FIELD STUDIES ON POPULATIONS AND CONTROL OF GREEN PEACH APHID MYZUS PERSICAE(SULZER) (HOMOPTERA:APHIDIDAE) IN THE CENTRAL HIGHLANDS OF JORDAN

BY

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INTRODUCTION

A Aphidoidea is considered to be a very important group of insects from an economical point of view. Members of this group attack many plants, infesting leaves, stems, fruits and roots, secreting honeydew that encourages sooty mold fungus to grow on plant parts.

The green peach aphid, Myzus persicae (Sulzer) (Homoptera: Aphididae) is of world importance causing striking reduction of vegetable yields (Lecrone & Smilowitz, 1980 ; Mack & Smilowitz, 1980 ; Parker et al., 1983; Woodford et al., 1983). It is highly polyphagous attacking almost all sorts of green vegetation. It has been recorded on 321 species belonging to 67 orders of plants from different parts of the world (Valentin & Calilung, 1980).

Beside the direct damage, it is able to transmit over 120 viral diseases of plants on about 30 different families, including major crops as pepper , tobacco, potatoe, bean , sugarbeet, sugarcane, brassicas, lettuce and citrus (Bodenhiemer & Swirski, 1957 ; Avidov & Harpaz, 1969 ; Valentine & Calilung, 1980). In Jordan, Mustafa (1985, 1986a, 1986b) recorded M. persicae on many host plants including tobacco, tomato, pepper, eggplant and lettuce. Many of the vegetables

grown in Jordan are considered as hosts of M. persicae . Virus diseases transmitted by M. persicae caused significant production problems to peppers (Batarseh, 1985), to cucurbits (Dababat, 1985) and to potatoes (Mnayer, 1985).

The objective of this study was to investigate certain factors affecting this pest on economic plants, ecologically and biologically. Findings of this study may provide practical measures of control and to clarify the pest problems.

In the present research, detailed population studies of green peach aphid (GPA) on seven vegetable crops and six pepper cultivars were carried out in a field situated in Al-Jieza, 40 Km south of Amman. The population of M. persicae and Brachycaudus amygdalinus on deciduous trees was studied in an orchard in Om-Ela'amad 30 Km south of Amman. Aphid population in relation to leaf age, leaf area and plant mineral content of the six pepper cultivars were correlated. The flight activity of the adult aphids within pepper plants and within deciduous trees were investigated using water tray traps and sticky traps. Available predators also were monitored using water traps. Moreover, chemical control of M. persicae using three foliar insecticides and two granular systemic insecticides were evaluated. Residues of these insecticides were determined in plant leaves and fruit using gas liquid chromatography sets.

SECTION I: REVIEW OF LITERATURE

I.1 Myzus persicae As A Species.

I.1.a Morphology

There are two morphs for this aphid; apterous morph (Plat 1) and alate morph (Plate 2). This species is charcterized by the presence of highly developed double antennary tubercles forming a deep furrow in the frontal region of the head (Talhouk, 1969). It has a pale green body with darker green longitudinal stripes in the early summer apterous and dark dorsal patch in all alate forms, slightly swollen cornicle in summer and fall forms (Palmer, 1952). The cauda bears three pairs of setae on its posterior end (Bodenheimer & Swirski, 1957).

Unnamed strains of M. persicae (Sulzer) have been distinguished by differences in morphology, coulor, biology, host-plant preferences, differential viral transmitting ability, by different feeding behaviour through parafilm membrane and by differential resistance to insecticides (van Emden et al., 1969).

I.1.b Termindogy

The considerable confusion in nomenclature of the various morphs of aphids makes it necessary to account for the

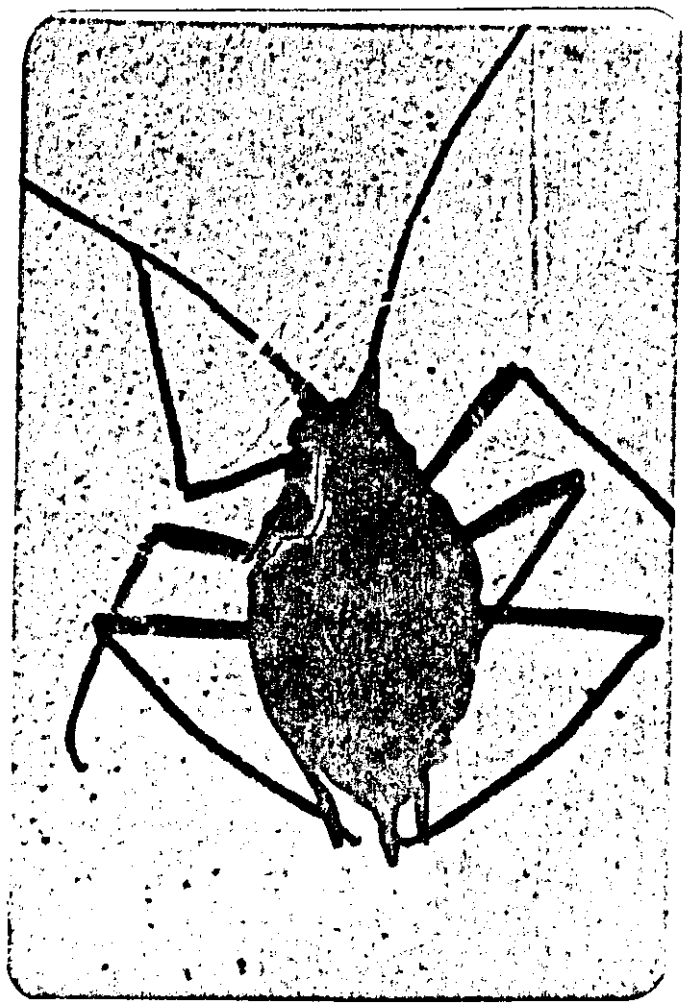

Plate 1: Apterous adult Myzus persicae

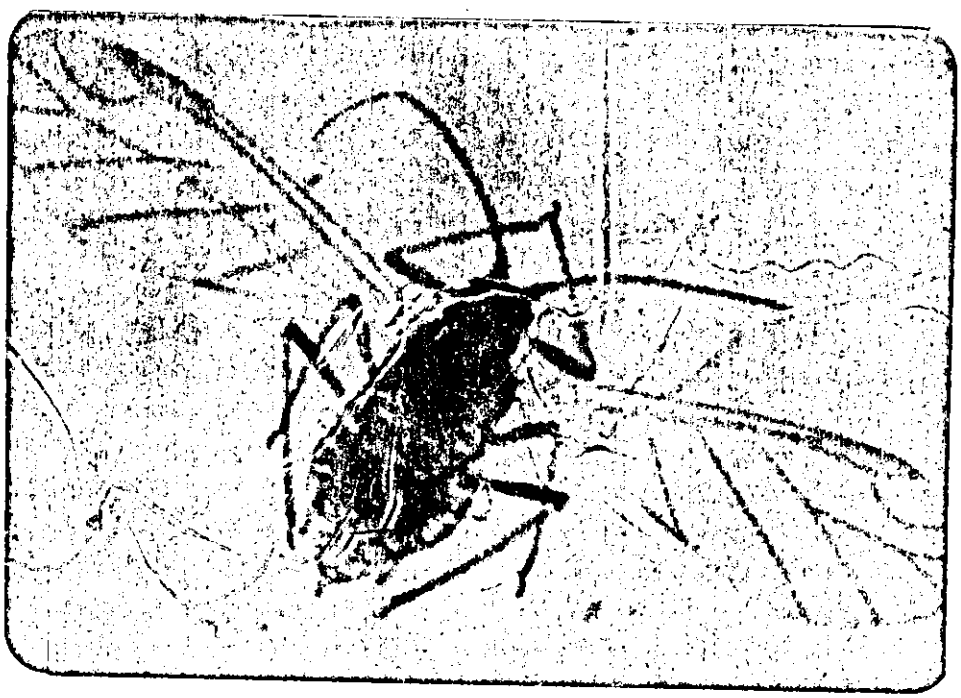

Plate 2: Alate adult Myzus persicae

terminology used (Bodenheimer & Swiski, 1957; Lamber, 1966; Talhouk, 1969):

Primary host-plant: The plant on which the species can successfully hibernate as eggs.

Fundatrix or stem mother: Viviparous parthenogenetic female developing from fertilized egg.

Virgenoparae: Viviparous parthenogenetic female producing other parthenogenetic viviparae.

Gynoparae: Alate viviparae that produces only oviparae.

Oviparae : Female that lays hibernating eggs.

Sexuparae: Adult viviparae that produces both oviparae and males.

Androparae: Apterous viviparae that produces only males.

Hiemalis: Specialized apterous that overwinters on the secondary host-plant.

Immigrant: Alate viviparous females that leaves a secondary host-plant and produces oviparae or viviparae and males on a primary host-plant.

Emmigrant: Alate viviparous female that leaves a primary host-plant and colonize a secondary host-plant.

Exules: Apterous and alate viviparae that are born on and colonize secondary host-plants.

I.1.c Geographical Distribution

Myzus persicae has a world wide distribution. It probably originated in a region with a mild winter climate, conducive to the development of anholocyclic tendencies (Blackman, 1974).

This pest was reported in different parts of the world; India (Lal., 1950); The United Kingdom (Kennedy, 1950; Eastop, 1951); North America (Weed, 1927; Davis & Landis, 1951; Walton, 1954; Adams et al., 1976; Mittler et al., 1976). In the USSR, Kolesova et al. (1982) studied variability in this aphid. In South Africa, Diaber & Scholl (1959) reported the infestation of this pest on several vegetables. In the Middle East, its occurrence was reported in several countries: Palestine (Swirski, 1954; Bodenheimer & Swirski, 1957); Lebanon and Syria (Talhouk, 1969); Iran (Hodjat & Bishop, 1978). In Jordan, this aphid was also reported on several host plants (Mustafa, 1985; 1986a, 1986b).

I.1.d Life History

Like most aphid species, the life cycle of M. persicae is complex involving production of oviparae, fundatrices and alate migrants on the primary hosts, and apterous and alate virgenoparae, males and gynoparae on secondary

hosts (van Emden et al., 1969). Various aspects of the life history of the green peach aphid (GPA) were studied by Barlaw (1962). He reported that the lower threshold for growth being below 5°C, while the upper threshold was 25°C-30°C.

Myzus persicae is a holocyclic with sexual reproduction in the temperate region (Blackman, 1974). He reported that although anholocyclic is wide spread in warm countries, there are life cycle variations in different parts of the world involving alternative methods of overwintering.

Talhouk (1969) stated that in region where winter temperature falls below freezing,such as Al-beqa'a in Lebanon; the interior plateaus of Syria, and the mountainous region of east mideteranian countries, the biology of this aphid follows a holocyclic pattern when the fertilized winter eggs are laid on almond, peach, cherrey or plum trees. He added that in early spring when the buds of the primary hosts start to open, the eggs hatch and the nymphs leave the woody plant parts to feed on the unfolding leaves. A number of parthenogenetic generations are formed on the summer hosts (Bodenheimer & Swirski, 1957). In approaching autumn, males and verginogenous females are produced which fly back to Prunus spp. to give birth to sexual viviparous females that mate and lay the fertilized eggs for hibernation (Talhouk, 1969). In Palestine,

the GPA reproduces parthenogenetically throughout the year on weeds, vegetables, ornamentals and fruit trees, but straingely enough, that it doesn't seem to occur on peach trees in Palestine (Avidov & Harpaz, 1969).

I.1.e Polymorphism

Lamber (1966) reviewed polymorphism in aphids. He assumed that internal heriditary factors are components in polymorphism in aphids. These factors have rarely been investigated experimentally. Whalon & Smilowitz (1979) determined thermal requirements for developmental stages, off-spring production and percent survival of three isolates of green peach aphid (GPA) over a range of constant temperatures from 12.4°C to 29.4°C. They found that off-spring production, surrival and thermal requirements were not different for the three isolates.

Weed (1927) found that there was a definite response in M. persicae to change in temperature and humidity. He found that the processes of metamorphosis, reproduction and longivity were proportional to temperature and humidity. Rivnay (1937) found that temperature didn't affect wing development in the black citrus aphid Toxoptera aurantii (Boy), but a great percentage of the aphid developed wings when they were crowded or when they were forced to feed on wet food. Also Hodjat &

Bishop (1978) found that nymphal production of the GPA decreased significantly under crowded conditions. Increased production of alate in response to density was well documented by several workers (Wyatt, 1965; van Emden et al., 1969).

Lee (1960) concluded that under permanent long day conditions, the'interval timer' operated at the appropriate moment, but the potentiality for forming oviparous remained latent until evoked by short days. Blackman (1974) declared that photoperiodism provided the timing mechanism for sexual morph production and the only other environmental factors clearly implicated in several morph production is temperature.

Several workers studied the effect of various synthetic insect growth regulators on M. persicae and other aphid species. Mittler et al. (1976) studied the effect of kinoprene on wing development and parthenogenesis of Aphis fabae and M. persicae. They found that the adult aphids fed on the treated radish plants had variously deformed wings reducing sclerotization, pigmentation and other apteriform features. Lamber (1966) stated in his review about polymorphism in aphididae that Lee (1960) applied juvenile bormone externally to third instar nymph of Megoura vicia Bunkton which became reproductively adult. He also added that vonDehn (1963) found that application of Farnesol which was known to have an effect simillar to juvenile hormone, to nymph of Aphis fabae Scop.

lowered the production of alate when applied to the 1st instar nymphs.

I.1.f Population Dynamics

Several workers had studied the factors concerned the population dynamics of M. persicae on a particular crop (Lal, 1950, Kennedy et al., 1950; Walton, 1954; Taylor, 1975; Tamaki et al., 1980; Hodgson & Lane, 1981; Hayumizu, 1982; and Trumble, 1982).

Lal (1950) reported that in India, during winter the population of M. persicae decreased but the cold climate was not determintal to the aphid life. He added that with the advent of spring, breeding proceeded rapidly and through March to April, colonies were again teeming with individuals. By the end of May, the colonies particularly disappeared. At the end of August, they once again appeared. He also found that sexual forms had not been shown to occur in India.

Large numbers of GPA were produced on peach trees in the spring at Yakima, Washington in USA (Davis & Landis,1951). In 1949 they found that through April to September, 14 generations of the GPA occurred on peach trees.

Walton (1954) found that M. persicae appeared to be active in and arround the spinash production areas during

the entire year being presented in Oklahoma in USA from October to May, but the heaviest infestation occurred on the spring crops. Wyatt (1965) studied the distribution of M. persicae throughout the year on chrysanthemums and observed that high population pressure brought about a redistribution on the plants followed by migration to other plants. Taylor (1977) reported that there were three seasonal cycles of population growth and reproduction in M. persicae in great Britain through spring, summer and autumn seasons. Annis et al. (1981) found that GPA population at all investigated sites peaked in spring and declined in summer in Yakima Valley in USA.

I.2 Host-Plant Relationships

From the arrival of the initial GPA infestation to the breakdown of the infestation, the host-plant plays a key role influncing all phases of the population (van Emden et al., 1969). A valuable review on the biology of aphids by Kennedy & Stroyan (1954), stressed the phenomena of plant resistance to aphid attack.

In Palestine, M. persicae was recorded on 87 plant species belonging to 34 families (Swirski, 1954; Bodenheimer & Swirski, 1957; Avidov & Harpaz, 1969).

I.2.a Primary Hosts

The GPA is a host alternative species which overwinters in the egg stage on peach trees, Prunus persica L. Batsch in Yakima Valley of Central Washington (Annis et al., 1982). Davis and Landis (1951) concluded that peach tree was an overwintering host in Central Washington. They reported that in the absence of peach trees, species of wild plums were satisfactory. In Palestine, Swirski (1954) reported M. persicae infestation on citrus, quince, pear, apple, almond, apricot, and Japanese plum. But, strangely engough, M. persicae was not found to infest peach in Palestine (Avidov & Harpaz, 1969).

I.2.b Secondary Hosts

The GPA reproduces parthenogenetically throughout the year on weeds, vegetables and ornamental plants as secondary hosts (Bodenheimer & Swirski, 1957). Mustafa (1985) recorded M. persicae on several secondary hosts in Jordan, among which Cardaria draba D. , Nicotiana tabaccum L. , Capsicum spp. , Zea mayz L. , Sorghun vulgare L. and Arundo spp. In Japan, Hayamizu (1982) reported M. persicae on cruciferous plants such as cabbage, while in Yakima Valley in USA, Annis et al. (1982) found that M. persicae preferred radish, Raphanus sativus L.

Palmer (1952) reported M. persicae to infest 54 secondary hosts as summer hosts. In Yakima Valley in USA, Tamaki,et al. (1980) reported GPA on flix weed Descurainian sophia(L.); common mallow Mulva neglecta wallr; prickly lettuce Lactuea seriola L. ,field bind weed Convolvulus arvensis L. and common lambsquarter Chenopadium album L. in peach orchard.

I.2.c Plant Damage And Viral Diseases

Myzus persicae is a pest which causes not only direct damage by sucking the plant sap, secreating honeydew which encourage sooty mold fungal growth on infested plant parts, but able to transmit over than 120 viral diseases of plants on about 30 different families including many major crops such as bean, sugarbeet, sugarcane, brassicas, potatoe tobacco, citrus and pepper. (van Emden et al., 1969 ; Valentin Calilung, 1979).

Plant viruses may result in 15-30% reduction in yield of sugarbeet (Annis et al., 1981). In Jordan, it transmitted viral diseases to peppers (Batarseh, 1985), to cucurbits (Dababat, 1985) and to Potatoes (Mnayer, 1985).

I.3 Short-Tailed Almond Aphid

In Palestine, Swirski (1954) reported that the short-tailed almond aphid, Brachycaudus amygdalinus (Schout.) (Homoptera: Aphididae) (Plates 3 & 4) infested almond, Prunus amygdalus Batch (Rosaceae) as a primary host and horstail knotweed, Polygonum equisetiforme L.(Polygonaceae) as a secondary host. He further added that the aphid infestation began in April, reached the peak in the spring at the begenning of May and disappeard completely from almond by early June.

Brachycadus amygdalinus has a world wide distribution. Bodenheimer & Swirski (1957) stated this aphid had been recorded in South Switzerlands, Italy, Spain, Portogal, France, Iraq, Palestine and Turkey. They also reported it infesting almond, peach , Horstail Knotweed , Rumex spp., and Pistacia spp. (Anacardiaceae). Mustafa (1985) reported B. amygdalinus in many localities in Jordan, infesting almond from the begenning of April to the end of May. Moreover, the same author (1986) recorded the aphid on Polygonum oviculare L. in Wadi Shuaib in Jordan in October.

Avidov & Harpaz (1969) reported that B. amygdalinus reproduces parthenogenetically on Polygonum spp. throughout the year in Palestine. They also added that the peak was

Plate 3: Apterous adult Brachycaudus amygdalinus

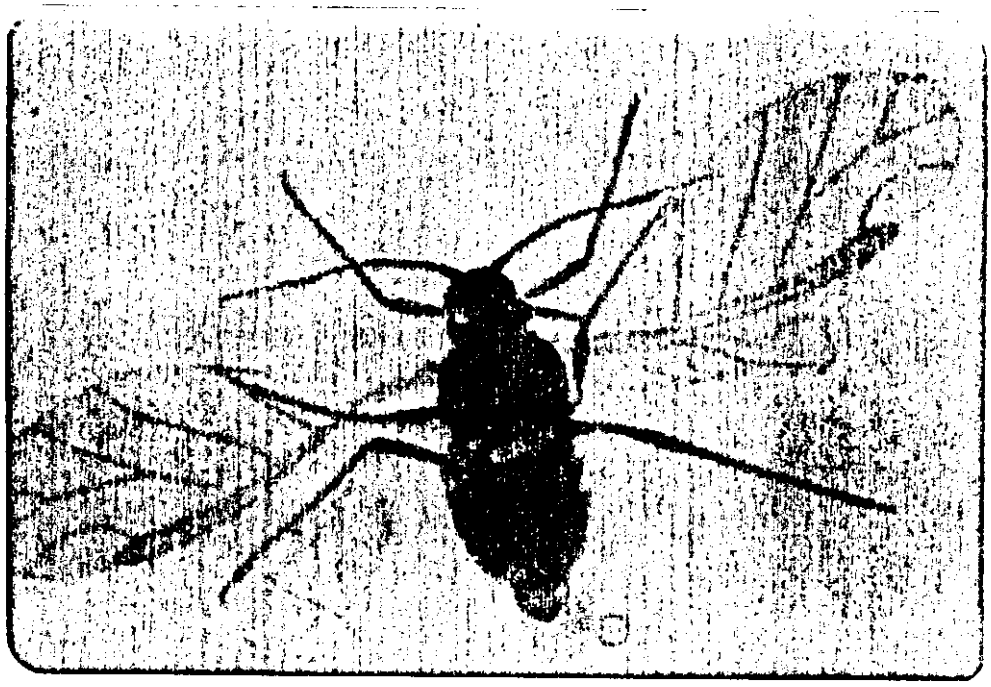

Plate 4: Alate adult Brachycaudus amygdalinus

reached in the spring and overwintered as fertilized eggs on almond branches. Then alate appeared through April to May and migrated to Polygonum spp.

I.4 Flight Activity

I.4.a Factors Limiting Flight Activity

Brandbent (1949) studied the factors affecting the activity of Myzus persicae alate and found that at light intensity below 100 foot candle, activity declined, and rapidly ceased with darkness. High humidity also retarded flight frequency and a combination of high humidity and high temperature (32.2°C) inhibited flight. Watson et al. (1975) used the weather data and counts of aphids in the field to predict the influence of yellowing viruses of sugarbeet in England. They found significant relationship of most environmental factors with yellowing viruses incidence.

Elliot & Kemp (1979) found that large flights trapped in early 1976 at Harrow and Jordan in Canada could be attributed in part to warm weather in April and in previous November. Crowding of M. persicae were found to response for increase in production of alate form (Wyatt, 1965; van Emden et al., 1969 ; Hodjat & Bishop, 1978).

I.4.b Colour Descrimination

Heathcote et al. (1969) observed that many aphids that feed on dicotyledons were more attracted to yellow than species feeding on grasses. However, van Emden (1972) found that selected British yellow colours (4-047) attracted more Myzus persicae than other colours. Moreover, Wigglesworth (1969) reported that Myzus persicae can distinguish two colour zones: a large wave zone, 660-500 mu i.e. red-yellow-green which excited the insects to probe and a short wave zone, extending to 400 mu i.e. blue-violet-purple. He added that flying aphids are attracted to yellow colour of foliage and traps.

I.4.c Migration

Bodenheimer & Swirski (1957) defined migration of aphids as the movement from primary host to a secondary one while emigration is the return to the usual primary host. They also found that 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.

