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Biology and Management of Aphids in Sustainable Field Production of Cucurbits[1]

O. E. Liburd and T. W. Nyoike[2]

Aphids (Hemiptera: Aphididae) are minute pear-shaped, soft-bodied insects. Their reproductive potential, salivary secretions, and ability to transmit viral diseases make them the most potent and worldwide enemies of many crops. There are approximately 4,400 aphid species in the world (Blackman and Eastop 1994). Several species can be found on cucurbits. Three species that can colonize members of the Cucurbitaceae family are: the melon aphid, *Aphis gossypii* Glover; the green peach aphid, *Myzus persicae* (Sulzer); and the cowpea aphid, *Aphis craccivora* Koch (Zitter et al. 1996). Members of the Cucurbitaceae family include watermelon, squash, and cucumber.

Biology and Lifecycle

In the spring, female nymphs hatch from the eggs on the primary host and feed to maturity. There are several variations of aphid life cycle. Aphids alternate primary hosts with secondary hosts, sexual with non sexual (parthogenetic) reproduction, migrant with nonmigrant forms and wingless with winged forms. Winged (alatae) forms migrate and feed on summer crops such as cucurbits. Females reproduce parthenogenetically giving rise to live nymphs. Males and females are produced in the fall that migrate onto winter host where they mate to produce eggs. In the tropics and subtropics, female nymphs are produced all year round (Zitter et al. 1996).

The bulk of aphid virus vectors belong to the genera, *Myzus* (e.g. green peach aphid), *Aphis* (e.g melon aphid, cowpea aphid), *Acyrthosiphon*, and *Macrosiphum* (Katis et al. 2007). Some authors have referred to the melon aphid as the most damaging aphid species, but others have argued against this when they consider transmission of non-persistently transmitted viruses. Melon aphids are able to establish and colonize on the leaves as opposed to non-colonizing species, which are mobile and hence more efficient in virus transmission.

Damage

Aphids suck sap from plants and cause the leaves to appear curled and distorted, especially when the population is high. They excrete honeydew, a sugar-rich substrate that promotes the growth of sooty mold (*Capnodium* spp.) on harvestable plant

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2. O. E. Liburd, associate professor and T. W. Nyoike, graduate assistant, Entomology and Nematology Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL, 32611.

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parts and leaves, lowering their quality (Nyoike 2007). Their most distinct damage to cucurbits is their ability to transmit viruses in a non-persistent manner (Figure 1). This is a mode of transmission that is characterized with a short time of acquisition, inoculation (< 1 min) and retention with brief stylet penetration before the virus is passed onto another host (Nault 1997). These viruses include *Papaya ring spot virus-Watermelon strain* (PRSV-W), *Watermelon mosaic virus* (WMV), *Zucchini yellow mosaic virus* (ZYMV) and *Cucumber mosaic virus* (CMV).

Figure 1. Viral symptoms on zucchini squash.

Monitoring

Effective management of aphids requires constant monitoring of the plants for apterae (wingless forms). The plants should visually be inspected by gently turning the leaves to check the undersides, where aphids inhabit (Figure 2). As the plant matures, flower buds and leaves should also be inspected for aphids (Figure 3). Honeydew and white skins left on plants by aphids during the molting process (Figure 4) are signs that can be used to detect aphid infestation.

Several trapping techniques can be used to monitor alate aphids. These aphids have poor visual acuity but they are known to be responsive to yellow and green light frequencies (wavelength 500-580 nm). For this reason, yellow commercial sticky traps are available to monitor alate aphid populations in the field and greenhouses. They can also be used for monitoring migrating populations in the field. Blue water pan traps are small containers that are filled with 10% detergent solution for collecting aphids. Pan traps function similar to sticky traps but the aphids are collected in the solution (Nyoike 2007).

Figure 2. Melon aphids on underside of a zucchini squash leaf.

Figure 3. Melon aphids in zucchini squash flowers.

Figure 4. Small white skins left after molting.

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Pan traps can be used to alert growers of aphid infestation and possibly predict risks of virus infections. Sticky and pan traps should be placed in the field early in the growing season (at transplanting or one week after planting). Traps can be placed close to field borders to detect migrating aphids, as well as in the center of the field to monitor resident population. Traps should be checked weekly.

Management

In sustainable agriculture, prevention strategies are one of the most important tactics that growers can employ to avert aphid infestation. These include cultural techniques such as use of physical barriers, removal of crop in space and time, mulching, crop rotation, border crops and cover crops. Both synthetic and living mulches have been shown to reduce population of alate aphids reaching/landing on plants and hence reducing the incidence of aphid-transmitted viruses. Crops receiving high levels of nitrogen are more susceptible (attractive) to aphids; therefore, slow release fertilizers may be an alternative to avoid high aphid infestations.

Aphids receive visual cues to land on crops when there is a clearly defined contrast in color between tilled bare soil and the lush foliage of crops. Living mulches reduce the contrast between the bare ground and the plant foliage so aphids do not detect their host. These mulches provide additional feeding sites for viruliferous aphids (aphids carrying virus) around the crop and hence reduce the incidence and spread of aphid-borne non-persistently transmitted viruses (Toba et al. 1977).

Aphids are attacked by parasitods, predators and pathogens. In some instances, both larvae and adults of predators belonging to the family Coccinellidae (ladybird beetles) are predaceous on aphids. In other cases, only the larvae are predaceous on aphids such as predators in the family Chrysopidae (lacewings). With regards to parasitoids, some species will pupate within or below the aphid cuticle (hardened skin) forming mummies. Adult wasps will emerge from the mummies and are free living. All species in the braconid subfamily Aphidiinae develop as endoparasitoids (inside) of aphids with one larva completing development in each host. Some species of entomopathogenic fungi infest aphids through the cuticle eventually killing the host.

Horticultural oils can also be applied against aphids and aphid-transmitted viruses. These oils are useful in interfering with the transmission of the viruses. They should be applied early in the growing season (two weeks after planting) as aphids are known to colonize plants shortly after germination. Tank mixes of horticultural oils and insecticides have also been used to enhance the control of non-persistently transmitted viruses (Katis et al. 2007). In organic systems, horticultural oils and soaps are effective when applied regularly with a drop nozzle (to get the undersides of leaves) and high pressure, but these must be applied regularly and may be cost prohibitive. Neem and pyrethrin are other options, but care must be taken when using these broad- spectrum insecticides to prevent harm to beneficial insects.

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