Appl. Ent. Zool. **20** (4): 439–442 (1985)

Temperature in Aestivating Sites and Adult Density of *Coccinella septempunctata bruckii* MULSANT (Coleoptera: Coccinellidae)

Yasuyuki SAKURATANI and Takahiro KUBO

Entomological Laboratory, Faculty of Agriculture, Kinki University, Higashi-Osaka 577, Japan

(Received May 9, 1985)

The number of aestivating adults of *Coccinella septempunctata bruckii* was investigated in several kinds of plant communities in the grassland on the bed of the Yodo River in the Osaka Plain, Japan. More adults aestivated in the *Miscanthus sacchariflorus* community than in *Solidago altissima* and other plant communities. The temperature in the *M. sacchariflorus* community was lower than in the *S. altissima*. In the *M. sacchariflorus* community more adults tended to be found in the plot with the lowest temperature, indicating that adults of *C. septempunctata bruckii* might prefer a low temperature site for aestivating.

INTRODUCTION

Coccinella septempunctata bruckii MULSANT is a familiar species and an important predator of aphids in Japan. This species often occurs in grasslands such as cornfields (SAKURATANI, 1977) or places covered with the grass of *Rumex* in spring and autumn when aphid density is high; in summer, however, the species disappears from those sites. MAETA (1965) reported that the adults aestivated in weeds growing under orchard trees in southern Japan, and SAKURAI et al. (1981) found that they aestivated at the base of eulalia grass, *Miscanthus sinensis*, in central Japan.

Details of the life history, diapause, population dynamics and other ecological characteristics of this species are not well known in Japan. This paper reports the relation between the density of aestivating adults and the temperature in several kinds of grassland in summer.

METHODS

The investigation was carried out in the grassland on the bed of the Yodo River in the Osaka Plain, Japan. The grassland was composed of several kinds of plant communities: *Miscanthus sacchariflorus*, *Phragmites karka*, *Solidago altissima*, *Rumex japonicus* and others. Each spring the population densities of aphids and *C. septempunctata bruckii* were high in the grassland, especially on *R. japonicus*.

Several plots (0.7×0.7 m) were chosen randomly from each plant community. The grass within the plots was cut with a sickle to facilitate the investigation and the number of adults was counted. Some captured females were kept in 70% alcohol to examine the degree of their ovarian development. Temperatures in the aestivating sites were measured by a radiation thermometer.

RESULTS AND DISCUSSION

The number of adults of *C. septempunctata bruckii* found in each plot is shown in Fig. 1; it varied widely from plot to plot in each plant community, especially in *M. sacchariflorus*. Though there was no significant difference in insect number among the plant communities, the percentage of *M. sacchariflorus* plots with more than ten adults was higher than the other plant communities. The highest density observed was 48 adults per 0.5 m^2 in the plot of *M. sacchariflorus* on 4th July 1984. The adults stayed motionless on the dead and dry leaves near the ground, but walked about slowly when they were disturbed by the cutting of the grass. No stages other than adult were observed and there were few aphids in any of the plant communities.

Females collected from the aestivating sites were dissected under a binocular microscope to determine the degree of their ovarian development. As the ovaries of most females were in stage 1 (non-developing stage (SAKURAI et al., 1981)), those adults might have been in the obligatory diapause mentioned by SAKURAI et al. (1981) (Table 1).

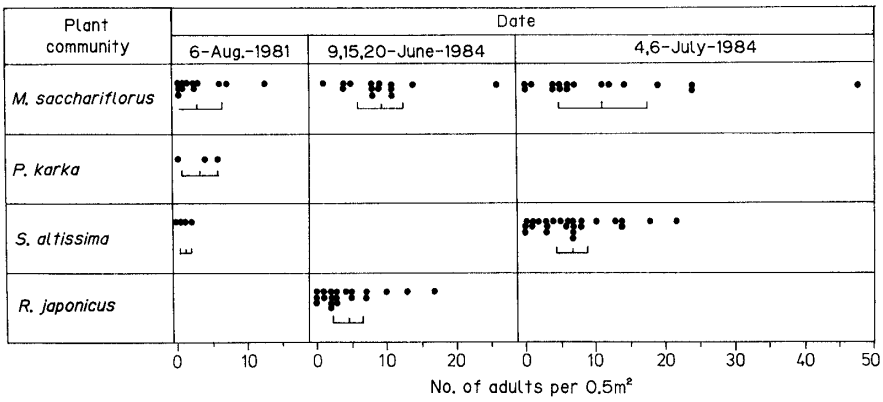

Fig. 1. Number of aestivating adults of *C. septempunctata bruckii* in various plant communities. Each point and bar indicate the number per 0.5 m^2 and mean±95% confidence limits, respectively.

