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Editorial

Misinformation Being Given

There are those who are telling others that with the passage of Senate Bill 1430 during the last Legislative session, DNR no longer has the authority to regulate how herbicides are used in aquatic plant management activities. This is not correct.

Senate Bill 1430 was amended to read, "This chapter is intended as comprehensive and exclusive regulation of pesticides in this state. Except as provided in Chapters 373, 376, 388, 403, and 482, OR AS OTHERWISE PROVIDED BY LAW, no agency, commission, department, county, municipality, or other political subdivision of the state may adopt laws, regulations, rules, or policies pertaining to pesticides...."

When the amendment was offered, its intent was stated, and it was noted at the time that it did not affect agencies that had statutory authority to regulate pesticide use. Section 369.20(7) states, "The Department shall develop standards by rule which shall address, at a minimum, CHEMICAL, biological, and mechanical control activities...." Before the amendment was agreed to, legal staff at DNR reviewed it, and was satisfied that it did not interfere with DNR's statutory authority.

Other sections of law which give DNR authority to regulate pesticide use include: s. 369.20(2); 369.22(3); 369.22(4); 369.22(5); 369.22(11); 369.22(12); and 403.088(1), F.S..

Chapter 403, which is specified in Senate Bill 1430, is enforced by DNR through an interagency agreement with DER regarding "APPLICATION OF CHEMICALS TO WATERS OF THE STATE FOR THE PURPOSE OF AQUATIC WEED AND ALGAE CONTROL."

Do not violate your aquatic plant control permits based on incorrect information, the penalties can be quite severe. DNR's authority to regulate herbicides remains unaffected by Senate Bill 1430, despite what you might be hearing.

Tom C. Brown, Chief
Florida Department of Natural Resources
Bureau of Aquatic Plant Management



About The Cover

It's Summer. It's Hot. Thank goodness the Hydrilla-clearing harvesters keep the Manatee Springs swimming hole open.

Photo by Jim Kelley, Department of Natural Resources, Floral City.

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CONTENTS

Controlling Eurasian Water Milfoil Infestations Using an Integrated Approach

by Frank M. De Steno 4

Going with the Flow

by Wendy Andrew 9

Operation "Air" Boat

by Don Doggett 12

Melaleuca Response To Various Herbicides

by Francois B. Laroche, D. D. Thayer, and M. J. Bodle 14

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Controlling Eurasian Water Milfoil Infestations Using an Integrated Approach

by Frank M. De Steno¹



2, 4-D application to Eurasian water milfoil infested area.

Introduction

Eurasian water milfoil (*Myriophyllum spicatum*) is becoming a serious threat to many lakes in Minnesota. Since its discovery in Lake Minnetonka in 1987, this aggressive weed has established itself in 47 Minnesota lakes (Sac, 1992), many of which are used by non-riparian boaters, creating the

potential for spreading the plant. Although the



Myriophyllum spicatum, plant, reprinted with permission from Ramey, V. (ed.) *Florida Prohibited Aquatic Plants*, Florida Department of Natural Resources.

Minnesota Department of Natural Resources (DNR) has an education and treatment program in place, the problem far exceeds the available resources. It is therefore up to local lake associations to address the problem either on their own and/or in conjunction with the DNR.

White Bear Lake, located in north suburban St. Paul, has focused on the Eurasian milfoil problem since 1989. Its discovery in the lake prompted the White Bear Lake Conservation District (WBLCD) to solicit professional help in dealing with the problem. A program was developed in which volunteers played a pivotal role in locating infestations which were chemically treated (De Steno, 1990).

This core of volunteers and their ability to identify the target species grew over time. Some of them brought snorkeling and SCUBA experience to the program and used these skills to not only identify infested areas but also to manually remove plants in some infested areas. This new dimension was then incorporated into the overall control strategy for White Bear Lake.

The integrated approach to controlling Eurasian water milfoil infestations grew out of the existing program instituted by the WBLCD. The concept itself is based on the assumption that during initial stages of an infestation, scattered populations begin growing throughout a water body. The

characteristics of these populations vary in plant density, area covered, depth and a host of other parameters. It is possible, therefore, to use various control methods on these sites.

Program Components

The volunteer citizen monitors are at the very heart of the program, insofar as the key to any control strategy is early detection. Monitors are responsible for checking a designated strip of shoreline twice monthly for any signs of Eurasian milfoil. They walk the shore or the shallows searching for the target species. Those that can, check their areas from boats or canoes which extends the coverage blanket.

Boat launch checks are performed at public access points by employees of the WBLCD and the boat owner. These have a double function. In lakes with known infestations such as White Bear, removing all weeds from the boat and trailer after lake usage limits opportunities for spread to the next lake used by the boater. Conversely, in a pristine lake, checking for and removing weeds prior to launching will prevent their spread. Recent state legislation has made it

¹ Associate Environmental Scientist, James M. Montgomery, Consulting Engineers, Inc., 545 Indian Mound, Wayzata, MN 55391.

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unlawful to transport Eurasian water milfoil on watercraft. People discovered violating this law can be fined. This has increased public awareness in the battle against the spread of Eurasian milfoil.

Within the lake itself, areas of known infestations are marked with distinctive yellow buoys. Efforts are made to keep boats, water skiers, fishermen and swimmers out of these areas to prevent unnecessary milfoil fragmentation and subsequent spread.



Training volunteer citizen monitors in Eurasian water milfoil identification.

These elements work well within the program's overall education component. In addition to signs posted at boat launches, marker buoys delineating infested areas, and brochures published by the WBLCD remind people of the Eurasian milfoil problem, the citizen monitors and boat-check employees talk with citizens, thus increasing overall awareness of the threat this exotic invader poses.

Control Alternatives

Initially, the WBLCD chose to treat infested sites with 2,4-D applications. This strategy limited the spread of those areas but did not eliminate the infestations. This resulted in repeated applications over the course of two growing seasons. For multiple-acre infestations, herbicide application is still the control alternative of choice. The herbicide arsenal continues to grow and includes fluridone and triclopyr, the latter being used on an experimental basis in Minnesota (Sak, 1992).

