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Population Trends of Grape Phylloxera, *Daktulospharia (Vites) vitifoliae* Fitch. (Homoptera: Phylloxeridae) and Effect of Two Insecticides on Its Different Stages in Jordan

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ABSTRACT

Population dynamics of root form of grape phylloxera, *Daktulospharia (Vites) vitifoliae* Fitch. (Homoptera: Phylloxeridae) were carried out in the field in 2004. Mean number of eggs, nymphs and adults showed peaks in mid-July and early August, respectively. All stages disappeared in late August. There were no galls noticed on the examined roots throughout this study. Treatments included two insecticides, imidacloprid and thiamethoxam and control. The insecticides were applied to the foliage of the grape vine. Mean numbers of different stages of phylloxera were separately combined throughout the two foliar spray periods. There were no significant differences between treatments; thiamethoxam and imidacloprid although it did differ than the control. Mean number of eggs, nymphs, adults and colonies treated with imidacloprid insecticide was less than in thiamethoxam treatment, but without significant differences. Although there were no statistical differences between the effect of the two foliar insecticidal treatments on different yield parameters, greater number of bunches was obtained from thiamethoxam followed by imidacloprid and then control. Mean weight of bunch was highest in imidacloprid treatment followed by thiamethoxam and then control. Among total soluble solids, the highest value was in imidacloprid and the lowest in the control. Imidacloprid and thiamethoxam effectively reduced the number of different stages; eggs, nymphs, adults, colonies and could be recommended for the control of grape phylloxera.

Keywords: *Daktulospharia (Vites) vitifoliae*, Phylloxera, Grape, Population trends, Chemical control, Jordan.

INTRODUCTION

The grape phylloxera (*Daktulospharia vitifoliae*, Fitch.), is an insect that induces formation of leaf and root galls on grapes (*Vitis vinifera* L.) (Granett et al., 2001).

The damage markedly decreases productivity and can be lethal to vines. Phylloxera is native to eastern and southern U.S.A. The pest was introduced to France from North America. It was identified in mid 1800´s and by the end of the nineteenth century it destroyed two-thirds of the self-rooted vineyards on the Europaen continent (Strik et al., 2000). Since that time, phylloxera has invaded most of the grape-growing areas of the world including Jordan (Al-Taher, 1958). In Jordan, the total area planted with grapes reached 14,575 ha. with a production of 69,270 tons in 2006 (Ministry of Agriculture,2007).

Grape phylloxera overwinter as small nymphs on

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roots. In spring when soil temperature rises, they start feeding and growing. First instars are active crawlers which may move from plant to plant in the ground, on the soil surface, or by wind. They may also be moved between vineyards on cuttings, boots or equipment. Established phylloxera feed externally in groups on roots. In fall when soil temperature falls below 15.5 ºC, all life stages die except the small nymphs in USA (Granett et al., 2001).

The insect was introduced into Jordan and Palestine in the 1940´s and destroyed about 400 ha. at different places such as Al-Salt, Ajlun, Jerash, Safad, Akaa and Hayfa (Al-Taher,1958).

At that time, farmers have been controlling phylloxera by planting commercial cultivars grafted on American rootstocks. This solution to the phylloxera damage was ineffective, in which in 1970´s most of the planted grapes were self-rooted because of problems with American rootstock, e.g. incompatibility, difficulties to get resistant rootstocks adapted to local climate conditions and cost of rootstocks (NCARTT, 2003). This led to the reappearance of grape phylloxera in the regions of Madaba, Al-Faissaliah and Husban in 1970´s and in Al-Salt (Al-Antary, 1985). In 1994, large commercial vineyards had been ruined at Al-Faissaliah (about 30 km East of Amman). Recently, in 2001/2002, the re-emergence of the insect was recorded in North of Jordan especially in Ramtha, Irbid and Ajlun (NCARTT, 2003).

Many researchers conducted studies to control phylloxera chemically (Granett et al., 1986; Rammer, 1980; Williams, 1979). Studying foliar and subsurface insecticidal applications to control aerial form of the grape phylloxera has been investigated in U.S.A. by Williams (1979). He evaluated sixteen insecticides for their efficacy against the aerial form of grape phylloxera by foliar and subsurface applications. Subsurface insecticide applications of granular carbofuran and aldicarb were effective in controlling grape phylloxera, and there was increased galling as dosage decreased. Fenvalerate and Permethrin were applied as a single foliar application. Theothermaterials; Phosalone, Endosulfan, UC51762, Chlorthiophos, Lindane, Fenvalerate, Carbofuran, Methyl parathion, Diazion, Carbaryl, Fenitrothion, Phosmet, Azinphosmethyl and Acephate were applied as aqueous sprays to the above ground portions of vines with 2 foliar sprays (10-14 days apart). Phosalone, Fenvalerate, Endosulfan, UC 51762, Chlorthiophos, Lindane and Aldicarb all gave better than 77% reduction of galls on leaves at one or more of the rates tested. Subsurface applications gave better results in seasons with high rainfall that distributed the chemicals in the soil profile, while rainfall decreased the effectiveness of foliar sprays (Rammer, 1980).

