Egyptian Journal of Biological Pest Control, 19(1), 2009, 1-4

Ecological and Biological Studies on Some Parasitoid Species Associated with *Scolytus amygdali* Guer. (Coleoptera: Scolytidae) in Fayoum Governorate, Egypt

Abd El-latif*, A. Nadia; R. H. A Solaiman and A. A. Abd El-Gayed****

*Plant Protection Research Institute, Agric. Research Centre, Giza, Egypt.

**Department of Plant Protection, Faculty of Agriculture, Fayoum University, Egypt.

(Received: January 4, 2009 and Accepted: January 27, 2009)

ABSTRACT

A study to survey parasitoid species associated with the almond bark beetle, *Scolytus amygdali* Guer. (Coleoptera: Scolytidae) was carried out at Fayoum Governorate, Egypt during the period extended for two years; Jan. 2006 until Dec. 2007. Results revealed the presence of eight hymenopterous parasitoid species parasitizing this insect pest *i.e., Rhaphitelus maculatus* Walk, *Cerocephala cornigera* West, *Cheiropachus quadrum* L., *Eurytoma* sp., *E. morio* Bohem, *Cephalonomia mycetophila* Kieff, *Metacolus* sp. and *Dendrosoter protuberans* Nees. The two main parasitoid species (*R. maculatus* and *C. mycetophila*) had three peaks during the successive years of study 2006 and 2007. The parasitoids were reared under the laboratory conditions (25 ± 1 °C and 65 ± 5 % R.H). Longevity of males and females averaged 12.40 and 18.60 days for *R. maculatus* and 14.10 and 18.70 days for *C. mycetophila*, respectively. Mean number of eggs laid was 29.2 and 21.4 eggs/female for *R. maculatus* and *C. mycetophila*, respectively. Total durations of immature stages were 20.8 ± 0.15 days for *R. maculates* and 18.80 ± 0.12 days for *C. mycetophila.*

Key words: *Scolytus amygdali, Rhaphitelus maculatus, Cephalonomia mycetophila*, Biology.

INTRODUCTION

The almond bark beetle, *Scolytus amygdali* Guer. (Coleoptera : Scolytidae) is a pest of stone and pome fruits (almond, plum, peach, apricot, apple, pear and quince) in the Mediterranean region and southern Europe. (Ben-Yehuda *et al.*, 2002).

Biological control is one of the important methods considered in integrated control programs. Parasitoids are among the principal agents and limiting biotic factors affecting pest population densities.

Survey of parasitoids attacking the almond bark beetles was carried out by several authors; in Egypt, Abd-Allah (1983), identified eight species of ectoprepupal parasitoids in association with each of *S. amygdali* and *Phloeotribus scarabaeoides* such as: *Raphitelus maculatus, Cephalonoma* sp., *Cheiropachus quadrum, Cerocephala cornigera, Eurytoma.* sp., *Monomorium* sp., *Litomastix truncatellus* and *Eupelmus* sp. Abd-El latif (1995), recorded four ectoprepupal parasitoids namely; *R. maculatus, Cephalonoma* sp., *Eurytoma* sp. and unidentified species. Abd-El Ghany (2002) identified five species, *R. maculatus, Cephalonomia* sp., *C. cornigera, C. quadrum* and *Eurytoma* sp. Khalil (2005) identified nine species of parasitoids on *S. amygdale*; *R. macutatus, Metacolus* sp., *Eurytoma* sp. (2 species), *Cerocephala* sp., *D. protuberanus, Holocrepis* sp., *Cerocephala rufa* and *Ipideurytoma* sp. As well, Alfieri, 1976; Ismail *et al.*, 1988; Okill, 1991 and Batt, 1999 recorded some of the abovementioned parasitoid species associated with this pest. Abroad, *R. maculatus* and *C. quadrum* were recorded associated with *S. amygdali* and/or *P. scarabaeoides* by Schaefer, 1964 (in France); Mendel & Gurevitz, 1985 (in Israel); Yang, 1989 (in China); Gonzalez & Campos, 1990 (in Spain); Naremdran *et al.*, 2001, Buhroo *et al.*, 2002 & 2006 (in India) and Stojanovic & Markovic, 2007 (in Serbia).

