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LIFE HISTORY CHARACTERSTICS OF *LYGUS ELISUS* IN THE LABORATORY

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Abstract

Life history characteristics of *Lygus elisus* were studied at 10, 15, 20, 25, 30 and 35 ^{0}C in the laboratory. The developmental duration of *Lygus elisus* was influenced by temperature. Total nymphal durations were 83.1, 44.2, 29.3, 21.0, 14.3, and 10.8 at 10, 15, 20, 25, 30 and 35 ^{0}C, respectively. The relationships between temperature and total durations were described by the same equation for both males and females. The total nymphal duration did not differ with sex. Sex ratio (proportion of males) of emerging adults of *L. elisus* did not vary from 1:1 and ranged from 0.46 to 0.64. Instar-specific survival rates also did not differ among all temperatures but total nymphal survival rates varied significantly across the temperatures ranging from 0.41 to 1.00.

Introduction

In recent years several species of *Lygus* bugs have been identified as emerging pests of cotton in the Texas High Plains. The *Lygus* complex in the Texas High Plains consists of *Lygus hesperus* (87%), *Lygus elisus* (12%) and *Lygus lineolaris* (1%). *Lygus* bugs are major pests of cotton in other parts of the cotton belt. *Lygus hesperus* is a major pest of cotton with simultaneous occurrence of *Lygus elisus* in the San Joaquin Valley, CA (Sevacherian et al. 1977), whereas *L. lineolaris* is a dominant cotton pest in the mid-south (Snodgrass and McWilliams 1992). Besides cotton, *Lygus* bugs are pests of many cultivated crops, including vegetables and fruit crops. In the central valley of California, the *Lygus* complex consists of *L. elisus* and *L. hesperus* with *L. hesperus* populations in most cases comprising 96-99% of the complex (Godfrey 2001). The potential factors influencing *Lygus* abundance include its migratory ability, wide host range and irrigation management. So it is imperative to have a thorough knowledge on the biology of the *Lygus* bug to strengthen IPM programs in managing this pest. Information on laboratory biology and field ecology of *L. elisus* has been lacking. The objective of this study was to determine the effect of temperature on immature development and survivorship of *Lygus elisus* in the laboratory.

Materials and Methods

Lygus elisus used in this study were from a laboratory colony that originated from a field collection near the Texas Agricultural Experiment Station, Lubbock, Texas. The *Lygus* adults collected from the field were reared in plastic containers (19.5 by 15.3 cm) with green beans (*Phaseolus vulgaris* L.) as food purchased at a local grocery store (Debolt 1982, Bailey 1986, Snodgrass and McWilliams 1992). A temperature of 25±2 ^{0}C and a relative humidity of 60±10% were maintained in the rearing room. Fresh beans were given to the bugs every 2 days and beans containing eggs were removed and placed in separate containers. The eggs were allowed to hatch in the rearing room (Beards and Leigh 1960) and these newly hatched nymphs were used for this study. The study was conducted at six constant temperatures (10, 15, 20, 25, 30, and 35 ^{0}C) in environmental growth chambers. A constant photoperiod of 14:10 (L: D) h was maintained in the growth chambers for all the temperature treatments. The newly emerged *Lygus* nymphs were individually placed in plastic petridishes (60 x 15 mm) with a small section (1" length) of a green bean. A piece of filter paper (5.5 cm diameter) was placed in each petri dish to provide footing for the nymphs. The green beans were replaced everyday. Each nymph was observed daily for molting and survivorship until the last individual from each treatment molted to the adult stage.

The data were analyzed as a 6 x 2 factorial design with temperature (10, 15, 20, 25, 30 and 35 ^{0}C) and sex (male and female) as factors for each of 5 instars separately and also for all 5 instars combined. Instar-specific nymphal survival rate was calculated as the proportion of nymphs surviving to the next instar and total nymphal survivorship calculated as proportion of nymphs reaching adulthood (Parajulee et al. 1995). The instar-specific and total nymphal survivorship data were analyzed using general linear models procedure (PROC GLM, SAS Institute 2000). Sex ratios of emerging adults across all temperatures were tested using a *G*-statistic (Sokal and Rohlf 1981). The relationship between temperature and nymphal developmental period of male and female *L. elisus* was described using the TableCurve 2D curve fitting program (Parajulee et al. 1995).

