



[Ecology home](#) > [Water Quality](#) > [Eurasian Watermilfoil Eradication and Control Strategies](#) > Treatment with of Eurasian Watermilfoil with Selective Herbicides

Milfoil Infested Lake Control Strategies

Eradication – Treatment with Selective Herbicides – 2,4-D and Triclopyr-TEA

2,4-D and triclopyr-TEA are relatively fast-acting selective herbicides that kills the entire plant (systemic herbicide). They have similar modes of action, primarily as a stimulant of plant stem elongation. Scientists consider these herbicides “selective” for milfoil because they generally target the broad-leaved plants (dicots) like milfoil. Most other aquatic plants are monocots (grass-like) and are unaffected by 2,4-D and triclopyr.

Using a selective herbicide is an excellent way of selectively removing Eurasian watermilfoil while allowing native plants to flourish. Navigate® and Aqua-Kleen® are granular 2,4-D products (ester formulations) registered for aquatic use and DMA*4IVM® is a liquid formulation (amine formulation). Renovate® is a liquid formulation of triclopyr. There may also be generic products on the market for both herbicides.

Waterbodies suitable treatment with selective herbicides

Sites suitable for treatment include lakes or ponds partially or completely infested with Eurasian watermilfoil. These herbicides are particularly suitable for spot treatments because they are fast-acting herbicides that only need a 48-hour contact time with the plant for effective treatment.

Granular formulations of 2,4-D appear slightly less effective in killing all milfoil plants than the liquid formulation - 85-95 percent efficacy for the granular formulations versus up to 100 percent efficacy with the liquid formulation. Because some plants remain alive and scattered throughout the littoral zone after 2,4-D treatment with the granular product, hand pulling extensive areas after treatment may not be effective in heavily infested lakes. Lake residents must be willing to fund the follow-up activities necessary to ensure continued milfoil eradication (or maintenance at extremely low amounts).

Applicators must identify water users need to be prior to herbicide application due to drinking water and irrigation concerns. For 2,4-D, water within the treatment areas cannot be used for drinking until 2,4-D concentrations have declined to 70 ppb and water used for irrigation cannot be used until 2,4-D concentrations are 100 ppb or less. If water users do not have other water sources, the project proponents must arrange for alternative water supply during the time that 2,4-D is in the water.

In Washington, testing has shown that water both inside and outside of the area treated with granular formulations is generally below the drinking water standard one to three days after treatment. Granular 2,4-D products are good to use in water bodies where drinking or irrigation water supply is of concern. While more effective in removing Eurasian watermilfoil, the liquid formulation of 2,4-D is much more persistent in the water. Water concentrations have been measured still above the drinking water standard for more than 30 days after treatment in a small lake.

Applicators need coverage under a permit called a National Pollutant Discharge Elimination System Permit (NPDES) permit to treat water bodies with aquatic herbicides in Washington. Obtain NPDES coverage under the Aquatic Plant and Algae Management general permit.

Description of a milfoil eradication project in Washington using 2,4-D

Lakes where 2,4-D is being used for milfoil eradication in Washington typically have milfoil scattered in patches within the littoral zone. The lake is surveyed immediately prior to herbicide application, milfoil locations are mapped, and Global Positioning System (GPS) points established.

Herbicide application can begin as soon as milfoil starts rapidly growing. Effective treatments can be made as early as April or May and as late as early September or even October. Timing is also dependent on salmon usage since juvenile salmonids should not be exposed to certain herbicides. Under a court decision, the granular (ester) formulations of 2,4-D cannot be used in waters with threatened or endangered salmon runs. Applicators may use the amine formulation in salmon-bearing waters, but its use is subject to fish timing windows. Follow spring/summer treatment by a late summer survey and possible retreatment if large patches remain or if more milfoil is discovered in untreated areas of the lake.

A month after the initial 2,4-D treatment, the littoral zone of the lake should be thoroughly inspected by divers to identify and map remaining milfoil plants. Sparse populations of remaining milfoil plants should be hand pulled or covered with bottom barrier. Larger, denser patches may need to be treated again with 2,4-D or another selective herbicide, although in that case some assessment should be made as to why the initial treatment was ineffective. Diver and surface inspections should continue at least twice a year during the growing season. Survey work should be as frequent as can be afforded since divers may overlook small milfoil plants within the native plant beds. Often divers report finding two-to-three foot tall milfoil plants in areas that they had extensively searched only three weeks earlier. Water quality can hamper diver visibility (algae blooms or tannin-stained waters).

