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SEASONAL ABUNDANCE OF LESSER CORNSTALK BORER (LEPIDOPTERA: PYRALIDAE) ADULTS IN SOYBEAN, PEANUT, CORN, SORGHUM, AND WHEAT IN NORTHERN FLORIDA

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ABSTRACT

Adult abundance of lesser cornstalk borer (LCB), *Elasmopalpus lignosellus* (Zeller), in agronomic crops in northern Florida was determined by pheromone trapping. Trap captures revealed that the temporal pattern of adult abundance differed for each crop. Multiple generations occurred in peanut and grain sorghum fields, with adults in abundance during both vegetative and reproductive crop-growth stages. Adults were abundant in the soybean fields only during vegetative and early reproductive crop-growth stages, with captures comprising individuals of two generations. Adults were abundant in wheat fields only during early seedling stages, while few adults were collected at any time in corn fields. Trap captures further indicated that there was rarely any considerable overlap between adult populations of different generations. The temporal patterns and magnitudes of adult captures were similar in fields of the same crop planted on about the same date, but dissimilar in fields of different crops or fields of the same crop planted on different dates.

Key Words: Pyralidae, *Elasmopalpus lignosellus*, corn, soybeans, peanuts, wheat, sorghum.

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INTRODUCTION

The lesser cornstalk borer (LCB), *Elasmopalpus lignosellus* (Zeller), is a polyphagous pest that severely damages crop throughout the southern U.S. Nearly all crops in northern Florida, including sorghum, corn, soybean, peanut, and wheat are suitable hosts, but economic losses usually occur only to those grown between late spring and early fall (i.e., peanut, sorghum, and soybean). Larval soil habitat and damage to each commodity have been described in Tippins (1982).

Recommended control measures against LCB usually involve prophylactic treatment with insecticide against the larval stages. Development of more sophisticated management strategies has been hampered by an inadequate understanding of the LCB phenology in all crops and geographical locations. Elucidation of phenology is immediately necessary to determine the need and optimal timing of scouting procedures, insecticidal applications, and other management tactics.

Informational shortfalls of LCB abundance and phenology in agricultural habitats undoubtedly have resulted from an unavailability of sampling methods which provide adequate estimates of population size, although pheromone trapping

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has been developed recently as a relative sampling device for adults. Payne and Smith (1975) noted that LCB males were captured in pieplate-type sticky traps baited with virgin females. Lynch et al. (1984) determined that four compounds are essential components of LCB pheromonal communication and that a synthetic mixture of the compounds is as effective as virgin females in luring males into traps. Funderburk et al. (1985) found in North Florida that changes in pheromone-trap collections in several crops relate reasonably well to LCB population trends. Consequently, generational cycles within crop habitats are detected by pheromone trapping with captures relating well to actual adult population levels at low densities, but not at high densities (T. P. Mack, Auburn Univ., unpublished data).

Therefore, the primary purpose of this study was to determine the temporal patterns of LCB adult abundance by pheromone trapping in major crop hosts in the northern Florida agroecosystem. These pheromone-trap captures also were used to compare temporal changes in LCB adult abundances between fields of the same crop and between fields of different crops.

MATERIALS AND METHODS

Field Establishment

Temporal patterns and relative magnitudes of LCB adult populations were determined in fields of crops that are potential major hosts in the northern Florida agroecosystem. These crops were corn, sorghum, soybean, peanut, and wheat. The studies were conducted between spring 1982 and fall 1984. During the growing season of each crop, two to six growers' fields of each crop were selected in Jackson and Gadsden Counties for monitoring LCB adult abundances. Crops were produced according to procedures for the particular crop in northern Florida (i.e., planting date, crop rotation, irrigation, etc.), but none was treated prophylactically with soil insecticide. All fields were separated by distances from 3 to 47 km.

Adult abundance in corn, sorghum, and wheat was determined over two growing seasons. Corn crops were produced between late February and late July in 1983 and between early March and early August in 1984. Three corn fields were sampled each year. The periods of wheat production were late November 1982 to early June 1983 and mid-November 1983 to late May 1984, with three and four fields sampled, respectively. All sorghum fields were double cropped after winter production of small grains, and were produced between early August and late November in 1982 and between late June and mid-October in 1983. Two fields were sampled in 1982 and three fields in 1983.

