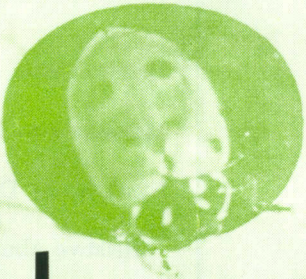
CIRCULAR 227
MAY 1976

The Relative and Seasonal Abundance of Selected Predaceous Arthropods in Alabama Cotton Fields



AGRICULTURAL EXPERIMENT STATION/AUBURN UNIVERSITY
R. DENNIS ROUSE, Director AUBURN, ALABAMA

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FIRST PRINTING 3M, MAY 1976

THE RELATIVE AND SEASONAL ABUNDANCE OF SELECTED PREDACEOUS ARTHROPODS IN ALABAMA COTTON FIELDS

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INTRODUCTION

THE IMPORTANCE of predaceous arthropods in the natural suppression of cotton insect pest populations has been established *(3,9,12,13,14,16)*. However, the potential of arthropod predators for pest suppression, especially when considered as an integral part of integrated pest management programs, cannot be fully realized until we have a better understanding of these organisms. For example, it is known that predaceous arthropod populations are not stable. Campbell and Hutchins *(1)* reported that predatory insect populations in Mississippi peaked in June and reached their lowest population levels in early July. After a 3-year study of predators in Arizona cotton fields, Wene and Sheets *(15)* concluded that big-eyed bugs, *Geocoris* spp., were the most prevalent predators during June, but populations of these insects decreased more rapidly than did spiders which were the second most abundant group. Lacewing, *Chrysopa* spp., populations progressively increased as the season progressed until they were the most prevalent group of predators present during August. Laster and Brazzel *(6)* found that lady beetles, Coccinellidae; damsel bugs, *Nabis* spp.; and big-eyed bugs were the dominant predators during early season in Mississippi cotton fields. Spiders became dominant in mid- and late-season. Dinkins, *(3)*, also working in Mississippi, reported that populations of most major predator groups reached their peak numbers in late June and declined thereafter. Lincoln *(7)* reported that in the cotton-soybean agroecosystem in

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Arkansas, natural biological control usually collapses in late June and early July.

One factor that contributes to seasonal instability of predator populations in cotton fields is variability of predator habitat around the fields. Campbell and Hutchins *(1)* attributed fluctuations in predator populations to the presence of corn. Predators moved from cotton to corn and back to cotton, apparently in response to plant maturity and prey abundance. These and other authors *(4,5,8,17)* suggested that corn or other crops be planted within or adjacent to cotton fields to increase predator populations. Whitcomb and Bell *(16)* reported that in Arkansas the dominant lady beetle in most fields was the convergent lady beetle, *Hippodamia convergens,* Guerin-Menville, but in fields adjacent to corn, Johnsongrass or sorghum, the pink lady beetle, *Coleomegilla maculata* DeGeer dominated.

In 1970, studies were initiated to ascertain the role of beneficial arthropods as cotton pest suppression agents in Alabama. The research reported herein was designed to determine the relative and seasonal abundance of selected insect predators and the effect of peripheral vegetation on their abundance.

METHODS AND MATERIALS

These studies were conducted in representative cotton fields in Shelby and Talladega counties in east-central Alabama. Beginning June 11, 1970, arthropod populations in 23 cotton fields were sampled with a sweep net (12-inch diameter). Each sample was collected by making 25 sweeps of the upper 18 inches of cotton plants within a 100-foot section row at selected sites within the field. Sampling sites were located within approximately 50 feet of the edge of a field or near the center of the field. Collected insects were preserved in 70 percent ethanol for subsequent identification and counting. Sampling data were categorized according to the predominant peripheral vegetation nearest the sampling site. Five categories were established; (1) soybeans, (2) corn, (3) meadows, (4) forests, and (5) middles. Samples classed as "middles" were collected from the center portion of relatively large fields (approximately 25 acres or larger) where non-cotton vegetation was not in close proximity to the sampling site. Sweep net sampling was continued on a weekly basis through August 27, 1970.

Additional samples were collected from 18 fields from July 16 through September 3, 1970, using a mechanical sampling device

FIG. Mechanical sampling device (McCoy 10).

