A Pacific Northwest Extension Publication
Oregon State University • Washington State University • University of Idaho

# Rattail Fescue

## Biology and Management in Pacific Northwest Wheat Cropping Systems

***Vulpia myuros* (L.) C.C. Gmel. var. *hirsuta* (Hack.) Aschers. & Graebn.**

**Daniel A. Ball and Andrew G. Hulting**

Farmers are discovering that weed management practices must be adjusted to control species previously susceptible to tillage as direct-seed wheat production practices become more widely adopted to conserve soil and water resources. Rattail fescue (*Vulpia myuros*) is an example, as this grass is becoming an increasingly common weed in wheat-based cropping systems across the Pacific Northwest (PNW). Rattail fescue has been a management problem in southern Australian pastures and wheat-based cropping systems since the mid-1980s (Dillon and Forcella 1984), and more recently it has become particularly widespread in PNW wheat cropping systems as minimum-tillage and direct-seeding practices have become commonplace throughout the region.

## Description

Rattail fescue was historically assigned to the *Festuca* genus because of the appearance of its stems and leaves, before being reclassified as part of the *Vulpia* genus. Also referred to as silvergrass, six-weeks fescue, or foxtail fescue, rattail fescue is probably native to Europe and is considered an invasive species in natural and wildland areas, native plant restoration sites, pastures, rangeland, roadsides, and cultivated cropland throughout the PNW and California (DiTomaso and Healy 2007).

Rattail fescue is a cool-season, winter annual grass with tightly folded leaf blades less than 1/16-inch wide (Figures 1 and 2). The narrow, compact panicles usually emerge from May to June in the PNW, and are 2–6 inches long and less than half an inch wide, with short awns (Figure 3). Rattail fescue is self-pollinating and reproduces solely by seed (Figure 4). Mature plants may reach up to 3 feet in height, but most range from 1 to 2 feet tall (Figure 5).

The fibrous root system of this grass usually only grows to shallow soil depths, but it may extend

Figure 1. Vegetative growth of rattail fescue.

Figure 2. Vegetative growth of rattail fescue showing the tightly rolled and thin leaf blades. Note the light-green leaf color, which can sometimes be useful for identification.

Daniel A. Ball, Professor of Weed Science, Oregon State University, Pendleton; Andrew G. Hulting, Extension Weed Management Specialist, Oregon State University, Corvallis.

PNW 613 • September 2009

Figure 3. Rattail fescue flowering stem.

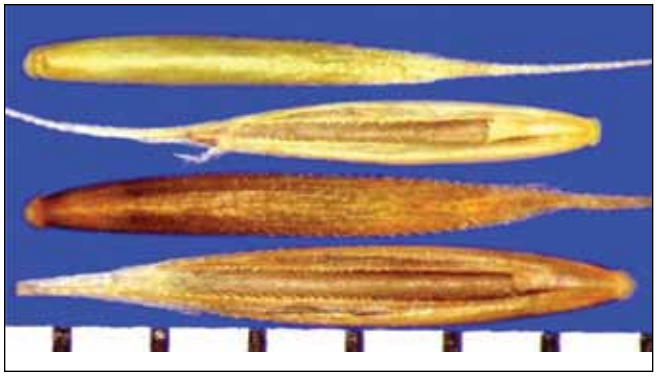

Figure 4. Magnified image of rattail fescue seeds (1mm scale). Seeds are reddish-brown in color, narrow and approximately 5mm (0.2 inches) in length.

Figure 5. Mature rattail fescue growing in winter wheat.

deeper than 12 inches if thin or rocky soils or limited moisture do not inhibit growth. It is able to grow and persist on acidic, shallow, or sandy soils. Rattail fescue is sensitive to drought and has generally been more prevalent in higher-rainfall areas around the world. Rattail fescue is considered to be a poor forage grass because its sharp awns can injure the face and mouth of grazing animals, and it is generally avoided by livestock.

