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SEASONAL VARIATIONS IN QUANTITATIVE TRAITS OF *DROSOPHILA TAKAHASHII*

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ABSTRACT

‘Traditional morphometrics’ allows us to decompose morphological variation into its major independent sources, identifying them usually as size and shape. To compare and investigate the properties of size and shape in natural populations of *Drosophila takahashii,* estimating their seasonal changes, we carried out collections on two different occasions i.e. winter and summer. In the present study the data clearly shows that mean trait values are higher for winter population as compared to summer population

KEYWORDS: ***Drosophila takahashii***, **thorax length, wing length, wing to thorax ratio and body weight etc**

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INTRODUCTION

For quantitative traits, investigations of natural populations have mostly evidenced spatial genetic variations such as latitudinal clines in various species and temporal variations are far less documented. This seems to be due to several practical difficulties and to the fact that such variations, if any are likely to be smaller than those observed across long distances. One difficulty is a lack on consensus on how to measure a quantitative trait. For example, wing size is generally estimated as wing length, but there are numerous dimensional parts which have been equated to length. Another difficulty is the sensitivity of quantitative traits to experimental conditions, such as food, temperature or population density. A related problem is a frequent lack of repeatability and an apparent unstability when the same measurement is undertaken several times on the same population. A final problem is the likelihood of genetic drift or conversely, of laboratory adaptation, when a population is kept for a long time under laboratory conditions (Condon C, 2014). Facing such difficulties, it has often been argued that natural populations of *Drosophila* are too complicated, unstable and unpredictable for a convenient analysis of natural selection upon fitness related traits. For example, several French populations of *D.melanogaster* were investigated with the isofemale line technique, for size and other quantitative traits, and slight but significant variations were evidenced between them (Capy *et.al.,*1993). Since the measurements were done in different years, on lines kept sometimes for many generations in the laboratory, the origin of these variations remained, however, unknown.

MATERIALS AND METHODS

In the present work we collected *D.takahashii* flies from Rohtak fruit market from two different seasons i.e. summer and winter. For each season ten isofemale lines (N= 200) were established and analyzed body weight, wing length and thorax length in both sexes. Measurements were done at four growth temperature (17, 21, 25 and 28°C). We analyzed phenotypic plasticity related to growth temperature over the whole thermal range of the species. We found a remarkable stability not only the size but also of the reaction norms and of their genetic characteristics, suggesting that, like size itself, they are also submitted to some kind of balancing selection. For investigating growth temperature effects, 10 pairs of adults were randomly taken from each line and used as parents. They were allowed to oviposit at 25°C for 24 hours in culture vials containing a high nutrient medium based on killed yeast. Such a medium prevents crowding effects which could affect fly size, and density ranged between 100 and 200 eggs per vial. These vials eggs were immediately transferred to one of four experimental temperature. (17, 21, 25 and 28°C). From each line at each temperature, 10 females and 10 males were randomly taken and measured for four quantitative traits (wing length, thorax length and W/T ratio, body weight) with a binocular microscope equipped with micrometer, and results are expressed in mm x 100. Wing length was measured from the thoracic articulation to the distal tip of the wing, and thorax was measured on a left side view, from the neck basis to the tip of the scutellum, (David *et.al.,*1994; Morin *et.al.,*1996). Wing/thorax ratio was also calculated. Body weight was taken at different temperatures.

RESULTS AND DISCUSSIONS

The mean values for four morphometrical traits (WL, TL, W/T and BW) are shown in (Table 1, 2). The values for all the traits are higher for winter population as compared to summer population. The average response columns of wing length and thorax length according to growth temperature are shown in (Fig. 1 to 2). Female and male columns are separated, showing the well-known fact that males are smaller than females. The major conclusion is that, for each trait, the reaction norms of two seasonal populations are significantly different. ANOVA (Table 3) shows significant seasonal variation for all the traits variation due to season and temperature were significant. For each character, a maximum was observed at low temperature i.e., 17°C for wing and thorax length. A large genetic variability existed, however, in natural populations which was revealed by ANOVA as significant differences among lines and significant line-temperature interaction. It was found that the W/T ratio, which is related to wing loading and presumably to flight capacity (Stalker, 1980) is strongly selected in natural populations (David *et.al.,*1994; Karan *et.al.,*1998a) while it is, of course, no more selected in laboratory cultures. As discussed in introduction, laboratory evolution experiments conducted by controlling some environmental factors, is certainly easier to interpret in terms of selection, although it may not be relevant to natural selection in nature. On the other hand, natural populations integrate so many environmental variables that their effects may be impossible to disentangle. Flies collected in nature and brought to the laboratory are likely to undergo some rapid adaptation to general laboratory conditions such as a stable temperature, food availability, early reproduction and absence of flight. For that reason, numerous experiments were started from populations already kept as laboratory cultures (e.g. Cavichi *et.al.,*1985; Partridge & Fowler, 1994). Laboratory evolution implies to establish aliquot strains under new conditions (e.g. different temperatures) while keeping the initial ones. Such a goal was attained on bacteria by keeping frozen aliquot samples of the starting population (Loescheke, V *et.al.,*1999). Our results which, of course, remain to be generalized, could provide a similar stable reference for *Drosophila*. In this respect, evolutionary experiments could encompass two kinds of controls: classical ones, kept under usual laboratory conditions, and wild living flies repeatedly sampled form the same locality. The present study gives some validation to this claim since weather conditions are known to vary from one geographic location to another. Hence, it is advisable to consult geologists and related experts before choosing a location for construction of pyramids for therapeutic purposes. Further studies could be conducted to determine what other variable factors related to geographic location influence the behaviour of the ‘energy fields’ and cosmic forces in the pyramidal cavity and hence form a variable factor during pyramid therapy.(Surekha et.at, 2010)

