The South Florida Aquatic Plant Management Society

The Hydrophyte

Volume 15 Issue 3

3rd Quarter 2011

Highlights

South Florida Aquatic Plant Management Society

General Meeting Announcement

DATE: Thursday, August 25th, 2011
TIME: 8:00 A.M. – 1:00 P.M.

Lake Worth Drainage District
13801 Military Trail
Delray Beach, FL 33484

Agenda

8:00am – 8:15am	Registration and Refreshments
8:15am – 9:05am	FDACS Core Training Frank Dowdle / Agriculture Safety Training Agent Palm Beach County Extension Service
9:05am – 9:55am	EPA's Numeric Nutrient Criteria – Rules and Regulations Luna Phillips / Attorney at Law Gunster,Yoakley & Stewart, P.A.
9:55am – 10:00am	**BREAK**
10:00am – 10:50am	Phosphorous, Algae, and Water Quality: Interrelationships and Management Implications Dharmen Setaram / Aquatic Specialist SePRO Corporation
10:50am - 11:40am	Climate Change Influence on Local Water Resources Dr. Jennifer Jurado / Broward County Natural Resources Planning and Management Division
11:40am – 12:30pm	Effects of Hydrilla on Florida Freshwater Ecosystems Ken Gioeli / Univ. of Fl / Institute of Food and Agricultural Sciences
12:30pm – 1:30pm	**Complimentary Lunch** **Sponsored by SePRO** **Dharmen Setaram**

Five (5) C.E.U.'s will be available for paid members.* Three (3) Core!

President's Message

The summer of 2011 has been a very trying time for our industry. Water levels have been lower than I can personally remember. What normally are lakes are looking more like deserts. Our experience in this industry will help us persevere through these challenging times. Education and exchange of ideas are invaluable. This is why it is most important now more than ever to attend our meetings to learn from each other.

As an organization that covers all aspects of water management, we are looked upon by the public to relate and advise as to how to deal with current changes and how to respect our uses of water.

Joel Wolf
President

" Cover Photo By Holly Sutter "

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Andy Hyatt (1 of 3)	T: 239.691.8953

The Francis E. "Chil" Rossbach Scholarship Fund

Funds from the scholarship are used to help defray costs for students taking classes related to the study of aquatic environmental sciences or related areas. The scholarship is open to anyone, and all are encouraged to apply. Applications will be accepted through the year and the scholarship awarded when a suitable candidate is found. Money raised by the Society throughout the year partially goes to fund this scholarship, the intent of which is to promote the study of aquatics. If you are interested in applying for the scholarship, please contact Scholarship Committee Chairperson Lydia Groves 954.370.0041 for an application.

UF UNIVERSITY of FLORIDA IFAS

Position Available

Assistant Professor - Weed Science 12-month, tenure-accruing, 60% research 40% extension position in Fort Lauderdale Research & Education Center, IFAS, University of Florida, Davie, FL

Call 954.577.6339 for more information

Upcoming Events

August 25, 2011
South Florida APMS General Meeting

Sept. 25-30, 2011
23rd Asian-Pacific Weed Science Society Conference
Queensland, Australia

October 10-13 2011
FAPMS, St. Augustine, FL

October 24-27 2011
TAPMS, Bandera, TX

October 26-28 2011
NALMS, Spokane, WA

January 17-19 2012
NEAPMS, New Castle, NH

Feb. 6-9, 2012
Weed Science Society of America
Big Island, HI

February 26-29 2012
MAPMS, Milwaukee, WI

Aug. 19-23, 2012
American Fisheries Society
St. Paul, MN

Feb. 4-7, 2013
Weed Science Society of America
Baltimore, Maryland

Feb. 18-22, 2013
International Herbicide Resistance Conference
Perth, Australia

Plant of the Month

Spatterdock (*Nuphar luteum*) - The Misunderstood Beneficial Aquatic Plant;

Description

Spatterdock, also known as cow lily and pond lily, is an aquatic plant found in freshwater ponds and other slow-moving bodies of water across parts of Europe, Asia, and North America. The scientific name of the plant is *Nuphar luteum*. It is part of the family Nymphaeaceae, which is composed of water lilies.

