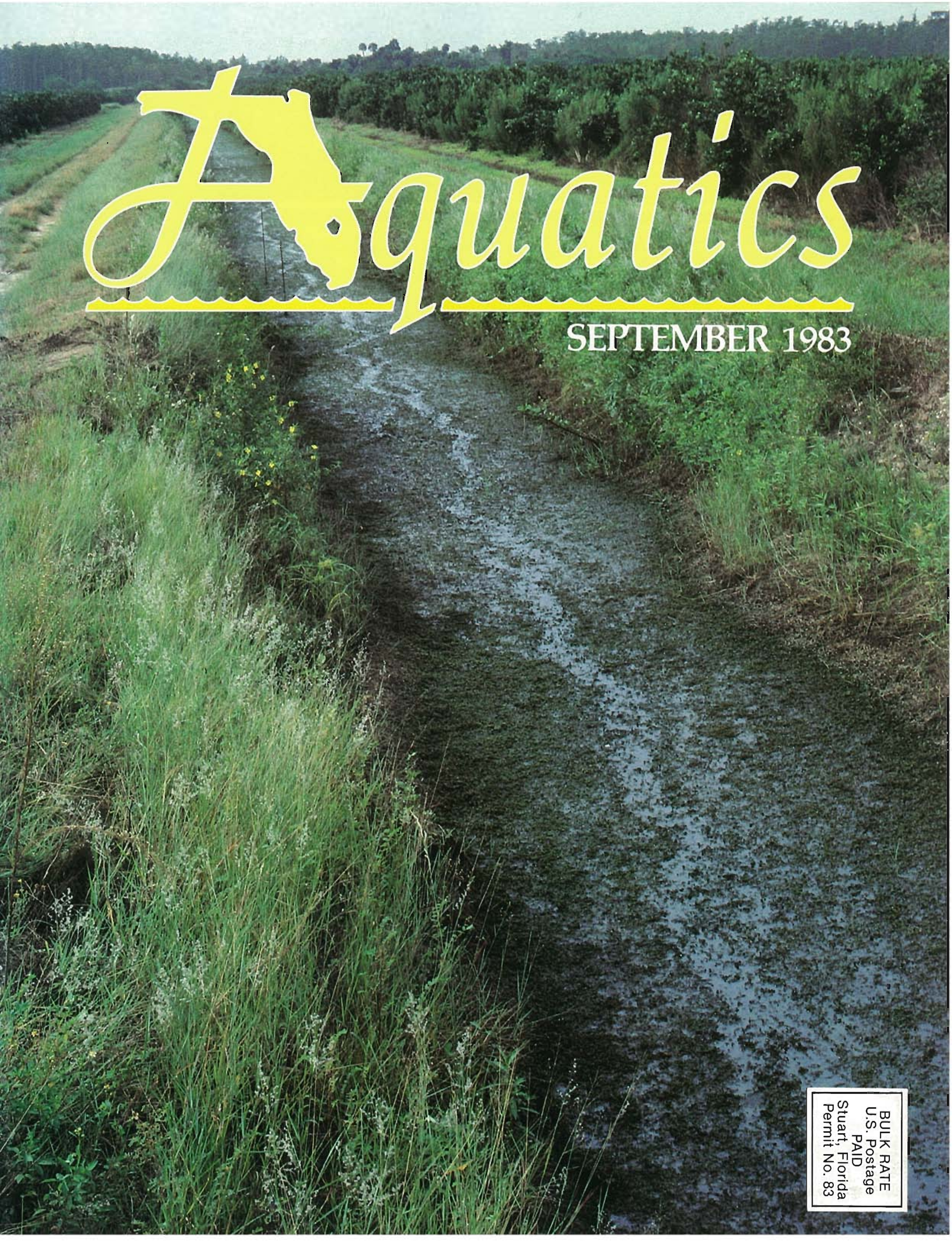
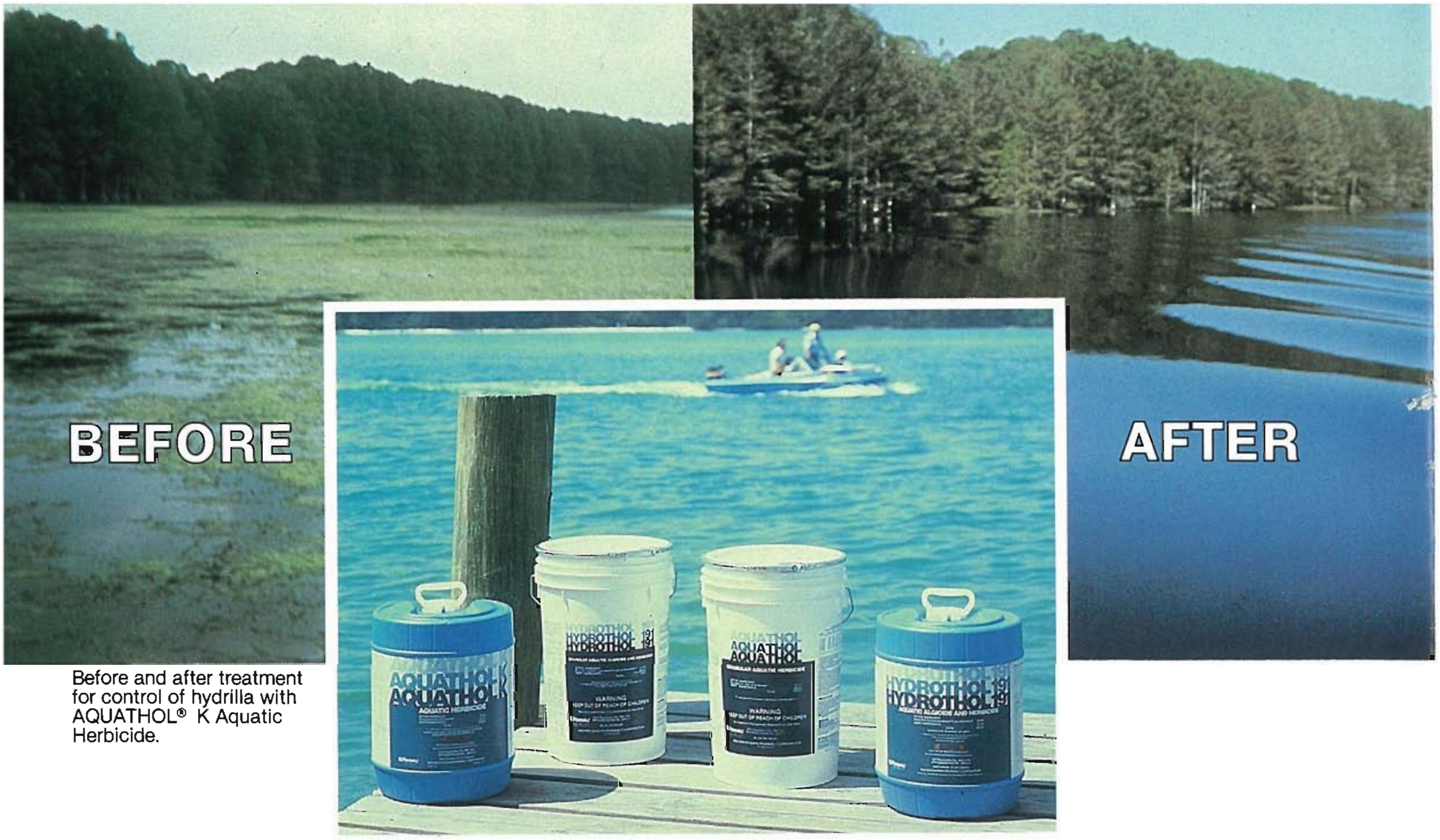
Aquatics

SEPTEMBER 1983



BULK RATE
U.S. Postage
PAID
Stuart, Florida
Permit No. 83



Before and after treatment for control of hydrilla with AQUATHOL® K Aquatic Herbicide.

Get results like this with Pennwalt Aquatic Herbicides

Pennwalt products control many troublesome weeds and algae, including hydrilla, coontail, milfoil and pondweeds.

Biodegradable

All Pennwalt aquatic herbicides are based on endothall. Endothall salts disappear rapidly from the water and soil through microbial degradation and do not accumulate in the food web. Properly applied, Pennwalt aquatic herbicides provide a satisfactory margin of safety to birds, mammals, and aquatic fauna. And Aquathol formulations have a wide margin of safety to fish.

Contact Action

Pennwalt aquatic herbicides kill weeds by contact. For best results, they should be applied as soon as the aquatic weed problem appears and weeds are actively growing.

Flexible Application

The application of Pennwalt aquatic herbicides can be fast, precise and economical. Application of liquid or granular formulations may be made by air, by boat or from the shore to treat small or large areas of lakes, ponds, rivers and canals.

Complete Line

The Pennwalt line of aquatic herbicides and algicides: an effective way to get rid of weeds and algae.

AQUATHOL® K Aquatic Herbicide
AQUATHOL® Granular Aquatic Herbicide
HYDROTHOL® 191 Aquatic Algicide and Herbicide
HYDROTHOL® 191 Granular Aquatic Algicide and Herbicide.

All pesticides can be harmful. Read label carefully and use only as directed.

AGCHEM
PENNWALT
CHEMICALS ■ EQUIPMENT
HEALTH PRODUCTS
Pennwalt Corporation, Three Parkway, Philadelphia, PA 19102 ● (215) 587-7219

ADV 8437/4-83/6958

EDITORIAL

Florida has the unenviable distinction of having the greatest exotic aquatic plant problem of all the states. Fortunately, along with the evolution of the problem, a network of technology and expertise has also evolved which has enabled us to maintain the plants within reasonable bounds. Without full use of this network much of the state's freshwater resources would be lost for use by boaters, fishermen and hunters. Flooding and pest insect populations would increase and agriculture would suffer from poor water flow through the intricate drainage and irrigation systems.

We have been blessed with general cooperation between the many governmental agencies that impact aquatic plant management programs. Of course we all know that this cooperative attitude has had its difficult times in the recent past. Philosophies between individuals and agencies are bound to differ from time to time. This is human nature and can serve as a healthy system of checks and balances to insure that our programs are carried out in a manner that best serves the interest of everyone. It is part of the overall system that has helped us to develop our current safe methods of managing aquatic plants. The more recent episodes of philosophical differences, however, began to build walls between various sectors of the aquatic plant management community. A hostile environment developed that seemed to block all chances of arriving at workable compromises.

Through recent changes it appears we may now have the opportunity to shorten the walls and collectively work together under a more cooperative attitude. Various entities are beginning to show more understanding of others' viewpoints. We are not out of the woods yet. Only through communication and cooperation have we been able to maintain control of a seemingly impossible problem. In order to maintain the high level of efficient vegetation management and provide the public with the best service we have to offer, we must all strive to work together towards this common goal.

Jim McGehee

THE COVER

Hydrilla dominates an irrigation ditch in a central Florida citrus grove.

