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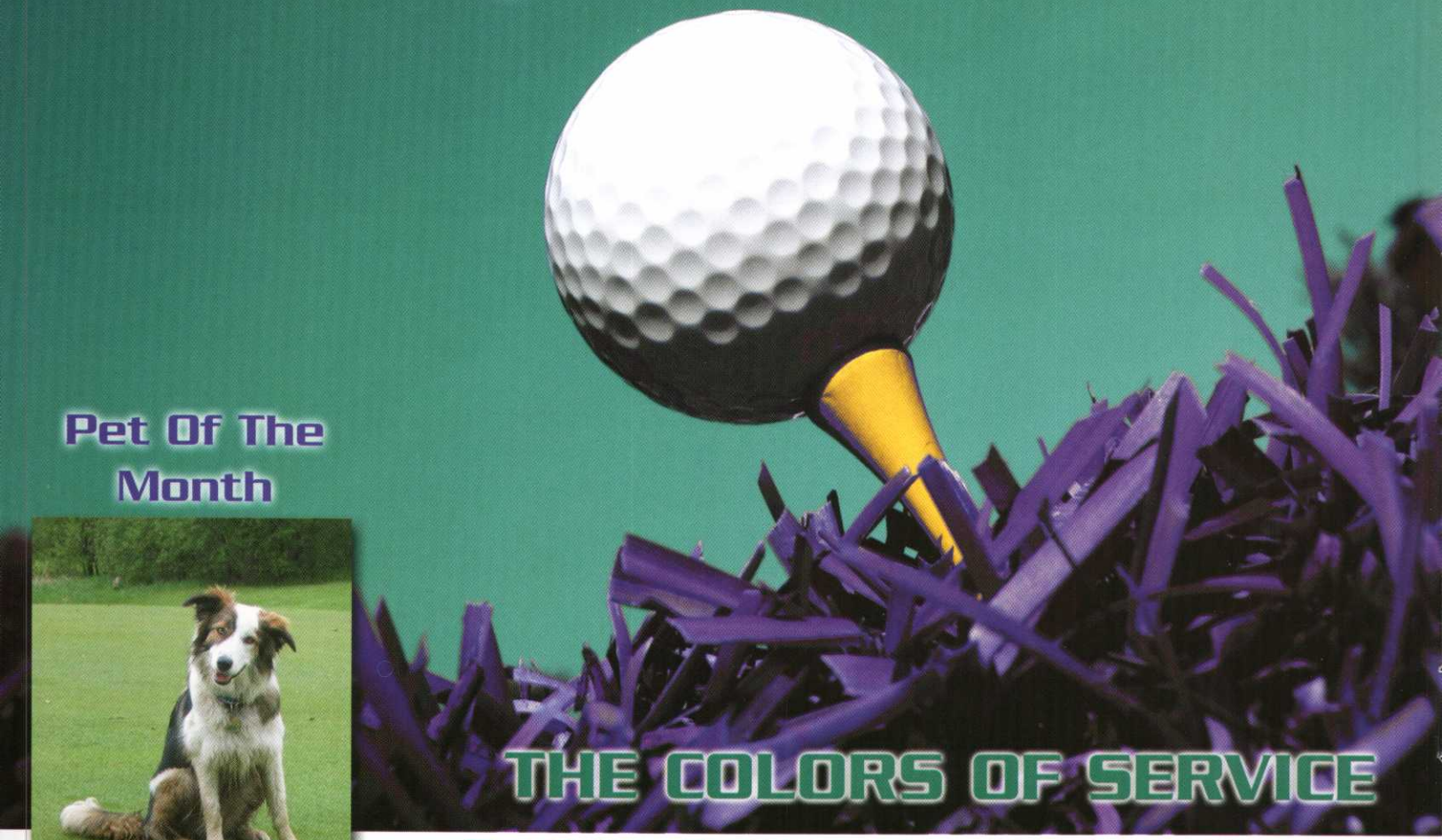

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Pet Of The Month

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Location: Benson Golf Club (Benson, MN)
Superintendent: Sally Barrens

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Inside This Issue Of Hole Notes