In England, Taylor (1977) found three seasonal cycles of population growth and redistribution in Myzus persicae,

while in Palestine, a small number of migrants found in June-July but remigrants began common in August-November (Bodenheimer & Swirski, 1957). In Canada, Elliot & Kemp (1979) found that the first alate aphids were caught in June and numbers increased to a peak usually in August. They added that flight activity had virtually ceased by October. In Taiwan, Myzus persicae was observed first in October (Su, 1982), flight of alate increased until November. Numbers then decreased gradually and the last specimen was recorded in May. In Hungarian orchards, the spring flight of M. persicae was recorded first in peach orchards in the 2nd half of May with gradual increase towards the end of the month (Jenser et al., 1980), but in summer months, low numbers were recorded, In September and October, high individual numbers were observed consisted mainly of gynoparae and males.

I.4.d Trapping

Interest in trapping as a technique for monitoring aphid dispersal has increased during the last 20 years in several countries (Trumble 1982). Eastop (1951) studied the diurnal variation in the aerial density of Aphididae using suction traps near Rothamested Experimental Station in Great Britain. Heathcote et al. (1969) reported that both suction traps and yellow sticky traps were more effective than a crop inspection programme for predicting the first seasonal

immigration of several important aphid species in England. Canadian scientists have used trap plants, yellow sticky traps and suction trapes to study the annual flight patterns of migrant aphids attacking vegetables in Ontario (Elliot & Kemp, 1979).

Few researchers have attempted to relate the number of aphids caught by traps to actual field populations. Jenser et al. (1980) carried out a study using yellow water traps to establish the presence of alate of Myzus persicae as a vector of plum pox virus in Hungarian orchards. They concluded that the spring flight might be regarded as dangerous. In Taiwan, also, using water traps showed that M. persicae was the most consistently occurring vector and presented early in the season to introduce and spread sweet pepper viruses (Su, 1982). In California, Trumble (1982) used water traps and sticky traps in a study to determine the correlation between trap catches and actual field population of aphids. He found that correlation coefficients were low or not significant for comparison of alatae from water or sticky traps and whole-plant aphid survey.

I.5 Control Of Myzus persicae

I.5.a Chemical Control

Insecticides have been and will continue to be used in the foreseeable future to regulate green peach aphid

population (Parker et al., 1983). Several workers studied the effect of different insecticides on aphids an different crops (Binns, 1971 ; Lecrane & Smilowitz, 1980 ; Powell, 1980 ; Dhondapani & Jayaraj,1981 ; Prasadaro et al., 1982 ; Woodford et al., 1983 ; and Parker et al., 1983). Primicarb was found to offer practical control of Aphis gossypii Glover on cropping cucumber without phytotoxicity or residues (Binns, 1971). Lecrone & Smilowitz (1980) studied the selective toxicity of Primicarb, Carboryl and Methamidophose to M. persicae and its predators. They found that Primicarb was less toxic than other insecticides to the predators and more toxic to aphids.

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). Powell (1980) found that Aldicarb and Thiofanox were more effective than Disulfoton, Phorate and Carbofuran with preplant broadcast or at planting time with furrow application for control of M. persicae on potatoes. Aldicarb and Disulfoton as granules were found to be the most effective in controlling M. persicae and resulted in higher yields of green leaves of tobacco, while Carbofuran was the least effective (Prasadaro et al., 1983).

Myzus persicae was found to be more susceptable to different insecticides when it occurred on tomato than on Chillie (Dhandapani & Jayaraj, 1981). Woodford (1983) found that granular insecticides decreased Potato leaf Roll Virus on potato to a quarter or less of that in check plots. However, Parker et al., (1983) demonstrated the need for careful testing and evaluation of insecticides for seed tuber protection in location with different climatic regions.

I.5.b Natural Enemies

Many natural enemies of M. persicae have been recorded, but there is little quantitative data on their ecology and value in controlling the aphid (van Emden et al., 1969). They listed 150 predators belong to 10 insect families from 4 insect orders namely:Coleoptera. Deptera ; Hemiptera and Neuroptera. In addition to that, 46 insect parasites and two acari parasites recorded to parasitize M. persicae. Moreover, 10 pathogens were also reported infecting the green peach aphid.

Mack & Smilowitz (1980) studied the diural and weekly abundance of the most common natural enemies of the green peach aphid in potato field. They found that Coleomegilla maculata (DeGeer) (Coccinellidae: Coleoptera) Larvae and adults were the most abundant natural enemy collected. They

also reported 3 predators from Arachnida and 17 predators from 4 insect orders namely: Hemiptera, Neuroptera, Coleoptera and Diptera, that found on potato foliage in central Pensylvania.

Tamaki et al. (1981) studied the response of natural enemies to GPA in different plant culture. They found that parasitic activity by Diaeretiella rapae (M'Intosh) (Aphidiidae:Hymenoptera)was 6 to 10 times greater in broccoli plots than in either radish or sugarbeet, but predators were 2-5 times less active on broccoli. Horn (1981) found that numbers of Chrysopa oculata (Say), (Chrysopidae:Neuropteral), Coccinellidae and Syrphidae were higher in plots in which weeds were not cultivated.

I.5.c Integrated Pest Management

A computerized integrated pest management programme for GPA control on potatoes, known as GPA-CAST, started in 1978 on potatoes in Pennsylvania State University (Smilowitz, et al., 1979, Walton & Smilowitz, 1979a). The strategy employed consisted of reducing the systemic insecticide Aldicarb at planting. Moreover, natural enemies are conserved by applying the selective Primicarb for aphids. Powell (1980) used soil systemic insecticides in IPM programme to control

aphids on potato. However, integration of natural enemies action with that of insecticides and with methods of control such as partial host plant resistance is a striking possibility for sophisticated control of Myzus persicae in the future (van Emden et al., 1969, Walton & Smilowitz, 1979a).

SECTION II: MATERIALS AND METHODS

II.1 Response of *Myzus persicae* To Different Vegetable Crops

To evaluate the response of the green peach aphid to different hosts, two experiments were carried out in Al-Jieza field, 40 Km south of Amman, in Fall season of 1984 and in Spring season of 1985. The vegetable crops used were: sweet pepper *Capsicum annum* L. cv.'Sharina', eggplant *Solanum melongenas* L. cv. 'Viserba', tomato *Lycopersicon esculeatum* Mill. cv. 'Star', lettuce *Lactuca sativa* L. cv. 'Paris Island Cos.', tobacco, *Nicotiana tabaccum* L. cv. 'Jordan I', cucumber *Cucumis sativus* L. cv. 'Beit alfa', and cauliflower *Brassica oleraceae* L. cv. 'High light'.

The two experiments were carried out in the same field after preparing the soil for planting by plowing, disking, broadcasting N:P;K fertilizer (18:18:18:) at rate of 500 kg/hectar, disking again to mix soil with fertilizer, spreading the drip irrigation system (Agro Drip company) and mulching the soil over the drip lines with black plastic 1.2 m wide x 45 um thick.

The soil was irrigated by 500 m^3 water per hectar before transplanting and irrigation continued every 3-5 days after transplanting. Nitrogen fertilizer applied as top dressing

at rate of 50 kg/hectar of urea (46.% N) twice, the first was one month after transplanting and the second was two weeks after the 1st application.

Weeds were left to encourage aphid infestation, while other necessary practices were applied similar to commercial plantings but niether acarisides, nor insecticides were applied. Fungicides were applied whenever necessary.

II.1.a The first experiment was conducted on 0.05 hectar in fall, 1984. It was designed in a randomized complete block design, with 5 blocks. Each block composed of seven plots with 1.0 meter unplanted area separating plots and blocks. Each plot was 2 x 6 m contained 12-15 plants planted in two rows on both sides of the drip line, with 0.5 m between rows and 0.4 m between plants.

Seeds of the different crops were planted in peatmoss on 15th June, 1984, transplanted to the experimental land on 22nd July 1984, thinned on 10th August, 1984. Except seeds of cucumber which were planted 15 days before transplanting .

Four plants from each replicate were randomly investigated for the GPA infestation every 7-10 days in the field using field lens. The number of aphids per plant e.g. apterous or alate, adult or nymphs were counted. The number of infested plants were also recorded.

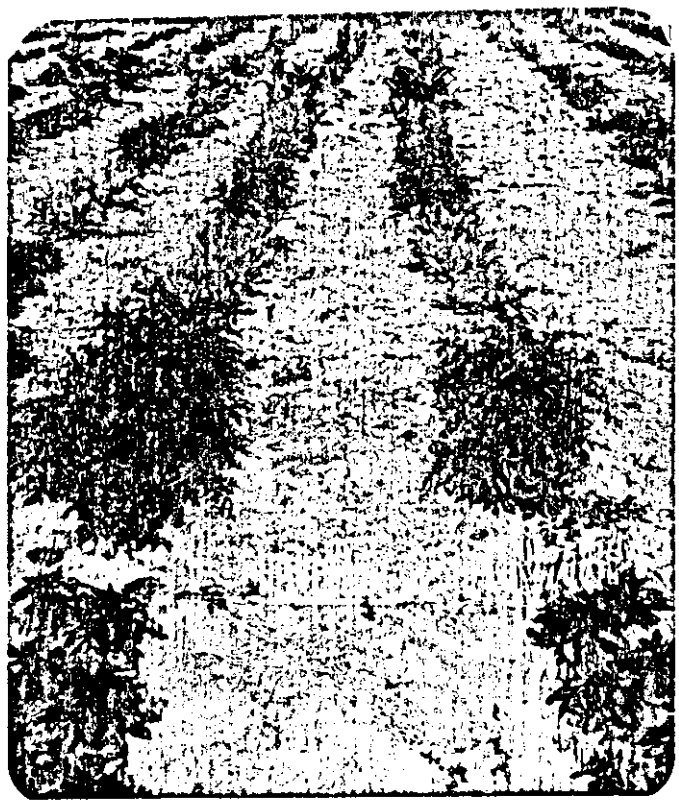

Plate 5: Seven vegetable crops planted in completely randomized design in Spring 1985.

II.1.b The second experiment was conducted in 0.06 hectar in the Spring of 1985. It was designed in a randomizely complete block design with 6 blocks (Plate 5). Each block composed of 7 plots. A plot of 4 x 2.5 m had 15-20 plants in 4 rows ; Two rows at both sides of drip line, with 0.5 m between rows and 0.4 m between plants in the same row.

Plots of each vegetable plants were replicated six times with 1.0 m unplanted area.

Seeds of the vegetable were planted in peatmoss on 7th March, 1985, transplanted to the experimental land on 10th April, 1985 and thinned to one plant on 1st May, 1985. But seeds of cucumber were planted in peatmoss 15 days before transplanting date.

Ten plants from the inside rows of each replicate were randomly observed for the green peach aphid (GPA) infestation every 7-10 days in the field using field lens. The number of aphids per plant e.g. apterous or alate, adults or nymphs were counted. The number of infested plants were also recorded.

II.2 Response of Myzus persicae To Different Pepper Cultivars

Temporal occurrence and response of GPA to different pepper cultivars were studied on six cultivars in the Fall

season of 1984 and Spring season of 1985 in Al-Jieza field. Soil preparation fertilization and irrigation were the same as in II.1.

The cultivars of sweet pepper, Capsicum annum L. were 'Melody', 'Piment sweet', 'Sharina', and 'Shamrock'. The cultivars of hot pepper, Capsicum frutescens L. used were 'Deers horn' and 'Piment hot'.

II.2.a Fall season 1984: The seeds of the six cultivars were planted in peatmoss on 10th June 1984, transplanted to the field on 20th July 1984 and thinned on 15th August, 1984.

The experiment was conducted in 0.04 hectar and consisted of eight blocks. Each block composed of 6 plots. A plot of 2 x 3 m was planted with 12-15 plants in two rows at both sides of drip line with 0.5 m between rows and 0.4 m between plants in the same row.

Each cultivar was replicated randomly eight times in randomized complete block design. Four plants from each replicate were randomly observed for green peach aphids.

The number of aphids e.g. apterous or alate, adults or nymphs were counted per plant every 7-10 days through the season. The number of infested plants were also recorded.

II.2.b Spring season 1985: Seeds of the six cultivars were planted in peatmoss on 15th March,1985, transplanted to

Plate 6: Showing pepper cultivars planted in a randomized complete block design in Spring 1985.

the field on 10th April,1985,and thinned on 5th May,1985.

The experiment was conducted in 0.06 hectar and consisted of 6 blocks. Each block composed of 6 plots. A plot of 4x3 m was planted by 15-20 plants in four rows. Two rows were planted at both sides of drip line with 0.5 m between rows and 0.4 m between plants in the same row.

Each cultivar was replicated randomly 6 times in randomizely complete block design (Plate 6).

Ten plants from the inside rows of each replicate were randomly examined for the green peach aphid. The number of aphids e.g. adults or nymphs and alate or apterous were counted in the field using field lens every 7-10 days through the season. The number of infested plants were also recorded.

II.3 Aphid Infestation On Deciduous Trees

An orchard containing the deciduous trees : almond Prunus amygdulus Batch , peach Prunus persica L. Batsch , cherry Prunus avion L. and pear (Europian) Pyrus communis L. was selected in Om-Ela'amad 30 Km south of Amman. There were more than 50 trees of each species. The trees were observed on weekly basis for the occurrence of green peach aphid Myzus persicae (Sulzer) and short-tailed almond aphid Brachycaudus amygdalinus (Schout) (Aphididae), from early

January to December, 1985. Samples of 15 infested leaves were randomly collected from 5 of each species and taken to the laboratory to be inspected using binocular dissecting microscope. Aphid species were identified and number of aphids per leaf was counted. During winter months where no leaves were found on the mentioned deciduous trees, a group of 100 shoots, 20 cm long each, of the different tree species were weekly examined for egg laying. The trees were sprayed by the owner with dimethoate 40% insecticide on 20th April, 1985. Prevailing predators were also observed.

II.4.a Population Dynamics Of *Myzus persicae* On Different Secondary Hosts

An experiment was conducted in Al-Jieza field in Spring 1985 to study the population dynamics of *M. persicae* on different secondary hosts.

Sweet pepper *Capsicum annum* L. cv. 'Sharina', eggplant *Solanum melongenea* L. cv. 'Viserba', lettuce *Lactuca sativa* L. cv. 'Paris island cos'. and hot pepper *Capsicum frutescens* L. cv. 'Deer's horn' planted in Al-Jieza field and used as secondary hosts. Fifty plants of each host species were randomly observed for the green peach aphid *Myzus persicae* (Sulzer) every 10 days in the field from early May to late

of July, 1985, using field lens. Number of aphids adult or nymph and alate or apterous were counted.

II.4.b Population Dynamics Of Myzus persicae On Different Pepper Cultivars

An experiment was carried out in Al-Jieza field (see II.2.b for more details) on Spring 1985 to monitor the population dynamics of Myzus persicae (Sulzer) on different pepper cultivars.

Four pepper cultivars were used (i) sweet pepper Capsicum annum L. cultivars: 'Melody', 'Piment Sweet' and 'Shamrock'. (ii) the hot pepper Capsicum frutescens L. cultivar was 'Piment hot'.

Fifty plants of each cultivar were randomly observed for the green peach aphid population in the field from early May to late July 1985, using field lens, every 10 days. Number of aphids adults or nymphs and alate or apterous were counted.

II.5.a Trapping And Flight Activity Within Sweet Pepper Planting In Al-Jieza Field.

A study was carried out to monitor the presence of alate aphids within sweet pepper planting in Al-Jieza field

from early September 1984 to December 1985 using yellow water traps. These traps consisted of circular yellow plastic trays 30 cm in diameter and 15 cm depth. They were chosen to detect flight activity of alate morph of the green peach aphid within pepper planting. Each trap was fitted with a small net-covered hole (3x8 cm) 10 cm from the bottom to prevent the over flow.

Five trays were placed on land surface between pepper plants Capsicum annum L. cv. 'Sharina' planted on 22nd July, 1984. The average distance between trays was 15 m. They were elevated to 60 cm hight when vegetation grown over the trap height.

The trap fluid was formed of 0.5 L formalin 37% and 30 m liquid detergent (Soft) added to 6 liter water. The fluid in each trap was changed monthly but additional water was added when become necessary.

The trapped insects were collected by pouring the trap fluid through muslin cloth in a plastic funnel, and the collected insects were transferred to the laboratory and preserved in ethanol 75% for inspection. Adults of the peach aphid were counted weekly using binocular dissecting microscope. Numbers of Chrysopa spp. and Coccenilla septumpuretata L. were also counted.

Records on the environmental conditions of the area were obtained from the Queen Alia Air-port Station.

II.5.b Trapping And Flight Activity Within Deciduous Trees In Om-Ela'amad Orchard

A study was carried out to monitor the presence of alate aphids within the deciduous in Om-Ela'amad orchard, using yellow water traps (see II.5.a for description) and yellow sticky traps.

a. Water traps: Five yellow water traps were placed on 1.5 m height wooden table within rows of each of almond, cherry, pear, and peach (Plate 9) from early January 1985 to end of December 1985. The traps were 1.0 m of the trunk of the trees. The average distance between traps in the rows was 10 m. There were 5 traps within each tree species.

Insects captured were collected weekly. Adults of the green peach aphid, Myzus persicae, short tailed almond aphid Brachycaudus amygdalinus were counted. Numbers of Chrysopa spp. and Coccinella spp. were also counted.

b. Sticky traps: Yellow cylindrical sticky traps were used to monitor aphids activity within peach trees(Plate 8).

Plate 7: Yellow water trap on wooden table within peach trees in Om-Ela'amad orchard.

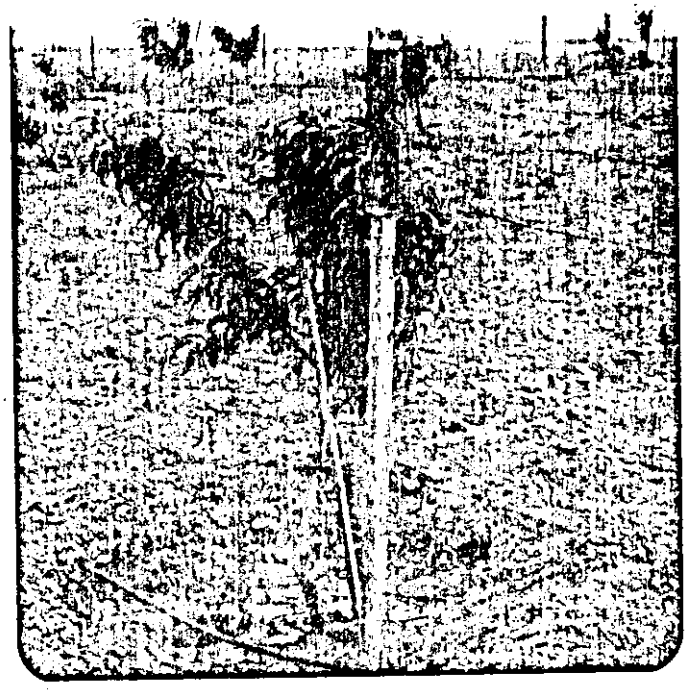

Plate 8: Yellow sticky traps within peach trees in Om-Ela'amad orchard.

Each sticky trap was consisted of polyvinyl chloride (PVC) pipes 3" diameter and 1 ft. length painted yellow (C1208 imported from A.M.E. International Inc.,USA) and supported by a wooden stake of 1.5 m hight (Plate 8). Each yellow cylinder was wrapped with an acetate sheet (0.01 mm thick) to fit arround the cylinder. The transparent sheet was held in place by clips at top and bottom. This sheet was coated with transparent banding grease (CF37 5 Su,UK) imported from the United Kingdom and renewed biweekly.

Five sticky traps were placed at 1.0 m from the trunk within peach trees from 5th March 1985 to late of April 1985 when becoming inefficient due to dusts being covered the sticky materials within few days through April and May. The average distance between traps was 10 m. The aphids captured were collected biweekly and counted using binocular dissecting microscope.

II.6 Certain Aphid-Host Relationships

II.6.a *Myzus persicae* Infestation In Relation To Leaf Surface Area Of Different Pepper Cultivars

A study was carried out to correlate the green peach aphid infestation with leaf area of different pepper cultivars, in Al-Jieza field (see II.2.b for more details).

The pepper cultivars used were 4 sweet pepper Capsicum annum L. cultivars namely: 'Melody', 'Sharina', 'Piment sweet', and 'Shamrock', and the hot pepper Capsicum frutescens L. cultivars namely: 'Deer's horn' and 'Piment hot'.

On 5th June ,1985, twenty old leaves from each cultivar were randomly collected from the infested leaves, pressed within new paper to be dried. The surface area of each leaf was recorded using leaf area meter (Li COR-Model 3100) in the laboratory to correlate M. persicae infestation with leaf surface area of pepper cultivars.

II.6.b The Distribution Of Myzus persicae Infestation On Old And Young Leaves Of Different Pepper Cultivars In Relation To Plant Mineral Nutrition.

To correlate the distribution of green peach aphid on old and young leaves of different pepper cultivars with plant mineral contents, a study was conducted in Al-Jieza field (see I.2 for more details) using four sweet pepper cultivars namely: 'Melody', 'Piment sweet', 'Sharina' and 'Shamrock' and two hot pepper cultivars namely: 'Deer's horn' and 'Piment hot'.

On 26th June ,1985, after a month of aphid incidence in Al-Jieza field (II.2), 100 old leaves and 100 young leaves were collected randomly from each cultivar and taken for mineral

analysis in the Department of Soil and Irrigation, University of Jordan. The samples were washed by distilled water, dried in oven at 70°C for 48 hrs then grinded and taken for determination of Nitrogen (N), Phosphorus (P), Potassium (K), Manganese (Mn), Cupper (Cu) and Iron (Fe) using procedures mentioned by Black et al. (1965). To correlate the green peach aphid infestation with mineral content, the accumulative aphid per plant on each cultivar was calculated up to date of sampling (26th June, 1985).

II.6.c Distribution Of Myzus persicae On Pepper Plants In Relation To Leaf Age And Leaf Surface Area.

The study was carried out in Al-Jieza field to correlate leaf age and surface area with infestation of green peach aphid on pepper leaves.

Fifty plants of sweet pepper cv. 'Shamrock' were transplanted into area of 12 m^2 on 20th April, 1985, in the garden of Al-Jieza field. The plot was composed of 4 rows 0.75 m apart and 33 cm between plants. Furrow irrigation was conducted every 7-10 days. Nitrogen fertilizer (Urea 46% N) was added at rate of 50 Kg/ha in the furrows, one month after transplanting. Other necessary practices were applied simillar to commercial field, but neither insecticides nor acarisides were applied.

Twenty infested leaves were randomly taken from each of the young, middle aged and old leaves on 29th July 1985. The prevailing green peach aphids on each leaf were separately transferred into vials contained 75% ethanol using fine small brush. The number of aphids were counted under the dissecting binocular microscope within one month of collection.

The picked leaves were kept between newspaper and pressed to dry. The leaf surface area for each leaf was measured using photometeric areameter (Li. COR. Model 3100 Areameter), on 15th November 1985.

II.7 Myzus persicae Control

II.7.a Toxicity Of Certain Insecticides To Myzus persicae

II.7.a.1 Experimental Details.

An experiment was conducted in 0.03 hectar in Al-Jieza field in Spring 1985, using a randomizely complete block design with six treatments and six replicates (Plate 9).

