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Biology of Elm Leaf Beetles *Xanthogaleruca luteola* (Coleoptera: *Chrysomelidae*) in Kurdistan Region-Iraq

Rebwar A. Mustafa*

Research Centre, Polytechnic University of Sulaimani, Kurdistan Region, Iraq

Abstract

Recently, Elm Leaf Beetle *Xanthogaleruca luteola* (Coleoptera: Chrysomelidae) has been recorded as new species in the Kurdistan region-Iraq, which is one of the most important pests on Elm and feeds on the leaves in either larval or adult stages. The biological study of the Elm Leaf Beetle *Xanthogaleruca luteola* (Coleoptera: Chrysomelidae) regarding lifecycle and behavior, was conducted in Halabja city, Kurdistan Region-Iraq. Elm Leaf Beetle *Xanthogaleruca luteola* adults were collected from the Elm host trees Ulmus glabra (Ulmaceae) in Halabja city in 2015 and 2016. The life cycle of Elm leaf Beetle was studied under laboratory condition (25℃ and 60 RH), the means of the incubation period, developmental time of 1st, 2nd, and 3rd larval instars were 2.11 ± 0.02, 4.21 ± 0.09, and 6.01 ± 0.0 1 days, respectively. The mean of a pupal period in the soil and under flurried leaves was 11.00 ± 0.03 days. Means of pre-oviposition, oviposition and post-oviposition periods were 10.42 ± 1.2, 7.78 ± 0.4 and 2.4 ± 0.2 days, respectively. The female and male longevity in rearing was 20.6 ± 0.3 and 21.04 ± 1.2 days, respectively. The mean number of eggs per adult was 78.79 ± 5.3. Overall, the total larval stage period was 18-30 days depending on temperature and humidity. Total larval stage period 18-30 days depending on temperature and humidity, the total period life cycle was 35-50 days. In this study, three generations were recorded per year either in the field and laboratory. Moreover, adults of Elm Leaf Beetle hibernate in the under fallen leaves or soil cracks or tree bark, same places where larvae molting.

Keywords: Elm leaf beetle • *Xanthogaleruca luteola* • Elm trees • *Ulmus* spp.

Introduction

Recently, the elm tree has been imported and cultivated as a shade tree in many urban and rural areas along the roads and streets of the Kurdistan region-Iraq for their attractive shape and foliage. The elm tree is vulnerable to various types of insect pest species. The most important insect pest of this tree is Elm Leaf Beetle (ELB) *Xanthogaleruca luteola* (Coleoptera: *Chrysomelidae*) which feeds on leaves in either larval or adult stages [1,2]. The feeding causes deformities in tree crowns and causes physiological disorders which makes the trees susceptible to several pests, pathological agents and environmental stress [3]. This insect was recently first found in the Kurdistan region of Iraq by a group of a researcher in 2018 [4].

The elm leaf beetle, *Xanthogaleruca luteola* reduces the resistance of elms to Dutch elm disease in addition to direct damages to the tree. The Elm Leaf Beetle is a native European *Chrysomelid beetle* [5] and was introduced to the United State of American, then after in several places of the world, damages of this insect have also been reported [6,7].

The Biology, bioecology of Elm Leaf Beetle has been studied in various regions of the world and on various elm tree species. The main objective of this study was to investigate the bioecology of Elm Leaf Beetle as a newly recorded insect in the Kurdistan region of Iraq, regarding its lifecycle, survival, reproduction, oviposition-site characteristics and feeding behavior. This study will also lead us to find a way to control this newly introduced pest with an environmentally safe pesticide.

Materials and Methods

Location and timing of experiments

Elm Leaf Beetle *Xanthogaleruca luteola* adults used in this study were field collected from the Elm host trees *Ulmus glabra* (Family: *Ulmaceae*) in Halabja city, Kurdistan Region, north of Iraq During 2015 and 2016.

Experimental procedure

After the adults have been collected from the field, they were transferred to the laboratory of the Horticulture Department in Technical College of Agriculture, Polytechnic University of Sulaimani, maintained under laboratory conditions (at 25℃, humidity rate (60-70)%. The adults were reared in a plastic cage (40 × 20 × 10 cm^2) and provided with Elm tree leaves (*Ulmus glabra*) for feeding to observe and record the occurrence and duration of individual development for two seasons (Survival, Reproduction, Oviposition-site characteristic and Feeding Behaviors)

The same observation and estimation were carried on in the field (where located nearby the college of Agriculture, the Polytechnic University of Sulaimani in Halabja City) where the elm trees have low densities and could be accessed easily. All the selected trees on the site were Siberian elm Ulmus pumila and infested by Elm Leaf Beetle during this study. A pair of twigs were selected and marked on each tree and the leaves on each twig were examined twice a week during this study.

***Corresponding author:** Mustafa RA, Research Centre, Polytechnic University of Sulaimani, Kurdistan Region, Iraq, Tel: +9647701474761, E-mail: rebwar.mustafa@spu.edu.iq*

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The Meteorological data of the location of this study were obtained from the weather station of the College of Agriculture, the Polytechnic University of Sulaimani in Halabja City for the whole period of this study (Table 1).

