**ENDOTHALL: HERBICIDE TREATMENT FAQ**

**FREQUENTLY ASKED QUESTIONS ABOUT THE USE OF ENDOTHALL TO TREAT HYDRILLA IN CAYUGA INLET**

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(PDF Version. One-page summary)

**What is Endothall?**

Endothall is a selective contact herbicide that has been used to manage submerged aquatic vegetation for over 50 years. The herbicide damages the cells of susceptible plants at the point of contact but does not affect areas untouched by the herbicide, like roots or tubers (underground storage structures). It is selective in the sense that some plants show greater susceptibility to endothall treatment than others; for example, hydrilla is very susceptible and elodea, a common native plant is not (See: Will Applications of Herbicide Harm Native Aquatic Plants? below)

Endothall (7-oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid) is in the dicarboxylic acid class of chemicals. Endothall is applied as either a dipotassium salt or an amine salt, which then breaks down after application to endothall acid, the form that acts as a herbicide. Either the dipotassium or amine salt can be used in aquatic applications.

Endothall works by interfering with plant respiration, affecting protein and lipid biosynthesis, and disrupting plant cell membranes (Senseman 2007, Madsen et al. 2010, US EPA 2005). It causes cellular breakdown of plants within 2-5 days. Symptoms of plant damage - including defoliation and brown, shriveled tissues - will occur naturally in our bodies.

Biotransformation of endothall occurs mainly by the tricarboxylic acid cycle after splitting of the oxabicyclo ring. Glutamic acid is the primary breakdown product. Minor metabolites include aspartic and citric acids, alanine, phosphate esters (not positively identified) and an unidentified product (HSDB, 1994 as cited in Sikka and Saxena, 1973). * (See page 103, Endothall: Environmental Fate/Transport).

The Tricarboxylic Acid Cycle is also known as the Krebs Cycle or the Citric Acid Cycle which is a series of chemical reactions used by all aerobic organism to generate energy. The byproducts cited i.e., glutamic acid, aspartic acid and alanine are amino acids which are the building blocks of proteins. Citric acid is a weak organic acid used to add a sour taste to food or drinks.

Adapted from the endothall summary information provided as part of the Massachusetts Aquatic Vegetation Management.

**IMPACTS ON BASS**

**Impacts of Endothall Application on Largemouth Bass Spawning Behavior and Reproductive Success**

The US EPA has approved application rates of 0.5 - 5.0 mg/L (= ppm, parts per million) of the dipotassium salt formulation of endothall for the control of aquatic plants, including the invasive species Eurasian watermilfoil and hydrilla. Tompkins County Soil and Water Conservation district is proposing an application rate of 3.0 ppm, the
**Is endothall toxic to animals or humans?**

The use of any aquatic herbicide poses risks to non-target plants and aquatic organisms. However, federal and state pesticide regulations and strict application guidelines are in place to minimize exposure of non-target organisms. Aquatic organisms will only receive short-term exposure to endothall in the water as a result of dispersion, dilution and microbial degradation of the chemical into carbon, hydrogen, oxygen and organic acids.

The dipotassium salt formulation of endothall applied at the concentrations approved by the US EPA (0.5 - 5.0 ppm) has not been found to be toxic to waterfowl and wildlife. Standard toxicity studies, required to fulfill EPA registration requirements for pesticides, have been conducted on mammals (rats, guinea pigs, rabbits; as reviewed in Extension Toxicology Network 1995) and birds (boobwise quail, mallard ducks; as reviewed in Mattson et al.2004). The concentrations of endothall found to be toxic to these animals far exceeds the rate of application and the concentrations that would be encountered by organisms in the aquatic environment.

Additionally, these studies indicate that the concentration of endothall in treated areas of the Cayuga Inlet will not be toxic to dogs, cats, or livestock incidentally exposed to the herbicide. However, as a precaution, the Aquathol K label restricts the watering of animals and livestock for 14 days after herbicide application. Signage installed along pathways adjacent to the Inlet will notify dog-walkers of the endothall application and the subsequent water use restriction.

The toxicity of the dipotassium salt formulation of endothall as applied in the water has also been tested on a number of non-target aquatic organisms, including aquatic invertebrates (water fleas and scuds; dragonflies and damselflies), fish (walleye, smallmouth and largemouth bass, bluegills), and softshell turtles. Lethal effects were observed in the invertebrates and fish only at very high concentrations that far exceed those experienced under labeled treatment concentrations (US EPA Office of Pesticide Programs 2011; Paul et al 1994): softshell turtles did not experience any lethal toxic effects (Paul & Simonin 2007).

