VARIAÇÕES NAS MEDIDAS MORFOLÓGICAS EM TRÊS TIPOS DE POPULAÇÕES DE *MUSCA DOMESTICA L.*

VARIATIONS IN MORPHOLOGICAL MEASUREMENTS IN THREE POPULATIONS TYPES OF MUSCA DOMESTICA L.

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ABSTRACT

Investigation of 18 morphometric characters in ***Musca domestica*** *strains showed that natural populations presented the smallest measurements while descendant groupings, assembled at a density of 400 eggs, showed the largest measurements. The groupings which started with 800 eggs presented many characteristics similar to those of the natural populations. This suggests that competition among larvae is an important selective aspect which may be responsible for the similarities presented by strains under natural conditions. All morphometric characters analyzed presented variations among the different types of populations and no character was found to be neutral.*

Keywords*: Strains, competition, environment, houseflies, selectionist theory, neutralist theory.*

RESUMO

A análise de 18 caracteres morfométricos em linhagens de ***Musca domestica****, mostrou que as populações naturais apresentaram as menores medidas para estas características; enquanto que, os grupamentos descendentes, montados na densidade de 400 ovos, apresentaram os maiores valores. Os agrupamentos iniciados com 800 ovos, mostraram muitas características semelhantes as apresentadas pelas populações naturais, o que sugeriu ser a competição entre as larvas um fator seletivo importante que pode ter sido o responsável por similaridades apresentadas pelas linhagens em condições naturais. Todos os 18 caracteres morfométricos analisados apresentaram variações entre os diferentes tipos de populações e nenhum caráter mostrou ser neutro.*

Palavras-chave*: Linhagens, ambiente, competição, mosca domestica, teoria selecionista, teoria neutralista.*

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INTRODUCTION

Morphological evolution occurs when the mean or variance of a character in the population changes, and this change is partially produced by gene frequency alteration at one or more loci or by reorganization of the genetic material correlated with the character. Morphological evolution occurs through selection acting on smaller quantitative phenotipic variations of panmictic populations (Arthur, 1984).

The spread of a morphological character showing quantitative variation commonly approaches normal distribution, and data analysis permits the use of parametric statistical tests without transformations instead of the equivalent and less efficient nonparametric tests. Fisher (1958) showed that a large number of loci, each having little effect on a particular phenotipic character in a population, could give origin to a continuous distribution, a characteristic named multiple inheritance factor or polygenic inheritance.

Bryant et al. (1986) observed that individuals of *Musca domestica* showed reduction in genetic variability in populations transferred to the laboratory. Bélo & Bianchini (1995) observed a prominent reduction in morphological variation in cultures of *M. domestica* with high and low densities in comparison with ancestral natural population, suggesting that under laboratory conditions, the variations occur as a result of selection for environmental adaptation, in agreement with results described by Anderson et al. (1972) for *Drosophila* populations.

The importance of morphological variations for population adaptation to the environment was pointed out by Bryant (1977) and Bryant & Turner (1972, 1978), whereas Black IV & Krafsur (1986) emphasized only that adult fly size is determined by the environment, without pointing out the importance of the genetic bases. Populations of *M. domestica* with more genetic variability showed better efficiency in the exploitation of the resources than genetically simpler ones and there is an optimum for fly emergence in laboratory populations (Brancalião & Bélo, 1997).

The confirmation of the original writing by Darwin that "every organism structure has a value in the adaptation to the environment" attracted many reseachers, while others showed new theories based on new discoveries, with the consequent development of studies about selectionist and neutralist theories. The main purpose of the present study was to analyze the changes in 18 morphological characteristics of eleven geographic strains of *M. domestica* under different ecological conditions.

MATERIAL AND METHODS

Figure 1 shows South America and the enlarged projection of the localities where collections were made. Laboratory cultures with natural flies from Avaré (SP) were not performed because the individuals were naturally contaminated by fungi of the genera *Brauveria* and *Paeilomyces*, which were lethal to the flies.

Each experimental group was placed in colorless plastic boxes (Atma, 842), containing culture medium (31.4 g of wheat bran, 2.4 g of commercial yeast, 1.5 g of powder milk and 60 ml of water), at starting densities of 400 and 800 eggs, which were collected from ovipositions by 180 females of each geographic strain. The containers with the experimental groups or cultures were placed in a room at 27 ± 2°C, 65-70% air relative humidity and 12 hours of photoperiod.

It is important to define three fly conditions (population types) in the experiments: first, the natural populations consisting of individuals captured in the layer hen houses; second and third, respectively, the groups or cultures started with 400 and 800 eggs, which were descendant of geographic strains from natural populations.

