FOLIA PARASITOLOGICA 36: 281–287, 1989.

POPULATION VARIABILITY OF SOME QUANTITATIVE CHARACTERS IN ARGAS POLONICUS LARVAE (ACARINA: ARGASIDAE)

F. DUSBÁBEK

Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice, Czechoslovakia

Abstract. The nature of variability of quantitative morphometrical characters was studied in larvae of two local populations of *Argas* (*Argas*) *polonicus* Siuda, Hoogstraal, Clifford et Wassef, 1979 collected in Czechoslovakia and Poland. Statistically significant differences in five quantitative characters studied, in which the larvae of both wild populations differed from one another, disappeared during three generations of laboratory rearing. The variability of these characters was lower in laboratory populations than in field collected ticks. The results of hybridization experiments and analysis of variability of larvae of individual populations and parental pairs suggest that rather adaptive than genetic variation is involved. The genetic component of the variation is inferior and is expressed probably by dominant relations between alleles of the same locus, or by different types of non-allelic interactions.

The phenotypic variation of continuous and discontinuous characters comprises genetic and nongenetic or environmental components of variation.

According to the predictions of Price (1977), the parasites will exhibit low level of genetic variation within populations and high level of variation between populations. In the case of ticks this prediction has been supported by the studies of Wallis and Miller (1983) and Bull et al. (1984), who analysed electrophoretically enzymes of different populations of several *Ornithodoros*, *Aponoma* and *Amblyomma* species and reported a relatively low average heterozygosity per individual. However, they found a very low genetic distance (Nei 1972) between conspecific populations. Hilburn and Sattler (1986a) on the basis of enzymatical studies carried out by Healy (1979a, b) on *Ixodes ricinus* (L., 1758) and their own studies of the tick species of the genera *Amblyomma* and *Boophilus* (Sattler et al. 1986a, b; Hilburn and Sattler 1986a, b) expressed their doubts about the general validity of this theory in large tick populations and suggested that population size, host specificity and mobility are more important factors in determining genetic heterozygosity in ticks.

The influence of nongenetic or environmental components of variation on the phenotypic variation of ticks has been recorded in many cases. Hunt and Drummond (1983), Davey et al. (1984) and Dusbábek (1986) observed phenotypic differences between laboratory-reared and field-collected tick population samples. Oliver and Herrin (1976) demonstrated that laboratory-reared populations of *Haemaphysalis longicornis* Neumann, 1901 are less variable than field-collected ticks. In our previous papers (Dusbábek 1984, 1985b) we pointed out that the phenotypic differences between local populations of *Argas* (*Persicargas*) *persicus* (Oken, 1818) have often a clinal character and change in dependence on the climatic gradient of the environment. Balashov (1972), on the other hand, did not find any dependence of the phenotypic variation of *Ornithodoros* (*Pavlovskyella*) *tartakovskyi* Olenev, 1931 local populations on the situation of the population in the distribution area of a species, physical conditions of the environment, or the main host species.

An analysis of individual variations in larvae of *Argas* (*Argas*) *polonicus* Siuda, Hoogstraal, Clifford et Wassef, 1979 was made by Siuda (1979). In our comparative

studies of the morphology and measurements of two local populations of the same species originating from Czechoslovakia and Poland, statistically significant differences were recorded in five of the 23 quantitative characters studied in larvae (length of hypostome, length of the second palpal segment, width of the dorsal plate, and length of the antero- and posterodorsal setae — Dusbábek 1985a). Since these characters are of a great taxonomical value, we attempted to evaluate their stability under constant conditions of laboratory rearing and to determine the portion of the genetic and nongenetic component of variation in their final phenotypic manifestation.

MATERIALS AND METHODS

The tick larvae of the Polish population originated from a type locality of the species at Krakow. The larvae of the Czechoslovak population were collected in pigeon nest site in St. Michael Chapel at Košice. In the laboratory, the ticks of both populations were kept at the constant temperature of 27 ±1 °C and 75 ±5 % r.h. in dark and fed on pigeons. Unfed larvae used for the measuring were prepared in Swan's medium. Each group consisted of 50 larvae originating from 5 different parental pairs. The first filial generation (F_1) comprised hybrid specimens of second laboratory generation, whereas F_2, B_1 and B_2 were specimens of the third laboratory generation. Larvae of the third laboratory generation were also designated as laboratory parental line.

