Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(3): 1126-1128

Received: 28-03-2020
Accepted: 30-04-2020

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First report on new record of natural enemy complex on sugarcane whitefly *Aleurolobus barodensis* Mask. in Southern India

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Abstract
Whiteflies are detrimental pests attacking wide range of agricultural crops predominantly in the tropics and subtropics. *Aleurolobus barodensis* Mask. is an important pest of sugarcane assuming serious proportions in the recent years in parts of North Karnataka. It damages the crop by sucking the sap from the under surface of the leaves, secreting honey dew leading to the development of sooty mould. It multiplies profusely under waterlogged and drought conditions. The new cropping systems, introduction of new genotypes and climatic variations paved way for emergence of some new pest problems like white grub, root borer, wire worms, sugarcane woolly aphid and whiteflies as additional threat in recent years. During 2019, outbreak of whitefly was observed in sugarcane area of Northern Karnataka and about 1000-1500 hectares of area crop was infested with whitefly. Current control strategies are mainly focused on chemical control which is uneconomical in sugarcane crop; hence, the study was carried out to record natural enemies of whiteflies in sugarcane ecosystem. During roving surveys, infested leaves were collected and kept for observation in laboratory. Two new parasitoids were noticed from the whitefly nymphs, *viz.*, *Encarsia muliyali* (Mani) and *Encarsia isaaci* (Mani), among which *Encarsia muliyali* was recorded for the first time in Southern India and *E. issaci* was recorded for the first time in Karnataka. Laboratory studies indicated that 10-12 per cent parasitization by *Encarsia issaci*, whereas 8-10 per cent by *Encarsia muliyali* on sugarcane whitefly. These are the two major parasitoids that were observed in combating pest in sugarcane. Encouraging natural enemies by conservation and augmentative releases in sugarcane ecosystem without any chemical intervention resulted in the better management of sucking pests.

Keywords: Whitefly, *Aleurolobus barodensis*, parasitoids, sugarcane, ecosystem, *Encarsia*

Introduction
Sugarcane (*Sacchrum officinarum* L.) is a major commercial crop cultivated mainly in tropical and subtropical regions. This crop provides rich sources of food (sugar, jaggery and syrups), fiber, forages, energy, chemical and fertilizer. Sugarcane is attacked by many insect pests which includes borers, defoliators, sap sucking insect pests and root feeders etc. Among these sucking pests plays a major role in affecting the quantitative and qualitative parameters of sugarcane. Whiteflies are generally small insects belonging to order Hemiptera. They belong to the family Aleyrodidae and super family Aleyrodoidea which consists of more than 1550 described species. Among the species of whiteflies only 3 species are known to infest the sugarcane, viz., *Aleurolobus barodensis*, *Neomaskellia bergii* and *N. andropogonis* of which the latter two species are sporadic in occurrence and only *Aleurolobus barodensis*, is reported to occur in serious proportions [1]. The life cycle consists of egg, nymph and adult. The adults are small and yellow in colour which measures about 3mm long. The nymphs are ovate and body with black and grey coating. There are four nymphal instars and oftenly the fourth nymph stage is referred as puparium. Nymphs suck the sap, the leaves turn to yellow colour, in severe cases of infestation it turns pinkish and gradually dry up [2]. Severe infestation causes stunted crop and reduced juice quality. Due to sucking the honey dew secretion deposited on upper surface of the lower leaves leads to development of sooty mould which renders the crop unfit as fodder. There is a 30-40 per cent loss in sucrose in whitefly affected canes [3]. Severe whitefly infestation may lead to reduction in cane yield up to 22.9 units [4]. Water logging coupled with low levels of nitrogen causes outbreak of this pest. Leaching of nitrogen due to heavy rains also results in heavy pest build up [5].

A severe outbreak of this pest occurred for the first time in 1946 in Nizamnagar (Shankar Nagar) area of Hyderabad state under water logged conditions and in the areas of low dose of nitrogen application. Similar outbreaks of the pest have since been reported in Bihar, Punjab and Tamil Nadu. An epidemic of this pest has been reported from Maharashtra in 1984 and from Gujarat in 1990 [6]. An outbreak of this pest has also been observed in North Karnataka (Bilagi taluka of Bagalkot district) during September 1997 [7]. As per the regular surveys conducted from 2006-2015 in 10 sugar factories located in Belagavi, Bagalkot and Vijaypur districts of Northern Karnataka, root borer (*Polyocha depressella)*, wire worms (*Agriotes* spp.) and whitefly (*Aleurolobus barodensis*) were considered to be the new threat in recent years in many of the factory zones, from July to December months [8]. Again in 2019, outbreak of this pest was observed in Mudhol taluka of Bagalkot district, Hukkeri and Bailahongal taluka of Belagavi district. About 1000-1500 hectares of area was infested with whitefly.

