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A FIELD STUDY ON SYNCHRONY BETWEEN THE POPULATIONS OF CITRUS PSYLLA, *Diaphorina citri* (KUWAYAMA) (HOMOPTERA : PSYLLIDAE) AND ITS NATURAL ENEMIES IN WESTERN SAUDI ARABIA

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ABSTRACT

Variations in the population density of *Diaphorina citri* (Kuwayama) and its natural enemy complex (Insecta and Araneida) were studied on a Mexican lime orchard in the Western region of Saudi Arabia from March 1997 to Feb. 1998. It was observed that the spider complex and the saprinus histerid predator, *Saprinus chalcites* (I I I) may have a potential as candidates for biological control against *D. citri*. However,the spider complex represents 33.6% of the total predatory complex. The regression test of the total number per week of spider complex to the total number per week of *D. citri* showed highly significant positive correlation of the spider complex to *D. citri*. The populations of 3 groups of the predatory insects including the predaceous saprinus histerid, *S. chalcites*, predaceous carabid, *Egaoola crenulata* Dejean and *Chrysopa vulgaris* were found in a good synchrony with *D. citri* during their activity period.

Key words: *candidates, populations, synchrony.*

1. INTRODUCTION

The citrus psylla, *Diaphorina citri* (Kuwayama) is a widely

distributed pest in tropical and subtropical countries all over the world. (Fadl-Alla 1985, Kawar *et al.*, 1989; Lyoussoufi *et al.*, 1992). This ubiquitous species is found on a wide range of citrus orchards and wild plants, (Ananthankrishnan 1995). The *D. citri* is the most destructive pest in the southwestern and southeastern Saudi Arabia, infesting citrus grooves and wild plants (Martin 1972, Wooler & Arafat 1994). Several avenues have been pursued towards the control of this noxious pest including chemical and agricultural control, but did not successfully stop the fast spread of *Diaphorina* which is the main vector in transmitting the greening disease agent which has caused devastation, decline and death in citrus orchards (Nasr *et al.*, 1980).

Due to failures in chemical and agricultural methods applied in curbing the populations of *Diaphorina* and evidently the spread of the greening disease, new approaches of control using the biological control with the objective of reducing the pesticides use have been adopted as reported by Graham *et al.*, 1986, Craig and Loan (1987), Ding *et al.*, (1987), Peter *et al.*, (1990), Silva *et al.*, (1992), Dreistadt *et al.*, (1994).

Little is known of the phenology and synchrony between the arthropod predators (Insecta and Araneida) and *D. citri* in Saudi Arabian citrus agroecosystem. The synchrony of the populations of *D. citri* and their natural enemies were studied to ascertain their potential in a biological control program to reduce the populations of *D. citri* to below the economic damage level.

2. MATERIALS AND METHODS

2.1. Sampling methods

To investigate if the complex of natural enemies composed of major groups of Insecta and Araneida is in synchrony with the population dynamics of *D. citri*, field studies were conducted in a Mexican lime orchard during 1997 -1998, at the research farm of the Ministry of Agriculture and Water Resources (MAWR) at Hada Al-Sham locality, Western Saudi Arabia. In this field study the seasonal variation in the population density of *D. citri* and its natural enemies, the lime trees of the citrus orchard were sampled weekly using a standard sweep net, 30cm in diameter and the sleeve has a standard

mesh. One hundred random sweeps (4 subsamples,25 strokes each) were taken once weekly by hitting the trees vigorously and randomly. Samples were placed directly into 70% alcohol and brought to the laboratory for identification. Weekly data were accumulated to give the total numbers recovered per week.

Degree-day temperature (DDT) accumulations

Daily maximum and minimum air temperature were obtained from the weather station at the University Farm of the Meteorological facility of the College of Metrology and Arid Land Agriculture, which is in the vicinity and it is about 100 meters away from the research farm of the MAWR. Degree-Day Temperature (DDT) accumulations, were calculated with the onset of sampling using Arnolds formula (Al-Ghamdi *et al.*, 1995). The threshold chosen was 18^0C as a base temperature for both *D. citri* and its natural enemies. To our knowledge there has been no published developmental threshold for *D. citri* and its natural enemies at the present time in Saudi Arabia.

Statistical methods

A simple linear regression model was used to test the correlation between weekly numbers of *Diaphorina* natural enemies and the weekly numbers of *D. citri* in the Mexican lime orchard.

