Economic Benefits of Selected Granular Insecticides for Control of Lesser Cornstalk Borer in Nonirrigated Peanut[1]

M. E. Gilreath, J. E. Funderburk*, D. W. Gorbet, D. J. Zimet, R. E. Lynch, and D. C. Herzog[2]

ABSTRACT

Selected prophylactic applications of granular insecticides were evaluated during 1985, 1986, and 1987 in North Florida for efficacy against lesser cornstalk borer (LCB), *Elasmopalpus lignosellus* (Zeller), effects on peanut seed yield and quality, and net economic return. Chlorpyrifos 15G, ethoprop 15G, and fonofos 10G were applied as band treatments over the row at various rates and times during the growing season. Dichloropropene was applied for separation of nematode effects alone and in combination with selected insecticides as an injection treatment 6 or 7 days before planting. Mean percentage of peanut plants infested with LCB larvae did not exceed 5% in any treatment, including the control, in any year. Mean densities of emerging LCB adults estimated from over-the-row wire traps did not exceed 1.2. moths per meter of row from early flowering until one month after scheduled harvest in any treatment during the study. No differences in LCB densities were detected among treatments. However, several treatments significantly improved peanut seed yield or quality in individual years and resulted in economic returns greater than the costs of treatment.

Key Words: *Arachis hypogaea*, *Elasmopalpus lignosellus*, soil insecticides, yield, quality, chlorpyrifos, ethoprop, fonofos, dichloropropene.

The lesser cornstalk borer (LCB), *Elasmopalpus lignosellus* (Zeller) (Lepidoptera: Pyralidae), is a key pest of peanut in the New World (27). The species is well adapted to sandy, well-drained soils typical of most peanut production areas in the U.S. (4,18). Outbreaks of LCB and subsequent crop injury occur frequently during periods of hot, dry weather (18,27). Although the population dynamics of LCB in peanut are poorly understood, multiple generations are typical (1), and larval infestations can occur during any stage of peanut growth (22). Numerous soil pests in addition to LCB may affect peanut yield and qualtity, including wireworms

---

[1] The research was supported in part by a Cooperative Agreement No. 58-43YK-7-0034 between the USDA-ARS and the University of Florida. Fla. Agric. Exp. Sta. Journal Series No. 9605.

[2] Environmental Specialist, Fla. Dept. Agric. & Cons. Serv., Tallahassee, Fla; Assistant Professor, N. Fla. Res. & Educ. Ctr., Quincy, Fla; Professor, Agric. Res. & Educ. Ctr., Marianna, Fla.; Assistant Professor, N. Fla. Res. & Educ. Ctr., Quincy, Fla.; Research Leader, Insect Biol. & Popn. Mgmt. Lab., ARS-USDA, Tifton, Ga.; and Professor and Center Director, N. Fla. Res. & Educ. Ctr., Quincy, Fla.

*Corresponding Author.

Peanut Science (1989) 16:82-87

(Elateridae), rootworms (*Diabrotica* spp.), white grubs (Scarabaeidae), and nematodes (23,27), among others. Rootknot nematodes (*Meloidogyne* spp.) are the most serious nematode pests of peanut, causing yield losses as great as 90% (23). Because of the cryptic nature of soil pests it is time consuming and often difficult to accurately assess population density, damage, and economic importance of each pest.

Economic injury levels have been determined and a binomial sampling program developed for LCB infestations in seedling grain sorghum (5). Although this sampling program was efficient and technically feasible, the cost of sampling exceeded the cost of prophylactic treatment with currently available insecticides. Laboratory studies have shown that peanut yield decreases linearly with increasing LCB density (20), and field studies have reported decreases in yield as a result of LCB injury (2,3,19,28). There is a lack of information, however, on effective management strategies for LCB and other soil pests in peanut. Economic injury levels and reliable, economical sampling procedures suitable for scouting programs are not available.