Table 1
Data on mean±SE and coefficient of variation for four morphometrical traits in female individuals of isofemale lines grown at four different temperatures for D.takahashii from two different seasons. (N=200)

Season	Trait	17°C		21°C		25°C		28°C	
		m±SE	CV	m±SE	CV	m±SE	CV	m±SE	CV
Summer	WL	262.93±0.98	0.99	255.55±0.66	0.69	247.41±0.68	0.72	234.61±0.14	1.287
	TL	98.99±1.00	1.01	98.00±0.54	1.45	94.75±0.25	0.69	91.80±0.46	1.24
	W/T	2.64±0.00	0.42	2.60±0.01	0.84	2.58±0.01	1.00	2.50±0.01	1.19
	BW	145.71±4.28	7.78	147.20±3.40	6.49	135.00±2.85	5.51	120.00±3.08	6.80
Winter	WL	276.85±0.81	0.92	268.36±0.79	0.93	258.53±1.16	1.41	245.21±6.85	1.09
	TL	102.49±0.42	1.29	101.49±0.47	1.45	96.15±0.30	0.98	93.14±0.35	1.14
	W/T	2.69±0.01	1.35	2.66±0.01	1.45	2.60±0.01	1.02	2.52±0.01	1.45
	BW	151.70±2.33	4.95	152.50±2.49	5.18	140.13±3.00	6.45	126.00±2.68	6.29

Table 2
Data on mean±SE and coefficient of variation for four morphometrical traits in male individuals of isofemale lines grown at four different temperatures for D.takahashii from two different seasons. (N=200)

Season	Trait	17°C		21°C		25°C		28°C	
		m±SE	CV	m±SE	CV	m±SE	CV	m±SE	CV
Summer	WL	236.70±0.71	0.79	231.56±0.78	0.89	218.87±1.40	1.70	202.03±0.63	1.66
	TL	92.05±0.35	0.99	91.23±0.27	0.79	89.15±0.46	1.39	85.10±0.32	0.98
	W/T	2.56±0.01	0.94	2.53±0.01	0.90	2.50±0.01	0.74	2.37±0.01	1.00
	BW	98.00±0.31	8.16	102.00±3.09	9.07	92.85±2.85	8.14	85.40±2.60	8.78
Winter	WL	247.80±0.64	0.82	241.88±0.67	0.88	227.30±0.92	1.26	208.90±0.87	1.27
	TL	95.60±0.31	1.04	94.28±0.31	1.06	90.99±0.49	1.70	86.30±0.49	1.70
	W/T	2.62±0.01	1.09	2.60±0.01	1.65	2.53±0.01	1.16	2.46±0.01	1.09
	BW	104.80±3.00	9.20	107.30±3.14	9.12	96.80±2.49	8.04	88.50±2.49	8.56

Table 3
Result of ANOVA for four morphometrical traits (WL,TL, W/T and BW) in ten isofemale lines at four growth temperature for D.takahashii of two different seasons from Rohtak.

Source of variation	df	WL		TL		W/T		BW	
		MS	% Var	MS	% Var	MS	% Var	MS	% Var
Season (1)	1	4271.87	3.77	229.97	8.61	.0777	7.36	2700.89	3.59
Temperature (2)	3	10161.56	8.99	128.32	14.42	.2279	64.81	2093.75	8.36
Isofemale line (3)	9	48.54	0.04	2.49	0.56	.00073	0.04	78.87	0.63
Sex (4)	1	87085.96	77.02	1804.58	67.59	.1768	16.75	58058.04	77.26
1 x 2	3	105.72	0.09	4.29	0.48	.0035	1.01	222.32	0.89
1 x 3	6	505.96	0.45	3.35	0.75	.00114	0.06	321.73	2.57
2 x 3	18	65.78	0.06	1.13	0.76	.00112	1.92	95.14	2.28
1 x 4	1	723.52	0.64	8.38	0.31	.0157	1.50	8.04	0.01
2 x 4	3	2062.32	1.82	10.46	1.17	.0049	1.41	36.61	0.15
3 x 4	6	155.38	0.14	0.82	0.18	.0010	0.06	16.37	0.13
1 x 2 x 3	18	531.36	0.47	0.93	0.63	.00054	0.09	118.15	2.83
1 x 2 x 4	3	2654.84	2.35	29.15	3.27	.00865	2.46	29.46	0.12
1 x 3 x 4	6	653.92	0.58	1.47	0.33	.00099	0.06	24.70	0.20
2 x 3 x 4	18	863.46	0.76	0.75	0.51	.000871	1.48	25.50	0.61
1 x 2 x 3 x 4	8	3183.72	2.81	0.60	0.41	.000563	0.96	15.58	0.37

