

A Study Biological and Ecological of Poplar Leaf Beetle, *Chrysomela populi* L. (Coleoptera : Chrysomelidae) In Kirkuk Governorate

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- Date of research received 30/6/2016 and accepted 22/6/2017

Abstract

The life cycle of poplar leaf beetle, *Chrysomela populi* L. which attack poplar studied in Iraq during season 2013. The study showed the mean of incubation period, hatching percent and larval stage (5.61 day, 87% and 8.1 ± 0.80 day) respectively. It was appeared that the larval stage lives and feed on the poplar leaves. The pupal instar was 4.8 days. After the emerge of adult it laid the eggs on the lower surface of the leaves with groups. The study also indicated that the mean number of eggs laid by a single female were 105.3 egg. The sex ratio of male to female was 1:1.7. The longevity of adult, males and females were 47.10, 56.21 days respectively. Also it was found that this beetle has two generations per year. The hibernation appeared in the adult stage. Ecological study has shown that the area and percentage of damage started with the primary appearance of the poplar leaves beetle adults as the beginning of April. The increasing of insects number caused an increase in the area and percentage of damage which reached their maximum means $10.70, 16.30 \text{ cm}^2$ and 12.10 cm^2 , 41.18, 45, 00 and 17.3% for *Populus euphratica*, *Populus nigra* and *Populus deltoids* respectively, this happened when the insects number means reached the maximum 2.00, 2.75 and 2.30 insect / leaf for the above mentioned poplar species at mean temperature 27.30 C^0 and R.H. 32.5%. The statistical analysis showed that there is a significant correlation between the mean insect number and mean of area and percentage damage of the three poplar species with r value (93.45, 90.16 and 89.25) for damaged area and for damage percentage (90.86, 88,71 and 89,60) respectively.

Key words: leaf beetle, biological, ecological, poplar, *Chrysomela populi* L.

دراسة حياتية وبيئية خنفساء أوراق الحور (*Chrysomela populi* L. (Coleoptera : Chrysomelidae) في محافظة كركوك

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الخلاصة

درست دورة حياة خنفساء أوراق الحور *Chrysomela populi* L. التي تصيب أنواع الحور النامية في العراق خلال عام 2013، حيث بلغ متوسط فترة حضانة البيض، على أوراق اشجار الحور النامية في المنطقة. بلغ متوسط فترة طور العذراء 4,8 يوم، بعد بزوغ البالغات وضع البيض على السطح السفلي للأوراق على شكل مجاميع، بلغ متوسط العدد الكلي للبيض للأنثى الملقحة الواحدة 105,3 بيضة، اما النسبة الجنسية فكانت 1 : 7,1 (ذكر : انثى) . بلغ متوسط عمر الذكر وعمر الانثى حوالي 47,10 و 56,21 يوم على التوالي. كما تبين من هذه الدراسة ان لهذه الحشرة جيلين في السنة وان تشنيتها تكون على هيئة حشره كاملة. اظهرت نتائج الدراسة البيئية ان مساحة ونسبة الضرر بدأت مع اول ظهور لكاملات خنفساء اوراق الحور، ومع زيادة اعداد الحشرات ازدادت مساحة ونسبة الضرر حيث بلغ اعلى متوسط لها 10,70 و 16,30 سم² و 12,10 سم² و 41,18 ، 45,00 و 17,30% لأنواع الحور الفراتي *Populus euphratica* والحور الاسود *Populus nigra* والحور الامريكي *Populus deltoides* على الترتيب عندما كانت متوسطات اعداد الحشرات قد بلغت الحد الأعلى وهي 2,00 و 2,75 و 2,30 حشرة / ورقة لأنواع الحور السابقة الذكر عند متوسط درجة حرارة $27,30 \text{ م}^0$ ورطوبة نسبية 32,5% ، كما اثبت التحليل الإحصائي وجود ارتباط معنوي بين متوسط اعداد الحشرات ومتوسط مساحة ونسبة الضرر لأنواع الحور الثلاثة حيث بلغت قيمة r (93,45 و 90,16 و 89,25) لمساحة الضرر و(90,86 و 88,71 و 89,60) لنسبة الضرر على التوالي.

الكلمات المفتاحية : خنفساء الأوراق ، حياتية ، بيئية ، الحور ، *Chrysomela populi*.