Low soil moisture limits percolation and inhibits contact of insecticides with subterranean insects. Although the southeastern U.S. usually receives adequate rainfall for peanut production, rainfall during certain periods of peanut growth often is less than desirable, and lengthy droughts sometimes occur. Chemical control of soil insects, such as the LCB, historically has been more difficult under dry conditions than under irrigation (1,25,29). This can be of particular concern for LCB, because dry periods are conducive to LCB outbreaks (4,19). Because of informational shortfalls and technical difficulties associated with management of soil pests in peanut, most producers rely on prophylactic rather than as-needed insecticide application to manage these pests under dryland production situations. Management schemes are needed to provide consistent control of LCB and other soil pests under dry or variable moisture conditions. In addition, the economic benefits of these controls need evaluation. Consequently, our purpose was to evaluate selected granular insecticides for efficacy against LCB, peanut yield and quality effects, and economic returns in nonirrigated peanut. Treatments of a soil fumigant alone and in combination with selected insecticides were included to separate the effects of insect and nematode injury on peanut yield and quality.

Materials and Methods

Florunner peanuts were planted in a randomized complete block design with six replicates on 10 May 1985 and 30 May 1986 at sites adjacent to the Dozier School for Boys in Jackson County, Fla., and on 18-19 May 1987 at the Agricultural Research and Education Center, Marianna, in Jackson County. Conventional production practices were followed each year for fertilization, weed control, and disease control. The soil type at the 1985 and 1986 sites was a Tifton loamy sand with organic matter content of 0.97 to 1.43%. Both sites were in pasture at least 15 years prior to this study. The soil type in the 1987 site was an Orangeburg sandy loam with organic content of 0.97 to 1.77%. The 1987 site was unmanaged fallow in 1985-1986, following peanuts in 1984. Plot size was 4 rows by 10.7 m in 1985, 4 rows by 9.8 m in 1986, and 4 rows by 12.2 m in 1987, with 0.9-m row spacing each year.

Treatments consisted of various rates and application schedules of the following granular insecticides: chloropyrifos (0,0-diethyl 0-3,5,6-trichloro-2-pyridyl phosphorothioate; Lorsban 15G; The Dow Chemical Co., Midland, MI); ethoprop (0-ethyl 5.5-diproyl phosphoro-dithioate; Mocap 15G; Rhone-Poulenc Ag. Co., Research Triangle Park, NC); and fonofos (0-ethyl S-phenyl ethylphosphonodithioate; Dyfonate 10G; Stauffer Chemical Co., Mountain View, CA). Selected treatments were applied alone and in combination with a preplant application of the soil fumigant dichloropropene (1,3-dichloropropene; Telone II; The Dow Chemical Co., Midland, MI). All insecticides were applied in a 25 to 30-cm band over the row. Treatments applied at planting were lightly incorporated into the upper 2 to 3 cm of soil, while treatments made later in the growing season were applied over the row when foliage was dry. Dichloropropene was injected under the row 6 or 7 days before planting at a depth of 20 to 25 cm with a gravity-flow, soil-fumigant applicator equipped with a single chisel centered in each row. All treatments were applied to entire plots.

Lesser cornstalk borer populations were monitored each year with adult emergence traps made of wire screen with 1.2-mm openings (19). Traps were placed over the two outer rows of peanuts in each plot and anchored at the lower edges with soil. Each trap was 42-cm wide, centered over the row (approximate width of pegging zone), and covered a 72-cm length of row. Emergence traps were placed in the field immediately after application of treatments. Traps were checked two or three times each week until approximately one month after the center two rows were harvested, thereby allowing larvae present at harvest to complete development. Traps were moved to new locations approximately every four weeks to correspond to LCB developmental time. Analysis of variance (26) was conducted for each set of data by trap check date and for trap catch totals over each growing season.

The extent of infestation by LCB larvae in each treatment was estimated approximately biweekly from the time of peanut plant emergence through harvest. Five plants from the two outer rows of each plot were uprooted and examined for LCB larvae and the number of infested plants recorded.

The two center rows of each plot were dug on 23 September 1985, 17 October 1986, and 2 October 1987, thrashed 3-4 days later, and dried to 8% moisture before weighing. A randomly collected 200-g sample of pods from each plot was graded for seed quality analyses. The percentage of total sound mature kernals (% TSMK) was determined from the 200-g pod sample by summing the weight of mature whole seeds that did not pass through a 0.6 x 2.54 cm screen plus the weight of split seeds over 0.6 cm in length divided by the total sample weight (200 g). All data were subjected to an analysis of variance (26), and significantly different means were separated by Duncan's (9) new multiple range test ($P<0.05$). The value of production was calculated for each treatment each year by multiplying the support price for 1985, 1986, and 1987 ($ 0.008736, 0.009480, and 0.009776, respectively) x yield (kg) x % TSMK. The change in value then was calculated by difference from the control. Net returns were determined as the change in value minus the cost of treatment.

