Control of Roughstalk Bluegrass (Poa trivialis) in Perennial Ryegrass (Lolium perenne) Grown For Seed¹

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ABSTRACT

Roughstalk bluegrass (Poa trivialis L.) can be a serious weed in perennial ryegrass (Lolium perenne L.) grown for seed production. The lack of methods to control established plants combined with erratic control of seedlings results in severe infestations of this weed in some perennial ryegrass fields in western Oregon. Yield losses associated with a heavy infestation were found to approach 50%, supporting the current grower practices of destroying infested stands and replanting alternative crops. Registered herbicide treatments which showed only fair control, as did non-registered treatments of 2.7 kg ha⁻¹ dichloropropanoic acid). Postemergence control of atrazine, prodiamine, simazine, chlorpropham, diuron, 3,3-dimethyl-5-benzofuranyl methanesulfonate], 2.2 kg ha⁻¹ dalapon (mixture of sodium and magnesium salts of 2,2-dichloropropionic acid), and 1.4 kg ha⁻¹ atrazine [6-chloro-N-ethyl-N'-[(1-methylethyl)-1,3,5-triazine-2,4-diamine]. Simazine (6-chloro-N,N'-diethyl-1,3,5-triazine-2,4-diamine) at 2.2 kg ha⁻¹ provided excellent seedling control, as did non-registered treatments of 2.7 kg ha⁻¹ diuron [N(3,4-dichlorophenyl)-N,N-dimethylurea] and 2.0 kg ha⁻¹ atrazine. Postemergence control of established roughstalk bluegrass was achieved with spring applications of either 0.14 to 0.28 kg ha⁻¹ fenoxaprop (ethyl ester of (±)-2-(6-chloro-2-benzoxazolo)oxyphenoxylpropanoic acid) or 1.7 to 2.2 kg ha⁻¹ dalapon (mixture of sodium and magnesium salts of 2,2-dichloropropionic acid). Roughstalk bluegrass control and ryegrass tolerance were satisfactory for both fenoxaprop and dalapon, and ryegrass seed yields and germination were not adversely affected compared with standard treatments.

Additional index words: Fenoxaprop, dalapon, ethofumesate, atrazine, prodiamine, simazine, chlorpropham, diuron, SC-1084, seed production, LOLPE, POATR.

INTRODUCTION

Roughstalk bluegrass (Poa trivialis L.) is a stoloniferous, spreading, perennial bluegrass differentiated from other bluegrasses by a rough, keeled leaf sheath; a long ligule; a large loose panicle; and greater height. Despite its perennial growth habit, seed production is prolific and has been estimated at 1,500 seeds per head and 16 million heads ha⁻¹ (Budd and Shildrick, 1968). While the main flush of germination usually occurs in early fall, additional germination will take place during periods of mild weather throughout the winter and spring (Oswald, 1980a).

Roughstalk bluegrass can be a serious weed problem in perennial ryegrass (Lolium perenne L.) grown for seed production (Budd and Shildrick, 1968; Johnson et al., 1982). The lack of registered methods for selective control of established plants, combined with erratic control of seedling plants, results in severe infestations of this weed in some perennial ryegrass fields in western Oregon. Despite the tendency of this weed to mature earlier than the crop and shatter its small seed during harvest, the presence of fine basal hairs on the seeds can lead to difficulty in mechanical separation from ryegrass seed; therefore, contamination of crop seed may be as serious a problem as yield loss associated with competition (Budd and Shildrick, 1968).

Herbicides currently registered for control of grass weeds in perennial ryegrass seed production fields include dalapon at planting if bands of carbon are sprayed over the crop row, ethofumesate both during and after the year of establishment, and atrazine, simazine, propanil (1-methyl phenylcarbamate), and chlorpropham only after the crop is well established (Hammond et al., 1976; Johnson et al., 1982; Lee, 1973; 1977; 1978; 1980; 1981; Oswald, 1985; William et al., 1986). Success in obtaining an economic seed yield the first summer after a fall planting is influenced by planting date; availability of irrigation water; growing conditions during the fall, winter, and spring; and severity of weed infestation. Assuming that they will be unable to harvest a seed crop the first year after planting, growers often reduce costs by omitting some of the herbicide treatments that are available for use during crop establishment, thereby increasing the weed problems they must manage during the subsequent life of the stand.

