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PREDICTION OF LARVAL INFESTATION IN PASTURE GRASSES BY *SPODOPTERA FRUGIPERDA* (LEPIDOPTERA: NOCTUIDAE) FROM ESTIMATES OF ADULT ABUNDANCE

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ABSTRACT

The seasonal fluctuations of adult *Spodoptera frugiperda* (J. E. Smith) populations were monitored for a 75-week period in pastures on a cattle farm in French Guiana. Adults were monitored using blacklight traps and sticky traps baited with (Z)-9-dodecen-1-ol acetate, an attractant for *S. frugiperda* males. Larval populations were sampled weekly using sweep nets. Significant correlations were obtained between adult captures for both trapping methods used and relative larval abundance. The highest correlation coefficient was obtained between weekly captures of moths in sticky traps and relative larval abundance one week later. The highest populations of moths and larvae were observed during the rainy seasons, and the lowest during the dry seasons. Results obtained in these experiments demonstrate that it is possible to use sticky traps baited with (Z)-9-dodecen-1-ol acetate in a system to warn growers of possible significant infestations of *S. frugiperda* larvae in pastures in French Guiana.

RESUMEN

Las fluctuaciones estacionales de las poblaciones adultas de *Spodoptera frugiperda* fueron seguidas durante 75 semanas en los pastos de una finca de cría de ganado en Guayana Francesa. Los adultos fueron seguidos por medio de trampas de luz negra y trampas pegajosas cebadas con (Z)-9-dodecen-1-ol acetato, un atrayente para los machos de *S. frugiperda*. Se recogieron muestras de poblaciones larvales cada semana, empleando el método de la red de siega. Correlaciones significativas fueron obtenidas entre las capturas de adultos por ambas trampas y la abundancia relativa de larvas. El coeficiente de correlación más elevado fue obtenido al comparar las capturas semanales de los adultos con trampas pegajosas y la abundancia relativa de larvas una semana más

tarde. Las mayores poblaciones de adultos y de larvas fueron observadas durante la estación de lluvias, y las más bajas durante el período de sequía. Los resultados obtenidos en estos experimentos demuestran que se pueden utilizar trampas pegajosas cebadas con (Z)-9-dodecen-1-ol acetato en un sistema destinado a caucionar a los ganaderos sobre posible infestación de *S. frugiperda* en pastizales en la Guayana Francesa.

Efforts to advance agricultural development in French Guiana have given priority to the establishment of intensive cattle farming on improved pastures and to rice production. *Spodoptera frugiperda* (J. E. Smith) is one of the most important insect pests of forage grasses, rice and soybeans in French Guiana. During certain years forage grasses, particularly *Digitaria swazilandensis* Stent which is most widely used in French Guiana sustain extensive damage due to population explosions of *S. frugiperda* larvae (Silvain & Thiberville 1984a). These infestations require insecticide (Deltamethrine) applications. However, without regular monitoring of pastures, these applications often are carried out when populations have already reached the last larval instar or even the pupal stage, and their impact is minimal.

Although much research has been carried out on monitoring techniques for *S. frugiperda* in North America (Tingle & Mitchell 1975, 1977, 1979; Waddill et al 1982; Starrat & McLeod 1982), on annual crops, little is known about seasonal abundance of this pest in perennial crops such as forage grasses (Lynch et al 1980). In tropical areas with continuous generations the prediction problems are different (Silvain & Thiberville 1984a). This paper reports experiments conducted from November 1981 to April 1983 to assess the possibility of using blacklight or pheromone traps to monitor *S. frugiperda* moths and to predict subsequent larval outbreaks.

MATERIALS AND METHODS

The experiments were carried out on a cattle farm in Matoury (52° 20' W, 4° 51' N) located 15 km from Cayenne, the capital city of French Guiana. This farm consists of about 60 ha. of pastures divided into 19 fields covered by an imported creeping grass, *D. swazilandensis*. The fields are grazed on a 45-day cycle and fertilized once a year. To the south and the east of the farm remnants of the original rain forest remain, while to the north and the west cultivated farmland is used for truck farming and sugar cane.

