PROCEEDINGS

WESTERN SOCIETY OF WEED SCIENCE

Volume 79, 2026

ISSN: 0091-4487

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2026

PROCEEDINGS

OF

THE WESTERN SOCIETY OF WEED SCIENCE

VOLUME 79

PAPERS PRESENTED AT THE ANNUAL MEETING

MARCH 2-5, 2026

The Tucson Marriott University Park

Tucson, Arizona

PREFACE

The Proceedings contain the written abstracts of the papers and posters presented at the 2026 Western Society of Weed Science Annual Meeting plus summaries of the research discussion sections for each Project. The number located in parenthesis at the end of each abstract title corresponds to the paper/poster number in the WSWS Meeting Program. Authors are indexed separately. Index entries are published as received from the authors with minor format editing.

This e-document is available at the WSWS website (**www.wsweedscience.org**) or from the WSWS Business Manager, 360 Oak Avenue, Suite #140, Eaton, CO 80615 (**info@wsweedscience.org**). Print copies may be ordered from Curran Associates (**http://www.proceedings.com/agriculture-conference-proceedings.html**) 866-964-0401.

The Minutes of the Board of Directors meetings and the Business Meeting are available at the WSWS website.

The WSWS would like to thank André Lucas Simões Araujo – Colorado State University who graciously volunteered his time and talents to furnish many of the award photographs included in this publication.

Proceedings Editor: Carl Libbey

GENERAL SESSION

Introductions and Announcements. Nevin Lawrence*; University of Nebraska, Scottsbluff, NE (141)

Abstract not available

WSWS Presidential Address. Carl Coburn*; Bayer Crop Science, St. Louis, MO (142)

Abstract not available

Flows of Time: Ancestral O'Odham Irrigation and Broader Understanding of Ancient Irrigation. Christoper R. Caseldine*; Arizona State University, Tempe, AZ (143)

Abstract not available

Washington DC Policy Update. Lee Van Wychen*; Weed Science Society of America, Alexandria, VA (144)

Abstract not available

POSTER SESSION

WSWS Project 1. Weeds of Range, Forestry, and Natural Areas

Improving Native Forb Seed Production through Herbicide Tolerance Screening. Eric Westra[1]*, Mirella Ortiz[1], Corey Ransom[1], Kevin Gunnell[2], Melissa Landeen[2], William Behling[2];[1]Utah State University, [2]Utah DNR- Division of Wildlife Resources (049)

Native forbs are important for ecosystem diversity and are often established in natural areas following weed control in restoration efforts. Native forb seeds are often harvested from native populations which can contribute to their relatively high seed costs. Utah State University in collaboration with the Utah DNR Division of Wildlife Resources established greenhouse trials to evaluate native forb tolerance to various herbicides in order to provide weed management options for growing native forbs for seed production in agronomic settings. *Heliomeris multiflora* and *Erigeron pumilus* were screened with multiple herbicides focused on POST and POST-layby applications to control agronomic weeds in field settings. Greenhouse applications were applied at 187 L ha^{-1} and evaluations consisted of visual injury evaluations, total flower number at harvest, and fresh and dry weight biomass. Greenhouse results for *H. multiflora* showed that flumioxazin, 2,4-DB, carfentrazone, and clethodim resulted in the best tolerance applied POST, while pendimethalin, pyroxasulfone, and ethafluralin applied POST-layby had the best tolerance. For *E. pumilus*, carfentrazone, flumioxazin, saflufenacil, and clethodim applied POST provided the best tolerance, while pendimethalin provided the best tolerance applied POST-layby. Preliminary greenhouse screening results on herbicide tolerance for native forbs will be used to select herbicide treatments to evaluate weed control efficacy and seed production in 2026 field trials. Evaluating native forb tolerance to POST and POST-layby herbicides in the greenhouse and field can help provide weed management options for growing native forbs in agronomic settings.

Use of Grass-selective Herbicides for Control of Non-native Pasture Grasses and Rangeland Restoration. Haley Monahan[1]*, Jacob Courkamp[1], Mark Paschke[1]; [1]Colorado State University (050)

Non-native pasture grasses were historically introduced to the western United States for the purpose of livestock forage production and soil stabilization resulting in their rapid spread. Today, the presence of non-native pasture grasses challenges native plant restoration in rangeland settings due to the competitive abilities of these grasses that result in reductions of biodiversity. We are exploring a novel approach for restoring biodiversity in degraded rangeland systems using a combination of grass-selective herbicide treatments (i.e., Group 1) and revegetation techniques for the purpose of improving native plant diversity in rangeland seedings. During the autumn of 2024, we used grass-selective herbicides to control crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromis inermis),* and Siberian wheatgrass (*Agropyron fragile*) in a degraded rangeland in northeastern Colorado followed by seeding of a native forb and shrub seed mix. While herbicide treatments were generally effective at reducing cover of target grasses, smooth brome responded the least to herbicide treatments and it is unclear which herbicide treatment performed the best overall. Revegetation was successful in seeded plots with overall forb and shrub cover approximating native plant assemblages. While many studies have looked at the efficacy of controlling non-native pasture grasses with herbicide treatments, few have used grass-selective

herbicides in combination with a forb and shrub seeding treatment for the purpose of improving diversity in restoration outcomes. This strategy will support land managers in restoring plant diversity to existing stands of non-native pasture grasses or within new restoration plantings that have seed banks dominated by these grasses.

Effects of Indaziflam on the Seedbank of Rangeland Broadleaf Weeds. Ryan Robertson[1]*, Jane Mangold[1];[1]Montana State University (051)

Treating invasive weeds in range and wildland ecosystems is costly labor-intensive and often produces mixed results. Most management practices involve post-emergent herbicides, which may result in positive short-term effects, but require consistency due to persistent seed banks. The pre-emergent herbicide indaziflam has shown promising results when treating invasive annual grasses, but minimal research has been published on its effectiveness against broadleaf, perennial weeds. We hypothesize that as a non-selective, persistent herbicide, indaziflam will reduce the seed bank and increase longevity of control of broadleaf, perennial weeds when tank mixed with post-emergent foliar herbicides. We quantified the effects of indaziflam at three sites in Montana dominated by one of three species: spotted knapweed (*Centaurea stoebe*), rush skeletonweed, (*Chondrilla juncea*), and sulphur cinquefoil (*Potentilla recta*). We applied six herbicide treatments at recommended rates (none, clopyralid, 2,4-D, clopyralid+indaziflam, 2,4-D+indaziflam, and indaziflam) to each site. Canopy cover was collected one month after application. Soil samples were also collected and used in a greenhouse bioassay to assess treatment effects on the seed bank. In the bioassay, all treatments that included indaziflam led to fewer germinations of all species. For example, at the spotted knapweed site mean grass and forb seedlings in non-indaziflam treatments was 10.9±7.8 and 4.8±4.9, respectively, and the mean in indaziflam-treated samples was 1.4±1.1 and 1.1±0.3, respectively. Invasive weed management using herbicide include tradeoffs among cost, labor, and impact. This study will help inform managers about the effects of indaziflam on a range of weed species and its impact on non-target plants.

Garlic Mustard (*Alliaria petiolata*) in the West: Evaluating Control Options and Barriers to Effective Management. Felipe Quatroni[1]*, Mirella Ortiz[1], Corey Ransom[1], Cody Beckley[1], Eric Westra[1];[1]Utah State University (052)

Garlic mustard (*Alliaria petiolata*) is an invasive biennial weed spreading rapidly in the western United States. Each plant can produce thousands of seeds that remain viable for years, so management must target suppressing bolting plants, reducing rosettes, and limiting seedling recruitment from the seedbank. In forest understories, however, soil-active herbicides can often be intercepted by the leaf-litter layer. To assess whether litter limits herbicide availability, we quantified and collected litter from Park City and Payson Canyon, Utah; simulated litter layers in trays under greenhouse conditions; and sprayed indaziflam, metsulfuron-methyl, aminopyralid + florpyrauxifen-benzyl, and triclopyr. Using HPLC-DAD, we quantified herbicide residues that passed through the litter during initial spray and again after a 2 mm simulated rainfall event applied 1 or 7 days after treatment (DAT). At Park City, a limited amount of herbicide moved through the litter during application (0.6 to 1.7%), while rainfall increased desorption for most herbicides. Delayed rainfall reduced recovery for some active ingredients, especially indaziflam (about half

of 1 DAT recovered at 7 DAT). Payson Canyon showed similar trends, but greater initial penetration of the active ingredients, consistent with lower litter amounts at that site (about 30% lower than Park City). Overall, litter strongly limits herbicide availability, while rainfall helps increase the fraction that moves through litter, and delaying rainfall reduces that recovery, likely due to time-dependent binding or degradation. Next steps are to characterize litter composition and evaluate how site-to-site differences in litter correlate with herbicide movement and plant responses under field conditions.

Effects of Clomazone on the Physiological Responses of Water Hyacinth. Bianca Jaqueline Santos Rodrigues[1]*, Bianca de Borba Barreto Moreira[1], Mirella Farinelli Ortiz[2], Marcos Antonio Bacarin[1], Junior Borella[3];[1]Federal University of Pelotas, [2]Utah State University, [3]Federal University of Rio Grande (053)

Water hyacinth is widely recognized for its high invasive potential in aquatic ecosystems of the United States, driven by its rapid reproductive rate and high tolerance to diverse contaminants; in this context, understanding its physiological responses and capacity to cope with herbicides is essential for proposing more effective strategies for species control. The clomazone doses tested were untreated (0 mg L^{-1}), 0.1 mg L^{-1}, and 0.3 mg L^{-1}, and the experiment lasted 28 days. Plants under continuous exposure were analyzed at 8, 16, and 28 days after application (DAA), while post-exposure plants were evaluated at 8 and 20 days after herbicide removal. Evaluations included visual injury symptoms, net CO_2 assimilation rate, and total dry biomass. At 8 DAA, foliar injury reached 20% and 35% for the 0.1 and 0.3 mg L^{-1} treatments, respectively, increasing to 70% at 28 DAA. During the recovery period, lesion area recovered to 8% (0.1 mg L^{-1}) and 35% (0.3 mg L^{-1}). Net CO_2 assimilation declined with increasing herbicide concentration, showing negative values at 0.3 mg L^{-1}, but recovery was observed at 0.1 mg L^{-1} during post-exposure. Total dry biomass was similar among treatments under continuous exposure and even higher at 0.1 mg L^{-1} after 20 days of recovery. The results indicate that water hyacinth exhibits high physiological plasticity and adaptive capacity in response to clomazone, rendering the herbicide ineffective at the tested doses and emphasizing the need for integrated management strategies.

Puncturevine Control: Physical Seed Removal and Preemergent Strategies. Tom Getts[1]*;[1]University of California (054)

Puncturevine or Goatheads (*Tribulus terrestris*) is a common non crop weed species that is notorious for its ability to produce troublesome seeds that pose (at best) as a nuisance and (at worse) physical injury. Puncturevine is often most problematic along roadways and around farmsteads, especially in areas of disturbance. In Northern California, puncturevine is particularly problematic at higher elevations where the stem feeding biocontrol weevil does not appear to persist. Fuels mitigation requires grass and weed removal in mid-summer, opening up space for puncturevine to thrive in the heat of the summer. There was interest from the local community to investigate physical seed removal, as well as preemergent herbicide control options. A study was conducted in North Eastern California, that compared the use of the "The GoatHead Roller" © to various preemergent herbicides applied in the fall and spring. The study was conducted at two sites. Both sites used the goat head roller, and seven herbicide treatments were replicated four times in a randomized complete block design. One of the sites had an additional 5 herbicide

treatments integrated in the study due to lack of sensitive vegetation on site. All herbicide treatments applied in the spring and fall included glyphosate at 840 g ae./ha to control emerged vegetation. The goat head roller was effective at picking up seeds, where at one site it averaged 80,000 seeds per 200 square ft. where at the other 4,400 seeds were removed per 200 square ft. All herbicide treatments resulted in adequate puncturevine control the summer after treatment, except flumioxazin applied at 70g ai/ha which did not control the puncturevine. Interestingly puncturevine plants were absent in the untreated check due to competition with other uncontrolled weeds. Where herbicides were applied other than flumioxazin there were significant increases on bare ground at each site during the August evaluation.($p<.05$ Tukey pair wise comparisons) The residual herbicide treatments and competition from other annual vegetation was enough to control puncturevine at both locations.

Herbicide-Resistant Kochia (*Bassia scoparia*) Emerging from Industrial Vegetation Management Areas. Eric Westra[1]*, Mirella Ortiz[1], Corey Ransom[1], Shannon Clark[2], Harry Quicke[2], Vicki Maloney[2];[1]Utah State University, [2]ENVU (055)

Kochia (*Bassia scoparia*) has widespread distribution across the United States and is often a focus of management for industrial vegetation management areas including transportation routes, utility substations, and other areas where uncontrolled vegetation can pose risks. With reliance on chemical control there have been reports of declining herbicide efficacy in industrial management areas. Kochia has evolved resistance to multiple modes of action which are often associated with agricultural production systems. Greenhouse screening trials were conducted to evaluate the frequency of resistance to herbicides commonly used in industrial management areas. Initial screening results have confirmed that kochia populations collected from industrial management areas in North Dakota, Kansas, and Oklahoma were able to survive 1,121 g ae ha^{-1} and 210 g ae ha^{-1} of aminocyclopyrachlor applied POST and PRE, respectively. These populations were screened with alternative auxin herbicides and displayed survival to kochia based field labeled rates of dicamba, 2,4-D, MCPA, combinations of 2,4D and dicamba, and glyphosate. These screening results indicate that there are auxin resistance mechanisms present in kochia populations from industrial vegetation management areas which emphasizes the need to diversify management approaches for sustainable vegetation management. These populations are currently being evaluated to confirm resistance mechanisms to better understand how plants have evolved resistance to herbicides commonly used for control in industrial management areas. Diversifying herbicide modes of action in addition to non-chemical integrated weed management tactics will be increasingly important as resistance continues to increase in non-agricultural settings.

WSWS Project 2. Weeds of Horticultural Crops

Evaluating Terbacil and Clethodim for Weed Management in Camas Species. Pamela Medeiros dos Santos[1]*;[1]Oregon State University (030)

Camassia spp. is a bulb crop to the indigenous peoples of the Pacific Northwest. Camas has high ornamental and restoration value, and weeds can reduce stand quality and yield. Studies were conducted in Corvallis, Oregon, starting in spring 2025 to compare two herbicides with different

ways of working: clethodim (ACCase inhibitor; Select Max) and terbacil (photosystem II inhibitor; Sinbar® 80% WP). Treatments included clethodim at 271 or 543 g a.i. ha^{-1} and terbacil at 448, 897, 1,794, or 2,690 g a.i. ha^{-1}. Applications were made over-the-top in the spring and repeated in the fall. Control of grass weeds (*Poaceae*) on the area depended on both treatment and rating time ($P < 0.001$). Clethodim control increased from about 10% at 0.5 months after initial treatment (MAIT) to about 48-56% at 1 - 2 MAIT and reached about 89-93% at at 0.5, 1 and 2 months after second treatment application, with no difference between the two rates. Clethodim caused crop injury (about 9-18%). Terbacil did not differ from the control at 0.5 MAIT, but it improved to about 43-58% at 1 - 2 MAIT and to about 90-93% at 0.5, 1 and 2 months after second treatment application. Terbacil caused no visible injury (0%) at any rate. Overall, both products can provide strong weed control in *Camassia* spp., especially after the fall application, and terbacil showed the best crop safety.

Evaluating Maleic Hydrazide for Branched Broomrape Management in Processing Tomatoes. Arpan Bhusal[1]*;[1]UC Davis (031)

Maleic hydrazide (MH) is a plant growth regulator that is registered in the U.S. for preharvest foliar use to prevent sprouting in onion, garlic, and potato in storage. Although it is not currently registered for use in tomato, emerging evidence suggests it may suppress root parasitic weeds such as branched broomrape that threaten the processing tomato industry in California. Therefore, field and greenhouse studies are being conducted to evaluate the efficacy and crop safety of MH in processing tomato to support its potential future registration. This research contributes to developing additional chemical control options for branched broomrape in processing tomatoes.

Impacts of Sorghum-Barley Crop Rotation on the Chile Pepper Growing Season. Ram Singh Insa[1]*, Brian Schutte[1], Erik Lehnhoff[1];[1]New Mexico State University (032)

Crop rotation may offer an effective strategy to reduce weed pressure and weed management costs in chile pepper. A field study was conducted to evaluate the effects of prior-season crops on weed density, hand hoeing time, nitrogen requirement, yield, and economic returns in spring-sown chile pepper. Treatments included summer fallow followed by (fb) winter barley, summer fallow fb winter fallow, sorghum fb winter fallow, and sorghum fb winter barley. Results indicated that the sorghum-barley rotation reduced broadleaf weed density in chile pepper by 21% compared with summer fallow fb winter fallow. Hand-hoeing time during the fourth through sixth week of the chile pepper growing season was reduced by 17 to 27% following sorghum fbbarley. However, the sorghum-barley rotation increased nitrogen requirements by 24%, compared to summer fallow fb winter fallow. Chile pepper fruit yield did not differ among treatments. Economic analysis revealed that barley following either fallow or sorghum increased crop production costs, which reduced net economic benefits relative to other rotations, despite comparable yields. Overall, replacing both summer and winter fallows with sorghum and barley, respectively, provided measurable weed suppression and labor savings in subsequent chile pepper production. However, sorghum-barley rotations may cause an increase in costs, relative to fallow, that are not offset by labor savings.

Chemical Management Strategies of Flazasulfuron-Resistant *Daucus carota* in Oregon. Davi Fiedler[1]*, Marcelo Moretti[1];[1]Oregon State University (033)

Daucus carota L. (wild carrot) is a biennial, competitive, invasive weed widely distributed in hazelnut orchards in Oregon. Repeated reliance on flazasulfuron as the primary control option has led to the development of flazasulfuron-resistance (FR) in D. carota. This study evaluated the efficacy of postemergence herbicides applied alone and in mixtures for management of flazasulfuron-susceptible (FS) and FR wild carrot, with the goal of developing effective management recommendations. In a container study comparing the responses of FR and FS populations, flazasulfuron applied at 50 g a.i. ha^{-1} controlled 36% of the FR and 85% of the FS populations at 42 days after treatment (DAT). All treatments containing florpyrauxifen-benzyl at 38 g a.i. ha^{-1}, applied alone or in mixtures, provided >90% control of both populations. In three field studies, glufosinate at 1,600 g a.i. ha^{-1} and florpyrauxifen-benzyl applied alone reduced biomass to approximately 12 and 5 g m^{-2}, 42 DAT, respectively. Conversely, tolpyralate, tiafenacil, and glyphosate did not effectively control D. carota. Mixtures containing two or more active ingredients improved control, particularly those including florpyrauxifen-benzyl. Flazasulfuron combined with tolpyralate consistently reduced biomass to less than 1 g m^{-2}, 42 DAT across all evaluated sites. Overall, reduced flazasulfuron efficacy associated with resistance development highlights the need for alternate management strategies. Tolpyralate showed improved performance when used in mixtures. Florpyrauxifen-benzyl particularly demonstrated strong potential as an alternate control option, especially where FR populations are present.

Barley Green Manure for Weed Suppression in Chile Pepper. Brian Schutte[1]*, Ram Acharya[1];[1]New Mexico State University (034)

Barley (*Hordeum vulgare* L.) cover crops that are mowed and incorporated into the soil (herein "barley green manure") suppress early-season weeds in spring-sown chile pepper (*Capsicum annuum* L.). Previous research suggested barley green manure can replace or enhance a residual herbicide that is commonly applied at chile pepper seeding (napropamide). To better understand the economic value of barley green manure, we conducted a study framed by the following objectives: 1) determine the effects of barley green manure and preemergence applications of napropamide on hand-hoeing time in chile pepper through 6 wk after seeding (WAS), and 2) determine the responses of early-season weed management cost to changes in labor wage for chile pepper grown with and without both barley green manure and napropamide. To address these objectives, we conducted a field study with treatments comprised of factorial combinations of barley green manure (+/-) and preemergence applications of napropamide at 2.24 kg ha^{-1} (+/-). Barley green manure was produced from an overwinter cover crop that was terminated 21 d prior to chile pepper seeding. Through 6 WAS, the amount of time required for hand hoeing 24-m2 sections of 38-m2 experimental units was determined for each treatment. Weed management cost through 6 WAS equaled the sum of herbicide application and green manure costs, plus the multiplicative product of hand-hoeing time and labor wage. The cost for the herbicide application included product and tractor operation. Components of green manure cost were seed, irrigation, and tractor operations for sowing and termination. Prices for tractor operation and irrigation were obtained from regional crop enterprise budgets. Labor wage — also from enterprise budgets —

was incrementally changed from US$16.77 hr^{-1} (hourly wage for farm workers in southern New Mexico in 2024) to US$25.16 hr^{-1} (50% greater than the hourly wage in 2024). Results indicated that hand-hoeing time was lowest for chile pepper grown with both green manure and napropamide. Removing the green manure or napropamide caused a 48% increase in hand-hoeing time. Removing the green manure and napropamide increased hand-hoeing time by 119%. One-way sensitivity analyses indicated US$1-increases in labor wage caused the following increases in weed management cost through 6 WAS: US$242 ha^{-1} for chile pepper grown with green manure and napropamide; US$336 ha^{-1} for chile pepper grown with green manure, without napropamide; US$367 ha^{-1} for chile pepper grown without green manure, with napropamide; US$418 ha^{-1} for chile pepper grown without both green manure and napropamide. These results suggest barley green manure mitigates the effects of increases in hourly wage for laborers who hoe weeds. For chile pepper in southern New Mexico, green manure-induced savings may be especially pronounced when this cultural strategy is combined with preemergence applications of napropamide.

Autonomous Weed Control in Fresh Vegetable Crops with the FarmDroid Robot. Pete Berry[1], Andrew Branka[1]*, Kristine Buckland[1];[1]Oregon State University (035)

Innovations in autonomous robotic planting and weeding technology have enabled small vegetable farms and organic producers to reduce costs associated with manual labor weed control efforts. The state of Oregon produces an annual value of $733 million of fresh vegetable crops, ranking 7th in the country. Approximately 75% of fresh vegetable farms in Oregon are smaller than 2 hectares, providing an opportunity to utilize autonomous robots effectively. In the summer of 2025, the FarmDroid system was used to plant three different vegetable crops at Oregon State University; turnip (*Brassica rapa*), beet (*Beta vulgaris*), and radish (*Raphanus sativus*). Treatments for these trials were inter-row weeding compared with inter plus intra-row weeding using the autonomous system. This trial assessed weed control and crop injury using remote sensing. Fields were flown and imaged before and after weeding treatments using an Unmanned Aerial System (UAS) and sensor with sub-millimeter resolution to quantify crop damage and weed control. Image analysis determined that crop injury did not differ between the two treatments. Weed control for radish, turnip, and beet plots ranged between 75 - 99%, with initial weed population and weeding intervals being the primary factors of control. Weeding intervals of less than a week improved the weeding efficacy of the autonomous system but efficacy differed based on weed species. The FarmDroid autonomous planting and weeding robot provides an opportunity for fresh vegetable growers to utilize new technology that can reduce the high costs of hand labor used for weed control.

Combining Hydromulch with Burlap for Biodegradable Weed Suppression in Fruit Production. Greta Gramig[1]*, Waqas Ahmad[2];[1]North Dakota State University, [2]Spectrum Brands (036)

We tested a modified hydromulching approach whereby hydromulch was sprayed on top of a woven biodegradable matrix (burlap) that would hopefully provide additional durability and strength to hydromulch when used in a perennial fruit crop over several years. Our objectives were to: (i) compare our original hydromulch formula (= DIY) to a commercially-available hydromulch

product (= COM); (ii) compare hydromulch tackifier (i.e., glue) materials and rates. The following mulch treatments were assigned randomly within each block, in plots measuring 0.9 x 3.0 m: (i) plastic woven landscape fabric; (ii) our original 'DIY' hydromulch with 6% guar gum tackifier; (iii) commercial hydromulch (Profile hydraulic cellulose) with 6% guar gum tackifier; (iv) commercial hydromulch with 3% guar gum tackifier; and (v) commercial hydromulch with 3% proprietary tackifier. The DIY formula was made by shredding 100% recycled content newsprint paper and mixing with water and the tackifier. For these different hydromulch formulations, we assessed weed control (measured as weed density and weed biomass) during 2025, the first season, in a newly established gooseberry (Ribes uva-crispa, var. 'Hinnomaki Red') planting. On July 31st, both the plastic woven landscape fabric and the DIY hydromulch formula with 6% guar gum contained zero weeds, whereas the other treatments contained low weed densities less than 25 weeds m^{-2}. On July 31st, commercial hydromulch with 6% guar gum was associated with less weed dry biomass than the commercial hydromulch with 3% guar gum, and the commercial hydromulch with 3% proprietary tackifier contained an intermediate amount of biomass. By October 9th, all mulch treatments contained some weeds, although the DIY formula and plastic woven mulch contained substantially fewer weeds than the three commercial hydromulches. However, plastic woven mulch only had less biomass compared to the commercial mulch with 6% guar gum and all the other formulations had an intermediate amount of weed biomass. These initial results indicate that the modified hydromulching approach could be a viable replacement for woven plastic mulch, but future studies are needed to assess long term weed control. A commercial hydromulch product with properties similar to our 'DIY' hydromulch would be needed to foster adoption.

Electric Mulch in Highbush Blueberries (*Vaccinium corymbosum*). Madden Robertson[1]*, Austin Frewert[1], Marcelo Moretti[1];[1]Oregon State University (037)

Barriers to weed management in Pacific Northwest northern highbush blueberry(*Vaccinium corymbosum*) production include high labor costs for hand weeding, restrictions of preemergence herbicide applications, and environmental and disposal concerns associated with plastic landscape fabric. Electrified mulch, a conductive mesh-based system that delivers low-voltage direct current to weeds upon contact, demonstrates potential as a nonchemical weed management tool, consistent with reports of electricity-based weed control in non-crop areas. This study evaluates the efficacy of electric mulch as a potential alternative weed management option in highbush blueberry. Five-watt solar panels were connected to conductive mesh screens delivering 6 mA at 50 V direct current. The screens were installed over mounded sawdust rows, around newly planted blueberry plants. Weeds emerged and contacted the screen, passing electrical current through the plant, leading to plant death. In this factorial trial, weed control, crop safety, and crop growth were compared among electrified 1m2 mesh screens with grid spacings of 2.5 mm or 5.7 mm, conventional pre-emergent herbicide applications of pendimethalin (4.2 kg ai ha^{-1}), and plastic landscape fabric. After five months, weed control was 9.3% with pendimethalin, 100% with landscape fabric, 95.6% with 2.5 mm electric mulch, and 76.7% with 5.7 mm electric mulch. Weed control using 2.5-mm electric mulch was comparable to landscape fabric, and both electric treatments exceeded pendimethalin, demonstrating the potential of electric mulch as a reusable,

nonchemical weed management tool. Performance was reduced under wet soil conditions and at high weed densities.

Evaluation of Tiafenacil Herbicide use in Grape Production. Rui Liu[1]*, Marcelo Moretti[2], Lynn Sosnoskie[3];[1]Washington State University, [2]Oregon State University, [3]Cornell University (038)

Poster withdrawn

Evaluating Crop Safety and Moss Control Using Saflufenacil + Pyroxasulfone in Cranberries. David King[1]*;[1]Oregon State University (039)

The Pacific Northwest (PNW) is among the top three cranberry-producing regions in the United States and globally. In this region, sphagnum moss (*Sphagnum spp*.) is a major weed in cranberry (*Vaccinium macrocarpon*) production, competing with vines for light, nutrients, and space, and interfering with harvest efficiency. Previous research identified flumioxazin (Group 14) as an effective moss control option; however, its use is limited to the dormant period, leaving growers with few or no effective options for moss management during the crop growing season. A new formulation using encapsulated saflufenacil (Group 14) combined with pyroxasulfone (Group 15) could provide improved crop safety for potential in-season applications; however, limited information is available on crop tolerance and moss control efficacy under cranberry production conditions. This study evaluated crop safety and moss control from tank-mixed saflufenacil + pyroxasulfone in cranberry production. A field experiment was conducted in 2025 in a mature commercial cranberry bog near Bandon, OR. Treatments were applied in spring of 2025 during crop bloom using an experimental chemigation chamber delivering 9,354 l ha^{-1}. Saflufenacil + pyroxasulfone did not cause visible injury to mature cranberry plants across the tested rate range (0.21-0.81 kg ai ha^{-1}). Treatments did not affect yield, which averaged 0.57 kg $plot^{-1}$, or fruit weight, which averaged 1.4 g $fruit^{-1}$. Sphagnum moss control ranged from 40 to 70% through 56 days after treatment (DAT). The highest control levels were observed with saflufenacil at 0.31 kg ai ha^{-1} combined with pyroxasulfone at 0.49 kg ai ha^{-1}. These results indicate that encapsulated saflufenacil + pyroxasulfone provides effective moss suppression while maintaining crop safety and yield, supporting its potential as a new in-season tool for integrated weed and moss management in cranberry production systems.

Efficacy and Residual of Diflufenican in Hazelnut Orchards for Herbicide-Resistant Italian Ryegrass and Annual Bluegrass. Juliano Sulzback[1]*;[1]Oregon State University (040)

Herbicide-resistant Italian ryegrass (*Lolium perenne* ssp. multiflorum) and annual bluegrass (*Poa annua*) are troublesome weeds in hazelnut orchards in Oregon. Often, resistance comes through overreliance of few modes of action. Diflufenican is an underutilized mode of action that could be used as an alternative for weed chemical control. A field-level experiment was conducted in a period of 90 days to evaluate the efficacy and residual activity of diflufenican for managing these species. The entire field was treated with glufosinate at the time of application. Treatments were diflufenican at 250, 500, or 1,000 g ai ha^{-1}; pendimethalin at 4,480 g ai ha^{-1}; a mixture of pendimethalin + diflufenican (250 g ai ha^{-1}); and pyroxasulfone (292 g ai ha^{-1}) + diflufenican (250

g ai ha^{-1}). Weed coverage, Italian ryegrass and annual bluegrass control assessments were performed monthly up to 90 days after treatment (DAT). At 30 DAT, diflufenican and pyroxasulfone mixture had the lowest ground coverage (13%) outperforming all other treatments, a results observed up to 90 DAT (15%). Weed coverage in other treatments were between 24% and 37%. Diflufenican and pyroxasulfone mixture controlled 96% of control for both species, while none of the treatments controlled more than 84% of annual bluegrass or Italian ryegrass. No crop injury was observed with diflufenican. Diflufenican is a safe herbicide to hazelnut and may expand management options for herbicide-resistant grass weeds when mixed with pyroxasulfone.

Residual Activity of Antorix in Hazelnut Orchards for Herbicide-Resistant Italian Ryegrass and Annual Bluegrass. Juliano Sulzback[1]*;[1]Oregon State University (041)

Herbicide-resistant weeds continue to limit effective weed control in Oregon hazelnut orchards. Controlling these weeds is crucial to maintain the quantity and quality of hazelnuts. Additionally, effective weed management before harvest is essential to ensure safe and efficient orchard operations. A field-level study was conducted to evaluate the preemergence efficacy of Antorix, the trade name for trifludimoxazin, a new group 14 herbicide. Treatments were applied in the spring and evaluated for 60 days. Treatments included a nontreated control; glyphosate at 1,260 g ae ha^{-1}; saflufenacil at 50 g ai ha^{-1}; Antorix applied alone and in mixtures with glyphosate (1,260 g ae ha^{-1}) and pyroxasulfone (90 or 180 g ai ha^{-1}); oxyfluorfen at 1,400 g ai ha^{-1}; rimsulfuron at 70 g ai ha^{-1}; orthosulfamuron at 150 g ai ha^{-1}; and tiafenacil at 75 g ai ha^{-1}. Mixtures of Antorix and pyroxasulfone outperformed other treatments at 15 days after treatment (DAT), averaging 88-91% of weed species, while other treatments where 69% control or lower. Weed species control with Antorix plus pyroxasulfone increased to 95% 60 DAT. The lowest ground coverage was observed with Antorix and pyroxasulfone 5.5%, followed by Antorix alone (11.5%). Treatments containing Antorix averaged a total of 2-3 plants m^{-2} at the end of the study, compared to 12 plants m^{-2} on check treatment. These results suggest that Antorix could serve as a valuable option for early-season residual control of herbicide-resistant weeds in hazelnut orchards.

Early Spring Applications of Rimsulfuron Suppress Established Johnsongrass in California Orchards. Ryan Hill[1]*;[1]University of California, Davis (042)

Johnsongrass (*Sorghum halepense*) is a perennial grass weed that is challenging to manage in California orchards where chemical control provides limited options, and non-chemical control is ineffective. Given that johnsongrass has a history of herbicide resistance this situation demands attention. Rimsulfuron is an ALS-inhibitor herbicide that can control johnsongrass seedlings and is labeled for use in most California orchard crops. This research explored use of rimsulfuron to control established johnsongrass populations at an early spring application timing, during johnsongrass emergence from underground rhizomes. This was accomplished through four replicated trials conducted in walnut and prune orchards in Shasta and Tehama County in northern California in spring 2025. Pre-emergent treatments including fluridone (450 g ai ha^{-1}) or oxyfluorfen (1734 g ai ha^{-1}) were applied in early February to control for seedling emergence. Subsequent herbicide treatments including rimsulfuron at 35 or 70 g ai ha^{-1} or glyphosate at 1344 g ae ha^{-1} were applied in early March and watered in by rainfall within 7 days. At 60 days after treatment (DAT) weed coverage was reduced by between 25 and 55% and biomass reductions

ranged between 43 and 67% relative to the glyphosate control. Pre-emergent treatments applied in February had minimal effect on johnsongrass populations. Reductions in weed vigor and coverage from rimsulfuron suggest that this treatment could be a useful tool to integrate into a integrated management plan allowing for eventual weed eradication. The unique application timing also may allow for greater flexibility in season-long management.

Use of PRE and POST Emergent Herbicide Admixtures for Optimizing Long-lasting Weed Control in Pear Orchards. Clebson Gonçalves[1]*;[1]University of California, Cooperative Extension (043)

There is a growing demand for a broad-spectrum herbicide alternative to glyphosate and an adequate tank mixture with other PRE-emergent herbicides to improve efficiency and long-lasting weed control in pear orchard floors. To meet the practitioner's demand, the objective of these studies was to examine different PRE- and POST-emergent herbicide programs and application rates in the field to improve weed management on the pear orchard floor. We compared PRE- and POST-emergent herbicide programs for a broad spectrum of weed control. Two field trials were conducted during the 2025 growing seasons from May to September as randomized complete block designs with an existing stand of mixed grasses and broadleaf weeds. Treatments included PRE-and POST-emergent herbicide programs at different rates. In general, Glyphosate (Roundup PowerMAX®) or Glufosinate (Rely® 280) applied alone or in tank mixtures with indaziflam (Alion®), rimsulfuron (Matrix®), or pendimethalin (Prowl H2O®) at all tested rates were safe for pear trees, with no injury observed. Preliminary results showed that the POST-emergent herbicides Roundup PowerMAX® and Rely® 280 present similar efficacy for controlling a broad spectrum of weeds. However, due to the high soil moisture from weekly irrigation, especially in June and July, when the fruit is increasing in size, and because of the high soil weed seed, most summer weeds will recover within four to six weeks after the initial application of only the POST-emergent herbicide application programs, requiring a sequential application to keep the orchard floors free of weeds during the growing season. The results showed that Roundup PowerMAX® or Rely® 280 tank mixture with the PRE-emergent herbicides Alion®, Matrix®, or Prowl H2O® improved efficiency and long-lasting weed control when compared to Roundup PowerMAX® or Rely® 280 applied alone. The results of two-year studies (2024 and 2025) strongly suggest that PRE- and POST-emergent herbicide programs may improve long-term weed control and reduce the total number of control operations required.

Screening of Herbicide Resistant Weed Species in the Columbian Basin Specialty Crops Production. Sohaib Chattha[1]*, Richardson Bien-Aime[1], Rui Liu[1];[1]Washington State University (044)

A comprehensive, Washington state-wide assessment of weed species kochia (*Kochia scoparia* L.) and common lambsquarters (*Chenopodium album* L.) accessions to a diverse group of herbicide mode of action has not been conducted. Our objective was to evaluate the response of state-wide collection of weed species and accessions to post-emergence (POST) herbicides commonly used in specialty crops production. Preliminary greenhouse house experiments were conducted for multiple accessions of kochia and common lambsquarters collected from Eastern Washington. Post treatments included glufosinate and glyphosate at 1x and 2x label rates. Current

assessment of kochia and common lambsquarters populations did not exhibit survival to 1x and 2x labels rates for glufosinate and glyphosate. Future work involves evaluating state-wide collected multiple weed species and accessions response to a diverse group of POST herbicide mode of action.

Evaluating Flazasulfuron for Weed Management in Hops (*Humulus lupulus*). Greeshmanth Alluri[1]*, Marcelo Moretti[1];[1]Oregon State University (045)

Long-term sustainability of weed management depends on diversity in herbicide modes of action. Currently, no acetolactate synthase (ALS) inhibiting herbicides are registered for use in hops (*Humulus lupulus* L.). Field experiments were conducted in 2025 to evaluate the efficacy and crop safety of flazasulfuron in Oregon hop production. Dormant-season applications of flazasulfuron at 50, 100, and 200 g ai ha^{-1} were compared with a non-treated control and a standard treatment. Crop safety was excellent, with no phytotoxicity observed at 14 or 180 days after initial treatment (DAIT) at any applied rate or timing. Harvest metrics, including hop cone dry weight, hop cone fresh weight, and hop string fresh weight, indicated no negative impact on crop productivity. Statistical analysis (Tukey's HSD, $\alpha = 0.05$) confirmed no significant differences in biomass among treatments. A sequential mid-season application (25 g ai ha^{-1}) was also evaluated to extend weed control. Flazasulfuron effectively controlled annual bluegrass (*Poa annua* L.), dandelion (*Hypochaeris radicata*), hairy bittercress (*Cardamine hirsuta* L.), and Canada thistle (Cirsium arvense (L.) Scop.), reaching 90-100% control by 28 DAIT. High levels of control persisted through 180 DAIT, particularly in treatments receiving the mid-season application. These results demonstrate that flazasulfuron provides consistent, season-long weed control without compromising hop growth, supporting its potential as a safe and effective tool to diversify herbicide modes of action in hop production.

