Pond Management & Aquatic Plant Control

PENNSTATE
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College of Agricultural Sciences

Contents

Pond Management

Pond Construction

Creating a pond that is an asset to a piece of property involves addressing many variables before and during its construction. The pond's intended purpose—including recreation, irrigation, livestock watering, aesthetics, and fish production—usually dictates its setting. As a result, expectations for a pond should be well defined and reasonable. Pond features are designed and constructed according to recommended standards. These standards, published by the U.S. Natural Resource Conservation Service, address safety, best construction practices, and ease of maintenance. Expert advice and information can be indispensable before and during pond construction.

Pond construction.

Groundwater sources are the best contributors of water to a successful pond. If groundwater is not available, surface runoff or a small stream can be the primary source of water. Ponds fed by surface runoff can have too little water in the summer months and too much after storm events. The drainage area should be large enough to ensure that combined surface runoff and seepage through the soil will maintain water in the pond even during the driest years. The best water sources exclude obvious nutrient input sources such as agricultural runoff and sewage.

Other important pond features include soil composition, water depth, and water removal features such as a spillway, an overflow pipe, or a drainpipe. Soil composition is a critical element in pond construction. Soil must contain enough clay to prevent leakage. To characterize a pond site's soil and geological conditions, have a professional consultant undertake a site investigation. The local U.S. Natural Resource Conservation Service or County Conservation District may be able to offer a partial listing of experienced pond contractors and consultants in your county.

A good pond construction reference point is a water depth of at least 3 feet at a point 9 feet from the shoreline (a 1:3 bank slope). This discourages algae and aquatic plant growth. It is best to slope the banks at this angle at the time of construction.

Final stages of pond construction with emergency spillway.

A drainpipe is helpful to manipulate the water level for fish management practices, pond repairs, or emergency situations. Cutoff or anti-seep collars placed around the drainpipe during construction prevent water from seeping along the outside of the pipe and cutting a channel through the dam. A combination overflow pipe and drainpipe is highly desirable for water level management. The overflow pipe is always open to maintain a normal pool level, and the drainpipe is open only at the discretion of the pond owner. These pipe sizes are determined by the pond's drainage area and storage characteristics.

Finally, an emergency spillway allows safe overflow of storm water from a 50- to 100-year rainfall event. The spillway usually is flat-bottomed and constructed in an undisturbed bank at one end of the dam. To prevent scouring, establish a good sod mixture. To provide an outlet for the normal flow of water, install the overflow pipe or L-shaped trickle tube through the dam approximately 12 inches below the emergency spillway. The tube should be large enough to drain the full pond down to normal water level within 24 hours after the flow through the emergency spillway ends.

Pond Maintenance

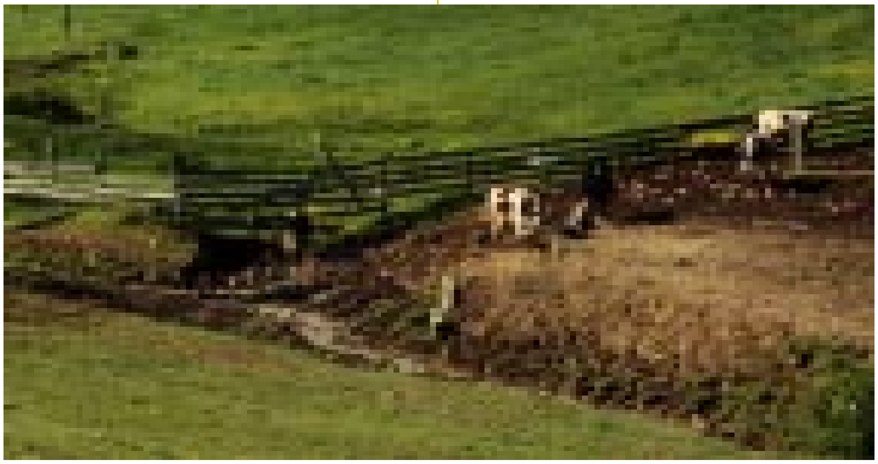
A pond must be maintained adequately if its intended purposes are to be realized throughout its expected life. Routine inspections and proper care of problems as they occur will save time and frustration later. In some localities, burrowing animals such as groundhogs and muskrats cause severe damage to dams or spillways. Prevention of burrowing pests can be built into the pond during the construction by anchoring chicken wire over the area to be protected. Installing riprap at least three feet below the water surface also discourages burrowing rodents.

Nutrient Management

Runoff from barnyards, cropland, feedlots, sewage systems, and intensively managed turf areas such as golf courses can introduce large quantities of nutrients to a pond. The nutrients will contribute to increased aquatic plant growth.