Meteorological information was obtained from instruments installed on the farm and from the Meteorological Station at Rochambeau airport. There are two main seasons in French Guiana: the rainy season from mid-November to mid-August and the dry season from mid-August to mid-November. There also may be a period of sunny weather in February-March. The site we used is situated in a climatic zone characterized by: high annual rainfall, with large variation from year to year; long pronounced dry season, during which crops may suffer from lack of water; and very little fluctuation in temperature.

Three Pherocon® 1C sticky traps baited with 25 mg of (Z)-9-dodecen-1-ol acetate in Conrel® hollow fiber dispensers (50 hollow fibers/dispenser) were located at the three corners of an equilateral triangle, whose sides measured approximately 500 m. Considering the surface area of the farm, this represented one trap for 20 ha. The traps were suspended one meter above the ground on a metal support and covered by a metal roof to protect the traps from heavy rain. The traps were operated each week from Friday morning through Monday morning. The sticky liners were changed weekly and the bait every two weeks.

An Ellisco® blacklight trap (type PT 110103 PC) fitted with a 15 W G.E. F15T8BL lamp was placed two meters from one of the pheromone traps in the southern angle of the triangle. The blacklight trap was operated on Monday and Thursday nights of each week. This method avoided possible interference between the two types of trap used. Daily trapping, however desirable, was not feasible in this present setting. Cotton, soaked with ethyl acetate, was placed in the bottom of the B.L. trap to kill the captured insects.

To estimate the seasonal abundance of *S. frugiperda* larvae over the study area, 6 of the 19 fields were sampled each week on Tuesdays and Fridays between 8 and 11 a.m. The experimenter chose a random path through each field and sampled larvae by taking 100 sweep-net samples (diameter of the sweep-net: 30 cm; 180° technique.)

RESULTS AND DISCUSSION

In 75 weeks, 4481 *S. frugiperda* males were captured by pheromone traps (\bar{x} : 6.6 ± 7.3 males/trap/night) as well as 23 females and 6 *S. latifascia* Walker males. During the same period 464 *S. frugiperda* moths were captured by the blacklight trap (\bar{x} : 3.1 ± 5.1 moths/night) of which 81.8% were females. Callahan and Chapin (unpublished data cited in Mitchell 1979) also observed a predominance of females in B.L. traps in Louisiana, of which ca. 55% have mated one or more times. Preliminary studies have indicated that approximately 90% of females attracted to B.L. traps in French Guiana have mated (Silvain 1982, unpublished data). A total of 9158 larvae of various instars were collected with the sweep net (\bar{x} : 23.8 ± 71.8 larvae/100 sweeps).

The capture of moths (both sexes) by the blacklight trap and males by pheromone traps show very similar patterns (Figure 1a), an observation which was confirmed by a Spearman's rank correlation test ($r_s=0.66$, $t=7.51$, $p=0.01$). These results are almost identical to those we obtained from November 1979 until October 1981 (Silvain 1984b).

Fluctuations in relative larval abundance (Fig. 1b) correlated closely to adult abundance in pheromone ($r_s=0.70$, $t=8.51$, $p=0.01$) or B.L. ($r_s=0.59$, $t=6.37$, $p=0.01$) traps. Comparisons of moth captures in pheromone and B.L. traps with relative larval abundance observed in the weeks preceeding or following adult catches (Fig. 2) show that the highest correlation coefficients were obtained between moth catches during a given week and relative larval abundance the following week.

