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## **MONITORING CALIFORNIA RED SCALE AND ITS APHELINID PARASITOID USING YELLOW STICKY TRAPS.**

### **ABSTRACT**

MONITORING CALIFORNIA RED SCALE AND ITS APHELINID PARASITOID USING YELLOW STICKY TRAPS.

Yellow sticky traps, which had been erected to monitor the dispersal of the sweet-potato whitefly, *Bemisia tabaci* Gennadius, from cotton fields to citrus orchards in Texas, also attracted adult male *Aonidiella aurantii* (Maskell) and its parasitoid *Aphytis* sp. Populations in three citrus orchards representing different host-plant varieties and maturity were studied and the effect of these and some environmental parameters on the numbers of male *A. aurantii* and of its parasitoid caught on the traps are described.

Key words: Rio Grand Valley, Aphelinidae, Diaspididae, flight periods, temperature, relative humidity, evaporation, wind speed, correlations

### **INTRODUCTION**

Recently (1990), *Bemisia tabaci* Gennadius (Hemiptera: Aleyrodoidea), a major polyphagous pest on many crops, has invaded citrus in the Rio Grand Valley, Texas, where it infested young grapefruit, sweet orange, lemon and mandarin in a field nursery. It is considered that the whitefly disperses from local cotton crops into the nearby citrus orchards and, in order to monitor this movement, yellow sticky traps were used. Yellow sticky traps have been used commercially in the United States for several years to monitor the California red scale (*Aonidiella aurantii* (Maskell)) (Hemiptera: Coccoidea: Diaspididae) populations and so it was not surprising that these traps also caught adult male red scale. In addition, it also caught a species of *Aphytis* (Hymenoptera: Aphelinidae) which was believed to be a parasitoid of the red scale. *A. aurantii* is one of the most important pests of citrus in Texas, causing economic loss through a reduction in tree vitality and in a downgrading of infested fruits (Georgala, 1988).

Several species of *Aphytis* are important parasitoids in biocontrol programmes directed against serious diaspidid pests. Moreno *et al.* (1984) indicated that sticky yellow cards attracted *Aphytis melinus* but also showed that the number of male *A. aurantii* caught on the traps was not correlated with population declines of female scale caused by *Aphytis* sp.

This paper considers the use of yellow traps to monitor (a) peak flight periods of *A. aurantii* as a method of predicting populations on fruit and to assist in interpreting or facilitating pest management decisions in the orchards, and (b) populations of its parasitoid, *Aphytis* sp.

#### MATERIALS AND METHODS

The following observations were made in three citrus orchards on the Texas Agricultural Experiment Station, Weslaco, Texas, between June and October, 1993 using rectangular yellow sticky traps (each side 7.5cm long x 1.5cm wide; 93.75cm<sup>2</sup> in area), placed in a horizontal position. Each trap was coated with a thin layer of insect trapping adhesive. The traps in the citrus orchards were inside the tree, pointing in a north-west direction. To count the insects captured on the traps, a fifth of one side of each trap (area of 18.75cm<sup>2</sup>) was thoroughly examined. The sticky traps were replaced by fresh traps each week. Counting started on 14th June in the citrus orchards and lasted for 17 weeks. For this experiment, the three orchards used were as follows:

*Site 1:* old grapefruit, planted June 1985. Area 2.74 acres, with a total of 640 trees. Sixteen traps counted weekly.

*Site 2:* Old marrs-orange, planted June 1985. Area 1.5 acres, with a total of 154 trees. Six traps counted weekly.

*Site 3:* Rio-red young grapefruit, planted January 1993. Area 1.5 acres, with a total of 154 trees. Six traps counted weekly.

The effect of climatic factors (i.e. temperature, relative humidity, evaporation (in inches/day) and wind (in miles/h)) on the numbers of *A. aurantii* and *Aphytis* sp. caught on the traps (and therefore the effect of these factors on flight behaviour) was calculated using simple correlations to verify their influence.