Results and Discussion

Nymphal Development

The instar-specific and total nymphal developmental duration varied significantly with temperature. The total nymphal durations were 83.1, 44.2 29.3, 21.0, 14.3, and 10.8 days at 10, 15, 20, 25, 30, and 35 ^{0}C, respectively and were significantly different from each other (Fig. 1, F = 2563.1; df = 5,5; P<0.0001; PROC GLM). The nymphs at 10 ^{0}C took the longest time to reach to adulthood. The second instar was the shortest at 10, 20, 25, and 30^{0}C and 3rd instar was the shortest at 15 ^{0}C and 1st instar was shortest at 35 ^{0}C. Therefore, the results indicated that the temperature influence was different for different developmental stages. The final instar was longest across all six temperatures. Butler and Wardecker (1971) reported developmental periods of 27, 16, and 12 days at 20, 25 and 30 ^{0}C, respectively, for *L. hesperus* which is slightly shorter than for *L. elisus* in this study. Leigh (1963) reported that *L. hesperus* took 13.5 days to reach adulthood at 27 ^{0}C. Debolt (1982) found that *L. hesperus* required 16.5 days to complete development at 25 ^{0}C. These data indicate that *L. hesperus* development is faster than *L. elisus*. The instar-specific and total nymphal durations of males did not significantly differ from that of females at any temperature regimes we evaluated in this study, but males took slightly more time than females across all temperatures. Sex did not effect the duration of immature development of *L. elisus*. Butler and Wardecker (1971) also found that nymphal development of *L. hesperus* was similar between males and females. The relationship between temperature and total nymphal development was described by the equation $(Development\ Time)^{0.5} = a + b/\log(Temp)$ for both females (Fig. 2) and males (Fig. 3). Sevacherian et al. (1977) suggested a development threshold of 11.1 ^{0}C for both *L. hesperus* and *L.elisus* where as Champlin and Butler (1967) determined the threshold temperature of 8 ^{0}C for *L. hesperus*. Our study on *L. elisus* showed the developmental threshold of 8.15 ^{0}C. We expect that the developmental threshold for *L. hesperus* and *L. elisus* would be similar.

Nymphal Survivorship

Instar–specific survivorship did not vary among temperatures but total nymphal survivorship varied significantly with temperature (Table 1) with highest survivorship obtained at 15 ^{0}C (72%) and the lowest at 10 ^{0}C (41%). Total nymphal survival rates were 0.41, 0.72, 0.63, 0.61, 0.44, and 0.56 at 10, 15, 20, 25, 30, and 35 ^{0}C, respectively. These results indicate that ideal environmental conditions for *Lygus elisus* growth and development lie within the range of 15-25^{0}C.

Sex Ratio

The sex ratio (proportion of males) of emerging adults of *L. elisus* ranged from 0.46 to 0.64 among temperatures, but was not significantly different from 1:1 for any of the temperatures examined in this study (Fig. 4, *G*-test, P>0.10). These results indicated that there was no significant effect of temperature on sex ratio of *L.elisus*.

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Table 1. Instar-specific survivorship of *Lygus elisus* at different temperatures.

Nymphal Stage	Temperature °C					
	10	15	20	25	30	35
First Instar	0.67	0.87	0.78	0.85	0.70	0.70
Second Instar	0.81	0.87	0.83	0.91	0.85	1.00
Third Instar	0.83	0.98	1.00	0.93	0.91	1.00
Fourth Instar	1.00	1.00	0.97	0.87	0.93	1.00
Fifth Instar	0.92	0.98	1.00	0.97	0.89	0.79
Nymphal Survivorship	0.41c	0.72a	0.63b	0.61b	0.44c	0.56b

