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Host Specialization And Egg Production in Drosophila Kikkawai Populations

Biotechnology

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ABSTRACT

Both developmental nutrition and adult nutrition affect life-history traits; how-ever, little is known about whether the effect of developmental nutrition depends on the adult environment experienced. We used the fruit fly to determine whether life-history traits, particularly fecundity, are affected by developmental nutrition, and whether this depends on the extent to which the adult environment allows females to realize their full reproductive potential. We raised flies on two different developmental food levels normal (corn-meal) and potato food. In the present study, it was found that fecundity was higher than the flies which were reared at usual corn-meal sugar food at two growth temperatures.

INTRODUCTION

Studies of ecological communities generally show that species richness is accompanied by a diversification of ecological niches (Hutchinson, 1978) and that the number of species coexisting at a tropic level is limited. In *Drosophila*, it has been argued (Shorrocks & Rosewell, 1984) that a guild of related species with overlapping niches would not exceed an average number of seven.

A usual way for avoiding strong competition is resource partitioning, i.e. evolution towards specialization (Hutchinson, 2004; Thompson, 1994). Phytophagous or parasitic groups offer numerous examples of specialized species. In *Drosophila*, many generalist species are able to use a diversity of resources, but many others are reduced to a narrow ecological niche. A much-studied case is the *D.repleta* group, in which many species co-evolved, with Cactaceae (Heed & Mangan, 1986).

Evolution towards specializing is likely to occur when a given resource is both abundant and predictable. The evolutionary mechanisms and genetic changes, which are necessary, remain poorly investigated, however. The main reason is that specialization is generally observed between different species where complete reproductive isolation precludes genetic analysis. Among a few favourable cases on different host races or sibling species, we may mention the work of Feder *et.al.,* (2008) on Rhagoletis, Thompson (1988) on butterflies and of R'Kha *et.al.,* (1991) on *D.sechellia.*

MATERIALS AND METHODS

Experiments were done with two natural populations collected from Shimla and Chennai situated at different latitudes. Ten isofemale lines were made, then lines were then pooled into a single mass population and kept in culture bottles. One sample of populations containing more than 100 adult flies were allowed to oviposit on rotten potato for 1 day. After that all the adult flies were aspirated out from the bottle containing decaying and rotten potato after the oviposition. Similarly same size of population sample were reared on simple corn-meal sugar medium (usual food), and allow to oviposit for 1 day and likewise adult flies were aspirated out after the oviposition. Upon emergence adults were taken out by aspirator. Now we have two samples, one emerged from rotten potato and other from cornmeal sugar medium (usual food). Number of emerged flies counted from each sample was more than hundred.

Experimental flies were reared at 25°C. Upon emergence, virgin females and males were separated. The virgin were allowed to feed on corn meal food medium seeded with live yeast and aged for 3 days. 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. Ten replicates were analysed. Eggs were counted daily. Oviposition took place on the usual cornmeal sugar food, seeded with live yeast. The duration of an experiment was generally 26 days.

RESULTS AND DISCUSSIONS

The data on mean values of fecundity for each replicate on normal and potato food are given in (Table 1& 2). On the basis of ANOVA there are significant differences due to food types for fecundity (Table 3). All the values for fecundity were higher for potato food as compared to normal food. Higher fecundity was observed on potato food as compared to normal food at both the temperatures (Fig.1& 2). Population taken from Shimla always showed higher fecundity than that of Chennai population. Experiment were done at 17°C and 25°C and a higher fecundity was shown by Shimla population observed at both these temperatures. As generally it was found that with decrease in climatic temperature body size increased, an increased body size resulted in more ovariole number and the higher ovariole number were correlated with fecundity than that for smaller body size. At lower temperature, size increased because of maintenance of the ratio of volume to surface area. It was already known that specialized food (preference) for *D.kikkawai* is rotten and decayed potato. In the experiments it was also proved that fecundity became higher than the flies which were reared at usual corn-meal sugar food.

When flies were grown at usual food, two different traits were modified according to egg production when the flies were grown at alternate food (decaying potato), progressively adapted fly usual food to alternate food in evolution. There was stimulating effect and which became specialized in case of *D.kikkawai.* Potato is universal food, hence this adaptive process favoured dispersal capacities in the whole world. Species richness was accompanied by diversification of niches, the present results support this observation in case of *D.kikkawai.* Now this species is more abundant density wise and also in diversification of niches. Resource partitioning causes evolution towards specialization. This specialization maintains relaxed interpopualtion competition and also relaxed intrapopulation competition because potato is universally abundant. Also when potato starts decaying bacterial and yeast grow on it more favourably, as a food for *D.kikkawai* and some related species. A diversity of resources relaxed the inter and intraspecies competition. This happens not only in *D.kikkawai* but also in other species of *Drosophila* like *D.jambulina* which is more abundant on Jamun, while *D.malerkotliana* is more abundant on guava fruits. Ovariole number is a polygenic inherited trait and ovariole number controls fecundity i.e. ovariole number is directly proportional to number of eggs or fecundity. During resource specialization the food that became favourable to some species to some extent might become toxic to other species that is why specialization became directional during evolution (resource allocation to reproduction). We also see some adaptations to new laboratory conditions than pure genetic drift as proved when body size increases in laboratory populations, fecundity also increase when traits are compared to natural populations. This was physiological and physical adaptation. Such physical adaptation are more complex than simple looking principles. In the beginning during resource specialization fallen ripe fruits were progressively degraded by yeast and bacterial so that toxicity disappeared and sensitive larvae could develop. Later on the fly may establish a more or less permanent resource relationship to that specialized food. Some physiological dependence (stimulation) developed in parallel way to the overall tolerance. In the population grown on decaying potato, very little genetic variability was found as shown by lack of correlation between ovariole number and fecundity. Thus the cause of higher fecundity was the preferred food. In *D.kikkawai* four natural factors might have caused specialization for their diversified niche i.e. stochastic process of repeated founder effect, recolonization, extinctions of other related species for the same food.