Table 1. Meteorological data of Halabja city during this study*

Date	Air temperature (°C)	Humidity (%)	Soil Temperature (°C)	Daily Sun Shine hours	Precipitation (mm)
Apr-15	17.8	38	18.9	8.4	9
May-15	26.2	26.4	24.2	8.2	9.9
Jun-15	32.2	20.9	29.9	10.7	0
Jul-15	36.2	20.1	32.8	10.4	0
Aug-15	35.6	20.5	33.3	10.5	0
Sep-15	31.9	23.7	29.7	2.7	2.8
Oct-15	23.5	40.8	24.6	2.8	186.1
Nov-15	13.3	53.1	15.2	5.8	143.6
Dec-15	8	54.5	10	4.8	86.1
Jan-16	6.9	57.3	8.8	0	88.9
Feb-16	11.1	49.5	9.9	0	71.2
Mar-16	13.5	46	13.6	0	125.2
Apr-16	20.6	39	18.6	8.3	72.7

* Source: the weather station of the College of Agriculture, Polytechnic University of Sulaimani in Halabja City

Data analysis

The data were analyzed using XL-STAT software to calculate the means.

Results and Discussion

The Elm Leaf Beetle females started to oviposit their eggs in clusters in late April on the field site. Meanwhile, the Elm Leaf Beetle females under laboratory conditions started to oviposit from 19th April, after 11 days period of incubation. In this study, it is noticed that the Elm Leaf Beetle egg clusters were irregularly distributed on the leaves, about 90% of all clusters were placed on the undersurface of leaves, and only 10% were found on the upper-surfaces. The females oviposited eggs in the cluster of various numbers of eggs. Eggs in a cluster were placed in two or three rows. In this study, a total of 118 clusters (1855 eggs) were collected during 2015 and 2016. Cluster size ranged from 7 eggs to 25 eggs. The average mean was 15.72 eggs per cluster.

As shown in Table 2 adult female longevity was divided on 10.42 ± 1.2day Pre-oviposition period, 7.78 ± 0.4 days oviposition period, and 2.4 ± 0.2 days post-oviposition period. The average of oviposited eggs per adult female was 78.79 ± 5.3 eggs.

Table 2. The elm leaf beetle longevity in different stages of its lifecycle.

Growth stage		Longevity period in days	
Larvae	1st instar longevity	2.11 ± 0.02	
	2nd instar longevity	4.21 ± 0.09	
	3rd instar longevity	6.01 ± 0.01	
Pupa		11.00 ± 0.03	
Adult male		21.04 ± 1.2	
Adult female	Pre-oviposition period	10.42 ± 1.2	Total=20.6 ± 0.3
	oviposition period	7.78 ± 0.4	
	Post-oviposition period	2.40 ± 0.2	
The average number of eggs per Female adults=€78.79 ± 5.3			

Molting and hibernation

Larvae molt under fallen leaves or soil cracks or tree bark. Adults hibernate in the same place as larvae under the fallen leaves or soil cracks or tree bark.

Lifecycle

The adults appeared on 8th April 2015 when the average temperature was 19℃, average humidity 38% soil temperature from 30 cm depth was 17.7℃ and sunshine 10.8.

The schemes of the elm leaf beetle life cycles either determined on the field site and under laboratory conditions. In a laboratory study, the collected eggs were kept in an incubator until hatching. The eggs started to hatch after seven days (171 hours). The larvae were confined in clear plastic containers (dimensions: 40 × 20 × 10 cm^3), to examine their life cycle. Similarly, the eggs in the field site started hatching in the middle of the spring season when the temperature was 17℃.

The data in Table 2 shows that the first instar larvae's longevity was 2.11 ± 0.02 days, second larvae 4.21 ± 0.09 days, and third larvae 6.01 ± 0.01 days. The mean of a pupal period in the soil and under flurried leaves was 11.00 ± 0.03 days. Adult male and female longevity were 20.6 ± 0.3 days and 21.04 ± 1.2 days respectively (Table 2 and Figure 1).

The total larval stage period was 18-30 days depending on temperature and humidity, and the total period life cycle was between 35-50 days.

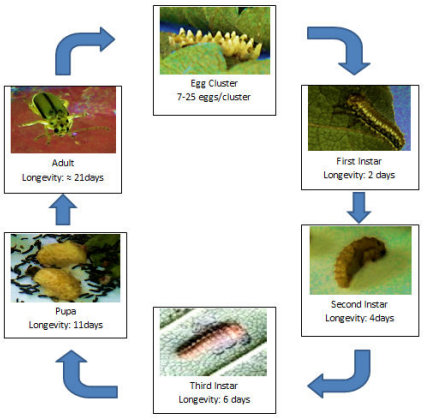

Figure 1. The schemes of the ELB life cycles in Kurdistan Region-Iraq.

During our study, three generations were seen per year depending on the temperature and length of the seasons: the first generation was from middle April to early June; the second generation from early June to middle July; and third-generation from middle June to middle September, while in (Europe, USA, Iran) usually one to two generations occur [8,9]. Additionally, during this study, it is also observed that on 17 October 2015 a few adults emerged oviposition.

Conclusion

In this study, it is found that the elm leaf beetle can adapt to the Kurdistan region-Iraq climate which has recently appeared in this region. Furthermore, this beetle has severely affected elm trees as a host plant in Kurdistan region-Iraq. This investigation on the biology and behavior of Elm Leaf Beetle as a newly recorded insect in the Kurdistan region of Iraq, regarding its lifecycle, survival, reproduction, oviposition-site characteristics and feeding behavior will lead us to find out how to control this newly introduced pest.

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