2025 WSU Weed Control Report

Drew Lyon, Professor, Endowed Chair Small Grains Extension and Research, Weed Science
Mark Thorne, Research Associate, Weed Science

Ian Burke, Professor, R. James Cook Endowed Chair in Wheat Research, Weed Science
Jessica Kalin and Marija Savic, Research Associates, Weed Science

Partial Research Support Provided by:

The Washington Grain Commission, The Washington Turfgrass Seed Commission, The Washington Oilseeds Commission, Washington State Commission on Integrated Pest Management, The USA Dry Pea & Lentil Council, Organic Research Extension Initiative, Otto and Doris Amen Dryland Research Endowment, and the Pacific Northwest Herbicide Resistance Initiative.

Additional Support Provided by:

BASF Corporation, Bayer Crop Science, Belchim Crop Protection USA, LLC, Gowan Company, Syngenta Crop Protection, FMC Corp., and Photosyntech

Contents

Chemical Fallow

Alternative Crops

Precipitation

Cover photo: 2025 WSU Weed Science Field Tour at the WSU Cook Agronomy Farm, Pullman, WA. Photo by Seth Truscott, WSU CAHNRS Communications.

Off-Label or Experimental-Use Disclaimer

Some of the pesticides discussed in this presentation were tested under an experimental use permit granted by WSDA. Application of a pesticide to a crop or site that is not on the label is a violation of pesticide law and may subject the applicator to civil penalties up to $7,500. In addition, such an application may also result in illegal residues that could subject the crop to seizure or embargo action by WSDA and/or the U.S. Food and Drug Administration. It is your responsibility to check the label before using the product to ensure lawful use and obtain all necessary permits in advance.

Statistical inference

Statistical inference is the process of drawing conclusions from experimental data that can be applied to a larger population or landscape. In our research, we replicate treatments in each trial to provide the variability needed to determine if differences are real or occur just by chance. While lack of statistical difference may indeed result from similar treatment effects or outcomes, e.g., a 100 lb/A fertilizer rate produced a similar yield to 101 lb/A, differences can also result from experimental or random error associated with the trial. We normally recognize statistical significance at the 95% probability level, which means there is a 95% probability that observed differences represent actual treatment effects and are not due to chance. This is indicated in our reports with the symbols $P \leq 0.05$ or $\alpha = 0.05$. We typically show statistical differences between treatments with the use of alphabetical letters. Treatment means that are statistically similar will be followed the same letter.

Predicting weed emergence timings in eastern Washington using hydrothermal time models

P. W. Maughan, Marija Savic, Jessica E. R. Kalin, and Ian C. Burke

Hydrothermal time (degree-days) models have been used regularly to predict crop emergence based of daily calculations of soil temperature and soil moisture potential, along with species-specific environmental thresholds (Bullied et al 2012) (Figure 1). In recent years, several studies have found success in using hydrothermal models to predict emergence timing of different weedy species (Bastida et al 2021, Oreja et al 2023). While these studies provide useful insight into weed biology, they were not performed in-field, nor aimed at creating decision-support tools.

Hydrothermal time models assume that seeds begin accumulating hydrothermal time immediately upon entering the soil; however, this assumption fails in field seedbanks where entry time is unknown and duration in the seedbank is inconsistent between seeds. In 2007, Batlla and Benech-Arnold noted that summer annual seedbank dormancy fluctuated between high dormancy in the autumn/winter, and low dormancy in the spring/summer. By using an approximation of the dormancy peak (Jan 1) as a hydrothermal reset date and the starting point of calculations, the model no longer required us to know when seeds entered the soil to predict their emergence.

Two wheat-fallow studies were conducted at the Palouse Conservation Field Station near Pullman, WA in 2024 (May-Aug) and 2025 (Jan-Sep). Weather data were collected from local (WSU Ag Weather Net) and on-site (Meter Group ATMOS 41 and TEROS 21 sensors) weather stations. Each study used a randomized complete block design with two replications (7 treatment timings in 2024; 10 in 2025). Plots (5 x 10 ft^2) were treated with glyphosate (16 oz ai A^{-1}) at staggered intervals (14 days apart, or 30 days apart before May) to reset weed emergence. Weed densities were measured 42 days after treatment using two 0.25 m^2 quadrats (Table 1).

To compute hydrothermal time on the same scale across all species, hydrothermal time was calculated starting at January 1st of the given year, using 0°C as the base temperature requirement and -1500 kPa as the base moisture potential requirement for all species. A permutation test (n = 5000) was used to compare emergence patterns of Mayweed chamomile (*Anthemis cotula*), redroot pigweed (*Amaranthus retroflexus*), common lambsquarter (*Chenopodium album*), prickly lettuce (*Lactuca serriola*), and Italian ryegrass (*Lolium perenne* subsp. *multiflorum*) across both years to evaluate model consistency ($\alpha = 0.05$). The T_{10} and T_{90} were calculated to represent the hydrothermal time required for the 10th and 90th emergence percentile, respectively, along with the median and mean of each species hydrothermal time requirement.

Across all species, T_{10} ranged from 148 to 1581 hydrothermal degree-days (HDD). Mayweed chamomile had the earliest emergence distribution (T_{10} = 148 HDD, T_{90} = 904 HDD) (Table 3). and prickly lettuce had the latest emergence (T_{10} = 582 HDD, T_{90} = 1746 HDD). Common lambsquarter and Italian ryegrass similar emergence patterns (T_{10} = 582, T_{90} = 1192). Redroot pigweed had the shortest window of emergence (T_{10} = 1581, T_{90} = 1581).

We found that several species' distributions were not significantly different (Table 2), indicating that the model effectively captured the same emergence distributions in both years. Mayweed chamomile populations were significantly different years, since the 2024 study did not effectively capture the emergence window. Common lambsquarter emergence patterns also significantly differed between years, which could be due to competition with other species.

These results suggest that a hydrothermal time model with resetting accumulations has a strong potential for developing decision-support tools for growers. By enabling more precise predictions of emergence patterns for target weed species, growers can better focus their weed management strategies on periods when weeds are actively emerging and adjust their approaches as emergence pattern change throughout the growing season. Future studies will seek to understand how these patterns shift across various sites in eastern Washington and northeastern Oregon."

References

Bastida, F., Lezaun, J. A., & Gonzalez-Andujar, J. L. (2021). A predictive model for the time course of seedling emergence of *Phalaris brachystachys* (short-spiked canary grass) in wheat fields. *Span J of Ag Res*. 19(3): e10SC02. DOI:10.5424/sjar/2021193-17876

Batlla D and Benech-Arnold RL (2007) Predicting changes in dormancy level in natural seed soil banks. *Plant Mol Biol.* 73(1-2):3-13. DOI: 10.1007/s11103-010-9601-z

Bullied WJ, Van Acker RC, Bullock PR (2012) Review: Microsite characteristics influencing weed seedling recruitment and implications for recruitment modeling. *Can J Plant Sci.* 92(4): 627-650. DOI:10.4141/cjps2011-281

Oreja FH, Genna NG, Gonzalez-Andujar JL, Wuest SB, Barroso J (2023). A hydrothermal model to predict Russian thistle (*Salsola tragus*) seedling emergence in the dryland of the Pacific Northwest (USA). *Weed Sci*. 72(1):108-112. DOI:10.1017/wsc.2023.67

Figure 1. Example of hydrothermal degree-day accumulation in the soil profile. Both y-axes are scaled such that the base temperature (left axis; T_{Base}) and base water potential (right axis; Ψ_{Base}) can be represented by the same horizontal line. When both the daily average soil temperature and soil water potential are higher than their respective base levels, the difference is added to the accumulation.

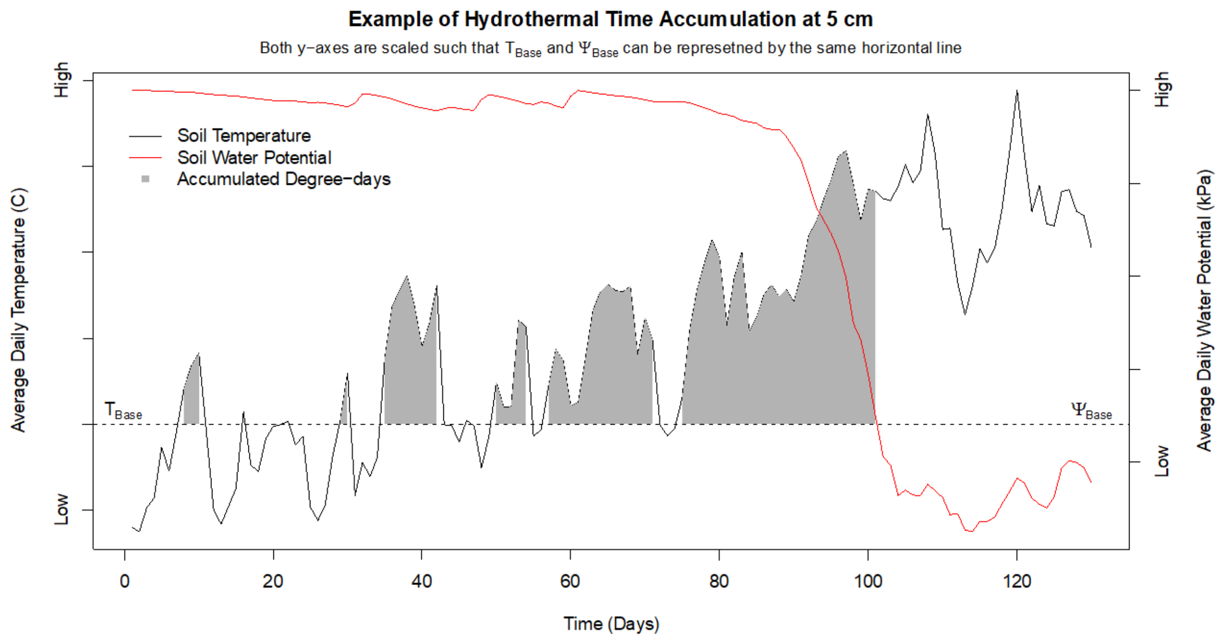


Figure 2. Plot of the accumulation of hydrothermal degree-days from January 2025 through September 2025. As an example, the T_{10}, median, mean, and T_{90} for Italian ryegrass (*Lolium perenne* subsp. *multiflorum*) emergence were calculated and are also show in the figure, as well as the corresponding calendar dates.

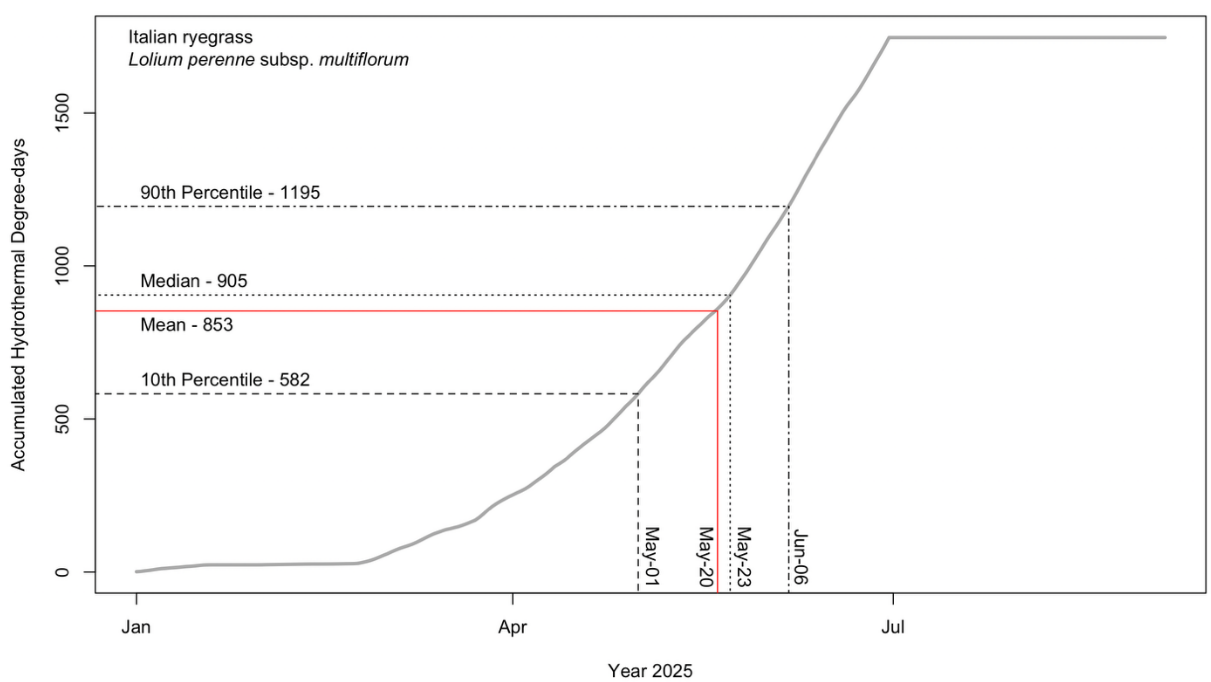


Table 1. Treatment and rating dates from the 2024 and 2025 studies on summer annual weed emergence near Pullman, WA. Treatments were applied 6 weeks prior to ratings.

Dates			
2024		2025	
Treatment	Rating	Treatment	Rating
-	-	12-09 (2024)	1-29
-	-	1-16	3-19
4-02	5-20	3-19	5-01
4-19	6-06	4-02	5-23
5-03	6-18	4-18	6-06
5-20	7-02	5-01	6-23
6-06	7-15	5-23	7-11
6-18	7-30	6-06	7-30
7-02	8-12	6-23	8-21
-	-	7-11	9-04

Table 2. The p-values between the emergence distributions of the 2024 and 2025 populations for five weed species near Pullman, WA, along with the 10th percentiles, medians, means, and 90th percentiles of the respective 2025 populations' emergences.

Scientific Name	**Common Name**	**P-value**	**2025 Population Statistics**			
			T_{10}	**Median**	**Mean**	**T_{90}**
			— hydrothermal degree-days —			
Anthemis cotula	Mayweed chamomile	0.04*	148	582	693	905
Amaranthus retroflexus	Redroot pigweed	0.41	1581	1581	1546	1581
Chenopodium album	Common lambsquarters	0.02*	582	905	1005	1195
Lactuca serriola	Prickly lettuce	0.32	582	905	977	1746
Lolium perenne subsp. *multiflorum*	Italian ryegrass	0.30	582	905	867	1195

Field horsetail control two years after initial applications in the Palouse region

Mark Thorne and Drew Lyon

Field horsetail (*Equisetum arvense*) is a member of a prehistoric group of plants in the genus *Equisetum*. Equisetums date back about 350 million years and were forage for dinosaurs and then became a major component of the vegetation that developed into coal during the Carboniferous period. Currently, three *Equisetum* species are common in the Pacific Northwest and include field horsetail, smooth scouringrush, and scouringrush. Field horsetail is a perennial rhizomatous species that produces fertile spore-bearing leafless stems early in the spring followed by vegetative stems that resemble Christmas trees that persist through the rest of the year up to freezing temperatures in the fall. Field horsetail can be found on flood plains and along roads where water collects in ditches and barrow pits.

In the high-rainfall Palouse region of eastern Washington and northern Idaho, field horsetail is a problem weed because it is very persistent, hard to control with tillage or herbicides, and is competitive with all crops grown (Figure 1). Herbicides that could be effective do not fit well in the commonly used crop rotations because of long plant-back intervals that would injure sensitive crops like canola or pulses. Chlorsulfuron is an herbicide that is labeled on wheat and is effective on other *Equisetum* species like smooth scouringrush but has up to a 36-month plant-back interval to crops other than wheat. Other herbicides that can control field horsetail, e.g., sulfometuron (Oust®) or dichlobenil (Casoron®), are also not labeled for use in field crops grown in this region because of long soil residual and potential crop injury.

Figure 1. Field horsetail in spring canola.