Photo by
David L. Sutton

Aquatics

SEPTEMBER 1983/Volume 5, NO. 3

CONTENTS

FLORIDA AQUATIC PLANT MANAGEMENT SOCIETY — 1983

President
Carlton Layne
217 Bolender Ct.
Auburndale, FL 33823
813-683-9767

President-Elect
Paul Myers
310 Thelma St.
Lake Alfred, FL 33850
823-956-3037

Treasurer
Jim McGehee
P.O. Box 212
Macclenny, FL 32063
904-791-2218

Secretary
Mike Mahler
116 Lake Sears Dr.
Winter Haven, FL 33880
813-533-1205

Editor of Aquatics/David P. Tarver/2416 McWest St./Tallahassee, FL 32303/904-562-1870

Directors At-Large

Debbie Valin
820 E. Robson St.
Lakeland, FL 33805
813-688-3754

Larry Maddox
2133 Wickham Rd.
Melbourne, FL 32935
305-254-1761

Andy Price
P.O. Drawer D
Plant City, FL 33566
813-752-1177

Herb Cummings
South Fla. W.M.D.
9001 N.W. 58th St.
Miami, FL 33178
305-592-5680

Ray Spirnock
140 South Wiggins Rd.
Plant City, FL 33566
813-754-6606

Bobby Corbin
P.O. Box 714
Crawfordville, FL
32727
904-926-3549

Eddie Knight
Hibernia Box 416
Green Cove Springs, FL
32043
904-284-3772

Lee Hale
P.O. Box 1069
5414 N. 56th St.
Tampa, FL 33601
813-282-9115

Nick Sassic
Orange County
2008 E. Michigan Ave.
Orlando, FL 32806
305-420-3102

Committee Chairmen

Governmental Affairs
Joe Flanagan
Rte. 3 Box 64
Live Oak, FL 32060
904-362-1001

Membership/Publicity
Jim Wilmoth
Rt. 1, Box 963
Palatka, FL 32077
904-328-8321

Aquatic Plant Advisory Committee
Herb Cummings
South Florida W.M.D.
9001 N.W. 58th St.
Miami, FL 33178
305-592-5680

Awards
Wayne Corbin
P.O. Box 144
Lady Lake, FL 32659
904-328-2463

By-Laws
Lowell Trent
P.O. Box 1903
Eustis, FL 32762
904-357-6631

Equipment Demonstration
Terry Shephardson
1461 N.W. 196th St.
Miami, FL 33147
305-592-5680

Local Arrangements
Bob Arnold
231 Stevenage Dr.
Longwood, FL 32750
305-862-1392

Nominating
Larry Maddox
2133 Wickham Rd.
Melbourne, FL 32935
305-254-1761

Program
Dee Brown
10307 S. Indian River Dr.
Port St. Lucie, FL 33452
305-878-3166

Site Selection
Beth Layer
P.O. Box 770
San Mateo, FL 32088
904-328-2393

Select Committee on Training
Jim McGehee
P.O. Box 212
Macclenny, FL 32063
904-791-2218

The Florida Aquatic Plant Management Society, Inc., has not tested any of the products advertised in this publication nor has it verified any of the statements made in any of the advertisements. The Society does not warrant, expressly or implied, the fitness of any product advertised or the suitability of any advice or statements contained herein.

©1983 FAPMS, INC. All rights reserved. Reproduction in whole or in part without permission is prohibited.

AQUATICS: Published quarterly as the official publication of the Florida Aquatic Plant Management Society. This publication is intended to keep all interests informed on matters as they relate to aquatic plant management, particularly in Florida.

CORRESPONDENCE: Address all correspondence regarding editorial matter to David P. Tarver, Editor, "AQUATICS" Magazine, 2416 McWest St., Tallahassee, Fla. 32303

IDENTIFYING FLORIDA'S MOST COMMON AQUATIC GRASSES

by John A. Rodgers

Biologist, Department of Natural Resources

It's been said that taxonomic books on grasses are only as good as its pictures. Actually, anyone who has difficulty in identifying grasses is in good company. Hopefully this article will enable one to identify four of the most commonly found grasses in our waterways.

These four aquatic grasses are *Panicum hemitomon* Schult., *Panicum repens* L., *Paspalidium geminatum* (Forsk.) Stapk., and *Panicum purpurascens* Raddi. Their leaves, except at the basal portion of the stem, are made up of two parts. The lower portion which envelops the stem is the sheath and the upper flat or folded portion is the blade. The flowering stalk or inflorescence contains numerous spiklets on ascending branches. A spiklet consists of a flower or floret surrounded by up to 4 scales or bracts. These bracts are further defined as the first glume, second glume, lemna and palea.

Panicum hemitomon or maidencane is a native grass found throughout the state in lakes, ponds, ditches and rivers. The lower portion of the stems are erect, which is in contrast to the decumbent (reclining on the ground before ascending) stems of knotgrass and para grass. Maidencane's leaf blades are between 15-25 cm long and 8-15 cm wide. Its sheaths are usually glabrous (without pubuscence), only occasionally covered with short hairs. The width of the inflorescence is very narrow; its branches suppressed against the central axis.

Panicum repens or torpedo grass is an exotic from the Old World (Africa, India and Australia). In Florida, it is more common in the southern and central regions of the state. The leaf blades of torpedo grass are usually less than 15 cm long and from 3-7 cm wide. They are folded at the midrib with the upper leaf surfaces rough to the touch. The sheaths of torpedo grass are always glabrous. Unlike maidencane or knotgrass, the inflorescence is opened with spreading floral branches 4-10 cm long.

Paspalidium geminatum (Panicum geminatum Forsk.) or knotgrass has a distribution range similar to torpedo grass. The thick decumbent stems of knotgrass have swollen nodes from which it derives its common name. Leaf blades are 15-35 cm long and only half as wide as the blades of maidencane. The surfaces of the blades have numerous raised longitudinal ridges. These pronounced ridges can be used to distinguish this species from maidencane. The sheaths of knotgrass are also glabrous. The narrow inflorescence is similar in width and length to maidencane but the floral branches are only 3-4 cm long.

Panicum purpurascens [Brachiaria purpurascens (Raddi) Henr.] or para grass is an African grass which often clogs and impedes water flow in canals in south and central Florida. Its decumbent stems have swollen nodes which are densely covered with long, soft hairs. In addition, the sheaths are also densely pubescent. The pubescent nodes and sheaths of para grass are characteristics which can be used to differentiate this species from maidencane when neither species is flowering.

Para grass leaf blades are 15-30 cm long and from 10-22 mm wide. The upper and lower surfaces of

continued on page 9

Comparison of the inflorescence of maidencane (left) and torpedo grass (right).

The raised longitudinal ridges on the blades of knot grass (center/left) distinguishes this species from maidencane's blades (center/right).

The pubescent sheaths and nodes are characteristic of para grass.

AQUATIC HERBICIDE BREAKTHROUGH

Sonar EPA Experimental Use Permit No. 1471-EUP-67

Sonar® gently puts the balance back in nature.

At last there's a new generation aquatic herbicide that manages a host of undesirable vascular plants without mismanaging the good life. Sonar® from Elanco.

Weed management.

One treatment of Sonar provides control during the critical growing season of many submersed and emersed aquatic weeds. Weeds controlled include hydrilla, elodea, water milfoil, pond weeds, torpedograss, paragrass, southern naiad and numerous other troublemakers.

When you make Sonar part of your weed control program, you get effective management of your valuable water resources.

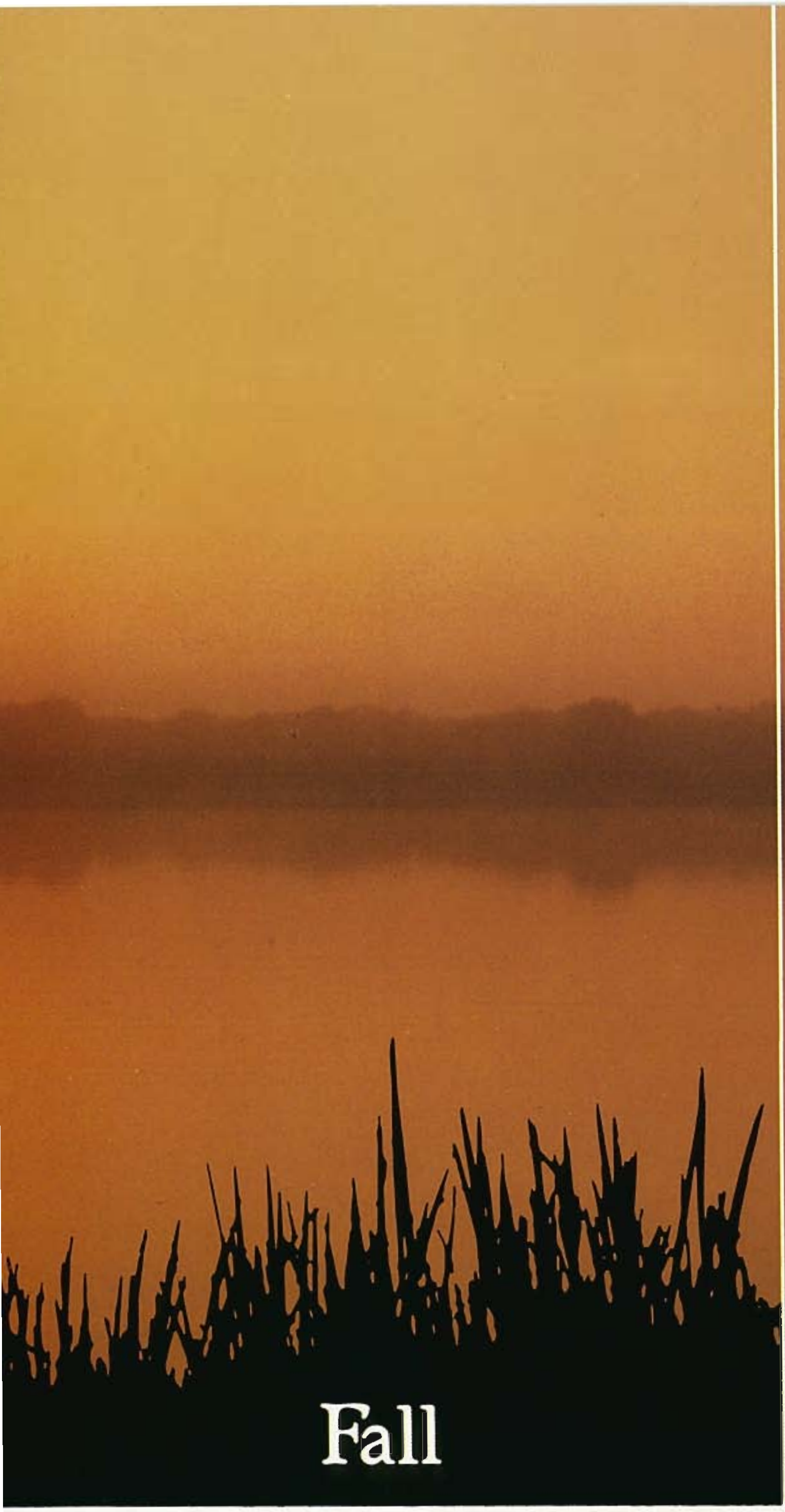
Slow but sure action.

Four to six weeks after treatment, Sonar takes its toll on undesirable vegetation. And because of its slow action, there is no rapid oxygen depletion. This makes Sonar highly compatible with the aquatic environment and makes fish kills a thing of the past. Applied as directed, Sonar will not harm fish,


Hydrilla


Elodea


Water milfoil



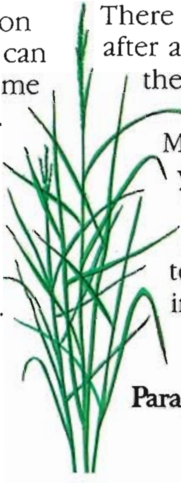
wildlife, or nearby trees and shrubs.

Flexible application.

Sonar can be applied to the entire surface of a pond or up to ten percent of larger bodies of water. Depending on existing equipment and user preference, Sonar is available as an aqueous suspension or 5% pellet and can be applied any time during the year. For best results, the label recommends applying Sonar when weeds are actively growing.

