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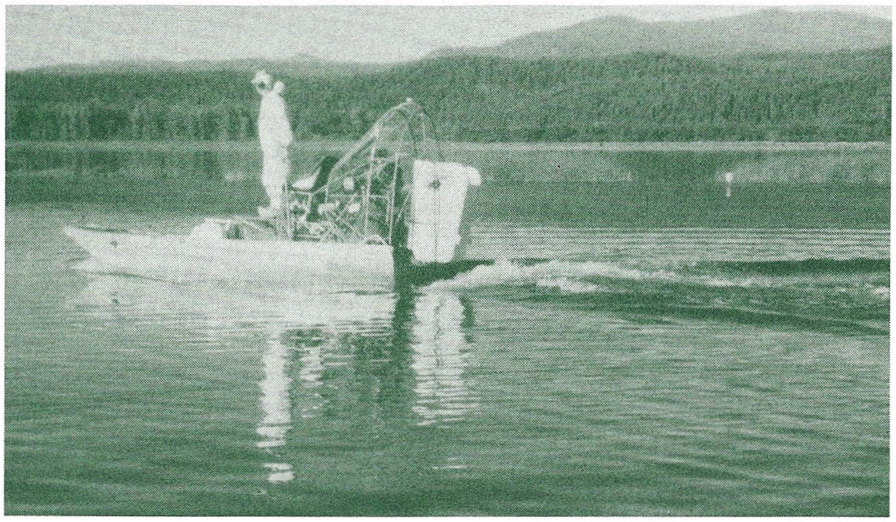

Airboat application of Rhodamine WT dye and triclopyr herbicide on the Pend Oreille River, WA

Field evaluation of the herbicide triclopyr for managing Eurasian watermilfoil

by

Kurt D. Getsinger, E. Glenn Turner, and John D. Madsen

The herbicide triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid), formulated as a triethylamine salt (Garlon 3A), has been used for over 15 years to control broadleaf weeds in forestry, industrial, and other noncrop terrestrial sites. Triclopyr is an auxinlike, systemic herbicide with a mode of action and spectrum of weed control similar to that of phenoxy herbicides, such as 2,4-D (2,4-dichlorophenoxy acetic acid). Manufactured by DowElanco, triclopyr is registered for aquatic sites through 1992 under a Federal Experimental Use Permit (EUP). The US Environmental Protection Agency is currently considering the product for full aquatic registration. Previous field evaluations have shown that triclopyr can provide aquatic plant managers with a feasible alternative to 2,4-D for controlling Eurasian watermilfoil, waterhyacinth, alligatorweed, melaleuca, purple loosestrife, and other nuisance vegetation (Getsinger and Westerdahl 1984, Langeland 1986, Green and others 1989, and Wujek 1990).

Results from concentration/exposure time studies conducted at the US Army Engineer Waterways Experiment Station (WES) showed that triclopyr provided excellent control of the submersed species Eurasian watermilfoil (hereafter called milfoil) under laboratory conditions when that plant was exposed to concentrations ranging from 2.5 to 0.25 milligram acid equivalent per litre (mg ae/L) triclopyr for 18 to 72 hours (Netherland and Getsinger 1992). In an effort to verify results from these laboratory studies and to evaluate the species-selective properties of triclopyr, WES researchers have been applying triclopyr under an EUP to milfoil-dominated plant communities in the Pend Oreille River, Washington, and Guntersville Reservoir, Alabama. Cooperators in this work have included the Seattle District, the Washington Department of Ecology, the Tennessee Valley Authority, and DowElanco. Results from these field evaluations will furnish guidance for the use of triclopyr in aquatic systems. This article provides an update on the ongoing triclopyr field studies.

Approach

Pend Oreille River

Two plots, located in the Pend Oreille River were selected for triclopyr treatment. A 6-hectare (15-acre) plot was established in a shallow region of the river near river mile 61; while a 4-hectare (10-acre) plot was established in a protected cove near river mile 48 (Figures 1 and 2). An additional area, located upstream from the herbicide applications, was selected to serve as an untreated reference plot (Figure 1). Water depth in the plots ranged from 0.25 to 2.8 meters, and all plots contained dense populations of milfoil, associated with lesser amounts of native macrophytes (for example, elodea, coontail, and pondweeds). In deeper areas of the plots, tips of milfoil plants were 15 to 20 centimeters from the water surface, but in most areas less than 1.5 meters deep, a dense milfoil surface mat had developed.