The best way to control excessive algae is to limit nutrient entry into the water body. The pond owner therefore must treat the source of the problem rather than the symptoms. Nutrient reduction efforts will not immediately decrease established rooted plants, but may lead to long-term growth reduction. Agricultural best management practices, reduction of lawn fertilizers, tall grass buffer strips, forested corridors, and on-lot septic system maintenance are a few ways to address nutrient management.

If sediment enriches and fills a pond, dredging can be a remedy, albeit an expensive one. The first steps in any dredging project should be to locate where the sediment originates, and then to determine how the sediment release may be controlled. Restoration of a pond to its original configuration usually provides significant benefits, but they can be short-lived. Dredging is a regulated activity, and pond owners should consult the Department of Environmental Protection before beginning any project.

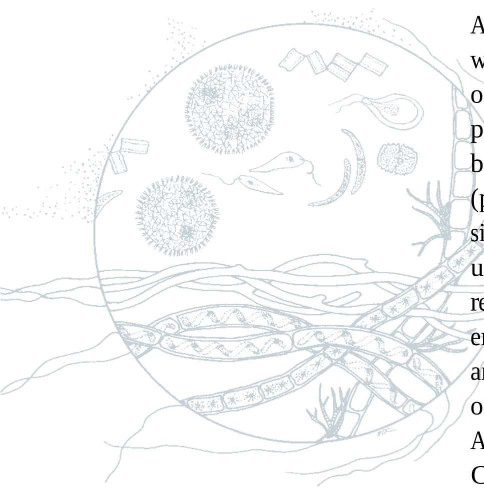


Nutrient addition (cows and runoff).

Types of Aquatic Plants

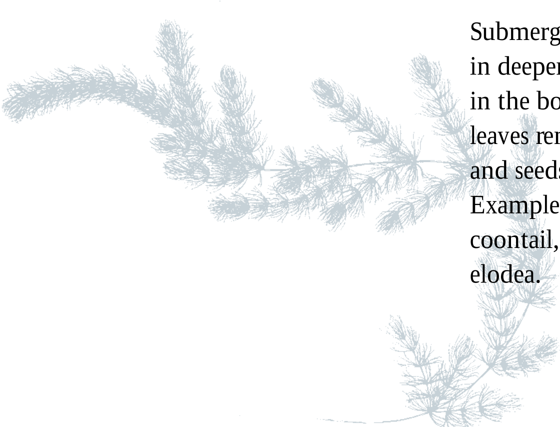
Most water bodies support some type of plant life, depending on the environment in which they are located. Aquatic plants can be separated into four categories—algae, submerged aquatic vegetation, emergent plants, and floaters. These categories are described in greater detail in the Commonly Controlled Aquatic Plants of PA section of this guide.

Algae (see pg 13)



Algae, the most well-known and widely distributed of all aquatic plants, occur in three different types—plankton, filamentous, and an attached branched form. Plankton algae (phytoplankton) are the minute, single-celled suspended types that usually make the water pea-soup green, reddish, or brown. Filamentous algae, erroneously described as moss or slime, are filaments that can form dense mats on rocks and other objects underwater. Attached branched algae, known as Chara and Nitella, resemble some flowering plants but have no root system. They often are gritty to the touch and have a skunk-like odor when crushed.

Submerged Aquatic Vegetation (see pg 15)



Submerged aquatic vegetation grows in deeper water and usually is rooted in the bottom of the pond. Most leaves remain underwater until flowers and seeds form out of the water. Examples of submergents include coontail, pondweeds, and common elodea.

Emergent Plants (see pg 18)

Emergents, such as cattails and rushes, grow along edges of the water body, with only short portions of their stems and roots submerged. Sometimes called marsh plants, they tend to cause fewer problems for water users than other plants do.

Floaters (see pg 20)

Most floaters are rooted plants that have much of their plant structure, especially their leaves, floating on the water surface. Examples of floaters include water lilies and spatterdock. They also can be unattached like duckweed, which obtains its nutrients through small rootlets dangling in the water.

Aquatic Plant Control—Management Alternatives

Aquatic plants become weeds when they impair the use of the impoundment. An integrated pest management (IPM) approach to weed control can prevent aquatic vegetation from reaching nuisance levels. Reducing submerged and floating aquatic plants leads to increased algae growth by releasing nutrients formerly bound up in living plant material. The IPM approach combines water quality and pond construction features with physical, mechanical, biological, and chemical controls to create a balanced management plan. A cause-and-effect rationale must form the basis for creating a customized plan for your pond.

Physical and Mechanical Control

Several aquatic plant control alternatives exist. Physical removal is most effective for small quantities of plants near the shorelines. This technique consists of cutting, mowing, raking, digging, or pulling. Pulling or cutting must be repeated several times to eliminate new growth as it appears. Most submerged aquatic vegetation can reproduce through fragmentation. Harvesting cut plants reduces the rate of regrowth and the amount of available nutrients.

Physical removal of filamentous algae.

Mechanical harvester.

