# Morphological, Biological and Ecological Studies of the Mycophagous Ladybird *Psyllobora vigintiduopunctata* L. (Coleoptera: Coccinellidae) on Powdery Mildew Fungi in the Coastal Region of Syria

***Ghydaa Hasan Younes*** [1] ✉, ***Mohammad Ahmad*** [2], ***Nawal Ali*** [3]

## ABSTRACT

The coccinellid tribe Psylloborini is comprised of obligate consumers of powdery mildew fungi (Ascomycota: Erysiphales). The 22-spotted ladybird, *Psyllobora vigintiduopunctata* L. (Coleoptera: Coccinellidae) has been considered as one of the most important powdery mildew consumers in the coastal region of Syria. Adults and larvae of this native species were active from early April until the end of November on powdery mildew infected plants in this region. The biology of *P. vigintiduopunctata* fed on many powdery mildew species was observed under constant environmental conditions [temperature: 25±2ºC, relative humidity: 70±5%, and photoperiod: 12: 12 (L: D) h]. Mean dimensions of the first instar larvae measured 1.99×0.65 mm and weighted 0.25±0.08 mg, increased to 5.51×1.78 mm in its size, and weighted 5.91±0.81 mg in the forth instar. The developmental period of the immature stages from egg to adult was 21.97±1.89 days when reared on *Phyllacctinia guttata* (Wallr.: Fr.) Lev/. on black mulberry (*Morus nigra* L.) leaves, and the mean fecundity was reached to 109.44±77.61 eggs/female. The average leaf surface area of *M. nigra* infected by *P. guttata* from which the larvae of *P. vigintiduopunctata* removed visible powdery mildew hyphae through consumption during the entire larval stage was 28.08±5.94 cm²/leaf, and decreased to 16.43±2.98 cm²/leaf when the larvae fed on *Uncinula necator* (Schw.) Burr. on Grape (*Vitis vinifera* L.). These observations indicated that *P. vigintiduopunctata* may be considered as a good biological control candidate against many powdery mildew fungi.

**Keywords**: *Psyllobora vigintiduopunctata*, powdery mildew fungi, predator, biological control, Syrian Coast.

## INTRODUCTION

The powdery mildews (Erysiphales), all obligate biotrophs, form one of the most important and widespread groups of plant-pathogenic fungi found worldwide. These fungi infect native plants, and important agricultural crops such as vegetables, fruit trees, and ornamentals, causing economic damage (Braun, 1995). In addition to host plants, these fungi are ecologically associated with other organisms including mycophagous insects as consumers. All members of the beetle tribe, Psylloborini Casey. (Coleoptera: Coccinellidae) are obligate consumers of powdery mildew fungi during both larval and adult stages (Klausnitzer and Klausnitzer, 1986), feeding on many genera of powdery mildews on many different host plants. Among the genera of this tribe, the genus Psyllobora Chevrolat, constitutes several species that are obligate feeders on all life stages of powdery mildews

[1] Environment directorate, Lattakia, Ministry of state for Environmental Affairs, Lattakia, Syria.
✉alaaagh4@yahoo.com
[2] Pro. Department of Plant Protection, Faculty of Agriculture, Tishreen University, Syria .
[3] Pro. Department of Botany , Faculty of Science , Tishreen University , Lattakia , Syria
Received on 7/4/2014 and Accepted for Publication on 24/7/2014.

(Ahmad et al., 2003; Sutherland, 2009). Iablokoff-Khnzorian (1982) observed *Psyllobora vigintiduopunctata* L., *Vibidia duodecimguttata* (Poda), and *Halyzia sedecimguttata* (L.), respectively, all to have mycophagous habits involving powdery mildew fungi. Cividanes et al. (2007) described the biological aspects of *Psyllobora confluens* fed with *Erysiphe cichoracearum* DC., powdery mildew on okra leaves, showed high standard of survival and reproduction during the life cycle. The host range (plants and powdery mildews), population dynamics, distribution of Psyllobora (Ahmad et al., 2003; Sutherland, 2005; Younes, 2009), may suggest their importance in ecological balance and biological control of the powdery mildews.

The seasonal occurrence of the species *P. vigintiduopunctata* is thought to be synchronized with the abundance of essential fungi (Younes, 2004), and the author recorded the beetle feeding on 24 powdery mildew species. Two species within Psylloborini Casey were recorded as feeding on powdery mildew fungi infecting native plants and agricultural crops at different sites in the coastal regions of Syria *P. vigintiduopunctata* and *P. bisoctonotata* Mul. (Coleoptera: Coccinellidae), and little is known about the biology and ecology of these two species in the coastal region of Syria (Younes, 2004). These predatory insects have been suggested for use as native bio-agents of powdery mildew (Cruz et al., 1989; Dharpur et al., 1990; Ratti, 1996; Almeida and Milleo, 1998; Soylu and Yigit, 2002; Krishnakumar and Maheswari, 2004; Sutherland, 2009).