A tank mix of Garlon 3A and Rhodamine WT (RWT) dye was evenly applied to the river and cove plot, using an airboat, on the mornings of August 21 and 22, 1991, respectively. This mixture was applied at rates calculated to achieve 2.5 mg ae/L (parts per million, or ppm) triclopyr + 10 micrograms per litre (µg/L or parts per billion, ppb) RWT in the river plot, 2.5 mg ae/L triclopyr + 10 µg/L RWT in the south half of the cove plot, and 1.0 mg ae/L triclopyr + 4 µg/L RWT in the north half of the cove plot. These treatment rates were selected based on information obtained from a previous water-exchange study conducted in the plots in August 1990 (Getsinger and others 1991). Results from that 1990 dye study showed that water-exchange half-lives averaged approximately 8 hours in the river plot and 40 hours in the cove plot (with a 17/73 hour, south/north half-life split in the cove plot). This water-exchange information allowed for a 30 percent reduction in the amount of Garlon 3A applied to the cove (compared to the maximum amount permitted under the Garlon 3A EUP label).

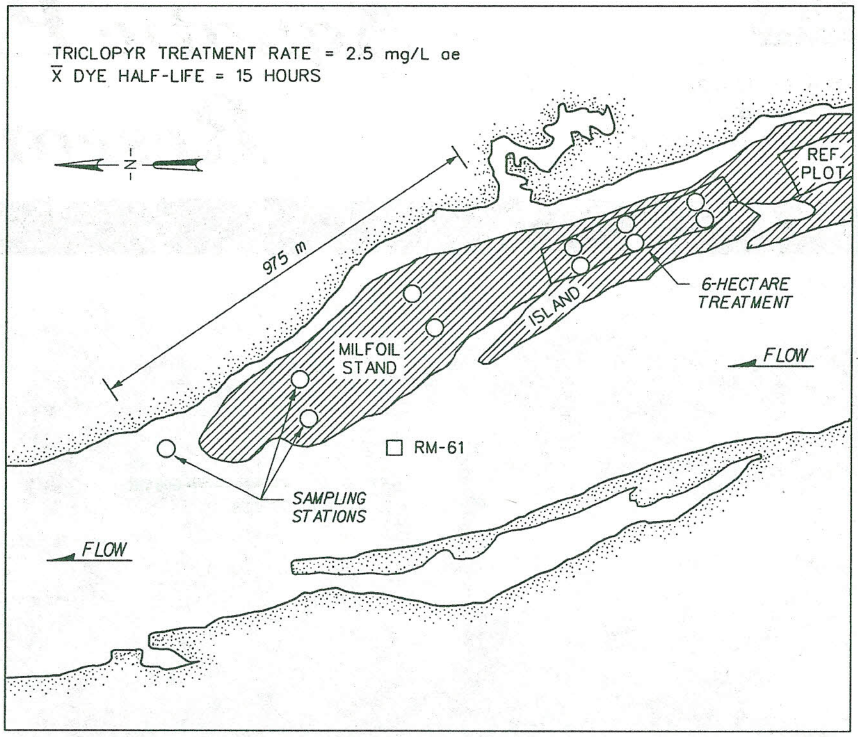

Figure 1. Dye/triclopyr study, river treatment, Pend Oreille River, 1991

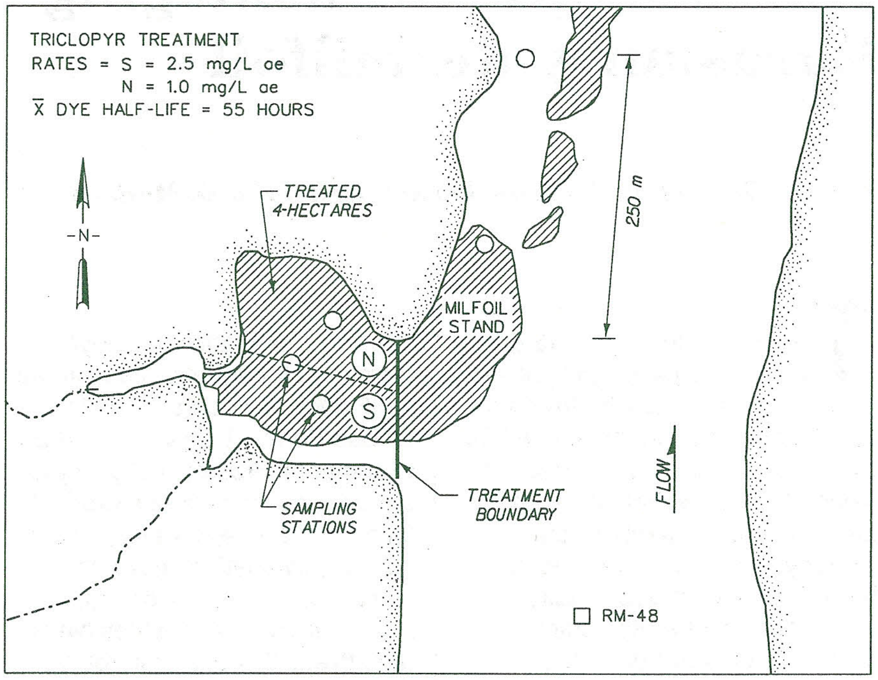

Figure 2. Dye/triclopyr study, cove treatment, Pend Oreille River, 1991

Posttreatment dye concentrations were monitored at selected sampling stations within, and outside of, the plots. Instantaneous dye readings taken during the study were used to predict any off-target herbicide movement, thereby improving the selection of water sampling stations located outside of the treated plots. In addition, water samples were concurrently collected with these dye measurements and stored for later triclopyr residue analysis. These data will be used to compare the dissipation of triclopyr with that of the dye following application. In an effort to characterize herbicide efficacy and selectivity, pretreatment and posttreatment plant diversity and biomass samples were collected in all plots.

Guntersville Reservoir

Two plots were selected for triclopyr treatment: plot 1, a 4-hectare (10-acre) area approximately 2 kilometres downstream of Comer Bridge near river mile 385; and plot 2, a 2-hectare (5-acre) area approximately 1 kilometre upriver of Comer Bridge (Figure 3). Water depth in the plots ranged from 0.5 to 1.75 meters. Dense milfoil growth covered about 90 percent of the surface area of plot 1, while plot 2 contained scattered stands of milfoil, at or near the water surface. These sites were selected based on a history of inconsistent milfoil control following chemical application.