Morphometric measurements were made on the head, wing and right legs. Figure 2 shows the points considered as references for making measurements of the wing. Thus, the measurements were made between the points: 1-R_1 (Wing-1), R_1-R_{2+3} (Wing-2), 1-R_{2+3} (Wing-3), 15-9 (Wing-4), 9-R_{4+5} (Wing-5), 15 R_{4+5} (Wing-6), R_1-M_3+Cu_1 (Wing-7), 11-7 (Wing-8), 7-M_{1+2} (Wing-9), 12-8 (Wing-10), 14-10 (Wing-11), 8-7 (Wing-m).

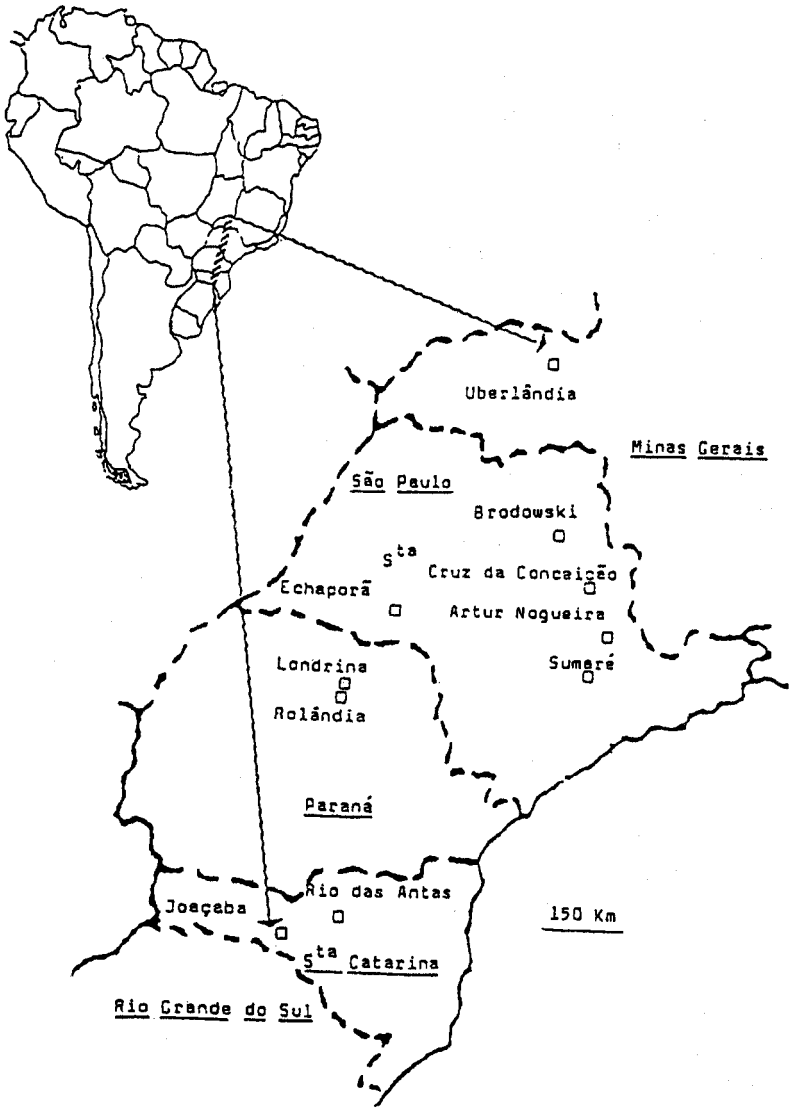

Figure 1. Map of South America with an enlarged projection of the localities where collections were made.

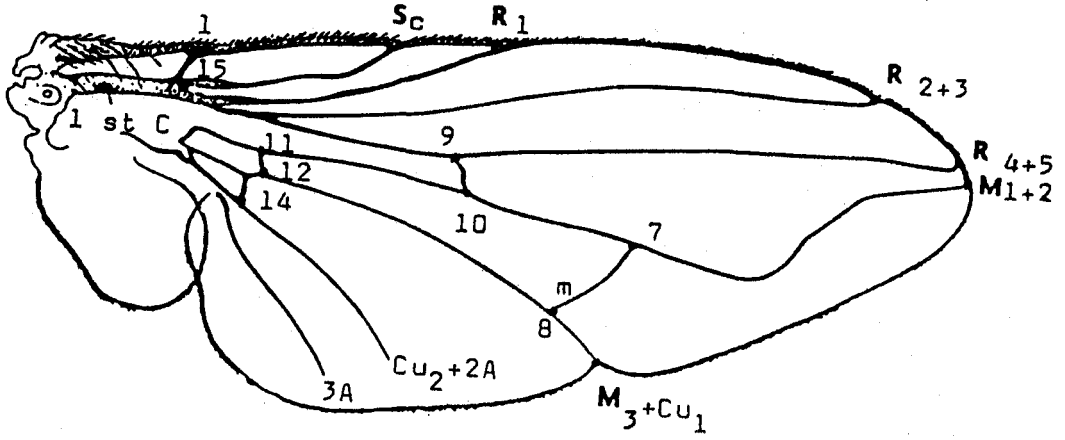

Figure 2. Musca domestica wing showing the points considered as references for making measurements.