3. RESULTS AND DISCUSSION

Data collected showed that there is a noticeable variation in the fluctuation of the populations of both *D. citri* and the predaceous complex from Insecta and Araneida (Table 1). Fig. 1 showed 6 peaks of *D. citri* populations observed during March, April, early July, early November, and late February, throughout the season. However, 7 peaks of the Araneida complex were observed in synchrony with the populations of *D. citri* in March, April, May, early July, early November, and late February. The spider complex was the dominant group of predators prevalent on the lime trees. This group belonged to 8 families : Lycosidae, Gnaphosidae, Thomicidae, Salticidae, Pholicidae, Oxyopidae, Theridiidaeand and Agelenidae. However, representatives of both families (Salticidae and Gnaphosidae) were more dominant

than members of other families. These groups of true spiders are considered of vital importance in biological control and their role is very well recognized by many workers in the field of integrated pest management (I P M) (Porovencher and Vickery 1988, Jackson and Willey, 1994, Tarsitano and Jackson 1994). In this study, this group was collected in high numbers than Insecta predators throughout the season which, may be due to the fact that no insecticides were applied during the period of study (Table 2). Furthermore 7 peaks of spider complex were found to be well synchronized with the populations of *D. citri*. However, 3 pronounced peaks of activity occurred during July, November and February. The degree-day temperature (DDT) accumulations are presented with the populations activity of both *D. citri* and the Araneida complex in Fig. 1.

Although some major groups of insect predators were noted throughout the season which include *Chrysopa vulgaris* , predaceous saprinus histerid, *Saprinus chalcites* and predaceous carabid, *Egapola crenulata* Dejean (Fig. 1) , it was observed that the populations of *C. vulgaris* was active only during the periods of early March to late April and from late September to October. However the pronounced peaks of *C. vulgaris* were found on the 1st week of March and 3rd week of October at a (DDT) accumulations of 320 DDT and 11358 DDT, DDT ,respectively (Fig. 1).

The predaceous saprinus histerid showed a slight weak peak during April 1997 and 3 pronounced peaks during early May1997, mid July1997 and mid November 1997 (Fig. 1). Also the last 2 pronounced peaks were in synchrony with the last 2 peaks of *D. citri* during early July and November 1997(Fig. 1).

The predaceous carabid, *E. crenulata* had 3 peaks throughout the season. Two of these peaks were pronounced and in synchrony with the *D. citri* populations during dates of sampling at a (DDT) accumulations of 6196 and 12959, respectively.

Data obtained from this studgive a clear indication that Insecta predators including the aforementioned 3 groups which have chewing mouth parts come as a 2nd important group in reducing the populations of *D. citri*. Also different insect predators were recovered but in less numbers than the already mentioned groups (Tables 1-2). These groups of Insecta predators range from 1.1% to 29.7%

Table (1) : Occurrence of *D. citri* and its natural enemies (weekly mean ± SD) in Mexican lime trees, Hada Al-Sham, Western Saudi Arabia, 1997 – 1998.

D. citri & its Predators	March	April	May	June	July	August
Diaphorina citri	120.50±47.05	62.00±3.56	15.15±8.09	14.75±5.97	48.25±17.64	12.25±4.27
Spiders complex	18.99±15.89	16.00 ±8.25	12.25±6.55	08.75±4.57	24.00±4.97	07.00±2.16
Saprinus chalcites	00.50±1.00	04.00±3.16	30.50±23.06	06.25±9.47	37.70±8.73	17.50±11.45
Egapola crenulata	00.00±0.00	00.00±0.00	00.00±0.00	09.50±14.18	24.25±13.59	01.25±1.50
Chrysopa vulgaris	20.75±9.61	06.75±1.89	00.00±0.00	00.00±0.00	00.00±0.00	00.00±0.00
Cydonia propinqua	02.75±4.27	00.00±0.00	00.00±0.00	00.00±0.00	00.00±0.00	00.00±0.00
Paederus alfierii	04.50±3.32	00.00±0.00	00.00±0.00	00.00±0.00	00.00±0.00	00.00±0.00
Coranus aegptius	01.50±1.73	00.75±1.50	00.75±1.50	00.25±0.50	00.50±1.00	00.00±0.00
Sphodromantis viridis	00.75±1.50	00.00±0.00	00.00±0.00	00.00±0.00	00.00±0.00	00.00±0.00

Cont. Table (1).

