Subtropical Plant Science. 46:16-19. 1994

False Spider Mite: Damage and Control on Texas Citrus

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Additional index words: Brevipalpus spp, leprosis, miticides, efficacy

ABSTRACT

Populations of the false spider mites, *Brevipalpus phoenicis* (Geijskes) and *Brevipalpus californicus* (Banks), have increased on Texas citrus since a severe freeze in December, 1989. In a preharvest evaluation in one grapefruit orchard, nearly 17% of the fruit was downgraded due to leprosis spotting caused by these species. Significantly more damaged fruit occurred on inside branches than on outside branches. Chemical screening trial results showed that fenbutatin-oxide (Vendex® 4L), abamectin (Agri-Mek®.015 EC) plus 0.25% Narrow Range (NR) 440 oil, experimental acaracide BAS 300 11I (BASF Corp.), and experimental ACS 303,630 (American Cyanamid Co.) provided false spider mite control for more than 6 weeks. Methidathion (Supracide® 2E), chlorpyrifos (Lorsban® 4E) or 1.0% NR 440 oil alone were ineffective against these mite species.

RESUMEN

En las plantaciones de cítricos de Texas, las poblaciones de las falsas arañuelas *Brevipalpus phoenicis* (Geijskes) y *Brevipalpus californicus* (Banks) se han incrementado desde una severa helada que ocurrió en diciembre de 1989. En una evaluación precosecha realizada en una huerta de toronjos, se encontró que aproximadamente 17% de los frutos fueron deteriorados debido al manchado tipo leprosis causado por estas especies. Significativamente se presentaron más frutos dañados en las ramas internas que en las ramas externas. Los resultados de la evalucación de productos químicos mostraron que Vendex® (fenbutatina-oxido), Agri-Mek® (abamectina) mas 0.25% de aceite "Narrow Range" (NR) 440, el acaricida experimental BAS 300 11I (pyridaben, BASF Corp.), y el compuesto experimental ACS 303,630 (American Cyanamid Co.) controlaron a las falsas arañuelas por más de 6 semanas. Supracide® (metidatión), Lorsban® (cloropirifós) o 1.0% de aceite NR 440 por separado no fueron efectivos en contra de estas especies de ácaros.

The false spider mite (FSM), or flat mite complex (Acari: Tenupalpidae) are long-standing pests of citrus in the Lower Rio Grande Valley of Texas. *Brevipalpus australis* Tuck was first recorded on grapefruit in the San Juan citrus area in January, 1952 (Dean, 1952). A second species, *B. phoenicis* (Geijskes) (red and black flat mite) was subsequently identified, occurring less frequently than *B. australis* in Lower Rio Grande Valley citrus orchards (Dean, 1959a). Both species were more prevalent from mid-to-late-season (July-December), with infestations heaviest on foliage in the west quadrants of the tree (Dean, 1959b). False spider mites were cited as a potential economic threat to Texas citrus, particularly when the pesticide, Zineb, failed to provide effective control (Dean and Sleeth; 1959, and Bailey and Dean, 1961). Zineb, with both acaricidal and fungicidal activity, was routinely used in sprays for control of citrus rust mite, *Phyllocoptruta oleivora* Ashmead and greasy spot, *Mycospaerella citri* Whiteside (Fisher, 1957 and 1958).

A serious rind spotting of Texas grapefruit was found associated with high populations of FSM in the summer of 1966 (Dean and Maxwell, 1967). Described as irregular-shaped, brownish "leprosis-like" blemishes, 1-30mm or larger, the damaged areas became excrescented and darkened as the fruit dried. False spider mites collected from the spotted areas were identified as *B. californicus* (Banks) and *B. phoenicis*. In Florida, *B. californicus* causes fruit and leaf spotting, referred to as leprosis or nailhead rust, and bark scaling on twigs and branches of sweet orange trees (Knorr, 1950). *B. californicus* and *B. australis* are now considered to be synonymous, with the former the preferred species name (Meyer, 1979; Ghai and Shenhmar, 1984). In California, feeding by the citrus flat mite, *B. lewisi* McGregor causes spotting or scaring of fruit on Navel, Valencia orange and lemon trees (Lewis, 1944; Elmer and Jeppson, 1957). Citrus production has at times been severely limited in the South American countries of Argentina, Paraguay, and Uruguay due to "lepra explosiva", synonymous with leprosis and caused by *B. obovatus* Donnadieu (Knorr and DuCharme, 1950; Knorr et al., 1968). In Venezuela, *B. phoenicis* has been associated with two sour orange seedling diseases, Halo scab and *Brevipalpus* gall (Knorr and Malaguti, 1960; Knorr, et al., 1960).