In this region, crops are generally grown each year without a fallow year in between. Therefore, herbicides are applied either following crop harvest in the fall, preplant in the spring, or to a growing crop. Finesse® Cereal and Fallow Herbicide (chlorsulfuron + metsulfuron) is a Group 2 ALS inhibitor herbicide that has been effective on smooth scouringrush when applied during a fallow year, but it has not been well tested on field horsetail. Finesse has a 36-month plantback restriction to peas and a bioassay is recommended for chickpeas and canola. Express XP® (tribenuron) is another Group 2 herbicide that has a molecular structure very similar to sulfometuron but has not been tested for field horsetail control; however, Express XP has no plantback restrictions that would affect a crop after 2 months following application. Widematch® (clopyralid + fluroxypyr) is a Group 4 synthetic auxin herbicide product that can be applied to wheat up to the flag leaf stage. It is not known if Widematch has any effect on field horsetail other than to burn down the current year's growth. The Widematch plantback interval to canola is 12 months or 18 months to any pulse crop.

Since field horsetail does not emerge early in the spring, foliar applications to field horsetail need to consider the labeled application window of the crop. Finesse, Express XP, and Widematch can all be applied to wheat when it is tillered up to the flag leaf stage, which is typically when field horsetail emerges in the spring. However, if these herbicides control field horsetail, crop rotations would have to be altered to avoid problems with plantback restrictions.

We initiated a field study September 2023 on the Druffel farm near Pullman, WA for field horsetail control in the high-rainfall (>20" annual precipitation) annual cropping region of the Palouse. The study site is on a floodplain near a creek with a Caldwell silt loam soil type having a pH of 5.4 and soil organic matter of 3.2%. The experimental design was a randomized complete block with four replicates per treatment and 10- by 25-ft plots. In 2023, the field was in spring canola and had been harvested prior to applying treatments on September 9. The soil surface contained canola stubble and green field horsetail stems that were 6 to 12 inches in height. Following treatment applications, the field was seeded to winter wheat in October 2023. Early spring applications were applied on April 2, 2024, when the winter wheat was fully tillered, but field horsetail had not yet emerged. Late spring applications were on May 9, 2024, when the wheat had flag leaves, and the field horsetail had vegetative stems up to 6 inches high but were still emerging. In 2025, the field was planted back to spring canola. All herbicide treatments were applied with a hand-held spray boom with six nozzles on 20-inch spacing and pressurized with a CO_2 backpack. Spray output was 15 gpa at 40 psi through TeeJet® AIXR110015 nozzles at 3 mph. All treatments included a nonionic surfactant (NIS) or an organosilicone surfactant (Syl-Coat®) (Table 1).

Figure 2. Field horsetail in spring canola in 2025. Left - Field horsetail in nontreated check. Right - Field horsetail control with Finesse applied in 2024 when winter wheat was near the flag leaf stage.

Final evaluations were made June 17, 2025, nearly two years after the initial applications in 2023, in a crop of spring canola (Figure 2). Visual ratings showed only 5% or less control from the fall 2023 Finesse applications, which was unexpected since Finesse has been successful for controlling smooth scouringrush, a related *Equisetum* species for up to three years after treatment. In this study, field horsetail control in 2024 was >90%, one year after Finesse was applied in September 2023 (Table 1). In contrast, field horsetail control this year (2025) was only 31% and 37% one year after Finesse was applied in 2024 when the wheat was in the flag leaf stage. Additionally, no difference was seen with either an NIS or the Syl-Coat surfactant. This would suggest that Finesse activity on field horsetail is limited to about one year, and that fall applications may be more effective than spring applications when the field horsetail is still emerging from winter. Furthermore, Express XP or Widematch were not effective in long-term control of field horsetail.

Field horsetail is very difficult to control in Palouse fields; however, fall applications of Finesse may be effective when they are applied to actively growing stems. Finesse applied to bare soil is not effective as there appears to be minimal herbicide uptake through the rhizomes. Furthermore, applying Finesse to field horsetail in spring does not appear effective and may be because plants have not yet begun to translocate photosynthates back into the rhizomes. Plant back intervals for sensitive crops should be observed following any Finesse application, and bioassays used if there is any doubt.

Table 1. Field horsetail control two years after initial applications in 2023.

			Field horsetail control**
Herbicides*	Timing – wheat stage	Target	6-17-2025
			% of nontreated check
Finesse + NIS	Fall – preplant	Horsetail	5 cd
Finesse + NIS fb Widematch	Fall – preplant fb flag leaf	Horsetail	4 cd
Finesse + NIS	Fall – preplant	Soil	0 d
Finesse + NIS	Early spring – tillered	Soil	11 bc
Express XP + NIS	Early spring – tillered	Soil	3 cd
Express XP + NIS	Late spring – flag leaf	Horsetail	2 cd
Express XP + Syl-Coat	Late spring – flag leaf	Horsetail	0 d
Finesse + NIS	Late spring – flag leaf	Horsetail	31 ab
Finesse + Syl-Coat	Late spring – flag leaf	Horsetail	37 a
Nontreated check	---	---	0

*Applications rates: Express XP = 0.33 oz/A; Finesse in crop = 0.4 oz/A; Finesse in fallow/preplant = 0.5 oz/A; Widematch = 1.33 pt/A; NIS (nonionic surfactant) = 0.5% v/v; Syl-Coat (organosilicone surfactant) = 0.5% v/v.
**Means followed by the same letter in each column are not statistically different (P≤0.05).

Long term control of smooth scouringrush with Finesse® Cereal and Fallow Herbicide in winter wheat/spring wheat/no-till fallow cropping systems

Mark Thorne and Drew Lyon.

Smooth scouringrush is a problem in no-till wheat/fallow rotations in the intermediate to low rainfall areas of eastern Washington (Figure 1). In spring wheat, smooth scouringrush has the potential to be more competitive than in winter wheat as the stems can emerge near the same time as the wheat; however, in winter wheat smooth scouringrush stem emergence often doesn't occur until the wheat plants are in the jointing stage and therefore early herbicide applications may occur before stems emerge.

We evaluated smooth scouringrush control following applications of Finesse (chlorsulfuron + metsulfuron) or Rhonox® (MCPA LV ester) during the no-till fallow phase, and Amber® (triasulfuron) or Rhonox during the crop phase. We have demonstrated that chlorsulfuron, one of the active ingredients in Finesse, is effective for controlling smooth scouringrush for at least two years after application. However, the question remains whether a second application in a subsequent fallow phase is needed for continued long-term control. Furthermore, this study evaluated the application of Amber during the crop phases. Amber is molecularly similar to chlorsulfuron and is hypothesized to be a bridge application between the two fallow Finesse applications. Rhonox is a synthetic auxin herbicide (Group 4) that is used for broadleaf weed control in both fallow and grass crops and is effective for quick burndown of smooth scouringrush stems but long-term control has not been observed.

Figure 1. Smooth scouringrush stem with spore-producing cone.

Two trials were initiated in 2019, one near Edwall on the Camp farm, and a second near Steptoe on the Hall farm. Each site is in a no-till winter wheat/spring wheat/fallow rotation. The Edwall site is in a gentle-sloping northwest-facing draw with good moisture and well-drained soil, which is classified as a Broadax silt loam. Soil organic matter and pH measured 2.9% and 5.0, respectively. The Steptoe site is on a low-lying flat with inundated soil during winter and early spring. Soil at Steptoe is classified as a Caldwell silt loam. Soil organic matter and pH measured 3.4% and 7.2, respectively. Both sites average around 16 inches of precipitation per year.

At each site, plots measured 10 by 30 ft and were arranged in a randomized complete block design with four replications per treatment. All herbicide treatments were applied with a hand-held spray boom with six nozzles on 20-inch spacing and pressurized with a CO_2 backpack. Spray output at both sites was 15 gpa applied at 3 mph. In 2019-2021, spray was applied through

TeeJet® XR11002 nozzles at 25 psi. Applications in 2022-2024 were applied through TeeJet AIXR10015 nozzles at 40 psi to reduce drift potential. Treatment sequences and herbicide rates are presented in Table 1. Treatment evaluations each year were made by counting smooth scouringrush stems in two 1.2-yd^2 quadrats per plot.

Table 1. Herbicide sequences for long-term study for control of smooth scouringrush in winter wheat/spring wheat/fallow cropping systems trials at Edwall and Steptoe, WA.*

Seq	Fallow 2019	WW 2020	SW 2021	Fallow 2022	WW 2023	SW 2024	Fallow 2025
1	Finesse	Amber	Amber	Finesse	Amber	Amber	
2	Finesse	Amber	Rhonox	Finesse	Amber	Rhonox	
3	Finesse	Amber	Amber	Rhonox	Amber	Amber	Final evaluations
4	Finesse	Rhonox	Rhonox	Rhonox	Rhonox	Rhonox	
5	Finesse	Rhonox	Rhonox	Finesse	Rhonox	Rhonox	
6	Rhonox	Rhonox	Rhonox	Rhonox	Rhonox	Rhonox	

*Seq=sequence; Fallow=no-till fallow; WW=winter wheat; SW=spring wheat
Finesse (chlorsulfuron/metsulfuron) is applied at 0.5 oz/A.
Amber (triasulfuron) is applied at 0.56 oz/A.
Rhonox (MCPA) is applied at 34.6 oz/A in fallow and 24 oz/A in crop.
All treatments include NIS surfactant at 0.33% volume/volume concentration.

Final evaluations of each herbicide sequence were made on July 2, 2025, which assessed the cumulative efficacy of all applications since trial initiation (Table 1). At both sites, Finesse provided some level of control up to three years after treatment (Figure 2).

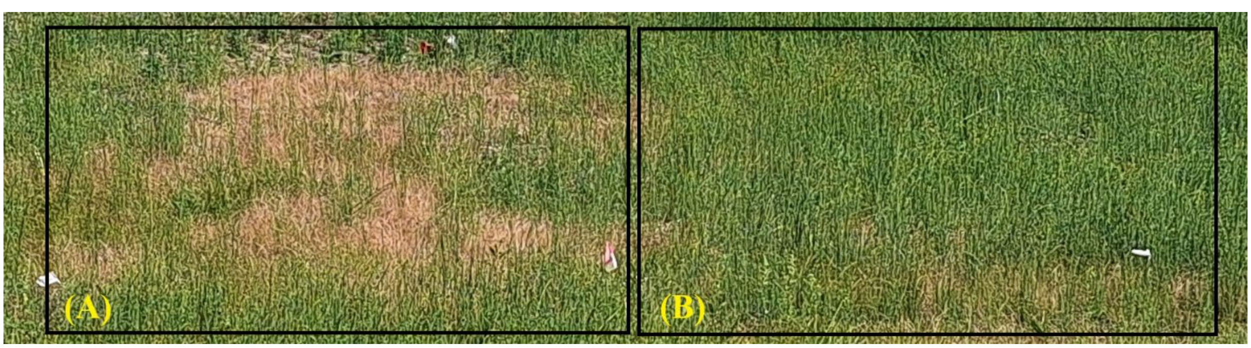
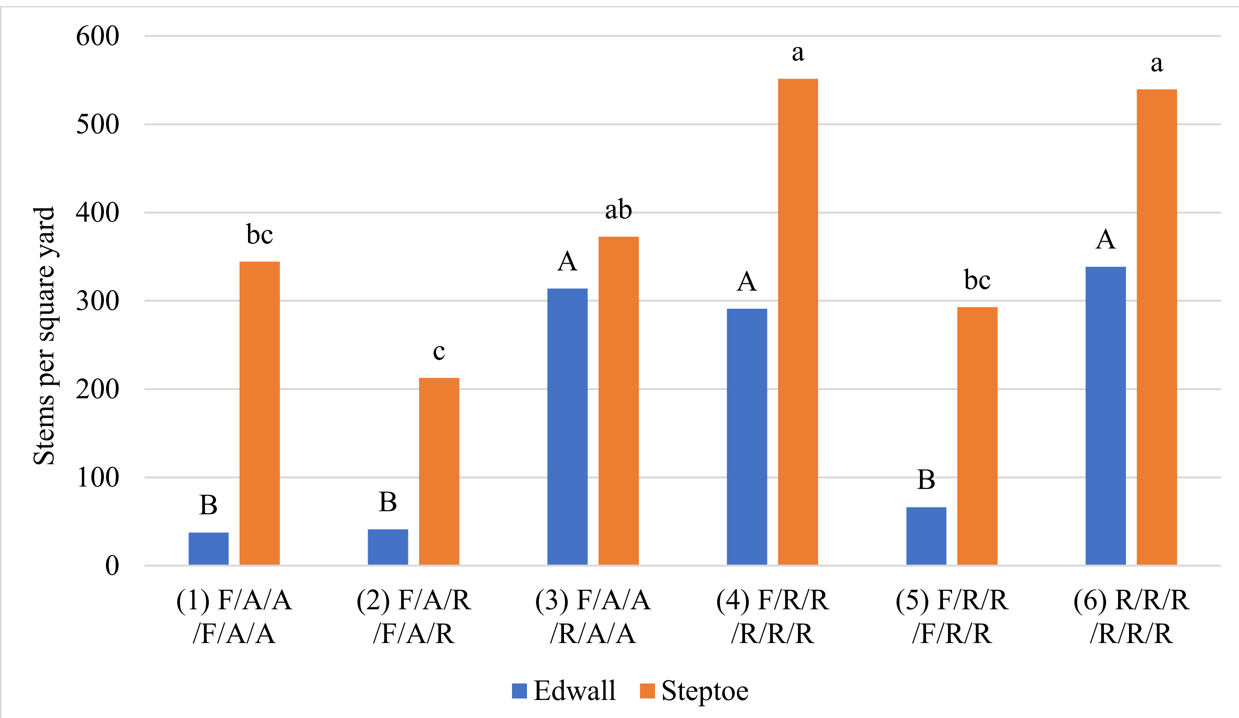


Figure 2. Smooth scouringrush in 2025 chemical fallow near Edwall, WA. Plot A had Finesse in 2022 and Rhonox in 2023 and 2024. Plot B had Rhonox in 2022, 2023, and 2024.

At the Edwall site, all treatments with Finesse applied in both fallow years (sequences 1, 2, and 5 in Figure 3) had the lowest stem density. At the Steptoe site, sequences with Finesse applied in both fallow years had the lowest stem densities compared with sequences with Finesse applied only in 2019 (sequences 3 and 4 in Figure 3) or the sequence with only Rhonox (sequence 6 in Figure 3); however, sequence 3 (Figure 3), where Amber was applied in each crop phase, was not different from sequences 1 or 5 where Finesse was applied in both fallow years. Furthermore, Finesse applied in both fallow years at Edwall was more effective than the same sequences at Steptoe. At either site, Amber applied in the crop phases provided no apparent additional control.

Smooth scouringrush can be a problem weed in non-irrigated wheat-producing areas in eastern Washington by interfering with farming operations, plugging drain tiles, and potentially reducing crop yield. Finesse can reduce smooth scouringrush density up to three years after being applied during the no-till fallow phase, but follow-up applications are needed when re-establishment occurs. Applications during fallow are preferred as stem densities are potentially greater than in a wheat crop and likely maximizes that potential for herbicide foliar uptake.

Figure 3. Final evaluations of smooth scouringrush control in 2025 fallow in a long-term herbicide sequence study that began in 2019 at Edwall and Steptoe, WA.*



*Herbicide sequences for each rotation are listed below each set of corresponding columns and coded as follows: F=Finesse; A=Amber; R=Rhonox. Refer to Table 1 for each herbicide sequence. Means associated with each column are based on four replicates per treatment combined over two locations. Columns for each location with the same letter, case specific, are not significantly different (P≤0.05).

Downy brome control in winter wheat with Zidua® SC and Beyond® Xtra

Mark Thorne and Drew Lyon

Downy brome (*Bromus tectorum* L.) is one of the first non-native annul grass weeds identified in the inland Pacific Northwest dating back to the 1890s. Since its introduction, it spread across the Columbia Plateau and became a major weed in winter wheat (Figure 1) capable of causing ≥90% yield loss. Effective herbicides for controlling downy brome in winter wheat have included Beyond (imazamox) and Zidua SC (pyroxasulfone); however, there is a possibility of developing resistance to either of these herbicides if used alone and too frequently. Downy brome has already developed resistance to Beyond in some areas in the Pacific Northwest and there are reports of reduced performance from Zidua SC. Using both herbicides together may help delay development of resistance by having both modes of action working at the same time, and including an effective adjuvant mix with Beyond may help performance.