On the morning of September 9, 1991, a tank mix of Garlon 3A and RWT was applied at a rate calculated to achieve 0.5 mg ae/L triclopyr + 10 µg/L RWT in plot 1, and 1.0 mg ae/L triclopyr + 10 µg/L RWT in plot 2. Concurrent dye and herbicide water residues were monitored posttreatment at sampling stations within the plots. In addition, visual efficacy evaluations were conducted during posttreatment periods.

Results and Discussion

Pend Oreille River

Analysis of preliminary posttreatment data and observations indicated that triclopyr provided excellent control of milfoil in both the river and cove plots. Milfoil shoots displayed epinastic twisting by 24 hours after herbicide application and began to sink to the bottom within 3 days posttreatment. At 1 week posttreatment, all milfoil shoots in the treated plots lay prostrate on the sediment, with leaves browning and dropping from the stems. During this period of milfoil degradation, some understory native plants were trapped by the sinking milfoil mats and pulled to the bottom. This situation undoubtedly contributed to a partial decline of native plants in the treated plots. Milfoil in the untreated reference plot remained vigorous and healthy.

The 4-week posttreatment biomass data showed a 99 percent reduction in milfoil shoot mass in both treated plots (Table 1). Although native plant biomass was reduced by 54 percent in the river plot and 76 percent in the cove plot, a similar reduction in native shoot mass (58 percent) was measured in the untreated reference plot. Some of this reduction in native plant biomass can be attributed to late season senescence of these plants, as winter bud formation was observed on the pondweeds in all plots. A visual evaluation at 8 weeks posttreatment indicated that milfoil shoots had completely decomposed in both treated plots, but were still upright and green in the untreated reference area. Furthermore, scattered patches of short native shoots (primarily elodea and coontail) were observed throughout the treated plots. Plant biomass and species diversity assessments will be conducted at 1 year posttreatment to determine the extent of milfoil control and recolonization.

