The Great Lakes Entomologist

Volume 14
Number 3 - Fall 1981 *Number 3 - Fall 1981*

Article 3

October 1981

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P. C. Kingsley
University of Wisconsin

B. J. Harrington
University of Wisconsin

DEVELOPMENT OF *ORIUS INSIDIOSUS* (HEMIPTERA: ANTHOCORIDAE) IN RELATION TO TEMPERATURE

P. C. Kingsley and B. J. Harrington[1]

ABSTRACT

A developmental threshold of 10.3°C and a thermal constant of 307 day-degrees C were estimated for a Wisconsin population of *Orius insidiosus* (Say) (Hemiptera: Anthocoridae) by rearing eggs and nymphs at various constant temperatures.

Orius insidiosus (Say) is a small (~3 mm) widely distributed predaceous bug, commonly associated with flowers. It is generally considered a polyphagous predator feeding on a wide variety of economically important arthropods including thrips, aphids, mites and eggs of various Lepidoptera.

This study estimates the two developmental parameters, thermal constant (K) and developmental threshold (t), or base temperature, for a population of *insidiosus* in Wisconsin. To date, estimations of t and K for *insidiosus* have not been reported although some studies have dealt with developmental times for this bug or related species (Askari and Stern 1972 a, b; Barber 1936; Marshall 1930; Rajasekhara and Chatterji 1970; Salas-Aguilar and Ehler 1977). Cambell et al. (1974) stated that the developmental threshold is "the temperature below which no measurable development occurs" and Peairs (1927) defined the thermal constant as "the total of effective temperatures expressed in day-degrees to which the organism is subjected during the developmental period under consideration." These parameters, estimated from laboratory rearing experiments, are necessary to predict the number of day-degrees required by *insidiosus* to complete a generation in the field and thereby better understand the phenology of this important predator.

MATERIALS AND METHODS

A total of 316 eggs were collected from several females reared at 28°C and under a long-day photoperiodic regime of 8 hours dark and 16 hours light (8D:16L). These females, after being denied ovipositional material for one day, were introduced to alfalfa sprouts (four to five days old) and allowed to oviposit for three hours. Sprouts with eggs were placed in 5-cm plastic petri dishes with two moist filter paper discs lining the bottom. These dishes, each with approximately 20 eggs, were distributed among four temperature treatments (15, 20, 28, 33°C) in Percival incubator cabinets. All treatments were maintained at 8D:16L photoperiod. Eggs were checked every 12 hours until the development of eyespots and thereafter at three hour intervals for eclosion.

In a separate experiment, to determine nymphal development time, first instar nymphs were collected at 12-hour intervals as they eclosed from eggs maintained at 28°C, 8D:16L. Two hundred and six nymphs were distributed among five temperature treatments (15, 20, 28, 30 and 33°C; all at 8D:16L). A large proportion of the nymphs were assigned to the 15° treatment to compensate for a high mortality which was expected from the results of pre-

[1]Department of Entomology, University of Wisconsin, Madison, WI 53706.

liminary rearing experiments. Rearing cages consisted of 9-cm by 5-cm Pyrex® crystallizing dishes with a filter paper disc lining the bottom and a Teflon® coating painted around the upper edge to prevent climbing and escape of the insects. Water was supplied from a 3-dram vial with a dental wick inserted into a hole in the cap. An average of five nymphs was placed in each cage and both checked for mortality and fed a more than adequate supply of eggs of *Trogoderma glabrum* (Herbst) (Coleoptera: Dermestidae), daily. These eggs had been killed by freezing and stored at −20°C for approximately one month. After *Orius* nymphs reached the fifth instar, cultures were checked every 12 hours for adult eclosion.

Thermal constant and developmental threshold parameters were estimated following the procedure used by Cambell et al. (1974), except that, from our experiments with *Orius*, values for t and K were determined for egg and nymphal stages separately.

To study the relationship between temperature and development of *insidious* eggs and nymphs, a linear regression, $y = a + bx$, was calculated for each stage as follows. The developmental times for each egg and nymph were converted to a rate of development (1/days) (y), and plotted against the corresponding temperature treatment (x). For clarity, only mean rates for each temperature treatment are indicated in Figure 1. A developmental threshold for each stage was calculated as the x-intercept of the corresponding regression line. Thermal constants (expressed in day-degrees C) were calculated as the reciprocal of the slope (b) of each regression line (Cambell et al. 1974).

RESULTS AND DISCUSSION

The duration and mortality of *O. insidiosus* eggs maintained at four constant temperature treatments are given in Table 1 and the computed regression line is shown in Figure 1.

The developmental threshold, estimated by extrapolation, for the egg stage was 8.8°C. A thermal constant of 66.5 day-degrees was required to complete development from oviposition to egg hatch.

Eggs maintained at 15°C showed very slow development and after 23 days the experiment was terminated. The expected duration for eggs maintained at 15°C (estimated from the regression line computed from the three remaining temperature treatments) is approximately 11 days. Yet, after at least twice this long, the experimental eggs had still not completed development, suggesting that the actual egg developmental threshold may be higher than the estimated 8.8°C.

Nymphs reared at 15°C were also very slow to develop and showed a high degree of mortality. The experiment was terminated after 35 days, by which time 96% (109 of 114) of the nymphs had died. The five surviving nymphs were in the fifth stadium.

