SEASONAL OCCURRENCE OF *SPODOPTERA FRUGIPERDA* LARVAE ON CERTAIN HOST PLANTS IN LOUISIANA[1]

J. R. Fuxa
Department of Entomology
Louisiana Agricultural Experiment Station
Louisiana State University Agricultural Center
Baton Rouge, LA 70803
(Accepted for publication 18 January 1989)

ABSTRACT

The seasonal occurrence of fall armyworm (FAW) larvae, [*Spodoptera frugiperda* (J. E. Smith)], was monitored weekly in corn [*Zea mays* L.], sorghum [*Sorghum bicolor* (L.)], signalgrass [*Brachiaria decumbens* Staph.], and bermudagrass [*Cynodon dactylon* (L.)] in southeastern Louisiana during 1980-84. The earliest and latest dates of detection of FAW during the study were, respectively, April 19 and August 4 for corn, June 9 and August 18 for sorghum, June 2 and September 21 for signalgrass, and June 8 and October 6 for bermudagrass. FAW generations overlapped in 1980, but in the other years generations were distinguishable and often coincided on the various host plants. The results indicated that there could be at least six generations in one year. In each year there was one major, and usually one or more minor, population peaks on each host plant. The range of dates for the greatest population peak density was June 24 - July 18 in corn, June 17 - July 7 in sorghum, June 30 -August 23 in signalgrass, and July 7 - August 18 in bermudagrass. The highest observed population density was ca. 3×10^5 larvae/ha in corn and 3×10^6 larvae/ha in bermudagrass.

Key Words: *Spodoptera frugiperda*, host plants, population density, population dynamics.

J. Entomol. Sci. 24(3): 277-289 (July 1989)

INTRODUCTION

Knowledge of the population dynamics of a polyphagous insect on its various host plants is important to the development of integrated pest management for that insect. In order to manage a population of insects in one field it is important to understand how that population is affected by movement of the insect among different crops as well as among other fields of the same crop (Rabb 1978). For example, research of seasonal occurrence of *Heliothis zea* (Boddie) on its host plants in North Carolina (Neunzig 1969) contributed toward conceptualization of the insect's life system and suggestions for area-wide pest management (Rabb et al. 1974; Stinner et al. 1977).

The fall armyworm (FAW), *Spodoptera frugiperda* (J. E. Smith), is polyphagous; but little is known about its population dynamics on various host plants over a wide area. This insect feeds on a variety of grasses and plants such as corn [*Zea mays* L.] and sorghum [*Sorghum bicolor* (L.)] (Luginbill 1928; Andrews 1980). Laboratory and greenhouse studies of FAW on its host plants have included oviposition and feeding preference, larval growth and development, and fecundity (e.g., Pencoe and Martin 1982; Pitre and Hogg 1983; Pitre et al. 1983; Chang et al. 1985, 1986). Field studies have been limited to seasonal or geographic occurrence

[1] Approved for publication by the Director of the Louisiana Agricultural Experiment Station as manuscript number 88-17-2004.

of larvae or adults in one crop (Pitre 1979; Hogg et al. 1982; Waddill et al. 1982; Pair et al. 1986; Raulston et al. 1986). There has been no rigorous study of seasonal larval numbers on various host plants over a wide area in spite of the fact that several researchers have pointed out the need for such data for FAW (Barfield and Jones 1979; Barfield et al. 1980).

The purpose of the present research was to contribute to our knowledge of FAW host plant utilization by monitoring seasonal FAW population density on various host plants in southeastern Louisiana.

MATERIALS AND METHODS

Fall armyworm larvae were sampled in Louisiana on corn, sorghum, signalgrass [*Brachiaria decumbens* Staph], and bermudagrass [*Cynodon dactylon* (L.)] during 1980-84, and on sorghum during 1980-81. Cornfields were sampled near Hammond (1 field in 1980, 4 in 1982 and 1983, 2 in 1984), St. Gabriel (1 field in 1980, 1981, and 1984; 2 fields in 1982), and Clinton (1 field in 1982 and 1984). Sorghum was sampled near Hammond (1 field in 1980, 2 in 1981). Signalgrass was sampled near Hammond (3 fields in 1980, 5 in 1981, 1 in 1982-84) and Clinton (2 fields in 1981, 1 in 1982-84). Bermudagrass was sampled near Hammond (1 field in 1980-84), Clinton (2 fields in 1980 and 1981, 1 field in 1982 - 84), Zachary (2 fields in 1980 and 1981), Baton Rouge (1 field in 1980-84), St. Gabriel (1 field in 1980 and 1982, 2 in 1981), and Beggs (2 fields in 1981).

