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Control of Southern Stem Rot of Peanuts With PCNB Plus Fensulfothion[1]

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ABSTRACT

Previous tests with PCNB for control of Southern stem rot in Georgia have not usually increased peanut yields. Tests were conducted with PCNB, fensulfothion and PCNB plus fensulfothion to determine if increased nematode damage with the use of PCNB might offset disease control with this fungicide. The results showed that PCNB had no effect on nematode numbers, but significantly increased yields only one year out of three. PCNB plus fensulfothion increased yields every year of the three. Field disease counts indicated that PCNB alone and PCNB plus fensulfothion both significantly controlled Southern stem rot. A laboratory test showed that PCNB plus fensulfothion is more toxic to *Sclerotium rolfsii* than PCNB alone. Fensulfothion plus PCNB may increase yields by delaying disease infection, providing better disease control, which was not measurable with dead plant counts, or a combination of these.

Keywords: fungicides, nematicides, lesion nematodes, ethoprop, *Pratylenchus brachyurus*, *Sclerotium rolfsii*.

Southern stem rot, caused by *Sclerotium rolfsii* Sacc., is the most important peanut disease in Georgia. Losses from this disease in 1976 were estimated to be about $31 million, which is 10 percent of the crop value.

Until 1975, the only recommended controls for Southern stem rot in Georgia were the cultural practices of rotation, deep plowing to bury surface litter and to avoid "dirting" of plants during cultivation (2, 3, 6). These practices provide economic control in most fields, but there are many peanut fields in which this disease causes losses in excess of 500 kg. per hectare.

The fungicide pentachloronitrobenzene (PCNB) has been shown to be effective in controlling *S. rolfsii* in other states (4, 7, 16). However, results with this chemical in Georgia have been erratic and a yield increase occurred only one year in a three-year test (8; D.K. Bell, unpublished results). In another Georgia test, yields from plots treated with PCNB plus terrazole were significantly lower than the untreated control (9). Because of these results, PCNB has not been recommended in Georgia for control of Southern stem rot.

Sturgeon and Russell (17) reported that PCNB plus a nematicide increased peanut yields more than the combined increases from PCNB or the nematicide alone. They suggested the possibility of a disease interaction between soilborne fungi and lesion nematodes, *Pratylenchus brachyurus* (Godfrey, 1929) or a synergistic effect with the combination of chemicals. Boswell (1) found that the use of PCNB significantly increased the number of lesion nematodes in peanut shells.

These two reports suggested to me that the erratic results with PCNB in Georgia might be due to a disease complex involving soil fungi and nematodes or an increase in nematode damage may have offset any disease control with PCNB. Therefore, I conducted tests from 1972-1974 with PCNB, O, O-diethyl O - [4-methylsulfinyl) phenyl] phosphorothioate (fensulfothion), a non-fumigant nematicide and insecticide and a combination of these two chemicals. In 1975, the combination of PCNB plus O -ethyl S, S-dipropyl phosphorodithioate (ethoprop) was compared with PCNB plus fensulfothion. Also, I conducted a laboratory test on the effects of PCNB and fensulfothion on the growth of *S rolfsii* in soil plates.

Materials and Methods

Fields tests. These tests were conducted in a field in Tift County, Georgia with a known Southern stem rot problem and a high population of lesion nematodes.

A plot consisted of two rows of the cultivar Florunner, 30.5m long with a 3.05m vacant border at each end with 91cm between rows. Two border rows were along each side of the test area. Plot design was a randomized complete block with six replications. Cultural practices, control of other pests, planting and harvesting followed recommendations for peanuts in Georgia (11).

Treatments in 1972 were PCNB, PCNB plus fensulfothion and an untreated control. In 1973 and 1974, fensulfothion alone was added. In 1975, treatments included PCNB plus fensulfothion; PCNB plus ethoprop and an untreated control.