Adult abundance in peanut and soybean fields was determined over three growing seasons. Peanut fields in 1982, 1983, and 1984 were produced between mid-May and mid-September, with two, three, and four fields sampled, respectively. Some of the peanut fields in 1984 reached the LCB economic threshold in mid-July, and chemical treatment (chlorpyrifos) was applied. LCB adult abundance was determined in soybean fields in 1982, 1983, and 1984. In 1982, soybean crops were produced between late May and mid-October, and none was double cropped after winter production of small grains. Two fields were sampled. In 1983 and 1984, adult abundance was determined in soybean fields, both following small grains and not following small grains. Soybeans in 1983 not following small grains were produced between late May and mid-October (three fields sampled) while those following small grains were produced between late June and late October

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(three fields sampled). All 1984 fields were produced between late May and mid-October with two fields sampled.

Each of the above crops are sometimes produced with irrigation in northern Florida. Corn and peanuts are produced with and without irrigation. Grain sorghum, soybean, and wheat are less likely to be irrigated. All corn fields in the study were irrigated. Peanut fields in 1982 were not irrigated but were irrigated in 1983. Adult abundance in the peanut fields differed substantially between the years; consequently, adults in 1984 was sampled in irrigated and unirrigated fields in an attempt to ascertain if this difference resulted from irrigation practices. No grain sorghum, soybean, or wheat fields were irrigated in any year.

Adult Sampling

LCB adult abundances were determined by pheromone trapping. Pheromone trapping was continuous in each field, beginning at planting or seedling emergence and ending at ca. crop harvest. One pheromone trap (Pherocon® 1 c trap, Zoecon Corp., Palo Alto, CA) was placed within each field, no closer than 30 - 40 m from any field edge. Traps were maintained in a manner so that captures relate to actual adult population trends (Lynch et al. 1984; Funderburk et al. 1985). Each was baited with a rubber septum containing 10 μg of a quaternary mixture of the essential female-pheromone compounds (Dr. J. A. Klun, Insect-Control Ecology Laboratory, Agric. Economic. Quality Inst., Beltsville, MD). Traps were placed at a height of ca. 92 cm, and all crops and weeds near the trap height were removed from a 3 - 4 m radius around the base. Pheromone-containing septae were replaced every 10 - 14 days, and sticky bottoms replaced each time 100 - 150 moths were collected. Numbers of captured males were counted every 1 - 7 days.

Comparing Temporal Changes in Pheromone-Trap Captures

Adult captures during each growing season in fields of the same and different crops were compared by computing correlation coefficients ($P = 0.05$). For analyses involving comparisons between fields of the same crop grown using the same production practices, pheromone-trap data on each sample date were converted to the average number of males captured per night. Mean captures on each sample date were used in analyses when comparing fields of different crops and when comparing fields of the same crop grown using a different production practice.

RESULTS AND DISCUSSION

LCB adults were frequently abundant in fields of each of the crop hosts produced within the period of late spring and late fall (i.e., grain sorghum, soybean, and peanut). Multiple generations of adult LCB typically occurred in the grain sorghum and peanut fields, and adults occasionally were captured in great numbers in both crops during both vegetative and reproductive crop-growth stages. Pheromone-trap captures in the grain sorghum fields are given in Figure 1. Mean captures over all fields are represented for 1983, but each field is represented separately in 1982 due to the substantial difference in planting dates. Two to three peaks in captures occurred in the sorghum fields, with each probably representing a separate LCB generation. In each field, a peak occurred during early vegetative sorghum growth stages, and another occurred during late vegetative

