بسم الله الرحمن الرحيم

Hebron University

College of Graduate Studies

M. Sc. Program in Plant Protection

Field Studies on Biology, Ecology and Management of Grapevine Aphid, *Aphis illinoisensis* (Shimer) [Homoptera: Aphididae] on Some Grapevine Cultivars *Vitis vinifera* L. in Al-Arroub Agricultural Experimental Station, Palestine

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This thesis is submitted in partial fulfillment of the requirements for the degree of Master of Science in Plant Protection, College of Graduate Studies, Hebron University, Hebron, Palestine

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DEDICATION

I Would Like To Dedicate This Thesis To

My Mother ***My Father***

&

My Wife

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I want to send my deepest and sincere thanks to all those who have helped me in conducting this research and, in particular, to:-

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

ABSTRACT

Grapevine is one of the most important fruit trees in Palestine. Homopteran insect (including Phylloxera, leaf hoppers and mealy bugs) are among the major pests reported attacking grapevine plants and causing economic damage to grapevine.

During the last few years, an infestation of the grapevine aphid, *Aphis illinoisensis* **(**Shimer**)** [Aphidoidea: Homoptera], was observed in many vineyards in the Hebron district, and the infestation increased progressively during the last three years. Taking in concentration that, aphids probably are of high importance primarily because of their role as virus vectors, and no studies had been recorded in the literature about the biology, ecology and control of grapevine aphid. Therefore, this field study was conducted to investigate the flight activity, population dynamics and management of the grapevine aphid, *A. illinoisensis* in Al-Arroub Agricultural Experimental Station, Palestine.

Results showed that, flight activity of *A. illinoisensis* started on the beginning of April and extended until the end of June, recording one peak in the middle of April. Furthermore, it was found that there was no significant difference between seven grapevine cultivars in respect to infestation with *A. llionoisensis*. This study showed that Diazinon was significantly more effective than either Chlorpyriphos or Cypermethrin in controlling *A. illinoisensis.* In addition, four coccinellid predators were identified feeding on colonies of the grapevine aphid.

In conclusion, further studies are recommended to be conducted including, studies on the role of *A. illinoisensis* in virus transmission; and studies on the conservation practices for the natural enemies, especially for

the coccinellids that were recorded in association with the colonies of *A. illinoisensis* in the field.

INTRODUCTION

Grapevine is one of the most important fruit trees in Palestine with 6.6% of the total cultivation area, being used for production of table grape, dried fruit, etc. Grapevine is planted in West Bank and Gaza strip with an acreage of about 76220 dunums concentrated mostly in the Southern Highlands of the West Bank. Hebron ranks first (40584 dunums) with 56.1% of the total vineyard area, followed by Bethlehem (17661 dunums) with 23.8%; Gaza Strip (3745 dunums) with 4.9%; Al-Quds with 4.7%, Ramallah 3.4% and finally the northern districts of the West Bank area with 6.2% (PCBS, 2005).

Grapevine is a woody, perennial plant that produces a typical type of fruit, the grape berry, which is known among others, for a number of unique secondary metabolites which are not found in other plant species (Lodhi & Reisch, 1995). Grapevines are temperate climatic plants characterized by climbing stems and prostrate canes.

Grape cultivation in Palestine can be traced back to the earliest recorded history (Sultan, 2005). Grapevine varieties in Palestine are all essentially related to European species, *Vitis vinefera*; these grapes respond well to the local climatic conditions of the West bank and Gaza Strip.

Most grapevines are rain-fed, mainly grown in altitudes greater than 800m, with an annual rainfall of more than 400mm and average temperature of 20ºC (ARIJ, 1992).

Climatic requirements of grapevine are long, warm to hot dry summers and mild winters. Daily mean temperature should be at least 18°C and the minimum temperature is -18°C, below which frost kills young shoots. Grapevine didn't endure the high temperatures coupled with high humidity of tropics, rain is desirable in winter but not in spring or fall, thus, grape culture is best where there is no rain between blooming and harvesting (Duke, 1978).

In Palestine, grapevine is attacked by many insect pests including grape berry moth, Phylloxera, leaf hoppers and mealy bugs, causing an economic damage with high loses in yield (Sultan, 2005). During the last few years, an infestation with the grapevine aphid was observed in many regions in the Hebron district.

Aphids are considered of greater economic importance primarily because of their role as virus vectors, and because of this, flight activity is important to be studied, but high aphid densities can also cause direct plant injury and significant yield losses (Adams and Kelley, 1950; Kolbe, 1970; Shands *et al*., 1972).

However, little studies were found published in the literature about the biology, ecology and management of the grapevine aphid. Therefore, this research was proposed to investigate the following **objectives**:

1. To monitor the seasonal flight activity of the grapevine aphid in Hebron district.
2. To monitor the population dynamics of the grapevine aphid on different grapevine cultivars.
3. To investigate the effect of chemical insecticides on the population dynamics of the grape vine aphid.
4. To survey the natural enemies associated with the grapevine aphid.

CHAPTER 1

LITERATURE REVIEW

Chapter 1: Literature Review

1.1 Origin and history of grapevine

Grapevine, *Vitis vinifera* is thought to be native to the area near the Caspian Sea, in southwestern Asia. Seeds of grapes were found in excavated dwellings of the Bronze-age in south-central Europe (3500-1000 BC), indicating early movement beyond its native range. Egyptian hieroglyphics detail the culture of grapes in 2440 BC. The Phoenicians carried cultivars to Greece, Rome, and southern France before 600 BC, and Romans spread the grape throughout Europe. Grapes moved to the Fareast via traders from Persia and India. Grapes came to the new world with early settlement on the east coast, but quickly died out or did poorly. This was due to poor cold hardiness, insect, and disease resistance of Vinifera types. Spanish missionaries brought Vinifera grapes to California in the 1700s and found that they grew very well there (Upshall, 1976, Diamond, 1997, Evans, 1998).

The widespread of old Romanian grapes presses in Palestine, especially in the Hebron hills, indicated the old planting and viticulture of grapevine and its spread there (Sultan, 2005).

1.2 Grapevine cultivars in Palestine

More than 20 grape cultivars are planted in Palestine (Sultan, 2005), including white, black and red grapes as follows:

1. **White cultivars** including: Dabouki, Zaini, Salti-khdari-Khdari, Hamdani, Marawi, Jandali, Bairouti (Tamar-Bairout), White Roumi (Baitmouni) and Miskat Alexandria, in addition to white seedless cultivars including Thompson Seedless Sultanina, Perlette and Delight.

2. **Black cultivars** including: Darawishi (Shyoukhi), Ballouti, Baitouni, Black Roumi, and Seedless Beauty.

3. **Red cultivars** including: Halawani, Flem-Tocky, Emperor, Cardinal, Fohaisi, Miskat Hamborg and Flame seedless.

1.3 Grapevine insect pests

Several species of insect pests recorded on grapevine in Palestine (Sultan, 2005):

1. Grape phylloxera, *Phylloxera vitifolia* (Fitch).
2. Grape thrips, *Retithrips syriacus* (Mayet).
3. Grape berry moth, *Lobesia botrana* (Denis & Schiffermuller)
4. Grape bud beetle, *Glyptoscelis squamulata* (Crotch)
5. Grape mealy bug, *Pseudococcus maritimus* (Ehrhorn)
6. Grape leaf hopper, *Erythroneura elegantula* (Osborn).
7. Grapevine aphid, *Aphis illinoisensis* (Shimer)

1.4 Importance of aphids

About 4000 aphid species occur in super-family Aphidoidea, with 20 recognized family categories (Remaudiere & Remaudiere, 1997). Blackman and Eastop (1984) reported over 250 species of the super -family Aphidoidea feed on agricultural and horticultural crops throughout the world.

Aphids (Homoptera: Aphidoidea) are an economically important group of insects throughout the world. The economic importance of aphids is mostly based on their destructiveness to agricultural and ornamental plants. Aphids belong to the most important agricultural pests worldwide, causing direct damage by plant feeding and indirectly as vectors of plant viruses (Kennedy et al., 1962; Carter et al., 1980; Conti, 1985).

Aphididae species tend to be pests of temperate regions and reported to transmit most of the known insect-vectored viruses (Blackman & Eastop, 2000; Nault, 1997). Most aphid species are relatively host-plant specific, although pest aphids tend to have a wider host range than economically unimportant species, for example, the green peach aphid, *Myzus persicae*, has an extremely wide host range of over 100 plants including a wide variety of vegetable and ornamental crops (Baker, 1982).

A. illinoisensis has many hosts including *Carica papaya* (pawpaw); *Cissus sicyoides*; *Cucumis sativus* (cucumber); *Mangifera indica* (mango); *Viburnum* sp. (black haw); *Vitis tiliaefolia*; *Vitis vinifera* (grape) (CABI, 2002) .

Hamman (1985) reported that aphids draw sap from plant (phloem) tissue using mouthparts modified for piercing and sucking, some aphids feed on foliage while others feed on twigs, limbs, branches, fruits, flowers or roots of plants and some species inject toxic salivary secretions into plants during feeding. Light infestations were usually not harmful to plants, but higher infestations resulted in leaf curl, wilting, stunting of shoot growth, and delay in production of flowers and fruit, as well as, a general decline in plant vigor (Day, 1996).

Aphids were also reported to be important vectors of plant diseases, particularly viruses, for example, the cotton aphid is known to transmit over 50 plant viruses and the *M. persicae* transmit over 100 plant viruses (Kennedy, *et al.*, 1962).

In addition most aphid species excrete a sticky substance called 'honeydew' which is similar to sugar water. This energy-rich anal secretion falls on leaves and other objects below the infestation, and a black-colored fungus called 'sooty mold' colonizes honeydew-covered surfaces. As a result, sunlight is unable to reach the leaf surface, restricting photosynthesis that produces the plant sugars (Borrer *et al.*, 1976, Day, 1996).

Grapevine aphid, *A. illinoisensis* reported feeding on the foliage and vines of grape plants, but more serious injury resulted from the infestation on the developing fruit clusters causing some berries to drop (Pfeiffer & Schultz, 1986, Liburd *et al*., 2004).

1.5 Geographical distribution of aphids

The Aphidoidea are predominately a north temperate group (North America, Europe and Central Asia) (Blackman & Eastop, 1984).

From 1985 to 2003, a survey on aphid species was done in Guadeloupe and in other Caribbean islands (Etienne, 2005). During this survey, 13 aphid species were reported for the first time including *Aphis illinoisensis* which is an American pest of *Vitis vinifera*. In the Caribbean, *A. illinoisensis* was found in: Cuba, Jamaica, Haiti, Puerto Rico, Guadeloupe.

Interestingly, it has recently been reported in the EPPO region in Turkey and Greece (Tsitsipis *et al.*, 2005). In June 2005, *A. illinoisensis* was recorded for the first time on the island of Kriti in all major viticultural areas. The pest was first found in several localities of Heraklion Prefecture and near the city of Khania (Khania prefecture) but within one growing season, it was found throughout the island. These aphids feed on young shoots and leaves and in some cases on berries. *A. illinoisensis* was reported in September 2002 in southern Turkey (Tsitsipis *et al.*, 2005).

1.6 Biology of aphids

1.6.1 Description and morphology

Aphid species may have several color forms; variable in size and shape; winged (alate) or wingless (apterous). Aphids range in size from 1.5 to 3.5 mm. in length; pear-shaped, globose, ovate, spindle-shaped or elongate and vary greatly in their body markings and color (black, grey, red, orange, yellow, green, brown, blue-green, white-marked, wax-covered, etc.). Winged forms are usually triggered by environmental changes including decreasing photoperiod or temperature; deterioration of the host plant or overcrowding (Borror *et. al.*, 1976). *A. illinoisensis* is small (adults approximately 2mm), dark brown, shiny, soft-bodied insect, (Pfeiffer & Schultz 1986; CABI, 2002).

1.6.2 General life cycle of aphids

Several species of aphids have a fascinating life cycle where in, aphids often use one host plant as the 'primary host' for sexual reproduction and another plants (perhaps a distantly related plants) as a 'secondary hosts' for parthenogenic reproduction (Blackman & Eastop, 1984)

The alternation of sexual and parthenogenic reproduction phases is common in aphids, where migrants that return to the primary host are winged males and winged females which produce egg-laying sexual females that lay its fertilized eggs on the primary hosts, and those fertilized eggs are able to survive the winter. In spring, when the overwintering egg hatches, a few parthenogenetic generations occur before winged migrants leave the secondary hosts where aphids continue to reproduce parthenogenetically during summer and fall. Later on, the fall weather induces the production of males and females, which migrate again to the primary hosts where they mate to produce the overwintering eggs (Blackman, 1980).

Some species have lost their host-alternating behavior and only have a complete life cycle on herbaceous plants. Most of the cosmopolitan species are able to live all year round parthenogenetically on crop hosts, and some have spread to areas where their primary hosts do not occur (Moran, 1992).

Pfeiffer and Schultz (1986) reported that, *A. illinoisensis* overwinter as egg stage, mainly around buds of black haw, *Viburnum* sp., which considered as primary hosts. Eggs hatch in early spring over a 2-3 weeks period, a few parthenogenetic generations occur before winged migrants leave for their secondary host plants including the grapevines. In the fall winged individuals again developed and return to *Viburnum* and produce the egg-laying females.

1.6.3 Population dynamics of aphids

The term patterns of dynamics refer to the ways in which numbers change from year to year, or from generation to generation. Under field conditions, there will always be more or less pronounced random fluctuations in aphid abundance, caused mainly by changes in the weather (Crawley, 1992)

Aphid populations are likely to be regulated by density-dependent processes because parthenogenetic reproduction and overlapping of generations that are common to most aphid species during spring and summer, often result in high densities (Dixon 1985). However, overlapping of generations and seasonality have proved to be major obstacles in the analysis of aphid population dynamics (Dixon 1990). Therefore, to avoid these obstacles, some authors have resorted to the use of annual abundance (Dixon, 1990, Turchin and Taylor, 1992, Woiwod & Hanski 1992).

The dynamics of aphid populations are complex and often unresolved phenomena, involving numerous regulating factors such as natural enemies, weather conditions, host-plant quality, defensive responses, complex polymorphic life cycles, as well as intra- and inter-specific competition (Dixon, 1977).

Price (1997) reviewed the dynamics of insect populations that have been studied for decades and concluded that factors that influence population dynamics can be categorized as extrinsic or intrinsic. Extrinsic regulators of population size include factors such as predation, and availability of food and habitat. Intrinsic factors are genetically basic attributes such as fundamental population growth rate, competitive ability, and vulnerability to attack by natural enemies.

Sophisticated models have been developed from which predictions can be made and tested regarding the relative importance of different factors (Royama, 1992; Cappuccino & Price, 1995).

1.7 Aphid behavior

1.7.1 Migration and local dispersal

Bodenheimer and Swirski (1957) defined migration of aphids as the movement from primary host to a secondary one, where as emigration is the return to their original primary host. Same authors found that aphid migrants showed no directive flight towards the secondary hosts, but remigrants began with intensive group flight and end in directive group flight toward the primary hosts.

Migration enables spatial redistribution of insect populations (Taylor & Taylor, 1983). Winged morphs can be considered obligate migrants with their production stimulated by environmental cues at least one generation in advance of appearance (Dixon, 1971).

Each speÿÿes has a minimum temÿÿratuÿÿ threshold for flight initiation, e.g., 12.8°C for *M. persicae* (Broadbent, 1949), and most species do not fly when temperatures are much above 30°C (Robert, 1979; Boiteau, 1986).

Trapping as a technique for monitoring aphid dispersal was used by several researchers. Suction traps, yellow sticky and water traps were observed to be more effective than a crop inspection program for predicting the first seasonal immigration of several important aphid species attacking vegetables (Heathcort *et al.*, 1969, Elliot & Kemp, 1979, Trumble, 1982; Hamdan, 1986).

Bodenheimer and Swirski (1957) reported that, in Palestine, a small number of aphid migrants was found in June-July but remigrants observed to be common in August-November. In England, Taylor and Taylor (1977), found three seasonal cycles of population growth and redistribution in aphids. In Hungarian orchards, Jenser *et al.*, (1980) reported that the spring flight of *M. persicae* for example, was first recorded in the 2nd half of May in peach orchards, with gradual increase towards the end of the month, but in summer months, low numbers were recorded.

1.7.2 Color discrimination

Many aphids that feed on dicotyledons were more attracted to yellow than species feeding on grasses. An aphid's acceptance or rejection of a host plant is a complex process governed by visual, tactile, and chemical cues (Heathcote et al., 1969; Kingauf, 1987).

Wigglesworth (1969) reported that *M. persicae* can distinguish two color zones: a large wave zone, i.e. red-yellow-green which excited the insects to probe and thus, flying aphids are attracted to yellow color of foliage and traps, and a short wave zone, i.e. blue-violet-purple. Van Emden (1972) found that selected British yellow colors attracted more *M. persicae* than other colors.

