*Jpn. J. Ent.*, **61** (4): 839–345. December 25, 1993

# Daily Behavior of Adult *Coccinella septempunctata brucki* (Coleoptera, Coccinellidae)

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**Abstract** Daily behavior of adult *Coccinella septempunctata brucki* MULSANT was surveyed in spring alfalfa fields and alfalfa planted pots. At over 10°C, adults were active only in the daytime when the luminosity was more than 0.2 MJ/m²/0.5 hr, and wind velocity was less than 10 m/s. Predation, oviposition and mating were observed constantly in the daytime. After sunset, the insects remained at the base of the alfalfa plants. Density of the aphid population also affected the intensity of their activities: the lower the density, the more active they were.

Key words: *Coccinella septempunctata brucki*; daily behavior; meteorological factors; aphid; alfalfa.

## Introduction

*Coccinella septempunctata brucki* MULSANT is one of the major natural enemies of alfalfa aphids (TAKAHASHI & NAITO, 1984). They begin to migrate to alfalfa fields from their hibernation sites early in spring and start oviposition (TAKAHASHI, 1993). The activity of predators in the field is affected by many ecological factors (HODEK, 1965). The relation between the daily behavior of adult *C. septempunctata brucki* and meteorological factors was surveyed in spring alfalfa fields and alfalfa planted pots.

## Materials and Methods

1) *Field observation*

All of the following surveys were done from April through May in the field of the National Grassland Research Institute in Nishinasuno in the northern part of Tochigi Prefecture in Japan.

Two male and two female adults of *C. septempunctata brucki* were traced in alfalfa fields from 4 a.m. to 7 p.m. and their behavior and microhabitats were individually recorded.

The number, behavior and microhabitat of adult beetles in alfalfa fields (200 m²) were recorded for three days based on direct observation every thirty minutes from 4 a.m. to 7 p.m. The number of beetles in twenty 1 × 1 m frames was counted in the same field to estimate their population density.

The main aphid infesting the alfalfa was *Acyrthosiphon kondoi* SHINJI and the average density was 2–4 aphids/alfalfa stem (500–1000 aphids/m$^2$). The alfalfa was around 30 cm high. Temperature, luminosity and wind velocity in the field were recorded every day.

2) *Observation in pots*

In the field observation, only four adults were traced, with more individuals traced in pots to re-check the effect of meteorological factors.

One alfalfa plant which had three stems was planted in a 1/5000 a plastic pot. The height of each stem was approximately 30 cm. About four hundred *A. kondoi* were released on the plant and a dead leaf of *Quercus serrata* THUNB. was placed in the pot. The pot was then covered with a nylon net. A male and a female adult were put in the pot and their behavior and microhabitats were recorded every fifteen minutes from 4 a.m. to 7 p.m. Twenty pairs (pots) were examined in one trial and two trials were carried out in late April. Temperature and luminosity were also recorded.

## Results

1) *Active time and microhabitat*

Beetles were active when the luminosity was more than about 0.2 MJ/m$^2$/0.5 hr (Figs. 1–3). There was a positive correlation between their activity and the strength of luminosity. But even under adequate luminosity, their activity decreased when the wind velocity was more than about 10 m/s (Figs. 1–2). The temperature was over 10°C in the daytime.

In the field, beetles were usually found on alfalfa, and sometimes on the ground when the luminosity was more than about 1 MJ/m$^2$/0.5 hr (Figs. 1–2). They were under alfalfa leaves when the luminosity decreased to less than 0.2–0.5 MJ/m$^2$/0.5 hr. They remained at the foot of alfalfa after sunset.

Although the estimated density of beetles was 150 to 200 per 200 m$^2$, only 11 to 23 beetles were actually seen in the field (Fig. 2).

In the pot, they were usually found on the ground or on the dead *Q. serrata* leaf, both on the upper side and under side, in the daytime (Fig. 3) and after sunset most of them remained at the base of the alfalfa plants or on the dead leaf.