Samples were collected weekly while FAW were found. In 1980 the first sample (May 28) was not taken until FAW were already present in corn. But in subsequent years sampling was begun in late March or early April, before the initial FAW infestations. Sampling was terminated when no larvae could be found for at least 2 weeks at any site after corn or sorghum had matured or after mid-September in pastures.

In corn and sorghum larvae were sampled by examination of the entire plant; plants usually were examined in the field but occasionally were cut at ground level and returned to the laboratory in plastic or cloth bags for examination, particularly with small plants. Two to 4 samples per field, including examination of a total of 60-200 randomly selected corn or sorghum plants, were collected on each sampling date. Generally, at least 100 plants were examined per field unless large numbers of FAW larvae were being found. Stages of corn growth and development were classified according to Bottrell (1979).

FAW were sampled in signalgrass and bermudagrass with a sweep net (38 cm diameter) by 180° sweeps taken as closely to the ground as possible. Two to 4 samples per pasture were collected on each sampling date. Each sample consisted of 50-400 sweeps, depending on the numbers of FAW larvae present.

Sampled larvae were returned to the laboratory and classified to instar according to the size of the head capsule. Instar data in Tables 1-3 were derived from only one sample if there were large numbers of FAW and from all four samples if there were few FAW.

RESULTS

Fall armyworm infestations generally appeared in late April or early May and ended in late September or early October in southeastern Louisiana (Figs. 1-5).

Table 1. Mean weekly numbers and ages of *S. frugiperda* larvae in four fields (one for each of four different host plants) at Hammond, Louisiana, during 1980.

	Corn					Sorghum					Signalgrass					Bermudagrass				
Date	no. per plant*	s.e.	mean instar	n	s.e.	no. per plant*	s.e.	mean instar	n	s.e.	no. per sweep*	s.e	mean instar	n	s.e.	no. per sweep*	s.e.	mean instar	n	s.e.
5/28	1.35	0.17	1.0	12	0						0					0				
6/4	replanted										0.028	0.026	3.4	8	0.7	0				
6/10	0					0					0.043	0.015	5.0	20	3.9	0				
6/17	0.11	0.03	3.7	60	1.2	2.40	1.03	3.3	121	0.8	0.015	0.010	5.3	16	1.8	0				
6/24	1.85	1.91	3.6	113	1.1	1.22	0.84	3.8	61	1.0	0.028	0.013	2.8	24	0.6	0.013	0.019	2.8	20	0.6
7/1	0.27	0.27	5.7	28	1.1	0					1.365	0.715	4.0	99	1.0	0.078	0.063	3.4	56	0.6
7/7	0.30	0.23	5.8	23	0.4	0						no sample				0.090	0.105	3.6	63	1.0
7/14†	0.17	0.15	5.0	39	1.0	0.38	0.29	2.8	38	1.4	0.675	0.813	4.2	126	1.0	0.295	0.498	3.5	55	0.9
7/21‡	0.54	0.22	4.9	49	1.3	0.54	0.54	3.0	54	0.8	0.348	0.486	4.9	107	0.8	0.050	0.056	3.1	52	0.5
7/28	1.34	0.62	5.1	67	1.0	0					1.050	0.448	4.5	136	0.8	0.358	0.140	3.5	102	0.8
8/4	0.03	0.02	4.3	4	1.3	0.50	0.49	4.0	25	1.3	0.533	0.566	3.1	89	0.5	0.220	0.061	4.9	51	0.7
8/11§	0					0.40	0.29	3.9	20	1.0	0.685	1.055	3.3	87	0.6	1.415	1.851	1.5	125	1.0
8/18	0					0.36	0.30	4.9	18	1.2	0.718	1.217	3.5	85	0.7	0.248	0.236	4.6	121	0.9
8/26	0					0					0.085	0.099	3.6	59	1.1	0				
9/1											0					0				
9/8											0.055	0.064	3.6	41	0.9	0.030	0.026	3.3	6	0.5
9/15											0					0.040	0.035	3.3	6	0.8
9/22											0					0				
9/29											0					0				
10/6											0					0.018	0.035	3.6	20	0.8
10/13											0					0				

* Four samples, each including 15-50 plants or 50-400 sweeps (see "Materials and Methods").

