J.Biol.Control, **8** (1), 5-9, 1994

Amitus minervae Silvestri, a Potential Parasitoid of the Sugarcane Whitefly *Aleurolobus barodensis* Maskell

K. ANANTHANARAYANA, K.P. SALIN, Y.SOMASEKHARA GOUD and K.SUBADRA BAI
Sugarcane Breeding Institute, Coimbatore - 641 007

ABSTRACT

Two parasitoids *Amitus minervae* Silv. and *Encarsia ochai* Viggiani were found to occur on the sugarcane whitefly *Aleurolobus barodensis* Mask. *A. minervae* occurred naturally at Coimbatore causing maximum parasitization of the whitefly. Its multiplication rate was as high as 90 times. It killed a large proportion of the female pupae of whitefly. Two to seven wasps developed from one pupa. It was also seen in Rajapalayam area of Tamil Nadu, Surat District of South Gujarat and Buldana area of Maharashtra. Distinguishing morphological and biological characters, habits and potential of *A. minervae* in biocontrol are discussed.

KEY WORDS: *Amitus minervae,Encarsia ochai, Aleurolobus barodensis*

Aleurolobus barodensis Mask. is an important pest of sugarcane assuming serious proportions in the recent past in parts of Bihar, Gujarat, Haryana, Maharashtra, Punjab, Tamil Nadu, Karnataka and Andhra Pradesh. It damages the crop by sucking the sap from the under-surface of the leaves, leading to the development of sooty mould on the honey dew excreted by the pest. It multiplies profusely under waterlogged conditions and in neglected crops. It also multiplies profusely under drought conditions though its survival depended on the crop stand. Mechanical, cultural and chemical control measures are not adopted widely due to the non-availability of labour and difficulty in spraying the grown-up crop. Aerial spraying does not help since the pesticides cannot reach the target insect on the lower surface of leaf. Hence there is a need to develop suitable biological control methods for suppressing this pest.

During the course of the study on the natural enemy complex of sugarcane whitefly, two parasitoids namely *Amitus minervae* Silv. (Platygasteridae) and *Encarsia ochai* Vig. (Aphelinidae) were observed parasitising the nymphs. In addition, *Encarsia tristis* Zehnt. (Aphelinidae) was collected from *A. barodensis* to a very low extent but this was obtained in large numbers from *Neomaskellia* sp., another whitefly infesting sugarcane crop. *Azotus delhiensis* Lal occurs along with *A. minervae* occassionally (Ananthanarayana, 1991).

A. minervae was identified by Dr. Norman F. Johnson, Associate Professor, Ohio State University, U.S.A. and *E. ochai* by Dr. David Rosen, Professor of Entomology, Levi Eshkal School of Agriculture, Israel. *E. tristis* and *A. delhiensis* were identified by Dr. M.Hayat of Aligarh Muslim University, Aligarh, India. Observations were made on the distinguishing morphological characters, habits, biology and potential of *A. minervae* and distinguishing features of other three parasitoids occurring along with it. A brief account of these observations is presented in this paper.

MATERIALS AND METHODS

Observations on the morphology were made after preparing slides of parasitoids and making camera lucida drawings for *A. minervae, E. ochai* and other two parasitoids. Biology was studied by releasing known number of *A. minervae* on a total of 7000 whitefly nymphs of first three instars. Observations on ovipositional habits of the parasitoid, its preference for instars of whitefly nymphs, duration of development, per cent parasitization and rate of multiplication of the parasitoid, symptoms of emergence and number of individuals emerg-

ing per pupa were recorded. Sex ratio was worked out by collecting the adult parasitoids from parasitized pupae. Biocontrol potential of the parasite was studied by working out per cent pupae of both sexes killed and proportionate females killed. The parasitoids were stored at 18 to 20, 10 and 5°C with and without 50 per cent honey and their survival and viability after storage were studied.

The parasitoids were exposed to insecticides endosulfan (0.1%), monocrotophos (0.04%) and malathion (0.1%) sprayed and dried glass jars and also treated cane leaves kept in glass jars to observe for their survival. Suitable control was also maintained.

Whitefly-infested fields were surveyed for occurrence of natural enemies particularly *A.minervae* during our field visits in Gujarat, Maharashtra and Tamil Nadu (Table 3) and the extent of parasitization determined by counting the total number of whitefly pupae and the number of pupae showing parasitoid emergence holes.