(10) (the figure). This device consisted of a suction apparatus mounted on a high clearance spray machine. With this device, from 1,000 to 8,000 row feet of cotton were sampled in each field on each sampling date. Collected samples were placed in paper or plastic bags, frozen and stored for subsequent identification and counting.

None of the fields used in this test was treated with insecticide prior to or during the sampling period.

RESULTS AND DISCUSSION

Many species of predaceous insects and spiders were collected in this study. Of those collected, five of the most abundant groups or species of insects were selected for analysis. These included damsel bugs, *Nabis* spp.; big-eyed bugs, *Geocoris* spp.; long-legged flies, Dolichopodidae; the pink or spotted lady beetle, *Coleomegilla maculata;* and the convergent lady beetle, *Hippodamia convergens.* Nymphs of *Nabis* spp. and *Geocoris* spp. were included, but immature forms of Dolichopodidae and Coccinellidae were not counted.

Relative Abundance

Big-eyed bugs were easily the most abundant of the predaceous insects studied, comprising 42 percent of the total number collected by sweep net and 52 percent of the total collected with the mechanical sampler (Table 1). The pink lady beetle was the second-most abundant predator group collected. Dolichopodid flies were quite abundant in sweep net samples, but were least abundant of the predators studied in mechanical sampler collections. We attributed this difference in abundance to basic differences in the two sampling techniques. The sweep net was used to sample the upper portions of cotton plants while the mechanical sampler collected insects primarily from the middle and lower portions of the plants. Thus these flies, which Whitcomb and Bell *(16)* reported as being unusually abundant in Arkansas cotton fields, seem to frequent the upper portions of cotton plants more so than the lower portions. Damsel bugs and convergent lady beetles were of approximately equal abundance and seemed to be evenly distributed over all portions of the cotton plants.

The results of this study differed from those of Nemec *(11)* and Dinkins *(3)* who found that damsel bugs were at least equally as abundant as big-eyed bugs in Texas and Mississippi cotton fields. Also, our data concerning lady beetle abundance differed from that collected by Whitcomb and Bell *(16)*, who found the convergent lady beetle to be the most common lady beetle in Arkansas cotton fields. Several factors may have caused these differences, but field size was perhaps most important. The average size of cotton fields used in this study was approximately 10 acres, which is considerably smaller than the average cotton field in Arkansas, Mississippi, and Texas. Thus the influence of surrounding habitat on predator populations in cotton fields may have been greater in fields included in this study than in the larger fields found in other cotton growing states. For example, most of

TABLE 1. NUMBER OF SELECTED PREDATORS CAPTURED BY TWO SAMPLING METHODS, SHELBY AND TALLADEGA COUNTIES, ALABAMA, 1970

Predator	Sweep net[1]		Mechanical sampler[2]	
	No. per acre per week	Percent total	No. per acre per week	Percent total
Pink lady beetle	113.0	20	430.5	30
Convergent lady beetle	51.3	9	98.4	7
Long-legged flies	90.6	17	52.2	4
Big-eyed bugs	231.8	42	731.7	51
Damsel bugs	63.3	12	106.6	8

[1] Samples were collected from June 11 through August 27.
[2] Samples were collected from July 13 through August 4.

the fields in our study were in close proximity to Johnsongrass, corn, or soybean, habitats thought to favor the pink lady beetle *(16)*.

Peripheral habitat did not appear to have a significant effect on the number of predators in a sampling site, but it did affect composition of the predator complex. Big-eyed bugs were the dominant predator group collected in all sampling sites, comprising 40 to 46 percent of the total in the various sites (Table 2). Populations of pink lady beetles were greatest near soybeans, forests, and in the middle of cotton fields, comprising 23 to 33 percent of the sample in these situations. Near corn or meadows, however, populations of this lady beetle were appreciably lower. Populations of long-legged flies, Dolichopodidae, also varied greatly. Near corn and meadows these flies were especially abundant, constituting 21 and 27 percent of the entire collection at these sites, but in samples taken near soybeans these flies comprised only 3 percent of the total. Collections of convergent lady beetles indicated soybeans or meadows were the best reservoirs for this lady beetle; samples taken near other peripheral vegetation contained few individuals of this species. Populations of damsel bugs were relatively consistent in abundance with similar numbers being collected in all sampling sites.