The sweet pepper Capsicum annum L. cv. 'Shamrock' was used. Each block composed of six plots. A plot of 2 m wide x 3 m long was planted by 12-15 plants in two rows on both sides of the drip line, with 0.5 m between lines and 0.4 m between plants in the same row. Soil preparation, fertilization and irrigation was the same as in II.1.

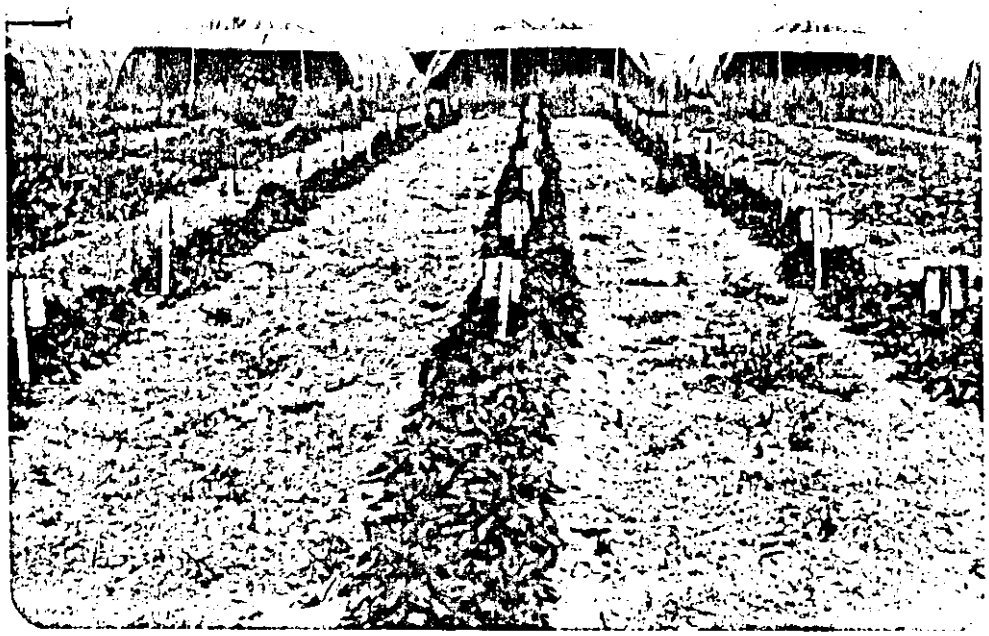

Plate 9: Layout of chemical control experiment of Myzus persicae.

II.7.a.2 Insecticidal Application

Five insecticides were applied twice through the season. First was one month after transplanting On 20th May 1985 and 2nd was on 27th June 1985, beside one treatment which was non treated control for comparison.

The first insecticide was Carbofuran 5% granular, applied arround the seedlings at the rate of 2g m/plant each time, and covered with 5-6 cm of soil and then irrigated.

The 2nd insecticide was Disulfoton 5% granular, applied also arround the seedlings at the rate of 2 gm per plant each time and covered with 5-6 cm soil and then irrigated.

The 3rd insecticide was Cypermethrin 10% E.C., applied at the rate of 1ml/liter of water as spraying using Knapsak sprayer.

The 4th insecticide was Dimethoate 40% E.C., applied at the rate of 1ml/liter of water as spraying using Knapsak sprayer.

The 5th insecticide was Primicarb 50% dispersible grains, applied at the rate of 0.5 gm/liter of water as spraying using Knapsak sprayer.

The recommended rates from the manufacturers were followed for the application of the mentioned insecticides.

Five plants of each plot were randomly observed at ten days interval for occurrence of green peach aphid populations including apterous, and alate forms. Aphid counts were made prior to insecticidal application and after 10, 20, 30 days of each application.

II.7.b Residues of the Insecticides

Residues of the applied insecticides were determined to find the most effective one against the green peach aphid on sweet pepper Capsicum annum L. cv. 'Shamrock' (see II.7.a.1) for more details). Three samples of leaves, and three samples of fruits from treated plants were collected on 23rd July, 1985, kept in polyethylene plastic bags and transferred to Toxicity Laboratory in Al-Hussain Agriculture Station in Baq'a for residue analysis. Each fruit sample was 3-4 Kg randomly taken from six replicates for each treatment, and 300-400 leaves were taken for each treatment. The insecticides used were Carbofuran 5% granular, Disulfoton 5% granular, Dimethoate 40% E.C , Primicarb 50% dispersible grains and Cypermethrin 10% E.C.

The method of Becker(1979) outlined below was adopted for determination of the insecticide residues from the collected samples:

Each sample was cut into pieces then mixed and 25 gm

of leaf samples taken, while 50 gm of fruit samples used. Each sample taken were extracted for one minute by acetone one ml/one gm of the sample, in a blender and then filtered through Buchner funnel. The extraction was repeated twice, diluted with sodium sulfate solution (2% in water) (3 times the volume of the total acetone) and then extracted 3 times with 50 ml of dichloromethane. The individual dichloromethane extract was dried passing through chromatography column contain 50 gm of anhydrous sodium sulfate. The column was rinsed with 20 ml of the same solvent. The extract was concentrated up to 2 ml using a rotary evaporator. Ten ml of acetone were added and evaporated again to get rid of dichloromethane. The extract was transferred quantitatively into volumetric flask using acetone to complete volume to 25 ml of leaf sample and 50 ml of fruit sample. The sample then was ready for injection into a gas chromatrography. Disulfoton, Dimethoate and Primicarb residues were detected and estimated using an apparatus (Dani 3800 chromatography) equiped with Nitrogen Phosphorus detector. Cypermethrin was determined using an apparatus (Dani 3800 chromatography) equiped with an electron capture detector. However, carbofuran was not determined because the suitable High Pressure Liquid Chromatography apparatus was not ready to work.

II.7.c Predators And Parasites

The population of aphid predators was observed and monitored in the vegetable fields in Al-Jieza field (II.1&II.5.a) from early September 1984 to early December 1985 and in the deciduous trees orchard in Om-Ela'amad (II.3&II.5.b) from early January to Late December 1985 using the yellow water traps and the plant inspection. The occurrence of predators in the pepper field (II.7.) was evaluated using a sweep net. The net was 25 cm in diameter. One hundred sweeps were made biweekly on pepper plants between early June to late July 1985. The contents were transferred to 75% ethanol and examined in the laboratory.

Pepper leaves infested with parasitized aphids were encaged in 500 ml conical flask covered with muslin in the laboratory. Adults emerged were preserved in ethanol 80% glycerin mixture at 20:1 ratio (Mustafa, 1985) placed in vials and sent to the British Museum for identification. The predators were identified in the laboratory.

RESULTS

SECTION III: *MYZUS PERSICAE* INFESTATION

RESULTS

SECTION III: MYZUS PERSICAE INFESTATION

III.1.a Occurrence Of Myzus persicae On Different Vegetable Crops During Fall 1984

Results of infestation on the 7 vegetable hosts: sweet pepper cv. 'Sharina', eggplant, tomato, lettuce, tobacco, cucumber and cauliflower through fall 1984 are presented in Table 1 and Appendix 1.

Infestation began in early September where the sweet pepper was significantly more infested ($P \leq 0.05$) than the other crops till the mid of September. Then the lettuce plants became the more infested ($P \leq 0.05$) during the late half of September.

In the 1st week of September, infestation as mean number of aphids/plant on sweet pepper, eggplant, tomato, lettuce and tobacco, were 4.1, 0.15, 0.15, 0.25 and 0.55 respectively. Sweet pepper was the most significant infestation while others without significant difference. Cucumber and cauliflower were free of Myzus persicae infestation in the same period.

In the 2nd half of September, lettuce became more significant in infestation with mean numbers of 0.95 aphid/plant,

Table 1: Detransformed mean numbers of green peach aphid on different vegetables during Fall 1984.

Crop	Number of aphids/plant				
	4.9.84	14.9.84	24.9.84	2.10.84	Accumulative
Sweet pepper	3.54 a	1.99 a	0.29 b	0.24 b	6.21 a
Eggplant	0.16 b	0.004 b	0.004 b	0.004 b	0.16 c
Tomato	0.14 b	0.004 b	0.004 b	0.004 b	0.14 c
Lettuce	0.24 b	0.004 b	0.78 a	0.64 a	1.6 b
Tobacco	0.48 b	0.004 b	0.004 b	0.004 b	0.48 bc
Cucumber	0.004b	0.004 b	0.004 b	0.004 b	0.004 c
Cauliflower	0.004b	0.004 b	0.004 b	0.004 b	0.004 c

Notes: 1. Means within columns sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

2. Equation of transformation is $\sqrt{\bar{x} + \frac{1}{2}}$, where $\bar{x}$=original mean.

3. Equation of detransformation is $\bar{y}^2 - \frac{1}{2}$ where $\bar{y}$= transformed mean.

4. For original means, see Appendix 1.

while sweet pepper became lower with 0.3 aphid/plant, but other hosts were free of infestation.

Infestation of aphids on lettuce and sweet pepper continued till the 1st week of October 1984.

Considering the accumulative mean number of aphids/plant through the season. Sweet pepper was the highest infested host with the aphid. The lettuce, eggplant, tomato and tobacco were infested briefly and mildy, while cucumber and cauliflower remained free of infestation throughout the whole season. Tobacco was noticed to be free of apterous aphid throughout the season while 0.55 alate aphid/plant found in early September.

III.1.b Occurrence of *Myzus persicae* On Different Vegetable Crops During Spring 1985

Results of infestation by the green peach aphid on the previous vegetable hosts (II.1) through Spring 1985 are presented in Table 2 and Appendix 2.

Infestation started in the last week of May, 1985 where lettuce and sweet pepper were significantly the highest infested hosts ($P \leq 0.05$), while infestation on all other vegetables did not differ significantly. Infestation of aphids increased in early June. The lettuce and sweet pepper remained significantly the highest infested crops, but through the 3rd week of June, infestation on lettuce

Table 2: Detransformed mean numbers of green peach aphid on different vegetables during Spring 1985.

Crop	Number of aphids/plant				
	30.5	9.6	21.6	3.7	Accumulative
Sweet pepper	1.38 b	4.16 b	7.85 a	2.06 a	17.65 b
Eggplant	0.48 bc	0.44 c	0.4 b	0.004b	2.49 c
Tomato	0.46 bc	0.38 c	0.08 b	0.004b	0.89 cd
Lettuce	10.26 a	19.48 a	6.84 a	0.004b	37.69 a
Tobacco	0.26 c	0.004c	0.004b	0.004b	0.26 d
Cucumber	0.03 c	0.02 c	0.004b	0.004b	0.03 d
Cauliflower	0.12 c	0.08 c	0.03 b	0.004b	0.24 d

Notes: 1. Means within columns sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

2. Equation of transformation is $\sqrt{\bar{x} + \frac{1}{2}}$, where $\bar{x}$ = original mean .

3. Equation of detransformation is $\bar{y}^2 - \frac{1}{2}$, where $\bar{y}$ = transformed mean .

4. For original means, see Appendix 2.

decreased to be simillar to that on sweet pepper. Infestation on eggplant and cauliflower decreased during the 3rd week of June, while tomato, tobacco and cucumber became almost free of infestation. In the first week of July only the sweet pepper showed significantly higher numbers of aphids than all the other crops.

Considering the accumulative mean number of aphids/plant throughout the season, lettuce was significantly the highest infested crop, followed by sweet pepper, even through, the other crops i.e. eggplant, tomato, tobacco, cucumber and cauliflower were significantly less infested than the sweet pepper. Tobacco was free of apterous aphid throughout the season.

III.1.c Percentage Of *Myzus persicae* Infested Plants Of Different Vegetable Crops

Percentages of *Myzus persicae* infested plants of eggplant , lettuce and sweet pepper during Spring 1985 in Al-Jieza field are shown in Figure 1.

Lettuce was infested in early May and then the percentage of infestation reached 100% in early June with the highest significant mean of aphids/plant ($P < 0.05$) compared with the other hosts. Sweet pepper was the 2nd host to be infested with the aphid. The percentage of infested sweet

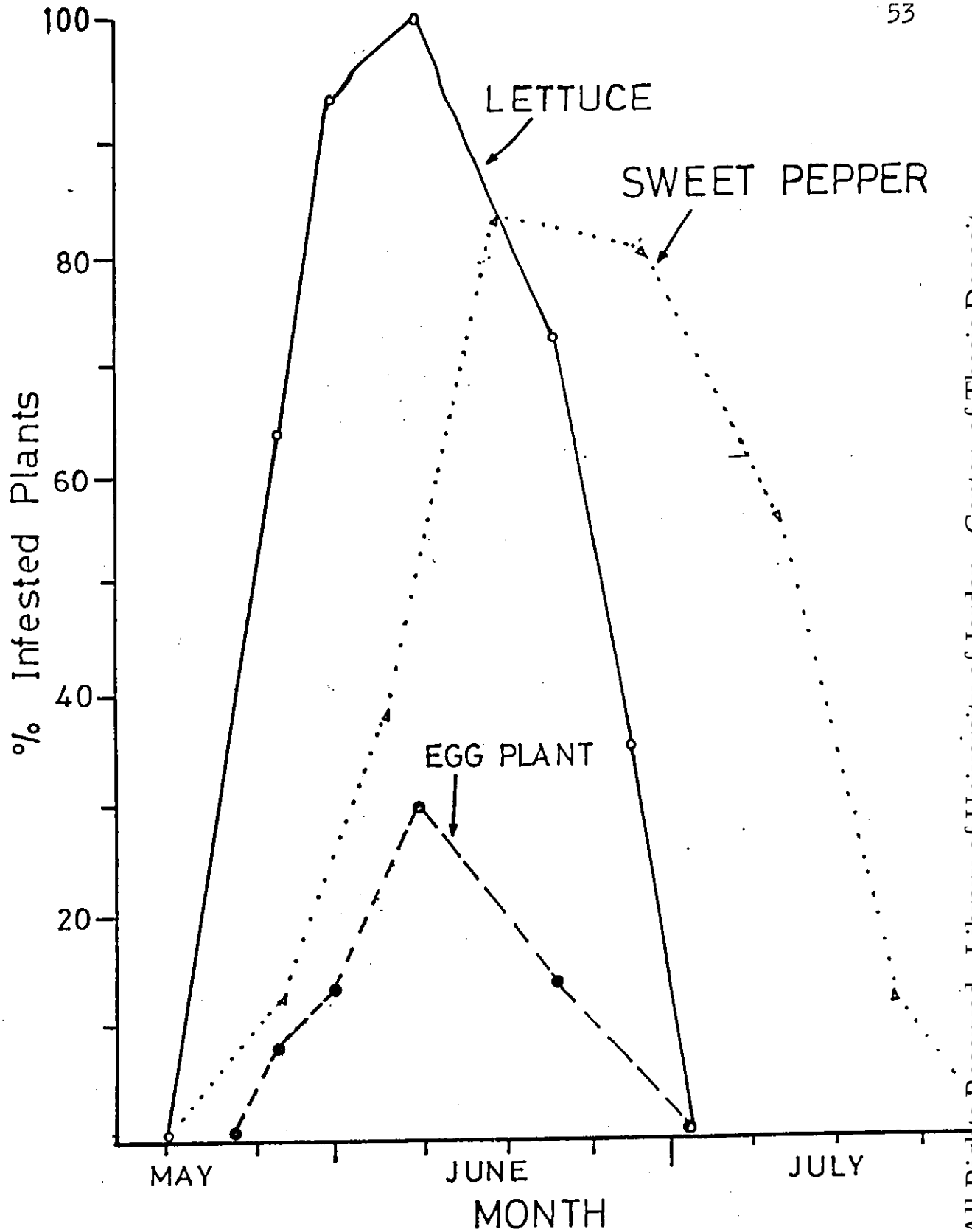

Fig. 1: Percentage of Myzus persicae infested plants of three vegetables in Al-Jieza field during Spring 1985.

pepper plants increased to 82% in mid-June.

Eggplant was the least infested host with M. persicae, where 30% of the plants were infested in early June with 1.02 aphids/plant.

Lettuce and eggplants became free of infestation in early July while sweet pepper remained infested till the end of July.

III.2.a Occurrence Of Myzus persicae On Different Pepper Cultivars During Fall 1984.

Results of infestation on the six pepper cultivars: Melody, Piment sweet, Sharina, Shamrock, Deer's horn and Piment hot are presented in Table 3 and Appendix 3.

Infestation through Fall 1984 began in late August. Sharina followed by melody were significantly the most infested cultivars ($P \leq 0.05$) compared with all of the others. In the same period, the least significant infested cultivars were Piment hot, Shamrock, Deer's horn, and Piment sweet, with mean number of aphids/plant were 2.09, 0.87, 1.93 and 1.18 respectively.

Through early September, the aphid population redistributed

Table 3: Detransformed mean numbers of green peach aphid on different pepper cultivars during Fall 1984.

Pepper cultivar	Number of aphids/plant						Accumulative
	23.8	2.9	12.9	22.9	30.9	7.10	
Melody	4.98 a	3.07 a	2.32 a	0.33 a	0.14 b	0.14 a	11.40 a
Piment sweet	0.92 b	4.26 a	0.22 b	0.004 b	0.09 b	0.17 a	6.1 a
Sharina	7.68 a	4.25 a	1.30 a	0.004 b	0.004 a	0.33 a	14.25 a
Shamrock	0.78 b	4.56 a	0.03 b	0.004 b	0.17 b	0.03 a	5.65 a
Deer's horn	1.35 b	1.72 a	1.09 ab	0.004 b	0.56 a	0.26 a	6.31 a
Piment hot	1.54 b	4.47 a	0.16 b	0.004 b	0.004 b	0.12 a	6.84 a

Notes: 1. Means within columns sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

2. Equation of transformation is $\sqrt{\bar{x} + \frac{1}{2}}$, where $\bar{x}$ = original mean.

3. Equation of detransformation is $\bar{y}^2 - \frac{1}{2}$, where $\bar{y}$ = transformed mean.

4. For original means, see Appendix 3.

among the six cultivars, all cultivars became infested but without significant differences among each other. In this period infestation on Sharina and Melody decreased while on the other cultivars increased. By mid-September the infestation on most cultivars decreased to the zero level except for the Melody, which sustained 0.34 aphid/plant. In the end of September, new infestation of the aphid on Deer's horn cultivar was significantly higher than on the other cultivars ($P \leq 0.05$).

Accumulative numbers of aphids/plant on the cultivars showed that Sharina was the highest infested cultivars. Melody, Piment sweet and Piment hot were medium, while Shamrock and Deer's horn were the lowest infested ones.

III.2.b Occurrence Of *Myzus persicae* On Different Pepper Cultivars During Spring 1985

Results of infestation on the six pepper cultivars through Spring 1985 are presented in Table 4 and Appendix 4.

Infestation began in late May, Shamrock was significantly the highest infested ($P \leq 0.05$) cultivar. Melody, Piment sweet, Sharina and Piment hot were infested but without significant differences among each other. Meanwhile, Deer's horn was free of infestation.

In early June, population of aphids on all cultivars increased, redistributed and reached high numbers in all

Table 4: Detransformed mean numbers of green peach aphid on different pepper cultivars during Spring 1985.

Pepper cultivar	Number of aphids/plant						Accumulative
	26.5	5.6	16.6	28.6	9.7	20.7	
Melody	0.27 b	0.63 bc	1.93 a	8.08 a	3.70 b	0.44 a	15.98 b
Piment sweet	0.12 b	1.32 ab	6.26 a	7.91 a	4.08 b	0.17 a	21.22 ab
Sharina	0.27 b	0.66 bc	6.89 a	13.79 a	7.12 ab	0.38 a	30.41 ab
Shamrock	1.16 a	2.04 a	6.26 a	8.08 a	3.5 b	0.59 a	20.75 ab
Deer's horn	0.004 b	0.38 c	4.65 a	12.75 a	6.00 b	0.19 a	24.40 ab
Piment hot	0.17 b	0.29 c	2.78 a	11.75 a	17.31 a	0.06 a	35.62 a

Notes: 1. Means within columns sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

2. Equation of transformation is $\sqrt{\bar{x} + \frac{1}{2}}$, where $\bar{x}$ = original mean.

3. Equation of detransformation is $\bar{y}^2 - \frac{1}{2}$, where $\bar{y}$ = transformed mean.

4. For original means, see Appendix 4.

cultivars at the end of the month, but without showing significant differences among each other.

In early July, infestation decreased on all cultivars, except on Piment hot, where population increased to levels being significantly greatest than all other cultivars ($P \leq 0.05$). The infestation continued to decrease in all cultivars to very low level until the end of the month. Concerning the accumulative of aphid population through Spring 1985, 'Piment hot' showed highest infestation while 'melody', showed the lowest infestation, other cultivars were without significant differences.

III.2.c Percentage Of *Myzus persicae* Infested Plants Of Different Pepper Cultivars

Percentage of *Myzus persicae* infested plants of sweet pepper cultivars namely: Melody, Shamrock, Piment sweet and hot pepper cultivars; Deer's horn and Piment hot in Al-Jieza field during Spring 1985 are shown in Figure 2.

Sweet pepper 'Shamrock' was the highest infested plant in early season compared with the other cultivars. Percentage of infested plants increased steadily and reached 87% in end of June. Melody and Piment sweet were infested in late of May, but infestation reached 76% and 73% respectively in late June. In the same time, Deer's horn and Piment hot infestation reached 72%.