Evaluating Electric Weed Control as a Novel Cover Crop Termination Method for No-till Production. Joshua Spanbauer[1]*, Aaron Becerra-Alvarez[1], Marcelo Moretti[1];[1]Oregon State University (046)

Organic farming is becoming more common; however, limited organic weed management tools are available. The use of cover crops are useful methods of weed management when terminated effectively before planting a crop. The objectives of this research were to measure the efficacy of cover crop termination with electricity, mowing and a combination of the two, and evaluate weed control and snap bean response after different cover crop termination methods in no- till and till seedbeds. A mix of oats at 90 kg ha^{-1} and crimson clover at 45 kg ha^{-1} were planted fall 2024. Termination was conducted for treatments with a flail mower, a Zasso electric weed control applicator (EWC) at 15 MJ ha^{-1}, or both in spring 2025. The treatments were, 1) mowing no-till, 2) mowing tilled, 3) EWC only, no-till, 4) EWC only, tilled, 5) EWC and mower, no-till, and 6) EWC and mower tilled. Weed counts and percent coverage were collected after termination and after bean planting in each plot. Weed and bean biomass was collected 50 days after planting. The cover crop control was at 90% for EWC treatments while mowing alone controlled clover at 60% but oats at 40%. When comparing no-till, treatments 1, 3, and 5, EWC, had 105 g less weed biomass than mowing alone. The tilled plots had 15 g more weed biomass and 50 g less bean biomass when electric was introduced.

Evaluating Pre-emergent Herbicides in Ornamental Nursery Crops. Paige Barden[1]*, Austin Frewert[1], Marcelo Moretti[1];[1]Oregon State University (047)

Ornamental plant production is a major component of Oregon's agricultural economy, generating $1.2 billion annually and ranking as the state's top commodity. Pre-emergent herbicides are widely used in container nursery production to maintain plant quality; however, many ornamental species lack pesticide label approval. Evaluating crop safety is essential to prevent phytotoxic injury and preserve marketability. As part of the USDA-funded IR4 Project, growth responses of *Cercis canadensis*, *Cornus sericea*, *Distylium* sp., *Quercus wislizenii*, *Vaccinium corymbosum*, and *Vitex agnus-castus* were assessed following granular, over-the-top applications of oxyfluorfen (Biathlon), dimethenamid-p and pendimethalin (Freehand G), flumioxazin plus prodiamine (Fuerte), and oxyfluorfen and pendimethalin (OH2) preemergent herbicides at multiple rates. Phytotoxicity, height, and trunk diameter were measured after two applications. Biathlon and OH2 caused no significant injury or growth reductions across species at any tested rate. Freehand G was safe for most species but caused transient, rate-dependent injury at 300 lb/A after the second application. Fuerte resulted in the greatest phytotoxicity, with visible injury at 400 lb/A after the first application and across all rates after the second application. Treatments were applied as a granular formulation over the top of the crops. Overall, Biathlon and OH2 demonstrated strong crop safety across evaluated species, while Freehand G and Fuerte require rate consideration depending on species sensitivity. These results support herbicide label recommendations and safe weed management in ornamental production.

Effect of Compost and Herbicides on Survival of Non-irrigated Transplants of *Corylus americana*. Stuart Turner[1]*;[1]Turner & Co., Inc. (048)

Poster withdrawn

WSWS Project 3. Weeds of Agronomic Crops

Efficacy of Pendimethalin Tank-mixtures Applied at 3-Leaf vs. 5-Leaf Rice Stage Managed with Leather's Method. Saul Estrada[1]*, Abel Bernal[1], Kassim Al-Khatib[1];[1]University of California, Davis (001)

Pendimethalin is a group 3 microtubule inhibitor herbicide with pre-emergent control of watergrass species (*Echinochloa* spp.) and bearded sprangletop [*Leptochloa fusca* (L.) Kunth] which is primarily utilized in drill-seeded rice, but is not widely used in water-seeded rice due to concerns of high crop injury. The leather's method is a water management technique in water-seeded rice where fields are completely drained after sowing and reflooded after the rice roots are well anchored in the soil which should reduce the probability root stunting after a pendimethalin application. Therefore, the premise of this study is to tank-mix pendimethalin with various rice post emergent herbicides to control pre-emerged and established weeds and compare the weed control efficacy and crop safety of pendimethalin tank-mixtures applied at 3-leaf stage rice versus 5-leaf stage rice when managed with Leather's Method.

Emergence and Control of White Water Fire in California Rice. Robinson Johnson[1]*, Deniz Inci[1], Kassim Al-Khatib[1];[1]UC Davis (002)

Bergia capensis L., commonly known as white water fire, is an annual broadleaf weed recently introduced to California. First identified by the Butte County Agricultural Commissioner's office in September 2023 within an organic rice field, this discovery marks the first confirmed report of the species in the United States. Its presence presents a significant concern due to it being a known competitor in international rice systems. In the field, white water fire appears morphologically similar to redstem (*Ammannia* L.), one of the more prevalent broadleaf weeds in California rice production, making it difficult to identify and leading to potential misidentification and mismanagement. This study sought to identify key morphological differences between white water fire and redstem. White water fire has some key distinguishing features, having broader, thicker, ovate leaves and white flowers with a rounder stem that has a distinct pinwheel aerenchyma, whereas redstem has narrower, thinner, linear leaves that are auriculate, sitting around a red, square stem, and typically exhibiting violet flowers. This study evaluated the efficacy of six herbicides commonly used in rice production (Loyant CA, Grandstand CA, Regiment CA EZ, Cliffhanger SC, RebelEX CA, and SuperWham! CA) as well as copper sulfate, a commonly used algaecide. Loyant and Grandstand provided 100% control of both redstem and white water fire, and copper sulfate gave over 50% control of white water fire. These findings provided essential information on the morphological characteristics and chemical control of white water fire, allowing for a rapid response to the emerging weed species.

†Evaluating Precision Herbicide Application Strategies During Summer Fallow in the Northern Great Plains. Devanshi Het Desai[1]*, Het Samir Desai[1], Paul Nugent[1], Lovreet Shergill[2], Timothy Seipel[1];[1]Montana State University, [2]Colorado State University (003)

Weed management in summer fallow is crucial to prevent seedbank replenishment and conserve moisture in the Northern Great Plains. To manage weeds, broadcast applications are used regardless of weed abundance, leading to excessive herbicide use. Sensor-based precision application technologies have the potential to reduce herbicide use and maintain sufficient efficacy. We developed a customized dual-boom system integrating conventional broadcast and WeedSeeker® booms to test herbicide application strategies. We conducted a field study in a randomized complete block design with four replications and ten treatments during 2024 and 2025. The treatment combinations included three application methods: (1) broadcast, (2) WeedSeeker® spot-spraying, and (3) a dual boom system with broadcast at a reduced rate (0.33×label dose) and WeedSeeker® spot-spraying at full rate. Herbicides were applied two times, first with Glyphosate+dicamba and second with glyphosate+carfentrazone. An additional dual-boom treatment [Broadcast (0.30 × label dose) and WeedSeeker® (0.70 × label dose), henceforth, reduced dual-boom] was included in the second year. Weed species and abundance varied between years. In 2024, WeedSeeker® resulted in biomass accumulation (1-2 g m^{-2}) comparable to broadcast while reducing herbicide use by 25%. In 2025, the reduced dual-boom resulted in 3 g m^{-2} of biomass accumulation and used 38% less herbicide than broadcast. WeedSeeker® treatment failed to manage late-emerging species in 2025, resulting in greater biomass accumulation (650 g m^{-2}). Contingent upon the species richness and abundance, our findings demonstrate that

application methods such as WeedSeeker® and reduced dual-boom could improve herbicide use efficiency while effectively managing weeds in summer fallow.

Assessing PPO Inhibitor Resistance in Kochia (*Bassia scoparia*) Across Small Grain Systems in the Great Plains. Curtis Lefler[1]*, Todd Gaines[1], Akamjot Brar[1], Daniel Guimaraes Abe[2], Caleb Dalley[2], Devanshi Het Desai[3], Patrick Geier[4], Brian Jenks[2], Jeremie Kouame[4], Jeanne Falk Jones[4], Timothy Seipel[3], Lovreet Shergill[1];[1]Colorado State University, [2]North Dakota State University, [3]Montana State University, [4]Kansas State University (004)

Kochia (*Bassia scoparia*) is a troublesome weed species throughout the Great Plains region of North America that reduces crop yields and land-use value. Previous surveys have documented resistance to acetolactate synthase (ALS)-inhibiting herbicides and enolpyruvyl-shikimate-phosphate-synthase (EPSPS) inhibitor glyphosate, increasing reliance on other herbicide modes of action such as protoporphyrinogen oxidase (PPO)-inhibitors for control. This study evaluated the frequency of resistance to PPO inhibiting herbicides in kochia populations. In total, 95 kochia populations collected from Colorado (CO), Kansas (KS), Montana (MT), and North Dakota (ND) were screened with saflufenacil at 50 g ha^{-1}. Populations (2 per state) with greatest survival to saflufenacil were screened with flumioxazin, oxyfluorfen, carfentrazone, and pyraflufen (70 g, 1,681 g, 17.5 g, and 3.6 g ae ha^{-1}) to evaluate cross-resistance among PPO inhibitors. Of the 95 populations screened with saflufenacil, 61.5%, 70.83%, 42.85%, and 66.66% of populations from CO, KS, MT, and ND were resistant (> 20% survival). Of the 8 populations selected for additional screening, 100% of populations from MT and ND were rated as resistant to flumioxazin, carfentrazone, and pyraflufen. Of the four populations from CO and KS, 50% (one from each state) were categorized as resistant to flumioxazin and carfentrazone while only one population from CO was rated as resistant pyraflufen. All eight populations were susceptible to oxyfluorfen. Future work will focus on using molecular and greenhouse assays to validate current findings and characterize suspected resistant populations of kochia.

Post-emergence Indaziflam Controls Weeds in Wheat Across Multiple Seasons. Peter Weston Maughan[1]*, Marija Savic[1], Jessica Kalin[1], Ian Burke[2];[1]Washington State University, [2]North Carolina State University (005)

Bromus tectorum is a problematic winter annual grass in dryland wheat production systems of the inland Pacific Northwest, where early-season growth depletes soil moisture and nutrients and reduces crop competitiveness. Indaziflam, a soil-active herbicide with low mobility and long persistence, may provide extended control in winter wheat-fallow rotations. Two randomized complete block studies were conducted near Davenport and Ritzville, WA, from 2021 to 2023 following a winter wheat-fallow-winter wheat sequence. Postemergence indaziflam was applied to winter wheat in spring 2021 at 0, 22.5, or 45 g ai ha^{-1}, followed by preemergence pyroxsulfone to subplots at 0 or 120 g ai ha^{-1} in fall 2022. Bromus tectorum control was evaluated in May 2023 and wheat yield at harvest. Wheat yield was not affected by treatment in either study (all $p > 0.05$). Indaziflam applied alone provided variable control. In Study 1, control increased from 18±18% in the nontreated to 80±17% at 45 g ai ha^{-1}, whereas the 22.5 g ai ha^{-1} rate did not improve control (23±15%). In Study 2, control increased from 15±15% in the nontreated to 68±23% and 60±18% at 22.5 and 45 g ai ha^{-1}, respectively. Across both studies, combining indaziflam with pyroxsulfone

resulted in consistently high control (>70% at 22.5 g ai ha^{-1} and >90% at 45 g ai ha^{-1}) with low variability. These results indicate that indaziflam persistence across fallow can contribute to B. tectorum control, particularly when integrated with other herbicides, although improved weed control did not translate to short-term yield gains.

Assessing the Impact of Red Clover (*Trifolium pratense*) Weed Suppression in Utah Small Grain Production. Olanrewaju Adeyemi[1]*, Eric Westra[1], Corey Ransom[1], Earl Creech[1], Mirella Ortiz[1];[1]Utah State University (006)

Barley (*Hordeum vulgare*) is an important rotational crop in the western U.S. due to its relatively low water and nutrient requirements; however, increasing herbicide resistance and water scarcity threaten the sustainability of small grain production systems. Interseeding red clover (*Trifolium pratense*) into barley may provide an integrated weed management strategy by suppressing weeds through competition while improving soil fertility and water use efficiency. This study evaluates the effects of red clover seeding density and termination timing on weed suppression and soil nutrient dynamics in Utah barley systems. Field experiments are being conducted across three sites in northern Utah under irrigated and dryland conditions. Before treatment establishment, preplant soil samples were collected at each site to characterize baseline fertility, with soil nitrate-N concentrations ranging from approximately 7 to 7.9 kg N ha^{-1} across locations. Treatments include red clover interseeded at 4.5, 9.0, and 13.5 kg ha^{-1} (representing 50%, 100%, and 150% of the recommended seeding rate), combined with multiple termination timings and methods. Clover termination timing evaluations began in fall 2025, with the first fall termination conducted in October. Preliminary visual observations indicate distinct visual differences in weed suppression among seeding densities, with high-density clover stands exhibiting greater competitive ability than medium or low densities. We also anticipate higher soil nutrient concentrations, particularly nitrogen, in high-density clover treatments due to greater belowground biomass and nitrogen fixation. Results from this study will inform best management practices for utilizing red clover for enhanced weed suppression and soil fertility in small grain production systems.

Evaluating Wheat Variety, Planting Time, and Herbicide Intensity's Influence on Weed Control in Winter Wheat. Claire Roche[1]*, Desiree McGriff[1], Liberty Galvin[1], Connor Cox[1], Amanda De Oliveira Silva[1];[1]Oklahoma State University (007)

Cultural weed control practices introduce integrated weed management (IWM) opportunities for multi-generational wheat producers navigating herbicide resistance in weedy grasses. Oklahoma State University has released 37 varieties of wheat since 2000; however, variety selection is not well studied within an IWM system. The basis of this project is to provide a comparison of IWM systems to one another by evaluating the interaction of variety selection, combinations of fall and spring chemical weed control, and planting timing. Three Oklahoma State University wheat varieties Orange Blossom (a ClearField+ technology/ tolerant to Beyond® herbicide) Smith's Gold (tall stature, early maturing) , and Butler's Gold (late maturing, moderate stature) were planted at Oklahoma State University Field and Research Service Units representing southern growing conditions (hot, dry), central (intermediate), and northern (cooler, wetter) Oklahoma. Wheat was planted at a conventional timing (mid-October) and a delayed timing (mid-November) at all three locations. Field experiments were organized as a split-plot design with variety being

the main plot and seven systems randomized within as subplots. Major weeds observed included *Aegilops cylindrica*, *Bromus tectorum* (northern location), *Lolium perenne* multiflorum (central location), *Sorghum halepense*, *Bromus secalinus* (southern location), *Lamium amplexicaule* (all locations). Delayed planting had considerably greater weed control ($p < 0.0001$) over all species observed compared with conventional planting timing regardless of all varieties and sites. This study is ongoing with the next phase being spring weed control to finalize all system treatments.

Competitive Enhancement of Winter Wheat Using Seed Treatment Under Annual Ryegrass (*Lolium multiflorum*) Infestation. Sushmita Dey[1]*, Brad Lindenmayer[2], Liberty Galvin[1];[1]Oklahoma State University, [2]Syngenta Crop Protection (008)

Italian ryegrass (*Lolium perenne* ssp. multiflorum) is a major factor limiting winter wheat production, especially with limited herbicide usage and resistance on the rise. Seed treatments may initiate competitive growth which establishes better weed control during critical early growth periods. The research evaluated how winter wheat seed treated with CruiserMaxx® Vibrance® Elite® competed against untreated wheat in different infestation scenarios of Italian ryegrass. In a greenhouse experiment, an additive design was used with a constant wheat density of ≈ 215 seeds/m²and the Italian ryegrass density varying to represent 0, 25%, 50%, and100% infestation levels. Four replications were done. The emergence of wheat and Italian ryegrass was recorded daily for 28 days after planting. The height of the plants was measured weekly. Harvesting was completed at 28 days after planting and included separating roots and shoots from five plants within each replication. The fresh weights were recorded, and then plants were dried to measure dry biomass. At the 25% infestation level, Italian ryegrass emergence was significantly less with treated wheat than untreated wheat ($p = 0.0037$). Using R statistical software and the stats package, we found no difference in wheat emergence whether treated or not. Across infestation levels, the height of treated plants was taller than that of untreated plants, and wheat was taller than Italian ryegrass at all densities regardless of the seed treatment Seed treatment may be a tool to improve early-season wheat competitiveness and subsequently assist in the suppressing of Italian ryegrass during the early period of crop establishment.

Herbicide Resistance Screening of Wild Oat (*Avena fatua*) Collected from Small Grain Production System. Sushmita Sharma Koirala[1]*, Chandra Montgomery[1], Traci Rauch[1], Joan Campbell[1], Albert Adjesiwor[1];[1]University of Idaho (009)

Wild oat (*Avena fatua*) is one of the most problematic weeds in small grains production system due to its competitiveness and resistance to commonly used herbicides. In Idaho, repeated reliance on limited number of herbicides has increased the risk of herbicide resistance in wild oat populations. This study aimed to screen for wild oat survival frequency to commonly used pre- and post-emergence herbicides in small grains production systems. A total of 87 populations were collected from growers' fields and screened under greenhouse conditions at labeled field-use rates. High survival was observed for Acetyl-CoA carboxylase (ACCase) and acetolactate synthase (ALS) inhibiting herbicides. Among the populations screened in greenhouse, 100% survived fluroxypyr + pyroxsulam (114 g ai/ha), while 73% survived quizalofop-p-ethyl (92 gai/ha). This was followed by mesosulfuron-methyl (15 g ai/ha) (59%), fenoxaprop-ethyl (93 gai/ha) (57%), pinoxaden (60 g ai/ha) (56%), and imazamox (26 g ai/ha) (44.3%). Among soil applied herbicide,

9% survived ethalfluralin (841 g ai/ha) while 15% survived triallate (560 g ai/ha). There was 0% survival to glyphosate (1262 g ai/ha) and clethodim (280 g ai/ha). Wild oat collected from Bonneville County and Madison County showed highest survival frequencies. In these locations several populations survived up to eight out of the ten tested herbicides. This finding focuses on the need for integrated weed management practices to slow down resistance development and spread in wild oat.

Statewide Assessment of Herbicide Resistance in Rye Brome (*Bromus secalinus*) in Oklahoma Wheat Systems. Ty Shreve[1]*, Amna Dar[1], Connor Cox[1], Liberty Galvin[1];[1]Oklahoma State University (010)

Rye brome (*Bromus secalinus*) is one of the most troublesome weeds in winter wheat production in Oklahoma. Limited availability of new herbicide sites of action, combined with heavy reliance on chemical control, increases the risk of selecting herbicide-resistant populations; however, resistance documentation for rye brome in Oklahoma remains limited. To assess the occurrence and distribution of resistant rye brome biotypes, a systematic statewide survey was conducted across 24 counties within active winter wheat fields. In each field, seeds from 15-20 mature plants were collected and pooled to represent a single population. Uniform second-generation progeny was grown under greenhouse conditions and screened using discriminating doses equivalent to two times the labeled field rates of glyphosate (Group 9), imazamox (Group 2), and quizalofop (Group 1). Herbicide treatments were applied individually, and plant injury was visually evaluated at 21 days after treatment (DAT). A laboratory-confirmed susceptible standard (complete plant death at the discriminating dose) was included to validate herbicide efficacy. A total of 40 unique rye brome populations were screened. Resistance was most frequently observed to Group 2 (39% of populations), followed by Group 9 (17%), while Group 1 resistance was rare (2%). Cross-resistance to two or more herbicide groups was detected in populations from 7 of the 24 counties surveyed, indicating the emergence of multiple resistance within Oklahoma wheat-producing regions. These findings highlight the need for diversified Integrated Pest Management (IPM) strategies including rotating effective sites of action, integrating non-chemical tactics, and reducing selection pressure to slow further resistance evolution and spread in rye brome.

Buckwheat Tolerance to Combinations of Isoxaflutole and Pyroxasulfone. Caleb Dalley[1], Daniel Guimaraes Abe[1]*;[1]North Dakota State University (011)

Buckwheat (*Fagopyrum esculentum* Moench) is a warm-season broadleaf pseudocereal crop commonly grown in the U.S. as cover crop because of its rapid establishment, dense canopy, and ability to suppress weeds. While buckwheat is a minor seed crop, North Dakota ranks first in grain production. Expansion of this crop may be limited by lack of registered preemergence herbicides for weed control. Field experiments were conducted near Hettinger, ND, in 2024 and 2025 to evaluate buckwheat tolerance to isoxaflutole (140, 280 and 420 g ai ha^{-1}) and pyroxasulfone (175 and 350 g ai ha^{-1}) applied alone and in combination. Experiments were arranged in a randomized complete block design with four replications. ‘Koto’ buckwheat was seeded mid-June and herbicide treatments were applied using a tractor-mounted sprayer soon after planting. Evaluations included visual crop injury at 2 and 4 weeks after treatments (WAT), stand establishment, plant height, and grain yield. Data were analyzed using the R statistical package; means were separated

using Fisher's protected LSD. Visual injury increased as herbicide rate increased for both herbicides; however, injury remained below 15% at 4 WAT. Stand establishment, buckwheat height, and grain yield were not affected by herbicide treatment in either year. Results indicated that buckwheat has tolerance to both isoxaflutole and pyroxasulfone whether applied alone or in combination. Only minor and temporary injury was observed and there were no negative effects on stand establishment, buckwheat growth, or yield. If registered, these herbicides would provide additional options for weed management in buckwheat production allowing for expansion of area planted to this crop.

Strategies to Maximize Seed Retention in Winter Wheat for Harvest Weed Seed Control. Lovreet Shergill[1]*, Akamjot Brar[1], Todd Gaines[1], Franck Dayan[1];[1]Colorado State University (012)

Bromus tectorum L. (cheatgrass) is a winter annual grass that substantially reduces winter wheat yield and grain quality in semiarid production systems in the western United States. The increasing incidence of herbicide resistance necessitates the integration of non-chemical tactics, such as Harvest Weed Seed Control (HWSC), which reduces seed bank inputs by targeting weed seeds retained above the crop cutting height at harvest. Because HWSC efficacy depends on adequate seed retention, this study evaluated the influence of cultural practices and a residual pre-emergence (PRE) herbicide on *B. tectorum* biomass, seed production, and seed retention in winter wheat. Field experiments were conducted ARDEC, Fort Collins, Colorado, using a split-plot design with four replications per treatment. Treatments included two planting dates (early and late), two wheat seeding rates (half and full), and two pre-emergent (PRE) herbicide programs (pyroxasulfone vs. no PRE). Weed biomass, seed retention above the harvest height, and wheat grain yield were quantified, and the data were analyzed using analysis of variance and correlation procedures. *Bromus tectorum* biomass was positively associated with total seed production and the proportion of seeds retained at harvest. Larger plants retained a greater fraction of seeds above the cutting height, increasing their suitability for HWSC. Late planting and reduced seeding rates increased weed biomass and seed retention but resulted in substantial wheat yield reductions. In contrast, early planting combined with a full seeding rate and PRE herbicide application maximized in-season suppression and preserved the yield, although surviving plants exhibited lower seed retention. These findings demonstrate a biological trade-off between aggressive in-season suppression and HWSC effectiveness. An integrated approach that prioritizes competitive crop management and residual herbicides to protect yield, followed by HWSC to capture surviving high-retention individuals, provides a practical and sustainable strategy for long-term *B. tectorum* seed bank management in winter wheat systems.

Assessing Herbicide Resistance in Cheatgrass (*Bromus tectorum*) to Amino Acid Synthesis Inhibitors and ACCase Inhibitors. Damian Stoy[1]*, Timothy Seipel[1], Devanshi Het Desai[1];[1]Montana State University (013)

Herbicide-resistant biotypes of cheatgrass (*Bromus tectorum*) are an increasing concern in Montana dryland cropping systems. Management relies heavily on acetolactate synthase (ALS; Group 2)- and 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS; Group 9)-inhibiting herbicides. Increasing resistance to ALS-inhibiting herbicides has led to greater reliance on acetyl-

CoA carboxylase (ACCase; Group 1) inhibitors. Producer reports of reduced herbicide efficacy raised concerns regarding the presence of herbicide resistant cheatgrass populations in Montana. To evaluate herbicide resistance in cheatgrass, we screened seven populations collected across Montana under greenhouse conditions with POST herbicides. Herbicide treatments included clethodim (210 g ai ha^{-1}), glyphosate (840 g ae ha^{-1}), imazamox (44 g ai ha^{-1}), mesosulfuron (15 g ai ha^{-1}), propoxycarbazone (37 g ai ha^{-1}), and quizalofop (84 g ai ha^{-1}). Visual injury was assessed 21 days after treatment (DAT). Of the seven populations screened, two were resistant to glyphosate, four to imazamox, five to mesosulfuron, and four to propoxycarbazone. No resistance was detected to clethodim or quizalofop. These results provide evidence of multiple herbicide resistance in Montana cheatgrass populations and are the first report of glyphosate-resistant Bromus tectorum in Montana.

Effects of Soil pH and Rainfall Activation Timing on the Efficacy of Early Post-Emergent Herbicides Oklahoma Winter Wheat. Connor Cox[1]*, Liberty Galvin1;[1]Oklahoma State University (014)

Herbicide-resistant grass weeds in winter wheat (*Triticum aestivum* L.) production systems have diminished the effectiveness of postemergence herbicide programs, intensifying selection pressure on a limited number of active ingredients. Early postemergence (EPOST), soil-applied herbicides offer an opportunity to diversify modes of action and strengthen early-season weed suppression; however, inconsistent performance driven by soil pH and rainfall activation has constrained broader adoption. This poster examines the interactive effects of soil pH and rainfall timing on EPOST herbicide efficacy under field conditions. Field experiments were conducted at three locations characterized by acidic (pH 4.8), slightly acidic (pH 6.2), and neutral (pH 7.0) soils. Treatments were arranged in a split-plot design with soil pH as a whole-plot factor and rainfall activation timing (0, 2, 7, and 14 days after application) as the subplot factor. Early postemergence (EPOST), soil-applied herbicide programs included chlorsulfuron + metsulfuron-methyl, saflufenacil + pyroxasulfone, and pyroxasulfone + carfentrazone. Simulated rainfall (1.27 cm) was applied at crop emergence to activate treatments. Weed control was visually evaluated at 2, 7, 14, 21, and 28 days after rainfall activation and analyzed using mixed-effects models (α = 0.05).Chlorsulfuron + metsulfuron-methyl provided the greatest residual weed control across soil pH levels and rainfall activation timings, followed by saflufenacil + pyroxasulfone, whereas pyroxasulfone + carfentrazone consistently resulted in the lowest control. Delayed rainfall reduced herbicide efficacy, particularly under acidic soil conditions, indicating a significant interaction between soil chemistry and rainfall-driven activation.These findings emphasize the importance of soil-informed and rainfall-aware herbicide selection and support the inclusion of EPOST herbicides as a strategic component of integrated resistance management programs in winter wheat.

Screening Oklahoma Italian Ryegrass (*Lolium perenne* ssp. *multiflorum*) Populations for Resistance to Key Postemergence Herbicides and Dose Response Characterization. Amna Dar[1]*, Liberty Galvin[1], Ty Shreve[1];[1]Oklahoma State University (015)

Abstract not available

Dry Edible Bean Response to Metamitron Soil Residue. Jenna Meeks[1]*, Nevin Lawrence[2], Andrew Kniss[1];[1]University of Wyoming, [2]University of Nebraska (016)

Metamitron provides preemergence control of several important weed species in sugarbeet. If a sugarbeet crop fails due to environment or pest pressure early in the season, producers often plant dry edible beans. Dry edible bean response to metamitron soil residues applied at sugarbeet planting is unknown. Studies were conducted near Lingle, WY and Scottsbluff, NE to evaluate dry edible bean response to soil residues of metamitron herbicide. In one study, metamitron + ethofumesate was applied at two rates in April and May, and dry beans were planted in late May and early June. Metamitron rates were 2.92 lbs/acre (recommended field use rate) and 5.84 lbs/acre (2X use rate), and ethofumesate rates were 1.25 and 2.5 lbs/acre for the 1X and 2X rates, respectively. When planted 27 d after herbicide application, dry bean stand and yield were not affected by any rate of metamitron + ethofumesate. At Scottsbluff, there was no effect on dry bean stand when planted 13 d after metamitron + ethofumesate even at the 2X rate. No yield data was collected from Scottsbluff due to a hailstorm. A second study at Lingle, WY applied metamitron with and without ethofumesate 7 d before planting at 2x, 1x, 0.5x, 0.25x field use rates. Metamitron did not cause dry bean stand loss at any rate. The herbicide rate causing 5% dry bean stand loss was estimated to be approximately 1.7 lbs/A of metamitron, and 0.16 lbs/acre of ethofumesate. Given the reported soil half-life of metamitron, it is unlikely that metamitron will cause significant injury to dry edible beans if planted more than 27 d after application. Injury from ethofumesate is more likely in a replanting scenario.

Evaluation of Acifluorfen and Lactofen in Dry Edible Bean. Nevin Lawrence[1]*;[1]University of Nebraska (017)

Palmer amaranth can severely reduce dry bean yield if not controlled. In Nebraska, there are no labeled POST herbicides to control HR Palmer amaranth in dry bean. Acifluorfen and lactofen are two soybean herbicides that may control Palmer amaranth in dry bean. In 2023, all herbicides were applied at V3. Only pinto beans were treated in the single efficacy trial. In two crop tolerance trials, one pinto, great northern, light red kidney, yellow, and pink bean variety were treated. In 2024, the single efficacy trial, herbicides were applied when Palmer amaranth was 1.27 cm in height, and again 7, 14, 21, and 28 days later. One crop tolerance trial was conducted where one pinto, great northern, and light red kidney variety were screened for herbicide tolerance at V1 and V3. In 2025 the single efficacy trial, herbicides were applied when Palmer amaranth was 1.27 cm in height, and again 3, 7, 14, and 21 days later. One crop tolerance trial was conducted where pinto varieties SV6139, Bronco, Cowboy, and Rattler were screened for tolerance at V1, at two different rates. In 2023, applying herbicides at V3 to control Palmer was too late for efficacious weed control. Lactofen reduced pinto yield by 420 kg ha^{-1}. In 2024, acifluorfen and lactofen provided similar control. No herbicides impacted yield when applied at V3. Lactofen and acifluorfen reduced great northern yield, and acifluorfen reduced light red kidney yield at V1. In 2025, lactofen provided better control than acifluorfen. Herbicide did not impact yield.

Characterization of Multiple Resistance in Italian Ryegrass (*Lolium multiflorum* Lam) from a White Clover Field. Victor Ribeiro[1], Ethan Frager[1]*, Carol Mallory-Smith[1], Pete Berry[1], Joseph Gallagher[2];[1]Oregon State University, [2]USDA - ARS - Forage Seed and Cereal Research Unit (018)

Italian ryegrass (*Lolium multiflorum* Lam.) is a troublesome weed in agricultural production systems in Oregon. In 2024, a grower reported a lack of Italian ryegrass control with clethodim in a white clover (*Trifolium repens* L.) field. The objectives of this study were to (1) determine whether this population was resistant to acetyl-coenzyme A carboxylase (ACCase)- and acetolactate synthase (ALS)-inhibiting herbicides and glyphosate, and (2) identify the resistance mechanism(s). Greenhouse experiments were conducted twice at Oregon State University, Corvallis, Oregon, using a randomized complete block design with four replications. Herbicide rates (g ai ha^{-1} or g ae ha^{-1}) ranging from 0 to 2X were tested for clethodim (X = 136), quizalofop (X = 92), pinoxaden (X = 60), imazamox (X = 35), mesosulfuron (X = 15), pyroxsulam (X = 18), and glyphosate (X = 1681), where X is the field recommended rate. Italian ryegrass plants were visually assessed as dead or alive 21 days after treatment. Target-site resistance mechanisms were investigated using polymerase chain reaction to detect known mutations in the ACCase and ALS genes. Population OR13 population was resistant to all ACCase- and ALS-inhibiting herbicides, with ≥91% survival at the 1X rate and ≥78% survival at the 2X rate but were susceptible to glyphosate. ACCase gene sequencing revealed target-site mutations, including Asp2078Gly (GAT-GGT) in three individuals and Cys2088Arg (TGC-CGC) in one individual. Work to sequence the ALS gene is ongoing. Cross- and multiple-resistance to ACCase and ALS inhibitors complicate Italian ryegrass management in white clover and rotational crops.

Performance of Halauxifen + Diclosulam on *Conyza* spp. from Post-emergence Efficacy to Pre-emergence Persistence Under Different Water Conditions. Joao Massaro[1]*, Pedro Antônio Vougoudo Salmazo[1], Elias da Silva Medeiros[2], Mirella Ortiz[3], Eric Westra[3], Paulo Da Silva[1];[1]University of São Paulo, [2]University of Grande Dourados, [3]Utah State University (019)

Climate change scenarios often result in water distribution and variable soil moisture. Therefore, early management of *Conyza* spp., requires specific control stages, such as the combination of postemergent and preemergent herbicides systemics. This study evaluated the efficacy of halauxifen + diclosulam for Conyza spp. control at different application times before soybean sowing and analyzed the dissipation of diclosulam in the soil. Applications of halauxifen + diclosulam (5.06 + 25.52 g ai ha^{-1}) were performed at 60, 45, 30, 15, and 0 days before soybean sowing (DBS) on *Conyza* spp. plants ranging from 0 to 25 cm in height, followed by sequential application of glufosinate ammonium salt (500 g ai ha^{-1}). Control efficacy was reduced only in plants 20-25 cm tall at 60 DBS, period to associated with greater water restriction after application. The highest initial diclosulam concentration (21.17 g ai ha^{-1}) was detected at 0 DBS, under 58 mm and −34 kPa. The control of *Conyza* spp. germination flows was effective with diclosulan, demonstrating not influenced of rain and soil matric potential. Water restrictions and lower soil matric potential have made the control of *Conyza* spp. slower. To avoid soybean phytotoxicity, application on the day of sowing is not recommended.

Benghal Dayflower (*Commelina benghalensis*) Control Using Florpyrauxifen-Benzyl and Subsequent Soybean Plant-back Interval. Hugo Augusto Pereira Zanatta[1]*, José Thiago Battaglin Souza[2], Pedro Antônio Vougoudo Salmazo[1], Mirella Ortiz[3], Eric Westra[3], Paulo Da Silva[1];[1] University of São Paulo, [2]University of Grande Dourados, [3]Utah State University (020)

Benghal dayflower (*Commelina benghalensis* L.) has shown an increase in infestation in pre-sowing soybean areas in Brazil. Since florpyrauxifen-benzyl has emerged as a viable control option, but requires evaluation of its agronomic efficacy and environmental dynamics, this study aimed to assess its effectiveness at different intervals before sowing and its dissipation, considering product carryover. Field and laboratory experiments were conducted using a randomized complete block design. Florpyrauxifen-benzyl was applied 60, 45, 30, 15, and 0 days before soybean sowing, followed by a sequential application of ammonium glufosinate 15 days later. Control of C. benghalensis was assessed through visual ratings, membrane damage, chlorophyll fluorescence (including electron transport), green-pixel quantification, and antioxidant enzyme activity. Residual concentrations were determined by HPLC with a diode-array detector at 0, 3, 5, 7, 14, 21, and 28 days after application. Regardless of application timing, control was excellent at 28 days after application, exceeding 96%, while green pixels progressively declined to below 8%. The 0-day interval coincided with greater soil water restriction (lower matric potential), reduced electron transport, and increased superoxide dismutase activity, indicating higher physiological stress. Herbicide dissipation varied with weed ground cover and edaphoclimatic conditions: higher C. benghalensis cover was associated with greater dissipation, whereas lower cover resulted in higher initial herbicide concentration and soybean phytotoxicity of 13-14% at 7-14 days after crop emergence. In summary, florpyrauxifen-benzyl is a strong option for Benghal dayflower control, but plant-back safety depends on dissipation conditions; in this study, a 15-day interval before sowing was required.

Epyrifenacil (Rapidicil®) Tank-mixtures for Cover Crop Termination (Cereal Rye and Wheat) in No-till Soybean and Corn Production. Garrison Gundy[1]*, Pat Clay[1], Nathan Drewitz[1], Chris Meador[1], Andrew Rodstrom[1], Matt Griffin[1], Sam Noe[1];[1]Valent U.S.A. (021)

Cover crops such as cereal rye (*Secale cereale* L.) and winter wheat (*Triticum aestivum* L.) are becoming an increasingly important component of no-till programs that improve soil health and suppress weeds. Current termination strategies include glyphosate +/- 2,4-D, where glyphosate can take more than 21 days to terminate a cover crop when environmental conditions are not ideal. Greater termination time and/or incomplete termination can cause planting issues and increase competition with the impending cash crop. Rapidicil® (epyrifenacil) is a novel, fast-acting PPO-inhibitor under development by Valent U.S.A. LLC for burndown use in corn, soybean and wheat. Rapidicil is pending EPA registration and not available for sale. Across the United States, research trials were conducted from 2022 through 2025 to assess speed and completeness of cereal rye and winter wheat cover crop termination of Rapidicil and glyphosate tank-mixes with and without residual herbicides. Treatments included glyphosate + 2,4-D, Rapidicil (20 g ai ha^{-1})+ glyphosate, Rapidicil (20 g ai ha^{-1})+ glyphosate + flumioxazin, V-10488 (200 g ai ha^{-1}) + glyphosate, and saflufenacil (25 g ai ha^{-1}) + glyphosate. Across all locations, Rapidicil + glyphosate combinations resulted in greater termination of wheat (93%) at 7 days after treatment (DAT) compared with glyphosate + 2,4-D (56%) and saflufenacil + glyphosate (75%). Cereal rye termination at 7 DAT with Rapidicil + glyphosate combinations resulting in 89% control compared with glyphosate + 2,4-D (61%) and saflufenacil + glyphosate (66%). These data suggest tank-mixing Rapidicil containing products with glyphosate to terminate cereal rye and winter wheat cover crops can

increase speed of termination and reduce potential interference in corn and soybean production in no-till systems.

Residual Efficacy of HPPD-Inhibiting Herbicides for Broadleaf Weed Management. Jessica Kalin[1]*, Ian Burke[2];1Washington State University, [2]North Carolina State University (022)

Herbicides with residual activity, such as 4-hydroxyphenylpyruvate dioxygenase (HPPD)-inhibitors may provide long-term weed control and are ideal for fall-planted crops, however their residual activity can vary. This field study examined the residual control of three HPPD-inhibiting herbicides bicyclopyrone (282 g ai ha^{-1}), pyrasulfotole (270 g ai ha^{-1}), and tolpyralate (220 g ai ha^{-1}) applied in the fall and the spring at two locations in eastern Washington. Plots were divided into five sublots: one with the main herbicide treatment alone, and four that were treated with glyphosate (1120 g ai ha^{-1}) 14, 28, 42, and 56 days after main herbicide treatments. Weed density and biomass were assessed by weed species at 30 days after the last glyphosate application. There was a three-way interaction between application timing, herbicide applied, and weed species ($p < 0.05$), though spring applications generally provided better residual weed control than fall applications at both locations, regardless of herbicide or weed species ($p < 0.001$). Findings indicate that preemergence applications do not provide sufficient control alone; incorporating other active ingredients will be necessary to achieve grass control and postemergence herbicide applications may still be necessary for dicot species examined in these experiments.

