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Variation of Elytral Spot Patterns in a Field Population of Lady Beetle *Epilachna* aff. *Sparsa* (Coleoptera : Coccinellidae) Feeding on Bitter Cucumber in Sumatra

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Abstract From March to December 1982, variation in elytral spot patterns was studied in a field population of *Epilachna* aff. *sparsa* C in Padang, Indonesia. Beetles with different spot patterns were categorized with regard to the position of nonpersistent spots and to their total number on each elytron. Twenty-two different spot combinations were recorded from among 225 adults marked during the study period. All adults had at least 3 nonpersistent spots, while only 4 had a confluence of spots.

Introduction

Unlike most other coccinellid beetles, which are carnivorous and feed upon aphids and small insects, the epilachnine beetles are phytophagous. In indonesia, some epilachnine species are serious pests of crops such as potato, eggplant and squash (Kalshoven, 1981). As Dieke (1947) pointed out in his revision of the Old World epilachnine beetles, the Indonesian Archipelago is rich not only in the number of species, but also in the intraspecific variation in elytral spot patterns in populations from different, or even the same localities. This has caused great confusion in the identification of Indonesian species, because no critical taxonomic studies have been carried out on this group since the work by Dieke, despite their abundance and economic importance (de Gunst, 1957 ; Kalshoven, 1981). The taxonomic status of these beetles should be resolved by detailed studies of

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intraspecific variation in maculation, examination of reproductive organs, especially male genitalia, and crossing experiments.

Since 1980 we have studied the population dynamics of some epilachnine beetles in the Province of Sumatera Barat in Indonesia (Nakamura et al., 1983). The preceding articles described adult population parameters and life tables in the field population of this species (Abbas et al., 1985), and survivorship and fertility schedules under laboratory conditions (Nakamura et al., 1984). This article describes variations in elytral spot patterns in a field population of one "species", *Epilachna* aff. *sparsa* C (hereafter referred to as "sp. C") feeding on bitter cucumber, *Momordica charantia*. Comparison with other species and related discussion will be given elsewhere.

Materials and Methods

The species studied : Sp. C is quite common at altitudes from 0 to 2000 m in Sumatera Barat and feeds exclusively on bitter cucumber, which is known as "pario" (Sumatera Barat) or "paria" (Java) in the local languages, a plant whose fruit is used as human food. The adults of sp. C have 28 or less spots, many of them "nonpersistent". The larvae have a yellow body color and their spines are entirely yellow to the tip. These facts suggest that sp. C may be identical with *Epilachna implicata* mentioned by de Gunst (1957) and Kalshoven (1981).

Study site and routine census : The study was carried out in the garden of the Sumatra Nature Study Laboratory, Andalas University at Ulu Gadut, Padang (140 m above the sea level). A regular census was repeated three times in 1982 : 22 March to 26 May (Period 1), 26 July to 27 September (Period 2), and 14 October to 30 December (Period 3). The mean monthly air temperature of Padang fluctuated only between 26.7 (September to December) and 27.5°C (May) and the annual rainfall was 4172 mm, according to the meteorological data from 1879 to 1941 (Rika-Nenpyo, 1983). The meteorological data at Bandar Buat (6 km WSW of the study site) for the study period was presented in Abbas et al. (1985). At the start of each census, 3, 2 and 3 flower pots were each sown with 2 bitter cucumber seeds and placed under a rack (250 cm in length, 100 cm in width, and 100 cm in height) in Periods 1, 2, and 3, respectively. The plants used in this study were completely eaten by adults and larvae of sp. C by the end of each study period. The censuses were carried out at 3 or 4 day intervals using the following procedure. All the beetles found were sexed and their elytral spot patterns recorded ; they were then individually marked with lacquer to prevent double counting and released on the same plant. Figure 1 shows the elytral spot pattern of epilachnine beetles : The basic pattern consists of 6 black "persistent" spots on each elytron. This pattern may be modified by the addition of 1 - 8 "nonpersistent" spots on each elytron, or by the enlargement and confluence of several spots (Dieke, 1947). The beetles were classified according to the position of nonpersistent spots *a-h* (Table 2) and to their total number on each elytron (Table 3), e.g. an individual with "*agh*" is counted