Results and Discussion

Sporadic infestations of LCB larvae were observed throughout each growing season during this study. These results support conclusions by Funderburk *et al.* (11) from adult seasonal abundance information that multiple generations occur in peanut fields and that fluctuations in population density occur temporally during the growing season. Because LCB densities were low and populations occurred sporadically during the growing seasons, differences in short- and long-term residual efficacy of the insecticide treatments could not be evaluated. Other techniques have been developed to evaluate efficacy under field conditions (21) and should be employed in future studies to access the residual efficacy of insecticides in the peanut agroecosystem.

Moth emergence in the traps was low (Table 1) during the study. There were no significant differences for individual trap check dates or for combined data during the three seasons. Total emergence through each growing season did not exceed 1.2 moths per meter of row (by extrapolation and addition of data from the untreated control and dichloropropene treatments for time periods before other treatment were applied). Lesser cornstalk borer larval densities cannot be accurately estimated from adult emergence data because of the unassessed effects of environmental factors, natural enemies, and injury from mechanical placement of emergence traps (4,16,30). Low

Table 1. Mean number of lesser cornstalk borer adults emerging and trapped in selected insecticide treatments in experiments conducted during 1985, 1986, and 1987 in Jackson Co., Florida.

Treatment and Rate (AI)/ha		Application Time (Days from Planting)	Mean No. Adults/m of Row[1]					
			1985		1986		1987	
			17 Jun to 16 Jul	17 Jul to 10 Oct	27 Jun to 7 Jul	8 Jul to 25 Nov	22 Jun to 16 Jul	17 Jul to 5 Nov
1. Chlorpyrifos	2.24 kg	0	—	—	0	0.99	0.22	0.66
2. Chlorpyrifos	2.24 kg	28 to 35	—	—	0	0	0.11	0.43
3. Chlorpyrifos	2.24 kg	41 to 60	—	0	—	0.22	—	0.24
4. Chlorpyrifos	1.12 kg	26						
	+1.12 kg	92	0.22	0.09	—	—	—	—
5. Chlorpyrifos	2.24 kg	0						
	+1.12 kg	41 to 59	—	—	0	0.11	0.22	0.45
6. Ethoprop	2.24 kg	41 to 60	—	0	—	0.22	—	—
7. Ethoprop	3.36 kg	41 to 60	—	0	—	0.66	—	0.21
8. Fonofos	2.24 kg	41 to 60	—	0	—	0.22	—	0.88
9. Dichloropropene	43.0 l	-7 to -6	0.83	0.17	0.22	0.88	0.11	0.55
10. Dichloropropene	43.0 l	-7 to -6						
+ Chlorpyrifos	2.24 kg	41 to 60	—	0.09	—	0.43	—	0
11. Dichloropropene	43.0 l	-7 to -6						
+ Ethoprop	2.24 kg	41 to 60	—	0	—	0.99	—	—
12. Untreated Control	—	—	0.36	0.17	0.11	0.88	0.11	0.43

[1] There were no significant differences ($P < 0.05$, F test) among means in columns. Dash indicates that no data were taken either because application timing had begun or treatment was not included in experiment that year.

moth emergence, however, corresponded well with observed low larval infestation levels in each treatment. Random plant sampling revealed less than 5% infested plants in all treatments throughout each growing season.

Mack and Backman (19) employed emergence trapping procedures in seasonal abundance studies to estimate LCB density in peanuts grown in Alabama. Moth emergence densities were comparable to those in our study, although higher densities were noted by Mack and Backman (19) especially during one growing season. Larval density and adult emergence were related in their study, but no statistical correlation between larval density and adult emergence was reported. Similarly, the relationship between larval density and adult emergence were not correlated in the present study.

