Study on survival rates of different stages of *Exochomus nigromaculatus* (Coleoptera: Coccinellidae) by using of mathematical curves

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Abstract: Study on survival rates of different stages of *E. nigromaculatus* by using of numerical curves were conducted. Experiments were done at laboratory conditions; 15, 20, 25, 30, 35, and 40°C, and 65±5% relative humidity, and 14:10 (L:D) photoperiod. Maximum survival rate was occurred at 30°C by 88.28% for immature stages from egg to adult, and minimum survival rate was occurred at 40°C by 8.88 % for immature stages from egg to adult. Results were showed that all of adult coccinellids were alive until 64^{th} day, and survival rate were 100% for this period. After 64^{th} day, survival rates were decreased. At 120^{th} day, last coccinellid was death. Biological equation of these adult coccinellid survival rates were:

$Y= -0.0003091x^2+ 0.00879x+ 0.9623$ (For males)
$Y= -0.0001214x^2+ 0.00719x+ 0.9316$ (For females)

Key-Words: survival rates, numerical curves, predator, biological parameters, *Exochomus nigromaculatus*

1 Introduction

Several aphid species can be important pests in glasshouses crops including sweet pepper and cucumber on a large area of Dutch glasshouses biological control of aphids is successful. Most aphid species in glasshouses can, when needed, be controlled with selective aphicides. The cotton aphid, however is highly resistant to selective insecticides (1).

Lady birds, members of the coleoptera, are well known insects because of their bright colors beneficial roles. These beetles are also commonly called lady beetles, lady bugs, and coccinellids. Most lady birds species are carnivores: both adults and larvae are primarily predators of aphids and other species pests (7). *Exochomus nigromaculatus* is an endemic predatory coccinellid beetle found throughout Iran (Guilan province)(2). Among all aphidophagous insects, the coccinellids often have the strongest impact on aphid populations . Comparisons of survival rates of different stages of *Exochomus nigromaculatus* with other coccinellids for select of best predator for biological control are goals of this survey.

2 Materials and Methods

Individuals of E. nigromaculatus used in this study were obtained from adults collected from Oleander infested in around of Rasht city in nourth of Iran.

Rearing cages (8×10×12cm) covered on all sides with 40 mesh/inch and top were used for the propagation of *E. nigromaculatus* infested Oleanders with *Aphis nerii*(4th and 5th nymphal stages)were periodically provided for development of the predator. Replicates of lasrval stages were 30 individuals for each stages and replicates of adult stage were 8 individuals for each sexes. The effect of 6 temperatures (15, 20, 25, 30, 35, and 40°C) on survival rate of immature stages were studied. Then survival rate of adult stage (male and female)of *Exochomus nigromaculatus* on 30°C, and 65 ±5% and 14:10(L:D) were attempted. Daily mortality of immature and mature stages of Lady beetle were noted and then numerical curves were conducted with numerical equation for each stages. In processing of data obtained standard methods of mathematical statistics were used namely dispersive and correlative analysis as well as Williamson (5).

Fig-1. Temperature effect on survival and duration on *E. nigromaculatus* development from the 1st instar larvae to the adult

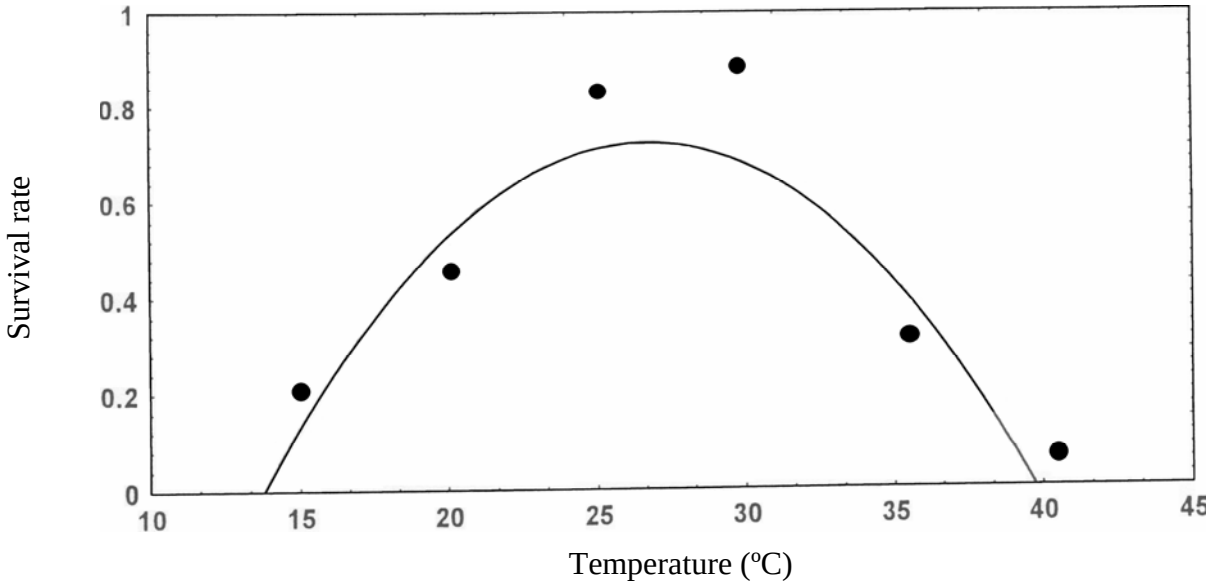
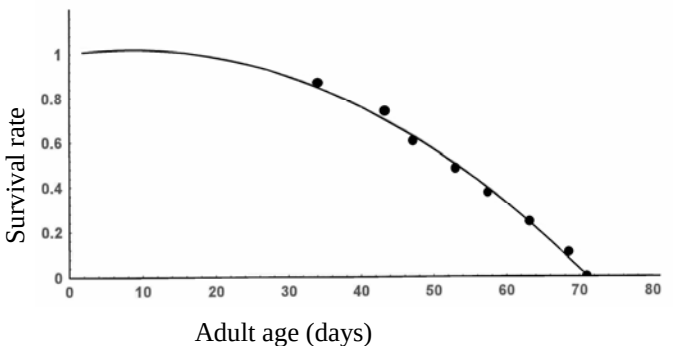