The estimated nymphal developmental threshold was 10.7°C and 240.4 day-degrees were required to complete the nymphal development (egg hatch to adult eclosion). Duration and mortality of nymphs reared at the various temperatures are given in Table 2 and the computed regression line for nymphal development is shown in Figure 1.

Table 1. Mortality and developmental duration of *Orius insidiosus* (Say) eggs maintained at four constant temperatures and 8D:16L photoperiod.

Temperature (°C)	Initial No. eggs	Mortality (%)	Duration of egg stage (days)				Rate (1/days)
			Mean	SE	N	Range	
15	88	—	23[a]	—	—	—	—
20	36	17	6.69	0.082	30	6.0–7.3	0.149
28	73	25	3.22	0.023	55	3.0–3.3	0.311
33	119	10	2.84	0.015	107	2.5–3.3	0.352

[a]Experiment terminated, see text for explanation.

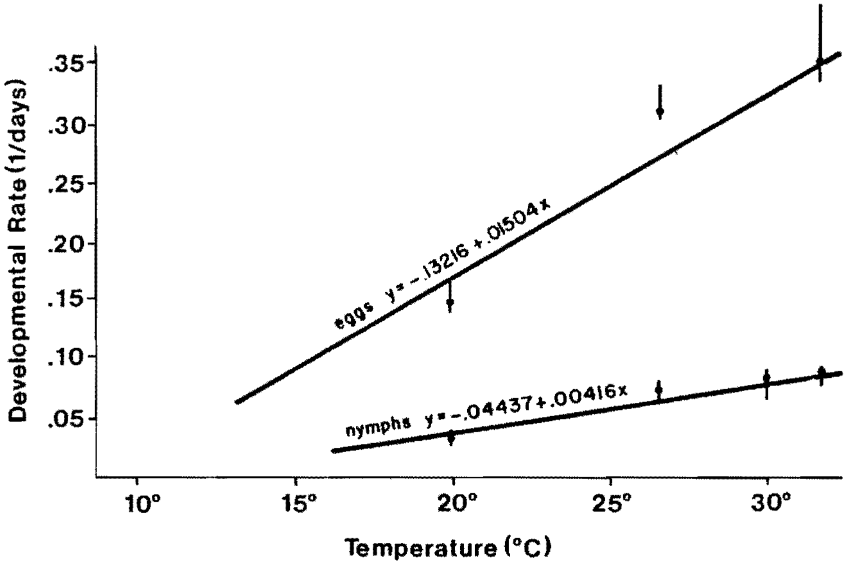

Fig. 1. Regression lines of developmental rate (y) on temperature (x) for *Orius insidiosus* (Say) eggs and nymphs maintained at constant temperatures. Points represent mean developmental rates with vertical bars indicating ranges.

Table 2. Mortality and total nymphal duration of *Orius insidiosus* (Say) reared at five constant temperatures and 8D:16L photoperiod.

Temperature (°C)	No. 1st instars	Mortality (%)	Duration of nymphal stage (days)				Rate (1/days)
			Mean	SE	N	Range	
15	114	96	35[a]	—	5	—	—
20	29	14	26.54	0.47	25	23.0–30.5	0.038
28	24	21	13.58	0.16	19	12.5–15.0	0.074
30	23	30	12.00	0.29	16	11.0–15.0	0.083
33	16	19	11.35	0.20	13	10.5–13.0	0.088

[a]Experiment terminated. see text for explanation.

Under the conditions of these experiments an overall K of 307 day-degrees, for *insidiosus*, development from oviposition to adult eclosion, can be approximated by summing the values obtained for the egg and nymphal stages. From separate experiments on egg and nymphal development, different developmental threshold values were calculated for the egg (t = 8.8°C) and nymphal (t = 10.7°C) stages. However, a single intermediate developmental threshold value of 10.3°C was estimated by interpolation

$$\frac{(\text{egg t} \times \text{egg K}) + (\text{nymphal t} \times \text{nymphal K})}{\text{overall K}} = \text{overall t.}$$

This overall t, utilized with minimal and maximal daily temperature information, can be used to calculate accumulated day-degrees in the field for *insidiosus* populations.

Two important limits to interpretation of the results of such experiments must be considered, however, when laboratory estimated values for t and K are applied to the phenology of field populations. First, and most obviously, the inherent differences between laboratory and field conditions must be remembered. Second, even though *Orius* is considered a generalist as a predator, developmental times may vary with different prey species and/or stages. The degree of omnivory also may play an important role in a predator's development. Recently, Salas-Aguilar and Ehler (1977) have reported that *O. tristicolor* (White) developed significantly faster when a diet of thrips was supplemented with pollen.

With these possible limitations in mind, our laboratory obtained developmental parameters may be used, with the addition of a preovipositional interval, to predict the number of generations and approximate time of population peaks for *insidiosus* in the field in Wisconsin. Such predictions for the single growing season of 1979 coincided quite closely with the actual field phenology of *insidiosus* obtained by regular sampling of soybeans and alfalfa at Arlington Experimental Farms, Arlington, Wisconsin, where two generations reached adult population peaks on 6 August and 27 September (Kingsley 1980).

ACKNOWLEDGMENTS

We thank D. M. Benjamin for helpful comments regarding the manuscript. Research supported by the College of Agricultural and Life Sciences, University of Wisconsin-Madison and by Federal Hatch Support, Project No. 2391.

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