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INFLUENCE OF SOME NATURALLY GROWING LOCAL HERBS IN DUHOK-KURDISTAN REGION- IRAQ ON THE MORTALITY OF WAX MOTH *Galleriea Mellonella* L. LARVAE

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ABSTRACT

The effect of some naturally growing local herbs from Gara Mountains in Duhok-Kurdistan region-Iraq on the mortality of wax moth (*Galleria mellonella* L. larvae were investigated in the laboratory using two different methods, first; spraying combs with the plant extract, second; directly smoking with dried herbs the larvae. During the first day, five hours after treatment, higher percentage of mortality were appeared in larvae fed on sprayed wax with Soryas (15 %) in June, (15%) in July, while larvae fed on Jater showed the highest percentage (22%) in August. Five days after treatment, higher percentage of mortality were found in larvae fed on sprayed wax with Jater (88 %) and with Soryas (82%) in August. Five hours after smoking, Strk (61 %) was the most effective than other plants, followed by Jater (55%) and Soryas (54 %). higher percentage of mortality was found two days after smoking in larvae treated with Jater (90 %) in June and (86%) in July. All tested plants were effective in controlling *Galleria mellonella* larvae, they showed during the experiment of smoking more than (80%) mortality of larvae four days after the treatment. Soryas and Jater were the most effective tested plants while Hnkdan was the least one.

KEYWORDS: *Galleria mellonella* , Wax , Natural herbs, Larvae.

INTRODUCTION

Greater wax moth *Galleria mellonella* is one of the most important and economically pests of wax in the world (Burges, 1978; Chang and Hsieh, 1992). The larvae bore in to the combs and make silken tunnels in the middle of the comb and feeding on honey, pollen, wax and brood of honey bees. The entire comb is covered with a mass of webbing and fecal matter of the larvae; a condition described as "Galleriasis" (Ellis et al., 2013). *Galleria mellonella* is a member of the Galleriinae subfamily within the family Pyralidae of Lepidopteran order, the greater wax moth, *Galleria mellonella* L. causes greater loss to the bee keeping in many countries especially in developing countries (Kapil and Sihag, 1983).

Greater (Lepidoptera: Pyralidae, *Galleria mellonella L.*) wax moths are common pests of honey bee colonies (Gillard, 2009; Ellis et al., 2013). Currently, wax moths are found in all parts of our country and considered the most important bee pest in the apiary as well as in the bee product storage. They present in all beekeeping regions but they are more active and spread rapidly in warmer climates (Crane, 2000).

It deteriorates the honeycombs and creates nuisance to the honeybees. Damage is caused only by the caterpillars, which feed on combs, propolis, pollen, larval skins and other protenaceous matters (ul-Haqa et al., 2004). The use of chemical insecticides is harmful to bee population (Surendra *et al.,* 2010; Mohamed, 2014). In this context the use of plant products as insecticides is emerging as a thrust for controlling large number of pests including greater wax moth (Ellis et al., 2013).

Natural plant products possess insecticidal activity. The plants based insecticides being the natural plant products are safer and hence their use against pests has gained importance all over the world (Mekawa *et al.,* 2015; Gomes et al., *2016*). High toxic effects of botanicals products on the larvae of *G. mellonella* have been reported (Surendra *et al.,* 2010; Ahmad *et al.,* 2014). Very little information is available on the comparative efficacy of different plant products

against the larval mortality of the greater wax moth, *Galleria mellonella* L. Therefore, this work is adopted to investigate variations in the effectiveness of some naturally growing herbs on larvae *G. mellonella* using spray method and smoking under laboratory condition. Greater wax moths (*Galleria mellonella L.; Lepidoptera: Pyralidae)* are common pests of honey bee colonies (Gillard, 2009; Ellis et al., 2013). Currently, wax moths are found in all parts of the country and considered the most important bee pest in the apiary as well as in the bee product storage. They present in all beekeeping regions but they are more active and spread rapidly in warmer climates (Crane, 2000).