The use of ethofumesate has provided the means to control many seedling grasses in ryegrass, most importantly annual bluegrass (Poa annua L.) and volunteer cereals (Haggar and Bastian, 1976; Hammond et al., 1976; Johnson et al., 1982; Lee, 1980; 1981). Partial control of roughstalk bluegrass has been reported for ethofumesate in Great Britain, but economically questionable rates of 2.0 kg ha⁻¹ or higher are required (Haggar and Bastian, 1976; Hammond et al., 1976; Johnson et al., 1982). No reports exist on the response of this weed to ethofumesate in western Oregon. Oswald reported successful control of roughstalk bluegrass in perennial ryegrass seed fields using dalapon and other herbicides, but effects on seed yield varied with time of application, crop variety, and level of weed pressure (Oswald, 1980a; 1980b; Oswald et al., 1972).


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Two graminicides, sethoxydim \{2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)-propyl]-3-hydroxy-2-cyclohexen-1-one\} and fluzifop (butyl ester of \((\pm)-2-[4-[(5\text{-trifluoromethyl})-2-pyridinyl]oxy\text{-phenoxy\text{-propanoic acid}}\}) are registered for use in red fescue (\textit{Festuca rubra} L.)

seed production fields. These herbicides suppress or kill annual and perennial grasses such as bentgrass (\textit{Agrostis} spp.), German velvetgrass (\textit{Holcus mollis} L.),
tall fescue (\textit{Festuca arundinacea} Schreb.), downy brome (\textit{Bromus tectorum} L.), Italian ryegrass (\textit{Lolium multiflorum} Lam.), and quackgrass (\textit{Agropyron repens} (L.) Beauv.) (Butler and Appleby, 1986; Lee, 1983; Wyse et al., 1986). Even in those instances in which treated grass weeds eventually recover, general weed vigor is greatly reduced, and seed head formation may be completely prevented, reducing the problem of seed contamination. Crops such as red fescue and certain weeds such as annual bluegrass and rattle fescue (\textit{Vulpia myuros} L.) show outstanding tolerance to these graminicides. This naturally suggests searching for other instances of crop tolerance and weed resistance to such herbicides (Butler and Appleby, 1986; Lee, 1983).

Fenoxaprop is selective in established perennial ryegrass and Kentucky bluegrass (\textit{Poa pratensis} L.), and is being developed as a herbicide for turf use (Anon., 1986). Seeding Kentucky bluegrass and roughstalk bluegrass are moderately susceptible to this herbicide (Brewster et al., 1983; Brewster et al., 1984). Response of established roughstalk bluegrass to fenoxaprop has not been reported.

The purposes of this research were to determine the level of yield losses due to roughstalk bluegrass in perennial ryegrass in western Oregon, to evaluate the efficacy of currently registered herbicides on seedling and established stages of this weed, and to evaluate new herbicides to selectively control this weed in perennial ryegrass.

**MATERIALS AND METHODS**

\textbf{Yield loss in natural infestation.} A naturally infested stand of \textit{\textit{Linn} perennial ryegrass} east of Tangent, Oregon, was sampled at crop maturity in 1985 to estimate effects on yield of varying levels of roughstalk bluegrass infestation. Weed density decreased with distance from the field periphery providing a wide range of infestation levels. Pairs of samples were harvested from 25 randomly selected locations across the field, each pair consisting of one sample each from directly adjacent visually weedier and cleaner 5.6 m² areas. Spacing of weedier strips was consistent with a hypothesis that this weed had been spread by the grower's combine. All samples were subsampled for hand separation to determine the botanical composition of the herbage (subsample size 5-10% of whole sample) and recombined before drying, threshing, and seed cleaning. Weights of both crop and weed seeds harvested per plot were measured. Yield data were subjected to regression analyses and tested for differences between results for random locations and those for weedier and cleaner adjacent samples. Because no differences in regressions were found, except that the range of percent weed seed in the samples was somewhat greater for those from the weedier than the cleaner samples, the data were pooled. Crop yield was more closely correlated with weed percentage derived from whole sample crop and weed seed yields than from subsample herbage botanical composition, possibly due to failure of the 5 to 10% subsample size to accurately represent actual weed composition of the whole sample. Therefore, regression of yield versus weed seed instead of weed herbage percentage was chosen to describe the yield response to roughstalk bluegrass.