1.7.3 Aphid distribution within the field

The aphid population may be larger or smaller near a windbreak (such as hedge) than elsewhere, depending on the direction of the prevailing wind. Thus, Moller (1958) suggested that, exposed edge-plants will usually have a larger aphid population than plants in the center of a crop. However, Taylor (1962) considered that the large infestation at the edges of *Vicia faba,* was less related to wind direction during the primary migration than to shelter given to migrants, and considered that, aphid populations on the edge of a field will differ from that of the center, and the greater the relative area of the edge the greater the populations on edge than on center-field plants.

1.7.4 Aphid distribution on plants

The distribution of aphids on most plants is far from uniform. In general, aphids prefer to feed and they reproduce faster on young or senescent than on mature leaves (Kennedy & Booth, 1951). In addition, the distribution of aphids may change when plants flower, thus, aphids on chrysanthemums tend to move towards the flowers and, exceptionally, aphids may be found feeding on the upper leaf surface as well as on the lower (Wyatt, 1965).

However, different varieties of crop plants not only support populations of different sizes, but also the populations may be distributed differently (Wyatt, 1965). In addition, different races of the same species of aphid may be differently distributed; for example, Tanaka and Shiota (1970) found that a green race of *M. persicae* was most numerous on the old leaves of cabbage while a pink form was most numerous on young leaves.

Trees that produce suckers also provide special problems when aphid numbers are to be estimated, for example, the number of suckers around the trunks of apple trees has a considerable effect on the population of *Aphis pomi,* which prefers young leaves to mature ones (Swirski, 1954).

1.8 Management

Most aphid populations are moderated by natural controls that include environmental stresses (high winds, heavy rains, extreme temperatures, etc.) and natural enemies (lady beetles, green lacewings, syrphid fly larvae, damsel bugs, braconid and chalcid wasps and parasitic fungi.

However, any aphid may be considered as potential pest when conditions are favorable for reproduction, and the reproduction rate of aphids is dependent upon food quality, host plant species and temperature (Day, 1996).

The grapevine aphid, *A. illinoisensis* is usually not important enough to necessitate specific treatments, and good production practices resulted in grapevines that were with sufficient vigor to tolerate attack by aphids (Liburd, *et al*., 2004)

1.8.1 Chemical control

Chemical control of certain aphid species has become extremely difficult due to resistance to insecticides, particularly organophosphate, carbamate and pyrethroid insecticides. Several workers studied the effect of different insecticides on aphids on different crops (Binns, 1971; Lecrone & Smilowitz, 1980; Powell, 1980; Dhondapani & Jayaraj, 1981; Prasadaro *et al.*, 1982; Woodford *et al.*, 1983; and Parker *et al.*, 1983; Hamdan, 1986). The effect of granular systemic insecticides and their methods of application in regulating population of *M. persicae* were investigated (Powell, 1980; Prasadaro *et al.*, 1982; Hamdan, 1986).

David (2001) suggested that Chemical control of aphids can be classified into four strategies:- the insecticides can be used in chemical control of aphids into three types:-Blackman and Eastop (1984) concluded that, short of generation time and overlapping of generations increased reproductive potential of aphids, and that increased the rate of development of resistance to insecticides.

French-Constant *et al.*, (1988) suggested that, pyrethroids might actually increase the green peach aphid problem by stimulating the production of nymphs. Aphid populations may dramatically increase following the application of insecticides that resulted in the destruction of natural enemies and failure to control the target pest (Oetting, 1985).

Blackman and Eastop (1984) concluded that chemical control of certain aphid species has become extremely difficult due to resistance to insecticides, particularly organophosphate, carbamate and pyrethroid insecticides.

1.9.2 Biological control and natural enemies

Day (1996) observed that aphids have many natural enemies, which naturally reduce their populations including lady beetles, lacewings, damsel bugs, flower fly maggots, certain parasitic wasps, birds, and fungal diseases. Liburd *et al.*, (2004) mentioned that *A. illinoisensis* population was observed to be under regulation by the presence of aphid predators like ladybird beetle adults and larvae, and lacewing larvae.

1.9.2.1 Predatory coccinellids on aphids

Aphids are known to have many natural enemies of different taxa. Aphid coccinellids may play a significant role in reducing aphid populations. Ladybirds, members of the Coleoptera, are well known insects because of their bright colours and beneficial roles. These beetles are also commonly called lady beetles, ladybugs and coccinellids (Emden, 1995).

Most coccinellid species are carnivores; both adults and larvae are primarily predators of aphids and other insect pests (Chinery, 1993). Obrycki (1995) mentioned that, the family Coccinellidae contains over 4000 species, almost all of these species are predators and feed on many different kinds of soft-bodied insects (e.g. aphids and scales), and these species including including the twelve spotted lady beetle, the convergent lady beetle, the seven spotted lady beetle and the two spotted lady beetle. Bado and Rodriguez (1997) reported life history data and prey preference of *Olla v-nigrum* feeding on various aphid species.

CHAPTER 2

GENERAL MATERIALS AND METHODS

Chapter 2: General Materials and Methods

This chapter discusses the general materials and methods used; constructions; equipments; and data analysis.

2.1 Vine yards*:*

Two vineyards in Al-Arroub agricultural Experimental Station were used for this research:

1. Hebron University vineyard No.1 (Arbor Field)
2. Hebron University vineyard No.2 (Prostrate Field)
2. Agricultural Secondary School vineyard

2.1.1 Hebron University vineyard No. 1:

Consists of grapevine plants >10 years old, planted in 10 columns and 10 rows with spaces of 4*4 meters between the columns and the rows (Diagram 2.1). Grapevine plants were planted in climbing system (Arbor) on iron net 1.9 m high. The vineyard included 7 grape cultivars (Sultanina, Ballouti, Shami, Salti-khdari, Halawani, Baitouni and Jandali) as shown in Fig. 2.1.

T	**T**	**T**	**T**	**T**	**A**	**T**	**T**	**A**	**T**
T	**A**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
T	**A**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
T	**A**	**T**	**A**	**T**	**T**	**T**	**T**	**T**	**T**
T	**T**	**T**	**A**	**T**	**T**	**T**	**T**	**T**	**T**
T	**A**	**T**	**A**	**T**	**T**	**T**	**T**	**T**	**T**
T	**A**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
T	**A**	**T**	**T**	**T**	**T**	**T**	**T**	**A**	**T**
T	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
T	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
Sultanina	**Ballouti**	**Shami**	**Balouti**	**Salti-khdari**	**Sultanina**	**Halawany**	**Shami**	**Baitouni**	**Jandali**

Fig. 2.1: 1st Vineyard of Hebron University, in Al-Arroub Agricultural Experimental Station (T: plant present, A: plant absent).

2.1.2 Hebron University Vineyard No. 2:

Consists of 150 grapevine plants >20 years old, planted in 15 columns and 10 rows with spaces of 4*4 meters between the columns and the rows (Diagram 2.2). Grapevine plants were planted in climbing system (Prostrate system). The vineyard included several grapevine cultivars (Jandali, Daouki, Beiruti, Drawishi, Baluti, Malekat Lobnan, Seedless, Hamdani, Shyokhi, Meskat, halawani and Flem Tuki) as shown in Fig. 2.2.

T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Jandali	**Jandali**	**Dabogi**	**Dabogi**	**Beiruti**	**Drawishi**	**Balluti**	**Malekat Lobnan**	**Sultanina**	**Hamdan**	**Shiyokhi**	**Meskat**	**Romi**	**Halawani**	**Flem Tuki**

Fig. 2.2: 2nd Vineyard of Hebron University in Al-Arroub Agricultural Experimental Station

2.1.3 Agricultural Secondary School Vineyard:

Consists of grapevine plants >20 years old, planted in 12 columns and 20 rows with spaces of 4*4 meters between the columns and the rows (Fig. 2.3).

Fig. 2.3: Al-Arroub Agricultural Secondary School Vineyard (T: plant present, A: plant absent).

2.2 Materials:

2.2.1 Chemicals:

Following are the chemicals used for preparation of agar media and for fluid of traps:

Ethanol 75%

Formalin 37%

Detergents (Liquid Soap)

2.2.2 Insecticides:

Three insecticides were used in the management experiment:

1. Diazinon

   Classification: Organophosphorous

   Mode of Action: semi-systemic (Hassal, 1987), contact, stomach respiratory action (Tomlin, 1997).

   Formulation: emulsifiable concentrate.

   Trade name: Dizictol

   Chemical Abstract name: 0,0 diethyl 0-[6-methyl-2-(1-methylethyl)-4-pyrimidinyl] Phosphorothiorate

2. Chlorpyriphos:

   Classification: Organophosphorous

   Mode of Action: non-systemic, contact, stomach and respiratory action. (Tomlin, 1997)

   Formulation: emulsifiable concentrate.

   Trade name: Derbas

   Chemical Abstract name: 0,0-diethyl 0-(3,5,6-trichloro-2-pyridinly) Phosphorothiorate

3. Cypermethrin:

   Classification: Pyrethroid

Mode of Action: Knock down and non- systemic (Tomlin, 1997)

Formulation: emulsifiable concentrate.

Trade name: Sherpaz

Chemical Abstract name: cyano(3-phenoxyphenyl) methyl 3-(2-2-dichloro=ethenyl)-2-dimethylcyclopropane carboxyylate.

2.3 Water traps:

Colored water traps (yellow, green and red) were used for monitoring the flight activity of aphids within vineyards. Traps were rectangle in shape, 30 cm long, 15 cm wide and 15 cm in depth.

Aqueous mixture used the water trap consists of 3L of water + 100ml formalin (37%) and 50ml liquid detergent as designed by Hamdan, (1986). This mixture was changed monthly, and the water was added when needed.

2.3. Research work plan:

Following studies were conducted in a period of two years 2004 and 2005:

1. Flight activity of the grape vine aphid within grapevine cultivars in Al-Arroub Agricultural Experimental Station, Hebron**.**

2. Study on the population dynamics of the grapevine aphid on grapevine cultivars during 2004 and 2005 seasons**.**

3. Population dynamics of grapevine aphid under chemical control measures that sprayed against grapevine pests**.**

2.4 Data Analysis*:*

Data analysis was done using percentages, standard deviations and one way ANOVA through using Minitab analysis package.

CHAPTER 3

FLIGHT ACTIVITY OF THE GRAPEVINE APHID, *A. ILLINOISENSIS* WITHIN GRAPEVINE CULTIVARS IN AL-ARROUB AGRICULTURAL EXPERIMENTAL STATION DURING 2004 AND 2005 SEASONS

Chapter 3: Flight Activity of the Grapevine Aphid, *A. illinoisensis* within Grapevine Cultivars in Al-Arroub Agricultural Experimental Station During 2004 and 2005 Seasons

3.1 Objectives

1. To investigate the effect of color of water traps on their efficiency in monitoring the flight activity of grapevine aphid, *Aphis illinoisensis*.
2. To monitor the flight activity of the grapevine aphid in Al-Arroub Agricultural Experimental Station.

3.2 Materials and Methods

The present study investigated the use of coloured water traps to monitor the flight activity of the grapevine aphid, *A. illinoisensis* in grape vine yards of Al-Arroub Agricultural Experimental Station for two years 2004 and 2005.

3.2.1 The effect of color of water trap on its efficiency in monitoring the flight activity of the grapevine aphid, *A. illinoisensis*:

Treatments: Three colors of water traps: yellow, green and red.

Replications: 5 traps/each color

Design: Completely Randomized Design.

Vineyard: Hebron University vineyard No.2 (Fig. 2.2)

This experiment was done during the period from 27th March -26th June, 2004. Five water traps from each color were randomly distributed among the rows of the grapevines and placed directly on the soil surface.

Each water trap consisted of a colored rectangular plastic container (30 cm long 15 cm wide and 15 cm in depth). The aqueous mixture of the trap consisted of 3L of water + 100ml 37% formalin and 50ml liquid detergent, as designed by Hamdan (1986). The aqueous mixture was changed monthly, and the water was added when needed.

Observations were done weekly. Insects were captured by the traps were collected from each trap by filtration of aqueous mixture using a cloth through a plastic funnel, and the cloth that included the captured insects from each trap was placed in a 90 mm diameter Petri dish and transferred to the laboratory. Collected samples were immersed in ethanol (75%), and aphids were identified and counted under 40X binocular dissecting microscope.

3.2.2 Monitoring the flight activity of grapevine aphid, *A. illinoisensis* within grapevine cultivars, using yellow water traps (2004 and 2005):

This experiment was done to monitor the flight activity of the grapevine aphid in two adjacent vine yards during 2004 and 2005 seasons:

1. Hebron University vineyard No. 1 (fig. 2.1): consisted of 2 dunums and included 100 vines planted in an **arbor** system at a spaces of 4*4 meters.

3. Hebron University vineyard No. 2 (fig. 2.2): consisted of 3 dunums and included 150 vines planted in a **prostrate** system at a spaces of 4*4 meters.

Replication: 5 (yellow water traps)/vineyard

Design: Completely Randomized Design.

Five yellow water traps were randomly distributed between the rows of each vineyard (plate 3.1) and placed directly on the soil surface. Traps were weekly observed as mentioned in section 3.2.1.

Plate 3.1: Yellow water traps randomly distributed between the rows within grape vineyards located in Al-Arroub Agricultural Experimental Station, 2004 & 2005.

3.3 Results

3.3.1 Effect of color of water traps on their efficiency in monitoring the flight activity of the grapevine aphid, *Aphis illinoisensis*

Results presented in Table 3.1 shows the weekly average number of alate *A. illinoisensis* (Plate 3.2) captured by three colored water traps (yellow, green and red).

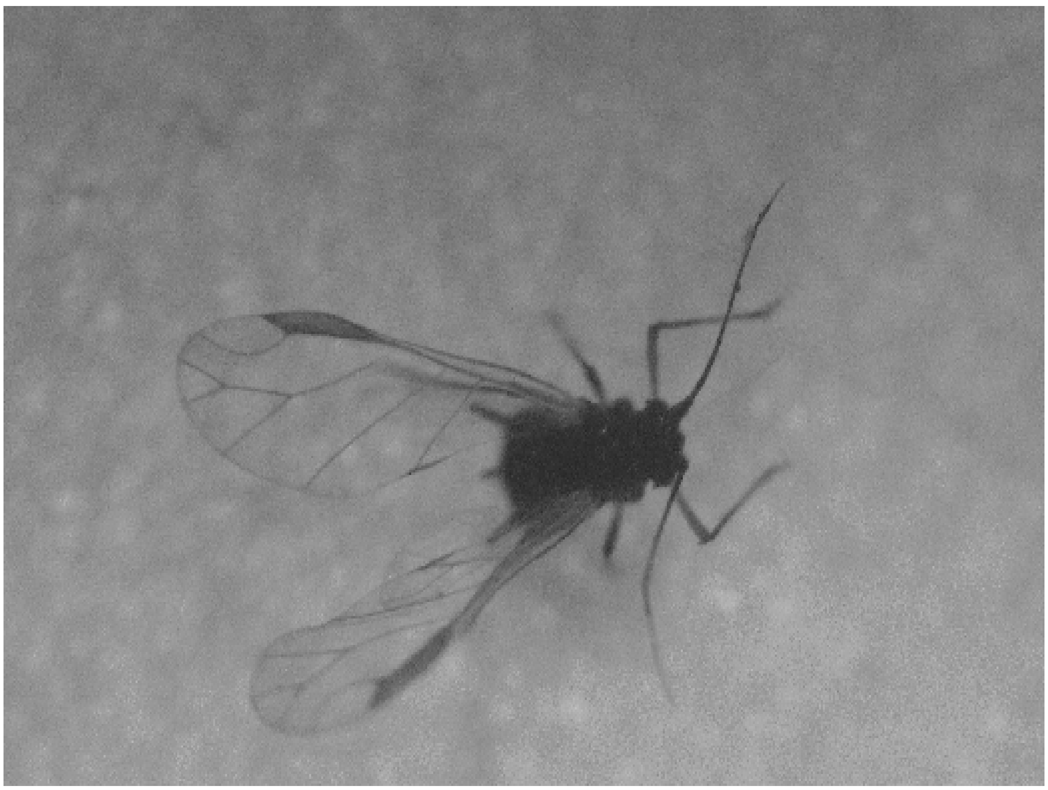

Plate 3.2: Alate *A. illinoisensis* captured by water traps within grape vineyards located in Al-Arroub Agricultural Experimental Station, 2004.

Statistical analysis of these results showed that, the color of the water trap had a significant effect on the efficiency of the traps in monitoring the flight activity of the grapevine aphid *A. illinoisensis*. Both yellow and green water traps were significantly more efficient in monitoring the flight activity of *A. illinoisensis* than the red water traps at $P\ value \leq 0.05$ (using one way ANOVA). Meanwhile, no significant differences were observed between the yellow and green colors in capturing *A. illinoisensis.* However, at the end of the season, when the activity of aphids decreased to its minimal level, no significant differences were observed between the three colors.

Table 3.1 Mean number of alate grapevine aphid captured/colored water trap in 2nd Vineyard of Hebron University. Mean*± S.E.

