MONTANA DEPT of AGRICULTURE NOXIOUS WEED TRUST FUND GRANT
No. 2009-014

Screening Trial of Water Column Injection Herbicides for Flowering Rush Suppression

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FINAL REPORT
Period 4/01/2009-10/15/2010

Activities Completed

Leaf height suppression curves were generated for the first growing season in the greenhouse buckets after injecting 8 different herbicides on May 23, 2009, each herbicide at three rates (Table 1). Figure 1 summarizes the mean leaf height (cm) data for three replicates of each herbicide at the maximum labeled rate. Control was generally less acceptable at mid label rates and certainly unsatisfactory at the low label rates. A number of the water column injection herbicides had high activity, at least at the maximum labeled rates. Endothall formulations (Aquathol K and Hydrothol 191), high rates of granular triclopyr + 2,4-D (Renovate Max), and high rates of granular triclopyr alone (Renovate OTF) provided rapid "first season" suppression. Diquat (Reward) was rapid with intermediate "first season" suppression. Imazamox (Clearcast) and fluridone (Sonar AS) arrested growth after injection, but full leaf knock-down did not occur until the end of the growing season. The copper carbonate (Nautique) was ineffective.

The flowering rush plants in buckets after being treated in May 2009 and reared out in the greenhouse until October 2009, were then given a hard cold treatment (including total freezing) for 2 months, returned to a heated greenhouse in mid Dec 2009, reared out under 12 hour day lighting for two months until mid February 2010. So these plants were in a simulated second growing season post-treatment. The green topgrowth was harvested Feb 18-22, 2010. The dry weight response data are indicative of the degree of rhizome kill. The low "second year" post treatment leaf production for the mid to high rates of Clearcast and the high rate of Renovate OTF are indicative of the highest rate of rhizome kill. These three treatments provided greater than 90% control (Table 2). Renovate Max and Hydrothol 191 at the high rates provided rapid leaf knockdown and at least 75% suppression of topgrowth in the second year post treatment (Figure 1 and Table 2).

Table 1. Herbicides and rates injected into the greenhouse buckets of flowering rush on May 23, 2009.

Product	Label Rate	ppm		Product	Label Rate	ppm
Aquathol K	low	0.500		Renovate OTF	low	1.000
Aquathol K	mid	2.750		Renovate OTF	mid	1.500
Aquathol K	high	5.000		Renovate OTF	high	2.500
Clearcast	low	0.050		Renovate Max	low	1.000
Clearcast	mid	0.225		Renovate Max	mid	2.500
Clearcast	high	0.500		Renovate Max	high	5.000
Hydrothol 191	low	0.500		Reward	low	0.100
Hydrothol 191	mid	2.750		Reward	mid	0.235
Hydrothol 191	high	5.000		Reward	high	0.370
Nautique	low	0.500		Sonar AS	low	0.020
Nautique	mid	0.750		Sonar AS	mid	0.085
Nautique	high	1.000		Sonar AS	high	0.150