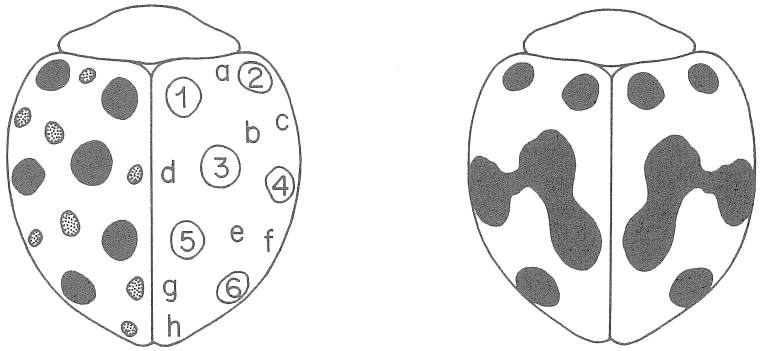

Fig. 1 Left : Standard elytral spot pattern of *Epilachna,* showing numbering of persistent (1-6) and nonpersistent (*a-h*) spots (modified from Dieke, 1947). Right : The confluence of spots, exemplified by 4 + 3 + 5.

independently in columns *a, g,* and *h* (Table 2).

Results and Discussion

Seasonal fluctuations in the number of adults and immature stages (Fig. 2 of Abbas et al., 1985) showed that adults of sp. C had colonized the plants within two weeks after planting of the seeds. Since no bitter cucumber was found near the study site and the presence of the host plasts at the site was sporadic adults found in the early stage of each Period must have been immigrants from areas at least a few kilometers away. In Periods 1 and 2, new adults emerged within one month after the colonization by parent adults, and the second peak of emergence was seen one month after that, soon followed by the death of host plant due to defoliation. In Period 3, the peak of adult emergence was seen only once because the initial egg number was so large that the food plants were killed by the larvae and new adults of the first generation. We could not differentiate newly emerged beetles from immigrants by their appearance, because the elytra of the former became hard within one or two days after emergence.

The total number of males and females marked in each study period was as follows :

Period	Female	Male	Total
1	54	43	97
2	26	25	51
3	41	36	77
Total	121	104	225

All the beetles marked had 6 persistent spots on each elytron. Table 1 shows the details of the combinations of nonpersistent spots on the beetles ; 22 different combinations were found. We recorded only the total number of nonpersistent spots on each elytron from 16 to 26 May in Period 1, during all of Period 2, and from 22 November to 30

December in Period 3. All beetles had *a* ; *b, c* and *h* were more common, while *f* and *d* were less frequent (Table 2). All beetles had at least 3 nonpersistent spots on each elytron

Table 1. Number of adult *Epilachna* aff. *sparsa* C with different combinations of nonpersistent spots on each elytron. The beetles marked from 19 to 26 May in Period 1 and from 22 November to 30 December in Period 3 are not included (for details, see text).

No. of beetles / Nonpersistent spots	Period 1			Period 3			Period 1 + 3		
	Female	Male	Total	Fmale	Male	Total	Female	Male	Total
abcdefgh	19	17	36	20	8	28	39	25	64
abcdefg	2		2				2		2
abcde gh	5		5	2	1	3	7	1	8
abcde h	1		1	8	4	12	9	4	13
abcde					2	2		2	2
abcd fgh	2	1	3				2	1	3
abcd h	1		1	1		1	2		2
abcd		1	1	1		1	1	1	2
abc e gh	3	2	5				3	2	5
abc eg 1	1	2					1	1	2
abc e h	1	2	3		1	1	1	3	4
abc fgh		1	1					1	1
abc gh	1	1	2				1	1	2
abc h	4	2	6				4	2	6
ab d				1		1	1		1
ab efgh	1		1				1		1
ab fgh		1	1					1	1
ab f h	1		1				1		1
ab gh		1	1					1	1
a c e g	2		2				2		2
a fgh	4	2	6				4	2	6
a gh		2	2					2	2
Total	48	34	82	33	16	49	81	50	131

Talbe 2. Number of adult *Epilachna* aff. *sparsa* C with different nonpersistent spots.