The overall objectives of this work were to observe and document the biology and natural occurrence of *P. vigintiduopunctata* in relation to powdery mildew-infected host plants, and to quantify the average amount of leaf area visibly cleaned of powdery mildew hyphae and conidia by the average *P. vigintiduopunctata* during its larval development and longevity of adults.

## 2. MATERIALS AND METHODS

### 2.1. Ecological studies

Plant species infected by powdery mildew naturally were chosen in this study. The plants were *Helianthus annuus* L. infected with *Erysiphe cichoracearum*, *Cucurbita pepo* L. infected with *Sphaerotheca fuliginea*, *Hibiscus esculentus* L. infected with *Sphaerotheca fuliginea*, and *Morus nigra* L. infected with *Phyllactinia guttata*. The powdery mildew species infecting each plant was determined according to Braun (1995) using asexual and sexual stages of powdery mildew. For regular observation, density changes of *P. vigintiduopunctata*, intensity of insect population (eggs, adults, larvae/ leaf) were visually recorded in the field. The relationship between population dynamics of *P. vigintiduopunctata* and host plant were determined.

### 2.2. Biological Studies

The experiments were carried out at a temperature of 25±2ºC, RH of 70±5% and a photoperiod of 12: 12 (L: D) h. Adults of *P. vigintiduopunctata* were obtained from black mulberry, *M. nigra* leaves infected with *P. guttata* powdery mildew from wild fields of Syrian Coast. The adults were arranged into pairs (male, female), each pair was kept in a Petri dish and provided with *M. nigra* leaves infected with *P. guttata* to determine the total development period (the duration of the immature stages from egg until adult emergence), the fecundity (the numbers of eggs/female deposited) and longevity (the period from adult emergence until death).

For determining the developmental duration of eggs, the laid eggs by females were daily removed and transferred by a fine hair brush to Petri dishes and incubated under the conditions mentioned above. Eggs were observed and checked daily until hatching.

Newly emerged larvae (<24-h-old, n=25) were transferred singly into Petri dishes and feeding on *P.*

*guttata* infected *M. nigra* leaves, each larva was provided with an infected leaf daily. These larvae were allowed to develop until pupation. Time required for development and daily survival were recorded. For the pupal stage, a piece of blotting paper was placed in each Petri dish to maintain adequate humidity and observed daily until the adult emerged. The prominent morphological characteristics regarding external shapes and colours of the different stages were closely observed and described. Insect life stages and instars were measured with a binocular microscope, and weighted with a sensitive scale (sensitivity 1\1000).

The fecundity and longevity of *P. vigintiduopunctata* were studied using plant leaves infected with powdery mildew (leaves of *M. nigra* infected with *P. guttata* and *H. esculentus* infected with *S. fuliginea*). The insects were daily provided with plant leaves, and when oviposition had started the eggs were monitored until the death of adults.

**2.3. Feeding Efficiency**

The ladybird beetles were reared and observed for their feeding behavior, and estimated daily feeding capacity ($cm^2$) through daily observations. Leaves were cut with a scalpel to circular pieces. These leaf discs were placed on filter paper in Petri dishes (9 cm in diameter). The $1^{st}$ instar larvae were individually transferred with a fine paintbrush to the dishes. All dishes were returned to the incubator in a randomized fashion. The total area consumed by the insect was recorded in each stage (larval and adult stages). The leaf area cleaned by *P. vigintiduopunctata* was quantified using an ocular micrometer.

Data were subjected to analysis of variance (ANOVA) (SAS program) and means were compared according to Duncan's Multiple Range Test (DMRT) at 0.05 level of probability (Sutherland, 2009). The consumed area by the ladybird was calculated according to Soylu and Yigit (2002) and Sutherland (2005). To have a good comparison the leaves used in the previous study were severely infected with powdery mildew (Sutherland, 2005).

**3. RESULTS**

**3.1. Morphology of *Psyllobora vigintiduopunctata***

*Eggs*: The eggs were observed to be laid in batches on the lower surface of the leaves and rarely on the upper surface with a mean of 6±2.05 eggs (2-16 eggs). Freshly laid eggs are elongate, oval, white yellowish-color, and firmly glued to each other, the eggs measured 1.04x0.41 mm (Length x Width) with hatching percentage of 100%. The eggs became blackish gray in color before hatching (Plate 1A). In the laboratory, the females laid eggs on the lower surface of plant leaves, or on the walls of dishes.