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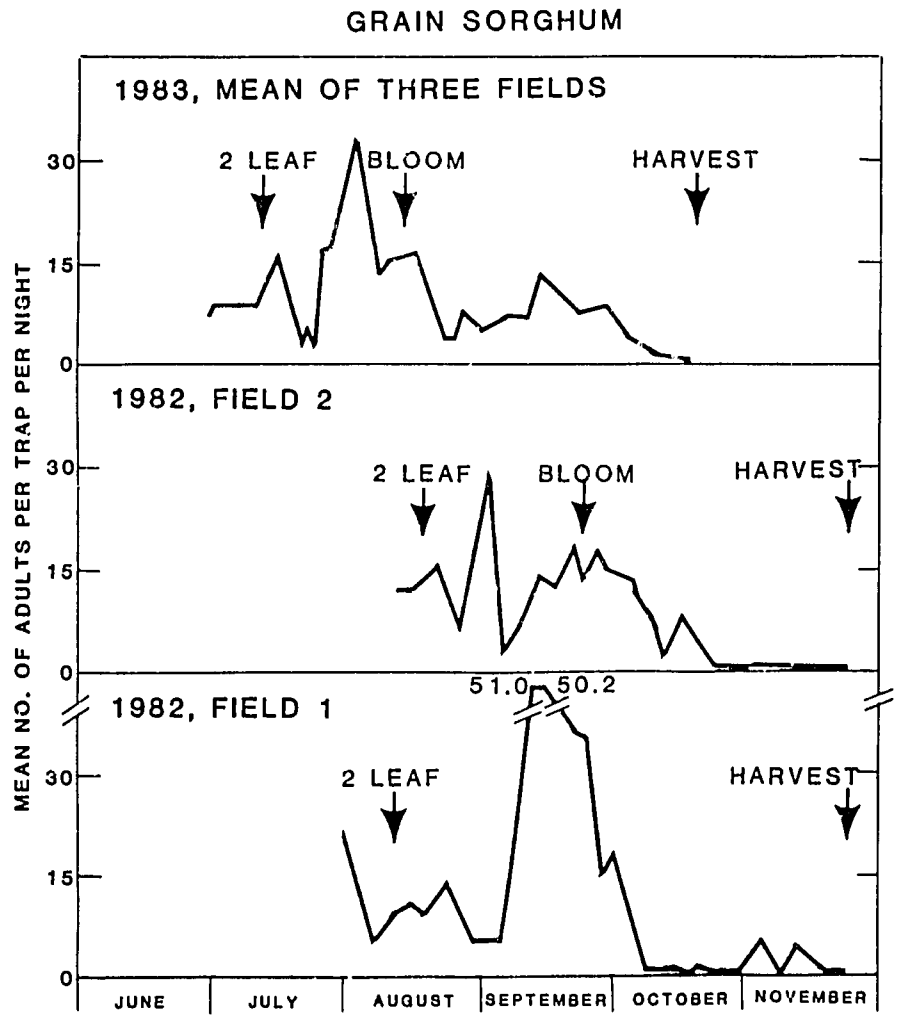

Fig. 1. Mean adult LCB pheromone-trap captures in grain sorghum fields in 1982 and 1983, Jackson and Gadsden Counties, FL.

and early reproductive growth stages. A third peak occurred during late reproductive growth stages in all fields except Field 2 in 1982. Captures were always greatest for the second peak.

Pheromone-trap captures in the peanut fields are given in Figure 2. Planting dates in each year were within one week for each field. Mean captures for all fields are represented for 1982 and 1983, while mean captures for irrigated and nonirrigated fields are given in 1984. These trap captures indicate that adults from three to four LCB generations were present in each peanut field. Two distinct peaks occurred in the 1982 dryland peanut fields. The first peak occurred during