† Corn in stage 4, tip of tassle emerged (Bottrell 1979)

‡ Corn in stage 5, silks emerging, pollen shedding.

§ Corn in stage 6, kernels in blister stage.

Table 2. Mean weekly numbers and ages of *S. frugiperda* larvae in three fields (one for each of three different host plants) at Hammond, Louisiana, during 1981.

	Sorghum					Signalgrass					Bermudagrass				
Date	no. per plant*	s.e.	mean instar	n	s.e.	no. per sweep*	s.e	mean instar	n	s.e.	no. per sweep*	s.e.	mean instar	n	s.e.
6/9	0.02	0.01	4.0	10	1.1	0.008	0.010	5.3	4	1.0	0				
6.16	0.08	0.05	4.2	31	1.5	0.380	0.254	3.2	98	0.6	0				
6/23	0.40	0.28	5.6	68	0.8	0.970	0.357	4.1	148	0.8	0.005	0.010	3.0	3	0
6/30	0.03	0.03	6.0	4	0	0.163	0.148	4.3	101	0.8	0				
7/7	0.48	0.49	2.0	67	1.4	0.025	0.030	1.9	25	1.5	0				
7/14	0.30	0.20	4.2	64	1.3	1.203	1.444	3.9	167	1.4	0.570	0.499	2.4	173	0.9
7/21	0.23	0.28	5.5	42	0.7	0.755	0.409	5.7	78	0.6	0.285	0.117	3.6	87	0.9
7/28	0.02	0.02	6.0	4	0	0.015	0.030	3.7	3	0.6	0.165	0.053	3.9	68	0.7
8/4	0.03	0.04	4.4	10	1.4	0.035	0.010	1.9	7	1.1	0.005	0.010	3.0	2	0
8/11	0.18	0.21	4.4	35	1.4	5.088	1.678	3.8	357	1.4	0.213	0.147	2.5	159	0.9
8/18	0					1.360	0.937	5.6	125	0.8	0.065	0.077	4.1	16	1.5
8/25						0.033	0.043	5.6	28	0.5	0.005	0.010	6.0	4	0
9/1						0					0.015	0.010	2.4	5	0.6
9/8											0.038	0.029	2.6	31	0.6
9/16											0.015	0.019	5.5	4	0.6
9/22											0				

* Four samples, each including 15-50 plants or 50-400 sweeps (see "Materials and Methods").

Table 3. Mean weekly numbers and ages of *S. frugiperda* larvae in three fields (one for each of three different host plants) at Hammond, Louisiana, during 1982.

	Corn					Signalgrass					Bermudagrass				
Date	no. per plant*	s.e.	mean instar	n	s.e.	no. per sweep*	s.e	mean instar	n	s.e.	no. per sweep*	s.e.	mean instar	n	s.e.
5/3	0.003	0.005	5.9	7	0.4	0					0				
5/12	0.45	0.39	3.7	66	1.4	0					0				
5/20†	0.11	0.09	5.1	86	0.9	0					0				
5/25	0.09	0.09	5.8	33	0.4	0					0				
6/1‡	0.12	0.11	5.4	37	0.9	0					0				
6/8	0.20	0.16	5.2	45	1.0	0					0.005	0.010	4.0	1	0
6/15	0.19	0.20	4.6	39	1.3	0.003	0.004	3.5	4	0.6	0.005	0.010	3.0	1	0
6/22§	0.10	0.09	5.8	22	0.5	0.030	0.026	3.3	22	1.0	0.010	0.012	2.9	7	0.4
6/29	0					0.014	0.014	3.2	20	0.8	0				
7/6						0.003	0.005	4.4	5	1.5	0.005	0.006	2.5	2	0.7
7/13						0.002	0.004	5.3	3	1.2	0.003	0.005	3.0	1	0
7/20						0.175	0.297	2.7	155	1.0	0.060	0.047	3.3	47	1.0
7/27						1.018	0.455	4.6	208	1.2	0.060	0.049	3.3	63	0.9
8/3						0.084	0.060	4.5	50	0.9	0.060	0.037	3.4	28	0.9
8/9						0.010	0.020	2.7	6	0.8	0				
8/16						0.010	0.012	3.7	3	0.6	0				
8/23						0.065	0.038	4.2	49	1.0	0.030	0.020	2.9	19	0.8
8/30						0					0				
9/6						0					0				
9/13						0.017	0.018	4.3	6	1.2	0.005	0.006	3.6	9	0.5
9/20						0					0				

* Four samples, each including 15-50 plants or 50-400 sweeps (see "Materials and Methods").

