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Effectiveness of Two Biorational Substances (Neem and Abamectin) Against Citrus Leaf Miner

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In southeastern Florida, citrus trees serve both as fruit trees and ornamentals. Recently, I tested two biorationals, azadirachtin and abamectin, both of which are essentially non-toxic to mammals, for effectiveness against the citrus leaf miner [*Phyllocnistis citrella* Stainton (Lepidoptera: Gracillariidae)], a pest that is native to Asia and new to Florida.

Materials and Methods

Seedlings of sweet lime (*Citrus limettioides* Tanaka) were kindly supplied to us by Charles Youtsey of the Florida Department of Agriculture and Consumers Services, Winter Haven. These were about 0.3 m tall and with about 30 leaves each, growing in a medium of equal parts of muck, sharp and and cypress sawdust in 15 cm dia plastic containers. They were initially kept in a screen cage to protect them from attack by citrus leaf miner. Each plant was fertilized on September 1, 1993, with a soil application of 5 g 18N-6P-8K Osmocote and removed from the cage and placed near an orange tree [*C. sinensis* (L.) Osbeck] infested with citrus leaf miner.

Twelve plants each were assigned at random to either of 2 different treatments or an untreated control. The treatments were: (1) Avid (abamectin 0.15 EC)(MSD Agvet, Merck & Co., Rahway, New Jersey) at 0.312 ml / l H2O (4 fl.oz. / 100 gal.), (2) Azatin (Agridyne Technologies, Inc., Salt Lake City, Utah) at 2 ml / l H2O (60 ppm azadirachtin) + 0.5 ml /

l H2O Triton B-1956 spreader-sticker (Rhom & Haas Co., Philadelphia, PA). The treatments were applied weekly for 4 weeks beginning September 9. Upper and lower leaf surfaces were sprayed to run-off using a 2-liter handsprayer.

Plants were examined for leaf miners on September 17 (one week after the first spraying) and weekly thereafter for four weeks. The number of leaves with mines per plant was determined. For comparing the treatments, only the leaves with well-developed mines and which were curled due to the leaf miner damage were counted. Mines in initial stages that did not cause significant damage or curling of leaves were noted separately. Numbers of leaves with advanced mines per plant were transformed with the x + 0.5 transformation before analysis by ANOVA and the means tested for significance with the Waller Duncan t-test.

At the end of the four week period, leaves with mines were removed from the plants and examined under the microscope to determine the fate of leaf miners in the different treatment groups.

Results

Citrus leaf miner damage was observed on newly flushed leaves, but not on hardened-off leaves. About 50 % of the plants in each treatment group and the control flushed during the 4-week period of the experiment and thus were susceptible to attack by leaf miners. During this period, leaf miners did not complete mines in leaves of the plants treated with Avid or Azatin. By comparison, at the end of the 4-week period, 58.3 % of the plants in the control group had well-developed leaf miner damage accompanied by leaf curl. There was a mean of 2.84 leaves with well-developed mines per plant in the control compared to 0 leaves with well-developed mines in the Avid- and Azatin-treated group ($P < 0.05$).

Examination in the laboratory of leaves from plants in the control group revealed several empty pupal cases rolled in leaf edges, indicating that leaf miners had completed development to adult. Some late instar larvae were also seen.

The plants treated with Avid remained completely free of

leaf miner damage. By October 1, 33 % of the plants treated with Azatin had 1 to 7 incipient mines. By October 8, 50 % of the Azatin-treated plants had incipient mines, and the incipient mines observed on October 8 had not progressed. These mines were observed again on October 15 and had not progressed and there was no leaf curl. Thus, although leaf miners initiated mines in the leaves, the Azatin treatment protected the leaves from being damaged significantly.

These results indicate that the 2 biorationals tested prevent damage by citrus leaf miners when sprayed on leaves prior to oviposition by this insect. Thus sprays must be timed just as trees are flushing, which may be expected to be different for different species and varieties of citrus and, as in the case of our test plants, for different individual plants. Further information is needed to determine the minimum effective dosage, maximum intervals between applications, and other parameters. Alternating treatments with azadirachtin and abamectin and possibly other compounds in the interest of insect resistance management needs to be investigated, as well as the potential effect of these compounds on beneficial insects.

Azadirachtin and abamectin products are potentially useful for controlling citrus leaf miner.

Water-lilies of Florida

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Introduction

The Nymphaeaceae or water-lily family contains the genera *Nymphaea*, commonly called water-lilies, and *Nuphar*, commonly called spatter-docks or yellow cow-lilies. Members of this family occur from tropical to northern cold temperate regions of the world. Many water-lilies produce large, showy flowers that make them attractive and sought after plants as compared to the spatter-docks.

Water-lilies grow best in full sunlight in static water protected from wind and wave action, whereas the spatter-docks will tolerate wind and water flow. The

floating leaves of water-lilies, although attached to the rhizome by long, trailing, flexible petioles, are damaged by the pounding action of wind and waves. Leaves of spatter-dock are held above the surface of the water on stiff, erect petioles, and thus are not influenced as much by wind and waves.