Are there any Sugarbeet-safe Herbicide Options for Pre-plant Control of Glyphosate-resistant Kochia (*Bassia scoparia*). Ian Waldecker[1]*, Jenna Meeks[1], Andrew Kniss[1];[1]University of Wyoming (023)

There are currently no effective herbicides labeled to control glyphosate-resistant kochia (*Bassia scoparia*) in sugarbeet. To improve kochia control it may be beneficial to apply a burndown herbicide in combination with residual herbicides for preemergence kochia control. However, many herbicides that have acceptable kochia efficacy lack crop safety. To evaluate the crop safety of several common burndown and residual herbicides, a two-factorial field study was established near Lingle, Wyoming in 2025. Herbicides evaluated included carfentrazone-ethyl, clomazone, diflufenican, fluroxypyr, tembotrione, and topramezone. Each herbicide was applied 1 d before sugarbeet planting, with and without ethofumesate + metamitron (EM), a common residual herbicide mixture applied in sugarbeet. Sugarbeet stand and visual injury were evaluated at the cotyledon, 4 true leaf (TL), and 6 TL sugarbeet growth stages. Biomass was collected when beets from the nontreated reached 8-10 TL. Of the herbicides not currently registered for use in sugarbeet, clomazone was the only one that did not reduce sugarbeet stand or biomass. All other herbicides evaluated, other than EM, reduced sugarbeet stand 32 to 99%. At the 6 TL evaluation, visual injury was 3% from EM and 17% in clomazone treated beets, treatments with carfentrazone-ethyl had the next lowest visual injury of 28%. Diflufenican, fluroxypyr, tembotrione, and topramezone all caused ≥67% sugarbeet injury at 6 TL. All herbicides other than clomazone and EM reduced sugarbeet biomass by ≥31%. This study reaffirms that many common herbicides used for kochia control lack adequate sugarbeet safety.

Tumble Mustard (*Sisymbrium altissimum*) Control and Seedling Kentucky Bluegrass Tolerance with Tolpyralate/Bromoxynil. Traci Rauch[1]*, Joan Campbell[1];[1]University of Idaho (024)

Weed control during Kentucky bluegrass seedling period is difficult due to low crop competition, crop sensitivity, and the availability of registered herbicides. In Idaho, suspected herbicide resistance of some broadleaf weeds to group 2 and 4 herbicides adds to the problem. Tolpyralate is a group 27 carotenoid biosynthesis inhibitor with no resistance reported in the PNW. In 2024, tolpyralate/bromoxynil (Tolvera) was registered for use in wheat. A field study in 3 year old 'Action' Kentucky bluegrass was initiated in the spring 2025 to evaluate tumble mustard control. Tolpyralate/bromoxynil at 0.147 and 0.196 lb ai/A were compared to standard treatments tribenuron, fluroxypyr/florasulam, bromoxynil, clopyralid/fluroxypyr, and pyrasulfotole/bromoxynil. The experimental design was a randomized complete block with four replications. Tumble mustard control was evaluated visually where 0% represented no control and 100% represented complete weed control. At 12 DAT, all herbicides controlled tumble mustard 95% or greater. AT 20 DAT, tumble mustard control decreased to 87 and 88% for tribenuron and clopyralid/fluroxypyr, respectively, but did not differ from all other treatments. All other treatments controlled tumble mustard 93 to 99%. In the greenhouse, tolpyralate/bromoxynil was applied at three application times at three rates to seedling 'Action' bluegrass. Tolpyralate/bromoxynil was applied at 0.147, 0.171, and 0.196 lb ai/A at the 2 leaf, 2 tiller, and 4 tiller growth stage. Visual injury and biomass were measured. At 7 DAT, all tolpyralate/bromoxynil rates applied at any timing injured Kentucky bluegrass 9 to 12%. Kentucky bluegrass chlorosis decreased over time; and by 14 DAT, injury ranged from 0 to 6% across all rates and application times. Dry biomass at 21 DAP did not differ from the untreated check by application time or herbicide.

Influence of Tillage Depth and Intensity on Weed Seed Diversity in the Soil Profile as a Strategy for Managing Herbicide Resistance. Connor Cox[1]*, Liberty Galvin[1], Daniel Adamson[1];[1]Oklahoma State University (025)

The increasing prevalence of herbicide-resistant weeds threatens the long-term sustainability of reduced- and no-till cropping systems, which depend heavily on chemical control due to limited mechanical weed management options. In Oklahoma, resistance in winter annual grass species has heightened the need for integrated, nonchemical management approaches. Strategic, infrequent soil disturbance may suppress herbicide-resistant populations by redistributing seeds below the critical germination zone, thereby reducing emergence and enhancing seed decay while maintaining overall soil conservation goals. This study evaluated how tillage intensity and depth influence weed seed redistribution, subsequent germination, and seed viability. Field experiments were conducted at a single location using a randomized design with three tillage treatments: moldboard plow, disk, and disk followed by a field cultivator. Aboveground weed cover was visually evaluated before and after tillage. Soil cores were collected at 0-5, 5-10, and 10-15 cm depths to characterize vertical seed redistribution. Samples were placed in greenhouse trays for six weeks to quantify the active (germinating) seedbank. Remaining seeds were recovered using the Malone (1967) soil-washing procedure, and seedbank density and species diversity were

determined using the Shannon Diversity Index (H'). Seed viability was evaluated with tetrazolium staining. Preliminary results indicate that tillage altered vertical seed distribution and influenced seed viability. Seeds already positioned below 2 inches prior to disturbance generally remained viable, whereas surface-deposited seeds exhibited greater decay when buried below 2 inches or were not recovered. Strategic soil disturbance may function as a tactical intervention to suppress herbicide-resistant weed seedbanks while limiting long-term soil disturbance. Producer-supported, long-term no-till trials will continue across Oklahoma in 2026 to assess consistency of these responses across environments and cropping systems.

Carrier Volume Effect on Glufosinate Efficacy. Timothy Seipel[1], Damian Stoy[1]*, Andy Fillmore[2];[1]Montana State University, [2]BASF (026)

Glufosinate is widely used in glufosinate-resistant canola, soybean, and corn production systems, as well as for fallow management and pre-plant burndown applications. As a non-selective, contact herbicide, glufosinate requires uniform spray coverage and relative humidity (RH) above 60% for optimal efficacy. Growers in Montana and across the Northern Great Plains, where low RH conditions are common, have reported reduced glufosinate performance when carrier volumes below 10 gallons acre^{-1} (93.5 L ha^{-1}) are used, resulting in poor weed control. The objective of this study was to evaluate the effect of different rates of carrier volumes on glufosinate efficacy against kochia (Bassia scoparia). A greenhouse experiment was conducted at Montana State University in spring 2025 using a spray chamber with carrier volumes at 46.8, 93.5, and 140.3 L ha^{-1}. Post-emergence applications of 18.7% glufosinate-P-ammonium (Liberty® ULTRA) were applied at 1.39 L ha^{-1} to kochia plants, with RH maintained above 60% throughout the experiment. Visual weed control ratings (0-100%) were assessed at 14 days after treatment (DAT). The experiment was repeated three times. Results indicated increased weed control with increasing carrier volume, with mean weed control of approximately 67%, 88%, and 98% for 46.8, 93.5, and 140.3 L ha^{-1}, respectively. These findings suggest that higher carrier volume, particularly at 140.3 L ha^{-1}, has the potential to improve glufosinate efficacy and support recommendations for increased carrier volume to enhance effective post-emergence weed control.

Effect of Cover Crop Residue on the Residual Activity and Weed Control Efficacy of S-Metolachlor Formulations. Paulo Da Silva[1]*, Robson Alves Ribeiro[2], Claudia Andréa Lima Cardoso[3], Pedro Antônio Vougoudo Salmazo[1], Mirella Ortiz[4], Eric Westra[4];[1]University of São Paulo, [2]University of Grande Dourados [3]Universidade Estadual do Mato Grosso, [4]Utah State University (027)

The straw from the predecessor crop can act as a physical barrier, hindering the transport of pre-emergent herbicides to the soil, thus reducing their availability in the solution and their control efficacy. Therefore, the objective of this study was to evaluate the influence of straw from Zea mays L. intercropped with Urochloa ruziziensis cv. ruziziensis (R. Br. ex A. Rich.) R.D. Webster and straw from Sorghum bicolor (L.) Moench on the availability of s-metolachlor in the soil, as well as the efficacy of preemergent herbicides in weed control. The experiment was conducted in a randomized block design, with four replications, in a 5 × 3 + 2 factorial scheme. Factor A consisted of five pre-emergent herbicides (s-metolachlor, s-metolachlor + fomesafen, s-metolachlor + metribuzin, s-metolachlor + flumioxazin, and s-metolachlor + sulfentrazone) and

two herbicide-free controls, while Factor B consisted of three straw conditions (absence of straw, straw from maize intercropped with *Urochloa ruziziensis* cv. *ruziziensis*, and sorghum straw). All herbicides showed high efficacy (>90%) in controlling *A. hybridus*, *D. horizontalis*, and *C. echinatus*. The presence of straw increased control by an average of 14% for *D. horizontalis*, *C. echinatus*, and *E. indica*, and by 9% for *A. hybridus*, compared to the absence of cover. The concentration of s-metolachlor in the soil showed similar behavior among the different types of straw, which may be associated with the 28 mm of rainfall at 2 DAA (days after application), sufficient to promote the transport of the herbicide to the soil. The types of straw did not interfere with the s-metolachlor concentration or the efficacy of the herbicides, due to climatic conditions favorable for transport. No visual symptoms of phytotoxicity were observed, although a reduction in the plant stand occurred. It is concluded that straw from maize intercropped with *Urochloa ruziziensis* and sorghum straw are effective tools in integrated weed management when combined with pre-emergent herbicides.

Does Cleaner Water Mean Better Weed Control? Assessing Reverse Osmosis Water in Glyphosate Applications. Marija Savic[1]*, Ian Burke[2];[1]Washington State University, [2]North Carolina State University (028)

Water quality can influence herbicide efficacy, particularly for weak acid herbicides like glyphosate that are susceptible to cation antagonism. Based on preliminary research demonstrating variable weed responses to herbicides applied from different water sources, this study evaluated the effect of reverse osmosis (RO) water compared with tap water on glyphosate performance for control of downy brome (*Bromus tectorum*) and Italian ryegrass (*Lolium perenne* ssp. multiflorum). Glyphosate was applied at 315, 631, and 1,262 g ae ha^{-1}, either alone or in combination with a nonionic surfactant (NIS) at 0.5% v v^{-1}, ammonium sulfate (AMS) at 0.75% v v^{-1}, or both adjuvants in the tank mix. Treatments were applied at the 3-5 leaf stage. Differences between RO and tap water were observed primarily at the two lower glyphosate rates. For downy brome, glyphosate alone at 315 g ae ha^{-1} with RO water resulted in greater fresh biomass reduction compared with the corresponding tap water treatment. For Italian ryegrass, glyphosate at 315 g ae ha^{-1} + AMS and glyphosate at 631 g ae ha^{-1} + AMS + NIS applied with RO water provided greater biomass reduction than treatments using tap water. At the highest glyphosate rate, water source had no influence on overall control for either species. Despite increased biomass reduction in low-rate treatments with RO water, control of both grass species was inadequate at the two lower glyphosate rates due to plant recovery. These results suggest that the benefits of RO water are limited and dependent on glyphosate rate and weed species.

Spray Solution pH Impact on the Performance of Bioherbicides for Control of Palmer Amaranth and Waterhemp. Kasey Schroeder[1]*, Milan Brankov[2], Milos Zaric[1];[1]University of Nebraska-Lincoln, [2]Maize Research Institute Zemun Polje (029)

The increase of herbicide resistant weeds, lack of new active ingredients and modes of action, and increased regulations surrounding products currently on the market create a unique position for the introduction of bioherbicides to agricultural practices. Although not yet widely adopted in the United States, bioherbicides offer an alternative to synthetic herbicides for weed management. Many bioherbicides are non-selective and not approved for broadcast in-crop use. However, some

products can be used in shielded or directed applications, making them potential options for targeted spray systems where crop exposure can be minimized. Some bioherbicides require a specific carrier pH to optimize efficacy. In general, there is limited information on the effects of pH differences in bioherbicide applications on weed control. Therefore, the purpose of this study is to investigate the spray solution pH impact on the performance of bioherbicides. Four bioherbicides, including ammonium nonanoate, clove and cinnamon oil, capric and caprylic acid, and eugenol at 13% v/v, 5 % /v, 9% v/v, and 3.51 L ha^{-1}, respectively, were selected. Treatments included each active ingredient alone, and with the addition of either citric acid at 1.5% v/v or potassium carbonate at 0.59 L ha^{-1} to alter the solution pH. Weeds tested were *Amaranthus palmeri* S. Watson and *Amaranthus tuberculatus* (Moq.) Sauer. The pH of the water used as a carrier was 6.73. Ammonium nonanoate had the highest initial pH, and the minimum change in pH when additives were used. Citric acid lowered the remaining active ingredients to an average of 2.48. Eugenol and clove and cinnamon oil showed the highest pH with the addition of potassium carbonate, averaging 9.72. Capric and caprylic acid had the lowest original pH, at 4.62, and were more affected by citric acid than potassium carbonate in regard to pH changes. Overall, eugenol was less effective than the other active ingredients, with 18.4 percent reduction in biomass for *Amaranthus tuberculatus* and 6.9 percent for *Amaranthus palmeri*. Control of *Amaranthus tuberculatus* were similar for ammonium nonanoate, clove and cinniman oil, and capric and caprylic acid with 65.7, 52.1, and 63.5 percent control, respectively. Capric and caprylic acid and ammonium nonanoate provided greater control of *Amaranthus palmeri*, at 65.3 and 56.8 percent, when compared to clove and cinnamon oil at 40.4 percent. The addition of citric acid or potassium carbonate did not affect the efficacy of the tested Amaranthus species, indicating active ingredient choice impacts weed control more than solution pH.

WSWS Project 4. Teaching and Outreach

Incorporating Brain Science into Weed Science Extension and Outreach. Jane Mangold[1]*;[1]Montana State University (063)

Weed science Extension educators conduct numerous in-person programs for their stakeholders every year. Most programs rely on slide presentations to present new information with minimal interaction or hands-on activities for the audience. Audience members, who were primarily passive learners, return home expected to apply new information to their weed management. In Montana, we have begun to train our Extension educators in strategies based upon cognitive neuroscience, the study of how the brain takes in, stores, retrieves, and uses information. In November 2025, I held our first two-day training for Extension educators using the Training from the Back of the Room (TBR) curriculum. This curriculum focuses on two foundational concepts: 1) six cognitive neuroscience principles and 2) the 4Cs instructional design framework. The TBR training is learner-centered, emphasizes active participation and engagement, and demonstrates brain-based strategies while teaching the curriculum content. Weed science programming that was developed by Extension educators during the workshop included plant and weed identification, understanding pesticide formulations, and integrated pest management. Prior to the training participants were surveyed to measure how much of their programming is interactive and hands-on and what limits

their use of such strategies. Participants indicated that they currently use interactive, hands-on strategies about 47% (±24%) of the time. Barriers to such programming included time, ideas and strategies, audience receptivity, choice to do so being out of their control, and location of training not being conducive. The survey will be conducted again in April 2026 to measure any change that has occurred in response to the training. Participant evaluations immediately after the training indicated that Extension educators found the training worthwhile and expanded their toolset for creating learner-centered programs that will promote improved knowledge retention and application.

PEST Academy - Hands on Spray Application Training for Agricultural Professionals. Jeffrey Golus[1]*, Milos Zaric[1], Kasey Schroeder[1];[1]University of Nebraska - Lincoln (064)

The Precision Education in Spray Technologies (PEST) Academy, hosted at the Precision Application Technology Laboratory (PAT Lab) at the University of Nebraska-Lincoln's West Central Research, Extension and Education Center in North Platte, Nebraska, aims to provide research-informed, hands-on training in modern pesticide application techniques. The goal is to equip custom and private applicators, educators, crop consultants, and industry professionals with the technical knowledge and operational skills needed for optimized and data-driven pest management. The Academy bridges science-based learning with real-world demonstrations and processes to strengthen decision-making, ensure regulatory compliance, and enhance the long-term sustainability of crop protection programs. Integrating spray technology fundamentals with resource understanding, participants learn to optimize product efficacy and minimize off- target movement. Nozzle selection, droplet-size classification, deposition and drift assessment, label interpretation, tank-mix effects, and the role of spray additives in enhancing performance across variable environmental conditions are covered. Interactive learning through spray table and spray chamber demonstrations enables participants to translate research-based insights into practical field applications. Understanding Endangered Species Act compliance steps is also reviewed. Offered in flexible formats, including half-day, full-day, and two-day sessions, the PEST Academy provides in-house and off-site training tailored to meet the needs and skill level of its audience. Participants earn Certified Crop Adviser continuing education units, a University of Nebraska-Lincoln Micro-Credential, and Nebraska Department of Agriculture recertification custom applicator credits (Categories 00 and 01), with recognition in other states possible upon approval. Overall, the PEST Academy empowers agricultural professionals to make data- driven, efficient, and environmentally responsible decisions that support sustainable crop production and long-term stewardship across Nebraska and beyond.

Changing the State Noxious Weed List: Outreach Opportunities, Impacts, and Needs. Corey Ransom[1]*, Mirella Ortiz[1], Eric Westra[1];[1]Utah State University (065)

In 2018, a major revision was made to the Utah State Noxious Weed List, increasing the number of species from 18 to 53 and changing the categories for classifying and regulating listed species. Almost a decade later, the impact of those changes is apparent and illustrates the role that extension outreach can have in assisting with invasive species management. Most of the opportunities for outreach involvement in noxious weed management are related to the need for educational materials addressing plant identification and effective management options. An effective outreach

effort was the publication of an updated noxious weed field guide. The revised guide, which includes images and descriptions of Category 1A weeds (weeds posing a threat, but not known to be in Utah at the time), likely contributed to discovery and identification in Utah of five of the nine species included in that category. The fact they were listed before their discovery further allowed resources to be immediately dedicated to their control and containment. With the addition of so many new noxious weeds, the number of native species being misidentified as noxious weeds has increased. This has led to efforts to develop a look-alike guide to differentiate the noxious weeds from similar looking native species. In some cases, there was little information on effective control treatments for newly listed noxious weeds, especially under Utah conditions. This created opportunities to conduct applied research on specific listed species and communicate best practices to County Weed Supervisors and land managers. Ongoing requests for fact sheets containing best control measures for County Weed Supervisors to give to the public resulted in a collaboration between Utah State University and the Utah Department of Agriculture and Food to produce individual fact sheets for every listed noxious weed. These will be jointly published as a definitive source of information, reducing liability at County levels. Finally, a significant challenge is that some newly listed species were historically used in ornamental plantings. The public is opposed to having plants removed from their landscapes, necessitating that information and programs are developed to communicate the negative impacts of the listed species and identifying alternative plants that could replace them. Related to this issue, the outcomes of the updated State Noxious Weed List illustrate the need to create partnerships between weed scientists and horticulturalists to proactively identify ornamental plants with invasive potential before they are released into the public market.

WSWS Project 5. Basic Biology and Ecology

Common Garden Study of Phenotypic Variation in Santa Maria Feverfew (*Parthenium hysterophorus*). Desiree McGriff[1]*, Liberty Galvin[1], Antonio DiTommaso[2], Sarah Kezar[3];[1]Oklahoma State University, [2]Cornell University, [3]University of Wisconsin-Madison (056)

Climate-driven range shifts increase invasion risk, underscoring the importance of early detection and rapid response (EDRR). *Parthenium hysterophorus*, an invasive weed native to Central and South America, causes significant damage in Asia, Africa, and Australia and has established populations in Mexico and the U.S., however, its invasiveness and different populations' performance in Oklahoma remain unclear. We evaluated allelopathic capabilities of *P. hysterophorus*, its responses to soil nitrogen, and phenotypic differences among global populations. Five populations of *P. hysterophorus* (Texas, Mexico, Pakistan, Israel, and Australia) were grown in a field experiment with three nitrogen levels in weedy and non-weedy plots. Plant growth and developmental traits were recorded, along with soil fertility and surrounding weeds. Results showed no strong evidence of allelopathic suppression of surrounding vegetation; weedy plots had significantly lower growth characteristics. Biomass differed among populations, with the Israel population producing significantly greater biomass than the Texas and Mexico populations. Additionally, population × weed presence significantly influenced biomass. Analysis revealed populations had significantly different height, and significant interaction of population × weed

presence and nitrogen × weed presence existed. Leaf area was also significantly reduced by the presence of weeds. Nitrogen application alone was not a significant variable. Because *P. hysterophorus* prefers warmer climates, cooler weather may have suppressed growth, suggesting that heat-seeking populations from Texas and Mexico are at risk of northern migration with future warming, and the warm-climate overseas populations may become established and invasive if introduced. Therefore, population-level variation in response to climate change is critical for EDRR**.**

Effect of Light and Dark on Bristly Hawksbeard (*Crepis setosa* Haller f.) Germination Under Alternating Temperatures. Renan Favera[1]*, Carol Mallory-Smith[1], Victor Ribeiro[1];[1]Oregon State University (057)

Bristly hawksbeard (*Crepis setosa* Haller f.) has become a difficult weed to manage in white clover (*Trifolium repens* L.) seed production systems in Oregon. The germination biology of this species remains poorly understood. This study investigated how maternal environment, light availability, and alternating temperature regimes influence seed germination. Seeds from two bristly hawksbeard populations produced under greenhouse and field conditions, were subjected to four alternating temperature regimes (15/5, 20/10, 25/15, and 30/20 ºC) under either a 12-h photoperiod or constant dark. Germination assays were conducted using a completely randomized design with four replicates, each consisting of 20 seeds per Petri dish. Radicle protrusion (≥ 1 mm) was recorded every two days over 14 days, and the study was repeated. Three-parameter log-logistic models were fitted to cumulative germination data to estimate the time required for 50% (T50) germination. Cumulative germination exceeded 90% across treatments, with no differences between populations; however, germination responses were strongly affected by light availability and alternating temperatures. Seeds produced in the greenhouse germinated more rapidly than those from the field. The fastest germination was observed at 30/20 ºC regardless of seed source and light availability. Constant dark accelerated germination (T50 = 1) compared to 12-h light/dark photoperiod (T50 = 2). These findings demonstrate that bristly hawksbeard possesses high germination plasticity, with dark and favorable maternal conditions shortening the germination window. Management strategies must account for the rapid germination of buried seeds, particularly during warm spring intervals when the efficacy window for pre-emergence herbicides is most restricted.

Temperature Effects on Pineappleweed (*Matricaria discoidea* DC.) Seed Germination. José Carlos Barbosa dos Santos[1]*, Clint Mattox[2], Carol Mallory-Smith[1], Victor Ribeiro[1];[1]Oregon State University, [2]USDA - ARS - Forage Seed and Cereal Research Unit (058)

Pineappleweed (*Matricaria discoidea* DC.) is a native species that commonly infests crop fields and disturbed areas in the Willamette Valley of Oregon. Information on the germination biology of this species remains limited. Therefore, this study aimed to determine how alternating temperatures influence pineappleweed seed germination. Twenty seeds were placed in petri dishes containing germination paper moistened with 5 mL of distilled water. Petri dishes were placed in growth chambers set to 15/5, 20/10, 25/15, and 30/20 °C with a 12-hour photoperiod. Each treatment was replicated four times, and the study was repeated. Germination was recorded every two days for 21 days, and seeds with a radicle at least 1 mm long were considered germinated and

were removed after counting. Three log-logistic models were fitted to the cumulative percent germination data, and the times required for 50 and 90% (T50 and T90) germination were estimated. Germination rate increased with higher alternating temperatures. The slowest germination occurred at 15/5 °C (T50 = 5.5 days; T90 = 7.2 days), followed by 20/10 °C (T50 = 5.3 days; T90 = 7.1 days) and 25/15 °C (T50 = 3.4 days; T90 = 4 days), while the fastest germination was observed at 30/20 °C (T50 = 2.8 days; T90 = 3.9 days). Although the fastest germination rate occurred at 30/20 °C, the highest maximum germination was achieved at 25/15 °C (97.5%), which was significantly greater than at 30/20 °C (89.9%). These findings help predict the germination window of pineappleweed seeds and support the development of more timely and effective control measures.

Investigating Dicamba Resistance in a Palmer Amaranth (*Amaranthus palmeri*) Population from Kansas. André Lucas Simões Araujo[1]*, Sofia Marques Hill[1], Chandrashekar Aradhya[2], Aruna Varanasi[2], Franck Dayan[1], Todd Gaines[1];[1]Colorado State University, [2]Bayer Crop Science (059)

Palmer amaranth (*Amaranthus palmeri)* is a highly competitive and troublesome weed species across diverse crop production systems in the United States. Auxin-mimic herbicides (Group 4), including dicamba, play an important role in the management of this species. However, a Palmer amaranth population from Kansas was recently identified with reduced sensitivity to dicamba, raising concerns about the evolution of resistance and its underlying mechanisms. Understanding the physiological and biochemical basis of dicamba resistance is critical for improving management strategies and slowing the spread of resistant populations. This study had three main objectives: (1) to quantify the level of dicamba resistance in a resistant (R) Palmer amaranth population relative to a known susceptible (S) population using a whole-plant dose-response assay; (2) to compare dicamba metabolism between R and S populations over time; and (3) to evaluate differences in dicamba absorption between R and S populations using radiolabeled herbicide. For objective 1, plants were treated with dicamba at rates of 0, 140, 280, 560, 1120, 2240, and 4480 g ae ha^{-1}. Fresh biomass was collected 28 days after treatment, and a three-parameter log-logistic model was fitted using the drc package in R to estimate resistance levels. For objective 2, targeted LC-MS/MS analyses were conducted on plant tissue collected at 24, 48, 72, 96, and 168 hours after treatment to quantify parent compound. For objective 3, dicamba absorption was evaluated using ^{14}C-labeled dicamba at the same time points as the LC-MS/MS analysis. Dose-response results indicated that the R population was 18.1-fold more resistant to dicamba than the S population. Herbicide metabolite profiling revealed no differences in dicamba metabolism between R and S populations across all time points evaluated. Similarly, absorption of ^{14}C-dicamba did not differ between R and S populations, suggesting that reduced uptake is not contributing to resistance. These results indicate that dicamba resistance in this Palmer amaranth population is not associated with enhanced metabolism or differential absorption. Future research will focus on evaluating dicamba translocation using ^{14}C-labeled herbicide and conducting genetic mapping to identify quantitative trait loci (QTL) and candidate genes that may confer resistance.

Effect of Germination Time on Downy Brome Seed Production and Seed Viability in Spring Wheat. Vhuthu Ndou[1]*, Fernando Oreja[2], Jennifer Gourlie[1], Judit Barroso[1];[1]Oregon State University, [2]Clemson University (060)

Downy brome (*Bromus tectorum* L.) is a widespread and problematic weed in the Pacific Northwest, with yield reductions ranging from 28% to 92% depending on infestation levels. Limited selective herbicide options and increasing resistance to ALS- and ACCase-inhibiting herbicides highlight the need for studying its biology and growth patterns to develop alternative control strategies. The objectives of this study were to characterize the emergence and reproductive timing of spring-emerging downy brome and quantify seed production and viability in spring wheat and fallow systems. Field experiments were initiated in 2024-2025 at the Columbia Basin Agricultural Research Center in Adams, Oregon. The emergence and progression of downy brome to reproductive stages were monitored on a weekly basis in spring wheat and fallow plots. Growing degree days (GDD; basal temperature (0°C)) were calculated using soil temperature data and logistic functions were employed to model cumulative emergence and reproductive development. Seed production and viability were evaluated by harvesting plants at 7-day intervals and assessing seed viability using tetrazolium staining under controlled conditions. The model predicted that 50% of emergence in spring wheat would occur at 315 and 332 GDD in 2024 and 2025, respectively. Spring-emerging downy brome that emerged in early April and mid-May, respectively, reached the reproductive stage in both years. In both years, late-emerging downy brome viability was low in spring wheat. However, in fallow, results were variable, with late-emerging downy brome showing high seed viability in 2024 and low viability in 2025. Although viable seed production declined, downy brome plants that emerged in late April in 2024 and in mid- to late May in 2025 were still capable of producing viable seeds in both spring wheat and fallow systems. These results underscore the importance of management initiatives that focus on spring-emerging downy brome, including downy brome that emerges as late as mid-May, to prevent replenishment of the soil seedbank.

Germination Ecology of Cotton Batting Cudweed (*Pseudognaphalium stramineum*). Victor Ribeiro[1]*, Jacob Powell[1];[1]Oregon State University (061)

Cotton batting cudweed (*Pseudognaphalium stramineum*) is a native species that has become difficult to control in wheat (Triticum aestivum L.) production systems in northeastern Oregon. Knowledge of its germination requirements remains limited, further complicating management. Thus, the objective of this research was to investigate the germination response of this species to alternating day/night temperatures. Germination tests were conducted in growth chambers set to 15/5, 20/10, 25/15, and 30/20 C with a 12-hour light/dark photoperiod. Twenty seeds were placed in petri dishes containing germination paper moistened with 5 mL of distilled water, with four replications for each treatment. Tests were run for 21 days, and germination was recorded every two days. Seeds with a radicle at least 1 mm long were considered germinated and were removed after counting. Three log-logistic models were fitted to the cumulative percent germination data, and the times required for 50 and 90% (T50 and T90) germination were estimated. Germination rate was greater at higher alternating temperatures, with the fastest germination (T50 = 5.3 days; T90 = 6.7 days) at 30/20 C and the slowest (T50 = 15.1 days; T90 = 19.5 days) at 20/10 C. These

results suggest that the optimal conditions for cotton batting cudweed germination occur at warmer temperatures and that management practices, including tillage and herbicide applications, will be most effective in the spring.

Characterizing the Seed and Soil Microbiome of Weed Species Extracted from a Long-term Irrigation Experiment. Franco Sanchez-Izurieta[1]*, Cody Willmore[2], Raissa Na-ah[1], David Weller[2], Timothy Paulitz[2], Daniel Schlatter[3], Olivia Landau[2];[1]Washington State University, [2]USDA-ARS Wheat Health, Genetics, and Quality Research Unit, [3]USDA-ARS, St. Paul (062)

The soil microbiome plays a critical role in plant health and seed persistence within the soil seed bank, making it a potential tool for non-chemical weed management. Exploring non-chemical options for weed management is increasingly relevant in the Pacific Northwest (PNW), where herbicide-resistant weed species, such as Salsola tragus, are widespread. Through the availability of next-generation sequencing, characterization of soil, seed, endosphere, and rhizosphere microbiomes has become commonplace. However, microbiome studies have been conducted more extensively in key crop species than in weeds within the PNW, and microbiome characterization of seeds directly extracted from the soil has not been performed. The objective of this study was to characterize bacterial communities associated with the bulk soil and weed seeds extracted directly from the soil seed bank. The study was conducted at a long-term field trial comparing irrigated and dryland spring wheat systems, where soil microbiomes have been characterized previously. Soil samples were collected three times during the growing season, and seeds were separated from soil by elutriation. Only irrigated plots yielded sufficient seeds for downstream analysis, and three weed species (*Setaria viridis*, *Polygonum aviculare*, and *S. tragus)* were selected for microbiome characterization. DNA was extracted from surface-sterilized seeds, non-surface-sterilized seeds, and soil to distinguish endophytic, surface-associated, and soil taxa. Microbial profiles were generated using 16S rRNA gene sequencing and analyzed in QIIME 2. Richness and diversity were significantly different between surface-sterilized vs. non-sterilized seeds. The most abundant bacterial taxa identified across all seed samples included: *Massilia* sp., *Lechevalieria* sp., *Conyzicola* sp., *Actinoplanes* sp., and *Pseudomonas* sp.. These results provide insight into the composition of weed seed-associated microbiomes within the soil seed bank and provide a foundation for future research characterizing functional effects of seed development. Furthermore, this work establishes the foundation for future research to investigate and develop weed management strategies that utilize microbiomes.

WSWS PROJECT 1: WEEDS OF RANGE, FORESTRY, AND NATURAL AREAS

Aquatic Weeds of Utah: Spatial and Genetic Insights. Francielli Santos de Oliveira[1]*, Corey Ransom[1], Eric Westra[1], Mirella Ortiz[1];[1]Utah State University (072)

Utah lakes and reservoirs support agriculture and recreation, yet invasive aquatic plants can degrade habitat, restrict access, and increase management costs. This study aimed to map the occurrence of native and invasive aquatic plants across 12 lakes and reservoirs in the state, with particular emphasis on genotyping *Myriophyllum* spp. Water bodies were selected based on their importance and accessibility. Shorelines were surveyed by a small boat at approximately 2 mph

within the shoreline (minimum depth 3 ft) using a sonar with integrated GPS. Submerged plants were sampled and identified. Plant species and coordinates were recorded when sonar indicated plant presence; algal blooms were noted when present, and water samples were collected for characterization. Where *Myriophyllum* spp. were detected, 2-5 apical meristem tissues were collected, DNA was extracted, quantified, and genotyped with KASP assays to determine whether collected plants were Northern watermilfoil (native), Eurasian watermilfoil (invasive), or interspecific hybrids. During summer 2025, 6 of 12 targeted water bodies were mapped; five reservoirs were at approximately 40% of capacity at the time of sampling, which could have impacted the presence of plants typically found near the shoreline. No aquatic plants were detected in Newton, Porcupine, or Echo reservoirs. Curlyleaf pondweed was predominant in Hyrum reservoir, forming a shoreline band, and sparse pockets at Rockport reservoir; Mantua reservoir supported mixed beds of curlyleaf pondweed, coontail, and KASP-confirmed Northern watermilfoil. The remaining six water bodies are scheduled for mapping in summer 2026, using the same protocol to support integrated management.

The History and Future of Tamarisk (*Tamarix ramosissima*) on the Rio Grande. David Clements[1]*, Erik Lehnhoff[2];[1]Trinity Western University, [2]New Mexico State University (073)

The invasion of tamarisk (*Tamarix* spp.) across the southwestern U.S. is challenging both because the plant is difficult to manage, and because it actually provides habitat benefits. Native to Eurasia, several *Tamarix* species were introduced to North America in the early 1800s for horticulture, wind breaks and erosion management. By the 1920s, these *Tamarix* species had naturalized and colonized many riparian areas in the southwest including the Rio Grande River. Meanwhile, the Rio Grande irrigation project resulted in large changes to the region's hydrology. In 1916, the massive Elephant Butte dam was built with a capacity to irrigate 178,000 acres. Together with other dams in the area, it has reduced the river flow such that large stretches of the Rio Grande no longer flow for approximately half of the year. Under such conditions, regeneration of native riparian vegetation such as willows and cottonwoods is limited, whereas the deeper-rooted tamarisk is still able to persist. Tamarisk provides nesting habitat for at risk bird species such as the Southwestern willow flycatcher and the yellow-billed cuckoo and thus its removal threatens their habitat. In 2001, the tamarisk leaf beetle was introduced for biocontrol and spread more rapidly than expected, defoliating tamarisk in many areas along the Rio Grande. Tamarisk makes fires more intense, and is better able to regenerate than native species following fire. In 2017 the Tiffany fire in the Elephant Butte area burned through 9200 acres, destroying many native cottonwoods and willows but the tamarisk persisted. Rio Grande tamarisk management efforts continue, including a major removal effort underway in Big Bend National Park in 2026. However, managers must carefully consider that tamarisk is frequently an important ecosystem component, and that the degradation of the Rio Grande environment makes it difficult for any woody species other than tamarisk to thrive.

Impacts of Imazapyr and Glyphosate Application Methods on Target Species Reed Canarygrass (*Phalaris arundinacea*) and Meadow Foxtail (*Alopecurus pratensis*) and Non-target Species Camas (*Camassia quamash*). Sofia Blair[1]*, Timothy Prather[1];[1]University of Idaho (074)

Seasonally wet meadows containing camas (*Camassia quamash*) were once common in the northwestern United States but declined with agricultural conversion and invasion by nonindigenous perennial grasses. Decline of camas, which is a traditional food source of cultural significance to Native Americans, reflects loss of other native plant species. Native species conservation and negative cultural impacts call for management options that mitigate the spread of invasive grasses and enhance outcomes for camas. We assessed the effectiveness of glyphosate and imazapyr herbicides with broadcast and wiper application methods on invasive grasses, reed canarygrass (*Phalaris arundinacea*) and meadow foxtail (*Alopecurus pratensis*), each paired with camas bulbs in a greenhouse. Lower camas emergence was observed in controls containing grasses. We found no visual negative effects from glyphosate nor imazapyr, applied to actively growing grasses prior to camas emergence. Broadcast applications to reed canarygrass resulted in similar levels of biomass reduction, with regrowth only in glyphosate-treated grasses. Glyphosate broadcast to meadow foxtail had lower biomass than control or imazapyr treated plants but subsequently began to regrow, while imazapyr broadcast to meadow foxtail had greater biomass than glyphosate-treated plants, without subsequent regrowth. Wiper application of either herbicide resulted in total loss of aboveground biomass. While camas lacked visual effects within herbicide treated pots, our next step is to analyze soil and camas bulb tissue samples for herbicide residue. Examining both visual impacts to camas and herbicide residue analysis will determine the utility of glyphosate and imazapyr in areas where camas may be harvested for consumption.

Evaluating Integrated Weed Management Strategies for Reed Canarygrass (*Phalaris arundinacea* L.) in Northern Colorado. Jacob Courkamp[1]*; [1]Colorado State University (075)

Abstract not submitted

From Above- to Below Ground: The Effects of Controlling Invasive Annual Grasses. Claire Anderson[1]*, Jane Mangold[1], Lisa Rew[1], Cathy Zabinski[1];[1]Montana State University (076)

Invasive annual grasses (IAG) like cheatgrass (*Bromus tectorum*) and ventenata (*Ventenata dubia)* are associated with reduced ecosystem stability. Herbicides are the primary tool used for management, but some land managers are interested in the use of soil amendments. Soil amendments aim to address underlying reasons for invasion by altering conditions to favor desired species, but there's little research on their effectiveness or their integration with herbicides. This study evaluated the effect of two herbicides and a soil amendment on IAG and perennial grasses. We applied four treatments at recommended rates: indaziflam (Rejuvra®), imazapic (Plateaue®), the soil amendment NutraFix®, and Rejuvra plus NutraFix (R+N) alongside a non-treated control in a randomized- complete- block design with five replications at five sites in 2024. One year post-application, we sampled cover of IAG and perennial grasses at peak vegetative growth. Data were analyzed using generalized linear models with ANOVA and Tukey's tests to separate means (α = 0.05).At all sites, R+N reduced IAG cover to less than 2%, always being lower than the control and, except for Rejuvra at one site, always lower than the other treatments. At three of the five sites, R+N increased perennial grass cover, while other treatment responses varied. At the other two sites, perennial grass cover did not differ among treatments. These first-year results are encouraging, but to accurately inform managers, a long-term response to treatment is needed and sites will be sampled again in 2026.

