Herbicide Trials on Grecian Foxglove (*Digitalis lanata*)
Along State Highway 95 Right-of-Way in Minnesota

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Presented at the 2001 National Roadside Vegetation Management Assocation Conference--September 26, 2001

ROSETTE

FLOWER

SEED POD W/ HOOKS

Introduction:

Grecian foxglove (*Digitalis lanata*) originates in southeast Europe. It grows best in well-drained, loamy sand soils in sunny areas, but is able to grow in some shade. This plant is capable of being either a perennial or biennial depending on the length of the growing season. In Minnesota it is primarily a biennialGrecian foxglove contains a number of chemicals that are used in the most effective heart medicines for heart failure. Some of these include digitalis and digoxin, which can be fatal to horses and cattle if small amounts of fresh or dried plant material is ingested. In addition, there are reports of human sensitivity and reaction from contact with the plant. The plant appears to expand rapidly, re-flowers when cut, and develops a prostrate form when grazed. Fortunately it spreads by seed only.

Grecian foxglove has been found thriving in eastern parts of the Twin Cities Metro area (see map), including approximately 5 miles (50' to 600' pockets) of state highway right-of-way. The Minnesota Department of Transportation (Mn/DOT) is partnering with the Minnesota Departments of Agriculture and Natural Resources, the National Park Service, and landowners in an attempt to eradicate the weed from Minnesota before it becomes a problem.

Mn/DOT conducted trials with several herbicides In order to determine effective chemical controls, chemical rates and application timing on Grecian foxglove. Herbicides used include 2,4-D Ester (2,4De); 2,4-D + mecoprop + dicamba (2,4Dmd--commercial); 2,4-D + mecoprop + dicamba (M2,4D--homeowner), triclopyr – homeowner strength (Htric), triclopyr (Tric), picloram (Pic), and metsulfuron methyl (Msm). See table 1 for cross-reference to the trade names.

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Table 1. Herbicide – Trade name Cross-Reference

Herbicide Abbreviation	Herbicide Name (% Active Ingred)	Trade Name and Manufacturer	User Availability
2,4De	2,4-D Ester (66.2%)	LV4® ⇒ Cenex LandoLakes	Commercial
2,4Dmd	2,4-D (30.56%)+ mecoprop (16.34%) + dicamba (2.77%)	Strike 3® ⇒ Riverside	Commercial
M2,4D	Mecoprop (10.6%) 2,4-D (3.05%)+ dicamba (1.30%)	Weed B Gon® ⇒ Ortho Lawn Weed Killer$_2$	Homeowner
Htric	Triclopyr (8 %)	Weed B Gon® ⇒ Ortho Chickweed, Clover, & Oxalis Killer	Homeowner
Tric	Triclopyr (61.6%)	Garlon 4® ⇒ Dow AgriSciences	Commercial
Pic	Picloram (24.4%)	Tordon K® ⇒ Dow AgriSciences	Commercial
Msm	Metsulfron methyl (60%)	Escort® ⇒ DuPont	Commercial

*The mention of trade names or companies does not constitute endorsement.

Materials and Methods:

Mn/DOT set up 210, one square meter plots along T.H. 95 north of Stillwater, MN, in order to determine herbicide efficacy on Grecian foxglove. We used seven herbicide treatments and a control of water. Different rates of certain herbicides were used. To test best treatment timing, applications were made in fall 1999, spring 2000 and summer 2000. Each treatment was replicated six times in randomly assigned plots per season using a simple random sampling process. If the plot did not have at least 20 plants, we selected the next highest numbered plot with at least 20 plants. Most plots had both the rosette form and the second year upright form. All applications were made with a backpack sprayer (Solo 425).

For the fall application, the labeled rate of herbicide was mixed with 0.5 gallon of water plus surfactant and several drops of blue dye (used to aid uniform application in the plot). The amount of the surfactant added to the water was not noted. Each plot was sprayed for 11 seconds and pressure was not noted.

For spring and summer applications, we mixed the calculated label amount of herbicide, 2.4 ml of Activate Plus and 2 ml of dye with one quart of water. The only exception was with Msm, which we mixed the proper amount of herbicide with 3 gallons of water, 29 ml of Activate Plus, and 12 ml of dye. Excess Msm mixture was sprayed on Grecian foxglove plants outside of the plots. Each plot was sprayed for 12 seconds at 21 psi (held constant with a controlled flow valve tip supplied by H.D. Hudson Manufacturing Company) in both the spring and summer applications. Table 1 shows the rate that each herbicide was applied for each season.

Results:

The most effective and consistent herbicide was Metsulfron methyl (Msm). It eliminated at least 94% of the plants for each application. Msm also provided good residual control of any germinating foxglove seed in all the plots. Picloram was only effective when sprayed in fall, where it eliminated 87% of the plants. 2,4-D Ester killed 64% of the plants when sprayed in fall and 11% when sprayed in spring. 2,4-D + mecoprop + diacamba (2,4Dmd) killed 39% of the plants when sprayed in fall and 3% when sprayed in the spring. Triclopyr (Commercial) eliminated 21% of the plants when sprayed in fall and 6% when sprayed in spring. M2,4D (Homeowner formulation) ineffective, giving only 5% control when sprayed in summer and no control in the fall and spring applicatons. Triclopyr (Homeowner formulation) was not effective during any season. Table 2 lists results of all treatments.

