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# Latitudinal Variations of Life History Traits in Indian Populations of D. *Melanogaster*

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**ABSTRACT:**

*Five geographical populations of Drosophila melanogaster from different latitudinal sites were analysed for their reproductive potential by measuring pre-adult life history traits such as fecundity, hatchability, viability and duration of development at usual growth temperature of 250C. The geographical patterns for fecundity, hatchability, viability and duration of development demonstrate positive correlation with latitude. The changes in life history traits are also correlated significantly with the body weight.The observed genetic divergence for life history traits can be explained on the basis of natural selection operating for these fitness related traits along the north-south transact of the Indian subcontinent.*

**Keywords***: Fecundity, hatchability, viability, duration of development and latitude etc*

## INRODUCTION

The geographic variations are often related to adaptiveness of the traits. The variations occur in the latitudinal populations suggesting some kind of climatic adaptation. Evolutionary adaptation to thermal environment can be revealed by examination of life history traits of the experimental population. Partridge et al.(1994) studied the pre-adult life history of the laboratory populations for evidence of adaptation to thermal regime by measuring the pre adult viability at two different temperatures and they suggested that pre adult traits might contribute to the differences in pre adult survival and adult body size.

Thus, it was considered pertinent to check fecundity, viability and duration of development in D. Melanogaster populations from different latitudinal sites differing in ecological parameters. Subsequently, populations each from northern, central as well as southern localities; were obtained and pre life history traits were characterized across full thermal range (12 to 31°C).

## MATERIALS AND METHODS

D. Melanogaster was collected from five different latitudinal sites from Banglore (12.58 'N) to Shimla (31°.30'N) and were analysed for their reproductive potential by measuring pre-adult life-history traits such as fecundity, hatchability, viability and duration of development at seven different growth temperatures from (12°C to 31°C). Wild populations of D. melanogaster were collected from different sites from India. Mass cultures were established and the adults emerging from these were reared on axenic food medium. Virgin females and males were separated. The virgins were allowed to feed on corn meal food medium seeded with live yeast and aged for 3 days. Three isogroups were used for each site. Single virgin female and male were kept in breeding chambers for mating and for laying eggs on a thin layer of food at the surface of breeding chamber plate. Five replicates were analysed. The different life history traits were measured. Fecundity means the number of eggs laid by the

female. After each 24 hours, numbers of eggs laid were counted for 18 days for each fly. For hatchability, the number of hatched eggs was counted after 24 hours when eggs were kept on a small squarish black paper moistened with 70% alcohol. In the present investigation, for hatchability four replicates of 25 eggs were taken continuously and were kept on food in such a way that eggs faced upwards. The eggs hatched and first instar larvae moved towards the food and only the chorion was left on black paper along with unhatched eggs. Egg to adult viability means number of adults emerged from hatched eggs. The number of adults were counted after their eclosion and the pre adult mortality was determined. Duration of development was considered as the time taken from eggs to the emergence which was calculated separately for males and females of D. melanogaster. The number of emerging adults was counted twice a day and the mean duration of development was calculated for each sex (Stearns, S.C, 1992). Body weight of groups of ten males or ten females (3 days old) was measured with electronic balance with a precision of 0.01 mg. For all the populations, mean values per fly (mg x 100) were based on ten replicates of groups of ten males or females.

**RESULT AND DISCUSSION**

Populations of D. Melanogaster were further analysed for life history traits across full thermal range and data are given in (Table 1-6). Data on fecundity, hatchability and viability across full thermal range (12 to 31°C) are given in (Table 2 to 5) and (Figs 1). Between populations differences are highly significant. This is supported by ANOVA (Table 6). For hatchability, 21.13% variation and for viability (5%) variation can be accounted due to geographical populations of D. melanogaster while for fecundity, such variation is lower. Temperature can account for maximum of trait variability whereas Pop x Temp. Interactions result in .4 to 3.6% of total viability. Table 3 & 4 demonstrates linear increase in hatchability and viability from 12 to 31°C. Fecundity and viability are significantly lower at 12°C and 31°C in all the populations.