Date of observation	Color of water traps			
	Yellow	**Green**	**Red**	*P. value*
4th Apr 04	16.6 ± 2.89^a	14 ± 3.16^a	1.2 ± 0.374^b	0.002
11th Apr 04	28.8 ± 6.36^a	23.4 ± 4.2^a	3.2 ± 0.583^b	0.004
18th Apr 04	164.2 ± 9.67^a	147.4 ± 9.85^a	4.8 ± 1.07^b	0.000
25th Apr 04	133.8 ± 12.1^a	124.2 ± 9.49^a	10 ± 1.41^b	0.000
2nd May 04	99.4 ± 18.5^a	81 ± 9.96^a	2 ± 0.548^b	0.000
9th May 04	77 ± 13.6^a	42.8 ± 7.68^a	1 ± 0.447^b	0.000
16th May 04	38 ± 8.11^a	19 ± 4.63^a	0.6 ± 0.245^b	0.000
23rd May 04	8.2 ± 1.59^a	2 ± 0.447^a	0.200 ± 0.200^b	0.000
1st Jun 04	1.40 ± 0.678^a	1.00 ± 0.447^a	0.200 ± 0.200^a	0.000
8th Jun 04	0.600 ± 0.245^a	0.400 ± 0.245^a	0.000 ± 0.000^a	0.139
15th Jun 04	0.600 ± 0.245^a	0.200 ± 0.200^a	0.000 ± 0.000^a	0.100
Total	568.6±74	455.4±50.61	23.2±5.08	0.02

*: Figures within rows with similar letters do not differ significantly at *p value* ≤ 0.05 at Fisher pairwise comparison (using one way ANOVA).

3.3.2 Seasonal flight activity of the grapevine aphid, *A. illinoisensis* in Hebron University vineyards in Al-Arroub Agricultural Experimental Station during 2004 and 2005 seasons.

Results presented in Table 3.2 and Fig. 3.1 show that alate *A. illinoisensis* was captured by the water traps throughout two years (2004 and 2005) within grape vineyards located in Al-Arroub Agricultural Experimental Station.

Table 3.2 shows the weekly average number of alate *A. illinoisensis* that were captured by yellow colored water traps in the two vineyards (Prostrate and Arbor).

Statistical analysis of these results showed that, at the beginning and at the end of the season, 2004 (1^{st} April - 18^{th} April), (16^{th} May – 20^{th} June) respectively, the flight activity of *A. illinoisensis* in arbor vineyard was significantly higher than that in prostrate vineyard. However, at the middle of the season, 2004 (18^{th} April- 16^{th} May), the flight activity was higher within the prostrate vineyard than that within the arbor vineyard but without significant differences at P $value \leq 0.05$ at Fisher pair wise comparison (using one way ANOVA). In addition, the flight activity of the aphid was traced with few numbers in the arbor vineyard till 20^{th} of June, 2004 while it disappeared from the prostrate vineyard from 6^{th} June 2004.

However, the flight activity of the aphid during 2005 season showed different patterns from that recorded in 2004. The average number of alate aphid captured within the Prostrate vineyard during 2005 season was significantly higher than that within the Arbor yard, except at the middle of the season when the peak of flight activity was higher within the Arbor yard than the prostrate one but the difference between peaks was not statistically significant at *P value*≤ 0.05 at Fisher pair wise comparison (using one way ANOVA).

Table 3.2: Mean number of alate grapevine aphid captured by yellow water trap in Hebron University vineyard, Al-Arroub Agricultural Experimental Station. Mean ± S.E.

Date	Mean ± S.E Of Prostrate	Mean ± S.E Of Arbor	*p- value*
27th Mar. o4	Start of monitoring	Start of monitoring	
04th Apr 04	16.6±2.89b	48.40 ± 9.23a	0.011
11th Apr 04	23.4±4.2b	64.4 ± 10.1a	0.006
18th Apr 04	164.2±9.67b	381.30 ± 8.57a	0.000
25th Apr 04	124.2±9.49a	77.80 ± 7.36b	0.005
2nd May 04	99.4±18.5a	62.80 ± 5.15a	0.093
9th May 04	77.0±13.6a	46.80 ± 5.54a	0.073
16th May 04	38.0±8.11a	25.60 ± 2.50a	0.182
23rd May 04	8.2±1.59a	12.60 ± 1.36a	0.069
30th May 04	1.40±0.678a	4.00 ± 1.30a	0.115
6th June 04	0.60±0.245a	1.20 ± 0.49a	0.305
13th June 04	0.0±0.0a	0.40 ± 0.245a	0.141
20th June 04	0.0±0.0a	0.20 ± 0.20a	0.347
Total 2004	**553.0±37.5b**	**725.8±29.8a**	**0.007**
22nd Mar 05	185.2±23.2a	63.20 ± 2.73b	0.000
29th Mar 05	403.2±46.0a	110.0 ± 18.8b	0.000
5th Apr 05	397.8±75.7a	459.8 ± 16.6a	0.447
12th Apr 05	373.4±58.4a	472.60 ± 7.76a	0.130
19th Apr 05	388.8±48.9a	335.6 ± 18.1a	0.338
26th Apr 05	374.6±47.1a	218.0 ± 22.3b	0.017
3rd May 05	253.8±30.9a	79.4 ± 13.0b	0.000
10th May 05	105.2±21.7a	38.40 ± 8.03b	0.020
17th May 05	37.0±6.47a	11.20 ± 3.06b	0.007
24th May 05	19.4±2.98a	1.20 ± 0.583b	0.000
31st May 05	11.8±1.46a	0.60 ± 0.245b	0.000
7th Jun 05	4.60±1.50a	0.20 ± 0.20b	0.020
14th Jun 05	1.60±0.510a	0.20 ± 0.20b	0.034
19th Jun 05	0.0±0.0a	0.20±0.60a	0.172
26th Jun 05	0.0±0.0a	0.20±0.20a	0.347
Total 2005	**2557.2±23.5a**	**1790±32.4b**	**0.012**

In conclusion, the total number of aphids captured within the Arbor vineyard was significantly higher during 2004 season but significantly lower during 2005 season than that within the prostrate vineyard.

Results presented in Fig.3.1 shows that for two successive years (2004 and 2005), the flight activity of the grapevine aphid, *A. illinoisensis* within the two vineyards started at the beginning of April, increased exponentially till middle of April when it reached its peak of flight activity and then decreased till it disappeared by the middle of June within the prostrate vine yard but it was traced till the end of June within the Arbor vine yard.

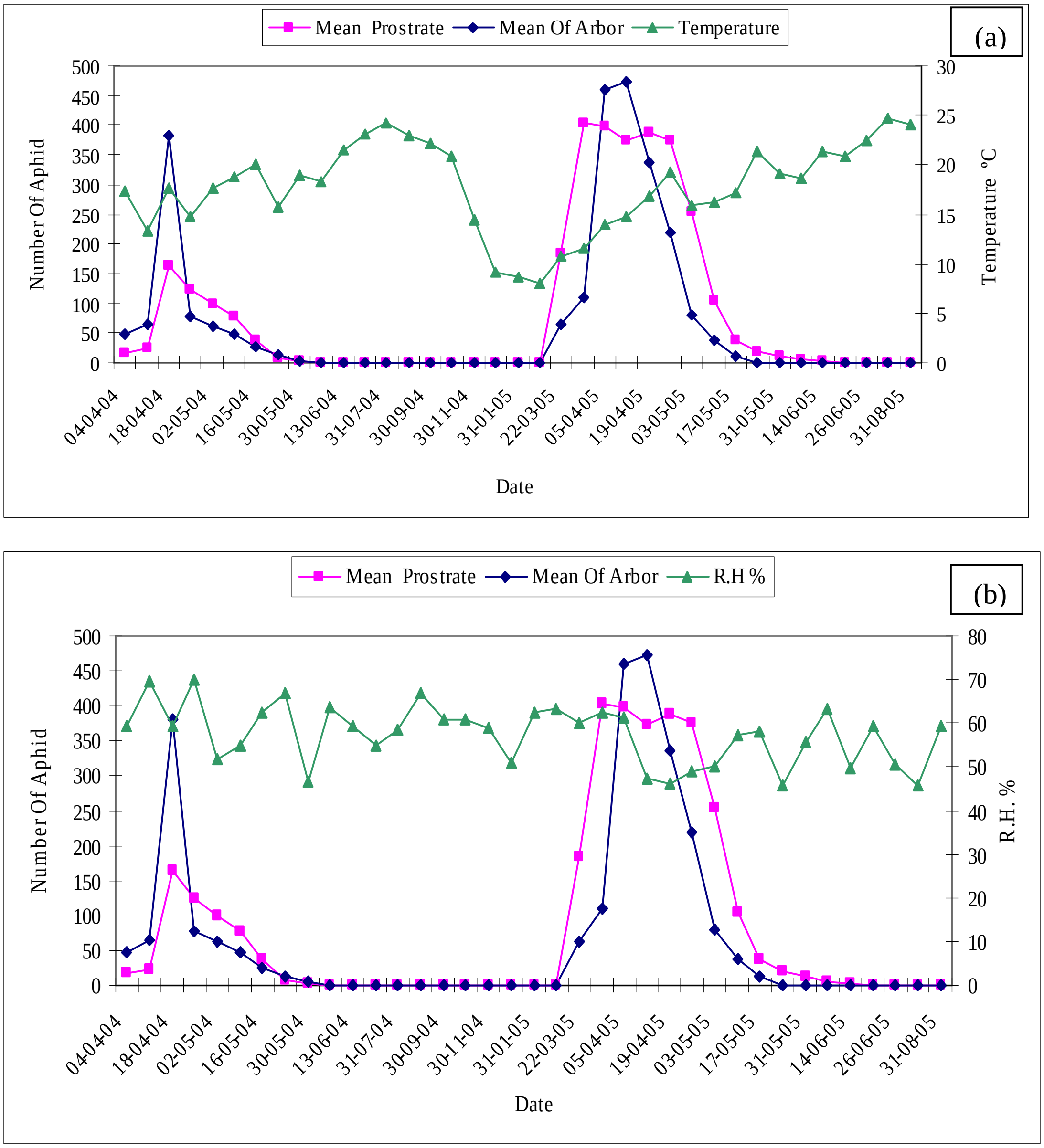

Figure 3.1: Flight activity of *A. illinoisensis* within Hebron University vineyard during 2004 & 2005 season as monitored by yellow colored water traps in relation to (a) temperature and (b) relative humidity.

Furthermore, results in Fig.3.1 show that the flight activity of *A. illinoisensis* has a relation with the temperature, relative humidity and rain. Thus, flight activity was recorded only within the temperature range of 10-20ºC and the average number of the captured alate aphids was affected by rain.

3.4 Discussion

Yellow colored traps were significantly more efficient in monitoring the flight activity of *A. illinoisensis* than the red colored traps, and this result agreed with the results of previous studies that were conducted on flight activity of other aphid species (Wigglesworth, 1969; Van Emden, 1972; Prokopy and Owens, 1983; Hamdan, 1986). Prokopy and Owens (1983) suggested that yellow and green traps probably mimic plant foliage confirming general pattern of attraction for herbivorous insects, Wigglesworth (1969); Van Emden (1972) and Hamdan (1986) reported that flying *M. persicae* were attracted to yellow color of foliage and traps.

The results of this research show that the flight activity of *A. illinoisensis* in Hebron District started in beginning of April reached its peak on the middle of April and ceased by the end of June, in addition, results also show that no flight activity of the aphid was recorded below 10ºC or above 20ºC. These results are in agreement with previous studies conducting on other aphids (Broadbent, 1949; Robert, 1979; Boiteau, 1986). Broadbent (1949) suggested that each species has a minimum temperature threshold for flight initiation, e.g., 12.8°C for *M. persicae*, in addition, Robert (1979) and Boiteau (1986) concluderd that most species do not fly when temperatures are above 30°C.

Results also show that the average number of the grapevine aphid, *A. illinoisensis* that were captured during 2005 season was much greater than that in 2004, although the climatic conditions (temperature and humidity) were within the same ranges. This variation might be due to the gradual build up of the aphid population in the area hence the incidence of infestation of the aphid on grapevines was observed to occur in the region during the last few years only and this aphid was not observer in Palestine before the year 2000.

CHAPTER 4

STUDY ON THE POPULATION DYNAMICS OF THE GRAPEVINE APHID, *A. ILLINOISENSIS* ON GRAPEVINE CULTIVARS IN AL-ARROUB AGRICULTURAL EXPERIMENTAL STATION DURING 2004 AND 2005 SEASONS

Chapter 4: Study on the Population Dynamics of the Grapevine Aphid, *A. illinoisensis* on Grapevine Cultivars in Al-Arroub Agricultural Experimental Station During 2004 and 2005 Seasons

4.1 Objectives

To monitor population dynamics of the grapevine aphid on grapevine cultivars in Al-Arroub Agricultural Experimental Station for two years (2004 and 2005)

4.2 Materials and Methods

Observations on the population dynamics of the grape vine aphid on grapevine cultivars were conducted in Hebron University vineyard No. 1 in Al-Arroub Agricultural Experimental Station for two years (2004 and 2005).

- Weekly survey was done to record the number of aphids on all plants in the vineyard for 2004 and 2005 seasons.
- The number of different stages of the grapevine aphid (nymph and adult) was weekly recorded on each plant using field lens (10X).

4.3 Results

Colonies of grape vine aphid, *A. illinoisensis* including nymphs, alate adults and apterous adults (Plate 4.1), were recorded infesting grapevine plants in Al-Arroub Agricultural Experimental Station, throughout 2004 and 2005 seasons.

Plate 4.1: ***A. illinoisensis*** **colony infesting grapevine plants in Al-Arroub Agricultural Experimental Station, during 2005 seasons.**

4.3.1 Percentage of plants infested with *A. illinoisensis* /grapevine cultivar in Hebron University Vineyard during 2004 & 2005 seasons

Results in Table 4.1 show that, the percentage of plants infested with *A. illinoisensis* during 2004 season were 50% on Salti-khdari; 31% on Ballouti; 18% on Sultanina; 14% on Halawani; 7% on Shami and Jandali, but Baitouni was free from infestation. However, during 2005 season, proportion of infested plants changed reaching the following values: 80% on Jandali; 40% on Ballouti and Sultanina; 20% on Salti-Khdari and, Shami and Halawani and 10% on Baitouni.

Table 4.1 Percentage of plants/grapevine cultivar infested with *A. illinoisensis* in Hebron University Vineyard during 2004 & 2005 seasons. Mean ± S.E.

Date	Grapevine Cultivars (n*)							*P value*
	Sultanina (19)	Ballouti (11)	Shami (20)	Salti-khdari (10)	Halawani (10)	Baitouni (8)	Jandali (10)	
2/8/04	18±18	22±22	1±1	42±42	14±14	0.0±0.0	0.0±0.0	0.65
9/8/04	0.00±0.0	31±31	7±6	50 ± 4^{0}	10±10	0.0±0.0	7±7	0.23
18/6/05	5±5	9±9	10±7	20±10	10±10	0.0±0.0	0.0±0.0	0.707
25/6/05	0.00±0.0	9±9	10±7	0.0±0.0	10±10	0.0±0.0	20±10	0.438
2/7/05	0.00±0.0	9±9	10±7	0.0±0.0	10±10	0.0±0.0	20±10	0.438
9/7/05	5±5	9±9	10±10	0.0±0.0	0.0±0.0	0.0±0.0	40±20	0. 109
16/7/05	30±1	9±9	5±5	0.0±0.0	10±10	0.0±0.0	30±20	0.129
23/7/05	40±1	20±10	10±7	0.0±0.0	20±10	10±10	40±20	0.136
2/8/05	36±1	40 ± 2^{0}	5±5	10±10	10±10	0.0±0.0	10±10	0.086
9/8/05	4±4	40±40	20±20	0.0±0.0	10±10	0.0±0.0	80±80	0.75
16/8/05	0.00±0.0	0.0±0.0	0.00±0.0	0.0±0.0	0.00±0.0	0.0±0.0	10±10	0.12

***: n = Number of plant / cultivar**

4.3.2 Infestation of grapevine aphid on grapevine cultivars during 2004 and 2005 seasons.

Results in Table 4.2 show the mean number of *A. illinoisensis* recorded on six grapevine cultivars in Hebron University during 2004 and 2005 seasons.

Table 4.2 Average infestations of *A. illinoisensis* on grapevine cultivars in Hebron University Vineyard during 2004 & 2005 seasons. Mean (Aphid/Plant) ± S.E.

