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Intra- and Inter-specific Predations of Lady Beetles in Spring Alfalfa Fields

Keiichi TAKAHASHI

National Grassland Research Institute, Nishinasuno, Tochigi, 329-27 Japan

Abstract Intra- and inter-specific predations of lady beetles were studied in spring alfalfa fields. All of the egg predations were sibling cannibalisms. Besides egg cannibalisms, pupal and prepupal predations were observed and these included intra- and inter-specific predations. In pupal and prepupal predations, those most abundant were ones by the larvae of *Harmonia axyridis* (PALLAS), which attacked the pupae or prepupae of *Coccinella septempunctata brukii* MULSANT. The cause of the inter-specific predations between *H. axyridis* and *C. septempunctata bruckii* seemed to be the time lag of the oviposition of *H. axyridis* and the lack of aphids.

Introduction

Cannibalism of lady beetles is well known through many laboratory tests, especially sibling cannibalism (PIENKOWSKY, 1965; BROWN, 1972; DIMETRY, 1974; KAWAI, 1978). However, intra- and inter-specific predations in the field are scarcely known.

Many aphids and predatory lady beetles are found in spring alfalfa fields (TAKAHASHI & NAITO, 1984). In 1982, '83 and '87, intra- and inter-specific predations of lady beetles were studied in spring alfalfa fields, and relations between the occurrence of aphids and those predations were discussed.

Methods

Field observations took place in the alfalfa field consisting of seventeen rows, the size of each row was 0.6×8 m. Egg batches of lady beetles were found every three to five days from April to June in 1987. Egg predations were checked every day until the end of the dispersal of the first instar larvae from the oviposition sites.

Other intra- and inter-specific predations were also found every three to five days from April to June in 1982, '83 and '87. The number of larvae and adults of lady beetles was checked by beating alfalfa rows in 1982 and '87. The number and species of infested aphids on alfalfa stems was also recorded in 1982, '83 and '87.

Results and Discussion

1. *Egg predations*

Some species of lady beetles can be found in alfalfa fields (TAKAHASHI & NAITO,

1984). The commonest species are *C. septempuncatata bruckii* MULSANT, *H. axyridis* (PALLAS) and *Propylea japonica* (THUNBERG). Egg batches found in 1987 were of *C. septempunctata bruckii* and *H. axyridis* (Table 1). Egg batches of *P. japonica* were not found in 1987.

The oviposition period of *C. septempunctata bruckii* was from April 3 to 20. All of the egg batches were laid under dead leaves. Hatching was observed from April 14 to 24. Sibling cannibalisms were observed after the hatching in nine out

Table 1. Oviposition and sibling cannibalism of lady beetles in spring alfalfa fields (1987).

	Oviposition sites	Oviposition period	Hatching period
Coccinella septempunctata bruckii	Dead leaf	Apr. 3–Apr. 20	Apr. 14–Apr. 24
Harmonia axyridis	Alfalfa, Weed	Apr. 30–May 13	May 5–May 17

	No. of egg batches	No. of eggs within an egg batch	Hatchability	Ratio of eggs attacked by the first instar larvae
C. septempunctata bruckii	13	32.0±23.3	70.4±34.2	15.7±16.5
H. axyridis	22	23.9±11.0	53.4±24.3	39.6±21.3

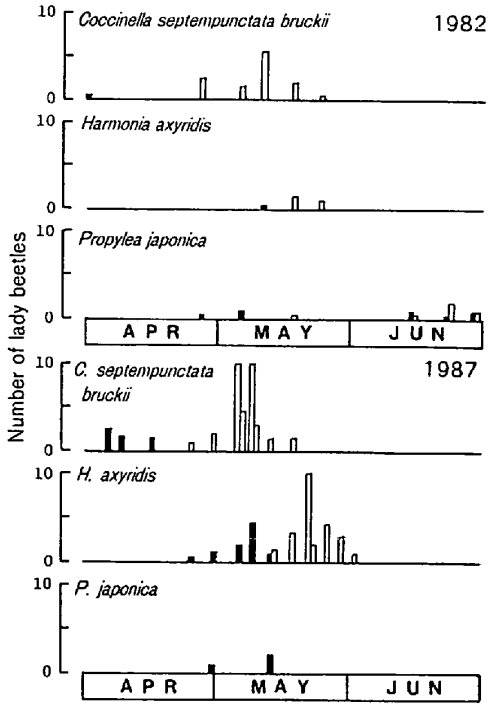

Fig. 1. Occurrence of lady beetles in spring alfalfa fields. Average number of adults (black column) and larvae (white column) per row (0.6×8 m) collected by beating.

of eleven egg batches, and 15.7% of the eggs were attacked by the first instar larvae. Hatchability of the eggs was 70.4%. Other egg predations by larvae or adults of lady beetles were never observed.