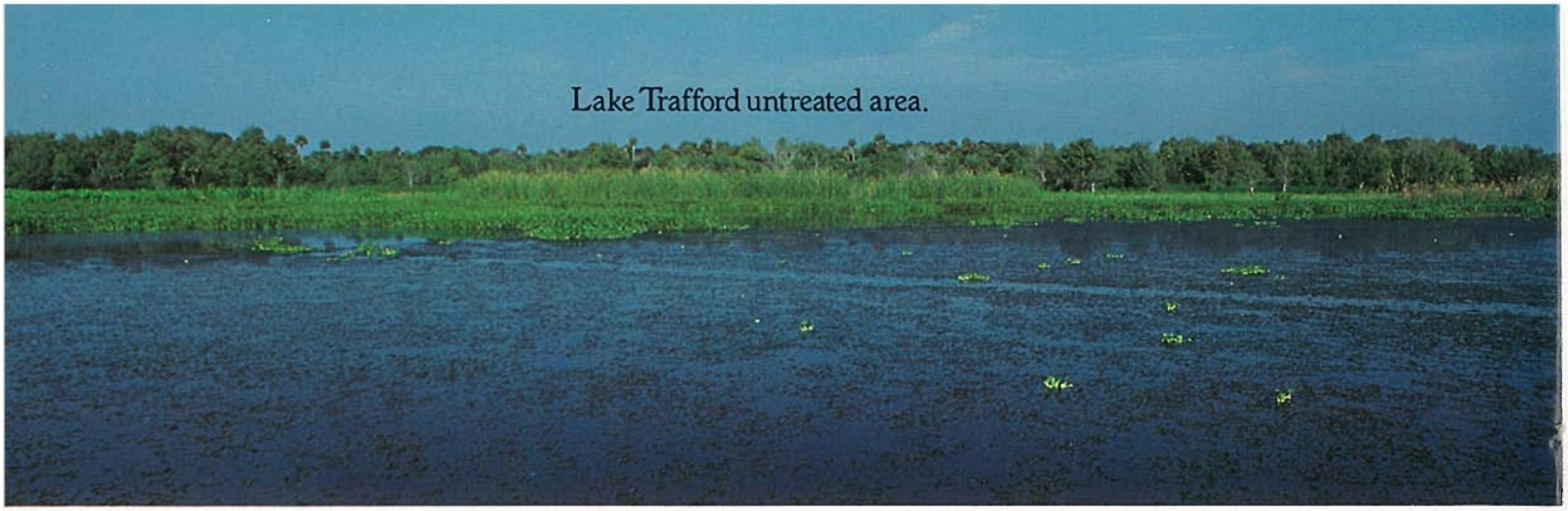

Pond weeds

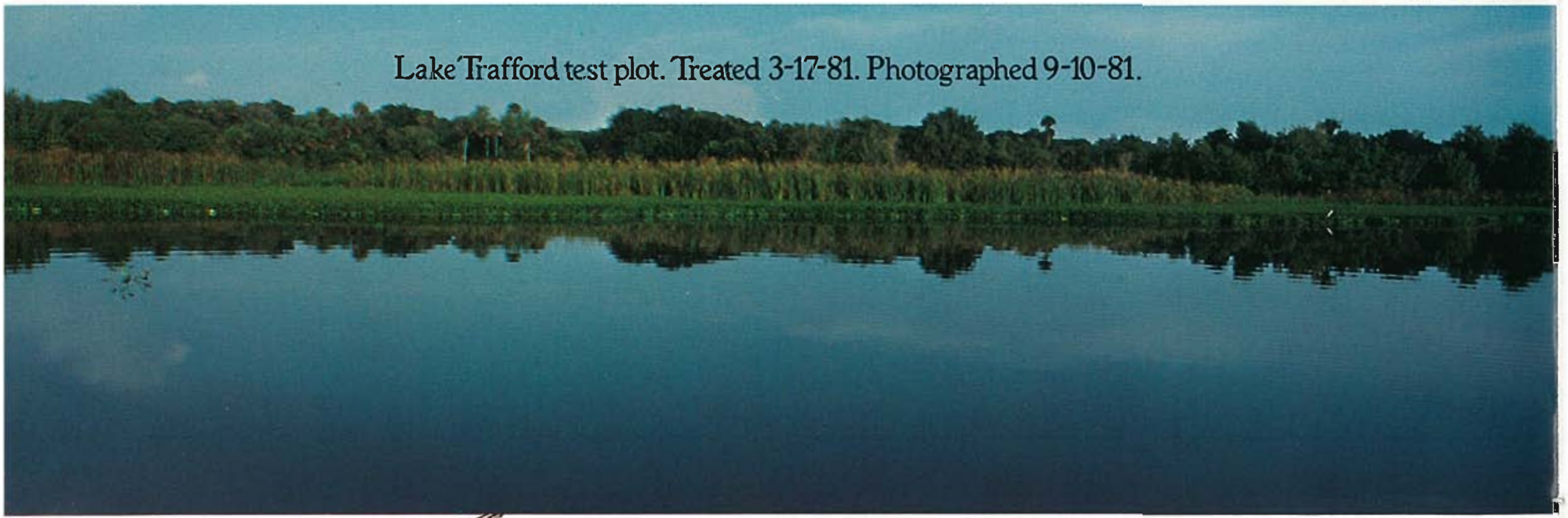

Torpedograss

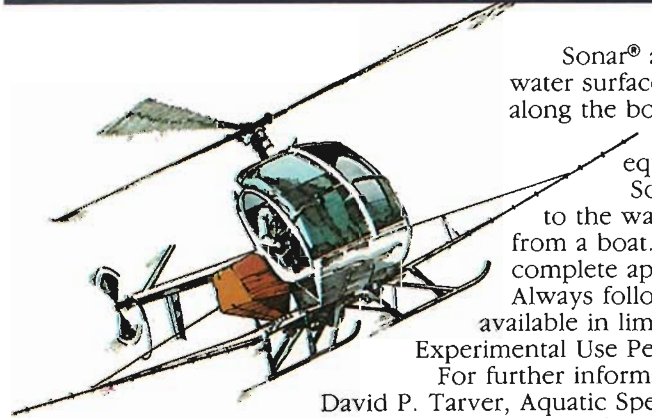

Paragrass

Inherent value.

There are few restrictions after application, and they are detailed on the product label. Make Sonar part of your management program. It's the simple, gentle way to put nature back in balance.


Lake Trafford untreated area.


Lake Trafford test plot. Treated 3-17-81. Photographed 9-10-81.

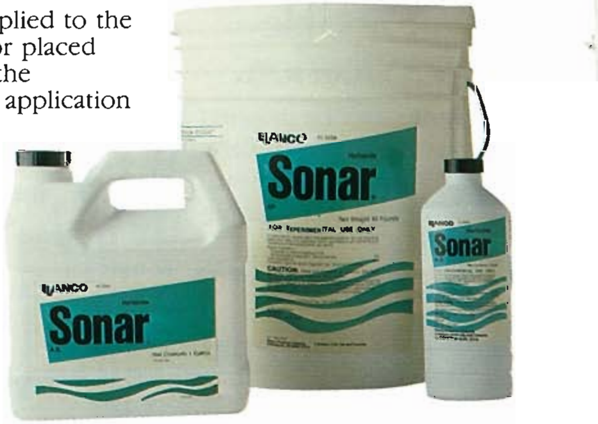


Sonar® aqueous suspension can be applied to the water surface or under the water surface or placed along the bottom of the water just above the hydrosoil. Any conventional application equipment can be used.

Sonar 5% pellet can be applied to the water surface from the shore or from a boat. Refer to the Sonar label for complete application instructions.

Always follow label directions. Sonar is available in limited quantities under EPA Experimental Use Permit No. 1471-EUP-67.

For further information write or phone:
David P. Tarver, Aquatic Specialist, 2416 McWest Street,
Tallahassee, FL 32303 (904) 562-1870



Elanco Products Company, A Division of Eli Lilly and Company, Indianapolis, IN 46285, U.S.A.

continued from page 4

COMPARISON OF THE FOUR AQUATIC GRASSES

	MAIDENCANE	TORPEDO GRASS	KNOTGRASS	PARA GRASS
Stems	erect	erect	decumbent	decumbent
width (mm)	3-7	2-3	6-10	5-10
nodes	glabrous	glabrous	glabrous	densely pubescent
Leaf Blades	flat	folded	flat	flat
length (cm)	15-25	<15	15-35	15-30
width (mm)	8-15	3-7	4-8	10-22
Sheaths	usually glabrous, sometimes pubescent	glabrous	glabrous	densely pubescent
Inflorescence (type)	panicle	panicle	panicle	panicle
length (cm)	15-30	6-15	15-35	15-30
width	narrow	open branching	very narrow	open
length of branches (cm)	2-10	4-10	3-4	2.5-10
Spiklets	green	green/purple tinge	green	green/purple tinge
length (mm)	2.5	2.2-2.5	2-3	2-3

the blades are smooth but the margins are rough to the touch. The inflorescence is open with floral branches 2.5-10 cm long.

In summary, the following simplified key can be written for the four species.

1. Surface of leaf blades with numerous raised longitudinal rides . . . . knotgrass.
1. Surface of leaf blades glabrous with no raised ridges.
    2. Blade width 2-7 mm. . . . . . . torpedo grass.
    2. Blade width 8-22 mm.
        3. Nodes of stems and leaf sheaths glabrous. . . . . . . maidencane
        3. Nodes of stems and leaf sheaths very pubescent . . . . .para grass.

While there are other species of aquatic grasses, none are as commonly found growing in Florida's lakes, canals and ditches according to recent floral surveys. Knowing the difference between maidencane, torpedo grass, knotgrass and para grass, one can accurately identify the aquatic grasses in the majority of the water bodies in Florida. ◻

Banvel 720

Cleared for Use on:

Aquatic Sites

Ditchbanks

Trees & Brush — R.O.W.

Banvel Herbicide

Cleared for Use on:

Pastures

Ditchbanks

Trees & Brush — R.O.W.

Fence lines

ECONOMY — EFFICACY — ENVIRONMENTALLY SOUND

Asgrow Florida Company
subsidiary of The Upjohn Company

AVAILABLE IN 14 DISTRIBUTION CENTERS
Marianna, Alachua, Vero Beach, Wauchula, Ellenton, Fort Myers, Belle Glade, Boynton Beach,
Homestead, Naples, Immokalee, Plymouth, Plant City, Hastings

Aquatic Plant Competition

by

David L. Sutton
Professor
Agricultural Research and Education Center
University of Florida — IFAS
3205 S. W. College Avenue
Fort Lauderdale, FL 33314

I. INTRODUCTION

An aquatic plant, like all other organisms, competes with other species and with other individuals of its own species for space in which to develop and grow. Those that can most effectively exploit a particular aquatic habitat will predominate.

There is no simple answer that can readily explain why certain plants are ubiquitous and present in large numbers while others are rare. A number of factors are involved in the dispersal, colonization, growth, and development of plant populations and the invasion of new habitats. Some of these are well known, others are poorly understood.

Physical factors which influence growth of all aquatic plants include light, temperature, water depth, air and water currents, and substrates. Nutrients, ph, and gases are included in the chemical factors. Biological factors include herbivores, pathogenic organisms, and allelopathic stresses. The interaction of these factors plus the influence of human activities results in complex relationships which encourage or prevent growth of plants.

In an ecological sense based primarily on terrestrial systems there is an orderly progression in the sequence of plants growing in an area. Initially pioneer plants invade and colonize an area. As these develop and spread they gradually modify the habitat allowing other species adapted to this change to become established. This process continues until eventually a climax stage is reached where certain plants become dominant and resistant to invasion by other plants.

II.EXOTIC PLANTS

Throughout the world over 70 species of aquatic plants have been introduced into areas far from their native homes during the past 150 years (9). Some of these plants have readily exploited their new habitats and made a nuisance of themselves while others have barely managed to survive outside their native home.

Introductions of certain exotic plants change the plant community structure by bringing with them characteristics and adaptations developed for life in other aquatic ecosystems which allow them to take advantage of the physical, chemical, and biological factors present. In many cases the natural checks which keep the exotic plant under control in its native home are not present in the area where it is introduced. Freed of these natural controls the exotic plant grows luxuriantly.

The most famous of all these introduced species is water-hyacinth [*Eichhornia crassipes* (Mart.) Solms]. This plant can be found on every continent and is included in the top 10 of the most troublesome weed species in the world (4).

Hydrilla [*Hydrilla verticillata* (L.f.) Royle] is another plant which has gained notoriety during the past several decades. This plant too is causing serious problems in many areas throughout the world. Furthermore, in Florida, hydrilla surpassed water-hyacinth as the most abundant species of those encountered during the 1982 survey by the Florida Department of Natural Resources (8).

