Research Journal of Chemical and Environmental Sciences
Res J. Chem. Environ. Sci. Vol 4 [2] April 2016: 16-18
Online ISSN 2321-1040
CODEN: RJCEA2 [USA]

Website: www.aelsindia.com/rjces.htm

RJCES

ORIGINAL ARTICLE

Effect of Larval Density on Starvation and Desiccation Tolerance in *Drosophila immigrans*

M.S Ghalaut
Department of Biotechnology, UIET, M.D. University, Rohtak (Haryana)
Corresponding Author: msghalaut@yahoo.com

ABSTRACT
There is evidence that starvation and desiccation resistance are determined by a common genetic mechanism. Starvation and desiccation resistance in Drosophila is affected by density during rearing. In this study, we examine how Drosophila immigrans responed to two larval density treatments at different growth temperatures. We observed that starvation and desiccation survival was greater in low density flies as compared to high density flies and males show lower resistance as compared to females.
Keywords: *Starvation and desiccation survival hours, Drosophila immigrans etc.*

Received 01.03.2016 Accepted 24.03.2016

INTRODUCTION

Organisms respond to environmental stresses with behavioural, physiological or morphological adjustment to counter its effects and maintain normal functioning. Temperature may be an agent of natural selection in producing evolutionary changes in the developmental mechanism that control growth rate and adult size and the thermal conditions during individual development may affect its final adult size [1].

The most important factor of the environment is water for any terrestrial animal and various structural, functional and behavioural adaptations have been described. It has been shown that tolerance to different kinds of stress could be mediated by a lower resting metabolic rate in *D.melanogaster* [2]. The starvation tolerance can be related to a lower metabolic rate on the basis of performance of artificial selected lines. Genetic variation for desiccation resistance, a stress related ecologically to high temperatures, has also been described in *D.melanogaster* [3, 4]. Most differences between lines selected for resistance and control lines were attributed to changes in metabolic rate, as a general stress response.

The experiment presented here focuses on genetic variation and starvation and desiccation resistance in *Drosophila immigrans* species

MATERIAL AND METHODS

Flies were collected from Rohtak fruit market and mass cultures were established after identification of species. Flies were reared at two densities. Low density flies were produced by placing mature adults, 10 females and 10 males, in each of four milk bottles with corn flour medium. High density flies were produced similarly, but 100 females and 50 males per bottle and the time of egg laying was increased by one day as compared to low density. Flies of both densities were serially transferred to new bottles with dead females replaced, and their progeny were used for the tests. The experiment was done at different growth temperatures (12, 14, 17, 21, 25 and 28°C).

For starvation and desiccation tolerance adults grown at different temperature were introduced in dry vials (10 individuals/replicate /sex) containing calcium chloride, so that relative humidity was close to zero (desiccation) or vials with water on foam sponge at the bottom (starvation). Tolerance was seen at six developmental temperatures (12, 14,17,21,25, 28°C) and survival hours were calculated.

RESULTS AND DISCUSSION

Both starvation and desiccation survival was greater in low density flies as compared to high density flies in both the species (Table 1, 2 & Fig. 1, 2). The difference became less pronounced at the higher temperature. This might indicate that at extreme temperature stress the variation due to density may be homogenized to some extent. Males show lower resistance as compared to females. The variation in both the traits due to density is significant (Table 3).

Table 1 : Data on mean±SE and CV of desiccation tolerance (in hours) in individuals of both the sexes grown at two different densities of *D.immigrans*

Species	Sex	12°C		14°C		17°C		21°C		25°C		28°C	
		m±SE	CV	M±SE	CV	m±SE	CV	m±SE	CV	m±SE	CV	m±SE	CV
D.immigrans													
Low	F	42.40±2.69	14.21	47.80±0.95	4.24	33.70±1.37	9.96	18.50±0.45	6.13	13.50±0.37	6.20	11.9±0.51	9.58
	M	34.40±2.20	14.33	43.86±2.43	12.38	26.24±1.46	12.42	15.00±2.44	3.49	11.70±0.55	4.68	10.10±0.37	8.28
High	F	36.20±1.80	11.11	44.65±2.43	2.38	29.50±1.71	13.64	15.90±1.65	25.58	11.30±0.32	6.26	10.50±0.37	7.97
	M	30.40±1.93	14.26	41.60±2.20	11.85	24.50±0.37	3.41	12.38±1.79	32.29	9.50±0.84	8.81	8.90±0.24	6.15