This study was aimed to investigate the effect of some cheap and available naturally growing local herbs in the area on the mortality of wax moth (*Galleria mellonella L.)* larvae in the laboratory using two different methods, first; spraying combs with the plant extract, second; directly smoking the larvae.

MATERIAL AND METHODS

These experiments were conducted in the laboratory of the Department of Plant protection, College of Agriculture University of Duhok ; from April to the end of August ; figure(1.A).

Fig. (1): (A); preparing water solutions from the herbs in the laboratory, (B); five natural herbs used in the experiments

Five different naturally growing herbs were collected from Gara Mountains in northern Iraq during end of April, these herbs were; Strk (*Eremurus spectabilis)*, Jater (*Kotschyanus)*, Hnkdan (*Ferula communis)*, Hndresh (*Anethum grarveolens)* and Soryas (*Alium jesdianum)*; figure(1.B).

One kilogram of each plant was gathered, divided into two halves each of 500 mg. A simple water extract was separately prepared from each plant; 500 mg of the plant was soaked in1 liter of water and stored overnight in cool temperature, then mixed using electric mixer and filtered for spraying the wax combs during the experimental period, the amount of the solution for spraying was one liter. The other part of the plants also (500mg from each plant) used as fumigation after drying the plants on the shade and burning the dried herbs inside bee smoker.

To obtain pure culture, parts of infested wax were cut and transferred to clean plastic jars. Emerged moths were taken to new jars provided with uninfected wax comb parts and left to copulate and lay eggs. Emerged larvae were monitored to obtain the desired instars for the following assay (Ellis et al., 2013). Rearing and treatments were conducted at room conditions (25± 2 ^{o}C temperature; and 65± 5% relative humidity); (Owayss and Abd-Elgayed , 2007).

Firstly a hundred young workers were collected from the brood nest, kept inside five small plastic containers (each with 20 workers) provided with a piece of wax comb containing honey and pollen, these combs were previously

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sprayed separately with the extract of tested plants. In order to test the effect of these plants on the bees, as well as the same bees were exposed daily to three puffs of smoke prepared from each plant.

The effect of all tested natural herbs on the mortality of larvae of the wax moth *Galleria mellonella L.* were investigated.

For the first experiment; small plastic containers (30 x 20 x 25 cm) provided with a piece of wax comb containing honey and pollen. These combs were sprayed with a water extract of each plant. Three replicates of each treatment were used in addition to the untreated combs (control); the total numbers of replication were 18. A hundred young larvae of *G. mellonella L.* were immediately kept inside these containers. The mortality of these larvae was recorded for the first five hours in one hour intervals, then the next days in 24 hours intervals.

The second experiment; the same experimental design was used; a hundred young larvae of *G. mellonella L.* were exposed daily to three puffs of each plant as smoking in five different treatments (each with three replicates), in addition to the untreated larvae (control) ; the total numbers of replication were 18. The mortality of these larvae was recorded as the same previously mentioned method.

The both experiments (spraying combs and direct smoking) were repeated three times; in June, July and August. Corrected percentage of dead larvae was calculated. The results of all experiments were analyzed using analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Five hours after treatment, higher percentage of mortality were appeared in larvae fed on sprayed wax with Soryas (15 %) in June, (15%) in July , and (19%) in August; while larvae fed on Jater showed the highest percentage (22%) of mortality in August; table (1).

Five days after treatment, higher percentage of mortality were found in larvae fed on sprayed wax with Jater (88 % and with Soryas (82%) in August; table (2).

Concerning the second experiment; after five hours larvae exposed to smoking, Strk (61%) was the most effective than other plants, followed by Jater (55%) and Soryas (54%) ; table (3).

Two days after smoking, higher percentage of mortality was found in larvae treated with Jater (90 % in June and (86%) in July. The tested plants were effective in controlling *Galleriea mellonella* L. larvae.