*Larvae*: Flat and spear form. The first instar is grey at hatching, with grey dots and hairs on the whole body and yellowish with black dots at the end of this instar. Larvae measured 1.99×0.65 mm and weighted 0.25±0.08 mg on average. This instar was poor in feeding (Plate 1B). The second instar is yellow with black dots and hairs on the whole body and larvae were more elongate flattened and measured 2.62×0.65mm, and weighted 0.82±0.12 mg on average (Plate 1C). Third instar: The larvae continued their growth through the third instars, their color became much darker, and measured between 3.91×1.2 mm, average weight of $3^{rd}$ larval stage was 2.59±0.31 mg (Plate ID).

Forth instar: the third instar molted into the fourth instar, which was almost similar to the third one, but with 5.51×1.78 mm in size, and weighed 5.91 ± 0.81 mg on average (Plate IE). *Pupa*: At the end of the forth instar (*Prepupa* (Plate IF) the larvae molted into pupae which fully encapsulated with larvae skin, which were yellow with dark spots over all the body, hemispherical shape, pupae measured 3.21×2.02 mm, and weighed 6.11±1.34 mg on an average. At the end of this stage the

adults emerged from the cover of the pupae (Plate IG). *Adults*: Body convex, hemispherical, and yellow in color, with 22 black spots (each part marked with 11 black spots), males measured 3.68×2.65 mm, and females 4.85×3.23 mm, respectively. The results showed that the females were larger than males in weight with an average of 8.71±0.71mg for females and 5.82±0.67mg for males (Plates 1 H and I).


**Plate 1. *Psyllobora vigintiduopunctata* feeds on powdery mildew: A. Eggs, B. First instar, C. Second instar, D. Third instar, E. Fourth instar, F. Prepupal stage, G. Pupa, H. Male, I. Female (×15.5).**

### 3.2. Population dynamics of *Psyllobora vigintiduopunctata*

Larval and adult stages of *P. vigintiduopunctata* were active from the beginning of April until the end of November on infected plants with powdery mildew. Every year, those beetles were associated with powdery mildew on okra plants infected with *Sphaerotheca fuliginea* the population of the ladybird began to appear at the beginning of June to the end of November. In 2009 the population average increased gradually to reach a peak of (27 eggs, 8 adults, 22 larvae/ leaf) during the second half of September, then the number of insects declined and the insects were observed in few numbers (3 adult, 2 larvae/leaf) during the end of November.

On *M. nigra* infected with *P. guttata* the migration of the insect to the overwintering site occurred during the end of December. In 2009, maximum population density of the insect (24 eggs, 11 adult, 17 larvae/leaf) was occurred during the second half of October, and generally declined to reached (2 larvae, 1 adult/leaf) at the end of December.

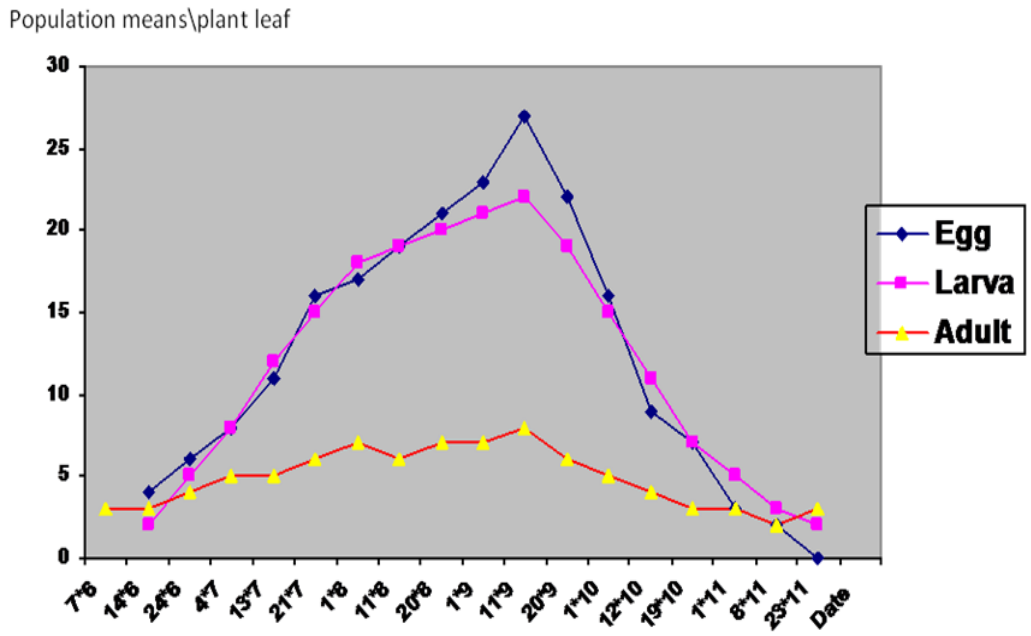


**Figure 1. The population means of *Psyllobora vigintiduopunctata* recorded on okra plants infected with *Sphaerotheca fuliginea* during June to the end of November (2009).**