We evaluated downy brome control in winter wheat at the Wilke Farm, Davenport, WA, with Zidua SC applied in the fall alone and followed by Beyond Xtra tank mixed with different surfactants and rates of UAN 32 (urea-ammonium nitrate 32% N) in the following spring. In addition, we include fall-applied Zidua SC followed by TRICOR® DF (metribuzin) in early spring as metribuzin is often used in the region and employs a different mode of action than either Zidua SC or Beyond Xtra.

Figure 1. Downy brome growing between rows of winter wheat at the Wilke Farm, Davenport, WA, April 15, 2025. Left - early germinated downy brome with several tillers. Right - late germinated downy brome with a few leaves up to one tiller.

The experimental design was a randomized complete block with each treatment present in each of the four blocks. Blocks were arranged horizontally across the slope so that block 1 was higher on the slope than block 4. Block 4 had considerably more crop residue remaining from the 2023 winter wheat crop than the other three. Fall Zidua SC treatments were applied September 16, 2024 (Table 1), the day after Piranha Clearfield winter wheat was direct seeded at 72 lb/A into chemical fallow at 2 inches deep. Fertilizer was applied at seeding with the drill at 75-12-12 N-P-S lb/A. On March 25, 2025, early spring treatments of Beyond Xtra and TRICOR DF were applied, both following Zidua SC in the fall. March 25 was likely the earliest time period when ground applications were possible as the soil surface was drying enough to support traffic. On April 15, Beyond Xtra was applied with different surfactant and UAN combinations at a timing more consistent with grower applications in the area. Surfactants included methylated seed oil products Glacier® EA and MSO® Concentrate with Leci-Tech®, and a non-ionic surfactant, M-90. UAN 32 was included at 5% or 30% of total spray volume. All herbicides were applied with a 10-ft hand-held spray boom with six TeeJet® AIXR110015 nozzles on 20-inch spacing and pressurized with a CO_2 backpack. Spray output was 15 gpa at 40 psi with a ground speed of 3 mph.

Downy brome control was visually evaluated on March 25, April 15, April 28, and June 3 (Table 1). By March 25, Zidua SC was controlling downy brome 78% to 86% compared with the nontreated check. By April 15 and 28, control was greater than 90% with all Zidua SC treatments and there was no statistical difference between Zidua SC alone or followed by the early applications of Beyond Xtra or TRICOR DF. On April 28, the later treatments with Beyond Xtra not following Zidua SC were controlling downy brome 46% to 66% with no statistical difference between treatments. Injury symptoms on the downy brome were stunted growth and yellow and orange leaf coloration. By June 3, there were no differences between any treatments with Beyond Xtra as all had greater than 90% control of downy brome. Zidua SC alone or followed by TRICOR DF only controlled downy brome 68% and 72%, respectively, and some downy brome plants produced seed. TRICOR DF was more effective when applied to later germinating downy brome, but not on earlier germinated tillered plants (data not shown). In contrast, all treatments with Beyond Xtra kept downy brome from producing seed.

In this trial, measurable rainfall in the area did not occur until October 15, 30 days after planting, therefore, germination of downy brome in the fall was slow and spotty. Downy brome established earlier in areas of the trial site that had remaining crop residue from the 2023 wheat crop, especially block 4, but did not establish in the fall in areas with bare soil. Zidua SC was effective early, but lost control later and allowed some downy brome plants to produce seed. TRICOR DF was very effective on all broadleaf weeds, and any small, late winter germinated downy brome present at time of application (data not shown) but was less effective when applied to larger tillered downy brome. All Beyond Xtra treatments were very effective whether following Zidua SC, or not. The effectiveness of Beyond Xtra indicates the downy brome population was not resistant to imazamox. Furthermore, there was no difference in efficacy with any of the surfactants and UAN 32 combinations. Furthermore, soil moisture variability and late rainfall delayed crop and downy brome emergence and establishment. If the winter wheat and downy brome had established earlier after seeding, fall applications of TRICOR DF and Beyond Xtra might have been possible before the downy brome tillered, which may have aided control.

Table 1. Downy brome control in winter wheat with Zidua SC, Beyond Xtra, and TRICOR DF.

	-- Application dates --			----- Downy brome control -----			
Herbicide treatments*	9/16	3/25	4/15	3/25	4/15	4/28	6/3
	------- oz/A** -------			----- % nontreated check*** -----			
Nontreated check	---	---	---	0	0	0	0
Zidua SC	3.25	---	---	83 a	96 a	92 a	68 b
Zidua SC fb Beyond Xtra + MSO + 30% UAN	3.25	---	6.0	78 a	94 a	94 a	99 a
Beyond Xtra + Glacier EA + 5% UAN	---	---	6.0	---	---	49 b	98 a
Beyond Xtra + Glacier EA + 30% UAN	---	---	6.0	---	---	58 b	97 a
Beyond Xtra + M-90 + 5% UAN	---	---	6.0	---	---	66 b	95 a
Beyond Xtra + M-90 + 30% UAN	---	---	6.0	---	---	57 b	94 a
Beyond Xtra + MSO + 5% UAN	---	---	6.0	---	---	46 b	99 a
Beyond Xtra + MSO + 30% UAN	---	---	6.0	---	---	51 b	98 a
Zidua SC fb TRICOR DF	3.25	6.0	---	84 a	97 a	91 a	72 b
Zidua SC fb Beyond Xtra + MSO + 30% UAN	3.25	6.0	---	86 a	99 a	94 a	99 a
Days after fall Zidua SC				190	211	224	260
Days after early Beyond Xtra				0	21	35	71
Days after late Beyond Xtra					0	14	50

*fb=followed by; UAN urea-ammonium nitrate 32% applied at the listed % volume per total volume (% v/v). Glacier EA methylated seed oil applied at 0.5% v/v; M-90 nonionic surfactant applied at 0.25% v/v; MSO (MSO Concentrate with Leci-Tech) methylated seed oil applied at 1% v/v.
**Rates for Zidua SC and Beyond Xtra are fl oz/A; TRICOR DF is dry oz/A. --- represents no application made.
***Means in each column followed by the same letter are not statistically different ($P \leq 0.05$). --- represents ratings not made or applicable.

Broadleaf weed control with pyridate in lentils

Jessica E. R. Kalin and Ian C. Burke

Pulse crops, such as lentil, offer farmers the opportunity for grass weed control in normally wheat-dominated fields, but broadleaf weeds are a particular challenge during this crop rotation. There are limited options for broadleaf weed management that offer residual control throughout the growing season. Tough® 5EC (pyridate) is a selective, contact herbicide that is effective on pigweeds and nightshades. It is registered in corn, mint, and pulse crops, and has no plant back restrictions. When tank-mixed with a partner herbicide, Tough 5EC may offer some residual weed control as lentils establish.

Table 1. Treatment application weather details.

Application Details	
Date	5-30-2025
Air temperature (˚F)	57
Soil temperature (˚F)	50
Wind velocity (mph, direction)	3, SSW
Relative humidity (%)	58
Weed size (inches)	3-4

In spring 2025, two field trials were established to evaluate broadleaf weed control with pyridate in lentil. The first trial focused on pre-plant applications of two different rates of Tough 5EC tank mixed with a PPO-inhibiting herbicide; the second trial focused on postemergence applications of Tough 5EC alone and tank mixed with metribuzin. The trials were located in the same field at the Palouse Conservation Field Station near Pullman, WA. For both trials, plots were 10 by 30 ft and arranged in a randomized complete block design with four replications. All herbicide treatments were applied with a CO_2 powered backpack sprayer (Table 1). The spray boom had four Teejet® 11002VS nozzles with 20-inch spacing and spray output was calibrated to deliver 15 gallons per acre at 3 mph. Lentils were planted for the postemergence trial on April 25, 2025; lentils did not get planted in time for the pre-plant trial, so we used a fallow plot for this trial.

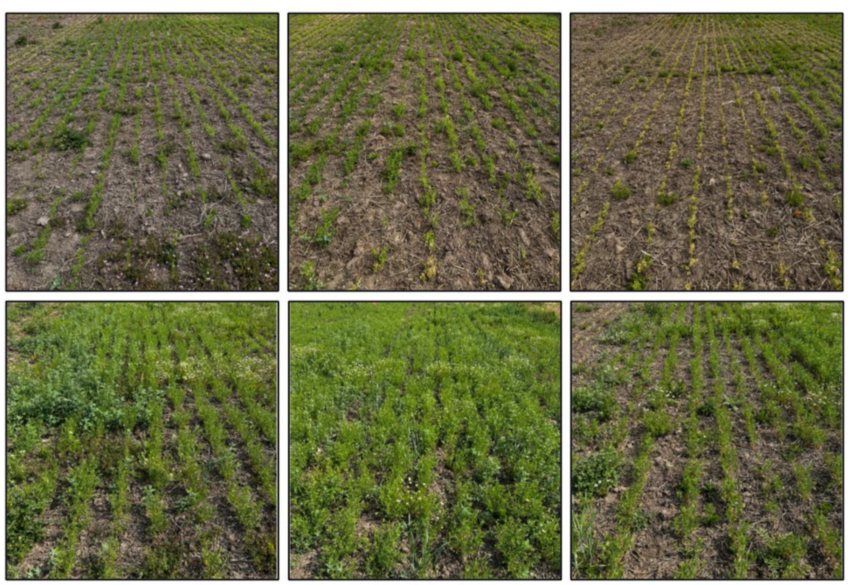


Figure 1. Injury following postemergence applications of Tough 5EC on June 6 (top row) and June 12 (bottom row).

Treatments were visually assessed for weed control at 7, 14, and 28 days after treatment for both trials and injury to lentil was assessed in the postemergence trial at the same interval as weed control. Yield was not assessed in either trial. Data were subject to ANOVA using the Agricultural Research Manager software (Ver. 2024).

Seven days after treatment, some bleaching (4-10%) was observed in all treatments in the postemergence trial (Table 2). Treatments that included metribuzin or high rates of Tough 5EC were particularly more injurious than Tough 5EC at 7 oz/A or the nontreated check (Figure 1). The lentils appeared to have mostly recovered by the June 12 rating (14 DAT), with the highest injury observed at 5% for Tough 5EC 20 oz/A plus metribuzin and the treatment with Select 2EC® (clethodim).

Mayweed chamomile control was not significantly different between treatments in the postemergence trial. The treatment with Tough 5EC, metribuzin, and NIS provided the highest control at 90% and Tough 5EC at 7 oz/A had the lowest control (40%) (Table 3). In the pre-plant trial, Mayweed chamomile control was variable between treatments and dates (Table 4). On the June 12 rating, Mayweed control was generally greater than 80% in all treatments except for low rate of Tough 5EC plus Aim EC (50%) and the low rate of Tough 5EC plus Vida (70%). Mayweed control on the June 23 rating was not significantly different between treatments, though the low rate of Tough 5EC plus Reviton® had 90% Mayweed control.

All treatments in the postemergence trial had 80% or greater control of common lambsquarters, except for Tough 5EC at 7 oz/A (40%) (Table 3). Common lambsquarters control in the pre-plant trial was slightly more consistent (Table 4), however the high rate of Tough 5EC plus Vida® had the lowest lambsquarters control (85%) at the June 12 rating. Lambsquarters control ratings on June 23 were not significantly different between treatments. Low or high rates of Tough 5EC plus Sharpen®, and low or high rates of Tough 5EC plus Reviton had consistently high lambsquarters control at both rating dates.

Prickly lettuce was present in both trials but was not controlled in either trial.

Control of common lambsquarters with pyridate appears to be effective in lentil. Though higher rates may cause some bleaching, the crop appears to have recovered. Futures studies should include yield measurement, if possible, to determine any yield loss from bleaching.

Figure 2. Weed control examples from the pre-plant trial. Tough 5EC at 6 oz/A plus Reviton (left); Tough 5EC at 12 oz/A plus Aim EC (middle); nontreated (right) taken at the June 23 rating date.

Table 2. Injury ratings (bleaching) for lentils following postemergence Tough 5EC applications.

	Treatment	Rate		Injury (%)[1]			
				6/6/2025		6/12/2025	
1	Nontreated			0	c	0	b
2	Tough 5EC	7	oz/A	4	bc	1	ab
3	Tough 5EC	14	oz/A	6	ab	1	ab
4	Tough 5EC	20	oz/A	9	a	4	ab
5	Tough 5EC	7	oz/A	5	b	0	b
	Metribuzin 75DF	2	oz/A				
6	Tough 5EC	14	oz/A	9	ab	4	ab
	Metribuzin 75DF	2	oz/A				
7	Tough 5EC	20	oz/A	10	a	5	a
	Metribuzin 75DF	2	oz/A				
8	Tough 5EC	7	oz/A	10	a	5	a
	Metribuzin 75DF	2	oz/A				
	Select 2EC	6	oz/A				
	COC	1	%v/v				
9	Tough 5EC	7	oz/A	8	ab	3	ab
	Metribuzin 75DF	2	oz/A				
	NIS	.25	%v/v				

[1]Means with the same letter are not significantly different ($p = 0.05$).

Table 3. Mayweed chamomile and common lambsquarters control following postemergence Tough 5EC applications.

	Treatment	Rate		Mayweed chamomile (%)	Common lambsquarters (%)[1]	
				6/12/2025	6/12/2025	
1	Nontreated			0	0	
2	Tough 5EC	7	oz/A	40	40	b
3	Tough 5EC	14	oz/A	50	80	a
4	Tough 5EC	20	oz/A	70	90	a
5	Tough 5EC	7	oz/A	60	90	a
	Metribuzin 75DF	2	oz/A			
6	Tough 5EC	14	oz/A	70	90	a
	Metribuzin 75DF	2	oz/A			
7	Tough 5EC	20	oz/A	70	95	a
	Metribuzin 75DF	2	oz/A			
8	Tough 5EC	7	oz/A	80	90	a
	Metribuzin 75DF	2	oz/A			
	Select 2EC	6	oz/A			
	COC	1	%v/v			
9	Tough 5EC	7	oz/A	90	90	a
	Metribuzin 75DF	2	oz/A			
	NIS	.25	%v/v			

[1]Means with the same letter are not significantly different ($p = 0.05$).

Table 4. Mayweed chamomile and common lambsquarters control following pre-plant Tough 5EC applications.

				Mayweed chamomile Control (%)[2]			Common lambsquarters Control (%)[2]		
	Treatment[1]	**Rate**		**6/12/2025**		**6/23/2025**	**6/12/2025**		**6/23/2025**
1	Nontreated			0		0	0		0
2	Glystar 5	22	oz/A	100	a	100	90	ab	90
3	Tough 5EC	6	oz/A	85	a	75	95	ab	90
	Sharpen	1	oz/A						
4	Tough 5EC	6	oz/A	90	a	90	100	a	90
	Reviton	1	oz/A						
5	Tough 5EC	6	oz/A	50	b	35	100	a	90
	Aim EC	1.5	oz/A						
6	Tough 5EC	6	oz/A	70	ab	45	90	ab	85
	Vida	1.32	oz/A						
7	Tough 5EC	12	oz/A	85	a	75	100	a	90
	Sharpen	1	oz/A						
8	Tough 5EC	12	oz/A	85	a	80	95	ab	90
	Reviton	1	oz/A						
9	Tough 5EC	12	oz/A	80	a	45	90	ab	75
	Aim EC	1.5	oz/A						
10	Tough 5EC	12	oz/A	85	a	70	85	b	85
	Vida	1.32	oz/A						

[1]All treatments included MSO at 1% v/v.
[2]Means with the same letter are not significantly different ($p = 0.05$).