For the measurements, the flies were dissected, the head was set up on a support with the part connected to the thorax turned right side up; this measurement was made on the broader part of this plane, taking as reference the insertion base of the last row bristles i.e., those more externally located.

Slides, coverslip and Canadian balsam, were used to measure the wings and legs. The coverslip, when compressed against the slide, forces the piece and distends it, facilitating the measurements. The leg segments measured were: femur, tibia, basitarsus and leg (sum of the measurements of the femur, tibia and basitarsus). The number of bristles on the fourth ventral abdominal sternite was also counted. Measurements were made on 50 individuals of each strain (25 males and 25 females) for the natural populations and on 40 individuals (20 males and 20 females) of the experimental groups of laboratory cultures.

RESULTS

Table 1 shows the means of the 18 morphological characteristics analyzed for three population types. There are 540 possibilities of differentiation or not among the means listed on the lines in the table; from these there were no significant differences among means in only 15 cases. The Joaçaba strain presented a larger number of homogeneities among individuals, with no differences in the following characters: wings 4, 7, 8, 10, femur, tibia, basitarsus, leg and head width. These individuals showed differences at the 5% level for wings 2, 5 and the number of bristles on the 4th abdominal sternite and at 1% level for wings 1, 6 e m.

Natural populations showed lower means than the other population types in 155 of 360 possible cases whereas, cultures started with 800 eggs showed lower means in 109 cases. Groups started with 400 eggs showed lower means in only 16 cases; six occurred in different strains with respect to the number of bristles on the 4th sternite, thus indicating that the groups started with 400 eggs showed the highest means for the morphological characters analyzed, followed by the cultures started with 800 eggs and finally by the natural populations.

With respect to the means listed in the columns of Table 1, the natural populations showed differences for all characteristics analyzed. The same was observed for the groups started with 800 eggs, except for the number of bristles on the 4th sternite.

The flies from Avaré showed high means for all characters which were equivalent to those obtained for Joaçaba flies; these means differed from those of the Rio das Antas strain, whose values were equal to those of other southern strains (Londrina and Rolândia).

The lowest mean values obtained for natural populations, were observed in flies from the northern region of the area studied, Uberlândia and Brodowski (wings l, 2, 3, 5, 6, 8, 10, m and tibia). The Sumaré strain presented lower means for other characters (wings 4, 7, 9, 11, femur, basitarsus, head width and the number of bristles) whose values did not differ from those obtained for natural populations from Uberlândia and Brodowski. The only exception was the smaller leg character of the Brodowski strain, which did not differ from the values obtained for the Sumaré and Uberlândia strains. Among the population types, the strains of natural populations were the only ones showing significant differences in the number of bristles on the 4th sternite.

In the cultures started with 400 eggs, the lowest values were for S^{ta} Cruz da Conceição (wings 4 and 8), Sumaré (wing 1), Londrina (wings 11 and m) and Joaçaba (head width) strains, while the highest values were for the Brodowski strain, which were statistically equal to those obtained for the Uberlândia flies, except for wing 1. The Rio das Antas strain predominated only in one case (wing m), with a value that did not differ from the means obtained for the Uberlândia and Brodowski strains.

In the groups started with 800 eggs, there were 17 cases of differences in the values obtained for the strains. The S^{ta} Cruz da Conceição flies always showed the lowest means for all morphological characters. The highest values were obtained for three strains: Uberlândia (wings 1, 3, 4, 6, 10, 11, femur, basitarsus, tibia and leg), Joaçaba (wings 2, 7 and m), and Londrina (wings 5, 8, 9 and head width).

Table 1. Morphometric measurements (mm) of the characteristics of *Musca domestica* (L.) from natural populations and of descendant groups, "F" values from ANOVA and results of Tukey's test.