Classified Ads

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(26) vt-4 Toro Controllers
Includes clocks & pedestal - $315
Reconditioned VT-4s for $275 ea.
Contact: Brad Hable
Bunker Hills Golf Course
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FOR SALE
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Ridges at Sand Creek
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FOR SALE
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3,733 hours...$1500
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Tartan Park Golf Course
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WANTED
A 4-wheel, liquid-cooled gas Cushman for parts.
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763-512-2356

FOR SALE
2005 Toro Flex 21
Greens Walk-Behind
200 hr. - $5,000
Contact: Butch Brown
Birch Bay Golf Course, Nisswa
218-820-2158

About the Cover

No. 2 green at Windsong Farm Golf Club, site of the the MGCSA Championship on August 7. Host Superintendent: Scottie Hines, CGCS

PRESIDENT'S MESSAGE

Recharging for the Backstretch

By James Bade

A "dog days of summer" greetings to you. This is going to be the quickest article I have written since I am scheduled to get out of town for three days!! I hope you are able to get away from it all to recharge yourself for the backstretch. I hope to catch some fish with my kids and spend some time with Stephanie doing a lot of nothing by a lake up north. To hear a loon in the stillness of the night…priceless.

This is the least amount of disease I have seen in a long time, especially compared to last year. But it is easily the driest year since 1988. Thank goodness for wetting agents. It would be interesting to know how many miles of hose has been moved around the golf course. The old bunkers, tile lines and tree roots sure leave their mark. It is a year where the VFD's come in handy and having two wells brings a peace of mind. It is amazing what a quarter inch of rain can do compared to all the effort of hose dragging. The sound of thunder…priceless.

Vendor Appreciation day was held at Heritage Links last month. Appreciation defined by Webster's dictionary is, "to value highly, to be fully aware of, and to recognize with gratitude." After being on the board of directors one becomes fully aware of the role the vendors play within the association. The relationship between the superintendent and the vendor is a highly valued one. As I sat around the table it was quite easy for me to remember all the vendors who served on the Board of Directors during my tenure: Kerry Glader, Bob Simondet, Ted Schirk, Joe Churchill, Jon Almquist, Dave Oberle, Jeff Hartman and Dan Brown. To think of their names that quickly means they brought a lot of insight to the board meetings. But more importantly new friends were made. Thank you Paul Eckholm and Heritage Links for hosting the event. Strong relationships between members of the MGCSA…priceless.

With guest days, drought and vacation I was unable to attend the BASF Fundraiser Tournament for the first time. What a nice way to raise some extra funds for the greater good of the association. Hats off to David Oberle and the BASF Corporation. To have a chemical representative in our own back yard of an international company is special. But more importantly David Oberle has a strong desire for our association to be a thriving one. My assistant and foreman had a great day at Albion Ridges. Thanks Brooks Ellingson for hosting. I will be waving as I drive by on my way to Park Rapids. The effort put forth by many in this association…priceless.

While I am tired of dragging hoses and sprinklers around, my son Sam is collecting sprinklers at home. He has six different styles in the backyard. At work we put rocks around the sprinklers due to the high pressure. So one night as I went out to pick up the yard, Sam had piled some rocks around his sprinkler heads. That just showed me how much he is watching what I do. The power of example and first impressions is amazing. So whether we are at home or at work, people are watching. Having good examples and mentors in your life…priceless.

Stay cool.

With gratitude
James Bade

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WEED CONTROL IN IRRIGATION WATER SUPPLIES

Prepared by Stratford H. Kay
Crop Science Extension Specialist, North Carolina Cooperative Extension Service, North Carolina State University

(Editor's Note: This article summarizes safe and effective techniques for managing aquatic weeds in irrigation ponds. It emphasizes preventive measures and the selection of cultural, mechanical, biological and chemical management techniques appropriate for irrigation water supplies. The advantages, disadvantages and environmental consequences of these methods are also discussed.)

Introduction

Reliable sources of water for irrigation of crops are becoming increasingly important in North Carolina. The primary sources for irrigation water are small surface impoundments. In the past 25 years, more than 75,000 ponds have been constructed in the state for collection and storage of irrigation water. The same ponds may also be used for swimming, sport fishing, livestock watering and aquaculture.