During the period of observation, the monthly rainfall on the study site varied from 667 mm (May 1982) to 22 mm (September 1982). The mean monthly temperature was $26.4 \pm 0.3^\circ\text{C}$, with minimal and maximal temperature being $22.8 \pm 0.6^\circ\text{C}$ and $30 \pm 1^\circ\text{C}$, respectively. The mean monthly relative humidity was $81.8 \pm 2.7\%$ with $66.1 \pm 5\%$ and $97.5 \pm 1\%$ as the minimum and the maximum daily values. The number of hours of sunshine each month varied from 95.4 (March 1982) to 270.4 (October 1982). A visual comparison of adult (Fig. 1a) and larval (Fig. 1b) abundance with patterns in seasonal precipitation (Fig. 1c) reveals the highest *S. frugiperda* populations during the rainy season, and the lowest in the middle of the dry season (September-October). During the 15 weeks when the weekly rainfall was less than 25mm (15th August-end of November), average larval abundance was 3.9 ± 15.4 , compared with 29.7 ± 80.6 during the remaining wet period. A significant correlation was observed between weekly rainfall and larval abundance 3 weeks later ($p=0.05$) and 4 weeks later ($p=0.01$), as well as between rainfall and males caught in pheromone traps 3 weeks later ($p=0.05$). A direct effect of rainfall on larval growth is unlikely; however, vegetative growth of the pasture grass is stimulated by rainfall, making the grass more attractive to ovipositing moths. This would tend to explain the increased abundance of adult moths recorded at approximately 3-week intervals.

