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POTENTIAL OF *GEOCORIS PUNCTIPES* [*HEMIPTERA : LYGAEIDAE*] AND *NABIS* spp. [*HEMIPTERA : NABIDAE*] AS PREDATORS OF *EPILACHNA VARIVESTIS* [*COLEOPTERA : COCCINELLIDAE*] (1)

BY

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Predation by *Geocoris punctipes* (SAY) and *Nabis* spp. on *Epilachna varivestis* MULSANT was studied in the laboratory at 26.7°C and in field cages containing soybeans. Both predator groups fed upon *E. varivestis* eggs, 1st, 2nd and 3rd stage larvae, but not upon 4th stage larvae, pupae, or adults.

G. punctipes females produced significantly fewer eggs when fed *E. varivestis* eggs or 1st stage larvae than those fed *Galleria mellonella* (L.). Longevity of male *G. punctipes* was significantly reduced when fed *E. varivestis* eggs; however, female longevity was not affected.

Results from field cage tests indicated both *G. punctipes* and *Nabis* spp. could significantly reduce the density of *E. varivestis*.

The Mexican bean beetle, *Epilachna varivestis* MULSANT, is considered an important pest of soybeans in many parts of the U.S. As a result of its large range and destruction of a number of crops many papers have dealt with its control and biology. This is attested by the sheer size (591 ref.) of a recent bibliography (NICHOLS & KOGAN, 1972).

Albeit, few manuscripts have considered biological control of *E. varivestis*. PLUMMER & LANDIS (1932) reported several species of Hemiptera and Coleoptera which were observed feeding on *E. varivestis* in Mexico and HOWARD (1936) listed its parasites and predators which occurred in the U. S. Cannabilism of eggs was attributed to both Mexican bean beetle adults and larvae (SHERMAN & TODD,1939).

Although the most abundant insect predators found in South Carolina soybeans were *Geocoris* spp. and *Nabis* spp. (TURNIPSEED, 1972), only *Nabis* spp. have been reported to feed on *E. varivestis*

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(HOWARD, 1936). Both *Geocoris* spp. and *Nabis* spp. have been consistently reported as predators of numerous other insect pests (VAN DEN BOSCH & HAGAN, 1966; WHITCOMB & BELL, 1964; BARRY, 1973).

Thus, there is a void of knowledge concerning the impact of *Geocoris* spp. and *Nabis* spp. on *E. varivestis* in soybeans. The current paper presents data obtained from both laboratory and field cage experiments on predation by *Geocoris* spp. and *Nabis* spp. on eggs and larvae of *E. varivestis*.

Materials and methods

LABORATORY STUDIES

Geocoris punctipes (SAY) and *Nabis roseipennis* REUTER were collected from soybean fields at Blackville, S. C., and from fields near Clemson, S. C. These adults were returned to the laboratory and held in plactic dishes (diam. 7.8 cm × 4.6 cm; Tri-State Plastic Molding Co., Henderson, Ky.) with Saran® screened lids. For predation studies, these plastic containers contained a 2 ml vial glued in a vertical position to the dish bottom and filled with water which supported a single lima bean leaf. This leaf provided moisture for the predators and foliage for *E. varivestis* larvae offered as prey. All predation studies were done in a rearing chamber at 26.7 ± 1.1°C, LD 14:10, RH 60 ± 10 %. Each predator was allowed to feed for a 5 day period.

E. varivestis egg masses on bean leaves were collected from a stock colony maintained in a greenhouse and 50 eggs per leaf were used in all tests. The bean leaf with its compliment of eggs was then placed in each container. Eggs were inspected daily for evidence of feeding (deflation) and replaced by a new egg mass. Predation on *E. varivestis* larvae was observed by placing 1 adult nabid or geocorid in the previously described container with the following numbers of larvae; ten 1st-instars, two 2nd-instars, or two 3rd-instars. Tests were replicated 10-20 times; they were checked daily and dead or molted larvae were replaced.

Fecundity and longevity of *G. punctipes* were observed by placing 1 pair of newly molted adults in plastic dishes which contained a small ball of cotton for oviposition and equipped as mentioned previously. Green bean sections and sunflower seed kernels were also provided as supplimentary food along with daily introduction of 50 *E. varivestis* eggs or 10 1st-stage larvae. Additional *G. punctipes* pairs were fed freshly killed *Galleria mellonella* (L.) larvae. These larvae were replaced every 2-3 days. Ten replicates were made of each diet. All dishes were checked daily and the numbers of prey taken, eggs deposited, and predator mortality were recorded.

