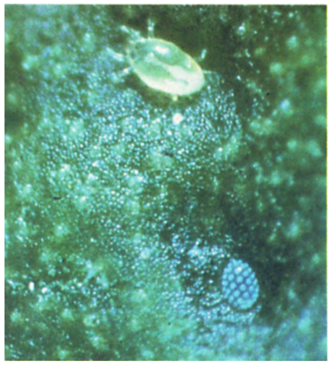

A distinctive, identifying feature of the broad mite is egg with six to seven rows of white tubercles (lower right), best seen with a 20-power hand lens and light at an angle. Adult female (above), translucent at first, darkens to straw color with white stripe down back.

Broad mite causes a silvering on the lemon surface and a speckled or mottled appearance on large fruit, because fruit grows after damage has occurred.

The broad mite on lemons in southern California

Robert D. Brown □ Vincent P. Jones

In the fall of 1979, a new mite pest was found damaging lemon fruit in a grove near the city of Ventura. This mite was identified as the broad mite, *Polyphagotarsonemus latus* (Banks).

The broad mite is a common pest on many crops in tropical areas, including tea, cotton, coffee, jute, chiles, tomato, and avocado, but in temperate and subtropical areas such as California, it is usually found attacking only greenhouse plants. It has also been reported attacking citrus (usually lemons) in at least a dozen countries. Although it had previously been reported on citrus nursery stock in California, the 1979 discovery was the first from a commercial citrus grove in California.

The damage caused by the broad mite is easily confused with that caused by the citrus rust mite, *Phyllocoptruta oleivora* (Ashmead), (also known as the silver mite when found on lemons). Both mites cause a silvering on the lemon surface. The citrus rust mite damages fruit of any size; the broad mite usually attacks fruit 3 cm or less in diameter. As a result, large fruit become speckled or mottled, apparently because of fruit growth after damage has occurred. This mottling has not been found associated with citrus rust mite infestations. Broad mite feeding on the lower surfaces of new, still-expanding leaves causes them to curl. This mite has also been implicated in an extreme rind-thickening of small fruit.

Identification and life cycle

Although citrus rust mite and broad mite cause somewhat similar damage, the mites themselves are distinctly different. The citrus rust mite is a typical eriophyid mite, elongated (0.15 mm), yellowish, and triangular shaped with only two pairs of legs at the front of the body. The broad mite has four pairs of legs and is elliptical shaped. The female's two hind legs are reduced to whiplike appendages. Citrus rust mites can be found on leaves or fruit of any age; broad mites are seen only on the newest leaves and small fruit. High populations of both mites may occur at the same time on the same fruit.

The broad mite also can be easily confused with closely related nonpestiferous tarsonemid mites that occur on citrus. In the areas where the broad mite has been found, we have primarily collected *Tarsonemus cryptocephalus* (Ewing) (table 1) but other *Tarsonemus* species are present. *T. cryptocephalus* is often associated with sooty mold caused by various species of honeydew-producing insects such as whiteflies, mealybugs, and soft scales.

The broad mite has four life stages: egg, larva, nymph, and adult. Eggs, laid on the undersides of new leaves and in the depressions of small fruit, hatch within two days to become six-legged, slow-moving white larvae 0.1 mm long. After one day, the larva becomes a quiescent nymph that is clear and pointed at both ends. The nymphal stage lasts about a day; nymphs are usually found in depressions on the fruit, although female nymphs are often carried about by males.

Under laboratory conditions, the adult female has a preoviposition period of about a day and then begins laying an average of five eggs per day for her ten-day life span. Generation time, from newly laid eggs to egg-laying female is

TABLE 1. Field separation of broad mite and nonpest tarsonemid

T. cryptocephalus	Broad mite
Bronze with white dot at rear of body	Straw colored with white stripe down back
Adult narrow at front, elongate	Adult wider at front than at rear
Egg clear, slightly barrel shaped	Egg clear, oblong, flattened, with prominent white tubercles
Generally found in groups of several	No grouping
Slow and sluggish movement	Very quick moving, especially the male
Found near or under the fruit button; fruit of all sizes	First found on the shaded side of the fruit; prefers fruit 3 cm or smaller in diam.