The variability of the characters studied in the progeny of different parental pairs within a population was evaluated using one-way analysis of variance after previous verification of variance homogeneity by Bartlett's test. Student's t-test was used for the comparison of mean values of individual characters of population samples and differences in variance values of these characters were compared by Fischer's F-test.

Individual populations and hybrid generations were designated as follows:
Pp = homozygous Polish population (P_1)
Cc = homozygous Czechoslovak population (P_2)
Cp = heterozygous progeny Cc ♀ × Pp ♂ ($P_2 \times P_1 = F_1$)
Cp × Cp = progeny of brother-sister cross ($F_1 \times F_1 = F_2$)
Cp × Pp, Cp × Cc = progeny of back-crosses (F_1 ♀ × P_1 ♂ = B_1, F_1 ♀ × P_2 ♂ = B_2)

RESULTS

The third laboratory generation of Pp and Cc populations kept under identical constant conditions did not exhibit the same differences in which the two wild populations originally differed from one another (Table 1). Of the five characters studied, the laboratory populations differed from one another only in the length of posterodorsal setae ($P < 0.05$), whereas other differences were statistically insignificant. Significant differences were found in two characters (length of IInd palpal segment and length of posterodorsal setae) in which the two laboratory populations differed from both parental field-collected population samples ($P < 0.05$—0.01), and in three characters (hypostome length, dorsal plate width and length of anterodorsal setae) they differed only from one of them. Compared to the field-collected larvae of Pp population, the variation of three characters (hypostome length, IInd palpal segment length and dorsal plate width) in both laboratory populations was significantly lower ($P < 0.01$), as it was demonstrated by F-test.

A similar situation was in F_1 and F_2 hybrid generations and in their back-crosses with B_1 and B_2 (Table 2). No differences were observed in the width of dorsal plate ($P > 0.05$), the length of hypostome was different only in F_1 generation and length of posterodorsal setae only in F_2 generation. The F_1 generation differed from F_2 in the length of IInd palpal segment and anterodorsal setae, but was always identical with one of the combinations of B_1 or B_2 back-crosses in these characters.

Table 1. Mean values of five main characteristics in field populations and laboratory colonies of *Argas (A.) polonicus* larvae from Poland and Czechoslovakia (in µm ± SD). Means followed by the same letter are not significantly different at the 5% level of confidence, by Student's t-test

	Pp field population	Pp laboratory colony	Cc laboratory colony	Cc field population
Hypostome length	153.6 ± 10.4[a]	162.4 ± 5.5[b]	162.7 ± 5.9[b]	164.7 ± 4.6[b]
Palpal segment II length	62.3 ± 7.7[a]	66.5 ± 4.5[b]	65.9 ± 3.9[b]	70.6 ± 3.4[c]
Dorsal plate width	254.6 ± 21.0[a]	227.2 ± 12.8[b]	225.8 ± 16.0[b]	224.1 ± 15.8[b]
Anterodorsal setae length	98.5 ± 8.2[a]	98.7 ± 6.7[a]	100.8 ± 6.2[a]	105.5 ± 7.9[b]
Posterodorsal setae length	147.7 ± 10.5[a]	154.4 ± 9.5[b]	150.8 ± 8.3[a]	155.3 ± 9.3[b]

Table 2. Mean values of five main characteristics in hybrids of first and second filial generations and back-crosses of Czechoslovak and Polish populations of *Argas (A.) polonicus* larvae (in µm ± SD). Means followed by the same letter are not significantly different at the 5% level of confidence, by Student's t-test

	F_1 Cp	F_2 Cp × Cp	B_1 Cp × Pp	B_2 Cp × Cc
Hypostome length	160.1 ± 6.0[a]	164.7 ± 6.1[b]	163.5 ± 4.3[b]	164.7 ± 5.1[b]
Palpal segment II length	64.6 ± 5.3[a]	68.1 ± 3.8[b]	68.3 ± 3.9[b]	65.4 ± 5.5[a]
Dorsal plate width	230.5 ± 10.9[a]	229.4 ± 10.0[a]	228.9 ± 11.2[a]	233.0 ± 14.7[a]
Anterodorsal setae length	103.9 ± 4.1[a]	105.9 ± 5.3[b]	103.0 ± 6.1[a]	105.5 ± 6.9[b]
Posterodorsal setae length	154.6 ± 8.5[a]	151.4 ± 10.6[b]	156.0 ± 9.1[a]	157.1 ± 11.9[a]