The use of mechanized weed control equipment can be expensive because of high maintenance costs. The most widely used type of mechanized equipment is called a plant harvester (weed cutter). Plant harvesters cut off the underwater rooted vegetation 4 to 5 feet below the water surface, and are used mainly on large lakes. One of the advantages of cutting includes the ability to collect all aquatic vegetation, including filamentous algae and vascular plants. Weed cutters that do not harvest or collect the weeds for transport to shore are not recommended because plant fragments can live for long periods of time, develop root systems, and grow in areas that previously were unaffected with a weed problem. No additional equipment or protective clothing is needed, and limited operating experience or permits are required.

Altering the pond environment to control plants also is a viable option. Seasonal drawdowns can be helpful for some lakes and ponds. A drawdown involves lowering the water in a pond, lake, or reservoir to expose sediments in the nearshore area. The degree of plant control from a drawdown is dependent on plant species and temperature. A drawdown accompanied by freezing temperatures provides the greatest aquatic plant control. A permit for drawing down an impoundment is required for ponds larger than one acre or for any pond drawn down to conduct an activity that requires another state permit, such as a Pennsylvania Department of Environmental Protection Waterways Obstruction and Encroachment Permit. Additional information is available through the Pennsylvania Fish and Boat Commission and the Pennsylvania Department of Environmental Protection.

Aeration can provide limited aquatic plant control. The most efficient type of aeration involves introducing air bubbles at the bottom of the lake or pond. The rising air bubbles, which oxygenate the water to some degree, push the oxygen-poor water to the surface where it is reaerated through an exchange with atmospheric oxygen. Surface aeration (fountains) may provide limited plant control benefits. Aerating pond waters can activate a number of complex processes that can help control blue-green algae. Please note that aeration alone is not an effective method of controlling aquatic weed and algae growth.

Biological Control

Biological plant control may be achieved by introducing a vegetation-eating fish. The triploid grass carp can be very effective at controlling submerged aquatic vegetation, its preferred food. Partial control of filamentous algae may occur as well. The triploid grass carp is a sterile, non-reproducing fish. This genetically altered carp was created by exposing the fertilized eggs to heat shock, causing both sexes of the fish to have three sets of chromosomes (triploid) rather than the normal two (diploid). A negative characteristic of the triploid grass carp is its defecation of consumed plant material, which causes recycling of nutrients back into the water. Pond owners must obtain permits from the Pennsylvania Fish and Boat Commission before stocking triploid grass carp.

Drawdown.

Triploid grass carp.

Koi, common carp, and Israeli carp are not exclusive plant eaters and are not recommended by the Fish and Boat Commission for plant control.

Chemical Control

Herbicides offer a widely used solution to nuisance vegetation control, but should be handled carefully. Select the correct chemical for the identified problem plant, and make precise water volume and chemical measurements. *Read and follow the product label carefully.* Using the wrong herbicide will result in failure to control the target plant. Excessive application rates also can cause damage to nontarget plants and animals. Chemical control also indirectly may cause a fish kill, because oxygen is consumed by the rapid decay of dead plants. To reduce this danger, treat only one-third to one-half of the pond at a time when controlling widespread growth. When applying herbicides along shorelines or spot-treating weed beds, start applications along the shoreline or in the shallowest area and apply out to the deeper water. This will enable fish to move into deeper water to escape the chemical.

Chemical control of algae can be a perplexing task. Chemicals of choice fall into two major categories, dyes and copper compounds. Algicidal dyes block sunlight penetration and inhibit photosynthesis. They are chemically benign, but unsuitable in cases where the pond overflows, or where algae mats already have formed at the pond's surface. Copper compounds are effective algicides, but may kill trout, channel catfish, triploid grass carp, and other sensitive fish at commonly used doses (0.25 to 0.50 parts per million). When ponds overflow, downstream aquatic life may be at risk from copper treatments. Some resistant forms of algae require species-specific identification and specialized treatment best provided by a professional aquatic pesticide applicator. Effective algae control usually integrates nutrient management into the control plan.

Piscicides such as rotenone and antimycin have become important in controlling excess fish populations. Use these chemicals when stunting occurs from overpopulation of certain fish species, or when manipulation of the fish community is desirable.

Permit Requirement

Use of an aquatic pesticide is a regulated activity, even if the chemical is to be used in a private pond. A joint Pennsylvania Fish and Boat Commission/Pennsylvania Department of Environmental Protection "Application and Permit for Use of an Algicide, Herbicide, or Fish Control Chemical in Waters of the Commonwealth" must

Granular application of herbicide.

