Orange Spiny Whitefly, *Aleurocanthus spiniferus* (Quaintance) (Homoptera: Aleyrodidae), and Its Parasitoids in the Republic of Palau

R. Muniappan[1], M. Purea[2], F. Sengebau[3] and **G.V.P. Reddy[4]**
[1] IPM-CRSP, Virginia Tech, Blacksburg, VA 24061 USA; e-mail: rmuni@vt.edu
[2] FAO Sub Regional Office, Private Mail Bag, Apia, Samoa
[3] Bureau of Agriculture, P.O. Box 460, Koror-96940, Republic of Palau
[4]Western Pacific Tropical Research Center, University of Guam, Mangilao, Guam 96923 USA

Abstract. The orange spiny whitefly (OSW), *Aleurocanthus spiniferus* (Quaintance) (Homoptera: Aleyrodidae) is one of the relatively new pests of citrus in the Republic of Palau. It is a problem on citrus trees and rose plants in home gardens. The leaves, fruit and branches of infested trees are generally covered with sooty mold. Also decline in vigor and yield was observed in infested trees.

Surveys were conducted to assess the distribution and population density of *A. spiniferus* and the occurrence of parasitoids in Palau. The number of citrus trees examined for OSW was 59 citrus trees in Koror, 41 in Babeldaob, 25 in Angaur, 14 in Kayangal and 30 in Peleliu. The islands of Angaur and Kayangel were free of *A. spiniferus* while Koror, Babeldaob and Peleliu were infested. This whitefly was observed in almost all parts of the island of Koror, in the village of Klauklu in Peleliu and in the States Airai, Aimeliik, Ngatpang (Ibobang), Melekeok, Ngiwal, and Ngarchelong in the island of Babeldaob. The parasitoids, *Encarsia aseta* Hayat and Polaszek (Hymenoptera: Aphelinidae) and *Amitus* sp. (Hymenoptera: Platygastridae) have been collected from Koror, *E. aseta* has been collected from Babeldaob, and none from Peleliu. Percent parasitism from collected samples varied from 0 to 42%.

Key words: Orange spiny whitefly, *Aleurocanthus spiniferus,* Homoptera, Aleyrodidae, parasitoids, Palau

Introduction

The orange spiny whitefly (OSW), *Aleurocanthus spiniferus* (Quaintance) (Homoptera: Aleyrodidae) is one of the serious pests attacking citrus. Kuwana (1928) first recorded OSW in Japan. It was recorded on Guam in 1951 (Peterson 1955), Hawaii in 1974 (USDA 1974), on Kosrae in 1982 (Nafus 1988), on Yap in 1986 (Nafus 1990), and on Pohnpei in 1987 (Muniappan et al. 1992). It causes general weakening of seriously infested plants due to sap loss and the growth of sooty mold (Anonymous 1974). The undersurfaces of infested leaves were heavily infested by OSW and the upper surfaces were covered with black sooty mold (Muniappan et al. 1992). Infested citrus trees have numerous small, brownish to black scales with a short fringe of white wax on the underside of many leaves (Marutani and Muniappan 1991). Heavy infestations reduced the vigor and fruit yield of plants. In Palau *A. spiniferus* attacks citrus (*Citrus* spp.) and roses plants (*Rosa* sp.).

Introduction of parasitoids for the biological control of OSW in various countries was begun more than 70 years ago (Van den Berg and Greenland 1996). Van den Berg et al. (2000) reported that classical biological control was practical and cost effective in parts of Southern Africa. A devastating outbreak of the pest in Japan was brought under control in the early 1920s by introduction of the parasitoid *Encarsia smithi* (Silvestri) (Hymenoptera:

Aphelinidae) from China (Watanabe 1958). Of five parasitoid species released in Guam in 1952, only *E. smithi* and *Amitus hesperidum* Silvestri (Hymenoptera: Platygasteridae) became established, and gave good control on citrus, with the former being the dominant species (Peterson 1955). Introductions of *E. smithi* to Kosrae (Nafus 1988), Chuuk and Yap (Marutani and Muniappan 1991), Pohnpei (Muniappan et al. 1992) and South Africa (Van den Berg and Greenland 1996, 1997, 2001) have resulted in effective control of OSW.

The purpose of this study was to survey Palau for the distribution and population density of OSW and the recruitment of local parasitoids.

