

Preliminary Experiments on Adult Food Preference of the Indonesian Phytophagous Ladybird Beetle, *Epilachna* sp. aff. *emarginata* (Coleoptera: Coccinellidae)

Naoyuki FUJIYAMA¹, Hideki UENO², Sih KAHONO³ and Haruo KATAKURA¹

¹Division of Biological Sciences, Graduate School of Science, Hokkaido University, Sapporo, 060–0810 Japan

²Laboratory of Biology, Faculty of Education, Niigata University, Niigata, 950–2181 Japan

³Balai Penelitian dan Pengembangan Zoologi, Puslitbang Biologi, LIPI, Jl. Raya Bogor Jakarta Km 46, Cibinong, 16911 Indonesia

Abstract. Adult food preference for two populations of the Indonesian phytophagous ladybird beetle, *Epilachna* sp. aff. *emarginata* Dieke was preliminarily investigated under uncontrolled room conditions. The two populations, that are known to show difference in host plant utilization patterns, were examined. Bogor population occurred on *Mikania micrantha* H. B. K. (Asteraceae) exclusively, and Cibinong population utilized *Leucas lavandulifolia* Smith (Labiatae) and *M. micrantha*. When beetles from each population were subjected to choice tests offering them *M. micrantha* and *L. lavandulifolia* simultaneously, beetles from the Bogor population and the “*Mikania* strain” of the Cibinong population preferred *M. micrantha* to *L. lavandulifolia* strongly, while the “*Leucas* strain” of the Cibinong population did not show a clear food preference. These results suggest that inter- and intra-population differentiation in adult food preference exist.

Key words: *Epilachna* sp. aff. *emarginata*, *Mikania micrantha*, *Leucas lavandulifolia*, adult food preference, Indonesia.

Introduction

Phytophagous coccinellid beetles of the subfamily Epilachninae are abundant and rich in species number in Indonesia, with twenty-six species including undescribed ones so far collected (Korschefsky, 1931; Dieke, 1947; Gunst, 1957; Bielawski, 1959; Fürsch, 1959; Richards, 1983; Katakura *et al.*, 1988, in press). While most Indonesian epilachnine species were host specific, at least at the family level of host plants, some species utilize host plants from two or three plant families (Katakura *et al.*, 1999, in press).

Epilachna sp. aff. *emarginata* Dieke is known to utilize *Mikania* spp. (Asteraceae) and some species of the family Labiatae, and the pattern of host plant utilization of this ladybird beetle seems to differ according to geographical populations (Katakura *et al.*, 1999, in press; Nakano, 1999). In the present report, we will show the inter- and intra-population differences of adult food preference of this Indonesian *Epilachna* species, based on simple food choice tests conducted as a preliminary step for further intensive ecological and evolutionary studies.

Materials and Methods

Ladybird beetles and host plants

The beetle studied here is closely similar to *E. emarginata* Dieke in its morphology but is different in some diagnostic characters (Katakura *et al.*, in press). In this paper, we call it “*Epilachna* sp. 3” according to Katakura *et al.* (in press). *Epilachna* sp. 3 is common in Indonesia and occurs in disturbed habitats. This beetle species had been known only on a herbaceous vine, *Mikania* spp. (Asteraceae) in and around Bogor, West Java, and in West Sumatra by early 1990s. However, recently, its occurrence on two species of Labiatae was reported: on *Leucas lavandulifolia* Smith in Bogor and in Central Java, and on Labiatae sp. in Purwodadi (East Java). *Epilachna* sp. 3 occurred mainly on *M. micrantha* H. B. K. in West Java, but it was not collected on this plant in Central and East Java, where it occurred on some Labiatae species (Katakura *et al.*, 1999, in press; Nakano, 1999). The utilization of *Mikania* plants by this beetle might be restricted in West Java and Sumatra (S. Nakano, pers. comm.).

In the present study, adult beetles were collected

from two populations, one from Bogor Botanic Garden (Kebun Raya Bogor: Bogor, West Java; 6°37' S, 106°32' E) and the other from Cibinong (Bogor, West Java; about 12 km northeast of Bogor Botanic Garden). Hereafter, these two populations are referred to as "Bogor population" and "Cibinong population", respectively. The two populations are known to utilize different host plants under natural conditions: the Bogor population occurs exclusively on *M. micrantha*, and the Cibinong population utilizes mainly *L. lavandulifolia* but also *M. micrantha* subsidiarily (Fujiyama *et al.*, personal observations). In this study, beetles of the Cibinong population were collected on *M. micrantha* and *L. lavandulifolia*, separately, and the former were tentatively treated as the "Mikania strain" and the latter as the "Leucas strain". The beetles collected from each population or host plant were kept in mass and were fed freshly picked leaves of respective host plant for one to two days before experiments.

Plant leaves used in the experiments were collected in the Bogor Botanic Garden (*M. micrantha*), and in Cibinong (*L. lavandulifolia*), on the previous day of the start of experiments. These leaves were kept in plastic bags in a refrigerator until the experiments were conducted.

Experiments

The experiments were performed in November 1999 under uncontrolled room conditions in Bogor. The following simple food choice tests were performed for determining adult food preference of beetles from the populations or strains.

Four to five beetles including both sexes (see below) and leaves of the two plant species were placed in a transparent plastic box (8×12×3 cm) whose bottom was covered by moist tissue paper. The beetles were allowed to feed leaves for 24 hours. This procedure was repeated twice using the same beetles, with an interval of five hours during which only the respective host plant leaves were offered to the beetles. All the three populations/strains were investigated simultaneously. The number of beetles examined was: for the Bogor population, two females and three males; for the *Mikania* strain of Cibinong population, two females and two males; for the *Leucas* strain of Cibinong population, two females and three males.

