K-STATE Research and Extension

Mealybug

Management in Greenhouses and Interiorscapes

Mealybugs are major insect pests of greenhouse and interiorscape environments (including conservatories) where they feed on a wide range of plants and are difficult to manage (suppress) with insecticides. Host plant range depends on the particular mealybug species but includes herbaceous annuals or perennials, foliage plants, orchids, vegetables, and herbs. Specific plants include aglaonema, begonia, chrysanthemum, coleus (*Solenostemon scutellarioides*), croton (*Codiaeum variegatum*), dracaena, false aralia (*Dizygotheca elegantissima*), ficus, grape ivy (*Cissus rhombifolia*), marigold, poinsettia (*Euphorbia pulcherrima*), pothos (*Epipremnum aureum*), and transvaal daisy (*Gerbera jamesonii*).

A number of mealybug species may be found in greenhouses and interiorscapes, but the predominant species are the citrus mealybug, *Planococcus citri* and the longtailed mealybug, *Pseudococcus longispinus*. In addition to these two species, which feed aboveground, root mealybugs (*Rhizoecus spp.*) are of concern because they are extremely difficult to detect and manage with available insecticides.

Biology and Damage

Mealybugs are elliptical in shape with white, waxy protrusions extending from the body (Figure 1). Females are white, wingless and 2 to 5 mm long when full-grown, (Figure 2). Males are typically smaller. Most mealybug species reproduce asexually (lay eggs). The typical female mealybug life cycle consists of five growth stages: an egg, three nymphs or crawler stages, and adult (Figure 3). Males undergo six growth stages including two pupal stages: prepupa and pupa. Before adult females die, they lay eggs underneath the body cavity. Longtailed mealybug females give birth to live offspring (Figure 4), and do not have to mate to reproduce (this is referred to as parthenogenesis). Eggs hatch into crawlers that actively move around seeking places to settle and feed. Crawlers are yellow-orange (Figure 5), eventually turning white after each successive molt. Once settled, mealybugs progress through several growth stages before becoming adults. Male mealybugs eventually become winged individuals (Figure 6), mate with females, and die after 2 to 3 days. Females continue development and die after depositing eggs. Eggs remain protected under the body of the dead female until they hatch (Figure 7). A single citrus mealybug female

Figure 1. Mealybugs feeding

Figure 2. Female citrus mealybug

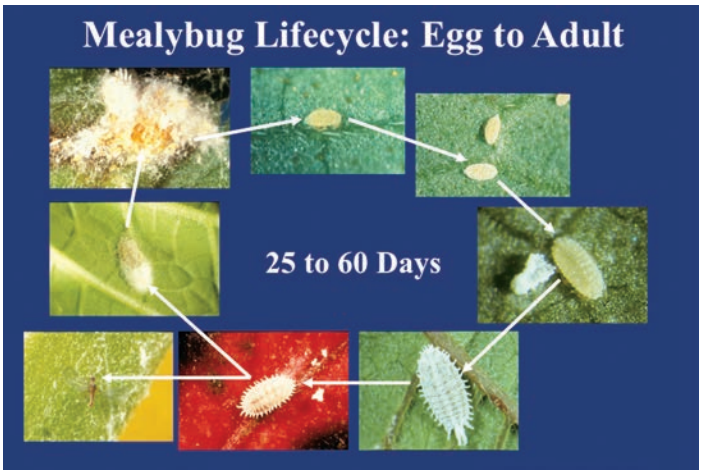

Figure 3. Mealybug life cycle

Figure 4. Long-tailed mealybugs

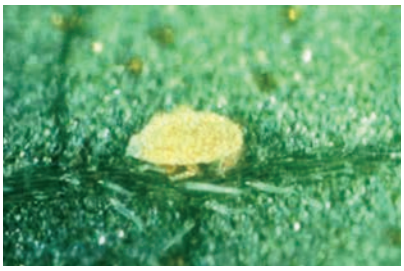

Figure 5. Crawler

Figure 6. Winged male

is capable of producing up to 600 eggs. Only the adult males and newly emerged crawlers actively disperse.

Figure 7. Eggs

Mealybugs, in general, have a longer developmental period (egg to adult) than most other greenhouse insect and mite pests such as aphids, spider mites, thrips, and whiteflies. The life cycle from egg to adult takes approximately 60 days, depending on temperature and host plant. The primary means by which mealybug crawlers disperse within a greenhouse or interiorscape are wind or air currents, workers handling infested plants and inadvertently transferring mealybugs to uninfested plants, watering equipment, plant leaves touching that allow crawlers to move among plants, introduction of infested plant material, and ants transporting crawlers among plants. The lateral waxy protrusions help protect mealybugs from natural enemies (e.g., parasitoids and predators) and promote the spacing of individuals in a colony. Mealybugs seem almost invisible during early stages of infestation, and then suddenly populations become noticeable, resulting in outbreaks. It is usually too late then to implement an effective management strategy.

