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Suppression of Peanut Stem Rot with the Insecticide Chlorpyrifos[1,2,4]

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ABSTRACT

The insecticide chlorpyrifos is registered for use in peanuts for control of stem and foliage feeding insects. Field research showed that insecticidal use rates also reduced stem rot in peanuts caused by *Sclerotium rolfsii* Sacc. as effectively as registered fungicides. Laboratory studies indicated a synergism between the active and the inert ingredients of the emulsifiable concentrate formulation (Lorsban[R] 4EC) in suppression of *S. rolfsii.*

Key Words: *Arachis hypogaea*, groundnut, Southern blight, white mold, nontarget effects.

Integrated pest management is recognized as an economic and environmental necessity for the continued development of agriculture. One of the mechanisms for achieving this goal is to optimize nontarget effects of pesticides for the overall benefit of the crop. Southern stem rot (Southern blight or white mold) caused by *Sclerotium rolfsii* Sacc. causes the greatest yield losses of any peanut disease in the United States (11). Pentachloronitrobenzene (PCNB) is the only fungicide with a federal label for stem rot control and is only 40-60% effective (1). State labels or labels granted under section 24(C) of FIFRA have been secured for carboxin, combinations of PCNB plus fensulfothion, and PCNB plus ethoprop. The combination labels rely on the reported fungistatic activities of the two insecticice-nematicides, fensulfothion and ethoprop (6, 7, 10). The insecticide chlorpyrifos (Lorsban[R], Dow Chemical Co., Midland, MI) and its chemically related derivatives also exhibit fungicidal activities (5). However, thse activities have not been exploited commercially.

Preliminary tests in 1978 indicated that stem rot severity in peanuts might be reduced by chlorpyrifos (4). The present study expands on the original report and indicates the usefulness of chlorpyrifos in an Integrated Pest Management (IPM) program for peanuts.

Materials and Methods

Locations for studies were selected from fields with a history of stem rot losses. Florunner cultivar peanuts were planted and maintained under a typical cultural and pest control program. Seventy to eighty days after planting, pesticides were applied for stem rot control. Typically this occurred in mid-July, just prior to the rainy season. Plots were 2 rows by 10 m with rows planted on 0.9 m centers. All treatments were replicated eight times.

Stem rot control tests always included a fungicide recommended for stem rot control and the chlorpyrifos treatments under study. PCNB 10% granules 112 kg/ha (Terraclor[R], Olin Corporation, Little Rock, AR) or carboxin 3F 3.4 L/ha (Vitavax[R], Uniroyal Chemical Co., Naugatuck, CT) were compared to chlorpyrifos 4EC applied at 2.27 or 3.4 L/ha. PCNB granules were applied in a 30 cm band over the center of the row with a granular spreader. Carboxin and chlorpyrifos were applied with a ground sprayer, operating at 9.0 kg/cm^2 and delivering 40 L/ha in a 15-cm band. Liquid sprays were directed by positioning two 8008 fanjet nozzles on a "drop" 4-6 inches above the ground, below much of the peanut foliage (2). This method of application assures treatment of the peanut crown. Numbers of disease loci (dead areas $\leq$ 30 cm = 1 locus) showing signs of *S. rolfsii* were counted just prior to harvest (8) and were related to treatment. Results from field trials were analyzed using Duncan's Multiple Range Test (9).

The growth of *S. rolfsii* and *Rhizoctonia solani* was determined on potato dextrose agar (PDA) supplemented with chlorpyrifos and/or the chlorpyrifos 4EC formulation ingredients; the following media were prepared: 1) PDA without ammendments, 2) PDA containing the Lorsban 4EC formulation at a rate of 60 mg/L of chlorpyrifos, 3) PDA containing 60 mg/L of technical grade chlorpyrifos, and 4) PDA containing the same amount of inert ingredients (formulation blank) as medium 2, but without the chlorpyrifos. Six plates of each medium were inoculated with 9-mm-plugs of *S. rolfsii* obtained from the margins of a culture growing actively on PDA. Cultures were incubated at 30 C and diametric growth was recorded daily; where D = (longest axis + shortest axis) ÷ 2.

Results

Data developed in field trials over a 3-year period indicated that chlorpyrifos 4EC consistently suppressed stem rot damage in peanuts (Table 1). In addition, control of stem rot was at least as good as that achieved with labelled fungicides. Yields are not presented because of the confounding effect of the insecticidal activity of chlorpyrifos. The relationship of stem rot severity to yield has been reported (8). Laboratory tests indicated that *S. rolfsii* continued to grow in media containing high concentrations of chlorpyrifos 4EC, but the rate of growth was markedly suppressed (Fig. 1A). When technical chlorpyrifos was compared to the formulated product, and the formulation blank, only the full formulation suppressed *S. rolfsii* growth. Similar studies conducted with *R. solani* indicated a similar pattern of growth suppression with the com-

Table 1. Effects of chlorpyrifos and recommended fungicides on severity of stem rot in peanuts.