Periodic soil-sift samples revealed that densities of individual pest species were low each growing season and undoubtedly did not have a major impact on yield or quality. However, populations of several soil-pest species were present each year and the combination of injury collectively may have contributed to seed yield or quality reduction. Soil pests other than LCB sometimes noted in the soil-sift samples included wireworms, white grubs, and whitefringed beetle larvae (*Graphagnathus* spp.), but densities of each were very low in all treatments on all sample dates. Injury from soil pests has a direct effect on peanut pods and kernels, and low densities can affect yield and quality (27).

Overall yields were higher in 1985 and 1986 than in 1987 (Table 2). Yield differences among treatments were noted during two of the three years. Some treatments included in the analyses are not reported here, although complete yield results for each year are available (10,12,13). In 1985, all treatments reported in Table 2 resulted in numerically higher yields than the untreated control. Chlorpyrifos applied 55 days after planting (DAP), dichloropropene applied 7 days before planting (DBP) + chlorpyrifos applied 55 DAP, and dichloropropene applied 7 DBP + ethoprop applied 55 DAP significantly increased yield over that for the untreated control.

In 1986, no significant differences in yield from the untreated control were noted. Treatments with numerically higher yields than the control were chlorpyrifos applied at planting + 41 DAP and fonofos applied 41 DAP.

In 1987, only two treatments significantly increased peanut yields over the untreated control; fonofos applied 60 DAP, and dichloropropene applied 7 DBP + chlorpyrifos applied 60 DAP. All other treatments resulted in numerically greater yields, but were statistically similar to the control.

Comparisons of treatments that included dichloropropene with similar treatments excluding the soil fumigant provide useful information for speculation on yield response as a result of preplant versus postplant control of nematodes, soil pests, and other organisms. Based on comparison of the dichloropropene treatment alone with the untreated control, nematodes and other organisms that might have been present before planting did not significantly suppress yield in any year. Comparisons of the dichloropropene treatment with combination treatments of dichloropropene plus either chlorpyrifos or ethoprop suggest that postplant infestations of soil insects and other organisms suppressed yield

Table 2. Mean seed yield and mean seed quality for selected insecticide treatments in experiments conducted during 1985, 1986, and 1987 in Jackson Co., Florida.

		Application Time	Yield (kg/ha)[1]			Seed Quality (% TSMK)[1]		
Treatment and Rate (AI)/ha		(Days from Planting)	1985	1986	1987	1985	1986	1987
1. Chlorpyrifos	2.24 kg	0	——[2]	5687 abcd	3557 bc	——	79.5 a	77.1 ab
2. Chlorpyrifos	2.24 kg	28 to 35	——	5696 abcd	3634 abc	——	80.3 a	73.7 d
3. Chlorpyrifos	2.24 kg	41 to 60	7337 ab	5794 abcd	3828 abc	77.6 c	80.5 a	75.5 abcd
4. Chlorpyrifos	1.12 kg	26	6962 bcdef	——	——	79.4 ab	——	——
	+1.12 kg	92						
5. Chlorpyrifos	2.24 kg	0	——	6120 a	3629 abc	——	80.0 a	75.3 bcd
	+1.12 kg	41 to 59						
6. Ethoprop	2.24 kg	41 to 60	6993 bcde	5637 cd	——	78.3 abc	79.8 a	——
7. Ethoprop	3.36 kg	41 to 60	7082 abcde	5832 abcd	3622 abc	78.5 abc	79.6 a	75.4 abcd
8. Fonofos	2.24 kg	41 to 60	6880 cdef	5899 abcd	4092 a	79.4 ab	80.4 a	77.5 a
9. Dichloropropene	43.0 l	-7 to -6	6836 def	5739 abcd	3890 abc	79.7 a	79.5 a	76.5 abc
10. Dichloropropene	43.0 l	-7 to -6						
+ Chlorpyrifos	2.24 kg	41 to 60	7310 abc	5654 bcd	4066 ab	79.3 ab	80.2 a	77.2 ab
11. Dichloropropene	43.0 l	-7 to -6						
+ Ethoprop	2.24 kg	41 to 60	7233 abcd	5531 d	——	79.0 abc	79.8 a	——
12. Untreated Control	——	——	6718 ef	5844 abcd	3513 c	78.9 abc	79.0 a	74.8 cd

[1] Means in the same column followed by the same letter are not significantly different ($P < 0.05$) according to Duncan's (9) New Multiple Range Test. (1955). Letters are taken from original analyses (10,12,13), with only selected treatments shown here.