Date	Grapevine Cultivars (n*)							*P value*
	Sultanina (19)	Ballouti (11)	Shami (20)	Salti-khdari (10)	Halawani (10)	Baitouni (8)	Jandali (10)	
2/8/04	4.32±4.15	6.82±6.82	0.3±0.3	62.0±62.0	4±4	0.0±0.0	0.0±0.0	0.317
9/8/04	0.0±0.0	25.1±16.7	0.95±0.55	68.8±68.8	1.5±1.5	0.0±0.0	1.4±1.4	0.285
18/6/05	0.11±0.07	2.27±2.27	0.5±0.295	6.4±4.22	8.7±8.7	3.62±3.62	0.0±0.0	0.349
25/6/05	0.0±0.0	50.9±50.9	69.05±69	0.0±0.0	0.0±0.0	33.1±33.1	318.4±318	0.666
2/7/05	0.0±0.0	78.2±78.2	118.5±82	0.0±0.0	1±1	0.0±0.0	44±44	0.539
9/7/05	6.26±5.13	4.55±3.33	1.95±1.95	0.0±0.0	0.0±0.0	0.0±0.0	25.9±13.2	0.024
16/7/05	177±11.2	28.3±28.3	0.55±0.55	0.0±0.0	2.1±2.1	0.0±0.0	228.2±228	0.193
23/7/05	290±17.2	67.9±67.9	6.5±6.5	0.0±0.0	11.5±11.5	19.3±19.3	582.4±53	0.333
2/8/05	22.8±9.81	441±43.8	13.3±13.3	0.0±0.0	6.2±6.2	0.0±0.0	872±82	0.359
9/8/05	5.3±2.1	52.2±51.8	2.31±1.98	0.0±0.0	0.8±0.8	0.0±0.0	120±120	0.348
16/8/05	0.0±0.0	1.2±1.2	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	12.4±12.4	0.456

*: n = Number of plant / cultivar

The beginning of infestation was first recorded on 2nd August 2004 on five cultivars (Salti-khdari, Ballouti, Sultanina, Halawani, and Shami); meanwhile, Baitouni and Jandali cultivar were still free from infestation. Thus, grapevine cultivars can be classified according to start of infestation to four levels as follow: Salti-khdari with high infestation; Balluti, Sultanina and Hallawani with medium infestation; Shami with low infestation and Beitoni and Jandali without infestation.

On 9th August 2004, observations found out that aphid infestation increased on Salti-khdari and Ballouti cultivars; decreased on Sultanina and

Hallawani cultivars; low infestation recorded on Jandali and Shami while Baituni was still free from infestation.

Results in Table 4.2 also showed that, during 2005 season, start of infestation was 1st recorded on 18th June on six cultivars (Sultanina, Ballouti, Shami, Salti-khdari, Halawani and Baitouni) meanwhile Jandali cultivar was still free from infestation. Results also showed that, aphid infestation during 2005 season was recorded for a period of two months and with greater numbers of aphids/plant than that during 2004 season.

However, statistical analysis of the results showed that, there was no significant difference between these grapevine cultivars in their susceptibility for aphid infestation during 2004 and 2005 seasons.

4.3.3 Development of aphid infestation on each grapevine cultivar during 2004 + 2005 seasons:

Results showed that, on the cultivar **Sultanina,** the aphid infestation during 2004 season, was recorded only during the first week of August, but during 2005 season, the aphid infestation was first recorded on 18th June, then disappeared for the next three weeks and later on, infestation was recorded for a period of month (from 9th July to 9th August) with its peak of 161.7 aphid/plant on 23rd July (Fig. 4.1).

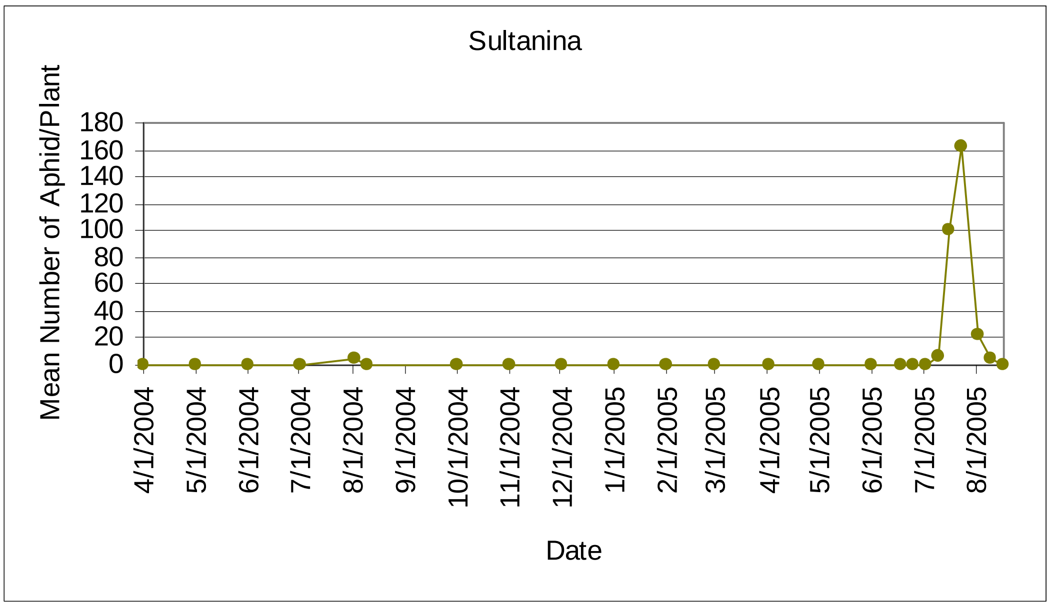

Fig. 4.1: Infestation of *A. illinoisensis* on Sultanina cultivar during 2004 and 2005 seasons.

Results showed that, on the cultivar **Ballouti,** the aphid infestation during 2004 season, was recorded only during the first two weeks of August, but during 2005 season, the aphid infestation was first recorded on 18th June and continued for a period of two months (18th June – 16th August) with two peaks of 78.2 aphid/plant on 2nd July and 441 aphid/plant on 2nd August (Fig. 4.2).

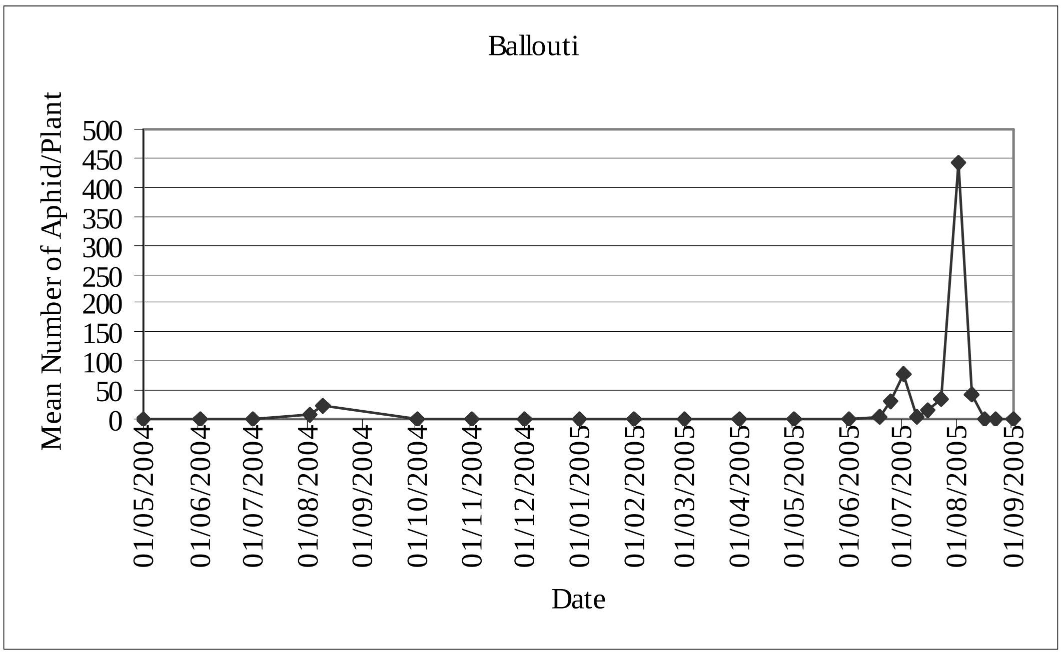

Fig. 4.2: Infestation of *A. illinoisensis* on Ballouti cultivar during 2004 and 2005 seasons.

Results showed that, on the cultivar **Shami,** the aphid infestation during 2004 season, was recorded only during the first two weeks of August, but during 2005 season, the aphid infestation was first recorded on 18th June and continued for a period of seven weeks (18th June – 9th August) with two peaks of 118.5 aphid/plant on 2nd July and 13.3 aphid/plant on 2nd August (Fig. 4.3).

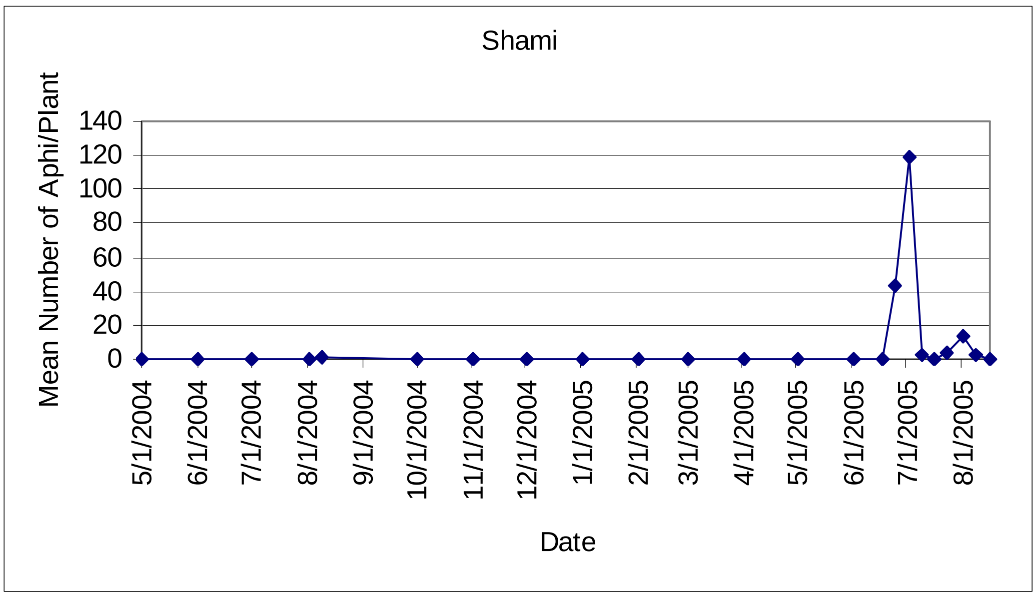

Fig. 4.3: Infestation of *A. illinoisensis* on Shami cultivar during 2004 and 2005 seasons.

Results showed that, on the cultivar **Salti-Khdari,** the aphid infestation during 2004 season, was recorded during the first two weeks of August, but during 2005 season, the aphid infestation was recorded for one week only during mid of June with 6.4 aphid/plant (Fig. 4.4).

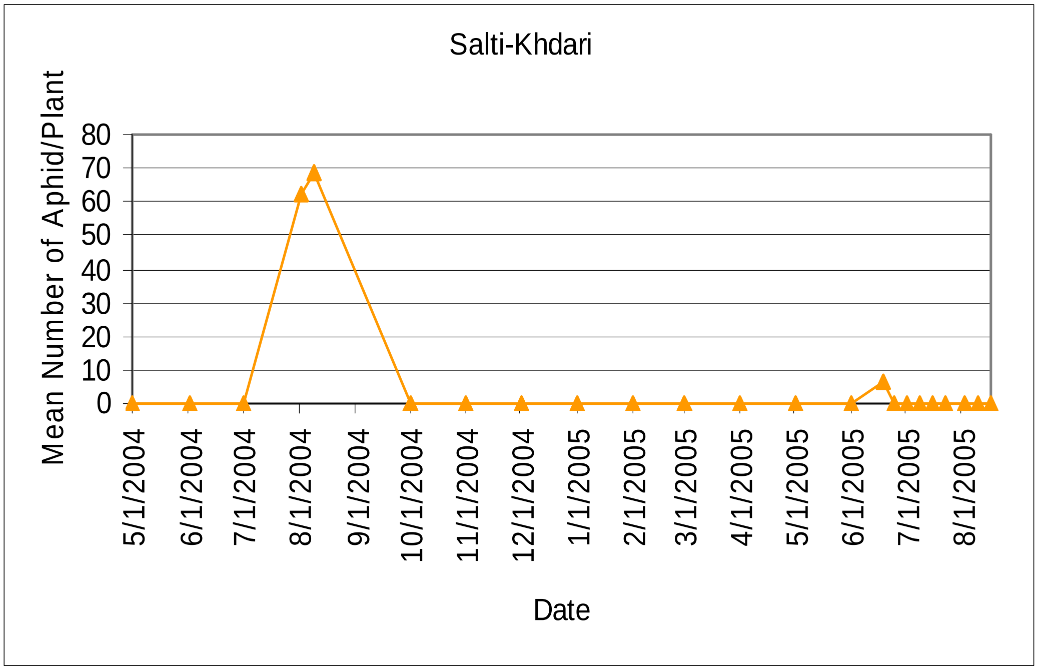

Fig. 4.4: Infestation of *A. illinoisensis* on Salti-khdari cultivar during 2004 and 2005 seasons.

Results showed that, on the cultivar **Halawani,** the aphid infestation during 2004 season, was recorded only during the first two weeks of August, but during 2005 season, the aphid infestation was first recorded on 18th June and continued for a period of seven weeks (18th June – 9th August) with two peaks of 8.7 aphid/plant on 18th June and 6.2 aphid/plant on 2nd August (Fig. 4.5).

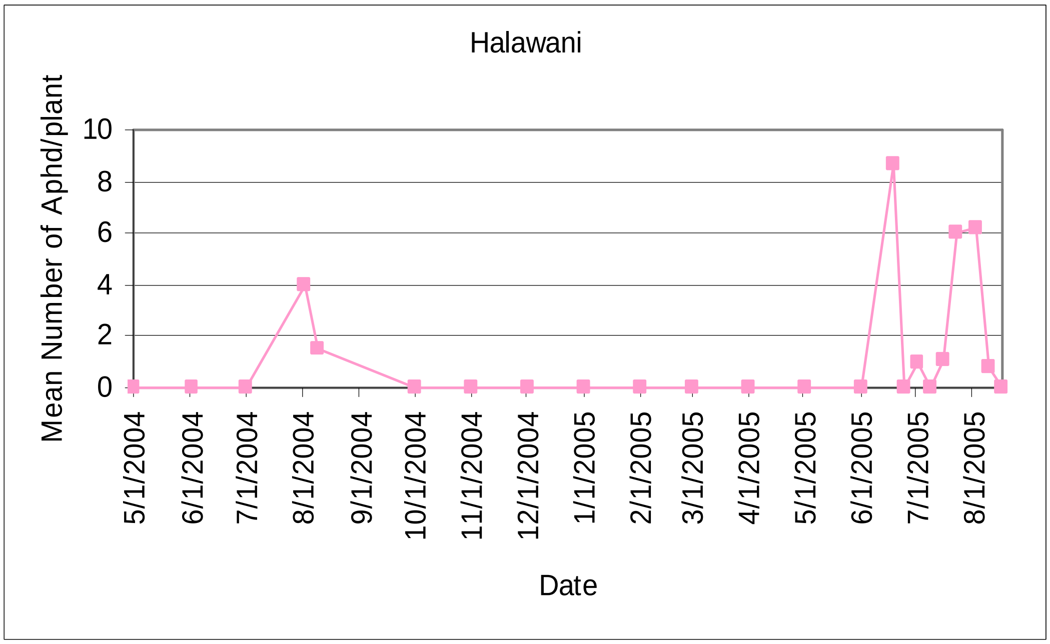

Fig. 4.5: Infestation of *A. illinoisensis* on Halawani cultivar during 2004 and 2005 seasons.

Results showed that, on the cultivar **Baitouni** was free from aphid infestation during 2004 season, but during 2005 season, the aphid infestation was first recorded for a period of two weeks from 18th – 25th June, the infestation disappeared till 23rd July when infestation observed with 10 aphids/plant (Fig. 4.6).

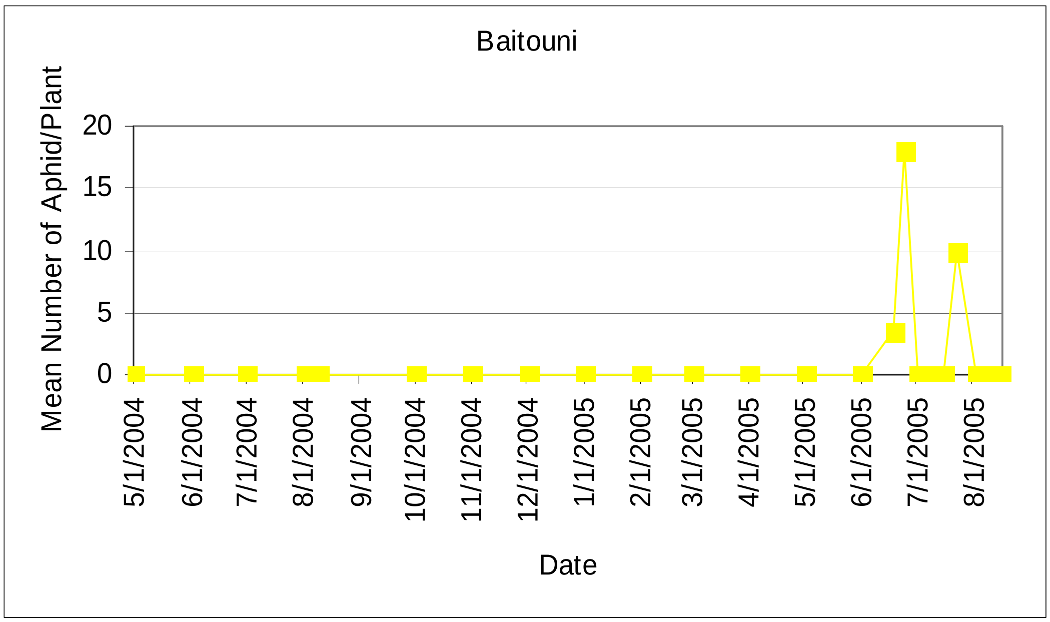

Fig. 4.6: Infestation of *A. illinoisensis* on Baitouni cultivar during 2004 and 2005 seasons.