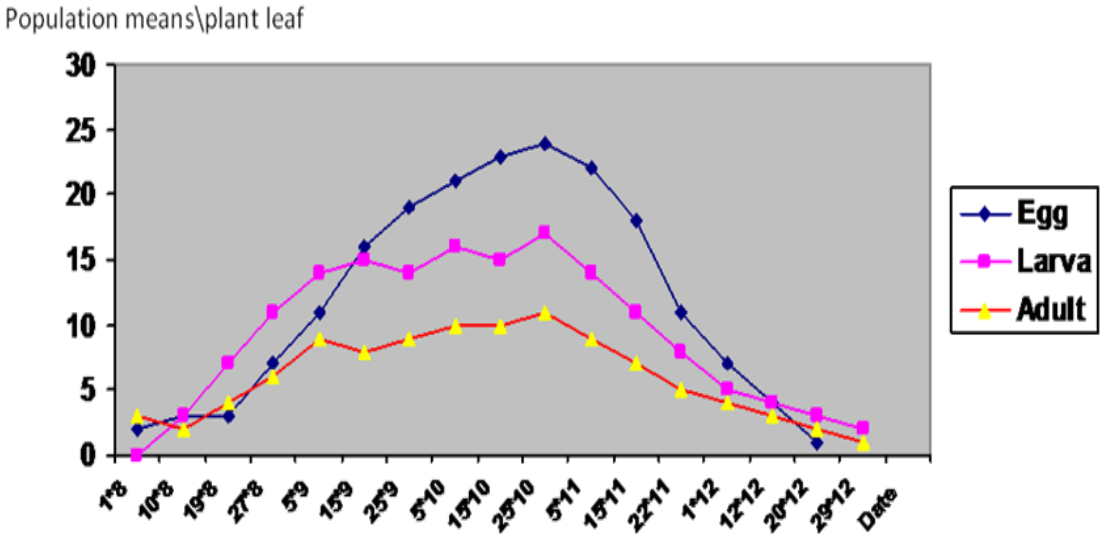


**Figure 2. The population means of *Psyllobora vigintiduopunctata* recorded on black mulberry infected with *Phyllactinia guttata* during August to the end of December (2009).**

### 3.3. Biological Studies of *Psyllobora vigintiduopunctata*

#### 3.3.1. Developmental Period and Survival of the Immature Stages

The developmental period of the immature stages from egg to adult of *P. vigintiduopunctata* which were feeding on *P. guttata* on black mulberry leaves is shown in Table (1).

**Table 1. Developmental period (days) of immature stages of *Psyllobora vigintiduopunctata* (Mean±SD, n=25) feeding on *Phyllactinia guttata* reared on *Morus nigra* leaves.**

| Life Stage | Development period (days) |
|---|---|
| Egg | 5.47±0.43 |
| 1st Instar | 2.99±0.33 |
| 2nd Instar | 2.30±0.39 |
| 3rd Instar | 2.46±0.61 |
| 4th Instar | 3.14±0.57 |
| Prepupae | 1.11±0.35 |
| Pupa | 5.07±0.71 |
| Total (egg-adult) | 21.97±1.89 |

#### 3.3.2. Adults' longevity

The longevity period was different according to host plants and fungi. The longest period was recorded when reared on *M. nigra* leaves infected with *P. guttata* (74.6±45.24) days for females and (48.22±18.71) days for males on an average. While the shortest period was achieved when reared on okra leaves infected with *S. fuliginea* (55.25±16.26) days for females and (38.8±26.79) days for males.

#### 3.3.3. Fecundity

*P. vigintiduopunctata* females deposited eggs often in groups (6 eggs on an average, sometimes individually. The total fecundity (eggs/female) was recorded (in two months) when females reared on *M. nigra* leaves infected with *P. guttata* with an average of 109.44±77.61 eggs/female. The lowest fecundity was 11eggs/female, and the highest was 250 eggs/female. The highest number of eggs/day was 29 eggs, whereas the lowest was one egg per day. The highest fecundity of *P. vigintiduopunctata* females on okra leaves infected with *S. fuliginea* was 45.78±20.28 eggs/female in two months. The lowest fecundity was 4 eggs/female. The highest number of eggs per females was 67 eggs during the same period. The highest number of eggs/female/day was 41 eggs, whereas the lowest was one egg per day.