No. of beetles(%) / Nonpersistent spot	Period 1			Period 3			Period 1 + 3		
	Female	Male	Total	Female	Male	Total	Female	Male	Total
a	48(100.0)	34(100.0)	82(100.0)	33(100.0)	16(100.0)	49(100.0)	81(100.0)	50(100.0)	131(100.0)
b	42(87.5)	30(88.2)	72(87.8)	33(100.0)	16(100.0)	49(100.0)	75(92.6)	46(92.0)	121(92.4)
c	42(87.5)	28(82.4)	70(85.4)	32(97.0)	16(100.0)	48(98.0)	74(91.4)	44(88.0)	118(90.1)
d	30(62.5)	19(55.9)	49(59.8)	33(100.0)	15(93.8)	48(98.0)	63(77.8)	34(68.0)	97(74.0)
e	35(72.9)	22(64.7)	57(69.5)	30(90.9)	16(100.0)	46(93.9)	65(80.2)	38(76.0)	103(78.6)
f	29(60.4)	22(64.7)	51(62.2)	20(60.6)	8(50.0)	28(57.1)	49(60.5)	30(60.0)	79(60.3)
g	40(83.3)	29(85.3)	69(84.1)	22(66.7)	9(56.3)	31(63.3)	62(76.5)	38(76.0)	100(76.3)
h	43(89.6)	32(94.1)	75(91.5)	31(93.9)	14(87.5)	45(91.8)	74(91.4)	46(92.0)	120(91.6)
Total	48(100.0)	34(100.0)	82(100.0)	33(100.0)	16(100.0)	49(100.0)	81(100.0)	50(100.0)	131(100.0)

(Table 3). The frequency of individuals increased with the increase in number of nonpersistent spots : about 1% of the beetles had 3 nonpersistent spots, while around 50% had 6 on each elytron (Table 3). There was no significant difference in the frequency of individ-

Table 3. Number of adult *Epilachna* aff. *sparsa* C. with different number of nonpersistent spots on each elytron.

No. of beetles(%) / No. of nonpersistent spots	Period 1			Period 2			Period 3			Period 1 + 2 + 3		
	Female	Male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
3	0 (0.0)	2 (4.7)	2 (2.1)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.4)	0 (0.0)	1 (1.3)	1 (0.8)	2 (1.9)	3 (1.3)
4	11 (20.4)	7 (16.3)	18 (18.6)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.4)	1 (2.8)	2 (2.6)	12 (9.9)	8 (7.7)	20 (8.9)
5	6 (11.1)	8 (18.6)	14 (14.4)	2 (7.7)	2 (8.0)	4 (7.8)	1 (2.4)	4 (11.1)	5 (6.5)	9 (7.4)	14 (13.5)	23 (10.2)
6	6 (11.1)	5 (11.6)	11 (11.3)	4 (15.4)	5 (20.0)	9 (17.6)	10 (24.4)	8 (22.2)	18 (23.4)	20 (16.5)	18 (17.3)	38 (16.9)
7	9 (16.7)	1 (2.3)	10 (10.3)	5 (19.2)	5 (20.0)	10 (19.7)	3 (7.3)	6 (16.7)	9 (11.7)	17 (14.1)	12 (11.5)	29 (12.9)
8	22 (40.7)	20 (46.5)	42 (43.3)	15 (57.7)	13 (52.0)	28 (54.9)	25 (61.0)	17 (47.2)	42 (54.5)	62 (51.2)	50 (48.1)	112 (49.8)
Total	54 (100.0)	43 (100.0)	97 (100.0)	26 (100.0)	25 (100.0)	51 (100.0)	41 (100.0)	36 (100.0)	77 (100.0)	121 (100.0)	104 (100.0)	225 (100.0)

uals with different nonpersistent spots either between the sexes ($\chi^2=0.515$, d.f.$=7$, $P>0.9$, for Periods 1 + 3) or between Periods 1 and 3 (males and females were combined. $\chi^2=11.283$, d.f.$=7$, $0.10<P<0.95$) (Table 2). No significant difference in the frequency of the beetles with different total number of nonpersistent spots was detected between the two sexes ($\chi^2=3.226$, d.f.$=5$, $0.10<P<0.95$, for Periods 1 + 2 + 3), but the frequency between the three Periods was significantly different, because nearly 20% of the beetles had 4 nonpersistent spots in Period 1, while only 0-2% of them did in Periods 2 and 3 (males and females were combined. $\chi^2=25.443$, d.f.$=6$, $P<0.001$).

Out of 225 beetles marked during the study period, only 4 (1.78%) had a confluence of spots. The confluences occurred only in Period 1, as follows :

Date	Sex	Nonpersistent spots	Confluence
22 Mar.	male	agh	1+2
22 Mar.	male	abcegh	3+4
10 Apr.	female	abcdefgh	b+c
24 Apr.	male	abcdefgh	b+c

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