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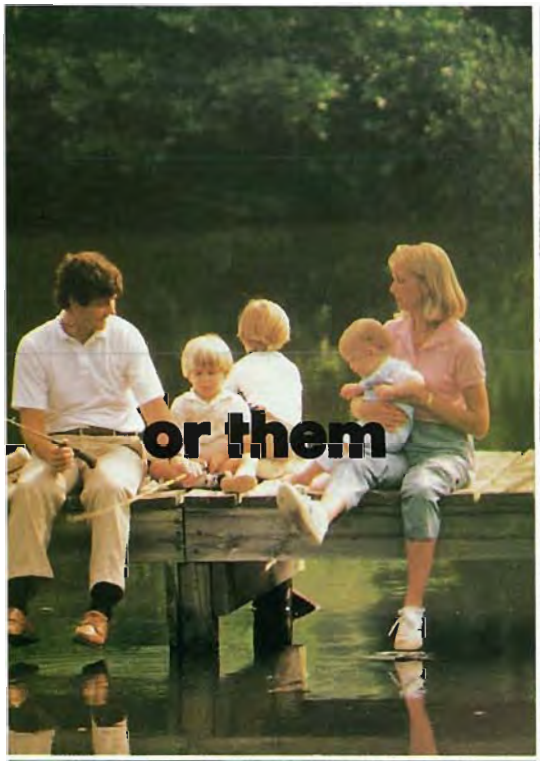

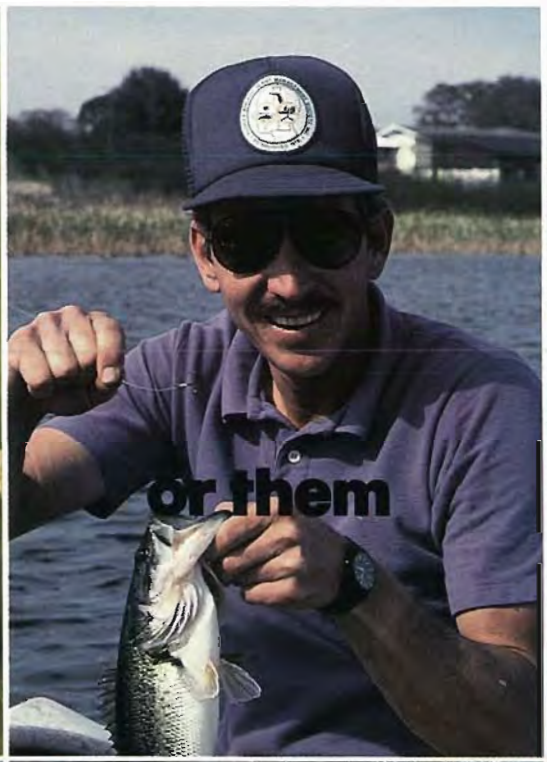

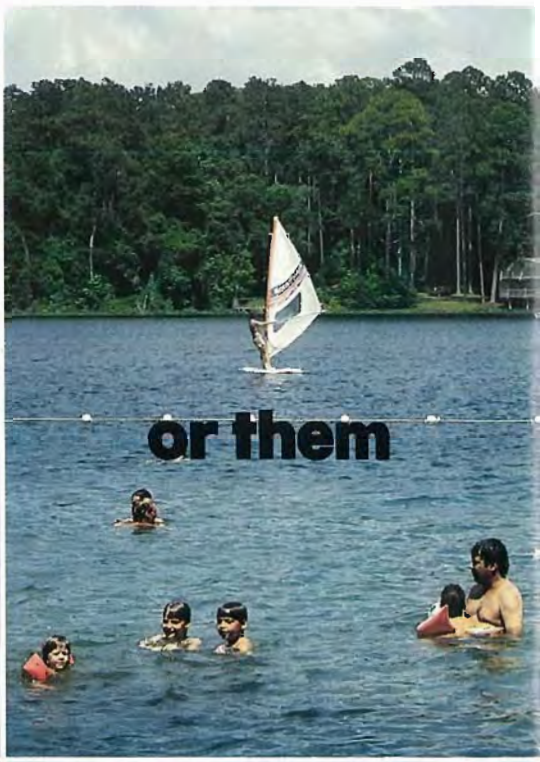

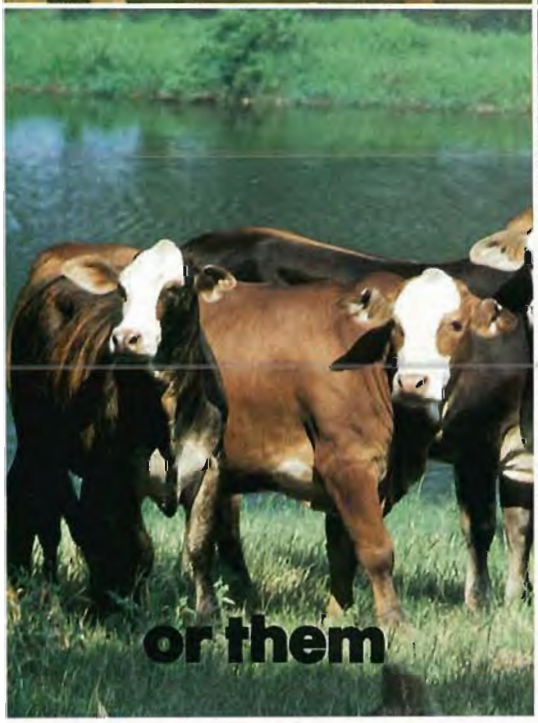

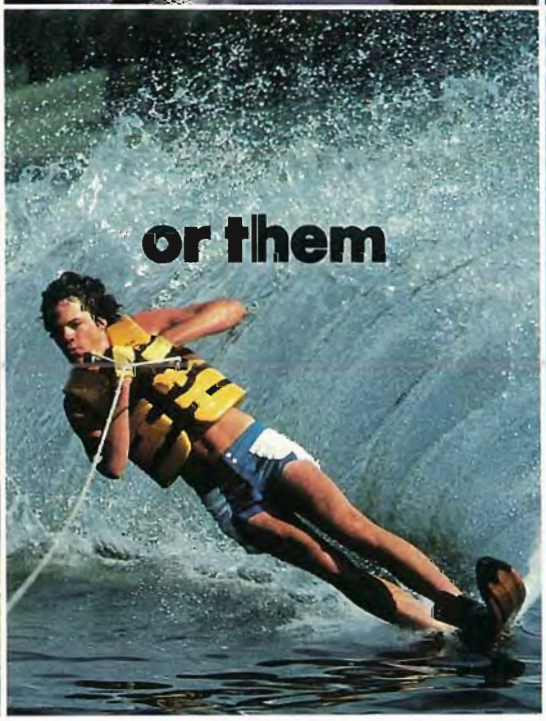

EDITORIAL

Although hard to believe, there are some who live by the credo "best to leave some seed hyacinths, so we can keep our jobs!" Fact is, proper maintenance control of waterhyacinths should find applicators on "search and destroy" missions in all of our waterways. The cost per acre of control would be high as you spend all day spraying small populations of plants totalling an acre. In fact, DNR reimburses for patrol time as you seek out the Wily Waterhyacinth as they hide behind bonnets and bullrush. In the past it was thought that when you had to call out the airplane or helicopter you had let the waterhyacinth get away from you. Now more and more good control programs in the state believe that when one or two airboats spend all day spraying hyacinths in an area, you've let them "get out of hand." It should make you bite your tongue when you hear someone say "good day today, we sprayed 40 acres of hyacinth on Lake So and So." The "good day" should have been three (3) months ago when you would have only had to spray four (4) acres. With the advances made in biocontrol and herbicide technology, waterhyacinth maintenance control is a reality — so practice it. Maintenance control uses less herbicide, results in less environmental impact and less public concern. Those who leave "seed hyacinths" for job security aren't getting the job done!