The leaf area consumed was traced on tracing papers and scanned into a computer, and then measured using image processing software (NIH Image ver. 1.59).

Results and Discussion

Beetles from the Bogor population and the *Mikania* strain of the Cibinong population exclusively and nearly exclusively fed on *M. micrantha*, respectively, whereas those from the *Leucas* strain of the Cibinong population fed the two plant species (Table 1). These results well agree with the host utilization patterns under natural conditions; that is, only the beetles utilizing *L. lavandulifolia* (i.e., *Leucas* strain of the Cibinong population) showed acceptability to *L. lavandulifolia*.

The utilization of *L. lavandulifolia* by beetles from the Cibinong population would be attributable to the co-occurrence of *L. lavandulifolia* and *M. micrantha* at Cibinong. However, it has been known that the Bogor population never colonized *L. lavandulifolia* when this plant was transplanted adjacent to *M. micrantha* (Kahono, unpublished). Although the feeding experiences before collection might have influenced the beetles' preference on plant species, results obtained in this study suggest inter-populational intrinsic difference in adult food preference in *Epilachna* sp. 3.

The obvious difference of adult food preference between the two "strains" of the Cibinong population could indicate the presence of intra-populational differentiation in adult food preference. Because experiments were conducted under mass conditions, however, we could not detect the level at which such an intra-populational variation occurs: namely whether all beetles of *Leucas* strain examined fed on the two plants, or they consisted of two types of individuals that specialized on one of the two plants, or whether both cases were mixed.

Thus, the results obtained in this study strongly suggest the existence of not only inter-populational difference but also intra-populational differentiation for adult food preference of *Epilachna* sp. 3. This situation is a good stage to investigate the problems concerning evolutionary ecology of phytophagous in-

Table 1. Results of food choice tests using field collected adult beetles of *Epilachna* sp. aff. *emarginata*. Consumed area (per individual beetle) for the two host plants were given in cm². BM, Bogor population; CM, *Mikania* strain of Cibinong population; CL, *Leucas* strain of Cibinong population.

	1st trial		2nd trial	
	<i>M. micrantha</i>	<i>L. lavandulifolia</i>	<i>M. micrantha</i>	<i>L. lavandulifolia</i>
BM (♀2/♂3)	1.182	0	1.316	0
CM (♀2/♂2)	1.617	0.002	1.289	0
CL (♀2/♂3)	0.517	1.287	0.684	0.869

sects, for example, evolution of diet breadth, host shift, host race formation, and sympatric speciation (cf. Nishida *et al.*, 1997). Further studies using many more populations, such as ones dealing with adult and larval performance, crossing experiments (cf. Nakano, 1999), genetic basis for host use, as well as adult food preference, will shed light on understanding of ecological and evolutionary aspects of interrelationships between *Epilachna* sp. 3 and its host plants.

Acknowledgments

We thank Dr. Susumu Nakano (Hiroshima Shudo University) who provided valuable information from his unpublished data. We also thank Dr. Jun-ichi Kojima (Ibaraki University) for critical reading of an earlier draft, and two anonymous reviewers for their useful comments. This study was carried out with the permission of Lembaga Ilmu Pengetahuan Indonesia (LIPI), and was funded partly by a Grant-in-Aid from Japan Society for the Promotion of Science (No. 11691161).

References

- Bielawski, R. 1959. Coccinellidae (Coleopt.) von Sumba, Sumbawa, Flores, Timor und Bali. *Verhandlungen der Naturforschenden Gesellschaft in Basel*, **69**: 145–166.
- Dieke, G. H. 1947. Ladybeetles of the genus *Epilachna* (sens. lat.) in Asia, Europe, and Australia. *Smithsonian Miscellaneous Collections, Washington, D.C.*, **106**: 1–183.
- Fürsch, H. 1959. Die palaearktischen und indomalayischen Epilachnini der zoologischen Sammlung des Bayerischen Staates München (Col. Cocc.). *Opuscula Zoologica, München*, **26**: 1–9.
- Gunst, J. H. de 1957. Indonesian ladybirds. *Panggemar Alam Bogor*, **36**: 3–38.
- Katakura, H., Abbas, I., Nakamura, K. & Sasaji, H. 1988. Records of epilachnine crop pests (Coleoptera, Coccinellidae) in Sumatera Barat, Sumatra, Indonesia. *Kontyû, Tokyo*, **56**: 281–297.
- Katakura, H., Nakano, S. & Kahono, S. 1999. Diversity and host plant specificity of epilachnine ladybird beetles in Indonesia. *Tropical Ecology Letters*, **34**: 3–7. (In Japanese with English summary.)
- Katakura, H., Nakano, S., Kahono, S., Abbas, I. & Nakamura, K. 2001. Epilachnine ladybird beetles (Coleoptera, Coccinellidae) of Sumatra and Java. *Tropics*, **10**: (In press.)
- Korschefsky, R. 1931. Coccinellidae I. In Junk, W. & Schenkl, S. (eds.), *Coleopterorum Catalogus, pars*, **118**: 1–224.
- Nakano, S. 1999. Host plant specificity and closely related populations of Epilachnine ladybird beetles in Indonesia. *The Nature and Insects*, **34**(12): 24–27. (In Japanese.)
- Nishida, T., Pudjiastuti, L. E., Nakano, S., Abbas, I., Kahono, S., Nakamura, K. & Katakura, H. 1997. The eggplant beetle on a Leguminous weed: Host race formation in Progress? *Tropics*, **7**: 115–121.
- Richards, A. M. 1983. The *Epilachna vigintioctopunctata* complex (Coleoptera: Coccinellidae). *International Journal of Entomology*, **25**: 11–41.

(Received December 28, 2000; Accepted January 26, 2001)