The leaves of the spatterdock plant are most often seen floating on the surface of the water or growing several inches above the water on long, sturdy stems. Some leaves may also be visible beneath the surface of the water. The roots of the plant are burrowed into the bottom of the pond or lake.

Spatterdock flowers are yellow and appear "half-opened" at or above the water surface.

Ecological Importance

They are very important for the ecosystem since they provide shade for fish and cover from predators. They provide excellent habitat for largemouth bass and sunfish; highly decorative----often planted in water gardens and required mitigation sites. It acts as a natural filtration system to help uptake the nutrients in the water. The seeds are eaten by ducks.

Maintenance: All aquatic plants need to be maintained.

Yellow water lilies (spatterdock) can grow and reproduce rapidly **if not maintained**. This occurs when there is an excess of nutrients in the pond.

Spatterdock (yellow water lilies) reproduce through both seeds and rhizome spread.

The strong odor of the yellow flowers attracts beneficial pollinators. Reproduction is from a seed, found in a pod in the flower's center. The plant begins growing beneath the water's surface in early spring, emerging from the rhizome in which it survived the winter.

Spatterdock has been used as a food source in some cultures. The roots have served as an ingredient in soups and have been made into flour. Some Native American cultures gathered the seeds for preparations similar to popcorn.

For medicinal purposes, the plant has been used to treat various ailments, including pain. More recently, it is gathered for cultivation in aquariums.

Spatterdock should be grown in water that is free of strong currents or movements. The plant will grow best in clear water and can quickly spread under the right conditions. This water lily will need at least partial sunlight to flower.

In addition to its benefits to humans, spatterdock is valuable to wildlife. The plant provides food and sanctuary for many different aquatic species.

A Wild, Weedy Scourge

Cogongrass

The federal government is spending millions to combat a nasty plant that is spreading like wildfire

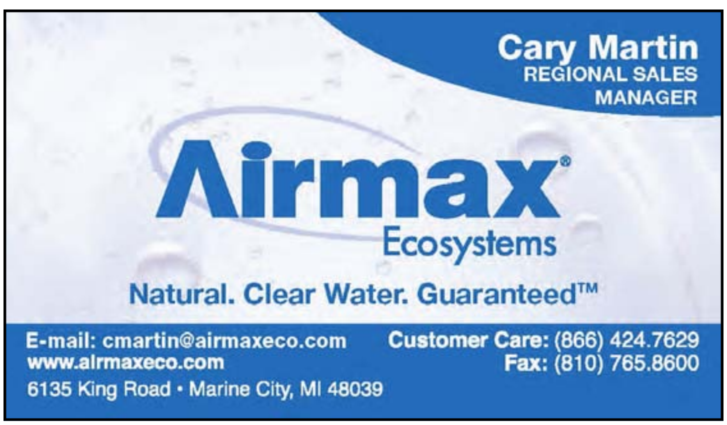
As a single plant, cogongrass is unassuming, bucolic even. But in dense stands, it is a powerful vegetative force that alters forests and forges monocultures. The plant, known as Imperata cylindrica, has established itself on tens of thousands of acres in Alabama, Mississippi and Georgia and on one million acres in Florida, and it's spreading fast. "Cogongrass could become a greater threat than kudzu or Japanese honeysuckle," says Stephen Enloe, an invasive plant specialist at Alabama's Auburn University.

Cogongrass not only forms into thick mats of thatch and leaves that make it nearly impossible for native plants to survive, but it also burns hotter than native species. After a burn, a six- to 12-inch-deep rhizome network sends up new shoots, regenerating themselves as soon as a month after the fire. This resilience makes it a severe threat to forests, especially the pine stands that make up a major industry in the South. Cogongrass is estimated to cost Alabama alone more than $7.5 million per year in lost timber productivity.

Heeding the call of worried scientists and others, the federal government has spent millions in American Reinvestment and Recovery Act money to fight the weedy scourge. These funds are being used to detect and treat infested areas of cogongrass, says Stephen Pecot of the Alabama Cogongrass Control Center.

