J. Agric. Sci. Mansoura Univ., 27(3): 1879 - 1889, 2002

SEASONAL ABUNDANCE AND HOST PREFERENCE OF THE LAND SNAIL, *Helicella vestalis* INFESTING FOUR CITRUS SPECIES AT BEHERA GOVERNORATE

El-Hawashy, Nadia; J.M. Nakhla and A.W. Tadros
Plant Protection Research Institute, Agricultural Research Center, Dokki-Giza, Egypt.

ABSTRACT

The small Land snail, *Helicella vestalis* (Prieffer) is a considerable harmful pest in citrus orchard, in the northern region of Egypt. The population dynamics and host preference was studied on four citrus species at Behera governorate during two successive years (1998 and 1999). The snail *H. vestalis* was abundant allover the year with maximum peaks during September and/or October. However, the least snail activity was during January and/or February. The number of snails almost doubled throughout only one year. Summer and autumn seasons showed the maximum snail activity with moderate activity during spring, but the least activity was in winter. The snail activity positively and significantly correlated with the temperature but negatively correlated with the relative humidity. Mandarin orchards harboured the least snail activity than orange orchards. Yet, the maximum snail activity was in navel orange, followed by moderate activity in Baladi orange then Sokkari orange at last.

Keywords : Citrus species, land snail, *Helicella vestalis*, population density, temperature, relative humidity

INTRODUCTION

In Egypt, land snails are serious animal pests especially in the northern coastal region. Kassab and Daoud (1964), Bishara *et al*. (1968), El-Okda (1980 and 1981) and Hashem *et al*. (1992 and 1993) recorded *Helicella vestalis* (Prieffer), *Theba pisana* (Müller), *Cochlicella acuta* (Müller), *Eobania vermiculata* (Müller), *Rumina decollata, Euparypha pisana* and *Eremina desertorum* in the north western Delta (Alexandria and Behera governorates). Land snails attack fruit trees, field crops, vegetables, ornamental plants and weeds. However, the small land snail, *H. vestalis*, prefers to feed on citrus tender than mature tissues of fruits, leaves, branches and tree stem by scraping off their surfaces. The snail *H. vestalis* has almost one generation each year.

The aim of the present study is to study the seasonal fluctuation of the snail *H. vestalis* on different citrus species and host preference at Behera governorate during two successive years (1998 and 1999).

MATERIALS AND METHODS

Monitoring and host preference studies of the land snail, *H. vestalis* were conducted in severely infested citrus orchards (40 feddans) located at the northern region of Behera governorate (Kafr El-Dawar district) during the two successive years, 1998 and 1999. Four citrus species namely : orange,

Citrus sinensis variety "Baladi", *C. sinensis* variety "Sokkari", *C. sinensis* variety "Navel" and mandarin, *C. reticulata* were subjected to these studies. The seasonal abundance of *H. vestalis* was carried out by counting the snails on 15 trees (divided into 3 replicates, 5 trees each) for each citrus species or variety. Inspection was carried out in the morning at half monthly intervals. Individuals on each tree were collected, counted and released again under each specific tree.

To determine the host preference between the four citrus species or varieties, data were determined at monthly basis and the relative degree of infestation was estimated.

Data were also calculated seasonally to study the seasonal variation for each of the four citrus species or varieties. The direct effect (simple correlation "r") of the daily mean temperature and relative humidity on the mean number of *H. vestalis* in every citrus orchards was calculated.

Analysis of variance ("F" test) was also calculated between the mean number of *H. vestalis* during the four seasons and between the four citrus species or varieties.

RESULTS AND DISCUSSION

Field observations in citrus orchards at the northern region of Behera governorate indicated the occurence of four snail species, *T. pisana*, *H. vestalis*, *C. acuta* and *E. vermiculata* (Muller) (Pulmonata : Helicidae). This study deal with the small land snail species *H. vestalis* which was the most economic snail attacking citrus orchards in Behera governorate.

A. The seasonal abundance

Table (1) showed that *H. vestalis* was abundant on citrus orchards during the year where the total numbers of individuals per tree on the four citrus species or varieties Baladi orange, Sokkari orange, Navel orange and mandarin were 178.5, 302.8, 363.7 and 396.4 individuals per tree in 1998; and 247.4, 320.8, 392.9 and 370.4 individuals per tree in 1999, respectively. Almost 14.4 % and 18.6 %, 24.4 % and 24.1 %, 29.3 % and 29.5 %, and 31.9 % and 27.8 % of the general total number of the snails were recorded on the respective four citrus species or varieties in 1998 and 1999 as shown in Table, 1. Thus, the relative susceptibility of host plant to the harmful snail could be descendingly arranged as Baladi orange (29.85 %), Navel orange (29.40 %), Sokkari orange (24.25 %) and Mandarin (16.50 %). Smoothing the frequency distribution curves of snails to almost normal curves showed that there was only one major peak in October, 1998 and in September, 1999 (Fig. 1)..Table (1) and Fig. (1) revealed the relative monthly numbers of snail on each citrus species during the periods of study (1998 and 1999). On mandarin trees, *H. vestalis* showed its highest population density during October, 1998 (35.9 individuals/tree) and September 1999 (37.2 indiv./ tree). The snail density decreased to its minimum (1.8 indiv./tree) during February 1998 and (3.2 individuals/tree) during January, 1999.