In laboratory tests, when they had no aphids, the larvae of *C. septempunctata bruckii* attacked eggs (TAKAHASHI, 1987). When they had adequate number of aphids, however, they hardly attacked the eggs, except in sibling cannibalisms. Within alfalfa fields, in the hatching period of *C. septempuncatata bruckii*, there were few advanced larvae which needed much prey (Fig. 1). The eggs escaped predation except for those cases of sibling cannibalisms.

On the other hand, the oviposition period of *H. axyridis* was from April 30 to May 13, almost one month later than in *C. septempunctata bruckii*. All of the egg batches were laid under alfalfa or weed leaves. Hatching was observed from May 5 to 17. Identical to *C. septempunctata bruckii*, sibling cannibalisms occurred after the hatching in twenty-one out of twenty-two egg batches, and 39.6% of the eggs were attacked by the first instar larvae of the same species. Hatchability of the eggs was 53.4%. Other types of predations by larvae or adults of lady beetles were never observed.

At the end of the hatching of *H. axyridis*, there were few adavanced larvae (Fig. 1), and therefore the eggs escaped predation.

2. *Pupal and prepupal predations*

Twenty-two pupal or prepupal predations by larvae were observed during the

Table 2. Pupal and prepupal predations of lady beetles in spring alfalfa fields (1982, '83 and '87).

	1982 May 19	1982 May 19	1983 May 18	1983 May 18	1983 May 18
Predator	4th instar larva (H.a)[1)]	4th instar larva (H.a)	3rd instar larva (C.s)	4th instar larva (C.s)	3rd instar larva (H.a)
Prey	pupa (C.s)	prepupa (C.s)	pupa (C.s)	prepupa (C.s)	prepupa (C.s)
Intra- or inter-specific predation	inter-	inter-	intra-	intra-	inter-
No. of observation	2	1	1	1	1

	1983 May 18	1983 May 23	1983 May 23	1987 May 26	Total
Predator	4th instar larva (H.a)	4th instar larva (H.a)	4th instar larva (H.a)	4th instar larva (H.a)	
Prey	prepupa (C.s)	pupa (C.s)	prepupa (C.s)	pupa (C.s)	
Intra- or inter-specific predation	inter-	inter-	inter-	inter-	
No. of observation	1	12	1	2	22

1) (H.a): *Harmonia axyridis*, (C.s): *Coccinella septempunctata bruckii*.

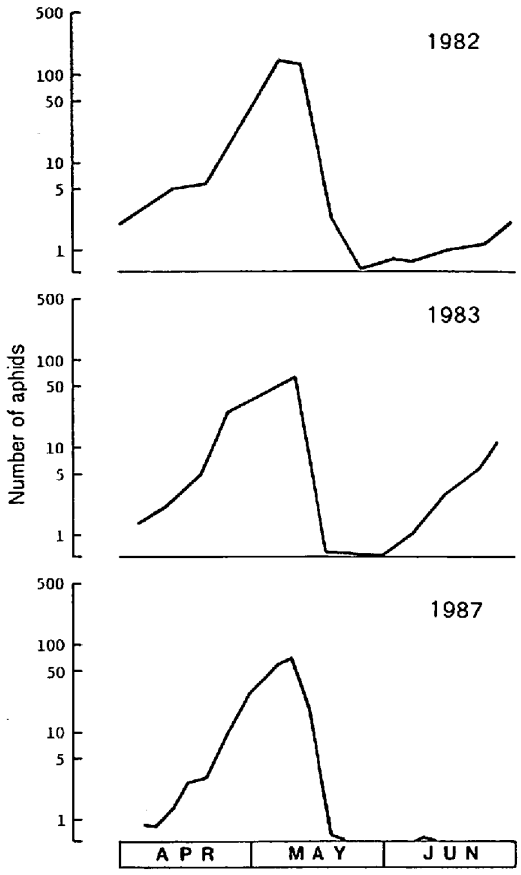

Fig. 2. Occurrence of aphids in spring alfalfa fields. Average number of aphids per stem.

three observation years (Table 2). Two predations were intra-specific, and the others were inter-specific predations. Predations by adults were never observed.

Intra-specific predations were by *C. septempunctata brukii* larvae. One of them was pupal predation by a third instar larva and the other was prepupal predation by a fourth instar larva. Inter-specific predations were by *H. axyridis* larvae and preys were pupae or prepupae of *C. septempunctata bruckii*. All of these predations were observed in late May. Predations by *P. japonica* were never observed.

In spring alfalfa fields, *C. septempunctata bruckii* laid their eggs early in April and their hatched larvae had enough aphids (mainly *Acyrthosiphon kondoi* SHINJI) for prey (Figs. 1–2). On the other hand, adults of *H. axyridis* came to alfalfa fields in May and laid their eggs, but it was too late for oviposition and the hatched larvae did not have enough aphids (Figs. 1–2). In such a situation, the larvae of *H. axyridis* became one of the predators of pupae or prepupae of *C. septempunctata bruckii* which were found in late May.

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