### 3.4. Feeding Efficiency

The results showed that *P. vigintiduopunctata* fed on different powdery mildew species during the larval and adult stages (Plate 2). The consumed area of powdery mildew is increasing from larval stage to another until the adult stage (Tables 2 and 3). Larva consumed about 25.06±5.81 cm²/leaf of *S. fuliginea* infecting *H. esculentus*, 28.08±5.94 cm²/leaf of visible *P. guttata* on *M. nigra* during the entire larval stages (Table 2).

**Plate 2. *Psyllobora vigintiduopunctata* fed on *Phyllactinia guttata* powdery mildew during larval and adult stage (×15.5).**

**Table 2. Mean (±SD) area of the infected leaf (cm²) feeding on with *Psyllobora vigintiduopunctata* larva on various host plants infected with powdery mildew.**

| Host plant | powdery mildew species | Mean area of the infected leaf (cm²) ±SD feeding on with *P. vigintiduopunctata* | | | | Mean total area of the infected leaf (cm²) ±SD feeding on with *P. vigintiduopunctata* larvae |
|---|---|---|---|---|---|---|
| | | Larval stages | | | | |
| | | 1st | 2nd | 3rd | 4th | |
| *Vitis vinifera* L. | *Uncinula necator* (Schw.) | 0.77 ± 0.53 **b c** | 1.71 ± 0.54 **c** | 5.36 ± 1.91 **b** | 8.59 ± 1.003 **b** | ±16.43 2.98 **c** |
| *Morus alba* L. | *Phyllactinia guttata*(Wallr.:Fr.) Lev/. | 1.38 ± 0.63 **a** | 3.67 ± 1.30**ab** | 8.65 ± 3.98 **a** | 14.38 ± 4.04 **a** | ±28.08 5.94 **a** |
| *Quercusc alleprinus*Webb. | *Microsphaera alphitoides* Griff. &Maubl., *var.alphitoides* | 0.02 ± 0.02 **e** | 2.19 ± 2.05 **c** | 6.03 ± 1.97 **b** | 10.12 ± 3.14 **b** | ±18.36 2.17 **c** |
| *Helianthus annuus* L. | *Erysiphe cichoracearum*DC., | 0.27 ± 0.15 **de** | 2.15 ± 0.74 **c** | 6.18 ± 2.13 **b** | 11.23 ± 3.79 **b** | ±19.83 2.21 **c** |
| *Convolvulus arvensis* L. | *Erysiphe convolvuli* DC., | 1.20 ± 0.62**ab** | 2.72 ± 1.19 **bc** | 9.56 ± 5.42 **a** | 16.41 ± 4.42 **a** | ±29.90 3.97 **a** |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Picris echioides* L. | *Erysiphe cichoracearum*DC., | 0.56 ± 0.19 **cd** | 3.99 ± 2.36 **a** | 5.97 ± 3.71 **b** | 11.45 ± 3.75**ab** | 21.97±3.15 **c** |
| *Hibiscus esculentus* L. | *Sphaerotheca fuliginea*(Schlecht.:Fr)poll. | 1.59 ± 0.94 **a** | 2.69 ± 1.23b **c** | 6.36 ± 5.35 **b** | 14.42 ± 5.90 **a** | ±25.06 5.81 **b** |

Means followed by the same letter vertically are not significantly different at 0.05 probabilities.

**Table 3. Mean Area of the leaf (cm²) infected with powdery mildew on various host plants on which *Psyllobora vigintiduopunctata* adults were feeding on.**

| **Host plant** | **powdery mildew species** | **Mean total area of the infected leaf (cm²) ±SD feeding on with *P. vigintiduopunctata* adult in 24 hour.** | |
|---|---|---|---|
| | | **Female** | **male** |
| *Convolvulus arvensis* | *Erysiphe convolvuli* | 6.388 ±2.18 aA | 3.35 ± 2.66 aB |
| *Quercus calleprinus* | *Microsphaera alphitoides* | 6.285 ±4.11 aAB | aB 4.19 ±3.41 |
| *Cydonia vulgaris* Pers. | *Podosphaera clandestina* | 1.37±1.02 aD | 0.82 ± 0.71 aC |
| *Cucurbita sp.* | *Sphaerotheca fuliginea* | 3.70 ±2.57 aC | 3.09±2.87 aB |
| *Picris echioides* | *Erysiphe cichoracearum* | 4.045±2.83 aBC | 6.29±3.83 aA |
| *Helianthus annuus* | *Erysiphe cichoracearum* | 3.34 ± 2.74 aC | 1.64±1.03 aBC |
| *Morus alba* | *Phyllactinia guttata* | 4.72±3.32 aABC | 3.64 ±3.04 aB |
| *Hibiscus esculentus* | *Sphaerotheca fuliginea* | 5.06±3.44 aABC | 3.51±2.18 aB |
| *Vitis vinifera* | *Uncinula necator* | 1.398±1.05 aD | 0.61±0.45 bC |