As the volunteer program began to grow in early 1991, so did the pool of talent these individuals brought to the project. Some, motivated by a concern over herbicide use, convinced the WBLCD and the program manager to incorporate SCUBA/snorkel removal into



Boater removing weeds from trailer after leaving White Bear Lake.

the control strategy. Advantages to this technique include specificity with respect to the target species and immediate removal of the entire plant. The main disadvantage are that not all targets are removed and the possibility of fragmentation is enhanced. An infested four-acre site was chosen as an experimental training area for the volunteer SCUBA removal team and in a few weeks, the majority of the Eurasian milfoil was removed. It should be noted here that these areas must be continually monitored in order to remove those plants that are missed in the initial effort.

This initial work led to another removal technique: manual or hand removal. There are some infestations in water too shallow for SCUBA removal so a manual removal group was mobilized. These volunteers walk or work from small boats in the shallows removing the plant, including the roots. The removed plants can be land-disposed or composted. As in SCUBA removal, advantages and disadvantages must be considered and these areas must be monitored over time to remove any milfoil missed in previous inspections.

Integrating Control Strategies

As the number of infested areas on White Bear Lake grew, it became clear that SCUBA and hand removal could not keep pace with this aggressive invader. Efforts were made to focus resources where they would have the greatest impact. The overall strategy presented to the WBLCD was to focus SCUBA and manual removal volunteers in areas where they could effectively eliminate the target over time. In the meantime, herbicide treatment could control the spread at multiple-acre sites until manual removal personnel could focus their efforts on it.

It is the program manager's responsibility to tailor the control method to the infested site characteristics. These considerations include but are not limited to the infestation size, target density within the area, size of the manual removal force, physical/biological characteristics of the infested area, herbicide efficacy in that site, and degree of urgency in effecting control. (SCUBA and manual removal require an increased time to effect control.)

Problems

The key to success in any program of this nature is finding infested sites. Volunteer monitors may not be able to maintain surveillance in their assigned area. This can be compensated for by assigning teams of up to four people to cover any given area, thus allowing the team to share the responsibility. The volunteer effort in White Bear Lake has been excellent and it is hoped that some SCUBA or snorkeling enthusiasts will join the monitoring efforts.

Individuals involved in the manual removal effort, whether it be hand pulling or SCUBA, become "burned out" resulting in coverage gaps. This can be compensated for by prudent scheduling of volunteer workers performing this arduous task.

Manual removal, by its nature, misses plants. To compensate, coverage in any area must be maintained on a regular basis. Alternately, an area that has been manually controlled can then undergo an herbicide application.

There may be a reluctance to use all the weapons in the control battle. The integrated approach has many tools and in time, even more will be developed. Reliance on a single control strategy weakens the overall program. Controlling an aggressive plant like Eurasian water milfoil requires both time and multiple weapons to work.

Conclusion

Controlling exotic invaders is complex and often frustrating. Patience, vigilance, cooperation and energy are required for success. A recent underwater survey of White Bear Lake revealed at least six new infestations of various sizes and

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multiple areas of scattered individual plants. As the 1992 growing season approaches, the WBLCD and DNR have major decisions to make. Those involved in this battle must do their best to keep up with current control methods and be open to new ideas. If, as in the case of Eurasian milfoil, various control methods exist, integrating them into an overall management plan may provide a welcomed advantage.

Acknowledgements

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Volunteer walking the shallows and pulling Eurasian water milfoil plants.



Volunteer divers removing milfoil during SCUBA trials on White Bear Lake.



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Going with the flow or why some aquatic plants "prefer" flowing water habitats

by Wendy Andrew
Aquatic Plant Manager
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We have all wondered why some aquatic plants occur in certain habitats but not others. Do plants "prefer" a set of environmental factors? Of course, plants do not actually "prefer" anything, but a particular habitat can include factors which are beneficial to one or more species and detrimental to others. The strongest connection between an aquatic plant family and flowing water occurs in the Podostemaceae, or river weed family. This family has adapted to colonizing the rocky substrate of waterfalls and other white-water areas of tropical Africa. The Podostemaceae are restricted to this specific habitat.

There are certain characteristics of flowing water which may contribute to the preference of aquatic plants for that habitat. Flowing water tends to maintain more moderate temperatures compared to still water within the same general vicinity (Hynes, 1970). Water flow can increase the availability of nutrients, particularly dissolved gases, and provide macro-nutrients such as nitrogen and phosphorus from upstream. Flowing water may also remove factors which can limit macrophyte growth, such as allelopathic substances or phytoplankton, which limit light availability. All of these characteristics of flowing water, however, are modified by the source, location, surrounding environments and uses of any particular water body. Flowing water may also inhibit plant growth as turbulence breaks and/or uproots plants. Physical relationships between flow rates and abiotic characteristics of a habitat are often difficult to separate, for example, the relation-

ships between flow rates and substrate (i.e., fine sediment vs. coarse sand vs. rock) and can affect nutrient availability.

Nutrient Availability

While availability of needed nutrients will vary with sediment type and water flow, probably the most important aspect of nutrient availability in flowing water is the effect of flow on dissolved oxygen and carbon dioxide concentrations. Flowing water tends to maintain carbon dioxide concentrations at equilibrium with air due to movement across the air/water interface (Hynes, 1970). In a study of stream macrophytes in Denmark *Callitriche stagnalis* and *Sparganium simplex* were determined to utilize only free carbon dioxide as dissolved inorganic carbon (DIC) for photosynthesis. Similarly, mosses require carbon dioxide for photosynthesis. These plants can successfully compete with species that utilize other sources of DIC, such as bicarbonate, in the hardwater streams where they are found, since these waters have a higher carbon dioxide exchange capacity than stagnant, softer waters (Sand-Jensen, 1983). Certainly there are other factors, particularly pH, which affect the amount of carbon dioxide present as DIC in a water body, but flowing water, as it tends toward air equilibrium, may be a preferred habitat.

