# GRASS WEED MANAGEMENT IN ESTABLISHED PERENNIAL RYEGRASS GROWN FOR SEED

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**Introduction**
Weed management studies were conducted over a two-year period (2011–2013) at the Oregon State University Hyslop Research Farm. The objective was to evaluate the efficacy and potential for crop injury from pre-emergent herbicide treatments applied as a management strategy for the control of roughstalk bluegrass (*Poa trivialis*), California brome (*Bromus carinatus*), and diuron-resistant annual bluegrass (*Poa annua*) in established perennial ryegrass grown for seed.

**Materials and Methods**
For the 2011-2012 study, soils at the research farm sites were Woodburn silty clay loams with a pH of 6, 2.32% organic matter (OM), and a cation exchange capacity (CEC) of 15.8. For the 2012–2013 study, soils had a pH of 5.5, 2.52% OM, and a CEC of 15.4.

The experimental design of both studies was a randomized complete block with four replications. In 2011–2012, the established perennial ryegrass stand was planted with the variety 'Prelude IV'. Three rows of diuron-resistant *P. annua* and three rows of *B. carinatus* were planted in fallow areas in the front portion of each plot prior to the pre-emergent applications. In 2012–2013, the established perennial ryegrass stand was planted with the variety 'Silver Dollar'. Three rows of diuron-resistant *P. annua* and three rows of *P. trivialis* were planted in fallow areas in the front portion of the plots. In both years, the seeded rows of weeds varied slightly in planting depth, leading to staggered emergence of the two species.

Herbicides were applied pre-emergent (Tables 1 and 2) or as a combination of a pre-emergent application followed by a second application applied 35 days later (Tables 3 and 4). Pre-emergent treatments were applied on October 20, 2011, the day following planting of the *B. carinatus* and the diuron-resistant *P. annua* as described above. Treatments were applied with a research sprayer calibrated to deliver 20 gpa at 20 psi. Weed control was evaluated visually. The perennial ryegrass seed was harvested, and clean seed yields were quantified. Data were analyzed using ANOVA and means separated by LSD.

The 2011–2012 study also evaluated tolerance of the established perennial ryegrass 'Prelude IV' to fall applications of pyroxasulfone and pyroxasulfone in combination with flumioxazin. These treatments were compared to industry standard treatments of flufenacet-metribuzin, dimethenamid-P, and s-metolachlor.

**Results and Discussion**
Results from the 2011–2012 study are shown in Table 1. No visible injury was apparent from any of the treatments on April 11, 2012. No reductions in perennial ryegrass seed yield were quantified following seed cleaning. Yield was lowest from the untreated check treatment, probably due to competition from volunteer perennial ryegrass "sprout."

Pyroxasulfone did not control the *P. annua* adequately at the lowest rate applied, but provided good control (above 90%) at the higher rates. When combined with flumioxazin, control of *P. annua* with the low rate of pyroxasulfone improved from 80% to 89%. Diuron-resistant *P. annua* control was also good with flufenacet-metribuzin and dimethenamid-P. Diuron-resistant *P. annua* control with s-metolachlor was poor.

Pyroxasulfone applied at the highest rate, flufenacet-metribuzin, and dimethenamid-P provided good control of seedling California brome. The addition of flumioxazin improved California brome control when applied with the lowest rate of pyroxasulfone.

In the 2012–2013 study, the pre-emergent herbicides flufenacet-metribuzin, pyroxasulfone, pyroxasulfone-flumioxazin, indaziflam, s-metolachlor, and dimethenamid-P provided 90% or greater control of diuron-resistant *P. annua* on November 9, 30 days following application (Table 2). *P. trivialis* control was greater than 90% except with the indaziflam treatment, which resulted in 85% control.