Table (1): Mortality (%) of larvae during the first five hours, inside plastic containers contained sprayed combs, using five natural plants in three experiments in June, July and August.

Months	Treatments	Mortality of larvae%				
		Hours after treatment (spraying)				
		1st hour	2nd hour	3rd hour	4th hour	5th hour
June	Strk	2%	4 %	5 %	8 %	10 %
	Jater	1%	3%	5%	6%	8%
	Hnkdan	1%	3%	4%	4%	6%
	Hndresh	2%	4%	5%	7%	8%
	Soryas	3%	7%	9%	12%	15%
	Control	1%	1%	3%	4%	5%
July	Strk	3%	5%	6%	8%	10%
	Jater	2%	4%	5%	7%	9%
	Hnkdan	2%	5%	7%	8%	9%
	Hndresh	1%	3%	5%	5%	7%
	Soryas	2%	5%	7%	10%	15%

	Control	2%	2%	3%	3%	4%
August	**Strk**	3%	5%	8%	12%	18%
	Jater	4%	7%	11%	17%	22%
	Hnkdan	3%	5%	8%	10%	13%
	Hndresh	2%	7%	10%	13%	13%
	Soryas	3%	6%	8%	12%	19%
	Control	1%	3%	4%	5%	6%

Table (2): Mortality (%) of larvae during the first five days, inside plastic containers contained sprayed combs, using five natural plants in three experiments in June, July and August.

Months	**Treatments**	**Mortality of Larvae%**				
		Days after treatment (spraying)				
		1st day	**2nd day**	**3rd day**	**4th day**	**5th day**
June	**Strk**	10%	19%	25%	35%	40%
	Jater	8%	21%	35%	45%	54%
	Hnkdan	6%	16%	21%	28%	35%
	Hndresh	8%	20%	28%	35%	54%
	Soryas	15%	25%	33%	38%	44%
	Control	5%	10%	17%	22%	33%
July	**Strk**	10%	18%	25%	35%	42%
	Jater	9%	17%	26%	33%	41%
	Hnkdan	9%	19%	25%	31%	41%
	Hndresh	7%	15%	22%	30%	37%
	Soryas	15%	23%	31%	40%	46%
	Control	4%	15%	21%	30%	40%
August	**Strk**	18%	34%	47%	58%	68%
	Jater	23%	37%	55%	73%	88%
	Hnkdan	13%	26%	35%	48%	60%
	Hndresh	13%	25%	37%	46%	57%
	Soryas	19%	34%	51%	67%	82%
	Control	6%	16%	22%	29%	36%

Table (3): Mortality (%) of larvae during the first five hours, inside plastic containers, the larvae exposed to smoking using five dried natural plants in three experiments in June, July and August.

Months	**Treatments**	**Mortality of Larvae%**				
		Hours after treatment (smoking)				
		1st hour	**2nd hour**	**3rd hour**	**4th hour**	**5th hour**
June	**Strk**	11%	20%	27%	33%	42%
	Jater	9%	16%	22%	30%	40%
	Hnkdan	6%	10%	18%	23%	29%
	Hndrsh	8%	13%	20%	26%	34%
	Soryas	7%	12%	21%	26%	35%
	Control	1%	1%	3%	4%	5%
July	**Strk**	9%	16%	24%	34%	40%
	Jater	14%	25%	36%	46%	55%
	Hnkdan	5%	9%	14%	21%	25%
	Hndrsh	4%	9%	13%	19%	25%
	Soryas	8%	17%	23%	30%	35%
	Control	2%	2%	3%	3%	4%
August	**Strk**	13%	24%	36%	46%	61%
	Jater	10%	19%	27%	34%	40%
	Hnkdan	11%	22%	32%	44%	50%
	Hndrsh	9%	17%	23%	30%	39%
	Soryas	14%	22%	33%	42%	54%
	Control	1%	3%	4%	5%	6%

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Table (4): Mortality (%) of larvae during the first five days, inside plastic containers, the larvae exposed to smoking using five dried natural plants in three experiments in June, July and August.