Bill Haller

ABOUT THE COVER

Little Jones spring creek run into Lake Panasoffkee, Sumter Co., Fl.

Photo by: Jim Kelley

Aquatics

MARCH 1987/Volume 9, No. 1

CONTENTS

Papyrus

by
Blair Griffin

Graduate Student
University of Florida — IFAS
Gainesville, Florida

Papyrus (**Cyperus papyrus** L.), Egyptian paper plant, is the largest of the sedges and one of the largest entirely herbaceous plants. The stems or 'culms' grow to 9 - 15 feet, but it can grow to 30 feet at high elevation sites (7). The culms are topped with a large inflorescence (umbel) up to 1-1/2 feet in diameter (Figure 1). The primary role of the umbel is photosynthesis in mature plants (4).

Papyrus is a native to Madagascar, Israel, and the African continent (7). It is the primary vegetation found in the Sudan flood region generally known as the Sudd region of the upper Nile. This swamp is considered the largest swamp in the world and comprises an area of approximately 36,700 square miles. (2). Papyrus may have disappeared from the lower Nile due to extensive harvesting for centuries. Records indicate it was used for paper (papyri), boat-making, cordage, matting, food, and medicine. (1).

Two habitats that papyrus usually occupies are slow flowing water in river valleys where it has the potential to spread in the flood plains during high water, and at the edge of freshwater lakes where it can form a large, dense, floating mats up to 4-5 feet thick, (Figure 2) which are independent of the water depth (4) (7). During low water these mats may settle on the bottom of shallow water bodies and refloat and break free during the flood season. (7). Researchers reported that the water layer below the floating mat was free of oxygen except near the outer lake edge and these anaerobic conditions are very unfavorable to animals living in the water. These conditions are very similar to those found in mats of water hyacinth (**Eichhornia crassipes**) (6).

Papyrus is a fast growing plant and is extremely adaptable, and is able to spread by both seeds and

Continued on page 6

Figure 1. The flower cluster of papyrus can obtain diameters of up to 1 1-2 feet. Photo by Bill Haller

Figure 2. A floating island of papyrus in Lake Naivasha, Kenya, Africa. Photo by Bill Haller

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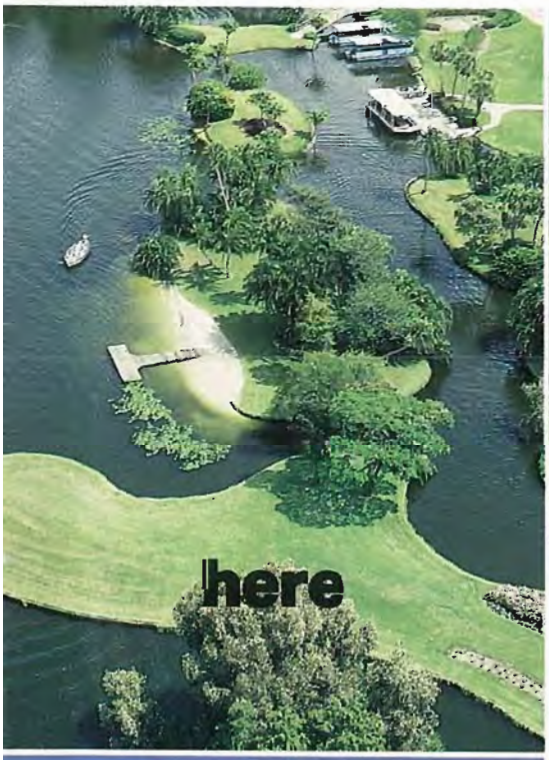