Hydrilla appears to have the potential to become, if in fact it not already is, the most troublesome of all the submersed aquatic species. In time however, hydrilla may demand more attention because it will grow in areas with temperatures lower than water-hyacinth will tolerate.

What special characteristics or adaptations do water-hyacinth and hydrilla possess which enable them to grow at such prodigious rates in so many aquatic sites? An understanding of these characteristics and adaptations will be useful in formulating methods to manage growth of these weeds.

III. WATER-HYACINTH

Water-hyacinth is a good example of an exotic plant which effectively competes for space in which to grow. This floating plant, introduced to the United States almost 100 years ago, still grows despite herbicidal, biological, and mechanical control efforts. Why is water-hyacinth so productive?

In Figure 1 a group of water-hyacinth plants in a canal in south Florida are beginning to spread over a mat of water-lettuce plants (*Pistia stratiotes* L.). And in the same canal another group of water-hyacinth plants have almost taken over a mat of water-lettuce (Figure 2). A few months after these pictures were taken this canal was completely filled with water-hyacinth.

This example of water-hyacinth crowding out water-lettuce in a canal illustrates the intense competition which takes place between plants for space in which to grow.

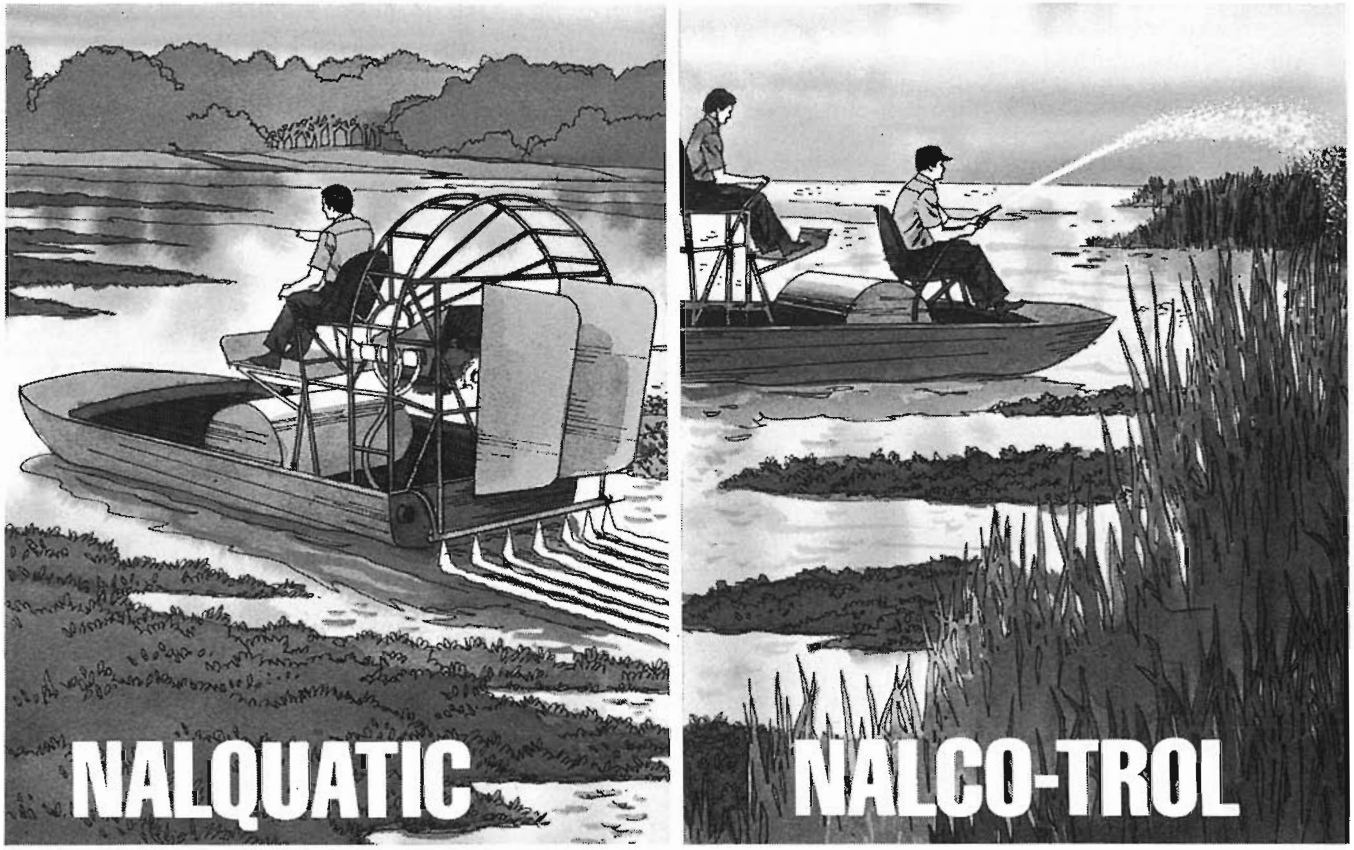
What are some of the factors which allow this plant to be so successful in these systems? For one, water-hyacinth extends its leaves above many of the other floating plants and reduces the sunlight available to them. The leaf shapes of this exotic plant are such that they efficiently gather the light falling on them, thus enhancing their ability to grow.

Figure 1. Water-Hyacinth encroaching on a mat of water-lettuce in a canal in south Florida.

Figure 2. Water-lettuce almost completely surrounded by water-hyacinth in the same canal.

continued on page 12

GOOD NEWS FOR AQUATIC WEED FIGHTERS:



DUAL HERBICIDE APPLICATION TOOLS THAT WORK

Nalco-Trol® and Nalquatic® are good news for the aquatic weed control specialist. Bad news for troublesome aquatic weeds like hyacinth and hydrilla.

When applying herbicide to terrestrial or floating weeds, Nalco-Trol drift retardant and deposition aid delivers more herbicide to the treatment area—better deposition and coverage, minimum drift. For submerged weeds, new Nalquatic aquatic herbicide carrier puts the herbicide on the weed surface and sticks it there for maximum contact effect.

Nalco-Trol and Nalquatic — the most effective herbicide application tools the professional aquatic weed control specialist can use. Both can be applied with all types of aerial or surface equipment. Get complete details and use directions by requesting our free Nalco-Trol and Nalquatic product bulletins.

Ag Products Div.: Regional Office
Route 3, Box 1328-E
Old Lake Unity Road
Leesburg, Fla. 32748

NALCO

NALCO CHEMICAL COMPANY
AG PRODUCTS DEPARTMENT
2901 BUTTERFIELD RD., OAK BROOK, IL 60521

NALCO Trademarks of Nalco Chemical Company

continued from page 10

Water-hyacinth grows not only in full sunlight but also in shade and in areas with subdued light. In some Florida river systems these plants grow in the shaded cypress swamp areas adjacent to the rivers. During periods of high water the plants then float down river with the current. Or, the plants will form mats along the river bank and eventually break loose to move with the current to new areas.

Leaves of water-hyacinth can act as sails so that they are freely moved by air currents. Their large inflated petioles with gas-filled aerenchyma tissue provide buoyancy to help keep the leaves high in the water so that the plants can move easily with the wind.

Furthermore, these exotic plants grow as an entangled interlocking mat which resists destruction by wind and wave action that would destroy other smaller floating plants such as the duckweeds (*Lemna* spp.). These dense mats of plants also effectively prevent light from reaching submersed plants growing beneath them.

Water-hyacinth tolerates a wide range of nutrients. They grow well in areas high in nutrients such as sewage lagoons (7), but when in waters of low nutrient concentration they greatly extend the length of their roots to increase the surface area available for nutrient uptake. However they are quite sensitive to salinity and cannot tolerate concentrations greater than 2.5 parts per thousand (3).

With regard to temperature water-hyacinth grows best when the ambient air temperature is from 25 to 30 C (77 to 86 F) (5), typical daily temperatures for most of the year in Florida. However, it is quite sensitive to cold and cannot survive freezing temperatures for long periods of time. Near freezing temperatures may kill the leaves but the plants regrow quickly, if the entire plant has not been killed.

Water-hyacinth plants spread not only by seeds but vegetatively as well. The importance of seeds in the spread of this plant from site to site is probably minor in comparison to vegetative means. However, germination of seedlings in shallow water areas may be the major source of young plants for reinfestation of an area.

Small floating plants such as duckweed, azolla (*Azolla* spp.), wolffia (*Wolffia* spp.), and others enjoy the protection offered by mats of water-hyacinth but these small plants are generally never present in large amounts. In older mats it is not uncommon to see pigweeds (*Amaranthus* spp.), primrose willows (*Ludwigia* spp.), water-pennywort (*Hydrocotyle* sp.), and other emergents normally found in the shallow areas of a body of water or along the shore line growing intermingled with the water-hyacinth.

The eventual outcome of not controlling a mat of water-hyacinth is that it provides a base to support growth of other plants. The buildup of plants on top of the mat can continue until the entire column of water is filled.

Water-hyacinth also tolerates some drying which gives it an advantage over many other aquatic plants. In Figure 3 a plant is stranded on a sand bank but yet is producing a flower with the potential of producing seed which could germinate when the water level rises again.

Figure 3. Stranded water-hyacinth producing flowers on a drained sandy ditch near La Belle, Fl.

In Florida it is not uncommon to control a water-hyacinth problem only to have hydrilla take over. A good example is Lake Trafford where the weed problem alternates between water-hyacinth and hydrilla depending on which species has been controlled.

IV. HYDRILLA

Man has probably been the single most important factor in the

AT YOUR SERVICE...
THE PROFESSIONAL AQUATIC WEED CONTROL SPECIALISTS — DISTRIBUTORS OF AQUATIC WEED CONTROL CHEMICALS AND SPRAY EQUIPMENT

COVERING FLORIDA FROM —

TAMPA
5414 N. 56th Street
P.O. Box 1096
Tampa, Fl 33601
(813) 626-2111

MIAMI
3701 N.W. 37th Ave.
P.O. Box 420981 Allapattah Station
Miami, Fl 33142
(305) 635-0321

JACKSONVILLE
1845 Wright Avenue
Jacksonville, Fl 33207
(904) 398-3759

TOLL FREE WATTS IN FLORIDA: 1-800-282-9115

SMCP
Southern Mill Creek
PRODUCTS COMPANY, INC.
TAMPA • MIAMI • ATLANTA

spread of hydrilla. Its demand for use as an aquarium plant has resulted in it being sold throughout the United States. Hopefully recognition of problems caused by hydrilla will lead to a cessation of its transportation across the country.

Fragments of hydrilla which resist drying are easily transported on boats and trailers from one site to another and readily develop into new plants. Every single node, of which there are many on a single branch, has the potential of producing a new shoot, and the larger the fragment, the greater the chance a shoot will form (6).

Hydrilla has several characteristics which allows it to take advantage of the area in which it is growing. Of prime importance, this exotic submersed plant can photosynthesize under light conditions lower than most other submersed plants (12) which enables it to begin to use carbon dioxide early in the morning when the supply is at its maximum. By the time the other plants receive sufficient light to begin to photosynthesize the amount of carbon dioxide has been reduced by the hydrilla.

Hydrilla has an interesting feature of developing long internodes on single strands when the plant is in deep water, but upon reaching the upper layers of the surface it begins to branch profusely. This branching results in a mat that blocks light penetration (2). Plants under this mat become starved for light and eventually die.

Another important characteristic of hydrilla is its production of specialized reproductive buds. Buds formed under the hydrosoil at the end of rhizomes are commonly termed "tubers" while those in the axis of the leaves are called "turions". Tubers appear to be more numerous than turions but both are important sources for regrowth once the mature parent dies.

Hydrilla also forms root crowns which have the potential to produce new plants. The importance of these crowns have received little attention, and therefore little is known of their role in regrowth.

Until recently there has been little concern about the spread of hydrilla by seeds since the plant populations consisted of only females. However, the recent discovery of male plants (10) raises new questions as to the importance of seeds in allowing this plant to invade new areas or serve as a source of reinfestation.