Rattail fescue can impact winter wheat yields in several ways and should be aggressively managed. Left uncontrolled for one or more growing seasons, rattail fescue can form dense mats of residue on chemical-fallow and direct-seeded wheat fields, because its tissues break down slowly (Figure 6). These residues can have an allelopathic effect on wheat seedlings, affecting radical elongation and shoot growth (An et al. 1997). Competition of rattail fescue with winter wheat during crop growth can reduce yields by 10–30 percent (Dillon and Forcella 1984). Rattail fescue is generally considered to be intolerant to repeated tillage, but with the continued increase in direct seeding of winter wheat,

Figure 6. A dense mat of dry rattail fescue stems and seeds on the edge of a winter wheat field in western Oregon.

the geographic range of rattail fescue has been expanding in the PNW.

Research studies have recently been conducted in the PNW to develop better management practices for rattail fescue in winter wheat–based cropping systems. These have primarily focused on understanding the biology of rattail fescue, in order to develop improved management strategies, and have also assessed the response of rattail fescue to various herbicides and herbicide timings used in winter wheat and chemical fallow.

## Rattail Fescue Biology

A variety of characteristics relating to rattail fescue — seed germination requirements, longevity of seed in the soil, and whether vernalization (a period of low winter temperatures) is needed for rattail fescue to produce seed — have been the subject of recent studies conducted in Oregon. Rattail fescue seeds were collected from eastern and western Oregon, to represent growing conditions on both sides of the Cascades. One study demonstrated that both an after-ripening period (biochemical seed aging) and a vernalization treatment increased rattail fescue seed germination (Figure 7). This observation reinforces the classification of rattail fescue as a winter annual in growing regions across the PNW, since the cool soil temperatures and adequate moisture for germination that occur in autumn will likely promote seed germination. The optimal soil temperature for germination was approximately 68°F, with 81–100 percent germination after six days (Figure 8). Soil temperatures above 95°F resulted in low germination (0–16 percent). No differences in germination requirements were observed among seeds collected from different Oregon locations.

In another experiment, rattail fescue seeds were collected and planted on both sides of the

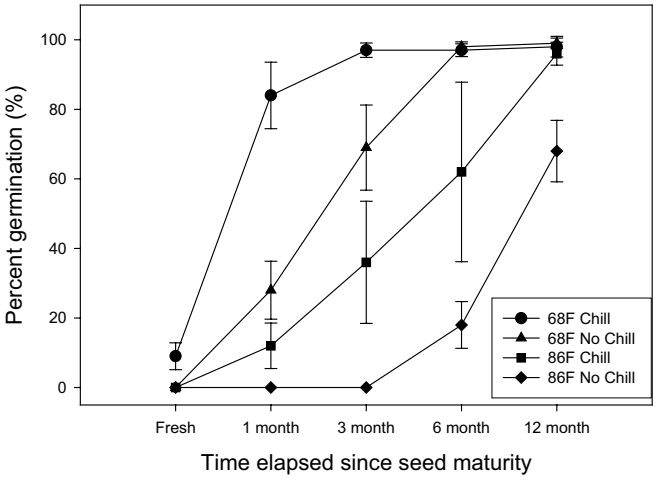


Figure 7. Effects of a 40°F prechilling treatment, seed germination temperature, and elapsed time after seed maturity on germination of rattail fescue.