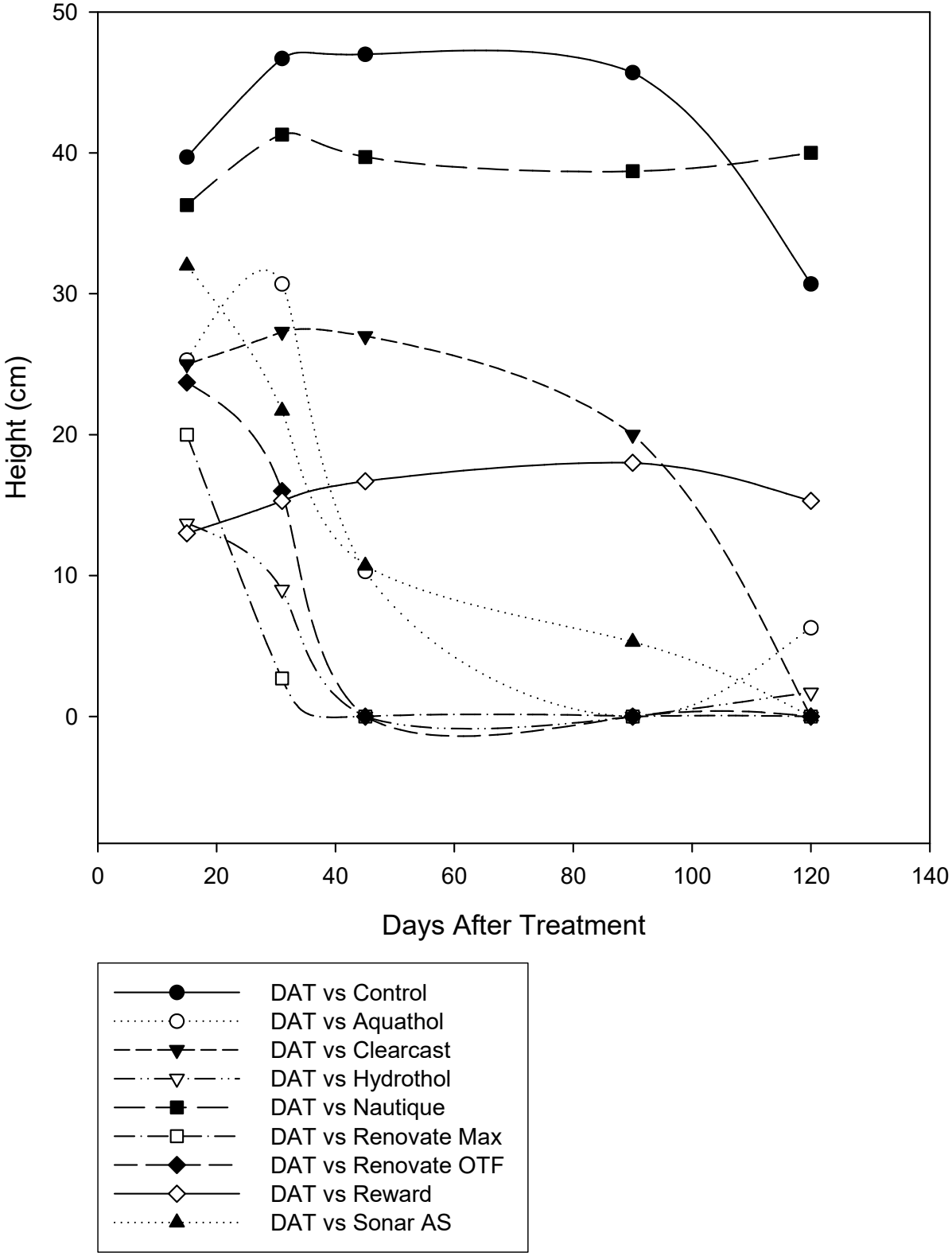

Figure 1. Flowering rush leaf height (cm) following herbicide injection into greenhouse buckets on May 27, 2009. Data is the mean height (cm) for three replicates of each herbicide at the maximum labeled rate.