Clarification of the etiology of leprosis led to the search for more effective chemical controls for FSM. Dicofol (Kelthane®) alone, and in combination with Zineb or azinphosmethyl (Guthion®), provided excellent mite control. But azinphosmethyl alone, after an initial mite knockdown, caused populations to increase beyond pretreatment levels (Dean and Maxwell, 1967). These authors speculated that elimination of predatory phytoseiid mites may have contributed to the FSM buildup after azinphosmethyl applications.

Since the severe 1989 freeze, FSM (mainly *B. phoenicis* and to a lesser extent *B. californicus*) have invaded recovering orchards in some central and western Lower Rio

Table 1. Pre-harvest evaluation of on-tree 'Rio Red' grapefruit (inside vs. outside branches) for false spider mite (FSM) damage, Edinburg, TX 1992.

	Outside		Inside
Avg. fruit / branch[z]	4.4		3.5
Total fruit evaluated	544		466
Total FSM damaged fruit	8.8%	**[x]	25.7%
Severely[y] damaged fruit	3.4%	**[x]	13.5%

[z] On 5 inside & 5 outside branches of each of 25 randomly selected trees.

[y] ≥ One-fourth of the fruit surface area showing FSM damage.

[x] Indicates statistical significance between inside and outside fruit, p=0.01.

Grande Valley locations. Incipient FSM infestations often going undetected until leprosis spotting appeared on fruit in the interior tree canopy. The number of orchards with severe fruit leprosis has increased, undoubtedly due to poor timing of spray treatments, inadequate coverage or use of ineffective chemicals.

In mid-season 1992, we inspected a heavy infestation of *B. phoenicis* on a 4-year-old 'Rio Red' grapefruit orchard near Edinburg. The trees supported their first crop after the freeze, but unfortunately much of the fruit already showed leprosis symptoms. In this orchard we initiated a preliminary spray trial to test the efficacy of a number of chemicals not previously targeted for FSM. Trial results showed that oxythioquinox (Morestan® 25WP) and bifenthrin (Talstar® 80F) both provided control for 5 weeks or longer, while abamectin (Agri-mek®.015 EC) tank mixed with 1% NR 440 oil, or the 1% NR 440 oil alone, gave mite knockdown but lost efficacy at 4 weeks (French and Hernandez, 1992a). Chlorpyrifos (Lorsban® 4E) was ineffective against FSM. However, a chlorpyrifos plus dicofol tank mix applied by commercial air blast sprayer to the reminder of the orchard surrounding the trial plots, gave FSM control comparable to oxythioquinox or bifenthrin (unpublished data).

In the fall of 1992, we conducted a preharvest fruit evaluation for leprosis in the aforementioned grapefruit orchard. Herein, we report the results of this fruit damage evaluation, as well as data from a second chemical efficacy trial against FSM conducted in an orchard at the Citrus Center's South Research Farm. Included in the latter trial were two promising new experimental acaricides currently under development.

MATERIALS AND METHODS

Pre-harvest fruit evaluation for leprosis. In late November, 1992, fruit damage was evaluated on-tree in the Edinburg orchard. The evaluation was made on 25 randomly selected trees in a .5 ha area adjacent to the chemical trial plots. Trees were ca. 2 m tall at the time of evaluation. Fruit on the outer and inner canopy of each tree were evaluated for leprosis damage and severity. All fruit on 5 random exterior and 5 interior limbs (greater than arms length inside the canopy) were counted and rated for leprosis. Damage ratings were based on the total fruit surface area covered by leprosis and were as follows: none; mild–leprosis on less than one-fourth the surface area; and moderate to severe–one-fourth or greater of the surface area covered. At harvest, fruit in the last category would be downgraded and marketable either as #2 fresh or used for processing.

Data were transformed by arcsin √4 for analysis and means separated by Waller/Duncan K-ratio Test, (P=0.01) (SAS Institute Inc., 1988).

Citrus center efficacy trial. Due to a questionable performance in the first efficacy trial, the abamectin plus NR 440 spray oil and the chlorpyrifos treatments were included again in the second trial. The numbered experimental acaricides, BAS 300 11I (BASF Corp.) and ASC 303,630 (American Cyanamid Co.) were tested for the first time against FSM. The acarcide test standard was fenbutatin-oxide.