For all the traits, optimum values are in the range of 21° to 28°C, while lower and higher temperatures evidence stressful effects. Two northern populations, which differ by about 1° latitude, are quite similar in respect of various life history traits. The values are significantly lower for southern populations across full thermal range as compared with northern and central Indian populations (Uller, T., et.al, 2013)

Geographical populations differ slightly across populations covering a range of 12.58 to 31.30° latitude, differences are higher at lower temperatures as compared with there at higher temperatures. As expected, duration of development decreases as growth temperature increase. Thus, the geographical populations of D. melanogaster are adaptively genetically differentiated with respect to the ecological conditions of the site of origin i.e. tropical V/s subtropical on the Indian subcontinent ( Roff, D.A, 2012)

In Drosophila, like other animal species, different habitats and resources are likely to impose different selective pressure on natural populations (Powsn ER, L. 2005). According to local conditions, various environments may result in increased polymorphism. D. melanogaster. Indian populations differing in latitudinal habitats exhibit divergence of life history traits. Such characteristics could be subjected to balanced polymorphism during seasonal cycles and to adaptive modifications during the process of colonization of different regions.

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These differences in various life history traits may be explained on the basis of differences in ecological and environmental conditions along the latitudinal axis of Indian subcontinent (Prakash, S. 1967). Drosophila populations in India experience almost homogenous hot and humid environmental conditions in the south as compared to northern part, where seasonal variability exists (natural populations experience progressively colder winter and hotter summer in the months of May, June and July). Thus, during winter, colder conditions impose greater selection pressure on abundant populations. The occurrence of latitudinal clines is a strong argument in favour of the adaptive significance of genetic variations since environmental parameters vary regularly according to latitude. In D melanogaster itself clinal variation for biometrical traits were observed.

***Table 1 : Data on mean body weight, fecundity, hatchability, viability and duration of development for five population of D. melanogaster at 25°C***

| Population | Latitude (N°) | Body weight | Fecundity (%) | Hatchability (%) | Viability (%) | Duration of development (%) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Female | Male |
| Shimla | 31.3 | 142.28 | 82 | 94.2 | 88 | 217.8 | 222.1 |
| Rohtak | 28.9 | 130 | 74 | 86 | 83 | 213.7 | 219.5 |
| Nagpur | 21.2 | 117.01 | 64.5 | 80 | 73 | 209.1 | 215.7 |
| Hyderabad | 17.2 | 105.33 | 53.6 | 70 | 69 | 203.5 | 206.5 |
| Banglore | 12.58 | 98 | 48.2 | 66 | 65 | 199 | 203.4 |

***Table 2 : Data on mean fecundity at seven different growth temperatures for five Indian geographical populations of D.melanogaster.***

| Population | 12°C | 14°C | 17°C | 21°C | 25°C | 28°C | 31°C |
|---|---|---|---|---|---|---|---|
| Shimla | 35.53 | 52.33 | 64 | 78 | 85 | 80 | 53 |
| Rohtak | 33 | 47.5 | 57 | 68 | 78 | 74 | 49 |
| Nagpur | 30.4 | 44.5 | 52.6 | 62 | 70 | 69 | 46.8 |
| Hyderabad | 23.75 | 34.5 | 42.4 | 53 | 62 | 65 | 37 |
| Banglore | 23 | 30 | 39.5 | 48 | 56.25 | 60 | 35 |

***Table 3 : Data on mean hatchability at seven different growth temperatures for five Indian geographical populations of D.melanogaster.***

| Population | 12°C | 14°C | 17°C | 21°C | 25°C | 28°C | 31°C |
|---|---|---|---|---|---|---|---|
| Shimla | 75 | 82 | 89 | 96 | 95 | 93 | 88 |
| Rohtak | 73 | 80 | 87 | 94 | 92 | 90 | 86 |
| Nagpur | 70 | 79 | 84 | 93 | 90 | 89 | 83 |
| Hyderabad | 68 | 75 | 80 | 90 | 87 | 84 | 81 |
| Banglore | 66 | 73 | 78 | 87 | 84 | 81 | 77 |

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*Table 4 : Data on mean viability at seven different growth temperatures for five Indian geographical populations of D.melanogaster.*

| Population | 12°C | 14°C | 17°C | 21°C | 25°C | 28°C | 31°C |
|---|---|---|---|---|---|---|---|
| Shimla | 46 | 60.4 | 79 | 87.2 | 77.4 | 69.6 | 47 |
| Rohtak | 43.2 | 56.1 | 70 | 82.1 | 70.5 | 64.9 | 44 |
| Nagpur | 37 | 47.8 | 63.4 | 76.5 | 66.4 | 53.8 | 40 |
| Hyderabad | 29 | 38.4 | 55.8 | 70.9 | 54.9 | 48.6 | 36 |
| Banglore | 23 | 32 | 47.8 | 66.6 | 50.4 | 42.6 | 32 |