An additional benefit to the plant as it takes up DIC is the reduction by flowing water in the thickness of the boundary layer (Westlake, 1967). The boundary layer is the area of resistance to flow immediately adjacent to the plant

structures. Movement of gases across this layer is reduced to the rate of molecular diffusion, which is dramatically slower in water than in air. Reduction in width of a boundary layer should increase the ease with which the plant can absorb dissolved gases needed for photosynthesis or respiration.

Plant Morphology as an Adaptation to Flowing Water

The morphology of aquatic macrophytes can be important in determining their ability to exploit the flowing water habitat. A very rigid plant will not be able to survive abrasion and buffeting it must undergo in flowing water, especially at high velocities. Many submerged macrophytes are not only affected by the surrounding flow of water but actually can affect and alter that flow. The growth habit of plant stands, their biomass and hydraulic resistance can affect the movement of water through and around the individual stand and create a micro-environment within the stand (Dawson, 1967). Additionally, the slowing of water around the stand may allow for suspended particles to be deposited, thereby changing the local sediment characteristics.

Plants of flowing waters must generally develop a pliable growth habit with low hydraulic resistance and root system, tailored to the substrate, which prevents uprooting (Westlake, 1973). Flowing water represents a potentially stressful environment for an aquatic plant, primarily due to physical damage. So, does a plant particularly "prefer" a flowing water environment or are other species excluded, creating an available niche?

Flowing Water in Florida as a Preferred Habitat

Flowing waterbodies within Florida are not as markedly different from still waters since they usually have relatively slow flow rates with little slope. Water sources, including precipitation, surface water runoff and ground water inputs, apply to both rivers and lakes. Florida rivers and lakes, as types of waterbodies, may actually vary more within their respective groups than between each other. However, certain differences, though more subtle than in other locations, still remain. Temperatures in Florida rivers tend to be close to the ambient ground temperature. Dissolved gases will tend toward equilibrium with air, though this will be muted at higher temperatures and slower flows. Sediment deposition will still be affected by water flow.

Plant responses to these habitat characteristics are reflected, to a degree, in the Department of Natural Resources (DNR) 1988 Aquatic Plant Survey (Schardt and Nall, 1989) and 1990 Aquatic Plant Survey (Schardt and Schmitz, 1991). Certain species included in the survey show a much higher rank and greater percentage occurrence in the category of rivers than they do in the lakes category. These species include: *Vallisneria americana*, *Najas guadalupensis* and *Juncus roemerianus*. The rankings and the percent coverage of these species are higher in the rivers than lakes surveyed. The two surveys are partially reproduced in Table 1.

The differences in occurrence and rank within these DNR surveys indicate that despite the relatively small physical differences in flowing water versus quiescent waters in Florida, some plant species do preferentially occur in flowing water habitats. Unfortunately, there is presently little information in the body of literature to document these observations in Florida. It is interesting to note, however, that hydrilla maintains relatively the same rank and percentage in both lakes and rivers. Because of flow, however, hydrilla is usually more difficult to control in riverine sites.

It appears that a number of species may have a preference for, or particular characteristics for survival in, flowing water habitats. Which characteristics of flowing water increase the survival rates of

Table 1. Some aquatic plant species found in rivers and lakes by rank and percent occurrence.

Species	Rank		Lakes Percent		Rivers Rank		Percent	
	1988	1990	1988	1990	1988	1990	1988	1990
<i>Vallisneria americana</i>	10	4	35	35	1	1	47	51
<i>Najas guadalupensis</i>	23	18	24	26	4	7	38	35
<i>Juncus roemerianus</i>	118	117	1	1	3	3	26	25
<i>Hygrophila polysperma</i>	99	115	1	1	65	52	7	8
<i>Sagittaria kurziana</i>	93	71	2	2	15	25	15	17
<i>Sagittaria stagnorum</i>	101	103	1	1	92	29	1	2
<i>Zizania aquatica</i>	119	112	1	2	34	51	22	20
<i>Zizaniopsis miliacea</i>	59	68	7	4	40	46	19	19
<i>Hydrilla verticillata</i>	1	1	41	39	2	2	45	44

which species and to what degree? Answers to these basic questions are not readily available. Managing aquatic plants in flowing water systems has long presented unique challenges. Information regarding mechanisms that plants have for succeeding in flowing water may greatly assist in managing current and future nuisance infestations in Florida and elsewhere.

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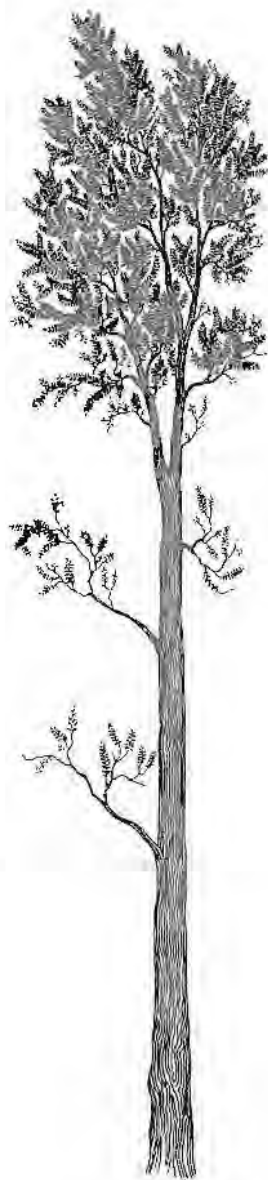
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Six Mile Cypress Slough Preserve lies in the heart of Lee County. The Slough was purchased by the residents of Lee County and the South Florida Water Management District through the Save Our Rivers Program. It is a 2,000 acre wetland ecosystem which measures approximately nine miles in length and averages 1/3 mile in width. The watershed collects runoff from approximately 56 square miles. The Slough is a diverse community of plants and animals, a number of which are endangered. This wetland serves as an important wildlife corridor providing habitat for travel through the county.

