# Common Reed (Phragmites Australis) Response to Mowing and Herbicide Application

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# Common Reed (*Phragmites australis*) Response to Mowing and Herbicide Application

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Common reed is an invasive species that has overtaken wetland habitats in the eastern United States and can spread into roadsides, turf, and ornamental sites. The postemergence grass herbicides used in nursery crops and turf, clethodim, fenoxaprop, fluazifop, and sethoxydim, did not control common reed. Dithiopyr, MSMA, and quinclorac also did not control this weed. Glyphosate applied at 2.24 kg ai/ha (2.0 lb ai/ac) was more effective in preventing regrowth of common reed than glufosinate at 1.12 kg/ha (1.0 lb ai/ac). Mowing every 2, 4, or 8 wk controlled common reed 93, 81, and 69%, respectively, by the end of the growing season, but only reduced regrowth by approximately 55% the following May. Applying glyphosate at 2% v/v either 1 mo after a mowing or 2 wk prior to mowing reduced common reed regrowth the following May by approximately 90%. Applying glyphosate without mowing provided similar common reed control the following spring compared to glyphosate combined with a single mowing. Common reed regrew in all treated plots 1 yr after study initiation, indicating that control treatments must be repeated if common reed is to be eradicated from a site.

**Nomenclature:** Clethodim; dithiopyr; fluazifop; fenoxaprop; glufosinate; glyphosate; MSMA; quinclorac; sethoxydim; Common reed, *Phragmites australis* (Cav.) Trin. ex Steud.

**Key words:** Postemergence grass herbicides, turf herbicides, perennial grass, integrated weed management.

Common reed, often referred to by its scientific name *Phragmites*, is an invasive plant that has overtaken coastal marshes and other natural areas in 18 primarily eastern states, including Virginia (Ailstock et al. 2001; Mal and Narine 2004; Saltonstall 2005). It grows in sunny, wetland habitats along brackish and fresh water marshes and along riverbanks and lakeshores, as well as growing along roadsides and disturbed areas. Common reed has been a marsh species in the United States for thousands of years (Orson 1999). However, it is only within the last century that it has been found in large monocultures with less diverse plant communities, suggesting the introduction of an invasive biotype (Mal and Narine 2004; Saltonstall 2002; Tewksbury et al. 2002.).

Common reed is a perennial grass that spreads by seed and vegetatively by rhizomes (Mal and Narine 2004; Saltonstall 2005), forming dense stands. It can reach heights of 2 to 5 m tall. This weed is common in disturbed soils and can become dominant in roadside ditches or other areas that have been dredged or when dredged material has been spread. Eleven out of 15 constructed wetland sites in Virginia were colonized by common reed (Havens et al. 1997). Common reed cover increased dramatically between

## Interpretive Summary

The selective postemergence grass and postemergence crabgrass herbicides used in turf and ornamentals do not control common reed. Glyphosate alone provided a high level of common reed control at the end of the growing season, with significant suppression the following year. Mowing 1 mo prior to or 2 wk after glyphosate application did not reduce control, so treated areas could be cut back if desired. Mowing significantly reduced common reed growth during the growing season, especially in the most frequently mowed plots, and would be an option where one preferred a nonchemical control strategy. The mowing program required more time, however, requiring three to 10 trips to the site compared to a single herbicide application, and was less effective than a glyphosate application when evaluated the following season. Additionally, mowing with a saw blade poses a hazard to the user, especially in wet or sloped areas. Additional data are needed to determine the effectiveness of mowing regimes conducted over multiple growing seasons. Regardless of the control option, treatments will need to be repeated in successive growing seasons if common reed is to be eradicated.

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6 and 9 yr after construction at one site, suggesting that constructed sites need to be monitored for this species for 10 yr.

