Relative Susceptibility of Pecan Cultivars to Fungal Leaf Scorch and Relationship to Mineral Composition of Foliage

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ABSTRACT

Significant differences were noted among 24 pecan cultivars being rated for susceptibility to fungal leaf scorch (FLS). Leaf samples were collected 20 September and complete mineral analyses were made. Correlation coefficients were determined for mineral content and FLS index. Significant negative γ values were obtained for FLS index when correlated with N, P, and Mn; and significant positive γ value for Ca content. Data indicate a need for additional research on fertility levels, mineral content, and reaction to FLS.

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The importance of maintaining healthy and functional foliage of pecan [*Carya illinoensis* (Wang.) K. Koch] has been emphasized (11). One of the main deterrents to maintaining foliage on pecan in the southeastern USA is fungal leaf scorch (FLS) (6). This condition usually develops in August or September, with necrosis beginning either at the apex or basal portion of the leaflets and advancing toward the center. Several genera of fungi from leaf tissues have been correlated with visible symptoms (5). For example, isolation of *Pestalotia* spp. from symptomless leaves throughout the growing season was highly correlated with the amount of FLS development. The effectiveness of several fungicides in FLS control is convincing evidence that fungi are involved. Trees treated with fungicides such as benomyl, captafol, and fentin hydroxide had significantly less FLS than trees which received the full-season application of insecticides only (6).

Early work by Hammar and Hunter (1) indicated a nutritional relationship to leaf scorch, a foliage problem apparently similar to FLS as described by Littrell and Worley (6). In a nutritional study where leaf samples were taken throughout the season, they suggested a high Ca + Mg/K ratio was related to premature defoliation of the cultivar 'Moore'. Nitrogen, P, and K decreased during the season, while Ca accumulated at a rapid rate. They suggested this increase might account for leaf scorch and deterioration of the leaves in September. A similar trend throughout the season in percentage mineral composition of leaves was also observed by Krezdorn (3), who also suggested that a high Ca + Mg/K ratio was possibly responsible for leaf scorch and early leaf deterioration. Because of the suggested relationship between mineral composition of leaves and premature defoliation, we decided to determine if leaves of pecan cultivars differed in mineral content and in susceptibility to FLS. Preliminary results indicated cultivars differed in susceptibility to FLS (4).

MATERIALS AND METHODS.—Leaves from trees of 24 pecan cultivars growing at the Coastal Plain Station, Tifton, Georgia, were evaluated for severity of FLS and analyzed for mineral content. All trees were maintained according to recommended practices of fertilizer, insecticide, and fungicide applications. Fentin hydroxide (Duter) was applied to all cultivars six times beginning 26 April and concluding 25 August. The FLS ratings were obtained by collecting 100 leaves from four sides of each tree and the number of leaflets showing symptoms of FLS were recorded. The cultivars which were rated are listed in Table 1. On 20 September, approximately 50 middle leaflets were collected from middle leaves of terminals around the periphery of the tree, and a complete mineral analysis was obtained by the emission spectrographic and Kjeldahl methods (2, 7). Correlation coefficients were determined for mineral content and FLS ratings.

TABLE 1. Comparative ranking of pecan cultivars according to fungal leaf scorch (FLS) severity

Susceptibility and cultivars	FLS Index[a]
Resistant	
Mahan Stuart	16.5 A[b]
Starking Hardy Giant	22.0 A
Hastings	27.5 AB
Choctaw	29.0 AB
Barton	30.0 AB
Tolerant	
Curtis	39.0 ABC
Mobile	44.0 ABC
Pabst	47.5 ABC
Harris Super	50.0 ABCD
Alley	54.5 ABCD
Gloria Grande	57.0 ABCD
Summers	59.0 ABCD
Delmas	59.0 ABCD
Desirable	60.0 ABCD
Elliot	63.0 ABCD
Frotscher	64.0 ABCD
Davis	77.0 ABCD
Pensacola Cluster	90.0 BCD
Moore	95.5 CD
Stuart	103.0 CD
Susceptible	
Moneymaker	123.5 D
Schley	272.5 E
Van Deman	352.5 E
Cape Fear	377.0 E

[a]Fungal leaf scorch index = Number of leaflets with scorch plus number of leaflets missing per 100 leaves. Data collected 20 September. Square root transformation of data was done before analysis of variance was performed.

[b]Means not followed by the same capital letter are not significantly different ($P = 0.05$) according to Duncan's multiple range test.

TABLE 2. Correlation coefficients (r) for selected minerals in leaf tissue for 24 pecan cultivars and fungal leaf scorch (FLS) index

	Correlation coefficients (r) for FLS and:				
Disease	N	P	K	Ca	Mn
FLS[a]	−.33*	−.27*	.07	.33*	−.47*

[a]Asterisk indicates correlation significant, $P = 0.05$.

TABLE 3. Fungal leaf scorch (FLS) index and mineral composition of pecan cultivars Mahan Stuart (FLS-resistant) and Cape Fear (FLS-susceptible) measured 20 September 1974 at the Georgia Coastal Plain Station, Tifton

Cultivar	FLS[a] FLS[a]	N (%)	P (%)	Ca (%)	Mn (μg/g)
Mahan Stuart	16.5 A[b]	2.45 AB	.22 B	1.52 A	845 B
Cape Fear	377.0 B	2.15 A	.16 A	2.12 B	267 A

[a]FLS = Fungal leaf scorch, = number of leaflets with scorch plus number of leaflets missing per 100 leaves.

[b]Means followed by the same capital letter are not significantly different ($P = 0.05$) according to Duncan's multiple range test.

RESULTS AND DISCUSSION.—Cultivars were separated into resistant, tolerant, and susceptible based on the FLS index (Table 1). All of the trees were sprayed with the recommended dosage of Duter, which we have shown to be only moderately effective in controlling the disease (Littrell and Worley, *unpublished*). Because trees were sprayed, the relative rating for FLS is presumed to be lower than that which would have been obtained in untreated trees. However, differences in the disease rating are considered to be based on the varietal characteristics, one of which is thought to be mineral composition of the foliage.

The correlation between N and FLS was negative, showing that tissue containing higher concentrations of N also has less FLS (Table 2). In contrast, a positive correlation for Ca content and disease severity was observed. This contrasts with other diseases in which Ca appears beneficial in preventing dissolution of middle lamella and subsequent disease development. A resistant cultivar, Mahan Stuart, contained significantly less Ca than Cape Fear, a susceptible cultivar (Table 3). The highest degree of negative correlation was found with Mn and FLS. Mahan Stuart contained almost three times the amount of Mn as the susceptible cultivar, Cape Fear (Table 3). Phosphorous and FLS severity were also negatively correlated (Table 2).

Data from the Pecan Leaf Analysis Service for years 1966-1969 show several instances relating to extremes in mineral composition (8, 9, 10). For example, relatively high calcium levels (> 1.50%) were found in approximately 50% of all samples submitted for analysis (10). In 1968 approximately 37% of the samples were low in nitrogen (< 2.50%). These data indicate additional research is warranted to investigate more precisely the influence of mineral composition on susceptibility to FLS. Also analysis of cultivars revealed significant differences in Ca, N, and P composition. This may partially explain differences in the FLS ratings of pecan cultivars.

Additional work is warranted to further investigate the correlation between mineral composition and FLS, and to determine if these constituents can be manipulated to control the disease.

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