[2] Dash indicates that treatment was not included in experiment that year.

significantly in 1985, but not in 1986 or 1987. The significant response of yield to the dichloropropene + chlorpyrifos treatment but not to either treatment alone in 1987 suggests that combined preplant and postplant infestations contributed to yield differences but that neither preplant nor postplant infestations were significant alone.

Seed quality (% TSMK) was consistently very good all 3 years of the study (Table 2). All treatments were statistically similar in seed quality to the untreated peanuts in 1985 and 1986. In 1987, treatments of chlorpyrifos applied at planting only, fonofos applied 60 DAP, and dichloropropene applied 7 DBP + chlorpyrifos applied 60 DAP had significantly better grades than the untreated peanuts. Treatments including dichloropropene were always in the higher % TSMK groupings in each of the 3 years. Although dichloropropene alone resulted in increased seed quality in comparison to untreated peanuts each year, the increases were not significant.

Interpretation of yield and seed quality data are complicated by the possibility of multiple effects by each chemical employed. Although dichloropropene is used most commonly as a nematicide, as a soil fumigant it also affects other soil organisms present at the time of treatment, such as insects (wireworms, white grubs, etc.), fungi, and bacteria. In addition, each of the granular insecticides utilized in this study has been reported to have anti-fungal activity (6,7,8,14,15,24). There is also the possibility of direct treatment effects on peanut growth and production.

The cost of treatment used in calculation of economic benefits was based on the actual market value of each material plus a standardized application cost (Table 3). Application costs for at-planting applications were considered planting expenses. The estimates of increased value reflect the actual increase in production value based upon yield and quality resulting from each treatment, without considering the cost associated with the treatments. The net return represents the economic benefit of each treatment or the difference in the change in value once the costs associated with each treatment are considered. Numerous treatments resulted in positive net returns in 1985 and 1987, but not in 1986. Treatments resulting in the greatest average net return over 1985, 1986, and 1987 were fonofos and chlorpyrifos applied 41 to 60 DAP followed closely by a chlorpyrifos split application (26 DAP + 92 DAP). Other treatments resulting in positive average net returns were ethoprop applied 41 to 60 DAP, the other chlorpyrifos split application (planting + 41 to 59 DAP), dichloropropene applied 6 or 7 DBP, and dichloropropene applied 6 or 7 DBP + chlorpyrifos applied 41 to 60 DAP.

Prophylactic application of certain soil insecticides frequently resulted in an economic return greater than the

Table 3. Economic return for selected insecticide treatments in experiments conducted during 1985, 1986, and 1987 in Jackson Co., Florida.

Treatment and Rate (AI)/ha	Application time (Days from planting)	Cost of treatment ($/ha)[1]	Change in Value ($/ha)			Net Return ($/ha)			
			1985	1986	1987	1985	1986	1987	Avg.
1. Chlorpyrifos 2.24 kg	0	51.03	——[2]	- 90.63	112.16	——	-141.66	61.13	- 40.26
2. Chlorpyrifos 2.24 kg	28 to 35	53.08	——	- 40.64	49.41	——	- 93.72	- 3.67	- 48.70
3. Chlorpyrifos 2.24 kg	41 to 60	53.08	343.36	44.95	256.56	290.28	- 8.13	203.40	161.88
4. Chlorpyrifos 1.12 kg	26	55.16	198.61	——	——	143.45	——	——	143.45
+1.12 kg	92								
5. Chlorpyrifos 2.24 kg	0	78.60	——	264.73	102.57	——	186.13	23.97	105.05
+1.12 kg	41 to 59								
6. Ethoprop 2.24 kg	41 to 60	32.63	152.91	-112.28	——	120.28	-144.91	——	- 12.32
7. Ethoprop 3.36 kg	41 to 60	47.92	226.16	24.19	100.96	178.24	- 23.73	53.04	69.18
8. Fonofos 2.24 kg	41 to 60	45.52	141.72	119.49	531.45	96.20	73.97	485.93	218.70
9. Dichloropropene 43.0 l	-7 to -6	112.58	129.12	- 51.44	340.36	16.54	-164.02	227.78	26.77
10. Dichloropropene 43.0 l	-7 to -6	165.66	443.63	- 77.98	499.82	267.97	-243.64	334.16	119.50
+Chlorpyrifos 2.24 kg	41 to 60								
11. Dichloropropene 43.0 l	-7 to -6	145.21	361.32	-192.47	——	216.11	-337.68	——	- 60.79
+Ethoprop 2.24 kg	41 to 60								

