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Potential for Improved Control of Southern Stem Rot of Peanut with Resistance and Fungicides[1]

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ABSTRACT

Potential for improved control of southern stem rot caused by *Sclerotium rolfsii* Sacc. on peanut (*Arachis hypogaea* L.) was evaluated by combining moderate resistance with fungicide use. Various fungicides including carboxin, oxycarboxin, propiconazol, OAC 3890, and PCNB were applied to peanut lines NC 8C, NC Ac 18016, and Florigiant in North Carolina during 1980, 1981, and 1982. Consistently fewer disease loci occurred on NC Ac 18016 than on NC 8C or Florigiant. At least one fungicide reduced stem rot incidence in two of three years tested, but fungicide use did not result in greater yields. Effects of disease resistance and fungicides on suppression of stem rot development were additive.

Key Words: Stem rot, *Sclerotium rolfsii, Arachis hypogaea*, groundnut, fungicides, disease resistance.

Southern stem rot caused by *Sclerotium rolfsii* Sacc. is an important disease of peanut (*Arachis hypogaea* L.) in North Carolina. Cultural practices such as crop rotation, deep plowing and non-dirting cultivation are the foundation of effective stem rot management on peanut (3,8), but when used alone are often inadequate to prevent disease losses. Carboxin (5, 6-dihydro-2-methyl-N-phenyl-1,4-oxathiin-3-carboxamide) applied once or twice at onset of symptoms, or PCNB (pentachloronitrobenzene) applied at pegging are recommended for stem rot control in North Carolina, but consistent suppression of disease by these fungicides has not been observed.

Commonly grown peanut cultivars have little resistance to infection by *S. rolfisii* (9). Wynne and Beute (18), however, reported that two breeding lines with resistance to black root rot (CBR) caused by *Cylindrocladium crotalariae* (Loos) Bell and Sobers, are moderately resistant to stem rot. One of the breeding lines, NC Ac 18016, is a virginia-type peanut with erect growth habit. The second breeding line showing improved resistance to stem rot compared with the standard cultivar Florigiant was released as NC 8C for resistance to CBR in 1981 (19).

Control of many plant diseases can be improved by using fungicides on moderately resistant cultivars. The purpose of this research was to evaluate the potential for controlling southern stem rot on peanut using moderate disease resistance in combination with several fungicides.

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Materials and Methods

Three peanut lines, Florigiant, NC 8C, and NC Ac 18016, were planted on 12 May 1980, 7 May 1981, and 30 April 1982 in 0.3 to 0.9-ha areas of fields in North Carolina having a history of stem rot. Rows were 0.9 m apart and plots were two rows wide x 12.2 m in length. Recommended procedures for fertilization, weed control, and leafspot management were followed (15). Aldicarb (2-Methyl-2(methylthio) propionaldehyde 0-(methylcarbamoyl) oxime) was applied at 1.7 kg a.i./ha in the furrow in 1980, and 1.1 kg a.i./ha disulfoton (0,0-Diethyl-S-[2-(ethylthio) ethyl] phosphorodiathioate) was applied in 1982 for control of soil insects. No insecticide was applied at planting in 1981. Experimental design each year was a randomized complete block arranged in a split-plot with peanut lines as whole plots. Subplot treatments were chemicals applied for control of stem rot.

