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Embryo Development and Egg Hatching of *Sitona crinitus* Herbst (Coleoptera: Curculionidae) under Constant Temperature Regimes

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Abstract: The effect of constant temperatures (5, 8, 10, 15, 20, 25, 30 and 35°C) on embryo development period and percentage of egg hatching of *S. crinitus* Herbst was determined in the laboratory. A significant negative relationship ($P < 0.05$; $r = -0.84$) was found between temperature and embryo development. At temperatures below 35°C there was no significant effect on egg hatching. At 30°C, the embryo development period was the shortest, 7 days; whereas at 8°C this parameter was the longest, 69 days. At 35°C eggs became dry and deformed. Temperatures below 10°C induced quiescence in the egg stage. This information is useful for predicting *S. crinitus* infestation levels.

Key words: *Sitona crinitus*, lentil, temperature, embryo development

INTRODUCTION

Many *Sitona* species infest leguminous plants, but only a few are important and widespread in the Northern Hemisphere of the old world[1]. In Eastern Mediterranean areas, five species are considered economically important to legumes. These are *S. crinitus* Herbst, *S. hispidulus* F., *S. limosus* Rossi, *S. lineatus* L. and *S. lividipes* Fhars[2,3].

S. crinitus Herbst is the major insect pest of lentil in West Asia and North Africa[1,4]. It is the most abundant species infesting lentil in Northern Syria. Ninety five percent of adults on lentil were *S. crinitus*[5]. The adult feeds on leaflet edges, causing severe damage to seedlings, especially when growing conditions are not favorable[6]. The main damage, however, is caused by the larvae feeding on the nodules, which negatively affects the ability of the plant to fix atmospheric nitrogen[1]. Infestation of leaflets may reach 95% and larvae may destroy 93% of the nodules[5,7]. At high infestation levels (93.5% nodule damage), yield losses of 17.7 and 14.1% in straw and seed, respectively, have been recorded[7].

Biological studies of the *Sitona* species, particularly *S. crinitus,* have been done in Syria under field conditions[1]. The objective of this study was to determine the effect of constant temperatures (5, 8, 10, 15, 20, 25, 30 and 35°C) on embryo development period and egg hatching of *S. crinitus* in the laboratory.

MATERIALS AND METHODS

Sexually mature adults were collected on 12 February 1998 from lentil fields at Tel Hadya, the experimental farm of the International Center for Agricultural Research in the Dry Areas (ICARDA). One hundred adults were placed in rearing cages (17×13×13 cm) and held under laboratory conditions (22±2°C, 60±5% Rh, 16 : 8 LD) for egg laying.

Seeds of a lentil local variety was planted in pots in a plastic house (20±2°C, 60±5% Rh, 16 : 8 LD) to provide fresh leaves for feeding. Eggs <12 h. old were collected daily from the rearing cages. Random samples of 25 eggs were placed on moist filter paper in petri dishes and transferred to thermo gradient plates. The plates were set at eight different temperatures (5, 8, 10, 15, 20, 25, 30 and 35°C). Each plate was divided into three sections and one petri dish with 25 eggs was placed in each section. The optimum Rh for egg hatching is 90%[3]. The humidity in petri dishes was maintained at 90±5% by adding a few drops of distilled water every morning. The number of eggs hatched was recorded daily by examining individual petri dishes under a binocular microscope (40X) until all eggs hatched. The data was analyzed using the Statistical Program[8]. The variability of the differences in lengths of embryo development period and percentage of egg hatch was analyzed with analysis of variance (ANOVA) and Duncan's Multiple Range Test. Regression analysis

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between temperature and the length of embryo development period and percentage of egg hatch was determined. Because there was no egg hatch at 5°C, data of this temperature were not included in the regression analysis.

RESULTS AND DISCUSSION

A significant negative relationship between temperature and development period of embryos was found ($P<0.05$; $r = -0.84$). As temperature increased, the period of embryo development decreased, except at 35°C where the length of embryo development period increased. The optimum temperature for development was 25-30°C (8-11 days). At 30°C, the embryo development period was the shortest, 7 days; whereas at 8°C it was the longest, 69 days (Fig. 1). At 5°C there was no egg hatching during the three months of the experiment. However, when eggs were transferred from 5 to 25°C they all hatched within 7 days.

