

THE PRESENCE OF *SPISSISTILUS FESTINUS*¹
AS A FACTOR AFFECTING EGG PREDATION
BY ANTS² IN SOYBEANS³

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ABSTRACT

Five ant species, of which *Solenopsis geminata* (F.) and *Conomyrma insana* (Buckley) were the most abundant, tended nymphs of the three-cornered alfalfa hopper, *Spissistilus festinus* (Say), on soybeans in a north Florida field. The presence of nymphs tended by ants was examined as a factor affecting predation on eggs of the soybean looper, *Pseudoplusia includens* Walker. Where *S. geminata* tended the nymphs, the percentage of looper eggs missing after 24 hr was significantly greater from plants with nymphs (77.1%) than from plants without nymphs (36.8%). Where *C. insana* tended the nymphs, the percentage of eggs missing was significantly greater from plants with nymphs than from plants without nymphs after 4 hr (36.8% vs. 17.5%) and 8 hr (65.6% vs. 42.9%), but not after 24 hr (90.7% vs. 86.3%). In all experiments, the proportion of eggs missing was greatest from the lowest 1/3 of the plant and least from the upper 1/3.

Ants are important predators on arthropod pests in agroecosystems (Cook 1904, Pierce et al. 1912, Whitcomb and Bell 1964, Whitcomb et al. 1972). Many predaceous ants supplement their diet by collecting honeydew from Homoptera (Carroll and Janzen 1973). This stationary and renewable food source can be an attractant resulting in locally-high ant population densities that may be maintained throughout the year (Finnegan 1974). The presence of Homoptera could consequently influence the effectiveness of ants as predators.

In 1975, ants were found tending nymphs of the three-cornered alfalfa hopper, *Spissistilus festinus* (Say), on soybeans in northern Florida. Since the ants were observed more often on plants on which the hopper nymphs also occurred, we hypothesized that ant predation on soybean pests increased in the presence of nymphs. To test this, ant predation on eggs of the soybean looper, *Pseudoplusia includens* Walker, was examined under field conditions.

1. Homoptera: Membracidae.

2. Hymenoptera: Formicidae.

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METHODS

Experiments were conducted between 15 September and 15 October 1975 in a 15-ha field of Bragg soybeans in Alachua County, Florida. Initially, the field was surveyed for ant species tending nymphs of *Spissistilus festinus*. Two areas were then selected, an 1,100-m² area in the interior of the field in which the nymphs were being tended mainly by *Solenopsis geminata* (F.) (designated as area 1) and a 45-m² area at the perimeter of the field in which the nymphs were being tended by *Conomyrma insana* (Buckley) (designated as area 2). On 3 and 15 October between 1200 and 1700 hr, nymphs were counted in 10 random, 3.05-m sections of soybean row in area 1 and three 3.05-m sections of soybean row in area 2. On both dates, the ant species present on each plant and the number of soybean plants in each 3.05-m section were recorded. An analysis of variance (Steel and Torrie 1960) was performed on the squareroot-transformed counts of nymphs. Data were arranged in a 2 × 2 factorial design (= 2 areas of the field × 2 dates).

In both areas, 14 plants were selected, 7 with 1 or more nymphs tended by ants and 7 without nymphs. The absence of nymphs was confirmed by shaking each plant selected as nymph-free over a 0.58-m² white cloth. Previous tests had established that nymphs were easily shaken from the soybean plants. A trifoliate leaf on the upper, middle, and lower 1/3 of each plant was marked with a small spot of water-soluble paint. Eggs of the soybean looper, *Pseudoplusia includens*, obtained from a laboratory colony maintained by N. C. Leppla, Insect Attractants, Behavior and Basic Biology Research Laboratory, ARS, USDA, Gainesville, Fla., were attached with casein glue to each marked leaf (1 on the upper surface of each leaflet). Therefore, 9 eggs (3 at each height zone) were attached to each plant, giving a total of 126 eggs/area, half of which were on plants with nymphs, and half on plants without nymphs. The number of eggs missing was recorded 24 hr later. Experiments were repeated over five 24-hr periods. An analysis of variance was performed on the arcsine-transformed data arranged in a 2 × 2 × 3 factorial design (= nymphs present or absent × 2 areas of the field × 3 heights on the plants) replicated on 5 dates.

On 14 October, an additional experiment was conducted in which the nymphs were being tended by *C. insana*. Experimental procedures were the same as before except that 1 set of 14 plants (7 with 1 or more nymphs tended by *C. insana* and 7 without nymphs) was selected in each of three 45-m² areas of the field. In addition, the eggs were examined after they had been in the field 4, 8, and 24 hr. An analysis of variance was performed on the arcsine-transformed data (numbers of eggs missing/21 eggs) arranged in a 2 × 3 × 3 factorial design (= nymphs present or absent × 3 elapsed periods of exposure × 3 heights on the plants) replicated in 3 areas of the field.