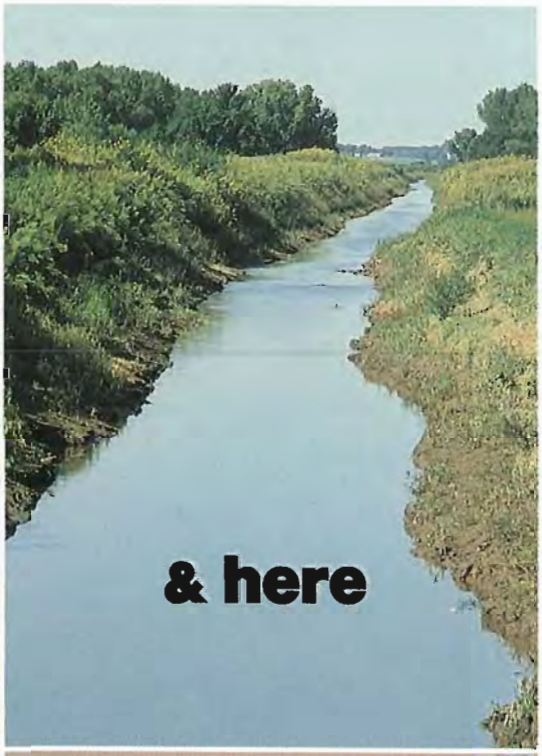

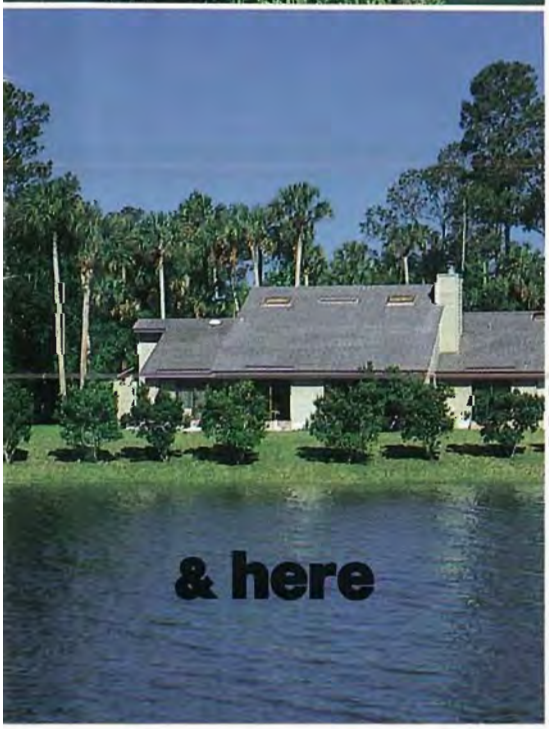

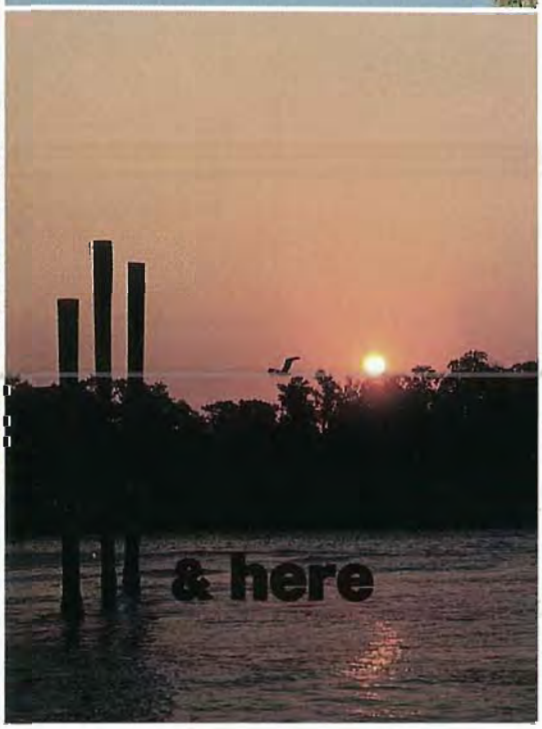

rhizomes. The seeds have the ability to germinate on bare mud and compete with wetland annuals (3). Once it becomes established the rhizomes push out into the water and the standeing leafless culms bearing umbels arise. The rhizomes also afford the papyrus the ability to reestablish itself after a fire. New stems arise from the rhizomes and the plants attain their maximum size in ten weeks (1). However, papyrus is restricted in its distribution in that it will not fully develop when seasonal flooding exceeds 9-12 feet (7).

Several studies have noted that papyrus has several physiological parameters that make it unique. It is one of a small group of emergent aquatic plants that grow in freshwater swamps and wetlands which possess the C4 pathway of photosynthesis. Most C4 species are adapted to some extent to growth under conditions where soil moisture deficits are likely to develop (5). Jones and Muthuri (5) noted that midday closure of the stomata occurs and transpiration is reduced even though water is available to the plant. They felt the reduction of water movement into the plant from anaerobic soil may assist in the reduction of toxic ferrous iron uptake.

Papyrus has become established in central and southern Florida as an aquatics ornamental (8). Similar to the areas in Africa where papyrus is considered a problem weed, Florida has large shallow lake systems and wetlands that do not endure seasonal flooding, so the potential to become an aquatic weed problem in Florida is present (7). At the present time papyrus is being distributed through some Florida aquatic nursery dealers and although it is not presently on the Department of Natural Resources prohibited aquatic plants list (16C-52.011) it has the potential to join the list if in fact the plant spreads and becomes established in natural wetland habitats.

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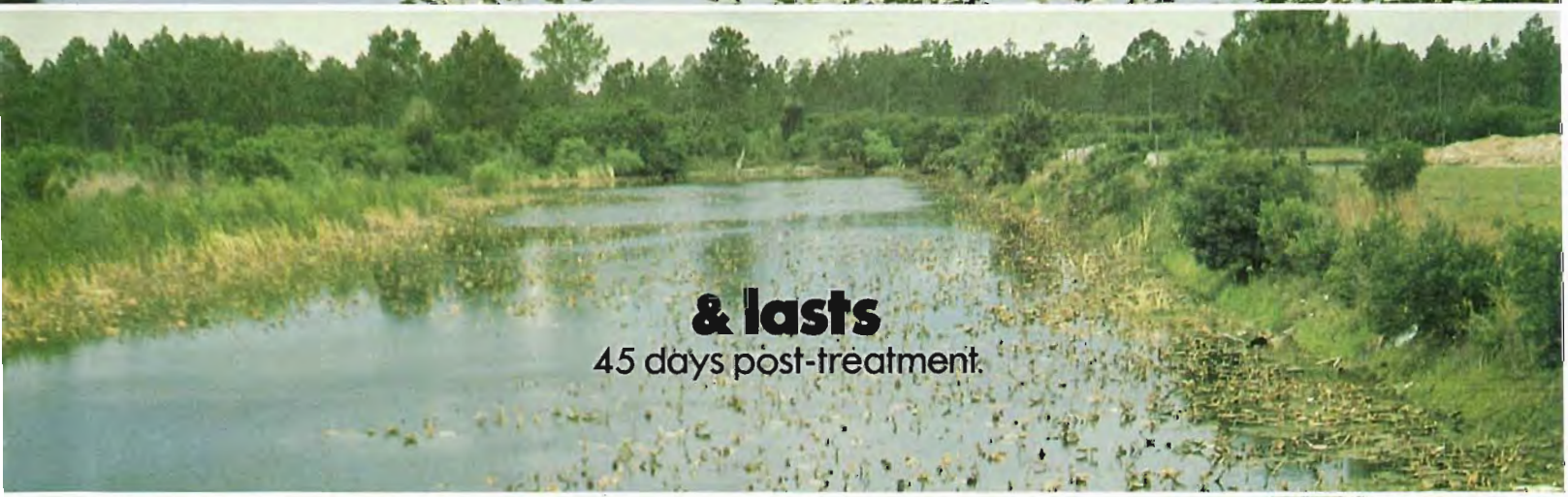

Effect of Herbicides on Floating Aquatic Plants

by
Daniel D. Thayer and William T. Haller
Biological Scientist, Florida Department of Natural Resources
and Professor, Center for Aquatic Weeds
Gainesville, Florida

Introduction

Free-floating plant species,such as duckweed, waterlettuce, and common salvinia, are often considered noxious weeds at relatively small populations by virtue of their unique growth characteristics. With the aide of prevailing winds or moving water, floating plants have the ability to readily invade virgin habitats. Additionally, many free-floating plants innately have excessive growth potentials, and coupled with the difficulty in controlling many of the smaller leaved floating plants with surface applied herbicides, makes these plants an especially troublesome group.

A herbicide widely used in Florida for control of these three plants is diquat, which is also the only herbicide that list all three plant species on the same label. Developed in the late 1950's, diquat is a fast acting contact herbicide used on a wide range of submersed, emersed, and free-floating aquatic weeds. With the cost of research and development of new herbicides escalating, the prospects for many new materials in aquatic plant management are bleak. We were, therefore, interested in evaluating currently registered products to determine their effectiveness for control of these species.

Results and Discussion

Average control ratings at 15 DAT (days after treatment) for all three plant species are listed in Tables 1, 2, and 3. Results for duckweed indicate that all rates of diquat essentially controlled 100% of the treated plants. The other herbicides tested had minimal impact on duckweed at 15 DAT and by 4 weeks post-treatment (data not shown) plants showed no herbicidal symptoms.