No marked difference of their behavior and microhabitat was observed between males and females (Figs. 1, 3).

2) *Predation of aphids*

Predation was investigated continuously during the daytime in the field (Fig. 1) with predation occurring on 2 and 11 aphids by male beetles and on 7 and 12 aphids by females.

Predation was also observed continuously during the daytime (Fig. 3) in the pots with predation by females twice as frequent as that by males.

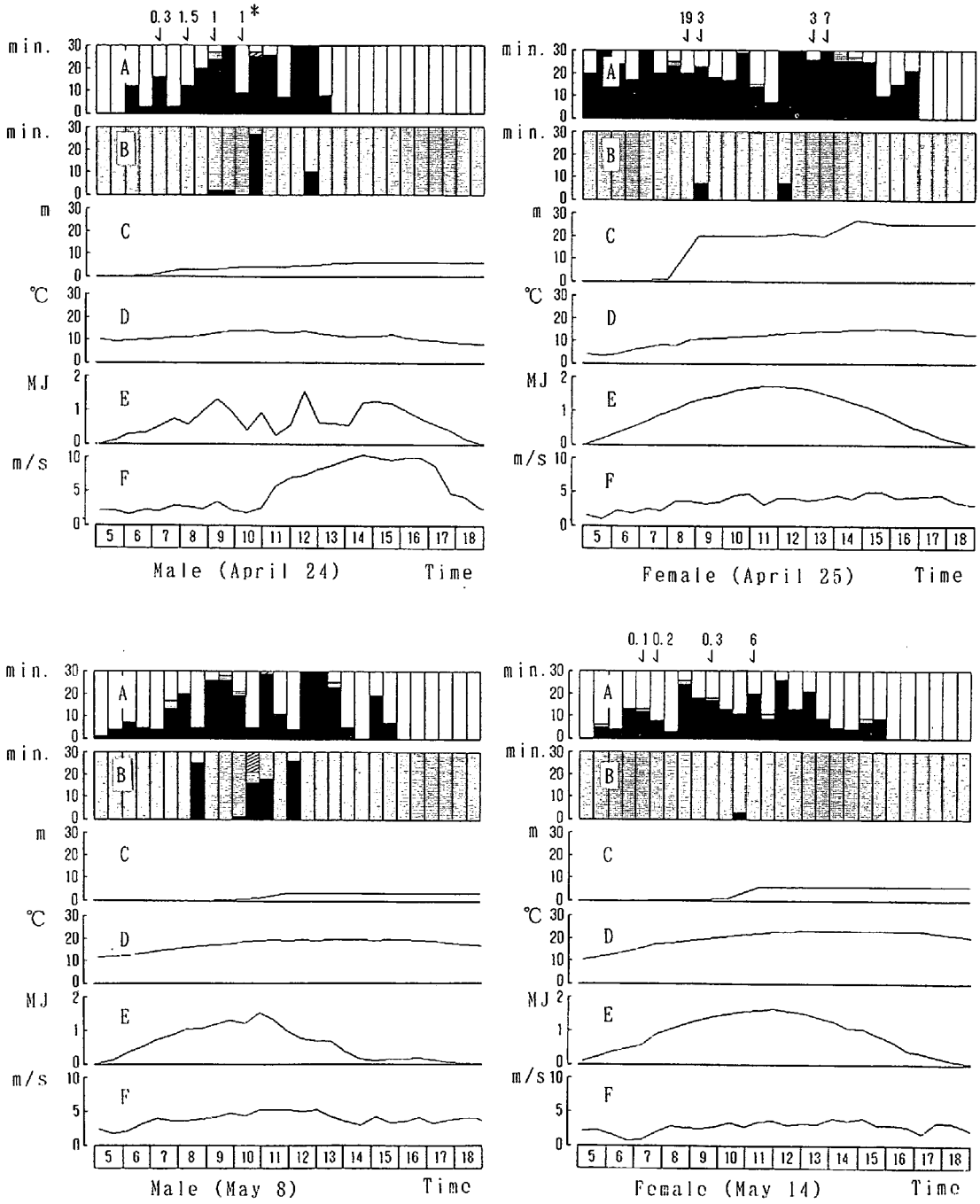


Fig. 1. Daily behavior of *C. septempunctata brucki* in alfalfa fields.
A: Behavior □; Resting ■; Walking ▒; Eating ▨; Mating
B: Microhabitat ▒; Alfalfa ■; Ground ▨; Dead leaf
C: Distance from the starting point
D: Temperature, E: Luminosity (MJ/m²/0.5 hr), F: Wind velocity
↓: Flight *: Flight distance (m)

