Monitoring *Pezothrips kellyanus* on citrus in eastern Sicily

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Abstract: Citrus thrips *Pezothrips kellyanus* was first recorded in Sicily in 1998. This species is considered a key pest in Sicilian citrus orchards. In a preliminary survey, *P. kellyanus* was the main thrips species in all samples, followed by *Thrips flavus* and *Thrips tabaci*, which are considered secondary pests; Lemon was the variety most commonly attacked, followed by orange. In a field trial, white sticky traps were the most attractive for adult thrips followed by blue traps, while yellow traps did not differ from the transparent check. Abamectin and spinosad were identified as potential candidates for integrated pest management programmes in field trials on lemon and orange. In 2000 and 2001, citrus thrips was monitored on lemon orchards to compare sampling methods (fruit counts or captures on blue sticky traps) and level of fruit scarring by citrus thrips. The ability to predict season-end scarring from May-June fruit counts was encouraging. In all monitoring sites, the presence of the predatory mite *Iphiseius degenerans* was observed. The ratio of predatory mites:thrips was tested as an "indicator" for predicting fruit damage at season-end.

Introduction

Since 1996 the presence of a new species of thrips attacking citrus in Italy has been suspected because of the dramatic increase of characteristic ring scarring (halo damage) on lemon and orange fruits in coastal areas. In 1998, *Pezothrips kellyanus* [previously known as *Megalurothrips kellyanus*] was first detected in Eastern Sicily, associated with the flower thrips *Thrips flavus* and a predatory thrips, *Aeolothrips ericae* (Marullo, 1998; Frittitta *et al*., 1998). In a 1998-1999 survey, *P. kellyanus* adults were found on the flowers of most citrus varieties examined, usually in mixed populations with *Thrips tabaci* and *T. flavus* (Conti *et al*., 2001). *P. kellyanus* larvae were commonly found causing feeding damage on immature fruits of lemons and oranges. They were also found on touching fruits several weeks after petal fall. Although *T. flavus* was present in flowers they did not appear to cause scarring on fruitlets. *T. tabaci* was also found, but never at a high level. *Heliothrips haemorrhoidalis*, once considered the main species on citrus, was found only at six sites, four of which were nurseries. *P. kellyanus* was the predominant species in all samples.

This new pest is suspected to compromise the production of export quality citrus in the coastal area of Eastern Sicily, as evidenced by the damage caused in Australia and New Zealand (Smith *et al.*, 1997; Blank & Gill, 1996). In Sicily, the most severe damage occurred on lemon and Navelina orange (18% culled). Lemon fruits were predominantly damaged around the calyx (halo damage, 17%). Tarocco and Valencia oranges received similar damage as well (7% and 12 % respectively) (Conti *et al.*, 2001). In several lemon orchards the phytoseiid predaceous mite *Iphiseius (Amblyseius) degenerans* was found. This mite plays a significant regulatory role on *Frankliniella occidentalis*, the Western flower thrips, on protected vegetable crops (Ramakers, 1995; van Houte & van Stratum, 1995), but it is unclear if it is responsible for natural control of citrus thrips.

Abamectin and spinosad were identified as potential candidates for integrated pest management programmes in pesticide screening field trials on lemon and orange. Chlorpyrifos, lufenuron, methomyl and dimethoate achieved good control of the pest. Acrinatrin gave the best thrips control but had the most deleterious

effect on beneficial phytoseiid mites (Benfatto *et al.,* 2000). Further investigation of organic-compatible pesticides is being conducted.

A major problem facing the pest control advisor is adequate monitoring of thrips populations in the period shortly after petal-fall when fruit are most susceptible (Morse, 1996). Monitoring methods include sticky traps (Childers & Brecht, 1996; Grout & Richards, 1992), counts of fruit infested (Grout *et al*., 1986), and number of predatory mites on leaves (Pehrson *et al.,* 1991). In preliminary field trials, white and blue traps were the most attractive for adults of *P. kellyanus* (Conti *et al.,* 2001). But little information is available concerning how many adults per trap are needed or what constitutes an accurate sample. The relationship between the number of fruit infested, of thrips captured on sticky traps, of predaceous mites on leaves and the fruit scarring at season-end is being investigated. Preliminary results are reported in this paper.

Materials and methods

Observations were carried out during the period 2000-2001 from mid-May to early-July and at harvest (November - January) on mature "Femminello" lemon located in Syracuse province (South-Eastern Sicily). In both years, samples were taken at three different sites, sampling methods being replicated at each site. These sites were, in 2000, Torrelandolina (TRL), Mazzarella (MZR) and Scuderi (SDR), and in 2001, MZR, SDR and Campisi (CPS).

Counts of thrips-infested fruit and predatory mites

At all locations, 5 randomly selected fruit were inspected weekly (from mid-May to mid-July) on both north and south sides of each of 20 trees randomly distributed in the orchard, giving a total of 200 fruits per site. On each fruit the presence of first and second instars and adults was observed in order to determine the percentage of fruit infested. In addition, 5 leaves inside the canopy were inspected on both north and south sides of each of 20 trees, giving a total of 200 leaves per site. For each leaf the number of predatory mites was counted. The period of monitoring was concluded when fruit diameter, recorded on 10 fruit from the sampled trees, was about 2 cm.

Blue cards

In 2001, glossy blue polyvinyl cards (7.8 by 12.7 cm), coated with polyisobutylene were suspended in the southeast quadrant of five non-adjacent trees at each site. The traps were hung on the outside of the canopy using large paper clips bent in an S-shape and were changed weekly. Traps were collected in polyethylene sleeves and citrus thrips were later counted under a stereomicroscope. The traps were used to monitor adult citrus thrips, and provided a mean number of citrus thrips per week per card.