Cutrine application.

be submitted *and* approved by both agencies before the pesticide is used. Aquatic pesticides must be registered with the U.S. E.P.A., listed with the Pennsylvania Department of Agriculture, and labeled specifically for aquatic use. The permit application requires the following information:

- name and location of the water body
- specific uses of the water body
- presence of warmwater or coldwater fish
- total area of the water body and the treatment area
- average depth of the water body
- name of plant or fish to be controlled
- commercial and manufacturer's name of the chemical to be applied
- dosage of each chemical to be applied
- number of treatments to be made throughout the year

Effects of the chemical in and downstream from the impoundment are considered in the approval process. If the water body overflows, downstream aquatic life may be affected. In an impoundment with a wet weather discharge, avoid problems by treating when little or no overflow is occurring. Treatment is more likely to be effective if the chemical stays in the water body.

Determining Chemical Dose

The most important difference between treating aquatic and terrestrial settings is that some treatments are calculated three-dimensionally (i.e., by volume rather than by area). An accurate calculation of the amount of chemical to be used must begin with accurate determinations of pond area and volume. Determine area geometrically or with a map and planimeter. Determine volume by accurately calculating *average* depth and multiplying by impoundment area. The standard unit of volume is an acre-foot, equivalent to one acre of water with a depth of one foot or 325,804 gallons. Volume changes markedly with water level variations. Accumulated sediment or organic material diminishes impoundment area and volume over time. Accommodate these changes when calculating the amount of chemical to use. An example follows.

Given:

1 acre = 43,560 square feet

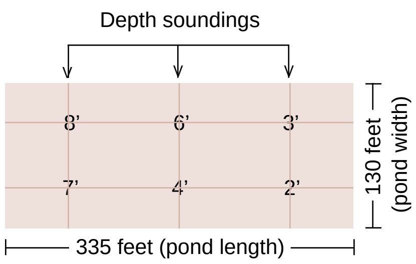
Area of a rectangle in acres =
$$\frac{\text{length in feet} \times \text{width in feet}}{43{,}560 \text{ feet}^2}$$

Area of a triangle in acres =
$$\frac{1/2 \text{ length of base in feet} \times \text{height in feet}}{43{,}560 \text{ feet}^2}$$

Area of a circle in acres =
$$\frac{3.14 \times (\text{radius in feet})^2}{43{,}560 \text{ feet}^2}$$

Volume in acre-feet =
area in acres x average depth in feet

Example:



Area and Volume Calculations

Using the pond-specific and general information provided above, make the following calculations:

> Area of nearly rectangular sample pond =
> $\frac{335 \text{ feet} \times 130 \text{ feet}}{43{,}560 \text{ feet}^2}$ =
> 0.99977 acre =
> 1.0 acre
>
> Average depth =
> $\frac{8 + 6 + 3 + 7 + 4 + 2 \text{ feet}}{6}$ =
> $\frac{30 \text{ feet}}{6}$ =
> 5 feet
>
> Volume of example pond =
> 1.0 acre x 5 feet average depth =
> 5 acre-feet

Determining Amount of Chemical

Select the chemical dose using the product label and the plant to be controlled.

Chemical #1 example:
The pond above has a heavy algae growth. Treat only half of the pond area at a time to prevent oxygen depletion. To determine the amount of algicide needed, use the following calculations when treating with a dosage of 0.7 gallon/acre-foot.

> Treatment volume =
> 5 feet deep x 0.5 acre =
> 2.5 acre-feet
>
> 2.5 acre-feet x 0.7 gallon/acre-foot =
> 1.75 gallons of algicide

Chemical #2 example:
For control of pondweed (Potamogeton) in one-third of the example pond, use a chemical dose of 1.5 gallons/acre.

> Pond area =
> 1 acre x 1/3 pond =
> 0.33 acre:
>
> 0.33 acre x 1.5 gallons/acre =
> 0.5 gallon of aquatic herbicide

For typical application rates of commonly used aquatic herbicides, see the table on page 22.

Chemical Mode of Action

The following information explains the modes of action for some pesticides commonly used in Pennsylvania.

Aquatic Dyes

Aquatic dyes are a blend of blue and yellow dyes specifically designed to shade portions of the light spectrum required by underwater aquatic plant and algae growth. These dyes normally are used to control planktonic algae, but also can inhibit photosynthesis in filamentous algae and submerged aquatic vegetation if applied early during the growing season.

Copper Sulfate and Chelated Copper Products

Copper sulfate controls many species of algae in lakes, ponds, and reservoirs. Copper works well because it disrupts the cell membrane, which inhibits the cell growth. Trout and other sensitive species of fish may be killed at application rates necessary to control algae. Chelated copper products or copper complexes kill algae using the same mode of action as copper sulfate but do not precipitate out of solution in hard water as easily as copper sulfate. Copper products can be used in combination with other products for specialized treatment of submerged aquatic vegetation. Copper is more toxic when water is soft (< 50 ppm $CaCO_3$ hardness) and acidic (pH < 7.0).

Diquat Dibromide

Diquat is a chemical that is quickly absorbed by plant tissues and interferes with photosynthesis. If it does not contact plant tissue, it binds rapidly and firmly to soil particles, sediments, and bottom mud. Diquat decomposes in aquatic environments through microbial degradation and exposure to light.

