Appl. Entomol. Zool. 33 (2): 327-331 (1998)

Report of the Mexican bean beetle, *Epilachna varivestis* (Coleoptera: Coccinellidae) in Japan

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(Received 12 December 1997; Accepted 19 February 1998)

Abstract
The Mexican bean beetle, *Epilachna varivestis*, was confirmed in leguminous vegetable fields in Yamanashi and Nagano Prefectures, central Honshu, Japan in the summer of 1997. It was estimated that this species had already colonized these areas about four or five years earlier, and that the adults can survive the winter there.

Key words: *Epilachna varivestis*, exotic insect, invasion, Leguminosae

INTRODUCTION

The Mexican bean beetle, *Epilachna varivestis* Mulsant, a serious insect pest of leguminous vegetables, is distributed only in Central and North America (CIE, 1954; Turnipseed and Kogan, 1976). There has been no report of invasion into Japan by this species (Morimoto and Kiritani, 1995). In early August, 1997, we identified *E. varivestis* in leguminous vegetable fields in Yamanashi and Nagano Prefectures, central Honshu, Japan. We conducted seven field censuses for confirmation of occurrence of this beetle in August and September, 1997. In the present communication, we report the current distribution area of this beetle and preliminary information about its natural enemies and overwintering stage.

MATERIALS AND METHODS

Field census. *E. varivestis* feeds on many kinds of leguminous plants (Schaefer, 1983). We conducted seven field censuses in vegetable fields of the genus *Phaseolus* (common bean, *P. vulgaris* and *P. vulgaris* var. *humilis*, scarlet runner bean, *P. coccineus*, and adzuki bean, *P. angularis*), from August 4 to September 28, 1997. The present census covered 32 locations in Yamanashi and Nagano Prefectures, and we investigated 2 to 18 vegetable fields at each location; the area of each vegetable field ranged from 1 a to 50 a. Whenever possible, we asked farmers when they had first found this beetle, and whether they had used insecticides to control it in their legume fields.

Collection of egg masses and pupae. In the field censuses conducted from August 27 to September 28, we collected some egg masses and pupae in the vegetable fields, and studied their eclosion in the laboratory under conditions of 24°C, 16L-8D.

RESULTS AND DISCUSSION

Distribution area

E. varivestis was identified in the central and western areas of Yamanashi Prefecture and a part of Nagano Prefecture that is contiguous with Yamanashi Prefecture (Fig. 1). In almost all locations where *E. varivestis* was confirmed in the field, every developmental stage from egg to adult was found on the same date (Table 1). Apart from our field censuses, both the Yamanashi and Nagano prefectural governments conducted their own field censuses of this beetle in late August and early September. The distribution area confirmed by the Yamanashi prefectural government was generally in accord with our findings. The Nagano prefectural government census also found this beetle around Lake Suwa, an area we did not study

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Table 1. Locations surveyed for the Mexican bean beetle, *Epilachna varivestis* (MBB) and the developmental stages of MBB found in the vegetable fields

No. on map[a]	Location	Date of survey in 1997	No. of surveyed vegetable fields	No. of fields where MBB was confirmed	Developmental stage of MBB found in the fields[b]
1	Takane T.	Aug. 4	3	3	E, L, P, A
2	Nagasaka T.	Aug. 4	3	3	E, L, P, A
3	Kobuchizawa T.	Aug. 4	6	6	P, A
4	Fujimi T.	Aug. 4	11	9	E, L, P, A
5	Chino C.	Aug. 4	3	2	A
6	Miyota T.	Aug. 26	5	0	—
7	Karuizawa T.	Aug. 26	4	0	—
8	Komoro C.	Aug. 26	6	0	—
9	Saku C.	Aug. 27	9	0	—
10	Yachiho V.	Aug. 27	5	0	—
11	Koumi T.	Aug. 27	5	0	—
12	Minamimaki V.	Aug. 27	9	0	—
13	Minamimaki V.	Aug. 27	6	2	L, P, A
14	Takane T.	Aug. 27	2	2	L, P, A
2	Nagasaka T.	Aug. 27	3	3	E, L, P, A
15	Sutama T.	Sept. 7	9	9	L, P, A
16	Sutama T.	Sept. 7	10	6	L, P, A
17	Kawakami V.	Sept. 7	14	0	—
18	Kawakami V.	Sept. 7	11	0	—
12	Minamimaki V.	Sept. 7	2	0	—
15	Sutama T.	Sept. 20	4	3	E, L, A
14	Takane T.	Sept. 20	4	3	L, P, A
12	Minamimaki V.	Sept. 20	5	0	—
13	Minamimaki V.	Sept. 20	8	1	P
19	Minamimaki V.	Sept. 20	14	13	E, L, P, A
20	Nirasaki C.	Sept. 25	6	3	L, P
21	Shikishima T.	Sept. 25	13	10	E, L, P, A
22	Kofu C.	Sept. 25	13	0	—
23	Yamanashi C.	Sept. 25	5	0	—
24	Makioka T.	Sept. 25	11	4	E, L, P, A
25	Uenohara T.	Sept. 28	6	0	—
26	Kosuge V.	Sept. 28	8	0	—
27	Tabayama V.	Sept. 28	7	0	—
28	Enzan C.	Sept. 28	5	0	—
29	Enzan C.	Sept. 28	12	0	—
30	Mitomi V.	Sept. 28	7	0	—
31	Makioka T.	Sept. 28	5	0	—
24	Makioka T.	Sept. 28	18	11	L, P
32	Yamanashi C.	Sept. 28	12	0	—

