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Efficacy of Wipe-On Applications of Glyphosate and Imazapyr On Common Reed in Aquatic Sites

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INTRODUCTION

Common reed, *Phragmites australis* (Cav.) Trin., is a helophytic grass found in all coastal states of the United States and has been reported to occur in nearly all states within the continental United States. Reeds are abundant and often dominate the flora in temperate climates around the fringes of marshes, particularly where they grade into freshwater wetlands (van der Werff *et al.* 1987). The U. S. Fish and Wildlife Service (USFWS) and other agencies, particularly in the Atlantic coastal and Great Lakes states, consider common reed to be a highly-invasive weed having little value for fish and wildlife.

Large infestations of reeds usually are managed with herbicide applications, particularly glyphosate [N-(phosphonomethyl) glycine]. Weed control following herbicide application is only temporary, so frequent re-treatments are needed. Herbicide spraying frequently eliminates more desirable non-target vegetation. Alternatives to herbicide spraying for reed control such as cutting, burning, or chopping also have serious impacts on nontarget plants.

The objectives of this study were to evaluate the feasibility to use wipe-on herbicide technology to control reed growth in a shallow, freshwater marsh environment as a more environmentally-acceptable alternative to spray applications and to compare this technique with mechanical removal.

MATERIALS AND METHODS

Testing was initiated on June 11-13, 1991, at the Mattamuskeet National Wildlife Refuge to assess efficacy of wipe-on herbicide applications of glyphosate and imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridinecarboxylic acid). An area approximately 30 x 30 m was divided into 18 plots 2.5 x 9 m each, separated by "alleys" 2.5 m wide. The alleys were cleared of vegetation to within 15 cm of the hydrosoil surface (about 30 to 40 cm beneath the surface of the water) using a hand-held, gasoline-powered weed trimmer equipped with a saw blade.

Herbicides were applied by driving along the alleys between adjacent plots in a boat equipped with a canvas-covered, Speidel^{R} applicator (Speidel Applicators, Inc., Lincoln, NE) attached to a boom on each side of the boat. Treatment rates were 0.50 and 0.25-strength dilutions of the commercial formulations of glyphosate (Rodeo) and imazapyr (Arsenal). Adjacent plots received the same relative dilutions of the two herbicides + 1% non-ionic surfactant (X-77^{R}). Untreated plots served as controls, and cut plots from which all vegetation had been removed were included to compare herbicide treatments with mowing under flooded conditions. The experiment was organized into a randomized complete block design having three blocks, with one replicate of each experimental treatment assigned to each block, for a total of six experimental plots per block. In September of 1992, the reeds in the remainder of the impoundment adjacent to the experimental plots were sprayed with a 1.25% solution of Rodeo. Experimental plots were not sprayed. Three plots were established within the sprayed area of the impoundment to compare the early-season applications with a typical late-season treatment.

Responses of the reeds to each management procedure were evaluated on June 28, September 11, and October 22, 1991, using visual estimations of percent control. Regrowth in each plot also was evaluated at the end of the 1992 and 1993 growing seasons using a visual estimation of the percent of total plot surface coverage with live reeds. Data were transformed by an arcsin of the square root conversion prior to statistical analysis, and transformed data were subjected to an analysis of variance. Means were compared using the Duncan's new multiple range procedure (Steel and Torrie 1960). Nontarget plant data were not analyzed statistically because of the patchy distribution of these plants initially within and among the different plots.

RESULTS AND DISCUSSION

Observations during 1991 suggested that early-season wipe-on applications of either 25 or 50 percent strength Arsenal would provide some suppression of reeds and that control would be significantly better than that with Rodeo at similar dilutions (Table 1). The percent dead reeds at the end of the 1991 season were significantly greater for both Arsenal treatments than for either Rodeo treatment, and the higher rate of Arsenal gave greater kill than the lower rate. The best control achieved with the wipe-on applications was not considered acceptable. Essentially complete reed sup-

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[2]Mention of a trade name does not imply endorsement of the product by the North Carolina Agricultural Research Service nor criticism of similar ones not mentioned. Received for publication November 17, 1994, and in revised form December 12, 1994.