TABLE 1 : Data on mean±SE, coefficient of variation (CV) for mean fecundity (normal food) in Shimla and Chennai populations of *D.kikkawai.*

Species	Latitude	17°C		25°C	
		mean±SE	CV	mean±SE	CV
Shimla	31°30'N	14.97±0.59	12.65	24.10±1.70	23.42
Chennai	13°00'N	10.79±0.72	21.32	21.30±1.21	18.01

TABLE 2 : Data on mean±SE, coefficient of variation (CV) for mean fecundity (potato food) in Shimla and Chennai populations of *D.kikkawai.*

Species	Latitude	17°C		25°C	
		mean±SE	CV	mean±SE	CV
Shimla	31°30'N	26.96±0.75	8.90	28.10±1.19	13.44
Chennai	13°00'N	15.64±0.63	12.45	21.73±1.62	23.61

Table 3 : Results of ANOVA applied to whole data to test the variability due to population, temperature, replicates and food in northern (Shimla) and southern (Chennai) populations of *D.kikkawai.*

Source of Variation	df	Fecundity	
		MS	Variation
Population (1)	1	668.110	18.633
Temperature (2)	1	1012.393	28.234
Replicate (3)	9	8.225	2.064
Food (4)	1	483.194	15.475
1 x 2	1	60.187	1.678
1 x 3	9	15.433	3.873
2 x 3	9	8.520	2.138
1 x 4	1	160.376	4.472
2 x 4	1	212.976	5.939
3 x 4	9	17.264	4.333
1 x 2 x 3	9	12.642	3.173
1 x 2 x 4	1	5.095	0.142
1 x 3 x 4	9	10.968	2.752
2 x 3 x 4	9	20.349	5.107
1 x 2 x 3 x 4	9	15.854	3.979

Fig.1. Comparison of fecundity for normal & potato food at two growth temperatures by shimla population

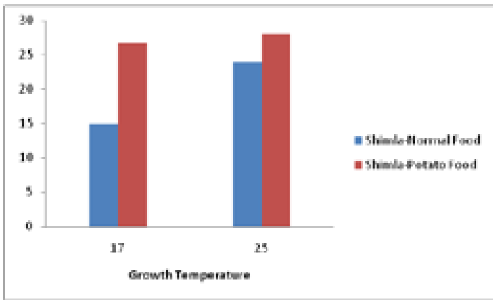
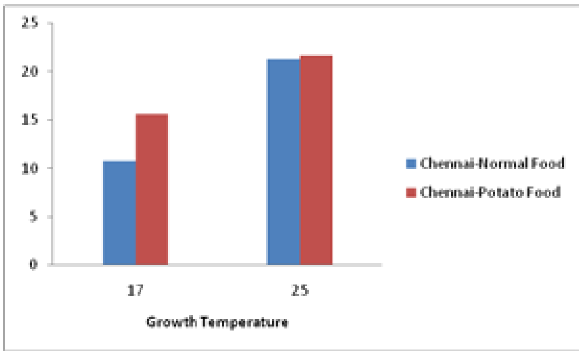


Fig.2. Comparison of fecundity for normal & potato food at two growth temperatures by Chennai population



REFERENCE

Feder, J.R, Chilcote, C.A. & Bush, G.L., (2008). Genetic differentation between sympatric host races of the apple, maggot fly Rhagoletic pomonella, Nature 336:61-64. | Heed, W.B. & Mangan, R.L. (1986). Community ecology of the Sonoran desert Drosophila. In Genetics and Biolgoy of Drosophila (ed. M. Ashburner, H. Carson & J.N Thomspon Jr) Vol. 3e pp. 311-341. London: Academic Press. | Hutchinson, G.E. (2004). An introduction to population Ecology, New Haven, Yale University Press | R'Kha, S., Capy, P & David, J.R. (1991). Host plant specialization in the Drosophila melanogaster species complex: a physiological behavioral and genetical analysis. Proceedings of the National Academy of Sciences of the USA 88, 1835-1839. | Shorrocks, B. & Rosewell, J. (1984). Interspecific competition isnot a major organizing force in many insect communities, Nature 310:310-312. | Thompson, J.N. (1988). Variation in preference and specificity in monophagous and oligophagous swallowtail butterflies. Evolution 42:118-128 | Thomspson, J.N. (1994). The co-evolutionary Process, Chicago: University of Chicago Press |