The Effects of Cheatgrass (*Bromus tectorum*) Management with Indaziflam on Live Fuel Moisture Content in Semi-Arid Grasslands Along the Colorado Front Range. John Watson[1]*, Jacob Courkamp[1];[1]Colorado State University (077)

The goal of this study was to better understand the effects of indaziflam on cheatgrass, native plant communities, and live fuel moisture content (LFMC), an important factor influencing wildfire risk in grassland plant communities.

Novel Solutions to a 100 Year Problem: Larkspur (*Delphinium geyeri*) Mitigation in Western Rangelands. Amber Pelon[1]*, Todd Gaines[1], Franck Dayan[1], Lovreet Shergill[1];[1]Colorado State University (090)

Foothills larkspur (*Delphinium geyeri*) is a perennial dicot plant native to the foothills of the Rocky Mountains that is toxic to cattle, causing intestinal stasis, bloat, muscular paralysis, and sudden death due to respiratory paralysis. This high risk of cattle fatalities significantly reduces the usable area of ranchland for cattle production and affects ranchers' annual economic returns. Developing new management tools to control foothills larkspur in rangelands would enable higher stocking rates on cattle ranches, which is a key regional and state issue for cattle producers. Our solution will involve two approaches: mapping and precision removal of above-ground plant mass using drones and robots, and research and testing of growth inhibitors targeting the terpenoid pathway that produces the toxin in plants. Both methods will allow this valuable forb to remain in the rangeland while reducing the toxic risk to cattle. Ultimately, we aim to provide innovative larkspur mitigation techniques and develop a tool to help ranchers choose the most effective strategy for their profit, herd health, and rangeland health.

Investigating Native and Weed Species Response to Indaziflam Using Agar. Maloree McDonald[1]*, Felipe Quatroni[1], Francielli Santos de Oliveira[1], Eric Westra[1], Corey Ransom[1], Mirella Ortiz[1];[1]Utah State University (091)

Indaziflam is widely used to control invasive winter annual grasses in natural areas. During restoration, land managers must understand indaziflam’s impact on both invasive and desirable species. This project investigated indaziflam tolerance in two invasive species, dyer’s woad (*Isatis tinctoria*) and medusahead (*Taeniatherum caput-medusae*), and two desirable species, Siberian wheatgrass (Agropyron fragile) and yarrow (Achillea millefolium). Seeds were germinated in agar under various indaziflam concentrations (0, 50, 100, 200, 400, 800, 1200, 1600, and 3200 pM). Concentrations were obtained using serial dilutions and verified by HPLC. Shoot and root lengths were measured at five, ten, and fifteen days after germination. Data were analyzed using a two-way ANOVA with multiple comparisons. Root length was reduced at and above 100 pM for dyer’s woad and 200 pM for medusahead, yarrow, and Siberian wheatgrass. Shoot length was reduced at and above 200 pM for yarrow, 400 pM for dyer’s woad, 800 for Siberian wheatgrass and 1200 pM for medusahead. Root-to-shoot ratios were significantly increased compared to the control at 1200 and 1600 pM for yarrow but significantly decreased at and above 200 pM for medusahead. Relative growth rate was significantly reduced at and above 1200 pM for medusahead. These data suggest lower tolerance to indaziflam in dyer’s woad compared with yarrow, Siberian wheatgrass, and

medusahead. It also reflects the differences in biomass partitioning between yarrow and medusahead in response to indaziflam-induced stress.

Predicting Turkish Thistle (*Carduus cinereus*) Habitat through Susceptibility Modeling in Canyon Grasslands of Oregon and Idaho. Ashton Sellke[1]*, Timothy Prather[1];[1]University of Idaho (092)

Turkish thistle (*Carduus cinereus*) is a winter annual native to the Irano-Turanian region. In 2007, the species was discovered in northeastern Oregon and incorrectly identified as Italian thistle (*C. pycnocephalus*). Seven years later, molecular phylogenic analysis correctly identified the invader after significant spread throughout the Snake and Salmon River canyon grasslands. Successful management requires knowledge of existing populations, but the topography of the region poses a barrier to efficient field surveying for inventory. Creating a habitat susceptibility model for Turkish thistle should decrease survey inputs and determine effort needed for control across a landscape with considerable challenges to safe accessibility. Environmental variables such as topography and moisture availability were combined with species presence and remote sensing calculated vegetation indices to produce a model of habitat susceptible to Turkish thistle invasion within the Hells Canyon region. The resulting model was classified into four categories, ranging from unsusceptible to highly susceptible habitat. Of the 547,113.84-ha within the model development extent, 512,857.88 ha were considered unsusceptible, 23,134.28 ha slightly susceptible, 7,505.16 ha moderately susceptible, and 3,616.52 ha highly susceptible Turkish thistle habitat. Setting strategies for managing this invasive species suggests detection surveys can be directed to highly susceptible areas more frequently, while areas of lower susceptibility can be monitored less frequently. The model extent will be expanded to cover affected areas within western Idaho. The habitat susceptibility model will be accessible to land managers as a GIS layer to assist with early detection, rapid response, and potential containment of Turkish thistle.

Seed Bank Response and Secondary Impacts After Indaziflam Application for Annual Grasses in Sagebrush Steppe. Timothy Prather[1]*, Lisa Jones[1];[1]University of Idaho (093)

Sagebrush steppe thresholds for annual grass cover include increased fire risk at 10% foliar cover, reduced native bunchgrass abundance at 15%, and potential transition to annual grass communities at 20%. Native plant communities are largely intact before fire, even at 20% cover of annual grasses. Reducing annual grasses below threshold levels is important to stemming the conversion to annual grasslands. Mountain big sagebrush is the dominate shrub at the location for studies focused on control of annual grasses, native plant seed banks for restoration, and impacts, both positive and negative, of using imazapic and indaziflam. We measured recruitment of native forbs in 2022 and 2023 (3 and 4 YAT), finding lower recruitment when treated with indaziflam than the other treatments in 2022. In 2023, however, imazapic + indaziflam had higher recruitment than the untreated plots. Forbs previously identified as important for greater sage grouse did not differ among treatments until 2023 when important sage grouse forb cover was higher for areas treated versus not treated. Native plant recruitment is critical to healthy grasslands as are animals that could be affected by changes to plant communities after herbicide application. In a separate study conducted, in part, within the same area, greater sage grouse used treated areas more than areas not treated with indaziflam +/- imazapic measured using sage grouse fecal pellet surveys. In

addition, western deer mice and Columbia Plateau pocket mice were either positively impacted or neutral to herbicide application, even though Columbia Plateau pocket mice are primarily granivorous.

Application Timing Effects of Indaziflam and Imazapic on Grass and Forb Seedlings. Cody Beckley[1]*, Corey Ransom[1], Eric Westra[1], Mirella Ortiz[1], Maloree McDonald[1];[1]Utah State University (094)

Invasive annual grass species (IAG) pose significant issues to rangeland and natural areas within Utah. In highly degraded sites, restoration is complicated by IAG reinvasion. The ability to apply herbicides near the time of planting, could protect the seeding from competition, but may pose injury issues. In 2025, trials were established to evaluate desirable plant species tolerance to indaziflam and imazapic applied at different rates and timings. Plots in Kaysville, UT and Millville, UT were planted with desirable forb and grass species, measuring 3 by 9 m, and were arranged in a RCBD, with four replications. Herbicide treatments were indaziflam and imazapic applied PRE and POST at three growth stages. A PRE indaziflam + banded carbon treatment was also evaluated. Plant density, frequency, height, injury, and cover of desirable species were collected. PRE imazapic was injurious and negatively impacted heights of nearly all species in early evaluations. Cover data showed lasting negative impact to grass species from PRE imazapic while forbs generally recovered. Various sensitivities to indaziflam by rate or timing were observed for many species. Banded carbon provided increased safety to PRE indaziflam in a few instances at the Logan site. Differences in timing of PRE applications after planting reduced indaziflam injury, likely due to seeds being germinated but not emerged. Some herbicide responses were confounded by weed competition, despite constant weeding. In general, waiting until plants were at least 6 inches tall reduced any long term negative impacts of herbicide applications.

What's Going on Down There? Exploring Plant-Soil Feedback as a Mechanism for Ventenata Invasion. Lisa Jones[1]*, Timothy Prather[1];[1]University of Idaho (095)

Ventenata (*Ventenata dubia*), is an invasive winter annual grass negatively impacting ecosystems in the northwestern US. Researchers have not determined how ventenata is able to invade and expand so prolifically since its diminutive physical features suggest low competitive ability. We hypothesize that plant-soil feedback (PSF) mechanisms between ventenata and soil microbes may facilitate invasion by altering its competitive ability relative to native grasses. High ventenata abundance is associated with low soil phosphorus. Evidence suggests that microbes from ventenata litter altered the root structure of ventenata in a way that would enhance its ability to access limited phosphorus. Additionally, on a per-mass basis, ventenata hosted more soil microbes that facilitate phosphorus acquisition compared to the native bluebunch wheatgrass (Pseudoroegneria spicata). Other research has shown that a Fusarium fungus cultured from ventenata increased the biomass of ventenata seedlings by 76% and decreased the biomass of bluebunch wheatgrass seedlings by 36%. In an exploratory study, we analyzed the bacterial and fungal communities of soil collected under ventenata and bluebunch wheatgrass from six field sites in Idaho. Results showed greater differentiation in the fungal communities than bacterial communities. Notably, compared to bluebunch wheatgrass, ventenata hosted 3.6 times more fungi in the genus *Pyrenophora*, which

can be pathogens to seeds and mature grasses. It could be that ventenata is a reservoir for *Pyrenphora* and transmits it to bluebunch wheatgrass seed, which has been shown to have greater mortality from this pathogen than other grass seeds. Taken together, there are many lines of evidence that ventenata's association with soil fungi may give it a competitive advantage at the seedling stage. However, we still lack knowledge about how it can quickly suppress long-lived mature perennial grasses soon after invasion, indicating further exploration of PSF is worthwhile. Understanding the mechanism of invasion can help inform best restoration practices.

Conifer Release Applications with 2,4-D Choline in Western U.S. Forestry. William Hatler[1]*, Jodie Crose[1], Byron Sleugh[1], Craig Alford[1];[1]Corteva Agriscience (112)

Paper withdrawn

Herbicide Induced Vegetation Dynamics Across a Mesquite Encroachment Gradient. Molly Reichenborn[1], Erik Lehnhoff[2]*, Akasha Faist[3];[1]Kansas State University, [2]New Mexico State University, [3]University of Montana (113)

Woody species such as honey mesquite (*Prosopis glandulosa* Torr.) have progressively encroached into historically grass-dominated ecosystems in the southwestern United States because of historic grazing and extreme drought. The transition to mesquite shrubland reduces native grass and forb abundance, increases soil erosion and redistribution of ecosystem resources, and ultimately decreases the ecological and economic services provided by these lands. Mesquite control by herbicide is a common practice to reduce mesquite dominance and increase herbaceous cover; however, control efficacy and herbaceous plant recovery may depend on encroachment severity prior to management. We established twenty sets of paired herbicide (2 L ha^{-1} Sendero [clopyralid + aminopyralid] and 0.6 L ha^{-1} Remedy [triclopyr])-treated and untreated 5-ha plots across a gradient of relatively low to high mesquite encroachment on the Jornada Experimental Range in southern New Mexico. Annual ground-based vegetation surveys were conducted pre-treatment (2020), immediately post-treatment (2021) and one year following treatment (2022). Mesquite mortality in low-encroachment plots (47%) was nearly double the mortality rate in medium- and high-encroachment plots (~26%). Mesquite regrowth ranged from 6-28% and did not differ across the encroachment gradient. Changes in plant community composition between years were primarily characterized by increasing annual grass and forb cover, and to a lesser degree perennial forb cover, following a favorable 2021 monsoon season. By 2022, forbs declined in treated plots, possibly as an off-target effect of the herbicide, whereas annual grasses increased. Perennial grass increased in both treated and untreated plots in 2022 in response to increased rainfall. While treatments did promote some grass recovery, initial results indicate that cover did not differ across the encroachment gradient. Results will help landowners and managers decide when to invest in mesquite management and anticipate post-treatment plant community recovery given initial mesquite encroachment severity.

Regional Assessment of PPO Inhibiting Herbicides for Resistance Management in Bareground Sites Targeting Kochia (*Bassia scoparia*), Palmer Amaranth (*Amaranthus palmeri*), and Russian Thistle (*Salsola tragus*). Shannon Clark[1]*, Derek Sebastian[1], Vicki Maloney[1];[1]Envu (114)

Group 2, Group 4, and Group 9 herbicides are widely used for bareground vegetation management; however, increasing reports of resistance in key species such as kochia (*Bassia scoparia*), Palmer amaranth (*Amaranthus palmeri*), and Russian thistle (*Salsola tragus)* pose a significant challenge to long-term control strategies. This study presents a regional, multi-site assessment of protoporphyrinogen oxidase (PPO)-inhibiting herbicides, sulfentrazone, carfentrazone, and saflufenacil, performance across bareground sites in diverse climatic and soil conditions. In spring 2025, replicated field trials were conducted at sites in Colorado, Kansas, North Dakota, and Alberta, with known high-level resistant B. scoparia, A. palmeri, and S. tragus, to evaluate herbicide efficacy, residual activity, and species-specific response under operational conditions. Across locations, sulfentrazone and saflufenacil-containing treatments achieved consistently high levels of bareground, with 90-100% bareground observed under moderate to heavy weed pressure. At several locations, Bassia scoparia and S. tragus control increased 5 to 14% with the addition of sulfentrazone to the base treatment. At the North Dakota location, the addition of a PPO plus synthetic auxins increased total bareground by ~5%, while the addition of only a PPO performed similarly to the base treatment. These results indicate that PPOs can be an effective component for resistance management in bareground applications, although tank-mixes with several modes of action are required to achieve high levels of control. Poor control observed at some locations with the base treatment may indicate populations with stacked resistance. These findings underscore the importance of proactive herbicide stewardship and regional strategies to sustain bareground vegetation management programs.

Evaluation of the Effectiveness of Pilot Programs to Control Noxious Weeds. Jim Sebastian[1]*;[1]Boulder County Parks and Open Space (115)

Boulder County Parks and Opens Space (BCPOS) implemented a pilot project program to evaluate effectiveness of select noxious weed management treatments and their applicability to BCPOS natural lands in 2025. This included: Hand-digging List A Species, steam weeding, soil amendment, goat browsing, and a volunteer Weed Warrior program. These five treatment methods were identified during the 2023-2024 public planning process as having potential for application on BCPOS natural lands. The advantages and disadvantages of each of these programs was explored in 2025. Considerable information was learned the first year of these projects that will be refined, improved, and implemented again in 2026.

WSWS PROJECT 2: WEEDS OF HORTICULTURAL CROPS

Enhancing Electrical Weed Control Through Pre-Treatment Mowing: Evidence of an Interactive Response. Juliano Sulzback[1]*;[1]Oregon State University (078)

Electrical weed control (EWC) is non-chemical option in perennial cropping systems, but information about interaction between EWC and other non-chemical options, including mowing, is still unclear. Four 3x5 factorial field studies were conducted, with each factor representing an application timing. First timing included treatments of EWC at 1 $km \cdot h^{-1}$, mowing, and a nontreated check; second timing involved four EWC speeds (1, 2, 3, and 4 $km \cdot h^{-1}$) along with a nontreated check. Studies were conducted near Corvallis (S1 and S2) and Oregon City (S3 and

S4), OR. The S1 and S2, were infested fields with annual weed species (*Sisymbrium thellungii*, *Poa annua),* study 3 was infested with horsetail (*Equisetum arvense*) and S4 with wild carrot (Daucus carota). Weed coverage and control were assessed every 15 days for 60 days. In S1 and S2, when EWC is applied at least once, weed control was 69-80% of multiple species control on 60 days after treatment (DAT). In S3, EWC on timing A, wild carrot control was more efficacious (53-65%) when compared to mowing on timing A (16-24%) 60 DAT. Similar results were observed in field 2 of site B, where applying EWC on timing A, horsetail control was more efficacious (60-64%) when compared to mowing on timing A (22-37%), and both outperforming nontreated on timing A 60 DAT. These results suggest that EWC damages belowground structures from perennial species, and improve overall weed suppression when in combination. Applying EWC first, sequential field operations may be performed at higher speeds without losing efficacy.

Pulse Electric Field as a Nonchemical Preemergence Weed Management Tool. Pamela Medeiros dos Santos[1]*;[1]Oregon State University (079)

Weed management in hazelnuts orchards often relies on herbicides, increasing the risk of herbicide resistant populations and highlighting the need for effective nonchemical alternatives. Soil applied pulsed electric field (PEF) technology delivers short high-voltage pulses capable of disrupting cell membranes, but its effectiveness for orchard weed control and the role of exposure pathway remain unclear. We evaluated soil-applied PEF for in-row weed suppression and hazelnut (Corylus avellana L.) tolerance under field conditions and assessed how planting time affects PEF efficacy under controlled conditions. In a young Oregon hazelnut orchard, treatments included a weedy check, a weed free hand-weeded control, and soil-applied PEF at 1, 10, and 100 J cm^{-3}, applied once to the tree row. In greenhouse experiments, *Cyperus esculentus* L.*, Echinochloa crus-galli*, and *Amaranthus palmeri* propagules were planted at 7, 5, 3, and 0 days before treatment. At 0 days PEF was applied at 0, 25, 50 and 200 J cm^{-3}. Soil applied PEF caused minimal crop injury and no consistent effect on leaf chlorophyl content, stomatal conductance, or PSII yield, indicating no detrimental effect of PEF to the crop. Weed suppression was minimal (<10%) even at 100 J cm^{-3}. In contrast, PEF applied to container reduced weed biomass, especially at 200 J cm^{-3} and when PEF was applied 5 to 7 days after planting. Improved PEF efficacy was observed with weed emergence. These results highlight that soil applied PEF is safe to standing trees, and for weed control foliar contract PEF may offer a more effective weed control method.

Response of Organic Herbicides Using Traditional Broadcast and Pinpoint Spray Technology. Clebson Gonçalves[1]*;[1]University of California, Cooperative Extension (080)

Postemergence organic herbicides are considered contact or burndown (non-selective) herbicides that kill weeds by directly affecting leaf epidermal cells. Due to the non-selective characteristic of those organic herbicides, they cannot be applied in traditional broadcast application systems post-crop emergence. Also, traditional broadcast foliar spray technologies available on the market usually lack accuracy, leading to resource wastage and potential dangers to both humans and the environment. The advent of hyper-precise pinpoint spray technologies delivers unprecedented precision, ensuring that applications are precisely targeted as intended. It may enable the use of non-selective herbicides during the post-crop emergence timeframe. Greenhouse research trials were conducted to assess different dose-response (0.75, 1.5, 3, 6, and 9 % v/v) of organic herbicide

(Caprylic acid + Capric acid) with and without adjuvant (alcohol ethoxylate), for better coverage and application effectiveness. Large crabgrass (*Digitaria sanguinalis*), palmer amaranth (*Amaranthus palmeri*), and common purslane (Portulaca oleracea) were submitted to the herbicide treatments at different weed growth stages (9, 18, and 27 days after germination - DAG). Results from these trials indicate a better organic herbicide effectiveness when applied in the initial weed growth stage (9 DAG). Weed control was greater than 90 % with a rate of up to 1.5% v/v of the organic herbicide when sprayed at 9 DAG, while when sprayed at 18 DAG, at least a rate of up to 3 % v/v was needed to provide similar control. For both weed growth stages (9 and 18 DAG), our results indicate that an added adjuvant in the organic herbicide solution increases the herbicide effectiveness. Additionally, our data suggest that hyper-precise pinpoint spray technologies provide high weed control effectiveness like the traditional broadcast foliar spray system and may enable the use of non-selective organic herbicides in systems post-crop emergence.

Evaluation of Branched Broomrape (*Phelipanche ramosa*) Seed Responses to Nitrogen Fertilizers and Flooding. Tong Zhen[1]*, Pershang Hosseini[1], Brad Hanson[1];[1]University of California, Davis (081)

Reports of branched broomrape [*Phelipanche ramosa* (L.) Pomel] in California represent a reemerged threat to the processing tomato industry following its presumed eradication in the 1980s. Although chemical control programs for branched broomrape suppression have been developed in the past few years as an emergency response, limited research has been conducted on cultural practices that could be incorporated into integrated pest management programs. Three lab-scale studies were conducted in 2024 and 2025 to evaluate the responses of branched broomrape seeds to nitrogen fertilization and flooding. The fertilizer study evaluated the effects of diammonium hydrogen phosphate, calcium nitrate tetrahydrate, potassium chloride, potassium nitrate, ammonium nitrate, ammonium sulfate, and urea on branched broomrape seed germination and radicle elongation at various concentrations (0, 1.56, 3.125, 6.25, 12.5, 25, 50 mM) and at various seed germination stages (preconditioning, germination stimulation, and radicle elongation). The flooding studies evaluated the effects of flooding duration (3, 7, 14, 28, 42, and 56 days) and temperature (10°C and 28°C) on branched broomrape seed germination and the number of seed attachments to the tomato host plant. Results from the fertilizer study showed that fertilizers containing diammonium hydrogen phosphate, ammonium nitrate and urea inhibited branched broomrape seed germination and radicle elongation, and this effect was only observed when fertilizers were applied during the germination stimulation stage. For flooding studies, the branched broomrape seed germination rate dropped to 20% after 14 days of flooding at 28°C. Flooding at both 10°C and 28°C reduced broomrape seed attachment to tomato plants by 50% within 7 days. These lab-scale data suggest that fertilization management and flooding have the potential to control branched broomrape infestation as cultural management strategies, but the results should be validated at the field scale in future experiments.

Assessment of Herbicide Programs for Weed Control in Onion Production. Sohaib Chattha[1]*, Tim Waters[2], Rui Liu[1];[1]Washington State University, [2]Franklin County Extension, Washington State University (082)

Weed management in direct-seeded onion is challenging. The objective of this study was to evaluate the efficacy of herbicide program for weed management in direct-seeded onion. Field experiments were conducted in 2024 and 2025 at the Washington State University Vegetable Extension Farm in Pasco, WA. Treatments were structured in a randomized complete block design, with four replications. Treatments were combination of pre-emergence (PRE), followed by (FB) early post-emergence (EPOST), fb late post-emergence (LPOST) herbicide applications. Less crop injury (5-17%) was recorded in pendimethalin + glyphosate + oxyfluorfen + bromoxynil + pyroxasulfone + pendimethalin + dimethanamid-P + dimethanmid-P herbicide program applied PRE, fb EPOST, and fb LPOST. Among all treatments, pendimethalin + glyphosate + oxyfluorfen + bromoxynil + pyroxasulfone + pendimethalin + dimethanamid-P + dimethanmid-P when applied PRE, fb EPOST, and fb LPOST provided excellent control for common lambsquarters (70-95%), common purslane (71-99%), redroot pigweed (68-95%), puncturevine (74-90%), and grass (71-94%) control through the seasons. This research suggests that an herbicide program pendimethalin + glyphosate + oxyfluorfen + bromoxynil + pyroxasulfone + pendimethalin + dimethanamid-P + dimethanmid-P applied PRE, fb EPOST, and fb LPOST could possibly reduce crop injury and provide acceptable broadleaf and grass weed control in direct-seeded onion production in the Columbia Basin.

Evaluating Foliar-applied Electrical Treatments for Weed and Downy Mildew Management in Hops (*Humulus lupulus*). Greeshmanth Alluri[1]*, Marcelo Moretti[1], David Gent[1];[1]Oregon State University (083)

As the global leader in hop (*Humulus lupulus* L.) production, the Pacific Northwest requires sustainable, non-chemical integrated pest management (IPM) strategies. Spring pruning is a critical management window where herbicides are traditionally used to remove early-season growth, reducing primary disease inoculum, while simultaneously controlling weeds. This study evaluated Electrical Weed Control (EWC) as a novel, foliar-applied alternative for pruning and the suppression of Canada thistle (*Cirsium arvense* (L.) Scop.), annual bluegrass (*Poa annua* L.), and false dandelion (*Hypochaeris radicata*). Additionally, the research assessed EWC's influence on downy mildew (*Pseudoperonospora humuli*) progression. EWC treatments (1.6 km h^{-1}) were delivered as single or sequential applications (14-day interval) and compared against carfentrazone (35 g ai ha^{-1}) and mechanical management. Sequential EWC and EWC plus carfentrazone provided superior weed control, maintaining near-total suppression (96-100%) through 36 days after treatment (DAT), significantly outperforming single applications (62-80%). For shoot removal, sequential EWC achieved 83-91% suppression at 14 DAT. While regrowth occurred by 21 DAT, sequential EWC maintained higher suppression (65-70%) than mechanical pruning (≈27%). Downy mildew severity peaked at ≈58% in sequential EWC plots compared to <20% in controls, however, increased EWC intensity was positively correlated with improved hop shoot removal (pruning efficacy). EWC demonstrated high crop safety ($p > 0.05$), cone weights (16.7-19.9 kg), bine weights (17.0-20.1 kg), alpha acids (7.5-8.5%), and beta acids (0.18-0.21%) were comparable to controls. This first of its kind study confirms EWC does not reduce hop yield or quality, suggesting it is a viable non-chemical alternative for weed management, though disease suppression effects remain unclear. This technology offers a promising tool for reducing pesticide reliance.

Timing and Frequency of Sucker Removal in Hazelnuts (*Corylus avellana*) Increases Yield. Austin Frewert[1]*, Marcelo Moretti[1];[1]Oregon State University (101)

European hazelnuts (*Corylus avellana*) grow naturally as multi-stemmed bushes, but are trained into single trunks to facilitate mechanized harvest and suppress Eastern filbert blight. Suckers grow continuously from spring to fall, making sucker management labor-intensive. Timing and frequency of sucker pruning on hazelnut growth and nut yield has not been widely evaluated. An orchard of 'McDonald' and 'Yamhill' was established in 2021 and applied with the following sucker pruning timing treatments: (1) control - no sucker removal, (2) no suckers; (3) winter; (4) May and winter; (5) June and winter; (6) July and winter; (7) August and winter; (8) May, June, and winter; (9) July, August, and winter. Tree growth, shoot elongation, yield, and nut quality were measured to quantify plant response. After four years, sucker removal increased trunk cross-section area (TCSA), with cultivar dependent responses. In 'McDonald,' the largest TCSA was observed in sucker-free trees and when suckers were removed in spring and summer, while in 'Yamhill', summer removal resulted in smaller TCSA than spring or sucker-free. In 'McDonald,' sucker removal increased yield by 25% compared to no sucker removal, with no difference among other treatments averaging 0.6 kg tree^{-1}. In contrast, 'Yamhill' yield under the sucker-free treatment was 1.25 kg tree^{-1}, 42% greater than the control. Removing suckers in the spring resulted in a similar response to sucker-free treatments, while summer sucker removal and winter-only removal resulted in yields comparable to nontreated. Timing and frequency of sucker removal can significantly impact growth and yield, with variations depending on the cultivar.

Evaluating Herbicide Programs and Nitrogen Applications in Spearmint Production. Rui Liu[1]*, Ruijun Qin[2], Doug Walsh[1], Troy Peters[1];[1]Washington State University, [2]Oregon State University (102)

Abstract not available

Hulk Herbicide Performance in Coffee and Papaya in Hawaii. Jesse Richardson[1]*, Julie Coughlin[2], Zhening Zhang[2], James Kam[2];[1]Corteva Agriscience, [2]University of Hawaii (103)

HulkTM herbicide field trials were initiated on the island of Oahu from 2022 through 2024, characterizing efficacy on weeds and crop safety in coffee and papaya orchards. Efficacy on key weeds was excellent and good crop safety was documented on both crops. All studies were funded through IR-4.

Performance of Tiafenacil on Hop (*Humulus lupulus*). Luisa Baccin[1]*, Marcelo Moretti[1];[1]Oregon State University (104)

Increasing regulatory scrutiny and safety concerns associated with paraquat have prompted the search for alternative strategies for in-row weed management and basal foliage removal in hop production. This study evaluated tiafenacil, a postemergence protoporphyrinogen oxidase inhibitor, as a potential tool for hop management. Field experiments were conducted for 2 years between 2022 and 2023 in Michigan (MI), New York (NY), Oregon (OR), and Washington (WA) to evaluate weed control, crop safety, and yield responses to tiafenacil at 50 and 100 g ai ha^{-1} compared with carfentrazone at 35 g ai ha^{-1}. Treatments were applied at four timings: in winter,

spring, early summer, and late summer. Carfentrazone provided no control of grasses, whereas tiafenacil improved control of grass species, including quackgrass, ryegrass, and annual bluegrass, especially when applied in both winter and spring. Tiafenacil also improved control of Canada thistle in OR and NY by up to 46% compared to carfentrazone. Although site-specific responses were observed, results showed that tiafenacil provided 16% greater basal shoot control than carfentrazone ($p < 0.001$). Both herbicides resulted in minimal crop injury in mature hops; however, tiafenacil caused transient injury in one-year-old hop without reducing plant height, shoot biomass, bine fresh weight, or hop cone yield. Across states and years, none of the treatments reduced bine fresh weight or hop cone yield. Collectively, these results support tiafenacil as a safe and effective herbicide for weed control and basal foliage removal in hop production.

Icafolin-Methyl – a New Molecule in the Chemical Class (Isoxazolin-Carboxamides) from Bayer CropScience. Angela Kazmierczak[1]*, Christopher Mansiere[1], Allan Kaastra[1], Lothar Lorentz[1];[1]Bayer Crop Science (105)

Icafolin-methyl is a unique molecule being developed by Bayer CropScience across a broad range of crops (soybean, cereals, pulses, oilseed crops, as well as pome and stone fruits, tree nuts, grapes, and citrus) for preemergent /preplant burndown of difficult to control grass and broadleaf weeds. Icafolin-methyl is classified as a group 23 herbicide in the new chemical class Isoxazolin-Carboxamides. Icafolin interrupts the assimilate transport from source to sink within the plant leading to a starvation of the sink tissue. It also inhibits the meristematic tissues which slowly dies off from either starvation and interrupted cell cycles. Icafolin-methyl will control all known resistant biotypes of proposed labeled weeds and will be used in an integrated weed managment strategy to protect other effective modes of actions and delay the onset of new resistant biotypes. Icafolin-methyl is currently under review and pending registration from the EPA and PMRA.

WSWS PROJECT 3: WEEDS OF AGRONOMIC CROPS

Patterns in Weed Emergence: Insights from Hydrothermal Time. Peter Weston Maughan[1]*, Marija Savic[1], Jessica Kalin[1], Ian Burke[2];[1]Washington State University, [2]North Carolina State University (066)

Effective weed management depends on accurately predicting weed emergence timing, which requires understanding the primary environmental drivers of temperature and water. Although hydrothermal time is widely used to model crop emergence, its utility for weedy species remains less explored. This study examined the influence of hydrothermal time on *Lolium perenne* subsp. multiflorum emergences across two growing seasons. Field experiments were conducted at two sites near Pullman, WA (2024-2025), using randomized complete block designs with two replications. Subplot treatments were applied every 2-4 weeks from January through August, consisting of tillage and glyphosate (1135 g ae ha^{-1}), respectively. Emergence densities were assessed six weeks after treatment. Hydrothermal time was calculated using a base temperature of 0 °C and base water potential of −1500 kPa. Permutation tests ($a = 0.05$) compared emergence distributions across years, treatments, and sites. In the first 2025 study, both tilled and herbicide-treated median emergences occurred at 905 °Cd ($p = 0.22$), consistent with 2024 tilled and herbicide-treated populations, respectively (both $p > 0.30$). In the second 2025 study, median

emergence occurred at 687 °Cd (tilled) and 627 °Cd (herbicide-treated; p = 0.85). Between sites, tilled plots did not differ (p = 0.23), whereas herbicide-treated plots differed by 278 °Cd in median emergence (p = 0.04). This shift corresponded with a 770 kPa lower soil water potential in one of the two sites during early emergence events. These findings indicate that hydrothermal time consistently described emergence timing, highlighting that refined models can enhance weed management strategies.

Wild Oat (*Avena fatua*) Control with Pinoxaden and Thiencarbazone Premix. Kirk Howatt[1]*, Joseph Mettler[1], Timothy Seipel[2], Ruby Tiwari[2], Damian Stoy[2], Jason Meier[3], Jim Daniel[4];1North Dakota State University, [2]Montana State University, [3]ADAMA, [4]Daniel Ag Consulting (067)

Including herbicides with multiple sites of action has been a tenet of best weed management recommendations. This became more necessary as presence of wild oat with resistance to Group 1 and 2 herbicides converged within fields. A formulation of pinoxaden and thiencarbazone, each at respective label rate, was evaluated for wild oat control at field locations near Bozeman, MT and Fargo, ND with no history of resistance. Adverse wheat response was not observed. Sites were not combined because wild oat control with pinoxaden at Fargo quickly exceeded 90% but slowly reached 70% at Bozeman. Control with thiencarbazone was generally 65% at both locations, while the combination provided near 80% control. Response of wild oat at Fargo indicated antagonism of pinoxaden activity by thiencarbazone, but the combination resulted in better control than either herbicide alone at Bozeman. Addition of MSO resulted in slightly higher numeric control values for early evaluations, but MSO only enhanced wild oat control with pinoxaden & thiencarbazone at Fargo (up to 10 percentage points). A second experiment was conducted at Fargo to evaluate various adjuvants further with a reduced rate of pinoxaden & thiencarbazone. Consistent control of wild oat with pinoxaden & thiencarbazone was observed across several adjuvant treatments that included various components, indicating flexibility in adjuvant use according to needs of tankmix partners or programs. The premix formulation of pinoxaden & thiencarbazone provided a valid option for wild oat control that could help mitigate the influence of wild oat in wheat as resistant biotypes develop.

Herbicide Resistance in Kochia (*Bassia scoparia*) Across Small Grain Production Systems in the Great Plains: Insights from a Regional Survey. Curtis Lefler[1]*, Todd Gaines[1], Akamjot Brar[1], Daniel Guimaraes Abe[2], Caleb Dalley[2], Devanshi Het Desai[3], Patrick Geier[4], Brian Jenks[2], Jeremie Kouame[4], Jeanne Falk Jones[4], Timothy Seipel[3], Lovreet Shergill[1];[1]Colorado State University, [2]North Dakota State University, [3]Montana State University, [4]Kansas State University (068)

Resistance to ALS inhibitors and glyphosate (EPSPS inhibitor) has increased reliance on synthetic auxin and PPO-inhibiting herbicides for controlling kochia within small grains while PS II and HPPD inhibitors remain important tools in corn systems. This study evaluated the frequency of resistance to dicamba, fluroxypyr, saflufenacil, atrazine, and mesotrione and assessed commercial premix efficacy. Ninety-five populations from Colorado, Kansas, Montana, and North Dakota were screened with dicamba, fluroxypyr, and saflufenacil at 560, 168, and 50 g ae ha^{-1}, respectively. Half of populations (n = 13, 16, 11, 6) were screened with Scorch EXT (2,4-D + dicamba + dichlorprop-p at 280, 280, and 560 g ae ha^{-1}), Maestro EXT (bromoxynil + dichlorprop-

p at 280 and 560 g ae ha^{-1}) and atrazine and mesotrione at 2,241 and 105 g ae ha^{-1}. Eight populations with the highest dicamba and fluroxypyr survival (two per state) were further evaluated with Scorch, Duplosan, Maestro 4EC, Cleansweep M, Huskie, and Huskie + Duplosan. Dicamba + 2,4-D proportions matching Scorch EXT and Scorch were included to assess the synergistic/antagonistic value of dichlorprop-p and fluroxypyr. Dicamba resistance (survival >20%) was 96.15% (CO), 96.77% (KS), 100% (MT), and 100% (ND). Fluroxypyr resistance was 34.6%, 22.22%, 9.52%, and 33.33%, respectively. Scorch EXT resistance was 7.69%, 6.25%, 0%, and 0%; Maestro EXT resistance was 0%. Saflufenacil resistance was 61.5%, 70.83%, 42.85%, and 66.66%. No atrazine or mesotrione resistant populations were detected. Future molecular and greenhouse assays will validate findings and characterize resistant populations.

Seed Retention Dynamics of Downy Brome (*Bromus tectorum* L.) at Winter and Spring Wheat Harvest in the Pacific Northwest. Noemi Codina-Pascual[1]*, Vhuthu Ndou[1], Fernando Oreja[2], Jennifer Gourlie[1], Judit Barroso[1];[1]Oregon State University, [2]Clemson University (069)

Herbicide resistance in downy brome (*Bromus tectorum* L.) has increased interest in non-chemical weed management strategies for cereal cropping systems. Harvest Weed Seed Control (HWSC) is a potential complementary strategy whose effectiveness depends on the onset of seed shattering and seed retention at crop harvest. This study aimed to assess seed retention dynamics of downy brome growing in winter and spring wheat in the Pacific Northwest. Downy brome populations were sampled at the Columbia Basin Agricultural Research Center (Adams, OR) during 2020, 2021, 2022, 2024, and 2025. Ten plants per population were collected weekly before crop and weed maturity until wheat harvest. Plants were hand-threshed, and seeds were counted to estimate maximum seed production per plant, which defined the onset of seed shattering. Seed retention over time was modeled using negative exponential regressions based on calendar date. Seed retention was evaluated at proposed wheat harvest dates, defined as July 15th for winter wheat and July 30th for spring wheat. Winter wheat populations began shattering earlier than spring ones. However, seed retention at harvest was similar between winter and spring wheat systems, with estimated values across the studied years ranging from 8 to 50 %. Seed retention declined significantly over time in both crops and varied widely among years and populations, with lower retention in winter wheat during dry seasons. Overall, the hypothesized advantage of HWSC for controlling downy brome in spring wheat was not consistently observed, given the similar levels of seed retention at harvest.

