

**ECOLOGICAL STUDIES ON THE FIRST RECORDED SCALE
INSECT, *PINNASPIS ASPIDISTRAE* (SIGNORET)
(HOMOPTERA: DIASPIDIDAE) AND ITS PARASITOIDS ON
MANGO TREES IN EGYPT**

ABD-RABOU, S. AND MONA MOUSTAFA

Plant Protection Research Institute, ARC, Egypt

(Manuscript received 3 March 2005)

Abstract

During the present work, fern scale, *Pinnaspis aspidistrae* (Signoret) (Homoptera:Diaspididae), is recorded here for the first time as a serious pest on mango trees in Egypt. This work includes distribution, parasitoids as well as the abundance of this scale. During 2002 – 2004 the scale *P. aspidistrae* was recorded in 9 localities of 5 governorates in Egypt and it was attacked by parasitoids : *Aphytis matruhi* Abd-Rabou, *Aphytis mytilaspidis* (Le Baron), *Encarsia citrina* (Craw), *Marietta leopardina* Motschulsky and *Habrolepis aspidioti* Compere & Annecke. The seasonal abundance of *P. aspidistrae* and its parasitoids were studied for two successive years from March 2002 to February 2004 on mango trees in Beheira and Qalyubiya Governorates. The obtained results showed that the insect population (preadult , adult female and gravid female) per 100 inch leaves of mango trees has three peaks during May 1st (3460 insects), July 1st (4694 insects) and January 1st (1310 insects) in the first year. In the mean time, the second year it has two peaks during July 1st (4394 insects) and February 15th (1575 insects). The results indicated that *A. mytilaspidis* and *E. citrina* are the effective parasitoids attacking *P. aspidistrae* in Egypt.

INTRODUCTION

Fern scale *Pinnaspis aspidistrae* (Signoret) (Homoptera:Diaspididae) attacks 73 host plant species; including citrus, mango, coconut palm and orchids (Dekle, 1965 and Labanowski and Soika, 2002). This pest feeds on plant juices and causes loss of vigor, deformation of infested plant parts, yellowish spots on leaves and even death of the plant (Beardsley and Gonzalez, 1975). Population dynamics of Fern scale was studied on citrus in Brazil by Gitirana *et al.* (2000). Nada *et al.* (1990) listed the armored scale insects that attacking mango trees in Egypt.

The present work deals with distribution, parasitoids and abundance of this armored scale species on mango trees in Egypt.

MATERIALS AND METHODS

1. Survey and distribution of the armored scale insect, *Pinnaspis aspidistrae* and its parasitoids in Egypt

A survey was carried out all over Egypt during 2002-2004. Infested mango trees with the armored scale insect *P. aspidistrae* were examined in the field, using a pocket lens. Leaves were collected and placed separately in paper bags for further examination in the laboratory. Identification of *P. aspidistrae* was made by examining its adult in Canada balsam, according to Abd-Rabou (2003).

Materials were also kept in a well-ventilated container until the emergence of any parasitoids. Identification of parasitoids was made by examining their mounted adults in Hoyer's medium (Noyes, 1982).

2. Seasonal abundance of the armored scale insect, *Pinnaspis aspidistrae*.

Seasonal abundance of *P. aspidistrae* was carried out on *Mangifera indica* trees (mango) in Beheira Governorate during March, 2002 to February 2004. The plant area selected for these investigations received no chemical control measures for several years. About 10 trees of mango; almost similar in age, shape, size and growth conditions; were randomly chosen for sampling two times a month at biweekly intervals. On each sampling, 100 inch leaves were chosen at random. Thereafter, the leaves were kept in a closed paper bags and transferred to the laboratory to estimate the total number of preadult, adult female and gravid female per 100 inch leaves of each sample by the aid of binocular microscope; where the number of preadult, adult female and gravid female of *P. aspidistrae* were counted per one leaf.