Fluridone

Plant shoots absorb the active ingredient fluridone from water, and aquatic plant roots absorb it from hydrosoil. Absorbed fluridone inhibits carotene formation. The absence of carotene pigment causes unprotected chlorophyll to photodegrade.

Glyphosate

Glyphosate moves through the plant from the point of foliage contact to and into the root system. This results in a cessation of growth, cellular disruption, and eventually plant death.

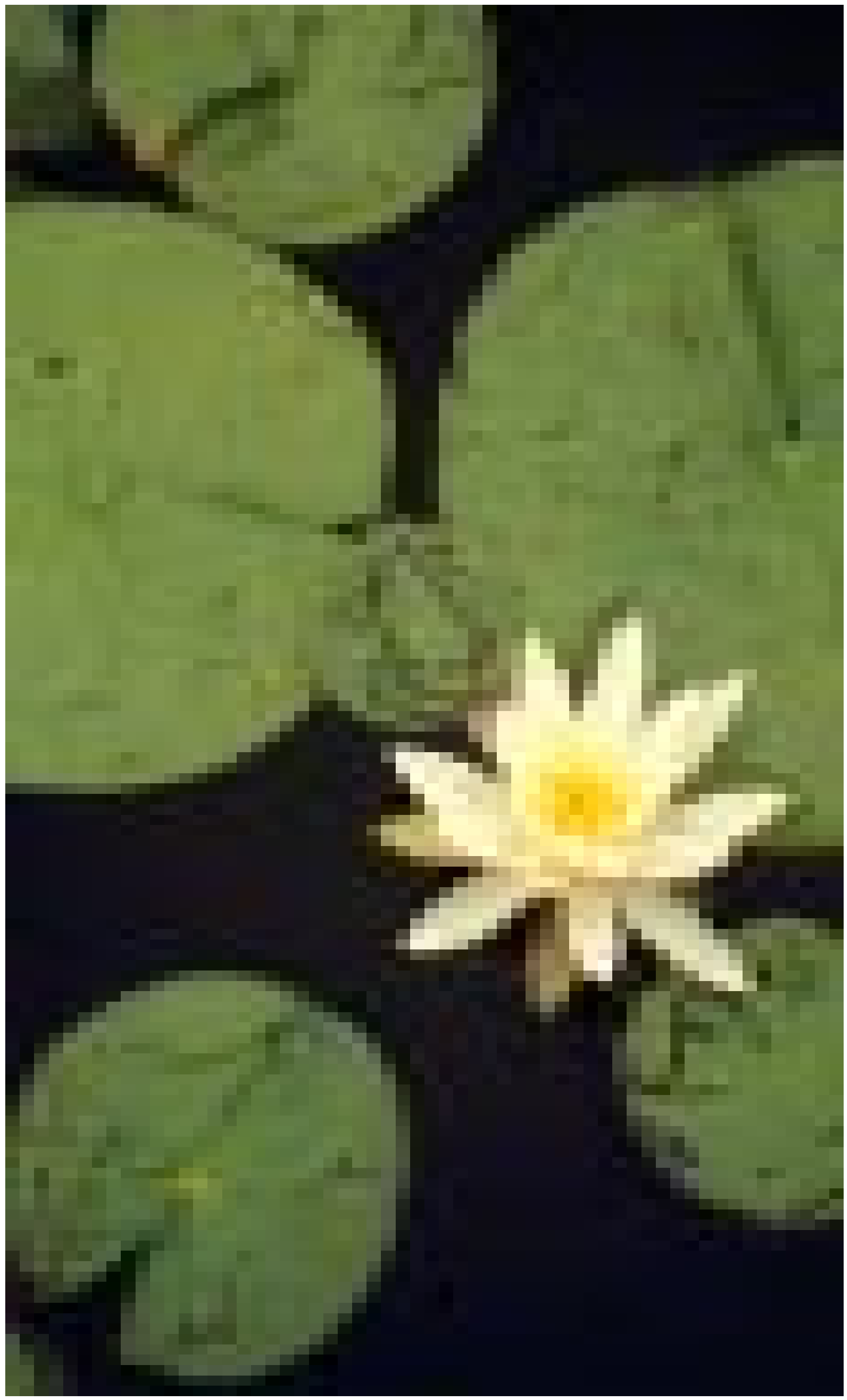
Endothall

Aquatic herbicides containing endothall as the active ingredient function as contact-type, membrane-active herbicides that inhibit photosynthesis. No endothall or toxic metabolite is accumulated in water or hydrosoils; however, fish consumption is prohibited for 3 days following endothall application.