Very few methods fight cogongrass effectively, so researchers are developing new ones. Investigators are testing herbicides, deploying remote-sensing techniques for mapping large infestations and detecting incipient patches that may be obscured by trees or shrubs, and studying cogongrass genetics to better understand the plants across their U.S. range.

Continues on Page 7



A Wild, Weedy Scourge

Cogongrass

Continued from Page 6

A study published in May in the American Naturalist reported that plants such as cogongrass grow best in nitrogen-rich soil, suggesting that lowering the nitrogen content—perhaps by boosting the number of nitrogen-devouring microbes in the soil—might work. Says Enloe: “With persistence, it can be dealt with, but it requires a lot of land managers to kick it up a notch.”

Credit: Scientific American

Budget Cuts Would Eliminate The Nation's Only Federal Research Program For Aquatic Weed Control

The US Army Corps of Engineers Aquatic Plant Control Research Program (APCRP) is the Nation's only federally authorized research program directed to develop technology for the management of invasive aquatic plant species. With its origins arising in the River and Harbor Act of 1958, APCRP was officially established in 1973 at the US Army Engineer Waterways Experiment Station in Vicksburg, MS. Since then, the program has provided research and technology development in the areas of chemical, biological, mechanical and integrated control strategies, as well as ecological studies.

The first budget blow to the program occurred in 1995, when its funding was cut by 65%. This was one of the landmark events leading to the establishment of the AERF in 1996, which established a Cooperative Research and Development Agreement (CRDA) with the program. This agreement allowed the private sector to fund research conducted by the APCRP scientists. Since that time, the program has been funded at approximately 50% of its previous peak budget level, supplemented by projects conducted through the AERF CRDA and other sponsors. It's during this period of partnership between APCRP and AERF that we have seen the surge in new products and technologies for the control of aquatic weed species.

Now this program faces complete elimination from the 2012 budget. This action has led to an outcry in the weed science community and letters have been sent to the Assistant Secretary of the Army for Civil Works from the Weed Science Society of America and its regional chapters, The Aquatic Plant Management Society and its regional chapters, as well as the AERF, urging restoration of the program's funding at $4 million for FY 2012 (1 October 2011). In part, the letter from AERF says:

Through the AERF/APCRP collaboration, a strong relationship has finally been established between the US Environmental Protection Agency, the Corps, and other Federal agencies for registering new environmentally compatible products – essentially doubling those available for aquatic use since 2002. This revolutionary process has occurred while simultaneously refining and streamlining the registration process utilizing a peer-reviewed science-based approach. Leveraging APCPR and AERF resources is a key to maintaining this meaningful and critical interaction with the regulatory community. More products are under development, but those may be lost to managers if the CRADA partnership is dissolved due to lack of Corps funding.

Clearly the APCRP is of vital importance to the maintenance of water resources, transportation infrastructure, environmental sustainability, and National security. Unfortunately, with an unbudgeted APCRP and the loss of leveraging capabilities that this Corps program provides, our important cooperative work will be greatly diminished and he Nation's water resources will suffer for it.

Without this program there will be no National R&D effort for aquatic plant control.

David G. Petty;

NDR Research

Fisheries Management & Sustainability

Establishing and maintaining a sustainable fishery is a major goal in lake management. A diverse fish population is not only an excellent indicator of the overall health of a lake, but has many other benefits as well. A well-balanced fishery can assist the natural biological and chemical processes of an aquatic system, improving water quality and esthetics. Sustaining populations of grass carp and mosquitofish can help control infestations of undesirable aquatic weeds and mosquitoes. Fish species such as largemouth bass, bream and black crappie provide excellent sport fishing opportunities.

Fish population surveys provide information about species composition, sizes and population densities. They also provide information necessary to maintain and improve a waterway system. A lake is a living ecosystem in which all components are interrelated, and a lake changes as it ages. For a waterway to support a productive fishery, some of the variables need to be regularly evaluated and maintained in order to keep pace with the evolving aquatic community.

Diversity and Population Density

Diversity and density in a fishery refers to the mixture of different species and the number of each species existing in a particular ecosystem. A successful management program promotes species diversity in a lake and maintains a balance between predator and prey populations. This balance ensures that no particular species becomes too dominant and uses all of the resources available. Monitoring populations also includes an evaluation of levels of undesirable species, such as certain nonnative fish. Some undesirable species can outcompete more desirable species and cause effects to the lakes ecosystem.