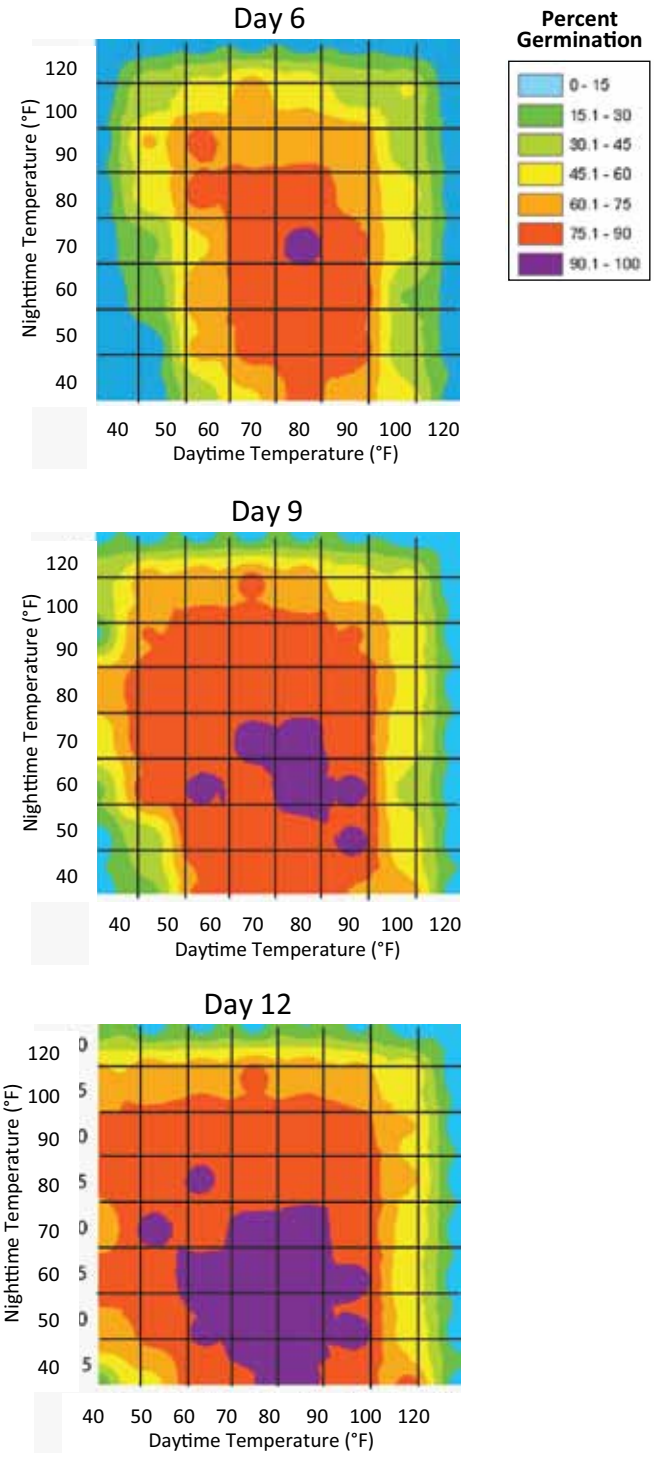


Figure 8. Percentage germination of rattail fescue seed on a two-way thermogradient plane after 6, 9, and 12 days.

Cascades from October to March to assess total seed production from plants germinating at these different dates. Study sites were located at Pendleton, Moro, and Corvallis, Oregon. The plants required a vernalization period to successfully produce panicles and seeds. Plants from seed sown on the earliest autumn planting dates were able to reach physiological maturity and produce viable seed, with seed production per plant decreasing for plantings later in the autumn. Plants from seed sown at the mid-winter through spring planting dates remained vegetative and did not produce viable seed. Limited soil moisture and the resulting delayed germination also affected plant growth and seed production at Moro, the site with the lowest rainfall. These results indicate that those rattail fescue plants that establish early in the fall probably contribute most to the soil seed bank and should be targeted for control.

A third study, in eastern Oregon, assessed the longevity of rattail fescue seed buried in various soil types over a three-year period. Seeds were collected from a common location and buried at different locations. Soil characteristics represented in this study included a range of soil pH from 6.4 at a site near Summerville, OR, 6.9 at a site near Pendleton, to 8.6 at a site near Imbler, OR. Seed viability decreased as burial time increased over a period of years. Less than 3 percent of seeds germinated after the third year of burial, similar to results other researchers have documented. Seed decay was most rapid in the higher pH soil. In addition, there was a tendency for seed longevity to increase as seed was buried more deeply in the soil, although this trend was not strongly evident. These findings indicate that rattail fescue seed is fairly short-lived in soil (Figure 9), which is consistent with the seed viability characteristics of many other annual grass species.