At the early of July, percentage of infested plants decreased rapidly in all cultivars reaching their lowest

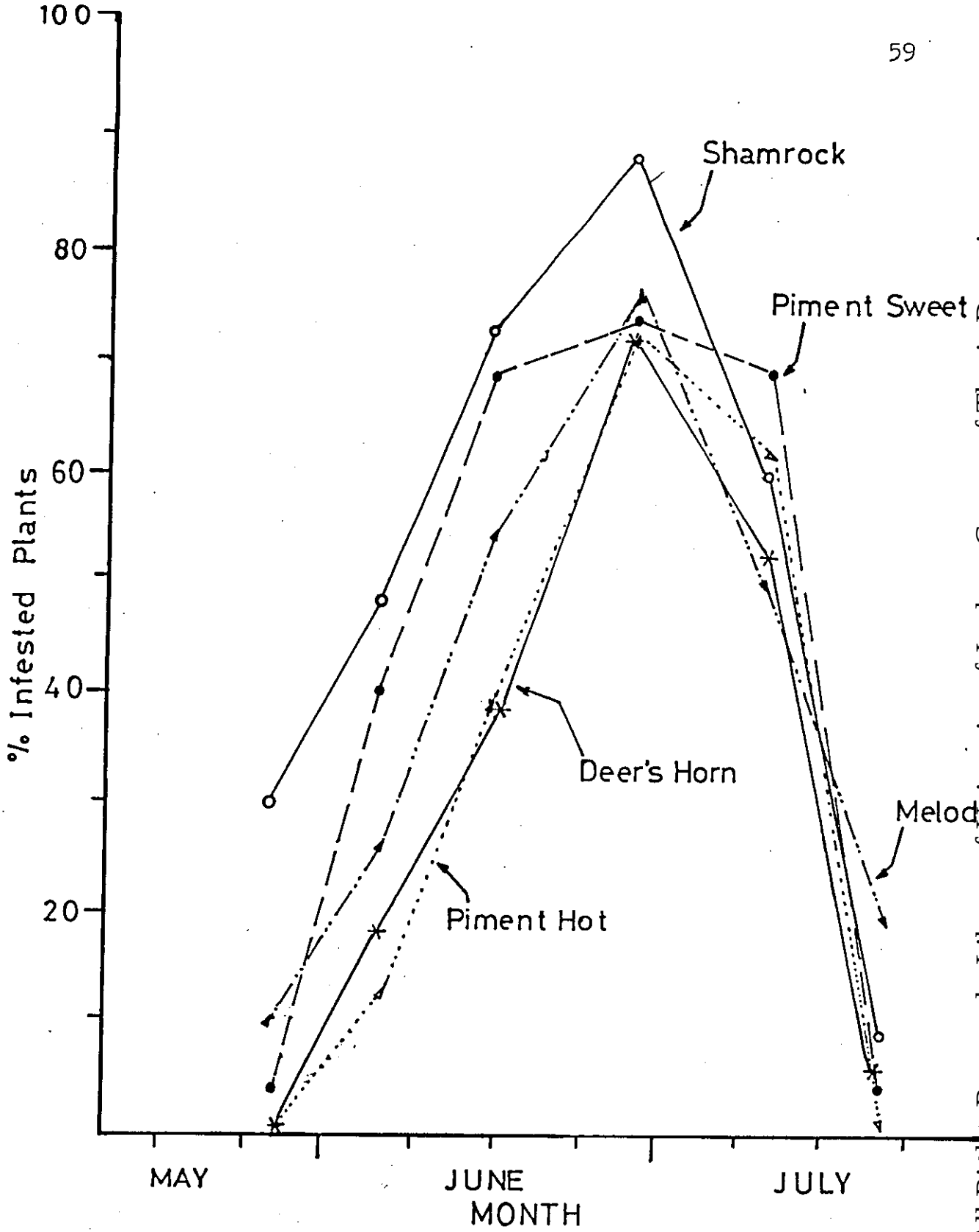

Fig. 2: Percentage of M. persicae infested plants of five pepper cultivars in Al-Jieza field during Spring 1985.

percentage after mid July. All cultivars became almost free of aphid infestation by the end of July.

III.3 Occurrence Of *Myzus persicae* And *Brachycaudus amygdalinus* On Deciduous Trees.

Results of *Brachycaudus amygdalinus* infestation on deciduous trees in Om-Ela'amad orchard are presented in Fig. 3. Almond, peach, cherry and pear trees were found free of *Myzus persicae* mobile stages in all months of 1985. No eggs of *Myzus persicae* detected on the woody branches in the cold months from December 1984 to February 1985.

Almond and peach trees were highly infested with the short-tailed almond aphid *Brachycaudus amygdalinus* in the Spring of 1985 where alate adult (Plate 4), apterous adult (Plate 3) and nymphs were found on infested leaves. The cherries and pears remained free of any aphid infestation throughout the year.

In April both almond and peach trees were infested with the short-tailed aphid, with the former being significantly more infested ($P < 0.05$) than the later using paired t-test. The highest numbers of aphids were 69 and 27 aphids per curled leaf on almond and peach respectively.

The population of *Brachycaudus amygdalinus* started to

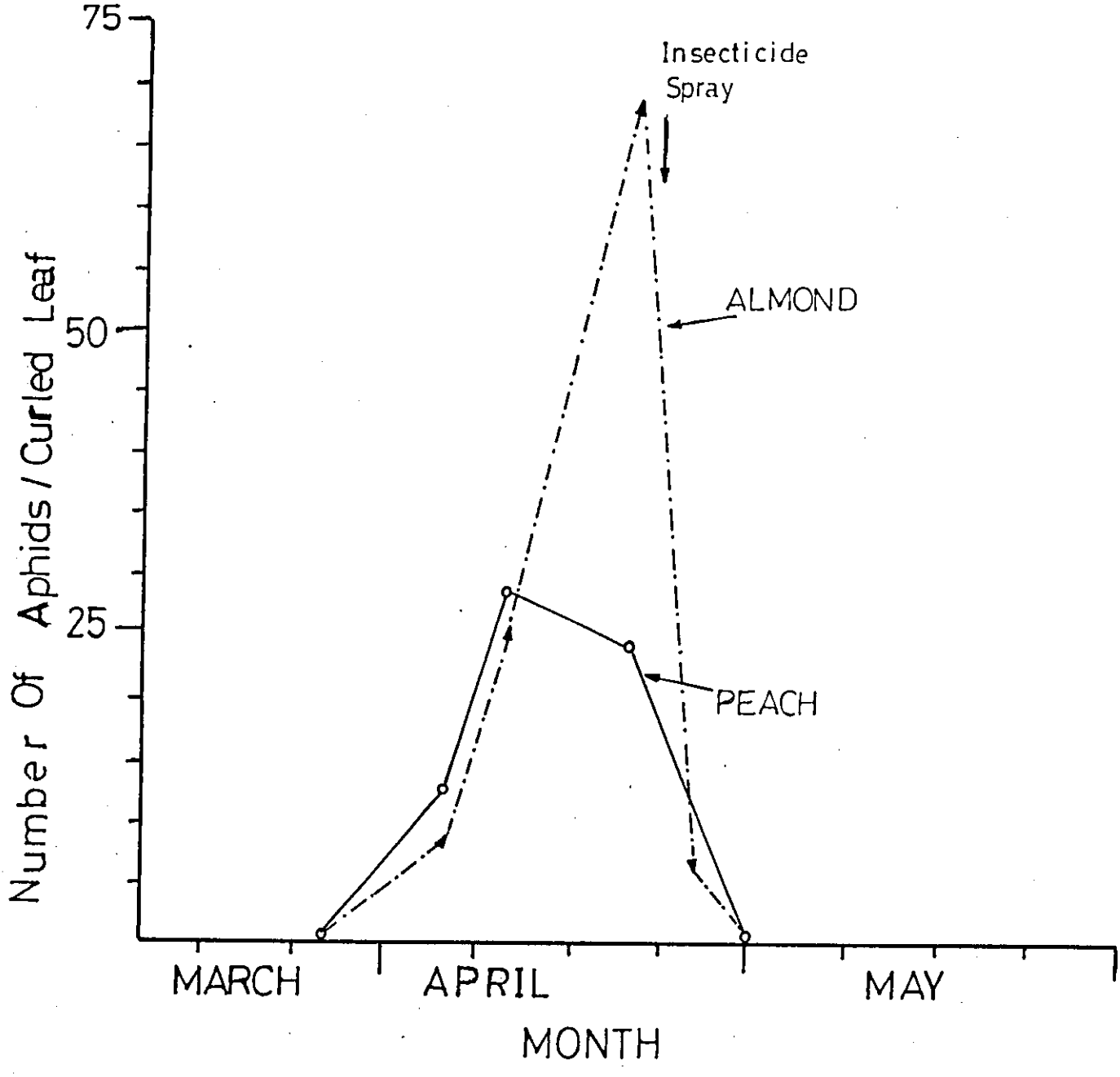

Fig. 3: Number of Brachycaudus amygdalinus on almond and and peach leaves in Om-Ela'amad orchard during 1985.

decrease in late of April, for the whole orchard was sprayed by the owner with Dimethoate 40% on 20th April, 1985. From there on, the orchard became free of aphids until the end of the year, and high numbers of Coccinella septempunctata (L.) were encountered on the vegetation of the infested trees (Plate 10).

Plate 10: Adult Coccinella septempunctata L.

SECTION IV: POPULATION DYNAMICS OF MYZUS PERSICAE

IV.1 Population Dynamics Of Myzus persicae On Different Vegetable Hosts.

Results of population dynamics of Myzus persicae on different vegetable hosts during spring 1985 are shown in Figures 4,5 , 6 and 7.

Population dynamics of Myzus persicae on eggplant during Spring season 1985 was shown in Fig. 4. Myzus persicae was found on eggplant during June 1985. Alate morphs was only found in the first week of June. Apterous adult and nymphs continued until the end of June. The peak of the aphid population was on 8th June where mean number of 1.22 aphids per plant was found. Nymphs were 78.7% and apterous adult were 21.3% of the population.

Population dynamics of Myzus persicae on lettuce plants during Spring season 1985 was shown in Fig. 5. Alate adult or apterous and nymph were found on plants through June, where infestation started in late of May and became free of infestation in early of July. The aphid population on lettuce reached its peak on 8th June with mean numbers of aphids per plant of 20.5. However, 81.5% of the population were nymphs 18.1% were adult apterous and 0.8% were alate aphid.

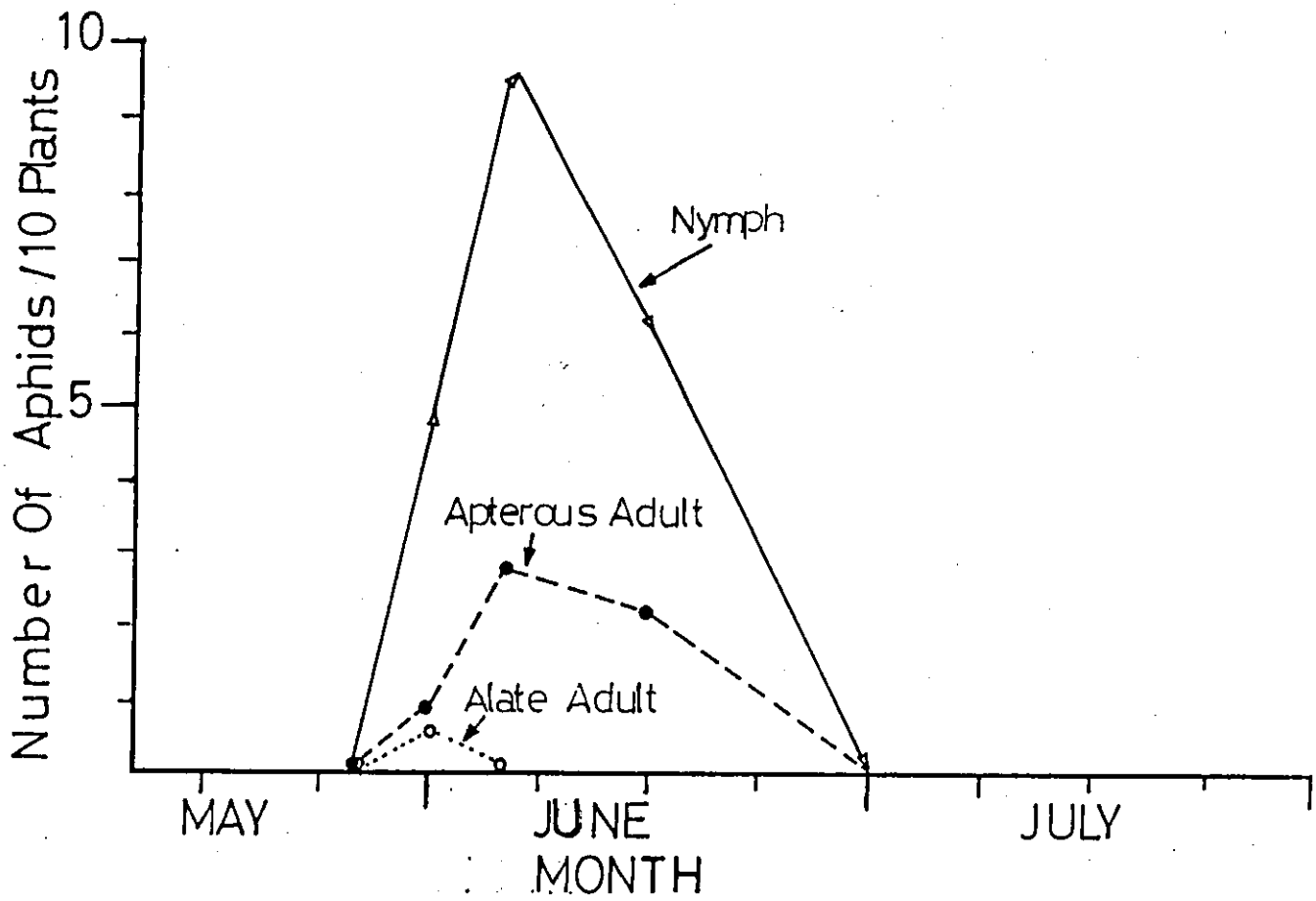

Fig. 4: Number of alate adult, apterous adult and nymphs of M. persicae on eggplant in Al-Jieza field during Spring 1985.

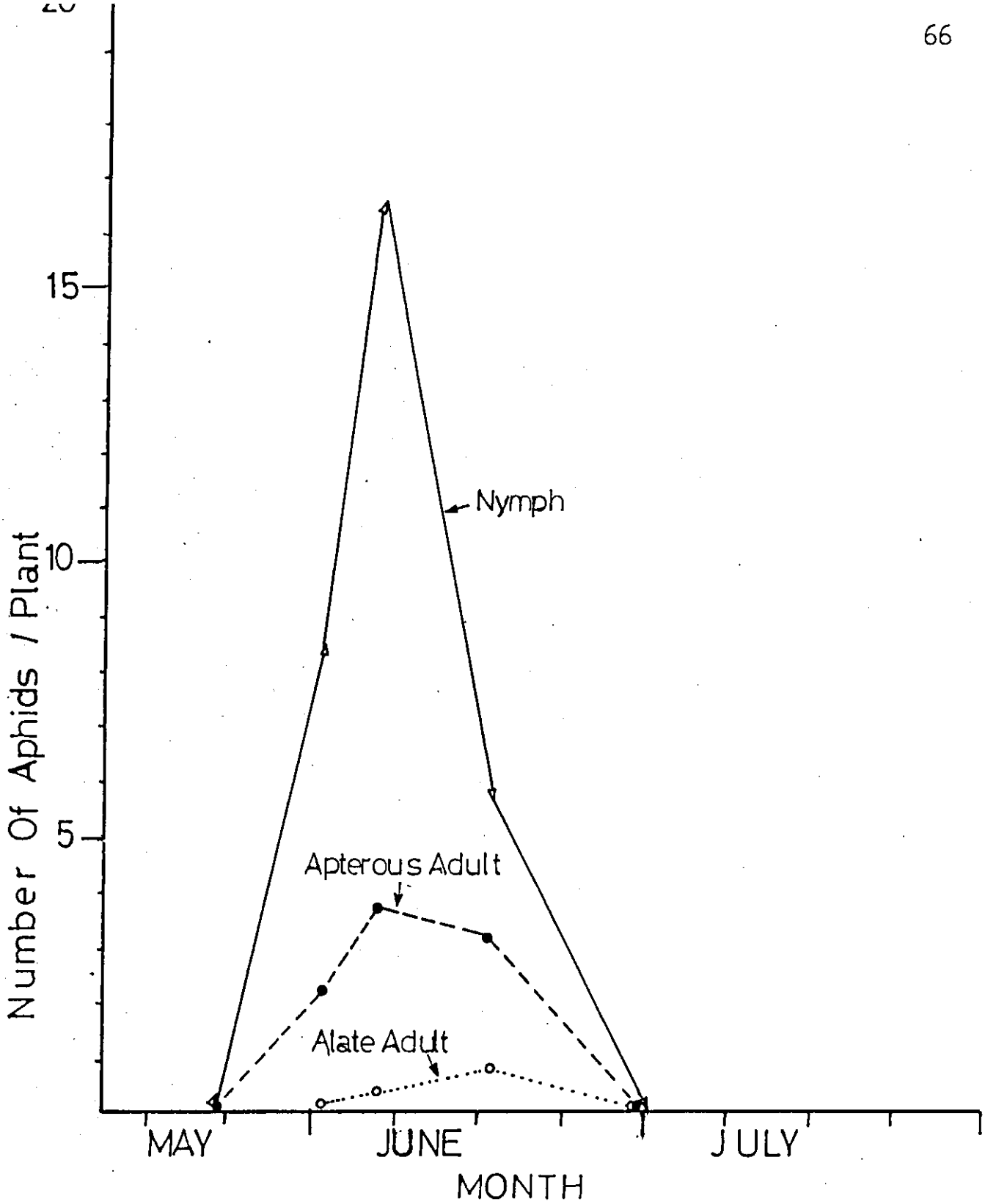

Fig. 5: Number of alate adult, apterous adult and nymphs of M. persicae on lettuce plants in Al-Jieza field during Spring 1985.

On sweet pepper cultivar 'Sharina' population dynamics of Myzus persicae is shown in Fig. 6. Alate adult. or apterous adult and nymphs were found mostly between May and 20th July.

The aphid population increased steadily reaching a peak at the end of June. The maximum population reached was 15.6 aphids/plant; 78.4% were nymphs and 21.6% were apterous. The population decreased and disappeared from the field in late of July.

Population dynamics of Myzus persicae on hot pepper cv. 'Deer's horn' is shown in Fig. 7. Aphid infestation started in early June, increased steadily to reach its maximum of 19.66 aphids/plant in end of June: 74.1% were nymphs, 25.8%, adult apterous and only 0.1% were alate.

IV.2 Population Dynamics Of Myzus persicae On Different Pepper Cultivars.

Results of population dynamics of Myzus persicae on four pepper cultivars: Shamrock, Piment hot, Piment sweet and Melody, during Spring 1985 are shown in Figures 8, 9, 10 and 11 respectively.

Figure 8 showed that Myzus persicae population started in early of May on Shamrock cultivar. Alate and apterous

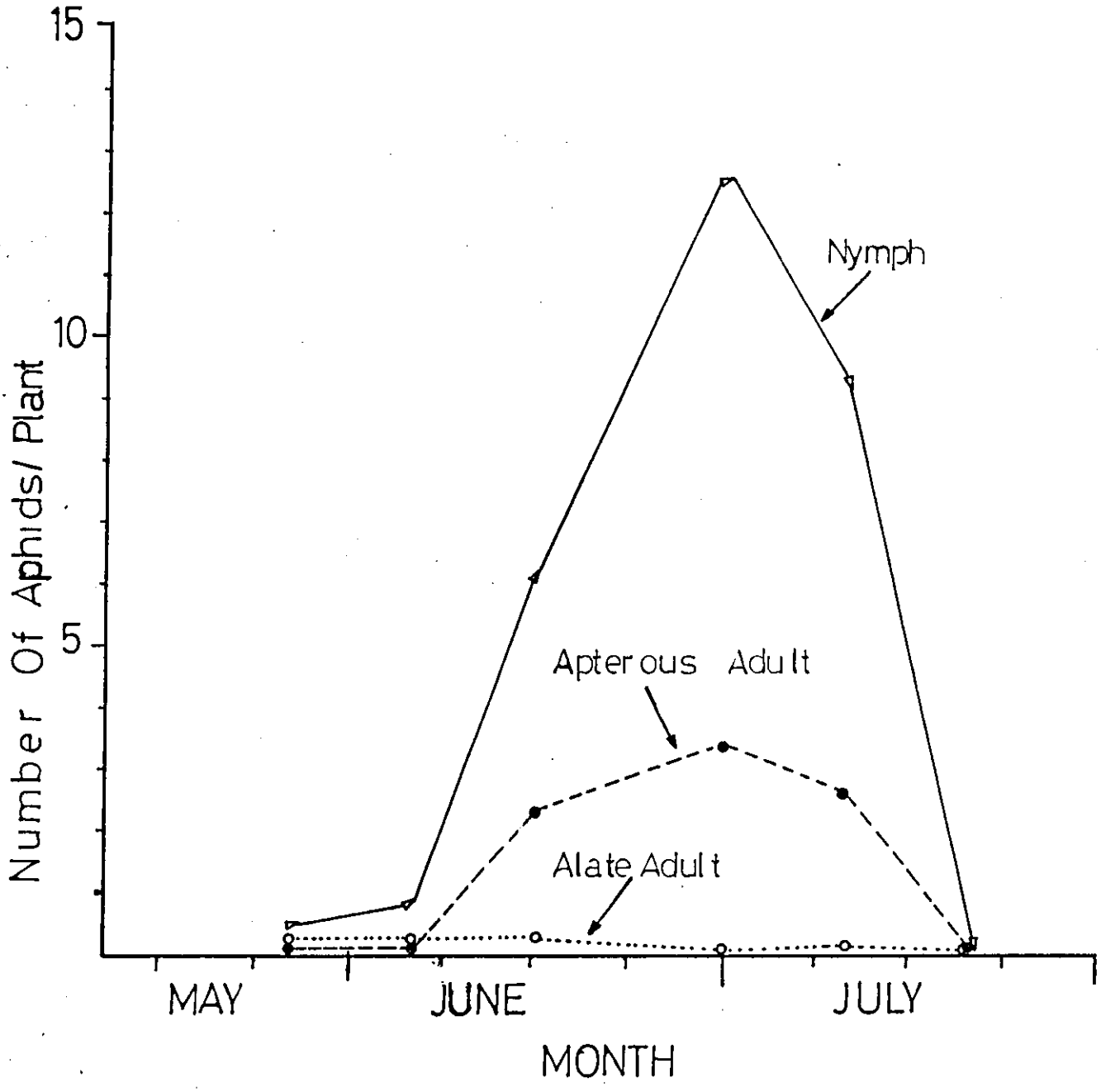

Fig. 6: Number of alate adult, apterous adult and nymphs of M. persicae on sweet pepper 'Sharina' in Al-Jieza field during Spring 1985.