The preserve has over a mile of boardwalk trails, an amphitheater, seating enclaves, shelters and observation decks. It was opened to the public in the fall of 1991. Prior to that, however, the Lee County Division of Land Management asked for our assistance in controlling floating vegetation in three ponds which bordered the boardwalk, for the purpose of restoring the open water aspect for wildlife habitat improvement. Two of the ponds were completely covered with water lettuce, *Pistia stratiotes*, and one with water hyacinths, *Eichhornia crassipes*.



A UFA (Unidentified Flying Airboat) spotted over Six Mile Cypress Slough, Lee County.

After procuring the necessary permits from Florida Department of Natural Resources, accessibility seemed to be the major obstacle to treating the ponds. Their location in the middle of a cypress swamp prohibited vehicles. Aerial application was considered, but due to the size of the ponds (less than one acre each), did not seem feasible due to concern for rotorcraft downwash of herbicide in the cypress

trees. The best alternative appeared to be to sling an airboat into the ponds with a helicopter.

We removed all the "extras" (except life jackets) from the boat and reduced the gross weight to 2,160 pounds. That was well within the carrying capacity of our Bell UH-1B helicopter. A 100 foot cable was attached to the cargo hook of the helicopter and to four points on the air boat. After several trial

unloadings and loadings of the boat on the trailer, and into and out of the water, we were ready to go. The first pond was treated after the airboat was helicopter-lifted from the trailer and set down in the water adjacent to the boardwalk where the crew awaited. The procedure was repeated for the next two ponds. Each of the three ponds were treated in succession. Thanks to the competent help of our aircraft and ground-support personnel, the procedure went very smoothly.

Although the total cost, per acre, of the operation may have been "slightly" more than normal, it proved to be a success and a good experience. We achieved excellent vegetation control. Only one pond required retreatment which was done by portaging a canoe and a back-pack sprayer.

After exotic plant removal, wading birds, several species of fish, and native aquatic plants have returned to the ponds and are observed daily by visitors of the Preserve.



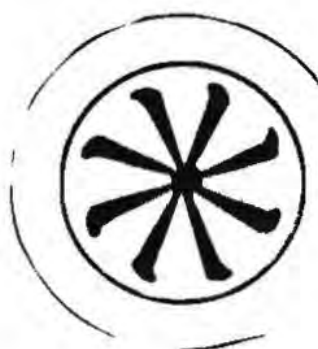
Pop Ash Pond lies within Six Mile Cypress Slough.



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Pop Ash Pond one and 170 days post-treatment.



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Melaleuca Response to Various Herbicides and Methods of Application

by Francois B. Laroche, D. D. Thayer,
and M. J. Bodle¹

Introduction

Melaleuca was purportedly brought into southern Florida in the early 1900s to transform the Everglades into a forestry resource. The biology and taxonomy of melaleuca have been well documented in the literature (Vandiver, 1981; Center and Dray, 1986; Meskimen, 1962). Since its introduction into South Florida, its spread has been phenomenal and it has become a pest plant of unparalleled proportion. Melaleuca is regarded by many researchers and biologists as the most serious ecological threat to the biological integrity of South Florida (Thayer and Bodle, 1990). The lack of natural enemies provides melaleuca with a great competitive advantage over native Everglades vegetation. Additionally, natural events such as drought, frost and wildfire facilitate the invasion of this exotic. Its competitive success stresses other species and gradually converts mixed plant communities into melaleuca monocultures. These monocultures are generally regarded as poor habitat with low wildlife utilization (Austin, 1978). Melaleuca threatens to permanently replace natural plant communities and displace native animals.

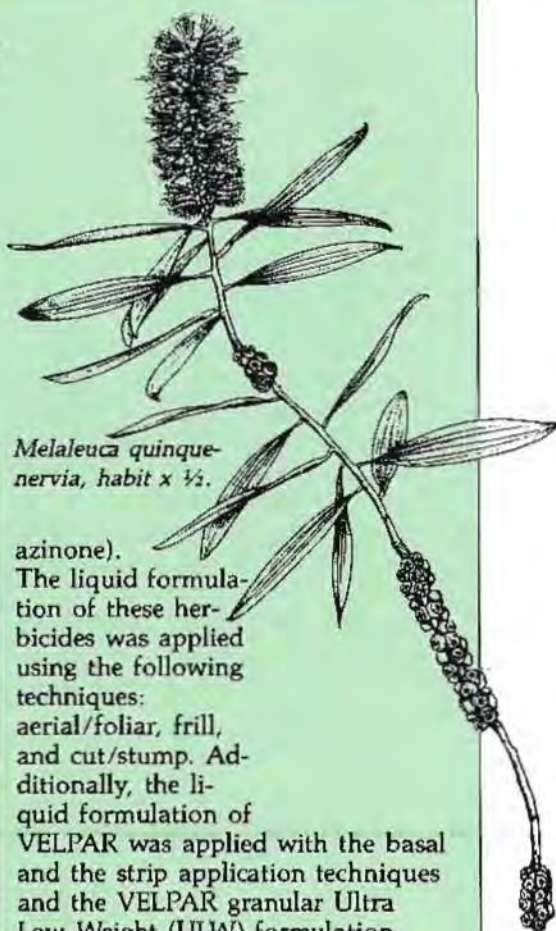
Essential elements of successful management of melaleuca should include: biological, herbicidal, mechanical, and physical control techniques (Langland, 1990). Melaleuca biocontrol agents are currently under study and are not presently available. Mechanical control is often too expensive and

physical control methods are somewhat limited. Consequently most melaleuca management practices have used herbicides along with limited mechanical and physical controls. Herbicides are currently the most important means of managing melaleuca. However, results from previous herbicide studies for the control of melaleuca have been inconsistent and are not well documented in the literature.

