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Abstract

Anaphes iole Girault has been reported to parasitize *Lygus lineolaris* Palisot de Beauvois eggs in several crops but not in strawberries. The ability of *A. iole* to parasitize *L. lineolaris* eggs in strawberries was evaluated. *A. iole* will parasitize and inhibit the development of *L. lineolaris* eggs in strawberry plants.

Disciplines

Agronomy and Crop Sciences | Ecology and Evolutionary Biology | Entomology | Fruit Science

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**Parasitism of *Lygus lineolaris* Palisot de Beauvois
(Heteroptera: Miridae) by *Anaphes iole* Girault
(Hymenoptera: Mymaridae) in Strawberries**

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ABSTRACT: *Anaphes iole* Girault has been reported to parasitize *Lygus lineolaris* Palisot de Beauvois eggs in several crops but not in strawberries. The ability of *A. iole* to parasitize *L. lineolaris* eggs in strawberries was evaluated. *A. iole* will parasitize and inhibit the development of *L. lineolaris* eggs in strawberry plants.

Lygus lineolaris Palisot de Beauvois, the tarnished plant bug (TPB), is the primary insect pest of strawberries (*Fragaria* × *ananassa* Duschene) in Iowa and the north-central United States. *L. lineolaris* feed on developing achenes (seeds) of strawberry flowers and green fruit. Fed-upon achenes are hollow and brown and cluster in a spiral pattern at the tip of ripe strawberries. This deformation is called apical seediness or “buttoned” berries (Schaefers, 1966; Handley and Pollard, 1993). Consumers will not purchase “buttoned” berries; therefore, strawberries damaged by *L. lineolaris* are unmarketable as fresh fruit. Current *L. lineolaris* management practices in Iowa involve spraying insecticides on a calendar, or preventive, basis.

Anaphes iole Girault (Hymenoptera: Mymaridae) is an egg parasitoid that occurs throughout North America from Alaska to southern Mexico. Studies have shown that *A. iole* will parasitize the eggs of *L. lineolaris* and *L. hesperus* Knight (considered the tarnished plant bug of the west) in several crops (Sohati et al., 1989; Graham et al., 1986). It is the primary egg parasitoid of *Lygus* spp. in the United States and occurs on plants where its hosts feed and oviposit (Jones and Jackson, 1990; Huber and Rajakulendran, 1988).

A. iole has been shown to parasitize *L. hesperus* eggs in strawberries in California (Norton et al., 1992), but no study has been reported that evaluates the possibility of using this parasitoid as a biological control agent of *L. lineolaris* in strawberries. The experiment reported here is the first step in determining if *A. iole* can be used as a biological control for *L. lineolaris* in strawberries. The purpose of this experiment was to determine if *A. iole* will parasitize *L. lineolaris* eggs oviposited in strawberry stems.

Materials and Methods

This experiment was conducted three times. On each occasion, strawberry plants (Jewel cultivar) were planted in 15-cm-diameter plastic pots and grown in the greenhouse. Flowers were periodically removed to stimulate vegetative growth. At the time of the experiment, plants were removed from the greenhouse and thinned to two stems per pot. Strawberry plants were kept in a Rheem® puffer hubbard environmental growth chamber and maintained at a constant temperature of 36°C and photoperiod of 16:8 L:D hr for the duration of the experiment.