2,4–D

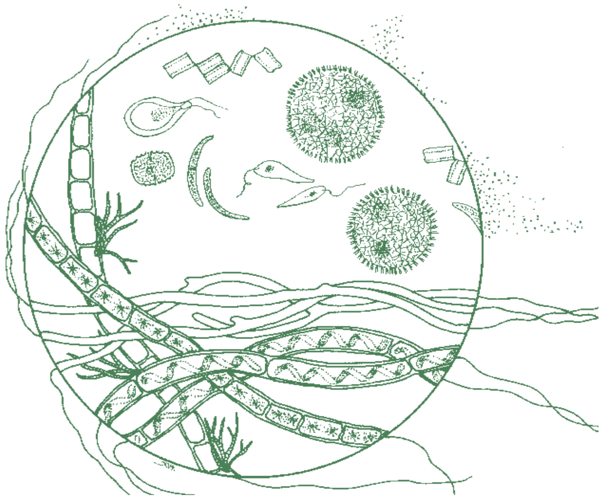
The application of 2,4–D causes the plant cells to divide rapidly and respiration to increase while photosynthesis decreases. The food supply of treated plants is nearly exhausted at their death. The roots of the treated plants lose their ability to take up soil nutrients, and stem tissues fail to move food effectively through the plant. The killing action is not caused by any single factor, but results from the effects of several disturbances in the treated plant.

Commonly Controlled Aquatic Plants of PA



Algae

Algae are simple plants without true roots, leaves, or flowers. They reproduce by cell division, by plant fragmentation, or by spores. They are found either free-floating in the water or attached to other plants, bottom sediments, rocks, or other solid substrates. Three types of algae (see chart below) include *microscopic* algae, mat-forming *filamentous* algae, and *attached branched* algae, also known as *Chara* and *Nitella.*



Algae

Nitella

Chara

Commonly used herbicides for algae control.

Aquatic herbicide	Active ingredient	Planktonic algae	Filamentous algae	Chara and Nitella
Aquashade/Aquashadow/ Lesco Hydroblock	Acid blue 9 dye 23.6% Acid yellow 23 dye 2.4%		x	
Copper Sulfate	$CuSO_4$ 99%	x	x	
Cutrine-Plus	Copper, elemental 9% (triethanolamine complex)	x	x	x
Cutrine-Plus (granular)	Copper, elemental 3.7% (ethanolamine complex)	x	x	x
Earthtec	Copper, elemental 5%	x	x	x
Hydrothol 191	Monopotassium salt of endothall 53%	x	x	x
K-Tea	Copper, elemental 8% (triethanolamine complex)	x	x	x
Lescocide-Plus	Copper, elemental 9% (ethanolamine complex)	x	x	x
Lescocide-Plus (granular)	Copper, elemental 3.7% (ethanolamine complex)	x	x	x

Submerged Aquatic Vegetation

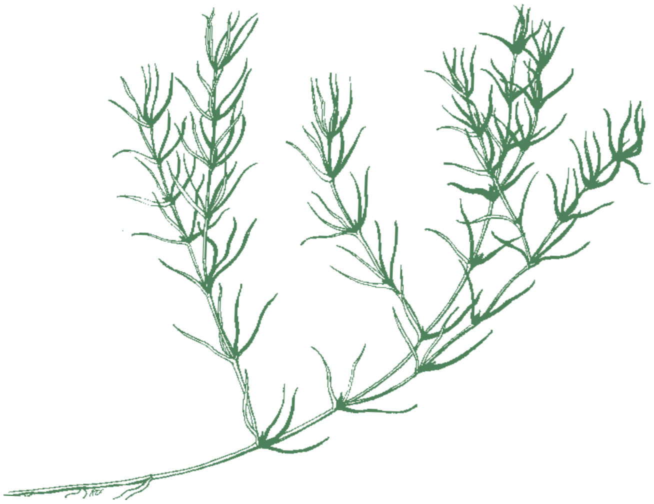
Submerged plants grow in deeper water and usually are attached to the bottom of the pond. They remain underwater until flowers and seeds form out of the water. Examples include pondweed, milfoil, and coontail. Additional plants are included in the chart on page 17.


Curlyleaf pondweed


Largeleaf pondweed


Eurasian watermilfoil

Coontail



Naiad

Elodea

Bladderwort

Commonly used herbicides for submerged aquatic vegetation control.