	Natural Populations							Groups started with 400 eggs and 800 eggs												"F" Values
Localities																				
	Uberlândia	2,18	A				a		2,44			C			c	2,34			D		b	42,89***
	Brodowski	2,20	A	B			a		2,48				D		c	2,30		C	D		b	37,08***
W	Sta. Cruz da Conceição	2,43				D		b	2,40	A	B			b		2,07	A			a		276,59***
I	Echaporã	2,22	A	B			a		2,45			C	D		b	2,28		C	D	a		19,71***
N	Artur Nogueira	2,33		B	C	D		b	2,40	A	B				b	2,22		B	C		a		10,13***
G	Sumaré	2,14	A				a		2,39	A					b	2,15	A	B			a		22,39***
	Londrina	2,23	A	B	C		a		2,40	A	B				b	2,35			D		b	16,13***
	Rolândia	2,18	A				a		2,43		B	C			b	2,22		B	C		a		31,65***
1	Rio das Antas	2,17	A				a		2,44			C			c	2,30			C	D		b	41,18***
	Joaçaba	2,36			C	D	a	b	2,42	A	B	C			b	2,31			C	D	a		5,73***
	Avaré	2,42				D																	
	"F" Values	13,69***							13,04***							17,21***						
	Uberlândia	2,06	A				a		2,26	A					b	2,20			C	D		b	36,56***
	Brodowski	2,06	A				a		2,31	A					c	2,18		B	C	D		b	45,80***
W	Sta. Cruz da Conceição	2,27			C			b	2,28	A					b	2,04	A				a		36,05***
I	Echaporã	2,07	A				a		2,28	A					c	2,18		B	C	D		b	18,42***
N	Artur Nogueira	2,20		B	C		a		2,27	A				a		2,14		B	C	D	a		1,66^{NS}
G	Sumaré	2,07	A				a		2,26	A					b	2,09	A	B			a		16,12***
	Londrina	2,09	A	B			a		2,27	A					b	2,23				D		b	26,41***
	Rolândia	2,07	A				a		2,25	A					b	2,11	A	B	C		a		24,19***
2	Rio das Antas	2,08	A				a		2,29	A					c	2,19			C	D		b	23,23***
	Joaçaba	2,22			C		a	b	2,29	A					b	2,21				D	a		4,40***
	Avaré	2,29			C																		
	"F" Values	15,26***							0,32^{NS}							10,31***						
	Uberlândia	4,24	A				a		4,71	A					c	4,54				E		b	45,53***
	Brodowski	4,26	A				a		4,79	A					c	4,48			C	D	E	b	46,34***
W	Sta. Cruz da Conceição	4,70			C			b	4,68	A					b	4,11	A				a		47,82***
I	Echaporã	4,28	A				a		4,73	A					c	4,46			C	D	E	b	20,82***
N	Artur Nogueira	4,53		B	C			b	4,67	A					b	4,36		B	C	D	a		10,00***
G	Sumaré	4,20	A				a		4,65	A					b	4,25	A	B			a		21,05***
	Londrina	4,32	A	B			a		4,67	A					b	4,58				E		b	24,31***
	Rolândia	4,25	A				a		4,68	A					b	4,33		B	C		a		30,53***
3	Rio das Antas	4,25	A				a		4,73	A						4,49			C	D	E	b	35,60***
	Joaçaba	4,58					a	b	4,71	A					b	4,52				D	Ea		5,57***
	Avaré	4,72																					
	"F" Values	15,35***							1,59^{NS}							15,35***						
	Uberlândia	1,61	A	B			a		1,80	A	B			b		1,74			C			b	32,54***
	Brodowski	1,62	A	B			a		1,85		B				c	1,72		B	C			b	35,36***
W	Sta. Cruz da Conceição	1,76				D	E	b	1,75	A				b		1,53	A				a		36,84***
I	Echaporã	1,63	A	B	C		a		1,81	A	B				c	1,71		B	C			b	21,46***
N	Artur Nogueira	1,69		B	C	D	a	b	1,76	A				b		1,65	A	B	C		a		7,52***
G	Sumaré	1,57	A				a		1,78	A	B			b		1,61	A	B			a		10,23***
	Londrina	1,64	A	B	C		a		1,77	A				b		1,76			C			b	19,95***
	Rolândia	1,61	A	B			a		1,79	A	B			b		1,67		B	C		a		22,93***
4	Rio das Antas	1,59	A	B			a		1,82	A	B				c	1,72		B	C			b	40,81***
	Joaçaba	1,73			C	D	E	a	1,80	A	B		a			1,71		B	C		a		2,58^{NS}
	Avaré	1,80					E																
	"F" Values	11,47***							3,81***							6,66***						