TABLE 2. Control of broad mite at a lemon grove 2½ miles south of Saticoy (Ventura County)

	Mean number of mites per fruit†					
		Days after spray				
Material, rate*	Pretreatment	9	21	36	50	63
wettable sulfur, 48	13.9 a	0.0 a	0.0 a	0.7 a	0.3 a	2.2 a
dicofol 1.6E, 4	10.8 a	0.0 a	0.1 a	1.3 a	1.1 a	8.6 ab
dicofol 1.6E, 8	12.8 a	0.0 a	0.0 a	0.2 a	1.9 ab	5.0 ab
oxythioquinox 25W, 2	10.4 a	0.0 a	0.0 a	0.0 a	3.4 ab	5.6 ab
chlorpyrifos 4E, 6	11.8 a	0.7 a	4.4 a	9.3 a	3.1 ab	4.6 ab
chlorobenzilate 4E, 4	9.2 a	3.3 ab	8.4 a	39.8 b	27.2 d	12.0 b
fenbutatin-oxide 50W, 2	10.4 a	12.3 b	20.4 b	30.3 b	10.2 bc	10.8 b
unsprayed control	10.5 a	25.1 c	36.2 c	55.6 c	14.7 c	13.6 **

* Ounces active ingredient per 100 gallons. Applied by handgun at about 1,100 gallons per acre on August 4-5, 1981. Five three-tree replicates.
† Materials sharing a common letter were not significantly different at the 0.05 level (DMRT).
** No undamaged fruit on two of the five unsprayed replicates.

approximately four to five days.

The adult male is smaller (0.11 mm) and faster-moving than the female. The greatly enlarged hind legs are used to pick up the female nymph and place her at right angles to his body for later mating. Since other tarsonemid species found on citrus do the same, this is not a good field identification character for the broad mite.

Detection

Low levels of the broad mite can be detected by examining the shaded side of small fruit (2 to 3 cm in diameter) on the interior of trees with the thickest canopies. This preference for the shaded side of the fruit often results in only one side of the fruit being damaged. In some cases one can walk through a grove without seeing damage, but on closer examination find that the shaded side of almost every fruit is silvered.

Broad mite infestations have occurred as far north as Santa Barbara County, a few miles east of Santa Paula in Ventura County, and south to Oceanside in San Diego County. In spring of 1980, there were scattered pockets of broad mite in several groves in Ventura County, but high populations were not detected until summer (late July to September). Similarly, in 1981 the mites were found in June, but did not reach damaging levels until mid to late July. Discoveries of broad mites were made progressively farther east (inland) in Ventura County as the summers progressed. Generally, it has not been necessary to spray in the spring, but if the broad mite is found in the summer, especially July and August, it is almost certain to reach damaging levels within a very short time. Populations requiring control can occur in September or later in the fall.

Control

None of the acaricides tested in the laboratory or in five field studies (in San Diego, Orange, and Ventura counties) seemed to give more than six to eight weeks' control when applied during the worst broad mite period (July and August) (table 2). This may be due to the lack of residue on new (post-spray) growth where the broad mite prefers to feed. Many contact pesticides work well on this mite, but residual activity is also necessary, because no material examined has been effective against eggs.

Sulfur and oxythioquinox (Morestan) have given consistently good control of the broad mite. Sulfur is also effective against the citrus rust mite; oxythioquinox controls citrus red mite *Panonychus citri* (McGregor) and is fairly effective against citrus rust mite. In an infestation of all three mites, oxythioquinox is the recommended material. Neither material can be mixed with oil.

Chlorpyrifos (Lorsban), which recently received federal registration on citrus for California red scale, has given good control of the broad mite. It has also shown some efficacy against the citrus bud mite but not against the citrus red mite. Chlorpyrifos is compatible with oil.