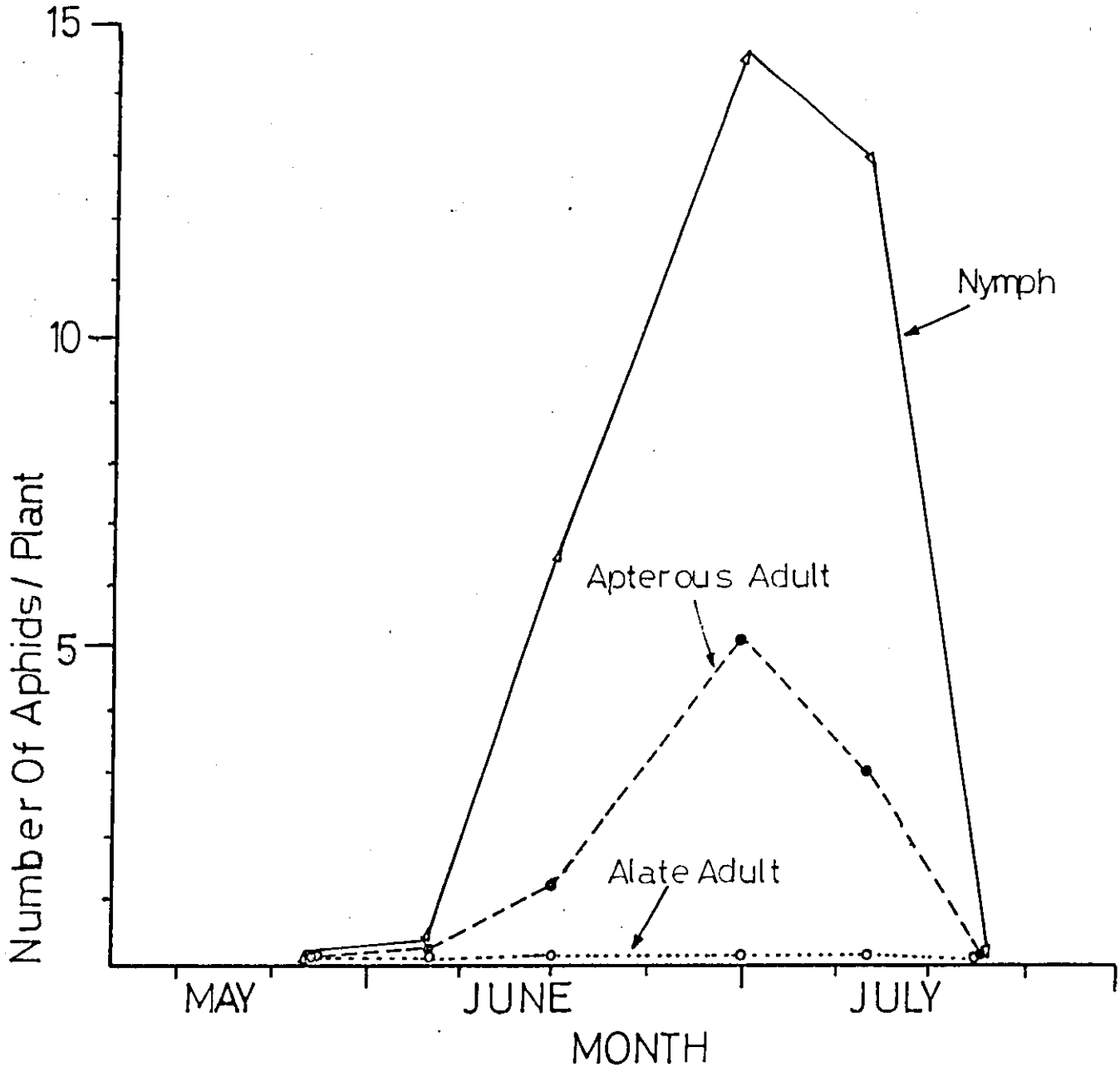

Fig. 7: Number of alate adult, apterous adult and nymphs of M. persicae on hot pepper 'Deer's horn' in Al-Jieza field during Spring 1985.

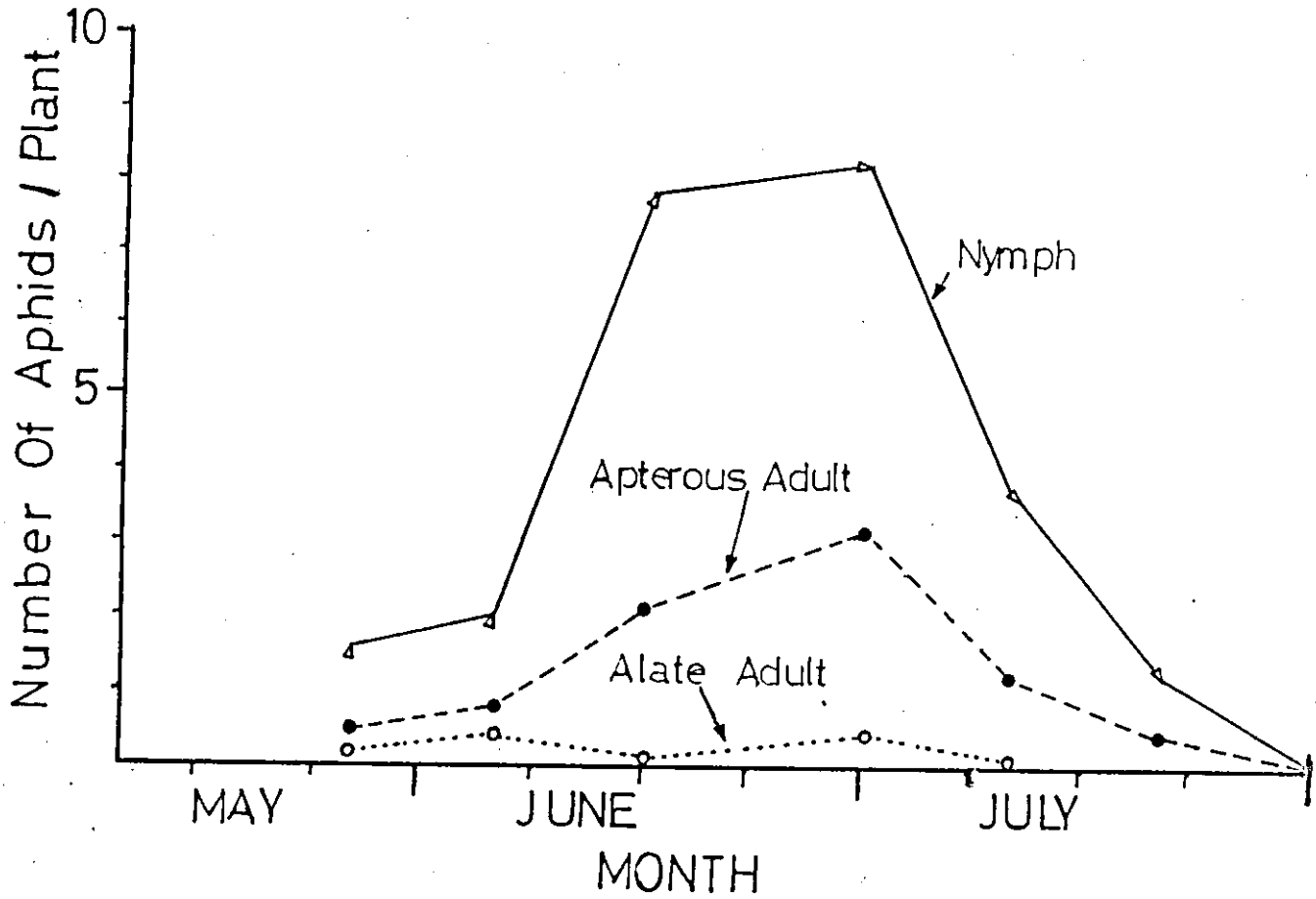

Fig. 8: Number of alate adult, apterous adult and nymphs of M. persicae on sweet pepper cultivar 'Shamrock' in Al-Jieza field during Spring 1985.

morphs and nymphs were found on Shamrock plants from 26th May up to late of July. The peak of the aphids population occurred at the end of June. The population peak was 10.9 aphids/plant; 72.4% were nymphs, 26.6% adult apterous and 0.9% alate morph.

The aphid population on Piment hot cultivar is shown in Fig. 9. This cultivar was found to be infested by Myzus persicae one week later than Shamrock. Few numbers of alate morph were found on Piment hot during most of the season. The maximum population reached 16.7 aphids/plant on 10th of July; 78.8% were nymphs, 21.5% adult apterous and 0.2% alate morph. However, Piment hot plants were found free of aphids by late of July.

Results of population dynamics of Myzus persicae on Piment sweet cultivar are shown in Fig. 10.

Alate and apterous adults and nymphs were found along the period of infestation. Aphid population started in late of May approaching a peak of 9.5 aphids/plant on 28th of June; 76.7% were nymphs, 21.8 apterous adults and 1.5% alate morph. The infestation continued till the end of July.

Results of population dynamics of Myzus persicae on Melody cultivar are shown in Fig. 11. The aphid population

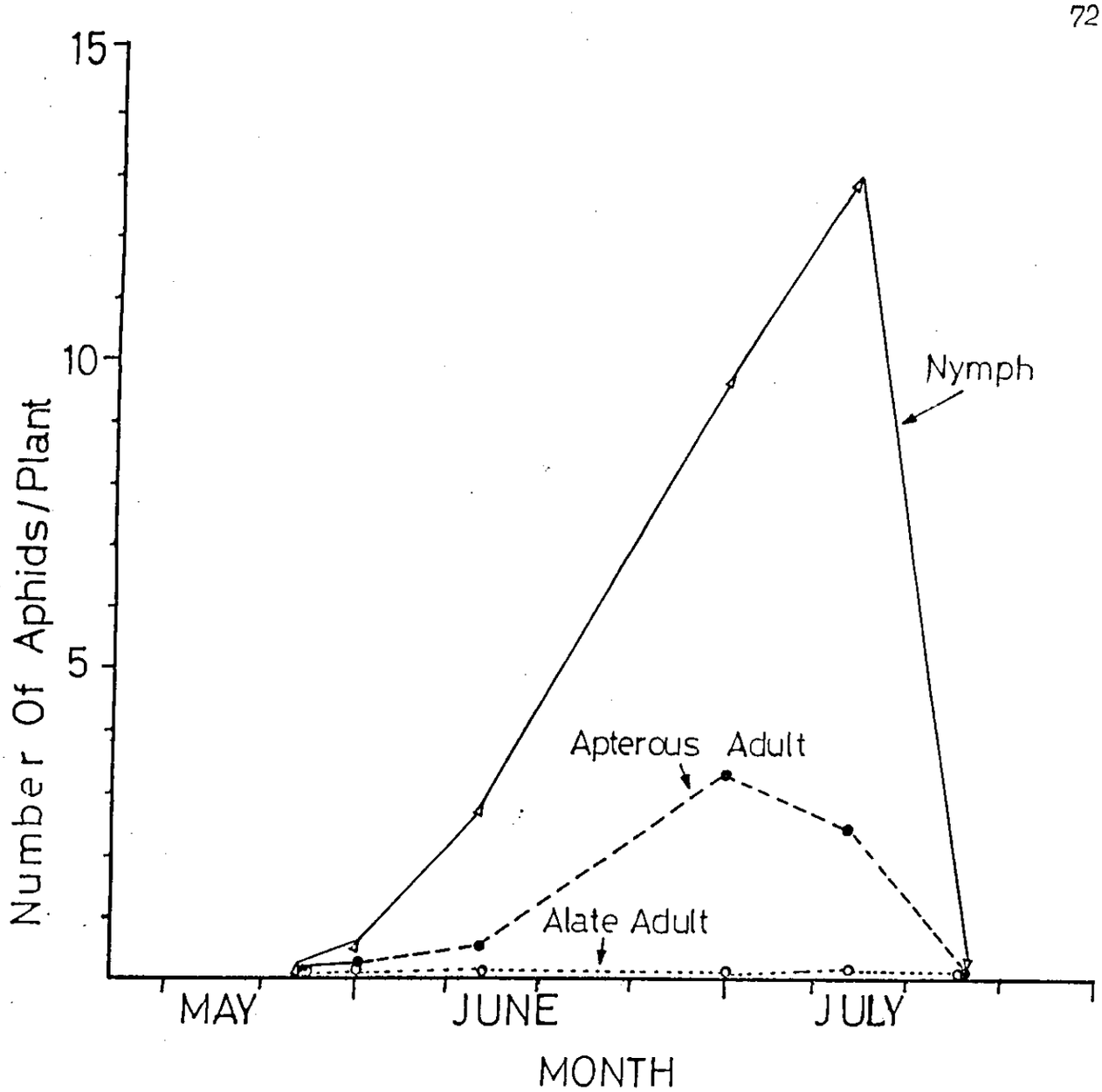

Fig. 9: Number of alate adult, apterous adult and nymphs of M. persicae on hot pepper cultivar' Piment hot' in Al-Jieza field during Spring 1985.

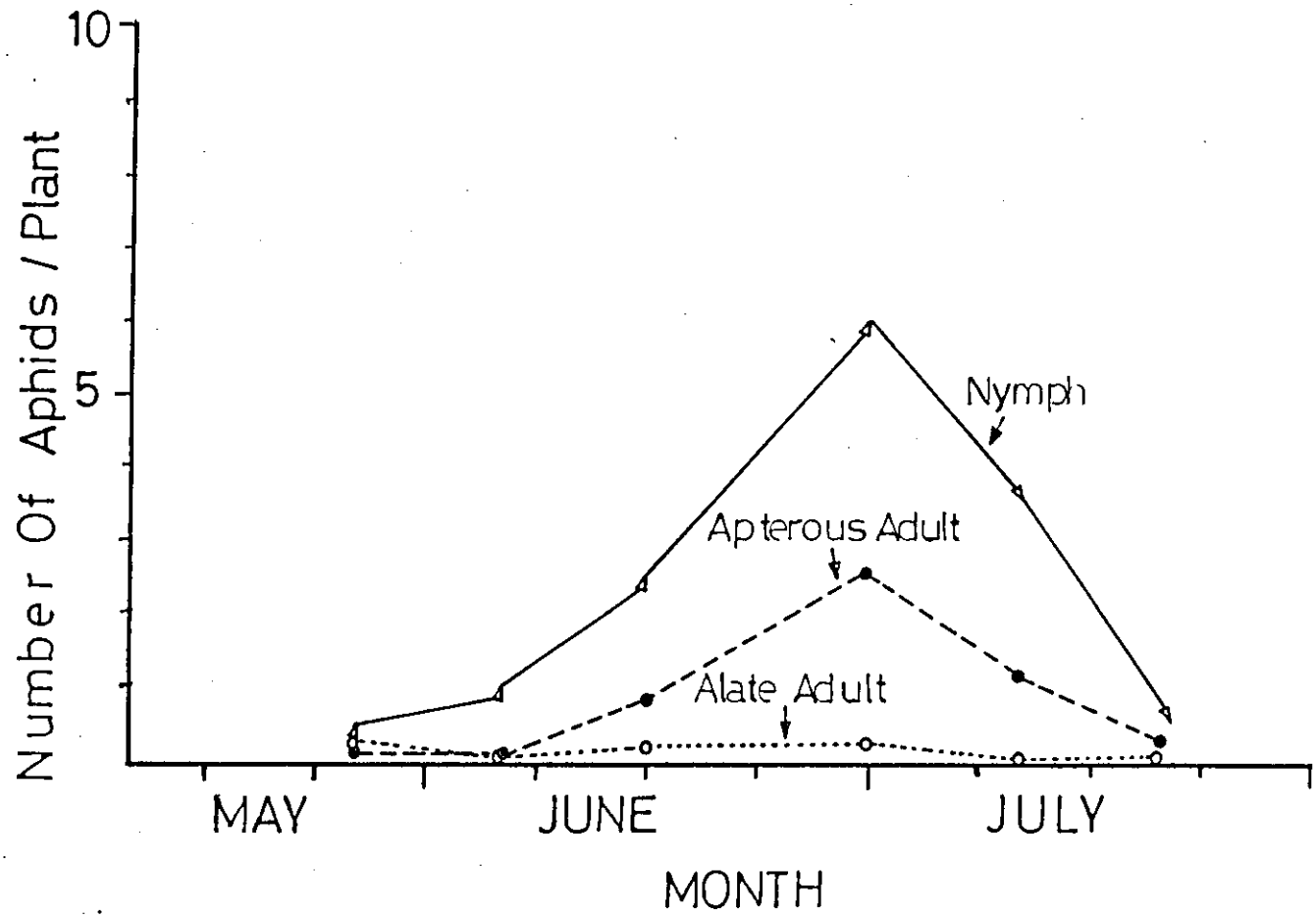

Fig. 11: Number of alate adult, apterous adult and nymphs of M. persicae on sweet pepper cultivar 'Melody' in Al-Jieza field during Spring 1985.

on Melody reached it's peak on 28th June, where 8.7 aphids per plant were found, 68.3% were nymphs, 30.3% apterous adult and 1.4% alate morph.

SECTION V: FLIGHT ACTIVITY

V.1 Flight Activity of Myzus persicae Within Sweet Pepper Planting

Numbers of alate adults of Myzus persicae in the water traps within sweet pepper plants (II.1) in Al-Jieza field throughout 16 months are presented in Fig. 12. Alate adults of the green peach aphid were caught in the traps during all months of the trapping period. In the Fall of 1984, a main flight period was recorded between late September and late October, showing two peaks; one in September 28 and the other in October 24, where the numbers of the GPA captured per 5 traps were 152 and 168, respectively.

In 1985, two main flight periods were recorded. The first was between mid-March and late May and the other was between late August and late October. The first period showed an obvious peak in mid-May with 34 green peach aphids per 5 traps. The second period was lower but wider with a peak in mid-October yielding 27 aphids per 5 traps per week.

During the main flight periods of M. persicae, the calculated means of temperature and relative humidity were 15°C and 55% R.H. through Fall of 1984, 16°C and 53% R.H. through Spring of 1985, and 20°C and 60% R.H. through Fall of 1985. However, flight

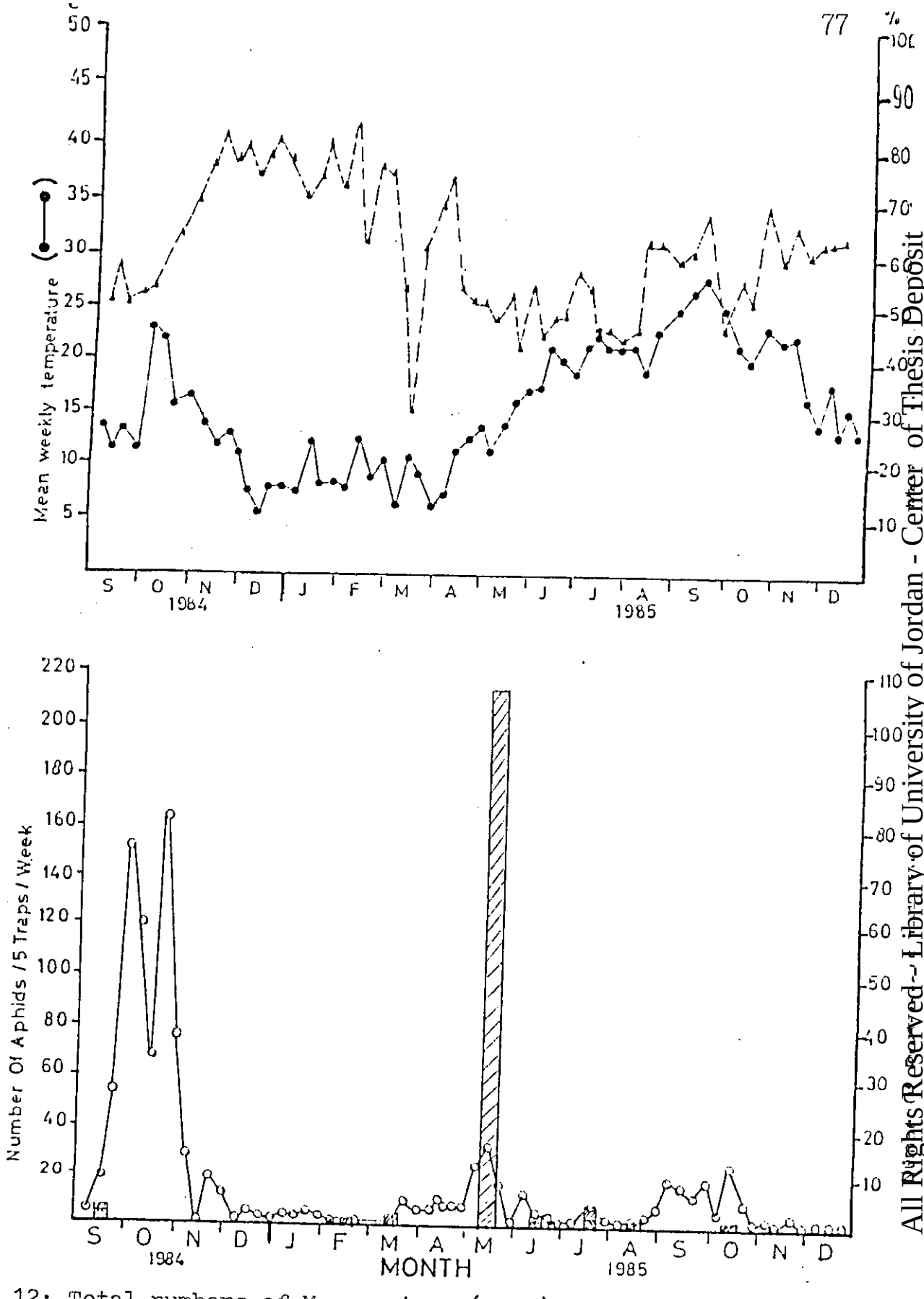

Fig. 12: Total numbers of M. persicae, (o—o) and the predators (Coccinella septempunctata ▨ and Chrysopa sp. ▨) captured in 5 water traps in Al-Jieza field between September, 1984 to December 1985.

activity decreased when temperature decreased less than 15°C through Winter or increased more than 25°C through Summer season.

V.2 Flight Activity Of Aphid Predators Within Sweet Pepper Planting

Numbers of captured predators in water traps throughout the trapping period in Al-Jieza field are presented as histogram per month in Fig. 12. In Fall 1984, the main captured predators were: Coccinella septempunctata (L.) (Coccinellidae: Coleoptera) (Plate 11) and Chrysopa sp. (Chrysopidae:Neuroptera) (Plate 12) in September.

In 1985, C. septempunctata L. was captured between early February to late March, early May to late August, and in early October. The peak of flight activity was in May whereby 107 adults of C. septempunctata were collected from 5 water traps. However, Chrysopa sp. was captured between late of June to early of August and in early of October, but with lower numbers than those of C. septempunctata L.

V.3 Flight Activity Of Myzus persicae, and Brachycaudus Amygdalinus Within Deciduous Trees.

The flight activity of M. persicae, and B. amygdalinus

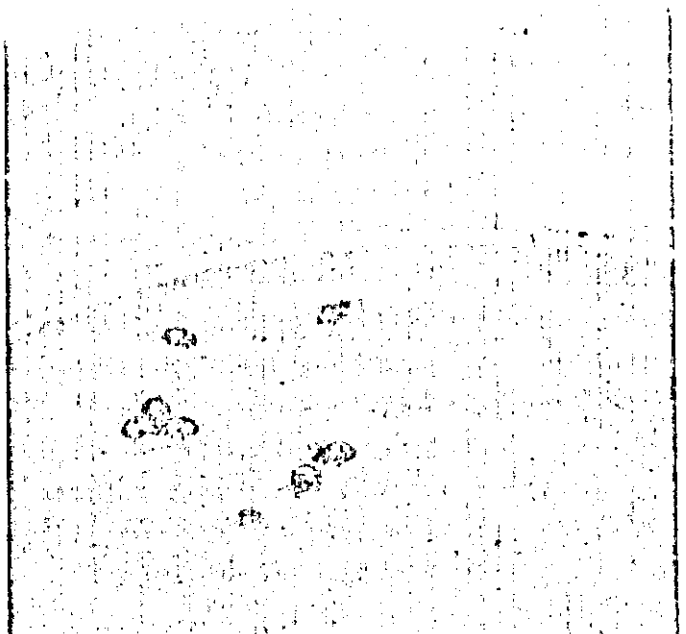

Plate 11: Coccinella septempunctata L. captured in water trap .

