EFFECT OF WIND SPEED AND DIRECTION ON THE
APPROACH OF SOYBEAN LOOPERS TO A
PHEROMONE SOURCE IN THE FIELD

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ABSTRACT
The influence of wind speed and direction on the attraction of soybean looper, Pseudoplusia includens (Walker), to a synthetic pheromone source in the field was investigated by employing a pheromone baited electric grid trap and a wind recording instrument. The 6-sided insect trap, with associated electronics, gave information on number and time of insect captures, and direction of their approach. Analysis of 2 years data showed that attraction of soybean loopers to the pheromone is not strongly influenced by wind speed over the range 0.2 m/s. There was evidence for a tendency of the attracted loopers to fly upwind to the pheromone source.

Williams (1961) found that catches of Lepidoptera doubled when the average nightly wind speed was reduced by one-half at 15 m above the ground. Persson (1976) determined that wind speed at the 3 m height accounted for 1/5 of the variance in catch of several noctuid species (negative influence). Increases in light-trap catches have also been shown to be associated with changes in wind direction (Haggis, 1971). Kishioka et al. (1970) conducted field tests with pheromone and caged males and found that stimulation of the males occurred 96 m downwind with wind velocities between 1.7 and 3.4 m/s. When insects were released 400 m downwind the few insects that were trapped tended to be caught within 10 min of release. Kaae and Shorey (1972) found from laboratory tests that female Trichoplusia ni (Hübner) spent maximum time releasing pheromone at prevailing wind velocities of 0.31 m/s, about half as much for calm air, and approaching zero at 4 m/s.

Our objective was to determine from field experiments, the influence of wind speed and direction on the attraction of adult soybean loopers, Pseudoplusia includens (Walker), to a synthetic pheromone source.

METHODS AND MATERIALS
The experiments were conducted in Alachua County, Florida during August and September 1974, on the University of Florida research farm, and during August, September, and October 1975 on a private farm. The test site in 1974 was an open, grassy area, with 12 ha plots of soybeans located around the site at distances of 60-300 m. In 1975 the site was an open, grassy area surrounded by fields of soybeans with borders 30-90 m from the trap.

The trap consisted of 6 electric grid panels (0.9 X 0.9 m) mounted vertically and adjacent to each other in a hexagonal pattern (Fig. 1). Each

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Fig. 1. Electric grid insect trap used to capture and record soybean loopers attracted to a pheromone source.

The trap was individually energized by a 4000 V, 10 mA transformer. Aluminum panels of 0.6 m width were mounted 0.3 m over the grid panels for protection against rain. Fiberglass screen was stretched across the top of the aluminum panels and around the 0.3 m space over the grids, to prevent insects from entering the center section of the trap from above. Six 0.3 x 0.3 x 0.9 m aluminum insect catch trays, with V-shaped inserts, were positioned under the grid panels, and supplied with Vapona® strips. Each grid panel was instrumented with electronic circuitry (Fig. 2) that caused a switch

![Circuit Diagram](image)

T1 110V 6.3V secondary filament transformer; 6.3V side connected in series with primary of electrucutor grid transformer.

FWB - Full wave rectifier bridge, 1A-50 PIV

C - 10 μF-450 V;DC electrolytic capacitor

RY - Sigma 5F 1000S adjustable relay (5 mW pickup power)

Fig. 2. Electronic circuit for recording insect strikes on electric grid panels.
closure when an insect contacted the grid. The switch closure was recorded on the continuously moving chart of an Esterline Angus 20-channel event recorder.

Wind speed and direction were monitored with a device located 3 m from the trap and situated 1.4 m above the ground (Fig. 3). The device consisted of a thin movable aluminum panel suspended on pivots from a frame to
which was also attached a fixed aluminum vane. The vane kept the smaller movable panel facing into the wind. The entire unit was mounted on a pipe stand by means of thrust-type ball-bearings. A magnetic strip was attached to the movable panel so that as wind deflected the panel, the magnetic strip moved progressively over 6 magnetically actuated reed switches, each of which indicated an increase in wind speed of 0.34 m/s. Switch closures were recorded on the event recorder. To record wind direction, 6 reed switches were mounted concentrically around the stationary pipe stand, with one switch at the north position. A magnet attached to the rotating wind device moved over and activated individual switches to indicate wind direction. Again the switch closures were recorded by the event recorder. Thus, insect strike and wind data were recorded simultaneously on the same chart by utilizing 18 channels.

At the beginning of the experiment, for each season, a 1.25 ml polyethylene vial of synthetic soybean looper pheromone, (Z)-7-dodecen-1-ol acetate, was suspended in the center of the grid trap, at the height of the top of the grid panels, and left for the duration of the experiment (Mitchell et al. 1975). Grids and recording instruments were activated and deactivated by a clock-timer at 2000 and 0800 hr in 1973 and 1974 and 2200 and 0600 hr in 1975, respectively. Insects were collected from the catch trays each morning and soybean loopers and other insects were counted. Control tests were conducted with all procedures being the same except that the pheromone was removed from the trap.