Aquatic herbicide	Active ingredient	Pondweed (Potamogeton)	Milfoil	Coontail	Naiad	Elodea	Bladder-wort
Aquathol-K	Dipotassium salt of endothall 40.3%	x	x	x	x		
Reward or Diquat	Diquat dibromide 35.3%	x	x	x	x	x	
Weedtrine-D	Diquat dibromide 8.53%	x	x	x	x	x	x
Hydrothol 191	Monopotassium salt of endothall 53%	x	x	x	x	x	
Sonar SRP	Fluridone 5%	x	x	x	x	x	x
Komeen	Copper, elemental 8% (ethylenediamine complex)	x	x	x		x	

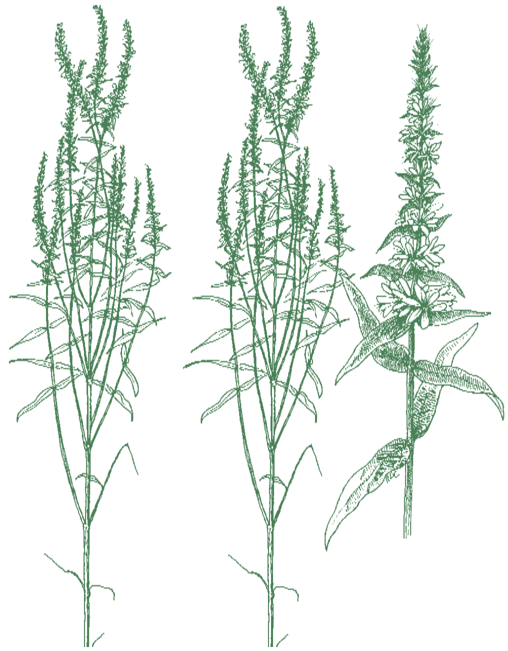
Emergent Plants

Emergents grow along the water body edges, with only short portions of their stems and roots submerged. Sometimes called marsh plants, they tend to cause fewer problems for water users than the other plants. Examples include cattail, water lily, rushes, and arrowhead. Additional plants are included in the chart on page 19.

Cattail

Common reed (Phragmites)

Bulrush



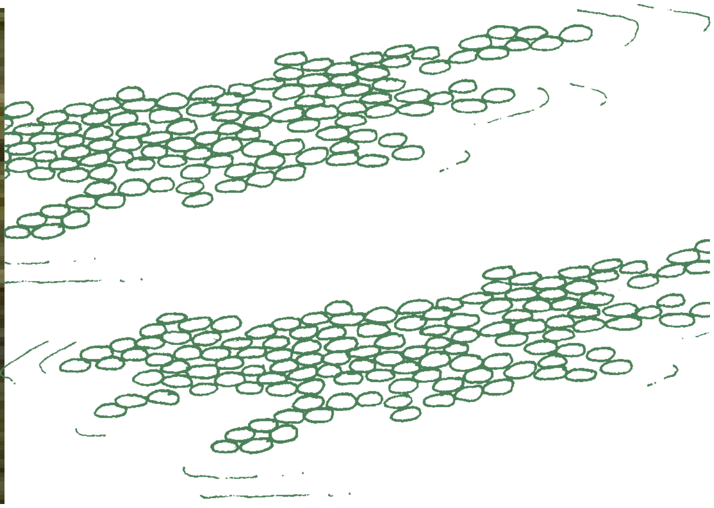
Purple loosestrife

Commonly used herbicides for emergent plant control.

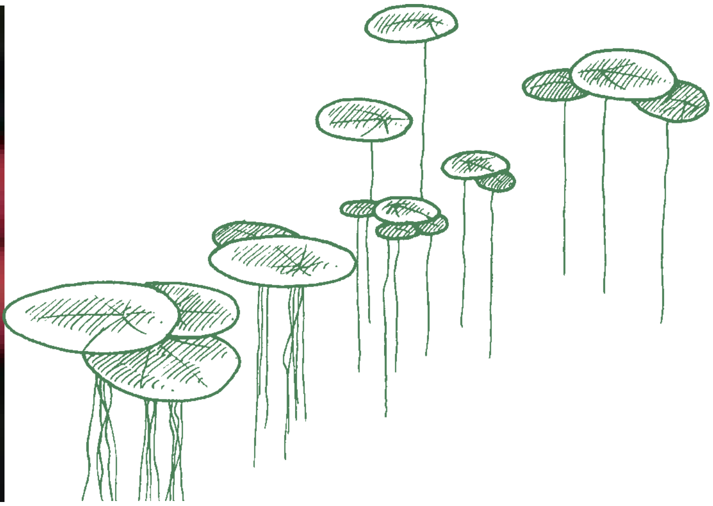
Aquatic herbicide	Active ingredient	Cattail	Common reed (Phragmites)	Bulrush	Arrowhead	Pickerelweed	Purple loosestrife
Rodeo	Glyphosate 53.8%	x	x		x		x
Weedtrine II	2,4–D (28.9%)			x	x	x	

Floaters

Floaters are rooted plants that have much of their plant structure, especially leaves, floating on the water surface. They also can be unattached like duckweed, which obtains its nutrients through small rootlets dangling in the water. Examples include watermeal and spatterdock. Additional plants are included in the chart on page 21.