Some ecological impacts of common reed include lower plant diversity and replacement of native vegetation (Ailstock et al. 2001; League et al. 2007; Teal and Peterson 2005) because it out-competes other vegetation and can dominate wetland communities. Species richness was greater in plots where common reed was removed compared to intact stands of this plant (Farnsworth and Meyerson 1999). Common reed provides less food and an unsuitable habitat for certain bird species (Anonymous 2000; Benoit and Askins 1999). For these reasons, control strategies for this invasive plant are needed.

Various control methods for common reed have been suggested, including mowing, burning, drainage, and herbicide application (Mal and Narine 2004). Applying glyphosate in late summer or early fall followed by prescribed burning in spring has been an effective means of control (Anonymous 2000). It must be followed by repeat applications in following years because one application does not provide complete control and the species can regrow to dominate the site. Glyphosate application, with or without burning, reduced common reed abundance and increased plant diversity (Ailstock et al. 2001). Common reed increased in abundance, however, in the third growing season after treatment.

Mowing, excavating and burning are less effective (Anonymous 2000). Excavating can damage wetlands and could spread the rhizomes, and mowing is difficult in wet areas. Burning does not control the rhizomes and can accelerate common reed growth. European insects are being researched as possible biological control agents for this weed (Tewksbury et al. 2002).

The predominant means of spread is through rhizomes and therefore long-term management for common reed requires complete control of rhizomes. Rhizome color can be used to determine effectiveness of herbicide application; brown rhizomes produced few shoots, but more than half of white rhizomes formed shoots after planting (League et al. 2007).

Glyphosate at 2.24 to 6.7 kg/ha (2.0 to 6.0 lb ai/ac) in 187 or 750 L/ha plus surfactant provided 65 to 90% control of common reed and the control increased with application rate (Riemer 1973, Riemer 1976). The addition of a surfactant was effective only when the herbicide was applied at low rates. Within the range of 187 to 750 L/ha (20 to 80 gal/ac), spray volume did not affect results except with very low rates of the herbicide. The optimum rate of application appeared to be in the range of 4.5 to 6.7 kg/ha (4.0 to 6.0 lb ai/ac). The application of glyphosate to common reed for two successive years was a very effective means of control, even at rates as low as 2.24 kg/ha (2.0 lb ai/ac).

There are concerns from the public concerning herbicide use for common reed control (Teal and Peterson 2005). Mowing could be an alternative in certain situations. Common reed biomass was 25 to 30% lower and shoots were smaller in plots mowed annually in June compared to control plots (Gusewell 2003). The decrease was attributed to a depletion of belowground reserves after several years of annual mowing. Common reed density decreased when plants were cut twice per year compared to once (Yamada et al. 2000). Mowing plus herbicide application might offer improved control. Monteiro et al. (1999b) observed a benefit from cutting common reed in September prior to an April application of glyphosate.

Although common reed can invade roadsides and adjacent turf and ornamental beds, no selective control options have been developed. Additional information is needed on the effect of mowing frequency on common reed growth. This research was conducted to evaluate herbicides, mowing, and treatments utilizing both chemical application and mowing as potential selective strategies for common reed control. Objectives for this research were to evaluate selective herbicides used in turf or ornamental sites, to evaluate different mowing regimes, and to compare chemical control to mowing treatments for management of common reed.