Dye dissipation half-lives (Table 2) characterized water exchange (and potential herbicide dissipation) within the treated plots. This water-

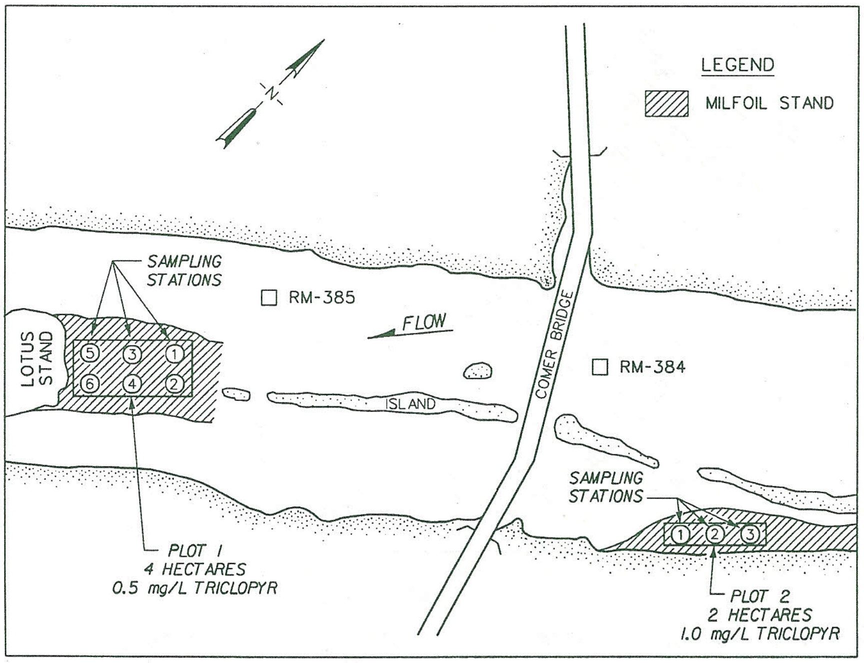

Figure 3. Dye/triclopyr study, Guntersville Reservoir, 1991

Table 1

Mean Pretreatment and 4-Week Posttreatment Shoot Mass for Garlon 3A-Treated Plots in the Pend Oreille River, 1991

	Eurasian Watermilfoil		Native Plants	
		4 Weeks		4 Weeks
Plot	Pretreatment	Posttreatment	Pretreatment	Posttreatment
Reference	291 (±48)*	281 (±36)	12 (±6)	5 (±3)
River	254 (±46)	3 (±2)	39 (±20)	18 (±10)
Cove	257 (±39)	2 (±1)	38 (±16)	9 (±4)

* Values are in grams dry weight per square metre (±1 standard error).

Table 2

Mean Half-Lives of Dye Dissipation for Rhodamine WT-Treated Plots in the Pend Oreille River and Guntersville Reservoir, 1991

Site	Plot	Half-life, hours	Regression Coefficient, r^2
Pend Oreille	River	15*	99
	Cove	55	91
Guntersville	1	2	94
	2	ND	ND

* Values represent mean of all internal sampling stations within each plot.

exchange information can be used to estimate herbicide half-lives within the plots. When these triclopyr half-life values are plotted against laboratory-derived triclopyr concentration/exposure time relationships, milfoil control in the field can be estimated. Figure 4 shows that sufficient triclopyr contact time was maintained to provide excellent initial knock-down and acceptable control of milfoil in the Pend Oreille treatments (verified at the 4-week posttreament biomass evaluation). Moreover, these exposure periods should provide large areas of complete milfoil rootcrown destruction, particularly in the cove plot. A final report, summarizing changes in plant biomass, species diversity, triclopyr efficacy, and dye/triclopyr water dissipation relationships, will be published following the 1-year posttreatment evaluation.