At temperatures below 35°C, there was no significant effect of temperature on egg hatching, with the highest percentage occurring at 30°C. At 35°C there was very little egg hatching as most of the eggs became dry and deformed (Fig. 2).

Although insects are not always exposed to constant temperatures in nature, controlled studies can provide valuable insight into the population dynamics of a particular species[9]. The results illustrated the effect of temperatures on embryo development period and percentage of egg hatching of *S. crinitus*; these are important parameters for laboratory and biological studies.

The relationship between developmental rate of arthropods and temperature is nonlinear. Typically, the development rate increases from zero at a low temperature threshold, reaches a maximum at an optimal temperature and then decreases rapidly to zero at an upper lethal temperature[10]. Similar temperature effects were recorded in the present study. The egg development period and percentage of egg hatch of *S. crinitus* increased to optimal levels at 25 and 30°C and then decreased at 35°C. However, this decrease was due to dryness and resultant deformation of eggs. (Fig. 1). Tsal and Liu[11] reported similar effects of temperature on the developmental time of rice aphid (*Rhopalosiphum rufiabdominalis* Sasaki) (Homoptera: Aphididae). High temperature (>30°C) caused a decrease in developmental rate of all immature stages and resulted in a departure from a linear developmental rate; the nymphs did not develop beyond

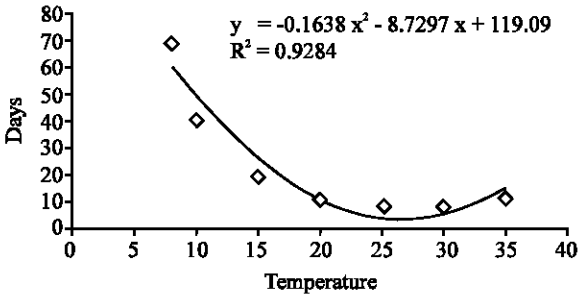

Fig. 1: Effect of constant temperature on egg embryo development period of *Sitona crinitus*, Tel Hayda, 1998

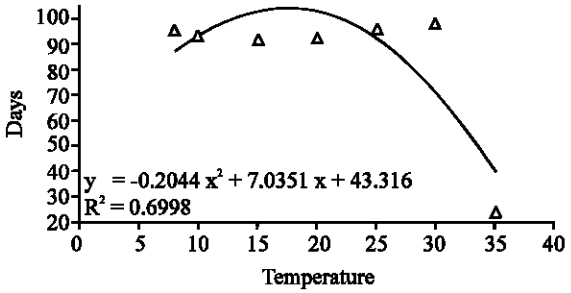

Fig. 2: Effect of constant temperature on percent egg hatch of *Sitona crinitus*, Tel Hayda, 1998

the 3rd instar at 35°C. The regression in our study was polynomial. The embryo development period (Y1) and percentage of egg hatching (Y2) were related to the temperature (X) in a quadratic fashion as described by the following equations:

$$Y1 = 0.1638x^2 - 8.7297x + 119.09 \quad (1)$$

$$Y2 = -0.2044x^2 + 7.0351x + 43.316 \quad (2)$$

Embryo development period of *Sitona* species was found to vary according to temperature and humidity[12]. The percentage of egg hatching for four species of *Sitona* (*S. hispidulus, S. lividips*, *S. lineatus* and *S. crinitus*) fed on pea leaflets was reduced when temperature exceeded 25°C and no eggs hatched at a relative humidity of 56% or less[3].

In Finland the embryo development period of 11 species of *Sitona* including *S. crinitus* was 29-32 days at a mean temperature of 11.5-12°C[13]. The incubation period of *S. hispidulus* was 21 days in summer and 150-200 days in winter[14].