Table 1. Survival percent of different developmental stages of *Exochomus nigromaculatus* feeding on *Aphis nerii* at six constant temperature

Temperature ºC	Survival rate (percent)							
	1st larvae	2nd larvae	3rd larve	4th larvae	1-4th larvae	Pre pupa	pupa	Total
15	72.63	82.65	81.33	88.54	43.22	73.78	66.20	21.14
20	85.76	90.37	95.70	96.55	71.61	82.82	77.46	45.93
25	91.73	93.53	96.21	100	82.53	100	100	82.54
30	94.80	95.18	97.84	100	88.28	100	100	88.28
35	81.73	86.30	84.00	88.93	52.69	84.61	71.81	32.00
40	69.40	72.66	83.33	74.60	35.00	62.50	40.00	8.88

Fig2- Survival rate of *E. nigromaculatus* (male) on the life span



3 Results and Discussion

The dependence of *E. nigromaculatus* survival rate at pre imaginal stages on temperature is approximated by the second order parabola (fig1). Observations of pre imaginal development at different temperatures showed that survival rate of each stages is less at lower and higher temperatures (fig1). The development of *E.nigromaculatus* is possible at temperatures rearing from 15 to 40 ºC. The maximum survival rate (88.28%) over the period of pre imaginal development is observed at 30ºC (table 1). According to the experimental data, the temperature at preimaginal development affect the adult longevity, female fecundity and survival rates of males and females. The dependence of the average adult longevity of *E. nigromaculatus* upon temperature conditions of adult stages (male and females) are approximated by the quadratic parabola respectively:

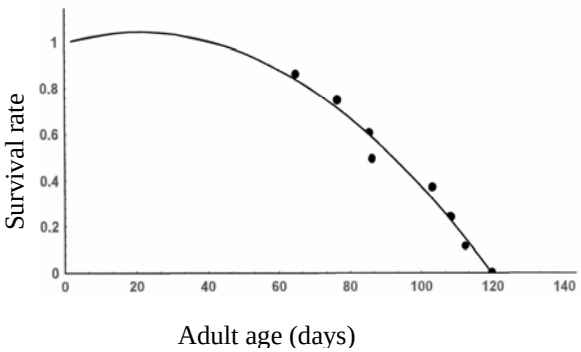
$$y= -0.0003x^2+0.00879+0.9623$$
$$y= -0.0001214x^2+0.00719+0.9316$$

The linear model has been widely criticized on various grounds, but still predicts phonological events in the field at least as non linear models (6). Therefore we consider it a useful model for comparing the development of E. nigromaculatus.

For adult stages, survival rate are decreasing to the end of life span and for male lady beetles are less than females. Athe first mortality of adults occurred at 32nd day and was 61st day for females (fig 2,3).

To choose temperature for the maximum production of biological material both aspects should be kept in mind. Let us use the approximate method of calculation of generation development duration (4).

Fig2- Survival rate of *E. nigromaculatus* (female) on the life span



References:

[1] Fark, C. and C. M. Hines. 1993. Aspects of insecticides resistance in the melon and cotton aphid, Aphis gossypii (Hemiptera: Aphididae). Annals of Applied biology. 123: 9-17.

[2] Gordon, R.D. 1985. The Coccinellidae of America, Asia, North of Mexico .J. of, American Entomol. Soc., 93:1-912.

[3] Honek, A.1985. Habitat preference of aphidophagous coccinelidae (coleopteran) Entomophaga, 30: 253-264.

[4] Pianka, A.I. and Izhevsky, S.S. 1979. The introduction and application of beneficial organisms for pest control in the USSR. In: Proceedings of the joint American- Soviet conference on use of beneficial organisms in the control of crop pests. Wash., 31-35.

[5] Williamson M., 1972. The analysis of biological popalations. Edward Arnold, Univercity of York. London.

[6] Worner, S.P. 1992. Performance of phonological models under variable temperature regimes: consequences of the Kaufmann or rate summation effect. Environ. Entomol. 21(4): 689-699.

[7] Yurtesever, S., 2001. A preliminary study on the Ladybirds (Coleopteran: Coccinelldae) of Edirne in North-Western Turkey. Turk J. Zool. Vol:25, 71-75.