

Biology and Management of Whiteflies in Sustainable Field Production of Cucurbits¹

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Whiteflies (Hemiptera: Aleyrodidae) are minute insects generally characterized by having wings covered with wax. Several species of whiteflies exist. They have a wide host range, including crops that are members of the Cucurbitaceae family (cucurbits). The major whitefly biotype that attacks cucurbits in the field is the silverleaf whitefly, *Bemisia tabaci* biotype B (Genn.) (Figure 1).



Figure 1. Adult *Bemisia tabaci* B biotype (Gennadius).
Credits: Scott Bauer, USDA

Biology and Lifecycle

Whiteflies have six life stages: egg, four instars, and adult. The eggs are usually elongate-oval in shape but occasionally may be reniform (bean shaped). The apex (distal end) of the egg is acute and the basal portion is usually broad, with a pedicel or stalk of varying length by which the female attaches to the host. Eggs are laid singly on the underside of the leaf and are white in color. Each female can produce

up to 300 eggs. The first instar, called the crawler, has legs and is the only mobile instar that moves to look for feeding sites. The other instars are sessile and they complete their lifecycle on the same leaf (McAuslane 2000). The life cycle is dependent on the temperature and plant species. It can take 14-60 days, but typically *Bemisia* spp. takes 20 days at 80°F. These species reproduce parthenogenetically (reproduction without fertilization) (Zitter et al. 1996). In northern Florida, high populations of *Bemisia* are often seen in the fall whereas in southern Florida populations tend to exist throughout the year with the peak in the summer.

Damage

Whiteflies damage cucurbits through direct feeding when they suck sap from the phloem and excreting honeydew, a sugar-rich substrate that promotes the growth of sooty mold (*Capnodium* spp.), on harvestable plant parts and leaves. They also damage the plant by transmitting viruses and inducing physiological disorders (Figure 2). *Bemisia tabaci* biotype B transmits geminiviruses to cucurbits in a persistent manner (i.e., once the virus is acquired by the whitefly they retain the ability to transmit it for a long period). The *Cucurbit leaf crumple virus* (CuLCrV) is an important geminivirus transmitted by *B. tabaci*, and during periods of high infestations, plants can become stunted and yield fewer fruits compared with healthy plants (Akad et al. 2008, Nyoike et al. 2008). Squash silverleaf disorder (SSL) is a systemic physiological plant disorder associated

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with the feeding of immature whiteflies Figure 3) and is characterized by silvering of the upper leaf surface. Depending on the severity of squash silverleaf disorder, they can reduce the quality of the fruit produced, rendering it unmarketable.



Figure 2. *Cucurbit leaf crumple virus* in zucchini squash.
Credits: Teresia Nyoike, University of Florida

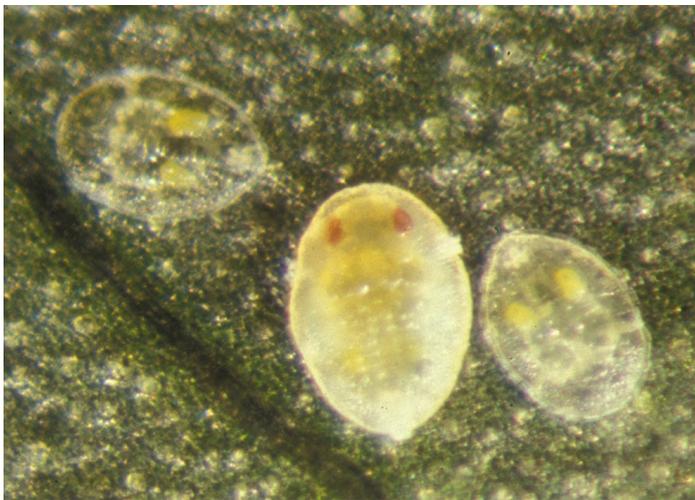


Figure 3. *Bemisia tabaci* (Gennadius) immature stage on the underside of leaf.
Credits: J. Castner, University of Florida

Monitoring

Monitoring is an essential part of a whitefly management program. Yellow sticky traps can be used to monitor adult whiteflies moving into the field, and these traps have been reported to give a good correlation between adult catches and actual whitefly numbers in the field in some systems (Basu 1995) and hence their use is very popular in whitefly IPM programs. *In-situ* count (leaf turn method) is another sampling technique used to estimate the absolute population of adults in the field. These counts should be done in the morning when the whiteflies are least mobile.