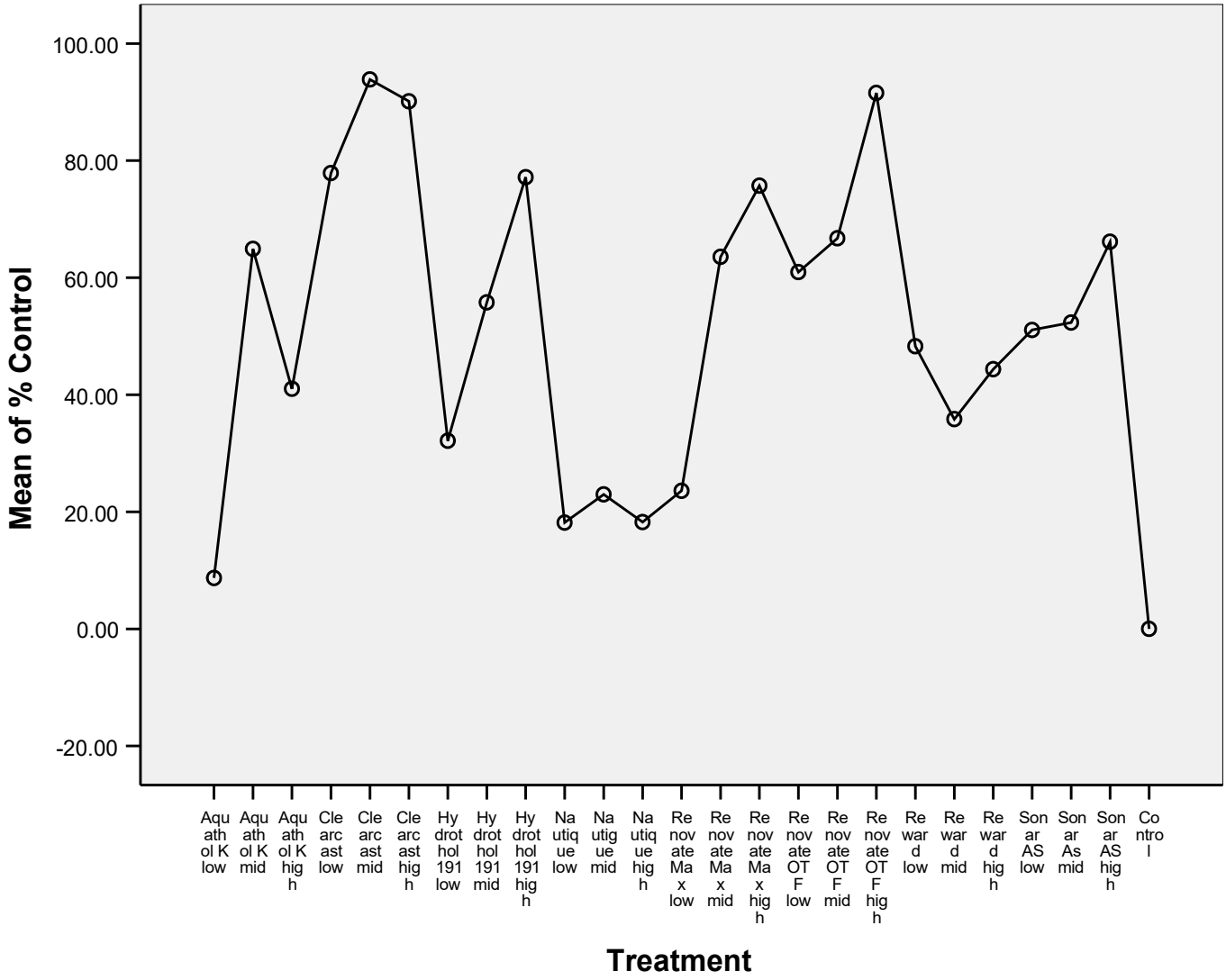

Figure 2. Percent control of flowering rush topgrowth in greenhouse simulated "second year" after herbicide treatments.

Table 2. Dunnett t test of percent control of topgrowth relative to the untreated control group in greenhouse simulated "second year" after herbicide treatments.

Dependent Variable: % Control

Dunnett t (>control)

Treatment	% Control	Std. Error	p.	95% Confidence Interval Lower Bound
Aquathol K low	8.7	15.74	.851	-35.1
Aquathol K mid	64.9 (*)	15.74	.001	21.1
Aquathol K high	41.0	15.74	.074	-2.8
Clearcast low	77.9(*)	15.74	.000	34.0
Clearcast mid	93.9(*)	15.74	.000	50.0
Clearcast high	90.1 (*)	15.74	.000	46.3
Hydrothol 191 low	32.1	15.74	.212	-11.7
Hydrothol 191 mid	55.8(*)	15.74	.007	12.0
Hydrothol 191 high	77.2(*)	15.74	.000	33.3
Nautique low	18.1	15.74	.611	-25.7
Nautigue mid	23.0	15.74	.460	-20.9
Nautique high	18.2	15.74	.608	-25.6
Renovate Max low	23.6	15.74	.442	-20.3
Renovate Max mid	63.5 (*)	15.74	.002	19.7
Renovate Max high	75.7 (*)	15.74	.000	31.9
Renovate OTF low	61.0(*)	15.74	.003	17.2
Renovate OTF mid	66.7 (*)	15.74	.001	22.9
Renovate OTF high	91.6(*)	15.74	.000	47.7
Reward low	48.3(*)	15.74	.026	4.4
Reward mid	35.8	15.74	.142	-8.0
Reward high	44.4(*)	15.74	.046	0.5
Sonar AS low	51.1(*)	15.74	.016	7.2
Sonar As mid	52.3 (*)	15.74	.013	8.5
Sonar AS high	66.1 (*)	15.74	.001	22.3

* The mean % control is significant at the .05 level.

a Dunnett t-tests treat one group as a control, and compare all other groups against it.

SePro provided additional funding and technical support to conduct a concentration exposure time (CET) greenhouse bucket trial to determine the exposure times (1, 3, 7 or 14 days) for Renovate Max, Renovate OTF, and Clearcast necessary to produce a particular level of suppression. The initial screening trial maximized the duration of exposure to the injected chemical. The CET trial is using a similar protocol except the water after being treated at mid or high label rates is pumped out of the buckets at 1, 3, 7 or 14 days after the injection, and the buckets are then refilled with untreated water (Table 3). The CET trial began in May 2010 and will continue through February or March 2011, a simulated second growing season, when regrowth of leaf biomass will be measured as indicative of rhizome kill. Preliminary results based on height of topgrowth indicate that Renovate Max may be the most robust and practical treatment to implement. Renovate Max when injected at the high label rate of 5 PPM is apparently causing similarly high levels of leaf injury independent of exposure duration (Figure 3). These CET response data will provide guidance for designing actual in-lake field trials with a reasonable expectation of acceptable control.