Unfortunately, these multiple-use ponds are often constructed poorly. Many have large areas of shallow water and receive substantial nutrient input from the surrounding watershed and other sources. The combination of shallow, clear water and excessive nutrient input inevitably results in dense growths of one or more species of aquatic plants. In large bodies of water, plants provide habitat and food for gamefish and waterfowl, and they oxygenate the water. In small impoundments, however, weedy growths of algae and vascular aquatic plants interfere with irrigation operations and fish production. They also cause fish kills through nighttime oxygen depletion, and harbor vectors of human and animal diseases.

Preventive Measures

Pond Design and Construction

Weed management in ponds begins with proper pond construction. Guidelines for pond construction are available from the U.S. Department of Agriculture Soil Conservation Service (SCS); ask for Agricultural Handbook No. 590, Ponds—Planning, Design and Construction. The SCS offers free assistance for re-designing new ponds if the landowner is a cooperator with the local Soil and Water Conservation District. An additional source of information is Coop-erative Extension Service publication AG-424, Pond Management Guide.

The establishment and growth of weeds can be prevented by minimizing the amount of sunlight that reaches the bottom of the pond.

The pond should be of adequate depth (minimum of 3 feet) throughout, and pond banks should have a slope of at least 1 to 4 (ratio of depth to distance from the edge) to minimize shallow areas in which growth begins. In properly designed ponds, fertilization and pond dyes that block light penetration may also be used to prevent the establishment of aquatic weeds. For either of these techniques to be successful, the pond should have minimal outflow. Ponds fed by streams usually have substantial, continuous outflow and

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do not respond well to fertilization or pond dyes because the fertilizer or dye washes out. These techniques are also much less effective in poorly constructed ponds that have extensive areas in which the water is less than three feet deep.

Fertilization

Fertilization is a useful method for reducing light penetration. Nutrients released from the fertilizer stimulate the growth of planktonic algae, thereby increasing the turbidity (cloudiness) of the water and decreasing light penetration. Plankton growth is observed as a green or brown coloration of the water. Pond fertilization can be an effective way to suppress the growth of filamentous algae and submersed macrophytes. At the same time, it can enhance fish production in the pond. However, fertilization must be done correctly and must be continued once it is started.

Fertilization should be done only if you plan to harvest fish regularly, or stunting of your fish may occur. A common mistake is to fertilize once or twice and then to stop. This results in the loss of the plankton bloom within a few weeks. The planktonic algae settles out, and the water column once again becomes clear. Filamentous algae and other weeds then grow rapidly as they absorb the nutrients that are released at the bottom of the pond by the decomposing plankton.

Another common mistake is to attempt to control emergent weeds (such as cattails, rushes and grasses) and floating weeds (such as duckweed and watermeal) with fertilization. The added fertility will cause these plants to grow prolifically, making further weed control measures necessary. Never fertilize when filamentous algae or submersed macrophytes (weeds that grow beneath the surface only) are already present because the added nutrients will only compound the problem.

Begin fertilization in early spring when the water temperature reaches 60 to 65 degrees F. Several types of fertilizers are available for pond use, including a 10-34-0 (N-P-K) liquid aquacultural fertilizer and granular formulations, such as 20-20-5 or 8-8-2. The liquid fertilizer is normally applied at a rate of 1 gallon per surface acre, whereas the granular fertilizers are applied at 40 to 100 pounds per surface acre for the two formulations, respectively. If fertilizers with higher levels of nitro-gen and phosphorus are used, the rate should be decreased proportionately. Granular fertilizers should be placed on a platform 10 to 15 feet from the pond's edge, constructed so that the fertilizer is approximately 12 to 18 inches below the water surface. Fertilizer should be reapplied as soon as you can see a shiny object (such as a tin can lid nailed to the end of a stick) 18 inches below the water surface. The period between applications varies among ponds, but it will generally be from 4 to 6 weeks throughout the growing season. Continue fertilization until the water temperature stabilizes below 60 degrees F in the fall.