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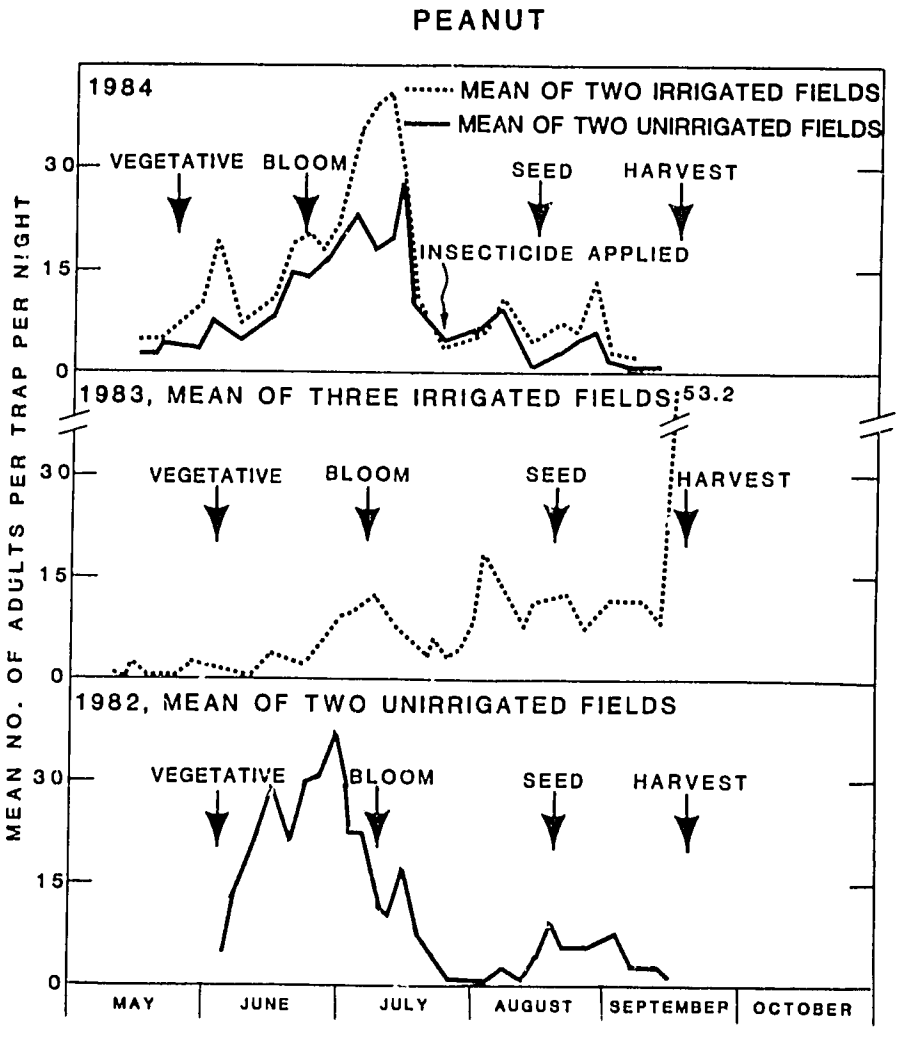

Fig. 2. Mean adult LCB pheromone-trap captures in peanut fields in 1982, 1983, and 1984, Jackson County, FL.

late vegetative and early reproductive crop-growth stages. Because captures were continiously large for 45 - 50 days, this peak probably represents two broadly overlapping LCB generations. Another peak from a third generation occurred during seed stages.

No distinct peaks of adults were captured during vegetative crop-growth stages in the 1983 irrigated peanut fields, and population size of this generation was very small. Three peaks in pheromone-trap captures occurred during the reproductive peanut growth stages, with each apparently representing adults from separate LCB generations. The peanut fields were harvested during the last peak

in captures. Three peaks in pheromone-trap captures occurred in the 1984 irrigated and unirrigated peanut fields. The first peak occurred during middle and late vegetative crop-growth stages, and the second during early reproductive crop-growth stages. Even though soil insecticide was applied in early seed stages to suppress larval populations, another peak in captures occurred during late seed stages. Each peak in these fields probably represented adults from a separate generation.

Although the gross phenology of adult [illegible] in the peanut fields was similar in each year, the widths and magnitudes of individual peaks differed substantially according to year. In 1982, the first peak, representing adults from two overlapping generations, was greater than the other peak. In 1983, the number of adults captured increased with each successive peak. Although the fields were harvested during the period, adults were most abundant during the last peak. In 1984, the second peak was the greatest.

Pheromone-trap captures in the soybean fields are given in Figure 3. Mean captures over all fields are represented for 1982 and 1984. Fields following wheat in 1983 were planted on very different dates from fields not following wheat; consequently, their mean captures are given separately. In each soybean field, captures were substantial only during vegetative and very early reproductive growth stages. Two distinct peaks in captures were noted over this period in all 1982 and 1983 fields, with each representing adults from separate generations. One peak occurred at soybean emergence/early vegetative (whenever trapping began) and another at late vegetative growth stages. In 1984 fields, captures were substantial during all vegetative growth stages, with adults of this peak probably from two overlapping LCB generations. Pheromone-trap captures in all soybean fields declined dramatically during reproductive growth stages. In all 1982 and 1984 fields, captures were negligible from soybean full bloom to crop harvest. In 1983, a small peak representing a third adult generation occurred during seed stages of soybean growth.