The temperatures needed for optimum germination explain why rattail fescue tends to germinate in late fall and throughout the winter, when cool temperatures and moist soil conditions exist across the PNW. This germination timing allows rattail fescue to establish early and to compete with a recently seeded winter wheat crop for resources throughout the winter and spring, during early stages of crop growth. Nonetheless, management of rattail fescue to prevent seed production for several growing seasons can significantly reduce an infestation over time.

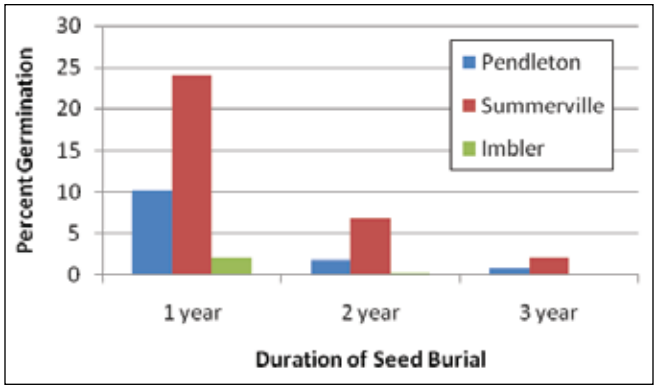


Figure 9. Effect of duration of burial on rattail fescue seed viability at three locations in eastern Oregon.

## Rattail Fescue Management

### Crop Rotation

Development of a crop rotation strategy that includes a spring cereal crop or a spring-seeded pulse or oilseed crop can be used as a tool to disrupt the winter-annual life cycle of rattail fescue and can provide effective long-term management. Although the rattail fescue sown in mid-winter in the study discussed above completed its life cycle, these plants produced half as many seeds as those planted in October and November. A spring-seeded crop sown after the typical autumn emergence of rattail fescue seedlings would allow for a reduction in infestation by opportunistic control of rattail fescue emergence with a preplant glyphosate application or tillage, or both. Because the seed longevity is relatively short in the PNW, adopting a rotation without winter wheat for two years, if economically feasible for wheat growers, would significantly diminish the rattail fescue soil seed bank. Control through the preplant tillage or glyphosate strategy is crucial, because postemergence herbicides available for grass weed control in pulse and oilseed crops are ineffective at controlling rattail fescue (including herbicides containing sethoxydim, quizalofop, or clethodim). These methods, however, will only be effective if rattail fescue has germinated and emerged prior to the tillage operations or glyphosate application.

## Management in Winter Wheat

There is a trend toward increased acreage of direct-seeded wheat production in the PNW. Management of rattail fescue in winter wheat has been investigated in a series of studies conducted over a two-year period at several locations throughout PNW wheat-growing regions. These studies were performed because crop rotation is not always possible, for a variety of reasons, and assessed the effectiveness of herbicide treatments in winter wheat. There are few herbicides specifically registered for rattail fescue control in winter wheat, but there are chemical options for selective control that should be considered by growers. Several herbicides registered for use in wheat were used to determine their activity on rattail fescue (Table 1). The most consistently effective treatment over the five sites was a flufenacet-containing herbicide applied preemergence to both winter wheat and rattail fescue. Control of rattail fescue in winter wheat was also obtained with treatments of flufenacet applied preemergence followed by sulfosulfuron, mesosulfuron, diuron, or imazamox applied postemergence. Flufenacet is primarily active on grass weeds and may not provide control of broadleaf weeds if used alone. The postemergence herbicides applied alone in this study did not generally provide acceptable control of rattail fescue in winter wheat.