Endothall does not concentrate in animal tissue, that is to say, it does not bioaccumulate. Fish and livestock that incidentally consume treated water will rapidly excrete endothall; it does not concentrate in meat. There are no restrictions for catching and eating fish from treated waters.

Endothall has not been found to cause neurological damage or cancer (US EPA 2005). No human deaths and very few incidents of illness have been reported due to endothall. Generally, reports have been limited to skin or eye irritation in people occupationally exposed to concentrated endothall (e.g., pesticide applicators). No hospitalizations have been reported due to endothall use (US EPA 2005).

**Where, when and how was endothall applied in 2011?**

The 2011 permit for application of Aquathol K to 95 acres of the Cayuga Inlet (see map) was received by the NYS Department of Conservation. Applications occurred on Oct 11 and 12 after permit approval and when there was a 3-4 day window of good weather (no precipitation and ideally with north winds).

The 95-acre Cayuga Inlet treatment area was bounded by the eastern jetty and lighthouse at the mouth of the Inlet to the north and the Rte. 79 (State St) bridge to the south. The treatment area included the Allan S. Treman State Marina, Johnson’s Boatyard & Marina, the Linderman Inlet and paddle docks at Cass Park, the Ithaca Farmers Market dock and portions of Cascadilla Creek, the embayment near the Cornell crew team boathouse, and the west side of the Inlet Island.

The treatment area was located away from major swimming areas and 3 miles from the municipal water intake at Bolton Point. Additionally, the Tompkins County Sheriff closed the Cayuga Inlet before, during, and after treatment to allow adequate and uninterrupted time for the Aquathol K to affect hydrilla.

This research paper states the research behind certain aquatic herbicides and their effects on fish spawning and reproductive success. The aquatic herbicide being examined is Aquathol K and the fish species corresponding with the research is that of the Largemouth Bass.

Aquatic herbicides are used in the eradication process of many different types of aquatic invasive plant species. Hydrilla is an example of one of these invasive aquatic plant species where the use of certain aquatic herbicides are very effective if done properly. The main goal of the research being mentioned is to address the concerns of anglers and the public about the effects of aquatic herbicides on different aquatic species such as fish rather than the targeted species that it is meant for.

Endothall was applied to achieve a concentration of 3 mg/L for an entire pond were it was directly applied to largemouth bass nest in three ponds in the month of March for three consecutive years which were 2005, 2006, and 2007. This same procedure was done using water instead of Endothall within another three ponds in order to create a controlled group. The applications were all applied at the time of the initial spawning of the largemouth bass.

Spawning activity was monitored throughout the 3 years and results were gathered. The findings showed that endothall did not affect nest guarding by the bass. Nest fidelity was also similar to that of the controlled ponds even after endothall concentrations declined but were still present. Examinations of young largemouth bass, 2-3 months after spawning, that has been in contact with endothall showed that the relative abundance and size was similar to that of the controlled groups. These findings provide evidence to the anglers and public that the application of this type of aquatic herbicide did not directly affect the spawning behavior and reproductive success of largemouth bass.

The licensed pesticide applicator, Allied Biological, applied Aquathol K below the water surface using air-boats outfitted with special booms. Areas that are inaccessible to air boats were be treated using a hand-sprayer.

**How long does endothall last in the water after treatment?**

In aquatic environments, endothall acid typically persists in the water less than 10 days (US EPA 2005). The half-life of a pesticide is a standard measure for pesticides and refers to the time it takes for half of an applied product to break down (Extension Toxicology Network 1995). In well-oxygenated water like the Cayuga Inlet, endothall has a half life of less than 7 days; it degrades more slowly under low oxygen conditions (US EPA 2005).

**Is water safe to drink or swim in after endothall treatment?**

The US EPA established the maximum contaminant level (MCL) for endothall in drinking water at 0.1 ppm (parts per million; this unit of measurement is also equivalent to mg/L) (US EPA 2011). This means the use of water for human consumption is prohibited when concentrations of the active ingredient (endothall) are greater than 0.1 ppm in the treated water. The US EPA has set this level of protection based on the best available science to prevent potential health problems. Some people who drink water containing endothall well in excess of the MCL for many years could experience problems with the stomach or intestines.