Seasonal Abundance

Weekly sweep net sampling data (Table 3) indicated pink lady beetles to be more prevalent in cotton fields in early- and mid-season than in late-season. This lady beetle was particularly abundant during June and early July in fields adjacent to young soybeans. Whitcomb and Bell *(16)* earlier reported soybeans to be a good reservoir for this lady beetle. During mid-season large populations were found in the center of cotton fields and in the edges of fields adjacent to wooded areas. Generally, the data appear to confirm the conclusions of Dinkins *(3)* that the pink lady beetle is most prevalent during early-season. However, data from mechanically collected samples (Table 4) indicated that pink lady beetle populations were second only to big-eyed bugs during July and August. These and other apparent disparities in our data and that reported by other researchers may well be due to sampling techniques. Many population abundance studies of predaceous arthropods in cotton fields have been conducted with the sweep net as the sole sampling tool. However, as cotton plants grow during the season, it becomes progressively more difficult to collect rep-

TABLE 2. RELATIVE ABUNDANCE OF SELECTED PREDATORS CAPTURED WITH SWEEP NET IN COTTON NEAR DIFFERENT TYPES OF PERIPHERAL VEGETATION, SHELBY AND TALLADEGA COUNTIES, ALABAMA, 1970

Predator	Number collected per acre per week, percentage of total[1]									
	Middles[2]	Percent	Soybeans	Percent	Corn	Percent	Meadows	Percent	Forests	Percent
Pink lady beetle	99.7	23	203.6	33	45.4	10	43.9	7	172.3	26
Convergent lady beetle	22.6	5	95.3	16	21.7	5	90.7	15	25.8	4
Damsel bugs	55.2	13	49.8	8	54.5	12	88.8	15	68.3	10
Big-eyed bugs	193.9	45	242.6	40	205.6	46	255.2	42	261.6	40
Long-legged flies	58.5	14	17.3	3	118.2	27	126.1	21	132.8	20
Total	430.1		608.6		445.4		604.7		660.8	

[1] Data collected June 11 through August 27.
[2] Center of large fields.

TABLE 3. SEASONAL ABUNDANCE OF SELECTED PREDATORS IN COTTON NEAR DIFFERENT TYPES OF PERIPHERAL VEGETATION, SHELBY AND TALLADEGA COUNTIES, ALABAMA, 1970

Predator and peripheral vegetation[1]	Average number collected per acre per week ending[1]										
	6/12	6/19	6/26	7/3	7/17	7/24	7/31	8/7	8/14	8/21	8/28
Pink lady beetle											
Corn	0	0	130	87	87	0	130	65	0	0	0
Soybeans	260	780	130	390	0	130	130	216	0	---	0
Middles[2]	260	130	0	87	65	455	---	0	0	0	0
Meadows	33	297	---	0	0	---	65	0	0	0	0
Forests	130	260	208	---	---	650	130	---	0	0	0
Convergent lady beetle											
Corn	0	0	0	0	87	0	0	65	87	0	0
Soybeans	0	260	0	260	0	130	65	43	195	---	0
Middles	87	0	0	43	0	0	---	0	0	0	98
Meadows	195	167	---	86	43	---	65	0	130	130	0
Forests	0	0	33	---	---	0	0	---	130	0	43
Damsel bugs											
Corn	360	0	0	87	87	0	0	65	0	0	0
Soybeans	0	260	0	130	0	0	0	43	0	---	65
Middles	130	130	0	0	130	130	---	0	0	0	32
Meadows	162	130	---	43	173	---	65	65	130	0	32
Forests	0	390	26	---	---	0	130	---	0	0	0
Big-eyed bugs											
Corn	0	0	0	217	87	130	853	390	520	0	65
Soybeans	0	910	0	260	260	130	390	346	65	---	65
Middles	216	260	130	0	650	260	---	0	195	0	228
Meadows	130	260	---	87	390	---	130	390	390	260	260
Forests	0	260	78	---	---	780	390	---	390	65	130
Long-legged flies											
Corn	0	0	0	0	217	260	195	325	43	260	0
Soybeans	0	0	0	0	0	0	65	43	0	---	65
Middles	0	98	0	0	130	130	---	0	65	130	32
Meadows	0	74	---	0	86	---	585	0	260	0	130
Forests	130	130	0	---	---	390	260	---	0	65	87

[1] All data based on sweep net sampling.
[2] Middles = center of large fields.

resentative samples with sweep nets, e.g., the relative area of plant sampled decreases. Thus, the accuracy of studies utilizing the sweep net alone may be subject to question.