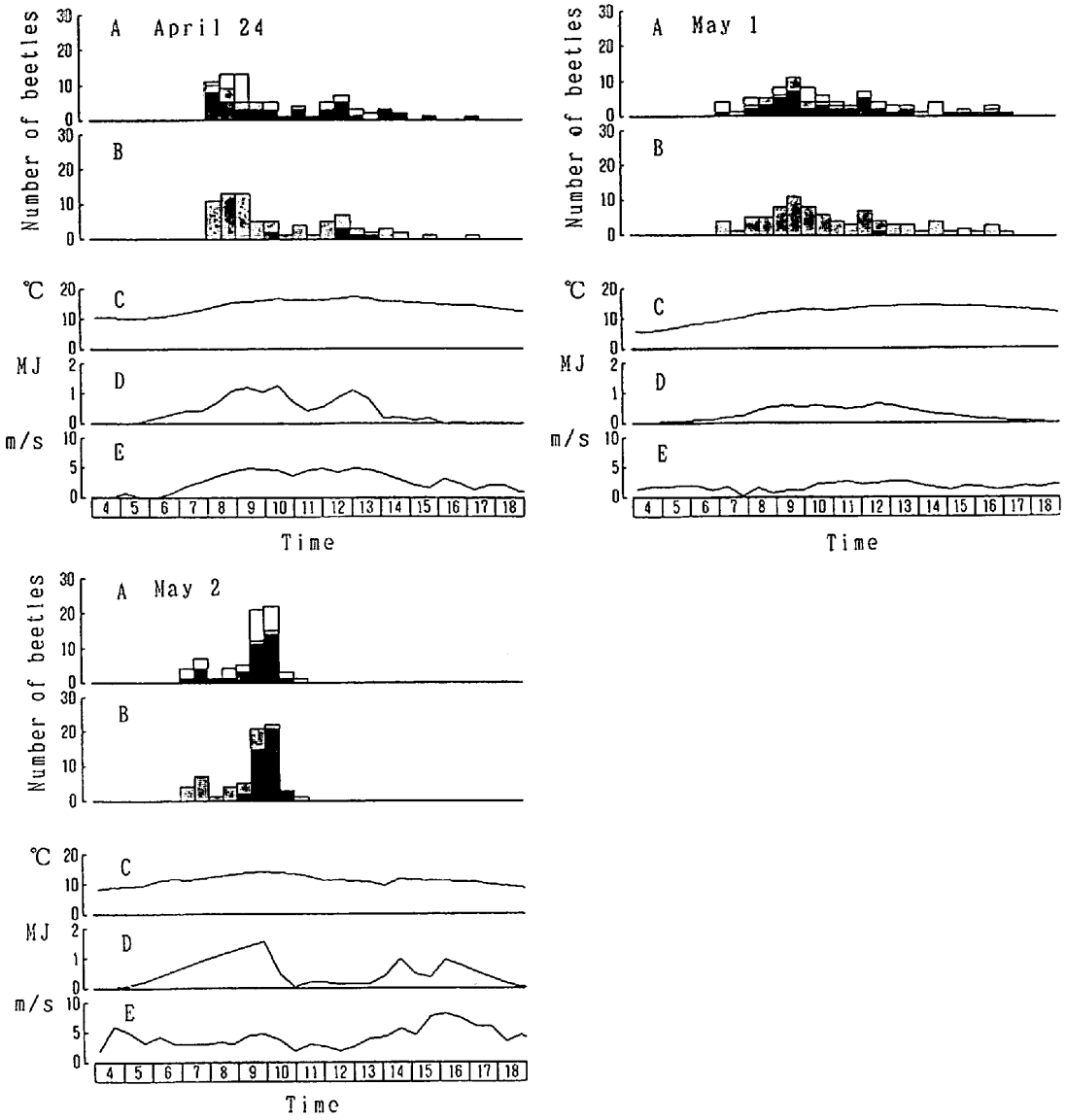


Fig. 2. Field observation of *C. septempunctata brucki* in alfalfa fields.
A: Behavior □; Resting ■; Walking ⬚; Eating
B: Microhabitat ⬚; Alfalfa ■; Ground
C: Temperature, D: Luminosity (MJ/m²/0.5 hr), E: Wind velocity

3) *Mating*

Mating was observed only twice in the field (Fig. 1). Whenever a male came across a female, the male chased the female and the percentage of successful mating was 50%. Mating took place either on the soil or on the alfalfa.

In pots, mating was also frequent (Fig. 3), occurring on the ground or on the dead leaves.