Records of the meteorological factors, mainly the daily means of minimum (D. Min. T.), maximum (D. Max. T.) temperatures and relative humidity (D. M. R. H.), were obtained from the Meteorological Department records. The daily records of these factors were recalculated to get the daily averages within two weeks prior to sampling date.

Simple correlation values were calculated to obtain information about the relationships between the three tested weather factors and the population of *P. aspidistrae*.

3. Seasonal abundance of the armored scale insect, *pinnaspis aspidistrae* parasitoids:

Susceptible stages of *P. aspidistrae* were sampled from mango trees at Beheira and Qalyubiya Governorates. Leaves of mango with scale insects were collected monthly during June 2002 until May 2004 (30 leaves per sample) and transferred to the laboratory. *P. aspidistrae* eggs and first nymphal stages of females were eliminated as

well as any other insect species. The second nymphal stage of female and adult female were recorded per leaf. Each leaf was stored in well ventilated emergence glass tubes and monitored daily for parasitoids emergence. Percent parasitism was calculated according to Abd-Rabou (1997).

RESULTS AND DISCUSSION

1. Distribution of the armored scale insect *Pinnaspis aspidistrae* and its parasitoids in Egypt:

As shown in Table 1 armored scale insect *P. aspidistrae* is recorded in 9 localities of 5 governorates in Egypt. These are Beheira, Beni-Suef, Cairo, Giza and Qalyubiya. Nada *et al.* (1990) recorded 10 armored scale insects attacking mango trees not including *P. aspidistrae*. The results indicated that this species recorded here for the first time in Egypt. *P. aspidistrae* recorded was associated with 5 parasitoids species (4 aphelinids and one encyrtid) (Table 1). These are: *Aphytis matruhi* Abd-Rabou, *Aphytis mytilaspidis* (Le Baron), *Encarsia citrina* (Craw); *Marietta leopardina* Motschulsky, *Habrolepis aspidioti* Compere & Annecke. Abd-Rabou (1999) reported 18 species of hymenopterous parasitoids of armored scale insects in a survey of host plants in three locations.

2. Seasonal abundance of the armored scale insect *Pinnaspis aspidistrae* in Egypt:

The seasonal abundance of *P. aspidistrae* was studied for two successive years from March, 2002 to February 2004 on mango trees in Beheira Governorate. The obtained results in Tables 2 and 3 showed that the insect population (preadult, adult female and gravid female) had three peaks during May 1st (3460), July 1st (4694) and January 1st (1310) in the first year (2002-2003). In the mean time, the second year (2003-2004) has two peaks during July 1st (4394) and February 15th (1575). The simple correlation values indicated positive and highly significant relationships between the seasonal abundance of *P. aspidistrae* population and the average of daily maximum and minimum temperatures ($r = \text{max. } 0.824, 0.5782$ in 2002/03 and 2003/04; $r = \text{min. } 0.911, 0.621$ in 2002/03 & 2003/04). The small insignificantly negative simple correlation (r) value between the seasonal abundance of *P. aspidistrae* population and relative humidity ($r = -0.185$ in 2002/03 & 2003/04; $r = -0.185$ in 2002/03 and 2003/04 185). It is concluded that *P. aspidistrae* occurred all year round on mango. These results agree with the findings of Labanowski and Soika (2002).

Five species of parasitic hymenoptera were reared from samples of *P. aspidistrae* on mango trees. These are listed below in alphabetical order:

Aphytis matruhi Abd-Rabou (Hymenoptera : Aphelinidae)

Aphytis mytilaspidis (Le Baron) (Hymenoptera : Aphelinidae)

Encarsia citrina (Craw) (Hymenoptera : Aphelinidae)

Habrolepis aspidioti Compere and Annecke (Hymenoptera : Encyrtidae)

Marietta leopardina Motschulsky (Hymenoptera : Aphelinidae)

