Distribution and Abundance of Early-Season Wild Host Plants and Bollworm and Tobacco Budworm Populations (Lepidoptera: Noctuidae) in an Intensively Cropped Area of the Mid-Delta of Mississippi[1]

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ABSTRACT An intensively cropped area of the Mississippi Delta located in Washington County, Mississippi was sampled to determine distribution and abundance of early-season wild host plants of *Heliothis virescens* (F.) and *Helicoverpa zea* (Boddie), and F_1 larval populations on them. The area sampled was approximately 6.4 km square with an approximate area of 4,146 ha. Wild host plants were most numerous along roadsides, ditch and field margins, and in small (usually dry) ditches and their margins. The total area of suitable habitat for these wild hosts was estimated as 98.8 ha which represented approximately 2.4% of the total area. Species of *Geranium* were the most abundant wild hosts found. *Helicoverpa zea* and *Heliothis virescens* were estimated to average a combined total of 62 larvae per ha of wild host plants. These data demonstrate that experiments on the control of both pest species on wild hosts on an area-wide basis in the Delta are possible due to the confinement of these pests and their wild host plants to a relatively small area.

KEY WORDS *Heliothis virescens*, bollworm, tobacco budworm, wild host plants, early-season control, Mississippi Delta.

In the mid-south the bollworm, *Helicoverpa zea* (Boddie), and the tobacco budworm, *Heliothis virescens* (F.), are major pests of cotton. Adults of both species emerge from overwintering pupae in the spring, and produce their F_1 larval generations on wild hosts before cultivated host crops are available (Stadelbacher et al. 1972, Stadelbacher and Pfrimmer 1973, Stadelbacher 1979, Stadelbacher 1981). The area of suitable habitat for these species of plants in the Delta has been estimated at 3.5% (Stadelbacher 1982) of the total rural area. Stadelbacher (1979, 1981) suggested that these wild host plants could serve as a trap in which a high percentage of the first generation of *Heliothis* and *Helicoverpa* could be suppressed through integrated cultural and biological control methods. He tested three control methods in small plots (Stadelbacher 1982, 1985) and obtained suppression of the F_1 larval generation of these pests as high as 97.4% by one properly scheduled mowing, 99.7% by one application of a selective herbicide, and 78.6% by five applications of *Heliothis* virus. Harris and Phillips (1986) found that mowing spring-flowering weeds in non-field habitats in southeastern Arkansas reduced *Heliothis* and *Helicoverpa* larval densities an average of 50% as compared to an unmowed area in a two-year study. In order to develop a plan for any area-

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wide program for control of these pests, more precise determinations of the wild host habitat and total area occupied by these wild hosts are needed. This study was conducted to help provide this information. Larval populations on the wild hosts were also sampled.

Materials and Methods

The study area was a square 6.4 km (4 miles) on each side located in Washington County approximately 10 km east of Leland, MS. The area is intensively cropped with cotton, soybeans, grain sorghum, rice, and winter wheat. The area is bisected in the northern one-half by a single-track railroad, and near the middle of the area from east to west by U.S. Highway 82.

The study was broken into the following land use categories for sampling purposes: (1) road margins — the area from the hard surface of a road to where the road right-of-way was no longer maintained by the state or county. On well maintained (no host plants growing on them) field roads, the road margin extended from the road to bare, cultivated ground; (2) field margins — the area around fields disturbed but not planted each year. Some field margins had host plants and were sampled; others were bare and were not sampled; (3) ditch margins — the area from the ditch edge to disturbed ground on a field side or to the maintained area of a state or county road. The area between a ditch and a field road running near it was considered ditch margin; (4) field roads — infrequently used dirt roads with host plants growing on them. The road and both margins extending to bare ground were measured; (5) large ditches — the area in a ditch from the top inside edge on one side extended to the other side. The bottom of these ditches usually contained water; and (6) small ditches plus margins — these ditches were usually dry with host plants found in the ditch and margins. The ditch and both margins were considered one area.

Samples were taken at approximately 0.16 km (0.1 mile) intervals along all roads and ditches in the study area. To cover distances rapidly, a Honda Fourtrax® TRX® 3500 all terrain vehicle was used. At each sample location, the width of the areas with host plants (the 6 categories listed previously) was measured at 3 random locations using a Rolatape Master Measure Wheel. Large ditches were measured with a tape measure. Length measurements for a road, ditch, etc., were taken from aerial photographs of the study area obtained from the USDA, Agricultural Stabilization and Conservation Service. Wild host plant populations were measured at each location using a 1 m^2 rectangle (0.61 × 1.64 m) made of aluminum (0.32 × 1.37 cm). The rectangle was placed on the ground at random and the number of host plants within the rectangle were counted. Three counts were taken of the numbers of each species of host at each sample location from each of the land use categories found at the sample location. These host plants included: Carolina geranium, *Geranium carolinianum* L., and cutleaf geranium, *G. dissectum* L., (both species were counted together as geranium); several species of clover, *Trifolium* spp.; narrow-leaved vetch, *Vicia angustifolia* L.; caley-pea, *Lathyrus hirsutus* L.; cutleaf eveningprimrose, *Oenothera laciniata* Hill and white eveningprimrose, *O. speciosa* Nutt. (both species of primrose were counted together as primrose). Counts of narrow-leaved vetch, clovers, and caley-pea were sometimes difficult to make when dense stands were sampled. In these cases a portion (1/4 or 1/10) of the area occupied by the host plants within the rectangle was visually estimated