If the pond contains very soft, acidic water, liming may be needed to raise the pH to the desirable range (approximately 6.5 to 7.5). To determine the amount of

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Table 1

Relative Effectiveness of Grass Carp and Herbicides for Control of Common Aquatic Weeds in North Carolina

Species	Grass Carp	Aquathol	Endothall Hydrothol*	Endothall Diquat	2,4-D	Compounds	Copper Fluridone	Glyphosate
Algae								
Planktonic algae	NR	NR	E	E	NR	E	NR	NR
Filamentous algae	NR	NR	E	E	NR	G	NR	NR
Macroalgae (Chara,Nitella)	E	NR	E	E	NR	G	NR	NR
Free-Floating Plants								
Duckweed	NR	NR	NR	G	P	P	E	NR
Watermeal	NR	NR	NR	NR	NR	NR	G	NR
Mosquito fern (Azolla)	NR	NR	NR	G	F	NR	E	NR
Waterhyacinth	NR	NR	NR	G	E	NR	NR	G
Submersed Plants								
American elodea	E	E	E	E	NR	F	E	NR
Bladderwort	G	P	P	G	G	NR	E	NR
Brazilian elodea	G	P	P	E	NR	G	E	NR
Brittle (spiny) naiad	E	E	E	E	NR	NR	E	NR
Coontail	G	E	E	E	G	NR	E	NR
Creeping rush	G	NR	NR	F	NR	NR	E	NR
Eurasian watermilfoil	P	E	E	E	E	NR	E	NR
Hydrilla	E	E	E	E	NR	F	E	NR
Parrotfeather	P	E	E	G	E	NR	E	NR
Pondweeds (Potamogeton)	E	E	E	E	NR	NR	E	NR
Southern Naiad	E	P	P	F	NR	NR	G	NR
Proliferating spikerush	E	NR	NR	NR	NR	NR	E	NR
Variable-leaf milfoil	P	E	E	E	E	NR	E	NR
Widgeongrass	E	F	F	G	NR	NR	E	NR
Emergent/Floating-Leaf Plants								
Alligatorweed	NR	NR	NR	NR	P	NR	P	G
American lotus	NR	NR	NR	NR	G	NR	P	E
Bulrushes (Scirpus)	NR	NR	NR	F	G	NR	NR	E
Cattail	NR	NR	NR	F	F	NR	F	E
Common reed (Phragmites)	NR	NR	NR	NR	NR	NR	NR	E
Creeping waterprimrose	NR	NR	NR	NR	E	NR	P	E
Fragrant waterlilly	NR	NR	NR	NR	G	NR	G	E
Grasses	NR	NR	NR	F	NR	NR	NR	E
Pickerelweed	NR	NR	NR	P	G	NR	F	G
Rushes (Juncus)	NR	NR	NR	NR	P	NR	NR	G
Smartweeds	NR	NR	NR	F	G	NR	F	G
Spatterdock	NR	NR	NR	F	G	NR	G	E
Water pennywort	NR	NR	NR	G	G	NR	F	G
Watershield	NR	F	F	F	E	NR	G	F
Waterwillow (Justicia)	NR	NR	NR	F	E	NR	P	F

*Hydrothol formulations may be toxic to fish at application rates used for weed control.

KEY: NR = Not Recommended P = Poor F = Fair G = Good E = Excellent

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lime to be applied, collect and dry a sample of the mud from the pond bottom and submit it for a soil test (available through the Cooperative Extension Service). The rate of lime application should be based on the lime requirement for the mud from the bottom.

Take care to avoid overfertilization or overliming. Overfertilization may lead to the development of noxious algal blooms. Die off of the bloom and the decomposition of dead algae during the summer may also cause oxygen depletion, resulting in fish kills. Overliming may raise the pH of the pond water above 9.0 and enhance the development of undesirable blue-green algae, which cause odor problems and produce off flavors in fish. Additional information is available in Cooperative Extension Service publication AG-424, Pond Management Guide, or from a Wildlife Resources Commission fisheries biologist.