Continuation

	Localities	Natural Populations						Groups started with 400 eggs						and						800 eggs						"F" Values
	Uberlândia	2,72	A				a		3,00	A						c			2,86			D	E	b	42,28***
	Brodowski	2,70	A				a		3,02	A						c			2,83		C	D	E	b	50,87***
W	Sta. Cruz da Conceição	2,98		B				b	2,96	A					b				2,59	A				a		52,35***
I	Echaporã	2,71	A				a		2,98	A					b				2,82		C	D	E	a		19,04***
N	Artur Nogueira	2,92		B				b	2,96	A					b				2,77		B	C	D		a	10,20***
G	Sumaré	2,67	A				a		2,92	A					b				2,67	A	B				a	19,33***
	Londrina	2,77	A				a		2,98	A						c			2,89				E	b	19,50***
	Rolândia	2,72	A				a		2,96	A					b				2,74		B	C		a		22,96***
5	Rio das Antas	2,73	A				a		2,97	A						c			2,85			D	E	b	23,45***
	Joaçaba	2,93		B			a	b	2,97	A					b				2,87			D	E	a		3,21*
	Avaré	2,95		B																						
	"F" Values	14,07***							1,64NS										17,01***							
	Uberlândia	4,33	A				a		4,80	A	B					c			4,60			D		b	44,18***
	Brodowski	4,32	A				a		4,88		B					c			4,55		C	D		b	53,68***
W	Sta. Cruz da Conceição	4,74			C			b	4,71	A					b				4,13	A				a		50,62***
I	Echaporã	4,34	A				a		4,80	A	B					c			4,53		C	D		b		21,93***
N	Artur Nogueira	4,60		B	C			b	4,72	A					b				4,42		B	C		a		9,34***
G	Sumaré	4,25	A				a		4,70	A					b				4,28	A	B			a		20,13***
	Londrina	4,40	A	B			a		4,74	A	B				b				4,65			D		b		22,97***
	Rolândia	4,33	A				a		4,75	A	B				b				4,42		B	C		a		26,42***
6	Rio das Antas	4,32	A				a		4,80	A	B					c			4,57			C	D	b		34,71***
	Joaçaba	4,66			C		a	b	4,77	A	B				b				4,59			C	D	a		5,35***
	Avaré	4,75			C																					
	"F" Values	13,81***							2,71**										18,56***							
	Uberlândia	2,02	A	B			a		2,21	A						c			2,13		C	D		b		21,86***
	Brodowski	2,01	A	B			a		2,28	A						c			2,13		C	D		b		35,02***
W	Sta. Cruz da Conceição	2,23				D		b	2,22	A					b				1,93	A				a		47,27***
I	Echaporã	2,04	A	B			a		2,25	A					b				2,12		C	D		a		16,18***
N	Artur Nogueira	2,13		B	C	D	a	b	2,20	A					b				2,05		B	C		a		9,05***
G	Sumaré	1,98	A				a		2,19	A					b				2,00	A	B			a		16,67***
	Londrina	2,06	A	B	C		a		2,20	A					b				2,14			C	D	b		11,39***
	Rolândia	2,04	A	B			a		2,21	A					b				2,07		B	C	D	a		15,31***
7	Rio das Antas	2,03	A	B			a		2,24	A						c			2,13			C	D	b		18,00***
	Joaçaba	2,18			C	D	a		2,22	A				a					2,15				D	a		1,87NS
	Avaré	2,21				D																				
	"F" Values	11,19***							1,81NS										11,39***							
	Uberlândia	2,43	A				a		2,71	A	B					c			2,60			D	E	b		38,92***
	Brodowski	2,43	A				a		2,77		B					c			2,48		C	D	E	b		37,23***
W	Sta. Cruz da Conceição	2,67			C			b	2,66	A					b				2,32	A				a		45,28***
I	Echaporã	2,43	A				a		2,73	A	B					c			2,57		C	D	E	b		24,12***
N	Artur Nogueira	2,60		B	C			b	2,66	A					b				2,48		B	C		a		9,29***
G	Sumaré	2,38	A				a		2,66	A					b				2,41	A	B			a		19,98***
	Londrina	2,46	A	B			a		2,65	A					b				2,61				E	b		17,68***
	Rolândia	2,43	A				a		2,67	A					b				2,49		B	C	D	a		20,36***
8	Rio das Antas	2,44	A				a		2,71	A	B					c			2,58			C	D	E	b	26,74***
	Joaçaba	2,64			C		a		2,69	A	B			a					2,60				D	E	a	3,33NS
	Avaré	2,68			C																					
	"F" Values	12,36***							3,30**										16,27***							