RESULTS AND DISCUSSION

Workers of *Solenopsis geminata*, *Conomyrma insana*, *C. flavopecta* (M. R. Smith), *Iridomyrmex pruinosus* (Roger), and *Pheidole morrisi* Forel tended threecornered alfalfa hopper nymphs in the soybean field in which our investigations were conducted. Although tending of *S. festinus* nymphs by ants in soybeans has not previously been reported, Jordan (1952) observed an unspecified ant species tending nymphs in alfalfa. In our experimental field, nests of *Pheidole morrisi* and *Iridomyrmex pruinosus* were

uncommon, and workers of each species were observed tending nymphs on only 2 occasions. *Conomyrma flavopecta* and *Solenopsis geminata* occurred over most of the interior of the field. Workers of *S. geminata* foraged on soybean plants from underground trails radiating from their mounds and opening at the bases of plants on which nymphs were being tended. Three clusters of *Conomyrma insana* nests, referred to as enclaves by Nickerson et al. (1975), were present along one edge of the field. Each enclave covered ca. 45 m² and extended ca. 3 m into the field. No other nests of *C. insana* were found in the field.

In the interior of the field (area 1), workers of *S. geminata* or occasionally, of *C. flavopecta* were observed tending threecornered alfalfa hopper nymphs. On 3 and 15 October, workers of *S. geminata* were found on 94.6% of the plants with nymphs and on 15.0% of the plants without nymphs. Workers of *C. flavopecta* were on the remaining 5.4% of the plants with nymphs and on 0.8% of the plants without nymphs. Within a *C. insana* enclave (area 2), *C. insana* was the only ant species observed tending threecornered alfalfa hopper nymphs. On 3 and 15 October, at least 1 *C. insana* worker was found on every plant with nymphs and on 83.0% of the plants without nymphs. Therefore, in both areas, ants were found on all of the plants with nymphs, but on fewer of those without nymphs.

Estimates of the densities of the threecornered alfalfa hopper nymphs are given in Table 1. Although nymphs were found on 50.4% of all plants examined on 3 and 15 October, only a single nymph was present on 77.7% of the plants with nymph(s). Densities of nymphs were not significantly different between area 1 and area 2 ($p = 0.1$), but significantly more nymphs were present in both areas on 3 October than on 15 October ($p = 0.005$). By 15 October the soybean plants were senescent, and many plants were apparently unacceptable as hosts for the nymphs.

The percentage of soybean looper eggs missing after 24 hr from plants in area 1 and 2 are presented in Fig. 1. A significantly greater percentage of eggs was missing from plants in area 2 (88.6%) than from plants in area 1 (57.0%) ($p < 0.005$). Within area 1, a significantly greater percentage of eggs was missing from plants with nymphs (77.1%) than from plants without nymphs (36.8%) ($p < 0.005$). Within area 2, a greater percentage of eggs was also missing from plants with nymphs (90.8%) than from plants without nymphs (86.3%), but the difference between the 2 sets of plants was not significant ($p > 0.1$).

The percentages of eggs missing after 4, 8, and 24 hr from plants within the boundaries of 3 *C. insana* enclaves are presented in Fig. 2. Significantly greater percentages of eggs were missing from plants with nymphs than from plants without nymphs after 4 hr (36.0% vs. 17.5%) and after 8 hr (65.6% vs. 42.9%) ($p < 0.005$). After 24 hr the percentage of eggs missing from plants with nymphs (96.8%) was not significantly different from the percentage of eggs missing from plants without nymphs (92.8%) ($p > 0.1$).

In the interior of the field, rates of predation were greater on plants with *S. festinus* nymphs tended by ants than on plants without nymphs. We hypothesize that workers of *S. geminata* were attracted to specific plants by the presence of the nymphs, and that, at any time, more ants were foraging on plants with nymphs than on plants without nymphs. Thus the probability of a prey item being encountered by ants would be higher on plants with nymphs than on plants without nymphs. Within the *C. insana* enclaves,

TABLE 1. NUMBERS OF *Spissistilus festinus* NYMPHS IN 2 AREAS OF A FLORIDA SOYBEAN FIELD: IN ONE AREA NYMPHS WERE TENDED BY *Solenopsis geminata* AND IN THE OTHER BY *Conomyrma insana*.