Assessing Kochia (*Bassia scoparia*) Resistance to PPO-inhibiting and Auxin-mimic Herbicides in Northeast Montana. Devanshi Het Desai[1]*, Het Samir Desai[1], Lovreet Shergill[2], Timothy Seipel[1];[1]Montana State University, [2]Colorado State University (070)

Herbicide-resistant kochia (*Bassia scoparia* A. J. Scott) is a serious threat to Montana's cropping systems. In northeastern Montana, durum, spring wheat, and pulses are grown in rotation. Consequently, herbicides used in these regions to manage weeds are synthetic auxins in monocot cereals and PPO inhibitors in pulses. Producers observed a decline in efficacy, raising concerns about the extent and distribution of herbicide-resistant kochia. To screen for herbicide resistance, we conducted a survey and collected 41 problematic kochia populations from producers and agronomists in September 2024. In the greenhouse, we screened these populations with POST-

emergence applications of dicamba (560 g ae ha^{-1}), fluroxypyr (157 g ae ha^{-1}), dicamba (560 g ae ha^{-1}) + fluroxypyr (157 g ae ha^{-1}), and saflufenacil (50 g ae ha^{-1}). We also screened for PRE-emergence herbicides using flumioxazin (70 g ai ha^{-1}), saflufenacil (50 g ae ha^{-1}), and sulfentrazone (140 g ai ha^{-1}). All 41 problematic populations were resistant to POST-emergence fluroxypyr; 67% were resistant to dicamba, and 40% were resistant to dicamba + fluroxypyr. Of 41 populations, 19% population survived POST-emergence saflufenacil, representing the first case of resistance to a PPO-inhibiting herbicide in Montana. Resistance to PRE-emergence was less prevalent, with only 5% of populations surviving saflufenacil and flumioxazin, and no population survived sulfentrazone. The distribution of multiple herbicide-resistant kochia biotypes is increasing in Montana; one population exhibited six-way resistance. These findings underscore the urgent need for diversified weed management practices to prevent the further spread of herbicide resistance in *B. scoparia* populations across northeastern Montana.

Varietal Competitiveness of Wheat and Barley in Western Canada. Breanne Tidemann[1]*, Charles Geddes[1], Shaun Sharpe[1], Chris Willenborg[2];[1]Agriculture and Agri-Food Canada, [2]University of Saskatchewan (071)

Herbicide-resistant weeds have expanded in frequency and acreage on the Canadian Prairies. Their impact has increased the need for integrated weed management strategies to improve management. One management strategy that has often been suggested is the selection and growth of competitive crop varieties, however, limited information is available by variety to allow producers to implement this strategy. The objective of this study was to investigate competitiveness of spring barley (Hordeum vulgare) and spring wheat (Triticum aestivum) varieties to weed communities, and, as protocol development, to a single species. Field studies were conducted over three years (2022-2024) in Lacombe and Lethbridge, AB and two locations in Saskatoon, SK. Each variety was grown under weedy and weed-free conditions to evaluate their ability to compete and ability to withstand competition. Results indicated that it is possible to separate varieties based on their competitiveness for both wheat and barley. However, that competitiveness ranking is not consistent by variety over years and environments, and a single weed does not represent the same interactions as a weed community. There is potential to develop a competitiveness ranking system for wheat and barley varieties in Canada, however, regionality and weed communities are critical. Additionally, relative value as an integrated weed management strategy should be evaluated, as well as regional complications of other pest species to ensure confidence in the rankings.

Early Season Glyphosate-Resistant Kochia (*Bassia scoparia*) Control with Burndown and Residual Herbicide Combinations. Ian Waldecker[1]*, Jenna Meeks[1], Andrew Kniss[1];[1]University of Wyoming (084)

Now that sugarbeet growers in the Western U.S. can apply metamitron at planting, there is renewed interest in evaluating burndown and residual herbicide combinations for glyphosate-resistant kochia (*Bassia scoparia*) control before sugarbeet planting. To investigate the efficacy of burndown and residual herbicide combinations on kochia, two studies were established in fallow near Lingle, Wyoming in 2025. The first field study (EARLY) was established on April 21 when kochia was <2.5 cm tall, the second field study (LATE) was established on May 22 when kochia was 5 to 10 cm tall. Burndown herbicides included carfentrazone-ethyl, dicamba, fluroxypyr,

glufosinate, paraquat, pyraflufen-ethyl, tembotrione, and topramezone. In addition, the EARLY study included diflufenican and the LATE study included tiafenacil. Each burndown herbicide was applied with and without ethofumesate + metamitron (EM). At 30 d after treatment (DAT) in the EARLY study, both dicamba treatments and diflufenican + EM provided ≥88% visual glyphosate-resistant kochia control. The inclusion of EM significantly improved kochia control in applications of glufosinate, paraquat, and pyraflufen-ethyl by ≥24%; however, these combinations only provided ≤51% kochia control. In the LATE study, burndown herbicides provided greater kochia control overall. Despite this, applications of glufosinate and pyraflufen-ethyl still resulted in poor kochia control (≤63%), 30 DAT. In both the EARLY and LATE studies, applications of dicamba reduced kochia biomass by 95 and 82%, respectively, which was the greatest reduction of any burndown herbicide evaluated. Overall, this research will be useful for growers investigating control options for glyphosate-resistant kochia at sugarbeet planting.

Bicyclopyrone + Bromoxynil: Earlier Applications for More Flexible Weed Control. Marty Schraer[1]*, Nathan Haugrud[1], Benjamin Westrich[1], Dan Wilkinson[1], Pratap Devkota[1], Tom Beckett[1], David Belles[1];[1]Syngenta Crop Protection (085)

Talinor® is a selective herbicide from Syngenta Crop Protection containing bicyclopyrone + bromoxynil that has provided control of key broadleaf weeds in spring wheat, winter wheat, durum wheat, and barley since its 2017 U.S. launch. Pending EPA approval, an expansion of the current Talinor label will include preplant, preemergence, and early postemergence application timings (spike to 2-leaf). Applied at these earlier timings, the previously established rates of 213 to 283 g ai ha^{-1} can be effective for both burndown and soil-residual weed control while maintaining crop safety and yield potential. Data from US field trials demonstrated that preemergence applications of Talinor controlled broadleaf weeds including kochia (*Bassia scoparia*), Russian thistle (*Salsola tragus*), pigweeds (*Amaranthus* sp.), common lambsquarters (*Chenopodium album*), and common ragweed (*Ambrosia artemisiifolia)* when sufficient activating rainfall was received. Additionally, these preemergence applications suppressed some annual grass weeds including foxtails (*Setaria* sp.) and barnyardgrass (*Echinochloa crus-galli*) with minimal crop response.

Critical Time of Weed Removal and Soil Active Herbicides in Establishment Alfalfa: Impacts on Yield, Crop Establishment, and Forage Quality. Kaitlyn Hoberg[1]*;[1]University of Wyoming (086)

Weeds compete with alfalfa in the establishment year. Utilizing weed control tactics can be crucial for successful alfalfa establishment. We initiated an experiment in 2024 and 2025 near Lingle, WY to determine the effect of soil active herbicides on the critical time of weed removal (CTWR) in establishment alfalfa. The trial was arranged in a spilt plot design with 4 replications. Herbicide treatment and weed removal timing were main- and sub-plot factors, respectively. Herbicide treatment consisted of no-PPI and EPTC 2452 g ai ha^{-1} + trifluralin 841 g ai ha^{-1} applied PPI. Weeds were removed from alfalfa at the distinct developmental stages: cotyledon, V1, V3, V5, early bloom, a weed-free and weedy check were also included. Glyphosate was applied at 1261 g ai ha^{-1} for weed removal. Alfalfa yield at first harvest, in no-PPI, was reduced from 2593 to 274 kg ha^{-1} and from 3544 to 555 kg ha^{-1} in 2024 and 2025, respectively, as weed removal timing was delayed. First harvest yield in PPI treated plots was reduced from 2648 to 1204 kg ha^{-1} by delaying

weed removal in 2024. The CTWR for first harvest, estimated at 5% yield reduction, occurred at 504 and 1201 GDD base 10C after alfalfa emergence when no-PPI was applied in 2024 and 2025, respectively. In 2024, a CTWR was estimated at 839 GDD in the PPI herbicide treatment. In the no-PPI treatment, delaying weed removal reduced alfalfa plant density at first harvest, crude protein content, and leaf area, in 2024 and 2025.

Optimization of Forage Sorghum Weed Control Programs via ImiFlex (Imazamox) and Igrowth Sorghum: Post-commercialization Experience. Ryan Bryant-Schlobohm[1]*, Ryan Henry[1], Cody Gray[1], Kathleen Seitzinger[1];[1]UPL (087)

Drought conditions and reduced water resources have challenged conventional forage production systems in the Western US. Forage sorghum provides growers with a relatively drought tolerant alternative to corn silage for meeting the needs of livestock forage requirements. Labeled herbicides for forage sorghum have limited the ability for growers to maintain consistent levels of grassy weed control. ImiFlex herbicide (imazamox) and igrowth herbicide-tolerant forage sorghum provide growers a new tool for optimizing weed management programs in forage sorghum systems, while meeting the needs of livestock forage requirements.

Volunteer Spring Barley (*Hordeum vulgare* L.) Management Prior to Spring Wheat (*Triticum aestivum* L.). Jace Heiman[1]*;[1]North Dakota State University (088)

Volunteer barley (*Hordeum vulgare* L.) continues to challenge wheat (*Triticum aestivum* L.) farmers in North Dakota when following barley. This prompted an evaluation of volunteer barley control with pyroxasulfone in two greenhouse experimental runs in winter of 2025. Pyroxasulfone was applied at 119 g ai ha^{-1} to sandy loam or silty clay soil after barley was seeded at three depths. Soil was irrigated with four water amounts. Percent visible efficacy and plant emergence were recorded every 7 days, and biomass 21 days after application. The data were analyzed in JMP using Tukey's mean separation at α=0.05. Pyroxasulfone provided 86% barley control in sandy loam soil, approximately twice the efficacy of that in silty clay soil across planting depths and irrigation amounts. In silty clay soil, barley efficacy increased with irrigation amount to 56%. A second greenhouse experiment was conducted twice in winter of 2025 to evaluate glyphosate efficacy on barley seed germination. Barley seeds were surface-seeded and covered by barley residue or left exposed. Glyphosate was applied at 3,090 g ai ha^{-1} via chamber sprayer one day before, the day of, or one day after pot irrigation with 1.3 cm of water. Data collection and analysis were similar to the previous experiment. The only treatments with control values greater than the nontreated control were uncovered seeds that were already imbibed prior to glyphosate application (95%). Pyroxasulfone did not adequately control barley in silty clay soil; however, glyphosate applied directly to uncovered-imbibed seeds was effective.

Herbicide Programs to Control Multiple Herbicide-Resistant Common Ragweed in Dry Bean. Joseph Ikley[1]*, Austin Weippert[1], Charlie Lim[1];[1]North Dakota State University (089)

Abstract not available

Bristly Hawksbeard (*Crepis setosa* Haller f.) Response to Postemergence and Preemergence Herbicides. Renan Favera[1]*, Carol Mallory-Smith[1], Victor Ribeiro[1];[1]Oregon State University (106)

Bristly hawksbeard (*Crepis setosa* Haller F.), an invasive species native to Europe, has recently emerged as a problematic weed in Oregon white clover (*Trifolium repens* L.) seed production, highlighting the need to identify effective herbicide control options. The objectives of this study were to evaluate pre-emergence (PRE) and post-emergence (POST) herbicides for control of bristly hawksbeard, including herbicides registered for use in white clover and unregistered herbicides to identify additional modes of action and potential improvements in control. Greenhouse screenings were conducted using a randomized complete block design with four replications, and the study was repeated. PRE treatments included the registered herbicides flumetsulam, flumioxazin, and oxyfluorfen, as well as the unregistered herbicides fluridone and mesotrione. POST treatments included the registered herbicides flumetsulam, flumioxazin, MCPA, oxyfluorfen, paraquat, imazamox + bentazon, in addition to the unregistered herbicides florpyrauxifen, florpyrauxifen + 2,4-D, and mesotrione. Data were collected 21 days after treatment, with plant counts recorded for PRE screenings and biomass measured for POST screenings. In PRE screenings, all treatments, except flumetsulam and oxyfluorfen, provided >96% density reduction. For POST screenings, all treatments, except flumetsulam, MCPA, and oxyfluorfen, provided ≥91% biomass reduction. Flumetsulam was ineffective for bristly hawksbeard control in both PRE and POST applications. In contrast, several registered herbicides, including flumioxazin, paraquat, and imazamox + bentazon, provided effective control. Unregistered herbicides such as fluridone, mesotrione, florpyrauxifen, and florpyrauxifen + 2,4-D also demonstrated high efficacy, representing additional modes of action that could expand future management options in white clover if registration is obtained.

Vyconic Soybeans: A Flexible Approach to Preemergent Weed Management with Acetochlor-Mesotrione Premix. Carl Coburn[1]*, Katilyn Price[1], Zewei Miao[1], Emily Scholting[1];[1]Bayer Crop Science (107)

Vyconic™ soybeans will offer the industry's first trait stack with tolerance to five herbicides (glyphosate, glufosinate, dicamba, 2,4-D and mesotrione based herbicides) to enable the broadest suite of weed management options, pending applicable regulatory approvals. Bayer Crop Science is developing an acetochlor plus mesotrione premix product for preemergent use in Vyconic™ soybean. A preliminary update on this product's development will be given featuring preemergent performance data from field trials. Given the increasing challenge of managing herbicide-resistant weeds, Vyconic™ soybeans will provide growers with more choice and flexibility in their herbicide programs.

Efficacy of Selected Herbicides for Control of Palmer Amaranth (*Amaranthus palmeri*) and Waterhemp (*Amaranthus tuberculatus*). Laura Rodriguez[1]*, Joel Felix[2], Clarke Alder[3], Rui Liu[4], Olivia Landau[5], Albert Adjesiwor[1];[1]University of Idaho, [2]Oregon State University, [3]Betaseed, [4]Washington State University, [5]USDA-ARS Wheat Health, Genetics, and Quality Research Unit (108)

Palmer amaranth (*Amaranthus palmeri*) and waterhemp (*Amaranthus tuberculatus*) have recently been introduced into the Pacific Northwest (PNW), prompting regional surveys and sample collection. This study, conducted in 2024 and 2025, aim to (1) confirm glyphosate resistance in several Palmer amaranth and waterhemp populations from Idaho and Oregon through dose-response bioassay, survival analysis and measurement of 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) gene copy number and (2) evaluate their sensitivity to selected herbicides commonly used in potato production systems. Most preemergence herbicides provided similar control of susceptible and Idaho/Oregon Palmer amaranth populations; however, reduced sensitivity to rimsulfuron was observed in all Idaho and Oregon populations. Three waterhemp populations from Idaho also exhibited reduced sensitivity to rimsulfuron. Postemergence metribuzin applications provided effective Palmer amaranth control, with optimal efficacy when plants were 10 cm tall or smaller. EPSPS gene duplication was detected in Palmer amaranth populations and three waterhemp populations, with up to 150 EPSPS gene copies in the Palmer amaranth and up to 10 gene copies in the waterhemp. Emerging resistance to rimsulfuron and metribuzin in Palmer amaranth, along with confirmed glyphosate resistance in both species, highlights limited postemergence options in potato production systems and suggests that Palmer amaranth and waterhemp may have been introduced from regions where these weeds have already developed resistance to multiple herbicide sites of action.

Optimized Herbicide Solutions for Effective Control of Multiple Herbicide Resistant Amaranthus. Benjamin Westrich[1]*, Scott Cully[1], David Belles[1], Mark Kitt[1], Jesse Haarmann[1];[1]Syngenta Crop Protection (109)

Waterhemp (*Amaranthus tuberculatus* [Moq.] Sauer.) and Palmer amaranth (*Amaranthus palmeri S.* Watson) are troublesome weed species in corn production due to the selection of populations with multiple resistance to herbicides commonly adopted for their control. Field trials were conducted over several locations with resistance to multiple modes of action in 2024 and 2025 to evaluate herbicide programs for the control of resistant Amaranthus spp. populations on LibertyLink® corn and Roundup Ready® Corn 2 technology. Results show that two-pass integrated weed management programs consisting of preemergence followed by postemergence herbicide applications provide effective control of multiple herbicide-resistant Amaranthus spp. in LibertyLink and Roundup Ready Corn 2.

Volunteer Glyphosate-resistant Alfalfa Interference and Management in Sugar Beet. Sushmita Sharma Koirala[1]*, Laura Rodriguez[1], Albert Adjesiwor[1];[1]University of Idaho (110)

Volunteer glyphosate-resistant alfalfa (*Medicago sativa*) is a major problem for sugar beet (*Beta vulgaris*) growers. Poor glyphosate-resistant alfalfa termination prior to sugar beet planting can result in crop competition and yield loss. This study aims to 1) identify effective herbicide options for alfalfa termination in the fall prior to planting sugar beet, 2) evaluate herbicide options for pre-plant and in-crop control of volunteer alfalfa, and 3) quantify potential sugar beet yield loss from volunteer alfalfa interference in sugar beet. Fall applications of 2,4-D alone (1120 g/ha) and 2,4-D combined with dicamba (560 g/ha) provided more than 90% alfalfa control which resulted in maintained 14% and 18% sugarbeet yield loss, respectively compared to hand weeded check. One-time application of clopyralid (263 g/ha) at the 2-leaf stage of sugarbeet resulted in statistically

similar visible volunteer alfalfa control (68%) as clopyralid (131 g/ha) at 2-leaf followed by clopyralid (131 g/ha) at the 8 to 10 leaf stage of sugarbeet. The addition of glufosinate (594 g/ha) to clopyralid did not improve pre-plant control of volunteer alfalfa. Similarly, tank mixing triflusulfuron (17.5 g/ha) with clopyralid did not increase volunteer alfalfa control. When left uncontrolled, volunteer alfalfa resulted in up to 73% sugarbeet root yield loss compared to hand weeding. These findings demonstrate that while clopyralid may provide some control of volunteer alfalfa, effective termination of volunteer alfalfa in the fall with an herbicide like 2,4-D is critical to preventing unacceptable sugarbeet yield loss due to volunteer alfalfa interference.

Evaluating PRE Herbicide Options with and without Glufosinate POST in Triple-stacked Herbicide-resistant Sugarbeet. Andrew Kniss[1]*, Jenna Meeks[1], Nevin Lawrence[2], Albert Adjesiwor[3], Joel Felix[4];1University of Wyoming, [2]University of Nebraska, [3]University of Idaho, [4]Oregon State University (111)

Field studies were conducted in Wyoming, Nebraska, Idaho, and Oregon in 2025 to evaluate herbicide programs that can be used in triple-stacked herbicide resistant sugarbeet. The triple-stacked herbicide resistance trait is not commercially available, but includes resistance to glyphosate, glufosinate, and dicamba. The studies included a factorial arrangement of PRE applications and POST treatments. PRE treatments included applications of dicamba, ethofumesate, metamitron along with all 2-way and 3-way combinations of these products, for a total of 7 treatments plus a no-PRE control (8 levels). POST treatments included glufosinate applied POST and a no-POST control (2 levels). The full factorial treatment arrangement (16 treatments) was replicated 4 times in a RCBD at all four locations. Common lambsquarters was present at all four locations, redroot pigweed was present at three locations, kochia was present at two locations, and Palmer amaranth was present at one location. Ethofumesate controlled common lambsquarters and kochia less than all other PRE treatments. Kochia control was greatest when dicamba PRE was included, however, dicamba alone PRE was among the worst for controlling redroot pigweed and Palmer amaranth. PRE herbicide combinations will likely be required to control common weeds in triple-stacked herbicide-resistant sugarbeet when it is commercially available.

Flax (*Linum usitatissimum*) Tolerance to Soil Applied Herbicides. Joseph Mettler[1]*, Kirk Howatt[1], Caleb Dalley[1];[1]North Dakota State University (116)

North Dakota is the leading producer of flax in the United States, accounting for about 75% of production and 65% of acreage. Flax is a weak competitor against weeds and has relatively few pre- and post-emergence herbicides registered for use. Soil applied pre-emergence (PRE) herbicides are limited to ethalfluralin, trifluralin, mesotrione and sulfentrazone; additionally, glyphosate and carfentrazone can be applied pre-plant or PRE. Research conducted from 2019 to 2021 near Hettinger, ND suggests other soil applied herbicides such as pyroxasulfone, metolachlor and pendimethalin could be viable options for use in flax with less than 20% visible injury observed and no impact on yield. In 2025, an experiment was conducted at Fargo, ND to further investigate PRE and early post (ePOST) soil applied herbicide options. A commercial standard of trifluralin was applied PPI with bentazon + MCPA + clethodim applied POST across the study area to focus on crop response. PRE treatments evaluated included glufosinate, 2,4-DP-P, 2,4-D

amine, carfentrazone, saflufenacil, pyroxasulfone, metolachlor and dimethenamid, along with ePOST applications of pyroxasulfone, metolachlor and dimethenamid when flax was 1 to 2 inches tall. Saflufenacil (50 g ha^{-1}) and dimethenamid (1120 g ha^{-1} ePOST) resulted in nearly 20% visible flax injury 14 DA-A. Glufosinate (840 g ha^{-1}), 2,4-D amine (560 g ha^{-1}), pyroxasulfone (140 g ha^{-1} PRE and ePOST), and metolachlor (2100 g ha^{-1} ePOST), resulted in nearly 0% injury at 14 DA-A. Injury from all other treatments was 10% or less. Flax yield was reduced, compared to the standard (1810 lbs/A), following PRE applications of 2,4-D amine and ePOST applications of pyroxasulfone and dimethenamid. No treatment significantly increased yield compared with the standard.

Epyrifenacil (Rapidicil®) Programs for Burndown Weed Control in No-till Corn, Soybeans, and Wheat. Pat Clay[1]*, Garrison Gundy[1], Nathan Drewitz[1], Chris Meador[1], Andrew Rodstrom[1], Matt Griffin[1], Sam Noe[1];[1]Valent U.S.A. (117)

Epyrifenacil (Rapidicil®) is a novel, non-selective PPO-inhibitor currently being developed by Valent U.S.A. LLC. Rapidicil demonstrates unique characteristics compared to other PPO-inhibitor herbicides, as it can be translocated via both the xylem and phloem. At a rate range of 20 to 40 g ai ha^{-1}, Rapidicil has exhibited fast-acting and broad-spectrum control of both broadleaf and grass weed species. Currently, commercialization of Rapidicil is focused on burndown uses in corn, soybean, wheat, and non-crop areas/industrial vegetation management. Field and greenhouse trials conducted with Rapidicil throughout the United States have shown control or suppression of more than 70 broadleaf and grass weeds. Valent has evaluated control of key winter annual and summer annual weeds during the development of Rapidicil including but not limited to common chickweed (*Stellaria media* (L.) Vill.), henbit/purple deadnettle (*Lamium* spp.), kochia (*Kochia scoparia* (L.) Schrad.), common lambsquarters (*Chenopodium album* L.), downy brome (Bromus tectorum L.), wild oat (*Avena fatua* L.), and foxtails (*Setaria* spp.). Stewardship of Rapidicil will require mixtures with other effective modes of action to mitigate further development of herbicide resistant weeds. Numerous Rapidicil programs have been evaluated to confirm efficacy against proposed labeled weeds in no-till corn, soybeans, and wheat, including tank-mix combinations with glyphosate, glufosinate, dicamba, 2,4-D as well as mixtures with residual herbicides such as flumioxazin and flumioxazin + pyroxasulfone. Rapidicil is pending EPA registration and not available for sale.

Convintro™ Herbicide: A New Tool for Managing Amaranthus Species in Corn and Soybean. Ryan Rapp[1]*, Carl Coburn[1], Jody Gander[1], Katilyn Price[1], Zewei Miao[1], Emily Scholting[1];[1]Bayer Crop Science (118)

The continued development and spread of herbicide resistance constitutes a major threat to corn and soybean producers across the United States. Some Amaranthus species, such as waterhemp and Palmer amaranth, have developed resistance to multiple herbicide modes- and sites- of action and are among the most challenging broadleaf weeds to control. Bayer Crop Science is developing ConvintroTM, a herbicide technology that features the active ingredient diflufenican which is a Group 12 phytoene desaturase (PDS) inhibitor site of action. While diflufenican has been used in other countries for several years, its introduction to North America will offer growers a new active ingredient for control of Amaranthus spp. in corn and soybean production systems, pending EPA

approval. Given the increasing challenge of managing herbicide-resistant weeds, diflufenican is being evaluated in field trials in North America for residual activity on *Amaranthus* spp. and crop selectivity in soybean and corn. A preliminary update on diflufenican development will be given featuring performance data from field trials. Pending registration with the U.S. EPA, diflufenican would enable a new weed management tool that should be used in combination with other integrated weed management practices.

Evaluation of Bromoxynil Mixtures Applied with Graminicides. Daniel Beran[1]*, Joe Vassios[1];[1]Nufarm (119)

Dichlorprop-p is a phenoxy herbicide being developed for use in small grains for the control of kochia (*Bassia scoparia*) and other broadleaf weeds. A premix herbicide with dichlorprop-p plus bromoxynil has been developed and submitted for registration for postemergence weed control in wheat and barley. Previous research has indicated that the active ingredient dichlorprop-p is compatible with grass herbicides and is less antagonistic than 2,4-D. Studies were conducted at 3 locations in North Dakota in 2025 to evaluate the effect of bromoxynil and bromoxynil premixes with dichlorprop-p or MCPA on the efficacy of the wheat graminicides, flucarbazone, thiencarbazone, and pinoxaden. When averaged across sites, formulations of bromoxynil plus MCPA or bromoxynil plus dichlorprop-p tank mixed with flucarbazone or pinoxaden did not reduce the efficacy on green foxtail and wild oats when compared to the graminicides alone. Similarly, wild oat control was not reduced by bromoxynil mixtures when tank mixed with thiencarbazone. These results indicate that the premix herbicide of dichlorprop-p and bromoxynil is compatible with grass herbicides commonly used in wheat.

Exploring Herbicide Options for Narrow-leaved Blue Lupin (*Lupin angustifolius*). Breanne Tidemann[1]*, Shaun Sharpe[1], Robyne Davidson[2], Mark Olson[3], Brendan Alexander[1], Hiroshi Kubota[1];[1]Agriculture and Agri-Food Canada, [2]Lakeland College, [3]Private Consultant (120)

Aphanomyces root rot threatens the production of pulse crops in western Canada. Narrow-leaved blue lupin (*hereafter lupin*) is a pulse crop of interest in western Canada as it provides the residual nitrogen and soil benefits of a pulse crop, while being resistant to aphanomyces. Weed control is a noted challenge in lupin due to limited registrations and/or limited western Canadian weed control information on the products. The objective of this study was to investigate lupin crop tolerance and western Canadian weed control with potential herbicide options in lupin. Products categorized as pre-emergence residuals, pre-emergence burn-off products, and post-emergence foliar options were tested, along with a weedy check and a weed-free check. The study was conducted at 3 locations in Alberta and Saskatchewan from 2022-2024. Crop tolerance was generally high to pre-emergence products, however, precipitation was limited at all site-years indicating that further investigation is warranted, particularly with products where there were single site-years with injury. Post-emergence applications of topramezone and fomesafen resulted in severe crop injury causing yield loss. Weed control with pre-emergence products was limited due to limited precipitation, however, pyroxasulfone plus sulfentrazone and flumioxazin plus pyroxasulfone showed potential for use in terms of yield and weed control. Because of the dependency on precipitation for pre-emergent product activity, a layering strategy utilizing pre-emergence residual products combined with post-emergence products is likely warranted.

Harvesting Tall Fescue Seeds While Avoiding Annual Bluegrass (*Poa annua*). Clint Mattox[1]*;[1]USDA – ARS – Forage Seed and Cereal Research Unit (121)

Annual bluegrass (*Poa annua* L.) is a problematic weed in grass seed production systems. The presence of annual bluegrass in tall fescue (*Festuca arundinacea* Schreb.) seed production fields often results in contamination of the crop and additional seed cleaning costs. When grown together, morphological differences in plant height exist between these two plants, perhaps providing an opportunity to modify traditional harvesting practices with the goal to harvest crop seeds without weed seeds. It is hypothesized that harvesting just below tall fescue panicles that grow higher in the canopy will avoid collecting lower growing annual bluegrass panicles. To elucidate this hypothesis, two randomized complete block design field experiments took place in Corvallis, Oregon on second year stands of tall fescue. Treatments included swathing moistures (15%, 25%, 35%, & 45%), swathing heights (5 cm and 28 cm), and swathing methods (swather and combine), along with a late season direct harvest treatment. There was no evidence that tall fescue yield was affected by altering the swathing heights when seed moisture was between 18% and 45%. When seed moisture was reduced to 10%, direct harvest seed yield decreased compared to traditional harvesting at higher percentages, likely because of seed shattering of the tall fescue. Annual bluegrass was not present in the first iteration of this experiment; however, there was strong evidence in the second iteration that annual bluegrass seed contamination was higher when tall fescue was harvested at 5 cm compared to 28 cm, demonstrating promise for further research.

Corrections in Adjuvant Use for Optimizing Herbicide Activity. Richard Zollinger[1]*, Kirk Howatt[2], Greg Armel[1];[1]AMVAC Chemical Company, [2]North Dakota State University (131)

Herbicide physical properties, formulation, adjuvant properties of the herbicide formulation, and herbicide salt moiety affect herbicide efficacy. Postemergence (POST) herbicide efficacy is influenced by added adjuvant type, active ingredient, mode of action, and rate. Generally, POST herbicide labels are written for non-preferential inclusion of nonionic surfactants, oil concentrates, and ammonium fertilizers in the form of ammonium sulfate or 28% urea ammonium nitrate. Most herbicide labels do not specify optimum adjuvant type, active ingredients, concentration of the adjuvant active ingredient, or optimum adjuvant rate or combinations. Lack of specificity results in decreased herbicide activity. For example, labels of hydrophilic herbicides include oil adjuvants which may antagonize the herbicides. High-surfactant oil concentrate (HSOC) adjuvants consisting of 25 to 50% surfactant/emulsifier plus a minimum of 50% oil were developed for use when combining hydrophilic and lipophilic herbicides to avoid antagonism of the hydrophilic herbicide and enhance activity of the lipophilic herbicide. Historically, oil adjuvants were applied on an area basis (per hectare or acre). Over time oil adjuvant rates evolved from an area basis to a volume basis (% v/v). Oil adjuvants applied on a volume basis may be insufficient to optimize herbicide efficacy if applied in spray volumes less than 234 L/ha (25 GPA). Oil adjuvants applied on an area basis (L/ha, pt/A) optimize herbicide activity independent of spray volume. Ammonium sulfate (AMS) enhances herbicide absorption and ameliorates antagonistic minerals in the spray solution. The ammonium ion of AMS activates the proton pump mechanism in plants resulting in greater herbicide absorption and efficacy. Acidification adjuvants are often named AMS (ammonium sulfate) Replacement or Water Conditioning adjuvants and may contain no or low

concentrations of AMS and can decrease spray solution pH to less than 4 which may be less than the herbicide pKa. Water pH <5 may result in higher concentrations of nonpolar forms of weak acid herbicides which can pass more easily through lipophilic cuticles and barriers. Substituting water conditioning adjuvants for AMS with POST weak acid herbicides only partially ameliorates antagonism from cationic minerals and results in reduced herbicide efficacy. Lowering spray solution pH with acidifying adjuvants also decreases water solubility of some herbicides, primarily Group 2 and 27 herbicides. Insolubilized herbicide molecules are not absorbed by plants, become inert, and reduce efficacy of the POST herbicide. Herbicide efficacy is reduced more as spray solution pH decreases. Basic pH blend adjuvants increase spray solution pH to 9 which increases herbicide water solubility and increases activity of many weak acid herbicides. Herbicides could be better optimized if herbicide labels specify optimum adjuvants, adjuvant combinations, and correct adjuvant rates. Lipophilic herbicides could be optimized if applied with methylated oil adjuvants and the oil adjuvants applied on an area basis. Weak acid herbicides could be optimized if AMS was used instead of acidification adjuvants and if spray solution pH was adjusted to alkaline pH for herbicides where water solubility increases as spray solution pH increases, particularly Group 2 and Group 27 herbicides.

Glufosinate Application Rates, Time of Day, and Adjuvants for 24-hour Autonomous Spot Spraying in Grass Seed Production. Kyle Roerig[1]*;[1]Pratum Co-op (132)

Several companies are developing machines that identify and spray grass weeds growing in grass seed production fields in western Oregon. These sprayers are mounted to a tractor and operate semi-autonomously, identifying and spraying weeds, while the operator only needs to turn the tractor around at the end of fields. These types of systems have the potential to save significant costs to the grower and may even offer the possibility of higher accuracy than hand spot spray crews. Spot spraying is often an essential step in producing grass seed that meets high purity standards. Since spot sprayers use light exclusion boxes with artificial light in the identification process, 24-hours spot spraying is theoretically possible. A likely herbicide to be used in this system is glufosinate. Glufosinate efficacy can be influenced by light intensity at time of application. These trials were conducted to assess the effect of daylight on the efficacy of glufosinate on weedy grasses by spraying treatments at intervals for 24 hours. Adjuvants were also evaluated during night applications to assess differences in efficacy without sunlight. The results from this study indicate that night applications result in increased weed canopy cover as compared to applications made in daylight. The addition of AMS increased the activity of glufosinate applied at night but may still result in unsatisfactory control.

The Utility of Glufosinate for Weed Management in the Western US. Philip Westra[1]*;[1]Colorado State University (133)

Western US weed management with Glufosinate.

Stale Seedbed and Cover Crop Techniques in Alfalfa Establishment. Clint Beiermann[1]*, Albert Adjesiwor[2];[1]University of Wyoming, [2]University of Idaho (134)

Competition from annual weeds emerging at the time of alfalfa planting can affect the successful establishment and nutritive value of alfalfa forage at first harvest. Stale seedbed weed management

involves the use of a sequence of tillage prior to crop planting to stimulate weed germination prior to crop planting. In 2025, field trials were initiated near Kimberly, ID and Lingle, WY to determine whether a sequence of stale seedbed tillage or a cover crop terminated with tillage or herbicide improved weed control in alfalfa establishment. The trial was designed as a strip plot, with tillage, no-tillage, or wheat cover crop as strip plot treatments. Strip plot tillage occurred on April 9 in both locations. The main plot treatment consisted of tillage or spraying glyphosate 21 days after strip-plot tillage, or tillage or spraying glyphosate 42 days after strip-plot tillage. Treatments tilled or sprayed at 42 days were also tilled at 21 days. All main plot treatments were planted with alfalfa on the same day as the final tillage or spraying treatment. First harvest alfalfa yield was increased by 47 and 74%, when planted April 30 compared to May 21, at Kimberly and Lingle, respectively. Tillage prior to planting increased first harvest alfalfa yield, compared to glyphosate application, at Kimberly from 265 to 480 kg ha^{-1}, but had no effect at the Lingle site. May 21 planting reduced total weed density at first harvest at both trial sites.

A Historical Ecology Approach to Smooth Scouring Rush (*Equisetum laevigatum*) Management. Nick Bergmann[1]*, Joaquin Casanova[1];[1]Washington State University (135)

Paper withdrawn

Performance of Deep Learning Models for Palmer Amaranth (*Amaranthus palmeri*) Detection in Grain Sorghum in No-till Dryland Production Systems of Western Kansas. Jeremie Kouame[1]*, Augustine Obour[1], Anita Dille[1], John Holman[1];[1]Kansas State University (136)

Palmer amaranth [*Amaranth palmeri* (S.) Wats.] is one of the most problematic weeds in dryland production systems of western Kansas. It is very competitive with grain sorghum [*Sorghum bicolor* (L.) Moench] for the already limited soil moisture, and it is becoming harder to control because it has evolved resistance to several herbicides, has an extended emergence, a high growth rate, and a high seed production. Effective control of Palmer amaranth requires herbicide programs targeting multiple sites of action. In this context, broadcast application of herbicides can become costly. Therefore, applying effective herbicides only where Palmer amaranth patches exist via a site-specific weed management (SSWM) system can help farmers in western Kansas to improve control and reduce herbicide input and application costs. Targeted application sprayers are available for SSWM in corn, soybean, and cotton. In contrast, such technology is not available for grain sorghum, a major crop in western Kansas. Effective use of deep learning techniques, combined with computer vision, has the potential to discriminate between Palmer amaranth and grain sorghum. However, few studies have used deep learning for Palmer amaranth detection in grain sorghum in western Kansas. This study investigated the use of object detection algorithms to detect Palmer amaranth in western Kansas no-till dryland grain sorghum production systems, pioneering the use of such technology. The objectives were to (1) develop an annotated image database of Palmer amaranth in no-till dryland production grain sorghum of western Kansas, 2) train five variants/sizes of the "You Only Look Once" (YOLO) object detection model (YOLOv8n, YOLOv8s, YOLOv8m, YOLOv8l, and YOLOv8x) to locate and identify Palmer amaranth in field images, and (3) compare the effectiveness of the Yolov8 model variants for Palmer amaranth detection. Images of natural populations of early-season Palmer amaranth were collected aerially and at ground level during summer 2025 in grain sorghum fields established in

no-till production systems in Hays, KS. A total of 582 annotated images were supplemented with 1,622 publicly available annotated Palmer amaranth images to train the YOLOv8 model variants. Mean average precision (mAP50 and mAP50-95) was used to evaluate the performance of the object detection model variants. Results demonstrated that all variants of YOLO v8 achieved good Palmer amaranth detection, with precision and recall ≥ 90% and ≥ 82%, respectively. The mAP50 to locate and identify Palmer amaranth within an image was 90.5, 96.3, 97.5,97.8, and 98.0% for YOLOv8n, YOLOv8s, YOLOv8m, YOLOv8l, and YOLOv8x, respectively, while the mAP50-95 was 61.0, 72.1, 76.1, 78.4, and 80.0% for YOLOv8n, YOLOv8s, YOLOv8m, YOLOv8l, and YOLOv8x, respectively. The results suggest that, under dryland no-till field conditions with residue cover, using YOLOv8 for object detection is promising for detecting Palmer amaranth when sufficient data are available. Combining deep learning Yolo models, drone-based remote sensing, and computer vision can be an effective option for developing SSWM strategies in western Kansas to reduce herbicide inputs and costs.

Remote Sensing-based Weed Counts and Growth Characterization Across Wheat Varieties. Pete Berry[1]*, Andrew Branka[1];[1]Oregon State University (137)

Using remote sensing to quantify interactions between wheat growth architecture and weed suppression improves our understanding of varietal competitiveness and canopy dynamics. This study evaluated seven winter wheat varieties representing a range of growth habits, from highly tillering to upright crop structure. Wheat varieties were drilled in the fall of 2024 and monitored throughout the production season using repeated ground-based and aerial measurements. In-field weed counts were conducted using replicated 0.5 m² quadrats, with weeds quantified both adjacent to crop rows and between rows. Red:far-red (R:FR) light ratios were measured with a Light Scout meter to characterize varietal differences in light interception and competitive suppression. Unmanned aerial system (UAS) imagery was acquired at multiple growth stages using high-resolution RGB sensors and LiDAR. Imagery and point clouds were used to estimate leaf area index (LAI), canopy closure, and biomass proxies, enabling quantification of temporal differences in crop growth among varieties. Image-derived weed counts were compared with manual field counts to assess remote sensing-based values. Results showed weed counts derived from imagery were similar to manual counts, however, weed counts adjacent to rows were more variable. Varieties differed in their capacity to suppress weeds; however, there were no differences in yield. Lower red:far-red (R:FR) ratios were associated with increased tillering and reduced weed pressure. These findings highlight the utility of integrating remote sensing to identify growth characterization within wheat varieties that could be utilized in breeding programs to reduce weed pressure.