## Materials and Methods

**Response to Postemergence Grass Herbicides.** Common reed was propagated by division and grown in 4 L containers containing pine bark and a commercial, peat-based potting mix[1] 2 : 1 v/v for 3 mo in a greenhouse. Plants grew vigorously in the containers, producing rhizomes and new shoots, and thus were well-established at application. Herbicides were applied broadcast to common reed that was 46 cm (18 in) tall with an average of 10 shoots per pot. Four selective herbicides used for postemergence grass control in ornamentals and certain turf situations were evaluated: fluazifop at 0.34 kg/ha (0.3 lb ai/ac), clethodim at 0.13 kg/ha (0.12 lb ai/ac), sethoxydim at 0.45 kg/ha (0.4 lb ai/ac), and fenoxaprop at 0.1 kg/ha (0.9 lb ai/ac). Herbicides used for the control of emerged crabgrass (*Digitaria* spp.) in turf were also evaluated: dithiopy at 0.56 kg/ha (0.5 lb ai/ac), quinclorac at 0.84 kg/ha (0.75 lb ai/ac), and MSMA at 2.24 kg/ha (2.0 lb ai/ac). The nonselective herbicides glyphosate at 2.24 kg/ha (2.0 lb ai/ac)and glufosinate at 1.12 kg/ha (1.0 lb ai/ac) were included for comparison. A nonionic surfactant[2] was added to fluazifop, clethodim, MSMA, and dithiopyr at 0.25% v/v. A crop oil[3] was added to quinclorac at 1% v/v. Herbicides were applied with a $CO_2$-pressurized backpack sprayer delivering 230 L/ha (25 gal/ac) using 8002 flat fan nozzles.[4] An isopropylamine salt formulation of glyphosate[5] was used in all trials.

Table 1. Impact of herbicide application on common reed growth in container trials. WAT, weeks after treatment.

| Treatment | Rate | Control 5 WAT | Common reed Shoot fresh weight 6 WAT | Common reed Regrowth shoot fresh weight 10 WAT |
|---|---|---|---|---|
| | kg ai/ha | % | g | |
| Untreated | | 5 | 103.9 | 36.1 |
| Fenoxaprop | 0.1 | 10 | 103.7 | 23.6 |
| Fluazifop | 0.34 | 23 | 89.2 | 29.9 |
| Clethodim | 0.13 | 23 | 90.9 | 28.8 |
| Sethoxydim | 0.45 | 11 | 102.3 | 30.8 |
| MSMA | 2.24 | 18 | 104.1 | 28.5 |
| Quinclorac | 0.84 | 11 | 111.5 | 27.4 |
| Dithiopyr | 0.56 | 9 | 102.1 | 25 |
| Glyphosate | 2.24 | 96 | 7.9 | 0 |
| Glufosinate | 1.12 | 71 | 20.2 | 4.7 |
| LSD (0.05) | | 7 | 15.2 | 8.3 |

Experimental design was a randomized complete design with four replications and two pots per plot. Percent control of common reed was evaluated 5 wk after treatment (WAT) on a scale of 0 to 100, with 0 indicating no control and 100 indicating complete control. Shoots were cut at the soil line and shoot fresh weight was recorded 6 WAT. Plants were allowed to regrow from underground rhizomes for 1 mo, and the shoot fresh weight for this regrowth was recorded. The experiment was repeated, and because no treatment by trial interaction was seen, data were averaged across the two trials. Data were subjected to ANOVA with mean separation using the Fischers Protected LSD test at a 0.05 significance level.

**Impact of Mowing on Common Reed in Container Trials.** Common reed was grown as described in the previous study. For the mowing treatments, one set of pots were mowed every 2 wk during the growing season, starting on May 24, for a total of eight mowing sessions. Another set was mowed every 4 wk (four total mowings) with another group mowed every 8 wk (two total mowings). For each mowing, common reed shoots were cut to 7.5 cm using pruning shears. One set of plants were mowed and then sprayed with glyphosate at 2.24 kg/ha (2.0 lb ai/ac) 1 mo later. Another group of plants were treated with glyphosate at 2.24 kg/ha (2.0 lb ai/ac) and then mowed 2 wk later. The two glyphosate/mowing treatments were cut back only once during the trial. Common reed height at treatment was 91 cm with an average of 12 shoots per pot. Shoot number and fresh weight were recorded 14 wk after trial initiation. Experimental design was a randomized complete block with four replications and three 4 L pots per plot. The trial was repeated. Because similar results were detected in both studies, data were averaged across the two trials and analyzed as per the first experiment.