Materials and Methods

The Republic of Palau (7°30'N, 134°30' E) comprises 458 sq km in Micronesia. Surveys of OSW and its parasitoids were carried out from October to November, 2004. Fifty nine citrus trees were selected for the survey in Koror, 41 in Babeldaob, 25 in Angaur, 14 in Kayangel and 30 in Peleliu. To assess the population density of the OSW and the incidence of parasitoids in Babeldaob and Koror, 10 shoots 30 cm length from infested citrus trees were collected in ziploc plastic bags. In Peleliu, OSW infested leaves of citrus trees that could be reached from the ground were collected and stored in ziploc plastic bags. All samples were examined in the laboratory at Koror. Collected shoots were sorted examined to ascertain the percentage of infested leaves. Fourth instar larvae (pupae), pupal exuviae with parasitoid emergence holes, and exuviae with splits forming T shaped openings through which adults emerged in the infested leaves were counted to ascertain the average OSW per leaf and the percentage of parasitism (Table 1). Pupae were picked from the leaves and individually placed in gelatin capsules for parasitoid emergence. Parasitoids collected on OSW were sent to the Natural History Museum, London for identification.

Results and Discussion

Survey results indicate that the introduction of OSW to the Republic of Palau possibly first occurred in Koror. OSW was found in almost all parts of the island of Koror. On Bebeldaob it was found only in the states Airai, Aimeliik, Ngatpang (Ibobang), Melekeok, Ngiwal, and Ngarchelong, while Ngchesar, Ngaraad, Ngardmau and Ngaremlengui in Babeldaob were OSW free. The islands of Angaur in the south and Kayangel in the north were free of OSW. However, Peleliu was infested (Figure 1). Lime (*Citrus aurantifolia* Swingle) and lemon (*Citrus limon* Burm.) had 38.5% and 28.6% infestation, respectively while calamansi (*Citrus madurensis* Laur.) had only 20% infestation indicating that calamansi is less preferred than lime and lemon.

We found the parasitoids, *Encarsia aseta* Hayat and Polaszek (Hymenoptera: Aphelinidae) and *Amitus* sp. (Hymenoptera: Platygastridae) parasitizing OSW in Koror. Only *E. aseta* was found in Babeldaob and no parasitoids were found in Peleliu. *Encarsia aseta* has been reported from China, India and Hawaii on the whiteflies, *Aleurotrachelus* sp. and *Dialeurolonga elongata*. According to the A. Polaszek (pers. comm.) the species of *Amitus* occurring in Palau is not the widespread *A. hesperidum*. Both these species are solitary and endoparasitoids of whitefly nymphs. These fortuitously introduced parasitoids to Palau were found parasitizing OSW. Percent parasitism varied from 0 to 42% in Koror, 0 to 3.3% in Airai and 0 to 1.4% in Aimeliik and Ngarchelong. No parasitism was observed in Ngiwal and Melekeok states in Babeldaob nor on the island of Peleliu. *Encarsia aseta* was about five times more abundant than *Amitus* sp. in the field samples.

Of the 59 trees examined in Koror, 22 trees were infected by OSW. Among the infested trees the percentage of infested leaves per tree ranged from 3.0% to 75.0%. The percentage

Table 1. Distribution of *A. spiniferus* and its parasitoids in Koror and Babeldaob.

Tree	Locality	Village	State	Leaves infested (%)	Avg. no. OSW per infested leaf	Parasitism (%)
1.	M&R	Malakal	Koror	44.9	5.3	2.94
2.	Fisheries	Malakal	Koror	15.9	17.4	8.94
3.	Rangers Office	Malakal	Koror	35.6	3.0	11.6
4.	Rangers Office	Malakal	Koror	73.2	7.8	6.6
5.	Power Plant	Malakal	Koror	7.3	7.3	22.2
6.	Boat Yard	Malakal	Koror	3.1	2.0	0
7.	Namie Takeo	Ngerkebesang	Koror	10.0	27.0	0
8.	Namie Takeo	Ngerkebesang	Koror	28.6	2.0	0.9
9.	Intersection	Ngerkebesang	Koror	3.0	9.0	0
10.	Echang	Ngerkebesang	Koror	30.0	2.0	0
11.	Echang	Ngerkebesang	Koror	16.7	2.0	0
12.	Nakamura House	Madalaii	Koror	40.0	2.0	0
13.	Behind IA Bld.	Madalaii	Koror	18.6	5.6	1.0
14.	Rock Is. Café	Madalaii	Koror	36.4	7.6	16.9
15.	Koror State Bld.	Ngerbeched	Koror	23.9	16.2	0.6
16.	Hiroko Sugiyama	Ngerbeched	Koror	48.3	19.2	0
17.	Penthouse Hotel	Ikelau	Koror	14.3	2.9	21.0
18.	Intersection	Ngerchemai	Koror	75.0	17.8	41.8
19.	Dock	Ngerkesaol	Koror	34.0	7.2	1.6
20.	Alfonso Diaz	Ngermid	Koror	9.2	6.4	0
21.	Martha Kyota	Ngesaol	Koror	39.4	3.9	1.5
22.	Next to basketball court	Ngerbodel	Koror	31.6	31.6	0
23.	Utekongel Store	Ordomel	Airai	46.6	14.0	0.7
24.	Elena Yamanguchi	Ordomel	Airai	21.2	14.8	0
25.	Pastor Amador	Ked	Airai	33.3	10.3	3.3
26.	Ochelochel	Ked	Airai	27.8	9.8	0
27.	Ito Udui	Ngiwal	Ngiwal	5.7	2.0	0
28.	Near Church	Melekeok	Melekeok	20.7	13.0	0
29.	Entrance to village	Ollei	Ngarchelong	42.7	11.4	1.4
30.	Rosendo Skang	Ollei	Ngarchelong	13.4	8.2	0
31.	Across Abai	Ollei	Ngarchelong	13.9	6.8	0
32.	Kalistus Ngirturong	Imul	Aimeliik	28.0	20.9	1.4
33.	State office	Imul	Aimeliik	25.8	22.0	0
34.	Entrance to village	Ibobang	Ibobang	50.0	1.2	0