Mealybugs cause direct plant injury by feeding on plant fluids or sap in the vascular tissues—primarily the phloem or mesophyll or both—with their piercing-sucking mouthparts. They may also inject a toxin. This may cause leaf yellowing, plant stunting, and wilting. In addition, mealybugs excrete a clear sticky liquid called honeydew, which serves as a growing medium for black sooty mold fungi. Mealybugs are also capable of transmitting diseases, including viruses. Mealybugs tend to congregate in large numbers at leaf junctures where the petiole meets the stem, on leaf undersides, on stem tips, and under the leaf sheaths of certain plants such as orchids and the prayer plant (*Maranta leuconeura*).

Scouting

Mealybugs do not fly, except for the adult male, so they are not captured on yellow sticky cards. Visual plant inspections are the only way to detect early mealybug infestations. Because of their cryptic behavior and small size, scouting via visual inspections is labor intensive and impractical. Scouting efforts should be focused on plant species highly susceptible to mealybugs. This can be done by tagging a number of plants (five to 10 per plant species) and inspecting them regularly, which may help detect mealybug populations early. Workers should wear disposable rubber gloves when handling highly susceptible plants.

Management

Cultural Management

This involves implementing practices such as weed removal, proper fertility, and old plant material disposal. Favorable environmental conditions (e.g., temperature) and plant growth may increase the mealybug population. For example, plants irrigated frequently that receive high concentrations of a nitrogen-based fertilizer tend to be more susceptible to mealybugs. Water-stressed plants may also be more susceptible to mealybugs. Furthermore, mealybug females feeding on plants receiving high concentrations of a nitrogen-based fertilizer may lay more eggs than usual. It is also important to immediately discard heavily infested plants, especially those that have been around for several years ("grandmother plants"), which tend to harbor mealybug populations. If feasible, a forceful or high-pressure water spray, conducted regularly (e.g., twice per week) is effective in dislodging or removing all life stages (eggs, crawlers, and adults) quickly, thus preventing outbreaks from occurring.

Insecticide Management

Factors that may impact suppression of mealybug populations with insecticides include:

- Mealybugs have a cryptic behavior or clumped spatial distribution, and tend to aggregate or establish themselves in concealed/protected areas of plants.
- Frequent overlapping generations with an age structure consisting of all the life stages present (eggs, crawlers, and adults) simultaneously.
- Hydrophobic (water-hating) waxy body covering repels hydrophilic (water-loving) insecticides.
- The mealybug life cycle and need to apply insecticides frequently increases the development of resistance.
- Certain insecticides may stimulate development and reproduction of mealybugs.
- Many insecticides are not compatible with natural enemies (e.g., parasitoids and predators) and repeated insecticide use will kill existing natural enemies.

The types of insecticide applications include foliar sprays and those directed toward the growing medium (drench or granule). Adult mealybugs are difficult to manage because they form a white, waxy protective covering that is nearly impervious to most insecticides. And because most insecticides have no activity on eggs (with the possible exception of petroleum-based or neem oils), at least two to three weekly applications usually are required to achieve satisfac-

tory suppression, especially when dealing with overlapping generations. The crawler stage, which does not possess a waxy covering, is most susceptible to insecticides including insect growth regulators (e.g., azadirachtin, buprofezin, and kinoprene), insecticidal soaps (potassium salts of fatty acids), horticultural oils (petroleum-based), and possibly insect-killing fungi (*Beauveria bassiana*). Although very few (if any) insecticides are able to penetrate the waxy covering of mealybugs, those containing ethyl alcohol (ethanol), such as some oil-based insecticides, may allow the material to penetrate through the waxy covering, killing mealybugs.

When applying high-volume sprays, thorough coverage is imperative, especially when using contact insecticides, because mealybugs are commonly located in areas that are not easily accessible, such as the base of leaf petioles, leaf sheaths, and leaf undersides. Adding a spreader-sticker to a spray solution may be helpful in improving coverage and penetration. Table 1 lists insecticides that are registered for use on mealybugs in both greenhouses and interiorscapes. For highly susceptible plants, it may be prudent to routinely spray with either an insecticidal soap or horticultural oil to prevent mealybug populations from reaching outbreak proportions. Also, it is essential to make multiple applications when crawlers are present because eggs will hatch (with the exception of the longtailed mealybug) over an extended time period. Insect growth regulators, such as those listed in Table 1, are only directly active on the crawler stages, so timing of these materials is very important.