Comparison of techniques

In late November and December, scar counts were taken on 10 trees at each site, randomly distributed in the orchard (50 fruit randomly selected per tree), to determine indirectly the degree of cumulative citrus thrips activity, and to rank the different orchards by the order of magnitude of citrus thrips scarring. On each tree, all outside fruit from knee to eye level were examined for scarring caused by citrus thrips. Scars were classified as either slight or severe (a severe scar was any that would cause the fruit to be culled from export quality). The order in which the locations were ranked by slight or severe scarring was then compared with the order in which they were ranked by each citrus thrips sampling technique (fruit counts and adults captures on traps) and by predatory mites counts (in this case, the number of predatory mites per leaf and the ratio between number of mites and percentage of fruit infested were both utilized). In addition, the correlation between fruit scarring at harvest and percentage of thrips-infested fruit from both years was tested by regression. All statistical comparisons were performed by ANOVA and Duncan's multiple range tests after appropriate transformation (ARCSINE and SQROOT), when necessary.

Results

Over the 2 years, the percentage of fruit infested and the mean number of predatory mites per leaf did not differ significantly between the north side and the south side of a tree ($P > 0.05$, data not reported).

Year	Site	% scarring		Fruit counts[a]	Predatory mites[b]	Ratio[c]	Traps count[d]
		Light	severe				
2000	TRL	18.6 a ± 2.7	3.8 a ± 0.9	11.1 a ± 3.1	1.3 a ± 0.2	0.13 b ± 0	-
	SDR	23.5 a ± 1.9	11.1 b ± 1.3	13.5 a ± 1.0	2.5 b ± 0.5	0.18 a ± 0	-
	MZR	32.4 b ± 2.1	15.4 b ± 1.8	25.6 b ± 5.8	1.09 a ± 0.2	0.04 c ± 0	-
2001	MZR	17.4 a ± 2.8	0.6 a ± 0.3	1.4 a ± 0.7	0.2 a ± 0.1	0.13 a ± 0	8.3 a ± 3.4
	SDR	33.2 b ± 5.5	2.3 b ± 0.5	3.75 a ± 1.2	0.9 b ± 0.3	0.83 a ± 0.6	14.1 a ± 3.43
	CMP	46.2 c ± 2.7	1.8 ab ± 0.6	5.9 a ± 4.0	0.2 a ± 0.1	0.2 a ± 0.1	15.6 a ± 5.4

Comparisons of data can only be made within the same sampling technique. Location within columns were significantly different ($P < 0.05$) when followed by a different letter according to Duncan's test.

[a] Mean percentage of small fruit infested with citrus thrips.

[b] Mean number of predatory mites per leaf.

[c] Ratio between n. of predatory mites per leaf and % of thrips infested fruit.

[d] Mean number of adult thrips per blue card per week

Table 1. Comparison of thrips scarring with relative thrips densities over the sampling period at each location ± SE

In 2000, light scarring was significantly lower at TRL and SDR sites than at MZR site (Table 1), while severe scarring was statistically lower only at TRL site. The ranking of sites using percentage of thrips infested fruit agreed with the light scar ranking but not with the severe scar ranking. The ranking of sites using the number of predatory mites per leaf, *I. degenerans* predominantly, and the ratio (mites:thrips-infested fruit) did not agree with the scar ranking.

In 2001, severe scarring was low at all sites and light scarring was significantly higher at CMP site. The ranking of sites using the different sampling technique did not agree with scar ranking. The ranking of trap count was not statistically different. The number of predatory mites per leaf as well as the ratio mites:thrips-infested fruit did not provide a good prediction of scarring, confirming that the relationship between *I. degenerans* and citrus thrips is not demonstrated.

However a close correlation (*P = 0.04*) between all severe scar data and all fruit count data was established (Fig. 1). More data are needed for establishing a relationship between trap captures and fruit scars. Apparently, the relationship between the numbers of citrus thrips sampled (or thrips-related predatory mites) using the different methods and the degree of scarring is not a simple relationship, and is one that requires further study.

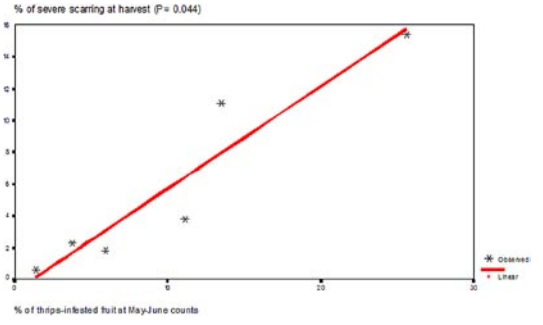

Figure 1. Relationship between percentage of severe thrips scarring at harvest and percentage of thrips-infested fruit at May-June counts

Conclusion

In recent years *P. kellyanus* has emerged as the key thrips pest of citrus in Eastern Sicily. This pest jeopardizes the possibility of expanding the production of high quality lemons. Research is needed to resolve the role of phytoseiids in biological control of citrus thrips. A major problem is adequate monitoring of the citrus thrips population in the period shortly after petal-fall when the fruit are most susceptible to scarring by citrus thrips. Blue and white traps were shown to be very attractive to some thrips species, and especially to *P. kellyanus*; research is needed to further resolve the relationship between trap captures and season's end fruit scarring. Direct fruit scouting appears to be the best method for treatment decision (Grout *et al*., 1986; Pehrson *et al.,* 1991), and a threshold level for fruit scarring is now under evaluation in Italy. New soft compounds have been tested (abamectin and spinosad), but because of their short residual persistence it is very important to time treatments optimally if they are to be effective.

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