And finally, hydrilla also competes with other individual hydrilla plants for space. For example, one shoot tip of this submersed plant was found to produce as much dry weight during a 16-week period as 16 similar tips planted under the same conditions (11). This study also showed that the dry weight of plant material after 16 weeks of growth was as high as 1,561 times that of the initial material planted. This helps to show why control methods must eliminate all hydrilla plants. Vegetative growth from even a small fragment, when given the opportunity, will rapidly fill in the area in which it can grow.

V. OTHER PLANT RELATIONSHIPS

There are other factors which contribute to the ability of a plant to dominate the area in which it grows. Location of the growing point helps determine the ability of a plant to compete with its neighbor. For example, eel-grass (*Vallisneria americana* Michx.) has a difficult time competing with hydrilla because its growing point is just above the surface of the hydrosoil whereas most of hydrilla's is from the tips of branches well above that point in the water column. Hydrilla can easily grow above the eel-grass and reduce the amount of available light necessary for its growth.

Biological factors other than the aquatic plants themselves will also determine their ability to survive in a given area. Herbivores, and pathogenic organisms can stress a plant to such an extent that it can no longer compete with its neighbors.

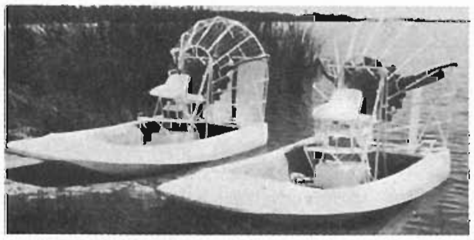
Certain herbivores combined with appropriate control methods can effectively reduce the competitive advantage of water-hyacinth and hydrilla. For example, herbivorous fish can be combined with herbicides to control hydrilla and at the same time encourage growth of plants that are more desirable for the body of water in question (10).

Wave action, silt, and currents can disrupt plant growth. If a

Combee Airboats Inc.

Full line of aluminum and fiberglass Airboats and Service
All sizes and types of airboats to meet your needs.

Combee Airboat Engine Options:
Aircraft power plants
Automotive power plants
High performance automotive belt drive power plants



Full Service Repairs:
Complete engine repairs by A&P certified mechanics
Aircraft to automotive change-overs
Complete metal work
Modification and repair to existing metal work
Stainless steel tank fabrication
Authorized Sensenich propeller dealer

Combee Airboats would like to make available to you our 20 years of experience in the manufacturing and service of airboats

Call or write today for additional information:

COMBEE AIRBOATS INC.
1210 33rd ST. N.W.
WINTER HAVEN, FL 33880
PHONE (813) 293-1917

plant cannot resist these forces, no matter how efficient it is in utilizing light, carbon dioxide, and nutrients, it will not survive. Likewise, a plant with a strong anchoring system and tough connective tissue, such as the submersed forms of *Sagittaria* spp. found in some of Florida's rivers, may resist these forces although they are not considered highly competitive with other plants.

Little information is available on allelopathy, the release of small amounts of material from a plant which adversely affects another plant, in aquatic systems. The best example of an apparent allelopathic response is from studies in California (1, 14) with slender spikerush [*Eleocharis acicularis* (L.) R. & S.] and dwarf spikerush [*Eleocharis coloradoensis* (Britt.) Gilly]. These spikerushes, although their growing points are near the hydrosoil, have been found to replace elodea (*Elodea canadensis* Michx.), American pondweed (*Potamogeton nodosus* Poir.), and sago pondweed (*Potamogeton pectinatus* L.) even though these weeds tower over them. However, no chemical compounds have yet been isolated from these spikerushes to substantiate this allelopathic interaction.

VI. CONCLUSIONS

The old saying that "nature abhors a vacuum" is certainly true for eutrophic aquatic environments such as are many bodies of water in Florida. Water does not sit long before something is growing in it. In many cases those plants growing in it interfere with water use, and therefore, some action must be taken to limit their growth.

One way to help reduce problems associated with excessive weed growth would be to grow those plants which interfere least with water use for a particular site. These plants would occupy some of the space that nature will fill, thus making it difficult for other plants to invade the area. For example, growth of plants short in stature in a canal would allow water movement but at the same time they occupy some of the space where a submersed weed would grow.

Maintaining the correct balance of plants in a body of water will require an understanding of plant competition as well as judicious use of control methods to enhance growth of desirable plants while, at the same time, retarding growth of the weed species. A goal of aquatic plant management is to maintain this balance of plants concomitant with minimal impact on various other components of the aquatic ecosystem. The complexity of the various factors involved with plant growth will make this a difficult and challenging job. □

Literature Cited

1. Frank, P.A. and N. Dechoretz. 1980. Allelopathy in dwarf spikerush (*Eleocharis coloradoensis*). Weed Science 28:499-505.
2. Haller, W.T. and D.L. Sutton. 1975. Community structure and competition between hydrilla and vallisneria. Hyacinth Contr. J. 13:48-50.
3. Haller, W.T., D.L. Sutton, and W.C. Barlowe. 1974. Effects of salinity on growth of several aquatic macrophytes. Ecology 55:891-894.
4. Holm, L.G., D.L. Plucknett, J.V. Pancho, and J.P. Herberger. 1977. The World's Worst Weeds: Distribution and Biology. The University Press of Hawaii, Honolulu. 609 pp.
5. Knipling, E.D., S.H. West, and W.T. Haller. 1970. Growth characteristics, yield potential, and nutritive content of water-hyacinth. Proc. Soil & Crop. Sci. Soc. Fla. 30:51-63.
6. Langeland, K.A. and D.L. Sutton. 1980. Regrowth of hydrilla from axillary buds. J. Aquat. Plant Manage. 18:27-29
7. Rogers, H.H. and D.E. Davis. 1972. Nutrient removal by water-hyacinth. Weed Sci. 20:423-428.
8. Schardt, J.D. and L.E. Nall. 1983. 1982 Aquatic Flora of Florida Survey Report. Bureau of Aquatic Plant Research and Control. Florida Dept. of Natural Resources, Tallahassee. 116 pp.
9. Sculthorpe, C.D. 1967. The Biology of Aquatic Vascular Plants. St. Martin's Press, New York. 610 pp.
10. Sutton, D.L. 1974. Controlling aquatic vegetation with herbicides, fish. Grounds Maintenance 9(8):18,22.
11. Sutton, D.L., R.C. Littell, and K.A. Langeland. 1980. Intraspecific competition of *Hydrilla verticillata*. Weed Sci. 28:425-428.
12. Van, T.K., W.T. Haller, and G. Bowes. 1976. Comparison of the photosynthetic characteristics of three submersed aquatic plants. Plant Physiol. 58:761-768.
13. Vandiver, V.V., Jr., T.K. Van, and K.K. Steward. 1982. Male hydrilla recently found in the United States. Aquatics 4(4):8.
14. Yeo, R.R. and T.W. Fisher. 1970. Progress and potential for biological weed control with fish, pathogens, competitive plants and snails. Tech. Pap. FAO Int. Conf. on Weed Control. Weed Sci. Soc. Am. 688 pp.

Toxicity of Adjuvants to Bluegill

Curtis E. Watkins II[1], D.D. Thayer[2], and W.T. Haller[1]

The use of adjuvants, various surfactants, drift control, weighting agents and inverting oils in aquatic weed control operations has increased dramatically in the past decade. Primarily, this is due to the relatively high cost of aquatic herbicides and the desire to reduce the amount of herbicides in the aquatic environment. Consequently, applicators are trying to optimize herbicide effectiveness by adding various adjuvants to their tank mixes.

Several confusing names have been employed to group spray tank additives. As a method of classification, adjuvants are grouped into three categories: (1) utility modifiers, which encompass those adjuvants that are emulsifiers, dispersants, stabilizing agents, and antifoaming agents, (2) spray modifier adjuvants which include stickers, spreaders, thickening and weighting agents and foams and, (3) activator adjuvants, which include surfactants, wetting agents, penetrants and oils (McWhorter et al. 1982).

Utility modifiers, as the name suggests, aid in modifying the compatability between herbicides as well as their solubility in water. Spray modifying adjuvants mechanically enhance spray application by reducing drift or increasing spreadability. Activator adjuvants act to enhance herbicide activity by increasing penetration, reducing leaf surface tension or aid in herbicide mixing.

Adjuvants, when used properly, may enhance herbicide properties and aid in application. Adjuvants do not claim to possess any herbicidal properties and therefore are not required to under go rigorous registration and testing requirements. Consequently, the knowledge of their toxicity has been of minor importance. The purpose of this investigation was to determine the toxicity of several adjuvants, marketed for use in aquatics on bluegill sunfish.

---

[1] *Center for Aquatic Weeds, 7922 N.W. 71st Street, Gainesville, FL 32606*

[2] *Florida Department of Natural Resources, 8233-22 Gator Lane, West Palm Beach, Florida*

A static bioassay as the name implies, is a "biological assay" or test to assess the biological response of an organism to a substance. The measured response can range from a change in behavior to death. As changes in behavior are determined at the discretion of the investigator, and therefore may be prone to bias, we chose mortality as the response of our test organism. The term static refers to the fact that water was not replaced through the duration of each test.

A static bioassay was conducted to examine the toxicity of nine adjuvants: Spra-Mate, Cide-Kick, X-77, Formula 403, IVOD, Big Sur (F-239), Nalquatic, Polysar, and Herbex, over a 96 hour period on bluegill sunfish[1]. Bluegill sunfish were chosen because they are a major component of the freshwater fish community throughout the United States and also because their popular use as a bioassay organism has made them a valuable reference for comparing toxicities between substances. Fish were obtained from the Fish and Wildlife Service Welaka Fish Hatchery in Welaka, Florida, and were transported live to the Center for Aquatic Weeds in Gainesville where the toxicity tests were conducted. The fish ranged in weight from 0.2 to 2.1 grams and from 26 to 61 mm total length.

Eighteen containers representing three replicates of five concentrations and three controls were used to test each surfactant. After a minimum four day acclimation period, ten fish were placed into each 50 liter tank containing various concentrations of the adjuvants. The acute toxicity of each adjuvant was determined by calculating the lethal concentration and the 95.0% confidence interval. This procedure determines acute toxicity, which is defined as that concentration which induces direct mortality. A common means of quantifying acute toxicity is by calculating the median lethal dose (LD) where 50 percent mortality is observed. Mortality, defined as evidence of no respiratory movement, was examined immediately after placing fish into the containers and every 24 hours up to 96 hours when each test was terminated. As the surfactants Herbex and Polysar made the solution opaque, fish were examined only after 96 hours, at the time when the containers were drained and the experiment was terminated. Temperature was recorded initially and every 24 hours through the end of the experiment from each container using a mercury thermometer (data not show).

The results of our investigation indicate median lethal concentrations (LD-50's) for all nine adjuvants ranged 0.96 ppm to 8100.0 ppm (Table 1). Polysar and Herbex, the two spray additives which produced opaque solutions were the least toxic. Their 96 hour lethal concentrations were 3600.0 and 8100.0 ppm respectively (Table 1). The toxicity of the seven other surfactants increased during the 96 hour lethal period (Table 1). The most toxic surfactants, Spra-Mate, X-77, and Cide-Kick, had LD-50's at concentrations of 10.0 ppm or less.

Currently, spray additives are applied according to recommended surface area rates or as a percentage of the tank mix; therefore, final concentrations in the water column are dependent upon depth. Based upon our results, final concentrations were calculated over several depths according to the manufacturers recommended rates of application (Table 1). These calculations assume additives are mixed thoroughly throughout the water column. Considering the highest recommended use rate it appears there is a large margin of safety for all of the adjuvants tested except for Spra-Mate, X-77, and Cide-Kick. Precautions should be used with these three adjuvants at depths of less than 1.5 feet, 0.3 feet, and 3 feet, respectively.

Unlike laboratory conditions, where physical, mechanical, and biological actions are minimized, the toxicities of these additives may be affected by external factors in natural waters. Differences in physico-chemical parameters (i.e. temperature, pH, and especially alkalinity) may also affect adjuvant toxicity. Generally, toxicities of compounds increases (lower LD-50) as water hardness increases.