Ant species	Survey date	% of plants examined with:				Nymphs/plant $\bar{x} \pm 95\% \text{ CI}^*$	Nymphs/ha (x1000) $\bar{x} \pm 95\% \text{ CI}^*$
		0 nymphs	1 nymphs	2 nymphs	3-5 nymphs		
<i>S. geminata</i> (area 1)	3 Oct.	36.0	49.0	11.0	4.0	0.84 \pm 0.22	111.3 \pm 32.7
	15 Oct.	67.0	28.0	5.0	0.0	0.38 \pm 0.20	63.8 \pm 38.1
<i>C. insana</i> (area 2)	3 Oct.	30.0	43.3	20.0	6.7	1.10 \pm 0.90	140.7 \pm 140.6
	15 Oct.	56.7	36.7	6.7	0.0	0.50 \pm 0.25	63.5 \pm 42.0

*mean \pm 95% confidence interval.

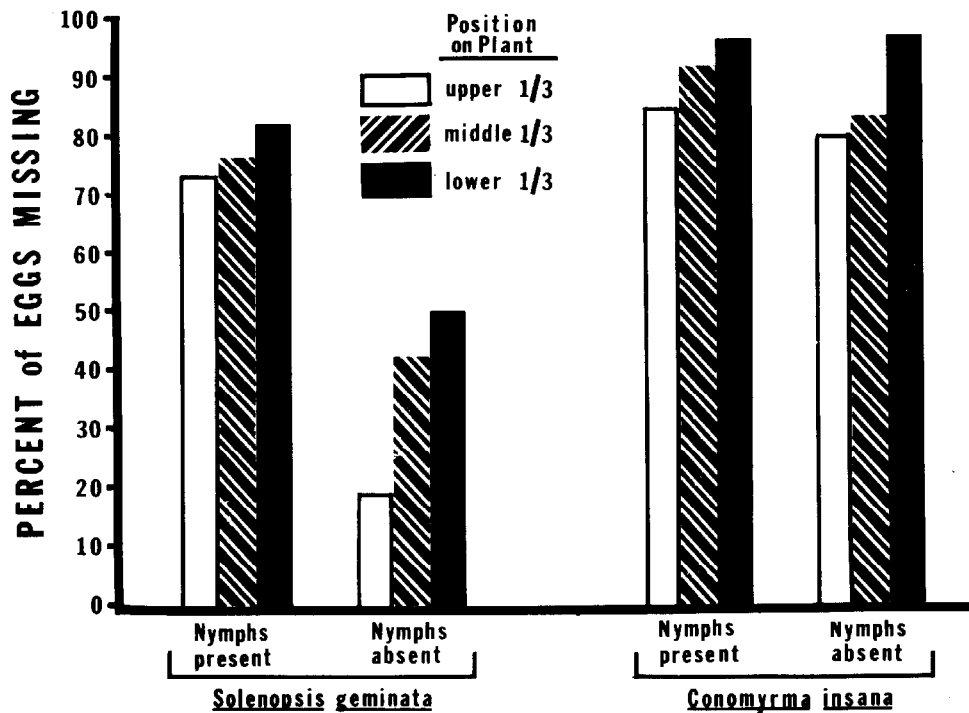


Fig. 1. Percentages of *Pseudopius includens* eggs missing after 24 hr exposure at 3 heights on soybean plants with or without *Spissistilus festinus* nymphs. Plants were in an area where *Solenopsis geminata* was the dominant ant (area 1) or in an area where *Conomyrma insana* was the dominant ant (area 2).

rates of predation were also greater on plants with nymphs than on plants without nymphs as long as a supply of eggs remained available to the ants. However, supplies of eggs were almost exhausted after 24 hr, and predation approached 100% on all plants. Our data indicate that, at least on cool autumn days, workers of *C. insana* patrol most plants within an enclave. Thus chances are high that, given a 24 hr period, a worker would encounter an egg or other stationary prey item on plants within the boundaries of an enclave regardless of the presence of an attractant such as the nymphs. Throughout the rest of the field, where egg predation was low on plants without nymphs, the presence of nymphs could be an important factor affecting survival of pest insects.

In both predation experiments, the percentages of eggs missing were greatest from the lowest 1/3 of the plant and least from the upper 1/3. Differences were statistically significant ($p < 0.005$). This suggests that the ants spent more time foraging on the lower than on the upper parts of the plants or that few ants foraged at the top of the plants. Eggs oviposited on the upper parts of the plants would, therefore, be encountered less frequently and may have a greater possibility of survival.