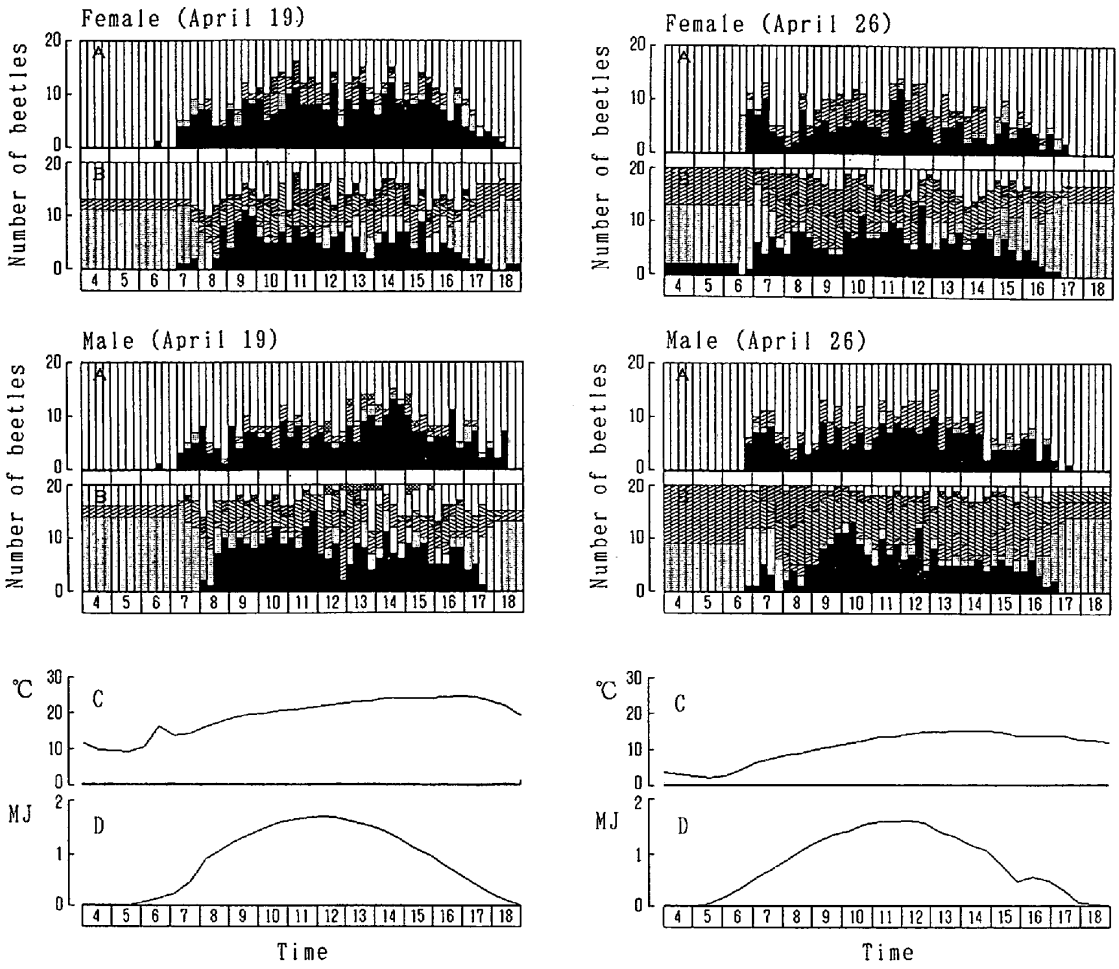


Fig. 3. Daily behavior of *C. septempunctata brucki* in pots.
A: Behavior □; Resting ■; Walking ▒; Eating □; Mating ▒; Flight ▨; Ovipositing
B: Microhabitat ▒; Alfalfa ■; Ground ▧; Dead leaf (Upper side) ▨; Pot □; Net ▨; Dead leaf (Under side)
C: Temperature, D: Luminosity (MJ/m²/0.5 hr)

4) *Flight*

Flights were observed twelve times in the field (Fig. 1), most of them in the morning when the luminosity exceeded 0.5 MJ/m²/0.5 hr. Flight distances were from 0.1 to 19 m with most less than 7 m. The total distance an insect marked in one day was 3.5 to 25 m.

In pots, flights observed were by males only (Fig. 3).

5) *Oviposition*

Oviposition occurred in pots at any time in the daytime. Each female laid one egg batch, which contained an average of 30.0 eggs, on the pot itself (27 batches), the dead leaf (6), the net (4), the alfalfa (2) and on the ground (1).

## Discussion

*Coccinella septempunctata brucki* begins to feed on aphids and to oviposit when the temperature rises above 10°C, and in laboratory tests is even more active at higher temperatures (TAKAHASHI, in press). In this survey, thetem perature was usually above 10°C. Under this condition, the factor that most affected beetle activity was luminosity: the more intense it was, the more active they were. Estimating the number of adults in the field is better done at a time of high luminosity, and it should also be noted that probably only 7–30% of the beetles present can be found by direct observation even in strong sunshine (EWERT & CHANG, 1966; HONĚK, 1982). Radiant heat is important for activity in winter (SAKURATANI *et al.*, 1986). There must be a positive correlation between luminosity and radiant heat.