Other important considerations include our experimental design and the biological test organisms. The purpose of our test was to examine the "static" effect of these adjuvants. Application of these adjuvants within streams, rivers, or lakes which are subject to constant or extreme wind-wave action may reduce their toxicity to bluegills. It should be noted this experiment was designed to assess

Heavy Weed Growth Ahead...

Clean, Open Water Behind

That's how it is when the HARVESTER makes its pass

You are looking at the most positive, most economical, cleanest method of aquatic weed control yet devised. Strong statement? We believe we can back it up.

POSITIVE — No need to wait days, or even hours to assess results. The HARVESTER reaches down, cuts and removes weeds *right now* — surely and efficiently as a combine gathers grain.

ECONOMICAL — Independent studies show that when it comes to the bottom line, you can't beat aquatic weed harvesting in the cost of work completed. Studies are available on request.

CLEAN — If water is clean enough for swimming before the HARVESTER makes its pass, it's clean enough for swimming in its wake.

LET US TELL YOU MORE — This HARVESTER is just one of many machines and systems pioneered by AQUAMARINE for effective waterweed control. Our track record shows every piece of equipment still in service. Let us help you select or design a system for you.

AQUAMARINE

AQUAMARINE CORPORATION
Subsidiary of DredgeMasters International
P.O. Box 616, 225 North Grand Avenue
Waukesha, WI 53187 • 414/547-0211

Table 1. Expected ppm for the ten surfactants in relation to various water depths and recommended use rate.

Surfactant	Recommended[3] Use Rate (qt/acre)	Expected ppm at Various Depths (feet) 2	4	8	96-hour LD-50 (ppm)
Spra-Mate	6	2.3	1.1	0.5	0.96
Cide-Kick	3	1.1	0.5	0.3	5.2
X-77	2	0.8	0.4	0.2	5.5
"403"	8	3.1	1.5	0.8	37.0
IVOD	8	3.1	1.5	0.8	37.0
Big Sur	2	1.1	0.4	0.2	112.0
Nalquatic	4	1.5	0.8	0.4	200.0
Latex Paint[1]	2	0.8	0.4	0.2	560.0
Polysar Latex	2	0.8	0.4	0.2	3600.0
Herbex	1	0.4	0.2	0.1	8100.0
#4 Fuel Oil[2]	8	3.1	1.5	0.8	91.0

[1] *Sherwin Williams White semi-gloss house paint.*

[2] *Hokanson, K.E.F. and Lloyd L. Smith. 1971. Some factors influencing toxity of Linear Alkylate, Sulfonate (LAS) to Bluegill. Transactions of the American Fisheries Society 100 (1):1-12. (based upon 24-hr LD-50).*

[3] *Recommended use rates on adjuvant labels often show a range of values or suggest a percentage of tank mix, i.e. X-77 at 0.5% of tank mix. Tank mix volume vary from applicator to applicator so the recommended use rate will vary considerably.*

the response of juvenile bluegill sunfish. The median lethal concentrations (LD-50) of each adjuvant may vary according to age and size of bluegill or any other test organism. Also other native fish species as well as invertebrate organisms which may serve as food, could respond differently to each adjuvant.

The effectiveness of any adjuvant as well as any pesticide program, rests in the hands of the applicator. With the acquired skill and experience, an applicator can often insure the pesticide being applied will affect only the target species and is applied such that it is both economically sound and environmentally safe. Presently, there is no standard guidelines to insure safe application of any potentially toxic substance based upon the results of bioassay tests (Hart et al. 1945, Henderson and Tarzwell 1947, Mount and Stephan 1967, Cairns 1981). Hopefully, the results of our investigation will provide a useful guideline to applicators and assure them that when properly used these products are not toxic to fish.

Acknowledgments

We wish to thank Margaret Glenn and Don Driggers for their assistance, Bill Maier for reviewing the manuscript and the following companies for supplying materials used in these studies: Spra-Mate is an inverting oil manufactured by KDM Company, San Antonio, Texas; Cide-Kick is a surfactant manufactured for J.L.B. International Chemical Co., Vero Beach, Florida; X-77 is a surfactant manufactured by Chevron Chemical Co., San Francisco, California; Formula 403 is an inverting oil manufactured by Asgrow Florida Co., Plant City, Florida; IVOD is an inverting oil manufactured for J.L.B. International Co., Vero Beach, Florida; Big Sur (Big Wet) F-238 is a wetting agent manufactured by J.L.B. International Co., Vero Beach, Florida; Nalquatic is a sinking agent-Polymer manufactured by Nalco Chemical Co., Chicago, Illinois; Polysar Latex is a stabilizing agent manufactured by Polysar Inc., Chattanooga, Tennessee, and Herbex is an activator-adjuvant manufactured by the American Colloid Co., Skokie, Illinois. □

[1] *Mention of a trademark or a proprietary product does not constitute a guarantee or warranty of the product by the University of Florida or the U.S. Department of Agriculture, and does not imply its approval to the exclusion of other products that may also be suitable. Project was funded in part through the University of Florida, USDA-ARS Cooperative Agreement No. 58-7B30-0-177.*

Asgrow Florida Company
subsidiary of The Upjohn Company

Aquatic & Non-Crop Herbicides —

Sonar
Roundup
Rodeo
Aquathol K
Velpar
Koplex
K-Tea
Banvel 720
Banvel Herbicide

Invert Adjuvants — Asgrow "403" Invert Adjuvant
SpraMate

AVAILABLE IN 14 DISTRIBUTION CENTERS

Marianna, Alachua, Vero Beach, Wauchula, Ellenton, Fort Myers, Belle Glade, Boynton Beach, Homestead, Naples, Immokalee, Plymouth, Plant City, Hastings

Planning for your Aquatic Weed Control Operation

by Vernon V. Vandiver, Jr.
Associate Professor, Agronomy
IFAS, University of Florida
AREC, Fort Lauderdale
Fort Lauderdale, Florida

The property manager, in developing an aquatic weed control program, faces a series of decisions which will determine the control measures which must be taken to resolve some problem or problems associated with excessive weed growth.

The information that the manager uses to make decisions and the way in which his decisions are made can lead to the following: the degree of success of the control program; the relative costs; the effect on non-target aquatic organisms in the area; the limitations placed on water use during control operations; and whether any desirable vegetation in the area sustains damage.

Prior to planning an aquatic weed control program, some individual or group will have identified one or more weed species that are perceived as limiting the use of a body of water. Water use, the ownership of the water and surrounding land, the resources available, and the desires of the controlling interests largely determine if some type of control program will be initiated to deal with the perceived problem.

Once a decision has been reached to proceed with a control program, proper identification of the weeds causing the problem is essential. Correct identification of the weed plays a very important part in a successful aquatic weed control program; mis-identification of a weed in many cases results in less-than-optimum results following the control operations.

If assistance is required in identifying a plant, the Plant Identification Service of the University of Florida Herbarium is available at no cost to the user. The Herbarium staff can assist by providing information on vascular plants such as scientific names and authors, common names, locations where the plant is known to occur, dates of flowering, and possible human or animal toxicity. The Herbarium facilities include an extensive taxonomic and general botanical library and a collection of over 200,000 preserved plant specimens which are used to aid in the identification of plant specimens sent to the Herbarium. For addition information or to use the Plant Identification Service, you may contact your local county Cooperative Extension Service, listed in the telephone directory under the county government section.

Figure 1. Unrestricted access by livestock may complicate herbicide selection.

During the planning phase of the control program, the manager must also decide if he or his staff will conduct the operation or if the work will be delegated to another individual or firm. Factors that should be considered here include: the experience of the manager and his staff; the size of the proposed operation; the amount of funds available; the availability of equipment and personnel; the ownership of the proposed treatment area; the relative difficulty of the proposed treatment program; and the desires of the property owner and the responsible manager.

The individual who will be responsible for the control opera-

continued on page 20

Which adjuvant do I need to sink my herbicide?

Which adjuvant do I need for drift control?

Which adjuvant is compatible with that herbicide?

SMILE!

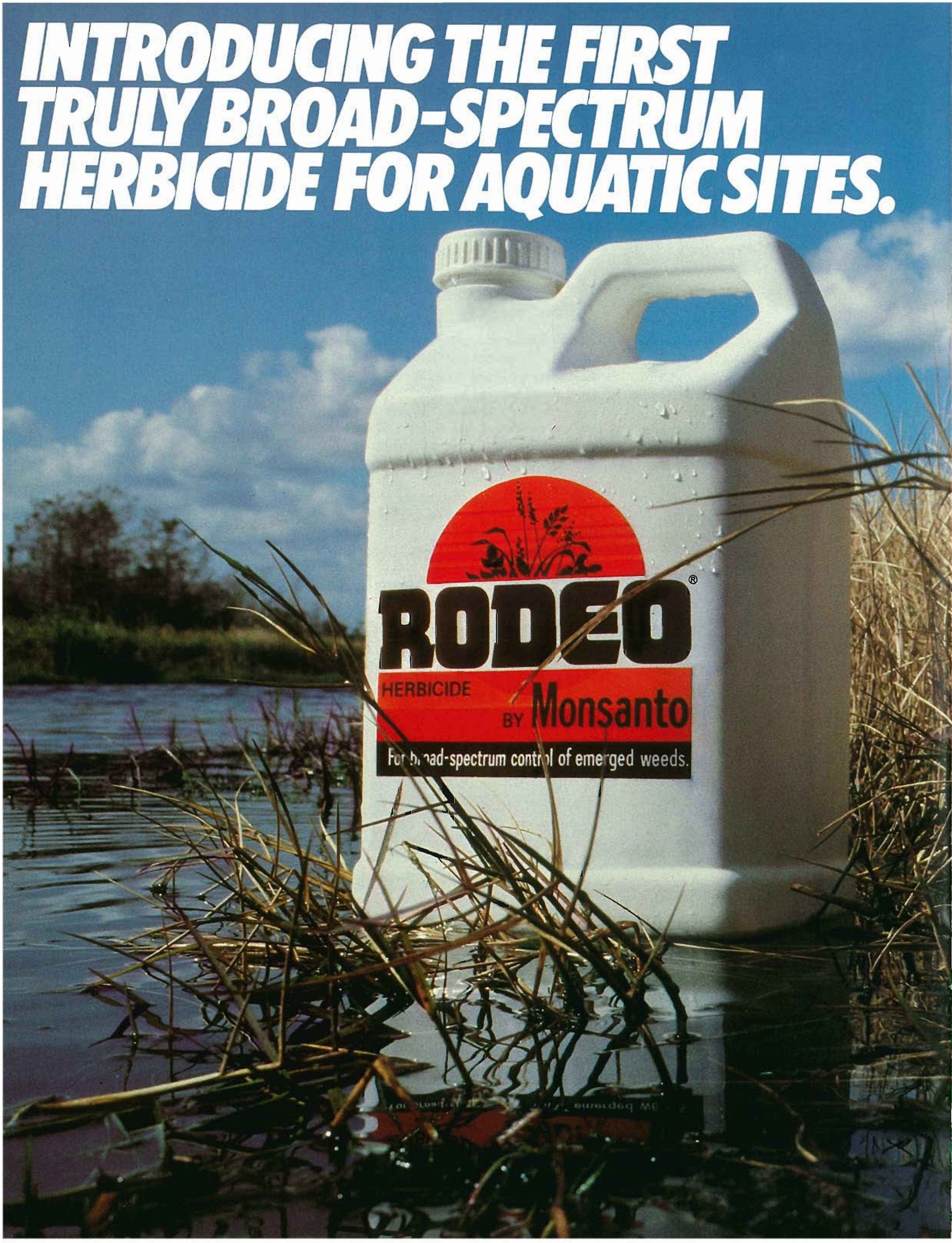
POLY CONTROL™ IS HERE!

Poly Control is a 30% polyacrylamide copolymer that is formulated to sink herbicides at 1-1½ gallons per 100. Poly Control also controls drift for surface spraying at 4-8 ounces per 100.