**3- Key to the species of parasitoids attacking *Pinnaspis aspidistrae*
(Modified after Abd-Rabou,1999):**

1. often less than 1 mm. in length; antennae with three to eight segments, rarely with nine; mesoscutum with parapsidal sulci always developed; fore wing with marginal vein extremely long; ovipositor never protruding strongly. Aphelinidae.....2
 - often 0.5-6 mm. in length; antennae with five to twelve segments; mesoscutum with parapsidal sulci seldom developed; fore wing with marginal vein relatively short; ovipositor rarely protruding strongly caudally; male funicle two segmented.....*Habrolepis aspidioti*
2. Antennae 4-6 segmented; fore wing generally with linea calva.....3
 - Antennae 8-9 segmented; fore wing without linea calva; submarginal vein with two setae; fore wing more or less parallel-sided beyond venation and with apex broadly rounded, without an inflexion at apex of reticulum..... *Encarsia citrina*
3. Eyes bare; pronotum composed of a single plate, not membranous in the middle; setae on thoracic dorsum short; metanotum at least as long as propodeum; propodeum acrenulate..... *Marietta leopardina*
 - Eyes hairy; pronotum membranous in the middle, setae on thoracic dorsum conspicuously longer; metanotum distinctly shorter than propodeum, propodeum crenulae in the middle of posterior margin4
4. Thoracic sterna infuscate; mesoscutum 12 setae; forewing with marginal long as width of disk *Aphytis matruhi*
 - Thoracic sterna dusky; mesoscutum 13 setae; forewing with marginal fringe 0.2 times as long as width of disc*Aphytis mytilaspidis*

In Beheira *P. aspidistrae* was parasitized by *A. matruhi*, *E. citrina*, *M. leopardina*, with average parasitism rates of 1.1, 2.0 and 0.7 % during the first year 2002-2003 . Parasitism peak were 3.7, 6.1 and 2.1 % respectively. While in the second year 2003-2004, the average parasitism rates were 2.7, 2.6 and 0.7 %. Peaks of parasitism were 5.7, 7.5 and 1.5 %, respectively. The results revealed that *E. citrina* is the effective parasitoid attacking *P. aspidistrae* in Beheira. Abd-Rabou (1997) found that *E. citrina* was associated with 8 armored scale insect species in different locations in Egypt and

maximum parasitism rate (65%) recorded when *E.citrina* was associated with *Chrysomphalus dictyospermi* (Morgan).

In Qalyubiya, The average parasitism rates by *A. mytilaspidis* and % by *H. aspidioti* were 4.2% and 2.5% during the first year while, in the second year the average parasitism rates were 2.7 % by *A. mytilaspidis* and 1.5 % by *H. aspidioti*, respectively. In the first year 2002-2003, peaks of parasitism of 11.3 and 7.5 % by *A. mytilaspidis* and *H. aspidioti* were recorded during August and September, 2002, respectively. Parasitism peaks rates 9.2 and 5.3 by *A. mytilaspidis* and *H. aspidioti* in the second year 2003-2004 were observed during August and September, 2003, respectively. The results indicated that *A. mytilaspidis* recorded here is a dominant parasitoid attacking this armored scale insect in Qalyubiya.

Table 1. Distribution collection dates of *Pinnaspis aspidistrae* and its parasitoids in Egypt

Distribution		Parasitoids	Date of Collection
Governorate	Locations		
Beheira	Rashid	<i>Aphytis matruhi</i> Abd-Rabou	June, 2003
	Itay El-Baroud	<i>Encarsia citrina</i> (Craw) <i>Marietta leopardina</i> Motschulsky	June, 2003
Beni-Suef	Beni-Adi	<i>Aphytis mytilaspidis</i> (Le Baron)	September, 2002
	El-Fashen	<i>E. citrina</i> <i>M. leopardina</i>	
Cairo	Helwan	<i>E. citrina</i>	August, 2003
	Maadi	<i>A. matruhi</i> <i>E. citrina</i>	October, 2003
	El-Basateen	<i>A. matruhi</i>	
Giza	Dokki	<i>E. citrina</i>	October, 2002
Qalyubiya	Tukh	<i>A. mytilaspidis</i> <i>Habrolepis aspidioti</i> Compere & Annecke	July, 2002