The field was plowed out in September 1985, and seedling weeds were treated with glyphosate \textit{[N-(phosphonomethyl)glycine]} by the grower on 11 April 1986, in preparation for a no-till planting of tall fescue on 19 April. The primary flush of roughstalk bluegrass germination did not occur here until late winter, perhaps explaining the apparent lack of control that had been seen in 1985 for fenoxaprop applied in fall of 1984 (data not reported).

Twelve herbicide treatments were applied to seedling roughstalk bluegrass in this field on 26 March 1986, in 257 l ha⁻¹ water with 1% (v v⁻¹) nonionic surfactant. Herbicides tested included glyphosate, paraquat (1,1'-dimethyl-4,4'-bipyridinum ion), sethoxydim, fluzifop-P, haloxyfop \{methyl ester of 2-[4-[[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy]-phenoxy\text{-propanoic acid}} (data not reported), flusilazole \{butyl ester of 2-[4-\text{-[3-chloro-5-(trifluoromethyl)-2-pyridinyl]oxy}\text{-phenoxy\text{-propanoic acid}}\}, DPX-Y6202 \{2-[4-[[6-chloro-2-quinoxalinyl]oxy\text{-phenoxy\text{-propanoic acid}}\}, and fenoxaprop. Roughstalk bluegrass control was rated 14 April 1986, soon after the grower had applied glyphosate to the entire area, and again on 4 June when recovery from some of the treatments was evident.

\textbf{Spring-planted seedling screening trials in 1983 and 1984.} Grasses were planted in pairs of rows 30 cm apart in conventionally prepared seedbeds on 13 May 1983 and 14 May 1984 at the Hyslop Crop Science Field Laboratory in Corvalis, Oregon. In 1983, 22 herbicide treatments were evaluated on 31 grasses, while 23 herbicides were tested on 28 grasses in 1984. All herbicides were applied in 234 l ha⁻¹ water with 1% (v v⁻¹) nonionic surfactant using a bicycle-type plot sprayer. Data from five species of interest were selected for all rates of fenoxaprop and SC-1084 (chemistry not disclosed) herbicide treatments for analysis of variance and summarization.