Means followed by the same letter vertically are not significantly different at 0.05 probabilities. The capital letters indicate significant differences between females and males while the small letters indicate significant differences among host plants and fungi for females and males, respectively.

This study showed that feeding capacity of *P. vigintiduopunctata* from egg eclosion until death when reared on *S. fuliginea* infecting *H. esculentus* leaves was 367.07 and 132.53 cm² for females and males, respectively, whereas this value was 219.44 and 197.20 cm² for females and males on *P. ehioides* infected with *E. cichoracearum*.

**4. DISCUSSION**

This study showed that *P. vigintiduopunctata* usually appear at the beginning of April on many plant species infected with powdery mildew, its activity continued up to the end of November, and found in many regions of Syrian coast.

Data showed that *P. vigintiduopunctata* is one of the

most important predators of powdery mildew in these regions, it was found associated with many herbaceous plants and trees infected with certain types of powdery mildew.

It seems that the environmental conditions in the Syrian coastal region, and the availability of plants infected by powdery mildew secured the continuity and existence of *P. vigintiduopunctata* until late of November, it appearance corresponded with the emergence of other types of Coccinelidae like *Coccinella septempunctata*, a predator of aphids (Hodek, 1973; Zhou and Carter, 1992).

The biological characteristics of *P. vigintiduopunctata* was similar to other species of Coccinellidae in terms of larval stages longevity and egg laying behavior in all studied cases (Almeida and Milleo, 1998; Bado and Rodrigueze, 1998; Cividanes et al., 2007). *P. vigintiduopunctata* fed on mycelium and conidia spores of powdery mildew in larval and adult stages. The first instar had a very poor feeding capacity while all the other instars up to the 4$^{th}$ were active feeders. The insect noticed consuming the cleistothecia, especially those which were still at the beginning of formation, which were soft, thin-walled, and attached to the plant weakly, but when completely mature, the cleistothecia became with thick walls and tough, and more closest to plant surface, and it was difficult to the insect and larvae to extract the cleistothecia.

There are several studies have shown that many species of Psylloborini tribe can feed on different species of Erysiphaceae (Parsad and Rai, 1988; Dharpur et al., 1990; Parrella et al., 2005 ; Kumar et al., 2010). Soylu and Yigit (2002) revealed that the average leaf surface area of okra leaves infected by *Erysiphe cichoracearum* from which the larvae of *P. bisoctonotata* removed visible powdery mildew hyphae through consumption during the entire larval stage and adults was 12.3 cm²/leaf at 25±2 temperature.

Liu (1951) estimated that the feeding capacity for *Halyzia hauseri* from egg eclosion until death was 99.72 cm² feeding on the powdery mildew *Podosphaera leucotricha* infecting apple in China, whereas in India, Krishnakumar and Maheswari (2004) measured powdery mildew control provided by *Illeis cincta* and *Illeis bistigmosa* (Mulsant) using potted mulberry plants infected with *Phyllactinia corylea* (Pers.) Karst., Sutherland (2005) showed that an average larva of *P. vigintimaculata* would clean 6.32±3.3 cm² of leaf area of *Erysiphe cichoracearum* powdery mildew spores and hyphae during development on Zinia plant at 20±5 temperature, and 50-90% relative humidity.

Sutherland (2009) have shown that there might be a physiological difference in the powdery mildew species, some plants have very dense and patchy powdery mildew, whereas others tends to be more diffuse and uniform, suggested an increase in reproduction and/or aggregation by the insect *(Psyllobora vigintimaculata*) in response to increase in its food, particularly if its density corresponds to powdery mildew density/severity. Thus, as powdery mildew density and severity increased, the density of *Psyllobora vigintimaculata* likewise increased.

Yurtsever (2001) found that there was a high abundance of *P. vigintiduopuncata* larvae and adults on many plant species, especially the yellow flowers of *Hibiscus sp*.