Table 2. Half monthly mean numbers of *Pinnaspis aspidistræ* on mango trees in Beheira Governorate during 2002 - 2003

Date	No. of preadult	No. of adult female	No. of gravid female	Total	Temperature		R. H. %
					Max.	Min.	
March 1 st 2002	215	195	1420	1830	20	8.8	54
15 th	620	310	1355	2285	23	9.8	54
April 1 st	1001	267	1320	2588	22	13	58
15 th	820	380	2150	3350	38	22.8	41
May 1 st	650	490	2320	3460	29	13	49
15 th	601	410	2121	3132	27	17.5	54
June 1 st	513	440	1885	2838	31	18.8	52
15 th	573	320	2800	3693	36	28	56
July 1 st	214	380	4100	4694	35	24	58
15 th	190	415	2101	2706	35.6	25	59
August 1 st	140	401	1870	2411	35	25	60
15 th	100	320	820	1240	33	24	60
September 1 st	70	110	340	520	38	22.5	51
15 th	120	90	125	335	37	21.5	51
October 1 st	160	70	411	641	34.2	23	55
15 th	177	130	419	726	32	21	50
November 1 st	190	157	480	827	28	17.5	55
15 th	210	144	309	663	26	14.2	55
December 1 st	290	150	221	661	24.8	14.2	59
15 th	310	159	299	768	22.2	17.8	65
January 1 st 2003	420	340	550	1310	22	13.2	55
15 th	390	211	420	1021	18.2	12	54
February 1 st	281	195	401	877	26.8	11.8	35
15 th	150	180	745	1075	18	10	62
Average	350.2	261	1207.6	1818.8	28.8	17.9	54.3

Table 3. Half monthly mean numbers of *Pinnaspis aspidistrae* on mango trees in Beheira Governorate during 2003 - 2004

Date	No. of preadult	No. of adult female	No. of gravid female	Total	Temperature		R. H. %
					Max.	Min.	
March 1 st , 2003	310	345	1250	1905	24.5	11.5	54
15 th	420	360	1130	1910	24.2	10	65
April 1 st	480	365	1420	2265	24	8.2	57
15 th	409	410	1708	2527	20	11	66
May 1 st	710	513	2120	3343	25.5	11	54
15 th	915	590	2830	3335	33	15.4	50
June 1 st	811	518	2155	3484	29	17.5	64
15 th	720	420	2988	4128	35	19.5	56
July 1 st	633	511	3250	4394	30.8	22	63
15 th	410	585	2318	3313	28.5	19	62
August 1 st	211	629	1140	1980	32.8	21.2	67
15 th	100	714	920	1734	30	19.5	67
September 1 st	70	510	440	1020	32.8	22.2	61
15 th	114	310	342	794	28.8	21	67
October 1 st	125	118	370	613	28	18	65
15 th	190	186	411	787	27.2	16	61
November 1 st	280	210	415	905	27.5	15	50
15 th	310	270	560	1140	22.5	13.5	70
December 1 st	230	281	512	1022	22.2	12.5	52
15 th	204	285	677	1166	21	14.2	50
January 1 st 2004	210	287	735	1232	19.5	9	53
15 th	213	293	810	1316	20	10	61
February 1 st	240	301	966	1507	17	9.5	70
15 th	270	330	975	1575	15	6.5	60
Average	3577	389.2	1268.4	1974.8	25.8	14.7	60.2

Table 4 . Percent parasitism of *Pinnaspis aspidistræ* on mango trees by different aphelinid parasitoids in Beheira governorate, in relation to the weather factors during 2002 - 2003.