Results showed that, on the cultivar **Jandali,** the aphid infestation during 2004 season, was recorded only during the second week of August with 1.4 aphid/plant, but during 2005 season, the aphid infestation was first recorded on 25th June and continued for a period of seven weeks (25th June – 16th August) with one peaks of 872 aphid/plant on 2nd August (Fig. 4.7).

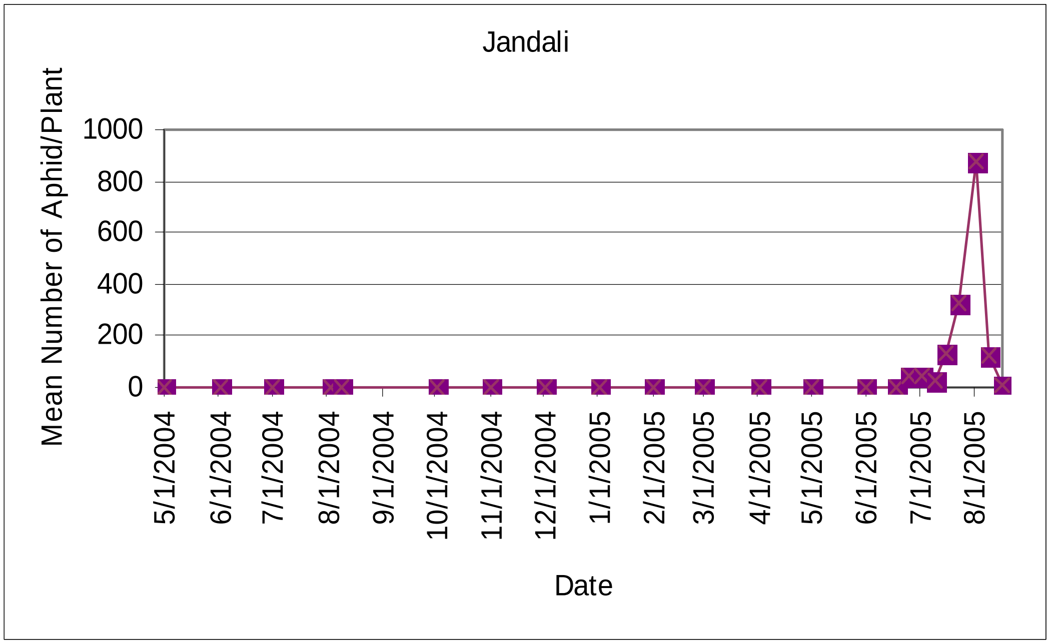

Fig. 4.7: Infestation of *A. illinoisensis* on Jandali cultivar during 2004 and 2005 seasons.

4.3.4 Mean number of grapevine aphid recorded on grapevine cultivars in Hebron University vineyard during 2004 and2005 seasons

The population dynamics of the grapevine aphid infesting the local grapevine cultivars in Hebron University vineyard during 2004 season, were investigated (Table 4.3).

Results show that, aphid infestation was recorded on 2nd and 9th August 2004. Aphid population was recorded on all grapevine cultivars except Baitouni which was free from infestation all the season. Maximum aphid infestation was recorded on Salti-Khdari with a average total population of 62 aphid/plant on 2nd August and, 68.8 aphid/plant on 9th August followed by Ballouti cultivar with 6.8 aphid/plant on 2nd August and reached to 25.1 aphid/plant on 9th August. Meanwhile, Sultanina, Shami, Halawani and Jandali were with populations <5 aphids/plant. In addition, results showed that, almost aphid colonies which were recorded infesting grapevine cultivars were consisted of small nymphs; medium nymphs; alate and apterous adults,(Table4.3).

However, statistical analysis shows that no significant differences were recorded between the aphid populations infesting the grapevine cultivars during 2004 season.

Even observation for aphid infestation was done weekly all over the season, aphid infestation was recorded on all grapevine cultivars only during the period from 18th June to 16th August 2005. However, Salti-Khdari cultivar (which was with the maximum infestation during 2004 season), was infested with the grapevine aphid for only one week that ends with 16th June 2005 and after that date, this cultivar was free from infestation for all 2005 season (Table 4.4).

Table 4.3 Mean number of grapevine aphid stages recorded on grapevine cultivars in Hebron University vineyard during 2004 season. Mean ± S.E.

Date	Stage		Grapevine Cultivars							*P value*
			Sultanina (19)	Ballouti (11)	Shami (20)	Salti-khdari (10)	Halawani (10)	Baitouni (8)	Jandali (10)	
2/8	**Nymphs**		3.48±0.77	0.73±0.73	0.25±0.25	36.4±36.4	3.7±3.7	0.0±0.0	0.0±0.0	0.356
	Adults	**Apterous**	0.7±0.7	1.36±1.36	0.0±0.0	5.6±5.6	0.3±0.3	0.0±0.0	0.0±0.0	0.396
		Alate	0.14±0.14	1.3±0.06	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.254
9/8	**Nymphs**		0.0±0.0	20.53±13.8	0.85±0.53	59.1±59.1	1.5±1.5	0.0±0.0	1.3±1.3	0.244
	Adults	**Apterous**	0.0±0.0	4.55±3.06	0.1±0.69	9.61±9.61	0.0±0.0	0.0±0.0	0.1±0.1	0.268
		Alate	0.0±0.0	4.05±0.5	0.1±0.1	0.09±0.09	0.0±0.0	0.0±0.0	0.0±0.0	0.321

Thus, the maximum average aphid populations were recorded on the grapevine cultivars in a decreasing sequence as follow: Jandali with 872 aphid/plant on 2nd August; Ballouti with 441 aphid/plant on 2nd August; Sultanina with 161.7 aphid/plant on 23rd July; Shami with 118.5 aphid/plant on 2nd July; Baitouni with 18.1 aphid/plant on 25th June; Halawani with 8.7 aphid/plant on 18th June and Salti-Khdari with 6.4 aphid/plant on 18th June. In addition, results also show that almost aphid colonies which were recorded infesting grapevine cultivars were consisted of nymphs and alate and apterous adults.

However, statistical analysis shows that no significant differences were recorded between the aphid populations infesting the grapevine cultivars during 2005 season.

Table 4.4 Mean number of grapevine aphid recorded on grapevine cultivars in Hebron University vineyard during 2005 season. Mean ± S.E.

Date	Stage		Grapevine Cultivars							P value
			Sultanina (19)	Ballouti (11)	Shami (20)	Salti-khdari (10)	Halawani (10)	Baitouni (8)	Jandali (10)	
18/6	Nymphs		0.05±0.05	2.11±2.11	0.5±0.385	6.4±5.08	8.2±8.2	2.4±2.4	0.0±0.0	0.332
	Adults	Apterous	0.05±0.05	0.27±0.72	0.0±0.0	0.0±0.0	0.5±0.5	1.3±1.3	0.0±0.0	0.252
		Alate	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.351
25/6	Nymphs		0.0±0.0	20.9±20.9	26.1±19.3	0.0±0.0	0.0±0.0	15.1±15.1	39±37	0.6023
	Adults	Apterous	0.0±0.0	29.6±29.6	36±28.8	0.0±0.0	0.0±0.0	16±16	42.7±42.7	0.666
		Alate	0.0±0.0	0.4±0.4	7±7	0.0±0.0	0.0±0.0	2.1±2.1	7.2±7.2	0.621
2/7	Nymphs		0.0±0.0	44.6±44.6	90.9±90.9	0.0±0.0	0.7±0.7	0.0±0.0	37±37	0.531
	Adults	Apterous	0.0±0.0	22.7±22.7	28±19.4	0.0±0.0	0.3±0.3	0.0±0.0	4±4	0.523
		Alate	0.0±0.0	0.92±0.92	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	3±3	0.325
9/7	Nymphs		1.05±1.05	2.73±2.73	1.65±1.65	0.0±0.0	0.0±0.0	0.0±0.0	6.4±12.1	0.006
	Adults	Apterous	4.81±4.81	1.82±1.82	0.3±0.3	0.0±0.0	0.0±0.0	0.0±0.0	4.4±2	0.722
		Alate	0.4±0.4	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.625
16/7	Nymphs		60.1±60.1	13.8±13.8	0.25±0.25	0.0±0.0	1±1	0.0±0.0	100±100	0.262
	Adults	Apterous	91.2±55.5	14.5±14.5	0.3±0.3	0.0±0.0	1.1±1.1	0.0±0.0	124±106	0.193
		Alate	8.7±8.7	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	25±25	0.624
23/7	Nymphs		130±130	22.2±22.2	2.8±2.8	0.0±0.0	5.8±5.8	9.02±9.02	251±251	0.342
	Adults	Apterous	148.6±71	34.6±33	3.7±3.4	0.0±0.0	5±3.56	10±10	266±116	0.333
		Alate	13.1±12.5	1.1±1.1	0.0±0.0	0.0±0.0	1±1	0.0±0.0	61±41	0.487
2/8	Nymphs		20.3±20.3	320±320	12.5±12.5	0.0±0.0	5.5±5.5	0.0±0.0	300±300	3.62
	Adults	Apterous	2±0.94	74.8±74.8	1.1±1.1	0.0±0.0	0.7±07	0.0±0.0	155±155	0.347
		Alate	0.0±0.0	9.6±9.6	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	17±17	0.921
9/8	Nymphs		2.1±2.1	15±15	1±1	0.0±0.0	0.0±0.0	0.0±0.0	40±40	0.295
	Adults	Apterous	3.2±3.2	1.2±1.2	1.31±1.31	0.0±0.0	0.8±0.8	0.0±0.0	75±75	0.412
		Alate	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	5±5	0.624
16/8	Nymphs		0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	4.4±4.4	0.296
	Adults	Apterous	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	8±8	0.123
		Alate	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.587

4.3.5 Population dynamics of grapevine aphid on each grapevine cultivar during 2004 and 2005 seasons:

Results showed, that during 2004 season, population of *A. illinoisensis* was recorded on Sultanina cultivar for only one week that ended on 2nd August, and population dynamics of the aphid consisted of all stages including small and medium nymphs and apterous and alate adults
(Fig. 4.8 A).

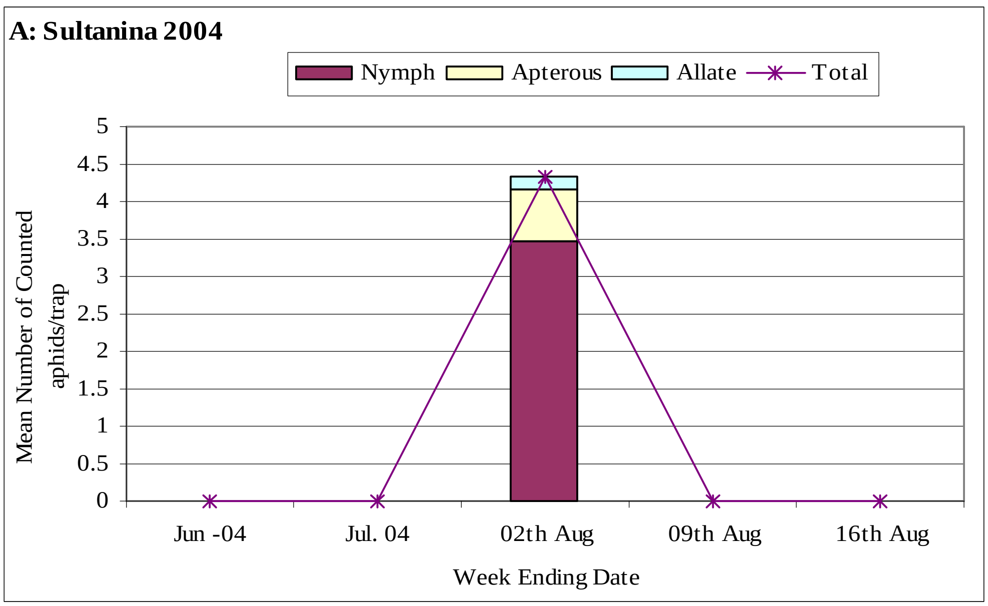

Fig. 4.8 (A): Population dynamics of *A. illinoisensis* on Sultanina cultivar during 2004 season.

Results showed, that during 2005 season, population of *A. illinoisensis* was recorded on Sultanina cultivar for five weeks (2nd July – 9th August) with its peak on 23rd July. Population dynamics of the aphid recorded on Sultanina cultivar, during 2005 season, consisted of: only apterous adults on 9th July; all stages including small and medium nymphs and apterous and alate adults on 16th and 23rd July and only nymphs on 2nd and 9th August (Fig. 4.8 B).

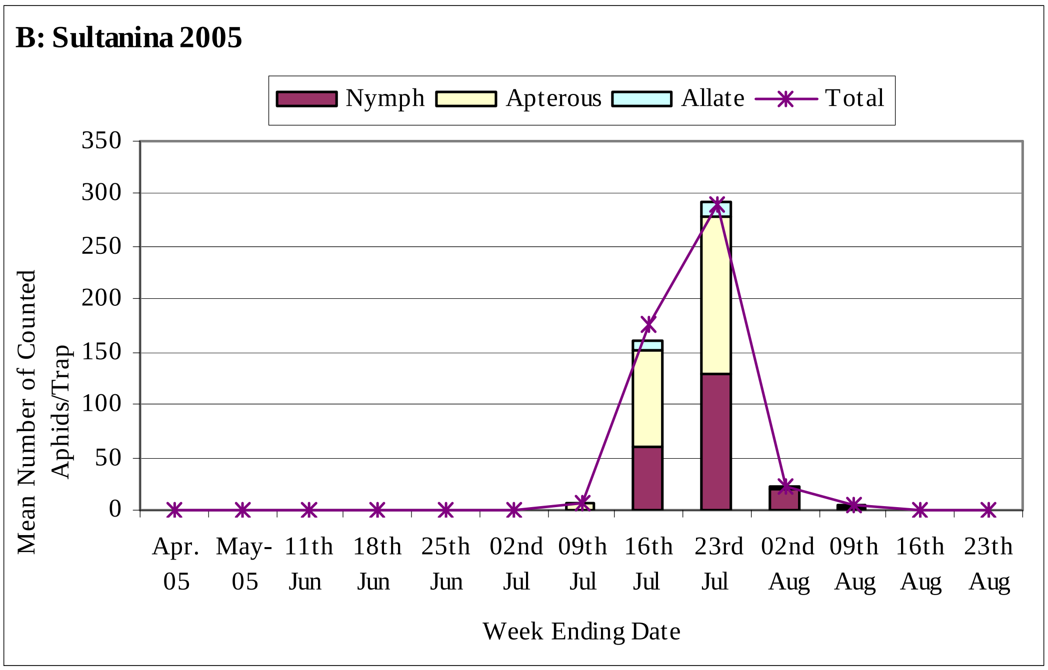

Fig. 4.8 (B): Population dynamics of *A. illinoisensis* on Sultanina cultivar during 2005 season.

Results showed, that during 2004 season, population of *A. illinoisensis* was recorded on Ballouti cultivar for two weeks (2nd -9th August), and population dynamics of the aphid consisted of small and medium nymphs and apterous adults on 2nd August meanwhile, all stages including alate adults were recorded on 9th August (Fig. 4.9 A).