Fall-applied Eptam® 7E herbicide for Italian ryegrass control in spring pulse crops

Mark Thorne and Drew Lyon

Controlling annual ryegrass (*Lolium perenne* L. ssp. *multiflorum*) in spring crops is a challenge in areas where Italian ryegrass has developed resistance to Group 1 (ACCase inhibitors) and Group 2 (ALS inhibitors) herbicides. We tested alternate herbicide strategies including Group 3 (microtubule assembly inhibitors) Sonalan® HFP, or Group 15 herbicides Eptam 7E, Far-Go®, or Zidua® SC that inhibit synthesis of very-long-chain fatty acids; however, Eptam 7E and Far-Go require mechanical incorporation and all of these soil active herbicides require rainfall for activation. The lack of rainfall after application can limit their efficacy when applied in the spring prior to crop planting. Fall application guarantees there will be sufficient moisture to activate soil-applied herbicides, but it is not clear if herbicides applied in the fall will still be active the following spring.

We initiated a follow up study in September 2024, similar to one we conducted in in 2023, to compare fall and spring applied herbicides for controlling Italian ryegrass in pulse crops. Spring wheat stubble left from the 2024 crop was flail mowed to help with soil preparations. On October 17, the field site was cultivated to a depth of 4 inches to expose enough soil to intercept the herbicides. On October 18, Eptam 7E was applied alone and in tank mixes with other soil-active herbicides (Table 1) following rains that moistened the soil enough for cultivation and to absorb the herbicides. Following herbicide applications, the study site was roller packed to help seal the soil to keep the Eptam 7E from volatilizing (Figure 1). Herbicides were applied with a 10-ft hand-held spray boom with six TeeJet® AIXR110015 nozzles on 20-inch spacing and pressurized with a CO_2 backpack. Spray output was 15 gpa at 40 psi with a ground speed of 3 mph.

Figure 1. Field site following Eptam 7E application and roller packing.

The Eptam 7E label allows for fallow applications at a minimum of 45 days prior to planting of a crop not labeled for Eptam 7E application; therefore, the application timing was within label requirements because it was in the fallow period between spring wheat harvest and spring planting. Fall-applied tank mixes with Eptam 7E included Far-Go, Zidua SC (pyroxasulfone, Group 15), and Sonalan HFP. Spring applications of Zidua SC and Sonalan HFP followed fall-applied Eptam 7E. Applications of Far-Go above 1.5 qt/A, Sonalan HFP above 2 pt/A, or Zidua SC applied preplant in the spring on lentils or dry peas are experimental off-label applications.

Table 1. Italian ryegrass control in spring pulse crops following fall and spring-applied soil-active herbicides.

Treatment	Rate	Timing	Italian ryegrass control			
			4/10/25	6/17/25**		
			Preplant	Peas	Chickpeas	Lentils
			------------- (percent of nontreated check) --------------			
Nontreated	---	---	0	0	0	0
Eptam 7E	7 pt/a	Fall	34 d	29 ed	8 c	9 e
Eptam 7E	7 pt/a	Fall	70 c	18 e	11 c	10 de
Far-Go	2 qt/a	Fall				
Eptam 7E	7 pt/a	Fall	80 b	65 abc	51 ab	47 abc
Far-Go	4 qt/a	Fall				
Eptam 7E	7 pt/a	Fall	39 d	49 bcd	26 bc	32 bcd
Far-Go	1.5 qt/a	Spring				
Eptam 7E	7 pt/a	Fall	86 b	67 abc	45 ab	55 ab
Zidua SC	4 oz/A	Fall				
Eptam 7E	7 pt/a	Fall	34 d	72 ab	51 ab	56 ab
Zidua SC	2.5 oz/A	Spring				
Eptam 7E	7 pt/a	Fall	91 a	79 a	57 a	65 a
Sonalan HFP	4.5 pt/a	Fall				
Eptam 7E	7 pt/a	Fall	35 d	37 cde	20 c	22 cde
Sonalan HFP	2 pt/a	Spring				

*Means followed by the same letter in each column are not different ($P \leq 0.05$).
**Crops were seeded on April 25, 2025.

On April 4, 2025, Roundup PowerMax® (glyphosate) was applied at 32 oz/A to control volunteer wheat, Italian ryegrass, and other winter annual weeds that had germinated since fall applications of 2024. Italian ryegrass density averaged 860 plants/yd^2. On April 6, 2025, spring preplant treatments of Zidua SC, Far-Go, and Sonalan HFP were applied; however, the soil was too wet for mechanical incorporation, therefore, treatments were purposely applied just ahead of a rainfall event to facilitate movement and incorporation into the soil, which totaled 0.8 inches over two days. On April 24, a preplant treatment of Roundup PowerMax was applied at 32 oz/A to control Italian ryegrass that had germinated since the earlier April 4 application. On April 25, spring peas (160 lb/A), chickpeas (130 lb/A), and lentils (45 lb/A) were direct-seeded across each plot with a Great Plains® drill with double-disc openers on 10-inch spacing.

Herbicide efficacy was evaluated visually as percent of the nontreated check plots on April 10, 2025, prior to applying the spring treatments and crop seeding, and again on July 17 when the Italian ryegrass was headed and could be easily identified in the crops. Crop injury from the herbicides was not evident so visual ratings were not made.

Italian ryegrass control through the winter and into early spring was evaluated on April 10. Control was 91% with fall-applied Eptam 7E tank mixed with Sonalan HFP, which was greater than all other treatments (Table 1). Tank mixes with Far-Go at 4 qt/A and Zidua SC resulted in 80 and 86% control, respectively. The 2 oz/A rate of Far-Go was less effective than the 4 oz/A rate, resulting in only 70% control. Eptam 7E alone averaged only 34% control of Italian ryegrass but controlled at least 90% of volunteer wheat (data not shown).

By June 17, all three crops were flowering, and the Italian ryegrass was headed. The peas were approximately 16 to 20 inches high while the chickpeas were 12 to 14 inches and the lentils were 8 to 10 inches high. Italian ryegrass had reestablished since the preplant glyphosate treatment and control varied by crop as competition from the peas was greater than from the chickpeas or lentils. Control in all three crops was greatest with fall-applied tank mixes of Eptam 7E with Sonalan HFP, Far-Go at 4 qt/A, or Zidua SC, or the fall-applied Eptam 7E followed by spring-applied Zidua SC. The fall-applied Eptam 7E alone resulted in the least Italian ryegrass control in all three crops but was not different than the fall tank mix with Far-Go at 2 qt/A or the spring application of Sonalan HFP. The spring application of Far-Go resulted in slightly better control than just the fall-applied Eptam 7E in only the lentil crop.

Fall-applied Eptam 7E in our trial only marginally reduced Italian ryegrass density into the following spring prior to planting, but control was improved with tank mixes of Sonalan HFP, Zidua SC, or Far-Go at the higher rate. Eptam 7E has the potential of volatizing if soil moisture is too high following application, and the wet 2024-25 fall and winter may have contributed to reduced control compared with the similar study conducted the previous year. However, of the more effective treatments in this study, only fall-applied Eptam 7E plus Zidua SC would be a labeled application. Spring-applied Far-Go or Sonalan HFP may have been more effective if they could have been mechanically incorporated and followed by rainfall to activate the herbicides, but that was not possible in this study. On a cautionary note, applying Zidua SC in the fall following a wheat crop where it may have been also applied is not recommended. Zidua SC is one of the few herbicides still active on Italian ryegrass and applications two years in a row may increase the possibility of developing resistance. Successfully incorporating other modes of action for Italian ryegrass control is critical for managing herbicide resistance, therefore, more work is needed to include herbicides such as Eptam 7E.

Italian ryegrass control with Liberty® Ultra and Sonalan® HFP in spring canola

Mark Thorne and Drew Lyon

Glufosinate is a Group 10 herbicide and is an alternative to Group 9 glyphosate for the control of Italian ryegrass in spring canola. Glyphosate is currently being used for Italian ryegrass control in glyphosate-resistant spring canola, and its extensive use increases the likelihood of developing glyphosate resistant Italian ryegrass. Sonalan® HFP (ethalfluralin) is a Group 3 herbicide that inhibits cell division in plant roots and shoots but must be incorporated in the soil prior to seed germination to be effective. The glufosinate mode of action differs from the mode of action for glyphosate by inhibiting glutamine synthetase, an enzyme involved in the synthesis of the amino acid, glutamine. Inhibition of glutamine synthetase quickly results in a toxic buildup of ammonia in plant cells that destroys cell membranes. Glufosinate is commercially available in several products; however, older glufosinate products contain two glufosinate molecular isomers, but only one isomer has herbicidal activity. Liberty Ultra is a new glufosinate product that consists of only the active isomer. Furthermore, the labeled rate for Liberty Ultra applications in spring canola crops has recently been increased from 19 to 23 oz/A.

Figure 1. Left - canola with just an early postemergence application of Liberty Ultra. Middle - canola treated with an early and late postemergence application of Liberty Ultra. Right - canola treated with an early application of Roundup PowerMAX at 44 oz/A.

LibertyLink® spring canola is resistant to glufosinate because of a gene that codes for an enzyme that converts glufosinate to a non-toxic metabolite in the plant. Glufosinate-resistant canola was first developed in 1995. Glufosinate-resistant canola provides an herbicide option for Italian ryegrass control that can help delay the development of glyphosate-resistant Italian ryegrass.

We compared herbicide treatments for Italian ryegrass control in spring canola at the WSU Cook Agronomy Farm (Figure 1). The study site produced chickpeas in 2024, and the residue was left in place through the winter. On April 18, 2024, liquid fertilizer, 110-20-0-25-0.3-0.3 N-P-K-S-

Zn-B lb/A was stream-jet applied and then cultivated to incorporate the fertilizer. On April 22, Sonalan HFP was applied at 24 and 32 oz/A preplant and incorporated (PPI) twice at 90° at a depth of 2-3 inches with a field cultivator and attached tine harrow. Spring canola cultivar 'InVigor® LibertyLink/TruFlex® LR354PC, which has resistance to both glufosinate and glyphosate, was seeded on April 25 with a direct-seed drill with double-disc openers on 10-inch spacing. The seeding rate was 12 seeds per ft^2 at 0.75 to 1.0 inch deep. Early postemergence (EPOST) applications were applied on May 21 (see Table 1 for rates) when the canola had 2-4 leaves. The Italian ryegrass had 1-4 leaves and averaged 20 plants yd^{-2} in the nontreated check plots. Late postemergence (LPOST) treatments were applied on June 4 when the canola had 3-7 leaves. The Italian ryegrass plants were tillered and 4-12 inches high

All herbicides were applied with a 10-ft hand-held spray boom with six TeeJet® AIXR110015 nozzles on 20-inch spacing and pressurized with a CO_2 backpack. Spray output was 15 gpa at 40 psi with a ground speed of 3 mph. All Liberty Ultra applications included ammonium sulfate (AMS) at 3 or 5 lb dry granules/A, and all Roundup PowerMAX® (glyphosate) applications, unless applied with Liberty Ultra, included AMS at 2.6 lb dry granules/A. Italian ryegrass control was rated visually on May 21, 30 days after PPI applications, June 4, 15 days after EPOST applications, and June 17, 14 days after LPSOT applications, as a percent of the nontreated checks. Canola was harvested with a plot combine, and samples were bagged and weighed to calculate plot yield.

Italian ryegrass control from Sonalan HFP applications average ≥93% by May 21, 30 days after treatment (DAT) when the canola had three leaves and the EPOST treatments were applied (Table 1). Overall density in this trial was low and averaged 20 plants/yd^2. The PPI treatments were effective early leaving few plants for the EPOST applications to control. However, Italian ryegrass control declined in plots treated with Sonalan HFP to 45 and 58% with the 24 and 32 oz/A rates, respectively, by June 17, 57 DAT. The decline in control may have been due to poor activation from lack of adequate rainfall following application. Sonalan HFP followed by PowerMAX controlled 100% of Italian ryegrass compared with only 67% when Sonalan HFP was followed by Liberty Ultra.

Liberty Ultra applied EPOST resulted in Italian ryegrass control 76 to 88% by June 4, 15 DAT, and then declined to 62% if no LPOST treatment was applied (Table 1). Where Liberty Ultra was re-applied LPOST, control by June 17, was 95% if AMS was included at 3 lb/A, and 99% if AMS was included at 5 lb/A; however, there was no statistical difference in control between the AMS rates. If Liberty Ultra was followed by PowerMAX, control was only 79%, whereas if PowerMAX EPOST was followed by Liberty Ultra, control was 100% by June 17. It is unclear why the PowerMAX application following Liberty Ultra was not effective. When PowerMAX was applied EPOST, all Italian ryegrass was controlled leaving little or no plants left when the LPOST Liberty Ultra treatment was applied. Applying PowerMAX first and then Liberty Ultra if needed may be the preferred treatment. Both the tank mix treatment of Liberty Ultra with PowerMAX and PowerMAX alone resulted in 100% control June 4, 15 DAT. Liberty Ultra is an effective option for controlling Italian ryegrass in Liberty Link Spring canola; however, it may need to be re-applied if plants recover from the first application or there are new flushes. Glyphosate resistance was not observed in our trial, therefore, Roundup PowerMAX was very effective in controlling Italian ryegrass. Sonalan HFP was effective early, but control did not persist as there was inadequate rainfall for good soil activation. Other weeds in this trial included common lambsquarters, which was easily controlled (>90%) with all treatments.

In this trial, Italian ryegrass density was inadequate to reduce yield and there was no apparent yield reduction from the glyphosate applications, therefore, no differences between treatments were found (Table 1). Yields ranged from 1470 to 1870 lb/A, which were lower than yields in 2024, but not unexpected given that the region was experiencing a drought. However, there were observable effects of the treatments on canola growth as stunting and thinning were observed in treatments with PowerMAX and with Sonalan HFP; however, these symptoms did not result in any statistically significant yield loss.

Table 1. Control of Italian ryegrass in spring canola and canola injury and yield with Liberty Ultra, Roundup PowerMAX, and Sonalan HFP herbicides.

	Treatment applications			-- Visual control ratings --			Canola Injury	Canola Yield
	PPI	EPOST	LPOST	--- Italian ryegrass ---				
Treatment*	4/22	5/21	6/4	5/21	6/4	6/17	7/17	8/14
				--- Percent of nontreated check** ---				- lb/A** -
Nontreated check		---	---	0	0	0	0	1660 a
LU (3)		23		---	83 cd	62 c	0 c	1670 a
LU (3)		23	23	---	76 d	96 ab	0 c	1870 a
LU (5)		23	23	---	88 bc	99 a	0 c	1620 a
LU (3) fb PM (2.6)		23	 22	---	85 bcd	79 bc	0 c	1660 a
PM (2.6) fb LU (3)		44	 23	---	100 a	100 a	20 ab	1630 a
LU + PM (3)		23 + 44		---	100 a	100 a	12 b	1690 a
PM (2.6)		44		---	100 a	100 a	16 b	1470 a
Sonalan HFP	24			97 a	87 bcd	45 c	12 b	1580 a
Sonalan HFP	32			97 a	89 bc	58 c	13 b	1630 a
Sonalan HFP fb LU (3)	24	 23		93 a	93 b	67 c	10 b	1690 a
Sonalan HFP fb PM (2.6)	24	 44		96 a	100 a	100 a	32 a	1750 a

*LU= Liberty Ultra (glufosinate); PM=Roundup PowerMAX (glyphosate). Numbers in parenthesis are lb/A of ammonium sulfate added to the herbicide. fb=followed by.
**Means in each column followed by the same letter are not significantly different (P≤0.05).

Glyphosate application timing and rate affects spring canola yield

Mark Thorne and Drew Lyon

Glyphosate is an effective tool for controlling Italian ryegrass in spring canola that has become resistant to Group 1 ACCase inhibitor herbicides. With the newer Truflex® cultivars, glyphosate can be applied to spring canola up to two times from emergence through the first flower stage of development. Application rates can vary but the total amount applied can't exceed the maximum rate of 1.6 lb acid equivalent per acre with no more than half the maximum applied when the canola has six leaves through the first flower. For a product like Roundup PowerMAX®, this corresponds to a maximum rate of 44 fl oz/A. With the expanded rates and timing of applications, growers have more flexibility in making applications that corresponds with Italian ryegrass emergence.

Over the past several years, our research has found that glyphosate applications sometimes have had a negative effect on spring canola, either by delaying flowering, delaying maturity, stunting growth, reducing yield, or all or some of the above. Furthermore, it is not clear whether timing or rate of glyphosate application or seeding date is the main contributing factor.