[1] Based upon 1988 prices and an application cost of $2.05 per application. At-plant granular applications were charged cost of material only.

[2] Dash indicates that treatment was not included in experiment that year.

cost of treatment; thus, prophylactic treatments should be an important economic consideration for peanut producers. Economic benefits primarily were the result of increases in seed yield, rather than seed quality. The average economic return over the 3 years of experimentation was substantial for some treatments; however, no individual soil insect pest exceeded currently recommended economic thresholds in Florida (17). Economic returns undoubtedly would be greater in situations where populations of soil pests reach outbreak levels. Effects on seed quality also may be substantial under such conditions. Additional years of experimentation are needed to refine long-term economic benefits of individual treatments.

The compatability of prophylactic insecticide application with integrated pest management programs of peanuts has not been fully assessed. Application of insecticide in this manner could result in excessive contamination of the environment and disruption of nontarget populations, and we emphasize the need for future research to address these and other informational shortfalls asssociated with management of soil pests in peanut.

Literature Cited

1. All, J. N. and R. N. Gallaher. 1977. Detrimental impact of no-tillage corn cropping systems involving insecticides, hybrids, and irrigation on lesser cornstalk borer infestations. J. Econ. Entomol. 70:361-365.
2. Berberet, R. C., R. D. Morrison, and R. G. Wall. 1979. Yield reduction caused by the lesser cornstalk borer in nonirrigated Spanish peanuts. J. Econ. Entomol. 72:526-528.
3. Berberet, R. C., R. G. Wall, and D. C. Peters. 1986. The lesser cornstalk borer: a key pest of peanuts in Oklahoma. Oklahoma Agric. Exp. Sta. Bull. B-778.
4. Carrola, H. L. 1984. Edaphic studies on the population biology of the lesser cornstalk borer [*Elasmopalpus lignosellus* (Zeller)]. Ph.D. Dissertation. Texas A&M University, College Station.
5. Cheshire, Jr., J. M., J. E. Funderburk, D. J. Zimet, T. P. Mack, and M. E. Gilreath. 1989. Economic injury levels and binomial sampling program for lesser cornstalk borer (Lepidoptera:Pyralidae) in seedling grain sorghum. J. Con. Entomol. 82:(270-274).
6. Csinos, A. S. 1984. Evaluation of the insecticide chlorpyrifos for activity against southern stem rot of peanut. Peanut Sci. 11:98-102.
7. Csinos, A. S. 1985. Nontarget activity of chlorpyrifos and hydrolysis products on *Sclerotium rolfsii*. Plant Dis. 69:254-256.
8. Csinos, A. S., and C. R. Andress. 1985. White mold, *Sclerotium rolfsii*, suppression in peanuts by fonofos (Dyfonate) soil insecticide treatments. Proc. J. Amer. Peanut Res. and Ed. Assoc. 17:95 (Abstr.).
9. Duncan, D. B. 1955. Multiple range and multiple F tests. Biometrics. 11:1-42.
10. Funderburk, J. E., M. E. Gilreath, D. W. Gorbet, and d. C. Herzog. 1987a. Lesser cornstalk borer control in peanuts in North Florida, 1985. Insect. Acar. Tests 12:307.
11. Funderburk, J. E., D. C. Herzog, and R. E. Lynch. 1987b. Seasonal abundance of lesser cornstalk borer (Lepidoptera:Pyralidae) adults in soybean, peanut, corn, sorghum, and wheat in northern Florida. J. Entomol. Sci. 22:159-168.
12. Gilreath, M. E., J. E. Funderburk, D. W. Gorbet, and D. C. Herzog. 1987. Lesser cornstalk borer control in peanuts in North Florida, 1986. Insect. Acar. Tests 12:308.
13. Gilreath, M. E., J. E. Funderburk, D. W. Gorbet, and D. C. Herzog. 1988. Lesser cornstalk borer control in peanuts in North Florida, 1987. Insect. Acar. Tests 13:272.
14. Hagan, A. K., J. R. Weeks, and J. A. McGuire. 1988. Comparison of soil insecticides alone and in combination with PCNB for suppression of southern stem rot of peanut. Peanut Sci. 15(1):35-38.