The New York Sanitary Code for public water supplies regulates endothall as an Unspecified Organic Contaminant (UOC), and has established the MCL for UOC at 0.05 ppm (or 50 ppb, parts per billion). This state rule takes precedence over the EPA limit, and means that human consumption of water is prohibited when endothall concentrations are greater than 0.05 ppm.

In 2011, Endothall levels were monitored within the 95-acre Cayuga Inlet treatment area as required by the NYS DEC pesticide permit. In addition, the Tompkins County Department of Health, working in cooperation with the City of Ithaca, developed a water quality monitoring program for three locations in the Cayuga Inlet and adjacent tributaries upstream of treatment area and five locations on the southern shelf of Cayuga Lake. Water samples were collected after the Aquathol K application and then 3, 7, and every 7 days thereafter until endothall levels were undetectable. View 2011 water monitoring results.

The label for Aquathol K requires potable drinking water intakes be 600 feet away from the site of application. The Bolton Point water intake is located three miles from the Inlet at a depth of 75 feet. Lake house owners, some of whom do not use municipal water but pull directly from Cayuga Lake, would have been notified of the Aquathol K application as a precaution if there had beena residence within 600 feet of the treatment area.

The Special Local Need Label # EPA SLN No. NY-980002 (49kb, PDF) prohibits swimming and bathing in treated waters for one day after application. This restriction is an extra safety precaution to minimize potential exposure to the chemical; endothall is poorly absorbed through skin and the small amounts that might be ingested while swimming are not considered toxic or harmful.

Additional water use restrictions and prohibitions as required by law include:

- Irrigation or spraying of agricultural crops is prohibited for 14 days after application.
- Use of water for domestic purposes is prohibited for 14 days after application.

**Will applications of herbicide harm native aquatic plants?**

Hydrilla, the target of the endothall application in the Cayuga Inlet, reproduces primarily by fragmentation and vegetative buds (turions). Native aquatic plants are largely seed producers, and seed production is well underway now. Seeds will not be affected by the endothall treatment, and will germinate next year.

Endothall is strictly a contact herbicide. It killed the growing green vegetation that it contacts in the water, but will not translocate to the roots and will not kill the roots.
Thus, submerged plants that lose green vegetation after treatment will be able to sprout next season from living root stock in the sediment.

Hydrilla is considered highly susceptible to the effects of endothall. Yet, not all aquatic plants are considered equally susceptible to the effects of the herbicide (NYSFOLA 2009). Common waterweed (Elodea canadensis), a beneficial native plant found in Cayuga Lake, for example, has low susceptibility to the herbicide. Other common native plants, including eelgrass (Vallisneria americana) and water stargrass (Zosteralesia dubia), are considered to have medium susceptibility to endothall. Some other plants, including some pondweeds (Potamogeton sp.), coontail (Ceratophyllum demersum), and Eurasian watermilfoil (Myriophyllum spicatum), are expected to be highly susceptible to endothall treatment at the concentrations anticipated in the Cayuga Inlet.

Significant dilution of Aquathol K occurred by the time treated water left the Inlet and entered Cayuga Lake, and thus there was minimal impact on the aquatic plants growing on the southern shelf of Cayuga Lake.

Was the 2011 herbicide treatment successful?
Post-treatment monitoring of treated areas indicated that at least 90 percent of the vegetative portions of the hydrilla were killed (5 mb pdf), with minimal impact to other species. The reproductive and propagation potential of hydrilla plants in these areas was significantly reduced, as was the potential for passing boat-traffic to chop up and spread plant fragments. The Hydrilla Task Force anticipated that the Aquathol K treatment would result in significant, but not complete control of hydrilla in the treatment area. The results that we observed - including significant biomass decline, accompanied by some delayed die-off and the initiation of new shoots - are consistent with observations from other water bodies in the Northeast where Aquathol K has been previously used to control other invasive aquatic plants (e.g., Eurasian watermilfoil). The data we collected during post-treatment monitoring will provide important information about how hydrilla responds to endothall treatment late in the growing season, information that was previously lacking for the Northeast. Moreover, the results we report here will be used to inform follow-up management actions next spring.

CITATIONS


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