Figure 1. Spring canola glyphosate timing and rate trial at the WSU Cook Agronomy Farm, Pullman, WA. Canola on the left seeded April 25; canola in the middle seeded May 5; canola on the right seeded May 15, 2025.

We set up a trial to test the effects of glyphosate rate and application timing on canola seeded at three different dates using the cultivar InVigor® LR354PC at the WSU Cook Agronomy Farm near Pullman, WA (Figure 1). Spring canola was seeded on April 25, May 5, and May 15, 2025.

For each seeding date, canola seeding rate was 12 seeds/ft^2 in strips measuring 22.5 by 120 ft. Prior to seeding, liquid fertilizer was applied at 110-20-0-25-0.3-0.3 N-P-K-S-Zn-B lb/A and Treflan HFP was applied for preemergence weed control at 24 fl oz/A and incorporated 2 in deep with a field cultivator. Four glyphosate treatments were applied to the canola at each seeding date. Roundup PowerMAX was applied at 22 and 44 fl oz/A when the canola had three leaves, and 22 fl oz/A when the canola had six leaves. All treatments were replicated three times in each seeding date strip.

Treatments effects were evaluated visually for herbicide injury when the canola was in the flowering stage for each seeding date and recorded as percent of the nontreated check. Injury was seen as stunting of plants and thinning and size of seed pods. Canola yield was measured by harvesting a 5 by 22.5-ft wide swath in each plot with a small plot combine. Canola samples from each plot were bagged and weighed to calculate plot yield. Italian ryegrass at this site was controlled by the preplant Treflan HFP application; therefore, densities were extremely low and did not affect canola yields.

Canola injury and yield responses were similar at each seeding date in relation to glyphosate application timing and rate, therefore, seeding date data were combined (Table 1). The highest yielding treatment was the nontreated check averaging 2310 lb/A indicating that glyphosate negatively affected yield. The least amount of reduction was with Roundup PowerMAX applied at 22 fl oz/A at either the 3-lear or 6 leaf stage. The lowest yielding treatment was with Roundup PowerMAX applied at 44 fl oz/A, which correlates with the 30% visual injury seen during flowering as a reduction in height as well as smaller size seed pods (Figure 2).

Table 1. Spring canola injury and yield in relation to glyphosate (Roundup PowerMAX) application timing and rate.

		Spring canola*		
Herbicide	Rate	Stage	Injury	Yield
	fl oz/A		% of check	lb/A
Nontreated check	0	---	0	2310 a
Roundup PowerMAX	22	3 leaf	20 b	2090 b
Roundup PowerMAX	44	3 leaf	30 a	1950 c
Roundup PowerMAX	22	6 leaf	6 c	2110 b

*Spring canola InVigor LR354PC Truflex and LibertyLink® cultivar resistant to both glyphosate and glufosinate.

Canola yields also differed between seeding dates with the highest yields from the April 25 seeding and lowest from the May 15 seeding (data not shown). However, we are not reporting individual yields by seeding date because of an apparent moisture bias based on slope position of each seeding. The canola seeded April 25 was on the lower part of a slope and likely had greater access to soil moisture compared with the other strips, especially the May 15 seeding which was highest on the slope. Because of this potential slope and moisture effect, it is impossible to separate the effect of slope position from seeding date.

Glyphosate resistance in canola is achieved from two processes, one of which is a gene that codes for a glyphosate-resistant enzyme (EPSP synthase) involved in the synthesis of aromatic amino acids phenylalanine, tyrosine, and tryptophan. These amino acids are critical for protein synthesis and other compounds including chlorophyll. Reports in the literature describes the glyphosate resistant enzyme as having only "reduced affinity," suggesting that some glyphosate can attach and reduce then enzyme's function. This may explain in part the injury we have seen in our research trials. Plant stress during flowering from heat or lack of soil moisture, or both, can also reduce canola yield. The impact of glyphosate, especially at the higher rate, may increase plant stress by delaying flowering and exposing the plant to higher temperatures and dryer soil in addition to reduced production of critical aromatic amino acids.

Figure 2. Spring canola in the pod fill stage. Left - pods of spring canola treated with 44 fl oz/A Roundup PowerMAX at the 3-leaf stage. Right - spring canola that was not treated with Roundup PowerMAX.

Triazine tolerant spring canola may add an additional option for Italian ryegrass control

Mark Thorne and Drew Lyon

Italian ryegrass and other weeds such as common lambsquarters can be difficult to control in spring canola. Currently, there are six modes of action with products labeled for weed control in spring canola and they include the following:

Group 1, ACCase inhibitors, e.g. clethodim, quizalofop

Group 2, ALS inhibitors, e.g. imazamox

Group 3, mitosis inhibitors, e.g. ethalfluralin, trifluralin

Group 4, synthetic auxins, e.g. clopyralid

Group 9, EPSPS inhibitors, e.g. glyphosate

Group 10, glutamine synthase inhibitors, e.g. glufosinate

Of these, Italian ryegrass has developed resistance to Group 1 and 2 herbicides in eastern Washington and northern Idaho. Group 4, clopyralid, is not effective for grass weed control. Italian ryegrass has also developed resistance to Group 9 and 10 herbicides in other areas, which could become a reality for growers in eastern Washington and northern Idaho. Lastly, Group 3 herbicides are only effective if they are incorporated into the soil and there is an adequate amount of precipitation (≥ 0.25”) shortly after application to activate the herbicide for uptake by the seedling roots of weeds. If all these herbicide options fail, then tillage followed by delayed seeding is a last resort.

Figure 1. Triazine tolerant spring canola 52 days after seeding. Left - Photosyntech NCC-25-TZ-07 spring canola. Right - Photosyntech NCC-25-TZ-412 spring canola. Photos taken June 17, 2025.

Triazine herbicides, Group 5, photosynthesis inhibitors, e.g., simazine and atrazine, have some activity on Italian ryegrass and are very effective on many broadleaf weeds. Spring canola cultivars have been developed with resistance to triazine herbicides; however, the use of triazine herbicides on canola is not yet labeled. We conducted a trial on the WSU Cook Agronomy Farm evaluating yield of two triazine tolerant cultivars, Photosyntech NCC-25-TZ07 and NCC-25-TZ-412, and atrazine herbicide (AAtrex® 4L) for control of Italian ryegrass control.

Prior to seeding, liquid fertilizer was applied at 110-20-0-25-0.3-0.3 N-P-K-S-Zn-B lb/A and then cultivated with a field cultivator to incorporate the fertilizer into the soil. Canola varieties were seeded April 27, 2025, in two non-randomized blocks with a Great Plains direct-seed drill at a seeding rate of 8 seeds/ft^2 at a depth of 0.75 to 1.0 inches into moist soil. Each cultivar block was 30 by 120 feet and was divided into three non-randomized 10-ft strips lengthwise for herbicide treatments. Herbicide treatments included a nontreated check, AAtrex 4L applied post-plant pre-emergence (PRE) at 56 fl oz/A, and AAtrex 4L applied at 28 fl oz/A PRE and again post-emergence (POST) at 28 fl oz/A (Table 1) when the canola had 3 to 5 leaves and the Italian ryegrass had 1 leaf to 3 tillers. In addition, common lambsquarters had germinated and was 0.5 to 2 inches in diameter. The PRE treatments were applied on May 1 and the POST treatments were applied on May 27, 2025. All AAtrex 4L applications included Crop Oil M at 1% v/v. All herbicides were applied with a 10-ft hand-held spray boom with six TeeJet® AIXR110015 nozzles on 20-inch spacing and pressurized with a CO_2 backpack. Spray output was 15 gpa at 40 psi with a ground speed of 3 mph.

Table 1. Italian ryegrass and common lambsquarters control in triazine tolerant spring canola with AAtrex 4L atrazine herbicide.

				Visual control ratings***				Canola
				IR	LQ	IR	LQ	Yield
#	Herbicide*	Rate	Timing**	5/27	5/27	6/17	6/17	8/18
		fl oz/A		------------ % of nontreated check ------------				lb/A
1	AAtrex 4L	56	PRE	10	95	68	95	2200
2	Nontreated	---	---	0	0	0	0	2070
3	AAtrex 4L	28	PRE + POST	10	87	45	100	2110

*All AAtrex 4L treatments included Crop Oil M at 1% v/v

**PRE=post-plant, pre-emergence; POST=post-emergence when the canola had 3 to 5 leaves.

***IR=Italian ryegrass; LQ=common lambsquarters.

Visual assessments of Italian ryegrass and common lambsquarters control were made May 27, when the POST treatments were applied, to evaluate early control from the PRE treatments. Statistical analysis was not performed because the study was non-randomized; however, evaluations were similar within each cultivar, therefore averaged together. Italian ryegrass had emerged following the PRE treatments and was only controlled 10% from AAtrex 4L at either the 56 or 28 oz/A rates. However, common lambsquarters control was 95% with the 56 oz/A rate and 87% with the 28 oz/A rate (Table 1). On June 17, Italian ryegrass and common lambsquarters control averaged 68% and 95%, respectively, from the 56 oz/A PRE treatment, and 45% and 100%, respectively, with the split 28 oz/A PRE + POST treatments. Canola yield was similar between cultivars and averaged between 2070 and 2200 lb/A and was not affected by either of the AAtrex 4L treatments.

Overall, Italian ryegrass was not controlled early as plants emerged following the PRE treatments. This was likely due to lack of rainfall after planting; however, control improved as the crop matured. The split PRE + POST treatment with 28 oz/A PRE did not appear to be quite as effective as the 56 oz/A PRE treatment. AAtrex 4L was very effective at controlling common lambsquarters as control on June 17 was 95% from the 56 oz/A PRE treatment and 100% with the split PRE + POST treatment. It is likely that a POST application on broadleaf weeds is effective because of direct foliar uptake.

Both cultivars yielded well given the drought conditions and lack of rain following seeding. Furthermore, the cultivars appeared to be very tolerant of atrazine as no obvious differences were seen between the AAtrex 4L treatments and the nontreated check strips. Italian ryegrass density averaged approximately 20 plants/yd^2 in the nontreated check strips on May 27, which was not dense enough to reduce yield, however, common lambsquarters was more prevalent and continued to emerge in the nontreated check strips as the crop matured. The success of atrazine for controlling Italian ryegrass appears only moderate, but adding a Group 3 herbicide as second mode of action may increase efficacy.

Alion® crop safety and efficacy in Kentucky bluegrass

Jessica E.R. Kalin & Ian C. Burke

Annual grass weeds, such as Italian ryegrass (*Lolium multiflorum*), are difficult to control in grass seed fields and infestations can reduce stand quality, longevity, and productivity. Alion (indaziflam) controls annual grass weeds by inhibiting cellulose biosynthesis in newly germinated seedlings. The objective of this study was to evaluate the crop safety and efficacy of Alion in Kentucky bluegrass grown for seed.

The study was established in a 1st-year Kentucky bluegrass field near Rockford, Washington. Treatments were applied when the Kentucky bluegrass was 3 to 5 tiller and actively growing in the fall of 2024. Treatments were applied with a CO_2 powered backpack sprayer. The spray boom had four Teejet 11002VS nozzles with 20-inch spacing and spray output was calibrated to deliver 15 gallons per acre at 3 mph. Plots were 10 ft wide by 30 ft long, arranged in a randomized complete block design with four replications. Treatments were assessed for crop response and weed control in the spring, 6 months after treatment A. Two ½ m^2 subsamples were harvested from each plot to estimate yield. Data were subject to ANOVA using the Agricultural Research Manager software (Ver. 2024).

Table 1. Treatment application details.

Application Code	**A**	**B**
Date	10/29/2024	4/17/2025
Application volume (GPA)	15	15
Timing	Postemergence	Postemergence
Crop Stage	3-5 tillers	3-5 tillers
Air temperature (˚F)	42	53
Wind velocity (mph, direction)	78	28
Relative humidity (%)	6, SSW	8, N

Weed control complete for all herbicide treatments across all evaluation dates (170, 176, and 211 days after first application). Alion, regardless of rate, and Callisto at 16 oz/a are effective for controlling Italian ryegrass.

No visible crop injury (0% phytotoxicity) was observed across all treatments during the evaluation period. Both Alion and Callisto were safe for use on Kentucky bluegrass at the rates tested in this trial. Plots were harvested on June 20, 20245. Yield was similar among treatments due to low weed pressure and absence of crop injury.

The yield data indicate that the split application of Alion (1.5 oz/a) slightly outperformed other treatments, achieving the highest yield. While Alion at 3 oz/a resulted in lower yields, suggesting that the higher rate might impact yield due to other factors rather than seed quality. The herbicides in this trial effectively controlled Italian ryegrass with no adverse effects on Kentucky bluegrass. These findings support their use as effective weed management tools in grass seed production systems. Future studies could explore tank mixes and longer-term effects on crop performance.

Table 2. Yield (lb/A) and germination (%) of Kentucky bluegrass in response to increasing rates of Alion herbicide treatments. Means were not significantly different between treatments (α=0.5).

Treatment[1]	Rate		Timing	Yield (lb/A) 6/20/2025
Alion	2	oz/A	A	3476
Alion	3	oz/A	A	3468
Alion	1.5	oz/A	A	3809
Alion	1.5	oz/A	B	
Callisto	16	oz/A	A	3873

[1]All treatments included NIS 0.05%V/V.

Anthem® Flex crop safety and efficacy in Kentucky bluegrass

Jessica E.R. Kalin & Ian C. Burke

Annual grass weeds are difficult to manage in grass seed fields due to similarities in physiology and lifecycles, and infestations can reduce stand longevity and productivity. Preemergence herbicides that control annual grasses selectively in Kentucky bluegrass are critical components of a weed management system. Pyroxasulfone, the active ingredient in Anthem Flex that has soil residual activity, is a new herbicide being considered for use in Kentucky bluegrass. The study objective was to evaluate Anthem Flex (pyroxasulfone + carfentrazone-ethyl) crop safety and efficacy in Kentucky bluegrass grown for seed.

The study was established in a 1st-year Kentucky bluegrass field near Rockford, Washington. Treatments were applied when the Kentucky bluegrass was 3 to 5 tiller and actively growing in the fall of 2024. Treatments were applied with a CO_2 powered backpack sprayer. The spray boom had four Teejet 11002VS nozzles with 20-inch spacing and spray output was calibrated to deliver 15 gallons per acre at 3 mph. Plots were 10 ft wide by 30 ft long, arranged in a randomized complete block design with four replications. Treatments were assessed for crop response and weed control in the spring, 6 months after treatment A. Two ½ m^2 subsamples were harvested from each plot to estimate yield. Data were subject to ANOVA using the Agricultural Research Manager software (Ver. 2024).

Table 1. Treatment application details.

Application Code	**A**	**B**
Date	10/29/2024	4/17/2025
Application volume (GPA)	15	15
Timing	Postemergence	Postemergence
Crop Stage	3-5 tillers	3-5 tillers
Air temperature (˚F)	42	53
Relative humidity (%)	78	28
Wind velocity (mph, direction)	6, SSW	8, N

Control of Italian ryegrass (*Lolium multiflorum*) was very good to excellent for all treatments. All treatments consistently provided over 95% control.

Crop injury presented as stunted growth in plots where Anthem Flex was applied at rates over 2.75 oz/A, either alone in the fall or combined fall and spring applications (treatments 3-6, 8) (Table 2). Calculated yields were not different among treatments, though treatments that kept Anthem Flex rates around 3 oz/A yielded higher than other treatments (up to 3400 lb/A) (Table 3).

In previous iterations of this trial, similar injury was observed with high rates of Anthem Flex on newly seeded and 1st-year Kentucky bluegrass (5-10%) (2023 and 2024 trials), but no injury was observed in the 2022 trial on 2nd-year bluegrass. We did find numerically lower yield in plots treated with Anthem Flex applied at 6 oz/A in the fall (treatment 5), however it was not significantly lower than other treatments.