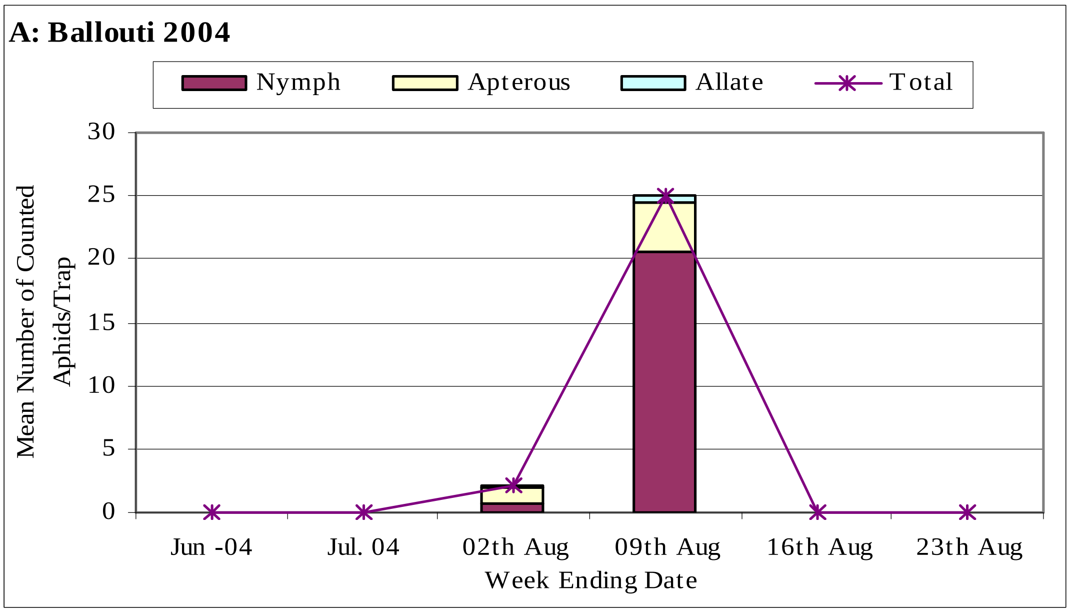

Fig. 4.9 (A): Population dynamics of *A. illinoisensis* on Ballouti cultivar during 2004 season

Results showed, that during 2005 season, population of *A. illinoisensis* was recorded on Ballouti cultivar for two months (18th June – 16th August) with its peak on 2nd August, and the population dynamics of the aphid consisted nymphs and apterous adults during the period from 18th June – 23rd July, then all stages including alate adults were recorded when high density population (441 aphid/plant), was observed on 2nd August, but on 9th August, only nymphs were found and, finally, population extinction was observed on 16th August (Fig. 4.9 B).

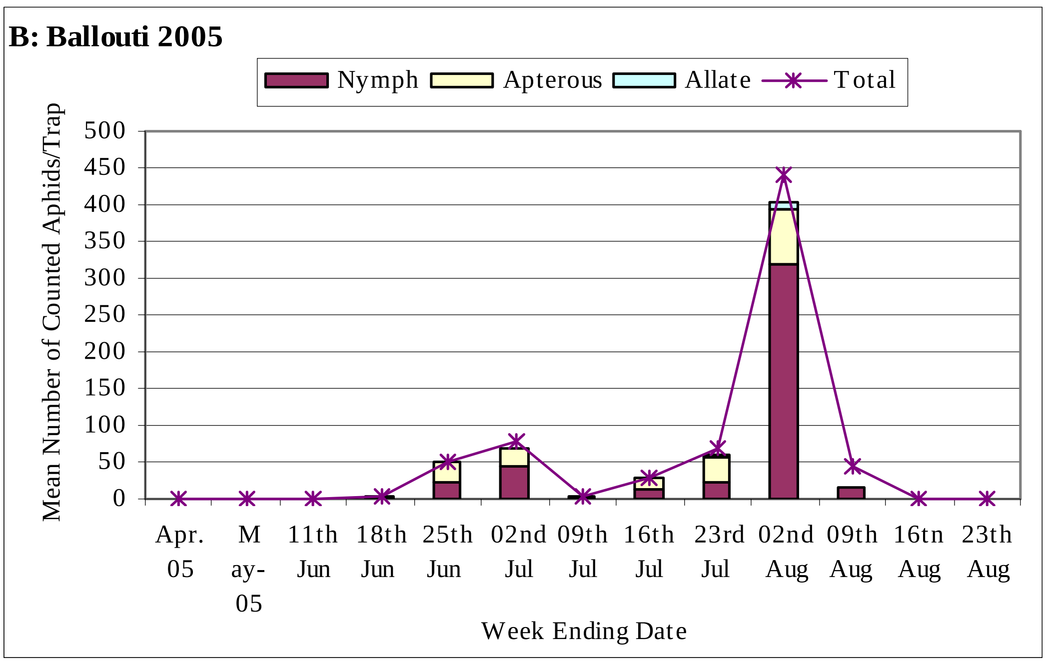

Fig. 4.9 (B): Population dynamics of *A. illinoisensis* on Ballouti cultivar during 2005 season

Results showed, that during 2004 season, population of *A. illinoisensis* was recorded on Shami cultivar for two weeks (2nd -9th August), and the population dynamics of the aphid including only small nymphs on 2nd August but small and medium nymphs in addition to apterous adults were recorded on 9th August and finally extinction of the aphid population was recorded on 16th August (Fig. 4.10 A).

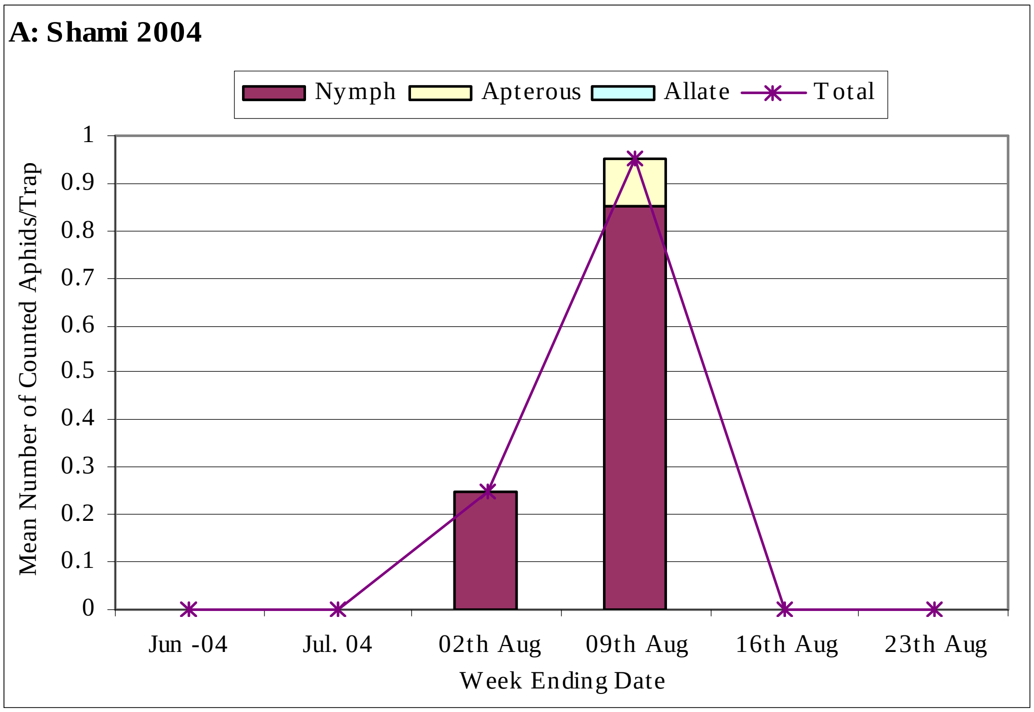

Fig. 4.10 (A): Population dynamics of *A. illinoisensis* on Shami cultivar during 2004 season

Results showed, that during 2005 season, population of *A. illinoisensis* was recorded on Shami cultivar for two months (18th June – 16th August) with its peak on 2nd July. On 25th June, population dynamics of the aphid on Shami cultivar, consisted of all stages including small and medium nymphs and apterous and alate adults, but alate adults were absent on 2nd July and aphid density decreased from 9th July – 9th August including all stages except alate adults, and aphid extinction recorded on 16th August (Fig. 4.10 B).

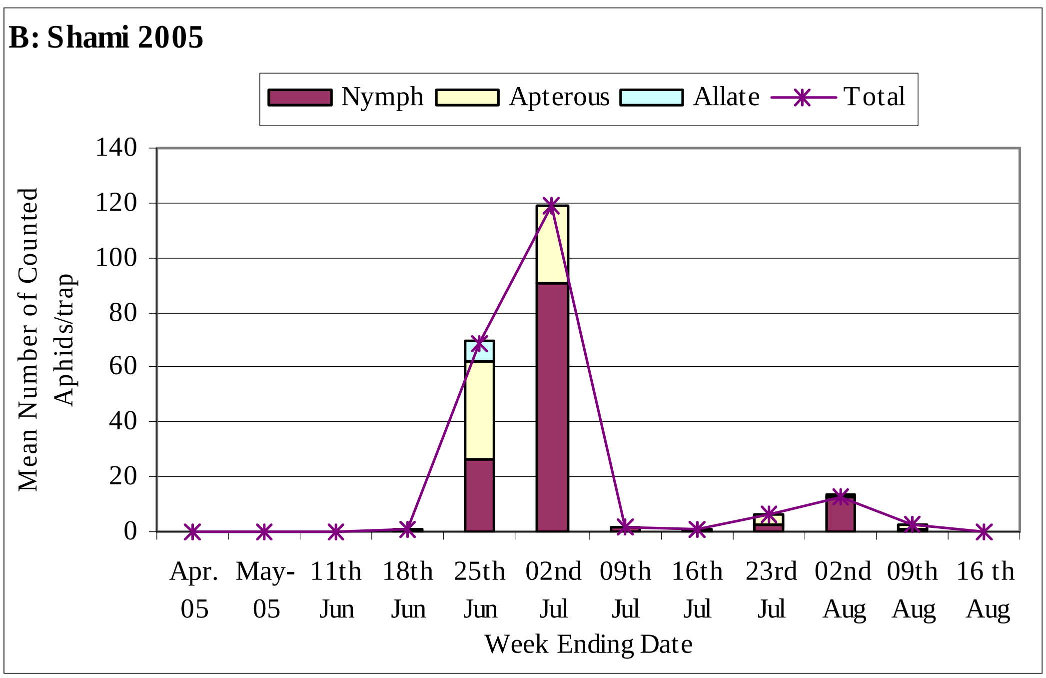

Fig. 4.10 (B): Population dynamics of *A. illinoisensis* on Shami cultivar during 2005 season

Results showed, that during 2004 season, population of *A. illinoisensis* was recorded on Salti-Khdari cultivar for two weeks (2nd -9th August), and population dynamics of the aphid consisted of nymph small and medium nymphs and apterous adult (Fig. 4.11 A).

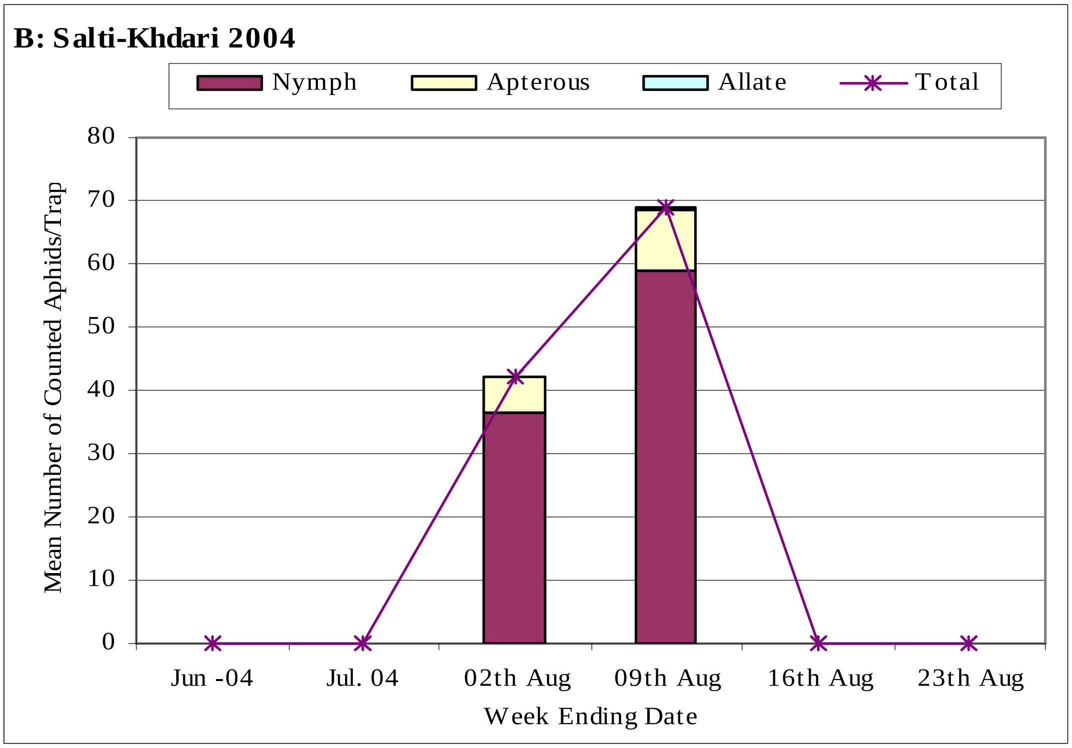

Fig. 4.11 (A): Population dynamics of *A. illinoisensis* on Salti-Khdari cultivar during 2004 season

Results showed, that during 2005 season, population of *A. illinoisensis* was recorded on Salti-Khdari cultivar for only one week that ended on 18^{th} July, and the population dynamics of the aphid consisted of small and medium nymphal stages (Fig. 4.11 B).

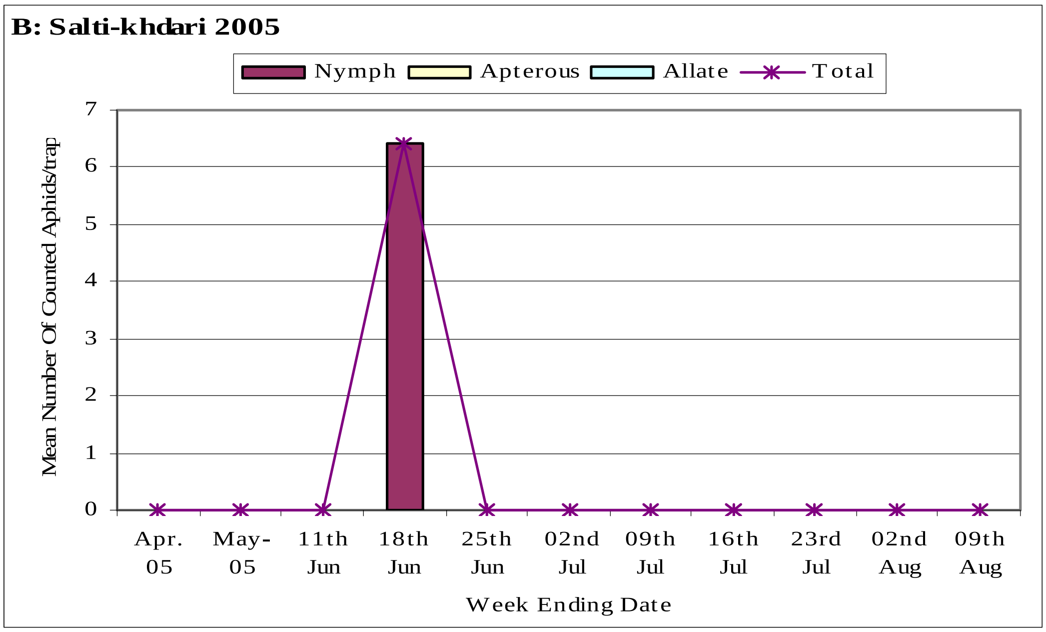

Fig. 4.11 (B): Population dynamics of *A. illinoisensis* on Salti-Khdari cultivar during 2005 season

Results showed, that, during 2004 season, population of *A. illinoisensis* was recorded on Halawani cultivar for two weeks (2nd - 9th August), and on 2nd August, population dynamics of the aphid consisted small and medium nymphs and apterous adult stage but on 9th August population dynamics of the aphid included just small and medium nymphal stages (Fig. 4.12 A).

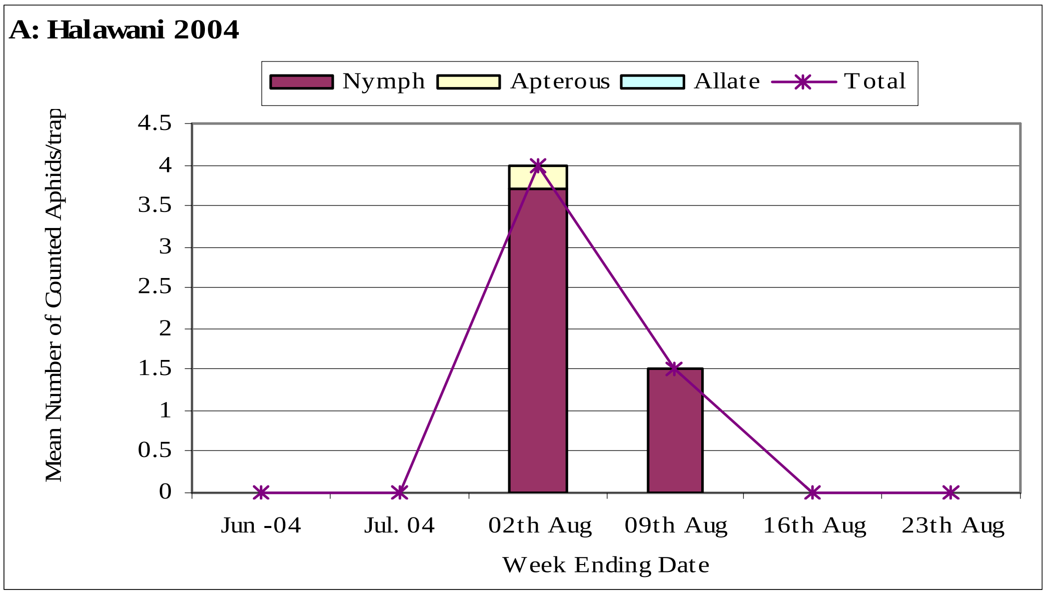

Fig. 4.12 (A): Population dynamics of *A. illinoisensis* on Halawani cultivar during 2004 season

Results showed, that during 2005 season, population of *A. illinoisensis* was recorded on Halawani cultivar for two months (18th June – 16th August) with its peak on 23rd July. The population dynamics of the starting colony (on 18th June) consisted of nymphs and apterous adults but on its peak (on 23rd July), all stages including small and medium nymphs and apterous and alate adults were observed (Fig. 4.12 B).