Continuation

	Localities	Natural Populations						Groups started with 400 eggs						and						800 eggs						"F" Values
	Uberlândia	1,64	A	B			a		1,80	A						c		1,73			C	D		b	32,80***
	Brodowski	1,64	A	B			a		1,82	A					b			1,70			C	D	a		30,96***
W	Sta. Cruz da Conceição	1,79				D		b	1,79	A					b			1,58	A				a		43,35***
I	Echaporã	1,64	A	B			a		1,78	A					b			1,70			C	D	a		12,70***
N	Artur Nogueira	1,73		B	C	D	a	b	1,78	A					b			1,68		B	C	D	a		5,86**
	Sumaré	1,61	A				a		1,77	A					b			1,61	A	B			a		21,01***
G	Londrina	1,66	A	B	C		a		1,80	A					b			1,75				D		b	22,65***
	Rolândia	1,63	A				a		1,79	A					b			1,66		B	C		a		28,89***
9	Rio das Antas	1,61	A				a		1,80	A						c		1,71			C	D		b	34,84***
	Joaçaba	1,74			C	D	a		1,80	A					b			1,72			C	D	a		8,00***
	Avaré	1,78				D																			
	"F" Values	12,57***							1,34^{NS}									13,24***							
	Uberlândia	2,04	A				a		2,26	A						c		2,17			C			b	29,24***
	Brodowski	2,05	A				a		2,30	A						c		2,14			C			b	32,31***
W	Sta. Cruz da Conceição	2,25			C			b	2,23	A					b			1,95	A				a		48,09***
I	Echaporã	2,06	A	B			a		2,26	A					b			2,13			C		a		15,87***
N	Artur Nogueira	2,18		B	C			b	2,22	A					b			2,09		B	C		a		7,01***
	Sumaré	2,02	A				a		2,21	A					b			2,03	A	B			a		15,29***
G	Londrina	2,08	A	B			a		2,22	A					b			2,18			C			b	12,30***
	Rolândia	2,07	A	B			a		2,23	A					b			2,09		B	C		a		13,77***
10	Rio das Antas	2,07	A	B			a		2,26	A					b			2,15			C		a		16,78***
	Joaçaba	2,21			C		a		2,24	A				a				2,18			C		a		1,71^{NS}
	Avaré	2,26			C																				
	"F" Values	11,82***							1,80^{NS}									12,89***							
	Uberlândia	1,44	A				a		1,61	A	B	C			b			1,57				D		b	33,32***
	Brodowski	1,46	A	B			a		1,67			C				c		1,55			C	D		b	36,51***
W	Sta. Cruz da Conceição	1,59			C	D		b	1,60	A	B				b			1,39	A				a		38,57***
I	Echaporã	1,46	A	B			a		1,63	A	B	C			b			1,53			C	D	a		19,70***
N	Artur Nogueira	1,52		B	C		a		1,59	A	B				b			1,49		B	C		a		6,82***
	Sumaré	1,42	A				a		1,59	A	B				b			1,45	A	B			a		16,99***
G	Londrina	1,46	A	B			a		1,58	A					b			1,56			C	D		b	21,31***
	Rolândia	1,44	A	B			a		1,60	A	B				b			1,50		B	C	D	a		23,14***
11	Rio das Antas	1,43	A	B			a		1,65		B	C				c		1,54			C	D		b	49,32***
	Joaçaba	1,56			C	D	a		1,62	A	B	C			b			1,53			C	D	a		10,12***
	Avaré	1,62				D																			
	"F" Values	12,31***							4,72***									11,33***							
	Uberlândia	0,77	A				a		0,87	A	B					c		0,82		B	C	D		b	33,34***
	Brodowski	0,77	A				a		0,89		B					c		0,84				D		b	32,95***
W	Sta. Cruz da Conceição	0,85			C			b	0,86	A	B				b			0,74	A				a		32,23***
I	Echaporã	0,78	A	B			a		0,88	A	B				b			0,82		B	C	D	a		24,19***
N	Artur Nogueira	0,83		B	C		a	b	0,86	A	B				b			0,79		B	C		a		9,19***
	Sumaré	0,76	A				a		0,86	A	B				b			0,78	A	B			a		16,67***
G	Londrina	0,78	A	B			a		0,84	A					b			0,83			C	D		b	13,33***
	Rolândia	0,76	A				a		0,85	A	B					c		0,80		B	C	D		b	23,75***
m	Rio das Antas	0,78	A	B			a		0,89		B					c		0,84				D		b	32,50***
	Joaçaba	0,84			C		a		0,88	A	B				b			0,84				D	a		5,40**
	Avaré	0,86			C																				
	"F" Values	11,65***							3,79**									11,44***							