Carbofuran was studied by Rammer (1980) for controlling root form of the grape phylloxera. He found that a post- harvest treatment consisting of 11.2 to 33.6 kg Al/ha. did not significantly affect the low population of phylloxera. In another research, it was found that first-instar grape phylloxera nymphs were more susceptible to Carbofuran than eggs and large nymphs and adults, indicating that early spring treatment when first instars become active would be optimal (Granett et al., 1986; University of California, 2002; Webbs, 2004).

This research was conducted to evaluate the foliar chemical control of phylloxera, that threatens areas cultivated with grape vines in Jordan. In previous reports, insecticides which belong to Organochlorine, Carbamates, Organophorous and Pyrethroids were tested against grape phylloxera(Rammer, 1980; Nazer et al., 2006). Insecticides that belong to the new group Neonicotinoids were not tested on this insect in Jordan. The two insecticides used in this research were Actara 25 WG (thiamethoxam) and Confidor 200 SL (imidacloprid) which belong to Neonicotinoides (a new class of insecticide). They are degradable and non-persistent in the environment, and their safety periods range from 2 to 3 weeks .

MATERIALS AND METHODS

Experiment Site: The experiments were carried out during May-August, 2004 in a commercial vineyard located in New Husban Municipality, about 25 km South East of Amman.

Soil Analysis*:* Soil samples were collected from the site and analyzed for textural class using Boyoucos method (ICARDA,1996), total nitrogen using Kjeldhal method (Bremner, 1965), available phosphorus using Olsen method (Olsen and Dean, 1965), available potassium using ammonium acetate extraction method (Pratt, 1965) and soil pH using pH-meter.

Cultural Practices: The major cultivar in the vineyard is "Baladi", which is highly susceptible to grape phylloxera (Al-Taher, 1958). It is trained on trellis and ranges from 10-12 years in age .The vineyard had naturally occurring infestation with root form of phylloxera grape (radicecole) in the past three years as reported by the farm manager. Drip irrigation system was established (but water was not uniformly distributed to treated trees). Protection against fungal pests was done using Triadimenol (5%) on 1/5/2004.

Experimental Design and Treatment : The two insecticides were applied according to recommended dosage of 0.25 g/L for thiamethoxam and 0.15 ml/L for imidacloprid at two application dates ; 24/5/2004 and 28/6/2004. The application of the insecticides in this experiment, was governed by the weather conditions, especially temperature and wind which triggers the activity of the hibernating insect on the roots of grape vines. Each tree was sprayed completely until solution dripping. Control trees were sprayed with water only.

The two foliar chemical treatments and control were arranged in a completely randomized design. Twenty four replicates were assigned for each treatment and each replicate consisted of one vine tree. A total of (72) vine trees were used in the experiment.

To assess the effect of the different treatments, number of harvested bunches/tree, average bunch weight (g)(one bunch for each replicate taken randomly) and total soluble solids (Brixº): a representative sample consists of berries from the center and all sides of each bunch were taken. Twenty four bunches of each single treatment were taken.

During May to August, sampling phylloxera from treated plots was carried out five times; on 24/5/2004 (before chemical treatment), 20/6/2004, 15/7/2004, 1/8/2004 and 28/8/2004. At each sampling date, root at soil depth of 0.1-0.5 m was digged up from two trees of each replicate and inspected for number of living insects and galls on 100 cm^2 of root surface. The root was assumed to be cylindrical and surface area was calculated according to the formula ($A=\pi$ dl) where d: is the root diameter and l is the root length. Since the diameter and length of root samples were not uniform, a proportion was done to have the approximate incidence on 100 cm^2. All mobile and immobile stages of phylloxera were counted using binuclear dissecting microscope. Means of all treatments were analyzed using two ways of analysis; analysis of variance and F test (S AS, 1994).