LiDAR and Multispectral Sensing to Quantify Herbicide Phytotoxicity and Recovery in Tall Fescue. Pete Berry[1], Andrew Branka[1]*;[1]Oregon State University (138)

The Willamette Valley of Oregon produces 88% of all tall fescue grown for seed in the United States. With the advancement of machine-vision-guided application systems, precision spot-spraying technologies are now being integrated into tall fescue seed production. However, accurately quantifying crop herbicide phytotoxicity and subsequent stand response within spot-treated areas remains challenging. LiDAR and multispectral imaging provide insight into crop

phytotoxicity, row closure, volumetric impacts, and regrowth from randomly distributed spot treatments by assessing isolated area changes over time. A trial was established at Oregon State University to assess crop damage and regrowth following different percentages of spot sprayed areas. Tall fescue plots with phytotoxicity ranging between 0 - 50% were flown at 0, 14, 28, 56, 104, and 214 days after application (DAA). Comparison of visual ratings and aerial imagery found the highest assessed phytotoxicity at 14 DAA (visual) matched the imagery analysis at 28 DAA. Phytotoxicity measured by changes in leaf area index (LAI) were similar from 28 to 56 days. By 104 DAA, maximum phytotoxicity ratings below 25% were similar to the untreated check when comparing LiDAR derived volumes. Collectively, these results provide a quantitative threshold for acceptable crop injury following spot-spray applications in tall fescue systems and demonstrate that remote sensing enables novel, objective based approaches to quantifying crop phytotoxicity and recovery dynamics. Keywords: precision weed management, spot spray, LiDAR, tall fescue, drone

Post-emergence Herbicide Options for Palmer Amaranth Control in Arizona Cotton Systems. Avik Mukherjee[1], Bhupinder Singh[1], Randy Norton[1]; [1]University of Arizona (139)

Herbicide-resistant Palmer amaranth (*Amaranthus palmeri)* continues to threaten cotton production in Arizona, where resistance to multiple herbicide sites of action, including glyphosate and acetolactate synthase (ALS) inhibitors, is widespread. The recent prohibition of dicamba use in 2024 has further constrained post-emergence weed control options, intensifying the need for effective and sustainable management strategies. This study assessed the performance of selected pre- and post-emergence herbicide programs for Palmer amaranth control under the arid conditions of Central Arizona. Field experiments were conducted at the University of Arizona Maricopa Agricultural Center using Enlist- and dicamba-trait cotton cultivars in a randomized complete block design with four replications. Herbicide treatments consisted of labeled combinations of glyphosate, glufosinate, acetochlor, pyroxasulfone, diuron, and 2,4-D choline. Weed control efficacy was evaluated through visual suppression ratings, biomass reduction, and plant height measurements up to four weeks after application. Results indicate that integrated, multi-site-of-action herbicide programs provided superior Palmer amaranth suppression compared with single-mode approaches. Collectively, these findings offer regionally relevant guidance to support herbicide stewardship, mitigate resistance development, and sustain cotton productivity in Arizona's low-desert production systems.

WSWS PROJECT 4: TEACHING AND OUTREACH

Surveying the State: Evaluating Remotely Sensed Estimates of Rangeland Vegetation Across Wyoming. Chloe Mattilio[1]*, Jaycie Arndt[1], Brian Mealor[1];[1]University of Wyoming (128)

Abstract not Available

The Label Game: Learning Contents of Herbicide Labels. Jeanne Falk Jones[1]*, Sarah Lancaster[1];[1]Kansas State University (129)

The Label Game was created to help commercial applicators, farmers and agronomy professionals better understand the contents of herbicide labels. This was a hands-on activity, with competition involved. This activity was used during the K-State Crop Pest Management Schools in 2025.

Coordinated Stinknet (*Oncosiphon pilulifer*) Control in Southern Arizona. Kelsey Landreville[1]*, Noah DeFino[1]*, Amanda Aguilar[1]*;[1]Pima County Conservation Lands & Resources (130)

The Sonoran Desert Cooperative Weed Management Area (SDCWMA) identified a need several years ago for a working group to focus on coordinating a response to the growing stinknet (Oncosiphon pilulifer) infestation seen in Southern Arizona. Participants in the SDCWMA represent a variety of organizations that manage invasive species in Southern Arizona and representatives from these organizations came together to form the Stinknet Taskforce. Since its creation, this taskforce and its committees have coordinated efforts to control stinknet, manage shared data including reports from the public, increase outreach efforts to the broader community, and facilitate sharing of lessons learned. This collaborative group has improved communication for land managers and volunteers through the creation of a stinknet newsletter to keep everyone informed. The group has also worked to share stinknet data across organizations and respond to stinknet reports from the public. The stinknet.org website was created as a resource and reporting tool for anyone to use. The group has also collaborated on producing outreach supplies and attending popular community events to help educate the public on stinknet and encourage them to remove and report any plants they find. Participants of the Western Society of Weed Science Annual Meeting will be updated on the current status of stinknet infestation in Southern Arizona and are encouraged to connect with the Stinknet Taskforce by contacting stinknetaz@gmail.com. All are welcome to join SDCWMA meetings and participate in the collaborative effort to prevent the spread of stinknet.

WSWS PROJECT 5: BASIC BIOLOGY AND ECOLOGY

Detection of Glyphosate-resistant Kochia (*Bassia scoparia*) in Utah and Preliminary Insights into Resistance Mechanisms. Olanrewaju Adeyemi[1]*, Eric Westra[1], Corey Ransom[1], Earl Creech[1], Mirella Ortiz[1];[1]Utah State University (096)

Kochia (*Bassia scoparia*) is an increasingly herbicide-resistant weed across the western U.S., posing significant challenges to weed management. Although glyphosate resistance in kochia has been reported in several western states, Utah has lacked updated resistance data since 1998. This research aimed to: determine the distribution and frequency of glyphosate resistance in Utah kochia populations and evaluate whether altered herbicide absorption or translocation contributes to resistance. During 2024-2025, kochia seeds were collected from all 29 Utah counties and screened in the greenhouse using glyphosate at the field-use rate (1,731.4 g ae ha^{-1}). Survival was assessed 21 days after treatment, and populations were classified as susceptible (<2% survival), low resistance (2-19% survival), or resistant (>20% survival). Results indicated that 10% of populations were resistant and 17% exhibited low resistance, for a total of 27% not fully controlled by glyphosate. Dose-response experiments on the highest-surviving population exhibited a 12-fold

glyphosate resistance. To quantify absorption and translocation, resistant and susceptible biotypes were treated with ^{14}C-labeled glyphosate. Glyphosate absorption increased rapidly and plateaued near 70% in both biotypes, with no significant differences observed. Translocation patterns and the time to reach 90% of maximum absorption and translocation were also similar between populations. These findings suggest that glyphosate resistance in Utah kochia is not associated with reduced absorption or translocation, indicating that alternative mechanisms, such as enhanced metabolism or altered target-site sensitivity, may be involved. This study confirms the presence of glyphosate-resistant kochia in Utah and highlights the need for integrated weed management strategies.

First Documented Case of *Daucus carota* Resistance to Flazasulfuron. Davi Fiedler[1]*, Marcelo Moretti[1];[1]Oregon State University (097)

Daucus carota L. (wild carrot) is a biennial invasive weed widely distributed in perennial cropping systems and roadsides throughout Oregon. In hazelnut, control of D. carota relies primarily on flazasulfuron. Increasing reports of control failures have raised concerns about herbicide resistance. This study aimed to confirm flazasulfuron resistance and explore potential resistance mechanisms of. Six D. carota populations were evaluated using whole-plant dose-response assays. Three populations were confirmed to be flazasulfuron-resistant (FR), with GR_{50} values 54.2-, 117.2-, and 34.3-fold higher than that of the flazsasulfuron-susceptible (FS) population (GR_{50} of 50 g a.i. ha^{-1}). The remaining populations indicated mixtures of FR and FS; however, their responses were highly variable and could not be reliably fitted to the dose-response model. This suggests that resistance development may be in an early phase. The FR populations were also resistant when treated with flazasulfuron at the pre-emergence stage. Approximately 80 g a.i. ha^{-1} of flazasulfuron were sufficient to control the susceptible population, whereas neither resistant populations gave a detectable response to flazasulfuron at the tested rates. Whole-plant dose-response experiments using malathion as a cytochrome P450 inhibitor did not differ in flazasulfuron response between treatments with and without the inhibitor ($p = 0.27$), indicating no evidence of cytochrome P450-mediated resistance. This study confirms the evolution of flazasulfuron resistance in D. carota in Oregon hazelnut production and indicates that resistance is unlikely to be driven by cytochrome P450-mediated metabolism. Therefore, further investigation is warranted to reveal alternate resistance mechanisms, particularly potential target-site mutations in the ALS gene.

The Natural Herbicide Rhein Targets Photosystem I. Alyssa Twitty[1]*, Franck Dayan[2];[1]University of Arizona, [2]Colorado State University (098)

The natural anthraquinone rhein has been identified as a novel herbicide with a potentially new mode of action using a generative AI system for functional molecules discovery. Its herbicidal activity was light-dependent and resulted in rapid burndown symptoms on leaves of treated plants. Rhein interferes with photosynthesis by acting as an electron diverter at the level of photosystem I (PSI). The redox potential of rhein suggests that it accepts electrons between P700 and NADP+ of PSI. This is consistent with the redox potential of rhein that enables it to accept electrons from flavoproteins. Ferredoxin-NAPD+ reductase is a flavoprotein with a redox potential near that of rhein. Thus, it is currently hypothesized that rhein acts as an electron acceptor at or near the PSI

Ferredoxin-NAPD+ reductase to form a radical and generate reactive oxygen species that drive the light-dependent herbicidal effect which is observed in treated plants from greenhouse trials.

Hyperspectral Sensing for Early Detection of Small Broomrape (*Orobanche minor*) Parasitism in Red Clover. Prayusha Bhattarai[1]*, Jing Zhou[1], Pete Berry[1];[1]Oregon State University (099)

Small broomrape (*Orobanche minor* Sm.) is a holoparasitic weed that affects red clover (*Trifolium pratense* L.) seed purity, as the presence of small broomrape seeds is cause for red clover seed lot rejection. Most of the small broomrape's life cycle occurs belowground, and by the time it emerges, management options are limited. Early detection of the parasitic weed, therefore, could enable site-specific management and prevent weed seed production and contamination. This study aimed to evaluate the use of hyperspectral imaging for early detection of small broomrape parasitism before emergence by monitoring changes in spectra obtained from the host plants. Greenhouse experiments were conducted in 2025 with parasitized and non-parasitized red clover plants as treatments. Leaf reflectance spectra were collected across 350 - 2500 nm wavelengths using an ASD FieldSpec spectroradiometer. The timing of small broomrape emergence was recorded for each parasitized plant, and reflectance between the control and parasitized plants was compared using a linear mixed-effects model. Results indicated differences between control and parasitized clover plants before emergence in the near-infrared (800 - 1300 nm) and shortwave infrared (1550 - 2400 nm) regions of the spectra. These spectral differences were not observed at 28 days before emergence, but were observed at 21, 14, and 7 days before small broomrape emergence. These findings identify specific spectral regions with the potential for early detection of small broomrape parasitism in red clover using hyperspectral sensing technologies.

Group 27 Premix Dose Response on Waterhemp (*Amaranthus tuberculatus*) for Wheat (*Triticum aestivum*). Ethan Mewes[1]*, Kirk Howatt[1], Joseph Mettler[1];[1]North Dakota State University (100)

Waterhemp (*Amaranthus tuberculatus* (Moq.) J. D. Sauer) is a competitive broadleaf weed that is difficult to manage due to its dioecious nature and ability to germinate throughout the growing season. A greenhouse study generated dose response curves of eight herbicide treatments labeled in spring wheat. Treatments included 2,4-D-ester, bromoxynil, tolpyralate, bicyclopyrone, pyrasulfatole, bromoxynil + tolpyralate, bromoxynil + bicyclopyrone, and bromoxynil + pyrasulfatole. The study was established in a randomized complete block design of eight rates (0x - 31.7x), with eight replicates and repeated. Data were analyzed within herbicide using a 3-parameter logarithmic regression model in JMP software to generate an effective dose of 85% visual control and biomass reduction of waterhemp 28 DAA. In addition, a second analysis was conducted using Colby's method to determine if synergism occurred with herbicide combinations using a matched paired t-test. Results indicated that tolpyralate achieved 85% visual control and biomass reduction at the lowest rate among the Group 27 herbicides. In addition, bromoxynil + tolpyralate achieved targeted visual control (15 grams ai ha^{-1}) and biomass reduction (8 grams ai ha^{-1}) at the lowest rate among the herbicide premixes. Results also indicated that at the 1x rate, bromoxynil + tolpyralate and bromoxynil + pyrasulfatole were synergistic. Notably, the premixes all provided reliable control, achieving at least 90% visual control at the 1x rate, with bromoxynil

+ tolpyralate achieving 97% visual control. This study concluded that bromoxynil + tolpyralate provided the most consistent and effective waterhemp control for spring wheat.

Establishing a Tissue Culture-based Transformation System for Cheatgrass (*Bromus tectorum* L.) to Enable Functional Genomic Studies. Shahbaz Ahmed[1], Jonah Mensonides[1], Ian Burke[2]; [1]Washington State University, [2]North Carolina State University (140)

Cheatgrass (*Bromus tectorum* L.) is one of the most invasive annual grasses in the western United States. It has spread extensively across rangelands and cropping systems and increasingly expresses herbicide resistance. Despite its ecological and agricultural significance as a major invasive weed, functional genetic studies in cheatgrass have been hindered by the absence of a reproducible transformation system. Here, we report the first successful protocol for *Agrobacterium tumefaciens*-mediated genetic transformation of cheatgrass. Mature and immature embryos were evaluated as explant sources to optimize callus induction and regeneration. Callus formation from immature embryos began earlier than from mature embryos, which required a longer culture period. Hygromycin-resistant calli expressing green fluorescent protein (GFP) were obtained from both explant types, confirming successful genetic transformation. Following *Agrobacterium* transformation, calli derived from immature embryos regenerated green, viable shoots, whereas those from mature embryos frequently produced bleached, chlorophyll-deficient tissues. PCR amplification of *GFP* and *hygromycin phosphotransferase (HPT)* confirmed stable integration of transgenes into the cheatgrass genome. Our work presents the first reproducible immature embryo-based transformation system for cheatgrass, enabling molecular genetics and functional genomics studies in weedy grasses

SYMPOSIUM: The Pacific Northwest Herbicide Resistance Initiative: An Invitation to Collaborate

In order to find durable and practical solutions to the complex sociobiological problem of herbicide-resistant weeds, robust research funding mechanisms that adequately support innovative collaborations are needed. The Pacific Northwest Herbicide Resistance Initiative (PNWHRI) – first funded in 2022 to address herbicide-resistant weeds in the PNW cereal-producing regions – includes researchers from three regional USDA-ARS research units and the land-grant universities, Oregon State University, University of Idaho, and Washington State University. The main objectives of the PNWHRI are to leverage these resources through intra- and interdisciplinary collaboration to make novel contributions to science that prevent and reduce the extent of herbicide resistance. Through an overview of the PNWHRI and a showcase of its ongoing projects, we hope to use this symposium to engage the audience in potential future collaborative opportunities beyond the PNW. This symposium will provide a unique opportunity for the Western Society of Weed Science to highlight a regionally coordinated, federally funded model for managing herbicide resistance through applied research, stakeholder engagement, and interagency collaboration. By showcasing the structure, approach, and progress of the PNWHRI, we aim to spark dialogue on how similar frameworks could be implemented in other regions. The symposium will feature key project outcomes, lessons learned from cross-institutional collaboration, and ongoing research activities, while also fostering new opportunities for cooperation across

geographic and institutional boundaries. Our objective is to share practical insights, facilitate knowledge exchange, and inspire broader, systems**-based solutions to herbicide resistance that extend beyond the Pacific Northwest.**

PNWHRI Origins, Inception, and Objectives. Ian Burke[1]*;[1]North Carolina State University (122)

Herbicide Resistance Surveys and Using Light for Weed Control. Joan Campbell[1]*;[1]University of Idaho (123)

Tools for Herbicide Resistance Characterization. Olivia Landau[1]*;[1]USDA-ARS (124)

Utilizing Germination Ecology as a Tool for Resistance Management. Albert Adjesiwor[1]*;[1]University of Idaho (125)

Integrating Tillage into No-till Systems to Mitigate Herbicide Resistance. Judit Barroso[1]*, Nicole Durfee[2], Fernando Oreja[3], Stewart Wuest[2], Vhuthu Ndou[1];[1]Oregon State University,[2]USDA-ARS,[3]Clemson University (126)

Herbicide Resistance in Grass Weed Species in Oregon Cropping Systems. Victor Ribeiro[1]*;[1]Oregon State University (127)

SYMPOSIUM: Panel Discussion: Transdisciplinary Collaboration to Improve Herbicide Resistance Management

A Human Geographer's Perspective. Nick Bergmann[1]*;[1]Washington State University

Cropping System Extension Educator's Perspective. Doug Finkelnburg[1]*;[1]University of Idaho

An Agricultural Economist's Perspective. Pat Hatzenbuehler[1]*;[1]University of Idaho

An Early-Career Weed Scientist's Perspective. Pete Berry[1]*;[1]Oregon State University

A Mid-Career Weed Scientist's Perspective. Ian Burke[1]*;[1]North Carolina State University

DISCUSSION SESSIONS

Project 1 Discussion Session: Pasture, Range, Forestry, and Natural Areas

Moderator: Jake Courkamp

Co-Moderator: Kelly Pruitt

Topic: *How can Weed Scientists do Research that is more Relevant to land Managers?*

Weed science is shifting and adapting - new tech - drones. Building on that, take that lens of change and put together research that is useful or helpful to land managers.

Publish papers with land managers (LM). More ownership with the LM? Tension between demonstration and research. Underestimate value of weed management.

Joe: Research on actual herbicide is fantastic but nice to see expanded into other areas such as wildlife and impacts to other elements of the ecosystem. Ancillary effects around herbicides. Mule deer study and how treatments impact wildlife is helpful. Reach out just beyond the weed control aspect.

Julie: It's important to keep in mind the scale of things. Long term issues. Lots of different ideas but financially limiting range v crop fields need to be relatable to land managers.

John: Clients research ideas such as steaming, goats, etc and don't realize difficulty in implementing that including the money.

Lisa: More economic studies

?: What are some of the more recent scientific studies that weed managers have adopted. Rejuvra

Use of sulfentrazone - not thought about in the past now into play

Jake: Interview rangers and LM in NW CO ventanata. Where do you start to find info on managing weeds? I searched the internet. Steaming and goats and NPR-type stories

John: There is a poster on weed list in UT. States inadvertently create these lists but some don't understand priorities. Annual grasses (AGs) are at the bottom of the priority list but that is what people want.

?: What influences industry and then tie into how weeds are listed and how they are managed.

Jake: Are you suggesting the triage of Lists A,B, and C could obscure others? When all large scale problems are list c then are smokescreen for other problems

Look at the scale of the entire state, the tiers make sense. But locally I'm thinking about what my priorities are. What are most important for me as LM.

Tim: We call them EDRR. What you want to avoid is those then becoming a big C problem. Don't de-emphasize that you need a different solution. Idaho has cooperative weed management areas where they set their own priorities. As well as mulit-county or state groups. They are funded via lump sum maintenance and bond with USFS BLM to contribute. Funders will want you to address the state list then become flexible with other lists.

Jane: Local priorities happen regardless of weed list. Managers make decisions on a local level

Jake: Whole middle section of problematic plants.

Better job thinking about limited working environment of resources available for LMs

Julie: Economics of species on list - with perennial pepperweed as an example, we have good tools but it's not EDRR or IAG but it is on the list. To help us as LM to understand and make the economics worse - look at the cost of losing resources and relate to recreation. Bridging that gap is hard to come up with those numbers, especially with Sage grass and mule deer. Those are hard numbers to come up with and have an economic twist

Jake: The third leg of stool - Weed Scientist (WS), LMs and the funding component to support the work coming through the pipeline.

Need to learn what research isn't useful.

Tim: Try to address situations like that and ask for input on group level

Rocky Mountain National Park rejected sesame seed oil as exceeding their acceptable toxicity levels.

John: Learn which targets are a priority and then provide more information and come up with a herbicide mix for some products with least amount of active ingredient as possible.

Jake: We saw that with Shannon's bare ground talk. Also, I've done that inadvertently, wanted a study on X weed but only found sites with XYZ weeds. Ex. Canada thistle on the East Beech reed canarygrass study. Maybe get more applicable results.

Derek: See all studies and data but hard going back to individual states. See it as a la cart and not as a big picture situation.

Corey: Sounds like tort law as agencies can get sued for this. Elongated mustard (?) herbicide treatments might cause cancer in tortoises. Then if a fire went through an untreated area, how many tortoises would survive? We need to show the consequences of doing nothing. They are starving for food supply, run over by fires. Now expose thousands more acres of habitat since we didn't spray. Risk averse.

Jake: Fire breaks.

Joe: The problem Kelly and I face is from those who are opposed to pesticides and they typically have small patch of land and can handpull weeds and not have to use herbicides. Then have this unbending opinion of herbicides and hold us at bay sometimes. This is a big challenge. Can't argue our way out of it. We've tried the cost of doing nothing. No impact. If they have the ear of Board of County Commissioners, just watch things go the wrong way.

Corey: Utah put in new reservoir. An opposition to herbicides group pulled leafy spurge by hand then asked if there's another way to manage as pulling didn't seem feasible anymore.

Joe: Post Marshall fire we treated open spaces such as 400 acres at Hall Ranch with Rejuvra and that is what started it all. Stone canyon fire - good look at real life event. As there was a group of

critics of the fire retardant used. But they quickly got shut down by other homeowners who wanted to protect their properties.

John: My first Rejuvra project, citizens tried to stop it. They dropped it but it started from the Boulder County intensity.

Jake: Opposition is very vocal but supporters are the quietest.

Jane: What managers need but pulled in socioeconomics. Many people we interact with want to do something about invasive plants. Secondary invasion or a product is too expensive. Lots of limitations, what is the research? One end, a group of managers say it's already been done in Utah and don't think it is necessary. Other end. The manager says till I see it work in my areas, then I don't trust what went on in UT. How do we bridge that spectrum?

John: Using equipment and practice similar to what LMs are using. Coverage? Integrate practical tools into the research

Jane: Partner with practitioners for research to use field equipment.

Shannon: Drones - no label guidelines or nozzle types. Research hasn't led the way yet.

Tim: Apply for grants then get denied. States are involved in writing regs for drones. Growing pain area but will be a useful tool once worked out.

Shannon: Private funding still available. Need more people to do the work. Hard to find partners.

Tim: got new US large drones to seed and spray.

Jake: Took students to Greeley to the weed district's drone application. Treatment area was under two acres and they had to refill the drone four times.

Tim: Challenge with drones there's another class of license and regs. LMs have been using drones for years so are ahead of it.

John: Science lagging and people winging it in how they should be applying herbicides.

Jane: Important to recognize science is conservative. Way more conservative about saying something works compared to the practitioner audience. Science takes time based on consensus and based on scientific questions. Non-scientific audiences don't understand. Interested in hearing from LM how you reconcile that when making decisions. Could be another gap between LM and WS.

Jake: EDRR. But don't have research to inform

Jane: EDRR has happened. New concept when working on PhD. Seminar on EDRR in 2002. Not cutting edge but enough as there are programs now. EDRR don't experiment, just go after it in isolated areas. Different scenario when developing solutions for larger scale situations. Maybe public is more accepting when showing risk of doing nothing.

EDRR v Wide distribution. Figure out best place to work where we get biggest return on investment. Refer to mesquite study has value with that type of research. Not sure we are doing better in that realm? How do we come up with thresholds? Manage and get return to end up in better place. Not doing that great with SK or rush.

Jake: Questions for environmental heterogeneity. What is the threshold for my ranch? What is the efficacy but also best time to intervene?

Corey: Use Dewey's fire model. Rush skeletonweed. Spot fires can you ever win? Look back at how do we prioritize. Is there a bigger question about if it has an epicenter, does it make sense to manage that location as well?

Jake: With annual grasses (AGs), has become defend the core(?) Have a tool in Rejuvra that can take 100% AGs and turn into dirt. Thinking about those really infested places where you'd get the most return on investment.

Shannon: LMs already do that. How do we get more research driven from LMs and not university so we are finding most beneficial solutions.

Tim: Work on that interfacing with WMAs. have collaborative relationships with grower driven work.

?: Recruit LMs maybe don't have a research background.

Shannon: Teach LMs how to do their own research. Very site specific to them then. They can still track efficacy.

Bob: Where are people getting ideas from for negative, then putting results on social media.

Jane: Email that Extension Bot, across the country. Type in question, and ai is only searching extension related materials. Searched for common tansy. A i tool that will only search extension. Extension bot Search say 'garlic mustard extension'

Julie: Researchers need to go to where managers are. Only from CO and WY are here. Get in front of people to build that trust. LMs want to see it on their own ground. Background and research is out there but some can't seem to find it.

?: Boulder community outreach are any of these grants going towards community engagement? Is that work also being funded. Bring all stakeholders to the table to facilitate in a structured way.

Tim: Really focus on smaller regional approach to get them to a meeting and ask what would be useful in that region? Ask here about bufflegrass with agency staff and counties. Will have WWCC joint meeting in Irvine.

?: Always try to do a side meeting the day before to bring specific stakeholders and LMs.

Julie: Done that with NAISMA. But I think it's worth either small scale or an all day event.

Shannon: Did ROW and WSWS combo. Brought in tons of LMs and was successful

John: There is a little bit of intimidation factor. Language is different. Symposium was good. Short course good. Using common language.

? SoCal: Put on partnership with CalIPC? Got 600 people to show up at the conference.

Corey: Do counties get invited? Cost prohibitive or timing?

?: Conference offers incentives.

Julie: Small fraction of people to spend the money and learn. Maybe if we got more credits, that would help. Can be overwhelming. Results could be presented in a different way?

Dahl: I was a nozzlehead. Need to have a meeting, with experts, throw in farmer panels, went over very well. Have that as part of the program.

?: Cattlemans have been doing that.

Tim: Have morning panels and have people to talk about their experience. Very well attended. Maybe try at the WSWS meeting.

Corey: Used to offer credits to most states but too onerous. Worth doing in state we are having meeting in?

Tim: EWM can be composted but not the hybrid.

Nominations for 2028 Section Chair (2026 Section Chair is Jake Courkamp)

Kelly Pruitt nominated Joe Swanson for 2028 Range section co-Chair. All approved.

Chair 2026:
Jake Courkamp, Colorado State University
jacob.courkamp@colostate.edu

Chair-Elect 2027:
Kelly Pruitt, City of Boulder Open Space and Mountain Parks
uhingk@bouldercolorado.gov

Chair-Elect 2028
Joe Swanson, Boulder County
uhingk@bouldercolorado.gov

Attendees: Lisa Jones (UI), Ashton Sellke (UI), Sofia Blair (UI), John Watson (CSU), Haley Monahan (CSU), John Coyle (Ark Valley Weed Management), John Walker (?), Jane Mangold (MSU), David Clements (Trinity University), James Jackson (Alligare), Julie Kraft (Sublette County, WY), Bob Finley (Fremont County, WY), Joe Swanson (Boulder County, CO), Damian Stoy (?), Ryan Robertson (?), Claire Anderson (?), Amber Pelon (CSU), Maloree MacDonald (USU), Derek Sebastian (Envu), Cody Beckley (USU), Josette Ball (?), Corey Ranson (USU), Shannon Clark (Envu), Scott Nissen (CSU – retired), Kelly Pruit (Larimer County, CO)

Project 2 Discussion Session: Weeds of Horticultural Crops

Moderator: Craig Alford

Topic: *Identifying our most troublesome Horticultural Weeds and What Has Led to Their Establishment*

Summary

Weed management in Western US specialty cropping systems is facing increasing constraints due to limited herbicide options, rising labor costs, and evolving weed pressures. In many specialty crops, herbicide tools are limited, leaving certain weeds uncontrolled. Historically, manual labor addressed these escapes, but labor shortages and high costs now reduce this option. Additionally, few new herbicides are being developed, and not all new active ingredients are suitable for high-value specialty crops due to crop safety concerns.

Cultural practices continue to affect weed communities. Intensive soil disturbance in annual cropping systems influences weed dynamics, while specific practices—for example buried drip irrigation in tomatoes in California—may suppress annual weeds but favor perennials. Crop rotation remains an important strategy, such as rotating corn before onions to manage nutsedge populations in eastern Oregon.

The western region's diverse and dynamic production systems present further challenges. Lower-value or poorly managed fields can serve as weed reservoirs, allowing spread into well-managed crops.

Equipment movement across states, including between Arizona and Oregon for the new weed control equipment like laser weeders, raises concerns about spreading invasive species. Equipment sanitation has become particularly important in managing broomrape, especially under California quarantine regulations. This has become an important tactic to highlight not just for weed management for integrated pest management.

Several problematic weeds were highlighted, including herbicide-resistant kochia in sugar beet, Palmer amaranth in Utah, stinkwort along California's North Coast, and broomrape in California and Oregon, with additional broomrape documentation in Washington sunflower systems.

Technological innovation is playing an increasing role in weed management. The new equipment may be useful for controlling troublesome weeds. Larger producers are adopting advanced tools such as Ecorobotix or Verdant smart sprayers, often using precision applications followed by broadcast treatments. However, high equipment costs and subscription fees limit access for smaller, diversified farms. There is potential for smaller companies and small diverse growers to develop in-house or small-scale precision technologies.

Research and regulatory processes of herbicides remain critical but challenging. The IR-4 program continues to screen herbicides for crop safety and support registrations, though registrations are time-intensive. There are fewer weed science priority submissions compared to other disciplines to the IR-4 Food Use Workshop. Industry investment and early-stage collaboration with universities appear to be declining. Risk aversion, particularly in high-value crops, further slows

product development. Long-term data documenting weed impacts on crop yield are also limited which can be a limiting factor is companies seeing the value of introducing new herbicides.

Looking ahead, a horticultural symposium focusing on broomrape management in horticultural crops has been proposed for the next WSWS meeting in Irvine, California.

Deniz Inci from Washington State University was elected as co-chair for next year's session. Aaron Becerra-Alvarez from Oregon State University is Chair for next year.

Chair 2026:
Craig Alford – Corteva
craig.alford@corteva.com

Chair-Elect 2027:
Aaron Becerra-Alvarez – Oregon State University
a.becerraalvarez@oregonstate.edu

Chair-Elect 2028:
Deniz Inci – Washington State University
deniz.inci@wsu.edu

Attendees:

Elizabeth Mosqueda	Rui Liu
Tong Zhen	Kai Umeda
Jacob Fischer	Brad Hanson
Carl Libbey	Josette Ball
Arpon Bhusal	Matthew Fatino
Ryan Hill	Deniz Inci
Joel Felix	Jesse Richardson
Aaron Becerra	Craig Alford

Project 3 Discussion Session: Weeds of Agronomic Crops

Moderator: Kyle Roerig

Topic: Contract Research – *Opportunities, Challenges, and Strategies for Success*

Discussion Summary:

Discussion topic started as contract research.

Marty Schraer commented that finding collaborators who are comfortable doing the research they are being offered in a priority. Getting data delivered in a timely manner is valued among industry who puts out contract trials.

Greg Dahl commented: high quality contractors are sought. Timeliness, data in understandable form. Mixture of contract and internal investigators to get research done.

Marty Schraer commented that placing trials is an important consideration. Need to start with ideas for the best area for the type of work and the expertise of the contract researcher. Industry wants good data returned.

Andrew Kniss poses the question. When deciding where to place trials and which go out is cost prioritized?

Marty Schraer commented that where a product is at in the timeline affects contract research potential. His company will not put something out in the public unless the product is withing 3 years of release.

Greg Dahl commented that he used to place more trials with university collaborators but is backing away due to legal difficulties and increasing prices. Indirect costs are increasing problems. Universities make it harder to get the work done for the cost.

CHS contractor comments that he thinks research at university does a poorer job delivering reliable yield data. Expresses that yields are lower than commercial growers.

The questions was raised: What does the university get from doing contract research?

Brian Jenks commented that when doing contract research he wants to learn something from doing the work. He prioritizes projects with the potential for positive impacts.

Andrew Kniss commented, if he wants to take on contract work, he considers three things: is the work well funded, intellectual, and interesting to stakeholders.

A comment was made that doing contract trials has valuable educational aspects in training graduate students. It provides opportunities for them to learn and see new things.

Kyle Roerig commented that knowledge is gained from doing the trials.

Earl Creech commented that experience is better from doing field trials. Seeing results visually has more value than the data.

Question for the group, is contract research essential to a university budget?

Comments were made by the group. Contract research is just something extra. The work is

important training for students. The money that is raised from contract work is easier to spend, and money can fill in the holes of costs that are not covered by other things.

Indirect costs required by the university are increasing, causing total revenue to down for a university contractor.

Comment was made theat the university ag experiment stations and industry need to work together to complement each other.

Question asked to the group. What are challenges and problems in contract research?

Comment was made that relying on outside seed labs for seed work is slow and takes a long time for data to be delivered.

Pete Berry commented, relation from field rep to grower is closer than grower to extension. Field reps see things before extension does.

Greg Dahl commented that he works regularly with contract researches to develop protocols and new technologies.

Question was posed to the group. How do we bridge the gap between implementation of technology and new product use? Example of the question was John deere exact apply other application technology.

Greg Dahl commented, how do we help farmers make better choices?

Brian Jenks commented, he does demos on how to make liberty work better. Other comments, we need to be testing different application techniques that farmers actually use. Consider carrier volume and speed. In decision making for growers, logistics beat agronomics.

Greg Dahl made a comment, how do we get more contractors to come to WSWS? National Alliance of Independent Crop Consultants (NAICC) has lots of contract researchers attend their meeting. People attending the meeting get applicator credits.

The question was raised, will consultants get something good from our meeting?

Breanne Tideman suggested making a schedule to have a later day in the meeting for outreach presentations. This could increase relevance and outreach to crop managers. Carl Coburn commented that our meeting should have value for contractors to meet industry reps.

Pete Berry was selected to be the chair elect for the upcoming year for the agronomic crops section.

Chair 2026:
Kyle Roerig, Pratum Co-op
kroerig@pratumcoop.com

Chair-elect 2027:
Clint Beiermann, University of Wyoming
clint.beiermann@uwyo.edu

Chair-elect 2028:
Pete Berry, Oregon State University
pete.berry@oregonstate.edu

Project 4 Discussion Session: Teaching and Technology

Moderator: Sandra McDonald, Chair

Topic: *If Artificial Intelligence were a Plant would it be Desirable or Invasive?*

The Teaching and Outreach section had 2 papers, "Surveying the State: Evaluating Remotely Sensed Estimates of Rangeland Vegetation Across Wyoming", and "The Label Game: Learning Contents of Herbicide Labels", preceding the discussion section. The discussion was facilitated by Sandra McDonald, assisted by Liberty Galvin, and began at 2:15pm.

Sandra opened the discussion with a short power point which posed the question, "is AI desirable?" coupled with a comparison to Invasive, or "undesirable" species. Various definitions of "invasive species" were supplied from Google, Wikipedia, to again generate more discussion around whether AI is "desirable" or "undesirable".

Teaching faculty in the room mentioned they ask this question to their undergraduates; typically, the response is "it depends on the setting." Current graduate students mentioned AI can be helpful in fixing [statistics] codes, grammatical proof-reading, but they do not rely on it for generating research questions. Several individuals agreed that AI may become "naturalized", meaning it is likely going to change our learning and application of programs. In this vein, another student referred to AI as a "patient teacher," but you must understand how to interact and ask it the right questions. He compared it to watching YouTube videos; AI can help streamline this process to learn new skills vs. searching through videos to find the info you need. Teaching faculty mentioned financial accessibility; once the "free trial" runs out, are students going to have access to the tool? Considerations for students at large, public/private institutions where AI can be paid for by the institution vs. small community colleges may further spread disparities between economic classes, learning, societal contributions, and career trajectories.

One participant mentioned AI in research can be highly problematic, depending on the platform used. They recall an instance of when an AI output generated fake research citations to appease the user. The AI search engine is meant to keep the user engaged, whether that is with true or false information. How individuals train their AI will also greatly influence the output. Biases are part of the human condition are becoming more and more obvious in AI outputs, but this could be highly detrimental for those who don't fact-check before using the information for research. The AI also has access to only published information online. The AI is not giving conference proceedings, or poster outputs, so the information is biased towards what has been published. The question, "is AI more efficient and accurate than a human?" came up in terms of teaching, due to the source of information that AI depends on for its output.

Liberty mentioned environmental and economic concerns over data-centers, which are causing strife for rural people. While AI is important, the way that we are incorporating data centers, the actual engine of AI, is problematic to the agricultural and rural populations that we serve. The discussion finished at 2:45pm and the session was complete.

The proposed discussion topic for 2027 is the *Role of social media in education, outreach, and recruitment of current and future weed scientists*. Liberty Galvin will chair this section and facilitate the discussion.

Newly elected chair-elect: Conner Cox

Chair 2026:
Sandra McDonald, Mountain West Pest
Sandra@mountainwestpest.com

Chair-elect 2027:
Liberty Galvin, Oklahoma State University
lbgalvin@okstate.edu

Chair-elect 2028:
Conner Cox, Oklahoma State University
conner.cox@okstate.edu

Attendees:

Sandra McDonald	sandra@mountainwestpest.com
Jeanne Falk Jones	Jfalkjones@ksu.edu
Elizabeth Mosqueda	elizabeth.mosqueda@maderacollege.edu
Conner Cox	conner.cox@okstate.edu
Clebson Goncalves	goncalves@ucanr.edu
Tong Zhen	tzhen@ucdavis.edu
Matt Baur	mebaur@ucanr.edu
Beth Fowers	bfowers@uwyo.edu
Carl Coburn	carl.coburn@bayer.com
Kasey Schroeder	kasey.schroeder@unl.edu
Jeff Golus	jeff.golus@unl.edu
Saul Estrada	saestrada@ucdavis.edu
Arpon Bhusal	arbhusal@ucdavis.edu
Andy Branka	brankaa@oregonstate.edu
Jenna Meeks	jmeeks8@uwyo.edu
Andrew Kniss	akniss@uwyo.edu
Liberty Galvin	lbgalvin@okstate.edu

Project 5 Discussion Session: Basic Biology, Ecology and Technology

Moderator: Albert Adjesiwor

Topic: *Granivory and Seed Decay for Weed Seedbank Management: have we Inherited Their Work?*

Section Chair Albert Adjesiwor gave a presentation about the basics of granivory and the weed seed bank. Discussion followed with suggested topics of knowledge gaps, role of modern ag, methodological constraints, barriers to collaboration with entomologists/pathologists, and opportunities. Highlights of the discussion include:

- Predation and pathogens have been said to account for 60% of weed seed decay. However, it is likely that we are overestimating decay due to the changing phenomenon of methodology. Studies related to seed decay were mentioned.
- Other considerations about the sheer number of species of weed seeds, debunking snake oil myths, and the limited funding due to the untenable task of seed bank management got brought up.
- A challenge to collaborating and funding weed seed bank studies is the review panel composition of many, particularly USDA-based, grant programs. There are few weed scientists to be on panels, and many have a conflict of interest if selected for review.
- Collaborating with USDA ARS has been fruitful. Talking with other colleagues is important. There was no consensus related to successfully having a project with an entomologist and/or pathologist related to a seed bank study.
- With microbiomes being a hot topic, discussion about current work and opportunities to explore that field were talked about.
- Concerns related to seed treatments and ecosystem impacts were discussed.