Quantification of immature whiteflies involves cutting of leaf discs of a designated area from the leaves to be sampled. Leaf discs are then examined under a microscope for identification of nymphal stages (Nyoike et al. 2008). Eggs are usually laid on the younger leaves and the developing stages are found on the middle and older leaves.

Management

In sustainable agriculture, prevention practices are the first line of defense for the growers. Management options include cultural techniques, use of physical barriers, removal of the crop in space and time, the use of biological control agents, and reduced-risk insecticide control.

Cultural Control

Some of the cultural practices available include mulching, crop rotation, floating row covers, and cover crops. Soil ground covers (synthetic and living mulches) have been shown to be effective in reducing whiteflies reaching host plants, and hence resulting in a lower incidence of whitefly-transmitted viruses (Frank and Liburd 2005, Nyoike et al. 2008). UV-reflective mulch reflects short-wave light, which repels incoming whiteflies, thus reducing their probability of alighting (landing) on host plants. Alternatively, living mulches decrease the chance of appropriate landings on host plants by reducing the contrast between bare ground and the plant canopy, hence diminishing the activities of whiteflies on its host. In addition, whiteflies are less likely to remain in mixed croppings, which have fewer resources as compared to pure stands (without living mulches). Buckwheat, *Fagopyrum esculentum* Moench, is as an important living mulch in cucurbit production systems. Significant reductions in whitefly densities and whitefly-transmitted viruses have been recorded when buckwheat was intercropped into squash production systems (Frank and Liburd 2005, Nyoike et al. 2008). Living mulches also provide habitats for natural enemies (beneficial insects) that can contribute to pest reduction.

Biological Control

Some biological control agents including parasitoids, *Encarsia formosa*, *Encarsia luteola*, and *Eretmocerus californicus* have been fairly successful in the greenhouse. There are very few cases of successes that have been reported under field conditions. Several generalist predators that prey on whiteflies include lacewing larvae, *Orius* spp. (minute pirate bugs), and *Geocoris* spp. (bigeyed bugs). The coccinellid beetle *Delphastus catalinae* (Horn) has been cited as a good biological control candidate for whiteflies (Figure 4). *Delphastus catalinae* is an obligate whitefly predator with

high prey consumption rates, high fecundity rates, and long adult lives (Heinz et al. 1999). *Delphastus catalinae*, when used in conjunction with buckwheat as a living mulch, could aid in the reduction of whiteflies on zucchini squash and reduce the incidence of whitefly-transmitted viruses (Razze et al. 2015).

Insecticidal Control

Horticultural oils, pyrethrins (PyGanic®), and insecticidal soaps (M-Pede®) can be used to reduce whitefly populations. A few biological pesticides, including *Beauveria bassiana* (Naturalis-O® and BotaniGard®), *Paecilomyces fumosoroseus* (PFR-97®), and a few neem-based formulations containing azadirachtin (Neemazad® and Aza-Direct®) have been reported to affect whitefly developmental stages.

Summary

Whiteflies can be a major problem in the production of cucurbits. Growers who have whiteflies and viral symptoms should contact their County Extension Agents or submit



Figure 4. *Delphastus catalinae* (Horn) feeding on immature *B. tabaci* on squash leaves.

Credits: Janine Razze, University of Florida

samples to Plant Clinic Diagnostic Laboratory (PCDL) at the University of Florida for identification. Samples can also be submitted electronically through Distance Diagnostic and Identification System (DDIS). Information on submitting samples through this system can be found at <http://ddis.ifas.ufl.edu/>.

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