Table 3. Concentration exposure trail (CET) with 3 replicates of each combination of Product x ppm x days exposure

Product	ppm	days exposure	Product	ppm	days exposure
Renovate MAX G	2.5	1	Clearcast liquid	0.25	3
Renovate MAX G	2.5	3	Clearcast liquid	0.25	7
Renovate MAX G	2.5	7	Clearcast liquid	0.25	14
Renovate MAX G	5	1	Clearcast liquid	0.5	3
Renovate MAX G	5	3	Clearcast liquid	0.5	7
Renovate MAX G	5	7	Clearcast liquid	0.5	14
Renovate OTF	1.5	1	Clearcast 2.7G	0.1	3
Renovate OTF	1.5	3	Clearcast 2.7G	0.1	7
Renovate OTF	1.5	7	Clearcast 2.7G	0.1	14
Renovate OTF	2.5	1	Clearcast 2.7G	0.25	3
Renovate OTF	2.5	3	Clearcast 2.7G	0.25	7
Renovate OTF	2.5	7	Clearcast 2.7G	0.25	14
Clearcast liquid	0.1	3	Clearcast 2.7G	0.5	3
Clearcast liquid	0.1	7	Clearcast 2.7G	0.5	7
Clearcast liquid	0.1	14	Clearcast 2.7G	0.5	14
			Control	na	na

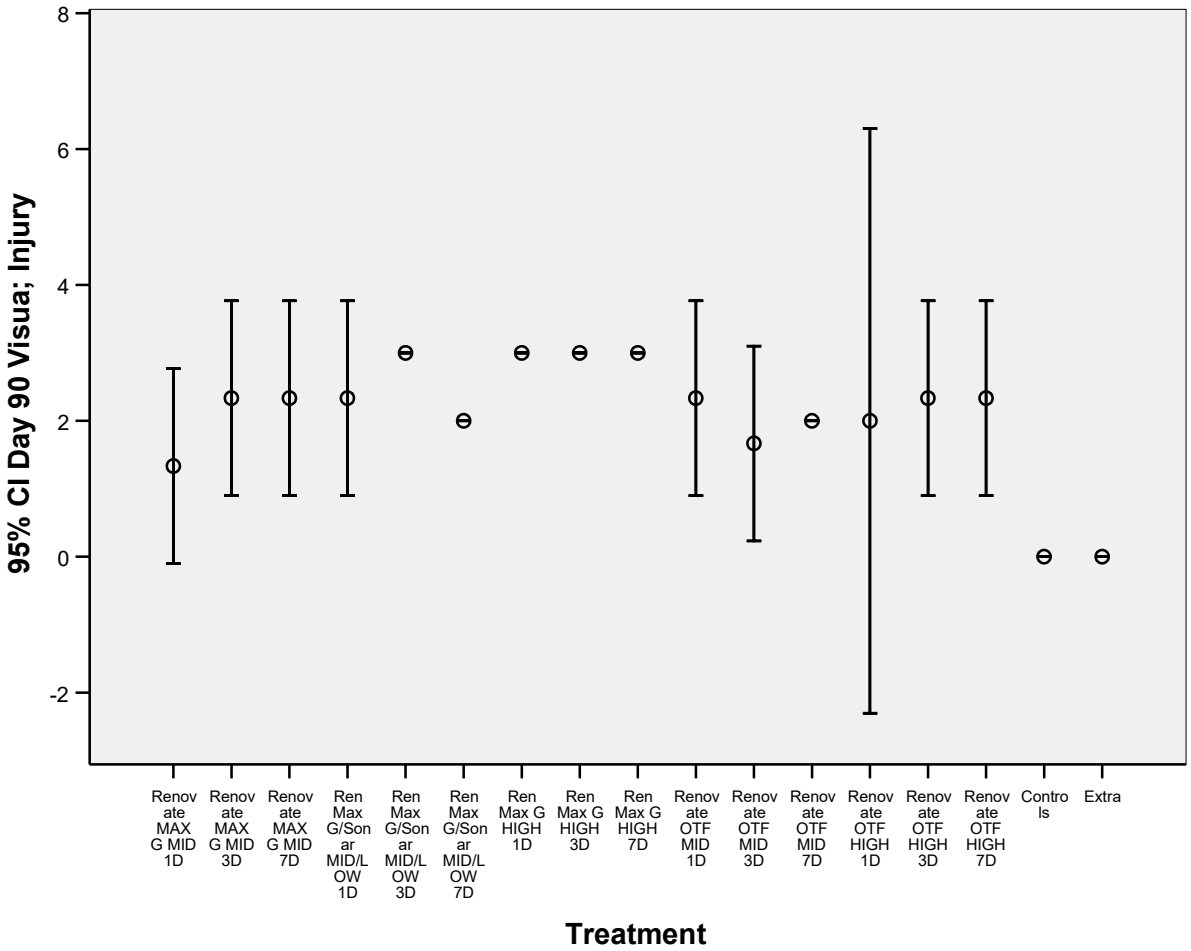

Figure 3. Visual injury ratings for concentration exposure time (CET) trial 90 days after treatment.