Continuation

	Localities	Natural Populations	Groups started with 400 eggs	and	800 eggs	"F" Values
FEMUR	Uberlândia	1,76 A B C D a	1,97 A	c	1,88 D b	28,23***
	Brodowski	1,75 A B C a	1,95 A	b	1,81 C D a	28,43***
	Sta. Cruz da Conceição	1,89 E b	1,90 A	b	1,65 A a	31,37***
	Echaporã	1,75 A B C a	1,96 A	b	1,81 C D a	21,05***
	Artur Nogueira	1,85 C D E a b	1,90 A	b	1,76 B C a	6,78**
	Sumaré	1,69 A a	1,89 A	b	1,71 A B a	17,51***
	Londrina	1,81 B C D E a	1,92 A	b	1,85 C D a b	8,10***
	Rolândia	1,76 A B C D a	1,93 A	b	1,79 B C D a	15,48***
	Rio das Antas	1,73 A B a	1,93 A	c	1,82 C D b	37,48***
	Joaçaba	1,87 D E a	1,91 A	a	1,84 C D a	2,41NS
	Avaré	1,92 E				
	"F" Values	9,76***	1,85NS		11,29***	
BASITARSUS	Uberlândia	0,62 A B a	0,69 A	b	0,67 D b	34,53***
	Brodowski	0,62 A B a	0,70 A	c	0,65 B C D b	37,31***
	Sta. Cruz da Conceição	0,67 C D b	0,69 A	b	0,60 A a	34,37***
	Echaporã	0,62 A B a	0,70 A	c	0,66 C D b	27,52***
	Artur Nogueira	0,66 B C D a b	0,68 A	b	0,63 A B C a	7,03***
	Sumaré	0,61 A a	0,68 A	b	0,62 A B a	21,16***
	Londrina	0,64 A B C D a	0,70 A	c	0,67 D b	23,50***
	Rolândia	0,63 A B C a	0,69 A	b	0,63 A B C a	15,37***
	Rio das Antas	0,62 A B a	0,69 A	c	0,66 C D b	39,57***
	Joaçaba	0,67 C D a	0,68 A	a	0,66 C D a	3,18NS
	Avaré	0,68 D				
	"F" Values	9,18***	1,60NS		13,28***	
TIBIA	Uberlândia	1,51 A a	1,68 A	c	1,62 C b	28,78***
	Brodowski	1,49 A a	1,70 A	b	1,59 B C b	43,17***
	Sta. Cruz da Conceição	1,64 C D b	1,66 A	b	1,45 A a	33,06***
	Echaporã	1,54 A B a	1,70 A	b	1,59 B C a	18,41***
	Artur Nogueira	1,61 B C D a b	1,67 A	b	1,55 B C a	7,90***
	Sumaré	1,47 A a	1,65 A	b	1,50 A B a	10,84***
	Londrina	1,55 A B C a	1,65 A	b	1,62 C b	10,82***
	Rolândia	1,53 A B a	1,67 A	b	1,55 B C a	19,38***
	Rio das Antas	1,50 A a	1,67 A	b	1,60 C b	13,33***
	Joaçaba	1,62 B C D a	1,67 A	a	1,61 C a	2,87NS
	Avaré	1,67 D				
	"F" Values	11,53***	0,84NS		7,76***	
LEG	Uberlândia	3,90 A B a	4,34 A	c	4,17 E b	31,16***
	Brodowski	3,86 A B a	4,37 A	c	4,05 C D E b	38,81***
	Sta. Cruz da Conceição	4,21 C D b	4,26 A		3,70 A a	33,37***
	Echaporã	3,91 A B a	4,37 A	b	4,06 C D E a	21,65***
	Artur Nogueira	4,12 B C D a b	4,25 A	b	3,94 B C a	7,46***
	Sumaré	3,77 A a	4,23 A	b	3,84 A B a	19,30***
	Londrina	4,00 A B C a	4,27 A	b	4,15 D E b	11,40***
	Rolândia	3,93 A B a	4,28 A	b	3,97 B C D a	17,63***
	Rio das Antas	3,85 A a	4,30 A	c	4,08 C D E b	42,83***
	Joaçaba	4,17 C D a	4,26 A	a	4,11 C D E a	2,74NS
	Avaré	4,27 D				
	"F" Values	10,58***	1,60NS		12,20***	

Continuation

	Localities	Natural Populations						Groups started with 400 eggs				and				800 eggs				"F" Values
HEAD WIDTH	Uberlândia	2,00	A	B	C		a	2,22	A	B			c	2,12			C		b	35,12***
	Brodowski	1,95	A	B			a	2,28		B			c	2,10			C		b	68,15***
	Sta. Cruz da Conceição	2,11			C	D	b	2,20	A	B			b	1,88	A				a	39,99***
	Echaporã	2,01	A	B	C		a	2,23	A	B			b	2,06		B	C		a	19,05***
	Artur Nogueira	2,08			C	D	a	2,19	A				b	2,03		B			a	11,26**
	Sumaré	1,91	A				a	2,20	A	B			b	1,97	A	B			a	29,71***
	Londrina	2,05		B	C	D	a	2,19	A				b	2,15			C		b	15,53***
	Rolândia	2,00	A	B	C		a	2,21	A	B			b	2,04		B			a	23,26***
	Rio das Antas	1,94	A	B			a	2,19	A				c	2,09			C		b	42,85***
	Joaçaba	2,11			C	D	a	2,16	A			a		2,10			C		a	2,03NS
	Avaré	2,17				D														
	"F" Values	9,58***						3,33**						16,72***						
BRISTLES* Nº	Uberlândia	30,92	A	B			a	34,35	A			a		32,65	A				a	2,42NS
	Brodowski	30,04	A				a	35,17	A				b	31,77					a b	6,27**
	Sta. Cruz da Conceição	34,80		B			c	33,55	A				b	29,65	A				a	5,98**
	Echaporã	31,24	A	B			a	32,60	A			a		30,32	A				a	1,16NS
	Artur Nogueira	31,82	A	B			a	34,40	A			a		31,57	A				a	1,78NS
	Sumaré	29,70	A				a	35,30	A				b	29,27	A				a	6,69**
	Londrina	31,72	A	B			a	33,85	A			a		32,07	A				a	1,22NS
	Rolândia	31,68	A	B			a	33,40	A			a		31,32	A				a	1,34NS
	Rio das Antas	29,74	A				a	34,45	A				b	31,57	A				a	9,55**
	Joaçaba	34,80		B			b	33,90	A			a		30,90	A				a	4,12*
	Avaré	35,38		B																
	"F" Values	4,41***						0,53NS						0,83NS						

