BIOLOGICAL STUDY OF PARASITOID ENCARSIA SP OF SUGARCANE WHITEFLY ALEUROLOBUS BARODENSIS (MASKELL) FROM SINDH, PAKISTAN

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ABSTRACT: Whitefly is one of the serious sucking pests of sugarcane crop. There is an essential need to control through economical and environmental friendly natural enemies. Among them the *Encarsia* sp. is most important parasitoids of whitefly *Aleurolobus barodensis*, for the control of whitefly the biological development stages of *Encarsia* sp. were studied in field/ laboratory condition at PARC-National Sugar and Tropical Horticulture Research Institute, Thatta. The *Encarsia* sp. completed their life stages from egg to pupa except adult stage in sugarcane whitefly nymphal instars. The adult head, legs, body was yellow colour with membranes wings. Female adult of *Encarsia* sp. lays their eggs in the all nymphal instar of hosts from 1st to 4th. The oviposition period of *Encarsia* sp. was observed ranged from 5-16 days with mean 8.57±1.01, the fecundity of female ranged from 53-222/ female with mean 123.47±19.60. However, the sex ratio of female was more than male adult with an average 56.67±16.44 %. The Longevity of adult females was ranged from 6-18 days with a mean of 13.03±1.18 and male longevity ranged from 5-16 days with a mean of 10.33±0.92 days. However, the overall longevity of adults was ranged from 5-16 days with mean average 11.83±1.26 days.

Keywords: *Encarsia* sp., Biology, Parasitoid, *Aleurolobus barodensis*, Sugarcane.

(Received 18-07-19 Accepted 08-09-19)

INTRODUCTION

Sugarcane is a major cash crop of Pakistan and grown under different agro ecological environments (Chohan *et al*., 2014). It contributes 0.5 % share in GDP and 2.9 % in agriculture's value addition (Survey, 2019). Sugarcane crops take 12 to 18 months, many insect pest species and diseases attacked from germination to harvesting. The main causes of the low yield are attack of insect pests (Iqbal *et al*., 2012). Due to insect pest infestation and diseases attack, the yield of sugarcane declines by 20.0 and 19.0 % respectively. However, reduction in sugar recovery 15 and 20 % in cane yield loss in sugarcane has been estimated (Avasthy, 1977). (Patil *et al*., 2004) reported that about 125 species are major pest of sugarcane crops in various part of the world. (Ahmed *et al*., 2004) recorded about 117 species of insect pest associated with sugarcane which were identified. Among these species, sugarcane whitefly is a destructive insect pest, after borer complex. The spider mites and whiteflies have been recorded attacking on sugarcane crop (Nikpay and Geobel, 2016)

Now a days, sugarcane whitefly (*A. barodensis*) is a serious insect pest of sugarcane crop, which is distributed in different countries of the world *i.e.* Philippines, Taiwan, India, Pakistan, Malaysia, Thailand and Java, etc. on different host plants of Poaceae: *Erianthus aurundanaceum*, *Miscanthus* sp, *Saccharum officinarum* (Evans, 2008), which cause heavy losses in CCS % and yield. The whiteflies are challengeable issue throughout the word for researchers, the adults of whiteflies are tiny, white or dull white in colour. (Gonsebatt *et al*., 2012) reported that the whitefly attacks on several crops in open field and in the greenhouse, which may cause changes in plant anatomy, physiology and biochemistry. Whiteflies are one of the major pests of ornamentals, vegetables, fruit crops, cereal crops, cotton, sugarcane, etc. All nymphal instars of whitefly and adults cause direct damage to crops and also act as carriers of several plant viral diseases, and primary source for the development of sooty mould fungi (Martin *et al.,* 2001).

In bio-control program, *Encarsia* sp. is the most successful agents to control different whitefly species on wide range of agriculture crops. Due to economic significant worldwide researchers interested in the taxonomy of particularly *Encarsia* sp. which is parasitoid of whiteflies (Trjapitzin *et al*., 1996; Schmidt *et al.,* 2001; Nikpay, 2017) reported that *Encarsia inaron* was more common than *Eretmocerus delhiensis* on sugarcane whitefly. While, the majority of *Encarsia* species is heteronymous, with males and females feeding and complete life cycle in various hosts. Females commonly grow as principal parasitoids, whereas males expand hyper parasitically on nonspecific or heterospecific

whitefly parasitoid nymphal instars or pupae (Hunter *et al.,* 1996). (Gerling *et al*., 1998) observed that for host feeding *Encarsia* female use their pointed ovipositor to penetrate host cuticle. Ananthanarayana, (1994) were found two parasitoids *Amitus minervae* Silv and *Encarsia ochai* Viggiani on the sugarcane whitefly *Aleurolobus barodensis* Mask. The *A. minervae* multiplication rate was as high as 90 times and two to seven wasps developed from one pupa. However Begum, (2011) reported that *Encarsia* sp. widely used in many countries for the control of different species of sugarcane whitefly.