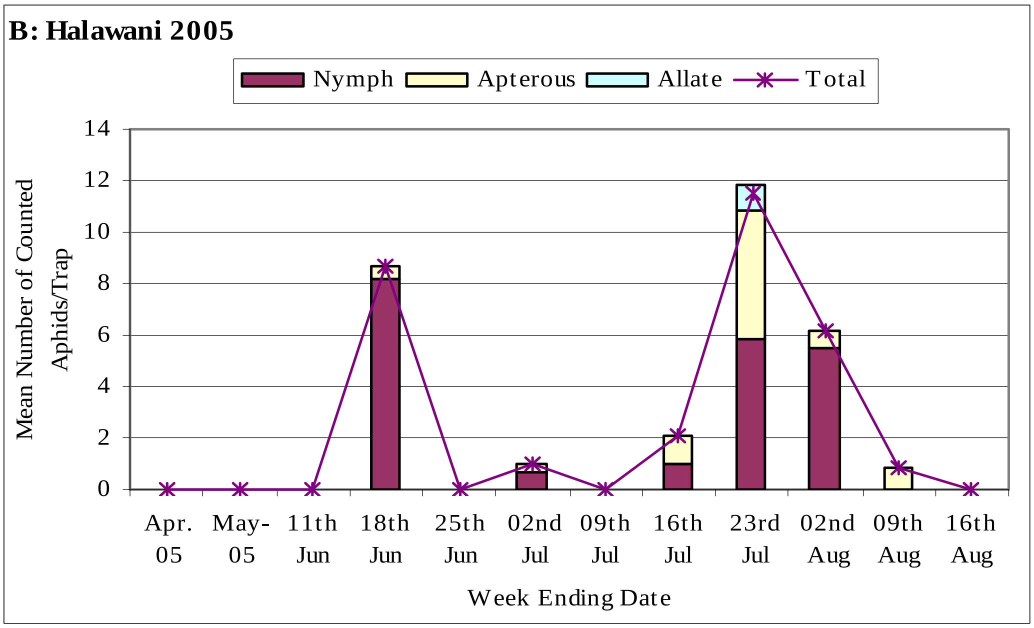

Fig. 4.12 (B): Population dynamics of *A. illinoisensis* on Halawani cultivar during 2005 season

During 2005 season, Baitouni cultivar was free from aphid infestation throughout all the season. However, Results in Fig. 4.13 show that, during 2005 season, two periods of aphid infestation were recorded on Baitouni cultivar. First period of infestation was for two weeks (18th – 25th June) and the 2nd period was for one week that ended on 23rd July. During the 1st period of infestation, the population dynamics of the aphid included small and medium nymphs and apterous adults on 18th June and all stages including alate adults on 25th June, but during the 2nd period of infestation (on 23rd July), small and medium nymphal stage and only apterous adults were observed (Fig. 4.13) .

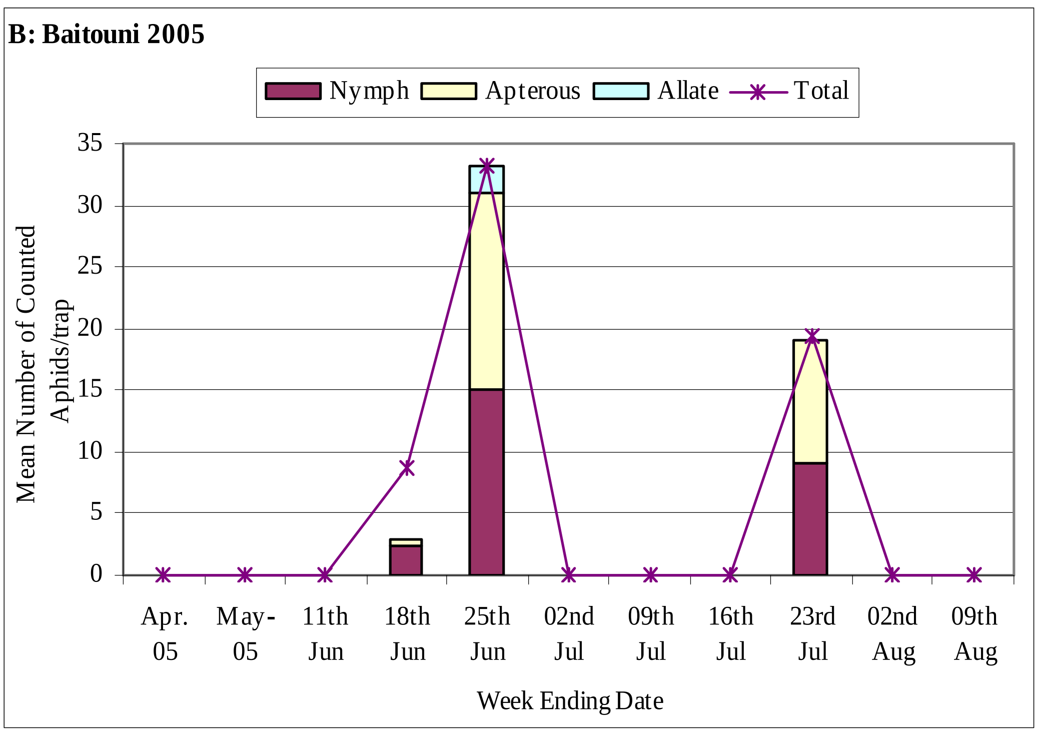

Fig. 4.13: Population dynamics of *A. illinoisensis* on Baitouni cultivar during 2005 season

Results showed, that during 2004 season, population of *A. illinoisensis* was recorded on Jandali cultivar for only one week that ended on 9th August, and included small and medium nymphal stages in addition to apterous adults (Fig. 4.14 A).

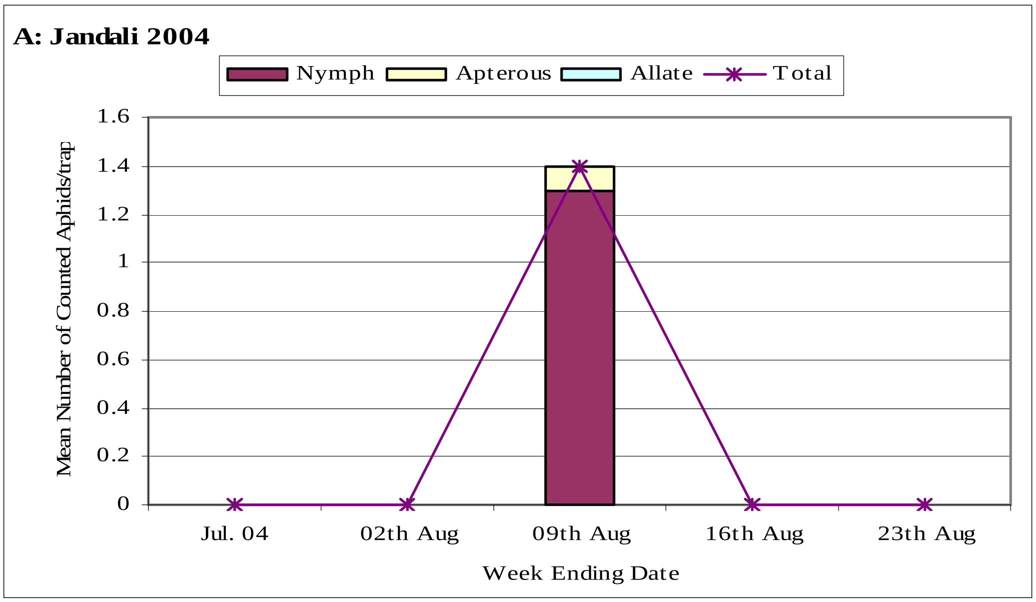

Fig. 4.14 (A): Population dynamics of *A. illinoisensis* on Jandali cultivar during 2004 season

Results showed, that during 2005 season, population of *A. illinoisensis* was recorded on Jandali cultivar for two months (25th June - 16th August) with its peak on 23rd July, and the population dynamics of the aphid including small and medium nymphs and apterous and alate adults were recorded on 25th June and during the period from 16th July- 2nd August (Fig. 4.14 B).

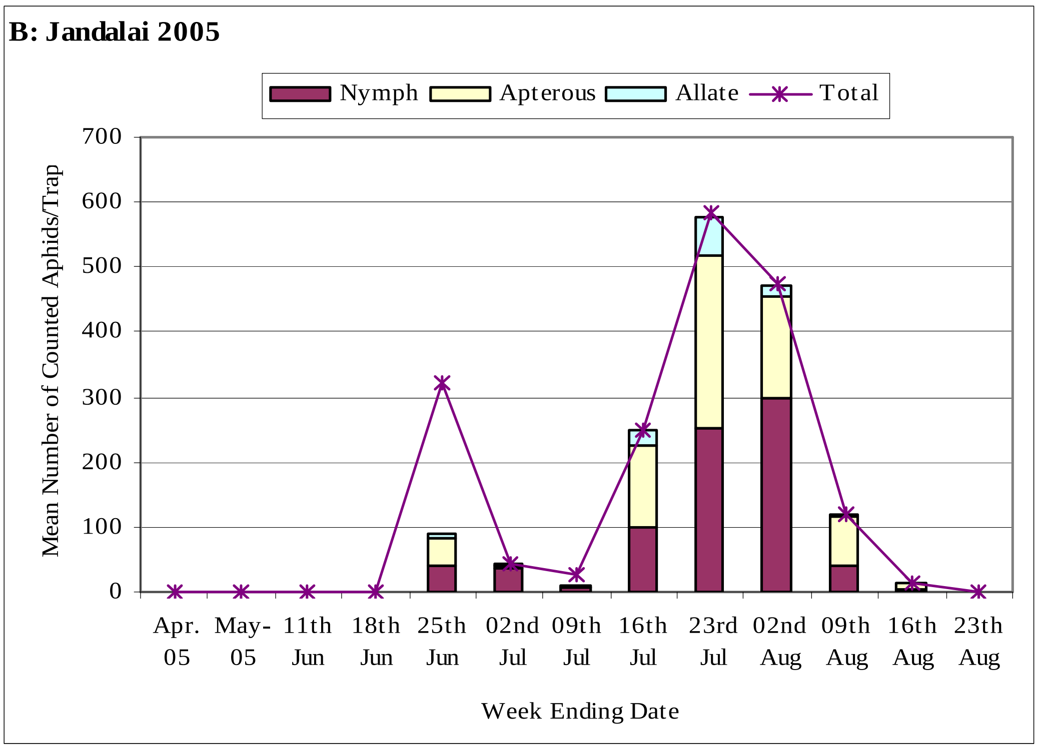

Fig. 4.14 (B): Population dynamics of *A. illinoisensis* on Jandali cultivar during 2005 seasons

4.3.6 Natural enemies:

Four species of coccinellids predators were observed feeding on colonies of the grapevine aphid in Al-Arroub Agricultural Experimental stations during 2005 season: (plate 4.2)

1. Two spotted coccinellid (Red-spotted Black Lady Beetle), *Chilocorus kuwanae* **(**Daeejeon**)**.
2. Seven spotted coccinellid, *Coccinella septempunctata* L.
3. Thirteen spotted coccinellid (Convergent Lady Beetle), *Hippodamia convergens* (Guerin-Meneville)
4. Seventeen spotted coccinellid (Ash Gray Ladybird Beetle), *Olla v-nigrum* (formerly *Olla abdominalis*)

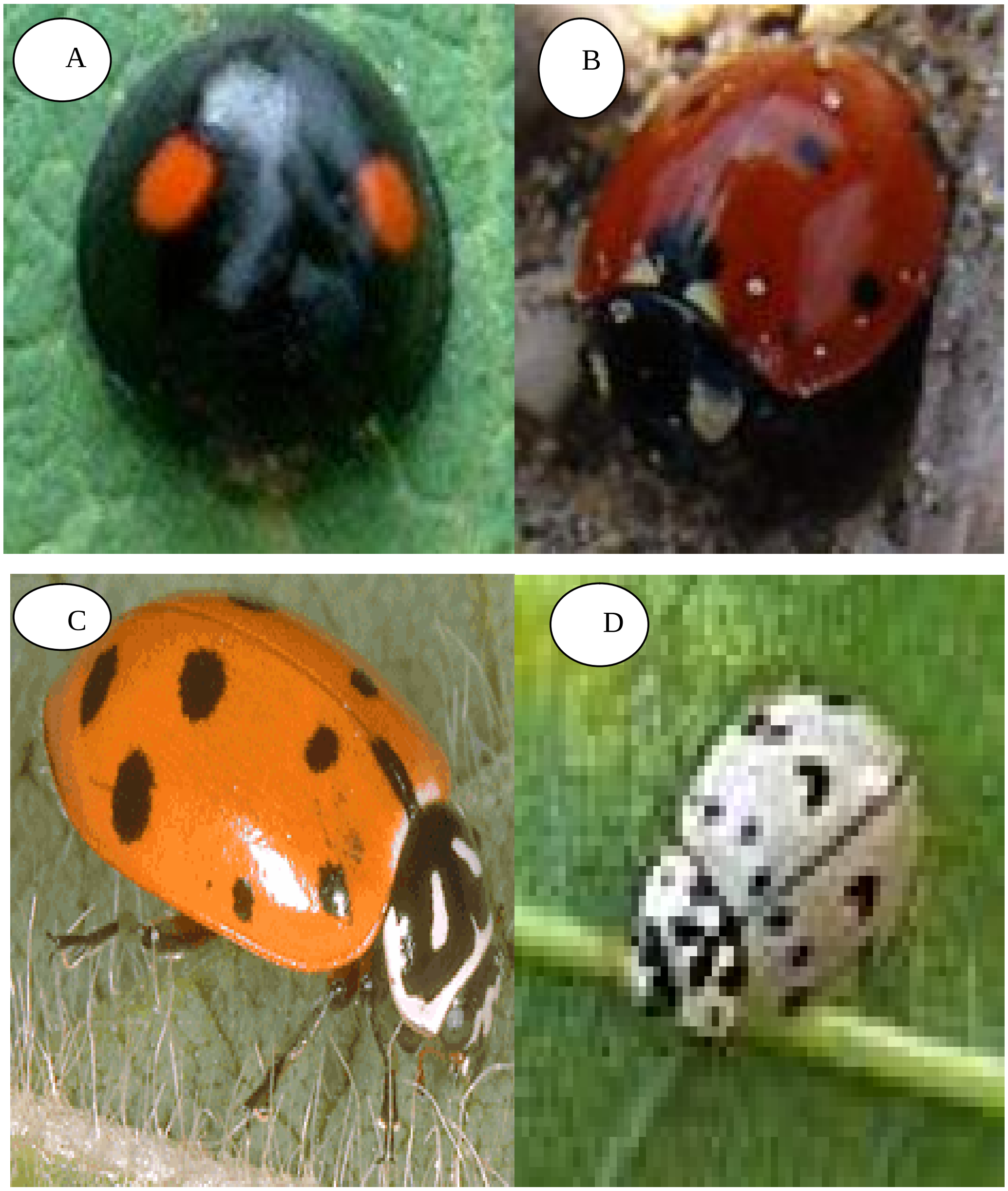

Plate 4.2: Four species of coccinellid predators feeding on colonies of the grapevine aphid in Al-Arroub Agricultural Experimental stations during 2005 season: A) Two spotted coccinellid (Red-spotted Black Lady Beetle), B) Seven spotted coccinellid, C) Thirteen spotted coccinellid (Convergent Lady Beetle), D) Seventeen spotted coccinellid (Ash Gray Ladybird Beetle),

4.4 Discussion

Grapevine aphid infestation was observed infesting young shoots and leaves of grapevine plants throughout two years of study (2004 + 2005). Low aphid population was recorded during 2004 season but heavy build up of population was observed during 2005 season.

Results show that, start of infestation occurred on med June 2005 and extended until med of August, and one - two peaks of aphid population were recorded on grapevine cultivars during July and August. However, no significant differences were observed on susceptibility of different cultivars to aphid infestation. In addition, high density aphid colonies consisted of all aphid stages including apterous and alate adults.

Thus, aphid infestation consisted of nymphs; alate and apterous adults, were recorded on 2nd and 9th August 2004, on all grapevine cultivars except Baitouni which was free from infestation all the season. Maximum aphid infestation was recorded on Salti-Khdari on 2nd August and, on 9th August followed by Ballouti, meanwhile, Sultanina, Shami, Halawani and Jandali were with low populations <5 aphids/plant.