RESULTS AND DISCUSSION

Grape phylloxera has two distinct forms; the leaf form which produces blisters on the upper surfaces of the leaves of resistant wild cultivars and the root form which infests vine roots and causes the greatest damage. The blister form occurs rarely in Jordan (Al-Antary and Al-Momany, 1990). The root form has been widely spread in Jordan since 1978 (Al-Antary, 1985).

Populations of grape phylloxera tend to be larger in clayey soil than in sandy one (Al- Antary and Al-Momany, 1990; Granett et al., 2001). The mechanical analysis for the orchard soil shows 15 % sand, 30% silt and 55% clay while the textural class shows 1.2% nitrogen, 1.4 % phosphorus, 6% potassium and 7.9 pH.

This has been attributed to the inability of crawlers and adults to disperse from infested to healthy roots which are usually deeper in the sandy soil than the clayey one, perhaps soil cracking in this clay soil has an effect on the dispersal of the alate phylloxera form.

The root grape phylloxera occurs commonly in many commercial vine yards in mountainous regions of Jordan; e.g. Madaba, Ajloon and Jarash. This investigation on population dynamics was carried out in 2004, particularly between April and September, for the first time in Jordan. Mean number of eggs, nymphs and adults per 100 cm^2 root started to appear in late May, 2004 and then increased gradually and steadily reaching a peak for eggs and nymphs in Mid-July and for adults in early August (Fig. 1).

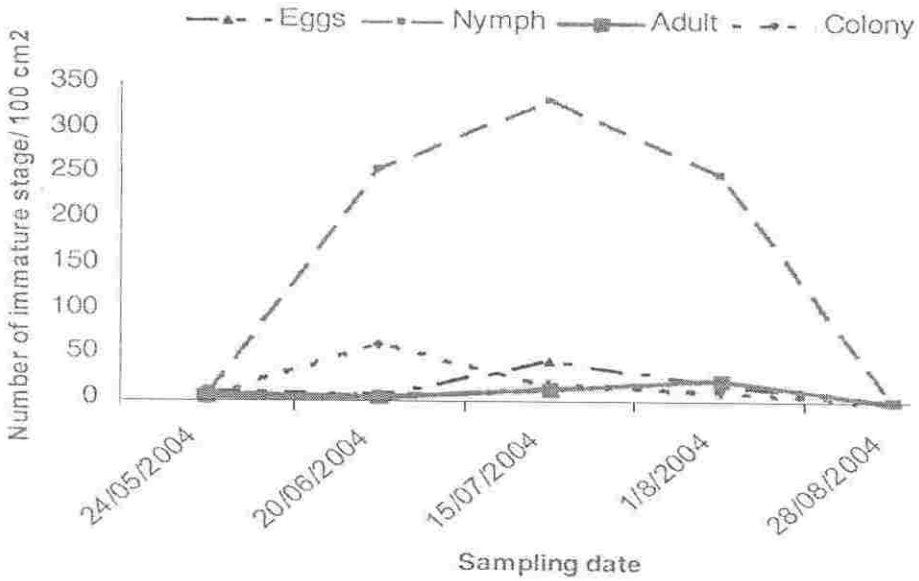

Fig.(1):Mean number of phylloxera stages and colonies found on 100 cm ^{2} root in the field between May and September, 2004.

The populations for the three stages then decreased gradually reaching zero population in late August. The sharp decline in population in July and August might be due to high soil temperature, low water content in soil and soil cracking.

Most aphids disappear in high temperature (Al-Momany and Al-Antary, 2008). In a previous study, Al-Antary (unpublished) reported to NCARTT in mid 1990s that there were no populations for phylloxera in commercial vine yards in autumn and winter months, although phylloxera symptoms were seen and recorded. The explanation for nymphs being more in numbers than eggs, was due to the difficulties in finding and counting eggs on sampled roots. In this study, eggs population ranged from 0 to 43.25 egg per 100 cm^2, nymphs population from 0 to 332.3 nymph per 100 cm^2, for adults from 0 to 24.32 adult per 100 cm^2 and for colonies from 0 to 61.63 colony per 100 cm^2 roots. It is worth mentioning that there were no galls noticed on the examined roots throughout this study.

Effects of control and foliar chemical treatment on different stages of phylloxera throughout the two sprays are shown in Table (1). Mean numbers of different stages of phylloxera were separately combined throughout the two spray periods. There were no significant differences between imidacloprid and thiamethoxam treatments, although they differed from the control. Mean numbers of eggs, nymphs, adults and colonies in imidacloprid treatment were less than in thiamethoxam, but without significant differences. Both insecticides are systemic and belong to the Neonicotinoides. Williams (1979) tested sixteen foliar and subsurface insecticidal applications on grapes phylloxera in USA. He reported that complete phylloxera control was achieved by Lindane from chlorinated hydrocarbon compounds, which are banned from use in Jordan and by Phosalone.