It is a law that only state-licensed applicators may apply aquatic herbicides in Washington under an NPDES permit. The granular formulation of 2,4-D is typically applied using a bow-mounted centrifugal or blower-type spreader and the pellets are uniformly spread over the water above the milfoil beds and slightly beyond. The clay particles sink to the bottom or are caught in the plants. The herbicide slowly releases from the clay and the plants take up the herbicide. Applicators generally recommend granular formulations for spot treatment since liquid applications may have more tendencies to move away from the application site. When the liquid formulation is used, it is extremely important for applicators to apply it using subsurface injection methods. If Ecology funds the project through an Ecology grant or if there are irrigation or drinking water concerns, monitoring will be required. A 2,4-D analysis test kit may be available soon or environmental laboratories can also perform 2,4-D analysis. Rapid turn around of results costs more.

General impacts of 2,4-D treatment

2,4-D is a selective herbicide and Eurasian watermilfoil is particularly susceptible at a labeled rate of about 100 pounds per acre (granular product). If using the liquid formulation, an effective rate is 2 ppm (maximum label rate is 4 ppm). At these rates, impacts to most other aquatic plant species are minimal. Even if applied at higher rates there are only a few other aquatic plant species that are affected by 2,4-D. A study conducted in Loon Lake Washington showed that Eurasian watermilfoil was the only aquatic plant whose growth was statistically reduced by the 2,4-D application (Parsons, et. al, 2001). In the Loon Lake study up to 98 percent of the Eurasian watermilfoil biomass in the treatment plots was removed after a July treatment.

[Click here to see Ecology's risk assessment for the environmental and human health impacts of 2,4-D.](#)

[Click here to see Ecology's risk assessment for the environmental and human health impacts of triclopyr-TEA.](#)

A few days after the 2,4-D treatment, observers will see the growing tips of milfoil plants twist and look abnormal. These plants will sink to the sediments usually within one to two weeks of treatment. Unless treatment takes place in dense beds of milfoil, it is unlikely for low oxygen conditions to develop. Results of spot treatment may be variable depending on water movement, size of treatment plot, size of the water body, density of milfoil, weather conditions, underwater springs, etc.

Follow-up

Follow-up is essential to ensure the success of eradication. Without follow-up, selective herbicides are not eradication tools. Some plants survive the treatment and regrow so these plants must be removed by other means. Surveys done in Minnesota indicated that, 2,4-D use did not result in eradication of milfoil over the long-term (Crowell, 1999). Treated lakes for which there was no follow up survey work or treatment eventually ended up with milfoil throughout the littoral zone.

There is some anecdotal evidence that milfoil plants may become resistant to 2,4-D or more herbicide-tolerant milfoil hybrids may occur (between Eurasian watermilfoil and northern milfoil). If this happens and the plant population is too large to be hand removed, consider using alternative herbicides such as triclopyr. There is also some anecdotal evidence that milfoil may germinate from seeds in areas where water levels dropped and then returned. This may happen in low rainfall or low runoff years. It is important to check those areas when the water returns to remove any milfoil that may have germinated.

Follow-up is the key

Once milfoil is discovered in a lake, it generally requires continual maintenance to keep it at low levels. Even if milfoil appears to have been eradicated it often is reintroduced by boaters or may germinate from seeds. As long as a lake group continues surveying on a yearly basis, new introductions can be identified quickly and targeted for removal before milfoil can re-establish in the lake. In treated lakes where a lake group has continued diver and surface inspections, milfoil remains at extremely low levels, without impacts to habitat or recreational activities.

Crowell, W.J. 1999. Minnesota DNR tests the use of 2,4-D in managing Eurasian watermilfoil. *Aquatic Nuisance Species Digest*. 3(4):42-46.

Parsons, Jenifer K.; K.S. Hamel, J.D. Madsen and K.D. Getsinger. 2001. The Use of 2,4-D for Selective Control of An Early Infestation of Eurasian Watermilfoil in Loon Lake, Washington: *J. Aquat. Plant Manage.* 39:117-125.

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