**Impact of Mowing on Common Reed in the Field.** An experiment was conducted at a field site adjacent to an interstate in Norfolk, VA, which contained a dense stand of common reed. Soil was a loamy Udorthents, a situation where the natural soil has been altered by excavation, with a pH of 6.7 and 2.8% organic matter. Plot size was 3 m by 1.5 m (10 ft by 5 ft). The site was treated in May under 100% cloud cover, air temperature 10 C (50 F), and relative humidity 36%. The trial contained the same three mowing treatments used in the greenhouse trial described above. Plots receiving mowing treatments were cut to a height of 7.5 cm with a weedeater fitted with a saw blade. Plots for the 2-wk mowing regime were mowed a total of 10 times during the growing season, with a total of six and three times for the 4- and 8-wk mowing intervals, respectively. Additional treatments evaluated glyphosate applied either without mowing, 2 wk prior to a single mowing, or 4 wk after a single mowing. Glyphosate was applied on a spray to wet basis as a 2% v/v solution using a hand gun. Common reed was 2 m tall at application. Experimental design was a randomized complete block with four replications.

The trial was repeated at a site adjacent to an interstate in Virginia Beach, VA, which contained the same soil type as the Norfolk location. Soil pH was 6.8 with 2.4% organic matter. The site was treated under 50% cloud cover, 17 C (63 F) air temperature, and 67% relative humidity. Common reed was 1.8 m tall (6 ft).

Common reed live shoots were counted 3, 4, and 12 mo after treatment (MAT). Percent control of common reed was determined 4 MAT. Shoot dry weight per plot was

Table 2. Impact of mowing and glyphosate application on common reed shoot number and weight 14 wk after study initiation in container trials.

| Treatment[a] | Common reed | |
|---|---|---|
| | Shoots | Shoot fresh weight |
| | No./plot | g |
| Untreated | 55.9 | 173.7 |
| Glyphosate | 0 | 0 |
| Glyphosate then mow at 2 wk | 0 | 0 |
| Mow then glyphosate at 4 wk | 0 | 0 |
| Mow every 2 wk | 1.9 | 0.2 |
| Mow every 4 wk | 14.9 | 4.7 |
| Mow every 8 wk | 20.8 | 39.2 |
| LSD (0.05) | 9.7 | 25.8 |

[a] Glyphosate was applied at 2.24 kg ai/ha.

recorded for the three mowing regimens at the final cutting 4 MAT. All plots were mowed to 30 cm (12 in) in January to remove dead stems from the study area. Common reed shoot fresh and dry weight were recorded 12 MAT. Similar results were detected in the two trials so the results were combined into one analysis.

## Results and Discussion

**Response to Postemergence Grass Herbicides.** The selective herbicides fluazifop, clethodim, sethoxydim, fenoxaprop, dithiopyr, quinclorac, and MSMA did not control common reed (Table 1). In contrast, fluazifop at 0.5 and 1.0 kg/ha (0.4 and 0.9 lb/A) gave very effective control of common reed and suppression of regrowth and was the most effective herbicide for postemergence control in soybeans and cotton (Xian and Price 1987). Although fluazifop injured common reed in the current study (Table 1), it did not provide acceptable control, perhaps because the plants were well-established with developed rhizomes. Glyphosate provided greater visual control than glufosinate, with numerically lower shoot and regrowth shoot weight. Monteiro et al. (1999a) also observed greater long-term control with glyphosate than glufosinate. Because glyphosate was the most effective treatment, it was utilized in the mowing trials.

**Impact of Mowing on Common Reed in Container Trials.** Glyphosate, with or without mowing, gave complete control of common reed (Table 2). Of the mowing regimens, the 2-wk schedule resulted in the lowest common reed shoot number and weigh, reducing both variables 97% compared to untreated plants. Common reed shoot number and weight increased as mowing frequency was decreased. In another study, mowing once or twice reduced common reed density compared to non-mowed areas (Yamada et al. 2000).