Introduction

Poplar is considered as important economic trees belongs to the family Salicaceae, which is distribution in medium, south and north of Iraq. It is having a rapid growth rate and capable of vegetative propagation. Poplar plays a significant role in rehabilitation of degraded forests and fragile ecosystems (FAO,2009; Konijnendijk, 2005 ;Plotnik , 2009). It also a very beneficial plant for industrial use and used locally for a variety of purposes, mainly as constructional timber in round for village hutments, as poles for shuttering work, paper, pulp ,veneer, lumber, particleboard and different hand industries (FAO, 1979 ,Jobling, 1981, Abady , 1988 ,Kasir, and Salih ,1990,Shamsaddeen ,1990,Taylor , 2002, Arab, 1996).The productive of poplar trees in Iraq declined because of humans activities, shifting cultivation, heavy grazing, wars and especially effect of insects' infestation on these trees. (Robert, 1972; Abdulla ,1988). The red poplar leaf beetle, *Chrysomela (Melasoma) populi* L.(Coleoptera : Chrysomelidae) is a common herbivore in poplar plantations whose infestation causes major economic losses. More than 80% of poplar cultivation area is being affected by larvae and adults of *C.populi* leading to attack young poplar plantations and nurseries which is caused reductions in biomass or the death of young nursery plants and destroy the new growth on old trees. Some species of the genus *Populus* and *Salix* are host plants of *C.populi*.

The economic important of red poplar leaf beetle, *C. populi* L. is attack all species of poplar trees and may lead to their death or decline in quantity and quality of their timbers and its known as the most abundant and most important species damaging on *Poplar* spp., and *Salix* spp. *C. populi* L. is distributed almost continuously in Northern Europe (Urban, 1996). There are several records on the harmfulness of this beetle particularly on poplars (Aslan and Ozbek ,1999Georgiev, 2000, Kasap ,1988, Thakur ,1999, Urban, 2006, Tillesse et al., 2007, ZekiveToros ,1996). Several control strategies have been tried to struggle with this pest. (Mustafa et al., 2016). *C.populi* is characterized by high requirements for food quality, leaves of poplars show the higher content of water and total nitrogen as compared with willows, generally ,their nutrition value is substantially higher than in willows, larvae develop normally and imagoes reproduce on poplars, there are considerable differences in the development ,mortality and fecundity of *C.populi* on various clones of *Populus* spp. (Urban .2006).The content and proportion of basic nutrients including secondary metabolites is the basic factor deciding on the selection of hosts and feeding behavior and development of *C.populi* (Zareh et al.,1984)

The researches and studies related to this species of poplar leaf beetle in Iraq are limited, therefore the aim of this review is to summarize information about the ecological and biological which may have driven the divergent evaluation of speared, damages and susceptibility for poplar species, , *Populous nigra*, *P.edltoides* and *P.euphratica* which against red poplar leaf beetle ,*Chrysomela populi* L.

Materials and Method

The experiment was conducted at Dept. of Forestry, College of Agriculture, University of Kirkuk during the spring 2013, at a mean temperature of 31.5±3 c, and relative humidity 25±3%. *Chrysomela populi* L., were collected in black poplar seedling for one generation. The collected adults from black poplar species were founded at Tag-Taq forests (figure 1) and it's transferred to laboratory and immediately putted in breeding cages at 30×40×7 cm with black poplar seedling, in this cages the insect feed on a new foliage. Ten adults for each pair (male, female) were putted in breeding cage and fed with black poplar seedling. In this experiment were studied, general description, adult age, pre-oviposition period, oviposition and post-oviposition, eggs number / female, behavior hatching and oviposition. The egg instar was appearance during of trans it to the petri- dish with 4 replicates, approximately (25) egg per replicate and recorded of observation following, general description, incubation period and hatching percentage. The study observation of larval and pupal stage were putted (20) larva from the first age with individual state inside

breeding cages and feed on the black poplar leaves and their observation until appearance adults for determine number of larval instars by ecdysis and its periods, pupa instar, adult emersion percentage , sex ratio for evaluation population density ,seasonal occurrence, area and damage percentage for leaf beetle , in this study , ten trees were chosen per of *Populus nigra*, *P.edltoides* and *P.euphratica* ,respectively ,which growing in Tag-Tag forests(Daudi,1979). 20 leaf were randomly collect per tree and per 15day according to the different aspects of tree (5 leaf/aspect) therefore, collected 200 leaf and its putted nylon papers and examined in the same day at laboratory and recorded insects inside nylon case. The area and damage percentage were calculated according to the Saied (1990), the correlation value and coefficient certainty were calculated for correlation between area, damage percentage and average of insects to each. The results statistical were analyzed by SAS (2000) and means comparing by Duncan test at P 0.05, (Antar,2010).