and the plants in it counted, then multiplied by 4 or 10 to convert the count to a 1 m^2 basis. Width measurements along roads began in the 1st week of March 1986, and host plant density samples were begun in the 3rd week of March. All samples were completed during the 2nd week of April. The host plant counts were begun at a later date than the width measurements to allow host plants sufficient time to emerge. Autocorrelation coefficients (Anderson 1971) were compared for each host plant species using plant density between consecutive sites (when at least 8 consecutive sites occurred at 0.16 km intervals) within road margins, field margins, ditch margins, field roads, and ditches plus margins.

Samples for bollworm and tobacco budworm larvae were taken on 24 and 29 April and on 8, 14, 22, and 30 May. To facilitate sampling, the 4,146 ha area was divided into quadrants. Twenty sample locations (areas containing host plants in 1 or more of the land use categories listed previously) at least 0.5 km in length were chosen from each quadrant. Large ditches were not sampled because of low host plant densities previously found in them. During the first 3 weeks of sampling, 21 sample locations were chosen each week at random from locations not previously sampled. This prevented any location from being sampled more than once. The process was repeated during the last 3 weeks of sampling so that no location was sampled more than 2 times during the test. Two random samples were taken at each location used on a sample date. In each sample all host plants within a measured area were swept with a standard 38-cm sweep net. No effort was made to separate the sample by host since the host plants commonly grew close together and could not be swept individually. The length for each area sampled was 30.5 m, while the width varied and was measured at 5 points approximately 6 m apart in order to obtain a mean width to estimate the area sampled. Samples obtained with the sweep net were returned to the laboratory where larvae were separated from the plant debris and identified. Larvae were reared to the adult stage for positive species identification.

Results

Approximately 98.8 ha of the total of 4,146 ha of land in the sample area was habitat typical of the species of wild host plants (Table 1). This habitat represents about 2.4% of the total area, which is a little lower than the estimate of 3.5% for the Delta (16 counties) made by Stadelbacher (1982). Wild hosts were most abundant in ditch and road margins, and in small ditches and their margins (Table 2). Low numbers of wild hosts were found on the banks of large ditches, which were usually overgrown with trees, shrubs, vines, or tall grass that preventd most wild host plants from growing. Ditch margins or small ditches and their margins were the best locations for geranium. Vetch and caley-pea were fairly evenly distributed in all locations, except banks of large ditches, and eveningprimrose was most common in road and field margins. Clover was most abundant in road margins. None of the autocorrelation coefficients were significant ($P = 0.05$).

Results of sampling wild host plants for bollworm and tobacco budworm larvae are shown in Table 3. Due to unusually dry weather from January through May 1986, the number of sample locations in which wild host plants could be found declined during May. Rainfall measurements taken from January through May 1986 by the National Oceanic and Atmospheric Administration, Mid-South Agricultural Weather Service Center, Stoneville, MS (located approximately 12 km from the

Table 1. Land areas categorized by use in which wild host plants of the bollworm and tobacco budworm were found within a 41.5 km² area of Washington County, MS in March and April 1986.

Land use category	No. of ha.	% of total area
Road margins	35.1	0.85
Field margins	15.1	0.36
Ditch margins	31.6	0.76
Roads	8.2	0.20
Ditches + margins	8.8	0.21
Sum	98.8	2.38

sample area) were the lowest recorded since 1915. During the last 2 weeks of May, 16 of the 80 sample locations were eliminated from sampling due to low numbers of hosts, and fewer sample locations (16) were used. During April and on 8 May only *H. zea* larvae were found in the samples (Table 3). On 14, 22, and 30 May; 25, 9, and 1 *H. virescens* larvae, respectively, were found, and the remaining larvae (8, 1, and 0, respectively) were *H. zea.* A total of 62 larvae were found in the 6 weeks of sampling. The total area sampled with sweep net was approximately 9918 m².

Discussion

The independence of plant densities will be useful information for experiments for control of wild host plants, because most commonly used experimental designs require independence of the experimental units.