The Aphelinid parasitoids are extensively used in biological control of agriculture, mainly the whiteflies. (Schmidt and Polaszek, 2007) observed positive identification characters of *Encarsia* sp. (females): antenna eight segmented; fore and hind tarsi five segmented and scutellum constantly with two pairs of setae. (Noyes, 2003) reported *Encarsia* genus contains 280 described species. While Heraty *et al.,* (2008) reported that the 343 *Encarsia* genus were described, which is parasitoid immature stages of various Aleyrodidae, scales, aphids, Lepidoptera. (Askarianzadeh and Minaemoghadam, 2018) recorded two parasitoid wasps from Iran *E. iranon* (Walker) and *Eretmocerus delhiensis* Mani as a Parasitoid of *N. andropogonis* sugarcane whitefly. The adult parasitoid of whitefly emerges through a hole which makes on dorsum of the host (Liu and Stansly, 1996). Two parasitoids of mulberry scale, *Encarsia berlesei* and *Aphytis proclia* were parasitize on *A. barodensis* (Aliakber *et al.,* 2010). The *Encarsia isaaci* Mani is parasitoid of, *A. barodensis* and *Neomaskellia bergii*. *Encarsia* (Lahorensis) *macroptera* Viggiani is parasitoid of *Aleurolobus barodensis*, which is distributed India Maharashtra Punjab, Uttar Pradesh and Pakistan (Hayat, 1989a; Hayat, 1998).

(Waage and Greathead, 1988) stated that the International Institute of Biological Control (CIBC) collected a record of 563 species of insect from 1063, against different 294 insect pests in 168 countries of the world. (Greathead, 1986a) reported that in classical biological control 570 parasitoid species has been released on 2110 occasions. The traditional control of sugarcane borer complex and sucking insect pests especially whiteflies are difficult to control through pesticides which create problems of underground water pollution and resistant in pests, forcing efforts in the direction of another means of control (Landa *et al.,* 1994). The *Encarsia* genus is a member of Aphelinids, familiar parasitoids of whiteflies were used in various biological control management programs. Investigation of biology and preferences of parasitoids is utmost important before using it in a biological control program and against specific insect pest. The present study was conducted to determine the biological parameters of *Encarsia* sp. parasitizing on sugarcane whitefly *Aleurolobus barodensis.*

MATERIALS AND METHODS

Collection and identification of Parasitoids: Parasitoids were collected directly from different sugarcane whitefly infested field through aspirator and also collected heavily infested leaves bearing healthy and bigger size puparia (parasitized and un-parasitized). The leaves cut into small pieces and kept in cages, prepared from plastic bottle having size 25X13X25cm, the lid of bottle covered with a net of 40 mesh size. For the identification of parasitoids, the emerging adult was collected from the rearing cages and was identified on the basis of morphological and taxonomic keys at Insect systematic laboratory, Department of Entomology, Sindh Agriculture University Tandojam. After the identification of significant parasitoid, the study of biology was carried out according to its life cycle behavior.

Stock culture of sugarcane whitefly: The biological study of the sugarcane whitefly parasitoid *Encarsia* sp. was conducted at the PARC-NSTHRI, Thatta. For the maintained the stock culture, sugarcane plants were grown in plastic bags. After six weeks the potted sugarcane plants were kept in sugarcane whitefly culture cages for egg-laying, when eggs hatched and whitefly reached at different nymphal stages, the identified parasitoid adult was released on plants.

Procedure for biological studies of *Encarsia* sp: The biology of *Encarsia* sp. was evaluated on sugarcane whitefly under field/ laboratory condition in rearing cages and plastic bottles. The material of different stages of the sugarcane whitefly and adults of *Encarsia* sp. were used from stock culture. The oviposition period, fecundity, sex ratio, longevity of male and female were determined on the daily basis. For the oviposition period, all nymphal instars and pupa of *A. barodensis* were separately exposed to freshly emerging a pair of *Encarsia* sp. adults. For the sex ratio 30 adults were observed and then calculated %. For the male and female longevity newly emerged a pair of adult male and female were kept in small plastic bottles, the head of bottles was closed with the muslin cloth. The adult diet was supplied regularly.

Statistical Analysis: The data were analyzed statistically by following analysis of variance (ANOVA) for statistical analysis of data the software M-stat 8.1 was used.