LCB adults were rarely abundant in wheat and corn fields, which were principally produced during winter and spring. Pheromone-trap captures in the wheat fields are given in Figure 4. Planting dates during each growing season were within one week for each field, and mean captures are given. A distinct peak in captures from a late fall LCB generation occurred in all fields during early vegetative crop-growth stages. Populations then declined, and few adults were captured throughout the winter. Adults were present in the wheat fields during the spring, but adult population sizes of these LCB generations were very small in both years. Captures were negligible in all corn fields throughout both growing seasons. A few adults from some spring and early summer LCB generations were captured in both years.

Correlation coefficients were calculated comparing pheromone-trap captures in fields of the same crop and cropping practices during 1983 and 1984 (Table 1) and comparing average pheromone-trap captures from 1983 and 1984 fields of different crops or cropping practices (Table 2). Because captures remained low on all sample dates in corn fields, data from corn fields was not included in these analyses. Captures in peanut, soybean, grain sorghum and wheat fields were always correlated ($P < 0.05$) with captures from other fields of the same crop and cropping practices. Average captures between fields of a crop were never significantly correlated with average captures in fields of a different crop or fields

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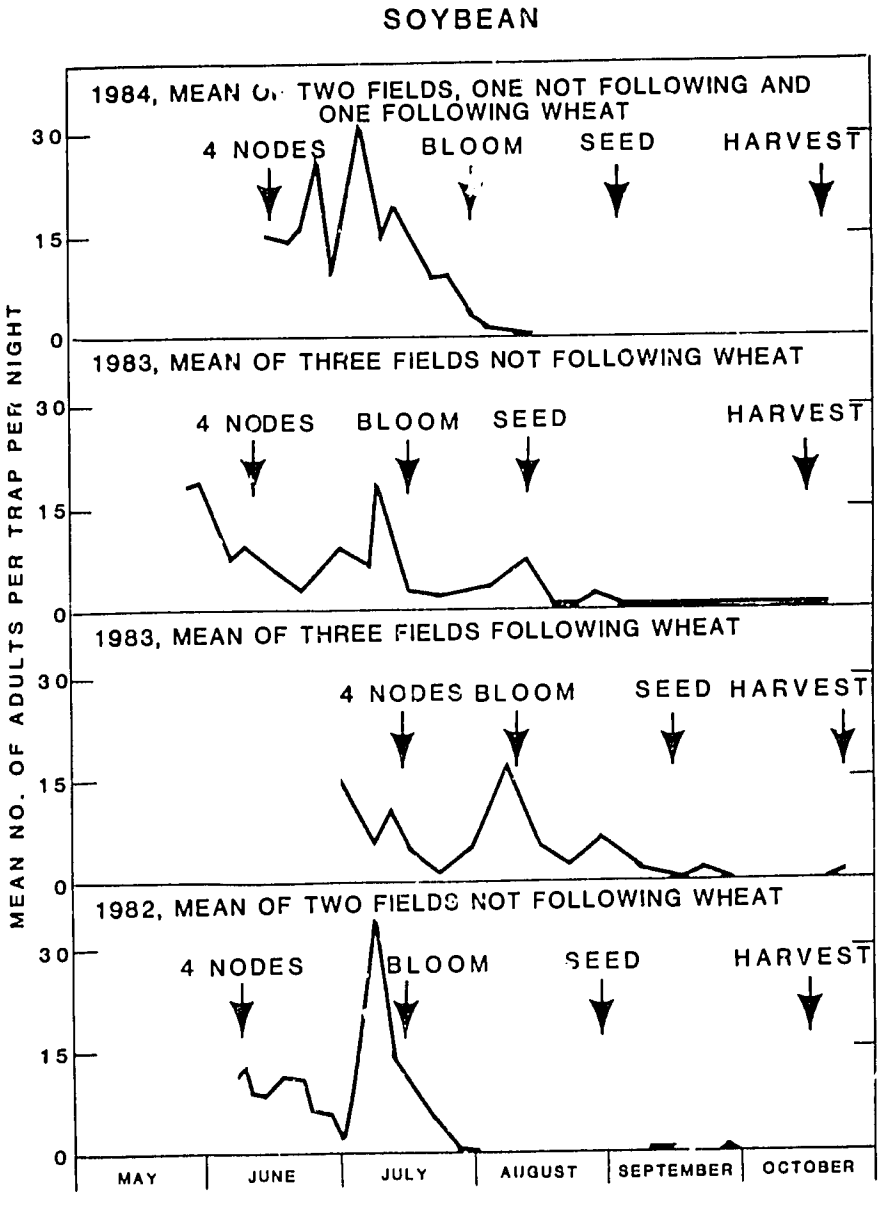

