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Comparison of Quantitative Traits in Latitudinal Populations of Drosophila Kikkawai: Wild Vs Lab Populations

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Abstract: *The quantitative characters in Drosophila such as body size or fecundity, are very sensitive to environmental changes e.g. temperature or larval nutrition under laboratory conditions. In nature, the same situation is found where changes in annual temperature or humidity affect the type of flora as well as the size of Drosophila, fauna. In the present studies, we found that latitudinal clines exist in natural populations of Drosophila kikkawai for the quantitative traits; thorax length and wing length and wing/thorax ratio i.e the values of wing length, and thorax length and wing to thorax ratio are smaller for southern populations while higher for northern populations in both wild caught and laboratory reared populations.*

Keywords: *Quantitative traits, Wing length, thorax length, Wing/thorax ratio and Drosophila kikkawai etc.*

1. Introduction

Cosmopolitan or sub cosmopolitan species can help to understand which genetic and biological characteristics had allowed them to colonise various countries (Lewontin, 1965; Carson, 1965). It is also worthwhile to consider possible migration fluxes between remote populations and the mechanisms which allowed them a huge geographical extension. A large geographical range, covering the places with various climates, favours the occurrence of specific genetic variations.

Six *Drosophila* species had been considered to be truly Cosmopolitan while twenty one species had been designated as wide spread (David and Tsacas, 1981; Lenieunier *et.al.,* 1986). All these species are ecologically versatile and are characterised by high resistance to physical stress, rapid developmental time and the exploitation of an array of food resources.

D.kikkawai is the most common and wide spread species in the montium subgroup of the melanogaster group in the subgenus sophophora (Bock and Wheeler, 1972). It has been found to colonise tropical and subtropical parts in India as well as South America but the ecological studies on the geographical populations of most species of montium species group are lacking.

Studies on morphology of wild populations as reported by Reed and Reed (I950) on *D.pseudoobscura* and *D.persimilis,* Prevosti (2005) on *D.subobscura,* demonstrated that the wing length and other traits decrease in size with geographical distribution from north to south.

There are some reports on the morphometrical studies in *D.melanogaster* and *D.simulans* but *D.kikkawai* remains to be unexplored. Therefore, the aim of present work is to show the geographical variability of *D.kikkawai* from natural populations collected from various sites for five morphometrical traits; traits related to their size (body weight, wing length and thorax length); a trait related to reproductive capacity (ovariole number). The first two types of traits are likely to be under selective pressures in natural conditions. From the selected traits, it is possible to determine that geographic variations exist and which geographical/climatic factors are involved. Shrimpton and Robertson (1988) found that the complex traits, such as fresh weight, involved large number of genes while some traits (like bristle number) is determinated by a few major genes.

2. Materials and Methods

Natural populations of *D.kikkawai* were collected with, attractive fermenting fruit traps by net sweeping from four latitudinal sites (Shimla to Chennai) and were analysed for morphometrical traits. Mass bread populations were used. Flies were put in stock bottles with highly nutrient killed yeast medium (axenic medium) and were removed after 24 hrs to avoid crowding effect because nutrition could play a great role in phenotypic plasticity.

Three morphometrical traits were measured; wing length (WL), measured from the point of attachment with thorax upto the tip of the third longitudinal vein (expressed in mm x 100); thorax length (TL), measured from anterior margin of the thorax to the tip of postscutellum (expressed in mm x 100) and W/T ratio and

3. Results and Discussion

Mean values, coefficient of variation for three morphometrical traits in wild versus laboratory populations are given in (Table 1& 2). Comparisons are made on the basis of student t-test. Mean values of wing length, W/T ratio are statistically significant but the value of thorax length is not significantly different. Variation among populations collected from various sites are highly significant showing that the populations are geographically differentiated on the basis of morphological traits. The values of Wing length, and Thorax length and Wing To thorax ratio are smaller for southern populations while higher for northern populations (Table 1& 2) and showed a clinal pattern of variation from north to south transect of the Indian subcontinent. All the possible correlations between mean values and latitude are significantly positively correlated.

Various geographical clines could be due to two factors; natural selection and variations in climate which in turn depend on the geographical position of the population (Endler, 1977). It has been found that size of the animal differs according to altitude and northern animals are larger in size than southern ones. Our results show that an overall higher phenotype is maintained in colder places (Northern populations) than warmer southern places i.e. northern populations having higher values for morphological traits (TL, WL and W/T ratio) than southern populations showing a latitudinal cline along the north-south transect of the Indian subcontinent.