Habitat and Cover

Adequate habitat and cover is necessary for fish populations to become self sustaining. Without protective cover, many fish populations become exceedingly susceptible to predators such as birds, otters and raccoons. Appropriate habitat includes areas that fish need to find food, and to spawn. Without these sanctuary areas, stocked populations will dwindle in a relatively short period of time. A sound habitat needs to include “nursery” areas to give newly hatched and fingerling fish sheltered areas to forage and grow, protected from predation by larger fish and animals.

Excessive levels of vegetation also create problems for a fishery in a lake. Since plants provide important habitat and cover for fish, many vegetation-associated species such as bluegill can be present in such high densities that limited food resources can limit their growth, and ultimately their size. Excessive plant densities can also reduce prey-capture efficiency of predators such as largemouth bass, which can lead to reduced body condition and growth rates. The end result can be fewer quality-sized sportfish in the lake. Obviously, excessive plants also reduce recreational opportunities such as fishing, swimming and boating.

Credit: Steve Montgomery; Allstate Resource Management

Aquatic Plant Resistance to Herbicides

Recently, aquatic plant managers have been introduced to the reality of weed resistance to aquatic herbicides. In Florida, hydrilla (Hydrilla verticillata (L.f.) Royle) has developed resistance to fluridone (MacDonald et al. 2001, Arias et al. 2005), and a species of duckweed (Landoltia punctata (G. Meyer) D.H. Les and D.J. Crawford) was identified that developed resistance to diquat (Koschnick 2005). Although the full extent of fluridone resistant hydrilla (FRH) is not known, it occurs in many of Florida's largest water bodies that have had historical hydrilla problems. Diquat resistant duckweed is less widespread. Weed resistance to aquatic herbicides is an emerging issue in aquatic plant management, and education and research are keys to managing this problem.

Herbicide Resistance and Tolerance

First, what is resistance? Resistance occurs in a plant species that was originally susceptible to an herbicide, but over time control is lost through the selection of an existing resistant individual or biotype. Think of it as a form of natural selection. There are slight genetic differences between plants in the same population. When the same herbicide is used repeatedly, a strong selection pressure is exerted for individuals with the genetic make-up that allows these plants to resist the herbicide and survive, and then increase their presence in the population. It is important to emphasize that the herbicide does not cause a mutation or create a super plant, and you can't visually discern the difference between a resistant versus susceptible individual. For example, hydrilla was initially susceptible to low use rates of fluridone, but over time a population was selected that was no longer controlled at these recommended use rates, and the appearance of the individual plant is the same. Additional applications of fluridone facilitated the spread or increased the proportion of a resistant biotype throughout the waterbody.

There are also concerns about cross-resistance, which is resistance to different herbicides with similar modes of action. This should not be confused with multiple resistance, which is resistance to multiple herbicides with different modes of action. Experimentally, we have shown cross-resistance under laboratory conditions. Diquat resistant duckweed is also resistant to paraquat because both these herbicides kill the plants by stopping the same biochemical process. In hydrilla, fluridone inhibits the enzyme phytoene desaturase. FRH is also resistant to norflurazon and several other herbicides that inhibit the same enzyme. There have been no cases of multiple resistance or resistance to at least two different modes of action by aquatic plants.

In contrast to resistance, tolerance is the term used to describe plants that have never been susceptible to a particular herbicide or class of herbicides at labeled use rates. For example, aquatic grasses tend to be tolerant of compounds such as 2,4-D and triclopyr. Likewise, a plant such as hygrophila has proven to be fairly tolerant of all currently registered aquatic herbicides. While the terms resistance and tolerance have often been used in the same context, they have very different meanings to those in the field of weed science. Resistance is the result of a trait that is selected for, whereas tolerance is an inherent ability to survive the herbicide application. Tolerance may be biochemical (e.g. metabolism), the result of reduced uptake (e.g. thick cuticle), or other means that allow some plant species to tolerate the herbicide.

