the field in 1990-1992. In all three years, final incidence and area under the disease progress curves were similar among Southern Runner and all three component lines. Final incidence of spotted wilt in Southern Runner and all component lines was less than for Florunner in all three years. AUDPC values were lower in Southern Runner and two of the three component lines than in Florunner. Incidence and AUDPC of spotted wilt in GK-7 was intermediate between Florunner and Southern Runner and its individual components. Disease increase was linear in all component lines and cultivars. Rate of disease progress was similar among Southern Runner and the three component lines. Disease progressed more slowly in Southern Runner and the component lines than in Florunner.

Key Words: Resistance, epidemiology, TSWV.

Spotted wilt, caused by the thrips vectored tomato spotted wilt virus (TSWV), causes serious problems in peanut (*Arachis hypogaea* L.) producing regions of India (9, 14), Texas (1,3,12) and the southeastern U.S. (4,5,8,11). Occurrence of spotted wilt has been sporadic, both spatially among fields within years and temporally among years. The most consistent means for suppressing spotted wilt epidemics has been the use of the cultivar Southern Runner (7). Incidence of spotted wilt increases more slowly and typically to a lower final apparent incidence in fields planted to Southern Runner than Florunner (7) and GK-7 (2), the most prominent runner-type cultivars grown in the southeastern U.S.

Southern Runner consists of an approximately equal mixture of three sister lines derived by pedigree selection from crosses of PI 203396 X Florunner (10). All selections of these lines were made prior to occurrence of spotted wilt epidemics in peanut in the southeastern U.S. so there was no active selection for resistance to TSWV. Because the apparent resistance in Southern Runner is not complete, the relative level of resistance to TSWV in the individual component lines is not evident. The purpose of this study was to compare apparent disease progress and final incidence of spotted wilt in each of the three component lines of Southern Runner, the cultivar mixture, and to Florunner and GK-7.

Materials and Methods

Field plots for 1990-1992 were located at The University of Georgia Attapulgus Research Station, Attapulgus, GA and consisted of Dothan loamy sand (fine loamy, siliceous, thermic Plinthic Kandiudults) in 1990, 1991, and 1992. Genotypes evaluated included the three sister-lines, UF80202-1, UF80202-2, and UF80202-3, that make up the blend for Southern Runner and the three commercial cultivars Southern Runner,

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Florunner and GK-7. A randomized complete block design with four replications was used in each year. Plots consisted of 2 rows (0.91 m apart) 6.1 m long.

Seed were planted with an International 295 planter with cone type hoppers at 24.6 seed/m of row on 18 April 1990, 16 April 1991, and 9 April 1992. Seeding rate was less than recommended for commercial production to facilitate examination of individual plants for symptoms and to promote higher incidence of spotted wilt (14). Stand counts were made for each row on 9 May 1990, 8 May 1991 and 28 April 1992.

Plots were maintained as recommended for peanut production in Georgia (13). Applications of chlorothalonil (Bravo 720, ISK Biotech, Mentor, OH), at 1.24 kg ai/ha were made for control of fungal diseases of foliage.

Plants were examined for symptoms of spotted wilt on 30 May, 12 and 28 June, 10 and 25 July 1990; 29 May, 26 June, 9 and 22 July, and 6 August 1991; and 2 and 16 June, 1 and 24 July and 11 August 1992. Symptoms included concentric ringspots, "oak leaf" patterns of chlorosis, and bronzing of leaves, stunting, distortion and/or necrosis of terminal buds. On each date, plants showing symptoms of infection were marked with colored surveyors' flags. A different color was used on each date, such that time of first symptom appearance in individual flagged plants was evident at harvest. Samples of leaves with symptoms were taken from one of each 10 symptomatic plants in all three years for confirmation of the presence of the virus by ELISA with antiserum developed by Sreenivasulu *et al.* (16) or commercially available antiserum to the common or "L-strain" isolate of the virus (Agdia Inc., Elkhart, IN). In all years, symptoms of plants that did not test positive via ELISA were re-evaluated. If symptoms indicated that the plant had spotted wilt, samples were taken and retested via ELISA.

Disease progress curves were constructed for each genotype using incidence which was the proportion (0-1.0) of symptomatic plants in the plot. Area under the disease progress curve (AUDPC) was calculated for each plot using the formula:

$$AUDPC = \sum_{i=0}^{n-1} [(L_{i+1} + L_i)/2]\,[t_{i+1} - t_i]$$

where t = time in days after planting, i = 0....n, Li = apparent incidence (0-1.0) on day i (15).