Pond Dyes

As an alternative to fertilization, a pond dye, such as Aquashade, can be used to reduce light penetration into the water column. This pond dye blocks the wavelengths of light that are necessary for photosynthesis. The dye also gives the water a bluish green color that some pond owners consider attractive. The upper two feet of the water column remain productive and provide food for fish. This dye is nontoxic to humans, pets, fish, wildlife, and plants. Aquashade is completely safe for use in irrigation water, water used for preparing pesticide sprays, and recreational ponds. Application to intensive aquaculture ponds may suppress the plankton bloom to an undesirable level and, in most cases, should be avoided. Application rates depend upon the volume of water to be treated and the particular weed. One quart is generally sufficient to treat one acre-foot of water (one surface acre of water averaging one foot in depth) for routine weed control. Difficult species, such as hydrilla, may require two quarts per acre-foot. Treatments usually are effective for 6 months or occasionally longer, depending upon the rate of water loss from the pond and the amount of fresh water entering the pond. If dense growths of algae or other weeds are present, mechanical removal or a herbicide treatment may be needed before applying a pond dye.

Cultural Control

Cultural techniques modify the environment to make conditions less suitable for weed growth. They include drawdowns and the use of benthic barriers (such as fibrous screens). Drawdowns are effective mainly on submersed vegetation (for example, Brazilian elodea) and are not generally recommended unless the pond is larger than 1 acre and has a control structure that allows you to adjust the water level easily. A drawdown should be done during the winter when the combination of drying and exposure to cold temperatures will kill many aquatic weeds. Drawdowns during the warmer months are not recommended, because they stress fish populations and may enhance the spread of marginal species (such as cattails, rushes, and willows).

Fibrous screens, such as xel, Aquascreen and Bottom Line, can be spread over the pond bottom to block out sunlight, preventing photosynthesis and eliminating weed growth. These materials are very expensive (as much as $10,000 per acre), but they may be useful in controlling submersed weeds around access areas and water intakes where other management procedures cannot be used. Benthic barriers are largely ineffective on floating species (for example, duckweeds) and emergent species (such as cattails).

Mechanical Removal

Mechanical removal of weeds by seining, raking, chaining, or using a backhoe is both the most common and most expensive form of pond weed management. Mechanical removal may be necessary where immediate control is required or in circumstances where other methods cannot be used. Mechanical harvesting equipment is available but is expensive and usually impractical in small impoundments. The primary advantage of the mechanical method is that the vegetation is totally removed from the water column. No decaying vegetation is present, and thus there are no noxious filamentous algal blooms caused by nutrient release or fish kills caused by oxygen depletion. Also, there are no herbicide residues that could damage irrigated crops and other desirable vegetation or that would require other water-use restrictions. Disadvantages include the problem of disposing of the weed mass, which may be 95 to 97 percent water, the physical disruption of the shoreline caused by the movement of equipment, the ineffective removal of portions of the vegetation and the dispersal of vegetative fragments that may take root elsewhere. Some aquatic weeds, such as alligatorweed, are amphibious and may become weeds in field crops and other terrestrial sites.

If a serious weed problem persists from year to year, a more viable option is to drain the pond and redesign it by excavating the shallow areas. This approach is quite expensive and requires the availability of an alternative source of irrigation water for an extended time.

Biological Control

Although many organisms (such as

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insects, mites, snails, ducks, geese, swans, manatees and fish) may feed on weeds, only herbivorous fish have proven effective for controlling aquatic weeds in North Carolina farm ponds. Various species have been suggested as agents for aquatic weed control, including Tilapia species, various strains of the common carp *(Cyprinus carpio)*, the Israeli carp and mirror carp, and the Chinese grass carp *(Ctenopharyngodon idella)*.

Tilapia. The tilapia are tropical species that can suppress growth of aquatic vegetation (such as filamentous algae) when stocked at high rates (300 per acre). Two species of tilapia have been considered for weed control. The blue tilapia *(T. aurea)* feeds entirely on algae (both planktonic and filamentous) but does not readily consume submersed macrophyte vegetation. The redbelly tilapia *(T. zilli)* feeds primarily on submersed macrophytes rather than algae. However, both species reproduce rapidly and consume both the vegetation and the small animals living in the vegetation that are important food sources for desirable fish populations. Therefore, use of the tilapia may have unwanted environmental consequences. Tilapia cannot survive normal winter water temperatures in North Carolina, however. This is a benefit from an environmental standpoint, but annual restocking is necessary unless a warm water supply (such as thermal spring or power plant cooling reservoir) is available as a refuge in which the fish can overwinter.