In theory, "every" plant species has a biotype that is resistant to "every" herbicide. The question becomes: Has it been selected for yet? The chances of selecting for that "one" individual increases in areas with repeated use of the same herbicide and widespread weed populations. Resistance is not a new subject with herbicides, but it is new in aquatics. There are currently over 177 plant species (>295 biotypes) that have developed resistance to herbicides worldwide, with approximately 70 species in the US, with most occurring in agricultural systems (www.weedscience.org).

There are four main mechanisms of herbicide resistance in plants. Some herbicides target or prevent formation of a key enzyme. Resistant biotypes have an alteration at the site of action that prevents an enzyme-specific herbicide (e.g. fluridone, ALS inhibitors) from affecting the target site. Resistance can also result in biotypes that have greater ability to metabolize or detoxifiy the herbicide (e.g. substituted ureas). Herbicides can also lose their effectiveness due to being compartmentalized or bound-up prior to getting to the site of action, or due to reduced transport or movement of the chemical (e.g. glyphosate). Finally, resistant biotypes may have reduced uptake of the herbicide into the plant or movement to the site of action inside the cell.

There are certain characteristics of herbicides that can lead to an increase in the development of resistance. Some herbicides, such as copper and endothall, kill cells by destroying membranes and shutting down respiration and photosynthesis, essentially affecting several cell processes simultaneously. In contrast, the more specific (simple) the mode of action the greater the chance of selecting for a biotype with one of the 4 resistance mechanisms. Herbicide characteristics and use patterns that favor resistance include: 1) use of compounds with similar or single modes of action; 2) persistence in the environment; and 3) products that are commonly or repeatedly used (high market share) due to the lack of effective or cost-effective alternatives.

Aquatic Plants and Herbicide Resistance

How many duckweed plants in a 10-acre pond? Ten billion? That is not out of the question if you assume a frond is 0.125 inches long by 0.0625 inches wide and consist of a single layer of plants (~800 million per acre). Even if 0.0000001% of the duckweed plants have one of these 4 resistance mechanisms (altered site of action, metabolism/detoxification, reduced transport, or reduced uptake/ movement to site of action) and 9,999,999,999 plants are killed by your treatment, 1 may survive. Dense infestations of hydrilla and duckweed are characterized by the presence of huge numbers of meristematic growing points in an aqueous environment. Moreover, this is also characteristic of numerous other aquatic plants.

Weed characteristics can also contribute to the development of resistance, especially characteristics that can increase genetic diversity in the weed population. These characteristics may include species with high reproductive rates (e.g. high seed production, asexual budding), short seed longevity, and species with naturally diverse genetic make-up. Also, once a species develops resistance, the resistant biotype must be able to compete and survive against susceptible biotypes in the absence of further selection pressure.

To reduce the chances of resistant populations developing in the aquatic environment the following practices are recommended: 1) alternate modes of action or use herbicide mixtures 2) utilize chemical, biological, and mechanical control options when feasible; 3) do not use herbicides with the same mode of action repeatedly, and 4) treat weeds when infestations are low. By following these recommendations, you will reduce the chances that a “single duckweed plant” will survive long enough to create a large population of resistant plants. The main key to weed resistance management in terrestrial systems has been alternating crops and herbicide modes of action. While we are limited in our ability to alternate our “weeds” in aquatic plant management, we can consider changing our herbicides or mixtures.

Aquatic weed control is conducted with very few herbicide choices, and managers are often heavily dependent on one or two standard herbicides for a particular weed species. Factors impacting these use patterns include cost-effectiveness, use restrictions, and selective properties of the herbicide. This reliance, coupled with the limited number of herbicides registered in aquatics, surprisingly has not resulted in widespread development of more resistance issues. While techniques such as biocontrol and mechanical control are well known, herbicide programs are generally implemented when neither of these options is feasible due to the scale of the problem or the need to provide predictable management results. Moreover, issues such as crop rotation, herbicide rotation, and pest scouting that are familiar to traditional integrated pest management programs in terrestrial agriculture have not proved to be easily incorporated into aquatic plant management programs. Therefore, in aquatics we are unable to utilize many terrestrial weed recommendations for reducing the potential for resistance development.

