NOTES

Efficacy of Triclopyr on Purple Loosestrife and Associated Wetland Vegetation

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INTRODUCTION

The impact of the exotic plant purple loosestrife (*Lythrum salicaria* L.) on North American wetlands has been widespread. Thompson et al. (1987) report that in many of these wetlands, purple loosestrife represents more than 50% of the biomass of emergent vegetation. Purple loosestrife infestations can be extensive and sudden due to the abundance of seeds produced, high seed viability, rapid seedling growth, the ability to colonize disturbed sites, and the lack of native herbivores or pathogens. Once established, purple loosestrife produces large, monotypic stands that displace native vegetation, decrease biodiversity, and provide little food and habitat for wildlife. In some areas, rare plant and wildlife species (e.g., bulrush *Scirpus lingii* Fern., dwarf spike rush *Eleocharis parvula* Rom and J. A. Schultes, bog turtle *Clemmys muhlenbergi* Schoeff) are threatened (Thompson et al. 1987, Malecki et al. 1993).

Mechanical, biological, and chemical strategies to manage purple loosestrife have been attempted with varying degrees of success. The use of selective herbicides to manage nuisance vegetation offers the advantage of reducing the target plant species with minimal disturbance to desirable, nontarget vegetation. This is especially important when managing purple loosestrife populations, where the presence of an abundant seedbank usually results in rapid reinfestation. Recent field tests indicate that the selective herbicide triclopyr ([(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid) is effective against purple loosestrife (Gabor et al. 1995). The objectives of this investigation were to evaluate the efficacy of triclopyr on purple loosestrife and the resulting vegetative changes to the wetland plant community.

MATERIALS AND METHODS

The study site was located in Pool 5 of the upper Mississippi River, near Weaver Landing in Wabasha County, Minnesota, and is currently managed by the U.S. Fish and Wildlife Service as part of the Upper Mississippi River National Wildlife and Fish Refuge. According to plant surveys, purple loosestrife was well established in this area by 1989. A chemical spray program using glyphosate (*N*-(phosphonomethyl) glycine) (Rodeo[R]) was initiated several years ago by refuge managers to control small infestations; however, large, mature populations were considered impractical to treat in this manner, and thus remained intact. Use of a non-selective herbicide such as glyphosate on mature stands of purple loosestrife offers short-term results, since total vegetation control greatly increases the accessibility of the treated area to seedling recruitment from the seedbank. The site selected for this study had not been treated with glyphosate or other herbicides in recent years.

Nine permanent transects measuring 25 m were established in mature stands of purple loosestrife and were randomly assigned one of the following treatments: 4.54 kg/ha triclopyr (as Garlon 3A), 3.41 kg/ha triclopyr or untreated control. Treatments were replicated three times. To enhance spray coverage a non-ionic surfactant, Ortho X-77 Spreader, was added to the triclopyr spray mixtures at a rate of 0.25% volume to volume. Treatments were applied on June 30, 1992, using an airboat equipped with a high-volume handgun sprayer. Vegetation was sprayed to wet with two passes of the airboat. Treatment swath width extended approximately 6 m along either side of each 25-m transect. At the time of treatment, purple loosestrife was in the late bud to early flower stage of development.

Prior to chemical application, percent cover of purple loosestrife was determined along each transect using line intercept techniques. Quadrat sampling 1.0×0.5 m placed at 3-m intervals along the transect was used to determine percent coverage of all plant associates and subsequent changes between monocot/dicot populations. Within each quadrat, the percent cover of each plant species was recorded using the following cover class values: 1-5%, 6-25%, 26-50%, 51-75%, 76-95%, and 96-100%. Cover values were recorded as the mean of the cover class value (i.e., 2.5, 15, 37.5, 62.5, 85, 97.5) for analysis. The amount of open space in each quadrat was also recorded. Subsequent vegetation sampling was scheduled for 10 weeks (9/9/92), and 1 (June 1993) and 2 years posttreatment (June 1994).

Data were subjected to analysis of variance procedures using SAS (SAS Institute, 1982). When significant treatment effects were found, means were separated using a protected Least Significant Difference (LSD) test at the 0.05 level of significance.

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RESULTS AND DISCUSSION

Pretreatment vegetation sampling showed that purple loosestrife was the dominant plant species (>50%) in the test area; the most common associate species were broad-leaved arrowhead (*Sagittaria latifolia* L.) (12%) and reed canary grass (*Phalaris arundinacea* L.) (10%). Giant bur-reed (*Sparganium eurycarpum* Engelm.), duckweed (*Lemna* sp.), spike rush (*Eleocharis* sp.), and broad-leaved cattail (*Typha latifolia* L.) were frequently encountered species but minor cover components (<10%). Overall, dicots were more abundant in the test area than monocots.

Results showed that triclopyr was an effective treatment for reducing purple loosestrife cover (Table 1). The higher treatment rate (4.54 kg/ha) reduced purple loosestrife by 95% 10 weeks after treatment (WAT), while untreated transects showed an increase (28.5%) in purple loosestrife cover. There were no significant differences between triclopyr treatment rates. Germinating seedlings (1-2 cm tall) were observed in all triclopyr-treated plots at 10 WAT. Seedlings were most abundant in bare ground areas adjacent to dead loosestrife plants. Although seedling recruitment was evident, it is unlikely that these late germinating seedlings (September) would survive until the next growing season. Studies by Shamsi and Whitehead (1974) revealed that summer-germinated loosestrife seedlings did not develop more than four to five pairs of leaves before the onset of winter and thus had a lower survival rate than spring-germinated seedlings. Nevertheless, Welling and Becker (1990) suggested that even where chemical treatment eliminated established plants and seedlings that subsequently emerge, the probability of exhausting an established seedbank is remote.