Table 3. Calculated values of F-distribution (F) and level of confidence (P) in comparison of values of characteristics studied among progenies of five parental pairs of the field populations and laboratory colonies of Czechoslovak and Polish *Argas* (*A.*) *polonicus*

	Pp field population		Pp laboratory colony		Cc laboratory colony		Cc field population	
	F	P	F	P	F	P	F	P
Hypostome length	1.02	n.s.	2.21	n.s.	0.51	n.s.	9.41	0.01
Palpal segment II length	4.56	0.05	6.54	0.01	6.93	0.01	1.18	n.s.
Dorsal plate width	8.23	0.01	14.60	0.001	12.66	0.001	9.75	0.01
Posterodorsal setae length	2.07	n.s.	4.71	0.01	3.02	0.05	2.81	0.05

An analysis of individual variations in larvae of both parental Pp and Cc populations, both wild and laboratory ones, made by means of one-way variance analysis demonstrated that the values of the characters studied significantly differ ($P < 0.05 - 0.01$) in most of the progeny of different parental pairs of the same population (Table 3). The least variable from this point of view was the length of hypostome, while the most variable was the width of the dorsal plate. The length of anterodorsal setae could not be evaluated by one-way ANOVA due to the heterogeneity of variances demonstrated by the Bartlett's test.

DISCUSSION

The disappearance of statistically significant differences in four of the five characters under study in *Argas* (*A.*) *polonicus* larvae of Cc and Pp laboratory populations kept under identical conditions indicates that the outer environment significantly affects their values and that the nongenetic or environmental components of their variation prevail.

Mean values of the characters studied in hybrid laboratory-reared generations were in most cases similar to those of parental laboratory generations which also

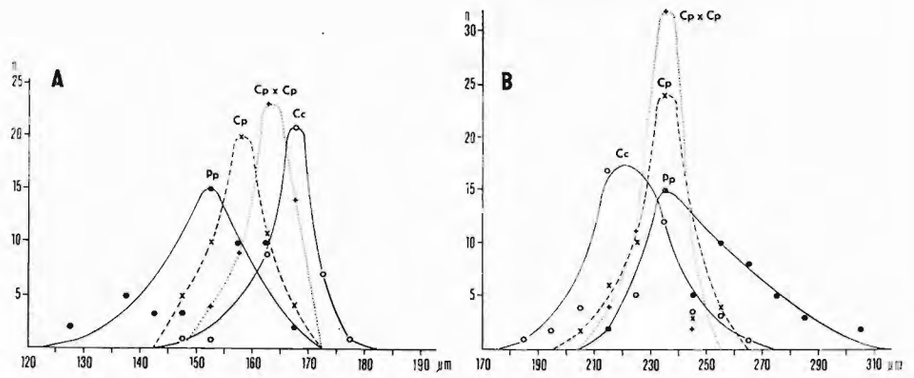

Fig. 1. Variation curve of distribution of metrical values of hypostome length (A) and dorsal plate width (B) in *Argas* (*A.*) *polonicus* larvae of Cc and Pp parental generations and hybrids of F_1 (Cp) and F_2 (Cp × Cp) generations.

shows the prevailing effect of constant conditions of the environment over the genetic factor in the phenotypic expression of these characters. The larvae of F_1 hybrid generation, which are the progeny of the first laboratory generation, significantly differ from other hybrid combinations (progeny of second laboratory generation) in two characters (length of hypostome and length of second palpal segment). Rather than the effect of the genetic component of variation, it can be supposed that an insufficiently long effect of constant conditions of the living environment was involved.