Systemic insecticides, those that move throughout plant parts, may also be used to protect plants from mealybug infestations. Applications should be initiated early in the cropping cycle or before introducing plants into interiorscapes. Systemic insecticides may be applied as either a growing medium drench or granule. It is important to avoid overwatering plants afterward so roots can absorb the active ingredient. Systemic insecticides, depending on the type, may be less effective on mealybugs than on aphids or whiteflies. This may be associated with mealybugs not ingesting lethal concentrations of the active ingredient because they feed within the mesophyll tissues or on plant stems.

Biological Management

The use of biological control agents such as parasitoids and predators has been successful in managing mealybugs, primarily citrus mealybug, under specific crop production systems and interiorscapes. Biological control agents currently available for suppression of citrus mealybug populations include the predatory ladybird beetle, *Cryptolaemus montrouzieri*, commonly referred to as the "mealybug destroyer," (Figure 8) and the parasitoid, *Leptomastix dactylopii* (Figure 9). The larval stages of the mealybug destroyer resemble mealybug adults (Figure 10). *Leptomastix dactylopii* females only attack the third instar and young adult female life stages. Both natural enemies may be effective in suppressing or regulating citrus mealybug populations, and they can be used together under certain systems and situations. The waxy covering of later life stages may provide protection against these natural enemies. In addition, mealybugs may encapsulate (smother) the eggs laid by the parasitoid, and the cryptic behavior of mealybugs may allow them to elude natural enemies.

Figure 8. Mealybug destroyer

Figure 9. *Leptomastix dactylopii*

Figure 10. Mealybug destroyer larvae

It is important to manage ant populations because ants will protect mealybugs from natural enemies. Ants perform several additional functions that are beneficial to mealybugs, including removing honeydew and constructing shelters. In the presence of ants, mealybugs tend to ingest more plant sap, resulting in greater plant damage. There are no commercially available parasitoids for the longtailed mealybug. Contact your state's extension entomologist or biological control supplier for additional information about using natural enemies to deal with mealybugs in greenhouses and interiorscapes.

Table 1. Insecticides registered for use against mealybugs in greenhouses and interiorscapes.[1]

Active Ingredient	Trade Name	Activity Type	Mode of Action
Acephate	Orthene/Precise	C and T	Acetylcholine esterase inhibitor
Acetamiprid	TriStar	C, S, and T	Nicotinic acetylcholine receptor disruptor
Azadirachtin	Azatin/Ornazin/Molt-X[2]	C and SP	Ecdysone antagonist
Beauveria bassiana	BotaniGard	C	
Bifenthrin	Attain/Talstar	C	Prolong opening of sodium channels
Buprofezin	Talus	C	Chitin synthesis inhibitor
Chlorpyrifos	DuraGuard	C	Acetylcholine esterase inhibitor
Cyfluthrin	Decathlon	C	Prolong opening of sodium channels
Dinotefuran	Safari	C, S, and T	Nicotinic acetylcholine receptor disruptor
Fenoxycarb	Preclude	C	Juvenile hormone mimic
Fenpropathrin	Tame	C	Prolong opening of sodium channels
Flonicamid	Aria	C, S, and T	Selective feeding blocker/blocks action of potassium channels
Imidacloprid	Marathon/Merit	C, S, and T	Nicotinic acetylcholine receptor disruptor
Kinoprene	Enstar II/AQ	C	Juvenile hormone mimic
Paraffinic oil	Ultra-Fine Oil	C	Suffocation or membrane disruptor
Petroleum oil	PureSpray Green/SuffOil-X	C	Suffocation or membrane disruptor
Potassium salts of fatty acids	M-Pede	C	Desiccation or membrane disruptor
Spirotetramat	Kontos	C, S, and T	Lipid biosynthesis inhibitor
Thiamethoxam	Flagship	C, S, and T	Nicotinic acetylcholine receptor disruptor

Activity Type Codes:
C=Contact T=Translaminar S=Systemic SP=Stomach Poison

[1]Be sure to read the label as some insecticides in the table may not be registered for use in both greenhouses and interiorscapes.

[2]Additional products include Azatrol, AzaGuard, Aza-Direct, and AzaSol.

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