Waterlettuce often occurs in mixed populations with waterhyacinth. Because 2,4-D is often used for waterhyacinth management, it would be desirable to find some additive that may make waterlettuce susceptible to this systemic herbicide at field application rates. The most efficacious of all the 2,4-D plus adjuvant treatments was that of 2,4-D plus the industrical strength detergent, LIQUA-NOX. At five DAT it appeared as though 50% of the treated plants would be controlled as indicated by browning and typical 2,4-D type symptoms; however, by 15 DAT regrowth decreased efficacy ratings to 20% of the control.

Plots treated with diquat had 100% control at the 1 qt./acre rate. Waterlettuce treated with endothall were rated at about 80% control with all three treatment rates 15 DAT, however regrowth occurred rapidly as new leaves sprouted from the central bud. Glyphosate treatments at 1.0 and 1.5 gal/acre were rated at greater than 90% control at 25 DAT and increased to 100% control by 30 DAT. The 1/2 gal/acre treatment rate with glyphosate resulted in no more than 70% control at 15 DAT and by 60 DAT, waterlettuce had re-established and 100% of the frames through formation of multiple daughter plants from the decaying parent plants.

With the exception of 2,4-D, all herbicides and herbicide rates tested for salvinia control were rated at about 80% control 15 DAT. Later ratings (30 DAT) of salvinia again indicated little difference between herbicidal treatments.

In summary, it appears that of the herbicides and rates tested, diquat provided the most effective long term control of duckweed and diquat and glyphosate were efficacious against waterlettuce. None of the herbicides provided over 80-90% control of salvinia as diquat, endothall, and glyphosate appeared to be equally effective at the rates tested.

Acknowledgement

The authors wish to thank Deborah White and Margaret Glenn, Biologists at the Center for Aquatic Weeds, for their assistance in evaluating herbicide efficacy.

Funding for this project was provided in part by the U.S. Department of Agriculture, ARS Cooperative Agreement No. 58-7B30-3-570. Published as Journal series No. 6226 of the Florida Agricultural Experiment Station, in the Journal of Aquatic Plant Management 23:1985.

Table 1. Effectiveness of several herbicides for control of duckweed.

Treatment	Rate (gal/acre)	Percent kill[ab]
2,4-D[c]	1/4	2%
2,4-D	1/2	2
2,4-D	1	10
diquat	1/2	99
diquat	1	100
diquat	1 1/2	100
endothall[d]	1/2	6
endothall	1	7
endothall	1 1/2	10
glyphosate	1/2	12
glyphosate	1	14
glyphosate	1 1/2	17

[a] Efficacy ratings were based on a scale of 0 to 100 with 0 having no effect and 100 having complete kill.
[b] Values for percent kill are the average of three replications per treatment and three evaluators rating control.
[c] As dimethylamine salt.
[d] As dipotassium salt.

Continued on page 11

The Role and Management of Cattails in a Lake Ecosystem

By
Katherine M. Gilbert
Bureau of Aquatic Plant Management
Department of Natural Resources

Cattails are native plants found growing in protected shallow water areas from the shoreline reportedly out into water nine feet deep. Their habitat includes soils ranging from sand and clay to high organic peat and water pH from 4.2-8.1. Optimum habitat is high organic soil, nutrient enriched waters, pH 6-8 and water depth 6-18 inches. There are three pure species and one hybrid given species status in the U.S. . All occur in Florida and hybridization regularly occurs. Generally, the hybrids produced have a greater tolerance of environmental fluctuations than their parents. Cattails rapidly establish in disturbed or fluctuating areas and areas of low density vegetation. Due to the lowering of the water table and increased nutrient loading, conditions which are favorable to cattail growth, cattail distribution has become extensive in some areas of Florida.

The 1984 DNR Aquatic Plant Survey reflects the increase in cattails during the years 1982-1984. There was a jump from almost 16,000 acres in 1982 to over 49,000 acres in 1983.

In terms of g/m^2 (dry weight), cattail is approximately twice as productive as hydrilla and up to a third again as productive as hyacinth. Approximately half of the biomass of a cattail is belowground in the rhizome. Vegetative reproduction occurs from branching of the rhizome with new shoot formation.

Figure 1 traces the route of rhizome growth and shoot production. "A" is the oldest growth, "E" the youngest. "A" is the first growth. It may have started from a seed. "B" is the second shoot produced during the first year. "C" and "D" are second year growths. "D" is producing new rhizomes and shoots that may be part of the main population of the third year or may come up at the end of the second year. "C" is producing a ramet, a clump of shoots. Ramets live up to three years and do not produce flowers during the first year. When flower spikes are produced each can yield one half a million flowers. Rhizomes build up a store of carbohydrate reserves in the fall just prior to leaf senescence and can live up to 2 years. In the early spring, cattail leaves are able to attain their maximum height utilizing the stored reserves.

Initial colonization of an area by cattail can occur with one seed which can reportedly produce 98 aerial shoots in a 9 feet diameter area within one season. Continued extensive vegetative reproduction produces clones, groups of genetically similar individuals. Seedling establishment is chemically inhibited within the clone area. Cattail stands usually consist of one to a few clones produced by one species or a combination of species and/or hybrids.

Cattail is a valuable plant of the freshwater lake ecosystem. It is able to assimilate nutrients, a process which can be utilized for wastewater (now referred to as "recovered water") treatment. Cattail has the ability to accumulate heavy metals, including copper. Leaching from the leaves occurs for all nutrients except nitrogen and calcium. A large amount of nitrogen and a fair amount of phosphorus is stored in the rhizomes over winter.

Additionally, the rhizomes take up some nitrogen and phosphorus from the soil during the winter. As for habitat, the tall leaves provide

an apical relief for birds, surface area for invertebrates and shelter for juvenile fish. When the leaves die, they provide nesting habitat and overall shelter for birds and small mammals. All parts of the plants are edible, for human and wildlife consumption. Cattail roots and shoots help hold soil and are useful for bank stabilization.

However, dense growth of cattail can be detrimental. The tall leaves can reduce visual and physical access to a waterbody. The number of plants may increase sedimentation and produce great amounts of organic ooze in areas where those processes are undesirable.

Dense growths of cattail are less useful for wildlife utilization than thin, patchy growth intersperced with other vegetation types. Several studies report that the greatest diversity of birds, fish and invertebrates occurs when there is a 30-60% mixed vegetation cover to openwater (Figure 2). If cattails are the only emergent plant available, they should be allowed to **contribute** to the lake community.

We realize that cattail is expanding in areas where it has not been previously observed. In a balanced or depauperate system, it is a beneficial wetland plant. There are areas in south-central Florida where extensive stands occur and must be regulated. There are many more areas where small, localized stands blend well with the aquatic community and present a positive contribution to the community.