## Management in Chemical Fallow

Rattail fescue management strategies in chemical fallow are particularly needed for growers using direct-seeding farming methods in the PNW. Adoption of chemical fallow, which primarily relies on applications of glyphosate for weed control,

Table 1. Control of rattail fescue by pre- and post-emergence herbicide treatments in winter wheat at five sites throughout the PNW.

| | | | Pendleton, OR (%) | | Corvallis, OR (%) | | Genesee, ID (%) | | Moscow, ID (%) | | Pullman, WA (%) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment[a] | Rate[b] lb ai/A | Timing | 2004 May 27 | 2005 Apr 13 | 2004 Mar 15 | 2005 Jan 11 | 2004 Jul 12 | 2005 Jun 22 | 2004 Jul 12 | 2005 Jun 22 | 2004 Jun 14 | 2005 Jul 11 |
| Untreated (check) | — | — | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flufenacet | 0.36 | Pre | 97 | 96 | 100 | 95 | 96 | 95 | 99 | 94 | 94 | 60 |
| Flufenacet+NIS | 0.36 | Post | 48 | 83 | 100 | 71 | 91 | 78 | 97 | 93 | 65 | 10 |
| Sulfosulfuron+NIS+UAN | 0.026 | Post | 35 | 92 | 95 | 73 | 85 | 83 | 92 | 80 | 30 | 34 |
| Mesosulfuron+NIS+UAN | 0.013 | Post | 33 | 65 | 85 | 45 | 74 | 65 | 74 | 63 | 10 | 5 |
| Diuron | 1.00 | Post | 25 | 0 | 76 | 59 | 65 | 73 | 97 | 73 | 20 | 0 |
| Imazamox+NIS+UAN | 0.044 | Post | 58 | 93 | 80 | 26 | 84 | 84 | 98 | 76 | 60 | 13 |
| Flufenacet/ sulfosulfuron+NIS+UAN | 0.36/0.026 | Pre/ Post | 100 | 99 | 100 | 96 | 98 | 88 | 99 | 94 | 90 | 68 |
| Flufenacet/ mesosulfuron+NIS+UAN | 0.36/0.013 | Pre/ Post | 100 | 99 | 100 | 98 | 93 | 93 | 99 | 95 | 94 | 74 |
| Flufenacet/diuron | 0.36/1.00 | Pre/ Post | 100 | 97 | 100 | 97 | 99 | 93 | 99 | 95 | 94 | 60 |
| Flufenacet/ imazamox+NIS+UAN | 0.36/0.044 | Pre/ Post | 100 | 99 | 100 | 94 | 99 | 94 | 99 | 95 | 97 | 73 |
| LSD[c] (0.05) | — | — | 10 | 9 | 7 | 15 | 12 | 19 | 8 | 20 | 24 | 30 |

a Nonionic surfactant (NIS) applied at 0.5% by volume (v/v) and 32% nitrogen (UAN) applied at 2.5% v/v.

b Herbicide application rates are expressed in pounds of active ingredient applied per acre (lb ai/A). Trade names are not provided here, nor does mention of an herbicidal product in this publication imply an endorsement or recommendation for commercial use. Read, understand, and follow all herbicide labels for appropriate and legal use directions.

c Least significant difference, 5% level.

eliminates the possibility of using tillage as a management tool for rattail fescue control during the fallow period. Studies have shown that glyphosate is only marginally effective in controlling rattail fescue and often requires the use of a higher-than-typical application rate for adequate control (Jemmett 2006). The effectiveness of glyphosate also depends on the growth stage of the rattail fescue (Leys et al. 1991; Dillon and Forcella 1984), so proper application timing is needed to optimize control in chemical fallow (Figure 10). An insufficient glyphosate application rate, or incorrectly timed applications, in chemical fallow can lead to an increase in rattail fescue infestations over a period of growing seasons in dryland wheat production regions where winter wheat is grown in alternate years following chemical fallow.