Our study showed that *P. vigintiduopuncata* was widespread in the Syrian coastal region on different powdery mildew-infected plants, and we found certain morphological and biological characteristics of this Coccinellid. This natural enemy is an important agent associated with Erysiphaceae and can feed on these fungi which may contribute in the development of biological methods to reduce damage caused by powdery mildew.

## REFERENCES


Ahmad, M., Younis, G., and Ali, N. 2003. Biology of the coccinellid *Psyllobora* (*Thea*) *vigintiduopunctata* L. (Coleoptera: Coccinellidae) a predator of powdery mildew fungi. Proceedings of the Eighth Arab Congress of Plant Protection, Elbeida. City, Libya, A-175 pp.

Almeida, L. M. and Milleo, J. 1998. The immature stages of *Psyllobora gratiosa* Mader. (Coleoptera: Coccinellidae) with some biological aspects. ***J. New York Entomol. Soc***., 106(4): 170-176.

Bado, S. G., and Rodrigueze, S.M. 1998. Aspectos morfologicos Y biologicos de und vaquita micetofaga: *Psyllobora bicongregata* (Boh.) (Coleoptera :Coccinellidae). Rev. ***Facultad De Agronomia*** 18(3): 181-184.

Braun, U. 1995. The powdery mildew (Erysiphales) of Europe. Jena, Stuttgart, New York, 337 pp.

Cividanes, T. M.S., Cividanes, F.J., Matos, B. A. 2007. Biologia de *Psyllobora confluens* alimentada com o fungo *Erysiphe cichoracearum*. ***Pesq. agropec. bras., Brasília***, 42(12):1675-1679.

Cruze, B., Gonzalez Avlla, M., and Soto, L. 1989. *Psyllobora nana* (Coleoptera: Coccinellidae) biological control agent of Dusty mildew. Instituto de investigaciones Fundamentales en agricultura, Calles 1 y2, Santiago de las Vegas. 36: 151.

Dharpur, S.R., Rao, M.K., and Sagr, R.B.S. 1990. New record of mycophagous beetle, *Thea cincta* Faber. on powdery mildew of Niger. ***J. Oilseede Research*** 7(1): 124-125.

Hodek, I. 1973. Biology of Coccinellidae. The Hague, Acad. Prague. Junk, 260 pp.

Iablokoff-Khnzorian, S.M. 1982. Les Coccinelles, Coleopterès-Coccinellidae: Tribu cocinellini des règions paléarctique et Orientale. Société Nouvelle des Editions Boubée, Paris, 568 pp.

Klausnitzer, B., and Klausnitzer, H. 1986. Marienkäfer (Coccinellidae). Die Neue Brehm, Bücherei. A. Ziemsem Verlag, Wittenberg, 104 pp.

Krishnakumar, R., and Maheswari, P., 2004. Management of powdery mildew in mulberry using coccinellid beetles, *Illeis cincta* (Fabricius) and *Illeis bistigmosa* (Mulsant). ***J. Entomol. Res***., 28: 241-246.

Kumar, R., Mittal, V., Patankar, N.V. and Ramamurthy, V.V. 2010. Bionomics of mycophagous Coccinellid, *Psyllobora bisoctonotata* (Mulsant) (Coleoptera: Coccinellidae). ***Munis Entomology and Zoology*** 5(2): 652-657.

Liu, C.L., 1951. Studies on the feeding capacity and life history of a mycophagous coccinellid, *Halyzia hauseri* Mader, in Kunming. ***Annales Entomologici Sinici*** 1: 1-15.

Parrella, M., Sutherland, A.M, Andrea, M., Gubler, W.D., Zagoy, E., and Van Hom, M. 2005. Natural presence, behavior and feeding efficiency of the Mycophagous Coccinellid *Psyllobora vigintimaculata* in an Urban Garden Setting within California`s central Valley. University of California, Davis, Slosson research en do wment for ornamental horticulture, 18 pp. http://slosson.ucdavis.edu/ documents/news letter 975.htm.

Parsad, R., and Rai, M. 1988. Record of the beetle *Thea cincta* Fabr. feeding on powdery mildew of Linseed farm. Science Journal. C.S. Azad University. ***India***. 3(1): 89-90.

Ratti, E. 1996. Ńota preliminare sui coleotteri che frequentano L, *Oidium evonymi*-japonici (Arc.) Sacc. (Fungi imperfecti) nei giaradini urbani di venezia. ***Boll. Mus. Civ. St. Nat. Venezia***, 45: 47-51.

Soylu, S., and Yigit, A. 2002. Feeding of mycophagous ladybird, *Psyllobora bisoctonotata* (Muls.) on powdery mildew infested plants. Biological control of Fungal and Bacterial plant pathogens. ***IOBC, Bulletin*** 25(10): 183-186.