#### RESULTS AND DISCUSSION

The biological control of scale insects on citrus in the lower Rio Grand Valley, Texas, has been economically important for the past 23 years. Male flight patterns have been shown to reflect the development of the scale generations, with peaks in the number of males as shown by pheromone traps coinciding with peaks in the number of virgin females (Kennett & Hoffmann, 1985).

The mean number of adult male *A. aurantii* caught each week in the three citrus orchards is shown in Fig. 1. A few males were caught most weeks but

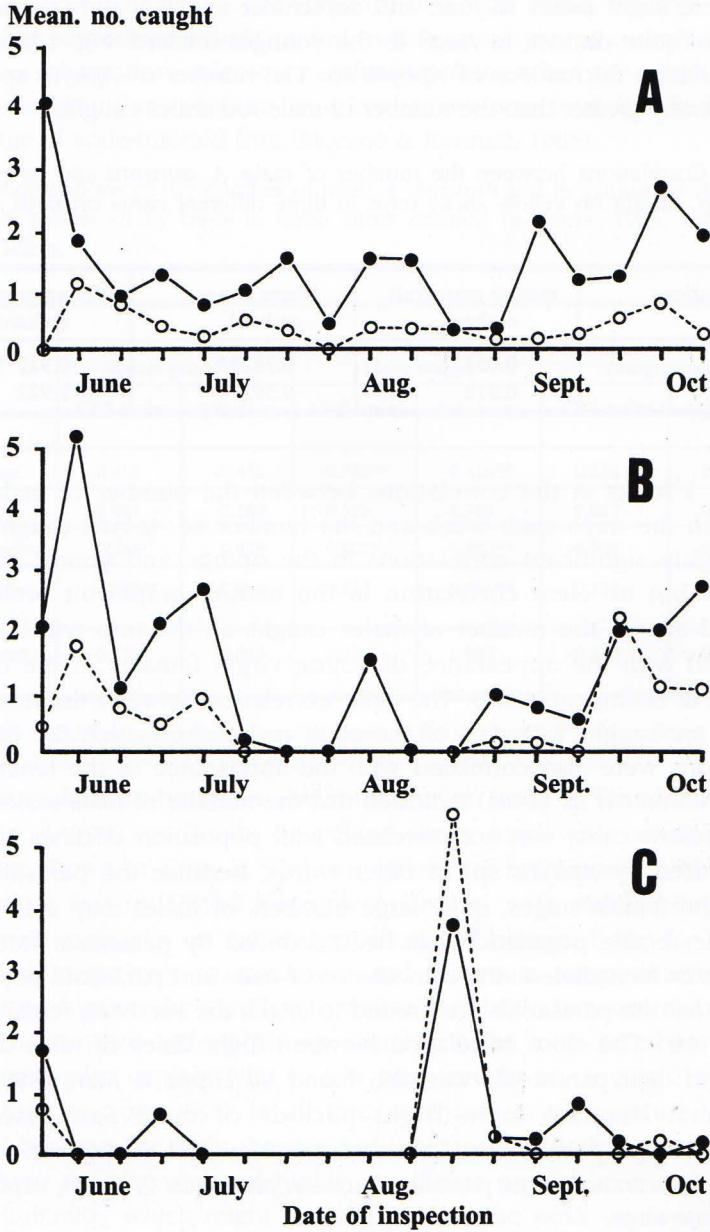


Fig. 1. Mean number of *Aphytis* sp. (●—●) and male *A. aurantii* (○—○) caught weekly on yellow sticky traps in three orchards in Texas: **A.** mature grapefruit orchard, **B.** mature orange orchard, and **C.** young grapefruit orchard.

there were slight peaks in June and September in the mature orchards but only one (quite distinct, in Aug.) in the younger orchard. Fig. 1 also shows the population fluctuations of *Aphytis* sp. The number of *Aphytis* sp. caught was generally greater than the number of male red scales caught.

Table 1. Correlations between the number of male *A. aurantii* and its parasitoid *Aphytis* sp. caught on yellow sticky traps in three different citrus orchards in Texas, 1993.

