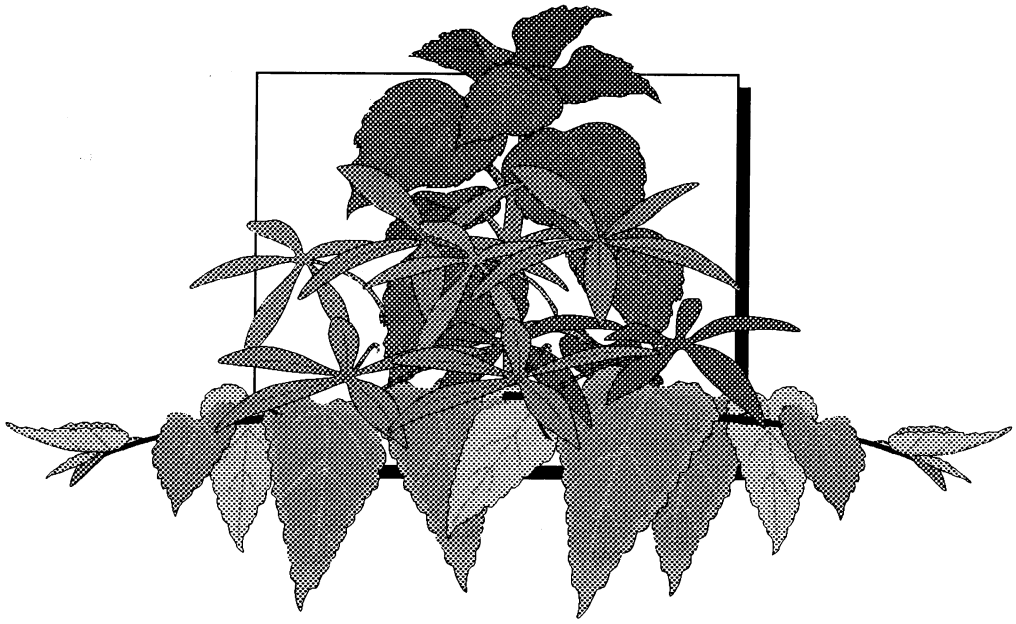
TECHNICAL
ASSISTANCE REPORT

CONTROL OF INVASIVE PLANT SPECIES IN CREATED WETLANDS



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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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INTRODUCTION

The Virginia Department of Transportation (VDOT) is responsible for creating wetlands in cases where roadway development results in the loss of wetlands at a particular site. In addition to creating these new wetlands, VDOT is in some cases responsible for the monitoring and maintenance of the sites for a specified time period. In cases such as this, the survival rates of planted wetland species must meet preset survival percentage requirements. Unwanted or invasive wetland plant species will often reduce the survival rates of the desired planted species. If not controlled, these invasive species can reduce wetland system diversity by crowding out those species that are desired. This can potentially result in the replanting of the desired species to attain the required survival ratios set forth in the monitoring plan.

VDOT has been using a herbicide in the form of glyphosate for the control of unwanted species in created wetlands. Results with this particular herbicide have been somewhat mixed. It was requested that the Virginia Transportation Research Council investigate other means of invasive species control that are being used or have been found to be effective and new products being developed. This report describes some of the more accepted and proven methods for controlling invasive species in wetland areas.

PURPOSE AND SCOPE

This report summarizes those methods of invasive wetland species control that have been researched within the past few years to determine if other methods of invasive species control could be utilized by VDOT. Only those methods deemed logistically feasible for VDOT's potential use are included in this document. The performance of a given method or product, however, is not a prerequisite for inclusion in the report, as unsuccessful methods are noted as well. Only those findings pertaining to emersed and marginal species are documented. Information pertaining to the control of algae, floating plants, and submersed plants is not included unless it happens to coincide with that of emersed or marginal species.

APPROACH

A literature search was conducted to determine what research exists regarding methods of controlling invasive wetland plant species. In order to receive the most recent research findings, the search was initiated on DIALOG, an on-line computer database. By way of this system, over 10,000 journal articles pertaining to aquatic vegetation were reviewed. Approximately 100 journal article summaries were downloaded and reviewed more closely. Those articles or journals that contained information directly applicable to control of invasive species in wetlands were examined, and the findings were then summarized.

FINDINGS/DISCUSSION

Methods of Control

The control of invasive aquatic or wetland species has received much attention since the early 1970s. For the purposes of this report, all methods of invasive plant species control were divided into four categories: (1) preventative, (2) mechanical, (3) biological, and (4) chemical (herbicides).

Preventative

It was found that most preventative measures taken to control invasive species have short-lived results. Researched methods included the placement of liners, gravel, sand, and nutrient poor soil around planted species to prevent unwanted species from germinating. This is effective for only the first one or two growing seasons. Controlling water depth has been proven to be one of the few effective methods if used in conjunction with some other control method. However, controlling water depth alone has been effective only temporarily.[1,2]

Mechanical

Methods of mechanical control include mowing, cutting, and digging of the unwanted plants. Due to the labor-intensive nature of most mechanical means, in all but a few cases this method is feasible for only small areas. Most of these methods must be repeated several times each growing season to prevent further spread of the species and, in certain instances, may actually result in the proliferation of the unwanted species. It was reported that cutting of unwanted species followed by a period of deliberate flooding is often successful in killing only the cut plants, thereby allowing very specific plant removal.[3,4] Control by burning has also been used in some situations, but again, the results are only temporary. Another method of mechanical control found to be somewhat successful was that of blasting potholes within stands of unwanted species such as *Typha* and *Phragmites*. This can be done with a mixture of ammonia nitrate and fuel oil.