Selection of herbicides for melaleuca control is difficult because the trees are often in aquatic habitats, saturated soils, or sensitive natural areas where damage to non-target vegetation is a concern. One of the major drawbacks to successful large scale melaleuca management is the lack of a selective, foliar-active herbicide that is labeled for use over water and results in consistent control (Langland, 1990). Short-term and long-term effects of herbicide applications need to be assessed and the benefits obtained weighed against potential or real environmental damage. Successful melaleuca control programs to date have been restricted to the use of frill and cut/stump application of herbicides with the quarantine strategy proposed by Woodall (1981). The purpose of this study was to determine the effectiveness of melaleuca control by several herbicides and application techniques, with particular emphasis on aerial application.

Materials and Methods

Several herbicides were evaluated using various methods of application. These were: ARSENAL (imazapyr), GARLON 3A and GARLON 4 (triclopyr), RODEO (glyphosate), and VELPAR L (hex-



Melaleuca quinquenervia, habit x 1/2.

azinone).

The liquid formulation of these herbicides was applied using the following techniques: aerial/foliar, frill, and cut/stump. Additionally, the liquid formulation of VELPAR was applied with the basal and the strip application techniques and the VELPAR granular Ultra Low Weight (ULW) formulation was broadcast with a backpack blower. Aerial treatments are listed in Table 1 and were applied at a total volume of 25 GPA with the exception of plot 5 which was applied at a total volume of 50 GPA. Each aerial plot was approximately four acres in size. The plot size for all of the cut/stump treatments and VELPAR L basal and strip treatments were 1800 ft². All frill treatments were made to 40 trees irrespective of plot size. The VELPAR ULW plot was 10,000 ft² in size. All herbicides in the ground application treatments were applied undiluted, unless otherwise indicated in Table 2. Records were kept on labor and equipment used in each plot, to determine cost per acre for each method of application. All treatments were applied between May 29, and June 1, 1990 at M.E. Thompson Park in Dade County, Florida.

Each of the various treatment plots were rated on a quarterly basis over a period of 18 months. Evaluations consisting of visual ratings, by at least three evaluators, at three intervals along an established transect in each of the aerial

¹ Staff Environmental Scientist, Vegetation Management Division Director, Sr. Environmental Scientist, South Florida Water Management District, West Palm Beach.

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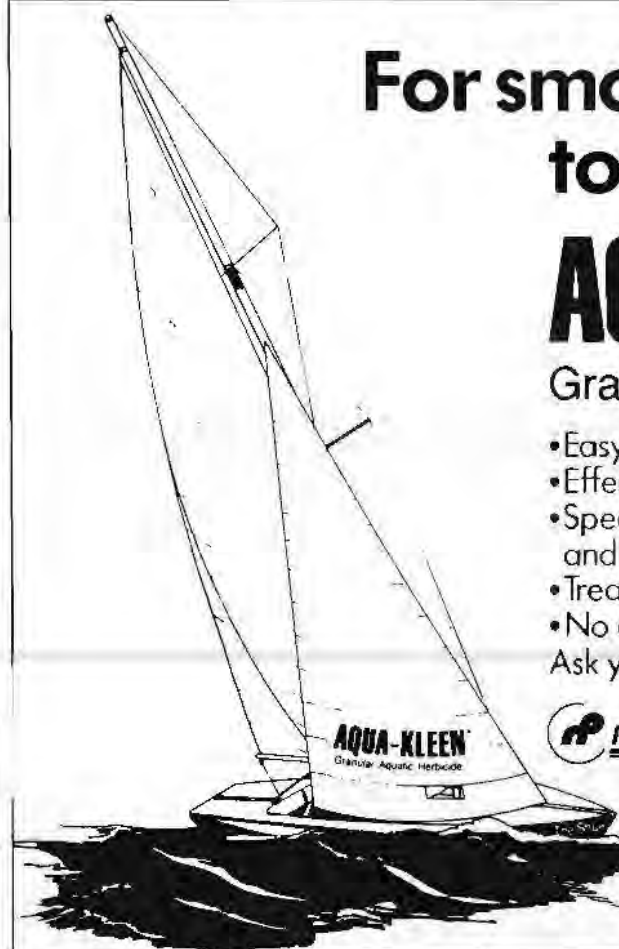
treatment plots. Percent mortality or defoliation was used to determine the effect of each herbicide on the in-stand overstory and understory of melaleuca, and on the non-target vegetation, which consisted mainly of sawgrass. In the frill, cut/stump and ground applied VELPAR treatments, the entire plot was evaluated. Percent control ratings were used in the cut stump treatments. Occurrence of basal and/or root sprouts and seedlings was also considered in the evaluation of each plot.

Results and Discussions

Melaleuca responded quickly to aerial herbicide applications. The effects of all herbicide formulations were visible within three months after application. However, most of the herbicides had no long term effect except in the case of the VELPAR applied at a rate of three gallons per acre, resulting in 85 percent mortality of melaleuca (Figure 1) at 18 months post treatment. Aerial application of ARSENAL at 2 qt per acre and at

Table 1 - Aerial treatments

PLOT	HERBICIDE	RATE/ACRE	ADJUVANT	RATE/ACRE
1	ARSENAL	1 qt	X-77	1 pt
2	ARSENAL	2 qt	X-77	1 pt
3	GARLON 3A	3 qt	X-771	pt
4	GARLON 3A	3 gal	X-77 +L-77	0.5 pt 6.5 oz
5	GARLON 3A	3 gal	X-77 +L-77	0.5 pt 0.5 oz
6	GARLON 4	9 qt	X-77	1 pt
7	RODEO	7.5 pt	X-77	1 pt
8	RODEO	7.5 pt	X-77 +L-77	0.5 pt 6.5 oz
9	VELPAR L	3 gal		
10	ARSENAL +GARLON 3A	1 qt 1 gal	X-77	1 pt
11	ARSENAL +GARLON 3A	1 pt 1 gal	X-77	1 pt
12	ARSENAL +RODEO	1 qt 3 qt	X-77	1 pt
13	RODEO +GARLON 3A	7.5 pt 7.5	X-77	1 pt



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1 qt mixed with 3 qt of RODEO per acre resulted in 58 percent and 63 percent mortality of melaleuca respectively. All the other herbicides applied aerially in this study did not kill melaleuca.