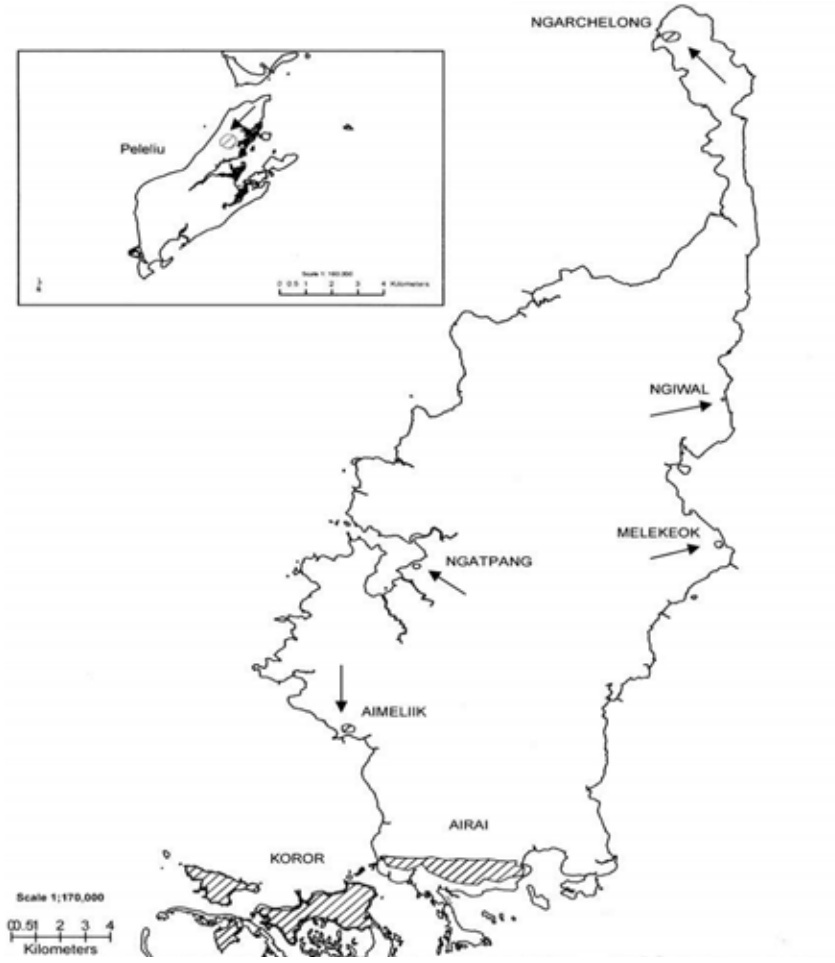

Figure 1. Distribution of orange spiny whitefly (*Aleurocanthus spiniferus*) in the Republic of Palau.

of infested leaves observed in Airai was 21.2% to 46.6%, Ngiwal 5.7%, Ngarchelong 13.4% to 42.7%, Aimeliik 25.8% to 28.0%, and Ibobang 50.0%. The nearness of the southern states, Airai and Aimeliik in Babeldaob to Koror has contributed to the higher OSW infestation. The introductions to the northern states of Babeldaob and Peleliu are likely to be very recent. The Peleliu infestations most probably originated from Koror as this island is south of Koror.

Partial control of OSW at Koror was provided by *E. aseta* and *Amitus* sp. All the states in Babeldaob are located along the coast line separated by thick native rain forests. Transaction between these states is limited but they all transact with Koror as it is the capital of Palau. Most probably the spread of OSW to various states of Babeldaob from Koror is direct and independent of each other.

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