† Corn in stage 4, tip of tassle emerged (Bottrell 1979).

‡ Corn in stage 5, silks, emerging, pollen shedding.

§ Corn in stage 6, kernels in blister stage.

The insects were first detected in corn. The dates of initial detection during the 5 years of the study (1980-84) were May 28, April 22, April 19, May 24, and May 7, respectively; and the final dates of detection in corn were August 4, July 31, July 27, July 26, and July 30, respectively. At least one late-planted cornfield (mid-late May) was included in each year's sampling except 1981, but no special effort was made to make corn available beyond the usual growing season. The initial detection of FAW in the other three host plants was always in June. FAW were initially detected in sorghum on June 17 in 1980 and June 9 in 1981, and the final dates of detection were August 18 and August 11. During 1980-84 FAW were initially detected in signalgrass on June 4, 9, 15, 27, and 25, respectively; the final dates of detection each year were September 15, September 21, September 20, August 22, and September 4. The final infestations of each season were in bermudagrass except in 1982 (signalgrass). The initial dates of detection in bermudagrass each year were June 24, 16, 8, 16, and 19; the final dates of detection were October 6, September 30, September 13, September 12, and September 25.

FAW population density often peaked simultaneously in two or more of the host plants (Figs. 1-5). These simultaneous peaks usually came at ca. monthly intervals, which was evident in every year except 1980. The highest population density in each crop and season usually occurred first in corn and last in signalgrass and bermudagrass. The date of the highest observed population density ranged from June 24 to July 18 in corn, June 17 to July 7 in sorghum, June 30 to August 23 in signalgrass, and July 7 to August 18 in bermudagrass.

Tables 1-3 show means and standard errors for one field of each type of host plant sampled at one site, Hammond, during 1980-82. The highest FAW numbers in corn occurred when the plants were in vegetative or silking stages; the populations declined quickly as ears grew and matured (Tables 1, 3). The instar data generally indicate that there were overlapping generations (e.g., in corn during June 17 - August 4, 1980), though distinct generations occasionally were discernable (e.g., sorghum during 1980 and bermudagrass during August 11-18, 1980). Means and standard errors are not shown for 1983-84, when there generally were only two samples per field on each sampling date.

Absolute population density of FAW can be estimated from the present data. For example, the heaviest infestation in corn was observed in July 1984 at 6.4 FAW/plant, and the fields sampled were planted in 0.91-m rows with ca. 4.1 plants/m of row. Thus on that date there were ca. 2.8×10^5 larvae/ha. The heaviest infestation in grass was 10.6 larvae/sweep in bermudagrass during July 1983, which can be converted to an estimate of absolute density of ca. 3.0×10^6 larvae/ha (Alvarado et al. 1983). Thus, the heaviest FAW infestation in bermudagrass had absolute FAW numbers ca. $10 \times$ greater than the heaviest infestation in corn. Numbers of FAW in the two grasses can be compared directly because both were sampled by sweep net; FAW generally were more numerous in signalgrass than in bermudagrass except in 1983.

DISCUSSION

The present research lends some circumstantial support to the hypothesis that FAW in Louisiana move into signalgrass and bermudagrass as corn matures and becomes unsuitable for oviposition. First, initial and peak infestations occurred