In order to simplify the data for analysis, insect strikes, wind speed, and wind direction were summed over 20-min. periods (P). Wind direction sums were defined as the percentage of time the wind was within each of the 6 direction sectors, and wind speed as the average per period.

Analysis of variance was used to determine the effects of average period wind speed (WS) on the number of insects striking the grids per period, of average nightly WS on the number of loopers caught nightly, and of wind direction (WD) on the direction of insect approach to the trap. Comparisons were made to determine how often the grid receiving the most strikes per period, or killing the most looper per night corresponded with the predominant WD (leeward grid). Effect of WD was also evaluated by comparing the percentage of strikes on the leeward grid in any given period with percentages on the 5 other grids, using the criteria that the wind was from a single direction for 70% of any given P, and that at least 8 strikes/P were recorded.

**Results and Conclusions**

The number of insect strikes, total insects killed, and soybean loopers killed were 2942, 2478 and 1776 for 1974 (10 nights), and 8110, 5777, and 1775 for 1975 (24 nights), respectively. Differences in insect strikes and total insects killed were due primarily to the fact that some insects actuated the counter circuits, but were not captured in the catch-trays. Separate analyses were made by use of data from all the nights, and from only those nights when captured soybean loopers amounted to >65% of total insect strikes (6 nights in 1974, 5 nights in 1975). Only the latter analysis gave an indication of soybean looper activity. It should be noted that winds were generally light during the 3 test periods, and particularly so in 1975.

It was evident from the data that periodic trends (night to night varia-
tion) in insect activity existed and that nightly activity also followed a recurring pattern. These were designated night (N) and P effects in the analyses. For those 11 N with mostly loopers captured, N effects were significant (5% level) for 10 of the 12 tests made (6 grid × 2 yr). P effects were significant (5% level) for each grid and year, with peak captures occurring at 0200 hr in 1974 and 2300 hr in 75. The trends due to N and P accounted for the major part of the variance removed by the analyses. Total variance removed by N, P, WS and WD ranged from 22 to 72%.

Wind speed had an effect on number of insect strikes for only one grid in 1974 and none in 1975. Linear and quadratic components of WS were tested and the tests were made after removal of N and P trends. Treating WS as categories of low (<.34 m/s), medium, or high (> .30 m/s), showed no significant influence by wind speed categories on insect strikes. However, a plot of insect strikes against average WS (Fig. 4) does suggest greater attraction at the intermediate WS for 1974. (The plotted points are averages for catches and WS for from 7 to 24 periods.) The most positive statistical result occurred when the nightly capture of soybean loopers in 1975 was compared with 3 categories of average nightly WS. Significance occurred at a probability level of 94.5%, with a linear, negative regression, i.e., increasing WS resulted in decreasing capture.

Stronger evidence resulted for the influence of WD on direction of approach of loopers to the pheromone. For the 11 N analysis, 4 of the 12 com-

![Graph showing insect strikes per period vs wind speed](image)

Fig. 4. Attraction of male soybean loopers to a pheromone as influenced by average period (20 min) wind speed (each plotted value is average of > 6 data points. Sufficient data points were not available for average WS > .34 m/s in 1975).
Comparisons showed a statistically greater (at the 5% level) number of strikes on the leeward grids. Comparing nightly capture of loopers with predominant nightly WD revealed upwind approaches for 7 of 18 comparisons (includes data from 1973 experiment).

The comparisons made relating direction of looper approaches and predominant WD showed correspondence for 73 of 234 (31%) P and for 20 of 39 (51%) N examined. Purely random insect flight would result in an expected 1 in 6 (17%) correspondence. Also, in considering all 44 N for the 3 years, the correspondence occurred for 132 of 390 (34%) periods examined, indicating that the general insect movement in the test areas was predominantly upwind. Comparison of percentages of insects striking the leeward grid with percentages striking the other grids (Fig. 5) shows the strong influence of WD on insect approach for the 1974 experiment. There were 45 P that met the criteria for this comparison. Only 7 periods met the criteria in 1975; the results for 1975 are not shown.

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**Fig. 5.** Comparison of number of male soybean loopers (% of total) attracted to a pheromone source (P) from the leeward, windward, and intermediate directions during 1974. Data were taken from 45 20-min periods meeting the criterion that wind direction was within a single 60° sector 70% of the period.
Our experiments give only weak evidence for the influence of average wind speed in the range of 0.2 m/s on the attraction of soybean loopers to a pheromone source in the field. Stronger evidence was obtained for the tendency of attracted males to fly upwind to the source. We believe that the reported results were due primarily to attraction and not to general flight activity.

LITERATURE CITED


BOOK NOTICE

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