15. Hagan, A. K., J. R. Weeks, and R. B. Reed. 1986. Southern stem rot suppression with the insecticide chlorpyrifos. Peanut Sci. 13:36-37.

16. Johnson, S. J. 1978. The population dynamics and natural mortality of the lesser cornstalk borer, *Elasmopalpus lignosellus*, in the peanut agroecosystem and the biology of selected primary parasites. Ph.D. Diss., Texas A&M University, College Station, TX.

17. Johnson, F. A., and W. B. Tappan. 1987. Peanut insect control. Ext. Entomol. Rep. No. 38. Plant Protection Pointer, Instit. Food Agric. Sci., Univ. of Florida.

18. Leuck, D. B. 1966. Biology of the lesser cornstalk borer in South Georgia. J. Econ. Entomol. 57:797-801.

19. Mack, T. P., and C. B. Backman. 1987. Density of the lesser cornstalk borer, *Elasmopalpus lignosellus* (Zeller) in peanut fields: endemic and outbreak population configurations. Peanut Sci. 14:61-66.

20. Mack, T. P., C. B. Backman, and J. W. Drane, 1988. Effects of lesser cornstalk borer (Lepidoptera:Pyralidae) feeding at selected plant growth stages on peanut growth and yield. J. Econ. Entomol. 81:1478-1484.

21. Mack, T. P., J. E. Funderburk, M. E. Gilreath, R. E. Lynch, and C. B. Backman. 1989. Efficacy of chloropyrifos in peanut fields as indexed by bioassays against the lesser cornstalk borer. J. Econ. Entomol. 82:1224-1229.

22. Morgan, L. W., M. H. Bass, and H. Womack. 1982. Lesser cornstalk borer as a pest of peanuts, pp. 56-64. *In*: A review of information on the lesser cornstalk borer, *Elasmopalpus lignosellus* (Zeller), H. H. Tippins, Ed.Ga. Agric. Exp. Sta. Spec. Publ. N. 17.

23. Porter, D. M., D. H. Smith, and R. Rodriguez-Kabana, eds. 1984. Compendium of peanut diseases. Amer. Phytopathol..Soc., St. Paul, Minn.

24. Rodriguez-Kabana, R., P.A. Backman, and P. S. King. 1976. Antifungal activity of the nematicide ethoprop. Plant Dis. Rep.60:255-259.

25. Sams, R. L., and J. W. Smith, Jr. 1979. Evaluation of insecticides for lesser cornstalk borer control on peanuts. Texas Agr. Exp. Sta. Progress Report PR-3587.

26. SAS Institute. 1985., SAS user's guide: statistics. SAS Institute, Cary, N.C.

27. Smith, J. W., Jr., and C. S. Barfield. 1982. Management of preharvest insects, pp. 250-325. *In*: Peanut Science and Technology, H. E. Pattee and C. T. Young, (eds.) Peanut Res. Educ. Soc., Inc., Yoakum,.Texas.

28. Smith, J. S., Jr., and R. L. Holloway. 1979. Lesser cornstalk borer density and larval damage to peanuts. J. Econ. Entomol. 72:535-537.

29. Smith, J. W., Jr., P. W. Jackson, R. L. Holloway, and C. E. Hoelscher. 1975. Evaluation of selected insecticides for control of the lesser cornstalk borer on Texas peanuts. Tex. Agric. Exp. Stn., Prog. Rep. 3303.

30. Smith, J. W., Jr., and S. J. Johnson. 1989. Natural mortality of the lesser cornstalk borer (Lepidoptera: Pyralidae) in a peanut agroecosystem. Environ. Entoml. 18(1):69-77.

Accepted July 29, 1989