Fig. 3. Mean adult LCB pheromone-trap captures in soybean fields in 1982, 1983, and 1984, Gadsden County, FL.

of the same crop planted on different dates, although some correlations approached significance. Results from these analyses indicate that the temporal patterns and magnitudes of adult populations were similar in fields of the same crop planted on about the same date, but dissimilar in fields of different crops or fields of the same crop planted on different dates.

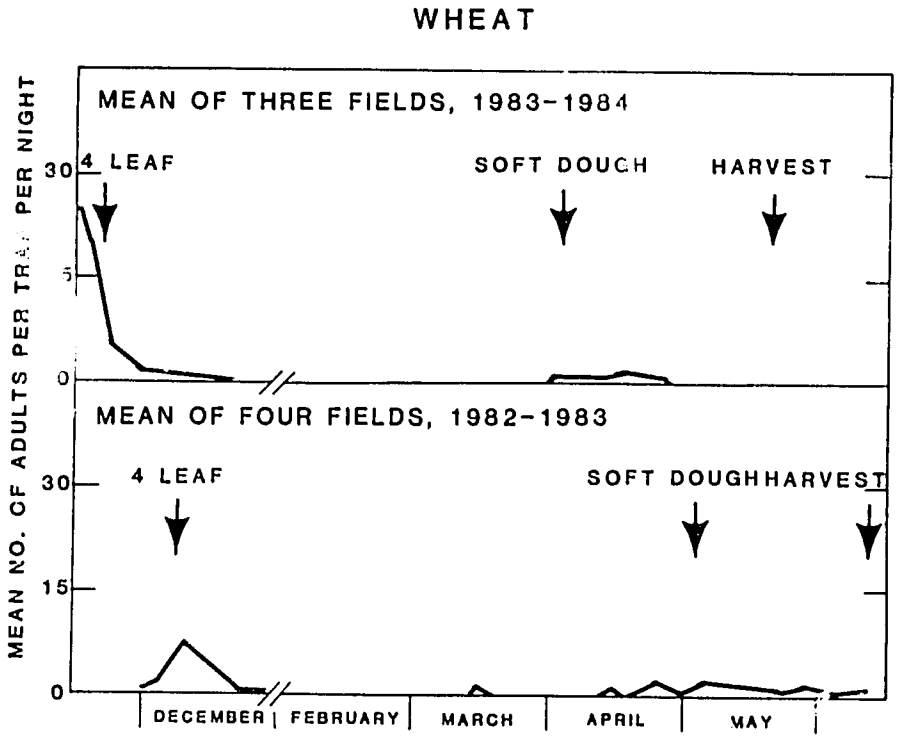

Fig. 4. Mean adult LCB pheromone-trap captures in wheat fields in 1982, 1983, and 1984, Gadsden County, FL.

Obviously, adult LCB population trends in all fields were determined by the growth rates of their populations and the amount of their adult movement into and out of fields. Crop host and planting date undoubtedly influenced adult population trends in a field by influencing over the growing season both the growth rates of LCB populations developing in the field (i.e., by influencing microclimate in the upper soil habitat and by being the larval food) and by determining over the growing season the attractiveness of the field to the mobile adults. All of these factors affecting adult population trends were similar over the growing season in fields of the same crop planted on about the same date, and this probably accounts for the similarity in adult population trends between such fields. Conversely, all factors affecting adult population trends were not similar in fields of different crops or in fields of the same crop planted on different dates, and this probably accounts for the dissimilarities in adult population trends between them.