Table (1) : The average number of *H. vestalis* on four citrus species at Behera governorate during 1998 and 1999.

Month	Year	The average number per tress			
		Mandarin	Sokkari	Navel	Baladi
Jan.	1998	2.1±1.2	2.0±1.3	5.6±2.5	5.4±1.3
	1999	3.2±1.3	3.5±1.2	6.3±1.6	7.2±2.1
Feb.	1998	1.8±0.9	5.3±2.3	5.2±3.1	6.3±3.4
	1999	5.1±1.2	6.1±2.1	9.1±1.3	9.3±3.9
Mar.	1998	6.1±1.6	9.3±1.5	13.9±4.1	18.1±1.5
	1999	11.3±2.1	12.3±2.1	15.2±2.3	16.2±3.2
Apr.	1998	9.1±2.5	15.6±3.2	22.1±3.9	23.1±5.1
	1999	19.3±3.1	20.1±5.1	25.2±5.6	27.1±4.2
May	1998	15.1±3.5	28.4±4.3	32.1±7.2	36.7±6.5
	1999	20.8±2.3	25.2±5.2	28.9±9.1	32.5±7.5
Jun.	1998	17.6±1.5	35.3±11.1	42.4±6.2	45.9±3.9
	1999	23.4±3.6	37.3±9.2	38.8±7.3	39.8±6.1
Jul.	1998	18.6±2.1	36.5±8.1	44.7±5.2	47.3±7.1
	1999	27.3±2.3	38.2±5.3	45.1±6.1	41.2±9.2
Aug.	1998	18.7±1.9	37.9±6.4	45.1±6.7	49.2±6.9
	1999	35.2±5.1	40.1±7.5	51.2±4.9	45.3±5.0
Sept.	1998	22.1±2.3	41.2±8.2	47.3±7.2	52.9±6.2
	1999	37.2±3.9	43.9±4.3	59.2±3.1	49.2±9.4
Oct.	1998	35.9±2.4	45.9±3.5	58.1±5.2	62.3±3.1
	1999	23.1±2.3	48.1±8.3	51.1±6.1	45.9±2.1
Nov.	1998	23.4±2.6	36.2±9.1	38.3±6.8	35.7±3.1
	1999	20.3±1.4	30.9±6.2	42.5±5.3	38.1±5.6
Dec.	1998	8.1±1.1	9.2±7.3	8.9±4.9	13.5±4.5
	1999	11.2±1.3	15.1 ±3.5	20.3±7.2	18.6 ±7.0
General	1998	178.5	302.8	363.7	396.4
total	1999	247.4	320.8	392.9	370.4
Relative	1998	14.4	24.4	29.3	31.9
(%)	1999	18.6	24.1	29.5	27.8

fig1

On Sokkary orange trees, the highest population density (occurrence) was recorded during October, 1998 (45.9 indiv./tree) and 1999 (48.1 indiv./tree), while the least was noticed during January, 1998 (2.0 indiv./tree) and 1999 (3.5 indiv./tree). On Navel orange trees, the highest level of occurrence of snail was noticed during October, 1998 (58.1 indiv./tree) and September, 1999 (59.2 individuals/tree). The snail activity decreased to (5.2 indiv./tree) in February, 1998 and in January, 1999 (6.3 indiv./tree). On the other hand, on Baladi orange trees, the highest level of occurrence of snail was noticed during October, 1998 (62.3 indiv./tree), and September, 1999 (49.2 indiv./tree). The lowet occurrence was during January 1998 and 1999 (5.4 and 7.2 indiv./tree, respectively).