In recent years due to deviations in climatological conditions, the sugarcane growing tracts of Northern Karnataka was severely affected by this pest both in drought and flood situations. Sustainable crop production is mainly focused on ecofriendly control measures like encouraging predators, parasitoids and entomopathogens, thus present study was aimed to explore the natural enemy complex of sugarcane whitefly.

Materials and Methods

Survey: Systematic and continuous roving survey were carried out in different locations in Belgaum and Bagalkot district of North Karnataka during June to September months of 2019 to understand distribution of host plant range and natural enemies of sugarcane whitefly of India.

Collection of samples: During the surveys, whitefly infested sugarcane leaves were thoroughly observed with the hand magnifying lens for the presence of any parasitoids around the nymphs and pupae of this pest. The infested leaf found with parasitoids was collected for the further laboratory studies.

Laboratory studies: Infested leaves that collected during the surveys were made into small bits and were placed in a humid chamber (to prevent desiccation of sugarcane leaf) to observe the emergence of parasitoids. Number of days taken by the parasitoids for its emergence from the day of collection was recorded. The parasitoids emerged from this insect were preserved in 70 per cent ethyl alcohol and later these specimens were sent to taxonomist for the taxonomic identification to Dr. Mohammad Hayat, Department of Zoology, Aligarh Muslim University, U.P, India.

Results and Discussion

The specimens that were sent for identification were got identified and which belongs to the order Hymenoptera and the family Aphelinidae. Among those specimens two different species were identified as *Encarsia muliyali* and *E. issaci*. Both of these were collected from ARS, Sankeshwar (Belagavi), among which *Encarsia muliyali* was recorded for the first time in Southern India and *E. issaci* was recorded for the first time in Karnataka. Both of these parasitoids took nearly 3-4 days for emergence from 3rd instar nymphs of *A. barodensis*. Laboratory studies indicated that 10-12 per cent parasitization by *Encarsia issaci*, whereas 8-10 per cent by *Encarsia muliyali* on sugarcane whitefly. These are the two major parasitoids were observed in combacting pest in sugarcane ecosystem.

The family Aphelinidae is a small group of Chalcidoidea containing 36 genera and more than thousand species globally and a major source of biocontrol agents of economically important pest species [9]. Generally, majority of the aphelinids are known as parasitoids of sternorrhynchous Homopetra. Species of the genera like *Encarsia* Foerster [10] attack Aleyrodidae. As per a checklist of Aphelinidae (Hymenoptera: Chalcidoidea) of India, which includes a total of 269 species under 24 genera [11].

Encarsia muliyali is a yellow coloured tiny parasitoid which belongs to family Aphelinidae; super family Chalcidoidae (Fig. 1) and described this species from Cuttack (Odisha) from *A. barodensis* on sugarcane [12]. It was later reported from Uttar Pradesh from the same host [13]. Later, it was described from Thailand from the same host insect [14] as a different species, but that species was synonymized with Mani's species by Hayat.

E. issaci this parasitoid is relatively larger than the *E. muliyali* and has black body with yellow thorax (Fig. 2) and described this species from Cuttack (Odisha) from *A. barodensis* on sugarcane[12]. It was later reported from Uttar Pradesh from the same host[13]. Later, reported the host as *Neomaskellia bergii*[15]. This species recorded from Andhra Pradesh and Tamil Nadu from undetermined aleyrodids on sugarcane [16].

However, extensive listed fauna of parasitoids was used to control whiteflies of various species of the genera *Eretmocerus* and *Encarsia* against silverleaf whitefly, *Bemisia tabaci* [17]. By introducing or encouraging and augmentative releases of natural enemies through mass production [18], the population of pest organisms decline. Conservation and augmentative releases of *Encarsia* parasiotoids as well as awareness programmes on the natural build up of the *Encarsia guadeloupae* to be conducted in all epidemic zones of coconut [19]. Management of coconut rugose whitefly using *Encarsia* parasitoids and *Isaria fumosorosea* [20].

Plate 1: *Encarsia muliyali*

Plate 2: *Encarsia isaaci*

Conclusion

Sugarcane whitefly, *Aleurolobus barodensis* which was considered as a minor pest is assuming serious proportions in recent years in Northern Karnataka due to climate change. The current blanket recommendation and indiscriminate use of pesticides against sucking pests may have negative impact on natural enemies. Biological control is recognized as the best alternative to the use of insect ides for controlling insect pests. Augmentative releases of *Encarsia* parasitoid to suppress whitefly population growth. At present, biological control of whiteflies with *Encarsia* is more feasible in a crop like sugarcane where chemical control is uneconomical. Further research is needed to improve our ability to use of these potential parasitoids inundatively to produce crops with below ETL whitefly densities.

Acknowledgement

Authors are thankful to Dr. Mohammad Hayat, Department of Zoology, Aligarh Muslim University, U.P, India who helped in identifying the above mentioned parasitoid species.

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