Conclusion/Discussion:

The herbicide that worked most effectively was Metsulfron methyl (Msm). However during the fall application, it was applied at a rate approximately 5 times the targeted rate amount due to a calculation error. Applying Msm too heavy resulted in high mortality of cool-season grasses. Msm applied at the target rate of .5 ounces per acre for spring and summer 2000 treatments provided good Grecian foxglove control with little to no observable cool-season grass damage.

The amount of each herbicide was changed at least one time during the experiment because of recalculation of rates. This was done to attempt to treat the Grecian foxglove at the target rate of each herbicide. Table 3 documents the rate changes.

Surrounding plots may have impacted the mortality percentage on Mecoprop + 2,4-D + dicamba (M2,4D) in the summer application due to spray drift resulting from spraying taller plants. Plants in one M2,4D plot showed Msm damage resulting from three adjacent plots sprayed with Msm.

Msm is effective at the rates applied; however it is easy to over apply these types of ultra low volume herbicides in small volume tank mixes. The two homeowner strength mixes did not work at the labeled rates for control of Grecian foxglove. Multiple rate adjustments with, Picloram and 2,4-D Ester clouds the results, however, we document the adjustments of rates for the record.

Acknowledgements:

The authors wish to especially acknowledge Jon Storr, United Agri-Products—Timberland (formerly Pro Source One), for providing test products and plot installation and monitoring assistance. We also acknowledge the assistance of Katie Hetchler – Mn/DOT Graduate Engineer in rotation, Bob Wryk – Mn/DOT Metro Division Maintenance Superintendent, and Stanly Ross – Mn/DOT Metro Division Coordinator of Sprayer Operators.

Table 2. Results for Each Application Date and Treatment

Date of Application	October 6, 1999				May 31, 2000			July 12, 2000	
Treatment	Average Initial Foxglove Count	% dead after 1 month (10/27/99)	% dead after 7 months (5/31/00)	% dead after 10 months (8/17/00)	Average Initial Foxglove Count	% dead after 1 month (6/29/00)	% dead after 3 months (8/17/00)	Average Initial Foxglove Count	% dead after 1+ month (8/17/00)
Control	45	NC*	0%	2.2%	53	0%	0%	31	0%
2,4-D Ester	55	NC	93%	64.4%	31	9%	11.4%	29	0%
2,4-D + Mecroprop + Dicamba (Strike 3®)	40	NC	60%	39.6%	39	2.5%	3.4%	30	0%
2,4-D + Banvel (Weed B Gon®)	43	NC	16%	3.5%	48	0%	0%	44	5.6%
Garlon (Weed B Gon®)	45	NC	-7%**	-5.2%**	45	0%	0%	39	0%
Triclopyr (Garlon 4®)	44	NC	36%	21.2%	42	2%	6.3%	34	0%
Picloram (Tordon K®)	37.5	NC	84%	87.1%	47	0%	0%	38	0%
Metsulfron methyl (Escort®)	34	NC	100%	97.6%	28	93%	98.8%	36	94.1%

* NC = Not Counted—none of the plants in treated plots showed appreciable herbicide effects after 22 days, however by the May 31, 2000 evaluation date herbicide effects were clearly evident

** Negative percentages indicate an increase in the number of foxglove plants per plot

Table 3. Rates of chemicals for Grecian Foxglove Experiment

Treatment	Rate / acre	Rate / ½ gal of water	Amount of Activate Plus/ Dye	Rate / qt of water	Amount of Activate Plus / Dye	Rate / qt of water	Amount of Activate Plus / Dye
Application Date		10/6/99		5/31/00		7/12/00	
Control (water)	170 gal		4.8 ml/Drops		2.4 ml / 2 ml		2.4 ml / 2 ml
2,4-D Ester	2 qts	20 ml	4.8 ml/Drops	0.094 oz = 2.8 ml	2.4 ml / 2 ml	5.6 ml	2.4 ml / 2 ml
Strike 3	2 qts	5.3 ml	4.8 ml/Drops	0.094 oz = 2.8 ml	2.4 ml / 2 ml	5.6 ml	2.4 ml / 2 ml
Ortho (2,4-D + Banvel)	2.65 gal	1.0 oz	4.8 ml/Drops	0.5 oz = 15 ml	2.4 ml / 2 ml	0.5 oz	2.4 ml / 2 ml
Ortho (Garlon)	1.32 gal	0.5 oz	4.8 ml/Drops	0.25 oz = 7.5 ml	2.4 ml / 2 ml	0.25 oz	2.4 ml / 2 ml
Garlon 4	2 qts	5 ml	4.8 ml/Drops	0.094 oz = 2.8 ml	2.4 ml / 2 ml	5.6 ml	2.4 ml / 2 ml
Tordon K	1 qt	2.5 ml	4.8 ml/Drops	0.047 oz = 1.4 ml	2.4 ml / 2 ml	2.8 ml	2.4 ml / 2 ml
Escort	0.5 oz.	0.44 grams	29ml/More Drops	½ gram / 3 gal of water	29 ml / 12 ml	½ gram / 3 gal of water	29 ml / 12 ml