The direct effect of daily mean temperature on the snail activity was highly significant during 1998 ("r" = 0.662, 0.834, 0.814 and 0.833) and 1999 (0.861, 0.838, 0.797 and 0.860) in the respective four citrus species orchards (mandarin, Sokkari orange, Navel orange and Baladi orange), respectively (Table 2 and Fig. 2). On the contrary, the snail populayion density was negatively and significantly correlated with the daily mean of relative humidity where "r" values averaged -0.329 and -0.478 for snails inhabiting Sokkari orange. These values averaged -0.292 and -0.480 in Baladi orange in 98 and 1999, respectively (Table 2 and Fig. 2). On Navel orange trees and mandarin orchards, the snail occurrence also negatively correlated with the daily relative humidity where "r" values were -0.258 on Navel and -0.427 on mandarin during 1998, respectively. In 1999, Baladi trees showed a significant and negative correlation (r = -0.577), while mandarin showed a positive correlation (+0.672) between the snail density and daily mean relative humidity.

Fig (1) clearly indicated that the cumulative numbers of the snail increased during only one year. This rapid increase imposed the urgent need to integrated control programmes (Nakhla and El-Sisi, 1993, and Nakhla *et al*., 1993 a and b and 1997).

B. The seasonal activity

Table (2) and Fig. (2) clarified that summer months showed the maximum number of individuals on citrus trees (38.3- 38.2 % in 1998 and 36.2-40.3 % in 1999). Large numbers also were recorded during autumn months (26.2-37.7 % in 1998 and 22.1-29.0 % in 1999). Moderate numbers were reported during spring months as they were 23.4-26.7 % in 1998, and 23.6-26.9 % in 1999. During winter months, the least snail activity was noticed in the four citrus orchards as the percentage of individuals per tree was 5.5-15.7 % and 8.8-12.0 % in 1998 and 1999, respectively.

It was also obviously noticed that the moderate temperature in autumn and higher temperature in summer were favourable for *H. vestalis* activity attacking citrus orchards. However, lower temperature was not suitable and negatively affected the snail activity.

C- The relative susceptibility of citrus species to infestation

The relative susceptibility to *H. vestalis* infesting citrus species or varieties was shown in Table (3) and Fig. (3).

table2

fig2

table3

fig3

Data indicated that the maximum snail activity was recorded in Navel orange orchard (28.1- 52.8 % and 23.3-31.2 % in 1998 and 1999, respectively). Moderate number of the snail was observed in Baladi orange orchard as the percentage of individuals per tree was 24.9-29.6 % in 1998 and 24.9-29.4 % in 1999. Also, the number of the snail in Sokkari orange orchard was 13.9-25.0 in 1998 and 23.8-29.3 % in 1999. The least snail activity was reported in mandarin orchards (8.4-17.9 % in 1998 and 149.-2.5 % in 1999).

It was clear that, although there were variable susceptibility levels between *Citrus sinensis* varieties, yet they were more susceptible to *H. vestalis* than *Citrus reticulata*. This may be due to physical and/or chemical properties of the different citrus species. However, analysis of variance ("F" test) showed significant differences between the mean number of individuals in the four considered seasons, but insignificant between Navel and Baladi varieties and between Sokkari and Mandarin species.

REFERENCES

Bishara, S.I.; M.S. Hassan and A.S. Kalliny (1968). Studies on some land snails injurious to agriculture in U.A.R. Rev. Zool. Bot. Afr., LXXVII (3-4) : 239-252.

El-Okda, M.M.K. (1980). Land snails of economic importance on vegetable crops at Alexandria and neighbouring regions. Agric. Res. Rev., 58 (1) : 97-85.

El-Okda, M.M.K. (1981). Locomotion activity and infestation abundance of certain terrestrial mollusca in fruit orchards, Alexandria Provinces, ARE. 4*th* Arab Pesticide Conf. Proc., Tanta Univ., 2 : 279-287.

Hashem, A.G.; J.M. Nakhla and A.W. Tadros (1992). Seasonal fluctuation in population of the land snails on citrus trees in the northern reclaimed lands. Al- Azhar J. Agric. Res., Cairo, Egypt, 16: Dec. 1992.

Hashem, A.G.; J.M. Nakhla; A.W. Tadros and M.A. Korashy (1993). Monitoring land snails on sweet orange trees in Behera governorate (Egypt). Zagazig J. Agric. Res., 20 (2) : 699-707.

Kassab, A. and H. Daoud (1964). Notes on the biology and control of land snails of economic importance in the U.A.R. Agric. Res. Rev., 42 : 77-98.

Nakhla, J.M. and A.G. El-Sisi (1993). Evaluation of some inorganic salts against the small garden snail *Theba pisana*. Egypt. J. Agric. Res., 73 (2) : 365-369.

Nakhla, J.M.; A.W. Tadros and A.G. Hashem (1993a). Effect of manual collection on the reduction of land snail population in citrus orchards. Egypt. J. Appl. Sci., Zagazig Univ., Egypt, 8 (10) : 554-542.