RESULTS AND DISCUSSION

A.minervae is a tiny shining black wasp with wings extending beyond last abdominal segment. The hyaline wing membranes have fine spines and marginal fringes. The body and wing measurements are given in Table 1. The female has broad abdomen with ovipositor visible a little (0.05 mm) beyond abdomen. Antenna in female has ten segments, the last three segments together forming a club with faint segmental demarcations across (Plate 1). Males are slender and smaller than females with wings similar to females with marginal fringes. Antenna has 10 to 11 segments, the terminal segment forming a small club with no markings.

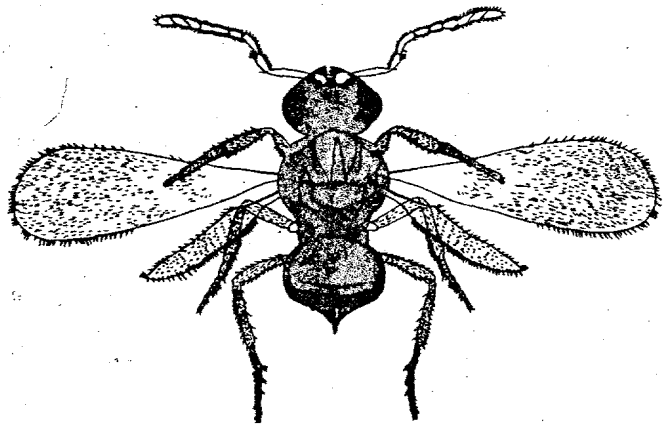

Plate 1. ***Amitus minervae*** **(female)**

Encarsia ochai Vigg. (Plate 2) is a small yellow wasp but bigger than *A. minervae* measuring 1.27 mm long and with clear body segmentation, red eyes, five segmented antennae and hyaline wings. In the female, the

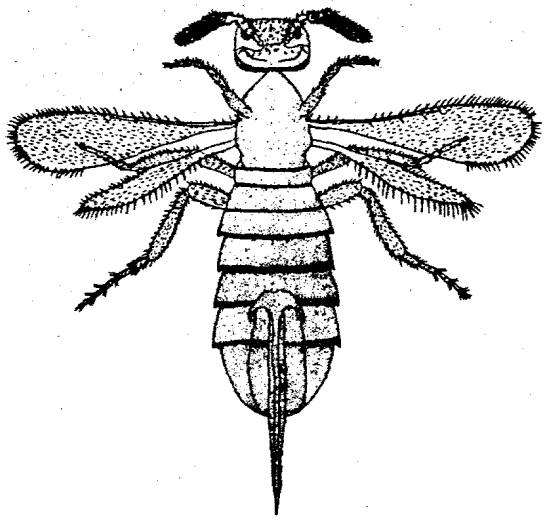

Plate 2. ***Encarsia ochai*** **(female)**

Table 1. Body and wing measurements (in mm) of *A.minervae*

Particulars	Male (Mean ± SE)	Female (Mean ± SE)
Forewing Length	0.862 ± 0.006	0.864 ± 0.009
Forewing Breadth	0.234 ± 0.010	0.260 ± 0.005
Hindwing Length	0.655 ± 0.012	0.610 ± 0.006
Hindwing Breadth	0.080 ± 0.003	0.078 ± 0.002
Body Length	0.803 ± 0.015	0.880 ± 0.020

ovipoistor is long, visible 0.22 mm beyond abdomen. Forewing measures 0.73 mm long and 0.28 mm wide. Hind wing is 0.52 mm long and 0.09 mm wide. Males are very rarely seen. This is also an effective parasitoid and the parasitization level went upto 68 per cent. A low level of parasitization occurred when it coexisted with *A. minervae*. One wasp developed per pupa and the wasp emerged through a single minute hole on the dorsal surface of pupae each hole representing emergence of one wasp. *E.ochai* developed in 21-24 days (Ananthanarayana and Salin, 1992).

Encarsia tristis Zehnt. is a small black wasp, little longer than the above two. It has yellowish white colouration on the dorsal thoracic region. Antenna has six segments with longitudinal markings. In females the ovipositor is prominent. Males have not been obtained in the collection. Eyes prominent large and appear spiny and artistic. It is a potential parasitoid of *Neomaskellia* sp. and a very low number have been collected along with *A. minervae* on *A. barodensis*.

Azotus delhiensis Lal is a shining black small wasp with a stout abdomen and red eyes. Wings are with irregular shades of dense fine spines. Antenna eight segmented with longitudinal markings. It moved fast by skipping or jumping. Since it occurred generally with *A. minervae*, its role as a parasitoid on *A. barodensis* or hyperparasitoid of *A.minervae* needs to be studied.