Convergent lady beetles generally were less abundant than pink lady beetles in most sampling sites. Sweep net sampling indicated that convergent lady beetles occurred only intermittently in the center of fields and near corn and forests (Table 3). Near meadows, however, convergent lady beetle populations were relatively stable throughout the season, and consistently outnumbered pink lady beetles. During the latter part of the sweep net sampling period (August), convergent lady beetles appeared to be the dominant species; pink lady beetles were conspicuously absent in sweep net samples collected during this period. However, mechanically collected samples showed pink lady beetles to be much more abundant than convergent lady beetles, during mid- and late-season (Table 4). Earlier we contended that sweep net sampling is effective only for the terminal portion of plants, while the mechanical sampler was used to sample only the middle and lower portions of cotton plants. Thus, comparison of data from the two sampling techniques indicated that pink lady beetles concentrated their activity in the middle and lower portions of cotton plants while convergent lady beetles tended to remain in the terminal region of plants.

Peripheral vegetation appeared to have little effect on seasonal fluctuations of damsel bugs. Data from sweep net samples taken near all types of peripheral vegetation indicated that damsel bugs were more prevalent during early-season and tended to decline in number as the season progressed (Table 3). Damsel bug populations were least stable near corn, soybeans, and forests. In these situations, mid- and late season sampling with sweep nets collected damsel bugs only intermittently. Near meadows, damsel bug populations appeared most stable; relatively consistent numbers were collected throughout the season. Mid- and late-season sampling with the mechanical sampler indicated that relatively stable populations of damsel bugs were present during July and August (Table 4). Thus, these insects may be more important mid- and late-season predators than previously reported *(3)*.

Dolichopodid flies were infrequently collected prior to mid-July. Sweep net sampling sites adjacent to forests were the best early-season source of these predaceous flies; soybeans appeared to be the worst source (Table 3). From mid-July through early August, however, long-legged flies were quite abundant in the

TABLE 4. MID- AND LATE-SEASON ABUNDANCE OF FIVE PREDATORY INSECT GROUPS BASED ON MECHANICALLY-COLLECTED SAMPLES FROM COTTON FIELDS, SHELBY AND TALLADEGA COUNTIES, ALABAMA, 1970

	Number per acre						
	7/16	7/23	7/30	8/6	8/13	8/27	9/2
Damsel bugs	145	91	75	164	65	107	99
Big-eyed bugs	1,004	720	877	1,212	947	228	146
Long-legged flies	106	50	42	33	73	16	45
Convergent lady beetle	54	134	113	148	62	100	78
Pink lady beetle	387	769	358	750	160	166	422

terminals of cotton, particularly in fields bordered by corn, meadows, or forests. Soybeans continued to be a poor source of these flies throughout the season. As noted earlier, the abundance of long-legged flies in sweep net samples (Table 3), particularly in mid-season, and their contrasting scarcity in mechanically-collected samples (Table 4) indicates that these small flies concentrated their search for prey in the upper portion of cotton plants.

Big-eyed bugs were clearly the most abundant of the predators studied throughout the season (Table 3). Maturity of peripheral vegetation appeared to govern their abundance in cotton. In fields adjacent to corn, for example, big-eyed bug populations were limited during June and early July. During this period corn was succulent and contained abundant prey. As corn reached maturity and began yellowing in mid-July, big-eyed bugs apparently emigrated from the corn to adjacent cotton. A similar succession was indicated in samples collected near meadows.

Samples collected with the mechanical sampler during mid- and late-season also showed big-eyed bugs to be the dominant predator studied (Table 4). These data indicate that populations of this predator group were very stable until late August when their numbers declined rather sharply.