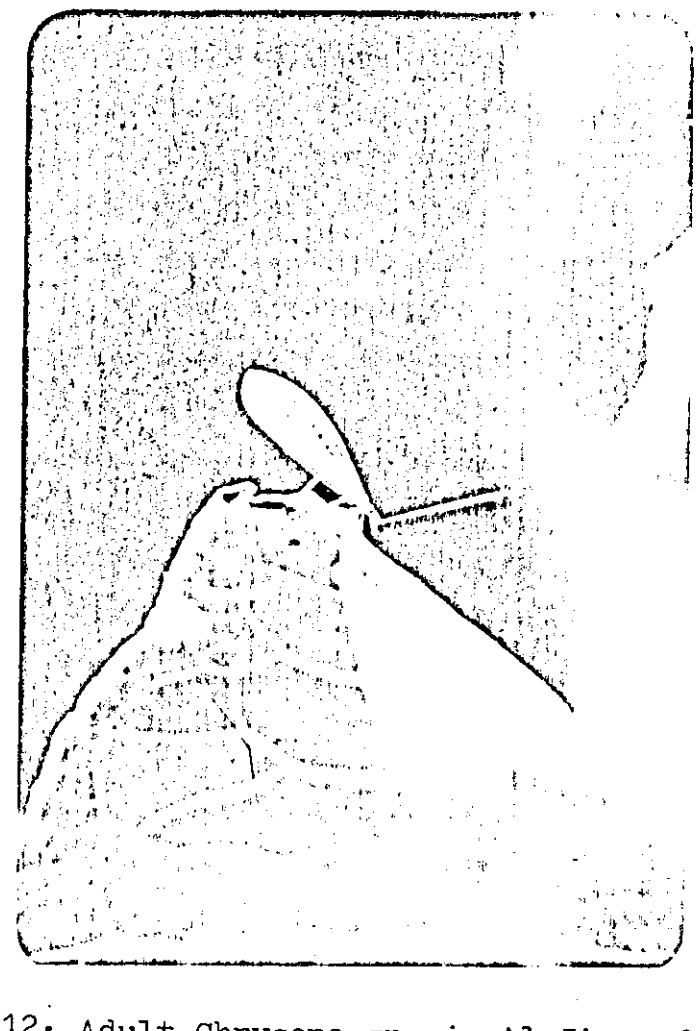

Plate 12: Adult Chrysopa sp. in Al-Jieza field.

were studied within almond, cherry, peach and pear trees during 1985 using the water traps. The trees were sprayed to suppress the aphid population only once on 20th April 1985.

a. Within almond trees:

Alate aphids were caught in the water traps during all months of 1985. Brachycaudus amygdalinus were 58.5% of the captured aphids (Fig. 13 a). However, 17.8% were M. persicae, mostly between March and May in the Spring and between August through October in Fall season (Fig. 13 a).

Two main flight periods of B. amygdalinus were recorded. The first was during the Spring season with two peaks. The first peak was in March where 52 aphids were caught (Fig. 13 a). The second peak was in May with 25 aphids were collected from 5 traps. The second main flight period occurred during the Fall season with a peak in September with 37 aphids per 5 traps.

b. Within cherry trees:

Alate aphids were caught in the water traps within cherry trees during almost all months of 1985. Most of the aphids caught belonged to B. amygdalinus (Fig. 14 a).

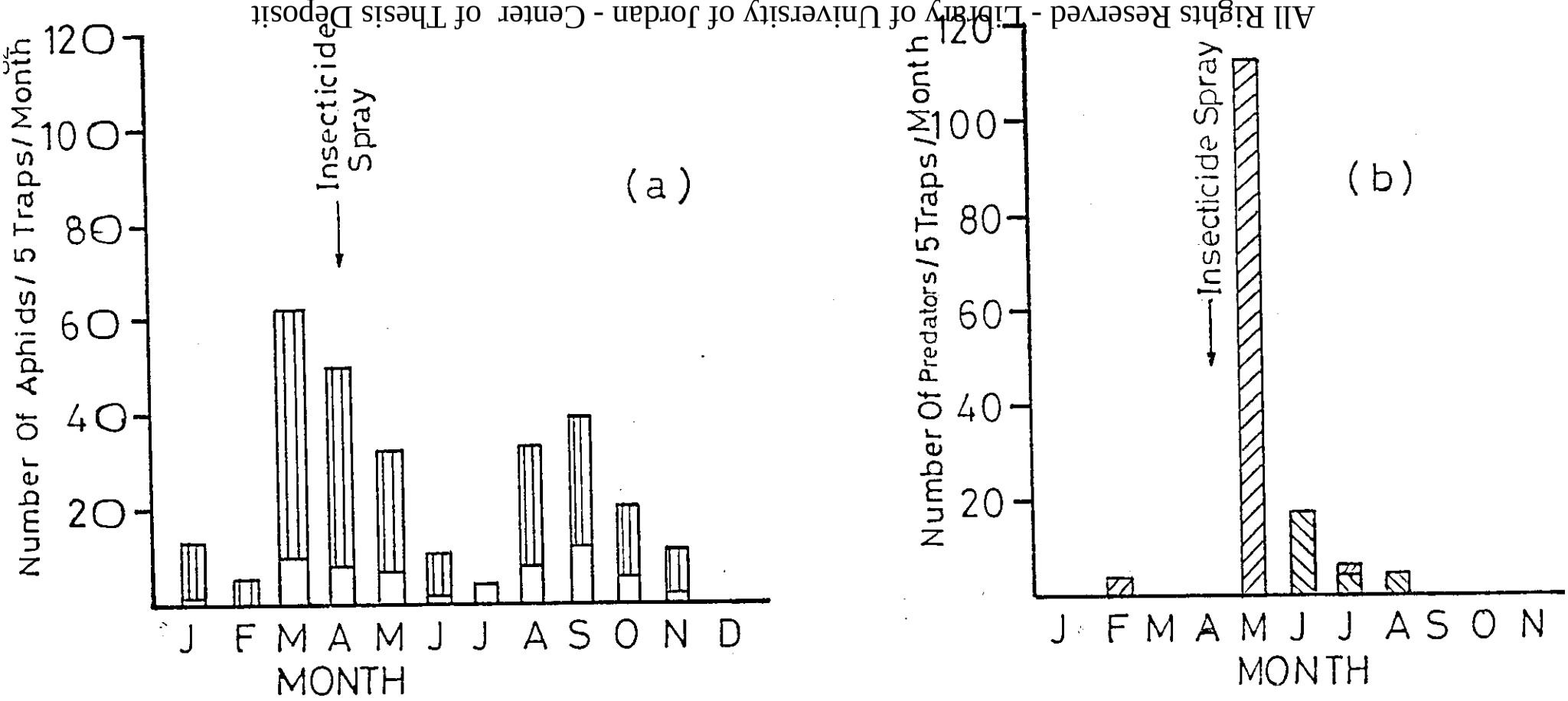

Fig. 13,ab: Total numbers of Myzus persicae □, Brachycaudus amygdalinus ▥, Coccinella septempunctata ▨ and Chrysopa sp. ▨ caught monthly in 5 water trap within almond trees in Om-Ela'mad orchard throughout 1985.

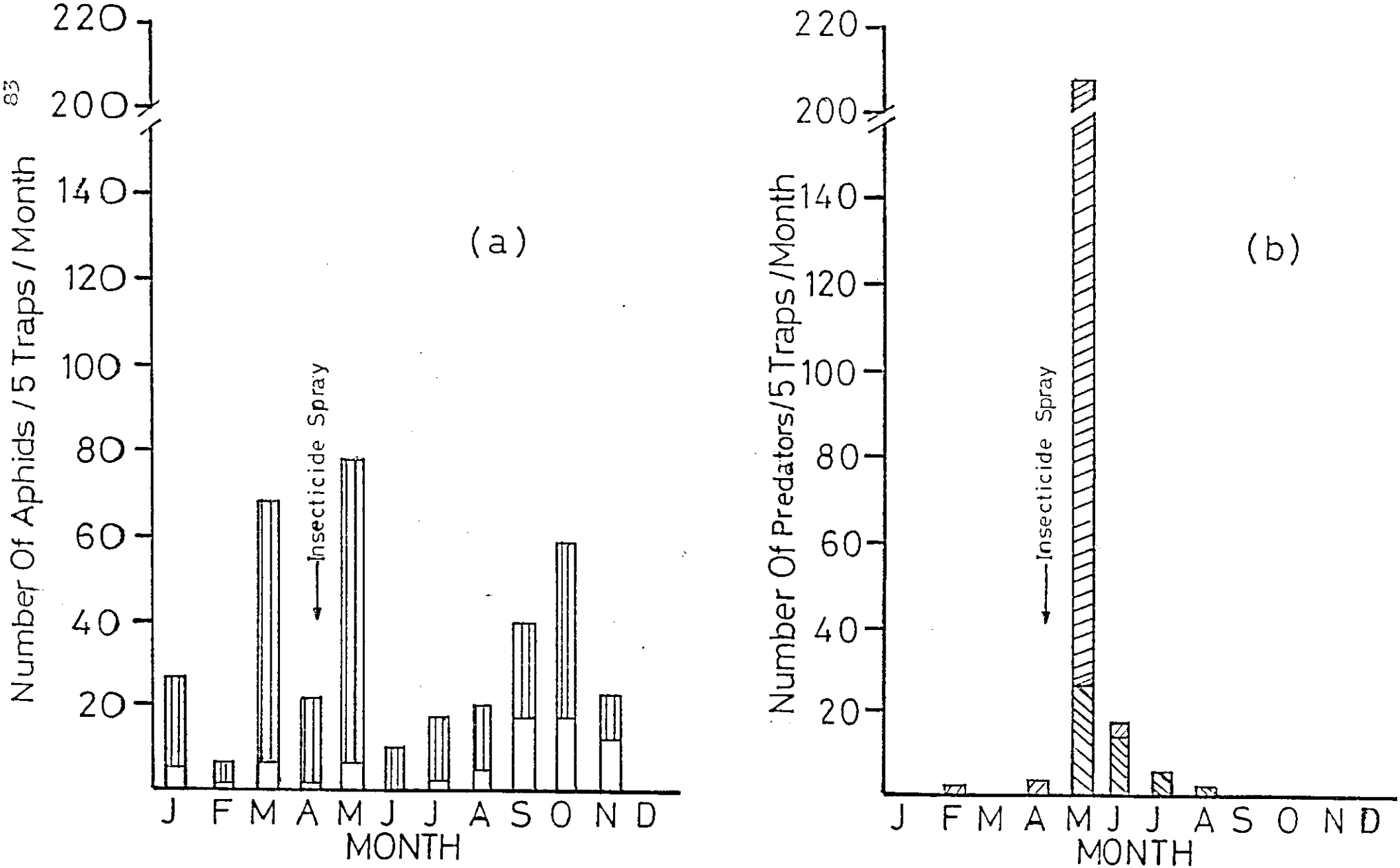

Fig. 14,ab: Total numbers of M. persicae □, B. amygdalinus ▥, Coccinella septempunctata ▨ and Chrysopa sp. ▧ caught monthly in 5 water traps within cherry trees in Om-Ela'mad orchard throughout 1985.

Two main flight periods for B. amygdalinus were found. The first was during the Spring season with two peaks. The first was in March with 62 aphids caught in 5 water traps and the second peak was in May with 72 aphids collected from 5 traps (Fig. 14 a). The second flight period was during fall season approaching the peak in October where 42 aphids were caught in 5 water traps. Few numbers were captured mostly during March through May in the Spring and from August to November in the Fall season.

c. Within peach trees.

Alate aphids were caught throughout almost all months of 1985. Relatively higher numbers of M. persicae were caught in comparison with those caught within the other deciduous trees. They occurred mostly between March to May in the Spring and from July to October in the Fall season (Fig. 15 a).

Two main flight periods of B. amygdalinus occurred, the first main flight period was during Spring with a peak in March where 78 aphids were caught and the second main flight period was during the Fall approaching the peak in September where 30 aphids were caught in 5 traps.

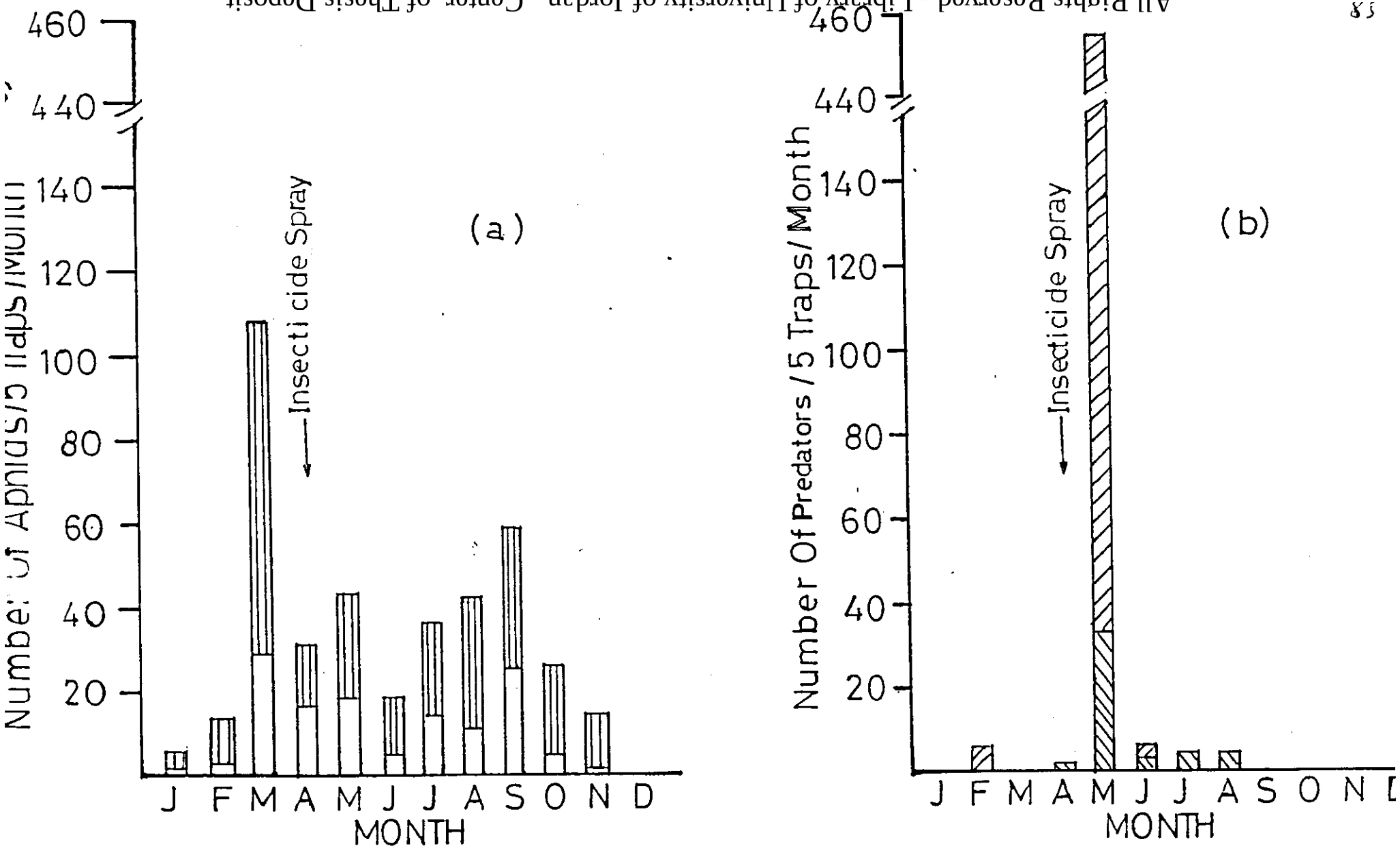

Fig. 15,ab: Total numbers of M. persicae ☐, B. amygdalinus ▥, Coccinella septempunctata ▨ and Chrysopa sp. ▧ caught monthly in 5 water traps within peach trees in Om-Ela'mad orchard throughout 1985.

d. Within pear trees:

Alate aphids caught within pear trees throughout all months of 1985. Two main flight periods occurred, the first was during the spring where the most captured aphids were B. amygdalinus but only few were M. persicae. The peak of this first period was in March where 126 aphids were caught, 22 of these were M. persicae and 75 B. amygdalinus and 29 were of other aphid species (Fig.16 a). The second main flight period was during the fall season. B. amygdalinus approached its peak in August with 33 aphids caught in the traps. While M. persicae reached a peak in September with 33 aphids caught in the traps (Fig. 16 a).

e. Comparison of numbers of M. persicae caught within the deciduous trees

Mean numbers of alate M. persicae caught monthly per water trap within deciduous trees are presented in Table 5.

Mean number of the aphids caught within peach trees was significantly greater than within the other deciduous trees ($P < 0.05$) in the period between March and June (Table 5). Generally there were more numbers of the aphid caught within peach trees than the other deciduous trees in most months.

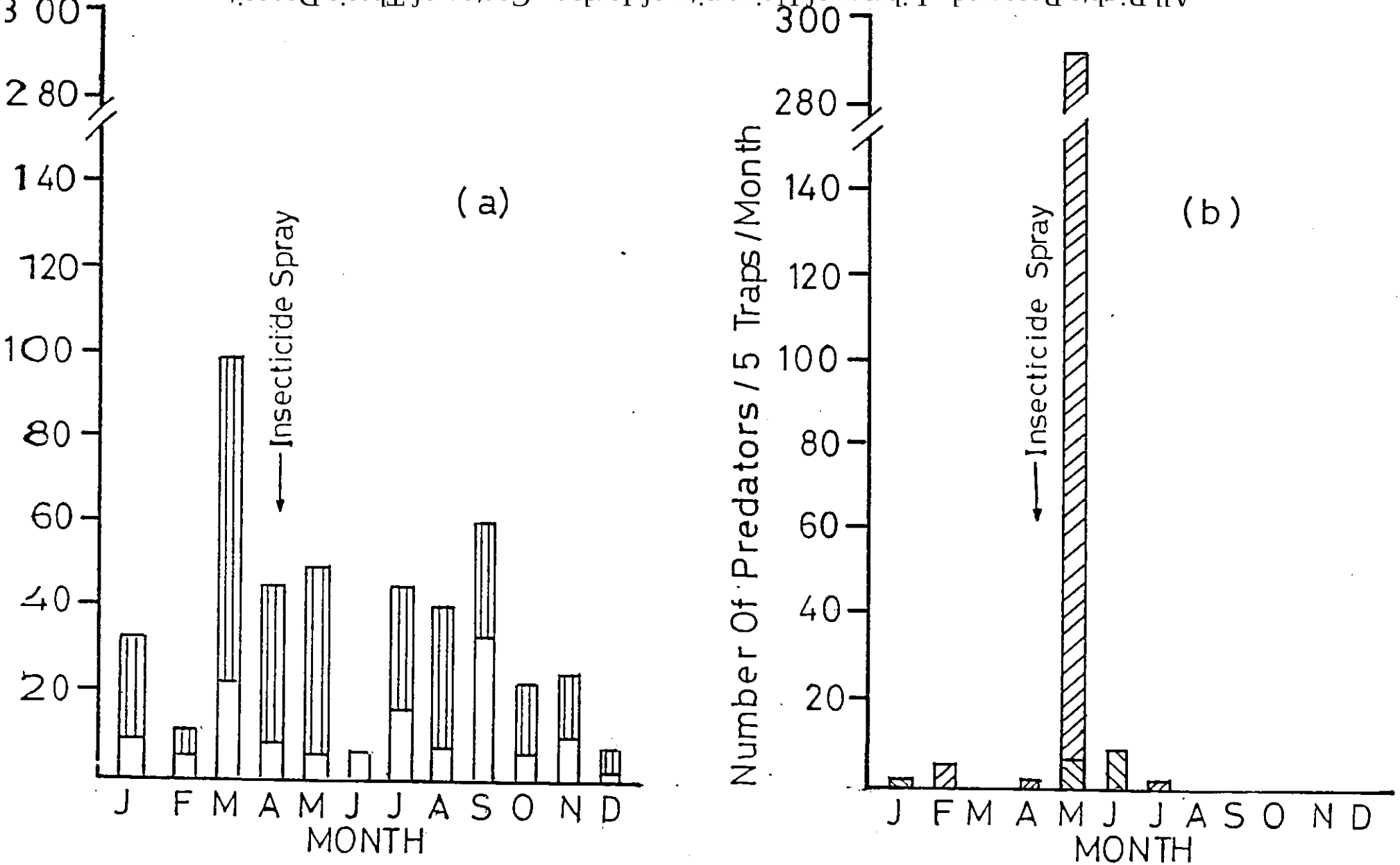

Fig. 16,ab: Total numbers of M. persicae □, B. amygdalinus ▥, C. septempunctata ▨, and Chrysopa sp. ▧, caught monthly in 5 water traps within pear trees in Om-Ela'amad orchard throughout 1985.

Table 5: Numbers of alate M. persicae caught monthly within deciduous trees using water traps during 1985.

Month	Number of aphids/trap/month ± SE*			
	Almond	Peach	Pear	Cherry
January	0.05a±0.05	0.10a±0.06	0.4a ±0.22	0.2a ±0.11
February	0.0a	0.2a ±0.1	0.26a±0.11	0.06a±0.06
March	1.0ab±0.39	1.93a±0.52	1.46a±0.4	0.4b ±0.23
April	0.26b±0.22	1.06a±0.26	0.53b±0.21	0.13b±0.09
May	0.3b ±0.14	0.95a±0.32	0.15b±0.08	0.4b ±0.08
June	0.06b±0.06	0.33a±0.15	0.0b	0.0b
July	0.2a ±0.11	0.7a ±0.3	0.8a ±0.3	0.15a±0.10
August	0.53a±0.25	0.73a±0.26	0.26a±0.21	0.33a±0.15
September	1.46a±0.26	1.73a±0.62	2.23a±0.33	1.13a±0.51
October	0.25a±0.17	0.35a±0.18	0.30a±0.14	0.85a±0.31
November	0.1a ±0.1	0.05a±0.05	0.5a ±0.23	0.55a±0.27
December	0.0b	0.0b	0.13a±0.09	0.0b

* Means within rows sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

f. Comparison of numbers of Brachycaudus amygdalinus caught within deciduous trees

Numbers of B. amygdalinus captured monthly within deciduous trees using the water traps in Om-Ela'amad orchard during all the months of 1985 are presented in Table 6.

Throughout all the months, there were no significant differences between means of B. amygdalinus captured within almond, peach, pear or cherry trees, except during the period from early April to end of May. The number of captured aphids within pears and cherries were significantly ($P \leq 0.05$) more than within almond and peachs. During December, the aphid was captured only within pear trees.

V.4 Flight Activity Of Aphid Predators Within Deciduous Trees

a. Within almond trees

Numbers of predators caught within almond trees by water traps are presented in Fig. 13,b. Coccinella septempunctata L. was captured within almond trees during February, May and July approaching an obvious peak in May with 113 adults in 5 traps (Fig. 13 b).

Seventeen adult Chrysopa were caught in June, 4 in July and 4 in August (Fig. 13 b).

Table 6: Numbers of alate B. amygdalinus caught monthly within Deciduous trees using water traps in 1985.