Fish also may be seined in the fall before the onset of cold weather and either harvested for food or maintained indoors for restocking during the next growing season. The loss of fish in the fall when water temperatures are too cool for survival may require the removal and burial of large numbers of dead fish at the end of each season. Usually, they will be consumed by bass or predatory birds before they die.

Common Carp. Various strains of common carp, especially Israeli carp, have been widely recommended for aquatic weed control, mainly for filamentous algae, in North Carolina. These fish can suppress filamentous algae growth but can have detrimental effects on ponds. Carp control weeds by muddying the water and by consuming the vegetation. They can survive North Carolina winters and can also reproduce in ponds.

Grass Carp. Sometimes referred to as white amur, grass carp were introduced into the United States under quarantine in the 1960s. Research showed that they were very effective in controlling many species of aquatic vegetation. However, their possession in most states and interstate transportation was made illegal, because biologists feared an environmental calamity might occur if these fish escaped into the larger rivers. There they might find suitable spawning habitat, reproduce prolifically and destroy natural aquatic plant communities that provide food and habitat for native sportfish and waterfowl.

In 1982, Malone and Sons Fish Hatchery in Lonoke, Arkansas, produced a grass carp that is incapable of reproduction. The fish's sterility results from disrupting the eggs during the developmental process, producing fish with an extra set of chromosomes (triploid). Because there is no danger of these fish reproducing if they escape, it is now legal to stock them in many states, including North Carolina.

The grass carp, particularly those that weigh between four and 15 pounds, may consume more than their own body weight of fresh vegetation in a single day, and they may grow to more than 50 pounds. This fish is totally herbivorous and does not feed on or compete with other freshwater fishes for food. Grass carp feed largely on submersed weeds (such as hydrilla, pondweed and naiads) and are recommended primarily for control of this group of weeds. They occasionally feed on filamentous algae, duckweeds and various emergent vegetation but generally do not provide satisfactory control of these species. One disadvantage of using the grass carp is that these fish tend to eat all of the vegetation available and then begin to starve. If this occurs, it may be necessary to feed them. Grass clippings or commercially available trout and catfish feeds may be used to prevent

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Table 2. Waiting Periods (Days) and Setback Distances to Observe After Application of Aquatic Herbicides[1]

Herbicide	Fish Irrigation	Consumption	Livestock	Swimming	Drinking Water
Copper (copper sulfate and various organic copper complexes[2]	NR 3	NR	NR	NR	NR
2,4-D (various formulations)4	see label	see label	see label	see label	see label
Diquat					
Reward 5	1-5	NR	1	NR	1-3
Weedtrine D	14	NR	14	1	14
Endothall[5]					
Aquathol K	7-25	3	7-25	NR	7-25
Aquathol (granular)	7	3	NR	NR	7
Hydrothol 191 [6]	7-25	3	7-25	NR	7-25
Hydrothol 191 [6] (granular)	7-25	3	7-25	NR	7-25
Fluridone				NR	
Sonar 4AS	7-30 [7]	NR	NR	NR	/mile
Sonar SRP	7-30 [7]	NR	NR	NR	/mile
Glyphosate					
Rodeo	NR	NR	NR	NR	fi mile

1 Labels of specific products may change without notice. Check the most current label for changes in water use restrictions.

2 Copper may be toxic to sheep and goats. Use of copper in ponds used for watering these animals should be avoided unless the animals can be provided with another source of drinking water for at least 3-5 days to allow dissipation. Copper (especially copper sulfate) also may be toxic to fish near the application rate required for control of certain weeds. Care should be taken to calculate the treat-ment rate carefully to avoid over-application and a possible fish kill.

3 NR = No restrictions.

4 Water-use restrictions vary by formulation and manufacturer. Most labels do not permit the use of 2,4-D in irrigation waters. regardless, if the water is used for irrigating sensitive crops, 2,4-D should not be used. Most turfgrasses are tolerant of low concentrations of 2,4-D.

5 Water-use restrictions vary depending on formulation, treatment rate, and site of application.

6 Hydrothol formulations may be toxic to fish at levels used for weed control.

7 Water use restrictions vary with formulation, site of application, and type and maturity of crop that is irrigated. In some cases, a 30-day restriction may be insufficient for irrigation of seedlings or new transplants of sensitive crops, such as tobacco