Nakhla, J.M.; A.W. Tadros and A.G. Hashem (1993b). Effect of soil management on the reduction of land snail population in citrus orchards. Egypt. J. Appl. Sci., Zagazig Univ., Egypt, 8 (10) : 543-551

Nakhla, J.M.; A.W. Tadros and A.G. Hashem (1997). Effect of fertilizers on the reduction of land snail infestation in citrus orchards. Annals Agric. Sci., Fac. Agric., Ain Shams Univ., Cairo, Egypt.

J. Agric. Sci. Mansoura Univ., 27(3), March, 2002

التذبذب فى التعداد والتفضيل العوائلى للقوقع الأرضى *Helicella vestalis* فى أربعة أنواع من حدائق الموالح

نادية الهواشى و جوزيف مترى نخله و أنطون ولسون تادرس
معهد بحوث وقاية النباتات، مركز البحوث الزراعية، الدقى - مصر.

يعتبر قوقع الرمال الصغير هيليسيللا فيستاليس *Helicella vestalis* آفة إقتصادية هامة فى حدائق الموالح فى المناطق الشمالية لمصر. درس التذبذب فى التعداد والتفضيل العوائلى للقوقع فى أربعة أنواع من حدائق الموالح فى محافظة البحيرة خلال عامين متتاليين (١٩٩٨، ١٩٩٩). لوحظ أن القوقع يتواجد بوفرة خلال العام مع التدرج حتى يصل إلى القمة خلال شهر سبتمبر و/أو أكتوبر، إلا أن أقل نشاط يكون خلال يناير و/أو فبراير. وقد تضاعف تعداد القوقع خلال عام واحد فقط تقريبا. إتضح أن أقصى نشاط للقوقع يكون خلال الصيف والخريف، إلا أن التعداد كان متوسطا خلال الربيع وقليل جداً خلال الشتاء. كان التأثير المباشر للحرارة على نشاط القوقع معنويا وموجبا فى حين كان تأثير الرطوبة النسبية غير معنوى وسالب. وجد أن أعداد القوقع فى حدائق اليوسفى أقل كثيرا من حدائق البرتقال، كما لوحظ وجود إختلاف فى نشاط القوقع فى كل صنف من أصناف البرتقال، حيث كان أعلاه فى حدائق البرتقال أبوسره يليه البرتقال البلدى وأخيرا البرتقال السكرى.

Table (2) : The relative numbers and percentages of *H. vestalis* in each citrus orchard species in each season during 1998 and 1999 at Behera Governorate.

Citrus species		Mandarin		Sokkari		Navel		Baladi	
Season		1998	1999	1998	1999	1998	1999	1998	1999
Winter	Av. No.	10.0	29.6	16.6	38.5	63.2	30.6	29.8	32.7
	%	5.6	12.0	5.5	11.4	15.7	7.8	7.5	8.8
Spring	Av. No.	41.8	63.5	79.3	82.6	96.6	92.9	105.7	99.4
	%	23.4	25.6	26.2	24.5	24.0	23.6	26.7	26.9
Summer	Av. No.	59.4	99.7	115.6	122.2	137.1	155.5	149.4	135.7
	%	33.3	40.3	38.2	36.2	34.1	39.6	37.7	36.6
Autumn	Av. No.	67.3	54.6	91.3	94.1	105.3	113.9	111.5	102.6
	%	37.7	22.1	30.1	27.9	26.2	29.0	28.1	27.7
Total	Av. No.	178.5	247.4	302.8	337.4	402.2	392.9	396.4	370.4
	%	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

"F" test at 0.05 = 5.35
Significant at 0.05 level

Table (3) : The relative numbers and percentages of *H. vestalis* on each citrus species during the four seasons of 1998 and 1999 at Behera Governorate.

Seasons		Winter		Spring		Summer		Autumn	
Citrus species		1998	1999	1998	1999	1998	1999	1998	1999
Mandarin	Av. No.	10.0	29.6	41.8	63.5	59.4	99.7	67.3	54.6
	%	8.4	22.5	12.9	18.8	12.9	19.4	17.9	14.9
Sokkari	Av. No.	16.6	38.5	79.3	82.6	115.6	122.2	91.2	94.1
	%	13.9	29.3	24.5	24.4	25.0	23.8	24.3	25.8
Navel	Av. No.	63.2	30.6	96.6	92.9	137.1	155.5	105.3	113.9
	%	52.8	23.3	29.9	27.4	29.7	30.3	28.1	31.2
Baladi	Av. No.	29.8	32.7	105.7	99.4	149.4	135.7	111.5	102.6
	%	24.9	24.9	32.7	29.4	32.4	26.5	29.6	28.1
General total		119.6	131.4	323.4	338.4	461.5	513.1	375.4	365.2
%		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

"F" test at 0.05 = 0.57
Non-significant differences at 0.05 level