The impact of the herbicides on the non-target vegetation (sawgrass) differed from the effects on the target trees. Herbicides applied aerially effectively killed at least 60 percent of the sawgrass in the plots (Figure 1). ARSENAL and VELPAR, which proved to be effective against melaleuca, resulted in 95 percent mortality of the sawgrass in the plot.

All of the herbicides were effective in killing melaleuca in the cut/stump treatments (Figure 2). ARSENAL applied at 75, 50, and 0 percent dilutions resulted in 100 percent control. Undiluted applications of GARLON, RODEO, and VELPAR killed at least 85 percent of the treated stumps. The herbicides used in the frill treatments were not found to be as effective at killing melaleuca trees as the other treatments. Undiluted ARSENAL, RODEO, and VELPAR applications resulted in approximately 70 percent mortality (Figure 2). Non-target vegetation was not evaluated in these two treatments. Field observation of completely girdled and treated trees indicate an increased mortality with the use of these herbicides.

The broadcast application of VELPAR ULW and the strip and basal soil applications of VELPAR L were all very effective at killing melaleuca (Figure 3). However, the impact of the basal soil applications on the non-target was significantly less than in the other methods of applications of VELPAR.

The results of the aerial treatments suggest that root active herbicides, such as VELPAR, are more effective at killing melaleuca. ARSENAL has limited root activity, hence the lower effectiveness against melaleuca. However, because of label restrictions these herbicides can be applied aerially only when the ground is free of standing water. Presently, ground application methods are more suitable for melaleuca control and

Table 2 - Ground application treatments

PLOT	METHOD	HERBICIDE	RATE	# OF TREES
1	Cut/Stump	ARSENAL 25%	1ml/inch DBH*	50
2	Cut/Stump	ARSENAL 50%	1ml/inch DBH	62
3	Cut/Stump	ARSENAL	1ml/inch DBH	41
4	Cut/Stump	GARLON 3A	1ml/inch DBH	69
5	Cut/Stump	RODEO	1ml/inch DBH	68
6	Cut/Stump	VELPAR L	1ml/inch DBH	75
7	Cut/Stump	Control	—	36
1	Frill	ARSENAL 25%	3 ml/cut @ 4 inch interval	40
2	Frill	ARSENAL 50%	3 ml/cut @ 4 inch interval	40
3	Frill	ARSENAL	3 ml/cut @ 4 inch interval	40
4	Frill	GARLON 3A	3 ml/cut @ 4 inch interval	40
5	Frill	RODEO	3 ml/cut @ 4 inch interval	40
6	Frill	VELPAR L	3 ml/cut @ 4 inch interval	40
1	Basal	VELPAR L	3 ml/inch DBH	—
2	Strip	VELPAR	3 gal/acre	—
3	Broadcast	VELPAR ULW	6.16 ai/acre	—

*DBH - Diameter at Breast Height

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cause less non-target damage. Based on the results of the ground application treatments, all the herbicides tested are successful in the cut/stump treatments. Only undiluted VELPAR, RODEO and ARSENAL at 100 percent concentration are recommended in the frill application. However, for best results, the tree must be girdled completely around its circumference. The soil applications of VELPAR were all effective, but the basal soil application caused the least non-target damage.



Dead and dying melaleuca tree bring tears of joy to the eyes of melaleuca nukers everywhere.

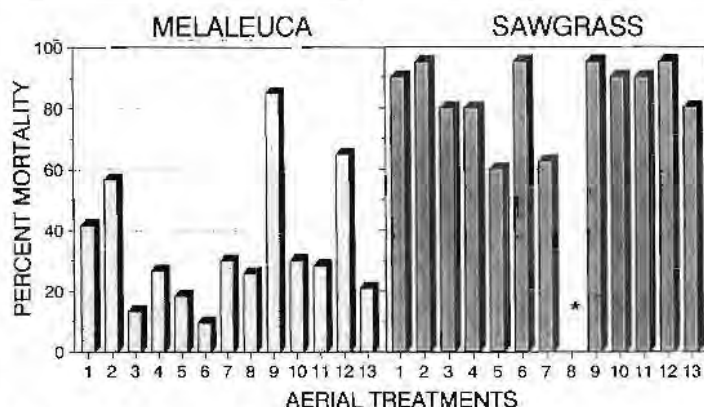


Figure 1 - Visual rating of mortality of herbicides applied aurally to melaleuca and sawgrass, 18 months post treatment M.E. Thompson Park, Dade County, Florida.

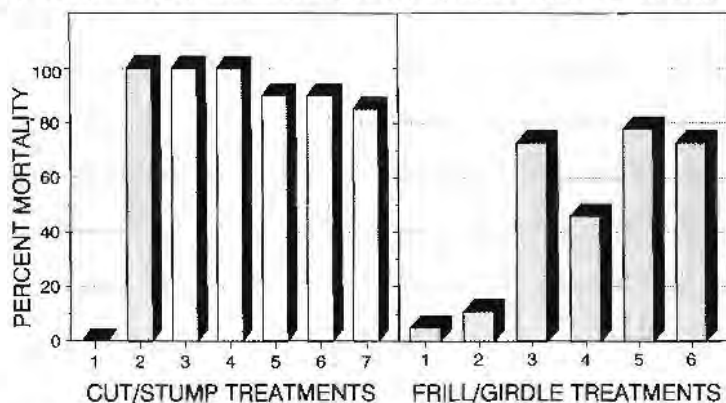


Figure 2 - Visual rating of melaleuca mortality eighteen months after treatments at M.E. Thompson Park, Dade County, Florida.

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Cost estimates listed on Table 3 suggest that aerial application methods are the most cost effective. However, because of concern for potential non-target damage, most melaleuca control is currently restricted to ground application techniques involving direct tree injection. These methods are more costly and labor intensive. In an actual melaleuca control operation it is important to consider transportation cost of crew and supplies to each treatment sites.