In 1980, carboxin was applied as a granule (4G formulation) or as a spray (3F formulation). Granules were applied at 1.1 kg a.i./ha as follows: i) once in a 30-cm band, ii) twice in a band, iii) broadcast once, or iv) broadcast twice. The flowable formulation of carboxin was applied as a spray at 1.3 kg a.i./ha one or two times, and PCNB 75WP at 11.2 kg a.i./ha was applied once. Sprays were applied in 470 L water/ha. All plots were treated after stem rot symptoms were detected in the test field; first application dates were 21 August for sprays and 25 August for granules. Plots receiving a second application were treated on 19 September. In 1981, carboxin 3F at 1.3 kg a.i./ha and oxycarboxin 75WP (5, 6-dihydro-2-methyl-1-1, 4-oxathiin-3-carboxanilide-4, 4-dioxide) at 2.2 kg a.i./ha were applied after stem rot symptoms were first detected in the field on 3 September. The remaining treatments were applied on 31 July and included oxycarboxin 75WP, 0.6 kg a.i./ha propiconazol 2.5G (1-[[2-(2,4-Dichlorophenyl)-4-propyl-1-3 dioxolan-2-yl] methyl]-1H-1,2,4 triazole), 5.6 kg a.i./ha OAC 3890 10G (Olin Corp., P.O. Box 991, Little Rock, Arkansas 72203), and PCNB at 11.2 kg a.i./ha. In 1982, fungicide treatments included presymptom applications of oxycarboxin, propiconazol, and PCNB on 5 August. Carboxin 3F was applied after stem rot was detected on 2 September. Formulations, application methods, and rates were as described for 1981. Each fungicide treatment in 1982 was applied to two sub-plots for each whole plot in the split-plot design, and one of these two subplots also received 2.5 kg a.i./ha of the insecticide chlorpyrifos 15G on 11 August. A nontreated control was included in each year. The treatments were replicated four times in 1980 and 1981 and 10 times in 1982.

Stem rot loci (12) were counted on 21 October 1980, 13 October 1981, and on 10, 17, and 24 September 1982. Peanuts were dug on 24 October 1980, 15 October 1981, and 24 September 1982. Harvesting was accomplished with a small stationary combine on 6 and 7 November 1980. A commercial combine was used to harvest peanuts on 21 October 1981 and 29 September 1982. Yield determinations were made after field drying in 1981 and 1982 and after field and forced-air drying in 1980.

Disease loci data were analyzed following square root transformation. Significance of main and interaction effects were tested by analysis of variance and differences in disease or yield were detected using Fisher's LSD or single-degree-of-freedom contrasts.

Results

Stem rot incidence was greatest in 1980 and least in 1982 (Fig. 1). Under higher levels of disease pressure 1980 and 1981, NC Ac 18016 had less stem rot than either NC 8C or Florigiant. On 9 and 17 September in 1982, significantly fewer disease loci were present in either NC 8C or NC Ac 18016 than Florigiant, but differences among lines were not significant at digging on 24 September (Fig. 1).

Although plots of NC Ac 18016 had fewest stem rot loci, yields were consistently lower for NC Ac 18016 than Florigiant or NC 8C (Fig. 2). Yield differences were especially noticeable under favorable growing conditions and low stem rot pressure in 1982.

Effects of peanut genotype and chemicals on disease incidence were additive in all three years; there were

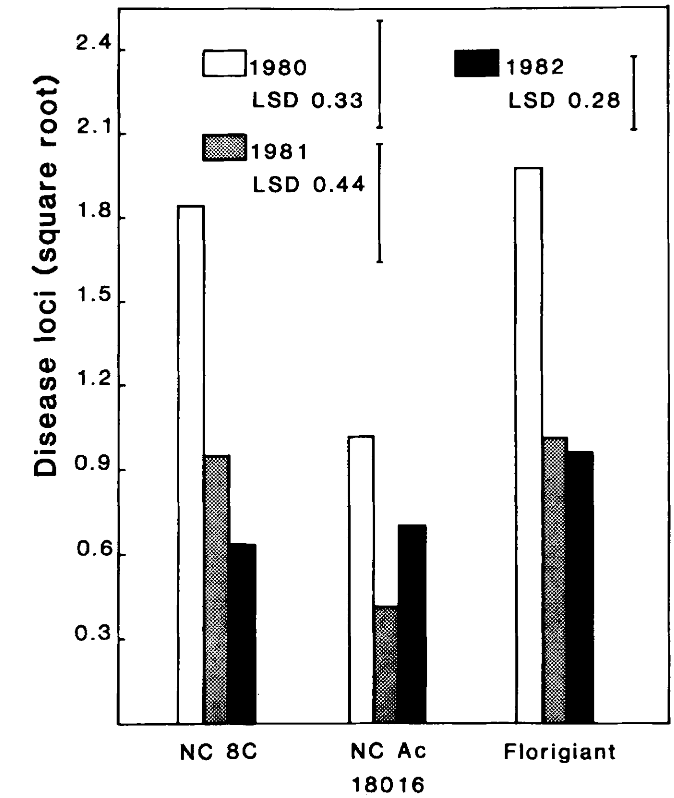

Fig. 1. Number of southern stem rot lesions at the end of growing season per 24-m plot (maximum of one lesion per 30 cm of row) on three peanut lines. Means represent five (1982), seven (1981), or eight (1980) fungicide treatments. LSDs are for P=0.05.