D. citri&its Predators	September	October	November	December	January	February	Mean / Year
Diaphorina citri	15.70±3.75	60.50±25.41	78.00±58.00	21.75±02.36	11.75±02.36	40.00±27.99	500.60
Spiders complex	09.00±3.56	22.75±4.11	24.75±8.20	13.25±3.86	03.00±1.41	20.25±15.39	179.99
Saprinus chalcites	01.75±2.06	27.50±12.76	30.75±20.25	00.00±0.00	00.00±0.00	00.00±0.00	156.45
Egapola crenulata	15.25±7.46	41.25±7.81	34.00±21.00	00.00±0.00	00.05±0.09	00.00±0.00	125.50
Chrysopa vulgaris	00.75±1.50	12.75±8.38	03.00±2.16	00.00±0.00	00.00±0.00	00.00±0.00	44.00
Cydonia propinqua	02.00±2.45	08.75±5.06	00.00±0.00	00.00±0.00	00.00±0.00	00.00±0.00	13.50
Paederus alfierii	00.00±0.00	02.50±2.08	00.50±0.50	00.00±0.00	00.00±0.00	00.00±0.00	7.50

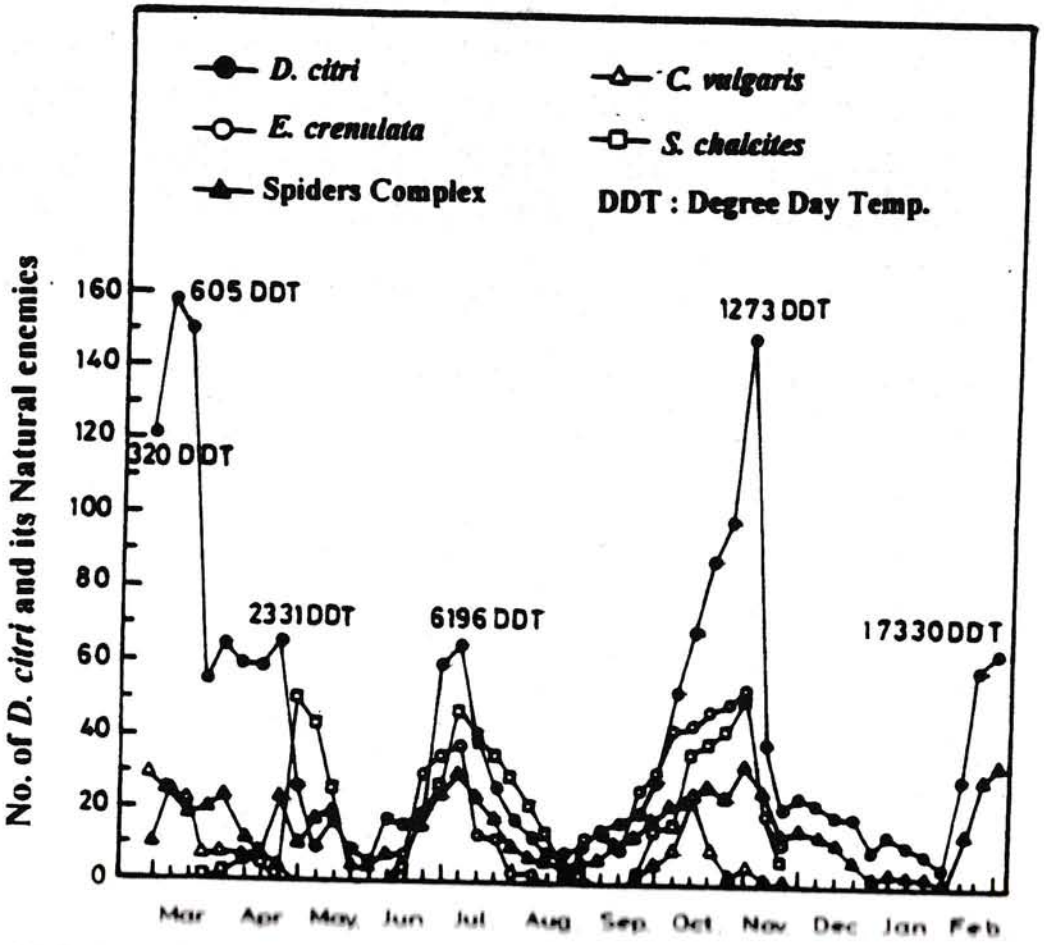
D. citri
C. vulgaris
E. crenulata
S. chalcites
Spiders Complex
DDT : Degree Day Temp.
No. of D. citri and its Natural enemies
160
140
120
100
80
60
40
20
0
605 DDT
320 DDT
2331DDT
6196 DDT
1273 DDT
17330DDT
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb

Table (2) : Total number and % of the *D. citri* natural enemies per 100 double sweeps during the period of 48 weeks from March to February, Hada Al-Sham, 1997 – 1998.