The results of these experiments demonstrate that adult trapping may be used to

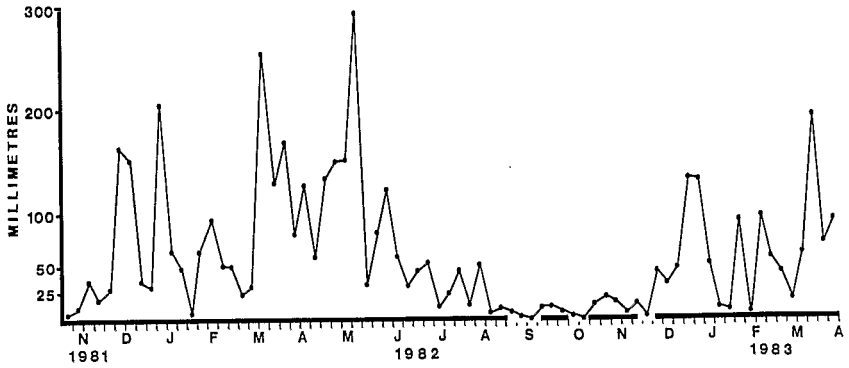


FIG.1c

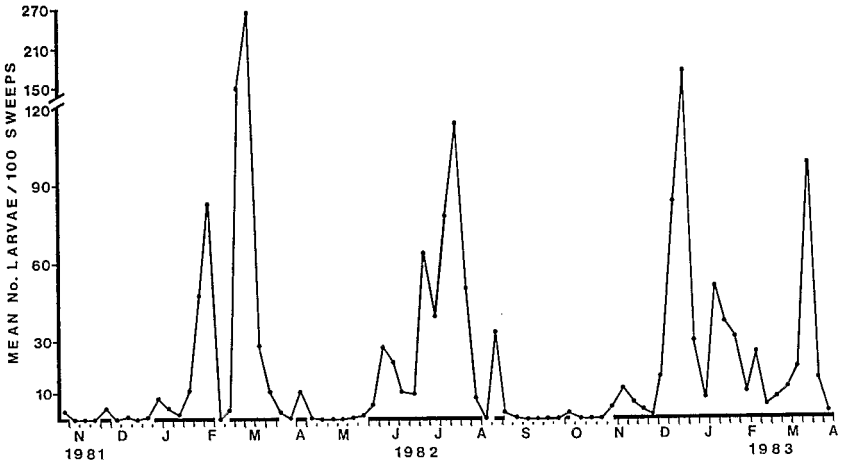


FIG.1b

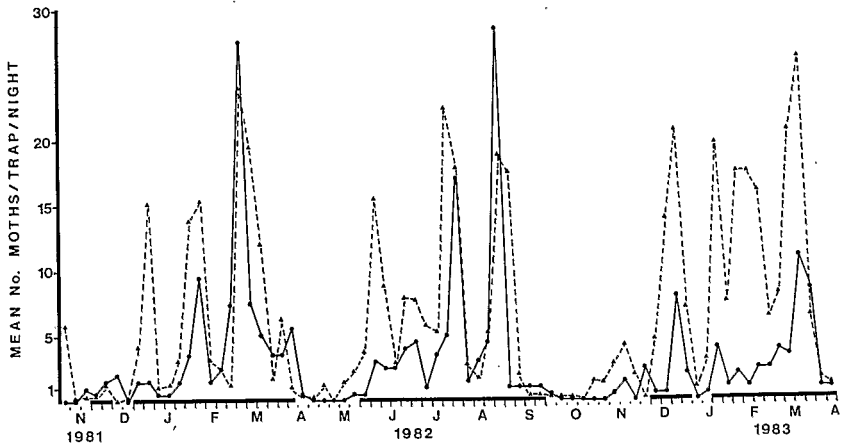


Fig. 1a. *Spodoptera frugiperda* moths captured per night in light trap (—) and in pheromone traps (---). Matoury, F. G., 1981-1983. Values for the BL trap include both males and females; values shown for the pheromone traps are males only. Fig. 1b. *Sp. frugiperda* larvae per 100 sweeps on *Digitaria swazilandensis* pastures. Fig. 1c. Rain-fall in Matoury, F.G.

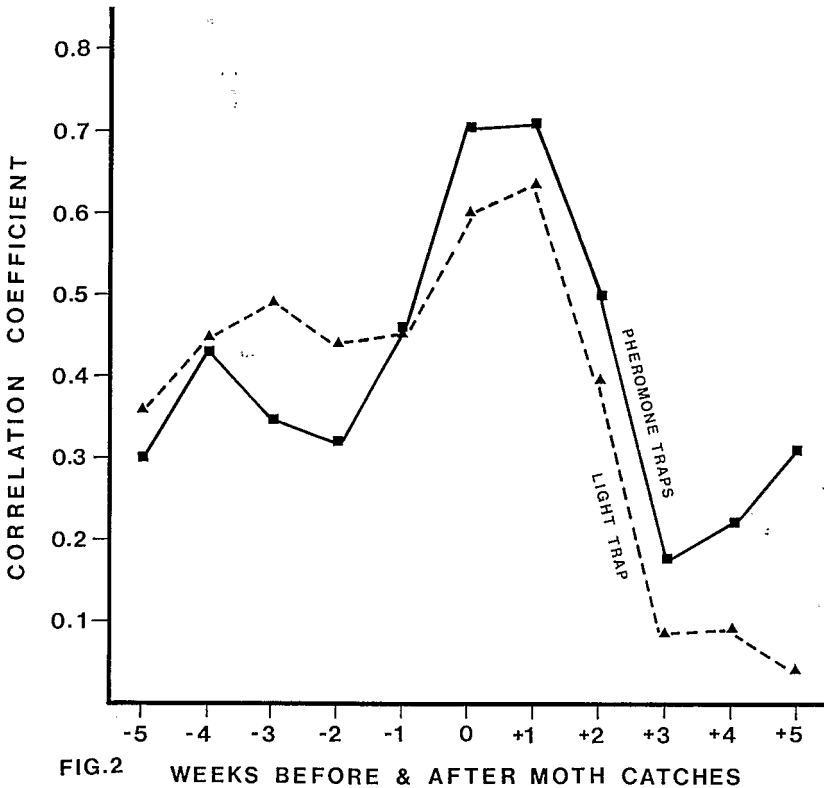


FIG. 2. Correlation coefficients between the number of moths captured in pheromone traps (males only) and light trap (males and females) and the number of larvae per 100 sweeps 0 to 5 weeks before and after the moth catches.

predict subsequent larval infestation of *S. frugiperda* on improved pastures in Matoury. The best correlations were obtained between males caught in pheromone traps and the number of larvae collected by sweeping the following week. These results are very similar to those reported for tobacco budworm, *Heliothis virescens* (F.) on tobacco by Tingle & Mitchell (1981). A practical warning system against *S. frugiperda* must provide information on the presence of early larval instars if it is to allow timely application of insecticides, as the later instars are of economic importance (Martin et al. 1980). Approximately 85% of the *S. frugiperda* larvae recovered using the sweep net sampling procedure described are in the 1st to 4th instars (Silvain, unpublished data). However, sweep net sampling is prohibitively expensive. The results we present indicate that pheromone traps may be a practical alternative, especially in the case of perennial crops in a tropical area where climatic conditions favor the maintenance of breeding populations of *S. frugiperda* throughout most of the year.

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