

PHEROMONE TRAPS FOR MONITORING FALL ARMYWORM, *SPODOPTERA FRUGIPERDA* (LEPIDOPTERA: NOCTUIDAE), POPULATIONS¹

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ABSTRACT

Comparisons of traps for capturing fall armyworm, *Spodoptera frugiperda*, baited with virgin females or synthetic pheromone were conducted at Dade County and Quincy, FL, Brownsville, TX, and Tifton, GA. Significantly higher numbers of fall armyworm males were captured in traps, irrespective of design, that were baited with a four - component lure, Terochem, than in identical traps baited with virgin females or a standard bait containing a 10 : 1 ratio of (Z) - 9 - dodecenol - 1 - ol acetate and (Z) - 9 - tetradecen - 1 - ol acetate. Wire - cone Hartstack traps baited with Terochem captured significantly more males than a plastic funnel - type Unitrap in two of three locations at Tifton, GA, during 1984 - 85, and at Quincy, FL, 1984. At Brownsville, TX, and Dade County, FL, the Unitrap baited with Terochem lures captured ca. as many or more fall armyworm males, respectively, than the Hartstack design. Standard green, yellow, and white Unitraps captured 2X more fall armyworm males than solid green Unitraps, suggesting that the color may influence rates of capture.

Key Words: Fall armyworm, population monitoring, trapping, *Spodoptera frugiperda*, pheromones.

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INTRODUCTION

Fall armyworm, *Spodoptera frugiperda* (J. E. Smith), populations in south Florida normally do not persist beyond ca. latitude 28°N during winter months (Pair and Sparks 1986). Also, severe winters and the persistence of low temperatures following cold fronts may largely determine the magnitude of populations and their rate of spring dispersal into more northerly areas (Pair et al. 1986).

Various designs of traps and combinations of synthetic pheromone baits have been employed to detect the spring arrival of adult migrants and to monitor fall armyworm (FAW) population fluctuations. Previous systems used to monitor FAW usually relied upon a combination of Pherocon 1C sticky traps baited with either (Z) - 9 - dodecenol - 1 - ol acetate (Z9 - 12 : AC) alone or in combination with small

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quantities of (Z)-9-tetradecen-1-ol acetate (Z9-14:AC) (Mitchell 1979). However, traps baited with these materials often failed to detect FAW prior to the infestation of corn in south Georgia (Sparks 1979). Tumlinson et al. (1986) identified five compounds from pheromone glands of FAW females and reported that although Z9-12:AC is attractive to FAW males, it was not detected in pheromone glands.

Mitchell et al. (1985) reported on the efficacy of baits containing four of the components in 75-50 cm cone (Hartstack et al. 1979), Pherocon 1C, and the International Pheromone Unitrap (IP) traps. Of the three types, the cone trap was the most effective when moderate to high densities of FAW were present, probably because of its large size and greater catch capacity. At low FAW densities, the IP trap was as effective as the Hartstack design - trap in catching FAW. These studies involving new pheromone blends did not include their comparisons with standard baits containing Z9-12:AC, nor with virgin females in different trap designs, except in the less efficient Pherocon 1C traps. To enhance our knowledge of the capability of the new pheromone for monitoring FAW at different population densities, we assessed its effectiveness in traps of various designs at four geographical locations.

MATERIALS AND METHODS

Previous experience with cone traps has shown the Hartstack trap captured more FAW males than the Pherocon 1C trap in moderate- to -high (> 10 males per trap per night) insect population densities; however, the Pherocon 1C trap proved to be as effective as the Hartstack trap for detecting initial migrants and low populations (< 10 males per trap per night) in the early spring, if both trap types were baited with Z9-12:AC. Therefore, a variety of locations and populations at different times of the year were designated for the studies.