JLB

INTERNATIONAL CHEMICAL • VERO BEACH, FL
(305) 562-0555

INTRODUCING THE FIRST TRULY BROAD-SPECTRUM HERBICIDE FOR AQUATIC SITES.



NEW RODEO IS LABELED FOR YOUR TOUGHEST GRASSES AND BROADLEAF WEEDS, INCLUDING:

ALLIGATORWEED*
CATTAIL
GIANT CUTGRASS*
GUINEAGRASS
JOHNSONGRASS
MAIDENCANE
PARAGRASS
PHRAGMITES*
REED CANARYGRASS
SPATTERDOCK
TORPEDOGRASS*

*Partial Control.

Now there's <u>one</u> aquatic herbicide that can handle a broad spectrum of obstructive emerged weeds. New Rodeo® herbicide[†] keeps the constant spread of even your toughest weeds within manageable limits, from perennial grasses like torpedograss and paragrass, to broadleaf weeds like alligatorweed, to brush species like willows. In fact, Rodeo does the job of many aquatic herbicides, controlling more than 90 kinds of weeds, roots and all.

When applied with surfactant[I] to the foliage of emerged, labeled weeds, Rodeo translocates to the root system, destroying the entire plant.

RODEO KEEPS WEEDS IN CHECK, LEAVES NATURE IN BALANCE.

Rodeo is compatible with your environmental standards. When applied according to label directions it is virtually non-toxic to mammals, birds and fish. Rodeo breaks down into natural products and does not bioaccumulate in the food chain. What's more, Rodeo has no residual soil activity so it won't leach into non-target areas.

RODEO CLEARS THE WAY IN FLOWING OR STANDING WATER.

You can use Rodeo in most aquatic sites, in recreation or utility areas, in flowing or standing water. This includes canals, ditches, lakes, rivers, streams and ponds.[II]

FLORIDA IRRIGATION DITCH

Treated 10/21/82 Results 11/23/82

[†] Label approval pending in California.

[I] X-77 at 0.5% v/v.

[II] Rodeo cannot be applied within a half mile upstream of domestic water intake points, in tide-water areas, or rice levees when flood water is present.

RODEO. BROAD-SPECTRUM CONTROL FOR AQUATICS.

Monsanto

ALWAYS READ AND FOLLOW LABEL DIRECTIONS FOR RODEO.

Rodeo® is a registered trademark of Monsanto Company.
© Monsanto Company 1983. RUP-SP3-111

continued from page 17

tion must decide on the type program that will be employed. The choices available will be one or a combination of chemical, biological, mechanical, or physical treatments.

For chemical control operations, herbicide selection is one of the critical points in the planning process. First, the herbicide or plant growth regulator should be effective in controlling the target weed and also be registered for that use. In addition, the chemical control program selected should be the most cost effective that is available. Also, the chemical control program, as with other types of control programs, must be consistent with water use in the area of the treatment. One important consideration is whether the water is used for irrigation of crops or ornamentals and turf in residential areas. Water that is essential for livestock watering or potable water supplies for humans imposes other restrictions on the type of chemical application that can be made.

The range of water-use restrictions is wide, depending upon the herbicide used. For most copper-containing herbicides and algaecides, the treated water may be used immediately for irrigation. With diquat, using water for animal consumption, swimming, or spraying must be delayed for 10 days after treatment or until the residue of the diquat ion falls to a level of 0.01 ppm. Also, for water treated with diquat, there must be a 14-day delay before the water is used for drinking or overhead irrigation or until the concentration of the diquat ion again falls to the 0.01 ppm level. For endothall, the treated water should not be used for irrigation of crops, with the restriction on livestock watering and domestic use ranging from 14 days to 25 days following treatment, depending on the herbicide treatment rate. Using fluridone under the current EPA Experimental Use Permit (EUP), when treating up to 10 percent of the total surface area of a lake, there is a 7-day restriction on using the treated water for such things as drinking, livestock watering, and irrigation. Under that same EUP, when an entire pond is treated, the restriction on drinking, livestock watering, and irrigation is 150 days.

With the use of simazine, there is no restriction on swimming or catching fish for food; however, there is a 12-month restriction on using treated water for: irrigation or spraying of crops, ornamentals, and turf; human consumption; and livestock watering. The above restrictions are not all-inclusive for the herbicides discussed, nor are all of the herbicides which can be applied to water mentioned. The examples are given only to illustrate the wide variation in water-use restrictions among the various available herbicides.

Figure 2. Multiple water use in urban areas must be considered when planning a herbicide application.

Another area of concern when planning an aquatic weed control operation is to ensure compliance with all Federal, State, and local regulations. For example, an aquatic plant control permit may be required from the Florida Department of Natural Resources, or a dredge and fill permit from the Florida Department of Environmental Regulation may be required.

It is also very important to read carefully the label and labeling for any herbicide you plan to use and to follow all instructions and precautions. It makes good sense and it is also required by law. The Federal Insecticide, Fungicide, and Rodenticide Act as Amended (FIFRA) states that, "It shall be unlawful for any person to use any registered pesticide in a manner inconsistent with its labeling". This includes following the application directions and carefully calibrating the application equipment to ensure correct application rates.

There are several active programs in the area of biological control. The U.S. Department of Agriculture, Agricultural Research Service and the U.S. Army Corps of Engineers have released three insects for the biological control of water-hyacinth, *Eichhornia*

World's Largest

Expertise of 31 years in Fish Husbandry

MALONES
HATCHERY OF
Chinese Fish

F1 HYBRID GRASS CARP (STERILE TRIPLOID)
Approved triploid verification.
Sales in accordance with Lacey Act Amendments of 1981

Nature's solution for aquatic plant problems; for improved water quality.

WHITE AMUR (GRASS CARP)
BIGHEAD AMUR CARP
SILVER AMUR CARP

For Further Details and Prices, Contact:

J. M. Malone & Son Enterprises
Highway 31 South — P.O. Box 158-O — Lonoke, Arkansas 72086
Phone (501) 676-2800 or 676-6554

crassipes (Mart.) Solms. These are *Neochetina eichhorniae* Warner, *Neochetina burchi* Hustache, and *Sameodes albiguttalis* (Warren). The impact of these introductions is still being evaluated. These insects have spread throughout Florida and thus do not generally require any further manipulation to develop an infestation in a water-hyacinth population.

The use of plant pathogens as a biological control for aquatic weeds is another area that is being actively pursued. Dr. R. Charudattan, Plant Pathology Department, University of Florida is currently evaluating *Cercospora rodmanii* Conway under an Experimental Use Permit (EUP) for control of water-hyacinth. The commercial formulation has not been marketed yet as the product is still undergoing field testing.

Another approach to biological control has involved the effort in Florida and elsewhere to develop biological control programs using herbivorous fish which consume aquatic weeds. At this time, in Florida only one exotic fish, a triploid hybrid from a cross of grass carp and bighead carp, is available to the public for biological control of aquatic weeds under a permit program administered by the Florida Game and Fresh Water Fish Commission.

No individual or organization may purchase, possess, or stock this triploid hybrid carp without first obtaining a permit from the Florida Game and Fresh Water Fish Commission. Additional information about the Hybrid Grass Carp Permit Program can be obtained from the Florida Game and Fresh Water Fish Commission.

A variety of equipment is available for mechanical control of aquatic weeds. Equipment such as draglines, backhoes, dredges, cutters, mowers, and harvesters can be contracted, rented, or purchased, depending upon the individual situation. Mechanical control costs may tend to be somewhat higher than some other control techniques because of the nature of the operation; however, this possible higher cost can some times be offset by some other factor. For example silt removal may be accomplished during removal of aquatic weed infestations or the vegetation removed may be utilized in some manner. Also, water use may preclude other types of treatments, making mechanical removal the only alternative.

Physical control measures also can play a somewhat limited, but important role in aquatic weed control. This would include such techniques as proper pond construction and water level manipulation in a lake. These can be especially effective when integrated with other control techniques such as a herbicide application following a drawdown.

With proper planning and preparation, the herbicides, equipment, and biological agents should perform as expected to give an acceptble level of control for the aquatic weed problem, without any compromise of safety or excessive use of resources. ☐

From the Citrus County Aquatic Services crews

You know it's gonna be a bad day when . . .

1) You go over your favorite jump only to find a ranger bass boat parked on the over side
2) That noise you heard at the prop was your bail bucket
3) You spray cattails and have a duck hunter stand up
4) O.S.H.A. asks to see your safety equipment
5) You take a shortcut across the swamp and find out it's been drained
6) You step off the boat, onto dry land and find out it has no bottom to it.

AQUASHADE
AQUATIC PLANT GROWTH CONTROL

SIMPLE & NON-TOXIC & PROVEN to SUPPRESS HYDRILLA, weed & algae with AQUA-BLUE COLOR

FOR Golf Courses-farms-fish farming recreational-fountains-parks

Economical, because it's long lasting Non-toxic, no harm to humans, livestock, fish, wildlife and turf. (EPA Registered)

APPLY when growth is on bottom by pouring AQUASHADE near water's edge in CONTAINED ponds & lakes.

AQUASHADE INC., P.O. BOX 198,
ELDRED, NEW YORK 12732 (914) 557-8077

AQUA-VINE

IPPC SPONSORED TOUR

by Bill Maier — Fla. Dept. of Natural Resources

The University of Florida, International Plant Protection Center's Aquatic Weed Program sponsored a tour on various aspects of aquatic plant management. The tour included several overseas scientists who attended the Aquatic Plant Management Society's Annual meeting in Lake Buena Vista. Dr. Haller arranged this trip which included visits to:

- The City of Lakeland's treatment plant which utilizes aquatic plants for nutrient removal
- Polk County Environmental Services Equipment Demonstration
- Florida Power & Light Company Martin County Power Plant reservoir — torpedo grass research
- Lake Okeechobee — Hydrilla and waterhyacinth control program
- Congen Properties — Hydrilla control with grass carp in agricultural canals.
- Lehigh Acres — Mechanical control of hydrilla and hygrophila

The tour ended with visits to the Corkscrew Swamp Sanctuary and Fairchild Tropical Gardens.

Over twenty-five persons participated in all or parts of this tour which covered many aspects of management and research. Needless to say, the trip was a great success and allowed for a tremendous exchange of knowledge and created personal contacts with scientists from around the world.

DR. BRUNER JOINS J E C

Dr. Marc Bruner has joined the staff of Joyce Environmental Consultants. He will serve in a position as Aquatic Ecologist at the firms Lake Worth office. His main concerns will be environmental impact analysis and research. Marc came to JEC from the USDA Aquatic Weed lab in Ft. Lauderdale.

The Society is in the process of putting together some bound volumes of past issues of "Aquatics". One slight problem — we are short on the following issues: March 1979, December 1979, June 1981 and December 1981. If you have any of these, please send them to Dr. Bill Haller and they will be put to good use.

Thank you,
Editor

Jim Harrison has joined St. John's Water Management District as an aquatic supervisor. He is occupying the position presently held by John Lager. Jim's previous experience includes 8 years as maintenance supervisor with South West Fla. Water Management District under Bob Gates.

Changes — Bureau of Aquatic Plant Research & Control

Position changes include Judy Locke as the Bureau's new Administrative Assistant. Her former Grants Coordinator position has been filled by Greg Bracko a new bureau employee. Greg's experience with grant-in-aid programs will insure the continued smooth operation of the aquatic plant control programs. Greg Jubinsky formerly a senior biologist in the Grants Administration section where he was involved in the state's matching fund program is now that section's new supervisor.

Two vacant positions have been deleted from the bureau. The cut positions include one of the two regional biologists positions in West Palm and a research section biologist in Tallahassee.

This year's proposed research grant fund of approximately $400,000 was cut by the legislature to $60,000. Only existing research grants will be continued during the next fiscal year. In-house research conducted by the Bureau was not affected by the drastic reduction in funds. It remains unclear as to the legislative reasoning behind this action.