Correlations	mature grapefruit orchard	Marrs Orange orchard	Young grapefruit orchard
r	0.051	0.782**	0.922**
b	0.018	0.393	1.922

Table 1 looks at the correlations between the number of male scales caught on the traps each week and the number of *Aphytis* caught. There were highly significant correlations in the orange and young grapefruit orchards but no clear correlation in the mature grapefruit orchard. As indicated above, the number of males caught on the trap will be closely correlated with the appearance of young virgin females in the orchards (Kennett & Hoffmann, 1985). The close correlation between the numbers of *Aphytis* sp. caught with that of the adult males shows that the parasitoid populations were also correlated with the appearance of the teneral adult female. Moreno *et al.* (1984) indicated that the number of male scales caught on the yellow cards was not correlated with population declines of female scale caused by *Aphytis* sp. In other words, because the parasitoid only attacks the female stages, quite large numbers of males may emerge even when the female population has been reduced by parasitism (Moreno & Luck, 1992). Nonetheless, the coincidence of male and parasitoid populations ensures that the parasitoids are around to attack the surviving females at the correct time. The close correlation between flight times of male diaspidid scales and their parasitoids was also found by Hippe & Mani (1995), who noted that the two main flight periods of male San José Scale, *Quadraspidiotus perniciosus* (Comstock), in May and September coincided with the appearance of its parasite, *Encarsia perniciosi* (Tower), captured on pheromone traps.

These results confirm that male flight phenology can be used to time the chemical control of *A. aurantii*, when chemicals are being used. In addition, Walker *et al.* (1990) indicated that the optimal timing for the release of

biological control agents for the control of red scale was 2-4 weeks after the peak of the second male flight period, which in our case was probably June. Using this information, release of *Aphytis melinus* when the virgin females were most abundant relative to other stages was found to reduce the percentage of scale-infested fruit (Moreno & Kennett, 1985).

Table 2. Correlations of the number of male *A. aurantii* and its parasitoid *Aphytis* sp. caught on yellow sticky traps in three citrus orchard in Texas, 1993, with certain climatic factors.

Climatic factors	Correlations (r)					
	Mature grapefruit		Marrs orange		Young grapefruit	
	CRS males	<i>Aphytis</i> sp	CRS males	<i>Aphytis</i> sp.	CRS males	<i>Aphytis</i> sp.
Max. temp.	-0.455	-0.452	-0.742**	-0.810**	0.226	0.146
Min. temp.	-0.081	-0.168	-0.520	-0.368	0.027	0.045
Rel. humidity	0.516*	0.458	0.807*	0.622**	-0.206	-0.106
Evaporation (in/day)	-0.689**	-0.059	-0.714	-0.691**	0.132	0.151
Wind speed m/h	0.132	-0.069	0.074	0.087	-0.318	-0.344

where CRS = California red scale; \* = significant at  $P < 0.05$  level; \*\* = significant at  $P < 0.01$  level.

The correlations between the numbers of male *A. aurantii* and its parasitoid *Aphytis* sp. caught on yellow sticky traps with certain climatic factors are shown in Table 2. The correlations for both insects with most of the climatic factors tested here were similar, with similar degrees of significance, especially on mature grapefruit and orange, both, for instance, responding negatively to maximum and minimum temperatures. These observations support the significant positive correlation between the numbers of male *A. aurantii* and *Aphytis* sp. caught on the traps noted in Table 1. These results also explain why so few were caught on August 2 when the temperature was over 99°F in all three orchards, a temperature which is presumably above the flight threshold of both species. Both male *A. aurantii* and *Aphytis* sp. also showed highly significant positive correlations with relative humidity, which might partially explain the peak on September 20 when the Relative Humidity reached its maximum (85.3% in the mature orange orchard, Fig. 1B). With regard to the young grapefruit data, there were slight positive correlations with maximum and minimum temperatures

the more mature orchards. The reasons for this are unclear.

It is concluded that: i. yellow sticky traps could be a useful method of monitoring not only the flight periods of male *A. aurantii*, but also the activity of its parasitoid, *Aphytis* sp.; ii. there appears to be a good correlation between peak flight periods of male scales and of *Aphytis* sp. caught on the traps, and iii. that the flight activity of both the male scales and the parasitoid appear to be similarly affected by the climatic factors studied here.

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