Months	Treatments	Mortality of Larvae %				
		Days after treatment (smoking)				
		1st day	2nd day	3rd day	4th day	5th day
june	Strk	42%	80%	90%	90%	90%
	Jater	40%	90%	90%	90%	90%
	Hnkdan	29%	49%	70%	85%	90%
	Hndresh	34%	57%	83%	89%	89%
	Soryas	35%	65%	86%	90%	90%
	Control	5%	10%	17%	22%	28%
July	Strk	40%	61%	82%	90%	90%
	Jater	55%	86%	90%	90%	90%
	Hnkdan	25%	50%	68%	89%	89%
	Hndresh	25%	50%	65%	85%	85%
	Soryas	35%	72%	86%	90%	90%
	Control	4%	15%	21%	30%	40%
August	Strk	60%	73%	81%	88%	88%
	Jater	35%	60%	88%	89%	89%
	Hnkdan	50%	71%	83%	86%	86%
	Hndresh	38%	64%	82%	87%	88%
	Soryas	49%	65%	78%	82%	85%
	Control	6%	16%	22%	29%	36%

All tested plants during the experiment of smoking showed more than (80%) mortality of larvae four days after the treatment, table (4). Certain volatile plant oils are cheap and safe materials and less contaminant to bees and honey, these materials are available to beekeepers, and can be used for controlling other hive infestations like *Varroa* and acarine mites. (Owayss and Abd-Elgayed , 2007). The above mentioned results showed that Soryas and Jater were the most effective tested plants against *Galleria mellonella*, while Hnkdan was the least one. Many essential oils (obtained from plants) and their components were registered for controlling bee parasites (Imdorf and Bogdanov, 1999). Recent studies to control severe bee disease and pests using plant products are highly considered (Williams *et al*. 1998).

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پوختە

ڤەکولینەک هاتە کرن دەربارەی کارتێکرنا کومەکا گیایێن ناڤخویی(لوکالی) کو بشێوەیەکێ سروشتی گەشێ دکەن و شوین دبن ل چیایێ گارە ل پارێزگەها دهوکێ-هەرێما کوردستانا عیراقێ ، کو دکەڤیتە باکورێ عیراقێ ، بریژا سەدی لسەر کوشتنا (کرمێ شەمایێ یی مەزن (Galleria mellonella ل تاقیگەهێن پشکا پاراستنا رووەکی/ کولێژا زانستێن ئەندازیاریا چاندنێ/زانکویا دهوک، من دوو ڕێک بکارئینان ڕێکا ئێکێ ڕەشاندنا کونکێت شەمایێ ب ڕێکا (ڕەشاندنا ئاڤا گیای) بو هەر گیایەکێ ل دویف ڤەبارێ پێتڤی , ڕێکا دووێ - ڕێکا دیکێلکرنا راستەوخو یا کرمان ب دیکێلا گیایێن هشک و سووتی و ئەڤ هەردوو ڕێکە هاتنە بجهئینان ب شێوێن جودا جودا د ماوێ سێ هەیڤان دا د هەیڤێن (حوزەیران, تەموز,تەباخ)ـێ دا ، ئەڤ ئەنجامە بو مە دیاربون:

ڕێژەیا سەدی یا ژناڤچونێ دروژا ئێکێ دا ل وان کرمان دیاربو ئەوێن ل شەمایا ڕەشاندی ب گیایێ)سوریاس(یێ خاری ل هەر ئێک ژ هەیڤێن (حوزەیران)ـــێ (15%) و(تەموز)ـێ (15%) ، بەلێ پا گیایێ