Chemical formulations and rates. The chemicals tested included: abamectin, (Agri-Mek®.015 EC) a mixture of avermectins containing ≥ 80% avermectin B1b (5-0-demethyl -25-de (1-methylpropyl)-25-(1-methylethyl) avermectin A1a), at a test rate of 0.001 kg (ai)/380L (Merck and Co. Rahway, NJ); fenbutatin-oxide (Vendex® 4L), Di(tri-(2,2-dimethyl-2-phenyllethyl)tin) oxide, at a test rate of 0.11 kg (ai)/380L (E.I. DuPont Co., Wilmington, DE); chlorpyrifos (Lorsban® 4E), 0.0-diethyl-0-(3,5,6-trichloro-2-pyridinyl) phosphorothioate, at a test rate of 0.23 kg (ai)/380L (Dow Elanco, Indianapolis, IN); methidathion (Supracide® 2E), 0,0-dimethyl phosphorodithioate, S-ester with 4 (mercaptomethyl)-2-methoxy-1,3,4-thiadiazolin -5-one, at a test rate of 0.23 kg (ai)/380L (Ciba-Geigy Co., Greensboro, NC); experimental ASC 303,630 2SC, 4-bromno-2-(4-chlorophenyl)-1-(ethoxymethyl)-5-(trifluoromethyl) pyrrole-3-carbonitrile, at a test rate of 0.08 kg (ai)/380L (American Cyanamid Co., Princeton, NJ); experimental BAS 300 11I 75WP, 2-tert-butyl-5-(4-tert-butylbenzylthio)-4-chloropyridazin-3(2Hd)-one, at a test rate of 0.09 kg (ai)/380L (BASF Corp. Parsippany, NJ).

Narrow Range (NR) petroleum oil was used alone as a standard treatment and tank mixed with abamectin, and has the following specifications: with emulsifier and unsulfonated residue rating of 92% minimum; A.P.I. gravity at 15.5 °C (60°F) of 34.8 minimum; 50% distillation point at 10mm Hg reduced pressure 227°C (440°F) and 10-90% range of 27°C (80°F) maximum, (Sun Oil Co., Philadelphia, PA).

Plot design and spray application. Treatments were randomly assigned to single tree plots and replicated 4 times in

Table 2. False spider mite (FSM), *B. phoenicis,* in treated and untreated plots of 8-yr-old 'Ruby Red' grapefruit trees, Citrus Center, Research Farm, Weslaco, TX 1993.

				Mean no. FSM/fruit					
				Days postspray:					
Treatment[z]	kg ai/ 380L lb	lb ai 100 gal	Pre spray	+7	+14	+21	+36	+42	Post spray mean
Abamectin 0.15 EC +NR 440 oil (0.25%)	0.001	0.002	17.8a[y]	0.0d	0.0c	0.6c	0.7bc	0.7c	0.4c
Fenbutatin-oxide	0.11	0.25	5.5c	0.0d	0.0c	0.0c	0.0c	0.1c	0.1c
BAS 300 11I 75 WP	0.09	0.20	9.8bc	0.3cd	0.0c	0.0c	0.1c	0.1c	0.1c
ASC 303, 630 2SC	0.08	0.17	10.1bc	1.8b	0.0c	0.0c	0.2c	0.2c	0.4c
Methidathion	0.23	0.50	11.0bc	0.0d	1.8bc	1.5bc	3.4ab	3.6b	2.1b
Chlorpyrifos	0.23	0.50	9.3bc	0.0d	2.8b	1.2bc	4.0a	4.3b	2.5b
NR 440 oil (1.0%)	---	---	6.8bc	1.3bc	1.5bc	2.4b	4.3a	4.8b	2.9b
Control	---	---	12.3ab	5.9a	8.1a	4.3a	6.3a	8.1a	6.6a

[Z]Spray treatments applied on August 30, 1993.

[Y]Treatment means within a column not showing a common letter are significantly different as separated by Waller/Duncan K-ratio Test (P=0.05).

an 8-yr-old 'Ruby Red' grapefruit orchard on 4.5 X 8.5m (15 X 28 ft) spacing. Treated trees were bounded on all sides by an unsprayed tree to prevent contamination by spray drift. Treatment sprays were applied to foliar runoff (ca. 7L/tree) using a Hypro 5200 portable high pressure handgun sprayer (Hypro Corp., New Brighton, MN) equipped with a D-5 nozzle and operating at 200 PSI.

