Chemical Control of Grape Phylloxera 
*Daktulospharia (Viteus) vitifoliae* Fitch. (*Homoptera: Phylloxeridae*) Using Three Chemical Soil Treatments  

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**ABSTRACT**

Population trends of grape root phylloxera were carried out in highly infested field in Husban, Madaba district in 2005. Mean numbers of eggs and mobile stages, showed a peak in early July. Eggs started to appear in late May, and Nymphs started to appear in late June. Numbers of all stages started to decrease in early August. Galls were noticed on examined roots in 2005 as compared with the 2004 season. There were significant differences among pesticide soil treatments for all stages in the two applications. The least mean numbers were found in imidacloprid followed by thiomethoxam with no significant differences. The mean numbers in the above two treatments were significantly different from oxamyl and the control treatments. Generally, there were no significant differences between the effects of soil pesticide treatment on different yield parameters. Taking into consideration the non significant differences between imidacloprid and thiomethoxam treatments, and the slight difference in the cost of the two insecticides in the present Jordanian market, they can be used successfully for controlling grape phylloxera.

**KEYWORDS**: Jordan, Grape, Phylloxera, Population trends, Chemical control, Soil treatments.

**1. INTRODUCTION**

Grapes are considered an important economic crop in Jordan. It ranks after olives and citrus in planted area and production. Grapes vineyards reached 14,240 ha with a production of 77,196 MT in 2003 (Ministry of Agriculture, 2003). Several insects attack grapes in Jordan. The most destructive pest to the local cultivars particularly (Balady) is the grape phylloxera (Mustafa and Sharaf, 1994).

The phylloxera is native to eastern and southern US (Strik et al., 2006). The pest was inadvertently introduced to France in 1860, and by the end of the 19th century it had destroyed two-thirds of the vineyards on the European continent, all soft-rooted *Vitis vinifera*.

Since that time, phylloxera has invaded most of the grape-growing areas of the world including the Middle East countries (Strik et al., 2000). It destroyed most grapes in Jordan and Palestine in 1930's and 1940's (Al-Taher, 1958; Mustafa and Al-Momany, 1990). The insect has at least two forms on the vines. The leaf form produces blisters on the upper surfaces of vine leaves particularly on American resistant cultivars. This form was recorded in few cases in Jarash and Ajloon districts. The root form causes the great damage to the European and local cultivars (Mustafa and Al-Momany, 1990). This form causes wounds on grape roots, and suck the plant

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sap. It destroys the grape root system (Mustafa and Sharaf, 1990; Granett et al., 2001). The adult roots are very difficult to detect on roots in soil. It hibernates on roots as small dark colored nymphs. In the spring when soil temperatures rise and grape sap starts to flow, these nymphs begin feeding and molt to adulthood (Strik et al., 2006, Al-Antari et al., 2005).

Root injury by grape phylloxera impairs the absorption of nutrients and water, causing a decline in vine vigor and productivity. Decomposition of root is also hastened by secondary infection with bacteria and fungi (Mustafa and Sharaf, 1990; Strik et al., 2006).

Farmers in Jordan as other countries, has controlled phylloxera by grafting desired cultivars on resistant American root stock; a solution to the phylloxera damage that was ineffective (Al-Antary et al., 2006). In the 1970’s, most of the vines planted were own-rooted because of problems with American root stocks particularly incompatibility problems, difficulties to get resistant root stocks adapted to local climate and soil conditions, and costs of root stocks (NCARTT, 2003; Al-Antary et al., 2005). This led to the reappearance of grape phylloxera, in regions of Madaba, Jarash and Al-Salt, in 1970s (Mustafa, 1985). In 1994, large commercial vine yards were ruined at Al-Faisaliah in Madaba district (NCARTT, 2003; Al-Antary et al., 2005). Recently in 2002 the reappearance of phylloxera pest was recorded in north of Jordan i.e. Ramtha, Irbid, Ajloon and Jarash (NCARTT, 2003).