Table 2 : Data on mean±SE and CV of starvation tolerance (in hours) in individuals of both the sexes grown at two different densities of *D.immigrans*

Species	Sex	12°C		14°C		17°C		21°C		25°C		28°C	
		m±SE	CV	m±SE	CV	M±SE	CV	m±SE	CV	m±SE	CV	m±SE	CV
D.immigrans													
Low	F	300.00±5.06	5.06	340.40±6.99	4.59	262.00±8.48	7.24	190.60±5.87	7.23	168.20±4.80	6.38	133.60±4.48	7.51
	M	268.40±6.99	5.82	292.40±6.99	5.35	226.00±5.36	5.30	168.00±5.51	7.33	137.00±6.57	10.73	112.00±3.79	7.58
High	F	275.00±5.36	4.51	310.80±7.20	5.46	240.40±4.48	4.17	176.80±3.66	4.63	151.40±6.99	10.33	119.50±2.93	5.51
	M	249.20±6.11	5.49	263.60±4.48	3.80	209.20±6.11	6.54	150.40±4.48	6.67	129.80±4.48	10.54	88.00±3.79	9.64

From a functional point of view starvation tolerance is mediated by the amount of available reserves, especially lipids [5]. Desiccation tolerance, on the other hand, depends upon capacity to resist water loss, and could be related to size, cuticular impermeability and also to respiratory rhythm [6]. The two traits are thus likely to be [7,4] found a positive correlation between desiccation and starvation tolerance, and explained their data by a modification of behaviour. A decrease of metabolism in quitter flies is likely to reduce both the rate of water loss through respiration and the rate of reserve utilisation.

The significant effect of rearing density on high temperature, starvation and desiccation resistance in the above experiment may have been related to the smaller size of-adults from high density cultures. Larger flies tend to have higher resistance to stress than smaller ones in several *Drosophila* species. For sand-flat bivalves, combining biotic and abiotic stress regimes, viz. higher density and sedimentation, increased mortality as compared with either stress alone. Here, higher density increased mortality to high temperature. Body size variations match desiccation tolerance along latitude and it is possible that lower desiccation mortality in low density grown flies is a simple physical by-product of large body size. Body size changes are correlated with starvation resistance. Because rate of metabolism is a function of body size, this has implications for the rate at which flies die of starvation. The smaller body size in high density grown flies may tend to cause starvation stress due to a higher rate of metabolism per unit weight.

Table 3: Results of ANOVA applied to test the variability due to temperature, density and sex for starvation and desiccation tolerance in *D.immigrans*.

Source of variation	df	Starvation		Desiccation	
		MS	% Var	MS	% Var
Temperature (1)	5	106460.7	90.58	4055.912	91.840
Replicate (2)	4	483.2	.328	15.288	.276
Density (3)	1	12080.1	2.055	256.961	1.163
Sex (4)	1	22742.5	3.870	332.001	1.503
1 x 2	20	150.6	.512	20.937	1.896
1 x 3	5	441.1	.375	10.046	.227
2 x 3	4	22.1	.015	.931	.016
1 x 4	5	311.2	.264	22.979	.520
2 x 4	4	89.9	.061	2.360	.042
3 x 4	1	38.5	.006	6.721	.030
1 x 2 x 3	20	107.1	.364	8.925	.808
1 x 2 x 4	20	307.3	1.045	9.530	.863
1 x 3 x 4	5	161.4	.137	4.240	.096
2 x 3 x 4	4	20.5	.013	4.617	.083
1 x 2 x 3 x 4	20	107.4	.365	6.957	.630

