

64. Observations on Geographic and Temporal  
Variations in the Ladybeetle *Harmonia*. II  
*Elytral Ridge*

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(Comm. April 12, 1969)

**Introduction.** The common polymorphic ladybeetle, *Harmonia axyridis*, is provided with a small transverse ridge on the elytra near the distal end (Fig. r). Nothing is known about the function of this structure. Since it is found almost without exception in individuals living in Hokkaido, North China, and Korea, it is perhaps of some use for the insect's life under cold climate. It is likely that the ridge belongs to a vestigial organ at least for the beetles inhabiting warmer localities. Hosino (1936) demonstrated by breeding experiments that the presence or absence of this ridge is controlled by a pair of allelic genes, that for the presence behaving as dominant. The breeding results show that the degree of penetrance of the dominant gene is fairly high.

**Geographic variation.** Kurizaki (1927) was the first who noticed geographic variation in the frequency of this ridge. Our examinations of more than 80 samples of the population samples

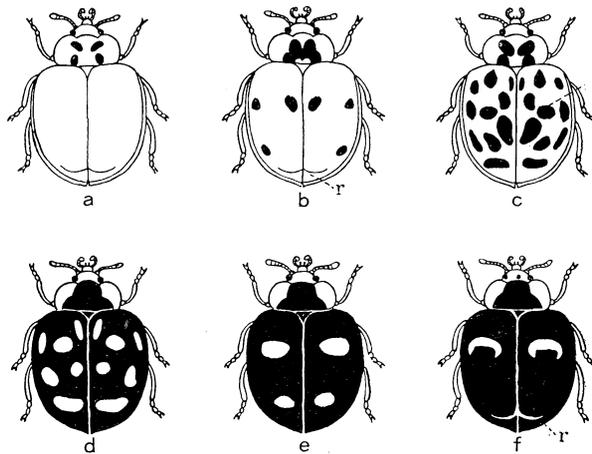


Fig. 1. *Harmonia axyridis*. Elytral pattern types and elytral ridge. a-c: *succinea*, d: *axyridis*, e: *spectabilis*, f: *conspicua* (heterozygote), r: ridge.

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derived from localities in various parts of Japan, from Hokkaido to Kyushu, as well as in Korea and North China, have confirmed this observation. Furthermore, there is found a gradient (cline) passing from Hokkaido to Kyushu, even though this is somewhat less distinct than that for elytral patterns presented in the preceding communication. The ridge occurs almost in every beetle found in North China, Korea and Hokkaido (95+%). The frequency abruptly falls to about 50% in populations in Tohoku districts, and further decreases to 40% (Nagoya-Gihu), 20~30% (Kyoto-Osaka), 15~20% (Tyugoku), and to 10~20% (Kyushu). (For further details, Komai, 1965a). Tan (1942) observed that most of the insects of this species inhabiting China had this ridge, but that none from Ishan in Kwangsi had it. The close resemblance in frequency of the elytral ridge of Hokkaido and Korean populations is another evidence for the probable colonization of this species the Japanese islands via Sakhalin—Hokkaido.

**Temporal variation.** In contrast to the elytral pattern frequencies, the insects of Suwa population does not show any significant temporal variation in respect to the frequency of the elytral ridge in samples from 1918~'20 through 1954 (Table I). This observation incidentally dispels the fear that the temporal variation discerned in the frequencies of pattern types in this period might have been due to immigration of some individuals from populations inhabiting the warmer south-western localities.

The new 1964~'65 material from Tatuno, 15~20 km. south-west of Suwa, has this ridge in  $420/911=46.10\%$  individuals. In gene frequency, the sample has  $.266\pm.146$  genes for the presence of the dominant gene. Compared with the Suwa sample for 1950 which had  $.350\pm.0105$  genes, the difference,  $.084\pm.018$  is statistically significant (Table I). Based on these values,  $s$  and  $\Delta p$  values were calculated:  $s=.0224$ ,  $\Delta p = -.00178$ . The corresponding values based on 1954 sample instead of the 1950 sample become  $s=.0300$ ,  $\Delta p = -.00236$ .

We have in the literature another case of temporal variation in the frequency of the gene for the ridge. This concerns with the population inhabiting Hukuoka (Fukuoka) in Kyushu. Kirizaki (1927) observed in his sample of 700 individuals obtained in 1925 that 175 (25%) had the ridge, while Sirôzu's 1944 sample of 995 individuals 120 (12.1%) had it. The gene frequencies calculated from these data are presented in Table II. The  $s$  and  $\Delta p$  values estimated from these data are:  $s=.1028$ ,  $\Delta p = -.00160$ . The  $s$  and  $\Delta p$  values estimated from the data in both localities suggest that the locus controlling this trait is of the heterotic type. This assumption

Table I. Frequencies of individuals having elytral ridge in Suwa-Tatuno population collected in different years

Year	Individuals with ridge (%)	Total number examined
1918, '20	52.6	420
1942, '43	53.2	823
1950	57.7	2220
1954	57.4	258
1964, '65(Tatuno)	46.1	911

Table II. Frequencies of genes for elytral ridge in Suwa-Tatuno and Hukuoka populations in different years

Locality	Year	Total number	Frequency of gene	Difference
Suwa-Tatuno	1950	2220	.350 ± .0105 (A)	
	1954	258	.347 ± .0297 (B)	(A—C) .084 ± .018
	1964, '65	991	.266 ± .0146 (C)	(B—C) .081 ± .033
Hukuoka	1925	700	.134 ± .0130 (D)	
	1944	995	.062 ± .0076 (E)	(D—E) .072 ± .015

is supported by the finding of a rather distinct geographic gradient observed in the frequency of this trait, as well as that of the controlling gene. Furthermore, this seems to afford another example to the view that the degenerative change of organ or function often takes place on the basis of heterosis of the pertinent locus (Komai 1968).

**Summary.** The presence or absence of a small elytral ridge in the ladybeetle *Harmonia* is controlled by a pair of alleles, that for the presence behaving as a simple dominant with a fairly high penetrance. There is a geographic gradient passing through the Japanese island chain in the frequencies of these genes. Significant temporal variations in the frequencies of the genes were observed in samples obtained at Suwa-Tatuno in Nagano Prefecture and at Hukuoka in Kyushu. The rates of temporal changes as well as the geographic gradient, suggest that the pertinent locus is of the heterotic type.

**Acknowledgement.** The authors are grateful to Dr. N. Yasuda for his generous help in statistical treatments of the data in this and preceding communications.

## References

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Abstract.