TIFTON, GA

In 1984, four replications of traps were compared at three locations, separated by ca. 4 km, one replication each at the Abraham Baldwin Agricultural College (ABAC) farm and the Gibbs farm and two replications at the Belflower Farm. Each replication consisted of Hartstack traps baited with 25 mg Z9-12:AC + Z9-14:AC Standard (STD) bait in a 10:1 ratio, a rubber septa containing 2 mg of a 4-component blend [(z)-7-dodecen-1-ol acetate (0.45%), Z9-12:AC (0.25%), Z9-14:AC (81.61%), and (z)-9-hexadecen-1-ol acetate (17.69%)], commercially available from Terochem (Terochem Laboratories Ltd., Alberta, Canada), or with five virgin FAW females, and an International Pheromone (IP) trap (International Pheromone Systems, Merseyside, England) baited with Terochem septa. Traps were positioned so that baits were 1 m above the ground 50 m apart. Traps were monitored daily from 15 May to 20 August and each replication was re-randomized on a weekly basis. Synthetic baits were changed every 2 weeks while traps baited with females were replaced weekly. Caged females were provided a 5% sucrose solution dispensed on dental wicks as a food source. Wicks were re-saturated daily to ensure survival of the females when high temperatures were encountered during the summer months.

In 1985, trap studies were conducted as in 1984 except that Pherocon 1C traps (Albany International, Sentry, Inc., Phoenix, AZ) baited with Terochem were included at each location. Monitoring was conducted from 28 February to 24 June, a period of low population density.

QUINCY, FL

Hartstack and IP traps baited with Terochem or the STD bait were compared at one location. These were permanently positioned and not re-randomized; traps were monitored 3 times each week from 17 May to 21 September 1984.

DADE COUNTY, FL

These studies were similar to those conducted at Quincy, FL, except that the IP traps were baited with Terochem only. Permanently installed Hartstack and IP traps were monitored at the Florida Agricultural Research and Extension Center (AREC), TV tower, and Long Key, but only Hartstack traps were used at the Graves location. All trap sites except Long Key were located in the Homestead, FL, city limits. Traps were monitored daily from 9 July to 31 December 1984.

BROWNSVILLE, TX

Hartstack and IP traps baited with Terochem lures were compared adjacent to corn and cotton fields. Each trap type was replicated 4 times in an alternate fashion, and individual traps were advanced one position each week. Traps were monitored daily from 21 January to 24 June 1986, except on weekends.

All data were analyzed by the General Linear Model procedure and least squares analysis was used to separate daily mean catches of FAW males in different trap/bait combinations (SAS Institute 1982).

COLOR EFFECTS: Single IP traps (green lid, yellow funnel, and white bottom) were compared with a Multipher trap (Bio-control Services, Ste-Foy, Quebec, Canada) with green lids and white bottoms and with solid green IP traps at Tifton, GA. The Multipher trap is designed upon the same principle as the IP trap but varies slightly in dimensions. Treatments (paired comparisons) were separated by ca. 200 m, and individual traps within tests were spaced 1 m apart and positions were alternated daily. All traps were baited with Terochem lure and were inspected daily from 25 July to 11 September, 1986. Data were analyzed using Student's *t*-test (Steel and Torrie 1960).

RESULTS AND DISCUSSION

Table 1 shows that Hartstack cone traps baited with Terochem lures captured significantly more FAW males ($p < 0.05$) than traps baited with virgin females or with the STD lure. The Hartstack trap - Terochem lure combination also captured significantly more FAW males at 2 of 3 locations tested. At the Belflower location, however, the IP trap - Terochem lure combination captured significantly more males than all other trap/bait combinations. In 1985, similar response levels were obtained, and Hartstack traps baited with Terochem again outperformed IP traps baited with Terochem except at the Belflower location. No explanation can be offered for this apparent site-specific reversed response. At the Gibbs site where catches were lowest, the Pherocon 1C traps baited with Terochem performed as well as most other trap/bait combinations.

The number of FAW males per night captured in IP and Hartstack traps baited with Terochem lures did not differ significantly under the relatively low to moderate populations of FAW at Brownsville, TX. Hartstack and IP traps captured an average of 6.8 and 6.1 FAW males per night, respectively.

