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Natural parasitization of aphelinid parasitoid, *Encarsia guadeloupae* Viggiani on coconut rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin

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Abstract

Field surveys were conducted at fortnightly intervals in the southern districts of Tamil Nadu viz., Thoothukudi, Tenkasi, Tirunelveli and Kanyakumari districts from December 2020 to August 2021. The prevalence of rugose spiralling whitefly *Aleurodicus rugioperculatus* in coconut gardens that are grown as a single crop has been observed for the parasitization and establishment of nymphal parasitoid, *Encarsia guadeloupae*. The affected coconut leaflets were assessed by destructive sampling for the parasitic potential of *E. guadeloupae* under Leica stereo zoom microscope with image analyser. Based on the obtained results, the natural parasitization of *E. guadeloupae* was found to be highest in Kanyakumari district (33.86%) throughout the period of study. The order of per cent nymphal parasitization by *E. guadeloupae* is as follows: Kanyakumari (33.86%) > Tirunelveli (17.66%) > Thoothukudi (12.45%) > Tenkasi (11.20%). The per cent adult emergence of *E. guadeloupae* was found to be maximum (21.41%) in the coconut gardens of Kanyakumari district, where as it was least in Tenkasi district (5.37%). The mean population of *A. rugioperculatus* observed in the districts were 49.46, 44.01, 39.68, 32.76 nymphs/leaflet in Kanyakumari, Tirunelveli, Thoothukudi, Tenkasi districts respectively.

Keywords: coconut, rugose spiralling whitefly, natural parasitization, *Encarsia guadeloupae*

Introduction

The rugose spiralling whitefly, *Aleurodicus rugioperculatus* Martin (Hemiptera: Sternorrhyncha: Aleyrodidae) which was previously known as the gumbo limbo spiralling whitefly is a new addition to the list of whitefly species. It is an invasive pest native to Central America that was first discovered in Florida in 2009 in Miami-Dade County. It is naturally found in Belize, Guatemala, and Mexico (Martin, 2008) [4], and has since spread to 22 additional Central and South American nations, including Florida, USA. This invasive pest was recently found in Tamil Nadu, Karnataka, Kerala and Andhra Pradesh in India (Selvaraj *et al.*, 2017) [5] feeding on palms, woody ornamentals and fruits. The most preferred host plants include coconut and banana. Whitefly feeding damages the host plant by depleting water and nutrients, as well as creating honeydew, which coats the upper surface of the lower leaves and promotes the formation of sooty mould (Elango *et al.*, 2019) [2]. Although sooty mould is not a plant disease, its presence on the top surface of the leaf can impair the photosynthesis of the plant. (Selvaraj *et al.*, 2017) [5] discovered the whitefly parasitoid *E. guadeloupae* Viggiani (Hymenoptera: Aphelinidae) on rugose spiralling whitefly infested trees which may be identified by its small size, yellow scutellum and reddish eyes. This little wasp deposits eggs in the bodies of immature whiteflies, and the larva feeds on the body as it grows. By eating the whiteflies cuticle and leaving an exit hole, the wasp will finish its development within the whitefly and emerge as an adult. This nymphal parasitoid was abundant in the coconut ecosystem and they are playing a significant role in the suppression of the host insect *A. rugioperculatus* which can be exploited as an effective management strategy in the control of rugose spiralling whiteflies in coconut. In this context, the present investigation was conducted to assess the natural parasitic potential of *E. guadeloupae* against rugose spiralling whitefly in coconut gardens of Southern Tamil Nadu.

