Figure 1. Rust mites can cause "sharkskin" damage in citrus.

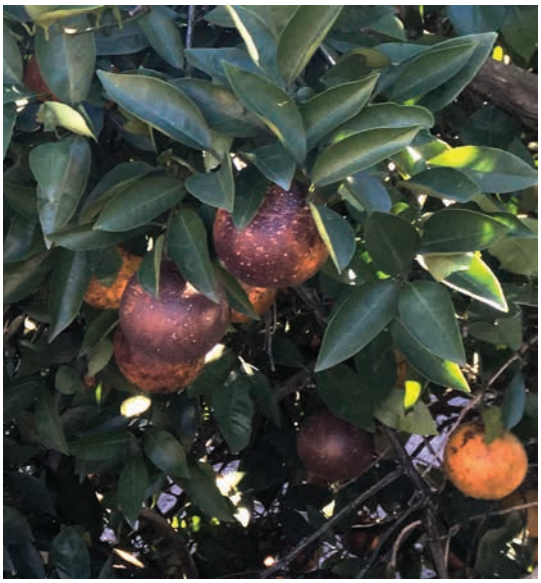

Figure 2. This sweet orange fruit shows severe "bronzing" damage from rust mites.

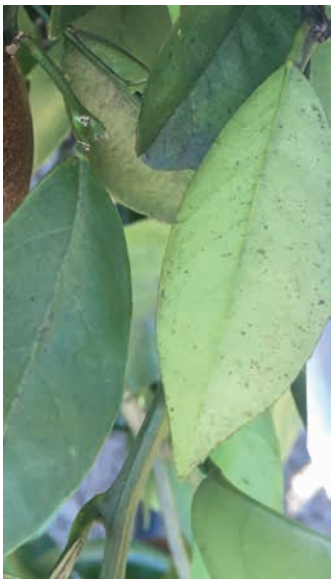

Figure 3. Small, chlorotic leaf spots caused by spider mite feeding are referred to as "stippling" damage.

Photos by Jamie Burrow, University of Florida

Managing mites in Florida citrus

By Lukasz L. Stelinski, Jawwad A. Qureshi and Philip A. Stansly

Florida citrus is host to four main groups of mites categorized by differences in lineage and morphology. However, only rust mites, spider mites and broad mites historically cause economic damage to commercially grown citrus in the state. The fourth group, referred to as false spider mites, are vectors elsewhere of the causal virus of the disease leprosis, but are currently not classified as causing serious economic concern in Florida.

RUST MITES

Rust mites are the most important of the economically relevant groups and include the citrus rust mite and the pink citrus rust mite. Both species feed on fruit and leaves, which causes damage to epidermal cells. Rust mite injury has a known history of reducing fruit grade in Florida citrus. Severe infestations can cause significant fruit water loss and thereby contribute to fruit drop.

Early-season damage is characterized by destroyed epidermal cells, which fracture as the fruit enlarges, causing a rough form of russeting known as "sharkskin" (Figure 1). Mature fruit maintains intact epidermal cells and a wax layer to take on a polished look when damaged by rust mites, referred to as "bronzing" (Figure 2). Leaf damage caused by mites appears in two distinct forms visually: 1) a dull, bronze-like and glossy appearance and 2) patches of yellowish discoloration where wounded epidermal cells have released ethylene, which causes the change in color from green to yellow. Sunburst tangerine is especially prone to rust mite damage.

SPIDER MITES

The other two taxonomic groups of concern are the spider mites and broad mites. In Florida, Texas citrus mite and citrus red mites are the species of economic concern. Spider mites are found primarily on mature leaves. Unlike rust mites, spider mites feed underneath the epidermis in the palisade cell layer. Spider mite feeding causes mesophyll tissue to collapse, resulting in small chlorotic spots called "stippling" (Figure 3). Severe damage can cause leaf desiccation, termed "firing," which can be exacerbated by cold, dry winds.

Spider mites are typically kept in check by a broad range of biological control agents, including predatory mite species and pathogens. These beneficial organisms are hindered by dry conditions, which favor spider mite populations. Petroleum oil kills eggs. Application of miticides may only be necessary if populations rise to the point where 10 mobile mites are observed per leaf between September and May.