Date	Stages of scale	Percent parasitism			Temperature		R. H.%
		<i>Aphytis matruhi</i>	<i>Encarsia citrina</i>	<i>Marietta leopardina</i>	Max.	Min.	
March 2002	218	0.3	2.6	0.1	20	8.8	54
April	980	3.7	6.1	0.0	22	13	58
May	422	2.1	3.5	0.3	29	13	49
June	358	0.9	2.9	0.7	31	18.8	52
July	123	0.6	1.0	1.2	35.6	25	59
August	98	0.2	0.5	1.7	35	25	60
September	69	0.0	0.3	2.1	38	22.5	51
October	76	0.1	0.6	1.4	34.2	23	55
November	110	0.9	1.0	0.7	28	17.5	55
December	165	1.4	1.5	0.5	24.8	14.2	59
January, 2003	256	1.9	2.1	0.0	22	13.2	55
February	189	0.8	1.5	0.0	26.8	11.8	35
Average	255.3	1.1	2.0	0.7	28.9	17.1	53.5

Table 5. parasitism of *Pinnaspis aspidistrae* on mango trees by different aphelinid parasitoids in Beheira governorate, in relation to the weather factors during 2003 - 2004 .

Date	Stages of scale	Percent parasitism			Temperature		R. H.%
		<i>Aphytis matruhi</i>	<i>Encarsia citrina</i>	R. H.%	Max.	Min.	
March 2003	310	0.5	3.2	0.1	24.5	11.5	54
April	1125	5.7	7.5	0.0	24	8.2	57
May	644	4.1	4.5	0.5	25.5	11	54
June	456	3.1	2.4	0.8	29	17.5	64
July	321	2.1	1.1	1.0	30.8	22	63
August	120	1.1	0.9	1.1	32.8	21.2	67
September	100	0.9	0.7	1.5	32.8	22.2	61
October	80	0.4	0.4	1.6	28	18	65
November	198	1.1	1.5	0.9	27.5	15	50
December	250	2.5	2.9	0.4	22.2	12.5	52
January 2004	285	3.4	3.1	0.0	19.5	9	53
February	230	2.3	3.0	0.0	17	9.5	70
Average	343.3	2.3	2.6	0.7	26.1	14.8	59.2

Table 6. Percent parasitism of *Pinnaspis aspidistrae* on mango trees by different aphelinid and encyrtid parasitoids in Qalyubiya governorate, in relation to the weather factors during 2002 - 2003.

Date	Stages of scale	Percent parasitism		Temperature		R. H. %
		<i>Aphytis mytilaspidis</i>	<i>Habrolepis aspidioti</i>	Max.	Min.	
March 2002	628	1.4	0.8	18	9.6	72
April	867	1.8	1.3	29.6	11.2	55
May	610	2.5	1.3	30.8	17	55
June	579	4.6	2.7	37	21.6	55
July	199	5.7	3.8	38	22.5	60
August	123	11.3	5.7	39	23.5	63
September	154	8.4	7.5	34.1	20.8	47
October	198	6.5	4.1	27.8	14.8	46
November	265	4.5	2.4	28.6	15.5	42
December	369	3.2	0.0	25.4	15.6	47
January 2003	411	0.0	0.0	22.4	13	47
February	298	0.5	0.1	27.4	10.4	31
Average	391.8	4.2	2.5	29.8	16.3	51.7

Table 7. Percent parasitism of *Pinnaspis aspidistrae* on mango trees by different aphelinid encyrtid parasitoids in Qalyubiya governorate and, in relation to the weather factors during 2003 - 2004.

Date	Stages of scale	Percent parasitism		Temperature		R. H. %
		<i>Aphytis mytilaspidis</i>	<i>Habrolepis aspidioti</i>	Max.	Min.	
March 2003	669	1.0	0.3	22	7.4	44
April	888	1.0	0.9	25.2	12.8	61
May	692	1.4	1.1	27.6	13	59
June	597	4.0	1.9	30.2	18.6	63
July	220	5.0	2.1	34.4	22.2	63
August	156	9.2	3.5	34.2	20.8	65
September	176	6.3	5.3	26.4	22.4	67
October	234	3.1	2.2	31.4	19.6	67
November	299	1.1	1.1	36.4	16.8	61
December	415	0.0	0.0	23.2	12.6	70
January 2004	458	0.0	0.0	23	7.6	61
February	342	0.2	0.0	20.2	10.8	70
Average	428.8	2.7	1.5	27.9	15.4	62.6