The effectiveness of different rates and timings of glyphosate on rattail fescue in chemical fallow has been investigated at sites in Washington, Oregon, and Idaho. Sequential applications of glyphosate resulted in the best control, and in general, higher glyphosate rates increased control in all three states (Table 2). However, for all treatments, control in Oregon was less than that in Idaho and Washington. Early postemergence (EPOST) treatments of glyphosate resulted in similar control to sequential applications in Idaho and Washington. EPOST applications were made to rattail fescue in the early tiller stage of growth (two to five tillers per plant) at the Idaho and Washington sites. Late postemergence applications (LPOST) provided somewhat less control, due to application to five- to ten-tiller plants. However, LPOST glyphosate applications provided more effective rattail fescue control than EPOST treatments in Oregon (Figure 10). This was primarily because the EPOST applications were being made to young (three- to five-leaf) rattail fescue plants, prior to significant tiller development in Oregon. The LPOST treatments of glyphosate were made to rattail fescue in the early tillering stages of plant development in Oregon.

Conclusions from these trials, and from other field observations throughout the PNW, suggest that rattail fescue control with glyphosate in chemical fallow is more complete when glyphosate is applied


Figure 10. Influence of glyphosate application timing on rattail fescue control in chemical fallow. An early application timing (left) was made too soon prior to tillering of rattail fescue and resulted in poor control. A later application (right) of the same glyphosate rate applied when the rattail fescue was at the three- to five-tiller stage of development resulted in excellent control.

to plants in the early to mid tiller stages of growth. Control with glyphosate is less satisfactory if applied at very early (seedling) or advanced stages of tiller development. A possible explanation of these findings is that rattail fescue in the seedling stage does not have sufficient leaf surface area to allow for adequate glyphosate coverage. In addition, the erect leaf orientation of young seedlings is such that it may be difficult for applicators to obtain sufficient spray coverage on the leaf blades.

## Integrated Weed Management Practices

Integrated weed management practices can facilitate effective long-term control of rattail fescue in PNW winter wheat production regions. For farming operations that have adopted direct seeding, inclusion of a spring-planted crop in the crop rotation, when possible, combined with appropriately executed rattail fescue control during chemical fallow periods, will provide an acceptable reduction in rattail fescue infestations. The use of herbicide treatments in the winter wheat crop may be possible, but control will be less than acceptable on dense populations of rattail fescue. Therefore, it is essential to reduce rattail fescue soil seed banks through crop rotations and effective control of rattail fescue seedlings during fallow periods.

Table 2. Rattail fescue control with glyphosate in chemical fallow averaged over two years (2004-2005) in Idaho and Oregon and in Washington for one year (2004).

| | | | Control (%) | | | |
|---|---|---|---|---|---|---|
| Treatment[a] | Rate[b] fl oz/A | Application timing[c] | ID 2004–05[d] | OR 2004–05[d] | WA 2004 | Average |
| **Glyphosate** | 16 | EPOST | 75 | 37 | 84 | 65 |
| | 24 | EPOST | 89 | 41 | 89 | 73 |
| | 32 | EPOST | 92 | 44 | 87 | 74 |
| | 40 | EPOST | 92 | 51 | 93 | 79 |
| | 16 | LPOST | 45 | 58 | 59 | 54 |
| | 24 | LPOST | 54 | 66 | 71 | 64 |
| | 32 | LPOST | 56 | 72 | 70 | 66 |
| | 40 | LPOST | 64 | 76 | 66 | 69 |
| **Glyphosate/glyphosate** | 16/16 | EPOST/LPOST | 92 | 68 | 87 | 82 |
| | 24/16 | EPOST/LPOST | 96 | 73 | 94 | 88 |
| | 16/24 | EPOST/LPOST | 96 | 74 | 93 | 88 |
| | 24/24 | EPOST/LPOST | 97 | 78 | 97 | 91 |
| | 24/32 | EPOST/LPOST | 97 | 76 | 94 | 89 |
| **LSD (0.05)** | — | — | 7 | 5 | 17 | — |

a Glyphosate applied with ammonium sulfate at 8.5 lb/100 gal. The glyphosate formulation applied was Roundup UltraMAX. Mention of an herbicidal product in this publication is not an endorsement or recommendation for commercial use. Read, understand, and follow all herbicide labels for appropriate and legal use directions.

b Spray volume = 10 gallons per acre.

c Early post-emergence (EPOST) and late post-emergence (LPOST) stage of growth. See text for more complete description of rattail fescue growth stage at the time of glyphosate applications in these studies.

d Data combined over two years.