Several workers conducted experiments to control root phylloxera chemically. Testing foliar insecticidal applications to control root phylloxera using two neonicotinoide insecticides has been tried in Jordan (Al-Antary et al., 2005). Rammer (1980) evaluated carbofuran for controlling root phylloxera and found that a best harvest treatment consisting of 11.2 kg i.e. /ha broadcasting and incorporating between vine rows resulted in excellent control. In another investigation, some workers found that first nymphal instars of grape phylloxera were more susceptible to carbofuran than 3–5 days eggs, large nymphs and adults (Granett et al., 1986; University of California, 2002; Webbs, 2004). The present research was conducted to evaluate the efficacy of three soil applied insecticides for the control of grape root phylloxera. It is an attempt to rescue areas cultivated with grapevine cultivars susceptible for grape root phylloxera in Jordan since previously foliar chemical control was tried by the authors (Al-Antary et al., 2005). No specific insecticide has been recommended to control grape phylloxera in Jordan.

2. MATERIALS AND METHODS

2.1 Study Location

Field experiments were carried out in commercial vineyard located in New Husban Municipality, about 25 km south east of Amman during May-August, 2005.

2.2 Cultural Practices

Trees in the vineyard ranged from 10-12 years of age and have been trained on trills and a drip irrigation system was established. The major cultivar was “Balady”, which is highly susceptible to grape root phylloxera. The infestation with root form phylloxera in the vineyard has been presented for the past four years. Protection against fungal diseases was done using Penconazol in early May and early June, while protection against weeds was done using Round-up in late June.

2.3 Experimental Design and Treatments

Three insecticides were used in this experiment, Thiamethoxam, Imidacloprid which belong to the neonicotinoides group and Oxamyl, a carbamate insecticide (Table 1). The neonicotinoides are used for the first time as soil application on this destructive pest in Jordan. They are degradable and non-persistent in the environment since their safety periods range from 2 to 3 weeks (Al-Antary et al., 2005).

The insecticides were applied as soil treatment according to recommended dosage at two application dates; June 5, 2005 and July 5, 2005. Each tree was drenched with 20 L of the insecticide solution. Control trees were drenched with water only.

Three soil chemical treatments and control were
studied using a completely randomized block design. There were five blocks; each block contained twenty vine trees for the four treatments. A total of 100 vine trees were used in the experiment. It is worth noting that, it is rare to find a farmer who offers such large number of trees (100) to be used in the experiment.

2.4 Parameters
To evaluate the efficacy of the different treatments, the following parameters were measured for each plot at harvest time on August 11, 2005:
1. Number of harvested bunches/ tree.
2. Average bunch weight (g): one bunch was measured for each of the 25 replicates of each treatment.
3. Total soluble solids (Brix°): a representative sample consists of 10 berries from the center and all sides of each bunch were taken. Twenty five bunches of each single treatment were taken.

Eleven sampling dates were carried out during the months of late May to mid-August, 2005. They were on May 29, June 5, 16, 22, 30, July 5, 14, 22, 28, and August 3, 11. Samples were used to monitor population trend of root phylloxera in all treatments.

2.5 Sampling Method
At each sampling date, five root samples at soil depth (0.25-0.50 m) were dug up from five different trees of each treatment. From each sample, the following data was recorded using binocular stereomicroscope:
1- Number of living insects (mothers) on root/ 100 cm² of root: where the surface area of root examined was calculated on the basis of an assumed cylindrical shape (A= π dl) were d: root diameter and l: root length. Since the diameter and length of root sample were not uniform, a proportion was done to have the approximate incidence on 100 cm² (Al-Antary et al., 2005).
2- All immobile stages of phylloxera were counted.
3- Number of colonies of phylloxera was counted.

In addition, two root samples of grapes were taken from the other cultivars on the vine yard “Halawany, Zainy, Shamy and Aswad” on July 22, 2005 and August 11,2005 to check the presence of Phylloxera.