All treatments were applied at pegging (50-60 days after planting) in a 30.5 cm band over the row. PCNB was applied as a 10% granule at the rate of 12.09 kg/ha (active ingredient); fensulfothion was applied as a 15% granule and ethoprop as a 10% granule at the rate of 3.62 kg/ha (active ingredient).

The number of *S. rolfsii* infection loci were recorded 48 hrs. after digging using the method of Rodriguez-Kabana, Backman, Karr and King (14).

Three grams of peanut shell were collected from each plot immediately after digging. These were fragmented in a blender and incubated 48 hrs. to recover lesion nematodes.

Laboratory tests. This test was conducted by using the soil plate test described by Rodriguez-Kabana, Backman and McCloud (13). Plates were prepared by adding 50cm^3 of a sieved (2mm) sandy loam soil from a peanut field to each of a series of glass dishes. The soil was flattened and five oat kernels infected with *S. rolfsii* (5) were placed radially around a centrally located kernel. PCNB, fensulfothion and PCNB plus fensulfothion granules were then sprinkled over the soil surface at rates equal to those used in the field tests. Each treatment and an untreated control were represented by five plates. Plates wee incubated in 26^{0}C.

The growth of *S. rolfsii* was measured on a scale of 0 (no growth) to 5 (extensive mycelial growth and mature sclerotia) (13). Measurements were taken every 24 hrs. for 5 days.

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Table 1. Effect of PCNB, fensulfothion and PCNB plus fensulfothion on yield of Florunner peanuts and control of *Sclerotium rolfsii*, Tift County, Ga., 1972-74.

Treatment	Rate AI[2] kg/ha	1972 mean yield kg/ha	1973 mean yield kg/ha	1973 S. rolfsii infection loci[3]	1974 mean yield kg/ha	1974 S. rolfsii infection loci[3]
PCNB + fensulfothion	12.09 + 3.62	4058a[1]	3893a	5.2a	5546a	5.2a
PCNB	12.09	3028 b	3567ab	8.1ab	5278ab	7.2a
fensulfothion	3.62	--	3089 bc	8.8ab	4644 b	12.6 b
Control	--	2875 b	2929 c	11.4 b	4510 b	14.2 b

[1]Values within columns followed by the same letter are not significantly different at the 5% level of probability, DMRT.

[2]Rate actually applied in a 30.5cm band.

[3]Infection loci per 30.5m of row.

Results

Field tests. Results from 1972-74 tests are shown in Table 1. The combination of PCNB plus fensulfothion was the only treatment which significantly increased peanut yields over the untreated control during all three years of the study. PCNB significantly increased yields only one year, 1973. In 1972, yield from the combination treatment was significantly greater than PCNB alone. In 1974 and 1972 yield from PCNB alone was not significantly greater than the untreated control.

In 1973, *S rolfsii* infection loci were significantly lower in plots treated with PCNB plus fensulfothion than in the untreated control. PCNB, in 1973, did not significantly reduce disease over the untreated control. In 1974, PCNB plus fensulfothion and PCNB alone, both significantly reduced disease over the untreated control.

The 1975 test (Table 2) was conducted to determine the comparative effectiveness of PCNB plus ethoprop to PCNB plus fensulfothion for the control of Southern stem rot. Ethoprop is as effective in combination with PCNB as fensulfothion for disease control and increasing peanut yields.

PCNB had no significantly effect on lesion nematodes (Table 3). Only fensultothion had an effect on nematode numbers. There was no apparent interaction between *S. rolfsii* and nematodes. Yields and infection loci were significantly correlated (p 0.05: 1973, r = -0.43; 1974, r = -0.72), but there was no correlation between infection loci and nematodes or between infection loci, nematodes and yield.

Laboratory test. The effect of these chemicals on growth of *S rolfsii* is shown in Table 4. There was no observable growth with PCNB plus fensulfothion; PCNB allowed very slight mycelial growth (0.74 growth index) and fensulfothion allowed somewhat more growth with a few sclerotial initials (1.90 growth index). Each of the three chemical treatments were significantly different from each other and the control. A factorial analysis of variance showed a highly significant interaction between PCNB and fensulfothion.

