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RESEARCH NOTE

Effects on *Trillium recurvatum*, a Michigan Threatened Species, of Applying Glyphosate to Control *Vinca minor*

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ABSTRACT: Clipping of *Vinca minor* followed by fall treatment with 2% glyphosate, controlled *Vinca minor* without adversely affecting *Trillium recurvatum* or other plant species in a second growth, mesic southern forest in southwestern Michigan.

Index terms: glyphosate herbicide, *Trillium recurvatum, Vinca minor*

INTRODUCTION

Natural areas can be invaded by alien species that have been planted in adjacent residential areas as ground covers, ornamental shrubs, or other landscaping enhancements (see review by Stone 2009). When this happens, the alien species need to be controlled, but control measures have the potential of harming desirable species. Such a situation presented itself on a former homestead in a forested preserve in Michigan where a past occupant had planted *Vinca minor* L. (Apocynaceae), hereafter called vinca. After the homestead was abandoned, the vinca persisted and is currently spreading into the forest. Complicating the need for control of the vinca is the presence among the vinca of ramets of prairie trillium (*Trillium recurvatum* Beck (Trilliaceae)), a Michigan state protected species.

Prairie trillium is a perennial, vernal, deciduous forest species that ranges from Texas north to Wisconsin, east to Kentucky and Tennessee, and south to Alabama and Louisiana (Case 2002). It has also been reported from Pennsylvania and North Carolina (USDA, NRCS 2015). In Michigan it reaches the northern extreme of its range in Berrien, Cass, and Van Buren counties (Voss and Reznicek 2012). Because it is at the extreme of its range in Michigan, and because of the loss of habitat, it is listed as a state threatened species with a global/state rank of G5/S2S3 (O'Connor 2007). The species is outcrossing and spreads by rhizomes (Sawyer 2010) and by ant-transported seeds (Moore et al. 2012). Plants break dormancy in early spring and become dormant in early to midsummer. Immature plants, those without flowers, become dormant in early summer; those with fruits become dormant in midsummer (R. Tatina, pers. obs.).

Vinca is an alien species introduced from Europe as a ground cover (Voss and Reznicek 2012). Because it grows well under shade, it may spread into forests, where it outcompetes most native species (Darcy and Burkart 2002). In addition, its presence significantly alters community dynamics on the forest floor (Schulz and Thelen 2000; Bultman and DeWitt 2008).

Recommendations for the effective control of vinca using glyphosate range from 2% glyphosate (Miller 2003), to 3% (Koepke-Hill et al.), to 5% (EcoLogic 2014), to the "highest rate allowed" (IPSAWG 2007). IPSAWG (Invasive Plant Species Assessment Working Group) also recommends clipping or mowing before applying herbicide to damage vinca, promoting herbicide uptake. Glyphosate has the following mode of action: it is translocated to meristems where it binds to phosphoenol pyruvate active sites, thus inhibiting the enzyme 5-enolpyruvylshikimate-PO_4 synthetase. This enzyme is part of the shikimic biosynthetic pathway, which is most active in meristems and is the source of aromatic amino acids, and precursors of auxins, folic acid, lignins, and a number of phenolic compounds (Salisbury and Ross 1992).

Glyphosate application is often recommended for control of perennial weeds when nontarget species are dormant. This reduces the effect of the herbicide on nontarget species. Thus, the objective of this research was to determine if clipping and treating vinca with 2% glyphosate after prairie trillium had become dormant will kill the vinca, but not adversely affect the prairie trillium.

STUDY AREA

Robinson Woods Preserve is a 32.4-ha, second growth, mesic southern forest located at N41°51.0', W86°38.8' in Berrien

County, Michigan, about 1.5 km east of Lakeside (and 82 km due west of downtown Chicago). At the southwestern end of the preserve, prairie trillium is spreading into areas that had been disturbed by past logging and home site development. Currently, ramets of prairie trillium are found growing among a large population (~ 0.2 ha) of vinca under the canopy of second growth sugar maple (*Acer saccharum* L.) and American beech (*Fagus grandifolia* Ehrh.). The soils at the southwest end of the preserve have been mapped as Morocco loamy sands, which are acidic and rapidly permeable (Larson 1980).