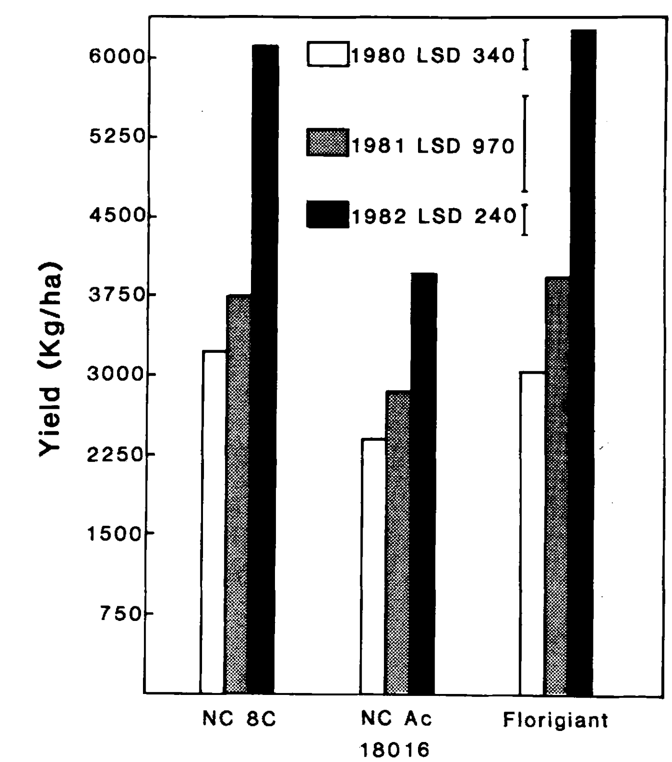

Fig. 2. Effect of three peanut lines on yield of peanut in 1980, 1981, and 1982. Yields represent the means of five (1982), seven (1981), or eight (1980) fungicide treatments. LSDs are for P=0.05.

no significant peanut line x chemical treatment interactions. An example of the additive effects of genotype and fungicides is illustrated by the disease data from 1980 in Table 1. On the average, about half as many disease loci occurred on NC Ac 18016 compared to NC 8C or Florigiant, and an average of half as much stem rot occurred in all plots sprayed one time with carboxin compared with plots that were not treated; combining the two treatments (NC Ac 18016 with one spray carboxin) resulted in about one-fourth as many disease loci as in unsprayed plots of Florigiant.

Table 1. Effects of carboxin and PCNB on number of loci of southern stem rot (caused by *Sclerotium rolfsii*) on three peanut lines in 1980.

Fungicide	Method of Application	Application Number	Disease loci[1/]			
			Peanut line			Fungicide mean
			NC 8C	Florigiant	NC Ac 18016	
Carboxin 4G	broadcast	1[2/]	1.6	1.8	1.7	1.7
	broadcast	2	1.8	2.5	1.0	1.8
	band	1	1.9	1.6	1.2	1.6
	band	2	1.1	2.0	0.3	1.1
Carboxin 3F		1	1.5	1.8	0.3	1.2
		2	2.4	2.0	0.9	1.8
PCNB		1	1.8	1.8	1.1	1.6
None		-	2.7	2.4	1.9	2.3
Line mean			2.0	1.9	1.0	1.6
LSD 0.05						
Fungicide			0.5			
Line			0.3			
Fungicide x Line			NS			

1/ Number of stem rot loci(after square root transformation)per 12.2 m x 2-row plot; maximum of one locus per 30 cm of row

2/ Fungicides were applied one or two times after symptoms appeared in the field. Dates were 21 or 25 August and 19 September.

Fungicides performed inconsistently in the three years of the test. In 1980, all fungicide treatments suppressed stem rot compared with the nontreated control (Fig. 3, $P<0.05$), but fungicides did not increase yield. In 1981, fungicide treatment similarly did not influence yield although plots treated with oxycarboxin had fewer disease loci than all other plots ($P<0.01$). In 1982, no fungicide treatment significantly affected stem rot development, and there were no significant differences between plots which were treated with the insecticide chlorpyrifos and those which were not.