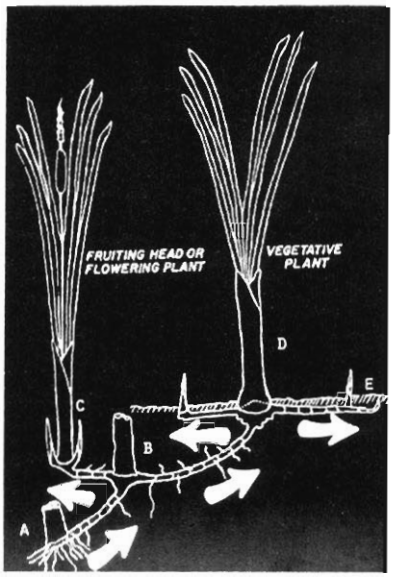

Figure 1. Growth and expansion of cattails.

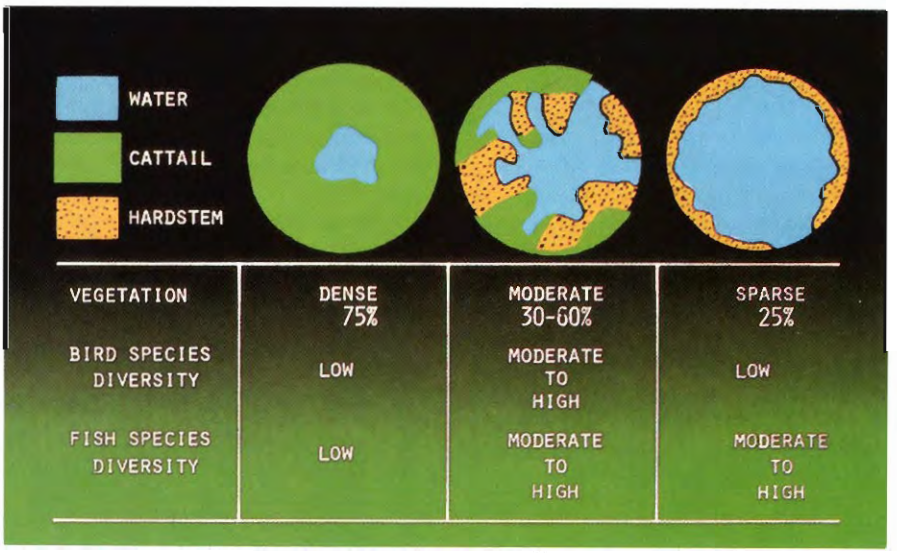

Figure 2. Affect of cattails on fish and wildlife.

When you consider the amount of wetlands lost in Florida every year, it seems wise to conserve and manage what we have regardless of age or origin. To attain a balance between the lakeowner's desire for view and access to the lake and maintain the usefulness of cattail as a valuable wetland resource, the DNR has come up with management guidelines that hopefully will provide as many benefits as are practical.

In some areas, removal of up to 75% of the cattail is allowed. Currently, the method is to cut a "V" shaped pattern which provides visual and physical access to the lake. This may also facilitate circulation. It is possible that the wildlife value of an area like this can be enhanced by cutting into the edge, forming pools or jagged indentations. For good control of the cattail stand it would be best to control the plants during periods when the carbohydrate reserves in the rhizomes are lowest. The best times are:

1. early spring to cut down new growth from overwintered shoots.
2. just prior to flower release when carbohydrate reserves are drained from flower production.
3. late summer, early autumn just prior to leaf senescence when the rhizomes are building up their overwinter carbohydrate store.
4. or during early winter when the rhizomes are depending upon emerged dead stalks for their oxygen supply.

In summary, cattails are native, aquatic plants. When intermixed with other wetland and aquatic plants, they contribute to the health and wealth of the lake ecosystem. In disturbed or enriched areas their growth can expand to proportions which decrease the usefulness of those areas. Man's ability to impact and maintain this plant and all other plants of the lake ecosystem should be handled with wise management practices for the mutual benefit of all life.

Continued from page 8

Table 2. Effectiveness of several herbicides for control of waterlettuce.

Treatment	Rate (gal/acre)	Percent kill[ab]
2,4-D[c]	1	6
2,4-D + kover II	1 + 1% v/v	17
2,4-D + CIDE-KICK II	1 + 1% v/v	14
2,4-D + Liqua-nox	1 + 1% v/v	20
2,4-D + Dermagene	1 + 1% v/v	13
diquat	1/2	100
endothall[d]	1/2	76
endothall	1	79
endothall	1 1/2	81
glyphosate	1/2	71
glyphosate	1	96
glyphosate	1 1/2	99

[a] Efficiency ratings were based on a scale of 0 to 100 with 0 having no effect and 100 having complete kill.
[b] Values for percent kill are the average of three replications per treatment and three evaluators rating control.
[c] As dimethylamine salt.
[d] As dipotassium salt.

Table 3. Effectiveness of several herbicides for control of common salvinia.

Treatment	Rate (gal/acre)	Percent kill[ab]
2,4-D[c]	1	8
diquat	1/2	87
enthothall[d]	1/2	75
endothall	1	80
endothall	1 1/2	80
glyphosate	1/2	87
glyphosate	1	86
glyphosate	1 1/2	85

[a] Efficacy ratings were based on a scale of 0 to 100 with 0 having no effect and 100 having complete kill.
[b] Values for percent kill are the average of three replications per treatment and three evaluators rating control.
[c] As dimethylamine salt.
[d] As dipotassium salt.

YOU KNOW IT'S GOING TO BE A BAD DAY WHEN
by
Citrus County Environmental Division

- When you hear the famous words, "Trust Me!"
- When you get your partner on the bow wet and you receive a sinister smile back.
- The airboat trail you've been using all year was chosen as a disposal site by a mechanical harvester. Banzai!
- You use another crew's boat and didn't know the toggle switch was for the charging system.
- When you're wet from head to toe and your partner heads straight for a ripe cattail patch.
- When the road department dumps limerock instead of rock to fix your boat ramp.

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AVOID ACCIDENTS. READ THE LABEL AND USE ONLY AS DIRECTED.

Illustrated are:

	Key
Waterhyacinth	A
Salvinia	B
Waterlettuce	C
Duckweed	D
Bladderwort	E
Naiad	F
Coontail	G
Watermilfoil	H

Diquat
Herbicide-H/A

For Aquatic Plant Management In Florida

ORTHO Diquat Herbicide-H/A is a highly active, water-soluble contact herbicide that controls a broad spectrum of floating, submersed, and marginal aquatic weeds. This illustration gives an overall view of aquatic plants controlled by ORTHO Diquat Herbicide-H/A. In some cases, a particular species represents several species within a genus.