Predator	Total	%
Spider complex	716	33.6
Saprinus chalcites	626	29.7
Egapola crenulata	502	23.6
Chrysopa vulgaris	176	08.3
Cydonia propingua	54	02.5
Paederus alfierii	30	01.4
Coranus aegyptius	23	01.1
Sphodromantis viridis	05	00.2

From this study it is observed that the populations of the major predatory complex was the araneids and it does represent 33.6% of the total predatory complex (Insecta and Araneida). In addition to this, the regression of the total numbers per week of spiders complex on the total numbers per week of *D. citri* showed a highly significant positive relation to *D. citri* adults on Mexican lime trees (Standard = 0.031, T = 4.722, and $P<0.001$). The other predatory group (Insecta) did not show any significant relation to *D. citri* when the regression test of the total numbers per week of each insect predator to the total numbers per week of *D. citri.*

This study has indicated that the impact of a complex of general polyphagous (Insecta) predators needed further critical evaluation to consider their role before natural mortality could be thoroughly exploited in rational pest management programs. Therefore inventories of indigenous insects and spider complex are targeted towards achieving the main objectives in reducing *D. citri* populations, before reaching damaging levels. The saprinus histerid predator, *S. chalcites* can be considered a suitable candidate biocontrol agent against *Diaphorina* bugs (immature and adult stages) since it represented 29.7% of the total predatory complex. Geden *et al.*, (1987) reported that the histerid predator *Carcinops pumiho* (Erichson) preyed on the immatures and adults of dipteran larvae and soft-bodied instars such as the immature hemipterans.

Some biological agents used in biological control programs using predaceous Insecta and Araneida were successfully mass

produced on artificial diets and / or on their natural hosts as reported by Coppel and Mertins (1977), Singh (1977), Norton *et al.*, 1994, Kumar *et al.*, (1996). This study showed that the saprinus histerid predator, *S. chalcites* and the spider complex may have a potential as promising candidates for the biological control of *D. citri* on Mexican lime trees in Western Saudi Arabia. We recommend more augmentative studies with the objective of exploiting the possibilities of using these predators in an integrated pest management program (I PM) against *Diaphorina* bugs in Saudi Arabia.

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دراسة حقلية على التوافق بين مجتمعات سيلد الموالح *Diaphorina citri*, (Kuwayama) (رتبة متشابهة الأجنحة : عائلة Psyllidae) واعدائها الطبيعيين في المنطقة الغربية من المملكة العربية السعودية

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الملخص

تم تحديد الاختلافات في كثافة مجتمعات حشرة سيلد الموالح *Diaphorina citri* (Kuwayama) ومعقد أعدائها الطبيعيين من الحشرات والعناكب الحقيقية في بساتين أشجار الليمون البلدي بالمنطقة الغربية من المملكة العربية السعودية في الفترة من مارس 1997 حتى فبراير 1998. لوحظ من نتائج هذه الدراسة أن معقد العناكب الحقيقية وخنافس الهستيرد المفترسة *Saprinus chalcites* (III) من الإمكانية أن يكونا مرشحين جيدين في برنامج المكافحة الإحيائية ضد حشرات سيلد الموالح بالمنطقة الغربية من المملكة العربية السعودية، نظرا لكثرة اعدادها . هذا وقد شكل معقد العناكب الحقيقية نسبة 33,6% من المجموع الكلي لمعقد المفترسات المصطادة. أوضح اختبار الارتباط لمجموع أعداد معقد العناكب الحقيقية لكل أسبوع إلي مجموع أعداد حشرات السيلد لكل أسبوع ارتباطا معنويا ايجابيا عاليا. أظهرت هذه الدراسة أيضا أن هناك ثلاث مجاميع لمجتمعات الحشرات المفترسة وجدت في توافقية جيدة مع مجتمعات حشرات السيلد خلال فترات النشاط وهي خنافس الهستيرد, خنافس الكربيد, و حشرات أسد المن.

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