3. RESULTS AND DISCUSSION
The epidemic infestation of the vine yard was identified as infestation with root form phylloxera, since the symptoms of leaf form (blisters on the upper leaf surface) were not present. The Blister form rarely occurs in Jordan (Mustafa and Al-Momanny, 1990). The Root form became a threat on grape trees in Jordan since 1978 (Mustafa, 1985). Some selected soil physical and chemical properties were presented previously for the same field (Al-Antary et al., 2005). Soil samples taken from the experimental vine yard infested with root form of grape phylloxera were analyzed in Soil, Water and Environment Department of the University of Jordan. The soil texture was clay leading to cracks in drought months which made the spread of infestation easy compared with the sandy soil. Several workers reported that grape root phylloxera population in clay soil tends to be greater than those in sandy soils (Mustafa and Al-Momanny, 1990; Granett et al., 2001). It was attributed to the inability of crawlers and apterous adults to move from infested to healthy roots which are deeper in sandy soil than in clay one. This fact explains the high infestation in Madaba district with clay soil than in other districts in Jordan with sandy soil texture.

In the present experiment, eggs and adults started to appear in late May, 2004 while nymphs started to appear in late June as observed from samples examined in the field and laboratory. The mean numbers of eggs, nymphs and adults per 100cm² of root from late May until mid August are presented in Fig 1. The numbers of all stages increased gradually from late May until reaching a peak in early July. This is in agreement with findings of (Al-Antary et al., 2005) in the same field in 2003. However, finding phylloxera on infested roots is difficult especially in the early stages of an infestation. Sampling from late July up to harvest increased the chance of finding phylloxera if they were present (Strik et al., 2006). The greatest decline in populations occurred in late July and early August which might be due to high temperature of soil and low water content (Al-Antary et al., 2005). Most aphids disappear in high temperature (Mustafa and Al-
Momanny, 1990). In this study, population trends showed that maximum eggs population ranged from 20.1 (Fig.1.1a) to 14.3 (Fig.1d) eggs per 100 cm² roots, and maximum mobile stages population ranged from 11.8 (Fig. 1d) to 5.0(Fig.1b) mobile stages and four colonies from 0.2 to 1.1 colonies per 100 cm² roots (Fig. 1a). It is worth noting that galls caused by root phylloxera were noticed on examined roots in early August (Plate1). On the other hand, galls were not observed in the previous year's study (Al-Antary et al., 2005).

Separate effect of control and three soil treatments on different stages of phylloxera through out the two sprays in 2005 are shown in Tables (2, 3). Mean numbers of different stages of phylloxera were combined for each spraying date.

For the first spraying date (Table2) mean numbers of eggs, adults, nymphs and colonies differed significantly among different treatments. The least number was found in imidacloprid followed by thiomethoxam but with no significant difference. Ox amyl results were less significant from the other two treatments A similar trend of results was obtained for the second spray (Table 3).

In previous study on foliar applications (Al-Antary et al., 2005) also found that imidacloprid had the least means for different stages of phylloxera comparing with other pesticides.

William (1979) evaluated sixteen insecticide applications in USA and found that some insecticides were effective in controlling grape phylloxera and there was an increase in root galling as insecticide dosage decreased. Complete phylloxera control was achieved by lindane , an organochlorine insecticide which is now banned from import and use in Jordan .

The effect of the three soil chemical treatments against grape phylloxera, on different yield parameters are shown in Table (4). There were no statistical differences between the two nicotinoid insecticides and oxamyl and the control in most of the parameters .

Samples taken from other cultivars in July and August, particularly Halawany, Zainy, Shamy and Aswad, showed no phylloxera on root of their root stocks which are American resistant ones. However, it is suggested to increase the number of samples in shorter intervals to be assured that the resistant root stocks have not lost any of their resistance. Moreover, investigation is needed for their resistance to root phylloxera and their compatibility to the previous mentioned local cultivars and other common cultivars. It is necessary to use root stocks that have strong resistance against grape root phylloxera to get sufficient control (University of California, 2000).

Taking into consideration the non- significant results between thiamethoxam and imidacloprid, they could be used to control grape root phylloxera as soil application since the cost/treatment of the two insecticides IS comparable. Moreover , it is recommended to use both in one schedule program to avoid or minimize the risk of gaining resistance by the pest to the mentioned pesticides.

Grape phylloxera is an aphid living on roots in soil. It is known that aphids can easily gain resistance against intensive use of most pesticides. Many phylloxera may be killed from the use of chemicals, but it's population may rebound rapidly and resume feeding on vine roots (University of California, 2002). Because it may take years of insecticide treatments to reverse severe damage, treatments to prevent damage may be a better strategy than curative treatments (University of California, 2002).