Plants of Florunner and GK-7 were inverted on 12 Sept 1990, 26 Aug 1991, and 4 Sept 1992. Plots of Southern Runner and all three component lines were inverted on 19 Sept 1990, 11 Sept 1991, and 14 Sept 1992. Plants were dried in the field for 3 - 7 days and pods were harvested mechanically. Pod yields were determined for each plot.

Final incidence (FI), AUDPC, and yield for the six entries were compared by analysis of variance. Fisher's protected least significant differences (17) were calculated for genotype comparisons. Linear regression (17) of apparent disease incidence on time in days after planting was used to describe apparent disease progress for the six entries. Goodness of fit for the linear model was evaluated by use of coefficients of determination (R2) and plots of residuals of the regression. Pearson's correlation coefficients (17) were calculated to describe correlation between pod yield and final incidence of spotted wilt and AUDPC.

Results

Diagnosis by symptoms was confirmed by ELISA in over 95% of the samples tested. There was no evidence of differences in correlation between symptoms and ELISA results among the entries.

FI and AUDPC for spotted wilt varied ($P \leq 0.05$) among the three years; the year by genotype interaction was not significant ($P > 0.05$). Genotype effects tested with data for FI and AUDPC pooled across the three years were significant ($P \leq 0.05$). There were no significant differences among the three component lines of Southern Runner for either FI or AUDPC (Table 1). Similarly, there was no significant difference in FI or AUDPC between the cultivar Southern Runner and any of the component lines. All three component lines and Southern Runner had FI's of spotted wilt lower ($P \leq 0.05$) than that of Florunner. Final incidences in UF80202-2 and Southern Runner were also lower ($P \leq 0.05$) than that in GK-7. AUDPC values were lower in UF80202-2, UF80202-3 and Southern Runner than in Florunner (Table 1). AUDPC of GK-7 was not different ($P > 0.05$) than those of Southern Runner, the component lines or Florunner.

Table 1. Effect of peanut genotype on spotted wilt final incidence (FI) and area under the disease progress curve (AUDPC) in field tests from 1990-1992.

	Final Incidence[1]				AUDPC[2]			
	1990	1991	1992	Mean[3]	1990	1991	1992	Mean[3]
UF80202-1	0.052	0.026	0.025	0.034	2.1	0.9	0.70	1.21
UF80202-2	0.034	0.028	0.012	0.025	1.4	0.6	0.51	0.84
UF80202-3	0.047	0.034	0.017	0.033	1.7	1.2	0.52	1.17
Southern Runner	0.036	0.029	0.010	0.022	1.3	0.9	0.10	0.75
GK-7	0.063	0.056	0.043	0.054	1.8	1.4	1.2	1.45
Florunner	0.089	0.054	0.053	0.065	2.6	1.2	2.1	1.97
LSD ($p \leq 0.05$)				0.026				0.79

1 Proportion (0-1.0) of plant population with symptoms of spotted wilt.
2 Proportion - days, calculated using incidence at five evaluations in each year.
3 Values represent the mean of results from 1990, 1991 and 1992, with four replications per cultivar or line per year.

Disease incidence increased linearly in all entries, although R2 values and plots of residuals indicated better fit on Florunner and GK-7 than for Southern Runner and the component lines (Fig. 1). Across all years, rate of disease progress was higher in Florunner than in Southern Runner or in any of the component lines. Rates of disease progress were similar among Southern Runner and the component