The total area sampled for larvae was almost (99%) 1 ha. Based on the finding of 62 larvae in the samples, approximately 6200 larvae were produced on the ca. 100 ha of wild hosts in the sample area. However, sampling with a sweep net probably greatly underestimated the actual larval population present on the wild hosts. Stadelbacher (1979) used unit area samples in which whole plants were examined during May 1977 in dense stands of *G. dissectum* to calculate that such stands produced over 47,000 and 299,000 first generation *H. zea* and *H. virescens* larvae, respectively, per ha of host. He also calculated that in 1978 an average of 4,028 F_1 *H. zea* and 12,755 F_1 *H. virescens* adults were produced / ha of *G. dissectum* in Washington County, Miss. These calculations, made after predators, parasites, pathogens, etc. had taken their toll on the egg, larval, and pupal populations, were based on the numbers of F_1 adults that emerged in screen cages placed over the geranium after it had matured, but before adults had emerged. The F_1 generation of *H. zea* moths emerged between 1 and 2 June, and that of *H. virescens* between 7 June and 5 July. In the present study we found *H. zea* larvae three weeks prior to finding *H. virescens* larvae, which shows that in 1986 the F_1 generation of *H. zea* adults were again present prior to the F_1 generation of

Table 2. Densities of wild host plants of the bollworm and tobacco budworm in 5 different types of land use categories in a 41.5 km² area of Washington County, MS in March and April 1986.

	No. of hosts/m²					
Location	Geranium	Vetch	Primrose	Caley pea	Clover	n
Road margins	4.10 ± 2.88	1.41 ± 1.40	1.97 ± 2.90	0.12 ± 0.17	3.05 ± 3.64	492
Field margins	2.12 ± 2.31	1.70 ± 1.66	1.68 ± 3.15	0.07 ± 0.13	0.82 ± 1.23	1164
Ditch margins	5.61 ± 3.21	1.55 ± 0.59	1.33 ± 0.64	0.12 ± 0.20	0.01 ± 0.004	1128
Ditches (large)	0.26 ± 0.33	0.27 ± 0.22	0.17 ± 0.42	0.004 ± 0.01	0.00 ± 0.00	765
Ditches + margins	4.33 ± 3.06	1.60 ± 1.73	0.71 ± 0.88	0.04 ± 0.11	0.01 ± 0.04	273
Roads	1.43 ± 2.37	0.70 ± 0.94	0.53 ± 0.73	0.12 ± 0.16	0.59 ± 1.11	239

Mean ± standard error of the mean.

Table 3. Numbers of bollworm and tobacco budworm F_1 larvae found by sweep net sampling wild host plants within a 41.5 km² area of Washington County, MS in March and April 1986.

Sample date	No. sites* sampled	No. larvae collected	% *Helicoverpa zea*	% *Heliothis* virescens	Total area sampled (m²)	No. larvae/ha *Helicoverpa zea*	No. larvae/ha *Heliothis virescens*
April							
24	21	6	100	0	2099	29	0
29	21	7	100	0	1763	40	0
May							
08	21	5	100	0	1424	35	0
14	21	33	24	76	1767	45	141
22	16	10	10	90	1522	7	59
30	16	1	0	100	1343	0	7
Total		62			9918		

* Two samples were taken at each sample site.

H. virescens adults. These F_1 adults disperse out of the marginal areas containing early season wild hosts, because this habitat lacks suitable wild host plants during the summer. Analysis by atomic absorption spectrophotometry of F_1 adults, produced on wild geranium treated with rubidium chloride, and similar analysis of eggs collected in cotton (E.A.S., unpublished data) show that these moths produce the intial infestation of cotton in the Delta of Mississippi. In this study, the actual number of moths produced on the wild hosts to infest surrounding crops in June was not determined.

Area-wide programs for control of the bollworm and tobbaco budworm by suppression of populations in early season wild hosts would involve management of wild hosts on road, field, ditch margins, and infrequently used field roads and small ditches. It is doubtful that treatment of the inside of large ditch banks would be necessary because few hosts were found in this habitat. This study indicates that a major part of an area-wide program in the Delta would be management of road margins because they made up 36% of the total area with wild hosts. Properly scheduled mowing or treating with herbicides of early-season wild hosts on state and county roads would be a normal operation for state or county highway departments and would not result in additional cost to the respective road departments or to producers. Management of wild host plants in the remainder of the wild host habitat would be the responsibility of the producers or of state or federal workers involved in such a program.

The area chosen for the present study is intensively cropped and the data obtained probably represents a lower estimate of the amount of area with host plants than could be found in other areas of the Delta or other cotton growing areas in the mid-south. However, as estimated by Stadelbacher (1982), much of the Mississippi Delta should have small enough areas with wild hosts to make an area-wide program to control bollworm and tobacco budworm populations found on wild hosts feasible.

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