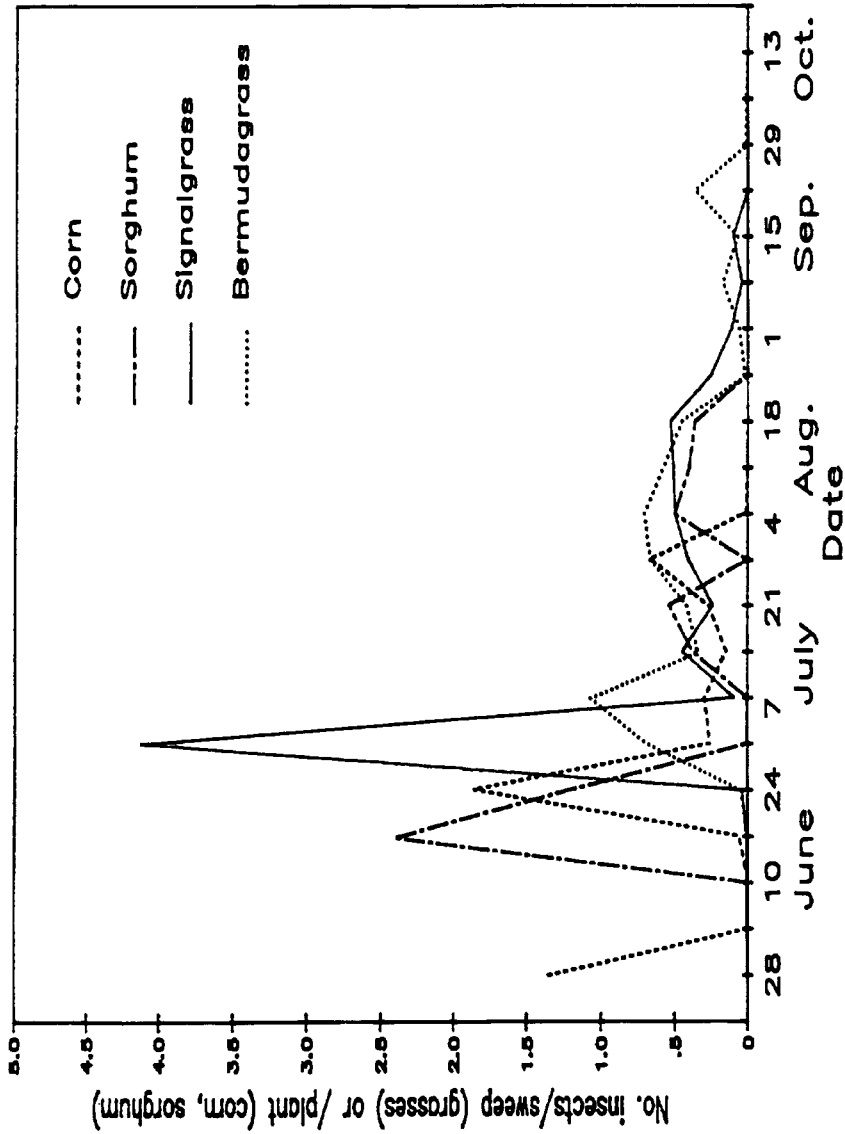

Fig. 1. Seasonal abundance of fall armyworm on four host plants in Louisiana, 1980.