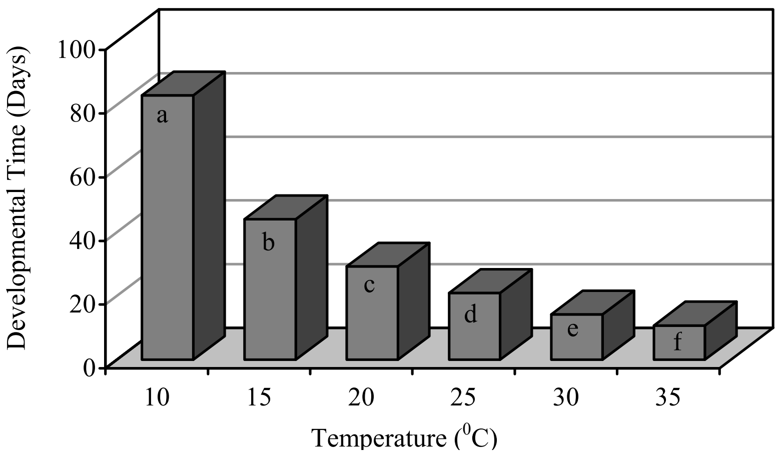

Figure 1. Total developmental duration of *Lygus elisus* as affected by different temperatures.

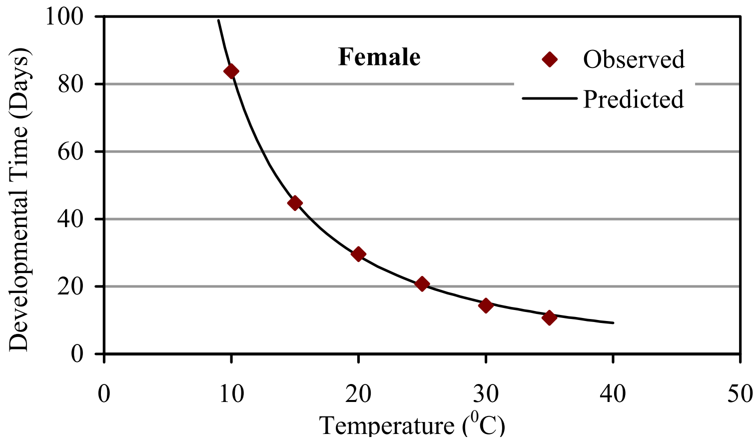

Figure 2. Relationship between temperature and nymphal developmental period of *Lygus elisus* female

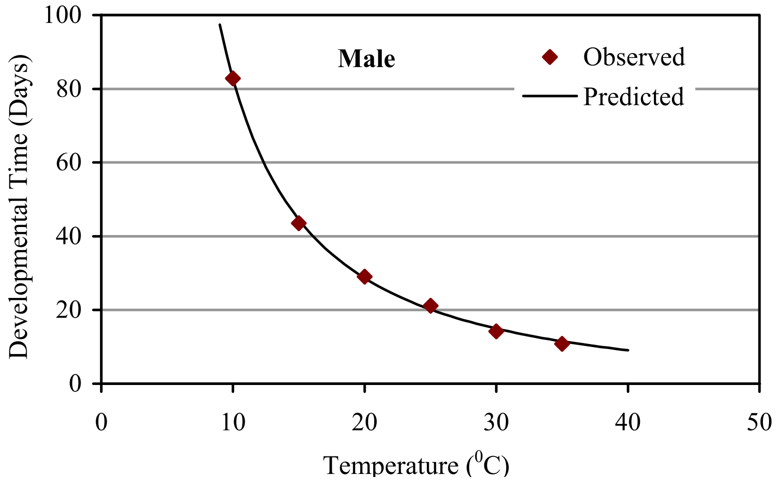

Figure 3. Relationship between temperature and nymphal developmental period of *Lygus elisus* male.

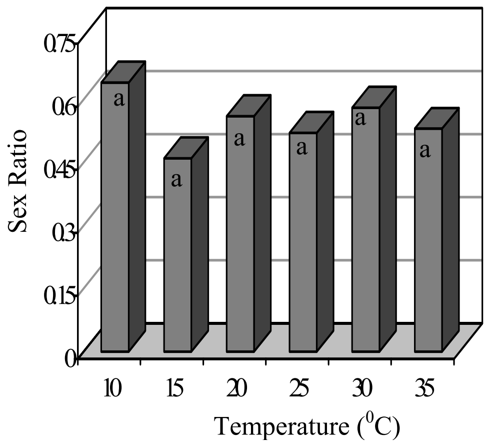

Figure 4. The sex ratio (percentage of males) of *Lygus elisus* at different temperatures.