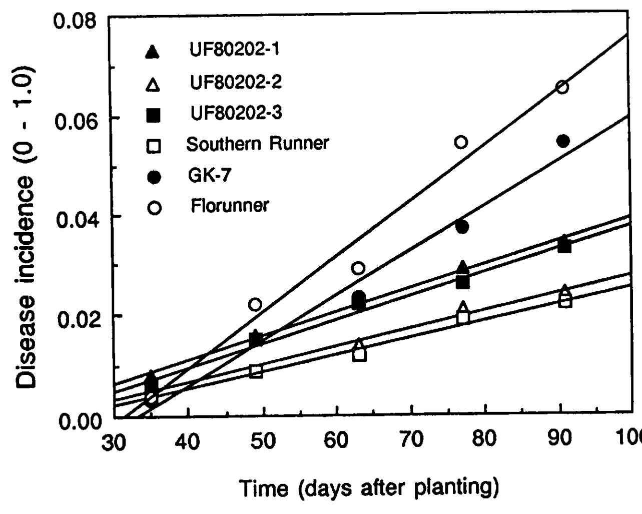

Fig. 1. Effect of peanut cultivar on apparent disease progress of spotted wilt. Means and regression lines represent the average of three years. Disease progress was described by linear equations: Disease incidence (i) $i = -0.07\ (\pm 0.019) + 0.002\ (\pm 0.0002)\ t$, $R^2 = 0.30$, for UF80202-1; $i = -0.06\ (\pm 0.019) + 0.002\ (\pm 0.0002)\ t$, $R^2 = 0.20$, for UF80202-2; $i = -0.05\ (\pm 0.014) + 0.001\ (\pm 0.0001)\ t$, $R^2 = 0.28$, for UF80202-3; $i = -0.05\ (\pm 0.016) + 0.001\ (\pm 0.0002)\ t$, $R^2 = 0.22$, for Southern Runner; $i = -0.08\ (\pm 0.016) + 0.0022\ (\pm 0.0002)\ t$, $R^2 = 0.42$, for GK-7; and $i = -0.010\ (\pm 0.019) + 0.003\ (\pm 0.0003)\ t$, $R^2 = 0.41$, for Florunner, where t represents time in days after planting. Values in parentheses are standard deviations.

lines. Rate of disease progress in GK-7 was intermediate between that for the Southern Runner group and Florunner.

Genotype x year effects on pod yield were significant ($P = 0.05$); therefore, data from each year were analyzed separately. Significant genotype effects on yield occurred only in 1992 (Table 2). Yield of Florunner was less than that of Southern Runner, UF80202-2 and UF80202-3. Yields for all three component lines, Southern Runner and GK-7 were similar (Table 2). There were no significant ($P > 0.05$) correlations between yield and either final incidence of spotted wilt or AUDPC.

Table 2. Effect of peanut genotype on pod yield in field tests from 1990-1992.

	Yield (kg/ha)		
	1990	1991	1992
UF80202-1	4038	3130	3058
UF80202-2	3611	3058	3521
UF80202-3	2922	2977	3666
Southern Runner	3548	2687	4029
GK-7	3139	2786	3203
Florunner	3321	3021	2323
LSD ($p < 0.05$)	NS[1]	NS[1]	985

[1] NS indicates no significant genotype effects in the ANOVA; therefore, no LSD was calculated.

Discussion

The three component lines of Southern Runner have similar apparent resistance to TSWV, and are superior to Florunner in apparent resistance. None of the lines are immune, however, and the similarity of spotted wilt incidence among the component lines of Southern Runner indicates that lower incidence in this cultivar than in Florunner is due to approximately equal contributions of the components.

The relatively low incidence in each of the three years may have prevented detection of small differences among the component lines. However, incidence was sufficient to separate the component lines and Southern Runner cultivar from Florunner. Relative apparent disease progress in Southern Runner and Florunner in this study, however, was similar to that reported for these cultivars in previous investigations that included tests in which low incidence was observed (7).

Previous studies indicate that the relative performances of Florunner and Southern Runner with respect to incidence of spotted wilt are consistent at low or moderate levels of incidence (7). This suggests that evaluation of genotype effects on incidence and disease progress in cases in which incidence remains low may provide at least an indication of performance of genotypes or cultivars in more intense epidemics. The epidemics encountered in these tests are exemplary of those encountered in Georgia during the past three years (18).

GK-7 appears to be intermediate between Florunner and Southern Runner in susceptibility to TSWV. Our results corroborate similar observations in Texas (2), and previous tests in Georgia (J. W. Todd, unpublished data). The mechanisms responsible for differences in incidence of spotted wilt among the cultivars remain unknown.

This study did not address possible differences in incidence of asymptomatic infections among the entries. Total incidence of TSWV infections in Florunner has been reported to be over two times higher than that indicated by symptoms (6). The implications of asymptomatic infections for interpretations of field evaluations such as this one remains to be determined.

Differential yield response to spotted wilt was limited for the entries. Incidence of spotted wilt was not high enough in any year to cause detectible reductions in yield in any line. The yield difference between Florunner and Southern Runner and two component lines may have been due to severe leaf spot (*Cercosporidium personatum*) pressure in spite of fungicide applications for leaf spot control. Southern Runner has more resistance and tolerance to *C. personatum* than Florunner (10).

Our results provide no evidence that resistance in Southern Runner cultivar might be improved by adjusting the proportions of the mixture represented by the respective component lines. The similar resistance in the three lines suggests that the apparent resistance trait is heritable. Since Florunner is one parent of Southern Runner, PI 203396 is the suspected source of resistance. Studies are in progress to determine the susceptibility of PI 203396 to TSWV and the potential for its use in breeding programs for resistance to TSWV.

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