Month	Numbers of aphids/trap/month ±SE*			
	Almond	Peach	Pear	Cherry
January	0.6a ±0.28	0.2a ±0.13	1.15a±0.39	1.05a±0.38
February	0.33a±0.18	0.73a±0.31	0.4a ±0.16	0.4a ±0.16
March	4.93a±1.58	5.2a ±1.73	4.4a ±1.35	4.2a ±1.61
April	1.26b±0.68	0.93b±0.31	2.4a ±0.37	1.33b±0.32
May	1.2b ±0.32	1.2b ±0.22	2.25ab±6.0	3.6a ±0.68
June	0.46a±0.21	0.93a±0.3	0.4a ±0.19	0.66a±0.27
July	0.1a ±0.1	1.5a ±0.46	1.4a ±0.58	0.8a ±0.35
August	1.66a±0.32	2.06a±0.34	2.2a ±0.56	1.0a ±0.28
September	1.13a±0.41	2.13a±0.33	2.33a±0.33	1.53a±0.83
October	0.75a±0.28	1.25a±0.25	0.75a±0.29	2.15a±0.28
November	0.35a±0.21	0.7a ±0.23	0.75a±0.22	0.5a ±0.19
December	0.0a	0.0a	0.33a±0.33	0.0a

* Means within rows sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

b. Within cherry trees

Coccinella septempunctata L. were captured from February, through April, May and June. The maximum number caught was 179 coccinelled adults in May. Chrysopa sp. were captured during May, June, July and August. The peak was 26 Chrysopa adult in May (Fig. 14 b).

c. Within peach trees

Coccinella septempunctata L. were caught in February, May, June, July and August. The peak was 421 coccinelled adults in 5 traps in May (Fig. 15 b).

Chrysopa sp. were captured in the traps within peach trees during April, May, June, July and August, reaching a peak of 33 adults in May (Fig. 15 b).

d. Within pear trees

Coccinella septempunctata L. were captured during February, April, May and July, 286 adults were captured in 5 water traps in May.

Few numbers of Chrysopa sp. were captured in water traps within pear trees during January, May, and July (Fig. 16 b).

V.5 Comparison Between Sticky Traps And Water Traps In Monitoring Flight Activity Of Aphids

Numbers of aphids captured on sticky traps and by water

traps within peach trees in Om-Ela'mad during the period from early of March to late of April 1985, are presented in Table 7. Using paired t-test at 5% level showed that the numbers of aphids caught in water traps throughout most of the trapping was significantly more than that caught by sticky traps.

Table 7: Number of aphids caught by water traps and sticky traps within peach trees in Om-Ela'amad orchard.

Trapping period	Number of aphids/trap ± SE*		P value
	Water traps	Sticky traps	
10.3 - 19.3.85	24.2a ± 2.84	9.20b ± 2.73	0.05
20.3 - 11.4.85	3.20a ± 0.97	6.80a ± 1.15	N.S
1.4 - 18.4.85	9.10a ± 0.65	0.80b ± 0.37	0.001

* Means within rows sharing the same letters do not differ significantly using paired t-test.

SECTION VI: APHID INFESTATION IN RELATION TO LEAF AGE, LEAF SURFACE AREA AND MINERAL CONTENTS.

SECTION VI: APHID INFESTATION IN RELATION TO LEAF AGE, LEAF SURFACE AREA AND MINERAL CONTENTS.

VI.1 Myzus persicae Infestation In Relation To Leaf Area Of Different Pepper Cultivars.

Mean numbers of M. persicae found on different pepper cultivars in relation to their leaf area are presented in Table 8. Leaf areas of sweet cultivars collected on 5th June 1985, measured using the areameter were found to be more significantly ($P < 0.05$) than those of hot cultivars.

Mean numbers of M. persicae found on sweet pepper cultivars on the above date were higher than on hot pepper. The results showed that M. persicae infestation correlate at highly positive rate with the leaf area of the different pepper cultivars, having a correlation coefficient of + 0.92.

VI.2 Distribution Of Myzus persicae On Different Pepper Cultivars In Relation To Leaf Age And Plant Mineral Content.

Concentrations of various elements in old and young leaves of six pepper cultivars are presented in Table 9. M. persicae infestation was found mostly concentrated on the abaxial sides of the older leaves. Concentrations of nitrogen and phorphorous in the young leaves were significantly

Table 8: Myzus persicae infestation in relation to leaf area of different pepper cultivars on 5th June 1985(1).

Pepper-Type	Cultivar(3)	Leaf area(2) cm^2 ± SE	Number of aphids/(2) plant ± SE
Sweet	Melody	50.82a ± 4.69	0.72bc ± 0.28
	Piment Sweet	53.21a ± 3.5	1.48ab + 0.45
	Sharina	54.21a ± 0.43	0.72bc ± 0.27
	Shamrock	50.85a ± 0.46	2.13a ± 0.43
Hot	Deer's Horn	24.91b ± 0.39	0.4c ± 0.09
	Piment Hot	25.54b ± 0.38	0.33c ± 0.17

(1) M. persicae infestation from III.2.b

(2) Means within columns sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

(3) Correlation coefficient $r = 1 - \frac{6 \sum d^2}{n(n+1)(n-1)} + 0.92$

Table 9: Concentration of various elements in old (O) and young(Y) leaves of six pepper cultivars collected from the field on 25th June 1985.

Pepper Cultivar	N%		P(ppm)		K(ppm)		Zn(ppm)		Mn (ppm)		Fe (ppm)	
	O	Y	O	Y	O	Y	O	Y	O	Y	O	Y
Melody	3.66	4.23	1866.6	2266.6	96000	112000	40	8	52	84	60	60
Piment sweet	4.25	4.48	1666.6	2066.6	126000	88000	8	8	52	0.0	440	460
Sharina	3.80	4.06	1533.3	1866.6	136000	96000	40	8	0.0	0.0	552	460
Shamrock	3.97	4.28	1866.6	2066.6	132000	96000	8	8	0.0	0.0	372	460
Deer's horn	4.28	4.42	1666.6	1866.6	142000	88000	8	8	84	0.0	320	520
Piment hot	4.12	4.25	1666.6	2266.6	122000	96000	8	8	24	0.0	312	320
Mean*	4.01b	4.28a	1711.05b	2066.6a	125666.7a	96000b	18.67a	8.0a	35.33a	14a	342.7a	380a
± SE	± 0.10	± 0.06	± 53.51	± 73.03	± 6601.35	± 3577.7	± 6.75	± 0.0	± 13.6	± 14	± 67.2	± 69.5
P-value	0.05		0.05		0.05		NS		NS		NS	

* Means (of the same element) within rows sharing the same letters do not differ significantly using paired t-test.

($P \ll 0.05$) higher than in old leaves. Meanwhile concentration of potassium in the old leaves was significantly ($P \ll 0.05$) higher than in young leaves (Table 9). However, there were no significant differences between concentrations of Zn, Mn and Fe elements in old leaves and young leaves. Copper was not found in the analyzed leaves.

Correlation coefficient between M. persicae infestation and concentrations of different elements in old leaves (place of infestation) are presented in Table 10. Correlation coefficient between M. persicae infestation and nutrition contents was found to be positively perfect (+ 1.0) with potassium content, medium positive (+ 0.49) with protein percent, and (+ 0.6) with iron content, and low positive (+ 0.03) with Mn content.

However, correlation coefficient were found to be medium negative (- 0.4) with phosphorous content and low negative (- 0.014) with zink content (Table 10).

VI.3 Distribution Of Myzus persicae On Pepper Plant In Relation To Leaf Age and Leaf Area

Myzus persicae infestation was observed mostly on the abaxial side of older leaves at the beginning of the infestation than on the young ones. When the infestation increased, aphid movement towards the medium leaves then

Table 10: *Myzus persicae* infestation on different pepper cultivars in relation to nutrient contents of old (infested) leaves.

Type	Cultivar	Protein % (1)	Phosph. ppm	K ppm	Zn ppm	Fe ppm	Mn ppm	Accumulative aphid/plant (2)
Sweet	Melody	22.87	1866.6	96000	40	60	52	12.46
	Piment sweet	26.56	1666.6	126000	8	440	52	17.9
	Sharina	23.75	1533.3	136000	40	552	0.0	25.0
	Shamrock	24.81	1866.6	132000	8	372	0.0	24.38
Hot	Deer's horn	26.75	1666.6	142000	8	320	84	27.66
	Piment hot	25.75	1666.6	122000	8	312	24	16.96
	r (3)	+0.49	-0.49	+1.0	-0.014	0.6	0.03	

(1) Protein % = N% x 6.25 according to Hassan (1980).

(2) Accumulative means of aphids/plant up to 25th June 1985.

(3) r = Correlation coefficient between aphid infestation and nutrient content = $1 - \frac{6\sum d^2}{n(n+1)(n-1)}$.

to the young leaves.

At heavy infestation aphid population was found on different leaf ages. Infestation on medium leaves found to be significantly ($P < 0.05$) higher than on younger and older leaves. Meanwhile leaf area of older leave was significantly more than of medium leaves and young leaves (Table 11).

Correlation between M. persicae infestation and leaf area was found to be medium positive (+ 0.5).

Table 11: Myzus persicae infestation in relation to leaf age and leaf area.

Leaf Age	Leaf Area in cm^2/ leaf + SE(1)	Number of Aphid/ leaf ± SE(1)
Young	8.21c ± 0.69	239.1b ± 29.38
Middle	25.87b ± 0.38	471.4a ± 39.15
Old	32.86a ± 0.37	288b ± 32.05
r (2)	+ 0.5	

(1) Means within columns sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

(2) r = Correlation coefficient = $1 - \frac{6\sum d^2}{n(n-1)(n+1)}$

SECTION VII: APHID CONTROL

VII.1 Effect Of Certain Insecticides To Myzus persicae On Sweet Pepper.

Results of field evaluation of insecticides against the green peach aphids on sweet pepper are presented in Table 12.

The first application of the chemicals was done on May 20, 1985. Till that date no infestation was found. One week after the application of insecticides, all treatment were infested with Myzus persicae but at low levels without significant differences between them. Two weeks after the application, the infestation increased on the plants of all treatment, but mean number of aphids on treatments of Dimethoate, Disulfoton were significantly lower than the others (Table 12). Meanwhile all chemical treatments showed significantly less infestation than the nontreated check.

During the 3rd week, Dimethoate and Primicarb treatments showed the lowest infestation, Carbofuran, Disulfoton and Cypermethrin treatments were medium while the control exhibited highest infestation (Table 12). Five weeks after insecticide application, infestation on the plants that received Carbofuran, Dimethoate and Primicarb and the nontreated control plants were significantly lower than cypermethrin and Disulfoton treatments

Table 12: Field evaluation of insecticides against the green peach aphid on sweet pepper 'Shamrock' from May 20 to July 27, 1985 (Δ).

Treatment	Mean number of aphids/plant ± SE(*)								
	25.5	4.6	13.6	24.6	2.7	14.7	27.7		
Carbofuran	0.83a±0.38	1.2b	±0.46	1.76ab±0.8	4.10a	±0.8	3.6a	±1.75	20.73a ±7.81	14.66a±5.88
Disulfoton	0.4a ±0.18	0.2a	±0.12	2.13ab±1.35	21.26c±2.72		37.93b	±10.4	209.20ab±76.8	42.1a ±13.29
Cypermethrin	0.53a±0.34	1.03b	±0.34	2.33ab±0.36	13.7b	±2.5	70.5c	±12.93	697.7c ±123.8	1241.91b±111.07
Dimethoate	0.0a	0.3a	±0.09	0.7a	±0.21	6.13a±1.64	13.76ab±5.63		30.83a ±8.36	39,8a ±7.1
Primicarb	0.10a±0.09	0.73ab±0.21		0.63a ±0.21	2.73a±0.5		0.03a	±0.03	0.63a ±0.26	6.8a ±3.4
Check	0.8a ±0.38	2.33c	±0.21	3.86b ±0.49	7.53a±1.07		20.73ab±7.89		23.93a ±7.71	3.6a ±2.35

(*) Means within columns sharing the same letters do not differ significantly at 5% level using Duncan's multiple range test.

(Δ) Date of first application was: May 20, 1985
Date of second application was: June 27, 1985.

($P \ll 0.05$) (Table 12).

On June 27, 1985, when the lowest infested treatments was without significant differences than the control treatment, the 2nd application was applied.

One week after the second application, aphid population in Primicarb and Carbofuran treatments were significantly decreased as compared with the other treatments (Table 12). On the other hand, aphid population in the other treatments increased than before insecticidal application. Two weeks after the second application, the mean number of aphids on plants treated with Primicarb was the lowest, although it didn't differ significantly ($P \ll 0.05$) from the Dimethoate, Carbofuran and control treatments (Table 12). One month after the second application aphid infestation on Carbofuran, Disulfoton and Control treatment decreased. While infestation on Primicarb, Dimethoate and Cypermethrin treatments increased with different rates to have 1241.91 aphids/plant on Cypermethrin treatment which was the highest significantly than all other treatments ($P \ll 0.05$). While infestation on all other treatments including the control treatment were without significant differences (Table 12).

VII.2 Residues Of Some Insecticides In Pepper Fruits And Leaves.

Residues of 4 insecticides in plant fruits and leaves of pepper after 26 days of the last application are presented in Table 13. Carbofuran was not determined because the HPLC apparatus was not prepared for analysis in the laboratory.

The determined residues of the insecticides used were lower than the tolerance level. These residues in fruits were lower than in leaves even with granular insecticide (Disulfoton) but they didn't differ significantly.

VII.3 Occurrence Of The Natural Enemies

The occurrence of natural enemies of Myzus persicae on sweet pepper was recorded during the experiment using the sweeping net. The main available predators were Chrysopa sp. (Chrysopidae: Neuroptera), Coccinella septempunctata L. (Coccinellidae: Coleoptera). High numbers of Cylapus sp. (Miridae: Hemiptera) and few numbers of (Nabidae: Hemiptera) predators were observed from late of June to late of July 1985. The parasite Aphidius picipes Nees (Aphidiidae:Hyminoptera) was collected from caged parasitized Myzus persicae on sweet pepper taken from the field through Fall 1984. The parasite was identified by the British musium.

Table 13: Mean residues of 4 insecticides applied agianst Myzus persicae on pepper plants after 26 days of the last application.

Insecticide (1)	Formulation	Fruits (ppm)	Leaves (ppm)	Tolerance (2) (ppm)
Disulfoton	G	0.006 a	0.037 a	0.5
Primicarb	EC	0.095 a	0.19 a	1
Dimethoate	EC	0.003 a	0.039 a	1
Cypermethrin	EC	0.02 a	0.03 a	1

(1) Means within rows sharing the same letters do not differ significantly using paired t-test at 5% level.

(2) According to Shuraiqi et al. (?).

SECTION VIII: DISCUSSION AND CONCLUSIONS

The green peach aphid is a polyphagous pest attacking different sorts of green vegetation. In Palestine, Swirski (1954) reported Myzus persicae (Sulzer) infestation on citrus, quince, pear, apple, almond, apricot and plum, but strangely enough the green peach aphid (GPA) was not found to infest peaches in Palestine (Avidov & Harpaz, 1969). This aphid is a host-alternating species which overwinters in the egg stage on peach trees in North America (Annis et al., 1981) and in the temperate regions of every contenent (Blackman, 1974). In South Africa, spring infestation of peach trees was attributed to secondary colonization by overwintered parthenogenetic forms until Scholl & Diaber (1958) found sexual morphs in Pretoria. Moreover, Bodenheimer & Swirski (1957) in Palestine, found that M. persicae reproduces parthenogenetically throughout the year on weeds, vegetables and ornamental plants.

In this study Myzus persicae was found to infest seven vegetable crops and six pepper cultivars, but no infestation of Myzus persicae was observed on the examined deciduous trees. Qasem (1984 & 1985) studied the population dynamics and control of Myzus persicae on peach trees in Jubaiha in the Central high lands of Jordan. In the present study and from previous investigations (Mustafa, 1985, 1986a, 1986b), no

infestation of M. persicae was found on peach trees in Jordan. Nevertheless the short-tailed almond aphid, Brachycaudus amygdalinus (Schout.) was found infesting peach and almond trees in Om-Ela'amad and in Jubaiha in the Central high land of Jordan indicating that Qasem might misidentified B. amygdalinus as M. persicae.

Myzus persicae has infested sweet pepper, eggplant, tomato, lettuce and tobacco in fall 1984 and in spring 1985 in Al-Jieza field. During the Fall planting, sweet pepper was the most preferred host for initial infestation but lettuce was the most preferred host for reproduction throughout the season. However, during the spring planting, lettuce and sweet pepper were similarly the most preferable hosts throughout the entire season. The eggplant and tomato showed medium preferred , while cucumber and cauliflower were the least preferrable to M. persicae. However, cucumber was heavily infested with Aphis gossypii (Glover) (Aphididae: Homoptera) while cauliflower was heavily infested with Brevicoryne brassicae (L.) (Aphididae: Homoptera). In the Philippines, Valentine & Calilung (1980) reported M. persicae on Brassicas sp., cucurbitaceous, solanaceous crops, radish, citrus, lettuce and tobacco. On the other hand, tobacco , Nicotiana tabaccum L. cultivar 'Jordan-I' was found to be highly resistant to M.persicae colonization throughout this study.Elsey &

Chaplin (1978) suggested that nonglandular trichomes may contribute to the resistance in tobacco 'Introduction (I.1) 1112' to the green peach aphid, M. persicae. Thurston & Webster (1962) also found that resistance in Nicotiana spp. was attributed to a toxic material exuded from the leaf hairs which was found to be toxic to several aphid species.

Significant differences of M. persicae infestation to six pepper cultivars was found in the Fall season of 1984 and Spring season of 1985. During the Fall of 1984 'Sharina' was the most preferred cultivar for initial infestation. As infestation progressed, sweet pepper cultivars were more preferred than hot cultivars, but towards the end of the season, the highest infestation was found on the hot cultivar 'Deer's horn'. As an overall judgment throughout the season 'Sharina' was the most preferred cultivar, but 'Melody', 'Piment sweet' and 'Piment hot' were medium while 'Shamrock' and 'Deer's horn' were the least preferred cultivars. However, no resistance tendency was found within the pepper cultivars evaluated.

In the Spring of 1985, similar trend to that in Fall of 1984, was found considering infestation on sweet and hot types. However, all cultivars were highly infested with the aphid, indicating no significant evidence of resistance by any of the tested pepper cultivars. Sweet pepper cultivars were again more preferred to initial infestation while hot cultivars were

more suitable for colonization towards the end of the season. These results may be attributed to certain physiological status of the cultivars during the growing stages of the plants e.g. nutrient contents. In this study, leaf area differences found to be correlated with the initial infestation in Spring season of 1985. Correlation coefficient between leaf area and infestation with M. persicae on the tested pepper cultivars was found to be highly possitive (+0.92). The direction of the leaf growth may be one of the reasons for differences in initial infestation. Leaves of sweet pepper grow horizontally forming suitable place for shading while leaves of hot pepper cultivars grow upwards. Moreover, Calabrese & Edward (1976) found predominant occurrence of M. persicae on the abaxial leaf surface of raddish plants below the light source, was significantly influenced by light and gravity during daylight and by gravity during darkness.

However, towards the end of the Spring season, when the sweet pepper cultivars became heavily infested, infestation was redistributed evenly on both sweet and hot cultivars, probably due to high competition to find suitable host and space for colonization. Wearing (1972) considered that redistribution of the population of M. persicae and Brevicoryne brassicae was caused by changes in the physiology of the host plant and governed by nutritional factors. The results of leaf analysis

of the pepper cultivars, one month after initial infestation showed medium positive correlation between M. persicae infestation and protein contents of the leaves of the pepper cultivars (r=0.49) and with iron content (r=0.6) but low correlation was found with mangenese content. However, perfect correlation was with potassium content (+1.0). Negative correlation was found with phosphorous content and with zink content.

Aphid infestation has been correlated with leaf content by several workers (Dixon, 1966; Rahir, 1978). The present results are agreed with Rahir (1978) who found that high proportions of nitrogen was favourable for the development of aphid colonies and the selection of the plant by the alate M. persicae. It is obvious from the results of leaf analysis that young leaves in pepper contain greater contents of nitrogen than old leaves. On the other hand, M. persicae preferred older leaves under low density but it moved to medium leaves and then to the young leaves when aphid become crowded. Wearing (1972) suggested that M. persicae may particularly require the nitrogenous and carbohydrate products in protein hydrolysis associated with leaf senenscence. He also stated that M. persicae prefers the old leaves. Kennedy & Stroyan (1959) suggested that amino acids are synthesised in the young leaves and proteins are hydrolyzed in the old senescent leaves. It was found that M.persicae

was more characteristics of old leaves. The superiority of young or senescing tissues over mature leaves for aphid multiplication has been shown for M. persicae by Kennedy (1950). His findings supported what have been found here that at high infestation, medium leaves were the highly infested with M. persicae than mature leaves or young ones. However, with potassium content in relation to M. persicae infestation, there are contradictory suggestions. Some workers (Barker & Tauber, 1951; Taylor, 1960) found that aphid infestation showed positive correlation with high potassium content, while others (Broadbent, 1952; Rahir, 1978) found that M. persicae colonizes more with low potassium.

Deciduous trees, were free of the GPA infestation throughout the year. Also Avidov & Harpaz (1969) reported that peach trees were free of M. persicae in Palestine. Bodenheimer & Swerski (1957) found that M. persicae reproduces parthenogenetically throughout the year on weeds, vegetables and ornamental plants.

In this study, Brachycaudus amygdalinus was found on peach and almond trees in Om-Ela'amad and in Jubaiha orchards during the Spring season, but disappeared completely in May as a result of Dimethoate spray. However, Swirski, (1954) found the peak of B. amygdalinus on almond in Palestine in Spring but the population disappeared completely by early June. Moreover,

Mustafa (1985) recorded B. amygdalinus infesting Prunus spp. in Jordan throughout a period from beginning of April till the end of May.

From the available literature it appears that prior to this study, no work has been done in Jordan on seasonal occurrence of green peach aphid, neither on vegetables nor on deciduous trees. From this study, M. persicae infested vegetable hosts in the Central Highlands of Jordan and it has two main periods of infestation throughout the year.The first main period of infestation was during Fall 1984 from mid-August to mid-October with a peak in early September on sweet pepper and in late September on lettuce. The 2nd main period of infestation was during Spring 1985 from late May to Mid-July with a peak in early June on lettuce and in late June on sweet pepper and hot pepper . During Spring 1985, number of Myzus persicae population per plant was much higher than that during Fall 1984 as shown by accumulative aphid per plant on sweet pepper, lettuce and hot pepper.

Myzus persicae heavily infested all six pepper cultivars in the two seasons. It was clear that infestatiion on six cultivars during Spring 1985 was much higher than that during Fall 1984. Accumulative aphids per plant on sweet pepper cultivars showed that no cultivar escaped from. infestation. 'Melody' harboured the lowest infestation, followed by 'Piment

sweet', 'Shamrock' and then 'Sharina' of sweet cultivars during Spring 1985. This work showed that there were two peaks for the population of M. persicae on the different pepper cultivars. The first peak was approached in late August on 'Melody' and 'Sharina' and in early September on 'Piment sweet','Shamrock' 'Deer's horn' and 'Piment hot' in Fall season of 1984. The second peak was approached in late June on 'Melody', 'Piment sweet', 'Sharina' and 'Shamrock' and in early July on 'Piment hot' in Spring of 1985. In the same season the hot cultivar 'Deer's horn' showed the lowest infestation followed by 'Piment hot.