In May 2013, flufenacet-metribuzin treatments followed by a different herbicide provided 99–100% control of *P. annua* and 94% or greater control of *P. trivialis* (Table 3). A pre-emergent application of dimethenamid-P followed either with flufenacet-metribuzin or indaziflam maintained control of both *Poa* species at greater than 94% through May (Table 4). Dimethenamid-P followed with s-metolachlor was equivalent to dimethenamid-P followed by pendimethalin for *P. annua* control, resulting in 90 and

Table 1. Crop injury and grass weed control (*P. annua* and *B. carinatus*) in established perennial ryegrass, 2011–2012.

| Treatment | Rate | Crop injury[1] | *Poa annua* | *Bromus carinatus* | Clean seed yield |
|---|---|---|---|---|---|
| | (lb ai/a) | (%) | ------- (% control 4/11/2012) | -------- | (lb/a) |
| Check | — | — | — | — | 906 |
| Pyroxasulfone | 0.05 | 3 | 80 | 68 | 982 |
| Pyroxasulfone | 0.09 | 0 | 95 | 85 | 987 |
| Pyroxasulfone | 0.18 | 0 | 100 | 95 | 978 |
| Flufenacet-metribuzin | 0.43 | 0 | 97 | 95 | 1,033 |
| Dimethenamid-P | 0.98 | 3 | 93 | 91 | 941 |
| s-metolachlor | 0.95 | 0 | 49 | 84 | 981 |
| Pyroxasulfone | 0.05 | 3 | 89 | 89 | 944 |
| + flumioxazin | 0.04 | | | | |
| Pyroxasulfone | 0.05 | 0 | 83 | 88 | 1,016 |
| + oxyfluorfen | 0.06 | | | | |
| LSD ($P$ = 0.05)[2] | — | NS | 19 | 9 | NS |
| CV | — | — | 17 | 89 | — |

[1]Crop injury visually assessed on April 11, 2012.
[2]NS = Not statistically different

Table 2. Grass weed control (*P. annua* and *P. trivialis*) and clean seed yield in established perennial ryegrass with pre-emergent herbicide application, 2012–2013.

| Treatment | Rate | Timing | *Poa annua* | *Poa trivialis* | *Poa annua* | *Poa trivialis* | Clean seed yield |
|---|---|---|---|---|---|---|---|
| | (lb ai/a) | | (% control 11/9/2012) | | (% control 5/31/2013) | | (lb/a) |
| Check | — | — | — | — | — | — | 663 |
| Flufenacet-metribuzin | 0.425 | Pre | 100 | 100 | 98 | 89 | 673 |
| Pyroxasulfone | 0.09 | Pre | 98 | 100 | 99 | 86 | 791 |
| Indaziflam | 0.02 | Pre | 90 | 85 | 91 | 97 | 788 |
| Pyroxasulfone-flumioxazin | 0.095 | Pre | 100 | 100 | 96 | 84 | 634 |
| Pyroxasulfone-flumioxazin | 0.143 | Pre | 100 | 100 | 99 | 94 | 735 |
| Dimethenamid-P | 0.98 | Pre | 93 | 98 | 48 | 29 | 646 |
| s-metolachlor | 0.95 | Pre | 90 | 90 | 18 | 8 | 692 |
| Pendimethalin | 2.38 | Pre | 30 | 33 | 0 | 10 | 768 |
| LSD ($P$ = 0.05)[1] | — | — | 19 | 20 | 30 | 21 | NS |
| CV | — | — | 17 | 18 | 35 | 26 | — |

[1]NS = Not statistically different

91% control, respectively. For control of *P. trivialis*, dimethenamid-P followed by metolachlor (79%) was better than dimethenamid-P followed by pendimethalin (60%). A pre-emergent s-metolachlor application followed by flufenacet-metribuzin, pyroxasulfone, indaziflam or dimethenamid-P maintained control of both *Poa* species at greater than 90%, with the exception of *P. trivialis* control with dimethenamid-P (86%) (data now shown). *P. annua* control remained greater than 90% through May with a single application of flufenacet-metribuzin, pyroxasulfone, indaziflam, or pyroxasulfone-flumioxazin (Table 2). *P. trivialis* control of greater than 90% through May was achieved with single applications of only indaziflam or pyroxasulfone-flumioxazin (Table 2) or by utilizing a combination of a pre-emergent application followed by a different herbicide (Table 3).