BROAD MITES

Broad mites are particularly important in greenhouse settings and on lemons and limes grown in the field. Broad mites primarily feed on the

youngest and most tender leaf flush tissues. New leaf growth is distorted by a toxicant in the saliva that is injected by these mites. Favorable environmental conditions, which include warm temperatures, high humidity and shade, can contribute to increases in broad mite populations.

SEASONALITY

Monitoring for rust mites should begin in early April and continue every two to three weeks throughout the season. In general, rust mite populations begin to increase in May and then decline in late August. While mite populations are historically highest from May to July with a second smaller peak in the fall, significant increases in late October and early November have been seen in recent years. Thus, monitoring for mites should not be neglected during the fall peak.

Monitoring for rust mites should begin in early April and continue every two to three weeks throughout the season.

UNINTENTIONAL FLARING OF MITE POPULATIONS

Natural enemies of rust mites include predaceous mites, small inconspicuous ladybeetles and the fungus *Hirsutella thompsonii*. Current control measures for Asian citrus psyllid and citrus canker could impact rust mite control programs. Applications of broad-spectrum insecticides, especially pyrethroids like Danitol, Baythroid or Mustang, can cause rust mite populations to flare.

Multiple copper sprays to control canker or fungal diseases of citrus may also increase rust mite populations. Therefore, more intense monitoring and/or additional sprays may be necessary for rust mite management after pyrethroid or copper applications. Use of a summer petroleum oil spray in place of copper for greasy spot control could reduce the need for a later miticide treatment; however, fungal pathogen management will, in part, dictate these decisions.

Florida citrus was affected by destructive Hurricane Irma in the fall of 2017. Mite populations in Central Florida immediately following Hurricane Irma and into November 2017 did not appear drastically different from the previous year. After the destructive hurricanes of 2005, mite populations were also not immediately affected, but did increase where they were not monitored and controlled soon after the storms of 2004, causing bronzing of fruit (Albrigo et al., 2005). Higher than normal rainfall and humidity in the spring of 2005 were thought to have contributed to an early rise in rust mite populations, rather than any possible lingering effects of the storms (Albrigo et al., 2005).

Perhaps a more important factor

affecting rust mite populations locally in 2017 was pyrethroid sprays for psyllids. Psyllid populations increase rapidly following mass defoliation events as trees produce new flush. It is imperative to kill off adult psyllids prior to a new mass flushing cycle before the populations can take off by depositing eggs on highly abundant new flush. Broad-spectrum insecticides, such as pyrethroids, can be some of the more effective tools to knock back adult populations prior to a new flush. In areas where these pesticides were used heavily following Irma, one would have expected to see flare-ups of rust mite populations. Mite populations may require additional monitoring following intense broad-spectrum sprays for psyllids to determine if a miticide is warranted.

MANAGEMENT

Selection of an appropriate miticide depends on the intended target of control. With the current emphasis on psyllid and citrus leafminer control, it would be wise to choose a miticide that may also have some activity against one of these two pests, such as diflubenzuron (Micromite 80 WGS) or spirotetramat (Movento). With the exception of petroleum oil, no miticide should be applied more than once per season to avoid development of resistance. For more detailed information on the latest miticides and recommended rates, see Chapter 10 of the Florida Citrus Pest Management Guide (http://edis.ifas.ufl.edu/cg002) on mite control.

Fruit appearance is a much greater priority in fresh-market fruit and thus will require more intensive management to prevent mite damage. Fruit growth and abscission will not be affected until 50 to 75 percent of the fruit surface is injured by rust mites. So there is less need for chemical control where fruit is destined for processing. Groves producing fresh-market fruit may be treated with miticides three to four times annually, typically during April, June, August and October, depending upon level of pest population. However, groves producing fruit for the processing market may receive zero to two applications for rust mites annually.

Source: Albrigo, L.G., Buker, R.S., Burns, J.K., Castle, W.S., Futch, S., McCoy,C.W., Muraro, R.P., Rogers, M.E., Syvertson, J.P., Timmer, L.W., Attaway, J., Bowmam, K., Hancock, K.W., Ritenour, M.A., Spyke, P.D. and Vachon, R.C., 2005. The impact of four hurricanes in 2004 on the Florida citrus industry: Experiences and lessons learned. Proc. Fla. Hort. Soc. 188: 66-74.

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