Mueller et al. (2005) discuss proactive weed management versus reactive weed management as it pertains to resistance. Most people employ a reactive strategy, which means “don’t do anything until resistance occurs”, since it won’t happen to me in “my lake”. This is driven by economics and often we wait until weeds are widespread (crisis) in order to gain public support and funding for operations. It is difficult to switch to more expensive management methods due to the priority of controlling weeds at the lowest cost in public funds. The proactive strategy involves determining what you can do to delay the onset of resistance since it will eventually happen in “my lake”, and try to protect the currently registered products. Rotate herbicides, don’t treat every year with the same mode of action at the same site, and use herbicide mixtures. However, this strategy typically comes at a cost, and scientists have not yet determined the most practical means of accomplishing this.

New Product Development and Resistance Considerations

The Agrichemical industry and state/federal scientists are trying to bring new herbicides and tools to the market to give managers more options for managing aquatic plants. In the last 5 years, 3 new herbicides have been registered for aquatics (triclopyr, imazapyr, and carfentrazone). Currently, there are 4 additional herbicides with experimental use permits (EUP) granted by EPA or applied for (penoxsulam, imazamox, flumioxazin, and bispyribac sodium), and hopefully more will be submitted for EUP status in the near future. While these new EUP products typically have good toxicity profiles that will aid in the aquatic registration process (some are classified as reduced risk products), they also have a single site of action in plants, which increases the chances for resistance to occur.

For example, 3 of the herbicides currently being developed for hydrilla control are classified as acetolactate synthesis (ALS) inhibitors (penoxsulam, imazamox, and bispyribac sodium). ALS-inhibitors affect a single enzyme necessary for amino acid/protein synthesis in plants; acetolactate synthase, and there are about 50 ALSinhibiting herbicides registered in the U.S. While most of these ALS compounds will likely prove active on hydrilla, resistance development to one of these products could lead to wide-scale cross-resistance (Tranel and Wright 2002), or resistance to all 50+ ALS-inhibiting herbicides. Resistance to ALS inhibiting herbicides has occurred in terrestrial sites over a relatively short period of time (few years) compared to other herbicide families such as the triazines (10 to 20 years). The first documented case of resistance was only 5 years after ALS herbicides were commercialized in 1982. Today, there are more plant species resistant to ALS herbicides than any other herbicide, including the triazines, which have been used for approximately 20 years longer than the ALS herbicides.

There are numerous species of wetland plants [e.g. Limnophila sessiliflora (Vahl) Blume] that have developed resistance to ALS herbicides in rice, and over 16 plant families have representative species that have developed resistance to ALS inhibitors (Heap 2005). This suggests that ALS resistance will occur in submersed aquatic species, unless active steps are taken to prevent this from happening. While recognition of this potential is an important first step, it is also important that resistance management strategies be put in place prior to wide-scale use of these products.

Based on the experience with large-scale fluridone use and the proven ability of hydrilla to develop resistance, developing programs for resistance management are critical to protect the long-term viability of ALS herbicides. In addition to ALS chemistry, there is a strong need to identify an alternate mode of action that can be used in rotation with other management tools.

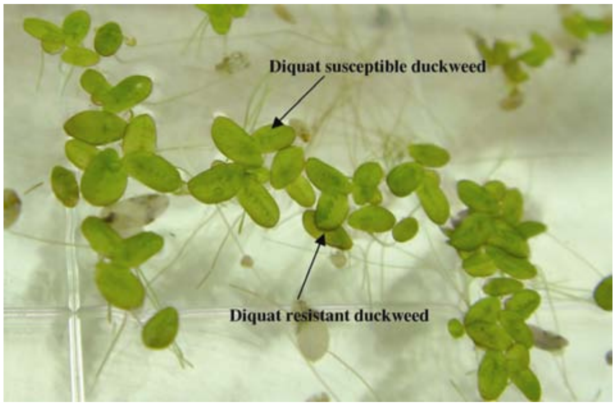
The number of herbicides or modes of action for use against hydrilla is limited. There are approximately 300 herbicides registered in the US representing 6 general modes of action (photosynthetic inhibitors, amino acid/protein synthesis inhibitor, cell division/growth inhibitors, cell membrane disruptors, pigment synthesis inhibitors, and growth regulators). Many of these compounds are too toxic for aquatic use (diuron, trifluralin, etc.), many do not control hydrilla (2,4-D, glyphosate, etc.), and many are off patent (dicholbenil, simazine, etc.), which greatly reduces the potential for incurring high registration costs. Decisions on registration and use of aquatic herbicides made in the next few years will determine managers' abilities to control aquatic weeds, particularly hydrilla, 20 years from now.