The selective factor that forms these clines is almost temperature. When- ever it is colder climate, the values are higher; this is evident in seasonal variation and in association with altitude. This has also been confirmed by selection experiments in laboratory when flies are grown at colder temperature for many generations acquire bigger size. A review of possible mechanisms of selection for size by temperature is given by Coyne and Beecham (1987). One hypothetical explanation discussed by them is selection connected with developmental time of flies. Since at higher temperature, flies develop faster and are smaller and; selection favouring rapid development could lead to smaller size of the flies. This hypothesis is confirmed by Cohet *et. al.*, (1980) who demonstrated faster developmental rate for African populations of *D.melanogaster* compared with European populations.

In nature, the stability of different populations could be considered as a consequence of strong stabilizing selection. Thus, the species facing a variable and unpredictable environment must undergo genetic changes for adapting themselves to such condition

Existence of latitude related morphological variability suggests that selective factors like temperature or rainfall could be involved. A strong negative correlation is observed between latitude and mean annual temperature, the temperature of the coldest month and total annual rainfall; morphometrical latitudinal clines are thus strongly correlated to these average parameters. Thus, the most significant factors regulating geographical variations appear to be temperature and rainfall. The role of rainfall is somewhat difficult to analyses, while the effects of temperature treatments can be investigated in the laboratory. In this respect several reports have shown that breeding at different temperatures may induce divergence of wing size and shape. Such phenomenon could be observed for most of the traits related to size as was evidenced by Anderson (2003) in *D.pseudoobscura*. On the other hand, it is also possible that adaptation is not tile result of the effect of a single climatic parameter, but could be due to a combination of these factors or to more complex environmental effects including interspecific competition.

Table1. *Comparison of trait value (m±SE, coefficient of variation) for wing and thorax length and their ratio in wild versus laboratory populations at 25°C of D.kikkawai males from four geographical population*

Population	Latitude		Trait	Wild Caught		Laboratory	
				m±SE	CV	m±SE	CV
Shimla	31°.30'N		WL	254.36±2.10	8.46	276.00±2.40	3.74
			TL	110.00±0.74	8.22	142.00±1.90	2.94
			W/T	2.64±0.04	7.04	2.52±0.02	3.98
Rohtak	28°.94'N		WL	226.44±1.10	7.62	234.53±2.09	3.24
			TL	91.33±0.64	7.02	96.13±1.19	2.35
			W/T	2.47±0.16	7.10	2.48±1.09	3.42
Nagpur	21°.09'N		WL	218.93±0.83	6.29	223.18±2.30	2.90
			TL	85.87±0.42	5.33	87.17±1.70	2.02
			W/T	2.55±0.01	3.40	2.50±1.67	2.42
Chennai	13°.00'N		WL	198.90±1.26	3.42	200.03±0.39	1.87
			TL	79.47±0.52	3.19	79.18±0.36	1.43
			WL	2.50±0.01	2.72	2.52±0.02	1.67

Table2. *Comparison of trait value (m±SE, coefficient of variation) for wing and thorax length and their ratio in wild versus laboratory populations at 25°C of D.kikkawai females from four geographical population*

Population	Latitude		Trait	Wild Caught		Laboratory	
				m±SE	CV	m±SE	CV
Shimla	31°.30'N		WL	282.00±1.80	7.37	298.74±1.60	3.49
			TL	134.14±0.89	7.02	114.16±2.20	3.21
			W/T	2.59±1.20	6.84	2.50±0.08	3.02
Rohtak	28°.94'N		WL	253.29±1.30	6.92	272.52±2.06	2.98
			TL	100.74±0.60	6.29	107.49±1.39	3.01
			W/T	2.51±0.01	5.24	2.53±0.04	2.64
Nagpur	21°.09'N		WL	241.26±1.20	5.48	249.31±1.80	2.42
			TL	95.19±0.76	4.20	99.47±2.30	2.58
			W/T	2.54±0.02	3.21	2.52±1.60	1.87
Chennai	13°.00'N		WL	215.97±1.20	2.42	226.93±0.56	1.67
			TL	87.29±0.74	1.94	88.87±0.33	1.94
			WL	2.47±0.01	2.14	2.55±0.01	1.41

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