Table 2. Comparison of PCNG plus fensulfothion and PCNB ethoprop for control of Sclerotium rolfsii and their effect on yield of Florunner peanuts. Tift County, Ga., 1975.

Treatment	Rate AI[2] kg/ha	mean yield kg/ha	S. rolfsii infection loci[3]
PCNB + fensulfothion	12.09 + 3.62	4414a[1]	2.8a
PCNB + ethoprop	12.09 + 3.62	4326a	2.6a
Control	--	3578 b	5.9 b

[1]Values within columns followed by the same letter are not significantly different at the 5% level of probability, DMRT.

[2]Rate actually applied in a 30.5cm band.

[3]Infection loci per 30.5m of row.

Table 3. Effect of PCNB, fensulfothion and PCNB plus fensulfothion on lesion nematodes, Pratylenchus brachyurus, in peanut shells.

Treatment	Rate AI[2] kg/ha	number of nematodes/3 gm shells 1973	1974
PCNB + fensulfothion	12.09 + 3.62	64a[1]	15a
fensulfothion	3.62	58a	4a
PCNB	12.09	463 b	52 b
CONTROL	--	589 b	90 b

[1]Values within columns followed by the same letter are not significantly different at the 5% level of probability, DMRT.

[2]Rate actually applied in a 30.5cm band.

Discussion

The results reported here show that PCNB has no

Table 4. Effect of PCNB, fensulfothion and PCNB plus fensulfothion on growth of Sclerotium rolfsii in petri plates containing nonsterile soil. Measurements made 72 hrs. after inoculation; chemicals applied simultaneously with inoculation.

Treatment	Rate AI[3] kg/ha	Growth[1]
Control	--	5.00a[2]
fensulfothion	10.86	1.90 b
PCNB	36.27	0.74 c
PCNB + fensulfothion	36.27 + 10.86	0.0 d

[1]Growth rated on scale of 0-5; 0 = no growth; 5 = extensive mycelial growth, and mature sclerotia.

[2]Numbers followed by different letter are significantly different, 1% level of probability, DMRT.

[3]Broadcast equivalent.

effect on lesion nematodes. This suggests that the erratic performance of PCNB in previous Georgia tests by Bell (unpublished resluts) and Jackson (8, 9) was not related to lesion nematode build up where PCNB was used.

These tests do not answer the question of why PCNB was erratic in previous tests inGeorgia or why PCNB alone did not consistently increase yeilds or control disease in the tests reported here. While PCNB alone did significantly increase yields over the untreated control in 1972, this was only one year. Also, in 1973, PCNB alone did not significantly reduce disease when compared to the untreated control. PCNB plus fensulfothion did significantly increase yields over the untreated control all three years and in 1972, this combination significantly increased yields over PCNB alone.

There is no obvious explanation here of why PCNB plus fensulfothion consistently increases yields and controls disease while PCNB alone does not. However, my laboratory test and other research with fensulfothion and Southern stem rot suggest some possibilities.

My laboratory test comfirms reports by Rodriguez-Kabana and Buckman (12) and Rodriguez-Kabana, Backman, Karr and King (15) that fensulfothion is toxic to *S. rolfsii*. They found that fensulfothion controlled Southern stem rot in the field up to 122 days after planting (15). In my laboratory test, the combination of fensulfothion plus PCNB reduced the growth of *S rolfsii* more than PCNB alone. The fungus growth measurements are probably more precise than field disease counts. It could be that the disease counts are not precise enough to separate the possibility better disease control with the combination of chemicals.

Fensulfothion apparently does delay fungus infection (15). The system of disease rating after harvest, based on dead plants, may not account for the lesser damage from rotting resulting from infection during the last 10-12 days prior to harvest. I have noticed that all pods on dead plants are not rotten. This could account for enough kilograms of pods per hectare to make the difference.