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(جاتر)ـــێ ڕێژا وێ پتر بو د هەیڤا (تەباخ)ـێ دا (22%) .پشتی بورینا پێنج روژان ژخارنا کرما لسەر شەمایا ڕەشاندی د هەیڤا (تەباخ)ـێ دا ڕێژەیا ژناڤچونا کرمان گەهشتە (88%) و (82%) ژ هەر ئێک ژ (سوریاس و جاتر)ـێ دا پشتی دیڤچونێ ، بەلێ پا ئەو کرمێن توشی دیکێلا گیایێن هشک بوین ڕێژەیا ژناڤچونا وان د روژا ئێکێ دا گەهشتە (61%) پشتی وێ هەر ئێک ژ رووەکێن (جاتر و سوریاس)ـێ (55%) و(54%). بلندترین ڕێژا کوشتنێ هاتیە دیتن پشتی دوو روژا ژ ڕەشاندنا دیکێلێ د کرماندا بڕێکا بکارئینانا رووەکێ جاترێ کو ڕێژا کوشتنێ (90%) بو ل هەیڤا (حوزەیرانێ) و (86%) بو ل هەیڤا (تەموزێ), و ئەنجام هوسا دیاربون کو هەمی رووەکێن هاتینە بکارئینان د تاقیگەهی دا چالاکبون بو کونترولکرنێ سەر کرمێ پەلاتینکێ , بەلێ بلندترین ڕێژا کوشتنێ ژ لایێ تاقیکرنا دیکێلێ بو کو گەهشتە (80%) پشتی چار روژا ژ بکارئینانا ڤێ تاقیکرنێ, ڕێژەیا کارتێکرنا گیایێ (سوریاس)و (جاتر) ێ زێدەتر بون ژ هە می گیایێن دی تی بە لی کیمترین کارتێکرن دیار بو ل گیایێ (هنگەدان)ـێ.

الخلاصة

دراسة تأثير بعض الأعشاب المحلية التي تنمو بشكل طبيعي والمأخوذة من جبال كارة في محافظة دهوك - أقليم كردستان- العراق على النسبة المئوية القاتلة ليرقات عثة الشمع في مختبروقاية النبات/ كلية علوم الهندسة*(Galleria mellonella)* الزراعية / جامعة دهوك ,, وذلك باستخدام طريقتين مختلفتين ، الطريقة الأولى : رش نخاريب الشمع بالمستخلص المائي لكل نبات على حدا، أما الطريقة الثانية: فكانت بالتدخين المباشر لليرقات بدخان النبات المجفف المحروق، نفِذت التجربتان بشكل منفصل ثلاث مرات خلال الاشهر الثلاثة (حزيران، تموز وآب) .

اظهرت النتائج بأن أعلى نسبة مئوية للقتل في اليوم الآول بعد خمس ساعات من المعاملة كانت في اليرقات التي تغذت على الشمع المرشوش بنبات السورياس، وذلك خلال شهر حزيران كانت نسب القتل (15%) وفي شهرتموز (15%) بينما تفوق نبات الزعتر عليه حيث كانت نسبة القتل في شهر أب (22%) ، وبعد مرور خمسة أيام من تغذي اليرقات على الشمع المرشوش وذلك في شهر أب وصلت نسبة قتل اليرقات الى (88%) و (82%) لكل من عشب السورياس والزعتر على التوالي.

بعد خمس ساعات من تعرض اليرقات لدخان النبات المجفف كان نبات السترك أكثر فاعلية من بقية النباتات وصلت معها نسبة القتل الى (61%) وبعدها مع كل من نباتي الزعتر والسورياس(55%) و(54%). أعلى نسبة قتل تم العثور عليها بعد يومين من التدخين في اليرقات المعاملة بعشب الجاتر حيث كانت نسبة القتل (90٪) في شهر حزيران و(86٪) في شهر تموز. وأظهرت النتائج أن جميع النباتات المختبرة كانت فعالة في السيطرة على يرقات العثة، ولكن اعلى نسبه قتل كانت خلال تجربة التدخين حيث وصلت(80٪) بعد أربعة أيام من المعاملة. كان السورياس والجاتر أكثرتأثيرا بينما عشب الهنكدان الأقل تأثيرا.