Table 1. Frequency of ovarian development in *C. septempunctata bruckii*

Plant community and date	Oogenic stage[a]					Total
	1	2	3	4	5	
M. sacchariflorus						
June 15	11	0	0	0	0	11
20	7	0	0	0	0	7
July 4	24	0	0	0	0	24
R. japonicus						
June 15	4	0	1	0	0	5
Total	46	0	1	0	0	47

[a] According to SAKURAI et al. (1981) (1: non-developing stage, 2: follicle differentiating stage, 3: early vitellogenic stage, 4: mid-vitellogenic stage, 5: late vitellogenic and mature egg stage).

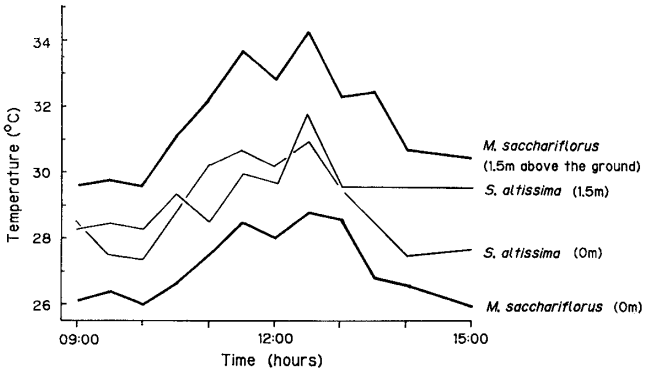

Fig. 2. Hourly changes of temperature in two kinds of plant communities, *M. sacchariflorus* and *S. altissima*, where adults of *C. septempunctata bruckii* aestivated, on 4th July 1984.

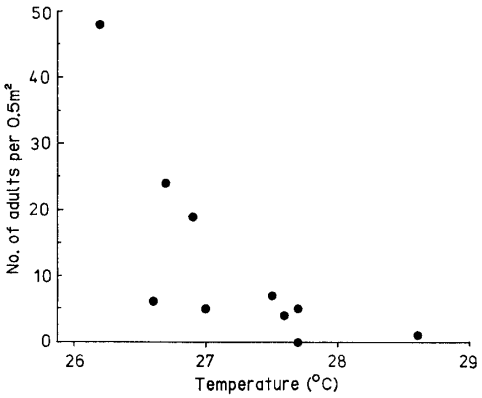

Fig. 3. Relation between temperature and adult density of *C. septempunctata bruckii* in an *M. sacchariflorus* community.

Figure 2 shows the hourly changes of temperature in the plant community observed on 4th July 1984 when the weather was clear all day. The temperature 1.5 m above the ground in the *S. altissima* community was higher by 2–3°C than that in the *M. sacchariflorus*. The temperature at the base of the *M. sacchariflorus* community, where the adults of *C. septempunctata bruckii* aestivated, was lower by 4–5°C than at the 1.5 m height and did not exceed 30°C even in the daytime. In the *S. altissima* community there was little difference in temperature between the upper and lower parts throughout the day.

The April to October accumulation of dead leaves and stems which might have an adiabatic effect to totalled 510 g/m^2 in the *M. sacchariflorus* community (MUTOH et al., 1968), whereas it was 260 g/m^2 in the *S. altissima* community (IWAKI et al., 1969). Thus the temperature in the community of *M. sacchariflorus* might be kept at a lower level by the greater abundance of dead leaves.

Figure 3 shows the relation between the temperature and the number of adults of *C. septempunctata bruckii* in several plots in the *M. sacchariflorus* community. Adult density in the plots with lower temperature was higher than in those with a higher temperature. The difference in temperature among the plots of this community might be ascribed to the difference in amount of dead leaves and stems of that plant. The adults of *C. septempunctata bruckii* might have moved from their emergence site in spring to the base of the plant with the most dead leaves and stems which protected the insects from the heat of the summer sunshine. The microclimatic condition at the aestivating site thus may favor the survival of aestivating insects (MASAKI, 1980). The low temperature at the micro-habitat seems to be suitable for the aestivation of *C. septempunctata bruckii* adults.

ACKNOWLEDGEMENTS

We wish to thank Dr. T. SUGIMOTO of Kinki University for his encouragement and critical reading of the manuscript.

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