Results also show that, aphid infestation was recorded on all grapevine cultivars during the period from 18th June to 16th August 2005. Maximum average aphid populations were recorded on the grapevine cultivars in a decreasing sequence as follow: Jandali; Ballouti; Sultanina;

Shami; Baitouni; Halawani and Salti-Khdari. In addition, results also show that almost aphid colonies which were recorded infesting grapevine cultivars were consisted of nymphs; alate and apterous adults.

However, statistical analysis shows that no significant differences were recorded between the aphid populations infesting the grapevine cultivars throughout the two years of study (2004 & 2005).

Results also show that, four coccinellid predators were recorded feeding on the colonies of grapevine aphid infesting grapevine plants. Therefore, conservation practices and precautions on chemical control are recommended to preserve those indigenous predators in the Palestinian vineyards. In addition, further studies are recommended on efficiency of those predators in suppressing the populations of grapevine aphid in the Palestinian vineyards.

CHAPTER 5

EFFECT OF DIFFERENT INSECTICIDES ON POPULATION DYNAMICSOF GRAPEVINE APHID, *Aphis illinoisenses*

Chapter 5: Effect of Different Insecticides on Population Dynamics of Grapevine Aphid, *Aphis illinoisenses*

5.1 Objectives:

To study the effect of chemical control measures on the population dynamics of the grape vine aphid.

5.2 Materials and methods*:*

Field study was conducted on chemical control of the grapevine pests in Al-Arroub Agricultural School vine yard, during 2005 season.

The experiment included four treatments:

1. Diazinon: Semi systemic, Organo-phosphorous insecticide.
2. Cypermethrin: Knock down (contact), Pyrethroid insecticide.
3. Chlorpyriphos: Stomach Poison, Organo-phosphorous insecticide.
4. Check treatment (control).

A completely randomized block design was used, with four treatments and four replications. Each replicate consists of 12 grapevine plants (4 columns and three rows). Chemical characteristics of used insecticides are presented in Table 5.1

Table 5.1: Chemical insecticides used

Trade Name	Active Ingredient	Formulation	Chemical Group	Dosage (Conc. %)
Sherpaz	Cypermethrin (10%)	Emulsion Concentrate	Pyrethroid	**0.1%**
Dezictol	Diazinon (25%)	Emulsion Concentrate	Organo-phosphorous	**0.3%**
Dorpaz	Chlorpyriphos (47.9%)	Emulsion Concentrate	Organo-phosphorous	**0.15%**

All treatments were monthly applied. First application was on the 21st of March and the last application was on the 30th of July 2005. Thus the schedule of application of insecticides respectively as follow, 21st March, 26th April, 23rd May, 29th June and on 30th July.

Even observation for aphid infestation was done every 10 days all over the season, aphid infestation was recorded on grapevine plants only during the period from 13th July to 2nd August 2005 (Table 5.2).

Population dynamics of the grapevine aphid were observed on all plants, every 10 days during 2005 seasons. For every observation, the aphid infestation including: nymph and adult stages (alates or apterous) was recorded. In addition, identification of the abundant natural enemies in the vineyard was done. All parameters were studied using field lens (10X).

5.3 Results

5.3.1 Effect of insecticides on infestation of grapevine aphid on grapevine plants:

Results in Table 5.2 show that, even though pesticides were monthly applied starting from 21st March, but aphid infestation was not recorded till 13th July i.e, after 4 applications of pesticides. However, aphid infestation on plants treated with Diazinon was recorded on 23rd July and disappeared on 2nd August i.e., after the last spray of insecticides that applied on 30th July, meanwhile, aphid infestation continued on Chlorpyriphos, Cypermethrin and Control treatments through 2005 season, till 2nd September, when it disappeared from all treatments.

However, the rate of increase of aphid populations during August and September (after the last application of insecticides) was significantly higher on Cypermethrin than that on Chlorpyriphos treatment (at *P value* ≤

0.05 using one way ANOVA). Thus, statistical analysis of results shows that, significant differences were recorded between the three used insecticides and the Control treatment (at p *value* ≤ 0.05 using one way ANOVA). Diazinon was the most efficient in controlling the grapevine aphid, meanwhile Cypermethrin and Chlorpyriphos were inefficient. Even though, on 22nd August, just before start of harvesting, aphid populations on Cypermethrin and Chlorpyriphos treatments were significantly higher than that on Control treatment.

Table 5.2 Average numbers of *A. illinoisenses* infesting plants treated with different insecticides during 2005 season. Mean (aphid/plant) ± S.E.

Date	Treatments (n*)				*P value***
	Diazinon (44)	Cypermethrin (39)	Chlorpyriphos (45)	Control (35)	
13/7	0.0±0.0^{a}	29.17±14.6^{b}	16.22±6.37^{b}	96±45.1^{c}	0.017
23/7	5.1±5.1^{a}	124±83.0^{bc}	41.7±15.0^{b}	370.8±184^{c}	0.034
2/8	0.0±0.0^{a}	885.9±249^{c}	105±58.0^{b}	221±186^{b}	0.000
12/8	0.0±0.0^{a}	1188±338^{c}	146±76.9^{b}	35.6±35.6^{ab}	0.000
22/8	0.0±0.0^{a}	355±126^{c}	77.3±53.9^{b}	6.67±6.67^{a}	0.001
2 /9	0.0	0.0	0.0	0.0	

*: n = number of replications/treatment
**: Figures within rows with different letters have significant differences at p *value* $\leq$ 0.05 using one way ANOVA.

Results in Table 5.3 show that, there is a significant difference between the percentage number of infested plants that treated with the four treatments during all dates of observation, and the maximum percentage of infested plants on Diazinon treatment (3%) and Chlorpyriphos treatment (9%) were significantly lower than that on Control treatment (30%) and on Cypermethrin treatment (40%).

Table 5.3 Effect of different insecticides on percentage of grapevine plants infested with *A. illinoisenses*.

Date	Treatments (n)				*P value*
	Diazinon (44)	Cypermethrin (39)	Chlorpyriphos (45)	Control (35)	
13/7	0.0±0.0^{a}	20±5^{bc}	10±6^{b}	30±8^{c}	0.008
23/7	3±3^{a}	30±7^{b}	9±4^{a}	30±8^{b}	0.003
2/8	0.0±0.0^{a}	30±7^{c}	9±5^{b}	30±6^{c}	0.000
12/8	0.0±0.0^{a}	40±7^{c}	6±4^{b}	30±7^{c}	0.001
22/8	0.0±0.0^{a}	40±7^{b}	3±3^{a}	20±5^{b}	0.000
2/9	0.0	0.0	0.0	0.0	

*: n = number of replications/treatment
**: Figures within rows with different letters have significant differences at *p value* ≤ 0.05 using one way ANOVA.

5.3.2 Effect of different insecticides on population dynamics of grapevine aphid on grapevine plants:

Table 5.4 shows the population dynamics of the grapevine aphid under chemical control measures. On 13th July, aphid populations recorded on Cypermethrin, and Control treatments consisted of all aphid stages nymphs and apterous and alate adults) but that recorded on Cypermethrin treatment were without alate stage. On 23rd July, aphid populations including nymphs, and apterous adults were recorded on all treatments meanwhile, alate adults were recorded only on Control treatment.

On 2nd August (after the last spray of insecticides which was applied on 30th July), aphid populations including all stages were still found on Cypermethrin; Chlorpyriphos and Control treatments, but disappeared from Diazinon treatment. In addition, aphid populations including all stages were also recorded on 12th August on Cypermethrin; Chlorpyriphos and Control treatments. On 22nd August, aphid population including nymphs, and apterous adults were recorded on Cypermethrin; Chlorpyriphos and Control treatments and alate adults were found only on Cypermethrin treatment. Finally, aphid populations disappeared from all treatments starting from 2nd September.

Statistical analysis of results presented in Table 5.4 show that, effect of insecticidal application on 30th July can be elaborated by comparison between populations on each treatment before and after spraying (23rd July and 2nd August respectively). Thus, results on 2nd August show that, Diazinon was the most effective one, killing all aphid stages on plants treated with it, however, Cypermethrin and Chlorpyriphos did not show insecticidal effect on aphid populations comparing with that on Control treatment.

Table 5.4 Effects of different insecticides on the population dynamics of *A. illinoisenses* during 2005 season.

Date	Stage of Aphid		Treatments (n)				*P value*
			Diazinon (44)	Cypermethrin (39)	Chlorpyriphos (45)	Control (35)	
13/7	Nymphs		0.0±0.0[a]	27.04±2.53[b]	15.81±0.82[b]	83.9±10.9[c]	0.049
	Adults	Apterous	0.0±0.0[a]	2.2±1.02[b]	1.21±0.55[b]	54.6±5.2[c]	0.028
		Alate	0.0±0.0	0.02±0.02	0.0±0.0	1.1±1.1	0. 250
23/7	Nymphs		4.26±1.7[a]	112±79.7[c]	38.76±15.15[b]	314±115.3[c]	0.040
	Adults	Apterous	0.21±0.21[a]	54.6±31.6[d]	2.45±0.86[b]	10.9±8.79[c]	0.056
		Alate	0.0±0.0	0.0±0.0	0.0±0.0	2.2±2.2	0.058
2/8	Nymphs		0.0±0.0[a]	776±227.1[c]	31.4±47.7[b]	210.4±169[b]	0.001
	Adults	Apterous	0.0±0.0[a]	72.8±25.1[c]	11.6±7.03[b]	17.8±15.3[b]	0.001
		Alate	0.0±0.0[a]	12.1±3.1[b]	0.5±0.5[a]	2.05±2.05[a]	0.001
12/8	Nymphs		0.0±0.0[a]	974±110[c]	41.8±21.9[b]	32.8±32.8[a]	0.000
	Adults	Apterous	0.0±0.0[a]	131±42.1[c]	11.2±5.66[b]	2.56±2.56[a]	0.000
		Alate	0.0±0.0[a]	23±11.3[c]	3.1±2.1[b]	0.0±0.0[a]	0.000
22/8	Nymphs		0.0±0.0[a]	320.4±116.8[c]	70.3±43.8[b]	6.31±6.31[a]	0.000
	Adults	Apterous	0.0±0.0[a]	34.4±13.0[c]	6.07±3.83[b]	0.51±0.51[a]	0.000
		Alate	0.0±0.0[a]	9.1±3.0[b]	0.0±0.0[a]	0.0±0.0[a]	0.000

*: n = number of replications/treatment
**: Figures within rows with different letters have significant differences at *p value* ≤ 0.05 using one way ANOVA.

5.4 Discussion

Results of the present study show that, among the three used insecticides, Diazinon proved to be the only effective one against *A. illinoisensis*. These results were in agreement with other that reported Diazinon as an effective insecticide against several plant aphids including melon aphid (Yudin, 1996); Banana Aphid (Nelson, 1998); Green Apple Aphid (Road, 1991).

Results also show that Diazinon had inhibited the population of aphid on grapevine plants directly after it was sprayed. Results also show that Chlorpyriphos was observed to be significantly lower in its effectiveness against *A. illinoisensis* than Diazinon.

The efficiency of Diazinon against the grapevine aphid might be due to its mode of action which is classified as semi systemic insecticide (Hassal, 1987). In addition, both Diazinon as semi-systemic and Chlopyriphos as a contact insecticide were reported to have killing effect against ants, which usually associated with aphid colonies feeding on honeydew and protecting aphids by discouraging their natural enemies (Waterhouse & Norris, 1987; Tomlin, 1997). Drees (1996) mentioned that in cases of use of non-systemic, contact insecticides (such as Chlorpyriphos) against aphids, all infested plant surfaces must come into direct contact with the insecticide solution.

However, aphid populations on Cypermethrin treatment were significantly higher than all other treatments including the control. These results were in agreement with several researchers who conducted experiments on using of insecticides against aphids (Oetting 1985; Hamdan, 1986; French-Constant, 1988). Oetting (1985) suggested that contact insecticides can cause aphid populations to dramatically increase following application, and might be due to the destruction of natural enemies and failure to control the target pest. Hamdan (1986) and French-Constant (1988) reported that populations of the green peach aphid on pyrethroid treated plants were significantly higher than that on other treatments.

CONCLUSIONS

- Flight activity of *A. illinoisensis* started on the beginning of April with one peak at middle of April, and ceased by the end of June.
- Low aphid population was recorded during 2004 season but heavy build up of population was observed during 2005 season.
- Start of infestation occurred on med June 2005 and extended till med of August.
- One - two peaks of aphid population were recorded on grapevine cultivars during July and August.
- No significant differences were observed on susceptibility of different cultivars to aphid infestation.
- The maximum proportion of infested plants on Diazinon and Chlorpyriphos treatments were significantly lower than that on Control and Cypermethrin treatments.

RECOMMENDATIONS

Following studies are suggested to be done:

1. Studies on the role of *A. illinoisensis* in virus transmission.
2. Laboratory and field studies on functional responses of coccinellids to different densities of *A. illinoisensis.*
3. Studies on the conservation practices for the natural enemies, especially for the coccinellids that were recorded in association with the colonies of *A. illinoisensis* in the field.

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بسم الله الرحمن الرحيم

Abstract in Arabic

<u>الملخص باللغة العربية</u>

دراسة حقلية من النواحي الحيوية والبيئية و المكافحة لحشرة مَنّ العنَبِ *Aphis illinoisensis* على بعض أصناف العنب في محطة العروب الزراعية، فلسطين

يعتبر نبات العنب من أكثر المحاصيل انتشاراً وأهمية في فلسطين، وتعتبر الحشرات متشابهة الأجنحة والتي تشمل (الفيلوكسيرا، نطاط لأوراق، البق الدقيقي) من الحشرات الرئيسية التي تهاجم نبات العنب تسبب خسارة اقتصادية لمحصول العنب.

منذ حوالي خمس سنوات بدأت تظهر على أشجار العنب وخاصة في منطقة الخليل حشرة المن، ولكن خلال السنوات الثلاثة الماضية بدأت أعدادها بالازدياد وبدأت بالانتشار بشكل بدأ يشكل إزعاجاً للمزارعين ؛ حيث أن هذه الآفة لم تكن معروفة في المنطقة قبل هذا التاريخ، كما أن حشرة المن تعبر من أخطر الحشرات على المحاصيل الزراعية لأنها تعتبر ناقلاً للفيروسات، علماً بأنه لا يوجد دراسات تتعلق بالحشرة من الناحية الحيوية والبيئية والمكافحة.

وكنتيجة لبدء ظهور هذه الحشرة ولانعدام الدراسات المتعلقة بها محلياً وندرتها عالمياً, حاولت هذه الدراسة وعلى مدى عامين من البحث الحقلي المتواصل إلقاء الضوء على بعض الخصائص وهي ، النشاط الموسمي للطيران والانتقال ومواعيد ظهورها واختفائها من حقول العنب، والفترات التي تسجل فيها أكبر ظهور وطيران ووجود الحشرة بمراحلها المختلفة ومكافحة هذه الحشرة.

أشارت نتائج هذا البحث إلى أن المصائد اللونية المائية الصفراء كانت الأكفأ والأقدر على رصد حركة طيران الحشرة، تلتها المصائد الخضراء، كما بينت النتائج أن فترة الطيران لهذه الحشرة تبدأ مع بداية موسم الربيع (النصف الثاني من شهر آذار) وحتى قبل نهاية الموسم تقريباً

(النصف الثاني من شهر حزيران)، وأن أعلى إصابة سجلت مع منتصف شهر نيسان إلى منصف شهر أيار، كما بينت النتائج أنه ليس هناك فرق معنوي في الإصابة بهذه الحشرة بين سبعة أصناف من العنب تم تطبيق البحث عليها، وعند دراسة تأثير المبيدات تبين أن هناك فروقاً منوية بين هذه المبيدات في التأثير على أعداد الحشرة، وكان أفضلها مبيد Diazinon.

كما لوحظ وجود أربعة أصناف من الحشرات المفترسة من رتبة غمدية الأجنحة، حيث وجدت تتغذى على مجموعات حشرة المن على العنب.

وفي النهاية يمكن التوصية بإجراء المزيد من الدراسات على هذه الحشرة، وخاصة فيما يتعلق بالمكافحة الحيوية لحشرة منّ العنب باستخدام الأعداء الحيوية، وخاصة الحشرات المفترسة التي وجدت في الحقل تتغذى على حشرة منّ العنب، ودراسة العلاقة بين العائل والمفترس بين حشرة منّ العنب وحشرة أبو العيد.

وفي النهاية، يمكن التوصية بإجراء المزيد مكن الدراسات على مختلف الجوانب المتعلقة بهذه الحشرة، بسبب ندرة الدراسات والأبحاث المتعلقة بها من جميع النواحي، وإجراء دراسات على المكافحة الحيوية لهذه الحشرة باستخدام المفترسات التي وجدت متزامنة في الحقل مع هذه الحشرة وتتغذى عليها، وهي حشرة أبو العيد والتعرف على العلاقة بين هذه الحشرة وهي منّ العنب وحشرة أبو العيد.