Captures in the 1984 irrigated peanut fields were correlated with captures in the 1984 unirrigated peanut fields (Table 2). Rainfall was above adequate throughout most of the growing season, and water was applied only twice in the irrigated fields. Direct comparison of adult phenologies between irrigated and dryland fields were not conducted in the 1982 and 1983 growing seasons. Such

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Table 1. Correlation coefficients (r) comparing temporal patterns of male lesser cornstalk borer pheromone-trap captures from different fields of the same crop and cropping practice, Gadsden and Jackson Counties, FL.

Comparisons	No. of fields	No. of sample dates	Mean r	Range r-values	Range probabilities
Peanuts					
1983, Irrigated	3	31	0.78	0.73 - 0.81	All < 0.0001
1984, Irrigated	2	17	0.94	—	< 0.0001
1984, Dryland	2	14	0.80	—	< 0.0005
Soybeans					
1983, Full season	3	26	0.83	0.80 - 0.89	All < 0.0001
1983, Double cropped	3	20	0.80	0.69 - 0.95	< 0.0008 - 0.0001
1984, Full season/ Double cropped	2	23	0.81	—	< 0.0001
Sorghum					
1983, Double cropped	3	21	0.59	0.46 - 0.75	< 0.04 - 0.0001
Wheat					
1982 - 1983	4	21	0.87	0.83 - 0.93	All < 0.0001
1983 - 1984	3	19	0.91	0.87 - 0.99	All < 0.0001

Table 2. Correlation coefficients (r) comparing temporal patterns of lesser cornstalk borer pheromone-trap captures from fields of different crops or cropping practices, Gadsden and Jackson Counties, FL.

Comparison*, year	No. of overlapping sample dates	r-Value	Probability
Full-season soybean vs. double-cropped soybean, 1983	20	0.10	0.683
Peanut vs. full-season soybean, 1983	25	0.29	0.165
Peanut vs. double-cropped soybean, 1983	20	0.14	0.545
Peanut vs. double-cropped sorghum, 1983	19	0.43	0.063
Double-cropped sorghum vs. full-season soybean, 1983	18	0.46	0.056
Double-cropped sorghum vs. double-cropped soybean, 1983	19	0.38	0.106
Double-cropped/full-season soybean vs. irrigated peanut, 1984	11	0.54	0.08
Double-cropped/full-season soybean vs. dryland peanut, 1984	11	0.40	0.25
Irrigated peanut vs. dryland peanut, 1984	14	0.80	0.0006

* Comparisons of mean pheromone-trap captures per sample date.

comparisons of phenologies in irrigated and dryland fields in dry years when irrigation is needed to reduce moisture stress will be needed before determinations can be made of the possible effects of soil moisture on adult phenology in peanut fields.

Captures in 1983 from soybean fields not following small grains were not significantly correlated with captures in soybean fields following small grains (Table 2). Planting dates differed by almost a month. All fields were planted on about the same date in 1984, and captures in fields following small grains and those not following small grains were highly correlated (Table 1). Because the gross phenology of adult captures was similar in all soybean fields, the lack of correlation in 1984 was probably due to the great difference in planting date and not to differences in other cropping practices.

Characteristic patterns of adult LCB abundances were indicated in our trapping studies in fields for each of the major agronomic crops grown in northern Florida. Multiple generations occurred in peanuts and grain sorghum, and adults were present during vegetative and reproductive crop-growth stages in fields of these crops. Adults were present in soybean fields only during vegetative and early seedling stages. Adult populations in each crop reached abundant numbers at discrete intervals, with generations rarely overlapping to any considerable extent.

Therefore, these results provide valuable information about patterns of LCB abundances in our agronomic crops, which is immediately useful in management programs for the pest. They also indicate that developmental rate of LCB populations in a field is affected by the crop being grown. An understanding of the influences of crop host on LCB development will be necessary in management models currently being developed for this pest.

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