FSM counts. Mite counts were made pretreatment and at 7-day-intervals posttreatment. At each sampling date, 6 fruit per tree (replicate) were randomly picked from the interior canopy, placed in a cold chest and removed to the laboratory. Fruit were examined under a binocular microscope at 20X and all live FSM counted and recorded. The FSM species was indentified as *B. phoenicis*.

All data were subjected to analysis of variance and means separated by Waller/Duncan K-ratio Test.

RESULTS

Fruit damage evaluation. The percentage of FSM damaged fruit (leprosis) was significantly higher on inside branches than on outside branches (Table 1). Also, nearly four times more fruit with severe leprosis occurred on inside branches (13.5% vs 3.4%). Thus, ca. 17% of the fruit evaluated had leprosis severe enough to reduce it to either #2 fresh, or juice fruit. This level of fruit damage would represent a significant loss to the grower.

Mild leprosis was generally restricted to the stem end of the fruit. Dense foliage in the lower tree canopy frequently covered fruit with leprosis that lay directly on the ground. Leprosis fruit did not appear to be more prevalent in any one tree quadrant. However, if one fruit in a cluster was affected, generally all the fruit in that cluster showed some degree of leprosis.

Chemical efficacy trial. All spray treatments provided an initial knockdown of FSM, with experimental ASC 303,630 and the 1% NR 440 spray oil slightly slower than other treatments (Table 2). Thereafter, the ACS 303,630 gave effective residual FSM control (> 6 wks), comparable to that by experimental BAS 300 11I, abamectin + 0.25% NR 440 oil and the fenbutatin-oxide treatments. The 1% NR 440 oil, methidathion and chlorpyrifos failed to give residual control, with FSM populations rebuilding in these treatments through the duration of the trial. No phytotoxic effects on foliage or fruit were noted after any of the spray treatments.

DISCUSSION AND SUMMARY

The FSM have become increasingly prevalent in Lower Rio Grande Valley citrus orchards since the severe freeze of 1989. In a survey conducted after the 1961-62 freeze, phytophagous mite populations were found to be much greater on recovering trees (Reed et.al., 1967). They attributed the mite increases to the more attractive vigorous new growth on recovering trees and post freeze changes in pesticide application practices. Non-bearing trees are not monitored as rigorously for pests and less likely to receive a regular chemical spray program. FSM's small size of 0.25mm (1/100 inch) and reclusive nature makes detection difficult. Mite populations build on interior tree foliage and move onto fruit as the tree begins to bear. Grapefruit is the preferred habitat for FSM in the Lower Rio Grande Valley (French unpublished data).

Leprosis fruit spotting is almost exclusive on grapefruit, affecting all varieties grown in the Lower Rio Grande Valley. Mild leprosis is occasionally observed on fruit of Navel and 'Marrs' orange, but only when FSM numbers exceed 20 per fruit. In Florida, leprosis affects only early and midseason varieties of sweet orange (Knorr et al., 1968). Navel and Valencia oranges, tangerines and lemons are afflicted with "scablike scars" from the feeding of the citrus flat mite, *B. lewisi*, in California (Elmer and Jeppson, 1957).

Several promising chemicals for controlling FSM were identified in this, and an earlier study (French and Hernandez, 1992a). Of these, fenbutatin-oxide, oxythioquinox, bifenthrin, abametin plus oil, and the experimental acaricides, BAS 300 11I and ASC 303,630 were most effective. Registration of the experimental materials would benefit the Texas citrus industry since both are also effective against citrus rust mite and spider mites (French and Hernandez, 1992b). The organophosphate compounds, chlorpyrifos and methidathion, while providing FSM knockdown could promote a population buildup over time. The latter chemicals are principally used for scale insect control, and in orchards with incipient FSM populations, tankmixing these chemicals with an acaricide would be imperative.

FSM overwinters mainly in the adult stage, although eggs and immatures were found in most months of the year. The highest concentrations of FSM motiles and eggs were usually in wind and insect scarred areas on the fruit surface. Unpicked fruit left in trees after harvest are potential sources of FSM for reinfestation of the orchard. The sanitary practice of removing this fruit can not be overlooked as an important part of FSM control in Lower Rio Grande Valley citrus orchards.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the technical assistance of Mr. Elias Hernandez, Jr. and Mr. Santiago Villarreal of the A&M University-Kingsville Citrus Center staff. We also thank Dr. John Fucik, Citrus Center Horticultrist, for assistance in data analysis and critical review of the manuscript; and Dr. Robert Meagher Jr., Entomologist at the Texas Agricultural Experiment Station-Weslaco, for technical advice and manuscript review.

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