Discussion

Fungicides such as PCNB (4) and carboxin (7), and fungicide-insecticide combinations (2, 10, 11) have been reported to suppress southern stem rot on peanut, but chemical control is often inconsistent or uneconomical (6, 16, 17). We found that significant suppression of stem rot with chemicals was not associated with significant increases in yield. Best control of stem rot resulted from use of fungicides and resistance to *S. roflsii* in concert.

Different botanical and morphological types of peanuts have been reported to vary in their resistance to stem rot; additional variation occurs among similar types (1,5). Virginia-type peanuts are generally least susceptible to stem rot (1), but virginia-type peanuts with erect growth habit have been reported either more or less susceptible to stem rot than other virginia-type peanuts(9).

The relationship between canopy morphology and resistance to Sclerotinia blight has been documented in bean (13), and canopy morphology may be one component of resistance to stem rot in peanut. Peanut genotypes with erect growth habit are less likely to have limbs in contact with sclerotia or organic debris which would increase vulnerability to stem rot (3, 8). Erect growth habit or a more open canopy in runner-type peanuts (such as in NC 8C) also allows greater penetration of light and improved air circulation in the canopy, resulting in conditions less favorable for stem rot development (14). Three years of field data presented herein support preliminary reports of resistance to stem rot in NC Ac 18016 (18), which is a virginia-type peanut with erect growth habit.

Results from advanced breeding trials indicated that NC 8C was slightly more resistant to stem rot than Florigiant (19). NC 8C was included in our tests because of its widespread use among growers threatened by CBR; NC 8C again performed slightly better than Florigiant. The performance of NC 8C in these tests does not support its use for stem rot resistance alone, however.

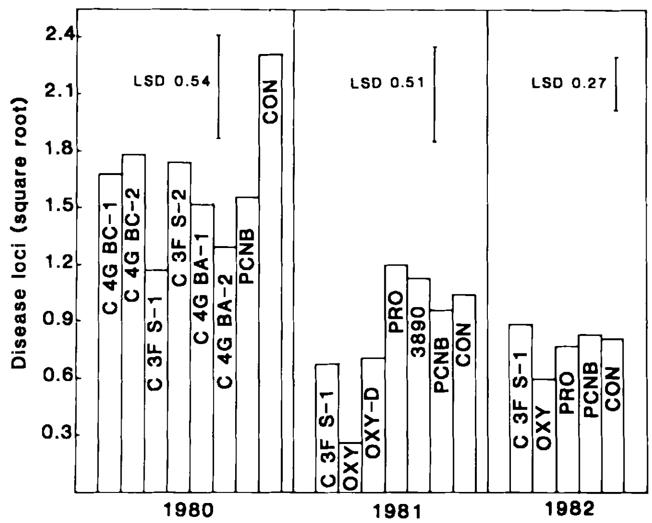

Fig. 3. Number of southern stem rot lesions caused by *Sclerotium rolfsii* per 24 m of peanut row (maximum of one lesion per 30 cm of row) treated with fungicides. Fungicides included C= carboxin 4G or 3F, PCNB, CON = no fungicide, OXY = oxycarboxin, PRO = propiconazol, and 3890 = OAC 3890. Fungicides were used as follows: BC-1, BC-2 = one or two broadcast applications of granular formulations; S-1, S-2 = one or two sprays of flowable or wettable powder formulations; BA-1, BA-2 = one or two banded applications of granular formulations, D = one application made after symptoms appeared (on demand). LSDs are for P = 0.05.

Although low yield potential and small seed size of NC Ac 18016 make it unacceptable for commercial use in North Carolina, NC Ac 18016 may be a good source of stem rot resistance. Other bunch lines or runner lines having relatively open canopy structure should be evaluated for stem rot resistance under field conditions.

Recent efforts to improve stem rot control have focused on the use of fungicides or fungicide-insecticide combinations on relatively susceptible peanut varieties (2,9,16). The additive increment of disease control attained with a moderately resistant line suggests that stem rot could be controlled more effectively and economically on peanut cultivars having higher levels of resistance. The potential for improved stem rot control with fungicides and moderate resistance justifies greater effort in breeding for resistance to *Sclerotium rolfsii* in peanut.

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