Acknowledgements

The authors wish to thank Steve "Sparkle" Smith and the Miami Field Station Aquatic personnel of the South Florida Water Management District, Jacqueline Jordan of the Department of Natural Resources, Bill "Otis" Kline and Keith Hems of DowElanco, Jerry Stephenson of DuPont, Alan J. "Bo" Burns of American Cyanamid, and Dade County Department of Environmental Resources Management for their support and cooperation in this project.

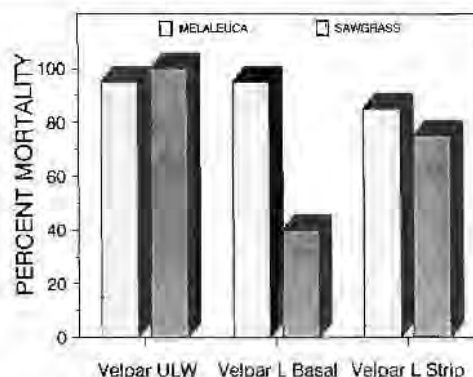


Figure 3 - Visual rating of melaleuca and sawgrass mortality eighteen months after treatment with VELPAR at M.E. Thompson Park, Dade County, Florida.

Table 3 - Average Application Costs¹ M.E. Thompson Park

APPLICATION METHOD	TOTAL LABOR		EQUIPMENT Cost/Acre	TOTAL Cost/Acre
	Hours/Acre	Cost/Acre		
Cut/Stump	22.3	\$ 480.00	\$ 58.00	\$ 538.00
Frill	10.0	\$ 126.00	\$ 5.60	\$ 131.60
Basal Soil	4.1	\$ 52.00	\$ 2.30	\$ 54.30
Strip Soil	1.4	\$ 17.64	\$ 0.78	\$ 18.42
Granule	.5	\$ 6.30	\$ 0.28	\$ 6.58
Aerial/Foliar	30 sec.	—	\$ 23.75	\$ 23.75
Aerial/Granule	15 sec.	—	\$ 28.50	\$ 28.50

¹COST CONSIDERATIONS: 1) Cost estimates based on an average of 1500 trees/acre greater than 4" DBH.
2) All costs based on 1991 dollars.
3) Equipment costs based on rental rates or actual contract rates.
4) Equipment costs do not include transportation costs.
5) Total costs do not include herbicide costs.

Literature citations available from the author.

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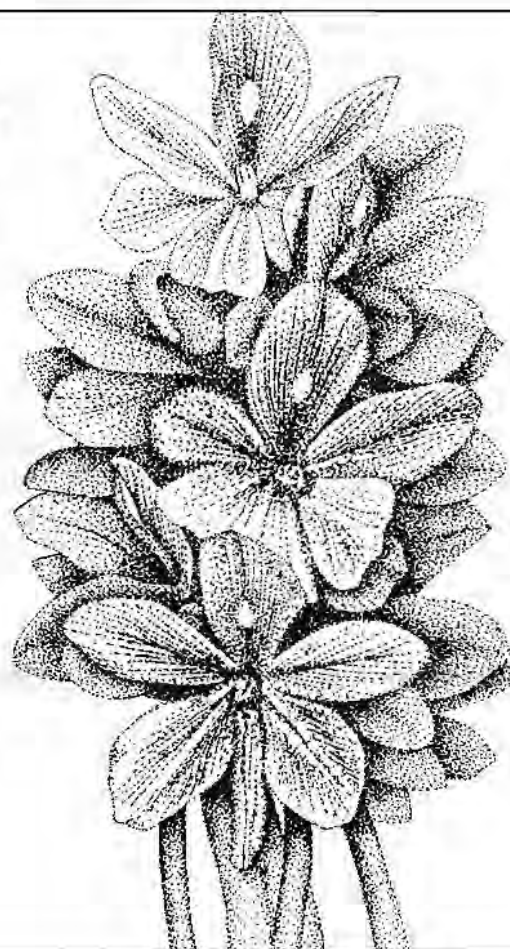
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In Memoriam George Martin-Culet

It is very sadly reported that George Martin-Culet, age 55, died Sunday, May 10, 1992 in Boynton Beach. George worked at the Lake Worth Drainage District, Palm Beach County, for 28 years. Hundreds of thousands may have never known that George was out in every storm, supervising the flood protection of their homes, crops, and families. But he was there. George was a dynamo, always ready for any challenge, and all who met him remember him. His boundless energy and public-mindedness is highlighted by his having donated more than 100

gallons of blood to the Palm Beach Blood Bank. His many friends will miss his strong opinions, practical jokes and friendship. George is survived by his wife, Geraldine, of Boynton Beach, two sons, five stepsons, one stepdaughter and ten grandchildren.

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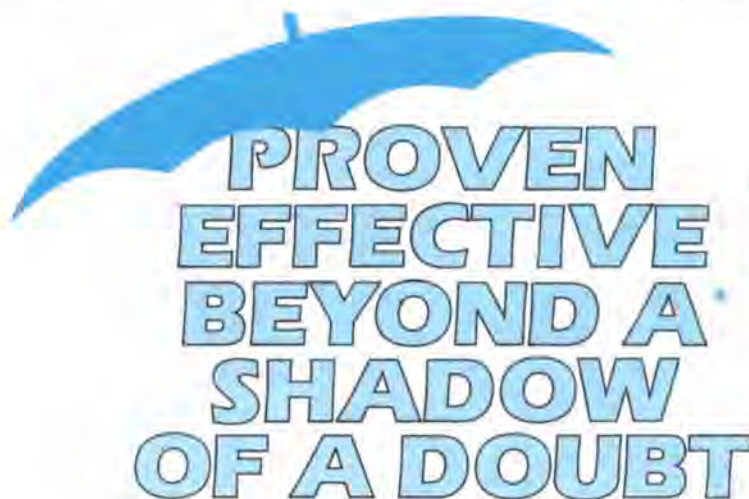
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Washington State limits herbicide uses

Washington State's Department of Ecology recently issued an Environmental Impact Statement on aquatic plant management. Terry McNabb reports that the Department has banned the use of Valent Corporation's DIQUAT herbicide and placed an 8-day swimming restriction and a 35-day domestic use restriction on Atochem's AQUATHOL products. Also, applicators using copper-containing herbicides must take sediment samples although copper limit levels have yet to be determined. Also, any non-target damage caused by use of Dow-Elanco's SONAR will have to be mitigated. Mr. McNabb, as president of a commercial aquatic services company in Washington, requests that members of the aquatic plant management community relay comments to the office of the Honorable Booth Gardner, Governor of the State of Washington, State Capitol, Olympia, WA 98504.