FIELD CAGE STUDIES

Cages (1.22 × 1.22 × 1.52 m) were constructed of 32 × 32 mesh Lumite® screen supported by metal conduit frames. For both tests, cages were positioned over 1 row of "Hutton" variety soybeans planted in 1.02 m rows. Cages were situated so the plant row was nearer one side of the cage, which allowed more room for sampling. To rid the cages of naturally occurring arthropods, all cages were treated with methyl parathion approximately 1 wk prior to initiation of the tests.

Test 1, using 12 cages, was begun on Aug. 1, 1973. Soybeans were approximately 1.1 m tall and were in the early pod-set stage. *E. varivestis* eggs (ca. 50 eggs per leaflet) were field-collected on soybean leaflets. A 7.5 cm stem was left on the leaflet containing the eggs. The leaflets were placed immediately in water and transported to field cages. To avoid leaf desiccation in the cages, a plastic vial was taped to the main stem of the soybean plant. Vials were filled with water and fitted with a plastic cap with a small hole through which the petiole of the leaflet containing the eggs was inserted. Two egg masses were placed in each cage for a total of approximately 100 eggs per cage.

After loading all 12 cages with *E. varivestis* eggs, 25 *G. punctipes* or *Nabis* spp. (*N. roseipennis* & *N. capsiformis* GERMAR) were placed in each of 4 cages. The remaining 4 cages served as controls. Cages were left undisturbed for 19 days then sampled by the ground cloth method (modified shake method of BOYER & DUMAS, 1963) and by a thorough examination of all the foliage for larvae which had not been dislodged. Results were examined by analysis of variance and treatment means separated by the least significant difference statistic.

Test 2, using 12 cages, was initiated on Sept. 22, 1973. Soybeans were ca. 1.3 m tall and were in the pod-fill stage. In this experiment, Ist-instar *E. varivestis* were placed in the cages by using a camel hair brush. One hundred larvae were positioned in each cage by putting 5 larvae per leaflet on 20 randomly chosen leaflets.

Ten *G. punctipes* or *Nabis* spp. were released in 4 cages each, with the remaining 4 cages serving as controls. Cages were examined 10 days later, as described for test 1 and the numbers of *E. varivestis* larvae recorded. Analysis of data was conducted as in test 1.

Results

LABORATORY STUDIES

Predation by *G. punctipes* and *N. roseipennis* on *E. varivestis* eggs and larvae was approximately equal except that *G. punctipes* consumed ca. 3 times as many lst-stage larvae as did *N. roseipennis* (table 1). The number of prey taken per predator per day dropped

TABLE 1

Numbers of E. varivestis *eggs or larvae taken per day per predator in the laboratory at* 26.7°C.

PREDATOR	PREY STAGE			
	Eggs	1st-stage	2nd-stage	3rd-stage
G. punctipes	3.11 ± 1.5 (20)*	3.2 ± 2.1 (11)	.38 ± .53 (10)	.20 ± .40 (10)
N. roseipennis	2.58 ± 1.8 (10)	1.08 ± 1.21 (10)	.34 ± .47 (10)	.30 ± 46 (10)

* Number in parenthesis is number of replicates.

steadily as the prey progressed to larger instars. *G. punctipes* consumed only about 1/8 as many 2nd-instars as lst-instars. Similarly, *N. roseipennis* took 1/3 as many 2nd-instars as lst-instars. Neither species fed on 4th-instars, pupae, or adults of *E. varivestis*.

Data from studies of longevity and fecundity of *G. punctipes* fed either *E. varivestis* eggs, lst-instars, or *G. mellonella* larvae are presented in table 2. Female longevity was not appreciably affected by the different diets, whereas males fed *E. varivestis* eggs lived a significantly shorter time than those fed *G. mellonella* larvae. DUNBAR (1972) reported that male and female *G. punctipes* lived 169 and 117 days, respectively when fed 5th-stage larvae of the potato tuberworm, *Phthorimaea operculella* (ZELLER).