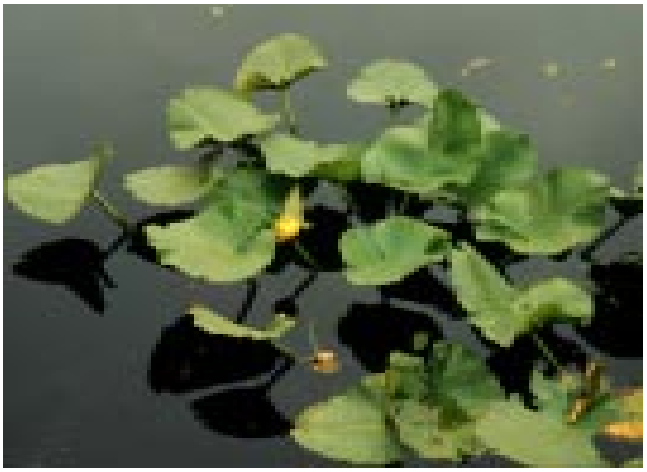


Watermeal (on index finger, compare to larger duckweed)



Duckweed

Water lily with extracted root system




Spatterdock


Watershield

Commonly used herbicides for floating plant control.

Aquatic herbicide	Active ingredient	Watermeal	Water lily	Duckweed	Spatterdock	Watershield
Rodeo	Glyphosate 53.8%		x		x	x
Sonar A.S.	Fluridone 41.7%	x	x	x	x	
Aqua-Kleen/Aquacide/ Navigate	2,4–D (20–27.6%)		x		x	x

Dosages and summary of commonly used herbicides for aquatic plant control.

Aquatic herbicide	Active ingredient	Controls	Dosage
Algae			
Aquashade/Aquashadow/ Lesco Hydroblock	Acid blue 9 dye 23.6% Acid yellow 23 dye 2.4%	Filamentous algae, early suppression of some submerged plants.	1 qt/acre-ft
Copper Sulfate	$CuSO_4$ 99%	Flagellated algae	.68–1.36 lb/acre-ft
Cutrine-Plus	Copper, elemental 9% (triethanolamine complex)	Planktonic/filamentous algae, Chara and Nitella	0.6 gal/acre-ft 1.2 gal/acre-ft
Cutrine-Plus (granular)	Copper, elemental 3.7% (ethanolamine complex)	Planktonic/filamentous algae, Chara and Nitella	60 lb/acre
Earthtec	Copper, elemental 5%	Planktonic/filamentous algae, Chara and Nitella	0.22 gal/acre-ft
Hydrothol 191	Monopotassium salt of endothall 53%	Planktonic/filamentous algae, Chara and Nitella	0.6–2.2 pt/acre-ft
K-Tea	Copper, elemental 8% (triethanolamine complex)	Planktonic/filamentous algae, Chara and Nitella	0.7–1.7 gal/acre-ft 1.7–3.4 gal/acre-ft
Lescocide-Plus	Copper, elemental 9% (ethanolamine complex)	Planktonic/filamentous algae, Chara and Nitella	0.6 gal/acre-ft 1.2 gal/acre-ft
Lescocide-Plus (granular)	Copper, elemental 3.7% (ethanolamine complex)	Planktonic/filamentous algae, Chara and Nitella	60 lb/acre
Submerged aquatic vegetation			
Aquathol-K	Dipotassium salt of endothall 40.3%	Pondweed (Potamogeton), milfoil, coontail, naiad	0.6–1.9 gal/acre-ft
Reward or Diquat	Diquat dibromide 35.3%	Coontail, elodea, naiad, pondweed, milfoil	1–2 gal/acre
Weedtrine-D	Diquat dibromide 8.53%	Bladderwort, coontail, elodea, naiad, pondweed, milfoil	5–10 gal/acre
Hydrothol 191	Monopotassium salt of endothall 53%	Naiad, elodea, coontail, pondweed, milfoil	0.7–3.4 gal/acre-ft
Sonar SRP	Fluridone 5%	Bladderwort, coontail, elodea, naiad, pondweed, milfoil	3.2–5 lb/acre-ft
Komeen	Copper, elemental 8% (ethylenediamine complex)	Milfoil, elodea, pondweed, coontail *(not an algicide)*	1.7–3.3 gal/acre-ft
Emergent plants/floaters			
Rodeo	Glyphosate 53.8%	Cattail, water lily, arrowhead, spatterdock, watershield, purple loosestrife, common reed	0.75 gal/acre
Sonar A.S.	Fluridone 41.7%	Duckweed, watermeal, spatterdock, water lily. Also coontail, elodea, pondweed, milfoil	< 5' deep .16–1.25 qt/af > 5' deep 1–1.5 qt/af
Weedtrine II	2,4–D 28.9%	Arrowhead, bulrush, creeping water primrose, pickerelweed	200 lb/acre
AquaKleen/Aquacide/ Navigate	2,4–D 20–27.6%	Water lily, spatterdock, watershield. Also milfoil, bladderwort	150–200 lb/acre 100–150 lb/acre

Note: See product label for use and dose details.

Illustrations
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Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U. S. Department of Agriculture.

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