Anthem Flex appears to be a robust tool for Italian ryegrass management in Kentucky bluegrass grown for seed. While Prowl H2O and Outrider offered limited individual efficacy, their integration in tank mixes provided enhanced weed suppression. Crop safety is still a concern, especially at higher rates of

Anthem Flex, though we did not find that the stunting affected yield or germination of the crop. Future studies could explore optimizing combinations and application timings for broader weed control.

Table 2. Crop injury and Italian ryegrass control for Kentucky bluegrass in response to increasing rates of Anthem Flex herbicide. Injury and control were not statistically different (α = 0.05) between treatments.

	Treatment[1]	Timing	Rate		Stunting (%) 4/23/2025	Control (%) 4/23/2025
1	Nontreated				0	0
2	Anthem Flex	A	2.75	oz/A	0	95
3	Anthem Flex	A	3	oz/A	0	100
4	Anthem Flex	A	2.75	oz/A	5	95
	Anthem Flex	B	1	oz/A		
5	Anthem Flex	A	6	oz/A	5	95
6	Anthem Flex	A	2.75	oz/A	5	95
	Prowl H2O	B	64	oz/A		
7	Prowl H2O	A	64	oz/A	0	100
8	Anthem Flex	A	2.75	oz/A	5	95
	Anthem Flex	B	2.75	oz/A		
9	Outrider	A	0.38	oz/A	0	95
10	Outrider	A	0.38	oz/A	0	95
	Anthem Flex	A	2.75	oz/A		

[1]All treatments included NIS 0.05%V/V.

Table 3. Yield and germination for Kentucky bluegrass in response to increasing rates of Anthem Flex herbicide. Yield was not significantly different between treatments ($\alpha = 0.05$).

	Treatment[1]	Timing	Rate		Yield (lb/A) 6/20/2025
1	Nontreated				3067
2	Anthem Flex	A	2.75	oz/A	2275
3	Anthem Flex	A	3	oz/A	2260
4	Anthem Flex	A	2.75	oz/A	2710
	Anthem Flex	B	1	oz/A	
5	Anthem Flex	A	6	oz/A	1759
6	Anthem Flex	A	2.75	oz/A	2712
	Prowl H2O	B	64	oz/A	
7	Prowl H2O	A	64	oz/A	2699
8	Anthem Flex	A	2.75	oz/A	2751
	Anthem Flex	B	2.75	oz/A	
9	Outrider	A	0.38	oz/A	3475
10	Outrider	A	0.38	oz/A	3105
	Anthem Flex	A	2.75	oz/A	

[1]All treatments included NIS 0.05%V/V.

Residual efficacy of HPPD-inhibiting herbicides

Jessica E.R. Kalin and Ian C. Burke

In the fall of 2024, a field trial was established to evaluate the efficacy of the HPPD inhibitor herbicides in controlling weeds under bare ground conditions in Eastern Washington. Weed control is critical for optimizing crop yields, and herbicides that provide residual activity provide longer-term weed control that may reduce early-season competition. HPPD-inhibiting herbicides prevent the production of chlorophyll, which disrupts plant growth. Talinor (bicyclopyrone), Tolvera (tolpyralate), and Huskie (pyrasulfotole) were selected for this study because they are available in Washington and registered in winter and spring wheat. The objective of this study was to evaluate (1) the overall weed control efficacy of different herbicide treatments, and (2) the residual weed control.

This trial took place at the Palouse Conservation Field Station near Pullman, WA. Initial herbicide treatments of Talinor (18 oz/A), Tolvera (14.7 oz/A), and Huskie (15 oz/A) occurred once in the fall and once in the spring. The plots were divided into five subplots: (A) main treatment alone, (B) main treatment with glyphosate applied 14 days after main treatment (DAT), (C) main treatment with glyphosate applied 28 DAT, (D) main treatment with glyphosate applied 42 DAT, and (E) main treatments with glyphosate applied 56 DAT. Main treatments that were applied in the fall received one glyphosate application in the fall and the remaining glyphosate applications were applied in the spring (Tables 1 & 2). All herbicide treatments were applied with a CO_2 powered backpack sprayer. The spray boom had four Teejet® 11002VS nozzles with 20-inch spacing and spray output was calibrated to deliver 15 gallons per acre at 3 mph. Plots were 10 ft wide by 75 ft long, with each subplot (A-E) measuring 10 ft wide by 15 ft long, arranged in a randomized complete block design with four replications. Treatments were visually assessed for weed control, by species, at 14 and 28 days after the last treatment. Weed density and biomass was taken by species in each subplot at the end of the growing season (early August) using two ½ m^2 quadrats.

RStudio (R version 4.5.1) was used to analyze and visualize data. Fixed effects included treatment, subplot, species, and the interaction between treatment and subplot. Random effects included replication. A negative binomial distribution was applied to model density data.

Each weed species germinated throughout the period of subplot treatments, although emergence declined after 5/30/2025. It should also be noted that the farm received little rainfall during this trial (Figure 4), which could prohibit the efficacy of these herbicides. The limited rainfall could have also affected weed germination throughout the trial. And while these herbicides are not specifically labeled for winter annual grass weed control, we did find that Talinor reduced the biomass of rattail fescue (Figure 3).

Common lambsquarters densities were highly variable across the trial but appear to be reduced in spring-treated plots (Figure 1). Trends in biomass trends were similar to trends in density, were spring Talinor and spring Tolvera reduced lambsquarters biomass, but was relatively consistent across fall-treated plots (Figure 2).

Mayweed chamomile density was reduced in spring-treated plots compared to fall-treated plots, though overall, Tolvera had no effect on Mayweed density (Figure 1). Mayweed biomass was more variable and showed no significant trends (Figure 2).

Overall, prickly lettuce was not controlled with any of the herbicides that were applied in the fall. Spring-treated Huskie and Tolvera plots have significantly lower densities, indicating better residual control compared to spring-applied Talinor (Figure 2). Biomass trends were similar – spring applied Huskie and

Tolvera reduced overall biomass compared to spring-applied Talinor and there was no difference between herbicides applied in the fall (Figure 3).

Tumble pigweed was present in all treatments and most subplots (apart from subplots A, B, and C in fall-applied herbicides), indicating limited residual activity for the three herbicides. The absence of tumble pigweed in the earlier subplots was most likely due to earlier germination of other weeds.

Growers now have three HPPD herbicide options to manage broadleaf weeds in wheat. The data presented here indicates that Talinor may be best utilized early in the season for residual activity on tumble pigweed and prickly lettuce, while Tolvera and Huskie should be utilized at the traditional postemergence timings for control of emerged weeds, as their residual activity appears to be shorter in duration and what residual activity there is appears to be more selective. More seasons are needed to determine best timing of application, and for individual species management recommendations.

We continue to recommend the use of herbicide systems that utilize multiple effective modes of action on each weed every season, and do not advocate for the use of two different HPPD inhibitors in the same season.

Table 1. Application details for fall-applied main treatments.

	Study Applications				
	Main Application	**Glyphosate Reset 1**	**Glyphosate Reset 2**	**Glyphosate Reset 3**	**Glyphosate Reset 4**
Date	10/18/2024	11/15/2024	4/15/2025	4/30/2025	5/30/2025
Application volume (GPA)	15	15	15	15	15
Air temperature (˚F)	53	38	55	51	69
Soil temperature (˚F)	37	42	41	54	53
Wind velocity (mph, direction)	8, S	8, W	5, S	7, WSW	2, SSE
Relative humidity (%)	44	90	49	58	42

Table 2. Application details for spring-applied main treatments.

	Study Applications				
	Main Application	**Glyphosate Reset 1**	**Glyphosate Reset 2**	**Glyphosate Reset 3**	**Glyphosate Reset 4**
Date	4/15/2025	4/30/2025	5/30/2025	6/17/2025	6/30/2025
Application volume (GPA)	15	15	15	15	15
Air temperature (˚F)	55	51	69	69	66
Soil temperature (˚F)	41	54	53	64	64
Wind velocity (mph, direction)	5, S	7, WSW	2, SSE	9, WSW	5, ESE
Relative humidity (%)	49	58	42	36	52

Figure 1. Mean weed density by treatment and subplot.

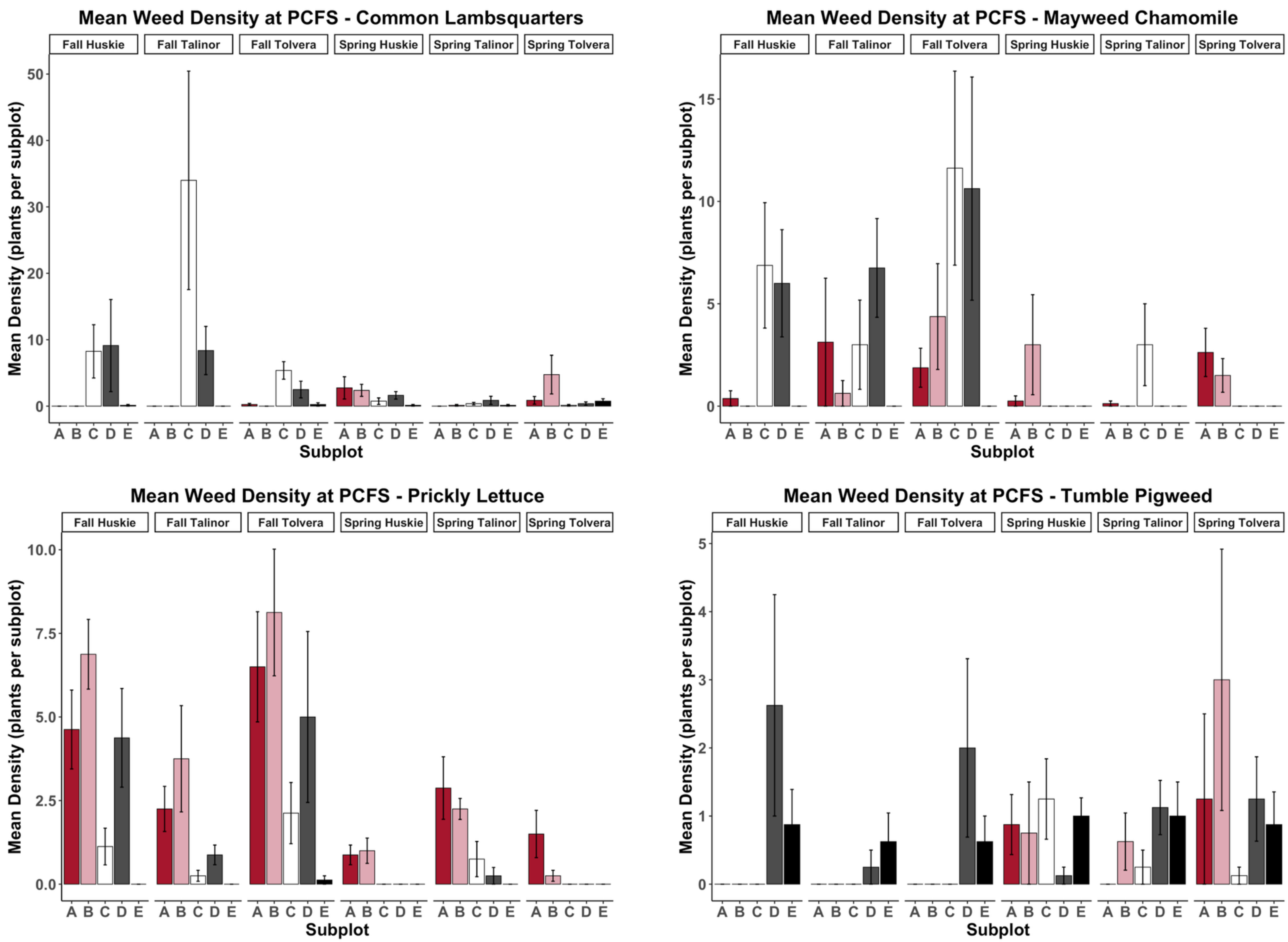


Figure 2. Mean weed biomass by treatment and subplot.

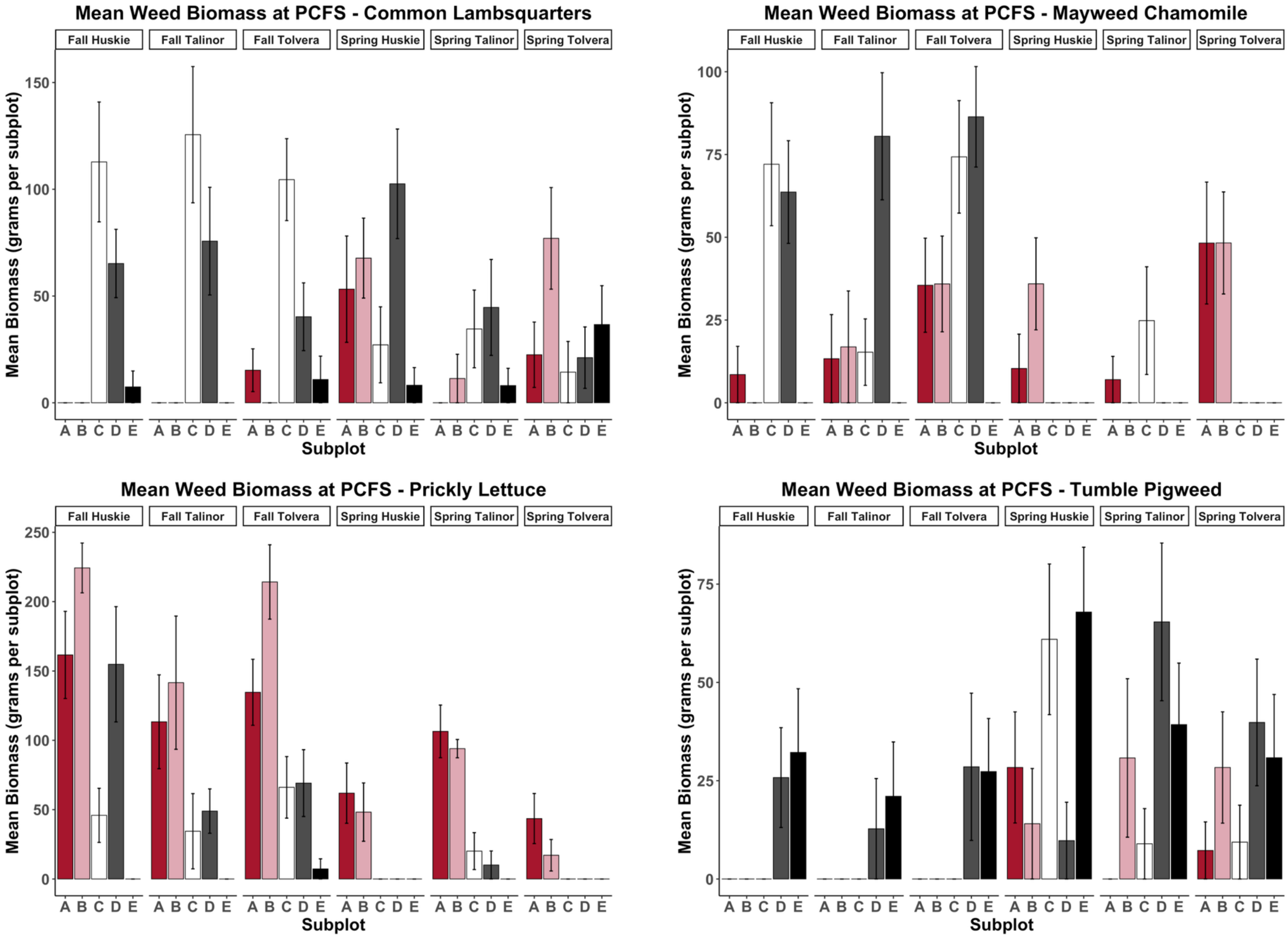


Figure 3. Rattail Fescue biomass by treatment and subplot.