This work was carried out to survey and to study some biological aspects of the most common parasitoid species associated with *S. amygdali*

MATERIALS AND METHODS

1- Survey and ecological studies:

Survey of the parasitoid species associated with *S. amygdali* and seasonal abundance of the two main parasitoids *R. maculatus* (Pteromalidae) and *C. mycetophila* (Bethylidae) were studied during the period extended from Jan. 2006 until Dec.2007. Newly infested ten cutting branches (20 cm. length. and 5 cm. diameter) were chosen randomly every month from apricot orchard at Ibshawai district, Fayoum Governorate. Sampled branches were transferred to the laboratory and kept in glass jars (30 cm. height and 20cm. diameter), covered with muslin cloth and rubber bands. Emerged parasitoid adults were separated, classified to species according to the identification of (Abd-Allah, 1983; Abd El-Latif, 1995; Abd-El-Ghany, 2002 and Khalil, 2005) and counted.

Simple correlation and regression values were computed to evaluate the relation between the populations of *S. amygdali* parasitoids and climatic

factors (mean min. temp., max. temp. and % RH) by using SPSS v8.0 computer program.

2-Biological studies

- Stock culture

To start the stock culture, infested cutting branches were collected from the field and placed in glass jars covered with muslin cloth and kept under laboratory conditions. Jars were examined daily till emergence of *Scolytus* adults. Newly emerged adults were collected from infested branches and transferred to uninfected cutting branches in similar jars. After one month, these cutting branches were peeled to obtain the full-grown larvae (Youssef *et al.* 2006). For the parasitoids, the initial culture began with adults emerged from the collected hosts. After being coupled, each pair was confined in a Petri dish 5cm. in diameter and provided with full grown *S. amygdali* larvae as hosts and droplets of 25 % sugar solution as source of food for parasitic adults. These dishes were incubated at the same conditions (25 ± 1 °C and 65 ± 5 % RH), inspected daily and parasitized prepupae were transferred to other dishes until emergence of adult parasitoids (Campos & Gonzalez, 1990 and Lozano *et al.* 2002).

Life cycles of the ectoparasitoids, *R. maculatus* and *C. mycetophila* parasitizing prepupae of *S. amygdali* were studied under the same laboratory conditions. Ten couples of newly emerged adults were used as replicates per each parasitoid species. Each pair was placed in a Petri dish (5cm. diameter) provided with drops of 25 % sugar solution for feeding and 5 full-grown larvae of *S. amygdali.* Petri dishes were examined daily to change the host larvae and estimate the fecundity and longevity.

Date of deposited eggs and numbers of eggs /female were recorded to determine the pre-ovipositional, ovipositional and post- ovipositional periods. Twenty newly hatched larvae were transferred each with its host individually in clean Petri dishes as replicates. Petri dishes were examined daily to estimate larval and pupal periods and sex ratios (Campos & Gonzalez, 1990).

RESULTS AND DISCUSSION

1- Survey

Data presented in Table (1) indicated that eight species of parasitoids; *Rhaphitelus maculatus* Walk, *Cerocephala cornigera* West, *Cheiropachus quadrum* L., *Eurytoma* sp., *E. morio* Bohem, *Cephalonomia mycetophila* Kieff, *Metacolus* sp. and *Dendrosoter protuberans* Nees), belonged to four families of order Hymenoptera were recorded on *S. amygdali.* These results are in greement with those of Abd-Allah, 1983; Abd-El-Latif, 1995; Abd-El-Ghany, 2002; Khalil, 2005 and Batt, 2006 in Egypt and Mendel & Gurevitz 1985 in Israel.

Table (1): Survey of parasitoid species associated with *Scolytus amygdali,* infesting apricot branches in Fayoum Governorate for the two years 2006 and 2007.

No	Species	Family	Abundance
1-	*Rhaphitelus maculatus* Walk.	Pteromalidae	High
2-	*Cerocephala cornigera* West.	Pteromalidae	Moderate
3-	*Cheiropachus quadrum* L.	Pteromalidae	Moderate
4-	*Metacolus* sp.	Pteromalidae	Moderate
5-	*Eurytoma morio* Bohem.	Eurytomidae	Low
6-	*Eurytoma* sp.	Eurytomidae	Low
7-	*Cephalonomia mycetophila* Kieff.	Bethylidae	High
8-	*Dendrosoter protuberans* Nees.	Braconidae	Moderate

2-Ecological studies

Seasonal fluctuations of the most common parasitoid species (*R. maculatus* and *C. mycetophila*) were conducted in Fayoum Governorate during the two successive years of study; 2006 and 2007 (Table 2).