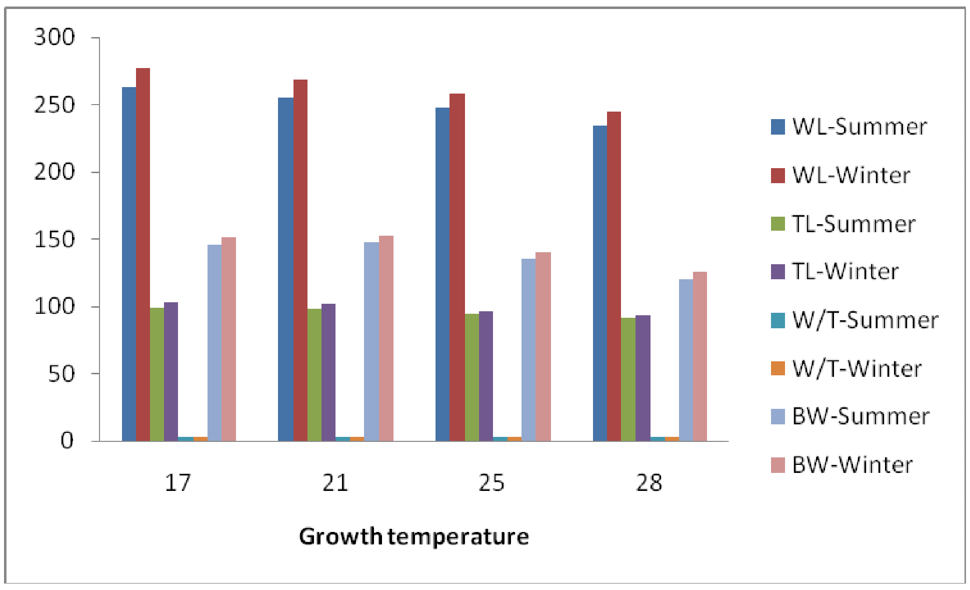

Figure 1
Different morphometric traits shown by female at different growth temperature.

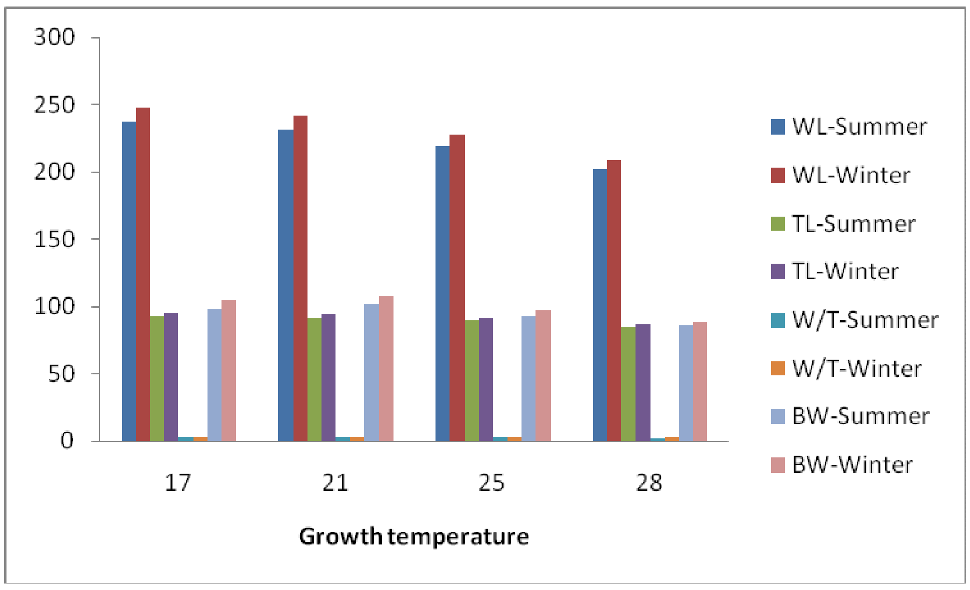

Figure 2
Different morphometric traits shown by male at different growth temperature

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