SUMMARY

Big-eyed bugs were the most abundant of the predators studied. Their abundance was greatest during late July. The pink lady beetle was second-most abundant in both sweep net and mechanically-collected samples. These lady beetles were especially abundant in the upper portion of cotton plants during early- and mid-season, and in the middle and lower portion of plants later in the season. The convergent lady beetle generally was much less abundant than the pink lady beetle. However, convergent lady beetles were more abundant in sweep net samples taken near meadows and in all sweep net samples late in the season. The late-season differences appeared to be the result of an apparent preference of pink lady beetles to inhabit the middle and lower portions of plants in contrast to a more general distribution for convergent lady beetles. Long-legged flies, Dolichopodidae, were very abundant in sweep net samples collected during mid-July and early August. Their scarcity in mechanically collected samples during the mid- and late-season indicated that these preda-

ceous flies concentrated their search for prey in the upper portion of cotton plants. Damsel bugs, *Nabis* spp., occurred in greatest numbers during the early season and decreased in numbers as the season progressed.

The type of vegetation on the periphery of cotton fields exerted an influence on the abundance of all predator groups. For example, corn proved to be a poor source of lady beetles, but a good source of long-legged flies and big-eyed bugs. Meadows were a good source of all predators, especially lady beetles and long-legged flies. Soybeans proved to be an especially good early- and mid-season source of lady beetles, but a very poor source of long-legged flies. Forests provided appreciable numbers of both of these groups.

The maturity of peripheral vegetation appeared to have considerable influence on seasonal fluctuations of the predator complex in cotton fields. Corn, for example, was a poor early-season source of most predators. Apparently, an abundance of prey on the early corn inhibited emigration of the predators to nearby cotton. As corn matured in mid-July, however, some predators, particularly big-eyed bugs and long-legged flies left the yellowing corn plants and moved to adjacent cotton.

In contrast, soybeans were a later maturing crop. Thus during June and July most predators appeared to seek prey on cotton rather than the small soybeans that lacked abundant prey. Later in the season, predator numbers in cotton adjacent to soybeans generally declined; apparently they moved to the soybeans in response to an increase of prey on that crop. Habitats with a diversity of vegetation at various stages of maturity, e.g., meadows, appeared to be a more stable source of predators throughout the season.

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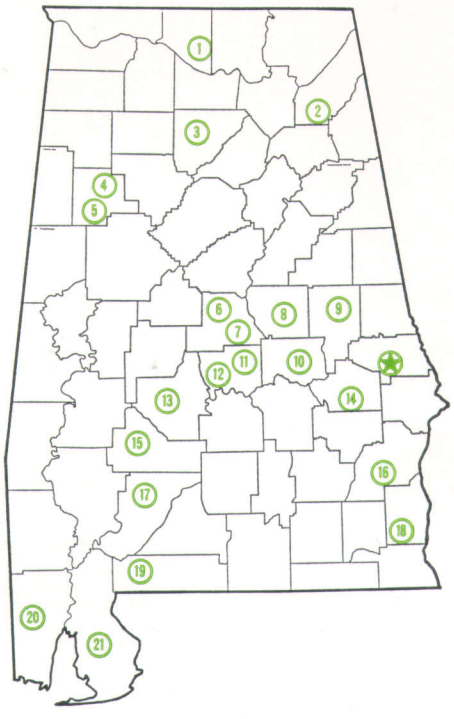

Research Unit Identification

★ Main Agricultural Experiment Station, Auburn.

1. Tennessee Valley Substation, Belle Mina.
2. Sand Mountain Substation, Crossville.
3. North Alabama Horticulture Substation, Cullman.
4. Upper Coastal Plain Substation, Winfield.
5. Forestry Unit, Fayette County.
6. Thorsby Foundation Seed Stocks Farm, Thorsby.
7. Chilton Area Horticulture Substation, Clanton.
8. Forestry Unit, Coosa County.
9. Piedmont Substation, Camp Hill.
10. Plant Breeding Unit, Tallassee.
11. Forestry Unit, Autauga County.
12. Prattville Experiment Field, Prattville.
13. Black Belt Substation, Marion Junction.
14. Tuskegee Experiment Field, Tuskegee.
15. Lower Coastal Plain Substation, Camden.
16. Forestry Unit, Barbour County.
17. Monroeville Experiment Field, Monroeville.
18. Wiregrass Substation, Headland.
19. Brewton Experiment Field, Brewton.
20. Ornamental Horticulture Field Station, Spring Hill.
21. Gulf Coast Substation, Fairhope.