The situation in Florida for hydrilla control is particularly problematic because of the widespread occurrence of fluridone resistant hydrilla in many of the economically important large lakes of central Florida. If a cost-effective ALS-inhibitor is registered for use by 2007, there will be pressure for frequent use of this herbicide. If the ALSinhibitors are used annually, will resistance to ALS-inhibitors also occur, making hydrilla resistant to both fluridone and ALS compounds? Then what? Ideally, to protect the use of ALS compounds in fluridone resistant hydrilla, we need another mode of action. The herbicide rotation should at least be ALS-new mode of action-ALS-new mode of action. In waters where fluridone susceptible hydrilla occurs (in parts of Florida and rest of the U.S.) then registration of the ALS inhibitors will provide one more tool that can be rotated with traditional chemistries and other control techniques. In this way, the chances of developing fluridone or ALS resistance (or any herbicide mode of action) should be greatly reduced.

Currently, resistance to aquatic herbicides is isolated to Florida. There are no documented cases of resistant aquatic plant species outside Florida. Yet, resistance will not be a problem isolated to Florida, and duckweed and hydrilla are likely not unique in their ability to develop resistance. It is best to take a proactive strategy where and when you can to delay resistance. While this may result in incurring greater costs in the short-term, the loss of our limited aquatic herbicides is a much greater cost in the long run.

Landoltia punctata, Lake Co. Florida

Landoltia punctata, Lake Co. Florida



Individual resistant plants appear the same as susceptible ones.

Credit: University of Florida, IFAS Extension

South Florida Aquatic Plant Management Society

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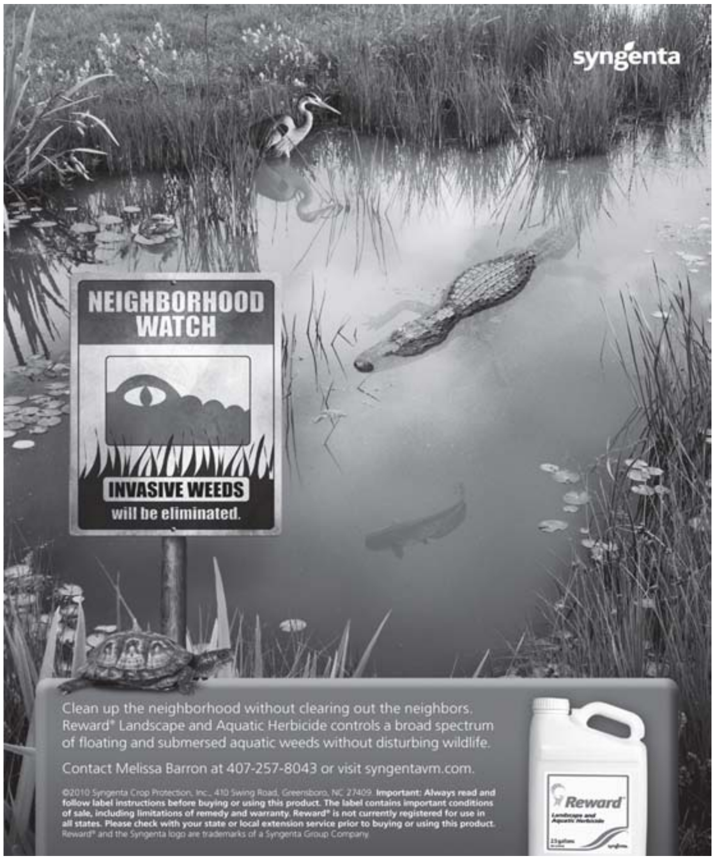
April 2011 - South Florida APMS General Meeting - Sunset Lakes Municipal Complex



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