\textbf{Control of fall-planted seedling roughstalk bluegrass in 1985-86.} Fall- and spring-applied herbicide treatments were evaluated for control of fall-planted roughstalk bluegrass at the Hyslop Crop Science Field Laboratory in Corvalis, Oregon, in the 1985-86 growing season. Source of roughstalk bluegrass seed were samples harvested from the natural infestation east of Tangent and cleaned to pure weed seed before planting. Weed seeds were broadcast and lightly incorporated on 10 October 1985 in a conventionally prepared seedbed prior to application of any herbicides. Herbicides were applied with a bicycle-type plot sprayer in 374 l ha⁻¹ of water. Ethofumesate application was delayed until rainfall had begun in mid-October and the soil was moist. A 1% (v v⁻¹) solution of nonionic surfactant was added only to the dalapon, SC-1084, and fenoxaprop spring-applied postemergence treatments. No rainfall occurred here either during or within the first several days after the 25 March 1986 spring application of herbicides. The main flush of weed seed germination appeared to occur during mid fall, with only a small number of additional weeds germinating in late winter. Large amounts of annual bluegrass were naturally present at this location.
Table 5. Response of established perennial ryegrass and roughstalk bluegrass at the Shedd, Oregon, site to herbicide treatments applied in 1985-86 growing season.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Application</th>
<th>Rate (kg ha⁻¹)</th>
<th>Date†</th>
<th>General seedling grass control (%)</th>
<th>LOLPE‡ injury 4-30-86 (%)</th>
<th>POATR** control 5-30-86 (%)</th>
<th>LOLPE seed yield (kg ha⁻¹)</th>
<th>LOLPE seed germination (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td>--</td>
<td>--</td>
<td>0 e*</td>
<td>0 a</td>
<td>0 f</td>
<td>1420 abc</td>
<td>98 a</td>
</tr>
<tr>
<td>Chlorpropham</td>
<td>Fall-1</td>
<td>2.2</td>
<td></td>
<td>78 ab</td>
<td>15 bc</td>
<td>18 f</td>
<td>1540 abc</td>
<td>99 a</td>
</tr>
<tr>
<td>Prodamine</td>
<td>Fall-1</td>
<td>0.84</td>
<td></td>
<td>20 d</td>
<td>6 ab</td>
<td>58 de</td>
<td>1330 abc</td>
<td>99 a</td>
</tr>
<tr>
<td>Ethofumesate</td>
<td>Fall-2</td>
<td>1.1</td>
<td></td>
<td>18 d</td>
<td>0 a</td>
<td>5 f</td>
<td>1570 abc</td>
<td>98 a</td>
</tr>
<tr>
<td>Atrazine</td>
<td>Fall-1</td>
<td>1.4</td>
<td></td>
<td>77 b</td>
<td>1 a</td>
<td>79 cd</td>
<td>1710 ab</td>
<td>98 a</td>
</tr>
<tr>
<td>Atrazine</td>
<td>Fall-1</td>
<td>2.0</td>
<td></td>
<td>90 a</td>
<td>8 ab</td>
<td>83 bc</td>
<td>1590 abc</td>
<td>98 a</td>
</tr>
<tr>
<td>Simazine</td>
<td>Fall-1</td>
<td>2.2</td>
<td></td>
<td>78 ab</td>
<td>8 ab</td>
<td>83 bc</td>
<td>1560 abc</td>
<td>99 a</td>
</tr>
<tr>
<td>Diuron</td>
<td>Fall-1</td>
<td>2.7</td>
<td></td>
<td>90 a</td>
<td>6 ab</td>
<td>53 e</td>
<td>1510 abc</td>
<td>99 a</td>
</tr>
<tr>
<td>Atrazine +</td>
<td>Fall-1</td>
<td>1.4</td>
<td></td>
<td>--</td>
<td>33 de</td>
<td>82 bc</td>
<td>1250 cd</td>
<td>98 a</td>
</tr>
<tr>
<td>Atrazine +</td>
<td>Fall-1</td>
<td>1.3</td>
<td>Spring</td>
<td>--</td>
<td>40 e</td>
<td>74 cde</td>
<td>1330 bcd</td>
<td>99 a</td>
</tr>
<tr>
<td>Atrazine + SC-1084</td>
<td>Fall-1</td>
<td>0.14</td>
<td>Spring</td>
<td>--</td>
<td>75 f</td>
<td>60 cde</td>
<td>950 d</td>
<td>98 a</td>
</tr>
<tr>
<td>Atrazine + SC-1084</td>
<td>Fall-1</td>
<td>0.28</td>
<td>Spring</td>
<td>--</td>
<td>30 de</td>
<td>100 a</td>
<td>1320 bcd</td>
<td>98 a</td>
</tr>
<tr>
<td>Atrazine +</td>
<td>Fall-1</td>
<td>1.4</td>
<td></td>
<td>--</td>
<td>46 e</td>
<td>100 a</td>
<td>1340 bcd</td>
<td>99 a</td>
</tr>
<tr>
<td>Dalapon</td>
<td>Fall-1</td>
<td>1.7</td>
<td>Spring</td>
<td>--</td>
<td>6 ab</td>
<td>99 a</td>
<td>1800 a</td>
<td>99 a</td>
</tr>
<tr>
<td>Atrazine +</td>
<td>Fall-1</td>
<td>1.4</td>
<td></td>
<td>--</td>
<td>18 cd</td>
<td>100 a</td>
<td>1680 ab</td>
<td>99 a</td>
</tr>
<tr>
<td>Fenoxaprop</td>
<td>Fall-1</td>
<td>0.14</td>
<td>Spring</td>
<td>--</td>
<td>25 cde</td>
<td>95 ab</td>
<td>1490 abc</td>
<td>99 a</td>
</tr>
<tr>
<td>Atrazine +</td>
<td>Fall-1</td>
<td>0.28</td>
<td>Spring</td>
<td>38 c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Means within a column followed by same letter do not differ at P + .05 level based on Duncan’s multiple range test.
† Predominant seedling grass was volunteer perennial ryegrass, with lesser amounts of roughstalk bluegrass, annual bluegrass, and other grasses present.
‡ Data were transformed using the square root of 0.5 + X for analysis of variance and means separation to correct raw data variance lack of homogeneity.
** Data were transformed using the square root of 100.5 - X for analysis of variance and means separation to correct raw data variance lack of homogeneity.
†‡ Application dates: Fall-1 = 15 Oct. 1985 (soil dry); Fall-2 = 23 Oct. 1985 (soil moist); Spring = 24 March 1986 (weeds well tillered).