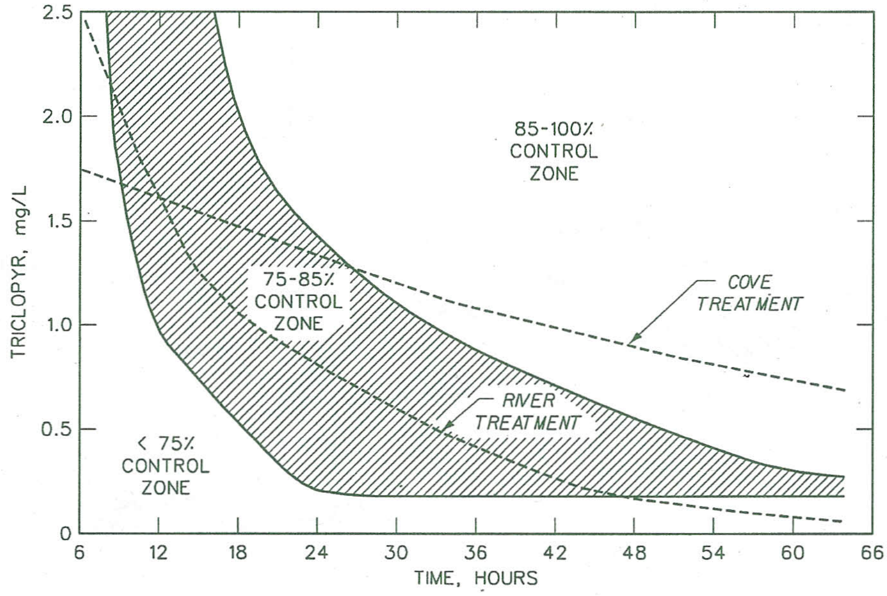

Figure 4. Predicted milfoil control on the Pend Oreille River using water-exchange information and laboratory-derived concentration/exposure time relationships; dashed lines represent estimated triclopyr half-lives

Guntersville Reservoir

Visual evaluations of efficacy conducted at 4 weeks posttreatment indicated a 50 to 60 percent control of milfoil in plot 1, but no observable changes in plant cover or milfoil health in plot 2. Dye dissipation data (Table 2) showed a short water retention time in plot 1, and dye levels were below detection before measurements could be taken in plot 2 (less than 2 hours posttreatment). These dye dissipation results suggest that extremely short triclopyr/milfoil contact times occurred in the treated plots.

Laboratory studies using short triclopyr exposure periods have resulted in good initial knock-down of milfoil, but rootcrown kill was minimal and milfoil regrowth was rapid following removal of the herbicide (Netherland and Getsinger 1992). This type of milfoil control probably occurred in plot 1. In plot 2, the swift disappearance of dye indicated that triclopyr contact time was insufficient to control milfoil.

The results from plot 2 underscore the importance of water-exchange information before herbicide application. Estimates of water movement within planned treatment locations can help managers select the appropriate herbicide, as well as avoid potentially unsuccessful and costly applications. Forthcoming analyses of triclopyr residues in water samples collected during the study will verify actual herbicide/plant contact times. Additional triclopyr evaluations are scheduled for Guntersville Reservoir in 1992.

Summary and Future Work

Preliminary results from the Pend Oreille River and Guntersville Reservoir field studies have demonstrated that triclopyr can be an effective herbicide for the selective control of milfoil, given sufficient contact time. The Pend Oreille cove treatment also demonstrated that if water-exchange patterns can be determined within the target plant stand, herbicide doses below the maximum label rates can be used to provide acceptable plant control. WES researchers will continue to evaluate triclopyr and other promising aquatic herbicides in the field, emphasizing the use of water-exchange information to improve the control of submersed plants in flowing-water systems.

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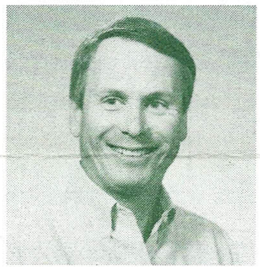

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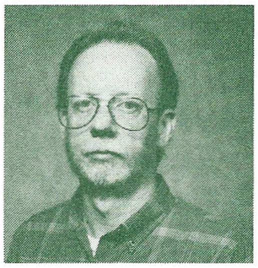

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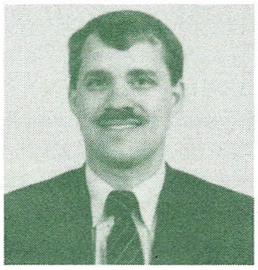

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