METHODS

In May 2013, six patches of prairie trillium were located among vinca and center marked with a pin. Within each patch, all non-vinca plants were counted and the cover of vinca in four classes (0–25%, 26–50%, 51–75%, and 76–100%) was estimated in a 2-m^2 circular plot centered on the pin. In early August, each plot was resurveyed, at which time no prairie trillium plants were found above ground. At the end of August, after the prairie trillium had been dormant for about 30 days, the vinca was clipped with electric shears in three randomly selected plots. After the vinca had been allowed to regrow, the three clipped plots were treated with 2% glyphosate (ClearOut 41 Plus, Chemical Products Technologies, LLC, Carterville, GA 30120, EPA Reg. No. 70829-3) on 8 November 2013. The three remaining plots served as controls. In May 2014, prairie trillium and other species in all plots were counted and the cover of vinca was estimated.

Statistical Analyses

The two sample *t*-test (Minitab Statistical Software 2014) with $\alpha = 0.05$, was used to determine whether the mean number of prairie trillium individuals in the treatment and control plots were initially similar. The paired *t*-test with $\alpha = 0.05$ was used to compare the number of prairie trillium individuals before (2013) and after (2014) herbicide treatment in control and treatment plots.

RESULTS

A census of individual plants in plots during May 2013, and again in May 2014, yielded the data shown in Table 1. A census of the same plots in August showed that all aboveground prairie trillium plants were absent and, thus, dormant. Treated and untreated plots were similar in mean numbers of prairie trillium individuals (two sample *t*-test: $t = -0.31$, $P = 0.777$, df = 3). When the numbers of prairie trillium plants were compared between years for both herbicide-treated and control plots, no difference was found that could be attributed to the clipping plus glyphosate treatment (paired *t*-test: $t = -1.29$, $P = 0.252$, df = 2). In addition, no difference was found between treated and untreated plots for non-trillium individuals (paired *t*-test: $t = -1.70$, $P = 0.100$, df = 29), including *Acer rubrum* L., *A. saccharum* L., *Euonymous obovata* Nutt., *Maianthemum canadense* Desf., *M. racemosum* (L.) Link, *Quercus rubra* L., *Prunus serotina* Ehrh., and *Sassafras albidum* (Nutt.) Nees.

All plots contained 76–100% cover of vinca when surveyed in May 2013. Those clipped and treated with glyphosate had 0–25% cover of vinca in May 2014, whereas control plots had 76–100% cover of vinca (Table 1).

DISCUSSION

The conspicuous decrease in the amount of vinca in treated plots indicates that 2% glyphosate sprayed in late fall following an earlier clipping would adequately suppress vinca. The lack of a statistical difference in number of prairie trillium plants in plots before and after treatment seems to show that this species is not negatively impacted by glyphosate treatment. However, the number of plants varied from one year to the next, a phenomenon that has been attributed to environmental factors such as soil disturbance, temperature, precipitation, and number of flowering individuals (Moore

Table 1. Number of *Trillium recurvatum* plants and cover of *Vinca minor* in plots clipped and treated with 2% glyphosate and control plots at Robinson Woods Preserve, Berrien County, Michigan. The number of *Trillium recurvatum* individuals was similar between treatment and control plots in 2013 ($P > 0.05$) and between years regardless of treatment ($P > 0.05$).

	2013	2014	2013	2014
	No. Trillium Plants	No. Trillium Plants	Vinca Cover	Vinca Cover
Clip & Herbicide	134	130	76–100%	0–25%
	23	18	76–100%	0–25%
	37	51	76–100%	0–25%
Mean ± sd	64 ± 61	66 ± 58		
Control	48	174	76–100%	76–100%
	150	180	76–100%	76–100%
	43	42	76–100%	76–100%
Mean ± sd	80 ± 60	132 ± 78		

et al. 2012). Finally, late fall glyphosate treatment seemed not to adversely affect other nontarget species.

Robert Tatina holds a PhD in botany from Southern Illinois University in Carbondale and is an emeritus professor of biology at Dakota Wesleyan University. Currently residing in Michigan, he sits on the board of Chikaming Open Lands, a land conservation organization in Sawyer, MI, and serves as chair of the stewardship committee. He is also the editor of the Proceedings of the South Dakota Academy of Science.

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