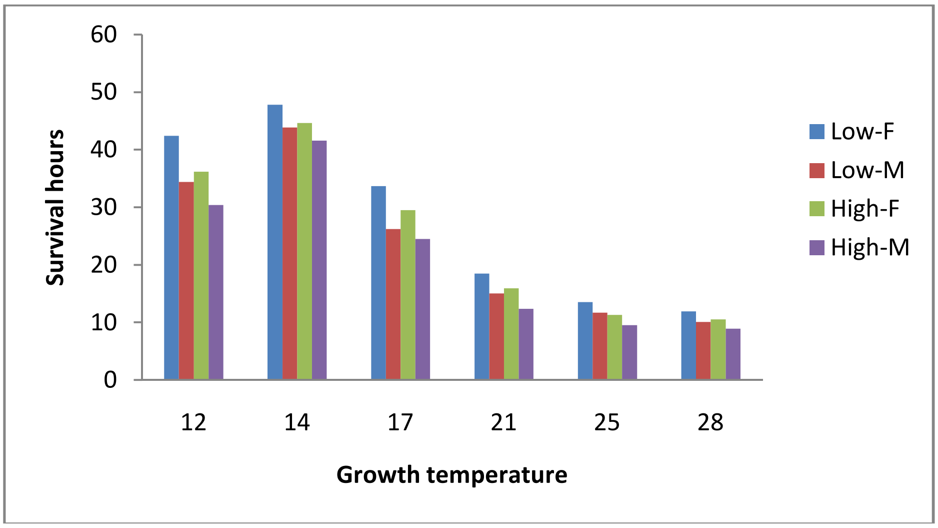

Fig 1. Comparison of desiccation survivl hours at low and high density in both the sexes in *Drosophila immigrans*

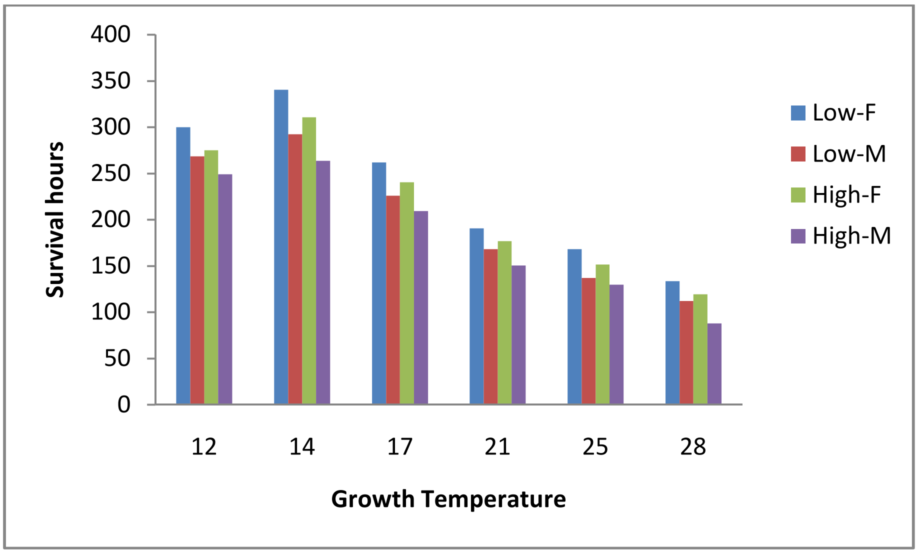

Fig 2. Comparison of starvation survival hours at low and high density in both the sexes in Drosophila immigrans

REFERENCES

1. Baldal EA et.al . (2005). The effects of larval density on adult life-history traits in three species of *Drosophila*. Mech Ageing Dev. Mar; 126(3):407-16
2. Da Lage, J.L., Capy, P. and David, J.R. (1990). Starvation and desiccation tolerance in *D.melanogaster*: differences between European, North African and Afrotropical populations. Genet. Sel. Evol. 22, 381-391.
3. Hoffman A.A., Parsons P.A. (1989b). An integrated approach to environmental stress tolerance and life history variation: desiccation tolerance in *Drosophila*. Biological Journal of Linnean Society, 37, 117-136.
4. Hoffmann A.A., and Parsons P.A. (1993). Selection for adult desiccation resistance in *Drosophila melanogaster*. Fitness components, larval resistance, and stress correlations. Biological Journal of Linnean Society, 48, 43-54.
5. Da Lage J.L., Capy P, David JR. (1989). Starvation and desiccation tolerance in *Drosophila melanogaster* adults: effects of environmental temperature. J. Insect. Physiol. 35, 453-457.
6. Hoffman A.A. and Parsons P.A. (1989). Selection for increased desiccation resistance in *D. melanogaster*: Additive genetic control and correlated responses for other stress. Genetics 122, 837-845.
7. Edney EB. (1977). Water balance in Land Arthropods. Springer, Berlin, W. Ger.

CITE THIS ARTICLE

M.S Ghalaut. Effect of Larval Density on Starvation and Desiccation Tolerance in *Drosophila immigrans*. Res. J. Chem. Env. Sci. Vol 4 [2] April 2016. 16-18