The wind velocity also affected beetle activity: the stronger the wind, the less active they were. For example, most of them remained under the plant leaves when winds were strong at more than 10 m/s.

When the density of the aphid, *Acyrthosiphon kondoi* SHINJI was more than 100/alfalfa stem in pots, most of the adult beetles were found on the ground or on dead leaves of *Q. serrata* resting and mating. Although aphid density was only 2.4/alfalfa stem in the field, adult beetles moved about on the alfalfa. These results indicate that the density of the aphid population also affected the intensity of their activities, with greater activity seen at lower density.

Flight ability of the female decreases with sexual maturation (HONĚK, 1982, 1985). Therefore, matured females in the pot oviposited every day and were never seen to fly.

Females lay one egg batch per day when enough aphids are available at temperatures around 20°C (TAKAHASHI, in press), which accords with the results of this survey. TAKAHASHI (1987) reported that most of the egg batches were laid under the dead leaves of *Q. serrata* and a few on the leaves of alfalfa. In this study too, most of the eggs were laid on the pots and only five percent were done on alfalfa in pots. Females leave the alfalfa to oviposit. Therefore, one reason for this may be to avoid cannibalism by other females as they search for aphids.

## Acknowledgment

I wish to express my sincere thanks to Dr. Yoshio HIRAI of the Entomological Laboratory, National Grassland Research Institute for his useful discussions and suggestions throughout the study.

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(Received July 15, 1993; Accepted September 8, 1993)