The fact that the mean values of the characters studied in laboratory and hybrid generations in most cases are close to those of single wild parental population suggests a certain dominance of the respective parental population in the canalization of phenotypical expression of the character under study and, consequently, a certain involvement of the genetic component of its variation. The preservation of individual variations in larvae of different parental pairs of laboratory populations can be regarded as a consequence of genetic homeostasis. It seems that under constant laboratory conditions, the effect of the genetic component of variation can also assert itself probably by means of the dominant relations between the alleles of the same locus. In case of the hypostome length this is indicated by the relatively high stability of this character in the progeny of different parental pairs of the same population (Table 3). Since the variance values of F_2 generation do not exceed significantly the variance values of F_1 generation ($P < 0.05$) and the variation curve of distribution of metrical values in the size groups is more sheer in F_2 generation (Fig. 1), the proportion of an aditive component of genetic variation in the variability of characters studied, can be considered negligible.

The phenotypic and genetic changes as consequences of insect's colonization were reported in the surveys by Mc Donald (1976) and Mason et al. (1987). They documented numerous cases of phenotypic changes in laboratory-reared insects such as changes in host-plant acceptibility, pheromonal responses, visual sensitivity, flight capacity, reproductive behaviour and other reproductive parameters. The behavioral differences in pheromone response between laboratory-reared and field-collected *Argas* (*Persicargas*) *persicus* were recorded by Dusbábek (1986). Hunt and Drummond (1983) also reported on the effect of laboratory rearing on the reproductive biology of lone star tick, *Amblyomma americanum*. Engorged colony females weighed less, look longer to engorge, had longer proeviposition and oviposition periods, laid fewer eggs per female, converted less of the engorged weight to eggs, and had significantly lower egg hatch than wild females. Davey et al. (1984) found the female weight, egg mass weight, and preoviposition period in laboratory-adapted *Boophilus microplus* to be significantly greater than in the representatives of five other wild populations. They found some phenotypic differences in quantitative morphological features, too. The laboratory-adapted males were significantly larger in whole-body surface and surface area of the caudal process than males of all wild populations compared. All these differences are considered to be the consequence of a limited gene flow due to the isolation of the laboratory tick colony. Similarly Mason et al. (1987) conclude that the causes of genetic changes in laboratory-adapted insect colonies include founder effect resulting in random genetic drift, nonrandom mating and selection.

It can therefore be summarized that the phenotypic expression of five quantitative characters studied by us in *Argas* (*A.*) *polonicus* larvae is influenced rather by nongenetic or environmental components of variation. The genetic component of variation is involved to a lower degree, most probably by means of dominant relations between the alleles of the same locus and by means of different types of non-allelic interactions.

Acknowledgements. The author thanks Dr. J. Benedik Ph. D. of the Faculty of Sciences, J. E. Purkyně University, Brno and Dr. F. Marec of the Institute of Entomology, Czechoslovak Academy of Sciences, České Budějovice for reading the manuscript and for valuable advice and comments. He also thanks Mrs. B. Danielová of the Institute of Parasitology, Czechoslovak Academy of Sciences, České Budějovice for excellent technical assistance.

ПОПУЛЯЦИОННАЯ ИЗМЕНЧИВОСТЬ НЕКОТОРЫХ КОЛИЧЕСТВЕННЫХ ПРИЗНАКОВ ЛИЧИНОК *ARGAS POLONICUS* (ACARINA: ARGASIDAE)

Ф. Дусбабек

Резюме. Изучали характер изменчивости количественных морфометрических признаков личинок двух локальных популяций *Argas* (*Argas*) *polonicus*, происходящих из Чехословакии и Польши. Статистически достоверные разницы в пяти исследуемых количественых признаках, в которых личинки обеих диких популяций отличались друг от друга, исчезли в течение трех генераций, разведенных в лаборатории. Изменчивость этих признаков у лабораторных популяций была ниже, чем у клещей, собранных в природе. Результаты опытов по гибридизации и анализ изменчивости личинок из отдельных популяций и родительских пар показывают, что изменчивость этих признаков имеет большей частью адаптивный, т. е. негенетический характер. Генетический компонент изменчивости осуществляется только в небольшой мере, вероятно через доминантные отношения между аллелями того же локуса и. вероятно, также через разные типы неаллелических взаимодействий.

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Received 29 June 1988

F. D., Parazitologický ústav ČSAV
Branišovská 31
370 05 České Budějovice, ČSSR