Figure (1): Adult of *Chrysomela populi* L.,on poplar trees.

Results and Discussion

1-Biological study:

a-Egg stage:

Eggs of *C.populi* are lengthwise oval , enlargement , and smooth and measured 1.98 mm in average length and 0.84mm in width. Newly laid down egg is white yellowish in color and then change gradually to orange yellowish and that is the color which will be gained by the egg until its hatching. Eggs laid as groups with average of 1-35 egg to the lower surface of poplar leaf. The study observed that average of incubation were 5.61 days at average temperature of 30+2°C and the humidity of 43+3%, while hatching percentage reached 78%, Urban (2006) Who mentions that the *C.populi* develops , from egg laying to hatching imagoes , about 1 month, in the laboratory about 21 days ., the number of eggs in groups is also related to the quality of food (Jodal et al.,1991).

b- Larval stage:

the study explains that this insect has three larval instars that could be recognized based on the removed head width and the length of larval body (table 1) newly hatched of larva were dark brown color then the color changes to yellow colour at the third age, and these results agreed with Urban (2006) who observation that the *C.populi* has three larvae instars, and its develop about 3 weeks depending on a temperature and photoperiod . The larvae is simple cylindrical type, it has many nipples distributed on its body, and it is of compressed type from above to lower, the jaws are strong and the body walls are solid, antennas and chest legs of good growth and feature rings, and it's abdominal distributed to clear ring. The average duration of larval instars reached 8.1+0.8 days. The number and period of stages of feeding and rest are dependent not only on the instar of larvae but also on their age within the same instar, the average consumption of food and mortality of larvae are also dependent on the number of larvae in a

group, the gregariousness of larvae significantly increases the defense of individuals by the cumulative effect of toxins in secretions of dorsal glands. (Urban, 2006).

c-Pupal stage:

at the end of 3rd instar the larva fixed itself on the hardened branches and then changing to the free pupa, similar to larva at the external appearance, average length was 9.75 ± 0.51 day and average width is 5.10 ± 0.42 mm. The study found that the average period of pupa instar is 4.8 day, while Urban (2009) who stated that the average period of pupa instar is 4day. The average percentage of adult emersion reached 80% and (sex ratio 1:7). Literature data on the period of the pupal stage differ, however, considerably, according to Plavsic (1958) the pupal stage takes on average 10.5 days at 19 C⁰, at 25C⁰ only 5.5 days.

Table (1): biological properties of leaf poplar larvae.

Larvae stages	Length at the begging of larva age (mm) and standard slop S.D	Duration of larva age (day)and standard slop S.D.	Width of head capsule at the end of larva age (mm) and standard slop S.D.
1 nd instar	1.7±1.0	2.16±0.14	0.27±0.15
2 nd instar	4.2±2.12	2.45±0.76	0.68±0.31
3 nd instar	9.8±1.91	3.38±0.55	1.10±0.80

d- Maturity stage:

Beetles are varying weakened and therefore, after reaching host species they begin to feed immediately. beetle is a medium size with greenish shining black color for both head and thorax. Sheathing is reddish brown color, contain long veins and small pit randomly. Antennae is dark black of clavate type, male smaller than female and its average length reached 8.51 mm and age reached 47.10 days. Female characterized motionless, average of female length until end of wing reached 10.08mm, the abdomen rings of female are larger and wider than male abdomen rings with circular end. The average of female age reached 56.21 days. The experiment results showed that the conjugation occurred at morning generally, and the female fertilized more than once. Adults emersion occurred from pupa instar, eggs putted by female on the lower surface of poplar leaves, pre-oviposition period, oviposition and post-oviposition were reached (8.15+1.35,36.75+2.40,12.11+4.30) day, respectively. The average number of laid eggs reached 105.3 egg, whale Urban (2006)

e-Number of generations and hibernation:

The field study explained that this beetle has 2 generations of the year and wintering generation (diapause) of *C.populi* on *Populus* spp., as adult under leaves on land throw the basses of tree , this result accept with Urban (2006) who showed that poplar leaf beetles has two generation per year ,diapause at the adult and who reported that the summer diapause was probably induced by above – mentioned high temperatures or increased relative air humidity inside breeding glass vessels and also by nutrition through physiologically older leaves.