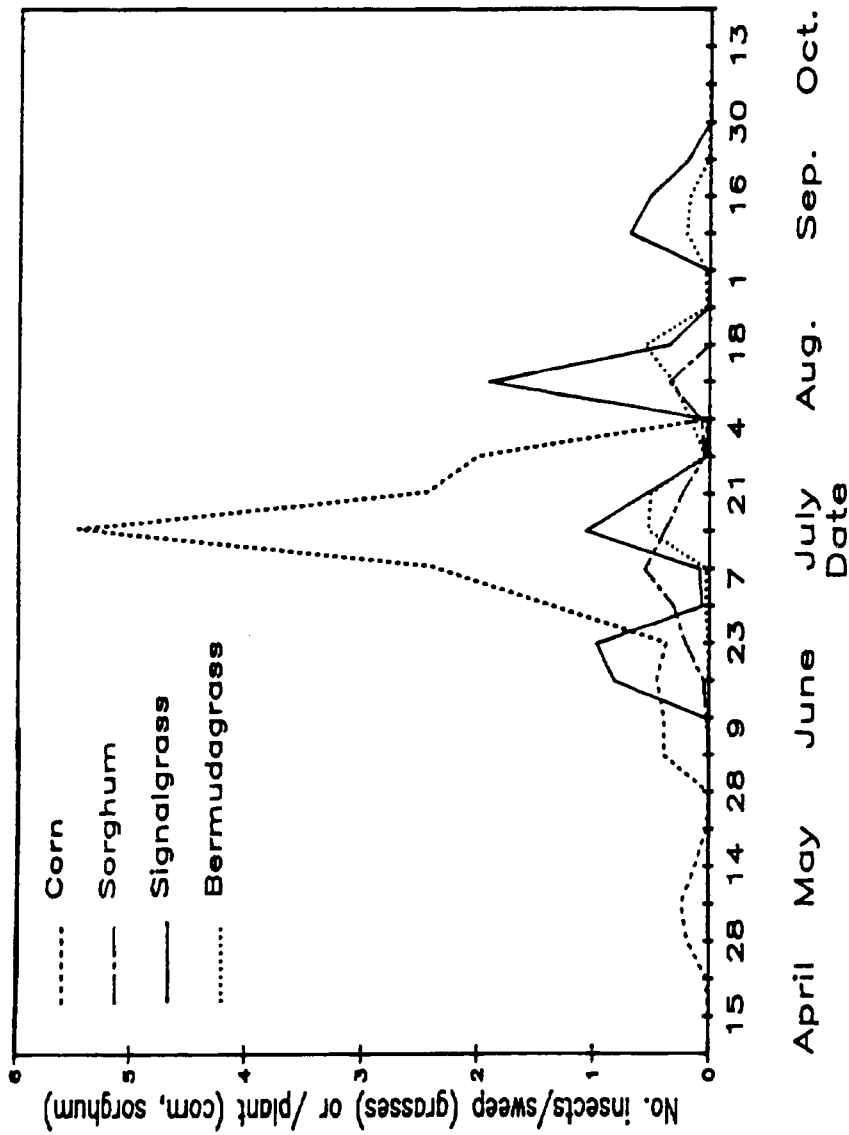

Fig. 2. Seasonal abundance of fall armyworm on four host plants in Louisiana, 1981.

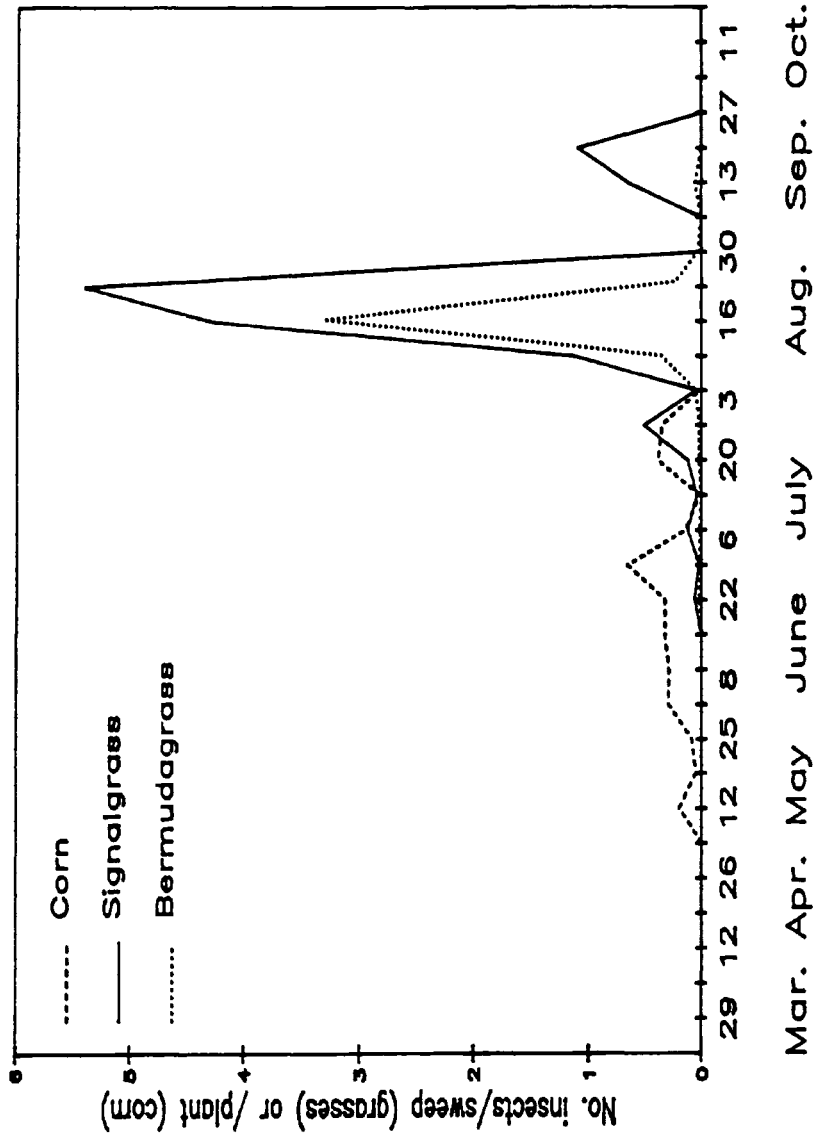

Fig. 3. Seasonal abundance of fall armyworm on three host plants in Louisiana, 1982.