Concerning flight periods, there were two main flight periods of Myzus persicae within pepper plantings throughout a year during the study period. The first main flight occurred from early September to early November during fall 1984 with two peaks; one in end of September and the second was in late October. The second main flight period was from mid-March to late of May in 1985 with a peak in mid-May and it was much lower than of the Fall flight. Bodenheimer & Swirski (1957) in Palestine found that M. persicae occurred in small numbers of migrants in Spring but become common in August up to November. The recorded mean of temperature through the main flight period, were 15-20^{o} meanwhile recorded means of relative humidity were 50-60%.

Flight activity of the aphid might not have a governed relation with field infestation. Alate adults of M.persicae were captured within deciduous trees through almost all months of the

year even throughout it was not found infesting these deciduous trees.

Flight activity of M. persicae within deciduous trees showed that greater numbers were captured within peach trees than the other deciduous trees in the Spring, and since aphid infestation did not occur on peach throughout the year, it does seem that peach is a preferable temporary host.

The results obtained from the water traps revealed three main periods of flight activity of Brachycaudus amygdalinus in Om-Ela'amad orchard in the Central High Lands in Jordan; The first was in March, probably indicating movement of the aphid from wild plants. Mustafa (1986a) collected specimens on certain weeds e.g. knot grass in Jordan in October 1983. The second main flight occurred in May probably indicating movement of the aphid from deciduous trees to wild plants. The third main flight was in September eventhough B. amygdalinus infestation on almond and peach was found only during Spring, indicating that considerable proportions of the migrant aphid might returned to overwinter on these trees.

Data of the water traps showed that the main aphid predators, C. septempunctata L. (Coccinellidae: Coleoptera), and Chrysopa sp. (Chrysopidae: Neuroptera) were caught in the period from mid-February to late August in pepper planting in Al-Jieza field. The peak of predator activity recorded in

May 1985 was spontanuous to the peak of aphid flight in Spring but with low infestation in the field. However, other predators were caught in late July in the period when infestation decreased indicating that predators had a good role in regulation of the aphid population in Al-Jieza field. Moreover, the predators showed high activity in Om-Ela'amad orchard in May, June, July and August approaching their peak of activity in May within almond and peach trees indicating that they might have an important role in regulation of the aphids on the deciduous trees also.

Myzus persicae might often reproduce in Jordan parthenogenetically all over the year. In the Spring, Summer and Fall it occurs on vegetables in the Central High Lands. In the winter it also occurs on vegetables in the Jordan Valley (Mustafa, 1986). However, Talhouk (1969) stated that in regions where winter temperature falls below freezing, such as Beqa'a and the mountain region of eastern mediteranian countries, fertilized winter eggs are laid on almond, peach, cherry or plum trees to overwinter and hatch in Spring when the buds of the primary hosts start to open. In the USA also, Davis & Landis (1951) reported that the green peach aphid overwinters in the egg stage on several species of Prunus including peach.

In comparison between traps for monitoring the aphid flight activity, sticky traps were not as efficient as the water traps for dusty winds in the area of the experiment reduced the sticky trap efficiency.

The insecticide Primicarb proved to be the most selective and effective aphicide through this study. It maintains the M. persicae population on sweet pepper lower than any other insecticide treatment and even when it lost its residual toxicity by time passing, predators were available to regulate the aphid population to be similar to the check plots. Binns (1971) found that Primicarb offered practical control of Aphis gossypii Glover. (Aphididae) on cucumber. In addition, Lecron & Smilowitz (1980) reported that Primicarb was less toxic to the natural enemies and more toxic to aphids. These findings support the results of this study in which the Carbofuran granular application and Primicarb foliar application kept aphid population below the check plots all most the time. At the end of July, a decrease of aphid populations occurred in the check plot and in the granular insecticides plots as a result of natural enemies role, while increase of aphid population occurs in the other plots treated by other insecticides. Moreover, an outbreak of the population occurred on Cypermethrin treatment having 1241 aphids/plant on 27th July, while only 3.6 aphids/plant on check plots. These results lead

us to conclude that Carbofuran and Primicarb proved to be practical insecticides against green peach aphid.

However, Carbofuran as soil systemic insecticide gave good results against M. persicae but the period between applications should be narrower to maintain enough toxicity in the plant sap. This soil systemic insecticide might be effective for reducing the spread of M. persicae infestation on pepper plants and other vegetables. However, more investigation on this point particularly in Jordan is needed.

The action of the soil systemic insecticides as selective aphicides could be used in integrated pest management programme in which the insecticides are directed only to insects that feed on plant sap and therefore has little effect on beneficial insects in the field. However, as a result of this study, some systemic insecticides could be applied as granular side-dressing for more than two times in the field before one month of harvesting. Residues of Primicarb, Disulfoton granular, Dimethoate and Cypermethrin applied 25 days before sampling were found to be lower than the tollerence level (Shuriqi et al. ?) under the experimental conditions.

The collected predators on sweet pepper plants during control experiment were C. septempunctata L., Chrysopa sp., Cylapus sp. and few numbers of predators from Nabidae family, Only one parasite was collected Aphidius picipes Nees

SUMMARY

In this work population densities of the green peach aphid, Myzus persicae (Sulzer) (Aphididae: Homoptera) on seven vegetable hosts namely: sweet pepper 'Sharina' , lettuce 'Paris island' eggplant, 'Veserba' Tobacco 'Jordan-I', tomato 'Star', cucumber 'Beit alfa', and cauliflower 'High Light', were studied throughout the Fall season of 1984 and the Spring season of 1985 in Al-Jieza field, 40 Km south of Amman. Cultivar preferences of the aphid on six pepper cultivars, namely: 'Melody', 'Piments sweet', 'Sharina', 'Shamrock', 'Deer's horn' and 'Piment hot' were also investigated. Population of Myzus persicae and Brachycaudus amygdalinus (Shout.) (Aphididae: Homoptera) were also studied on deciduous trees in an orchard in Om-Ela'amad area, 30 Km south of Amman. Flight activity of Myzus persicae , Brachycaudus amygdalinus, and available predators were monitored. Correlations were studied between M. persicae infestation and leaf age, leaf surface area and nutrional contents on six pepper cultivars. Moreover, chemical control to M. persicae on sweet pepper 'Shamrock' using three foliar insecticides and two granular systemic insecticides were evaluated during the spring season of 1985 in Al-Jieza field.

The results have shown that sweet pepper and lettuce were

highly infested with M. persicae throughout the two seasons. Eggplant and tomato were medium while cucumber and cauliflower were the lowest. The tobacco, however, showed high resistance to M. persicae colonization. Infestation of M. persicae during the spring season of 1985 was much higher than that of the fall season of 1984.

All tested pepper cultivars were highly infested within M. persicae in the two seasons but with different means . The sweet cultivars were more susceptible to initial infestation but as the season progressed the hot cultivars showed a higher level of infestation. Contradictory results were found within the sweet cultivars in both seasons, Sharina cultivar was the most preferrable for initial infestation in the Fall of 1984 while Shamrock was the most preferrable in the Spring of 1985.

During spring 1985, percentage of infested plants reached 100% in lettuce, 82% in sweet pepper, 72% in hot pepper, and 30% in eggplant. However, percentage of infested plants within sweet pepper cultivars reached 76% in 'Melody', 88% in 'Shamrock', 82% in 'Sharina' and 74% in 'Piment sweet'. Moreover percentage of infested plants within hot pepper cultivars reached 72% in 'Deer's horn' and 74% in 'Piment hot'.

Correlation between M. persicae infestation on six pepper cultivars and certain plant status showed that in the initial

stage of infestation, most sweet pepper cultivars were significantly infested more than hot cultivars. In such stage, the leaf area of sweet pepper plants was larger than that of hot pepper. The correlation coefficient between infestation and leaf area at initial infestation was highly positive (+0.92), but when the infestation progressed, an interaction between leaf area and nutrientional contents of leaves might caused redistribution of aphid population among the six cultivars. Although correaltion coefficient between leaf araa and infestation decreased to +0.5, the correlation coefficients between infestation and nutrient content of the leaves were +0.49 with protein, +1.0 with K, +0.6 with Fe, +0.03 with Mn, -0.4 with P and -0.014 with Zn. Even protein content of old leaves was lower than that in young leaves, infestation was always initiated on older leaves.

Two peaks of M. persicae infestations were found on vegetable hosts throughout the year. The first was in early September 1984 and the second was in mid-June 1985.

Flight activity of M. persicae within vegetables in Al-Jieza showed two main flight periods. The first was between early September and late October of 1984 and from mid-August to early November of 1985, with two peaks in late September and late October. The 2nd main flight period was between mid-March and late May showing an obvious peak in mid May. The flight

period in Fall of 1985 was lower than that of Fall of 1984.

Tested deciduous trees were found to be free of M. persicae infestation throughout the year. But almond and peach trees were highly infested with Brachycaudus amygdalinus (Shout.) (Aphididae: Homoptera) during Spring from late March to early May. The almond tree, were found to be more preferrable to B. amygdalinus than peaches.

Within deciduous trees alate B. amygdalinus was recorded through all months of the year with 4 peaks: in late March within almond, cherry, peach and pear trees; in mid-May within cherry and pear trees, in early September within almond and peach trees and in mid-October within cherry and peach trees in Om-Ela'amad orchard in the Central Highlands of Jordan.

The occurring aphid predators were captured mainly in May 1985 in water traps. They included primarily Coccinella septempunctata L. (Coccinellidae: Coleoptera) Chrysopa sp . (Chrysopidae: Neuroptera).

In the deciduous orchard, two main flight periods of M. persicae were recorded during 1985. The first main flight period was between early March and late May with a peak in mid-March, and the second main flight period was between mid-June and late November with a peak in mid-September.

Water traps were more practical and efficient than sticky traps. That was due to dusty winds that covered the sticky sheets with dust particles from March through May, 1985 in Om-Ela'amad area.

Chemical treatment for controlling of M. persicae showed that soil application of granular insecticide Carbofuran reduced the aphid population below the check plots without affecting the prevailing predators. However, Primicarb gave good results also, in controlling M. persicae infestation on sweet pepper. Cypermethrin gave unsatisfactory results allowed outbreak of the population after 3 weeks of the second application.

Residues of the used insecticides in fruits and leaves of pepper plants sampled 25 days after the last applications were found to be much lower than the tollerance level.

During the control experiments, several species of predators were collected. They included mainly C. septempunctata L., Chrysopa sp., Cylapus sp. (Miridae: Hemiptera) and few numbers of predator from Nabidae family. The Cylapus sp. was observed to be an active predatiuous on M. persicae on sweet pepper plants. The parasite collected from caged parasitized M. persicae was Aphidius picipes Nees. (Aphidiidae:Hymenoptera).

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Appendix 1: Mean numbers of green peach aphid on different vegetables during Fall 1984.

Crop	Mean number of aphids/plant				
	4.9.84	14.9.84	24.9.84	2.10.84	Accumulative
Sweet pepper	4.10	2.05	0.30	0.25	6.7
Eggplant	0.15	0.0	0.0	0.0	0.15
Tomato	0.15	0.0	0.0	0.0	0.15
Lettuce	0.25	0.0	0.95	0.75	1.95
Tobacco	0.55	0.0	0.0	0.0	0.55
Cucumber	0.0	0.0	0.0	0.0	0.0
Cauliflower	0.0	0.0	0.0	0.0	0.0

Appendix 2: Mean numbers of green peach aphid on different vegetables during Spring 1985.

Crop	Mean number of aphids/plant				
	30.5.85	9.6.85	21.6.85	3.7.85	Accumulative
Sweet pepper	1.58	4.33	8.05	2.92	17.88
Eggplant	0.5	1.02	0.7	0.0	2.22
Tomato	0.5	0.48	0.0	0.0	1.13
Lettuce	10.42	20.03	8.4	0.0	38.85
Tobacco	0.33	0.0	0.0	0.0	0.33
Cucumber	0.03	0.01	0.0	0.0	0.03
Cauliflower	0.13	0.08	0.03	0.0	0.18

Appendix 3: Mean numbers of green peach aphid on six pepper cultivars during Fall 1984.

Pepper cultivar	Mean number of aphids/plant						Accumulative
	23.8.84	2.9.84	12.9.84	22.9.84	30.9.84	7.10.84	
Melody	5.53	3.80	2.93	0.34	0.15	0.15	12.93
Piment sweet	1.18	5.60	0.25	0.0	0.09	0.18	7.28
Sharina	8.62	4.6	1.43	0.0	0.0	0.37	15.03
Shamrock	0.87	5.4	0.03	0.0	0.19	0.09	6.62
Deer's horn	1.93	2.4	1.4	0.0	0.74	0.28	6.78
Piment Hot	2.09	6.41	0.15	0.0	0.0	0.15	8.81

Appendix 4: Mean numbers of green peach aphid on six pepper cultivars during Spring 1985.

Pepper cultivar	Mean number of aphids/plant						Accumulative
	26.5.85	5.6.85	16.6.85	28.6.85	9.7.85	20.7.85	
Melody	0.33	0.72	2.32	8.47	4.18	0.60	16.6
Piment sweet	0.15	1.47	6.58	8.65	4.47	0.22	21.53
Sharina	0.35	0.72	7.4	14.2	9.43	0.45	32.55
Shamrock	1.43	2.13	8.27	9.2	4.08	1.12	26.23
Deer's horn	0.0	0.4	6.43	16.52	7.76	0.25	31.36
Piment hot	0.13	0.33	3.05	12.17	20.8	0.07	36.55

ملخص باللغة العربية

دراسات حقليه على تعداد ومكافحة من الدراق الاخضر

Myzus Persicae (Sulzer) (Homoptera :Aphididae)

اجريت دراسات حقليه على العوامل المؤثرة على تعداد من الدراق الاخضر على سبعة محاصيل حقليه مختلفة وهي : الفلفل الحلو ، الخس ، الباذنجان ، التبغ ، البندورة ، الخيار ، والزهرة خلال موسم خريف عام ١٩٨٤ وموسم الربيع لعام ١٩٨٥ ، في منطقة الجيزة الواقعة على بعد ٤٠كغم جنوب عمان ، كما اجريت دراسة على تعداد هذا المن على سته اصناف من الفلفل ، اربعه منها من اصناف الفلفل الحلو وهي شارينا ، بيمنت حلو ، شمروخ ، وميلودى ، وصنفان من الفلفل الحار هي قرن الغزال وبيمنت حار .

بالاضافة الى ذلك أجريت دراسة لمراقبة وجود وتعداد من الدراق الاخضر ومن اللوز قصير الذيل في حقل للاشجار متساقطة الاوراق يحتوى على لوز ، كثمرى ، كرز ودراق في منطقة ام العمد الواقعه على بعد ٣٠كغم جنوب عمان.

كما أجريت دراسة لمعرفه نشاط وحركه من الدراق الاخضر بالاضافة الى مفترسات المن في منطقة الجيزة باستعمال مصائد مائيه صفراء وضعت بين نباتات الفلفل الحلو . وكذلك اجريت دراسه لمراقبه حركه ونشاط من الدراق الاخضر ومن اللوز قصير الذنب بالاضافة الى دراسه مفترسات المن في منطقه ام العمد بين اشجار كل من اللوز والكرز والكمثرى والدراق باستعمال مصائد مائيه صفراء وضعت بين هذه الاشجار ومصائد لاصقه وضعت بين اشجار الدراق ، ذلك خلال عام ١٩٨٥.

وقد اجريت دراسة لايجاد معاملات ارتباط بين تعداد المن على اصناف الفلفل المستعمله وعده عوامل من حاله النبات الفسيولوجيه والمورفولوجيه منها عمر ومساحه ورقه النبات وتركيز العناصر الغذائية في الاوراق من مختلف الاعمار لمختلف الاصناف. ومن هذه العناصر والتي اجرى تحليل كيميائي في تحديد تركيزها كل من النيتروجين والفسفور والبوتاسيوم بالاضافة الى الحديد والزنك والنحاس والمنغنيز .

كما أجريت دراسه لمكافحه من الدراق الاخضر في حقل فلفل حلو صنف شمروخ في منطقة الجيزة خلال ربيع عام ١٩٨٥ باستعمال خمسه مبيدات حشرية . اثنان منها محببه هي الفورودان ٥٪ والسلفركس ٥٪ اضيفتا حول الاشتال في التربه اما المبيدات الاخرى فقد كانت سمبش ١٠٪ ، بريمو ٤٠٪ وبريمور ٥٠٪ وقد استعملت رشا ثم تم تقدير متبقيات هذه المبيدات بعد ٢٥ يوم من آخر معامله.

ومن هذه الدراسات السابقه الذكر تبين ان محصولي الفلفل والخس هما اكثر المحاصيل ملائمه لاصابه من الدراق الاخضر حيث وجدت عليها الاصابه وبكثافه عاليه خلال الموسمين المذكورين سابقا . كما وجد ان الباذنجان والهندوره من المحاصيل متوسطه الملائمه للاصابه ، اما الخيار والزهره من المحاصيل نادره الاصابه. علما بان التبغ اظهر مقاومه عاليه جدا لتكاثر المن على نباتاته خلال الموسمين. هذا وقد وجد ان تعداد المن على النباتات خلال موسم الربيع لعام ١٩٨٥ اعلى وبنسبه كبيره من موسم الخريف لعام ١٩٨٤.

لقد اصيبت جميع اصناف الفلفل المستعمله في البحث بمن الدراق الاخضر وبكثافه عاليه. خلال الموسمين مع ملاحظه بعض التباين بين هذه الاصناف من حيث بدايه الاصابه وكثافتها خلال الموسم ، فقد وجد ان اصناف الفلفل الحلو كانت اكثر ملائمه لبدايه الاصابه بينما كانت اصناف الفلفل الحار اكثر ملائمه لتكاثر المن في نهايه الموسم.

لقد وصلت نسبه النباتات المصابه بمن الدراق الاخضر خلال ربيع ١٩٨٥ في المحاصيل المدروسه كما يلي الخس ١٠٠٪ ، الفلفل الحلو ٨٢٪ ، الفلفل الحار ٧٢٪ ، الباذنجان ٣٠٪ ، بينما بلغت نسبه النباتات المصابه في اصناف الفلفل خلال نفس الموسم كما يلي: شمروخ ٨٨٪، شارينا ٨٢٪ ، بينمت حلو ٧٤٪ ، قرن الغزال ٧٢٪ ، سيلودي ٧٠٦٪ .

عند محاوله ايجاد العلاقه بين اصابه المن مع الحاله الفسيولوجيه للنباتات وجد انه في بدايه الاصابه كان تعداد المن يتناسب طرديا مع مساحه الاوراق لأصناف الفلفل المختلفه بمعامل ارتباط مقداره ٩٢٪ ، ولكن عند تقدم الاصابه وجد ان معامل الارتباط قد انخفض الى ٥٠ر٠ وبالنسبه للعلاقه بين الاصابه وتركيز العناصر الغذائيه في الاوراق. فقد وجد ان مقدار المن يتناسب طرديا ويشكل مثالي مع تركيز البوتاس بمعامل ارتباط مقداره ١ر٠ ومع النيتروجين بمعامل مقداره ٤٩ر٠ ومع تركيز الحديد بمعامل مقادره ٦ر٠ ومع المغنيز بمعامل مقداره ٣ر٠ ، بينما وجد ان الاصابه تتناسب عكسيا مع كل من الفسفور بمعامل مقداره ٤ر٠ ومع الزنك بمعامل مقداره ١٤ر٠ بينما وجد ان أوراق الفلفل لا تحتوى على عنصر النحاس. مع ان نسبه النيتروجين في الاوراق الحديثه كانت اعلي منها في الاوراق القديمه الا ان الاصابه كانت تتركز على الاوراق الاقدم عمرا.

من نتائج دراسه نشاط وطيران من الدراق الاخضر بين نباتات الفلفل وجد ان هناك فترتين رئيسيتين لنشاطه ، الاولى بين بدايه ايلول وحتى نهايه تشرين ثاني مع وجود موعدين لقمه نشاطه خلال هذه الفتره وهما نهايه ايلول ونهايه تشرين اول . اما الفتره الرئيسية الثانية فكانت من منتصف آذار وحتى نهايه ايار مع وجود قمه واضحه للطيران خلال منتصف ايار وملاحظه ان طيران هذه الحشرة خلال الخريف كان اكثر منه خلال الربيع.

لقد وجد ان اشجار اللوز والدراق والكمثرى والكرز كانت خاليه من الاصابه بمن الدراق الاخضر خلال عام ١٩٨٥ بينما وجد ان اللوز والدراق اصيبا بمن اللوز قصير الذنب خلال ربيع عام ١٩٨٥ في المدة من اوآخر آذار حتى بدايه ايار مع ملاحظه ان الاصابه على اللوز كانت اعلى منها على الدراق.

اما فيام العمد فقد وجد انه هناك فترتين رئيسيتين ايضا لطيران من الدراق الاخضر بين الاشجار متساقطه الاوراق خلال عام ١٩٨٥ ، كانت الفتره الاولى من بدايه آذار حتى نهايه ايار مع قمه في النشاط في منتصف آذار . اما الفتره الرئيسيه الثانيه فكانت من منتصف حزيران حتى نهايه تشرين ثاني مع قمه النشاط خلال منتصف ايلول. وقد وجد ان كل من حشره ابو العيد المفترسه وحشره اسد المن المفترسه قد سجلا قمه نشاطهما خلال شهر يار .

لقد وجد ان حشره من اللوز قصير الذنب قد جمعت خلال جميع اشهر السنه مع وجود اربع فترات لزياره نشاطه هي نهاية آذار ومنتصف ايار وبدايه ايلول ومنتصف تشرين اول في منطقة ام العمد .

وقد وجد ان معظم المفترسات التي صيدت في المصائد المائيه في الجيزه هي حشره ابو العيد واسد المن.

بالنسبه لمكافحه حشره من الدراق الاخضر كيمياويا وجد ان المحببات وبالاخص الفوردان تعطى نتائج ايجابيه وعمليه حيث تحافظ على تعداد الاصابه اقل مستوى من المعاملات الاخرى مع ملاحظه انتشار المفترسات بنشاط في المعاملات المستعمل فيها العلاجات المحبيبه وبشكل واضح ادى الى تخفيض الاصابه في نهايه شهر تموز بينما لوحظ ارتفاع في تعداد الاصابه بصوره متميزه على المعاملات المستعمل لها مبيدات حشريه رشا باستثناء البريمور الذى اظهر سميه عاليه للمن ومنخفضه للمفترسات ، كما وجد ان نسبه المتبقيات من المبيدات المستعمله بعد ٢٥ يوم من آخر معامله كانت اقل وبشكل كبير من المستوى المسموح به عالميا حتى في للمعاملات المحبيبه.

وباستعمال الشبكه الكانسه امكن جمع عينات من المفترسات الموجوده في الحقل وامكن تصنيفها وكان من المفترسات في منطقه الجيزه كل من Cylapus sp., Chrysopa sp., Coccinella septempunctata L. بالاضافه الى وجود حشره متطفله على المن وهي Aphidius picipes Nees والتي تم تصنيفها من قبل المتحف البريطاني في لندن.