RESULTS AND DISCUSSIONS

The parasitoid *Encarsia* sp. of sugarcane whitefly *A. barodensis* are tiny wasps completed their life stages from egg to pupa except adult stage on sugarcane

whitefly nymphal instars. The *Encarsia* sp. females and males are endoparasitoids of nymphal instars and pupa.

Eggs: Female adult of *Encarsia* sp. lays their eggs on the all nymphal instar i.e. 1st, 2nd, 3rd and 4th of sugarcane whitefly *A. barodensis* and able to complete their development. (Nechols and Tuber, 1977a) reported that all host stage from 1st to 4th nymphal instar and pupal stages were found susceptible for parasitoid, *Encarsia formosa* oviposition, these report are conforming the present study. (Ys *et al.,* 1089) observed that eggs and crawler of *A. barodensis* did not parasitoid by *Encarsia* sp. (Hu *et al.,* 2002) found that all four nymphal instars of greenhouse whitefly were parasitoid by *E. formosa* for completion of their developments. The eggs hatch inside nymphal instar as a larva that feeds within the body of nymph and completes their life cycle and emerges as an adult. (Avila, 1988) also reported that eggs are laid within the body fluid of the host.

Oviposition period: The data presented in Table-1 indicated that the oviposition period of *Encarsia* sp. was noted ranged from 5-16 days with mean 8.57±1.01. **(**Laska, 1980) observed the life cycle of *E. formosa* averaged 25.4 days, and the average interval between oviposition by the parasite and blackening of the whitefly pupae was 11.5 days.

Fecundity: The data in Table-1 showed that the fecundity of female ranged from 53-222/ female with mean 123.47±19.60 were recorded. Urbaneja *et al.,* (2006) recorded fecundity of parasitoid female *E. mundus* were 147.8±12.6 on tomato crop. Whereas, (Vet, 1980) observed that at 17°C, the female of *E. formosa* in 20 days period were laid 165.6 average eggs.

Sex ratio: The sex ratio of sugarcane whitefly parasitoid *Encarsia* sp. adults was observed. From the result which is depicted in table-1 indicated that the sex ratio of female was more than a male adult with an average 56.67±16.44 %. (Liu, 2007) reported that female sex ratio of *Eretmocerus melanoscutus* parasitizing *Bemisia tabaci* on cabbage was 53.58%.

Adult: The parasitoid adults of *Encarsia* sp. are winged and actively search for whitefly hosts, while they laying eggs, larvae and pupae live entirely within the juvenile whitefly. The colour of adults head, legs, body is yellow with membranes wings. Ananthanarayana *et al.,* (1994) reported that *Encarsia ochai* (Vigg) is a small yellow wasp with precise body segmentation, whereas, *Encarsia tristis* (Zehnt) is a tiny black wasp, it is a potential parasitoid of *Neomaskellia* spp. and a very low number has been observed in *A. barodensis.* Adult females were larger in size with broad abdomen with visible ovipositor where the adult male was smaller in size with slender body. The data revealed in Table-1 showed that the Longevity of adult females were larger than male, the female lasts 6-18 days with a mean of 13.03±1.18 and the male lasts 5-16 days with a mean of 10.33±0.92 days. (Qui *et al.,* 2004) recorded that the average longevity of *E. formosa* (Dutch) strain reared on whiteflies (at 25 °C on tobacco plants) was 11.2 days. Drobnjakovic *et al.,* (2016) observed adult longevity of *E. formosa* (Gahan) in host presence was 12.45 days. (Avila, 1988) found that the longevity of *E. cibeensis* females was 17.41 days. Whereas, adult females of strains of *Encarsia* and species of *Eretmocerus* lived longer at low temperatures in the presence or absence of hosts (Qiu, 2004). However, overall longevity of adults was observed ranged from 5-16 days with mean average 11.83±1.26 days. (Nechols and Tauber, 1977b) reported that *E. formosa* completed development duration at 25±2°C from oviposition to adult in 17.04 days on the third instar nymphs of *Trialeurodes vaporariorum.*

Table-1. Duration of various development stages of *Encarsia* sp on sugarcane whitefly *Aleurolobus barodensis* (Mean±SD).

Stages of Development	Duration period	
	Mean ± S E	Range
Oviposition (Days)	8.57±1.01	5–16
Fecundity /female	123.47±19.60	53–222
Sex ratio female	56.67±16.44	
Over all longevity of adults	11.83±1.26	5–18
Male longevity	10.33±0.92	5–16
Female longevity	13.03±1.18	6–18

Conclusion: This study revealed that *Encarsia* parasitoids are most successful agents to control sugarcane whitefly species. The knowledge of the developmental parameters of parasitoid on particular pest plays significant role in rearing procedure and its employment in pest management programme. This is a safest and confirmable method to control the insects from crops.

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