Season 2006

As shown in Table (2), parasitoids activity occurred during the period extended from April 1st to Dec. 1st (After a month from appearance of the beetle, *S. amygdali*). Total numbers of the two obtained parasitoids began with 4 adults/10 cutting branches on April 1st (16.5 min. temp., 28.9 max. temp. and 56.8 % RH), followed by gradual increase to record the first peak (33 individuls/10 cutting branches) on May 2nd. The population fluctuated to record two other peaks, 30.0 and 47.5 individuals/10 cutting branches on July 1st and Oct. 1st, respectively. After that, the population decreased gradually until the end of December.

Season 2007

As shown in Table (2), populations of the two parasitoid species took the same trend of season 2006, *i.e.*, the parasitoid species began to appear during April until Nov. thereafter; the populations fluctuated to record few counts. Three peaks were recorded in May, July and Oct. (11.0, 26.0 and 24.0 individuals /10 cutting branches, respectively).

Generally, the relationship between the populations of *S. amygdali* parasitoids and climatic factors (min. temp., max. temp. and percentage of relative humidity) were insignificant during 2006 year. While r values with min and max. temp. were significant ($r = 0.79^{**}$ and 0.80^{**}, respectively) but insignificant with relative humidity in 2007 (Table 2).

The above mentioned results agree with those obtained by Abd-Allah (1978), Abd-El-Latif (1995)

Table (2): Monthly counts of the common parasitoid species, *Rhaphitelus maculatus* and *Cephalonomia mycetophila* emerged from *S. amygdali* per 10 cutting branches of apricot at Fayoum Governorate during the two seasons 2006 and 2007.

Year	2006				2007			
Month	Mean no. of emerged parasitoids	Climatic factors			Mean no. of emerged parasitoids	Climatic factors		
		Mean Temp.		Mean R H %		Mean Temp		Mean R H %
		Min.	Max.			Min.	Max.	
Jan.	0.0	9.0	18.8	58.2	0.0	7.0	18.7	62.5
Feb.	0.0	9.7	21.8	53.6	0.0	7.0	19.8	57.5
March	0.0	11.4	26.3	55.1	0.0	7.9	19.6	55.0
April	4.0	16.5	28.9	56.8	4.0	10.4	26.2	51.0
May	33.0	16.1	31.8	51.3	11.0	14.1	33.7	44.1
Jun	11.0	17.7	37.1	52.5	6.5	19.3	34.3	52.1
Jul.	30.0	21.7	37.4	52.0	26.5	20.5	37.4	52.5
Aug.	6.5	25.1	39.4	52.0	23.5	20.4	38.0	50.5
Sep.	33.5	20.9	34.3	57.6	7.0	21.1	36.0	53.0
Oct.	47.5	19.0	31.3	55.5	24.5	19.1	33.1	53.6
Nov.	14.5	17.6	26.2	56.0	12.5	14.2	30.0	53.1
Dec.	4.5	10.2	21.7	61.5	0.0	8.0	21.9	53.3
R =		0.55	0.50	-0.24		0.79**	0.80**	-0.39

and Abd-El-Ghany (2002) in Egypt, and Campos and Gonzalez (1990) in Spain, who mentioned that the populations of these parasitoid species occurred after two months from the pest appearance and recorded three peaks throughout the season.

Concerning the activity periods, present results differed than those obtained by Mendel and Gurevitz, 1985 in Israel (6 generations), Michalski, 1976 in Poland (reported that the adults of *R. maculatus* had two emergence peaks in late July and late August) and Khalil, 2005 in Egypt who recorded (7 generations).

3-Biological studies

Biological studies were carried out under the laboratory conditions (25 ± 1°C and 65 ± 5 % RH) on prepupal stage of *S. amygdali*.

1- The parasitoid species, *R. maculates*

Durations of immature stages

Durations of egg, larva and pupa were 2.40 ± 0.10 (2-4), 9.30 ± 0.16 (7-13) and 9.10 ± 0.13 (7-12) days, respectively. Total period of immature stages ranged between 17 and 27 days, with average of 20.80 ± 0.15 days. Sex ratio was 4 females: 1 male. The pupae of this parasitoid had no cocoons.