2-Ecological study:

The results of table 2 showed the effect of number larvae and adult for poplar leaf beetle at area and damage percent as a result was (0 : 0) in the begging April and infestation appearance observed of poplar leaves with increase insect stages (larvae and adults) in the first of May, these results agree with Urban (2006) who observed that the larvae of *C.populi* occur in nature roughly from mid-May –to mid-July and the gregariousness of larvae significantly increases the defense of individuals by the cumulative effect of toxins in secretions of dorsal glands and the imagoes of the 1st generation occur on host poplar species from June to September (in the laboratory from the end of May to mid-September) . In this study ,the results showed the area

and damage percent increased to 4.50, 3.90, 2.15 cm² and 11.60, 5.65, 8.00cm² for the black poplar, American poplar, euphratic poplar, respectively, Urban(2006) who observed the average weekly area of leaves of *P.nigravar.,italica* damaged by imagoes of the 1st generation of *C.populi* under laboratory examination was reached 118 cm² (growing up leaves) and 88 cm² (newly grown up leaves), while Sylvie et.al. (2010) who showed that the insects were preferable *Poplar nigra* leaves and *P.euramericana*, the average consumption of food and mortality of larvae also dependent on the number of larvae in a group.

On the other hand, Augustin et.al. (1993) mention that *Chrysomelapopuli* were infested numerous clones of poplar. Table 2 shows that highest average consumption of food occurring in the first of June were reached, 2.75, 2.30, 2.0 adult /leaf, on the black poplar, American poplar and euphratic poplar, respectively, these results accepted with Robert (1970) who reported that poplar trees infested by leaf cutter during July. Recently, however, Jodal et al. (1991) substantiate biological foundation of repeated copulation. Knopf(1969) stated that the black poplar and American poplar species will be infested deeply by leaf poplar beetles during summer. Nevertheless, the number of insect stages decreased and reached 0.53, 0.49, 0.12 insect / leaf on the three poplar species, respectively, the area and damage percent were 1.2, 0.6, 0.90 cm², 3.2, 0.90, 3.2% respectively, this study agree with Swaillemad Al-Marroof (1981) who that the population density of *C.populi* were reduced in the mid of September, table 2 observe that the poplar species were effect on the numbers of beetle stages and its effects on area and damage percent produced as a result of feeding of beetle- stage (larvae and adults).

The area and damage percent increased with increased number of insects, heavy feeding and complete defoliation cause undesirable branching of shoots and technical impairment of trees. Table 2 showing the temperature and relative humidity has effect on the beetle stages which is affecting on the area and damage percent resulted by insect infestation, therefore, the temperature increasing for specific value, the area and damage percent were increased, while the relationship with humidity showed non clear, humidity decreasing of limit value; the area and damage percent were increased, however, high summer temperatures affect unfavorably the development and harmfulness of *C.populi*. Thus, with the autumn decrease of average daily temperatures, the harmfulness of *C.populi* increases again,

The statistical analysis and Duncan experiment showed significant difference at the probability level of 5% between means of area and damage percent and number of insect stages for poplar species in this study, the highest average area, damage percent and number of poplar insect in a black species was (7.87, 21.74, 1.50 insect / leaf) respectively. Samir (2008) who Stated that the grain beetle, *Anisoplia leucaspis*, family; chrysomelidae which is considered leaf cutter that infested poplar species in Iraq, black poplar were preferred *Poplar nigra* than other poplar species, while the least of average for damaged area and number of insect stages were found on *P.euophratic* reached 4.33 cm², 0.95 insect / leaf, respectively, on other hand, the least average of damage percent reached 8.03% on *P.deltoids*, the reason of decrease damage percent in American poplar, *P.deltoids* due to large of leaf size comparing to the other two species of poplar, the damage is related to indispensable losses in total and quality increment, insufficient lignifications of annual shoots and their low frost resistance (Urban .2006). David et.al (2001) showed that larvae was different in their preferences of feed on clones poplar species. The results of statistical and Dunkin test founded significant differences at the probability of level 5% between means of studied features with dates of sample collecting, therefore,

the mean of area and damage percent with number of insect stages were highest reached 1/6 which is (13.33 cm², 34.49% and 2.35 insect / leaf) respectively. These results agreement with Urban (2006) and Aziz at.el.(2008) who showed The *chrysomela populi* caused significant injures of black poplar leaves during June, from the result of this study the relationship between