Another possibility is that the combination of chemicals controls the pod rot stage of Southern stem rot better than PCNB alone. Pods and pegs may become infected independently of stem rot infection (10). Thus, plants which are not dead at harvest may have lost significant yield thru pod and peg rot.

Fensulfothion is also a soil insecticide. As such, it might reduce insect injury which could provide portals of entrance for *S rolfsii*. While this possibility cannot be completely eliminated, if insect injury did play a part in the effectiveness of PCNB plus fensulfothion, it was negligible. No obvious insect injury was noted as the test plots were monitored by an entomologist.

I suggest that fensulfothion plus PCNB (and ethoprop plus PCNB) gives more effective disease control, when measured by harvestable product, by extending the length of effective control, by slowing down the rate or degree of pathogenicity during the entire season, or a combination of these.

References

1. Boswell, T.H., 1968. The pathogenicity of *Pratylenchus brachyurus* to spanish peanuts. Ph. D. Dissertation. Texas A&M University, College Station. 156 pp.

2. Boyle, L.W., 1958. Fundamental concepts in development of control practices for Southern blight and root rot of peanuts. Plant Disease Reptr. 40: 661-665.

3. Boyle, L.W., 1961. The ecology of *Sclerotium rolfsii* with emphasis on the role of saprophytic media. Phytopathology 51: 118-119.

4. Cooper, W.E., 1956. Chemical control of Sclerotium rolfsii in peanuts. (abstr.) Phytopathology 46: 9.

5. Epps, W.M., J.C. Patterson and I.E. Freeman. 1951. Physiology and parasitism of *Sclerotium rolfsii*. Phytopathology 41: 245-256.

6. Garren, K.H. 1958. The effects of deep covering of organis matter and non-dirting weed control on peanut stem rot. Plant Disease Reptr. 42: 629-636.

7. Harrison, A.L. 1961. Control of *Sclerotium rolfsii* with chemicals. Phytopathology 51: 124-128.

8. Jackson, C.R. 1967. Evaluation of Terraclor Super-X for control of soilborne pathogens of peanuts in Georgia. Univ. of Ga. Res. Rept. 4.

9. Jackson, C.R. 1967. Effects of preplanting soil treatments on peanut losses and reduction of pod mycoflora in Georgia. Plant Disease Reptr. 51: 461-464.

10. Jackson, C.R. and D.K. Bell. 1969. Diseases of peanut (groundnut) caused by fungi. Research Bull. 56. University of Georgia. 137 pp.

11. McGill, F., R.J. Henning, L.E. Samples, J.C. French and S.S. Thompson. 1974. Growing Peanuts in Georgia. Univ. of Ga. Coop. Ext. Serv. Bull. 640. 46 pp.

12. Rodriguez-Kabana, R. and P.A. Backman. 1974. Selective activity of two contact nematicides on *Sclerotium rolfsii* and *Trichoderma* spp. (abstr.) Proc. Am. Phytopathol. Soc. 1: 70.

13. Rodriguez-Kabana, R., P.A. Backman and Carol McCloud. 1975. A soil plate method for rapid screening of pesticides against Sclerotium rolfsii. Plant Disease Reptr. 59: 439-442.

14. Rodriguez-Kabana, R., P.A. Backman and J.C. Williams. 1975. Determination of yield losses to *Sclerotium rolfsii* in peanut fields. Plant Disease Reptr. 59: 855-858.

15. Rodriguez-Kabana, R., P.A. Backman, G.W. Karr, Jr. and Peggy S. King. 1976. Effects of the nematicide fensulfothion on soil-borne pathogens. Plant Disease Reptr. 60: 521-524.

16. Sturgeon, R.V. 1973. Evaluation of methods of applying soil fungicides for control of soil fungi on spanish peanuts. J. Am. Peanut Res. and Ed. Assoc. 5: 175-181.

17. Sturgeon, R.V. and C.C. Russell. 1971. Spanish peanut yield responses to nematicide-soil fungicide combinations. J. Am. Peanut Res. and Ed. Assoc. 3: 29-30.