*Table 5 : Data on duration of development of both the sexes at seven growth temperatures for five Indian geographical populations of D.melanogaster.*

| Population | Sex | 12°C | 14°C | 17°C | 21°C | 25°C | 28°C | 31°C |
|---|---|---|---|---|---|---|---|---|
| Shimla | F | 1112.6 | 896.94 | 631.4 | 385.2 | 278 | 250 | 202 |
| | M | 1120.5 | 905.38 | 637.8 | 397.4 | 289 | 259.2 | 207 |
| Rohtak | F | 1050.4 | 731.08 | 559.5 | 367.8 | 250 | 234 | 185 |
| | M | 1068.6 | 742.4 | 566 | 372.4 | 258 | 239 | 191 |
| Nagpur | F | 1046 | 708.9 | 555 | 360.7 | 246 | 228 | 179 |
| | M | 1058 | 719.5 | 561 | 366.8 | 253 | 234 | 173 |
| Hyderabad | F | 908.1 | 640 | 513 | 321 | 208 | 176 | 168 |
| | M | 920.3 | 653 | 524 | 330 | 205 | 180 | 171 |
| Banglore | F | 890.6 | 632 | 510 | 316 | 204 | 171 | 166 |
| | M | 904.2 | 646 | 519 | 322 | 209 | 177 | 164 |

*Table 6 : Results of ANOVA applied on life history traits (Fecundity, Hatchability and viability to test the variation due to populations, temperature and replicates of D . melanogaster*

| Source of Variation | df | Fecundity | | Hatchability | | Viability | |
|---|---|---|---|---|---|---|---|
| | | MS | % Variation | MS | % Variation | MS | % Variation |
| Population (1) | 4 | 86.446 | 0.71 | 138.95 | 21.13 | 604.83 | 5.57 |
| Temperature (2) | 6 | 3918.53 | 96.69 | 270.63 | 61.73 | 6602.59 | 91.26 |
| Replicates (3) | 4 | .755 | 0.01 | 2.22 | .34 | 14.99 | .14 |
| 1 x 2 | 24 | 4.707 | 0.46 | 4.00 | 3.66 | 32.25 | 1.78 |
| 1 x 3 | 16 | 5.465 | 0.36 | 2.70 | 1.64 | 4.35 | .16 |
| 2 x 3 | 24 | 6.284 | 0.62 | 2.72 | 2.48 | 2.47 | .14 |
| 1 x 2 x 3 | 96 | 2.88 | 1.14 | 2.48 | 9.01 | 4.25 | .94 |

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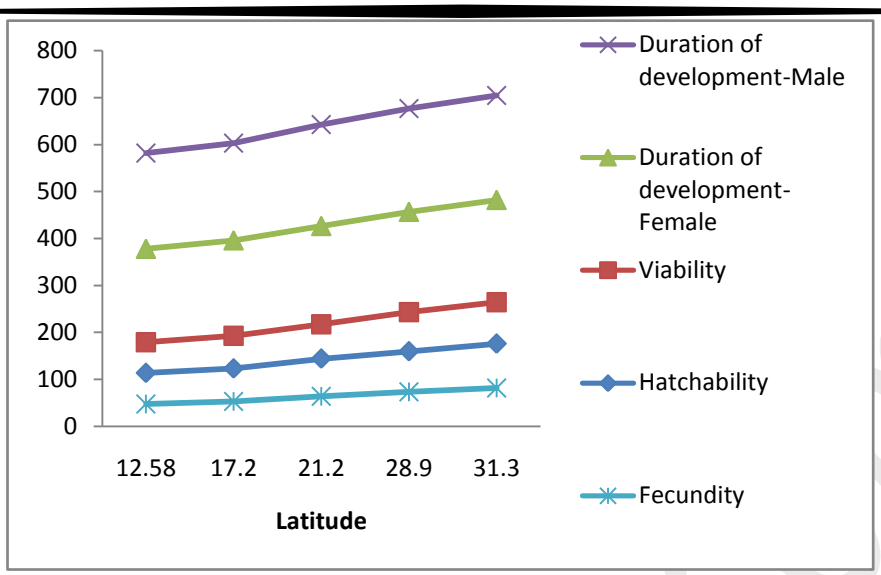


***Fig 1.Positive correlation of life-history traits with latitude.***

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