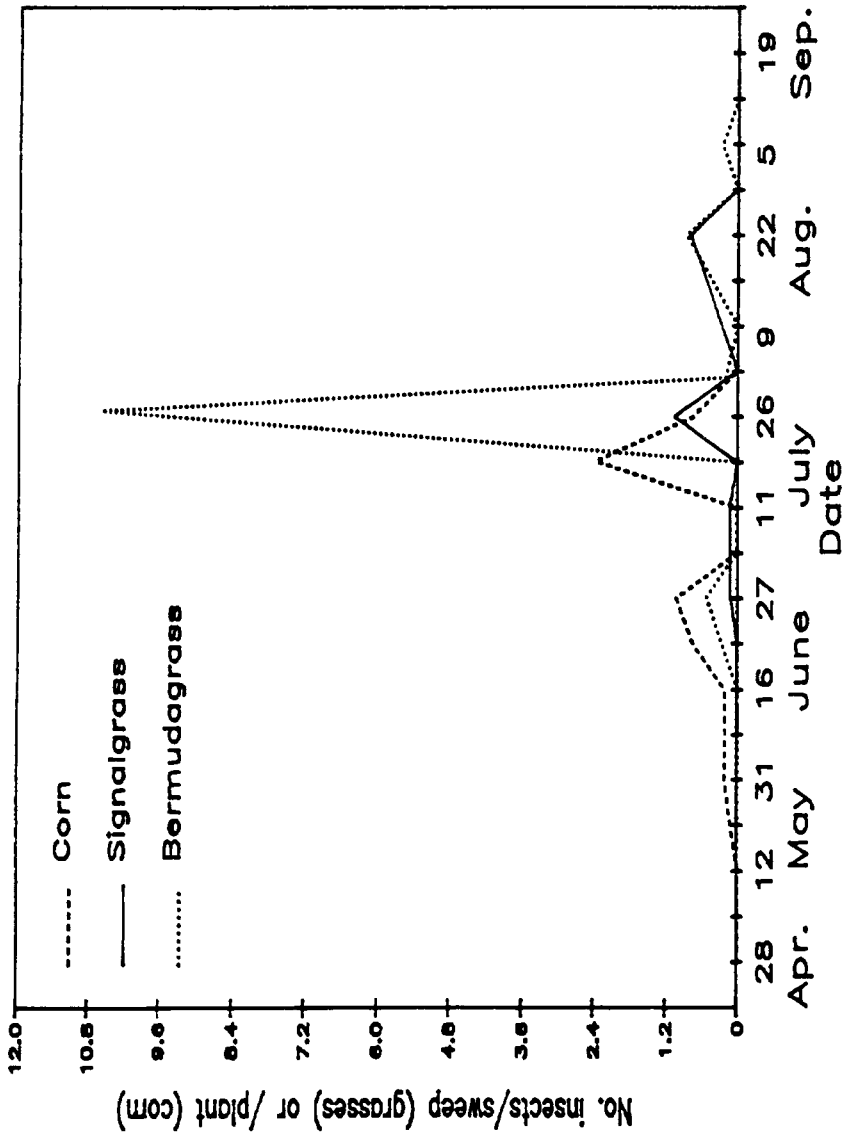

Fig. 4. Seasonal abundance of fall armyworm on three host plants in Louisiana, 1983.