Table 1. *L. lineolaris* eggs and nymphs and *A. iole* recovered per experiment

No. <i>A. iole</i> released	<i>L. lineolaris</i> eggs		<i>L. lineolaris</i> emerged		<i>A. iole</i> emerged	
	\bar{x}	SD	\bar{x}	SD	\bar{x}	SD
Experiment one						
Zero	23.83	8.37	5.33	2.25	0.33	0.58
Two	16.83	14.27	1.33	1.15	2.50	2.00
Four	3.33	4.48	0.67	0.29	1.33	1.44
Six	7.67	2.84	0.83	1.04	3.17	2.47
Experiment two						
Zero	15.33	12.5	1.33	1.53	0.00	0.00
Two	13.33	17.38	1.00	1.73	0.00	0.00
Four	21.67	10.26	2.33	2.52	3.33	4.16
Eight	28.67	8.33	1.00	1.00	3.33	5.77
Experiment three						
Zero	4.33	7.51	0.33	0.58	0.00	0.00
Two	0.00	0.00	0.00	0.00	0.00	0.00
Four	1.67	2.89	0.00	0.00	1.33	2.31
Eight	3.00	5.20	0.00	0.00	0.33	0.58

A 25-cm to 50-cm length of plastic dialysis tubing (7.6 cm wide) was placed over a strawberry stem and closed at the top and bottom with a foam rubber plug to form exposure arenas. Either two male and two female (first experiment) or one male and two female (second and third experiment) *L. lineolaris* collected from alfalfa by using a sweep-net were released into the dialysis tubing for 72 h. to allow mating and oviposition.

After removal of *L. lineolaris*, different numbers of *A. iole* were released onto the plant stem inside the dialysis tubing and allowed to oviposit until the parasitoids' death. *A. iole* (80% female) were purchased commercially from Biotactics Inc., 425 W La Cadena Dr. #12, Riverside, CA 92501. The experiments were conducted with three replications. Each replication was placed on a different shelf in the growth chamber. Four treatments were randomly assigned to the strawberry plants: 0, 2, 4, and 6 *A. iole* (first experiment) and 0, 2, 4, and 8 *A. iole* (second and third experiments). *L. lineolaris* nymphs and adult parasitoids were collected and counted every 2 days as they emerged. After no insects emerged for at least 3 days, strawberry stems were removed, and *L. lineolaris* eggs were visually counted by using a dissecting microscope.

Analysis of variance (PROC GLM ($P \leq 0.05$), SAS Institute 1985) was used to compute means, standard deviations, and significant differences treatments.

Results

A. iole adults were recovered from exposure arenas, indicating that *L. lineolaris* eggs in strawberry plants were parasitized and that parasitoids were able to develop in this species. *L. lineolaris* began to appear approximately 7 days after ovipositing, and *A. iole* began to emerge about 2 weeks following their release. *A. iole* emerged from a replication in experiment one that had not been treated with parasitoids, indicating contamination of the replication (Table 1).

Analysis of variance indicated that the number of *A. iole* that emerged from *L. lineolaris* eggs exposed to differing numbers of the wasps showed no significant differences (experiment one d.f. = 3, $F = 2.85$, $P = 0.13$; experiment two d.f. =

3, $F = 1.27$, $P = 0.37$; experiment three d.f. = 3, $F = 0.78$, $P = 0.55$). The large standard deviations indicate that there was a large amount of variability among the number of *L. lineolaris* eggs laid and emerged *L. lineolaris* and *A. iole* (Table 1).

Discussion

Results of this experiment show that *A. iole* will parasitize *L. lineolaris* in strawberries and justifies further field research on augmentative releases. *A. iole* have been shown to parasitize an average of 10 *Lygus* spp. eggs, therefore, greater parasitism rates were expected in this study (Jackson and Graham, 1983). Although rate of parasitism was low in this experiment, few *L. lineolaris* emerged from eggs.

Several factors may have contributed to the lack of insect emergence in this study. In alfalfa, drying plant tissue crushed *L. lineolaris* eggs (Clancy and Pierce, 1966). In this experiment, there may not have been enough oxygen or water penetrating the foam that sealed the ends of the dialysis tubing for plant, egg, and insect development. The strawberry plant stems may have dehydrated, thus crushing the *L. lineolaris* eggs. There was also no food source given to the *A. iole* in this study. Well-fed *A. iole* parasitize more eggs than starved wasps; *A. iole* require a constant carbohydrate source for increased longevity of fecundity (Jones and Jackson, 1990).

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