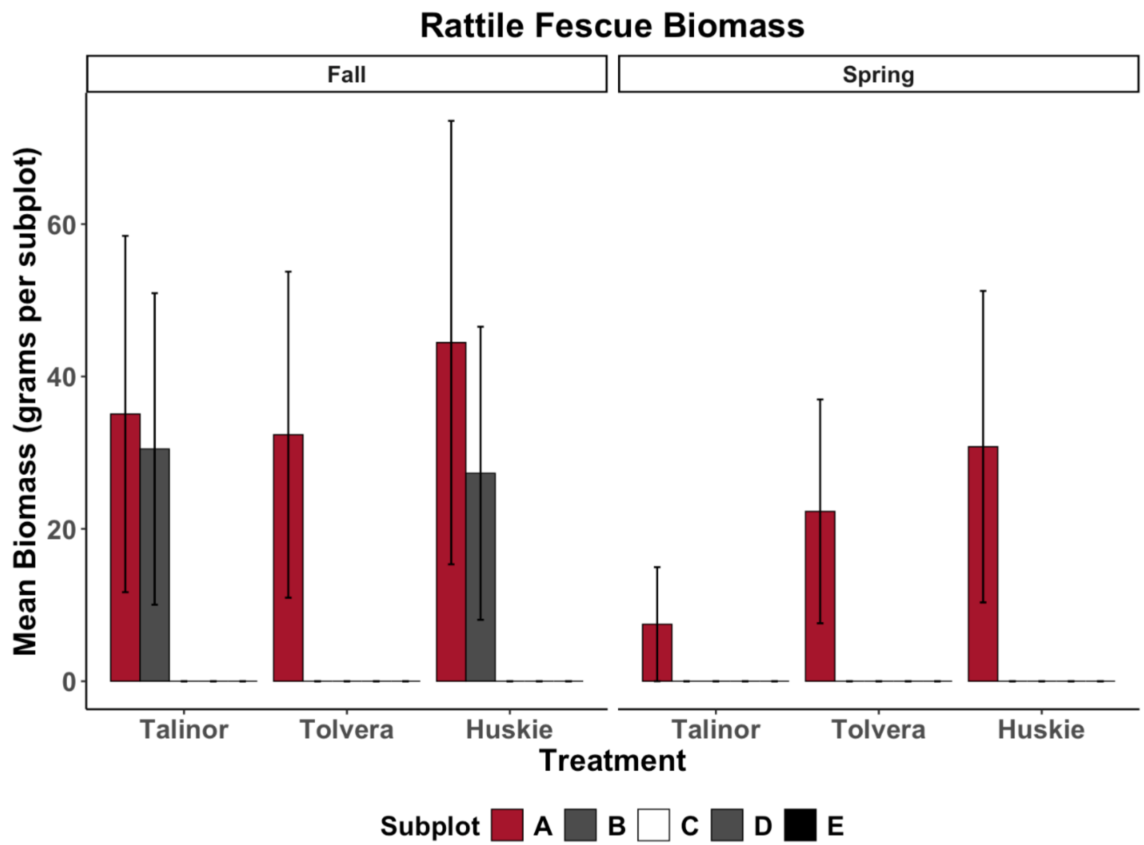


Table 3. Total rainfall (fall 2024) for Pullman, WA by date.

Date	Total Rainfall (mm)
10/04/2024	0.255
10/16/2024	1.003
10/21/2024	3.451
10/27/2024	0.255
10/30/2024	0.017
10/31/2024	0.306
11/01/2024	0.527
11/02/2024	0.884
11/03/2024	0.306
11/04/2024	1.089
11/05/2024	0.051
11/11/2024	0.051
11/13/2024	0.153
11/16/2024	0.017
11/17/2024	0.595
11/20/2024	0.612
11/22/2024	0.051
12/07/2024	0.068
12/09/2024	0.017
12/17/2024	0.017
12/18/2024	0.017
12/26/2024	0.085
12/29/2024	0.17
12/30/2024	0.017

Table 4. Total rainfall (spring 2025) for Pullman, WA by date.

Date	Total Rainfall (mm)
1/3/25	0.017
1/10/25	0.034
1/31/25	0.136
2/1/25	0.017
2/19/25	0.051
2/22/25	0.017
2/23/25	0.051
2/24/25	0.85
3/13/25	0.068
3/15/25	0.34
3/20/25	0.085
3/21/25	0.068
3/22/25	0.034
3/28/25	0.017
3/31/25	0.119
4/7/25	0.255
4/29/25	0.034
5/11/25	0.017

Residual efficacy of PPO-inhibiting herbicides

Jessica E.R. Kalin and Ian C. Burke

In the spring of 2025, a field trial was established to evaluate the efficacy of PPO-inhibiting herbicides in controlling weeds under bare ground conditions in Eastern Washington. Weed control is critical for optimizing crop yields, and herbicides that provide residual activity provide longer-term weed control that may reduce early-season competition. These group 14 herbicides inhibit the PPO enzyme, which blocks the production of chlorophyl, as well as destroying cell membranes, leading to cell death. The objective of this study was to evaluate (1) the overall weed control efficacy of different herbicide treatments, and (2) the residual weed control.

Initial herbicide treatments of Reviton (tiafenacil) at 1 and 2 oz/A, Sharpen (saflufenacil) at 1 and 2 oz/A, Flumi FX (flumioxazin) at 1 and 2 oz/A, Rapidicil (epyrifenacil) at 5 and 10 oz/A, Voraxor (saflufenacil) at 1.5 oz/A, Goal (oxyfluorfen) at 1 pt/A, and a "nontreated" plot that was treated with glyphosate only occurred in the spring. The plots were divided into three subplots: (A) main treatment alone, (B) main treatment with glyphosate applied 14 DAT, and (C) main treatment with glyphosate applied 42 DAT. This trial was located at the Palouse Conservation Field Station near Pullman, WA. Plots were 10 ft wide by 30 ft long - with each subplot (A-C) measuring 10 ft by 10 ft - and arranged in a randomized complete block design with four replications. All herbicide treatments were applied with a CO_2 powered backpack sprayer (Table 1). The spray boom had four Teejet® 11002VS nozzles with 20-inch spacing and spray output was calibrated to deliver 15 gallons per acre at 3 mph. Treatments were visually assessed for weed control, by species, at 14 and 28 days after the last treatment. Weed density and biomass was taken by species in each subplot at the end of the growing season using two ½ m^2 quadrats.

Table 1. Application details for all herbicide treatments.

	Main Application	**Glyphosate Reset 1**	**Glyphosate Reset 2**
Date	5/9/2025	5/30/2025	6/30/2025
Air temperature (˚F)	66	70	66
Soil temperature (˚F)	51	53	53
Wind velocity (mph, direction)	6, SE	2, SE	5, ESE
Relative humidity (%)	42	41	52

RStudio (R version 4.5.1) was used to analyze and visualize data. Fixed effects included treatment, subplot, species, and the interaction between treatment and subplot. Random effects included replication. A negative binomial distribution was applied to model density data.

Flumi FX at the low rate had the most significant overall weed density reduction compared to the nontreated ($p = 0.04$). The majority of rainfall occurred before we started this trial (Table 2/Figure 3), which could have affected the activation of some of the herbicides.

Common lambsquarters was not completely controlled by any of the treatments (Figure 1), however, Reviton and Flumi FX at the high rate, and Voraxor had lower densities than other plots. Lambsquarters biomass was significantly lower in the 'B' subplots compared to the 'A' plots (Figure 2), suggesting that all treatments provide some residual control. Prickly lettuce was controlled by Rapidicil at the high rate, and to lesser extent, by Rapidicil at the low rate (Figure 1). There was no residual control with the Flumi

FX or Voraxor treatments (Figure 3). Mayweed chamomile was controlled by Flumi FX at both low and high rates, as well as Rapidicil at the high rate (Figure 1). Mayweed biomass follows the same trends as lambsquarters biomass – lower biomass in the ‘B’ plots suggest some residual control.

Growers have five PPO herbicide options to manage broadleaf weeds in wheat - Rapidicil is not yet available in Washington. The data presented here indicates that Flumi FX may be best utilized for lambsquarters and Mayweed control, while Sharpen and Rapidicil show more activity on prickly lettuce. More seasons are needed to determine best timing of application, and for individual species management recommendations.

We continue to recommend the use of herbicide systems that utilize multiple effective modes of action on each weed every season, and do not advocate for the use of two different PPO inhibitors in the same season.

Figure 1. Mean weed density per subplot. 'L' represents the low rate and 'H' represents the high rate.

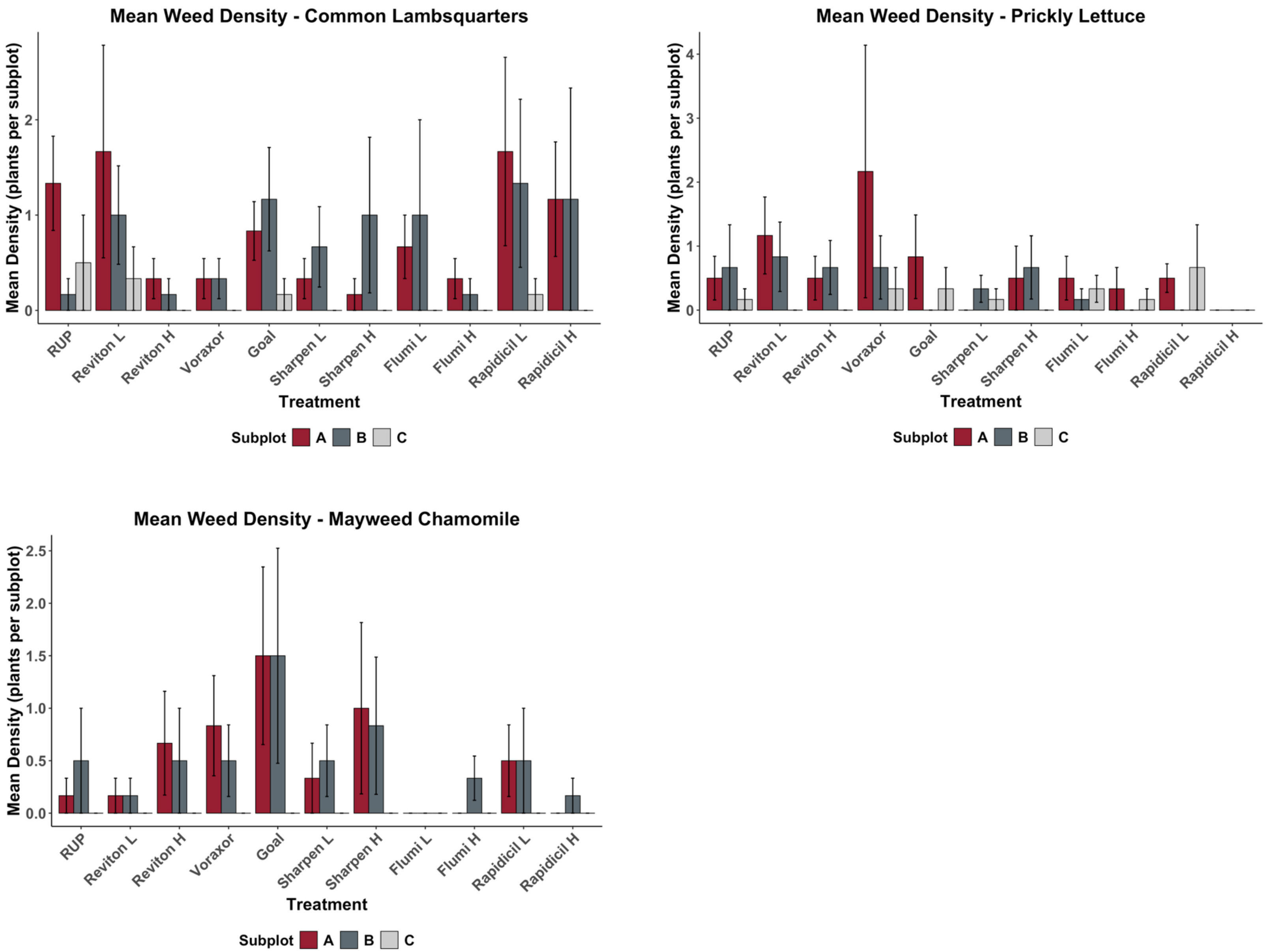


Figure 2. Mean weed biomass per subplot.

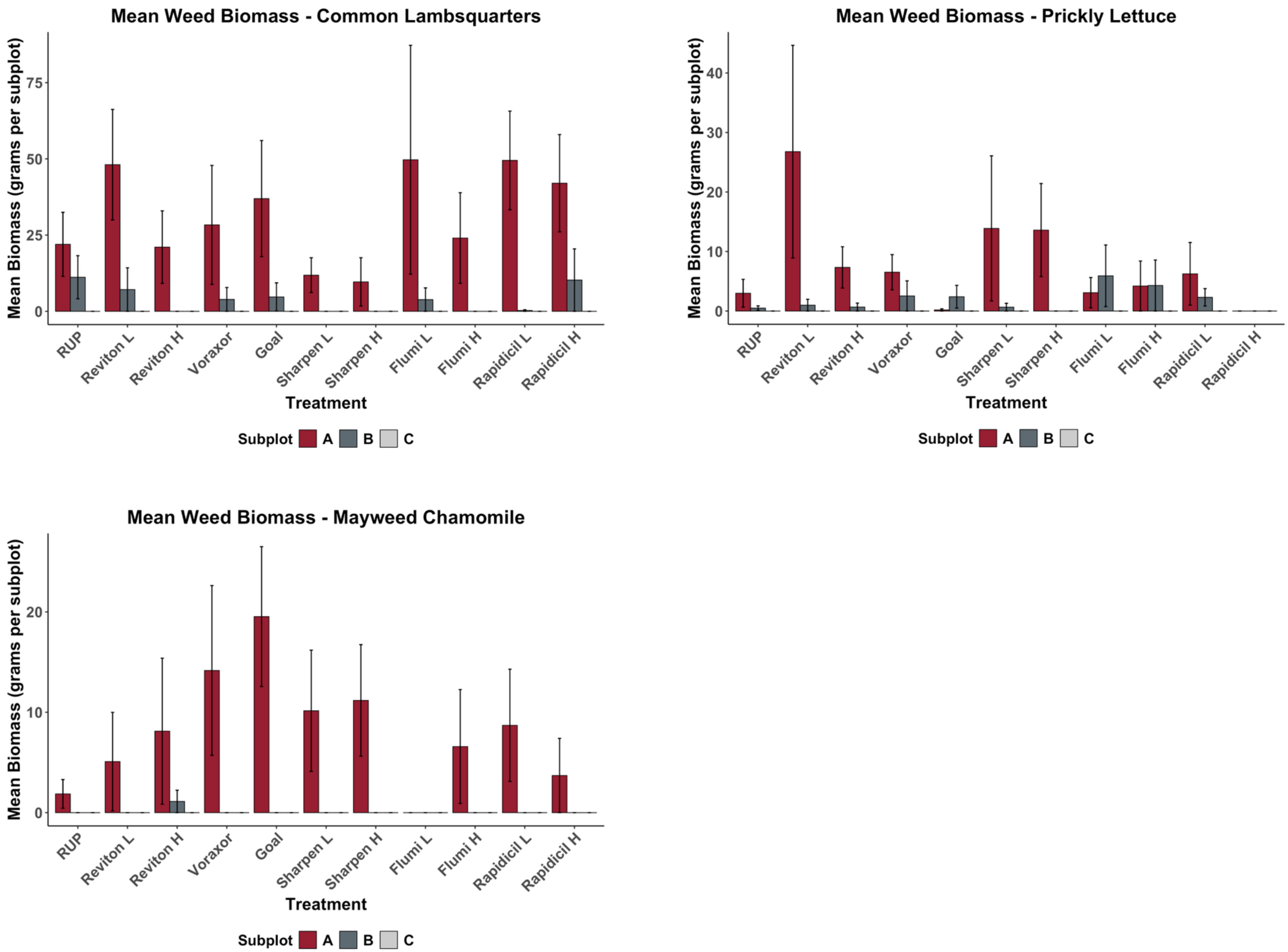


Table 2. Total rainfall for Pullman, WA for spring 2025.