	Stem Rot Loci/30 M Row			
Treatment	1978	1979	1980	MEAN
Control	9.3 a	3.1 a	8.8 a	7.1
Recommended Fungicide*	5.5 b	2.5 ab	6.0 ab	4.7
Chlorpyrifos 4 EC	4.8 b	0.7 b	4.0 b	3.2

Means within columns followed by the same letter are not significantly different (P = 0.05) using Duncan's Multiplle Range Test.

* 1978 = Vitavax 3F; 1979 and 1980 = Terraclor 10G.

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mercial formulation, but not with the formulation components (Fig. 1B).

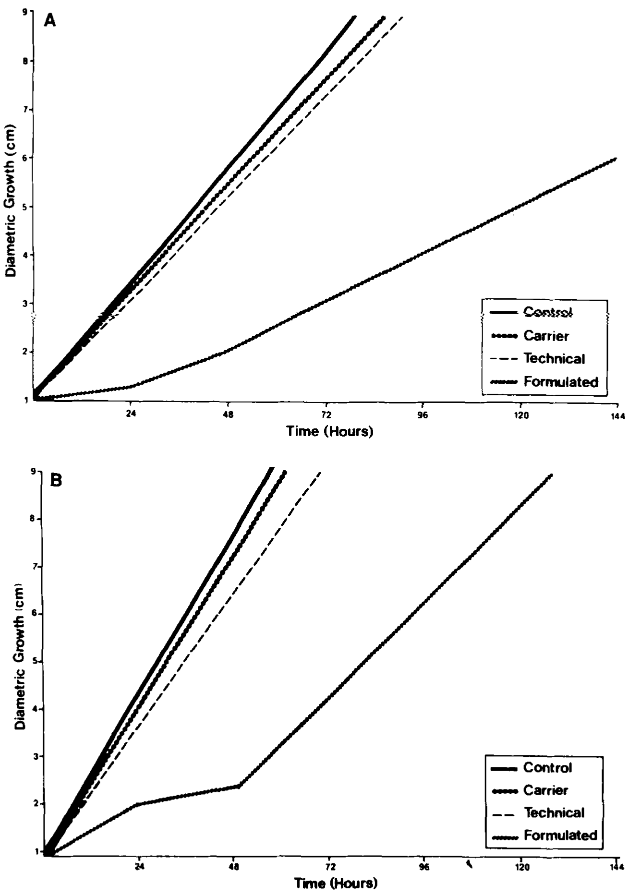

Fig. 1. (A) The effects of chlorpyrifos (60 ppm) incorporated in PDA on diametric growth of *Sclerotium rolfsii;* and (B) The effects of chlorpyrifos incorporated in PDA (60 ppm) on diametric growth of *Rhizoctonia solani.*

Discussion

Field trials indicate that chlorpyrifos significantly reduces peanut losses from *S. rolfsii,* and that the suppression of this fungal disease is at least as good as that afforded by commercial fungicides labelled for stem rot control. A tolerance for chlorpyrifos in peanuts was recently granted by the Environmental Protection Agency (3). Registrations for its use as an insecticide in peanuts are forthcoming, with some state labels (sec. 24(C) of FIFRA) having already been granted. The rates used in this study (2.2 - 3.3 l/ha of the 4EC formulation) are typical of those used to control insects.

The data presented in Figures 1 and 2 indicate that growth of *S. rolfsii* and *R. solani* in amended agar continues even in the presence of high rates of Lorsban. However, these results do indicate that growth rates were reduced, but only in the presence of both the "inert ingredients" and the chlorpyrifos. These inert ingredients include surfactants, emulsifiers, etc., that would not be found in granular formulations. It might be anticipated that the antifungal activity of chlorpyrifos formulated as a granule would be lower than that reported here for the emulsifiable concentrate. Further research should be conducted on the efficacy of other formulations (particularly granular chlorpyrifos) and for their effects on other fungi pathogenic to peanuts.

In addition to the data presented here, Hammond (4) has reported growth suppression in vitro of *Sclerotinia sclerotiorum, Pythium* sp. and *Fusarium* sp. by chlorpyrifos. The use of chlorpyrifos in a comprehensive IPM program for peanuts could reduce both the numbers and quantity of pesticides applied. Advantages to the farmer would be afforded through reduced pesticide cost, and fewer pest control operations.

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