Table (1): Effects of two foliar chemical treatments on different stages of phylloxera in the field, in 2004.

Treatment	Mean number of insect stage /100 cm ^{2} of grape root			
	Eggs	**Nymphs**	**Adults**	**Colonies**
Imidacloprid	0.00 a	2.00 b	0.00 b	0.53 b
Thiamethoxam	6.88 a	28.50 b	0.85 b	1.93 b
Control	14.55 a	168.30 a	8.28 a	18.53 a
LSD	15.9	92.3	5.1	13.0

Note: Means within the same column sharing the same letter do not differ significantly using LSD at 5% level.

The effects of two foliar chemical treatments against grape phylloxera on different yield parameters are shown in Table (2). Although there were no statistical differences among number of bunches for the treatments, the best results in term of number of bunches was obtained from thiamethoxam, followed by imidacloprid and then by the control. Meanwhile, the average weight of bunch was highest in plots treated with imidacloprid followed by thiamethoxam and then by the control. For total soluble solids (TSS), the highest value (17.75) was in imidacloprid and the lowest (16) in the control, but without significant differences.

Table (2) : Effects of two foliar chemical treatments against grape phylloxera on different yield parameters.

Treatment	Mean number of bunches	Mean weight of bunch (kg)	TSS (Boix)
Imidacloprid	45.5 a	0.168 a	17.75 a
Thiamethoxam	46.5 a	0.140 ab	17.50 a
Control	36.5 a	0.078 b	16.00 a
LSD	37.7	0.0736	3.45

Note: Means within the same column sharing the same letter do not differ significantly using LSD at 5% level.

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التغيرات العددية لحشرة فيلوكسرا العنب .*Daktulospharia (Vites) vitifoliae* Fitch (متشابهة الأجنحة: عائلة الفيلوكسرا) وتأثير المعاملة بمبيدين حشريين في أطوار الحشرة المختلفة في الأردن

توفيق مصطفى العنتري**، إبراهيم الناظر* وإيناس فديمات

ملخـص

تمت دراسة ديناميكية أعداد حشرات فيلوكسرا العنب على الجذور في الحقل في عام 2004. وكانت متوسطات أعداد البيض والحوريات والحشرات الكاملة في قمتها في منتصف شهر تموز وفي أوائل شهر آب، على التوالي. وقد اختفت جميع الأطوار في نهاية شهر آب. ولم تتم مشاهدة أية عقد على جذور النباتات التي تم فحصها في المختبر طول فترة الدراسة. شملت المعاملات مبيدين حشريين هما؛ اميدا كلوبريد وثيوميثوكسام إضافة إلى الشاهد. ولم تكن هناك فروقات معنوية بين معاملة المبيد اميدلكلوبريد ومعاملة المبيد ثيوميثوكسام بالرغم من أنه كان هناك اختلاف عن معاملة الشاهد. لقد كان متوسط أعداد البيوض والحوريات والحشرات الكاملة والمستعمرات الحشرية في معاملة المبيد أميدلكلوبريد أقل منها في معاملة ثيوميثوكسام، ولكن دون فروق معنوية. وبالرغم من أنه لم تكن هناك فروق معنوية بين معاملتي رش المبيدين على المجموع الخضري على قياسات المحصول الإنتاجية، إلا أن أكبر عدد لعناقيد العنب كان في المعاملة بمبيد ثيوميثوكسام متبوعاً بالمعاملة بمبيد أميدلكلوبريد ثم بالشاهد. وفي الوقت نفسه، كان وزن العناقيد أعلى ما يمكن في معاملة أميدلكلوبريد يليه معاملة ثيوميثوكسام ثم معاملة الشاهد. كما كان مجموع المواد الصلبة الذائبة أعلى ما يمكن في معاملة أميدلكلوبريد وأقل ما يمكن في معاملة الشاهد. المبيدان اميدلكلوبريد وثيوميثوكسان كانا فاعلين في تخفيض اعداد الاطوار المختلفة ؛ البيض والعذارى والحشرات الكاملة وعدد المستعمرات، ويمكن التوصية باستخدامها لمكافحة فيلوكسرا العنب.

الكلمات الدالة: *Daktulospharia (Vites) vitifoliae*، فيلوكسرا، عنب، اعداد الحشرات، المكافحة الكيميائية، الأردن.

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