Sutherland, A.M. 2005. Evaluation of *Psyllobora vigintimaculata* (Say.) (Coleoptera: coccinellidae) for

biological control of powdery mildew (Erysiphaceae). M.Sc. thesis, University of California, Davis. 46 pp.

Sutherland, A.M. 2009. The feasibility of using *Psyllobora vigintimaculata* (Coleoptera: Coccinellidae), a mycophagous ladybird beetle, for management of powdery mildew (Erysiphales). Ph.D. Thesis, University of California, Davis. 99 pp.

Younes, G. 2004. Ecology and biology study of powdery mildew and insects feeding on these fungi in the Syrian Coast. M.Sc. Thesis, Tishreen University, Lattakia, Syria, 229 pp.

Younes, G. 2009. Contribution to the study of the ecological relationships, biodiversity, and possibility for biological control of powdery mildew fungi. Ph.D. Thesis, Tishreen University, Lattakia, Syria, 175 pp.

Yurtsever, S. 2001. A preliminary study on the ladybirds (Coleoptera: coccinellidae) of Edirne in North western Turkey. ***Turk. J. Zool***. 25: 71-75.

Zhou, X. and Carter. N.1992. The ecology of coccinellids on farmland. ***Aspects of Applied Biology***, 31: 133-138..

# دراسات بيئية، بيولوجية، ومورفولوجية لحشرة أبي العيد (Coleoptera :Coccinellidae) *Psyllobora vigintiduopunctata* (L.) على فطريات البياض الدقيقي في المنطقة الساحلية من سوريا

***غيداء حسن يونس✉ [1]، محمد أحمد [2]، نوال علي [3]***

## ملخص

تعد أنواع قبيلة Psylloborini مستهلكات إجبارية لفطريات البياض الدقيقي (Ascomycota: Erysiphales). تعد حشرة أبي العيد ذي 22 نقطة (Coleoptera: Coccinellidae) *Psyllobora vigintiduopunctata* (L.) واحدة من أهم هذه المستهلكات في المنطقة الساحلية من سوريا. تنشط الحشرات الكاملة واليرقات لهذا النوع من آوائل نيسان حتى آواخر تشرين الثاني على الأنواع النباتية المصابة بفطريات البياض الدقيقي في هذه المنطقة. دُرست بيولوجيا الحشرة تحت ظروف بيئية ثابتة (حرارة 25±2C° ، رطوبة نسبية 5%±70، فترة ضوئية 12:12 إضاءة : ظلام) بتغذيتها على أنواع عديدة من البياض الدقيقي. بلغ متوسط أبعاد يرقات العمر الأول (1.99×0.65) ملم، ومتوسط أوزانها(0.25±0.08) ملغ، وتزايد معدل أبعادها إلى (5.51×1.78) ملم، ومعدل أوزانها إلى (5.91±0.81 ) ملغ في العمر اليرقي الرابع. بلغت المدة الكلية للتطور من البيضة إلى الحشرة الكاملة (21.97±1.89) يوماً عند تربيتها على النوع *Phyllacctinia guttata* (Wallr.:Fr.) Lev/. على أوراق التوت الأسود *Morus nigra* L. ، كما بلغ متوسط الخصوبة الكلية للأنثى (109.44±77.61) بيضة/أنثى. بلغ متوسط مساحة سطح ورقة التوت الأسود المصابة بالبياض الدقيقي *P. guttata* التي تتغذى عليها يرقة النوع *P. vigintiduopunctata* خلال كامل الطور اليرقي (28.08±5.94 ) سم$^2$/الورقة بينما انخفضت هذه المساحة إلى 16.43± 2.98 سم$^2$/الورقة عند تغذيتها على الفطر *Uncinula necator* (Schw.) Burr., على أوراق الكرمة *Vitis vinifera* L. . تشير الملاحظات أن النوع *P.vigintiduopunctata* يمكن أن يكون مرشحاً كعامل مكافحة حيوية للعديد من فطريات البياض الدقيقي.

**الكلمات الدالة:***Psyllobora vigintiduopunctata* ، فطريات البياض الدقيقي، مفترس، مكافحة حيوية، الساحل السوري.

[1] مديرية البيئة–اللاذقية، وزارة الدولة لشؤون البيئة، سوريا.

✉alaaagh4@yahoo.com

[2] أستاذ– قسم وقاية النبات، جامعة تشرين، اللاذقية، سوريا.

[3] أستاذ– قسم النبات، جامعة تشرين، اللاذقية، سوريا.

تاريخ استلام البحث 2014/4/7 وتاريخ قبوله 2014/7/24.