Long embryo development period of *S. crinitus* with high percentage of egg hatching at a lower temperature (Fig. 1 and 2) and unhatched eggs at 5°C with high

percentage of egg hatching when incubated at 25°C indicates that temperatures <10°C induces quiescence in eggs of *S. crinitus*. That result was in agreement with previous studies that indicated that some *Sitona* species overwinter as eggs in colder climates[15]. However, Melamed[3] indicated that the temperature threshold for egg development of *S. crinitus* was 5.8°C, whereas it was 4.8, 4.6 and 6.5°C for *S. lividips*, *S. hispidulus* and *S. lineatus,* respectively.

The relationship between temperature and these biological parameters is useful for predicting *S. crinitus* infestations. The long period of quiescence at the egg stage of *S. crinitus* should provide some flexibility in rearing the insect and its egg parasitoids.

REFERENCES

1. Hariri, G., 1981. Insects and Other Pests. In: Lentils, Eds. Web, C. and G. Hawtin (CAB). England and ICARDA, Syria, pp: 173-189.
2. Hariri, G., 1979. Insect pests of chickpea and lentil in the countries of the eastern Mediterranean: A review In: Food legume improvement and development. Eds. Hawtin, G.C. and G.J. Chancellor. Proceedings, Workshop held at the University of Aleppo, Syria. ICARDA and IDRC, Canada, pp: 120-123.
3. Melamed M.V., 1966. Observations on four species of *Sitona* (Coleoptera: Curculionidae) occurring in eastern Mediterranean regions. Bull. Entomol. Res., 56: 505-514.
4. Solh, M.B., H.M. Itani and N.S. Kawar, 1986. The effect of Sitona weevil on nodulation and yield of lentils and the implication of certain control measures. Lebanese Sci. Bull., 2: 17-26.
5. Tahhan, O. and G. Hariri, 1982. Chemical control of lentil insects in northern Syria. Lens Newslett., 9: 37-39.
6. Weigand, S., M. Pala and M.C. Saxena, 1992. Effect of sowing date, fertilizer and insecticide on nodule damage by *Sitona crinitus* Herbst. (Coleoptera: Curculionidae) and yield protection. J. Plant Dis. Protect., 99: 174-181.
7. Cardona, C., 1983. Insect pests of Fababean, lentil and chickpea in North Africa and West Asia: A review of their economic importance. In Faba beans, Kabuli chickpeas and lentil in the 1980s, Eds. Saxena, M.C. and S. Varma, Proceedings International Workshop, May 1983, ICARDA, Aleppo, Syria, pp: 159-167.
8. MSTAT, Michigan State Microcomputer Statistical Program, 1986. Microcomputer Statistical Program: User's Guide. Michigan State University, East Lansing.
9. Summers, C.G., R.L. Coviello and A.P. Gutierrez, 1984. Influence of constant temperatures on the development and reproduction of *Acyrthosiphon kondoi* (Homoptera: Aphididae). Environ. Entomol., 13: 236-242.
10. Lactin, D.J., N.J. Holliday, D.L. Johnson and R. Craigen, 1995. Improved rate model of temperature dependent development by arthropods. Environ. Entomol., 24: 65-75.
11. Tsal, J.H. and Y.H. Liu, 1998. Effect of temperature on development, survivorship and reproduction of rice root aphid (Homoptera: Aphididae). Environ. Entomol., 27: 662-666.
12. Andersen, K.T., 1931. Der linierte Gratürnssler older Blattrandkåfer. Monog. Pflanzenschutz, Rev. Applied Entomol., 6: 1-88.
13. Markkula, M., 1959. The biology and especially the oviposition of the *Sitona germ.* (Coleoptera: Curculionidae) species occurring as pests of grassland legumes in Finland. Publications, Finnish State Agricultural Research Board, 178: 41-74.
14. Underhill, G.W., C.E. Turner and R.G. Henderson, 1955. Control of the clover root curculio on alfalfa with notes on life history and habits. J. Econ. Entomol., 48: 184-187.
15. Grigorov, S.P., 1956. Investigations of biology, damage and control measures of the most prevalent species of the genus *Sitona*, Germ. (in Bulgarian with Russian summary), *Nautšni trydove*, Sofia, 3: 325-434.