Wasps of *A.minervae* emerged during the early hours of morning and were active and fast moving. Mating took place immediately after emergence and oviposition followed shortly thereafter. The females before oviposition tapped the host with its antennae and on finding its suitability moved on to leaf surface and oviposited by backward thrust of ovipositor into the host body as has been observed in other platygasterids (Clausen, 1940). The eggs are lemon shaped with short tapering rounded end on the front and narrow tapering tail end. The eggs can be easily made out under magnification (Plate 3).

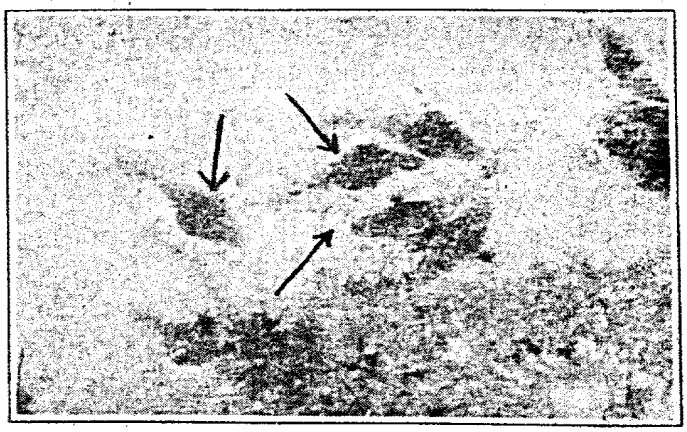

Plate 3. *A.minervae* eggs (indicated bt arrow)

The first, second and third instars and early fourth instar of whitefly were parasitised before deposition of wax coating. The duration of development and per cent parasitization varied with the instar of the host. It exceeded 65.0 per cent in first instar, about 45.0 per cent in second instar and 16.0 per cent in third instar. In all cases, the wasp emerged from the pupal stage of the host. The development period varied from 45-57 days in first and second instar and 30-35 days in third instar. The wasps made large circular holes through the dorsum of puparium for emergence. In *A. minervae* the number of wasps per puparium

Table 2. Multiplication rate of *A.minervae*

	I set	II set	Mean
Number of pairs of parasitoids released	30 pairs	50 pairs	40 pais
No. of whitefly pupae	1519	1670	1595
No. of pupae parasitized	706	1095	900
Per cent parasitization	46.0	65.0	56.0
Total number of parasitoids emerged	2637	3100	2868
Multiplication rate	90 times	60 times	75 times

varied from 2-4 in male and 3-7 (rarely eight) from female. When heavy parasitization occurred, more than 70.0 per cent of female and 30.0 per cent male pupae were killed (Ananthanarayana and Salin, 1992). Sometimes there will be total parasitization.

In the field, the parasitoids emerged 8-10 days later than the whitefly adults and continued for 5-14 days. This is advantageous particularly in fields with partial parasitization, in that by the time the parasitoids emerged, the whitefly eggs started hatching and/or first instar nymphs settled and the parasitoids readily oviposited.

The parasitoids collected from field were predominantly males as compared to those collected from caged pupae. Out of 2470 parasitoids collected from the field, 2140 were males and 330 females, the sex ratio being 7:1 (M:F); while under caged condition, out of 243 parasitoids, 125 were females and 118 males, the ratio being almost 1:1. This indicates that females after mating dispersed in search of host nymphs for oviposition while males remained on the under surface of leaves (Ananthanarayana and Salin, 1992).

The mated females of *A. minervae* on dissection were found to contain an average of 700 eggs. The exact number of eggs laid per host nymph by this parasitoid needs to be studied. However, in one instance, a third instar nymph dissected had about 20 eggs. This indicates that the parasitoid may be host density- dependent and in the absence of sufficient number of host population, superparasitism may occur.

The multiplication rate of this parasitoid was found to be high varying from 60-90 times (Table 2).