## References Cited

An, M., J.E. Pratley, and T. Haig. 1997. Phytotoxicity of *Vulpia* residues: I. Investigation of aqueous extracts. Journal of Chemical Ecology 23(8):1979–1995.

Dillon, S.P., and F. Forcella. 1984. Germination, emergence, vegetative growth and flowering of two silvergrasses, *Vulpia bromoides* (L.) S.F. Gray and *V. myuros* (L.) C.C. Gmel. Australian Journal of Botany 32(2):165–175.

DiTomaso, J.M., and E.A. Healy. 2007. Weeds of California and Other Western States. University of California Agriculture and Natural Resources publication 3488.

Jemmett, E.D. 2006. The biology and management of rattail fescue in winter wheat cropping systems. Master's thesis, University of Idaho.

Leys, A.R., B. Cullis, and B. Plater. 1991. Effect of spraytopping applications of paraquat and glyphosate on the nutritive value and regeneration of vulpia (*Vulpia bromoides* (L.) S.F. Gray). Australian Journal of Agricultural Research 42(8):1405–1415.

## For More Information

Ball, D.A., S.M. Frost, L.H. Bennett, D.C. Thill, T. Rauch, E. Jemmett, C. Mallory-Smith, C. Cole, J.P. Yenish, and R. Rood. 2007. Control of rattail fescue (*Vulpia myuros*) in winter wheat. Weed Technology 21(3):583–590.

Ball, D.A., S.M. Frost, L. Fandrich, C. Tarasoff, and C. Mallory-Smith. 2008. Biological attributes of rattail fescue (*Vulpia myuros*). Weed Science 56(1):26–31.

Jemmett, E.D., D.C. Thill, T.A. Rauch, D.A. Ball, S.M. Frost, L.H. Bennett, J.P. Yenish, and R.J. Rood. 2008. Rattail fescue (*Vulpia myuros*) control in chemical-fallow cropping systems. Weed Technology 22(3):435–441.

Whitson, T.D., ed. 2000. Weeds of the West, Ninth Edition. Laramie: University of Wyoming.

## Acknowledgments

Research cited in this bulletin was funded through a special grant from the USDA-CSREES-STEEP III program and through funding from the Oregon Wheat Commission.

The following individuals cooperated on studies and provided data cited in this publication: *Donn C. Thill*, Professor of Weed Science, University of Idaho, Moscow; *Carol Mallory-Smith*, Professor of Weed Science, Oregon State University, Corvallis; *Joseph P. Yenish*, Associate Professor of Weed Science, Washington State University, Pullman; *Lynn Fandrich* and *Catherine Tarasoff*, former Graduate Research Assistants, Oregon State University, Corvallis; *Eric Jemmett*, former Graduate Research Assistant, University of Idaho, Moscow.

## Photo Credits:

Andrew G. Hulting, Daniel A. Ball, Karin Neff, and the Oregon State University Seed Laboratory.

## Appendix of herbicide common names and corresponding trade names mentioned in this publication.

| Common Name | Site of Action Group Number | Trade Names |
|---|---|---|
| Glyphosate | Group 9 | Roundup, Touchdown, Glyphomax and many others |
| Sethoxydim | Group 1 | Poast and various others |
| Quizalofop | Group 1 | Assure II and various others |
| Clethodim | Group 1 | Select and various others |
| Flufenacet | Group 15 | Define |
| Diuron | Group 7 | Karmex and various others |
| Sulfosulfuron | Group 2 | Maverick and various others |
| Mesosulfuron | Group 2 | Osprey |
| Imazamox | Group 2 | Beyond |



Published and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914, by the Oregon State University Extension Service, Washington State University Extension, University of Idaho Cooperative Extension System, and the U.S. Department of Agriculture cooperating.



Published September 2009.