Upcoming Meetings

July 12-17 — International symposium on aquatic plants; Aquatic Plant Management Society 33rd annual meeting, Daytona Beach, FL. Contact: Alison Fox, (904) 392-9613.

August 10-13 — 75th Florida Entomological Society annual meeting, Hutchinson Island, Stuart. Contact: Jorge Pena (305) 246-7048.

August 12-14 — South Carolina Aquatic Plant Management Society annual meeting, Sullivan's Island, Charleston, S.C. Contact: Phil Fields (803) 737-0800.

September 30 - October 2 — Midsouth Aquatic Plant Management Society annual meeting, Lake Guntersville State Park, Alabama. Contact: Earl Burns (203) 386-3650.

October — Minnesota Lake Management Federation, Radisson Hotel, Alexandria, MN. Contact: Kevin Kretch, (612) 478-9421.

October 27-29 — Florida Aquatic Plant Management Society annual meeting, Clearwater. Contact: Any of the boneheads on page 3.

October 27-30 — 14th annual Natural Areas Association meeting, "Rediscovering America: Natural Areas in the 1990s," Bloomington, Indiana. Contact: NAC Registration, Indiana University Conference Bureau, IMU Room 677, Bloomington, IN 47405. (812) 855-6541.

November 2-7 — 12th North American Lakes Management Society annual symposium on lake and reservoir management. Contact: Lorraine Duncan, (904) 462-2554.

November 10 — Texas Aquatic Plant Management Society, Victoria, TX. Contact: Joyce Johnson, (512) 389-4858.

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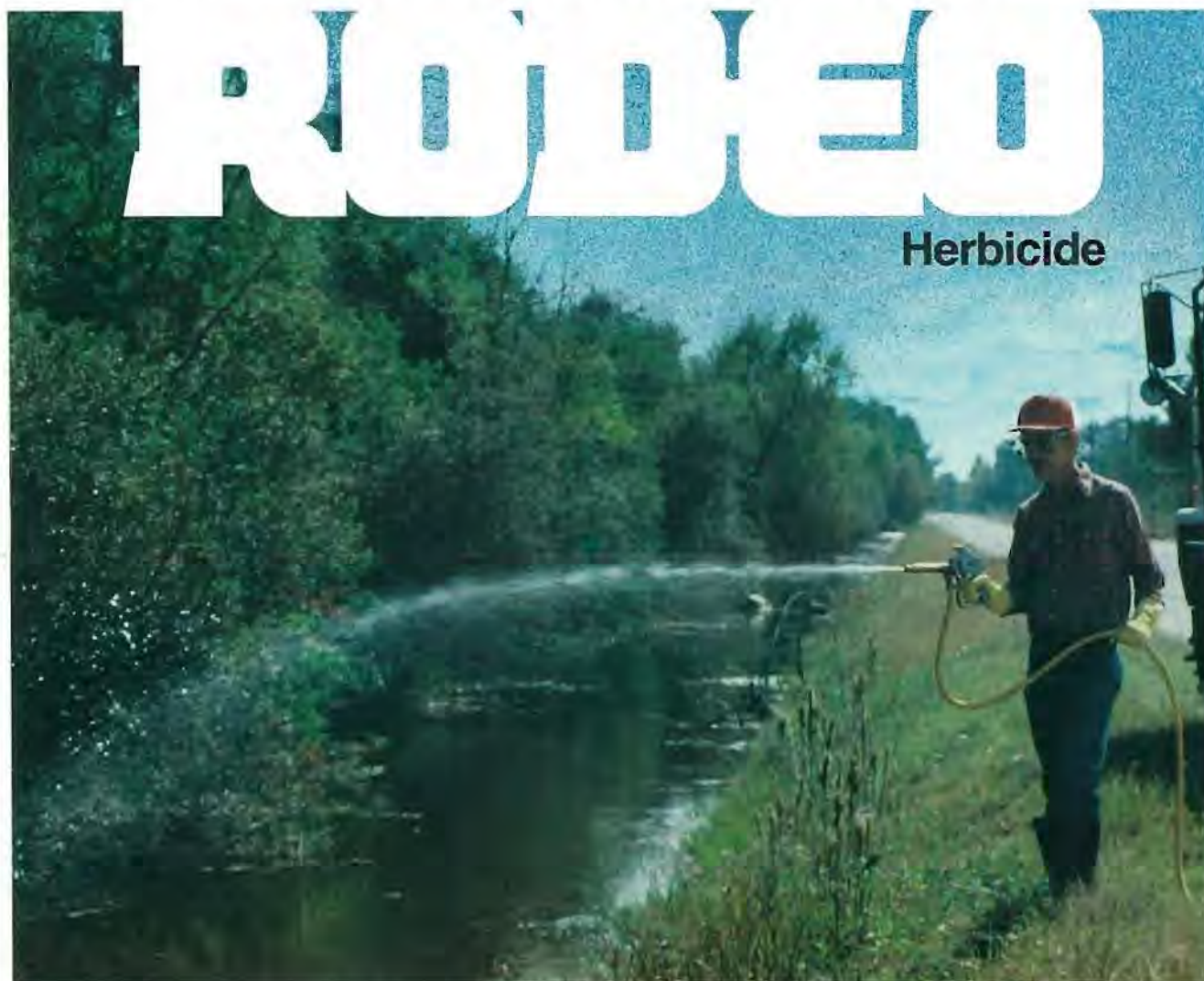
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