Adult Stage

As shown in Table (3), females of the pteromalid *R. maculatus* laid the first egg after 3-4 days from emergence. Ovipositional period ranged between 10 and 17 days, with a mean number of 29.2 eggs/female (the daily number of eggs averaged 2.17 ± 0.16). Longevity of female was longer (18.6 days) than that of male (12.4 days).

Table (3): Means±S.E., range of adult longevity and egg laying potential of *R. maculatus* and *C. mycetophila* under the laboratory conditions (25 ±1°C and 65±5% RH).

Parameter	Species	
	R. maculatus	*C. mycetophila*
Pre- oviposition (days)	3.00 ± 0.01 (3-4)	3.9 ± 0.12 (3-4)
Oviposition	12.6 ± 0.12 (10-17)	11.0 ± 0.13 (6-17)
Post- oviposition	1.9 ± 0.11 (1-3)	3.9 ± 0.11 (2-7)
Adult longevity ♀	18.6 ± 0.19 (14-24)	18.7 ± 0.17(15-22)
Adult longevity ♂	12.4 ± 0.20 (8-17)	14.1 ± 0.18(11-20)
Total deposited eggs/♀	29.2 ± 0.26 (16-48)	21.4 ± 0.27 (10-46)
Number of eggs/day/female	2.17 ± 0.16 (1.3-3)	2.10 ± 0.19 (1.3-2.7)

In this respect, Campos and Gonzalez (1990) reared the parasitoid, *R. maculatus* on *S. amygdali* under the laboratory conditions of (22 ± 2 °C & 60 ± 5 % RH). They found that the average longevities of males and females were 14.95 and 15.57 days, respectively, while the average fecundity was 44.5 eggs / female. Under these conditions *R. maculatus* completed its life cycle in 17 – 18 days. Michalski, 1976 found that the sex ratio of male to female was 1.0: 4.2.

2- The parasitoid species, C. *mycetophila*

Biological studies on the parasitoid took the same trend as *R. maculatus*, but the larvae pupated in small white cocoons beside the host. Previous studies on the biology of this parasitoid species are rare or nil.

Durations of immature stages

Incubation period of eggs ranged between 2 and 3 days, with an average of 2.40 days. Hatchability was 100%. Larvae of the bethylid, *C. mycetophila* were recorded as ectoparasitoid on prepupal stage. The duration of larval stage ranged between 7 and 10 days (averaged 7.70±0.13 days). Highest

mortality rate was recorded in 1st and 2nd larval instars. Pupal stage lasted 7.93 ± 0.22 days.

Adult Stage

Data in Table (3) demonstrate that the pre-ovipositional, ovipositional and post-ovipositional periods were 3.90 ± 0.12, 11.00 ± 0.13 and 3.90 ± 0.11 days, respectively. Female longevity was longer (18.70 days) than that of male (14.10 days). The mean total deposited eggs/♀ was 21.40 ± 0.27eggs. The mean number of eggs /day/ ♀ was 2.10 ± 0.19.

REFERENCES

Abd-Allah, F. F. 1978. Studies on the shot-hole borer, *Scolytus amygdali* Guer. and its control. M. Sc. Thesis, Fac. Agric., Cairo Univ., 117 pp.

Abd-Allah, F. F. 1983. Studies on certain borer of olive and almond trees in Egypt. Ph. D Thesis, Fac. Agric., Cairo Univ., 172pp.

Abd-El-Gayed, A. A. 2004. Studies on effect of some pesticide residues on some pests attacking tomato and associated predators. Ph. D Thesis, Fac. Agric., Cairo Univ., 46pp.

Abd-El-Ghany, M. A. 2002. Studies on some coleopterous borers infesting fruit and wood trees. M. Sc. Thesis, Fac. Agric., Minofiya Univ., Shibin El-Kom, Egypt, 188pp.

Abd-El-Latif, Nadia A. 1995. Studies on some insect pests of apricot trees and associated natural enemies in Fayoum Governorate. M. Sc. Thesis, Fac. of Agric., El-Fayoum, Cairo Univ., 176pp.

Alfieri, M. A. 1976. The coleopterous of Egypt. Bull. Soc. ent. Egypt, 5: 361.