Materials and Methods

Surveys were conducted at fortnightly intervals in the southern districts of Tamil Nadu viz., Thoothukudi, Tenkasi, Tirunelveli and Kanyakumari, on five locations of each district from December 2020 to August 2021 to assess the per cent parasitisation and per cent adult

emergence of the parasitoid, *E. guadeloupeae* on rugose spiralling whitefly affected coconut leaflets. Natural parasitization by *E. guadeloupeae* is calculated using the following formula.

$$\text{Per cent parasitization (\%)} = \frac{\text{Number of parasitized whitefly nymphs}}{\text{Total number of whitefly nymphs}} \times 100$$

(Elango *et al.*, 2020) [3]

The number of parasitoids that emerged from the whitefly nymph was recorded based on the emergence hole (fig.1) in the nymph and the per cent emergence was worked out using the formula.

$$\text{Per cent adult emergence (\%)} = \frac{\text{Number of nymphs having emergence hole}}{\text{Total number of parasitized nymphs}} \times 100$$

The rugose spiralling whiteflies affected leaflets were collected from the coconut field and observed under LEICA stereo zoom microscope with image analyser on the parasitic efficiency of *E. guadeloupeae*. The observations on the natural parasitization of *E. guadeloupeae* were statistically analysed by two-way ANOVA using SPSS version 16 software.

Results and Discussion

The survey results on the natural parasitization by *Encarsia guadeloupeae*, per cent adult emergence and the mean population of coconut rugose spiralling whitefly are presented Table 1,2, and 3.

Natural parasitisation of *Encarsia guadeloupeae* on invasive rugose spiralling whitefly

Natural parasitization of *E. guadeloupeae* was observed from December 2020 to August 2021 in four districts of southern Tamil Nadu. The highest nymphal parasitization was

observed in Kanyakumari (33.86%) followed by Tirunelveli (17.66%) and Thoothukudi (12.45%) whereas, Tenkasi (11.20%) had the lowest per cent parasitisation of *E. guadeloupeae*. When comparing parasitic potential in different months across the four districts, February 2021 has the highest rate of parasitism (23.65%) followed by December 2020 (19.77%). The lowest per cent parasitization was observed in June 2021(16.64%) (Table.1).

Adult emergence of *Encarsia guadeloupeae* on invasive rugose spiralling whitefly

The adult emergence of *E. guadeloupeae* was found to be maximum in Kanyakumari (21.41%) and minimum in Tenkasi (5.37%). The per cent adult emergence of *E. guadeloupeae* was found to be maximum in January 2021 (14.47%). Among the months of observation, the lowest adult emergence percentage was observed in May 2021 (8.86%) (Table.2).

The natural parasitisation of *Encarsia guadeloupeae* on *A. rugioperculatus* in coconut indicated that the current findings are in line with the findings of (Pradhan *et al.*, 2020) [6] who stated that natural parasitization by *E. guadeloupeae* ranged between 7 and 80 per cent in Karnataka. The highest natural parasitization recorded in Kanyakumari district in the present study is in accordance with the results of Elango *et al.* (2019) [2] who reported that the whiteflies collected from Kanyakumari district showed maximum parasitization of 60.75 per cent. Alagar *et al.* (2020) [1] reported the natural parasitization of rugose spiralling whitefly by *E. guadeloupeae* was found to be 40.6 per cent in Kanyakumari district during 2018-19 and it is in tune with the present findings. The per cent adult emergence of *E. guadeloupeae* was found to be maximum in Kanyakumari district and it is in agreement with the findings of Elango *et al.* (2020) [3] who revealed that the adult emergence of *E. guadeloupeae* in coconut ecosystem was 26.30 per cent during 2017.

Table 1: Natural parasitization of *Encarsia guadeloupeae* on coconut rugose spiralling whitefly