The parasitoids can be maintained alive when fed on 50.0 per cent honey at 19-20°C for 2-3 days and at 10°C upto 7 days but storage at and below 10°C appeared to affect the parasitoid's viability and fecundity adversely. Since the emergence of the parasitoid continue for 5-14 days, the leaves with parasitized pupae can be collected when symptoms of parasitoid emergence appear and transported overnight. The leaves with parasitized pupae are folded backwards individually and 15-20 such folded leaves were held loosely by rubber bands and 10-15 such bundles were loosely packed in wet

Table 3. Extent of parasitization by *A. minervae* at different locations

Location	Sugar Factory	Year	No. of fields	Per cent Parasitization
Tamil Nadu				
Rajapalayam	M/s Dharani Sugars and Chemicals Ltd	1989	6	2.5 - 5.4
		1990	6	2.6 - 8.4
		1991	2	28.0 - 42.0
			3	44.0 - 80.0
Vadapathimangalam	M/s Thiru Arooran Sugars Ltd	1989	1	1.0
Vellore	Vellore Co-op. Sugar Mills Ltd	1989	2	1.0 - 2.0
Gujarat				
	Shree Khedut Sahakari Khand Udyog Mandali Ltd, Bardoli	1990	2	57.0
	Shree Madhi Vibhag Sahakari Khand Udyog Mandali Ltd, Madhi	1990	1	35.0
	Shree Maroli Vibhag Sahakari Khand Udyog Mandli Ltd	1990	3	2.0 - 38.0
Maharashtra				
Telegaon	M/s Jeejmata SSK Ltd, Shankar Nagar	1987	2	36.0 - 40.0

cloth. This wet cloth bundle was wrapped in a single layer of plastic gunny sheet and tied. This kept the leaves turgid and aerated. On reaching the release spot, these leaves are cut into small bits, cut ends placed in glass/plastic containers with 2 cm height of water. This can keep leaves without drying and parasitoids normally emerged upto 7 days. Since the parasitoids showed better performance when released on first instar whitefly, it should be possible to multiply the same in large numbers if releases are made about 10-12 days after eggs are laid by whitefly, by which time settling of first instar would have commenced. Care has to be taken to see that ants do not attack the pupae on these leaves.

Attempts were made to multiply this parasitoid on *Bemisia tabaci* G. on cotton/brinjal and on *Trialeurodes ricini* Misra on castor but without success. This parasitoid appeared to be specific to *A. barodensis* Mask, but whether other species of *Aleurolobus* are parasitised needs to be studied.

From preliminary observations made, these parasitoids were found to be highly sensitive to insecticidal application at normal doses recommended for sugarcane whitefly control. Endosulfan (0.1%), monocrotophos (0.04%) and malathion (0.1%) caused 100 per cent mortality of adult wasps within an hour of exposure to treated surface.

A. minervae occurred naturally at Coimbatore on *A.barodensis* and most of the time it caused total parasitization. This may be the reason for whitefly population not building up at Coimbatore. The parasitoid is usually active at Coimbatore between July and March. This species has also been observed in other white fly - infested sugarcane fields in villages detailed in Table 3 under respective sugar mill areas in Tamil Nadu, Gujarat and Maharashtra.

In heavily-parasitized fields, the whitefly population generally did not build up or only a very low population developed since in such fields, the majority of females were killed. This has been observed in Coimbatore and parts of Rajapalayam area of Tamil Nadu. About 4000 wasps of this species were released in M/s Arooran Sugars Limited mill area, Vadapathimangalam, an endemic area for whitefly infestation and its establishment is being watched.

Considering the above points it can be summarised that *A.minervae* is a potential parasitoid of sugarcane whitefly *A. barodensis*. There is a need to conserve and redistribute this parasitoid wherever whitefly is a problem. Insecticidal spraying (ground or aerial) should be minimised and there is also a need to identify relatively selective insecticides.

ACKNOWLEDGEMENT

The authors are indebted to the Director, Sugarcane Breeding Institute for the facilities and encouragement given in the conduct of this study.

The help in identifying the parasitoids by Dr. Norman F.Johnson, Dr.David Rosen and Dr.Mohammad Hayat is gratefully acknowledged. The authors are thankful to the Cane department staff of the sugar factories for their help and facilities in surveying the natural enemies of whitefly.

REFERENCES

ANANTHANARAYANA, K. 1991. Parasite complex of whitefly. *A. Rep. Sug. Cane Breed. Inst. Coimbatore* (1990-91), p.60.

ANANTHANARAYANA, K. and SALIN, K.P. 1992. Parasite complex of sugarcane whitefly. *A. Rep. Sug. Cane Breed. Inst.*, Coimbatore. p. 62.

CLAUSEN, C.P. 1940. Platygasteridae - Entomophagus Insects. McGraw Hills Book Co. Inc., pp. 240-241.