Fenbutatin-oxide (Vendex) did not provide acceptable control in four of our tests. However, in a San Diego County test, it provided very good, although somewhat delayed, control, possibly because predatory mites were present. We feel that predatory mites surviving the fenbutatin-oxide application were able to control the broad mite population, which had been lowered by the chemical. The addition of oil increases the efficacy of fenbutatin-oxide against the broad mite. Since oil also must be added to this pesticide to control the citrus bud mite, *Eriophyes sheldoni* Ewing, fenbutatin-oxide probably should not be used on coastal lemons without oil.

Formetanate hydrochloride (Carzol) and some other carbamates abruptly halted egg laying by the broad mite in the laboratory, even at very low rates (one-tenth the lowest recommended field rate). Formetanate hydrochloride is sometimes used in coastal areas for citrus thrips control, but is not recommended because it interferes with biological control of some other pest species, particularly brown soft scale. Propargite (Omite) and amitraz (Baam, Mitac) did not control the broad mite.

Predatory phytoseiid mites have been seen feeding on broad mite in the field and may contribute significantly to their control, especially in the spring, when conditions are relatively unfavorable for the broad mite but favorable for predators. There is some evidence that the introduced predator *Euseius* (= *Amblyseius*) *stipulatus* is a better control agent for broad mite than *E. hibisci*, the most common predatory mite on California citrus.

The apparent success of these predators in controlling spring populations of the broad mite indicates that the acaricide must be carefully chosen. For example, dicofol (Kelthane) is fairly toxic to predatory mites and probably should be used only when broad mite population pressure is high or when predatory mites are at a minimum or not present. Fenbutatin-oxide and oxythioquinox are safer to predator mites than sulfur, dicofol, or formetanate hydrochloride (in that approximate order).

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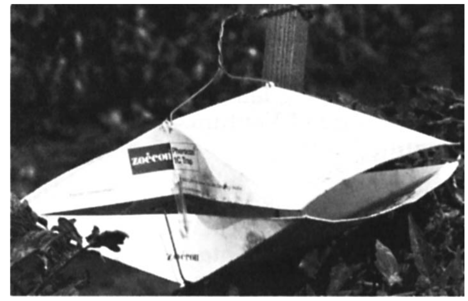

The tomato pinworm (TPW) is a major pest of tomatoes in southern California, Florida, southeastern Texas, and Mexico. In California, it is especially serious on fall-crop tomatoes, where it attacks both foliage and fruit and may cause extensive fruit damage if not controlled.

Growers now control the pinworm by weekly applications of broad-spectrum insecticides. Such measures not only are costly but also suppress parasites of TPW and may result in secondary outbreaks of russet mites and vegetable leafminers, requiring additional applications. The use of pheromone traps to monitor the fall population buildup of TPW and time the initiation of insecticide treatments would prevent unnecessary applications in the early fall.

We conducted four years of trials on tomato pinworm, *Keiferia lycopersicella*, at the University of California South Coast Field Station, Santa Ana, on fall-crop fresh market stake tomatoes (Peto Seed 7718VF). We used fall-crop tomatoes, because a preliminary pheromone-trap study indicated that TPW is not normally a problem during the spring and summer crops.

Insecticide treatments were with methomyl (0.45 pound active ingredient with 100 gallons of water per acre, applied by high-clearance ground sprayer), because it was the only effective insecticide registered with a short preharvest interval (three days). After these studies were conducted, Pydrin also received registration under a Special Local Need permit. (Consult the county agricultural commissioner for current status of the permit.)

We used Pherocon 1C pheromone traps to monitor the male TPW population, checking the traps at three- and four-day intervals and changing the pheromone fibers every six weeks. One trap was placed in the center of each replicate and periodically adjusted to a level equal to the top of the foliage.

To monitor larval populations, we collected all TPW-mined leaflets from 1 to 6 row-meters of foliage per replicate and examined the foliage in the laboratory for live larvae. We evaluated fruit infestation by harvesting all pink and red fruit at three- and four-day intervals