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Table 1. Basic information about insecticides used in the field experiment in 2005.

<table>
<thead>
<tr>
<th>Common name</th>
<th>Thiamethoxam</th>
<th>Imidacloprid</th>
<th>Oxamyl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trade name</td>
<td>Actara 25WG</td>
<td>Confidor 200SL</td>
<td>Vydate L (24%)</td>
</tr>
<tr>
<td>Chemical name</td>
<td>3-(2-chloro-1, 3-thiazol-5-ylmethyl)-1, 3, 5-oxadiazinan-4-ylidene-N-nitroamine</td>
<td>1-(6-chloro-3-pyridin-3-ylmethyl)-N-nitroimidazolidin-2-ylidenamine.</td>
<td>N-N-dimethyl-2-methylcarbamoylexylmino-2-(methylthio)acetamide</td>
</tr>
<tr>
<td>Application rate</td>
<td>3 gm /20 L / tree</td>
<td>10ml/20L /tree</td>
<td>10ml/20L/tree</td>
</tr>
</tbody>
</table>

Plate 1. Galls caused by root grape phylloxera on infested root collected from the vine yard in 2005.
Fig 1.a, b. Mean numbers of root grape phylloxera stages in the vineyard for control and three pesticides treatments in 2005. Arrows show application dates.
Fig 1.c, d. Mean numbers of root grape phylloxera stages in the vineyard for control and three pesticides treatments in 2005. Arrows show pesticide application dates.
Table 2. Effect of first soil insecticide application on different stages of phylloxera in the field in 2005.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean numbers of insect stages/ 100 cm$^2$ of grape root</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eggs</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>0.97 b</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>0.034 b</td>
</tr>
<tr>
<td>Oxamyl</td>
<td>3.200 a</td>
</tr>
<tr>
<td>Control</td>
<td>5.096 a</td>
</tr>
</tbody>
</table>

Means having same letters are not significantly different at p=0.05 according to Duncan’s multiple range test.

Table 3. Effect of second soil insecticide application on different stages of phylloxera in the field in 2005.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean numbers of insect stages/ 100 cm$^2$ of grape root</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eggs</td>
</tr>
<tr>
<td>Thiamethoxam</td>
<td>0.772 b</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>0.026 b</td>
</tr>
<tr>
<td>Oxamyl</td>
<td>2.656 a</td>
</tr>
<tr>
<td>Control</td>
<td>4.972 a</td>
</tr>
</tbody>
</table>

Means having same letters are not significantly different at p=0.05 according to Duncan’s multiple range test.

Table 4. Effect of three soil pesticide treatments against root grape phylloxera, on different yield parameters.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mean number of bunches</th>
<th>Mean weight of bunch (kg)</th>
<th>TSS (Boix)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiamethoxam</td>
<td>35.28 a</td>
<td>175.30 a</td>
<td>15.400 bc</td>
</tr>
<tr>
<td>Imidacloprid</td>
<td>37.64 a</td>
<td>237.80 a</td>
<td>16.9600 a</td>
</tr>
<tr>
<td>Oxamyl</td>
<td>30.84 a</td>
<td>203.20 a</td>
<td>14.9200 c</td>
</tr>
<tr>
<td>Control</td>
<td>35.76 a</td>
<td>128.40 a</td>
<td>16.4800 ab</td>
</tr>
</tbody>
</table>

Means having same letters are not significantly different at p=0.05 according to Duncan’s multiple range test.
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http://www.ipm.ucdavis.edu/pmg/r302300811.html#disri ption%20of%20the%20pest.


Daktulospharia (Viteus) vitifoliae

THREE MANAGEMENT PRACTICES IN JUICE, IBRAHIM JABAR, AND ABU WARYID AN-ASHTI

*REASSESSMENT OF DISEASE GEOMETRIC MEASUREMENTS AND THEIR EFFECTS ON THE DEVELOPMENT OF THE DISEASE IN THE 2005/2006 ACADEMIC YEAR. ADEQUATE MANAGEMENT RESULTS IN A REDUCTION OF DISEASE BURDEN.