Hartstack traps baited with Terochem captured significantly more FAW males ($\bar{x} = 8.9$) than any other combination of lures and traps at Quincy, FL. IP ($\bar{x} = 4.7$)

Table 1. Response of fall armyworm males to STD, Terochem, or virgin fall armyworm female baits placed in Hartstack, IP, and PC - 1C traps at Tifton, GA, 15 May - 20 August 1984 and 28 February - 24 June 1985.

Trap type	Bait	Average no. captured/night*		
		ABAC	Belflower	Gibbs
	1984			
Hartstack	STD	2.6c	10.8d	5.4c
Hartstack	Terochem	19.9a	32.4b	27.8a
Hartstack	females	12.7b	24.6c	15.3b
IP	Terochem	11.9b	45.0a	12.8b
	1985			
Hartstack	STD	0.1d	0.2e	0.1c
Hartstack	Terochem	1.1a	0.8b	1.0a
Hartstack	females	0.4c	0.7c	0.3b
IP	Terochem	0.7b	1.3a	0.3b
Perocon 1C	Terochem	0.2c	0.4d	0.3b

* Means in a column followed by the same letter are not significantly different at $p = 0.05$, as determined by least - squares analysis.

and Hartstack traps baited with Terochem captured ca. 4 and 5 times more FAW males, respectively, than when either trap was baited with the STD bait.

At each site in Dade County where IP traps baited with Terochem were located, significantly more males were captured than in similarly baited Hartstack traps (Table 2). Interestingly, Hartstack traps at Long Key baited with STD or Terochem captured zero and 0.03 males per night, respectively, while Terochem - baited IP traps captured a significantly higher 1.40 males per night. Since Hartstack traps are of a dull metallic color, these differential responses to the traps may have resulted from a visual attractancy of FAW males to the multi-colored IP trap in an area that is generally devoid of host plants except sparse areas of grasses.

Table 2. Response of fall armyworm males to STD and Terochem lures placed in Hartstack and IP traps at Dade County, FL, 9 July - 31 December 1984.

Trap type	Bait	Average no. captured/night*			
		AREC	Graves	TV Tower	Long Key
Hartstack	STD	0.08c	1.02b	1.00c	0.00b
Hartstack	Terochem	2.08b	7.52a	0.90b	0.03b
IP	Terochem	3.94a		16.30a	1.40a

* Means in a column followed by the same letter are not significantly different at $p = 0.05$, as determined by least - squares analysis.

Differential responses to the IP traps at Dade County led to the comparison of different colored traps at Tifton, GA, in 1986. There was no significant difference in the number of FAW males captured in Multiplier (\bar{x} = 13.9) and IP traps (\bar{x} = 14.4). However, solid green IP traps (\bar{x} = 10.8) captured significantly fewer males ($P < 0.01$) than the standard IP trap (\bar{x} = 22.0) (39 replicates, $t = 2.95$, Student's t test)).

These studies confirm the results of Mitchell et al (1985) in that the four-component formulations are far superior to STD baits such as Z9-12:AC for attracting FAW males to traps. Furthermore, new formulations such as Terochem are as or more effective than virgin females when used in Hartstack cone traps. Our studies also confirmed their assessment that the IP trap was as effective as the Hartstack when low populations were present but that the Hartstack design captured more FAW males in most high density situations, due, probably, to the Hartstack traps' greater size. Although our results were similar to theirs at ceratin locations, in Dade County, FL, and at the Belflower site in Tifton, GA, the IP trap was superior in capturing higher numbers of FAW males, irrespective of the FAW population density. Several factors may have influenced higher catches of FAW males in IP traps in Dade County and at the single site at Tifton. These differences in trap performance may have been due to color, plant habitat, trap-site location, or a combination of these factors. Trap color may be an important factor in certain situations, as illustrated with the IP trap at Dade County, FL, and at one location at Tifton, GA, as well as by the decreased efficiency observed in the solid green IP trap. For most situations, the standard IP or similarly designed traps such as the Multiplier baited with improved formulations of pheromones such as those reported by Tumlinson et al. (1986) should suffice for detecting FAW and monitoring subsequent population fluctuations. Both traps are easy to maintain and are relatively inexpensive (\$10) compared with an estimated \$75 for the Hartstack type cone trap.

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