Of the currently registered herbicides for use in grasses grown for seed, the flufenacet-metribuzin pre-emergent treatment followed by pendimethalin is the only option that avoids using herbicides in sequence with the same site of action. Sequential applications of herbicides with the same site of action is a practice that is troubling from a resistance management viewpoint. Pyroxasulfone, pyroxasulfone-flumioxazin, and indaziflam are not currently registered for use on grasses grown for seed. However, pyroxasulfone-flumioxazin is in the IR-4 program in an effort to develop labels for use in grasses grown for seed. Indaziflam seems to have utility in grass seed production and would introduce a new mode of action to the cropping system.

**References**

Curtis, D.W., K.C. Roerig, A.G. Hulting, and C.A. Mallory-Smith. 2013. Annual bluegrass management with pyroxasulfone and flumioxazin in perennial ryegrass and tall fescue grown for seed. In A. Hulting, N. Anderson, D. Walenta, and M. Flowers (eds.). *2012 Seed Production Research Report*. Oregon State University, Ext/CrS 143.

Table 3. Grass weed control (*P. annua* and *P. trivialis*) and clean seed yield in established perennial ryegrass with pre-emergent (flufenacet-metribuzin) and post-emergent herbicide application, 2012–2013.

| Treatment | Rate | Timing | *Poa annua* | *Poa trivialis* | *Poa annua* | *Poa trivialis* | Clean seed yield |
|---|---|---|---|---|---|---|---|
| | (lb ai/a) | | (% control 11/9/2012) | | (% control 5/31/2013) | | (lb/a) |
| Check | — | — | — | — | — | — | 663 |
| Flufenacet-metribuzin fb pyroxasulfone | 0.425<br>0.09 | Pre<br>+ 35 days | 100 | 100 | 100 | 100 | 791 |
| Flufenacet-metribuzin fb indaziflam | 0.425<br>0.02 | Pre<br>+ 35 days | 95 | 95 | 99 | 100 | 782 |
| Flufenacet-metribuzin fb dimethenamid-P | 0.425<br>0.98 | Pre<br>+ 35 days | 100 | 100 | 100 | 98 | 676 |
| Flufenacet-metribuzin fb s-metolachlor | 0.425<br>0.95 | Pre<br>+ 35 days | 100 | 100 | 99 | 94 | 738 |
| Flufenacet-metribuzin fb pendimethalin | 0.425<br>2.38 | Pre<br>+ 35 days | 100 | 100 | 100 | 95 | 681 |
| LSD ($P$ = 0.05)[1] | — | — | 6 | 6 | 2 | 4 | NS |
| CV | — | — | 5 | 5 | 2 | 3 | — |

[1]NS = Not statistically different

Table 4. Grass weed control in established perennial ryegrass with pre-emergent (dimethenamid) and post-emergent herbicide application, 2012–2013.

| Treatment | Rate | Timing | *Poa annua* | *Poa trivialis* | *Poa annua* | *Poa trivialis* | Clean seed yield |
|---|---|---|---|---|---|---|---|
| | (lb ai/a) | | (% control 11/9/2012) | | (% control 5/31/2013) | | (lb/a) |
| Check | — | — | — | — | — | — | 663 |
| Dimethenamid-P fb flufenacet-metribuzin | 0.98<br>0.425 | Pre<br>+ 35 days | 95 | 95 | 98 | 94 | 729 |
| Dimethenamid-P fb indaziflam | 0.98<br>0.02 | Pre<br>+ 35 days | 93 | 95 | 95 | 98 | 746 |
| Dimethenamid-P fb s-metolachlor | 0.98<br>0.95 | Pre<br>+ 35 days | 90 | 95 | 90 | 79 | 730 |
| Dimethenamid-P fb pendimethalin | 0.98<br>2.38 | Pre<br>+ 35 days | 90 | 95 | 91 | 60 | 676 |
| Dimethenamid-P + pendimethalin fb pendimethalin | 0.98<br>2.38<br>1.43 | Pre<br>Pre<br>+ 35 days | 100 | 100 | 79 | 71 | 739 |
| LSD ($P = 0.05$)[1] | — | — | 9 | 9 | 31 | 22 | NS |
| CV | — | — | 7 | 7 | 29 | 24 | — |

[1]NS = Not statistically different