[a] Location number in Fig. 1.
[b] E: egg mass, L: larva, P: pupa, A: adult.

(unpublished data). As of autumn, 1997, it can be concluded that the distribution of *E. varivestis* is limited to between the areas around Lake Suwa, Nagano Prefecture and the central part of Yamanashi Prefecture (Fig. 1). Since 1995, this beetle has been frequently found in leguminous vegetable fields between Kobuchizawa Town (No. 3 in Fig. 1) and Nirasaki City (No. 20 in Fig. 1) (Atsuo Fujimaru, personal communication). In addition, some farmers have stated that damage due to the beetle has been evident in their fields for

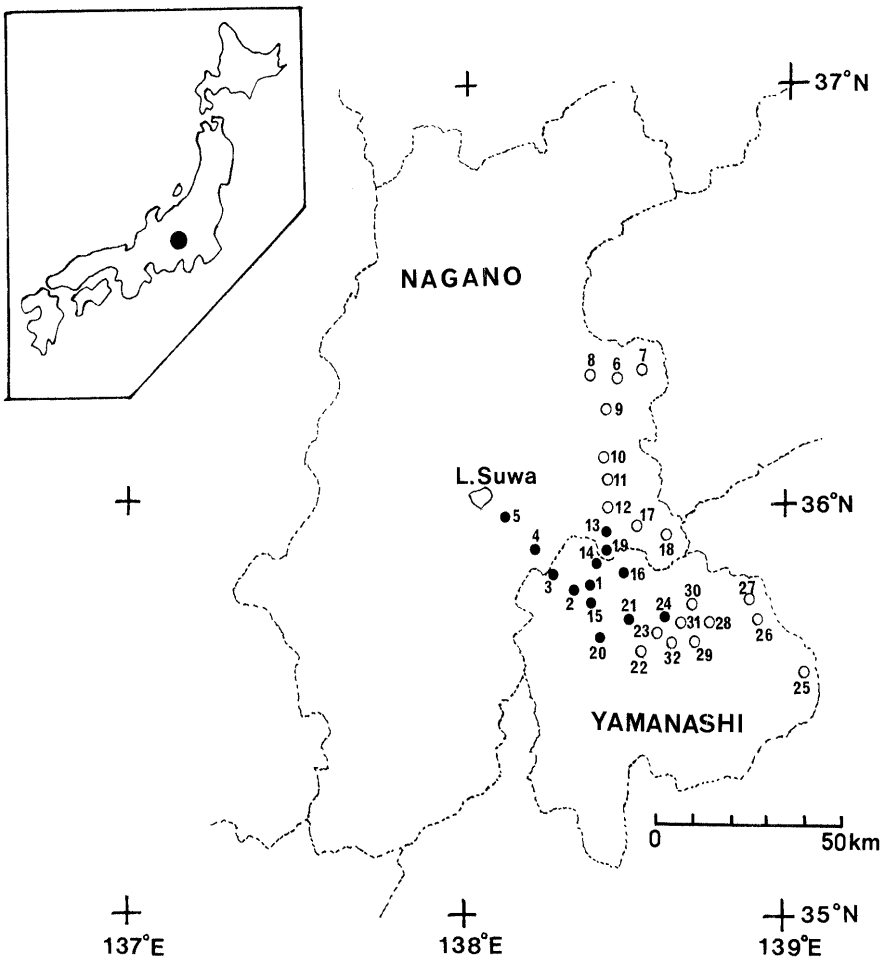

Fig. 1. Locations surveyed for occurrence of *Epilachna varivestis* in August and September, 1997. ●: *E. varivestis* was confirmed. O: *E. varivestis* was not confirmed. See Table 1 for the location numbers in the map.