**Impact of Mowing on Common Reed in the Field.** All treatments reduced common reed shoot number at 3 and 4 MAT (Table 3). Shoot dry weight recorded for the three mowing regimes at 4 MAT was 16.2, 56.8, and 148.6 g per plot. Comparing shoot number and weight at 4 MAT indicates that the shoots were smaller in the 2-wk mowing regime and increased in size with less frequent mowing. At 12 MAT, all glyphosate treatments, with or without mowing, resulted in fewer common reed shoots and lower shoot dry weight than the three mowing regimes. No

Table 3. Impact of mowing and glyphosate application on common reed shoot number, percent control, and shoot dry weight in field trials. MAT, months after treatment.

| Treatment[a] | Common reed | | | | |
|---|---|---|---|---|---|
| | Shoots | | | Control | Shoot dry weight |
| | 3 MAT | 4 MAT | 12 MAT | 4 MAT | 12 MAT |
| | No./plot | | | % | g |
| Untreated | 212.5 | 288 | 314.5 | 0 | 3134.1 |
| Glyphosate | 58.4 | 36.1 | 25.3 | 81 | 184.9 |
| Glyphosate then mow at 2 wk | 15.9 | 13.3 | 37.5 | 90 | 324.1 |
| Mow then glyphosate at 4 wk | 9.8 | 22.6 | 42.4 | 86 | 381 |
| Mow every 2 wk | 22.8 | 20.9 | 161.4 | 93 | 1654.8 |
| Mow every 4 wk | 51.1 | 56.4 | 121.9 | 81 | 1131.9 |
| Mow every 8 wk | 27.1 | 57.6 | 143.6 | 69 | 1188.6 |
| LSD (0.05) | 26.2 | 28.7 | 60.7 | 7 | 674 |

[a] Glyphosate was applied at 2% v/v.

differences were observed among the three glyphosate-containing treatments, with approximately 90% reduction in stem count and 91% reduction in shoot weight at 12 MAT. No differences were seen among the three mowing regimes at 12 MAT, with approximately 55% reduction in stem count and 56% reduction in shoot weight at 12 MAT. Cutting common reed in June but not July reduced aboveground biomass of common reed (Asaeda et al. 2006).

Common reed regrowth was observed in all treated plots at 12 MAT (Table 3), indicating that sufficient storage reserves in the rhizomes were present going into winter. Therefore, mowing or herbicide application would have to be repeated in the second growing season if eradication of common reed was desired. Ailstock et al. (2001) observed regrowth of common reed in plots treated with glyphosate or glyphosate followed by burning.

Glyphosate at 2.24 kg/ha (2.0 lb/ac) is more effective for common reed control than glufosinate at 1.12 kg/ha (1.0 lb ai/ac). The selective postemergence grass herbicides used in turf and ornamental plantings do not control this perennial grass. Glyphosate applied as a 2% v/v solution provides approximately 90% control of common reed 1 yr after application, with or without additional mowing. Mowing every 2 wk during the growing season reduced common reed growth by approximately 90% at 4 mo after initiation of the cutting treatments but only reduced common reed growth by approximately 55% 1 yr later. Mowing might be an acceptable suppression strategy for sites containing desirable vegetation that tolerates frequent cutting.

## Sources of Materials

[1] Pro-Mix, Premier Horticulture Ltd., 1785 55th Ave., Dorval, Quebec, Canada H9P 2W3.

[2] Latron AG-98, Dow AgroSciences LLC, Indianapolis, IN 46268.

[3] AGRI-DEX, Helena Chemical Co., 225 Schilling Blvd., Collierville, TN 38017.

[4] 8002 flat fan, Teejet Technologies, P.O. Box 7900, Wheaton, IL 60189–7900.

[5] Roundup Pro, Monsanto Company, 800 North Lindbergh Blvd., St. Louis, MO 63167.

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