This method is becoming common enough that the blasting mixture is now commercially available.[3,4]

Biological

Several types of biological controls were found in the literature. The use of waterfowl as a method of controlling wetland plants has been well documented.[2] Although this may be beneficial in certain settings, because there is no control over what species are consumed by the waterfowl, this would not be an option VDOT could utilize. Herbivorous fish, such as the grass carp (*Ctenopharyngodon idella*), are also said to be beneficial, but again the lack of control over what is consumed renders this type of control useless in a created wetlands setting. Although this particular fish has been shown to be extremely effective in the proper setting, the need for ponded water for its survival all but eliminates this as a viable option for VDOT's species control needs.[2,5]

Chemical (Herbicides)

Herbicides are the most preferred method for the control of aquatic weeds.[2,4] When plants are treated with herbicides, there are several advantages over the other control methods. Regrowth will be very slow or in some cases nonexistent. Problems associated with decomposition are often reduced since large quantities of floating debris normally do not result from herbicidal use. The ability to choose the plants to be killed is also a major advantage of herbicidal use. This does, however, require the selection of the appropriate means of herbicidal application.[5,6]

Control with Herbicides

By far the majority of research that has been done on control of invasive species in aquatic environments has been done for herbicides of various types. Table 1 lists the more common and accepted herbicides used for the control of emersed and marginal plants. Some of these compounds may or may not be acceptable for submersed or floating species. The following herbicides are potentially appropriate for VDOT's use:

- **2,4-D Low Volatile Ester** {2,4-dichlorophenoxy acetic acid}. Common trade names for this chemical include Aqua-Kleen, Weedar 64, and Weedone LV4. 2,4-D is has been found to be highly effective on *Typha* spp., *Scirpus* spp., and most woody vegetation. The chemical performs by way of translocation from plant foliage to the roots, where it causes disruption of normal cell division. Best results are obtained when applied to plants in the spring and early summer at an approximate rate of 300 to 500 gallons per acre. Use of a plymeric thickener or invert emulsion adjuvant is recommended.[2,7]

- **Dichlobenil** {2,6-dichlorobenzonitrile}. The two trade names normally associated with this herbicide are Casoron 10G and Norosac 10G. Dichlobenil has been found to be effective on most emersed plants, though it is not recommended for control of *Phragmites* spp. All sources of information specified that this granular chemical must be applied to water where the granules will dissolve and enter the plant via the root. It is recommended that application take place in the very early spring.[2,4,7]

Table 1: Effective Herbicides for Selected Wetland Species[2,4,7-11]

EMERSED PLANTS	HERBICIDE						
	2,4-D	DI-CAMBA	DI-CHLO-BENIL	DIQUAT	ENDOTHAL DIPOTAS-SIUM SALT	FLURI-DONE	GLYPHO-SATE
Bulrush *Scirpus* spp.	X		X	X			X
Cattail *Typha* spp.	X	X	X	X		X	X
Common Reed *Phragmites australis*							X
Giant Foxtail *Setaria magna*							X
Maidencane *Panicum purpurascens*							X
Smartweeds *Polygonum* spp.	X	X	X		X		
Spatterdock *Nuphar luteum*	X	X			X	X	X
Torpedo Grass *Panicum repens*						X	X

- **Diquat** {6,7-dihydrodipyrido pyrazinediium dibromide}. Weedtrine-D and Ortho Diquat are the common trade names for Diquat. This herbicide is nonselective and is absorbed by the foliage of the target plants.[7] Because the herbicide is also quickly absorbed by silt and clay particles, it is not as effective when applied to soil or water containing suspended materials.[4] Destruction of the foliage occurs almost immediately due to the release of oxidants. Effective application can take place any time during the growing season.[2,7] Due to the rapid necrosis of the plant material that comes in contact with Diquat, it is recommended that no more than half of a given weed stand be treated during one application to prevent oxygen depletion in water beneath the plant due to decomposition of the plant material.[2] It is recommended that a nonionic surfactant adjuvant such as Ortho X-77 Spreader be used when the herbicide is applied

to emersed or floating vegetation.[7]

- **Fluridone** {1-methyl-3-phenyl-5-[-3(trifluoromethyl)-phenyl]-4(1H)-pyridinone}. This herbicide commonly goes by the trade name Sonar AS. It obstructs normal photosynthesis resulting from chlorosis at the terminal buds of the affected plant. Best results are obtained when application takes place before the initiation of new growth. No adjuvants are recommended.[2,7]

- **Glyphosate** {N-(phosphonomethyl) glycine}. Rodeo is the trade name used for glyphosate. It is commonly used due to its effectiveness and relative safety. It is a nonselective herbicide. Best results are obtained when it is applied when the plant is undergoing vigorous growth. Although it is still effective in water, research indicates that less regrowth occurs when it is applied to upland plants. It is also known that glyphosate does not provide residual weed control. A non-ionic surfactant is needed for application.[2,4,7,8]

CONCLUSIONS

The majority of the invasive species control methods that are not chemical in nature will not be feasible for use by VDOT at its created wetland sites (with the possible exception of pothole blasting with ammonium nitrate).

Most of the herbicides reported on have been available and in use for several years. Although this is advantageous in that application methods have been refined, it does not appear that new, more effective chemicals will soon be available.

It appears that glyphosate (Rodeo) is still one of the most effective herbicides available for control of invasive species in wetland settings due to its effectiveness on a wide variety of species and its benign effects on the surrounding environment.

RECOMMENDATIONS

If VDOT's Aquatic Ecology Section continues to be dissatisfied with the performance of available herbicides, it may be beneficial to initiate research directed at developing specific guidelines and application methods for those herbicides currently used. Target species could be isolated and treated with given herbicides under various conditions to determine better application methods.

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