TABLE 1. COMPARISON OF CUTTING, WIPE-ON APPLICATIONS OF IMAZAPYR (ARSENAL) AND GLYPHOSATE (RODEO) AND SPRAY APPLICATION OF GLYPHOSATE FOR CONTROL OF COMMON REEDS AT THE MATTAMUSKEET NATIONAL WILDLIFE REFUGE, NORTH CAROLINA.[1]

		% Dead[2]	% Surface Cover with live reeds[2]	
Treatment	Rate	1991	1992	1993
Control	0	3 a	80 a	78 a
Cut	0	100 e	2 d	4 c
Arsenal	25 %	57 c	55 b	64 a
Arsenal	50 %	75 d	16 c	55 a
Rodeo	25 %	38 b	65 ab	70 a
Rodeo	50 %	33 b	47 b	70 a
Rodeo (spray)	1.25%	100 e	<1 d	15 b

[1]Data shown are the means of three replicates. Means in a column followed by the same letter are not significantly different according the new Duncan's multiple range procedure at alpha = 0.05.

[2]Evaluations were made at the end of the growing season and are visual estimates of the percentage of standing reeds that were dead at the end of the 1991 season and the percentage of live reed cover on the different treatments in the 1992 and 1993 growing seasons.

pression occurred in the cut plots and in sprayed areas in comparison with only 75 percent in plots treated with the higher rate of Arsenal. Many of the loose, cut stems resprouted and were alive at the end of the growing season, but there was no sign of overwinter survival during the following season. By the end of 1992, the percent surface cover by live reeds had begun to recover in the wipe-on plots; but there still was less coverage in both Arsenal treatments and the 50% Rodeo treatment than in controls. By the end of the 1993 season, there were no significant differences between controls and any of the wipe-on treatments. Reeds either sprayed or cut still were almost completely suppressed by the end of the 1992 season. By fall 1993, there was some recovery in sprayed areas but almost none in the cut plots. The effect of plant height was not examined in this study, but taller reeds did seem to be damaged more than shorter ones. This observation suggests that the shorter reeds were protected from the applicator by the adjacent, taller plants.

Several nontarget plants were present in or adjacent to the experimental plots at the beginning of this study. The most common species were two emergents, rice cutgrass [*Leersia oryzoides* (L.) Swartz] and foursquare [*Eleocharis quadrangulata* (Michaux) R. & S.]. Wipe-on treatments slightly damaged spikerush and cutgrass, because the applicators were very close to the surface of the water. Regrowth of these plants in wipe-on plots seemed to be greater in areas where the reeds were taller and denser (not quantified). Damage to non-target emergents in wipe-on plots was temporary, and considerable recovery had occurred by the end of the season. There still were no nontarget emergents in the sprayed areas even two years after treatment. Cutting eliminated all emergent plants through the end of the 1993 the season. Submersed plants including water primrose [*Ludwigia palustris* (L.) Ell.], widgeon grass (*Ruppia maritima* L.), and southern naiad [*Najas guadalupensis* (Sprengel) Magnus], appeared (not quantified) in open areas within wipe-on plots and throughout cut plots and alleys by the end of the initial season, but almost no submersed vegetation was present at any time in the control plots or in the sprayed areas.

Some success has been demonstrated previously for ditchbank weed control using wipe-on technology (Comes and Kelly 1988), but no published information was found on the application of this technique to open-water settings. Efficacy of either herbicide probably would have been better if application had occurred later in the season during or after flowering, as has been demonstrated previously for glyphosate (Cross and Fleming 1989) and other herbicides (Beck 1971). However, another report suggested that spray application of glyphosate in June could provide satisfactory control (Riemer 1976).

Longer control observed following either mechanical removal or spraying of Rodeo indicates that large-scale treatments using wipe-on applicators from a boat may not be practical. Cutting will provide fairly long-term reed control, but the impact on nontarget emergent vegetation very likely will be as severe as that caused by spray application. Use of wipe-on technology on reeds in wildlife impoundments also might be improved by treatment while dewatered, as was demonstrated previously for control of giant burreed (*Sparganium eurycarpum* Engelm.) in fallow, wild rice (*Zizania palustris* L.) paddies (Leif and Oelke 1990). This should be investigated further.

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