four directions of tree and studied features observed the northern direction were high averages for area, damage percent and insect stages reached (10.16 cm², 20.31 %, 1.48 insect / leaf) respectively, The reason of insect preferable of north direction to the environmental conditions of moderate temperature, while the least average of area, damage percent and number of insect stages were the south direction of the tree reached (2.43 cm², 7.65 % , 0.87 insect / leaf) respectively, the reason is because of non preferable insect of heavy light and warm environmental conditions, under conditions of suitable nutrition, larvae consume first preferred food and only after its destruction they also feed on less suitable food on commonly damaged or normally undamaged species (Augustinet al.1992), while the Raupp and Sadof(1991) who showed that the food quality and its availability worsen during the growing season because the number of undamaged leaves on actively growing shoots rapidly decreases already from June. The results of correlation values and coefficient certainty between average of number beetle stages and area with damage percent showed significant positive correlation for these features (table 3). The r value of *P.nigra* reached 93.45 and 90.86 respectively. This study explained through slope equations between numbers of insect stage and area with damage percent were existence high effect reached 80 % of poplar species, *Populus euphratica*, *Populus nigra* and *Populus deltoids*, and this indicate the great impact for numbers insect stages for injuries occurred on this trees (table 4).

Table (3) Correlation value and coefficient certainty for relation between average number of poplar leaf beetle, *Chrysomela populi* and average area and damage percent infested by insects.

Tree species	Correlation value and coefficient certainty			
	Damage area(cm ²)		Effect percent %	
	r	r ²	r	r ²
Populous nigra	93.45*	87.33	90.86	82.56
Populous deltoids	90.16	81.29	88.71	87.69
Populous euphratica	89.25	79.66	89.60	80.28

* Correlation is significant at probability of 5%.

Table (4) Slope equation for relation between average number of insect and average area and damage rate on some types of poplar leaves.

Tree species	Slope equation of damage area cm ²	Effect percent %	Slope equation of damage percent cm ²	Effect percent %
Populous nigra	A = -0.312 + 5.153N +	87.33	P = 0.978 + 14.226N +	82.56
Populous deltoids	A = -0.093 + 5.53N +	81.29	P = 1.032 + 7.358N +	78.69
Populous euphratica	A = -0.140 + 5.274N +	89.66	P = 0.316 + 20.132N +	80.28

Damage area =a, damage rate=p, number of insect stages=N

Table (2): Number of insect stages with area and damage percent of poplar species with average temperature and humidity during 2013.

Sample Date (Day)	Average tempt.(c°)	Average humidity(%)	<i>Populous euphratica</i>			<i>Populous nigra</i>			<i>Populous deltoids</i>		
			No. insect stages	Damage area	Damage percent	No. insect stages	Damage area	Damage percent	No. insect stages	Damage area	Damage percent
15/04	14.90 *	75	0.19 kl	0.60 kl	2.30opq	0.23 jkl	0.27 lm	0.38 r	0.30 ijk	0.48 kl	0.72 r
01/05	17.10	54	1.17 ef	2.15 il	8.0 klm	1.20 ef	4.50 hj	11.60ijk	1.40 def	3.90 j	5.65 lmn
15/05	23.80	45.5	1.85 cd	9.35 de	35.35d	2.70 a	15.35 b	42.25 b	2.0 c	9.70 de	14.0 ij
01/06	27.30	32.50	2.0 c	10.70 d	41.18c	2.75 a	16.30 a	45.0 a	2.30 b	12.10 c	7.30 hi
15/06	33.00	30.5	2.0 c	7.0 g	26.6 fg	2.25 b	11.40 cd	31.30 e	1.71 cde	6.60 g	10.01 jkl
01/07	33.10	29.5	0.80 fgh	5.65 gh	21.90gh	1.75 cd	10.30 d	28.50ef	1.77 cd	8.37 ef	11.90 ijk
15/07	32.60	28.5	0.75 gh	4.75 hj	17.80hi	1.50 cde	8.70 ef	24.40fg	1.81 cd	8.55 ef	12.30 ijk
01/08	32.80	25.5	0.45 ghi	2.70 ij	10.10jkl	1.10 ef	6.40 g	18.0 hi	1.20 ef	5.45gh	8.0 lmb
15/08	31.75	24.00	0.38 ij	2.0 ij	7.65 lmn	1.50 cde	6.31 g	17.65 hi	0.88 fgh	2.83 ij	4.07 mno
01/09	29.10	27.0	0.25 jkl	1.85 jk	7.30 lmn	1.0 efg	5.85 gh	16.45hij	0.55 ghi	2.45jk	3.51 nop
15/09	7.15	34.5	0.12 lm	0.90 kl	11.20nol	0.53 ghi	1.20 jk	3.20nop	0.49 hi	0.60 kl	0.90 r
General average	25.69	36.95	0.95	4.33	16.49	1.50	7.87	21.74	1.31	5.56	8.03

*Means within one column followed by the same letter are not significantly different at P=0.05.

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