Batt, A. M. 1999. Survey of the borers attacking deciduous fruit trees in Egypt with reference to certain biological and ecological studies. Egypt J. Agric. Res., 77 (3): 1081 – 1102.

Batt, A. M. 2006. Survey of some entomological parasitoids and predators attacking fruit and wood tree borers in Egypt. Egypt J. Agric.Res., 84 (4): 1079 – 1093.

Ben-Yehuda, S.; T. Tolasch; W. Fancke; R. Gries; D. Dunkelbum; Z. Mendel; P. witzgall; B. Mazemenos and M. Konstantopoulou 2002. Aggregation pheromone of the almond bark beerle *S. amygdali* (Coleoptera: Scolytidae). Bulletin OILB SROP. 25 (9), 259 – 269.

Buhroo, A. A. ; M. Z. Chishti and M. A. Masoodi, 2002. Biocontrol agents of shot hole borer, *Scolytum. nitdus* Schedl (Coleoptera : Scolytidae) infesting apple orchards. India J. Plant Protection, 30(10): 71- 73.

Buhroo, A. A. ; M. Z. Chishti and M. A. Masoodi, 2006. Parasitoid complex and its efficacy in the management of shot-hole borer, *Scolytus nitdus* Schedl (Coleoptera : Scolytidae) on apple trees. J. Biol. Cont., 20(1): 25- 32.

Campos, M. and R. Gonzalez, 1990. Influence of breeding conditions on longevity and fecundity of *Raphitelus maculatus* (Hym: Pteromalidae) reared under standard laboratory conditions. Entomophaga, 35(3): 411 – 420.

Gonzalez, R. and M. Campos, 1990. Rearing of *Cheiropachus quadrum* under standard laboratory conditions. Redia, 73: 495 – 505.

Ismail, I. I. ; N. A. Abo-Zeid and F. F. Abd-Allah, 1988. Ecological and behavioural studies on olive tree borers and their parasites. Agric. Res. Rev., 66 (1): 145 – 152.

Khalil, H. L. 2005. Mechanical and agricultural methods for control of *Scolytus amygdali* (Coleoptera: Scolytidae) on apricot trees at Fayoum Governorate. M. Sc. Thesis, Fac. of Agric., Cairo Univ. pp 60- 75.

Lozano, C. ; T. Gonzalez ; A. Pena ; M. Campos ; M. T. Plaza ; M. Rodriguez ; I. Izquierdo and J. Tamasyo, 2002. Response of parasitoids *Dendrosoter protuberans* and *Cheiropachus quadrum* to attractants of *Phloeotribus scarabaeoides* in an olfactometer. J. Chemical Ecology, 26(3): 791- 799.

Mendel, Z. and E. Gurevitz, 1985. Hymenopterous parasitoids of the almond bark beetle in Israel, Alom Hanotea. 39(12): 1057 -1060.

Michalski, J. 1976. Sex ratio of some chalcids (Hym. : Chalcidoidea) parasitizing *Scolytus* sp. (Coleoptera: Scolytidae) during the development of the host. Polskie-Pismo-Entomologiezne, 4(1): 3-16.

Naremdran, T. C.; A. A. Buhroo and M. Z. Chisti, 2001. Taxonomic studies on four new species of Chalcidoidea (Hymenoptera) of economic importance from Kashmir, India, Entomo., 26(2) : 147 -159.

Okill, A. M. 1991. Studies on some trees in Fayoum Governorate. Ph.D. Thesis Fac. Agric., El-Fayoum, Univ., 183 pp.

Schacfer, L.1964. The almond scolytid, *Scolytus amygdali* in Languedoc. Phytoma, Paris16(159): 36.

Stojanovic, A. and C. Markovic, 2007. The hymenopteran parasitoids of some elm bark beetles in Serbia. Phytoparasitica, 35(3):239-243.

Yang, Y. Q. 1989. One new and other pteromalids parasiting bark beetles in Shaanti, China. (Hymenopterta, Chalcidoidea, Pteromalidae). Entomotaxonomia, 11 (1-2): 97- 103.

Youssef, N.A.; F.F.M. Mostafa ; A.A.M. Okil and H.R. Ali, 2006. Laboratory studies on shot-hole borer, *Scolytus amygdali* Guer. attacking apricot trees and its associated parasitoids at El-Fayoum Annals Agric. Sci., Cairo, 51(2):523-532.