Olivia Landau was unanimously elected as co-chair.

Chair 2026:
Albert Adjesiwor, University of Idaho
aadjesiwor@uidaho.edu

Chair-elect 2027:
Jenna Meeks, University of Wyoming
jeeks@uwyo.edu

Chair-elect 2028:
Olivia Landau, USDA-ARS
olivia.landau@usda.gov

Attendees:

Ian Burke	Andrew Kniss
Beth Fowers	Shahbaz Ahmed
Nevin Lawrence	Greta Gramig
Francielli Santos de Oliveira	Clint Mattox
Felipe Quatroni	Carol Mallory-Smith
Olanrewaju Adeyemi	Olivia Landau
Bianca de Borba Baretto Moreira	Franco Sanchez-Izurieta

WSWS BOARD OF DIRECTOR'S BOARD POST ANNUAL MINUTES (2025)

Seattle, Washington
Thursday March 13, 2025

WSWS President Carl Coburn called the meeting to order at ~11:45am

Board members and guests present included: Nevin Lawrence, Tim Prather, Ryan Rapp, Ian Burke, Greg Dahl, Alan Helm, Beth Fowers, Mirella Ortiz, Carl Coburn, Brad Hanson, Eric Gustofson (business manager), Hillary Sandler (WSSA president), Wes Maughan, Albert Adjesiwor, Erik Lehnhoff, Eric Westra (guest).

- Meeting debrief, comments, suggestions: (no agenda; free-flowing discussion)
  - Eric – meeting attendance. 213 registered.
    - Noted that the hotel waived the attrition penalty.
  - General comments/suggestions
    - Facility was generally good and staff were responsive
    - BoD thought the meeting went relatively well
    - Eric Westra commented on one of the breakout rooms was very small, but hotel accommodated by the second day.
    - Tim: If attendance continues to decrease, should we go to 20 minute talks?
    - Carl: Marcelo Moretti suggested we consider a 2-day mtg (instead of 2.5) to save members money
    - Eric: could we wait until we see how many submission and then decide 20 min vs 2 d?
    - Question: do we want to have an ad hoc committee explore this and report to the summer board meeting?
      - Suggested that Carl could appoint Marcelo to lead this.
    - Ian: noted that IWSS empowers the session chairs to have a longer "keynote" in some/all of the sessions.
      - Canadian Society and SRM do something similar.
        - Could be a way to engage session chairs in the program, and develop location-related topics and speakers of interest.
    - Sandra: we (BoD) told Carol M-S and Sandra that WSWS was doing an ESA symposium so Carol did not put in a symposium request. But, this did not happen. Need to communicate better about symposia and symposia goals.
    - Greg: TeeJet (exhibitor) felt isolated from the action of the meeting due to the location. Should think about this so the vendors get better traffic at future locations. (partially a function of this hotel layout).
    - Comment: we had a sit down meal at business breakfast (vs normal buffet). Interesting that sit-down was actually cheaper than buffet at this location.
    - Albert: commented that the discussion sessions were all pretty late in the program. Carl noted that it kind of had to happen that way this year to accommodate the program and avoid key overlaps.
    - Mirella: Why was student silent auction so light this year? Of ~$1350 raised, $1000 was a single donation, so auction only raised $3-400.
      - Needs more reminders to membership. Note for Wes: needs more proactive outreach to potential donors, not just listserv emails
      - Eric noted that the NCWSS uses some kind of action software that can also take donations. Software might be called "Better World". Student Liaisons should investigate.

Old Business:

- Summer board meeting date needed. Will need to coordinate with Kai Umeda as local arrangements chair for Tuscan.
  - Carl will send out a meeting schedule poll soon.
    - Aim for: travel Tuesday, meeting Wednesday, site visit and travel Thursday
    - Greg noted to avoid dates of summer weed contests.
- Finance Committee (Ryan Rapp)
  - Will link Marty Schrar (Sustaining Members) with Finance Committee
  - Committee recommended that WSWS move financial management from current company to the same service that WSSA uses.
    - Feeling was that the current provider has not been doing a good job and is not responsive to WSWS needs and committee communications.
    - Current provider is also more expensive than the alternative
    - Some benefit to having service (not the funds) for WSWS "lumped" in with other weed societies since the financial goals are similar.
  - Ryan outlined the committee's recommendation as:
    - Move all WSWS investment funds to Holloway Harmon and Associates; handled by managing partner, Jeff Holloway (https://www.raymondjames.com/hollowayandharman).
      - The committee recommends that all current investment accounts be transferred as it makes sense based on market conditions based on consultation with Holloway.
      - The funds that are currently held in CD's would be moved to the new provider as they mature or cashed-in if funds are needed for current WSWS operations.
      - The checking account would remain with American Heritage Bank.
    - Greg Dahl moved to accept this recommendation and Alan Helm seconded
      - Vote called and passed unanimously.

New Business:

- Future meeting location(s).
  - Nevin: can we get back on a more formal regional rotation (e.g. CA, PNW, Southwest)?
  - Carl: we should try to get back on a two-year lead time for meeting locations
    - Q: Should we ask Tina if there is an advantage to two-year lead vs flexibility?
    - Reminder: Craig Alfred is the new site selection committee chair.
  - Hillary Sandler (WSSA President): Raised the idea of a 2027 joint meeting with WSSA. WSSA is exploring locations in Hawaii for 2027.
    - Ryan: last time we had joint Hawaii meeting with WSSA, it was a money-maker for WSWS
    - Hillary: alternatively, could WSWS accommodate joint WSSA/WSWS in the California location in 2027?
      - Carl: hesitant to change on CA location since we agreed as BoD on Monday on this location recommendation. Could Irvine handle a couple hundred more attendees if we were joint with WSSA?
    - Sandra: WSWS generally does not favor joint meeting with WSSA. However, WSWS membership does favor Hawaii and understands that a joint meeting might be our best bet to go to that location due to costs constraints to WSWS.

- Tim: could WSSA delay HI by a year to 2028? Hillary: WSSA is focused on HI (or western) in 2027 because they'll be in the east in 2026 (Raleigh) and then probably back to DC area in 2028.
- Greg: is interested in the joint meeting with WSSA in either HI or Irvine. Noted that we had back-to-back meetings in the west this year with WSSA in Vancouver BC and WSWS in Seattle two weeks apart. Sense was that this probably hurt WSWS attendance.
- Ian noted that WSSA in 2028 is likely to be a joint meeting with IWSS in Washington DC
- Tim: What are/were the friction points if we do a joint meeting with WSSA? How do we have a "joint" meeting rather than "two co-located" meetings?
  - Several BoD members noted that WSWS members expressed feeling "taken over" last time we were joint with WSSA.
  - Hillary noted WSSA has made more efforts to highlight the uniqueness of the regional societies in more recent joint meetings.
  - Mirella: was student rep at last joint WSSA/WSWS meeting. Sense was that WSWS student night out got swamped by WSSA students.
    - Sandra: WSWS is great at mentoring and supporting students, we could/should highlight this.
  - Sandra: noted that the WSWS retirees reception got swamped by the WSSA at the 2020 joint meeting.
- Action: we need more info from WSSA to make a final decision.
  - Might need a zoom meeting if we learn from WSSA if they are definitely going to Hawaii in 2027.
  - Hillary added that WSSA is looking at Maui or Kauai (not the big island).

Lunch break at 12:25. – restarted at 12:40

- Other topics:
  - Nevin (president-elect) will appoint Breanne Tideman as his Member-at-Large, Public Sector. She agreed to serve but will not attend the summer 2025 board meeting.
  - Carl: revisited the issue of declining involvement of Federal and State employees
    - Do we have an ad hoc committee on this? Answer: no, we dissolved it previously.
    - What tangible actions can we work towards to reverse this?
      - Tim Prather agreed to continue to pursue this as Past President
      - Comment was made to either find some action to take or stop raising the issue.
    - Suggestions and discussion
      - Think about program changes such as plenary sessions and symposia specifically to appeal to fed/state folks.
      - Could bring some focus to engage the fed/state offices in the region where the meeting is being held.
      - Nevin: Could use plenary session to bring in local land management agency speakers.
      - Sandra: could encourage local weed management areas to hold their meeting in conjunction with WSWS. (e.g Colorado weed management areas).
        - She also noted this was a particularly bad year due to political and funding challenges at the federal level.
        - Ryan: politics should stop outreach to regional offices though.
      - Carl: do we want to explore Zoom-in workshops? Would be extra costs and logistics at the venue. Is it worth it?
      - Tim: Does President Coburn want to appoint an ad hoc committee? Who should be on it? (Tim, Erik Lehnhoff and ????)

- Still more other topics:
  - Albert: noted that we used to get more undergrad students than we do now.
  - Nevin: from Awards Committee perspective, noted that all three Sanchez travel awards went to PhD students due to fatter CVs. Should we reserve one for MS?
    - Discussion was that this is normal ebb and flow. No action needed after this discussion
  - Sandra: WSWS needs to introduce new Board members. Maybe an email blast after the meeting.
    - Noted comment from membership that "not many women on the board" but we actually have several joining now. Making the board more visible might help this perception.
      - The website now has a full list and photos of the BoD
    - She also noted that Tim's effort to shorten the business breakfast was appreciated but that not having all the board members and committee chairs in front of the membership might also be a lost opportunity for the membership to see established and upcoming leaders in the society.
  - Albert: question about WSWS voting. How many members actually vote?
    - Erik: it's low but in line with other societies.
    - Suggestion made to ensure voting goes out in both the newsletter and via email blast; emails get read "slightly" more than newsletter according to stats.
  - Tim: a question was raised as to how WSWS "sunsets" a committee. Lisa Rew from the Legislative Committee might suggest that one be ended.
    - Sandra. Sunsetting steps are the reverse of setting up a new committee. Committee can tell the BoD they think the committee is no longer effective or needed and recommend they be dissolved. Then BoD can vote on the recommendation.
  - Ryan: Steve Valenti's HRW committee completed the HRW trifold and needs direction what to do with this? (who is the BoD contact for this committee?)

President Coburn called for a motion to adjourn

- Moved by Tim Prather and seconded by Nevin Lawarence
- Motion passed unanimously.
- **Meeting adjourned around 1:50pm March 13, 2025**

The minutes were recorded by Brad Hanson, WSWS Secretary.

WSWS BOARD OF DIRECTOR'S SUMMER BOARD MEETING MINUTES (2025)

Tucson Marriott – Tucson, Arizona
Copper Board Room (or Zoom)
August 6, 2025

Welcome, call to order, and approval of agenda– *Carl Coburn*

Call to Order: President Coburn called the meeting to order and for approval of agenda at 7:15 am (MST).

Attendees: Nevin Lawrence, Carl Coburn, Beth Fowers, Jessie Richardson, Derek Sebastian, Lovreet Shergill, Brad Hanson, Eric Gustafson (by Zoom), Lee Van Wychen, Breanne Tidemann

Officer Reports:

Secretary - *Brad Hanson*

Approval of minutes from March 2025 BOD meeting

- *Motion to approve: Ryan Rapp. Second: Nevin Lawrence.*

Business Office – *Eric Gustafson*

- (presented by Zoom rather than in person due to a family emergency).
- Briefly summarized his report
- WSWS currently has 225 paid members, 24 lifetime/comp members.
- IMI physical offices will be moving in August 2025. He will update address on all accounts as needed.

Treasurer – *Ryan Rapp*

- Treasurer report much the same as the Finance Committee report.
- Noted that end of our FY is March, so overlaps with meeting income/expense so year-over-year finances are hard to interpret.
- Society currently has assets ~$373k. Down a bit but generally doing ok.
- Treasurer/Finance committee still recommending and proceeding on changing of financial advisors. This should be completed by the end of October.
- Ryan and Eric have been going through profit/loss sheets for past few years but the data are messy to interpret.
  - Recommendation that Society consider smaller (e.g. cheaper) cities and venues because our society is shrinking.
    - E.g. Spokane, Salt Lake City, Bozeman, Billings, Tucson, etc
    - Noted that the current venue in Tucson will be a good test of this smaller venue idea
  - Also, consider more joint meetings because the finances are generally favorable for WSWS
- Eric noted that we can work with Tina as we outline what our square footage and space needs are. Might open up some smaller venues and second-tier cities.
  - Consider also if one large poster session is needed; we could also do two smaller ones (putting up posters twice in same space)

  - Greg noted NCWSS does this. Will be complaints if we change, but it does work for NCWSS. Could consider posters and social events in the same space too.
  - Carl: Can we update the RFP with Tina regarding space requirements? Ans: yes but Eric will need assistance on this. Ryan suggested let's revisit this after the Tucson meeting once we have a better idea of how the smaller space worked.
- Discussion of joint meetings:
  - Sandra. How do we do with WAPMS? Ans: We are the larger society in that scenario. When we met with them in Boise, it was more of a co-meeting but not very financially connected.
  - Derek: have we ever met jointly with NIASMSA? (timing isn't great since they meet in the fall). Ans: we did meet with them when they first formed. Lee VW noted that NIASMA will come back to Washington DC in Fall 2025.
  - Sandra: What about SRM? Discussion of how WSSA got swamped by much larger SRM group when they met jointly in Denver (and WSSA is much larger than WSWS). Lee VW noted that SRM is shrinking too given federal land manager budgets.

President – *Carl Coburn*

- Briefly summarized his report.
- Met with Lee and other Regional and National Weed Science Presidents on Capitol Hill to advocate for priority issues – was very humbling and good to see Lee VW in his element.
- Sits on WSSA Science Policy Committee. Largely related to actions the Societies need to weigh in on at federal legislative level.
- Introduced that we will change meeting program software. Nevin will expand on this later.
- WSWS Committees. Mostly filled with just a few remaining slots; should be filled by the March meeting
  - Nevin observed that the Fellows Committee was a hard one to fill (members have to be Fellows, but many Fellows are senior. Sandra noted that Fellows committee service doesn't have to be in person at the meeting, make sure to reach out to recently retired Fellows who are often still pretty active in the Society.
- He met with Western Weed Coordinating Committee to discuss potential joint meetings. They are smaller group with really focused meetings. Seems like a good group to consider but needs more legwork before putting the idea to the WSWS.
  - Nevin noted this group is pretty budget-conscious so maybe an add-on symposium at low- or no-cost might draw them in
  - Sandra: these are state/local weed coordinators. Carl noted this is a group we should reengage with. Nevin noted that Erik Lehnhoff is working local AZ groups.
- Discussion of "Thursday symposia". These can work really well if we get good topics and local advertising.
  - Eric: tailing meetings can keep the symposia crowds off the WSWS food/bev budget which is helpful if they are no-cost or lo-cost attendees
  - Breanne noted that the Canadian society does this regularly. They get good participation from agronomists and grower for the add-on. But, it didn't work well when they tried it mid-conference (tracking one day attendees with coffee breaks, etc.).
  - Carl: This sounds like a Program Chair idea to develop. Should reach out to specific people to facilitate making it happen (rather than hope it will materialize from a general call for proposals)

Past President – *Tim Prather*

- Tim was supposed to join by Zoom but was unable to make it. So, no discussion of this report.

President-Elect/Program Chair – *Nevin Lawrence*

- Activities captured in his report.
- Has one symposium proposal. Is working with Erik Lehnoff on another
- He attended several trainings on the new FourWaves meeting program software. "It was hard to pay attention in the training because it is so intuitive". Looks very promising. Canadian society has been using for several years and it is working well. Expects that it will work very well for us
  - Discussion of how to share workload and delegate tasks. Breanne noted that it is easy to give permissions and it works very well for Canadian society
  - Breanne noted that "cloning" of events has been extremely helpful after the first year. She is available to Nevin for advice on the software (she's used it two years with Canadian society)
- Poster Board logistics. Where are these things and how do we get them to AZ then to CA?
  - Nevin will reach out to Marcelo Moretti and figure out how to get them from OR to AZ. Jessie Richardson will get them from AZ to CA after the meeting.
  - Ryan noted that it cost $8k when we rented poster boards in Seattle. Would like to avoid this!

Education and Regulatory – *Lovreet Shergill*

- Discussion of symposia. Suggest to leave technically open and work with Erik L to get an AZ-related symposia.
- Beth: discussion of title deadlines (relative to travel plans and CEU requirements)
- Beth: discussion of how the section chairs work with session chairs and chair elects so that they are part of the process.

Member-at-Large Public – *Breanne Tidemann*

- Limited activities so far.

Member-at-Large Private – *Derek Sebastian*

- Nothing to report at this time.

Research Section Chair – *Beth Fowers*

- All projects have chair and chair elects. Ready to go for meeting.

WSSA Representative – *Alan Helm*

- Not present (Carl had wrong email address so Alan may have missed some communications)
- Eric and Greg summarized WSSA activities
  - WSSA planning meeting in Raleigh in 2026. Several sustaining members have HQ in this region so will have opportunities for tours
    - Make sure students sign up early for tours as space will be limited

- WSSA considering 2027 locations (had considered CA but decided against due to WSWS in 2027. 2028 may be joint meeting with Southerns in Savannah GA
- WSSA new logo recently. Working on strategic and financial plan.
- Greg: financially WSSA in great shape, FourWaves software looks good and WSSA covering most of the cost for the societies
  - WSSA would love another joint meeting with WSWS. Good cost proposition for WSSA. Would like to make the regional meeting the host (rather than WSSA swamping the region) – this worked better at NC and Canada.
  - WSSA is asking past presidents to get/stay more involved. Will have a Past Presidents event in Raleigh.

CAST Representative – *Greg Dahl*

- Jill Schroeder and Matt Bauer did a great YouTube video (topic???)
- CAST still reorganizing structure and new location in Ames, IA
  - Open for input on CAST structure and outreach efforts. Greg will remain active in CAST and present at meetings.
- Carl: what about CAST town hall this year? Eric: 107 registered and about 80 attended. Ian hosted and MC. Half updates from WSSA, half discussion about WSSA activities. All was very positive.
- Greg was "cranky farmer" at WSSA weed contest last week.

Student Liaison – *Wes Maughan*

- Brief report submitted.
  - Would like more clarity on goals for student night out.
    - Ryan: This was brought up last year by industry member that there's an unspoken expectation that a mixed group still get paid for by industry rep.
    - Carl: also benefits to having a group from the same industry (more openness than mixed company groups)
    - Greg: Breanne -what does Canadian soc do? Dine-arounds not focused on students and more informal.
    - Breanne- was student rep when we switched to mixed group. This was beneficial to students who can't decide and also for limited number of govt reps
    - Eric: could the society consider reimbursement to facilitate this?
    - Nevin: this could be done in the app. Registration portal could include "academic, industry, mixed" then discuss how costs are covered.
    - Sandra: recalled Bomb Cyclone student night out in Denver. This ended up being a pretty well received event; more intimate and relatively less expensive.
    - This ultimately is up to Wes to figure out how to run this.
      - Encourage communication of hosts in mixed groups to discuss paying expectations
    - Encourage silent auction participation. Last year, most money came from donations rather than auction. Ryan noted rough treatment of luggage and fragile items. Sandra noted last year auction table placement wasn't great. Shipping possible, but Eric prefers that bidder ships, not WSWS.
      - Board reminded Wes to solicit auction items early and several times.

Director of Science Policy – *Lee Van Wychen*

- Lee's report pulled up and discussed.
- Discussion of President's budget and how house and senate will respond
- Discussed weed president's visit to DC – was very successful. Good connections with staffers, especially appropriations related staffers as super-important to advocate for funding priorities. Over 40 visits with staff groups
    - Carl: Was it beneficial to have regional president AND elect (or Past) to have some continuity year to year? There was a total of 7 in 2025; is a group of 10 viable? Also the group to divide and hit more meetings during visit.
    - Science policy fellow/interns. This class was very competitive and hard to pick this year.
    - Science fellows working on a database of local congressional reps to encourage membership interaction on weed issues at local level (e.g. inviting staffers to local weed events)
    - Weed survey is out now. Please fill it out. (Broadleaf crops and hemp focus this year)
    - National org of pest control advisors tour. Good in 2024 in WI and focused on ESA issues. In 2025 (Sept 22-24) will be in Virginia and region (peanut, aquatic, etc). Participation of EPA, NMFS, etc.
    - Some discussion of USDA reorganization. WSSA focused on encouraging maintenance of ARS labs (not closing or totally eliminating sites, probably 4 or so at serious risks but not know which ones).
    - Pesticide Program Dialog Committee – will need nominations to replace David Shaw (Jill S can be renewed one more 3-year term)
    - Carl: did your recommendation of appointing WSSA science polity committee from regional society get covered? Carl: asked because WSWS Legislative committee may disband, this could be something that group could engage in.

Constitution and Operating Procedures Representative – *Sandra McDonald*

- Updating and editing OPS. Thanks to those who read and provide updates.
- Please keep providing updates and corrections.

Committee reports:

Publications Committee (Nevin Lawrence – board contact)

Proceedings – *Carl Libbey*
WSWS Newsletter – *Carl Libbey*
Website – *Eric Gustafson*

- Carl is updating committee list; knows website is out of date

Local Arrangements – Jesse Richardson – chairperson (Nevin Lawrence – board contact

- Kai doing as much as he can, but he is retired so a bit above and beyond. Will discuss more later on under New Business

Finance – *Cody Creech* – chairperson (Ryan Rapp - board contact)

- Same as treasurers report. Nevin should reduce redundancy in future agenda items

- Ryan, working with Eric and a tax attorney to change how WSWS is categorized for tax and donation purposes. Has to do with IRA disbursements and donations from individuals (can be tax free if donated to society if we are categorized appropriately). Makes us a Foundation not a charitable organization. (I don't think I have the details correct on this).
  - Carl thanked Ryan for creative thinking on this issue that we haven't addressed before

Nominations – *Breanne Tidemann* – chairperson (Tim Prather – board contact)

- Breanne has a partial slate and still working on filling the remainder of the positions.
- Discussion of why Secretary is two-year and others are 3 year. This year happened to have 5 open positions while last year only had 3. But this is staggered such that it's only every 6 years so maybe not that big of an issue.
- Breanne could really use suggestions for Industry members to run for president. Schrar said no, Sandra suggested Clark Alder. A couple board members sent suggestions during meeting.
- Goal to have full slate by September or Oct.

Public Relations – ***Gino Graziano*** – chairperson (Lovreet Shergill – board contact)

- Lovreet should chase Gino for report
- Sandra noted Social media team doing a great job recently.
- Breanne. Social media person (Amy) reached out. Has had negative feedback on BlueSky (about toxic company supporters); advice just to block them.
  - Eric shared Amy's report.
    - Only 2 board profiles submitted so far (Nevin and Brad)
    - Social media account engagement continues to increase. Looks good.
  - Greg reminded "please send Amy stuff". She can work with a pictures and brief description.

Fellows and Honorary Members – ***Carol Mallory Smith*** – chairperson (Tim Prather – board contact)

- Andrew Kniss is the actual chair, not Carol (and responded to email!).
- Tim should follow up with Andrew for report.

WSWS Rep to WSSA Finance Committee – *Ryan Rapp*

- All looks ok financially. Publication revenue likely to go down a bit due to open access model
- Herbicide Handbook proceeding; close to done but in final edits.
  - Not quite sure how this will be distributed (purchase, subscription, etc.)
- Ryan is on WSSA finance strategic plan subcommittee.
  - The committee having to describe why registration costs are so high when there's a $2M endowment. This is a good model for WSWS to consider as well.

Site Selection – *Craig Alford* – chairperson (Tim Prather – board contact)

- Jesse summarized.

- This was first year using Tina for site selection. Jesse was not a fan of this idea originally but is now a huge supporter of what Tina has done for the society. She is aggressive, much more than what members can do as non-professionals in this arena
  - Very happy with her services
- We are going to Irvine in 2026. Irvine site is freshly remodeled and will be a great venue for us (and probably out of our financial range once it gets rediscovered).
- Regarding AZ. AZ is really competitive between Oct and March because of snowbirds and then baseball spring training. We didn't get tons of responses to our RFP so hard to negotiate very aggressively.
  - This Tucson venue is not a particularly impressive place from a curb appeal perspective, but this has been a great location for another society (good restaurants, and light rail access).
  - This is a smaller venue than we're used to but might work ok given our recent size.
  - *Jesse noted that we might not be able to come to AZ in March due to spring training (mostly Phoenix but spills to broader region).
    - Maybe focus more on NM when we rotate to southwest. Eric said Santa Fe can be good, Alb can be a little rough and not super nice.

- Discussion of how we are doing with trying to be three years out on meeting locations. We've really gotten closer to a year out.
  - Recommendation for Board action. Give Tina suggestions for region/cities for 2028
    - Sandra noted that joint meetings can skew this a bit and probably not 3 yrs out.
    - Greg reiterated WSSA desire to meet jointly with WSWS
  - What is our guidance?
    - Suggestion inland. Eg Salt Lake City, Boise, (what about locations in Montana – hard to get to but maybe an opportunity for local engagement). Provo?
    - Jesse will share info with Craig.

Awards – *Drew Lyon* – chairperson (Tim Prather – board contact)

- No report submitted. Tim should follow-up with Drew.

Poster – *Shannon Clark* – chairperson (Nevin Lawrence – board contact)

- No report or probably anything to report

Student Paper/Poster Judging – *Jake Courkamp* – chairperson (Nevin Lawrence – board contact)

- No report or probably anything to report
- Discussion of students who win more than once. Wes will send email to Sandra and ask for clarification in the OpGuide. (Clarify if within a degree program, or ever, or only on specific project).

Necrology – *Earl Creech* – chairperson (Brad Hanson – board contact)

- Brad contacted Earl. Report submitted. Will follow-up closer to conference

Sustaining Membership – *Ben Westrich* – chairperson (Tim Prather – board contact)

- Carl: does this committee need a new person appointed?

- We may have missed this last year; Carl appointed two new people Jenna Meeks next chair, then Albert Adjesiwor.
- But, we usually get industry folks to do this. Be sure to broaden who we consider to be industry (I think we were confusing Sustaining members and meeting sponsors in this discussion)
- Sandra: what about my level of industry. Ryan: we have levels for this as we discussed in previous meetings.
  - Board needs to follow-up with Eric to make sure the call for Sustaining members goes out appropriately. (Seems Sandra's company didn't get the invitation).
- Carl will reconsider Albert's appointment and get an industry person to keep balance on the committee.

Legislative – *Lisa Rew* – chairperson (Alan Helm – board contact)

- No report prepared.
- Discussion. Lisa's report at last Board meeting was to disband this committee. She requested that the Board vote on this potential action.
  - Carl: with federal turmoil, this might not be the year to disband as it wouldn't be a good look for the society.
  - Ryan: what is the mandate for this committee? Can they be tasked with helping Lee with his legislative efforts?
    - Sandra read OPS.
      - When Sandra did this, she simply reached out to weed coordinating committee
    - Greg: when committee was very active, there were lots of invasive weeds added to list. Also on issues like city of Boulder trying to ban pesticides.

- Discussion of what Legislative, Resistance, and Invasives committees do.
  - Was suggested that these three committee discuss roles and reconfigure?
- Our discussion as a Board seemed to be that we don't want to vote to disband this committee. (Resignation not accepted).
- Nevin moved to accept committees request to disband. Brad seconded
  - Vote called. No votes in favor of motion, Unanimous "no" vote by the Board.
  - Carl will follow-up to encourage the committee to recast roles and goals.
  - Committee should talk to Sandra to get updates to MOPS etc.

Herbicide Resistant Plants – *Rui Liu* - chairperson (Derek Sebastian – board contact)

- Recruiting new members. Discussing the herbicide resistance tri-fold.
- No budget request. Have not yet decided how to share the trifold.
- The trifold should be put on webpage.
- Should distribute to the Social Media person.
- One task of this committee is to serve as resource to WSSA resistance committee
- Carl will email Derek and have him communicate it Rui with board suggestions.

Diversity and Inclusion Committee – *Elizabeth Mosqueda* (Carl Coburn – board contact)

- Report submitted.

- Had social hour at last meeting. 70-90 attended. Had brief program and guided discussion. Asked membership what the committee should focus on at poster session and via survey; results in report.

Invasive Species Ad-Hoc Committee – *Mirella Ortiz/Lisa Jones* (Carl Coburn – board contact)

- Discussion of how this committee might provide info into ESA discussion
  - Shannon Clark and Jodie Crose attended the May WSSA ESA committee discussion.
- To vote on this committee's request to be a standing committee,
  - Greg moves that this committee assemble what is needed to for them to be a standing committee. Ryan seconded.
  - Vote unanimous approval.
  - Assign this task to public sector member at large (rather than president).
    - Discussion of which "at large" member should be their contact
  - Ask the committee feasibility of doing this in time for Board to vote during late 2025, then the membership could vote in March 2026? If they cannot, we can vote as Board in March 26 then the society can vote in 2027.

Break for lunch at 11:15 and reconvened at 12:30pm local time.

Reconvened 12:30

New Business

1) Program Chair-Elect Position Options
   - Sandra (with Curtis R and Andrew K) suggested options for consideration
     - No change, but better communication
     - Move election earlier so the new -elect can attend the summer board meeting
     - Add a new non-voting BoD member "program chair elect". This makes a 4 yr commitment to the rotation but provides a lead-in year to the program.
   - Discussion:
     - Greg: most other societies have a 4 year rotation. Suggested have the -elect serve also on the WSSA public relations committee. Gets them into society leadership
     - Nevin: I'm not worried about the program this year; thinks software will resolve. Worries more about the unexpected stuff that comes up (venue related etc). Could -elect do the program and the program chair freed up to do more of that stuff?
     - Sandra, maybe there should be a more regular meeting of the program team leading up to the conference (to keep accountability and engagement).
     - To option 2, good idea but the meeting is good for soliciting nominees so can't be super early vote.
     - Discussion about the Res and Ed section chair doing more of the program work; delegating more of this down the chain. The technology should make this more feasible.
       - Carl. Let's go with option 1. Use software to allow section chairs to do more of the program work.
     - If elections were moved earlier, would that help/hurt the other BoD positions that would be elected? Seems beneficial generally to have them engaged or looped in on BoD communications.

        - We could vote on this voting date as a BoD (not a vote of the membership).
    - Brad moved to accept committee recommendation to make no change at this time but encourage greater delegation of program development to section chairs. No second.
    - Brad moved to table this topic until the March 2026 Board meeting. We can discuss then after we experience the new software. Seconded by Ryan.
        - Vote unanimous to table the topic.
    - Jesse discussed how pacific branch entomology has a program chair and chair elect so there is continuity (but this is not part of the presidential rotation). They had four monthly meetings leading up to the meeting; he thought that worked well
        - Sandra discussed that she basically did this for the 2020 COVID zoom meeting.
        - Nevin was already considering something along these lines. Initially, section chairs then closer to the meeting the session chairs.
            - Eric said also to include local arrangement and Business Mgr

2) Role of local arrangements committee
- Nevin led this discussion. Kai is current local arrangements chair; is very busy in retirement.
- How much overlap is there between what Local Arrangements does and what Business Mger does?
- Sandra: Local Arrangements has a couple duties. The before-meeting stuff needs to be someone that knows the area (restaurants etc.) but the at-meeting things doesn't have to be a local (resolve temperature or AV issues, signing sessions etc.).
- Beth: some of this on-site stuff sounds like something the Section chairs could be doing.
- Ryan: other Board members could assist too.
- Brad and Sandra:
    - Should take the logistics of at-meeting room and program stuff out of Local Arrangements and put on Section Chair
    - Keep pre-meeting responsibility with Local Arrangements and the Business group at registration desk.
    - Where did we end up on this?
- Nevin. Got out of discussion feedback that is needed. Will look at task and work with Program Team.

3) Fellows Committee
- did not discuss further. We handled this earlier discussion.

4) Added discussion of symposium for 2026 meeting
- potentially an AZ focused one if Lehnhoff can organize
- receive symposium proposal on herbicide resistance. This would be within the regular program

Nevin moved to accept the HRW symposium. Ryan seconded.
- Vote was unanimously in approval

Further discussion
- What can we do better to get more symposia? Greg: this seems not unusual in other societies (although WSSA has had 5 or more proposals in recent years)
- Is "symposia" to restrictive? Could say symposia or workshops (or otherwise broaden)
- These tend to work when it's a timely topic in an appropriate location.

- Breanne: Canadian society polls members about plenary session topic ideas and workshops. Use that to "poke" potential symposium organizers.
- Ryan: interviewing for industry is different than interviewing for academia – student training symposia. Behavioral based interviewing.
  - Could be under DEI? Or Education and Regulatory?
- Post meeting survey? Could we ask for symposium ideas (in addition to other information we seek about meeting feedback)
- Breanna can do this as member at large (she will cut and paste from Canadian society).
- Eric – noted this kind of happens within sessions. Good idea to separate "symposium ideas" from "symposium organization".

5) 2026 Weed contest. Bayer hosting this in Gothenburg NE. Will be ~last week of July 2026.
   - Request of Western university participation and WSWS awards for western division
     i. Ryan says will not be only corn and soybeans. Sugarbeet, drybeans, etc.
   - Greg: moved that we "morally support the idea" with future discussion on level of financial support in the future.
     i. Nevin seconded
     ii. Unanimous support for moral support.

Breanne: is there any interest in a "dine around" at WSWS for Tuesday night? Opportunities for networking for folks that don't know many people. Seems to be interest in trying this. They just do a sign in sheet at registration desk. Breanne will pursue this. Nevin will put in program (don't forget to put in newsletter article before the meeting).

Sandra asked about updates for what is being done (or not) in committee responsibilities
Breanne: a bridge between Public Relations Committee and Local Arrangements for local media sources.

Motion to adjourn at 2:15. Nevin moved, Greg second.

2:15 pm August 6, 2025. President Carl Coburn adjourned the WSWS summer board meeting.

Secretary's note: Because we finished early on the afternoon of the 6th, we ended up doing the walk-through of the venue with hotel staff the afternoon of the 6th.

August 7th 8:00 AM– Copper

Secretary's note: Because we got through the Summer Board meeting business early on the afternoon of the 6th, we ended up doing the walk-through of the venue with hotel staff the afternoon of the 6th. Thus, we did not meet further as a board on August 7th.

WSWS PRE-CONFERENCE BOARD MEETING MINUTES (2026)

Tucson Marriott – Tucson, AZ
March 2, 2026

10 am – 3 pm Board Room.

WSWS President Carl Coburn called the meeting to order at 10:02 am

Welcome and Introductions: Board members and guests present included: Carl Coburn, Brad Hanson, Sandra McDonald, Liberty Galvin, Greg Dahl, Eric Westra, Eric Gustafson, Ryan Rapp, Nevin Lawrence, Breanne Tidemann, Wes Maughan, Shannon Clark, Jeanine Falk-Jones, Tim Prather, Kai Umeda, Ian Burke, Lee VanWychen, Beth Fowers, Lovreet Shergill, Byron Slough, Ola Adeyemi

- Online: Derick Sebastian, Mirella Ortiz, Elizabeth Mosqueda

Approval of Agenda– *Carl Coburn*

- Carl: Instructed Board to focus on action items and board requests. No need to review reports unless needed.
- Ryan Rapp moved to approve agenda, Tim Prather second. No discussion, unanimous approval

Officer Reports

Secretary – Brad Hanson

- No requests. Report forthcoming

Business Manager Report – Eric Gustafson

- No request.

Treasurer Report – Ryan Rapp

- No action requested. Finance/Treasurer.
- New financial advisor is working well. Rebalancing and familiarizing with WSWS funds.
- Working with tax attorney to recategorize our non-tax status (helps potential donations from estates) – is taking some time but is moving.
- S. Nissen donated $2.5k to both Beard and scholarship fund; plans to do annually. Others may do similarly.

President – Carl Coburn

- WSWS representative to WSSA. Current rep changed career path (Alan Helm); WSSA asked for new person to reinvigorate.
  - We need to ID a new person to fill in; what is our process? Carl has a potential nominee.
    - Where is Alan in his term? He has completed a couple of terms but is probably close to being termed out. (Alan has been largely unresponsive).
    - Can we nominate a "representative-elect" then will be ready to slot in if Alan resigns or is unresponsive.
      - Carl. Pat Clay is willing to do this.

- Pat has been WSWS president and regularly attends WSSA
- Ryan R nominated Pat as WSSA rep elect. Tim second
  - Unanimous approval
  - ACTION ITEM: Carl Coburn will contact Pat and Alan

- CAST representative. Greg mentioned to Carl that he's willing to continue to serve but also is open to giving someone else the opportunity to served. Greg is nearing the end of his second 2-yr term. Greg is willing to overlap for a year to help train-up new person.
  - Carl suggested might be good to open it up to a new person.
  - Sandra: President can nominate this person. We should think about who might be asked to serve – this takes a special kind of person.
    - ACTION ITEM; Carl and Nevin will brainstorm and come back to board.

- Diversity and Inclusion committee. This committee had an opening that Carl did not get filled. Raised it with the committee to get a new person; two people asked but declined.
  - Sandra/Elizabeth. Thought we had someone, but they must have rethought. Lisa Jones is current chair.
    - ACTION ITEM. Carl and the committee will discuss options this week to get this slot filled.
    - ACTION ITEM. Nevin should call this (and other committees) out at the business breakfast.
  - Ryan: committee members should be encouraged to suggest replacements.

Past President– Tim Prather

- No request

President Elect/Program Chair – Nevin Lawrence

- No request,
- We are roughly on track with number of paper and poster submissions.
- 171 registrations. Seems low. Probably will get a few more trickle-ins but likely to be low.
  - This might be a good test of our current size/venue.
- Discussion of new meeting software.
  - Titles and submissions etc. seemed smooth.
  - Building the program was not super-smooth (how to order talks. He ended up doing it in Excel to sort, then uploading. Suggested that all societies could press FourWaves to develop a software solution.).
    - Nevin estimated 20 hrs of excel coding to get it to upload back to FourWaves software.
    - Ideal situation would have an export of titles, that you then drag/drop or number them.
  - Was some challenge with opening/closing software for title, then abstracts, then submissions.
    - Tried to accommodate even late submissions due to poor following instructions
    - Nevin noted that 80% of late submissions were from University of Wyoming and this should be reflected in the minutes.