Pondweed	I
Hydrilla	J
Elodea	K
Cattail	L

Pennywort	M
Filamentous Algae (*Pithophora* spp.)	N
Filamentous Algae (*Spirogyra* spp.)	O

Clearing the Air on 2,4-D

by
Ken Langeland
Extension Aquatic Weed Specialist, IFAS, Gainesville, Florida
Dan Thayer
Biologist, DNR, Gainesville, Florida
Danny Colvin
Extension Specialist, IFAS, Gainesville, Florida

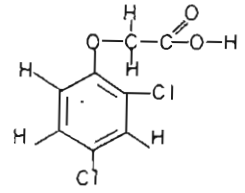
Use of 2,4-D has come under close scrutiny on several fronts recently. The Florida Department of Agriculture and Consumer Services "Organo-Auxin Herbicide Rule" placed new restrictions on the use of 2,4-D in the State. Studies that suggest the detrimental effects of 2,4-D on non-target aquatic plants such as bulrush, during waterhyacinth control operations has caused concern among spray crews and supervisors. And, an article published in the Journal of the American Medical Association (JAMA 1986;256:1141-1147) suggested a link between the occurrence of non-Hodgkins lymphoma (NHL) and the use of 2,4-D by Kansas farmers. In a letter to the editor in the December 1986 Aquatics, it was stated that several speakers at the 1986 Annual FAPMS meeting "belittled" the JAMA report by S.K. Hoar et al. This report should not be "belittled", but should be put into perspective. We will discuss these issues as they relate to use of 2,4-D for aquatic weed management in this article.

Organo-Auxin Herbicide Rule

A question that I have been asked several times in regard to this rule is whether all ester formulations of 2,4-D are illegal under the new rule. The answer to this question is no; and a quick review of the basic chemistry of 2,4-D will help to explain this more fully.

Figure 1 is the structure of 2,4-D acid. It is composed of a phenol ring that has chlorine substitutions at the 2 and 4 positions and an acetic acid molecule attached to the oxygen at the 1 position. Different 2,4-D formulations that vary in their volatility, solubility and toxicity properties are made by replacing

Structure 1

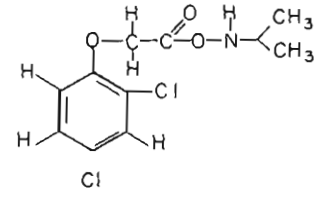


2,4-D acid

the Hydrogen on the acetic acid with various side chains.

Amine formulations of 2,4-D are synthesized by attaching a nitrogen (N) containing compound to the oxygen (0) of the acetic acid. An example is the dimethyl amine (structure 2) that is commonly used

Structure 2

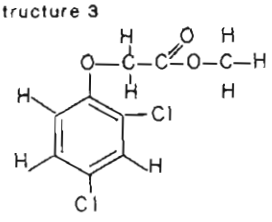


dimethylamine (DMA) salt of 2,4-D

for aquatic weed control. 2,4-D amines are nonvolatile. Since they do not change from liquid, to gasses at ambient temperature they do not present a hazard to nearby crop plants if particulate drift is controlled, and treated water is not used for irrigation or mixing sprays for use on sensitive crop plants. 2,4-D amines are soluble in water and have very low toxicity to fish. For example, the average 96 hour LC50 for bluegill is 168 ppm dimethyl-amine salt of 2,4-D; or 716 gallons of a typical 3.8 lb ae formulation per acre in 6 foot depth.

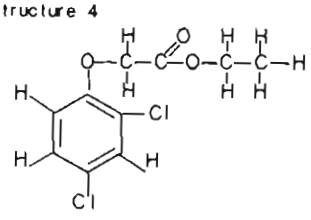
Esters of 2,4-D are synthesized by attaching the carbon (C) chain of an alcohol (OH) to the -0- of the acetic acid portion of the molecule. Esters with short carbon chains (structures 3-6) are inexpensive to produce but are highly volatile. Because of potential damage to crop plants by vapor drift the "Organo-auxin herbicide rule" prohibits the sale or use of these compounds, specifically methyl (Structure 3), ethyl (Structure 4), propyl (Structure 5), isopropyl, and butyl esters (Structure 6), in Florida. Prohibition of these compounds should not affect the aquatic weed control industry because there are no high volatility, short chain 2,4-D ester formulations labeled for aquatic weed control.

Structure 3



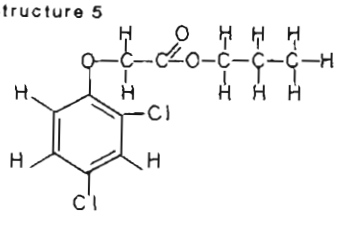
methyl ester of 2,4-D

Structure 4



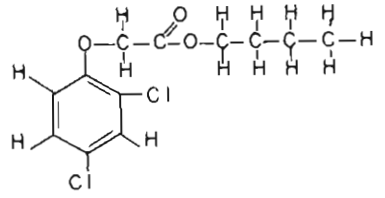
ethyl ester of 2,4-D

Structure 5



propyl ester of 2,4-D

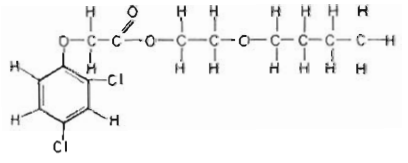
Structure 6



butyl ester of 2,4-D

Low-volatile esters of 2,4-D are synthesized by attaching long chain alcohols with an ether linkage (C-0-C). Formulations of 2,4-D butoxyethyl ester (Structure 7) and

Structure 7



butoxyethyl ester of 2,4-D

isooctyl ester (2, ethylhexyl ester) are labeled for aquatic and ditchbank use and **are not prohibited** by this rule.

Esters of 2,4-D are not readily water soluable and are applied as oil in water emulsions or as inverts. They are generally considered more phytotoxic than amines, especially on woody plants, because they are more readily absorbed. Esters are therefore important tools for use on ditchbanks to manage woody and difficult to control weeds.

It should be remembered that some volatilization of low-volatile esters can occur on hot humid days, so for large area applications to waterhyacinths where vapor drift to susceptible crops such as squash, melons and beans is a concern, 2,4-D amine is a better choice.

It should also be remembered that in comparison to amines, esters are much more toxic to fish. For example the average 96 hr. LC50 for bluegill is 1.2 ppm butoxyethyl ester of 2,4-D. However, if foliar application is done properly, so that a minimum of sprayed material enters the water, problems will not occur. Likewise, when granular formulations of 2,4-D ester are used most 2,4-D is tied up in the hydrosoil and plant material so that toxic concentrations do not occur in water.

Decisions that must be made by applicators with respect to application of amines and esters of 2,4-D must be based on common sense and knowledge of the characteristics of the formulations and the target species. These decisions should not change under the "Organo-auxin rule".

The major complaint with the "Organo-auxin rule" is with the record keeping that is required in part -6. The interpretation of the record-keeping requirement is that records must be kept for any particular 24 hour period that an excess of 5 acres is treated. Records do not have to be kept for other days when less than 5 acres is treated. Good record-keeping can be beneficial in many ways, and can be especially important for the applicators protection to demonstrate that applications were made according to regulations, if a law suit over crop damage arises.