REFERENCES

1. Abd-Rabou, S. 1997. Parasitoids attacking genus *Aleurolobus* (Homoptera: Aleyrodidae) in Egypt. Acta Phytopathologica et Entomologica. Hungarica, 32 (3-4): 364 - 367.
2. Abd-Rabou, S. 1999. Parasitoids attacking the Egyptian species of armored scale insects (Homoptera : Diaspididae). Egypt J. Agric. Res., 77 (3): 1113 - 1129.
2. Abd-Rabou, S. 2003. Scale insects and their management in Egypt Adv. Agric. Res. In Egypt Vol. 4 (1): 1 - 63.
3. Beardsley, J. W. Jr. and R. H. Gonzalez. 1975. The biology and ecology of armored scales. Annual Review of Entomology, 20: 47 - 73.
4. Dekle, G. W. 1965. Arthropods of Florida Vol.3, Florida Armored Scale Insects. Division of plant Industry, Florida Department of Agriculture, Gainesville. 265 pp.
5. Gitirana, N. J., C.F. Carvalho, B. Souza and L. V. C. Santa -Cecilia. 2000. Population dynamics of the *Pinnaspis aspidistrae* (Signoret, 1869) (Hemiptera : Diaspididae) in citrus trees in Lavras-MG. Ciencia e Agrotecnologia, 24 (3): 632 -645.
6. Labanowski, G. and G. Soika. 2002. The present problems in ornamental plant protection against pests. Progress Plant Protection, 42 1:188 - 195.
7. Nada, M. A., S. Abd-Rabou and G. E. Hussien. 1990. Scale insects infesting mango trees in Egypt (Homoptera : Coccoidea). Proc. ISSIS, VI, Part II: 133 - 134.
8. Noyes, J.S. 1982. Collecting and preserving chalcidid wasps (Hymenoptera: Chalcidoidea). Journal of Natural History, 16: 315 - 334

دراسات إيكولوجية على حشرة المانجو القشرية و طفيلياتها على المانجوفى مصر

شعبان عبد ربه ، منى مصطفى

الجيزة- النقي- معهد بحوث وقاية النباتات - مركز البحوث الزراعية

في هذا العمل تم عمل دراسات إيكولوجية على حشرة المانجو القشرية *Pinnaspis aspidistrae* و طفيلياتها على المانجوفى مصر. أثناء الفترة من ٢٠٠٢ - ٢٠٠٤ تم تسجيل حشرة المانجو القشرية فى ٩ أماكن فى ٥ محافظات و أن هذه الآفة تهاجم بـ طفيليات وهى *Aphytis matruhi* Abd-Rabou, *Aphytis mytilaspidis* (Le Baron), *Encarsia citrina* (Craw), *Marietta leopardina* Motschulsky and *Habrolepis aspidioti* Compere & Annecke. و أن التوزيع الموسمى لحشرة المانجو القشرية و الطفيليات المصاحبة لها تم عمله لموسمين متتالين فى محافظتى البحيرة و القليوبية أثناء الفترة من ٢٠٠٢ - ٢٠٠٤ وقد أظهرت النتائج أن هذه الآفة لها ثلاث قمم فى الأول من مايو (٣٤٦٠ حشرة) و الأول من يوليو (٤٦٩٤ حشرة) و الأول من يناير (١٣١٠ حشرة) فى السنة الأولى. أما فى السنة الثانية فكان لها قمتين فى الأول من يوليو (٤٣٩٤ حشرة) و النصف الثانى من فبراير (١٥٧٥ حشرة). و قد تبين من العمل أيضا ان الطفيليين *Aphytis mytilaspidis* (Le Baron), *Encarsia citrina* (Craw) من الطفيليات المؤثرة فى مهاجمة هذه الآفة.