FLORIDA WELCOMES POLISH GRASS CARP EXPERT

Noted fish scientist and aquaculture expert, Dr. Karol Opuszynski, from the Inland Fisheries Insitute, Zabieniec, Poland, has begun a six month sabbatical at the Center for Aquatic Weeds, University of Florida, Gainesville. Dr. Opuszynski, author of over 70 scientific papers on reproduction and rearing of Cyprinid fish and a textbook on basic fish biology, was invited to Florida to cooperate with Dr. Jerome Shireman on various grass carp projects. Opuszynski conducted some of the original studies on grass carp. He has traveled extensively in the People's Republic of China, the Soviet Union and in Eastern Europe. Florida scientists have long been seeking feasible methods for sterilizing grass carp and raising young fry to stocking size large enough to escape predation by other fishes. Dr. Opuszynski will be working with the IPPC literature retrieval system also and requests other scientists to contribute any recent information on grass carp that may not yet be in the database.

Reprinted from "Aquaphyte"

SPECIAL TO AQUATIC MAGAZINE

TO: David Tarver, Editor

By Doyle Conner
Commissioner of Agriculture

Recent changes in the Florida statutes regarding pesticides left intact the authority of the Florida Department of Agriculture and Consumer Services regarding the registration process for pesticides.

In fact, the 1983 Legislature strengthened the department's capability to manage the pesticides which protect Florida's crops and livestock from insects and diseases by authorizing the employment of specialists to held assess the effects these products will have on the state's environment.

A new bureau will be set up within the Division of Inspection to analyze and evaluate data on pesticides submitted by companies which want to register them for use in Florida, as well as to review the uses and effects of products already in use.

This new bureau provides the scientific expertise to make sound judgments on environmental effects as a part of the overall water quality assurance act. This act also abolished the Pesticide Technical Council and in its place, established a new Pesticide Review Council.

The new Bureau of Product Data Evaluation created to help make decisions on new registrations and to evaluate current usage will have a toxicologist, a hydrologist and a biologist to bring those disciplines into the assessment process. The new Pesticide Review Council, while retaining experts from the environmental agencies, will have members trained in hydrology and toxicology and an expert scientific research consultant with experience in government and industry.

The new Pesticide Review Council will have the authority to review all U.S. Environmental Protection Agency data on newly-registered restricted-use-pesticides, advise the EPA of specific environmental conditions in counties where restricted pesticides are used extensively, and inititate scientific study of any such product when there is enough evidence that the product poses an unreasonable adverse effect on the environment or on human health, or when the product does not conform with the manufacturer's claims.

The new council is directed to employ the services of state agencies or the universities to make the investigations.

In addition, the council may ask the EPA to require pesticide manufacturers to provide environmental data generated in Florida or from simulated Florida environmental conditions.

The council also shall evaluate the feasibility of biological control methods as a substitute for chemicals to control insects or diseases.

And, the council may determine that field testing of products applying for registration in Florida is necessary before it makes any recommendation on whether the pesticide should be registered, under rules and conditions to be set by the department of agriculture.

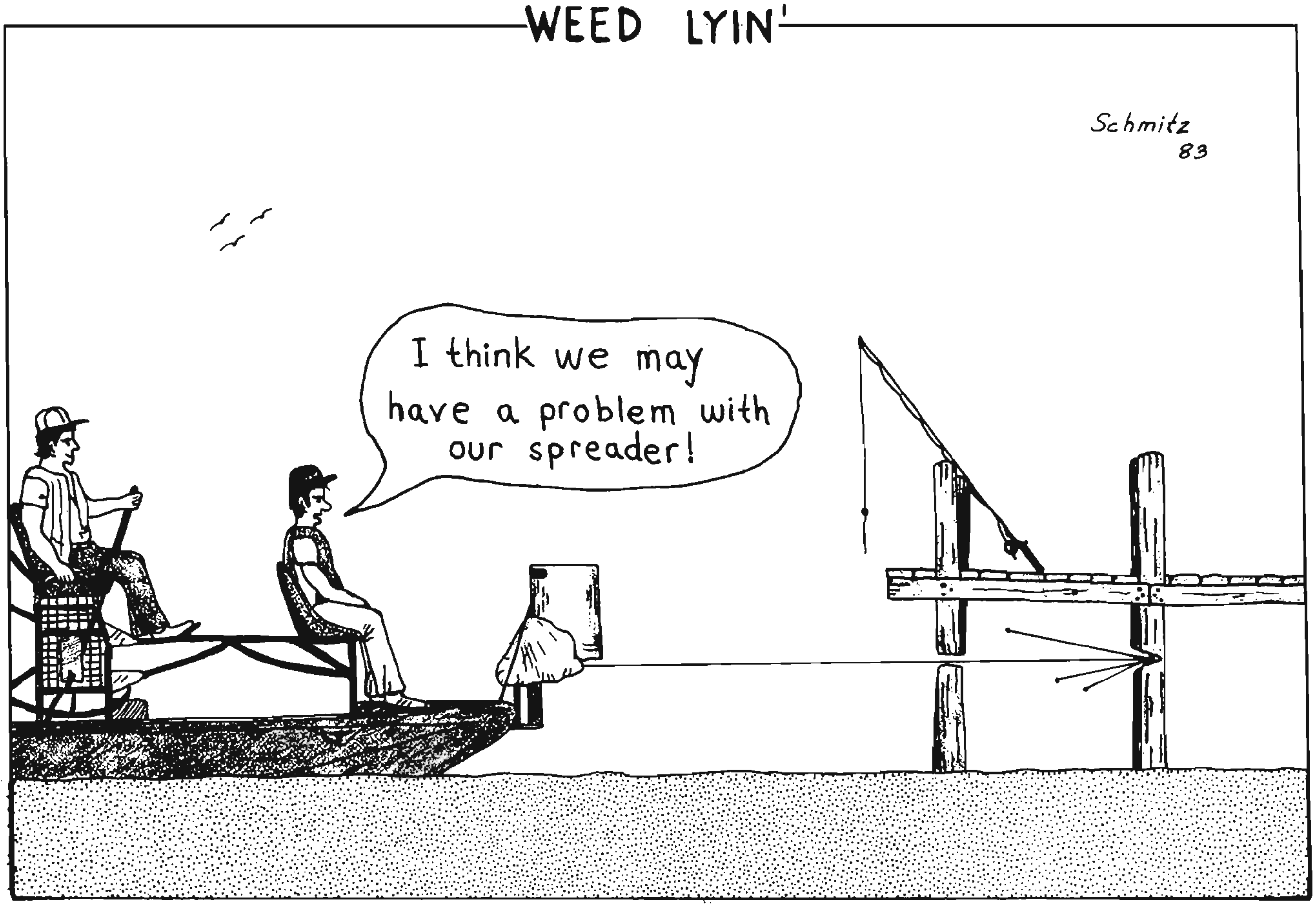
The objective of the legislation obviously is to safeguard our water supply from accidental or unexpected contamination by harmful chemicals.

The department has a continuing obligation to regulate pesticide applicators, especially those purchasing and using Restricted Use Pesticides (RUP). Pesticides are classified as Restricted if it is determined they are highly toxic to man or the environment. Applicators who wish to use a RUP must have a license issued by the department to purchase and use the products.

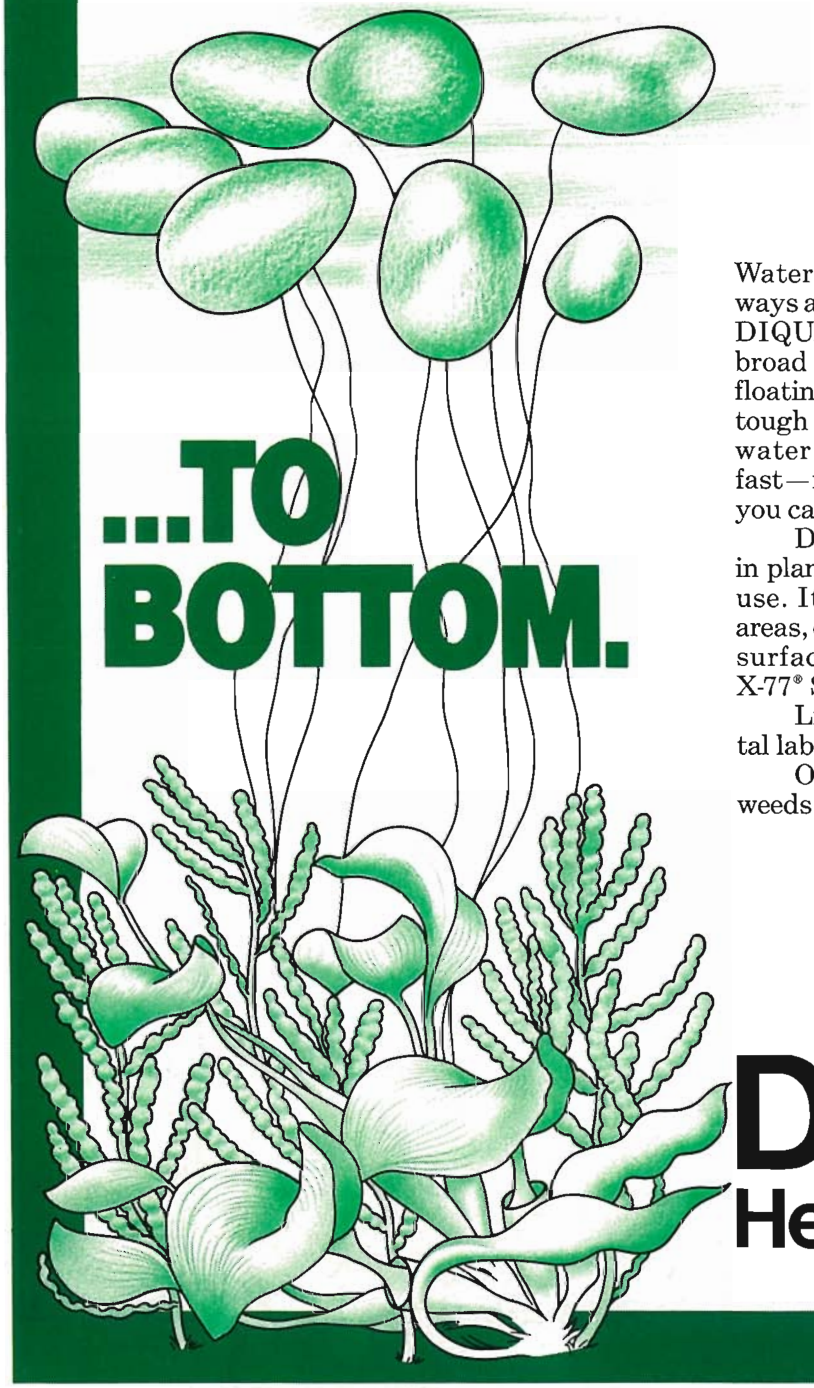
The South Carolina Aquatic Plant Management Society would like to invite all interested individuals to join their Society. Write Dr. Harold Ornes, Biology Dept. University of South Carolina, Aiken, South Carolina 29801 for membership information.

Bob Lazor has left the Bureau of Aquatic Plant Research and Control, DNR to assume a position with the U.S. Army Corps of Engineers. Bob will be working with the Dredging Operation and Technical Support section at WES in Vicksburg, Miss.

WEED LYIN'



DIQUAT CLEARS OUT WATER WEEDS FROM TOP...



...TO BOTTOM.

Water weeds that clog Florida's waterways are sunk when treated with ORTHO DIQUAT Herbicide-H/A. DIQUAT is a broad spectrum herbicide that kills both floating and submerged weeds—even the tough ones like hydrilla, water lettuce and water hyacinth. And DIQUAT works fast—in just a few days after application you can see dramatic results.

DIQUAT interrupts photosynthesis in plants. And DIQUAT is economical to use. It can be used to spot-treat small areas, or control larger infestations. When surface spraying, apply with ORTHO X-77® Spreader for best results.

Licensed applicators: see supplemental label for complete details.

ORTHO DIQUAT. It sends water weeds straight to the bottom.

Chevron

ORTHO

**Chevron Chemical
Company**

DIQUAT
Herbicide-H/A