Effects on Non-Target Aquatic Plants

Some concern has recently been expressed about using 2,4-D when native, non-target vegetation may be incidentally sprayed. It is inevitable, when you manage a free-floating plant like waterhyacinth, that you will eventually find yourself spraying in and around a desirable plant like bulrush.

This concern was partly generated from the results of a study evaluating the potential impact of herbicides used for waterhyacinth control on the bulrush communities of East Lake Tohopekaliga, Osceola County, Florida. The recommendations of the evaluation suggested using diquat when targeting waterhyacinths mixed with bulrush. This was based on the long-term impacts to bulrush using multiple treatments of 2,4-D. For the purposes of the study, the entire emergent portion of the bulrush was sprayed. Each of the treatment plots were separated by buffer (non-sprayed bulrush) zones. Throughout the 2-year study, there never appeared to be any impact to adjacent vegetation, indicating that drift or absorption from submersed portions of the bulrush plant did not adversely affect growth.

The cost advantage and well documented efficacy of 2,4-D to waterhyacinth makes it a desirable method for its control. When spray crews are targeting waterhyacinth around desirable vegetation such as bulrush, they should do everything possible to avoid direct contact to bulrush stems. Only when waterhyacinths are growing deep within a bulrush community should a spray crew be concerned about the use of 2,4-D, and in this situation, switching to a herbicide like diquat would be prudent.

It should be noted that the only plant studied on East Lake Tohopekaliga was bulrush. It is quite possible that desirable vegetation such as maidencane, knotgrass, spatterdock, and so on, may be less impacted by 2,4-D than bulrush.

Studies measuring the impacts of waterhyacinth control operations on these and other desirable plants should also be conducted. But one thing is certain, the uncontrolled growth of waterhyacinth will most assuredly have more of an impact on desirable vegetation and water quality than any maintenance control program.

Health Effects

2,4-D was first sold as a herbicide in 1944. It quickly became a widely used herbicide in both crop and non-crop situations; and probably remains as the most widely used herbicide in the world. This extensive history of use without incidence of human health effects attests to the safety of the compound, along with an excess of 40,000 scientific articles and technical reports related to the herbicide.

In spite of the safety record and scientific data to support its safety, public concern over the use of 2,4-D began to to grow when a link was suggested between birth defects and the exposure of Vietnam veterans to TCDD, a contaminant in the defoliant "agent orange", that was used during the war. Agent orange was a 1:1 mixture of 2,4-D and 2,4,5-T. The source of the TCDD contamination was the 2,4,5-T component. Although TCDD does not occur in any 2,4-D formulations, concern grew because of misconceptions and press coverage.

Use of 2,4-D has once again become a matter of public concern after the publication and media coverage of the JAMA paper by J.K. Hoar et al. that related NHL and 2,4-D use by Kansas farmers. This was a good study with proper controls and proper statistics applied to the data. Results of this study show a correlation with the

occurence of NHL in farm workers who applied 2,4-D on a regular basis. This data shows a six-fold increase in the chance of contracting NHL when 2,4-D was applied by the worker for over 20-plus days per year and no protective clothing was worn. The strongest association of increased NHL reported in the study was based on a total of only seven farmers who were in the 20-plus days per year exposure group. Misclassification of only a few farmers could substantially change the conclusions of the study. In addition, no correlation was found that would relate 2,4-D usage to the occurrence of Hodgkins disease or Soft-tissue sarcoma.

The National Cancer Institute (NCI) is conducting somewhat similar epidemiological studies in several states, including Iowa, Minnesota, and Wisconsin. In these studies there were preliminary findings that did not show an increased risk of NHL associated with farming in Iowa or Minnesota, although there appeared to be a slight increase in Wisconsin. These early studies did not ask as detailed questions about the use of herbicides as was done in the Kansas study. Other NCI efforts underway, presumably, will more specifically address questions regarding the use of herbicides and help clarify these results.

Regardless of the differences and inconsistencies observed the various epidemiological studies, the Kansas study is of scientific interest and warrants careful review and follow-up. Such review must consider the results of the Kansas study in context with other existing and on-going toxicological and epidemiological research.

As a further note, the Industry Task Force on 2,4-D has reviewed preliminary unaudited results of a two-year mouse oncogenicity study which indicates that 2,4-D acid was not oncogenic (did not cause tumors of any kind) after a lifetime of daily feeding to male and female mice. These results support the Industry Task Force position that 2,4-D acid is not a public carcinogen risk. Further information can be obtained from the task force by calling: U.S. (800) 345-5109, Canada (800) 654-5650, other areas (503) 370-8297. Direct all calls to Mr. David Dietz.

Shortly after the publication of the JAMA article, a large lawn care service was referenced in a St. Petersburg newspaper as saying that they would never use 2,4-D in their business again. This type of over reaction is unnecessary; and publication of the JAMA article should not affect the use of 2,4-D in aquatic weed control operations. We have always emphasized the importance of safety and use of protective clothing when handling aquatic herbicides and 2,4-D is no exception. There is no scientific data in the literature, nor does this recent publication suggest a health hazard to the general public from using 2,4-D as an aquatic herbicide.

Summary

Increased regulation of 2,4-D use in Florida and recent scientific data concerning toxicity and effects on non-target aquatic plants should be taken as reminders to respect the chemical tools of our trade. We continue to stress the importance of safe handling and judicious use of aquatic herbicides that are brought about by knowledgeable personnel in the aquatic plant management profession; and we will continue to provide up-to-date information and training to the best of our ability to make this possible.

The Major Aquatic Plants of Peninsular Malaysia

by
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Geography

Peninsular Malaysia lies between latitudes 1o and 7o north, and longitudes 100o and 105o east. The area covers approximately 50,905 square miles and measures 460 miles at its greatest length, while its greatest width is only 200 miles.

There are 1,200 miles of coastline, with muddy mangrove swamps predominating the west and sandy beaches fringed with green casuarinas in the east. A central mountain spine runs through the peninsula from northwest to southeast of which Gunung Tahan (7,183 ft.) is the highest peak.

The topographical relief of Pensinsular Malaysia is characterized by a central mountain range and featuring rolling plains and tidal flats. Sedentary soils are found in 36,284 square miles of mountains to undulating plains, while alluvial soils are found in riverine and coastal plains covering approximately 13,896 square miles. There are hundreds of river systems in Pensinsular Malaysia. Most of the rivers originate in steeply sloped mountainous catchments meandering through the flat plain alluvial areas and subsequently end up at estuaries which are generally in the tidal flat regions (Fatt-1985). The lowland areas particularly in the northern region, are mainly utilized for rice cultivation.

The climate is typically tropical and is strongly influenced by the sea. From October to March, the northeast monsoon brings heavy rain and strong winds to the east coast and to all the areas east of the central mountain range. On the other hand, from June to September, the southwest monsoon brings heavy rain to the west coast areas. Generally, the air temperature ranges from 70oF to 90oF and in most cases the water temperature is almost constant throughout the year (77oF to 90oF). The total annual rainfall averages between 50 and 80 inches (Papineau's guide to Malaysia — 1980).