Resprouting shoots from mature loosestrife rootcrowns were also observed at 10 WAT. Resprouting was visually noted more frequently in areas treated with 3.41 kg/ha triclopyr. Statistically, the triclopyr treatments did not differ in their ability to reduce purple loosestrife populations, however the observance of regrowth suggests that the lower rate of triclopyr may be insufficient to completely eliminate mature, underground rootcrowns. Inadequate canopy penetration or coverage of chemical spray during application may also result in poor control and/or regrowth.

During the spring and summer of 1993, record high water inundated much of the upper Mississippi River Basin. As a result, water levels in Pool 5 averaged 1.3 m above normal from June through September, eliminating 1-year posttreatment data collection. This flood event had a significant impact on all of the vegetation at the test site. Two years after the initial herbicide treatment, purple loosestrife populations in all transects had substantially decreased (Table 1). Triclopyr-treated transects were nearly void (< 1%) of purple loosestrife whereas untreated areas showed a 72% decline in purple loosestrife cover compared with pretreatment population levels. Although flooding was not intended as part of this study, the data show that areas treated with triclopyr followed by long-term submergence resulted in elimination of purple loosestrife. There were no significant differences between triclopyr treatment rates. Despite the magnitude and duration of flood conditions, purple loosestrife was reduced but not eliminated from untreated areas. Several researchers have reported that flooding alone has little effect on purple loosestrife seedling and mature plant survival (Haworth-Brockman et al. 1993, Mal et al. 1992, and Thompson et al. 1987).

Because triclopyr is selective for control of most herbaceous dicots, changes within the monocot/dicot plant community were determined (data not shown). Ten weeks after chemical treatment, percent cover of all dicots species significantly decreased compared to untreated areas (P = 0.0012) indicating triclopyr efficacy. The decrease in dicots corresponded to a significant increase in open space (no plants) (P = 0.0301). Although there was no statistical difference among treatments, monocots in the triclopyr-treated areas did show an increase 10 WAT. The most dominant monocot species that occurred in triclopyr-treated areas included (in decreasing order of percent cover): duckweed, broad-leaved cattail, rice cutgrass (*Leersia oryzoides* (L.) Swartz.), reed canary grass and giant bur-reed. As expected, there was little change in the plant community structure of untreated areas.

By 2-years posttreatment, only monocots showed a significant difference among treatments (P = 0.0497). Untreated areas had significantly more monocots than triclopyr-treated areas. Monocot species in the untreated areas, (specifically broad-leaved arrowhead, reed canary grass, river bulrush (*Scirpus fluviatilis* (Torrey) Gray), broad-leaved cattail, giant bur-reed, and sedges) increased by approximately 70% from the 10-week evaluation in 1992 to 1994. Monocots in the triclopyr-treated areas showed a slight decrease in abundance to that observed at 10 WAT. Some monocot species (mainly broad-leaved arrowhead, rice cutgrass, and reed canary grass) did exhibit slight injury symptoms (e.g., leaf burn and chlorosis) 10 weeks after triclopyr treatment. Reduced plant vigor followed by the catastrophic flood event may explain the decrease in monocot cover in chemically-treated plots. Percent cover of dicot species increased slightly from the 10-week to the 2-year posttreatment evaluation for triclopyr-treated areas, and showed a decrease (32%) in untreated areas. Despite significant decreases in percent cover of purple loosestrife, the most frequently encountered dicot species in all sampled quadrats was purple loosestrife. There were no statistical differences in percent cover of dicots between treatments 2 years after chemical application.

Although there were no significant differences in percent cover of purple loosestrife between the two treatment rates evaluated, regrowth from rootcrowns was more evident in

TABLE 1. PERCENT PURPLE LOOSESTRIFE COVER (± SE) AS MEASURED BY LINE INTERCEPT TECHNIQUES FOLLOWING APPLICATION OF TRICLOPYR[1].

Triclopyr Rate	Pretreatment[2] (6/29/92)	10 WAT (9/9/92)	2 Year Posttreatment (6/6/94)
4.54 kg/ha	51.51 (5.37)a	2.61 (0.89)b	0.28 (0.24)b
3.41 kg/ha	55.77 (7.51)a	9.11 (4.60)b	0.12 (0.12)b
Untreated	71.16 (2.20)a	91.47 (3.28)a	20.16 (5.95)a
LSD (0.05)	NS	13.32	18.61

[1]Triclopyr applied as Garlon 3A, a triethylamine salt formulation (0.36 kg triclopyr/L); Ortho X-77 surfactant added at 0.25% v:v.

[2]Within columns, means followed by different letters are significantly different (LSD test, P ≤ 0.05); WAT = Weeks after treatment.

areas treated with the low rate than the high rate of triclopyr. Surviving rootcrowns are neither desirable nor acceptable from the standpoint of successful management of purple loosestrife. Seedling recruitment was observed in all triclopyr-treated areas 10 WAT, however late germinating seedlings have a low survivability and thus should not pose a threat of immediate reinvasion. Gabor et al. (1995) found that triclopyr at a rate of 12.0 kg/ha effectively controlled adult purple loosestrife plants and had a neutral or positive effect on the abundance of native plant species in an Ontario wetland. Seedling recruitment was also observed 1 year post-treatment in this study. Purple loosestrife plots in Washington treated with 0.5, 1.0, and 2.0% solutions of Garlon 3A showed a 99% reduction in loosestrife, 3 months after treatment[2]. Moreover, the highest treatment rate continued to show an 87% reduction in loosestrife 1 year after treatment.

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