Water-lilies, because of their large, showy and sometimes fragrant flowers, are favorite aquatic plants for use in ornamental pools and ponds. Modern-day interest in water-lilies is said to have begun in 1786 with the introduction to England of fragrant white water-lilies from North America for use as ornamental aquatic plants.

There are about 35 species of water-lilies worldwide. Many water-lily hybrids have been produced for ornamental purposes. A few hybrids have naturalized from cultivation but none are known to cause problems. Water-lilies in Florida include both native, e.g., Fragrant white water-lily, and introduced species, e.g., Cape Blue water-lily; naturalized hybrids, e.g., Dauben water-lily; and one natural hybrid, Sulphur water-lily.

Native

Fragrant White Water-lily (*Nymphaea odorata* Ait.)

Fragrant white water-lily plants are the most abundant of all the water-lilies in North America and they occur from Canada to Nicaragua. Two varieties occur in Florida. Variety *gigantea* Tricker has large flowers and medium to large leaves and occurs through out much of Florida. Variety *godfreyi* Ward has small flowers and small to medium leaves and occurs primarily in West Florida. Several other varieties of fragrant white water-lily occur

in other areas of North America.

Yellow Water-lily (*Nymphaea mexicana* Zucc.)

Yellow water-lilies occur in Florida, along the southeast coast of the US into Texas and Arizona, and in Mexico. Yellow water-lilies were abundant in many shallow water areas in Florida before the introduction of water hyacinth (*Eichhornia crassipes*). Yellow water-lilies have been crowded out by the aggressive floating waterhyacinth plants. Now that maintenance control of waterhyacinth plants has been achieved in many lakes such as in Lake Okeechobee and the Kissimmee Chain, yellow water-lilies are much more common than they were a few years ago.

Flowers of yellow water-lilies extend above the surface of the water on a stout peduncle. The yellow petals open around noon and close about 4 PM in the afternoon. Upper surfaces of leaves tend to be bright green in the summer and greenish-purple in the winter.

Sulphur Water-lily (*Nymphaea* x *thiona* Ward)

This plant is a natural hybrid of the yellow water-lily and variety *gigantea* of the fragrant white water-lily, and may be found where both parents grow close to each other. Its flowers are quite large like the fragrant white water-lily with light yellow petals on inflorescences that extend above the surface of the water like the yellow water-lily. The Sulphur water-lily appears to be sterile since viable seeds have never been collected.

The Sulphur water-lily was first described in 1957 from plants collected in the St. Johns River. A horticultural hybrid was developed a number of years ago but this hybrid is probably the result of the cross between the yellow water-lily and the fragrant white water-lily variety *odorata*.

Lloyd Mitchum, 11 to 12 years ago, observed the Sulphur water-lily in areas between Indian Prairie Canal and Dykes Ditch on Lake Okeechobee. Within the last few years however, this plant has been found in several areas south of the Monkey Box on Lake Okeechobee. The apparent expansion of the Sulphur water-lily again suggests that maintenance control

of water hyacinth is allowing re-establishment and growth of native aquatic plants.

Everglades Water-lily (*Nymphaea elegans* Hook.)

The Everglades water-lily is found in shallow water areas primarily in the south to southwestern portions of Florida. It flowers from August to November. The flower consists of small pale blue to almost white petals. The petals always have a bluish tinge that deepens on drying.

Naturalized

Cape Blue Water-lily (*Nymphaea capensis* Thunb.)

Cape Blue Water-lilies are native to South Africa. As its name indicates, the flowers contain blue to lavender petals that are whitish at the base. This plant has many horticultural variations, and the plants in Florida may be variety *zanzibariensis* (Casp.) Conard.

Dauben Water-lily (*Nymphaea* x *daubeniana*)

The Dauben water-lily is a horticultural hybrid that has naturalized in a few areas of Florida. Its leaf blades are usually green on both surfaces. The upper leaf surface contains a mound of fibrous tissue at a point above the juncture of the blade and petiole from which epiphyllous plantlets form. These plantlets may be used to propagate new plants. Petals of Dauben water-lilies are light blue and may be confused with other blue water-lilies.

Sleeping-beauty Water-lily (*Nymphaea blanda* G. F. W. Meyer) and *N. jamesoniana* Planch.

These two species are rare in Florida. Although they belong to a large South American group of night blooming water-lilies, they probably are native to Florida. They occur primarily in the west central areas of Florida. Because they bloom at night, they are easily overlooked. These water-lilies produce white flowers from September to November.

Nymphaea ampla (Salisb.) DC.

This water-lily, native to tropical America, has naturalized in areas of Lee County. The plant has flowers with white petals that extend above the surface of the water.

Management of Water-lilies

Water-lily plants are not generally considered to be problem aquatic plants. However, at times they may present problems in localized areas of a body of water or in small ponds. Foliar applications of glyphosate products registered for use in aquatic sites at label rates will provide adequate control of problems resulting from excessive growth of water-lily plants. With careful applications, a desirable level of plants can be maintained.

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