Location	Per cent parasitization*									Mean
	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	
Thoothukudi	16.21 (23.64)	12.86 (20.97)	12.90 (20.97)	11.47 (19.77)	11.39 (19.68)	11.79 (20.04)	12.62 (20.77)	11.34 (19.64)	11.48 (19.65)	12.45 (20.58)
Tenkasi	9.00 (17.41)	11.35 (19.55)	11.79 (19.95)	11.36 (19.56)	11.37 (19.56)	11.96 (19.81)	10.04 (18.26)	10.65 (18.77)	13.27 (21.22)	11.20 (19.35)
Tirunelveli	18.20 (25.19)	16.49 (23.86)	25.15 (30.09)	16.76 (24.09)	17.78 (24.92)	15.44 (23.06)	17.57 (24.68)	16.33 (23.76)	15.19 (22.83)	17.66 (24.72)
Kanyakumari	35.65 (36.52)	34.19 (35.73)	44.74 (41.97)	33.99 (35.59)	30.85 (33.65)	34.26 (35.67)	26.33 (30.76)	30.21 (33.31)	34.48 (35.93)	33.86 (35.46)
Mean	19.77 (25.69)	18.72 (25.03)	23.65 (28.25)	18.40 (24.75)	17.85 (24.45)	18.36 (24.65)	16.64 (23.62)	17.13 (23.87)	18.61 (24.91)	
SE(d)	District = 0.513; Month = 0.769; D×M = 1.539									
CD (P=0.05)	District = 1.014; Month = 1.521; D×M = 2.009									

*Mean of five replications. Figures in the parentheses are arcsine transformed values.

Table 2: Per cent adult emergence of *Encarsia guadeloupeae* on coconut rugose spiralling whitefly

Location	Per cent adult emergence*									Mean
	Dec-20	Jan-21	Feb-21	Mar-21	Apr-21	May-21	Jun-21	Jul-21	Aug-21	
Thoothukudi	14.15 (22.04)	12.53 (20.69)	11.18 (19.30)	4.68 (12.40)	5.33 (13.32)	5.59 (13.64)	4.78 (12.60)	5.31 (13.29)	5.12 (12.99)	7.63 (15.58)
Tenkasi	8.19 (16.53)	4.98 (12.85)	5.28 (13.26)	5.03 (12.94)	5.1 (13.02)	4.87 (12.71)	4.62 (12.38)	4.54 (12.22)	5.74 (13.83)	5.37 (13.30)
Tirunelveli	14.68 (22.50)	16.3 (23.79)	14.87 (22.67)	13.73 (21.72)	12.832 (20.94)	6.54 (14.60)	9.82 (18.19)	6.66 (14.86)	8.97 (17.33)	11.60 (19.62)
Kanyakumari	17.66	24.06	21.5	21.48	22.14	18.44	19.92	23.86	23.66	21.41

	(24.82)	(29.37)	(27.59)	(27.59)	(28.06)	(25.42)	(26.49)	(29.21)	(29.09)	(27.51)
Mean	13.67 (21.47)	14.47 (21.67)	13.21 (20.70)	11.23 (18.66)	11.35 (18.83)	8.86 (16.59)	9.79 (17.41)	10.09 (17.39)	10.87 (18.31)	
SE(d)	District = 0.320; Month = 0.481; D×M = 0.962									
CD (P=0.05)	District = 0.634; Month = 0.951; D×M = 1.903									

*Mean of five replications. Figures in the parentheses are arcsine transformed value

Table 3: Nymphal population of *A. rugioperculatus* and its parasitization by *Encarsia guadeloupae*

District	Population of nymphs of <i>A. rugioperculatus</i> (No/leaflet)	Per cent parasitization by <i>E. guadeloupae</i>	Per cent adult emergence of <i>Encarsia guadeloupae</i>
Thoothukudi	39.68 (6.30)	12.45 (20.58)	7.63 (15.58)
Tenkasi	32.76 (5.73)	11.20 (19.35)	5.37 (13.30)
Tirunelveli	44.01 (6.56)	17.66 (24.72)	11.60 (19.62)
Kanyakumari	49.46 (7.00)	33.86 (35.46)	21.41 (27.51)
SE(d)	0.133	0.513	0.320
CD (P=0.05)	0.262	1.014	0.634

(Mean of five locations: December 2020 – August 2021)



Fig 1a: *Encarsia guadeloupae* parasitized pupae



Fig 1b: Exit hole of *Encarsia guadeloupae*

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Conclusion

From the present study, it is concluded that natural parasitization of *E. guadeloupae* occurs in the southern districts of Tamil Nadu and which can be exploited as a management measure against coconut rugose spiralling whitefly.

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