Geocorid fecundity was more severely affected by diet than was longevity (table 2). Females fed *G. mellonella* larvae produced a mean of 183.8 eggs which approximated the 189.9 eggs/female fed potato tuberworm larvae and green beans (DUNBAR & BACON, 1972). *G. punctipes* produced significantly fewer eggs when *E. varivestis* eggs or larvae were provided as food than when the diet was *G. mellonella* larvae.

TABLE 2

Mean longevity (days) and fecundity of adult Geocoris punctipes *fed on three different diets* (*)

Diet	N	Longevity ♂	Longevity ♀	No. Eggs/♀
G. mellonella larvae	10	89.6a	65.2a	183.8a
E. varivestis lst-instar	10	77.8a	59.2a	75.2b
E. varivestis eggs	10	45.6b	59.6a	39.6b

(*) Means not followed by the same letter are significantly different (LSD, 95.0% confidence level).

FIELD CAGE STUDIES

In test 1, a significant reduction in numbers of *E. varivestis* occurred in cages with *G. punctipes* when compared to control cages (table 3). *Nabis* spp. reduced the number by 41.6 % but this was not significantly different from controls. Since laboratory studies indicated that *G. punctipes* consumed more *E. varivestis* eggs than did *N. roseipennis*, these field cage results were expected.

TABLE 3

Predation by Geocoris punctipes *and* Nabis *spp. in field cages innoculated with* Epilachna varivestis *eggs (test* 1*) or lst-stage larvae (test* 2*).*

Treatment	No. cages	No. predators	*E. varivestis* remaining/cage	% reduction
			TEST 1	
Control	4	0	48	—
G. punctipes	4	25	21*	56.25
Nabis spp.	4	25	28	41.66
			TEST 2	
Control	4	0	37	—
G. punctipes	4	10	14**	62.16
Nabis spp.	4	10	10**	72.97

* Significantly different from control (95% confidence level).
** Significantly different from control (99% confidence level).

Both predaceous genera significantly reduced the number of larvae found in cages in test 2 (table 3). *Nabis* spp. reduced the prey by 73.0 % while *G. punctipes* caused 67.2 % larval mortality.

Discussion

These findings clearly indicate that *G. punctipes* can reproduce on *E. varivestis* eggs and larvae. However, in this case the proposal by DUNBAR & BACON (1972) that *G. punctipes* is basically an egg predator did not appear true, as *G. punctipes* produced almost twice as many eggs when fed lst-stage *E. varivestis* larvae as when fed eggs. In addition, since fecundity and longevity were greatly enhanced when *G. mellonella* larvae were provided as prey, these findings indicate that eggs and larvae of *E. varivestis* may lack some essential nutrients and may not be their preferred host.

From the laboratory and field cage studies, it is apparent that *G. punctipes* and *Nabis* spp. may reduce populations of *E. varivestis*. However, in both laboratory and cage studies, alternate prey were missing. This situation would never exist in a soybean agroecosystem, but insight has been gained into the predatory potential of these 2 genera on *E. varivestis*. More encompassing and detailed ecological studies are required before the full impact of these 2 predaceous genera can be ascertained.

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RÉSUMÉ

Potentialités de *Geocoris punctipes (Hemiptera: Lygacidae)* et de *Nabis* spp. *(Hemiptera: Nabidae)* comme prédateurs de *Epilachna varivestis (Coleoptera: Coccinellidae)*

La prédation de *Epilachna varivestis* MULSANT par *Geocoris punctipes* (SAY) et *Nabis* sp. a été étudiée en laboratoire à 26°7 C et dans la nature dans des cages contenant du soja. Les deux types de prédateurs s'alimentent aux dépens des œufs et des trois premiers stades larvaires de *E. varivestis*, mais non aux dépens des larves du 4e stade, des nymphes et des imagos.

Les femelles de *G. punctipes* donnent significativement moins d'œufs si elles sont nourries avec des œufs ou des larves du premier stade de *E. varivestis* que celles alimentées avec *Galleria mellonella*. La longévité des mâles de *G. punctipes* est significativement diminuée avec une alimentation sur œufs de *E. varivestis*, toutefois la longévité des femelles n'est pas affectée.

D'après les résultats des essais sous cage *G. punctipes* et *Nabis* sp. peuvent réduire de façon significative la densité des populations de *E. varivestis*.

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