head formation and seed production than in actually killing the established roughstalk bluegrass plants. Other applications of fenoxaprop made several days later at nearby sites at rates up to 0.56 kg ha⁻¹ did cause moderate visible injury to perennial ryegrass at the highest rate, but it is not known if this injury was sufficiently severe to cause yield reductions since yield data were not recorded.

Applications of glyphosate, paraquat, and five graminicides to seedling roughstalk bluegrass on 26 March 1986 at the plowed out site east of Tangent further confirmed the effectiveness of fenoxaprop on this weed (Table 6). Control was rated 19 days after treatment because the grower had applied 0.28 kg ha⁻¹ of glyphosate to the entire area 3 days earlier. At that time, sethoxydim, fluzifop-P, haloxyfop, and DPX-Y6202 all appeared to be more damaging to roughstalk bluegrass than equal rates of fenoxaprop. All rates of glyphosate and paraquat were giving nearly total control. Ratings made at 70 days after treatment, however, revealed considerable recovery by roughstalk bluegrass in those plots that had been treated with sethoxydim, fluzifop- P, and the lower rate of paraquat on 26 March, despite application of glyphosate 16 days after the first herbicide treatment. Final control was good for all rates of fenoxaprop, glyphosate, haloxyfop, and DPX-Y6202, but only fenoxaprop would be selective in perennial ryegrass.

CONCLUSIONS

Failure of all but one of the herbicide treatments registered for use in perennial ryegrass to fully control even seedling roughstalk bluegrass helps to explain why this weed has become a serious problem. Even the most successful treatment, 2.2 kg ha⁻¹ of simazine applied preemergence, probably benefited from unusually severe late fall weather, and control with it might be less satisfactory under other growing conditions. Given this difficulty in preventing successful
establishment by seedling roughstalk bluegrass, the acute need for methods to control established roughstalk bluegrass becomes obvious. Dalapon and fenoxaprop applied in the spring both show good promise for controlling established roughstalk bluegrass with a minimum of ryegrass injury. Fenoxaprop appears to possess slightly greater crop safety, but dalapon is able to control additional weeds such as annual bluegrass.

Investigations are continuing into optimum rates and timing of dalapon and fenoxaprop treatment for controlling roughstalk bluegrass with a minimum of injury to perennial ryegrass. Future studies will be conducted to determine long-term effects of dalapon and fenoxaprop on established roughstalk bluegrass, measuring the degree to which injured weeds might eventually recover and require retreatment in subsequent years.

LITERATURE CITED