Values in the same column with a capital letter in common do not differ significantly at the 5% level of probability using Tukey's test.
Values on same line with a lower case letter in common do not differ significantly at the 5% level of probability using Tukey's test.
NS = not significant.
*** = significant at the 5% level.**
**** = significant at the 1%level.**
***** = significant at the 0,1% level.**

DISCUSSION

According to Toda (1973), the variations occurring in insects are adaptative and have an evolutive meaning by the consequent occurence of gene frequency variations in the populations. The importance of morphometric variations was pointed out by Stalker & Carson (1949) in *Drosophila robusta* and by Tantawy (1964) in *D. melanogaster*, who observed fluctuations in the values of the means analyzed during the year. However, it should be considered that morphological changes not only originate from genetic variations, since these variations between and within populations are affected by genetic and environmental constituents.

In the present study, the morphometric measurements showed some repetitive characteristics for different strains. The Joaçaba strain was the least differentiable among the three population types. while the strains from Brodowski, Sta Cruz da Conceição, Sumaré and Rio das Antas, showed differences in all characteristics among the population types. These facts suggest the possibility of strain classification among those with more or less bias for changes. Also, it is possible to measure quantitatively the morphological characteristics that are more or less flexible to changes.

Natural populations from the northern part of the area studied showed the smallest

measurements of morphological characters, in accordance with Alves (1997), who also showed that southern populations were the least versatile and presented the highest values of morphological characters. In the experimental groups no differences were observed in relation to the distribution of those values corresponding to the natural populations. These facts were useful to confirm the differences between the environments explored by flies under natural and laboratory conditions.

Strains of flies from natural populations showed significant differences in all morphological characteristics. Practically the same occurred in the groups started with 800 eggs, with only one exception. Of the 18 characteristics analyzed for groups started with 400 eggs, only in six cases were differences observed in the measurement made, and these flies showed the highest measurements, followed by the flies from groups started with 800 eggs and finally by those from natural populations.

According to Alves (1997) the high performace of the groups started with 400 eggs shows that this density provides best conditions for strain development and more efficient exploitation of available resources such as space and food than in population types started with 800 eggs. Similar results were obtained by Bélo & Bianchini (1995). Fly growth under conditions for total development in the groups started with 400 eggs reduced differences in the genetic expression for adaptation among individuals, since different types of deficiency commonly presented by the flies of each strain could not be expressed due to the abundance of favourable opportunities, covering the effects of genetic load in different individuals. This did not occur in the groups started with 800 eggs or in the natural populations, where competition among larvae was the major factor for natural selection.

Both genetic and environmental influences are important for the variations in morphological characteristics in *M. domestica*. Brancalião & Bélo (1997) and Alves (1997) observed that larval density increases at the breeding sites, producing adults of smaller size. Therefore, such decreases are not correlated quantitatively in the same way for all analyzed strains and differences among them were detected. This was also observed by Bryant & Meffert (1990, 1995) in studies about the bottleneck effect, where the genetic relation among the characteristics inside the shift populations were changed, a fact that can promote speciation and differentiation among populations.

It is evident that at the same time no morphological variations changed in the populations and the measurements of a character could be influenced by an environmental condition and not by others. In general none of the analyzed characters was positively neutral or even without value regarding the strengths of natural selection and showed that genetic and/or morphologic variants constitute the basic substrate for different selective regimens.

According to Mayr (1970), neutralist and selectionist interpretations may not diverge completely. Thus, the genetic variations of a phenotipic characteristic such as body size can be considered neutral sometimes, but can become significant if the selection promotes a mean size, in the same way that alleles of a locus may be neutral in a given genetic environment, but may affect fitness in others.

Most information favoring the neutralist theory is based on isozyme interpretation, but it is virtually impossible to establish the allele frequency that contributes to the variation in most morphological characteristics because there are generally so many loci influencing the character. Thus, the pleiotropy of genes is the most important factor responsible for the selectively neutral feature of the phenotype.

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