Table 2. Hatchability of egg masses and eclosion of pupae of *E. varivestis* collected from fields in the summer to autumn of 1997

Date of collection	Location	Stage	No. individuals examined	Factors responsible for life and death	No. individuals
Aug. 27	Minamimaki V.	Pupa	12	Emergence	6
				Parasitism by *Nothoserphus afissae*	3
				Physiological death	3
Sept. 7	Sutama T.	Pupa	15	Emergence	6
				Parasitism by *Pediobius foveolatus*	4
				Physiological death	5
Sept. 20	Sutama T.	Egg	3[a]	Hatching	3[a]
Sept. 20	Minamimaki V.	Egg	2[a]	Hatching	2[a]
		Pupa	10	Emergence	6
				Physiological death	4
Sept. 25	Shikishima T.	Egg	2[a]	Hatching	2[a]
		Pupa	15	Emergence	2
				Physiological death	13
Sept. 28	Makioka T.	Pupa	16	Emergence	12
				Physiological death	4

[a] Number in egg stage indicates the number of egg masses.

several years. Recently, Sasaji (1997) also reported that adults of *E. varivestis* were collected in Nirasaki City in July 1996 and June 1997.

In the central parts of the current distribution area, the beetle was confirmed in almost every field we surveyed (Table 1 and Fig. 1). On the other hand, in the outlying parts of the distribution area, for example, in Nobeyama, Minamimaki Village (No. 13 in Fig. 1), and Nishiho, Makioka Town (No. 24 in Fig. 1), the beetle was confirmed in only about 20% and 50% of the fields surveyed, respectively (Table 1). This suggests that the beetle invaded into these locations only recently, and that its distribution has begun to increase.

Natural enemies

Two species of parasitic wasp were identified from pupae of *E. varivestis* (Table 2). One monoparasitic species, *Nothoserphus afissae* Watanabe (Hymenoptera: Serphidae), was imported from Japan in 1980 to suppress this beetle in the USA (Schaefer, 1983). Another gregarious parasitoid, *Pediobius foveolatus* Crawford (Hym. Eulopidae), was also introduced from India for use in a biological control program in Maryland, USA (Biddle et al., 1992). Natural enemies including these two wasps may be useful for reducing the beetle population in Japan, because many farmers did not use any insecticides in fields of scarlet runner bean in the mountainous areas of Yamanashi and Nagano Prefectures. It is necessary to study the seasonal prevalence of the occurrence of these parasitic wasps, because no parasitoids emerged from the pupae collected in late September (Table 2). In addition to the parasitic wasps, adults of *E. varivestis* parasitized by the mold fungus *Beauveria brongniartii* were found in Hirasawa, Minamimaki Village (No. 19 in Fig. 1), on September 20.

Overwintering stage

The phenology of this beetle from early spring to summer has not yet been studied in Japan. In the present study, many newly emerged adults and egg masses were confirmed in early August, and, thereafter, mated pairs of adults and new egg masses were found until late September (Table 1). All egg masses collected from the field hatched in the laboratory (Table 2). In the USA, adults of this species overwinter in woodlands or within well drained areas of field margins (Biddle et al., 1992). It is likely that the *E. varivestis* confirmed in Yamanashi and Nagano Prefectures can overwinter in the adult stage, as in the USA. However, it is unlikely that newly emerged *E. varivestis* adults have summer diapause in midsummer or ovarian degeneration induced by short photoperiod conditions, unlike the case of *E. vigintioctomaculata* (Maki et al., 1964; Shirai, 1991) which is a native species in Japan. In the south-eastern USA, there are three or four generations per year with a great deal of overlap between each generation. In the western and northern USA, there is one generation per year, with a partial second generation. Adults between the second and fourth generations are able to overwinter (Howard, 1922; Biddle et al., 1992). With the *E. varivestis* in Japan, it will be necessary to elucidate the seasonal prevalence of occurrence throughout the year, the number of generations per year, and the generation that overwinters.

ACKNOWLEDGEMENTS

We thank Mr. Atsuo Fujimaru (Kiyose City, Tokyo) for first informing us about *E. varivestis* in Yamanashi Prefecture. Cordial thanks are also extended to Dr. Kazuhiko Konishi (National Institute of Agro-Environmental Sciences), Dr. Kenzo Yamagishi (Meijo University), and Dr. Mitsuaki Shimazu (Forestry and Forest Products Research Institute) for identifying the natural enemies of *E. varivestis*.

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