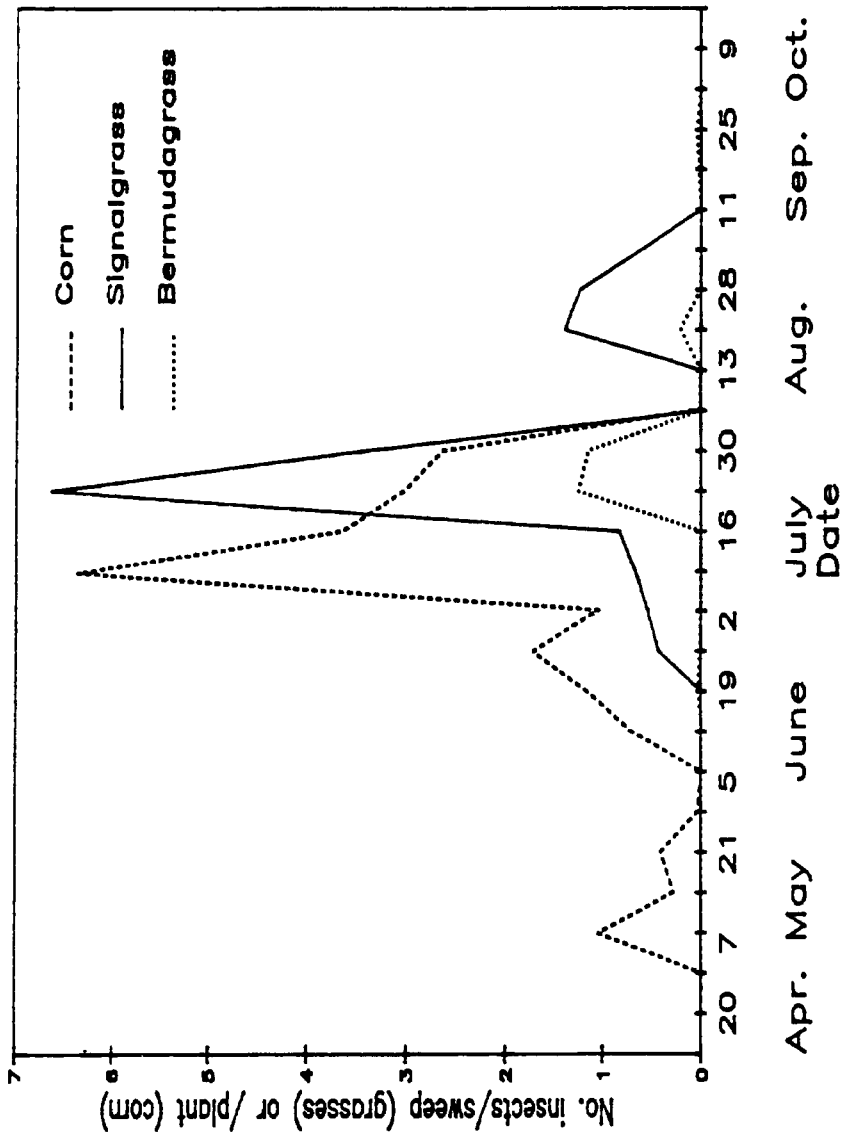

Fig. 5. Seasonal abundance of fall armyworm on three host plants in Louisiana, 1984.

earlier in corn than in the other three crops. In every year except 1980, the biggest peak in FAW numbers in the two grasses came just as or right after the populations declined in corn for the final time. Even in 1980, the data at one site (Table 1) indicated that a dense population of young insects occurred in bermudagrass (August 11) 2 weeks after the last dense population of the season was pupating in corn (July 28), which was probably becoming an unsuitable host plant as it matured. Second, FAW numbers almost always peaked simultaneously in the two grasses which, in turn, peaked at ca. the same time as in corn in 1981-83 (Figs. 2-4). On the other hand, in 1980 and 1984 (Figs. 1, 5) the peaks in corn were similar in magnitude to those in the two grasses but were not quite simultaneous with them.

Two characteristics of FAW make conclusions difficult concerning population dynamics on different host plants. The moths are strong fliers and are migratory (Sparks 1979). Additionally, fall armyworm may be comprised of different sibling species, each feeding on different hosts. Pashley (1986) found at least two strains of FAW; one normally feeds on corn and the other on rice and bermudagrass, though the "corn" strain was able to feed on rice and vice versa. Thus, it is possible that the "corn" strain of FAW emigrates when corn becomes an unsuitable host rather than ovipositing nearby on a different plant species.

The present data, particularly in Table 1 and Fig. 2, agree with previous conclusions (Luginbill 1928) that there can be at least six generations of FAW per year in the most southerly parts of the USA. Also, the dates of initial infestations in corn in the present study were similar to those in Mississippi in 1978-79, where FAW larvae were initially detected in May (Hogg et al. 1982).

There are many questions yet to be answered concerning FAW population dynamics. One of the more intriguing is, where do the Louisiana insects go in late September? There can be occasional larval infestations late in the year (Oliver and Chapin 1981). Yet the present results clearly indicate that larval populations in signalgrass and bermudagrass decline greatly by late September, when the temperature in southeastern Louisiana is not yet cold enough to kill FAW. There is circumstantial evidence for southerly migration of FAW in the fall (Sparks et al. 1986). Further research is necessary to determine whether they move to a different host plant or emigrate from Louisiana.

ACKNOWLEDGMENTS

I thank B. H. Wilson for his advice in the early stages of the research, G. W. Warren for assistance with some of the sampling, and D. P. Pashley, S. S. Quisenberry, and R. N. Story for critically reading the manuscript and for providing helpful suggestions.

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