Date	Total Rainfall (mm)
1/3/25	0.017
1/10/25	0.034
1/31/25	0.136
2/1/25	0.017
2/19/25	0.051
2/22/25	0.017
2/23/25	0.051
2/24/25	0.85
3/13/25	0.068
3/15/25	0.34
3/20/25	0.085
3/21/25	0.068
3/22/25	0.034
3/28/25	0.017
3/31/25	0.119
4/7/25	0.255
4/29/25*	0.034
5/11/25	0.017

*Main herbicide application occurred after this date (5/9/2025).

Forage soybeans and blue Hopi flint corn as alternative crops on the Palouse

Mark Thorne and Drew Lyon

Crop rotations on the Palouse are predominately comprised of cool season annual crops including wheat, pulses, and canola, which limits weed control strategies to pre-emergence herbicides or herbicides applied earlier in the growing season. Warm-season crops are planted later in the spring compared with cool season crops, so they offer differences in herbicide timing as well as mode of action. Furthermore, troublesome cool season weeds like winter annual grasses or broadleaf species can been controlled prior to planting warm season crops.

Climate patterns in the Palouse region have been less favorable to growing warm season crops common to the Midwest region because of diminishing rainfall through spring and summer; however, other options may be possible. We planted "Laredo" forage soybeans and blue Hopi flint corn on the Palouse Conservation Field Station near Pullman, WA (Figure 1). Forage soybeans are bred for leaf production instead of seed production and can be grazed or cut for silage or hay. Because they are bred for forage, they can be grown in drier areas and be harvested long before flowering. The Laredo cultivar is the oldest forage soybean that can tolerate a wide range of environmental conditions. Laredo is a bush-type soybean with small black seeds with a seed count of ~8,000 seeds/lb.

Blue Hopi corn originated with the Hopi people over centuries in northeast Arizona for its drought tolerance. It can be eaten fresh during the milk stage or used for hominy, grits, or cornmeal. It can also be used for livestock feed as green chop, silage, or corn grain. Blue Hopi corn is a ~110-115 day open pollinated flint type of corn that has blue pigment in the aleurone layer of the seed (Figure 2).

Figure 1. Blue Hopi flint corn (left) and Laredo forage soybeans (right) at the Palouse Conservation Field Station, Pullman, WA.

Laredo soybeans and blue Hopi corn were direct seeded 2 inches deep on May 15, 2025, with a Great Plains double disc drill. The soybeans were seeded at 48 lb/A in 10-inch rows. Seeding rate for the corn was 1 seed/ft of row with rows on 30-inch spacing yielding a density of 17,420 seeds/A. The soybean block was not fertilized but the corn block was broadcast fertilized after seeding with urea pellets at about 115 lb N/A.

For weed control, both blocks were sprayed with Roundup PowerMAX® (glyphosate) at 32 oz/A preplant to control established weeds. The soybean block was sprayed with Spartan® 4F (sulfentrazone) at 8 oz/A post-plant for preemergence weed control. On July 11, Butyrac® 200 (2,4-DB) was applied at 0.9 pt/A to control common lambsquarters, pigweed, and prickly lettuce. The corn block had no preplant or preemergence applications but was sprayed with Weedar® 64 2,4-D) at 1 pt/A on June 23 when the corn was about 12 inches high and still in the vegetative stage to control common lambsquarters, pigweed, and prickly lettuce. All applications were within label guidelines.

Laredo soybeans were sampled for biomass and nutrient composition on September 23 by collecting plants from six 1 m^2 areas across the block. At collection time the plants were beginning to flower. Plants were bagged and placed in a drying oven at 122 °F for four days until the bags had reached a consistent weight. Samples from each bag were collected and sent to Dairy One Forage Lab, Ithaca, NY, for nutrient analysis. Sampled biomass averaged 4520 lb/A (Table 1), which is comparable with first cutting alfalfa. Nutrient analysis indicated moderate forage quality as crude protein was only 9.4% and relative feed value was 124.5; however, total digestible nutrients was 63% and in the good range for alfalfa. These quality measures would likely have been higher if samples were collected earlier when the stems were less developed and also if there had been summer rainfall. From May through September, only 1.5 inches of rain fell, which was 3.7 inches below normal for the period. However, even with the drought conditions, nitrate accumulation in the plants was well within the safe zone (<1012 ppm). In other warm season crops like sorghum, drought or frost conditions can cause accumulation of prussic acid (cyanide), which is toxic in livestock. The benefit of feeding forage soybeans is that there is no risk of prussic acid; however, there is a slight risk of bloat in cattle similar to alfalfa if cattle are introduced too quickly to soybean forage, either fresh or hay. Planting forage soybeans with an annual grass such as oats can lower the risk of bloating. Furthermore, earlier grazing or haying can stimulate regrowth and would pair well with regrowth from an annual grass forage crop.

Figure 2. Blue Hopi flint corn.

Corn yield was assessed on October 7 by collecting all ears from four 30-ft lengths of rows. Parts of rows where the drill had not seeded evenly were excluded so yield would not be biased by planter issues. The ears (Figure 2) were shucked, bagged, and placed in a 122 °F drying oven for three days. Each ear was then shelled by hand and the kernels checked for moisture and weight. Yield was calculated on an acre basis with a standard moisture content of 15.5% and test weight of 56 lb/bu. Final yield was 89 lb/bu, or 5000 lb/A (Table 2), which was greater than yields from cool season spring crops in the area. In addition, several ears were collected from the field, shucked and shelled, and the kernels ground to make cornbread, which was delicious! A concern for growing corn on the Palouse is getting ears dry enough for harvesting, therefore, shorter-season, drought-tolerant, and cold-tolerant cultivars may be needed. At the time of this picking, the black line at the tip of the kernel, which indicates full maturity, had not yet developed and the milk line on the kernels was still 3/4 to 7/8 down from the top of each kernel. Alternatively, high moisture (65%) corn plants with ears could be chopped for silage, or just the ears picked later when drier (20%) and put into corn cribs for shelling at a later date.

Warm season crops can be successful if cultivars are adapted for regional climate conditions. Yields of both the forage soybeans and the corn were relatively outstanding given the drought conditions through this summer. Weed control was very effective with the strategies employed; however, the drought conditions may have aided weed control by not causing later flushes. Warm season crops add both new and challenging options and may be useful when confronting herbicide resistance in traditional crops grown in the area.

Table 1. Nutrient analysis on average of forage soybeans sampled September 23, 2025, grown at the Palouse Conservation Field Station – Pullman, WA.

Nutrient	Concentration	Value**
Biomass*	lb/A	4,520
Crude protein (CP)	%	9.4
Water soluble carbohydrates (WSC)	%	11.2
Total digestible nutrients (TDN)	%	63.0
Net energy - gain (NEg)	Mcal/lb	0.35
Relative feed value (RFV)	N/A	124.5
Calcium (Ca)	%	1.1
Phosphorus (P)	%	0.2
Nitrate-N (NO_3)	ppm	146.0

*Biomass listed as oven-dried weight after reaching a constant weight, all other nutrients listed on dry matter basis.
**Values are averages of six 1 m^2 samples per nutrient, except for nitrates which is the average of two samples.

Table 2. Yield components on average of Hopi blue flint corn grown in 2025 at the Palouse Conservation Field Station - Pullman, WA.

Component*	Measurement	Value
Yield	lb/A	5000
Yield	bu/A	89
Ears	#/ft of row	1.1
Kernels	lb/ear	0.26

*Yield calculated on a 15.5% moisture basis and 56 lb/bu test weight.

Precipitation data for Pullman, WA - Palouse Conservation Field Station

Day	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug
	---------------2024---------------				----------------------------------2025----------------------------------							
	---precipitation in inches---											
1	0	0	0.14	0	0.02	0.58	0	0.25	0	0	0	0.17
2	0	0	0.12	0	0.05	0	0	0.02	0	0	0	0
3	0	0	0.16	0	0.12	0	0	0	0	0	0	0
4	0	0.04	0.03	0	0.49	0.06	0	0.02	0.01	0	0	0
5	0	0	0.32	0	0.35	0.31	0.01	0	0	0	0	0
6	0	0	0	0	0.06	0.02	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0.08	0	0	0	0.02
8	0	0	0	0.3	0.02	0	0	0.56	0	0	0	0
9	0	0	0	0.04	0	0.1	0	0.2	0	0	0	0
10	0	0	0.05	0	0	0	0.06	0	0	0	0	0
11	0	0	0.01	0	0.17	0	0.09	0	0.03	0	0	0
12	0.2	0	0.01	0	0	0	0.07	0	0.23	0	0	0
13	0	0	0	0.11	0	0	0.29	0	0.25	0	0	0
14	0	0	0.41	0.2	0	0.04	0.05	0	0.01	0	0	0
15	0.32	0	0	0.03	0	0.08	0.15	0	0	0	0	0
16	0	0.33	0.05	0	0	0.12	0.28	0	0.12	0	0	0.13
17	0	0.18	0.33	0.11	0	0.37	0.16	0	0.04	0	0	0
18	0	0	0.59	0.34	0	0.2	0.14	0	0.09	0	0	0
19	0	0	0.01	0	0	0.02	0	0	0.03	0	0	0
20	0	0	0.21	0	0	0.47	0.03	0.01	0.16	0	0	0
21	0	0.25	0.03	0	0	0	0.13	0	0	0	0.03	0
22	0.01	0.34	0.47	0.22	0	0.02	0.39	0	0	0.07	0.01	0
23	0	0	0.53	0.15	0	0.38	0.08	0	0	0.04	0	0
24	0	0	0.79	0.02	0	0.84	0.28	0	0	0	0	0
25	0	0	0.03	0.58	0	0.2	0.02	0	0	0	0	0
26	0	0	0.01	0.12	0	0	0	0	0	0	0	0.04
27	0	0	0.02	0.12	0	0	0	0	0	0	0	0
28	0	0.02	0	0.29	0	0	0.12	0	0	0	0	0
29	0	0	0	0.16	0		0.13	0.02	0	0	0	
30	0.05	0	0	0.29	0		0	0.07	0	0	0	
31		0.36		0.09	0		0.09		0		0	
Total	0.58	1.52	4.32	3.17	1.28	3.81	2.57	1.23	0.97	0.11	0.04	0.36
Normal	2.67	1.94	2.05	1.96	1.81	1.22	0.44	0.48	0.65	1.8	2.62	2.77
Depart	-2.09	-0.42	2.27	1.21	-0.53	2.59	2.13	0.75	0.32	-1.69	-2.58	-2.41

Sept 1, 2024 – Aug 31, 2025, total = 19.96 inches; Normal average = 20.41 inches.

Normal precipitation based on 1991-2020 data; Depart = departure from normal.

Precipitation data for Davenport, WA – Davenport

	---------------2024---------------				-------------------------------------2025-------------------------------------							
Day	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**
	--------precipitation in inches--------											
1	0	0	0.19	0	0	0.29	0	0.04	0	0	0	0
2	0	0	0.71	0	0	0	0	0.02	0	0	0	0
3	0	0	0.11	0	0.07	0	0	0	0	0	0	0
4	0	0	0.04	0	0.43	0	0	0	0.05	0	0	0
5	0	0.05	0.3	0	0.24	0	0.03	0	0	0	0.08	0
6	0	0	0	0	0	0.06	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0.37	0	0	0	0.22
8	0	0	0	0.11	0	0	0	0.16	0	0	0	0.12
9	0	0	0	0	0	0	0	0.02	0	0	0	0
10	0	0	0.05	0	0	0	0	0	0	0	0	0
11	0	0	0.03	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0.23	0	0	0
13	0	0	0	0	0	0	0.42	0	0.11	0	0	0
14	0.03	0	0.68	0.32	0	0	0	0	0.09	0	0	0
15	0	0	0	0	0	0.08	0.11	0	0.03	0	0	0.02
16	0.02	0.05	0	0	0	0.12	0.19	0	0	0	0	0.11
17	0	0	0.1	0.07	0	0.07	0	0	0.13	0	0	0
18	0	0	0	0.53	0	0	0	0	0.11	0	0	0
19	0	0	0	0	0	0	0	0.09	0.03	0	0	0
20	0	0	0.11	0	0	0.06	0	0	0.47	0	0	0
21	0	0.16	0.23	0	0	0	0	0	0	0	0	0
22	0	0.17	0.32	0.2	0	0.07	0.54	0	0	0	0.04	0
23	0	0	0.33	0.17	0	0.32	0	0	0	0.11	0	0
24	0	0	0	0.26	0	0.32	0.12	0	0	0	0	0
25	0	0	0.33	0	0	0	0	0	0	0	0	0
26	0	0.04	0	0.52	0	0	0	0	0.13	0	0	0
27	0	0.17	0	0.07	0	0	0.21	0	0	0	0	0
28	0	0	0	0	0	0	0.15	0	0	0	0	0
29	0	0	0	0	0		0.03	0.11	0	0	0	0
30	0	0	0	0.66	0		0	0.03	0	0	0	0
31		0.15		0	0.13				0		0	0
Total	0.05	0.79	3.53	2.91	0.87	1.39	1.8	0.84	1.38	0.11	0.12	0.47
Normal	1.73	0.99	1.53	1.11	1.37	1.15	0.42	0.3	0.49	1.26	1.72	1.9
Depart	-1.68	-0.2	2	1.8	-0.5	0.24	1.38	0.54	0.89	-1.15	-1.6	-1.43

Sept 1, 2024 – Aug 31, 2025, total = 14.26 inches; Normal annual = 13.97 inches

Normal precipitation based on 1991-2020 data; Depart = departure from normal.

Precipitation data for Lind, WA – WSU Lind Dryland Research Station

	---------------2024---------------				-----------------------------------2025-----------------------------------							
Day	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**
	----precipitation in inches----											
1	0	0	0.2	0	0.06	0	0	0.18	0	0	0	0
2	0	0	0.15	0	0.07	0	0	0	0	0	0	0
3	0	0	0	0	0.33	0	0	0	0.02	0	0	0
4	0	0.05	0.13	0	0.31	0.01	0	0	0	0	0	0
5	0	0	0	0	0.07	0.01	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0.01	0.02	0	0	0.58	0	0	0	0
8	0	0	0	0	0.02	0.12	0	0.04	0	0	0	0
9	0	0	0	0.06	0.01	0.02	0	0	0	0	0	0
10	0	0	0.06	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0.01	0	0	0
12	0	0	0	0	0	0	0.05	0	0.2	0	0	0
13	0	0	0.48	0.03	0	0.05	0.26	0	0.06	0	0	0
14	0.03	0	0	0.13	0.01	0.02	0	0	0	0	0	0
15	0	0	0	0	0	0.16	0.09	0	0	0	0	0
16	0	0.04	0	0.09	0	0.04	0	0	0	0	0	0
17	0	0	0.09	0.15	0	0.1	0	0	0	0	0	0
18	0	0	0.02	0.11	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0.24	0	0.05	0.07	0	0	0
20	0	0	0.36	0	0	0	0	0	0.11	0	0	0
21	0	0.2	0.13	0.09	0	0	0.04	0	0	0	0.05	0
22	0	0	0.67	0.15	0	0.13	0.05	0	0.02	0	0.05	0
23	0	0	0.18	0	0	0.31	0.11	0	0	0	0	0
24	0	0	0.05	0.47	0	0.18	0	0	0	0	0	0
25	0	0	0.03	0.05	0	0.09	0	0	0	0	0	0
26	0	0	0	0.38	0	0	0	0	0.02	0	0	0
27	0	0	0	0.02	0	0	0.03	0	0	0	0	0
28	0	0.06	0	0.11	0	0	0.07	0	0	0	0	0.05
29	0	0.01	0	0.2	0		0	0.05	0	0	0	0
30	0	0	0	0	0		0	0	0	0	0	0
31		0.16		0	0.17		0.04		0		0	0
Total	0.03	0.52	2.55	2.05	1.07	1.48	0.74	0.9	0.51	0	0.1	0.05
Normal	1.29	0.88	1.05	0.83	0.86	0.69	0.34	0.24	0.34	0.92	1.29	1.4
Depart	-1.26	-0.36	1.5	1.22	0.21	0.79	0.4	0.66	0.17	-0.92	-1.19	-1.35

Sept 1, 2024 – Aug 31, 2025, total = 10.0 inches; Normal annual = 10.13 inches

Normal precipitation based on 1991-2020 data; Depart = departure from normal.