The threecornered alfalfa hopper is common in soybean fields and can kill young soybean plants (Tugwell et al. 1972, Caviness and Miner 1962, Mueller and Dumas 1975). At the present time, however, the economic impact of the insect on soybean production is unclear. Mueller and Dumas

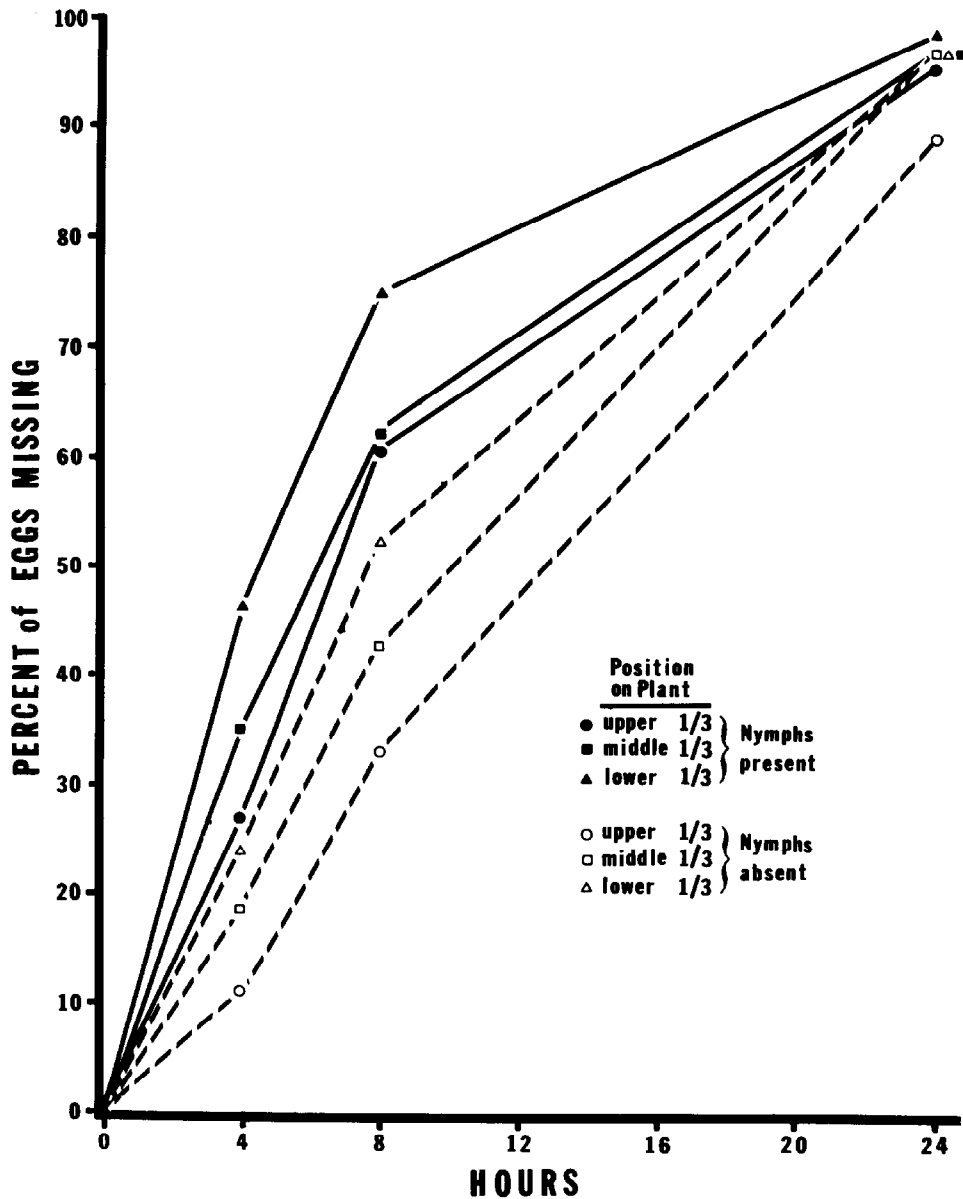


Fig. 2. Percentages of *Pseudopius includens* eggs missing after 4, 8, and 24 hr exposure at 3 heights on soybean plants with or without *Spissistilus festinus* nymphs. Plants were in 3 areas where *Conomyrma insana* was the dominant ant.

(1975) found that no yield losses were incurred under Arkansas conditions even when 30-50% of the soybean plants in a field were destroyed by *S. festinus*. Threecornered alfalfa hopper nymphs attract ants to soybean plants. The ants, by preying on other pest insects, may protect the soybean plants and offset damage caused by the feeding of the hopper nymphs, a possibility which should be considered when assessing the economic status of homopteran pests.

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