Politically, Peninsular Malaysia is divided into 12 provincial states including the Federal Capital, Kuala Lumpur (KL). Apart from Kuala Lumpur, there are eight states in the west coast of the peninsula namely; Perlis, Kedah (rice bowl of Malaysia), Penang, Perak (tin-mining state), Selangor, Negri Sembilan, Malacca and Johore. Although the eastern part of Johore is on the east coast, normally only three are basically considered as the east coast states. The states are Kelantan, Terengganu and Pahang.

Aquatic ecosystem

According to Lim and Fong (1985), freshwater ecosystems in Peninsular Malaysia can be classed into riverine and lacustrine systems.

The riverline system includes; mountain (› 3,280 ft), upland (› 500 ft), lowland floodplain, blackwater and brackish water rivers. Also categorized under the riverine systems are the networks of man-made irrigation and drainage canals (Figure 1), particularly in the rice field areas, and the monsoon drains and ditches which are predominantly in the urban areas. Almost all the running waters, either natural or man-made in this case, are being considered under a riverine system.

All non-moving water bodies or lacustrine systems include; upland and lowland lakes (normally impoundments), reed, mangrove and blackwater swamps, reservoirs, unused mining pools, fish ponds and rice fields.

The unique ecosystem created by rice field culture harbours various species of exotic aquatic plants that are normally considered under a specific rice field system. In a man-made rice field system, besides vast areas that are heavily utilized for rice cultivation, run miles and miles

Figure 1. Waterhyacinth enroaching into an irrigation canal.

of dug up canals which are principally used to irrigate the rice fields.

To date, there are several major irrigation schemed areas in the peninsula. The MADA irrigation scheme which irrigates approximately 236,868 acres of rice field and made up of more than 1,378 miles of canals, is the largest rice development scheme ever implemented by the Malaysian Government. The first major irrigation scheme in the peninsula was undertaken in the Krian District, north of Perak. Most of the construction took place between the years 1899 and 1906 during the colonial time (Malaysia obtained her independence in the year 1957 from the British.) As a matter of fact, the MADA area and the Krian district have the most diversified species of aquatic plants.

Aquatic Plants

Approximately 55 species of aquatic plants are commonly found in the Malaysian freshwater ecosystem. Among these plants, 13 species are considered as noxious weeds including waterhyacinth (**Eichhornia crassipes**) and hydrilla (**Hydrilla verticillata**). Economically, eight species of aquatic plants are considered important. Rice (**Oryza sativa**) is widely cultivated, particularly in the northern peninsula and for decades has been a staple food for the people of Malaysia.

There are 44 dominant species found in the rice field areas and they constitute more than 50% of the major aquatic plants in the peninsula. There are about 21 species of aquatic plants found abundantly in the river systems. It is known that several species such as common reed (**Phragmites communis**) and wild saccharum (**Saccharum spontaneum**) have played a major role in preventing river banks from erosion.

Spike-rush (**Eleocharis dulcis**) is dominant in blackwater swamps which are widely distributed in the east coast states of Peninsular Malaysia. In addition, hanguana (**Hanguana malayana**) is dominant in several swamps in the State of Perak. Lepironia (**Lepironia articulata**) thrives well in the Malaysian largest swamp, Tasik Bera in Pahang. The old unused mining pools are generally rich in aquatic plants, namely sacred lotus (**Nelumbo nucifera**), Figure 2, hydrilla and water-hyacinth. Approximately 17 species of aquatic plants are commonly found in the stagnant water habitats.

Figure 2. Sacred lotus growing in an old mining pool.

i. Floating plants

To date, it is known that only five species of floating plants are widely distributed in Peninsular Malaysia. Most of

them are considered as weeds. Giant salvinia (**Salvinia molesta**) is rated the worst weed in the Krian rice field district. Common duck weed (**Lemna perpusilla**), giant duckweed (**Spirodella polyirhiza**), azolla (**Azolla pinnata**) and waterlettuce (**Pistia stratiotes**) are known to cover the whole surface of waterways.

Of all the free floating plants **Eichhornia crassipes** is by far the most noxious weed. Evidently, waterhyacinth is also widely distributed in Southeast Asian Countries. It is also one of the most problematic plants in the Asian Region.

ii. Submerged plants

There are about 11 species of submerged plants which are abundantly found in freshwater ecosystems. Two of the species, hydrilla (**Hydrilla verticillata**) and coontail (**Ceratophyllum demersum**) are considered as serious weeds. Although these two species are considered as weeds, however, they are also utilized as aquarium plants.

Apart from these two species, there are several species such as fanwort (**Cabomba caroliniana**), tapegrass (**Vallisneria gigantea**), limnophila (**Limnophila heterophylla**) and cryptocorne (**Cryptocorne griffithi**) that are also commercialized as aquarium plants.

iii. Emergent plants

There are about 16 major species in this type of life form. Among them, several species such as pepperwort (**Marsilea crenata**), smart weed (**Polygonum barbatum**), water snowflake (**Nymphoides indica**) and monochoria (**Monochoria vaginalis**) are considered as weeds. The seeds and fruits of sacred lotus (**Nelumbo nucifera**) and water chestnut (**Trapa maximowiczii**) are consumed by the local people. The tubers of arrowhead (**Sagittaria sagittifolia**) and water mimosa (**Neptunia natans**) are edible and generally sold in the local markets. Water morning glory (**Ipomoea aquatica**) and yellow bur-head (**Limnocharis flava**) are also largely consumed by the local inhabitants.

Marginal plants

These amphibious macrophytes can survive on land or in water. There are about 23 species dominantly found in Peninsular Malaysia. Bulrush (**Scirpus grossus**) is one of the conspicuous species which is known to heavily colonize the abandoned rice fields.

Several species from the family Poaceae have posed severe problems to the rice farmers. These species, including barnyard grass (**Echinochloa crusgalli**), offer a keen competition to the rice plant (**Oryza sativa**) particularly in a direct seeding area. As a result, rice productivity will be greatly reduced.

Conclusion

This text briefly described the commonly distributed aquatic plants in Peninsular Malaysia. It should be noted that apart from the 55 species observed, there may be several other species yet to be discovered.

From various studies made, it is fairly difficult to conclude whether a species of plant is a native or an exotic species. However, based on several works, it may be safe to conclude that most noxious weeds found in the peninsula were introduced species. Thus, human activities have rendered a valuable service in the wide distribution of these plants in Peninsular Malaysia.

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CHEMTREC operates 24 hours a day, seven days a week to receive calls on phone numbers shown below. The number is widely circulated in professional literature and is distributed to emergency service personnel, carriers, the chemical industry, bulletins of government agencies, trade associations and others who may have need. It is *not* circulated in the public press. The public need is best served through the emergency services. It is vital that callers understand CHEMTREC is neither intended nor equipped to function as a general information source.

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