- Noted that several awards not included in the program from 2019-2024. Weed manager etc.
  - ACTION ITEM. Nevin start looping Byron into this to help future navigation with FourWaves
- Ian noted that folks didn't align how they listed their affiliations. (NDSU, ND State, NDSU research station, etc).
- Tech support has been good, ideally will coordinate with the other societies to make similar requests. Ian and Nevin both noted that this coordination is happening.

Education and Regulatory – Lovreet Shergill

- No request. Mainly assisted Nevin with program development. No other action.

Member-at-Large Public – Breanne Tideman

- No request. Assisted with program.
- Intended to setup dine-arounds but it did not happen due to extenuating circumstances. Will pick this up in 2027

Member-at-Large Private – Derek Sebastian

- No request.

Research Section Chair – Beth Fowers

- No request.

WSSA Representative – Alan Helm

- No report submitted. No discussion

CAST Representative and WSSA President – Greg Dahl

- Will have symposium and discussion section on invasive weeds. We need our state and federal parters involved in this society and these discussions.
- Involved in a CAST paper on surfactants in agriculture.
- Appreciates WSWS and all societies support of CAST. Lots of changes going on w CAST.
  - Lots of non-ag voices in hot topics, need to ensure ag and weed science represented in getting our story out. Ag has been taken for granted for ~25 years; need to change that and get our story out.
  - Great meetings and cross pollination to AnSci and FoodSci issues.
  - ACTION ITEM: Greg should mention at business breakfast that potential for expressions of interest for new CAST rep

Student Liaison – Wes Maughan

- No request.
- Several committees have reached out looking for student reps.
- Student night out is happening. About 40 students signed up; maybe 20 hosts.
  - ACTION ITEM – Wes should reach out today to make sure groups get numbers to facilitate reservations etc.
  - 5 or 6 groups at this time. Tried to group appropriately.

Director of Science Policy – Lee Van Wychen

- Seven items.
  - Support letters for appropriations. 30 or more organizations submitting organized support letters. Request 6 weed societies sign on (coordinates dollar asks and details among all supporters. Will request this of WSWS).
  - Rebuilding Federal agencies. Lots of positions.
    - One is national program lead for Weed Sci (vice S. Young who left).
    - Pest Program service (vice Cameron Douglass).
  - Science Policy Fellows
    - Next application deadline March 27. Student must be WSSA member.
  - Regenerative Ag Pilot Program.
    - Was in MAHA etc. Lots of jockeying for helping shape this.
    - Will be meeting with head of NRCS soon.
      - Please share ideas with Lee how to make weed science a part of this.
      - Two states have program (VT and CA) CA program is probably not our preferred model.
  - Some discussion of where various Fed programs will be consolidated. Several major cities are Raleigh, Fort Collins, Indianapolis, Kansas City.
  - Invasive Species
  - President's visit to Capital Hill. DC fly-in. Will discuss more under New Business
    - This is important and makes a difference. Ensure WSWS participation.
    - Tim: can we coordinate with NCFAR? That group has a lot of power.
      - Is this a forum for us (Weed Sci) to raise stature with political leaders?
        - Yes, coordinating similar asks from several groups
      - Lunch-and-Learn. Hot topic lunches with staffers. Could be a way to get in front of these groups.
    - Presidents fly in April 21?
    - Lee: comment about how can we team up with Society for Range Management?
      - Shannon. Noted newly established Invasive Plants Committee. Happy to be a resource to Lee and to national level society
    - Ian. Noted that NCFAR board has a lot of directors of extension, etc, who can speak on our (WSSA/WSWS) behalf. These site visits build relationships and helps us learn how things get done in WDC.
      - Tim thought staffers paid more attention when we were part of NCFAR, more-so than when we were just weeds.
      - Ian, noted WSSA has a good "two-pager" that includes WSWS info to congressional visits. Brings baseline info about our discipline.
    - Carl: is there opportunity for larger group in DC? Lee indicated probably don't want more than 10 or so – that is large enough to divide if needed but small enough to have all together.
    - Ian – look at our leadership and used their direct congressional reps. Really powerful if they align with current leadership (society and congress).

Constitution and Operating Procedures Representative – Sandra McDonald

- No request. Will interject during committee reports.

Committee Reports

Publications Committee (Nevin Lawrence – board contact)

- No reports received.
  Proceedings – *Carl Libbey*
  WSWS Newsletter – *Carl Libbey*
  Website – *Eric Gustafson*
- Erik notes that website has had ADA updates completed.

Local Arrangements – *Kai Umeda* – chairperson (Nevin Lawrence – board contact)

- No request. Erik G. does a lot of this. Seems like it's going ok. Erik is happy to continue to support society.
- Kai noted that many committee chairs contact Erik directly. Kai's job was pretty easy.
  - Beth is going to meet with committee chairs about who to be point person on room issues. ACTION ITEM: Beth should coordinate and have Kai be the point person for this.
- Discussion of poster boards. Posters will be here later this evening; could use some help setting them up after the reception. (would be good for students who are nervous about getting posters set up).

Finance – *Cody Creech* – chairperson (Ryan Rapp - board contact)

- No request. Already shared important info during treasurers report

Nominations – *Breanne Tidemann* – chairperson (Tim Prather – board contact)

- No request. Corey Ransom will be next chair. Went well, was a little late communicating to Board, but good success filling nomination slots and getting bios and headshots.

Public Relations – ***Gino Graziano*** – chairperson (Lovreet Shergill – board contact)

- Erik shared Amy's report on social media (followers, posts, etc).
  - Breanna noted that interacting (follows, likes, etc) helps drives algorithm success.
- Tim asked if we could post on website how to get info to Amy.
- Eric W. Do we have an official photographer? Andre is willing to do it again but will graduate in a year or so.

Fellows and Honorary Members – *Andrew Kniss* – chairperson (Tim Prather – board contact)

- Fellows voted upon and obtained. No honorary member nominees this year.

WSWS Rep to WSSA Finance Committee – *Ryan Rapp*

- No report submitted but Ryan will get one post hoc.
- WSSA has a financial strategic plan overview (Lauren did a great job on this).
  - Ryan recommends a similar plan for WSWS based on the roadmap that WSSA prepared.

Site Selection – *Craig Alford* – chairperson (Tim Prather – board contact)

- No request.
  - Discussion of potential 2028 site; Salt Lake vs Reno (preferred SLC)?

- Have Tina focus on SLC and Reno with SLC preferred
- Since aiming for smaller venues, we need to get further in advance. So, we need to get direction for our consultant (Tina) working on SLC (2028) and whatever region we decide for 2029
- Sandra. We should decide today on preferred region for 2028.
- ACTION ITEM: Need to get 2027 location on the website
- Tim moved to have tina focus on Reno and SLC for 2028. Nevin seconded.
  - No discussion
  - Unanimous approval. ACTION ITEM: Tim will tell Tina to look into SLC and Reno for 2028
- Next discussion topic
  - We should get a regional rotation plan for future meetings. We used to have a OP direction to be 3 years in advance; should try to get back on this
- Greg Dahl proposed having a joint meeting with WSSA (pref Hawaii) between 2029-2032
  - Ryan; joint meetings make a lot of financial sense for WSWS, especially as we get smaller.
  - For example, could meet with Southerns in TX or OK.
  - Not just WSSA, could also think about other societies to hold joint mtg
  - Question from Beth. How many years to we want between joint meetings? Will discuss in followup meeting.
- Unrelated discussion
  - Sandra will take on the task of updating committee membership and terms. The program is not fully accurate and this info does not exist.
  - ACTION ITEM. Sandra will followup

BREAK FOR LUNCH at 12:00. Meeting resumed at 12:45

Awards – *Drew Lyon* – chairperson (Tim Prather – board contact)

- No request.
- Did not have nominees for all awards (Roland Shirmin grant was not awarded this year).
- Tim said he pushed hard in 2024 and was successful but did not push as hard this year. How to get this engrained.
  - ACTION ITEM. Sandra will put in OP to remind this committee to solicit nominations.

Poster – *Shannon Clark* – chairperson (Nevin Lawrence – board contact)

- No request.
- Shannon says there was an error; she should not have been listed as chair. Marcelo M is the current chair. MM did submit a report.

- Unrelated discussion
  - Who's is responsible for keeping the lists of committee members?
    - Is presidential responsibility. Should have a drop box or live document that resides somewhere
    - Should get passed to Secretary by president.

- Ryan – could be a Members at Large task.
  - Carl – the president could/should delegate this to Member at Large
    - This person can then ensure the website gets updated.

Student Paper/Poster Judging – *Jake Courcamp* – chairperson (Nevin Lawrence – board contact)

- No request.
- No report submitted. Judit Barruso is organizing.
  - Judit had suggestion for OP and shared with Nevin/Sandra.
  - Raised question of the roll of the student member on the committee.
  - Is it an issue if the student member knows who the judges are? We don't think this is a concern.
  - Discussion of whether the abstract word counts could be automated or streamlined?
  - Eric W: Did we have enough judges?
    - Yes, there is enough; can join the judge meeting this afternoon if interested in joining in.

Necrology – *Earl Creech* – chairperson (Brad Hanson – board contact)

- No request.
- Eric Westra will follow up with Earl.
- Carl – Earl had reached out to Erik and Carl.
- ACTION ITEM: Brad will follow up with Earl before tomorrow.

Sustaining Membership – *Jenna Meeks* – chairperson (Tim Prather – board contact)

- Request an "easy to pay" with credit card (vs filling out a form).
  - Ryan – said his "easy button' was to call Erik directly and pay by phone..
- Suggest to count Jenna's first year as "chair" to standardize among committee.
- Suggest that we remove a meeting registration as part of the benefit. We agreed to not include the membership.
  - Byron S said he gets some pressure from his company about the value of being a sustaining member. Shannon said her company does the same.
  - Greg Dahl said this is part of the society being "taken for granted".
  - Ryan – we as an industry (group of industry members) could get together the selling points to internal leadership. Maybe a 1-pager "return on investment"
  - Erik – could separate that low level membership from including conf registration.
  - ACTION ITEM: Ryan will coordinate an effort with current existing sustaining members to create a 1-page ROI document.

Legislative – *Lisa Rew* – chairperson (Alan Helm – board contact)

- No report submitted.

Herbicide Resistant Plants – *Rui Liu* - chairperson (Derek Sebastian – board contact)

- No report submitted.
- Recommendation: Upload the tri-fold on the website. Carl will forward to Erik. Erik asked if under Publications.

Diversity and Inclusion Committee – Lisa Jones (Carl Coburn – board contact)

- Board report posted

Invasive Species Ad-Hoc Committee – Mirella Ortiz/Lisa Jones (Carl Coburn – board contact)

- Recommendation to approve the committees request to become a standing committee. We will address in new business.

Agency Needs Ad-Hoc committee – Tim Prather summarized

- Eric Lenhoff had a survey that he reported on previously. It's hard for agency folks to get permission to attend this event; having workshops and symposia is helpful.
- Tim recommended ACTION ITEM: suggest moves this committee responsibility to the Invasive Species Committee once it is a standing committee. Then, this ad-hoc committee could be dissolved.
  - ACTION: membership will have to vote on the Invasive Species Committee at business breakfast.
  - ACTION: President Coburn dissolved the Agency Needs Ag-Hoc committee

New Business:

2027 Joint meeting with Western Weeds Coordinating Committee (in CA meeting)

- We've previously voted to approved this. WWCC is requesting feedback on next steps.
  - Carl – is an MOU the next best step?
  - Yes, Erik will draft one and share with Carl/Nevin for feedback.
- WWCC would like to start organizing. They have a fairly different format; so we need to get them in the conversation
  - Sandra – could they hold much of their separate sessions on the day we do our Board meeting?
  - Tim – there are some strategically important leaders (of BLM etc) who are a part of WWCC that would be good to connect.

WSSA representative

- discussed earlier. Carl has an action plan for this

Invasive Plants Committee Operating Procedures

- Breanne asked a clarifying question about the committee attending other society meeting vs being a liaison. Sandra thought it might be read as needing to find a WSWS member to represent.
  - Suggest changing wording to "encourage" attendance. Or, "attend or delegate another WSWS member to represent"
- Brenna moved to vote on this. Beth seconded
- Discussion.
  i. Greg Dahl noted that many other societies have a similar committee. Should suggest that this committee participate in WSSA committee.
  ii. Ian will encourage that with the WSSA committee as they are developing their mission and leadership
- Vote: unanimous acceptance of the motion.

i. Lisa Jones is the committee chair. She can raise this as a seconded motion at the business breakfast. Carl can call for a vote under new business
    1. ACTION. Carl will prep Lisa for this
    2. ACTION. Carl will add to business breakfast agenda

Attendance at President's DC Fly In

- Normally, Nevin would go to this as president but he has a conflict in 2026.
- So, in 2026, president-elect will go instead of president (Byron in place of Nevin).
- In 2027, the past president (Nevin) will attend
    - This is simply a swap of Nevin/Byron for 2026/2027
- In 2028, back to the president representing WSWS at WDC fly-in

Weed Contest:

- Greg Dahl: there will be a weed contest in Gothenburg NE. July 29 and 30, 2026
    - Greg would really like to see 4-6 teams from the WSWS
    - Greg is trying to get Milos at UNL on board for a tour of the spray application lab after the contest.

Potential Joint Meeting ideas:

- Lee VW raised question about joint meeting with WAPMS.
- Carl wondered about a 3-way joint meeting with WWCC
    - This might be good in 2028 in SLC or Reno
- Sandra noted that WAPMS tends to like the western part of the west (Denver isn't great, they tend to like Boise; maybe Reno, maybe SLC)

Committee reports at BoD meetings

- Beth asked what committee members need to give reports at business meeting.
    - Tim noted that he tried to expedite this in previous year but it seemed like it we lost something important (visibility of society activity to membership)

Nevin moved to adjourn art 1:55 and Ryan seconded. Unanimous agreement.

Meeting adjourned at 1:56pm.

WSWS ANNUAL BUSINESS MEETING MINUTES (2026)

WSWS Business Breakfast Meeting
Tucson Marriott – Tucson, Arizona
March 5, 2026

Call to Order at 7:00 AM by President Carl Coburn

Welcome and Recognition of Incoming and Outgoing Officers- Carl Coburn

Officer Reports:

Secretary – Brad Hanson

- Presented that 2025 Annual Business Meeting minutes have been posted online. President called for a motion to accept minutes.
  - Moved by Tim Prather, seconded by Sandra McDonald
  - Voice vote: all in favor, no votes against. Minutes of the 2025 business meeting are accepted.

Treasurer and Finance Committee Report – Ryan Rapp

- Full report available online
- Society has transitioned to a new financial advisor and is going well.
- Committee is working with a tax attorney to change/clarify non-profit status as it affects potential individual donations to the society (e.g. estate gifts).

President – Carl Coburn

- Acknowledged officers and committee members rotating off after terms ended.
- Noted several important votes and board actions during the past year: FourWaves software, investments/finance, future joint meetings.
- Thanked Pat Clay for filling in for WSWS Rep to WSSA.
- Noted opportunity for expressions of interest to be CAST rep (Greg is willing to continue, but also willing to train a replacement).

Past President– Tim Prather

- Nothing additional to report

President Elect/Program Chair – Nevin Lawrence

- Oversaw the program committee and worked on assembling the program
  - Nevin thought the Four Waves software worked quite well for first year
    - Noted this was our third new software in three years; seems to be a keeper.
  - Thanked the program committee, session chairs, and volunteers
- Registration was down a bit from previous. ~170 registered for 2026.

Education and Regulatory – Lovreet Shergill

- Nothing additional to report

Research Section Chair – Beth Fowers

- Reminder to include the chair-elects in the process to facilitate planning and training.

- Reminded Project-Chairs to get discussion reports to Beth within the next few weeks

WSSA Representative – Alan Helm

- Not present

Member-at-Large Public – Breanne Tidemann

- Considering "dine arounds" like the Canadian society does for future meeting
- Nothing additional to report

Member-at-Large Private – Derrick Sebastian

- Not present

CAST Representative and WSSA President – Greg Dahl

- All US Regional Weed Science Societies and WSSA are members of CAST and having a CAST rep is very valuable to the member societies
- Recent (March 2026) CAST publication on Invasive Species
  - Webinar scheduled for April 8, 2026

Student Liaison – Wes Maughan

- Ola Adeyemi from Utah State will be Student Liaison next year
- Silent action closes after business meeting
  - Thank you to those that donated money or items to the silent auction
- Student night out had about 40 students and 20 hosts participating.
- Greeshmanth Alluri from Oregon State University will be the next Student Liaison in rotation

Constitution and Operating Procedures Representative – Sandra McDonald

- Reminded committee chairs, officers, etc to "read the Operating Procedures"
- This is a "living document". Contact Sandra to get Procedures updated to make current and relevant.

Director of Science Policy – Lee Van Wychen

- Lee reported in the general session and submitted a report
  - Reminder that the Science Policy Fellow applications are due by March 27, 2026
  - Reported that the Farm Bill passed the house ag committee yesterday; next will move to the House floor and then on to Senate

Committee Reports:

Publications Committee

Proceedings – Carl Libbey

WSWS Newsletter – Carl Libbey

- Nothing additional to report
- Reminder: Newsletter is 4 times a year. Carl will reach out to members for more reports/info for the proceedings

Website – Eric Gustafson

- nothing to report

Local Arrangements – Kai Umeda

- No major issues to report.
- Noted that Beth (Research Section Chair) and Eric G did a great job with the facility and minor issues
- Thanked Matt F and the posterboard relay team for getting boards to site. Also thanks to volunteers for rapid setup and teardown of posterboards/easels.

Nominations – Breanne Tidemann

- Noted that the committee secured a full slate of officer nominees. Thank you to nominees for allowing their names to stand.
- Corey Ransom will chair this committee next year.

Awards – Drew Lyon

- Awardees were honored at Luncheon.
- Awardees:
  - Lisa Rew, Outstanding Weed Scientist, Public Sector
  - Craig Alford, Outstanding Weed Scientist, Private Sector
  - Eric Westra, Outstanding Weed Scientist, Early Career Public
  - Shannon Clark, Outstanding Weed Scientist, Early Career Private
  - David King, Professional Staff
  - Kelly Pruit, Weed Manager

  Thanks to those who nominate and support nominations

Fellows and Honorary Members – Andrew Kniss

- Recognized those that nominated members for awards, and encourage other members to do the same
- WSWS Fellows for 2026 are Curtis Rainbolt and Greg Dahl.
- There were no nominees for Honorary Member this year.
- Carol Mallory-Smith will rotate off the committee, Brad Hanson will chair in 2027.

WSWS Representative to WSSA Finance Committee – Ryan Rapp

- Noted that WSSA is financially stable.
- WSSA developed a financial strategic plan recently to serve as a guide to spending and investing strategy.

Site Selection – Craig Alford

- 2027 meeting will be at the Hyatt Regency in Irvine, California
- For 2028, we are aiming for Salt Lake City or Reno; working with our site planner.
- For 2029+, trying to get back to our goal of having sites lined up three years in advance.
  - This is becoming more important as we vie for mid-size venues as our attendance has been shrinking over the past several years.

Poster – Marcelo Moretti

- Thank you to volunteers to set up and tear down poster room

- Thank you to poster board relay team. Suggested the Society consider renting boards or purchasing a second set to reduce cross-region transport needs.
- 60 total posters submitted this year

Necrology –Earl Creech

- Recognized Bob Kline who passed in March 2025

Sustaining Membership – Jenna Meeks

- Thank you to the 11 current Sustaining Members for supporting WSWS

Herbicide Resistant Plants – Rui Liu

- In past year, the committee developed a poster for this meeting. Greenhouse resistance screening methods

Diversity and Inclusion Committee – Lisa Jones

- Became a standing committee last year after six years as an ad hoc committee.
- This year, activity focused on student involvement. Started a new scholarship "grown the future" that made a $2,000 undergrad award
- Held a DEI "social hour" held on Tuesday morning

Invasive Species Ad-Hoc Committee – Lisa Jones

- Committee has been ad hoc for 4 yrs
- Committee worked over the last year on changes to Operating Procedures to become a standing committee. The membership will be asked to vote on this during the New Business part of this meeting.
- Coordinated activities with Western Weed Coordinators and provided feedback to them on one of their documents.
  - The 2027 WSWS meeting in Irvine will be joint with the WWC; they will hold a symposium as part of our program
- This committee has been participating in the WSSA ESA committee; providing feedback to that committee with special focus on western rangelands and invasive weed issues.

Student Paper/Poster Judging and Awards– Judit Barroso

- There were 46 student presenters (26 posters, 20 oral presentations).
  - 11 were undergrads
- Thank you to students and the 22 members who served as judges.
- Winners:
  - Posters (undergrad):
    - Agronomic section: Ethan Frager, OSU (1)
    - Horticulture section: Madden Robertson, OSU (1)
  - Posters (grad)
    - Agronomic section: Ian Waldecker, U Wyo (1) Devansh Het Desai, MSU (2), Wes Maughan, WSU (3)
    - Horticulture section: Davi Fiedler, OSU (1); Greeshmanth Alluri, OSU (2)
    - Range, Forestry, Natural Areas: Felipe Quatroni, USU (1)

        - Basic Biol.Ecol.: Renan Favera, OSU (1)
    - Oral presentations (grad)
        - Agronomic section: Ian Waldecker, U Wyo (1), Renan Favera, OSU (2), Laura Rodriguez, U Idaho (3)
        - Horticulture section: Pamela Medeiros dos Santos, OSU (1)
        - Basic Biol. Ecol.: Ola Adeyemi, USU (1)
        - Range, Forestry, Natural: Claire Anderson, MSU (1)

New Business:

- Carl Coburn: motion from the Board of Directors to move the Invasive Plants Committee from ad hoc to a WSWS Standing Committee
    - Moved by Sandra McDonald, second by Jenna Meeks
    - No discussion offered by membership
    - Carl called for a voice vote.
        - All members presented voted in favor, none voted in opposition.
        - Motion passes to make Invasive Plants committee a WSWS standing committee
- Ceremonial "passing of the gavel" from outgoing president Carl Coburn to incoming president Nevin Lawrence
    - Nevin thanked Carl for his service to the WSWS
- President Lawrence called for a motion to adjourn
    - Moved by Andrew Kniss, seconded by Phil Banks

Meeting adjourned at 7:56am

WESTERN SOCIETY OF WEED SCIENCE NET WORTH REPORT

April 1, 2025 through March 31, 2026

ASSETS	
Cash and Bank Accounts	
American Heritage Checking	$105,203.74
American Heritage Money Market	$75,092.46
TOTAL Cash and Bank Accounts	$180,296.20
Investments	
Raymond James	$259,326.21
TOTAL Investments	$259,326.21
TOTAL ASSETS	$439,622.41

WESTERN SOCIETY OF WEED SCIENCE CASH FLOW REPORT

April 1, 2025 through March 31, 2026

INFLOWS ($)	
Annual Meeting Income	103,050.00
Interest Income	3728.60
Dividend Income	8105.12
Membership Dues	510.00
Miscellaneous Income	150.00
Royalty for Proceedings - RPR	180.00
Security Value Change	17,036.40
Rita Beard Endowment	2550.00
Student Travel Account	2650.00
Donations	2470.00
Roland Schirman Travel	1000.00
Sustaining Member Dues	15,325.00
TOTAL INFLOWS	**156,755.12**
OUTFLOWS ($)	
Annual Filing Fee	70.00
Annual Meeting Expense	141,935.23
Abstract Submission	1647.71
Bank Charge	3536.62
Copies	135.88
Director of Science Policy	15,714.62
Fee Charged	4251.60
Insurance	473.00
Management Fees	32,349.96
Miscellaneous	364.31
Proceedings/Publications	750.00
Postage	1143.92
Summer Meeting	3951.59
Student Awards	6031.48
Supplies	429.76
Taxes	532.5
Travel to Summer Meeting	981.62
Travel to WSWS Meeting	4532.96
Web Site Design	1000.00
Weed Contest	0.00
Web Site Hosting	3000.00
WSSA Rep Travel	1636.29
TOTAL OUTFLOWS	**224,469.05**
OVERALL TOTAL	**$-67,713.93**

WSWS 2026 FELLOW AWARDS

The fellow is the highest honor that WSWS awards. The society selects no more than two members per year as Fellows. Fellows are members of the society that have provided meritorious service to the Society. The 2026 awardees were Greg Dahl and Curtis Rainbolt.

This year's committee members were Brad Hanson, Andrew Kniss (chair), and Carol Mallory-Smith.

Greg Dahl, Winfield United, Retired – Eagan, Minnesota

Greg Dahl (right) receives the WSWS Fellowship Award from President Carl Coburn (left).

Greg Dahl recently retired after a distinguished career of over 25 years with Winfield United and precursor companies (Winfield Solutions LLC and Agriliance LLC), where he worked in product development research roles since 2000. Before Winfield, he spent 10 years as Pesticide Coordinator with North Dakota State University in Fargo, and worked 4 years as a technical services representative with American Cyanamid. Greg earned his B.S. in Crop Science and M.S. in Agronomy from North Dakota State University.

While working with NDSU, Greg helped develop Project Safe Send, the North Dakota program for the collection and disposal of banned, canceled and waste pesticides. From the program's initiation in 1992 through Greg's last year at NDSU in 1997, Project Safe Send collected and disposed of over 500,000 pounds of waste.

In his roles with Winfield and Agriliance, Greg conducted research and development leading to over 70 new or improved commercial products that are applied to over 100 million acres annually, in at least seven countries on four continents. Greg and his team have received over 10 U. S. patents and many international patents for products and spray application testing methods and technologies. Greg is credited with discovering Class Act NG and InterLock, among other products.

Greg has been an active participant in the WSWS for over 20 years. He has served as the CAST representative, on several committees including Sustaining Membership, Necrology, and Legislative and has judged many papers and posters in the student contests. In addition to the WSWS, Greg is active in the North Central Weed Science Society (NCWSS), Canadian Weed Science Society (CWSS), and the Weed Science Society of America. Greg has served in the presidential rotation of the NCWSS (President in 2017) and WSSA (President in 2024).

Greg received the Outstanding Weed Scientist – Private Sector award from the WSWS in 2024, the NCWSS Distinguished Achievement Award in 2011, and was named a Fellow of the NCWSS in 2019. He has also received the Land O' Lakes President's Award twice for his work with Micronutrients and Adjuvants in 2011 and 2012, respectively.

Greg has been participating in regional and national weed science societies for over 40 years, and he received 1st place for the Unknown Herbicides event at the 1982 North Central Weed Control Conference summer weed contest. In addition to his remarkable track record in weed science, an important theme from the nomination packet included numerous comments on his kindness, dependability, humility, and eagerness to recognize the contributions of others.

Curtis Rainbolt, BASF, Meridian, Idaho

Dr. Curtis Rainbolt received his B.S. in Agronomy from Texas Tech University, followed by M.S. and Ph.D. degrees in Plant Science from the University of Idaho. After completing his PhD, he spent several years as a Regional Extension Agent and then an Assistant Professor with the University of Florida at the Everglades Research and Education Center near Belle Glade, FL, where he developed integrated weed management programs in sugarcane, vegetable crops, rice, and turfgrass.

Curtis Rainbolt (right) receives the WSWS Fellowship Award from President Carl Coburn (left).

He accepted a position with BASF in California in 2008, and then moved to Idaho in 2015. Curtis has been in technical service roles with BASF, providing sales support and product training, as well as product development and trial management across a large swath of the Western United States.

One letter of support noted that Dr. Rainbolt's "*technical expertise, combined with his capacity to bridge research and application, has yielded substantial and lasting benefits to growers and the broader agricultural community."* Dr. Rainbolt worked on the development and launch of important herbicides for the Western U.S. including Treevix (saflufenacil), and Zidua (pyroxasulfone) in wheat as well as label expansions into onions, potatoes, and mint. His efforts have been recognized within his organization when receiving the Team Choice and Top Performer awards from BASF.

Curtis has been actively involved with the WSWS as a graduate student and again upon his return to the West. He chaired the Horticultural Crops section in 2010, and has served on the Sustaining Membership committee, and currently serves on the Awards Committee. Dr. Rainbolt served on the Board of Directors as Secretary in 2015-2016, and recently completed the Presidential rotation, serving as our President in 2024.

Dr. Rainbolt participated in the Southern Weed Science Society during his years in Florida, and has been an active member of the California Weed Science Society, serving as Section Chair and on the Board of Directors.

Additional comments the nomination packet included:

“Curtis has demonstrated exceptional leadership, technical expertise, and a sustained commitment to advancing our discipline across academic, industry, and professional society roles.”

“I can say without a doubt that Curtis is one of the most supportive of young weed scientists that I know. His practical insights, inclusiveness, and generosity strengthen the vital bridge between industry and academia.”

“Curtis’s combination of sustained society leadership, impactful industry contributions that directly benefit growers, and consistent professionalism clearly meets and exceeds this standard.”

WSWS 2026 HONORARY MEMBER

This award was not conferred in 2026.

WSWS 2026 OUTSTANDING WEED SCIENTIST AWARDS

Outstanding Weed Scientist, Early Career, Public Sector: Eric Westra

Dr. Eric Westra is an Assistant Professor in Weed Science at Utah Sate University in Logan, Utah. He received his B.Sc. in Soil and Cropp Sciences in 2009, his M.Sc. in Weed Science in 2012 and his Ph.D. in Bioagricultural Sciences and Pest Management with a focus in Weed Science in 2016, with all degrees earned from Colorado State University. After completion of his Ph.D. Dr. Westra worked as a Research Associate and then Research Scientist at Colorado State University in Fort Collins, before moving to Utah State University in January of 2023. Dr. Westra has become a highly respected weed scientist requested to speak on several weed science topics including management of weeds in vegetables, winter annual grass control, herbicide resistance and many others. His versatility and expertise across multiple weed science topics is highly impressive. He has published or submitted 16 peer reviewed papers, 10 extension presentations, 6 technical extension documents, and is an author or co-author on 52 conference abstracts. Eric has been involved in research spanning the spectrum from highly practical on-farm management techniques to gene flow and herbicide resistance mechanisms. Dr. Westra has been a member of the WSWS since 2009 participating as a graduate student, and now a full member. He participated in student presentations and competitions, and has served as a judge for several years to give back to the society. He has served on multiple committees and served as the Local Arrangements Chair for the 2024 annual meeting in Denver.

The Outstanding Weed Scientist, Early Career, Private Sector: Shannon Clark

Dr. Shannon Clark received her undergraduate degree from the University of Colorado, Colorado Springs in 2009. She then relocated to northern Colorado where she completed her MS (2011) and PhD (2019) at Colorado State University. Her interest in weed management began when she worked as the manager of the MacGregor Ranch in Estes Park, CO. This 3,600 acre ranch borders Rocky Mountain National Park and is a historic site established in 1873. It is maintained as both a working ranch and an educational facility. During her four years as ranch manager and director of educational program Shannon developed a real world understanding of how weeds can impact both native and managed ecosystems. Her PhD research focused on improving rangeland and natural areas by managing weeds to aid in native plant establishment and release. Shannon has been active in WSWS since 2017 and has presented numerous oral and poster presentations, served on several committees including; Poster Committee Chair, Weeds of Range, Forestry, and Natural Areas Project Chair, Liaison to WSSA Endangered Species Committee and Western Weed Coordinator Committee. Shannon has been employed by ENVU since 2021 and currently holds the position of Senior Solutions Development and Technical Services Manager with ENVU.

The Outstanding Weed Scientist, Public Sector: Lisa Rew

Dr. Lisa Rew is a Professor of Weed and Invasive Plant Ecology for Montana State University. She is an extraordinary weed science educator, scholar, and mentor. Her discoveries have generated local, regional, national, and international renown while enriching educational opportunities for our students and stakeholders. Dr. Rew is driven to understand non-native plants within wild, range and cropped systems. Her work improves our knowledge and understanding of the factors driving invasion, enabling quantification of negative impacts and the development of cost-effective management solutions for our stakeholders. Dr. Rew's research on the ecology of invasive weeds has been supported by her more than 80 peer-reviewed papers with ~half co-authored with students, and over $7 million in research funding. Nationally, Dr. Rew has been subject editor for Weed Research and Invasive Plant Science & Management Journal, while also serving as an invited reviewer for NSF and USDA-NRI proposals and over a dozen different scientific journals. Consistent with these accomplishments, she has been invited to submit articles, review for multiple weed science journals, speak locally and internationally, and has chaired conference sessions for scientists and ranchers alike. Her distinction was recognized by her receiving our College's 2021 Excellence in Research & Discovery Award, our University's 2023 Faculty Award for Teaching and Research Award, and nationally, the WSSA 2024 Outstanding Research Award.

The Outstanding Weed Scientist, Private Sector: Craig Alford

Dr. Craig Alford has been active in the agriculture industry and weed science for over 25 years. Most of his career has been spent in private industry with DuPont Crop Protection, then Corteva Agriscience, following the merger between Dow AgroSciences and DuPont. Craig has served in many roles over the years, including regional leadership of R&D teams; product development, portfolio management, and Biology Leader across multiple segments such as range and pasture, specialty crop herbicides, and biostimulants; Global Biology Leader responsibilities for rice, specialty, and pasture and land management herbicides; herbicide discovery field testing leadership; resistance management leadership; and Field Development R&D. Earlier in his career, Craig also served as an Associate Research Scientist with the University of Wyoming and a Research Associate with Pioneer Hi-Bred International.

WSWS 2026 PROFESSIONAL STAFF AWARD

The Outstanding Professional Staff: David R. King

David R. King has served as a Faculty Research Assistant in the Moretti Lab at Oregon State University (OSU) since 2019. He brings a strong practical and academic background in agriculture and agricultural machinery, supported by a B.S. in Agricultural Science from OSU. Over the past six years, David has developed expertise in weed science with an emphasis on herbicide efficacy, perennial cropping systems, and the integration of novel weed-management technologies. In his role, David installs, maintains, and evaluates a wide range of field experiments across multiple perennial crops. He oversees approximately 30 research trials each year and provides essential mentorship and technical guidance to graduate students, undergraduate students, and seasonal interns. David has made significant contributions to weed science through co-authored research reports, extension publications, and active participation in USDA IR-4 projects. His work has directly supported eight new herbicide registrations for specialty crops in Oregon, strengthening management options for growers across the region.

The Outstanding Weed Manager: Kelly Pruitt

Kelly Pruitt has been the Vegetation Stewardship Manager for the City of Boulder's Open Space and Mountain Parks Department since 2021. She provides leadership and support to advance the goals of the OSMP Vegetation and Invasive Species Management Program. Kelly is recognized in Colorado for her skills in managing weeds while working in areas under public scrutiny. She has been successful in managing weeds through a combination of patience, grace, can do attitude and a willingness to work with the public. She is a proponent of ecological-based weed management. Kelly has assisted the training team of the Western Invasive Weed Short Course and she has been an outstanding addition to the team. The Short Course participants have expressed their appreciation of her perspective as a land manager. Kelly's passionate leadership in state, county and city weed management has set a standard for other weed managers in Colorado.

WSWS 2026 PRESIDENTIAL AWARD OF MERIT

Ryan Rapp

Ryan Rapp received the Presidential Award of Merit from Carl Coburn. Through his contributions as treasurer and leadership on the board of directions, the Western Society of Weed Science has an improved investment strategy, improved tax status that encourages charitable donations, and more sustainable financial standing. Ryan has displayed a unique ability to advocate for improvements in current procedures as well as propose new strategies that prioritize the betterment of the society and contribute to career success for student members.

Ryan Rapp (right) accepts the Presidential Award of Merit from WSWS President Carl Coburn (left).

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WSWS 2026 ELENA SANCHEZ MEMORIAL STUDENT SCHOLARSHIP RECIPIENTS

The Elena Sanchez Memorial Outstanding Student Scholarship promotes greater student participation at the WSWS annual meeting and encourages new weed science research and future weed science careers. Scholarships are awarded to three outstanding undergraduate and/or graduate WSWS student members who will attend and present at the WSWS annual meeting. The winners of the 2026 scholarships were:

Greeshmanth Alluri is a Ph.D. student at Oregon State University, where he conducts research under the guidance of Dr. Marcelo L. Moretti. His work focuses on developing integrated weed and disease management strategies for hop production in the Pacific Northwest, with an emphasis on combining chemical, electrical, and mechanical approaches to improve sustainability and crop safety. Greeshmanth earned his M.S. in Horticulture from Michigan State University, where he studied non-chemical weed management in ornamental systems, and holds a bachelor's degree in agriculture from India. He has authored peer-reviewed publications, received multiple graduate fellowships, and actively engages in teaching, extension, and grower outreach. His long-term goal is to advance practical, sustainable weed management solutions while mentoring future scientists.

Renan Nasser Dalla Favera is a master's student in Crop Science at Oregon State University, where he works as a Graduate Research Assistant under the supervision of Dr. Victor H. V. Ribeiro. His research focuses on weed biology and management, addressing both established and emerging challenges in western cropping systems. Renan's thesis research investigates the germination ecology and management of bristly hawksbeard (*Crepis setosa*), an emerging weed threat in white clover seed production, while he also contributes to herbicide resistance screening of downy brome populations. He holds a bachelor's degree in Agronomy from the Federal University of Mato Grosso, Brazil, and has experience in research, teaching, and extension. Renan aspires to pursue a Ph.D. and a career as a research or extension specialist focused on integrated weed management.

Olanrewaju (Ola) Adeyemi is a Ph.D. student in Plant Science (Weed Science) at Utah State University, where he conducts research under the supervision of Dr. Mirella Ortiz. His doctoral research focuses on surveying and identifying the mechanisms of herbicide resistance in kochia (*Bassia scoparia*) across Utah, with the goal of developing science-based management strategies for growers. Ola holds a master's degree in Plant Science from the University of Idaho and a bachelor's degree in Horticulture from the Federal University of Agriculture, Abeokuta, Nigeria. He has published peer-reviewed research, secured competitive extramural funding, and actively presents his work at regional and national weed science meetings. In addition to his research, Ola contributes through teaching, extension, and professional service, and aspires to a career as a weed science professor integrating research, education, and outreach.

President Carl Coburn pictured with the 2026 Elena Sanchez Memorial Scholarship recipients Renan Nasser Dalla Favera, Greeshmanth Alluri, & Olanrewaju Adeyemi (from left to right).

WSWS 2026 ROLAND SCHIRMAN MEMORIAL TRAVEL GRANT RECIPIENT

The Roland Schirman Memorial Travel Grant promotes greater participation by county extension agents and county weed district personnel to attend the WSWS annual meeting and encourages additional weed science education and research efforts. One travel grant is awarded annually to an outstanding county extension agent or county weed district supervisor to be used towards travel-related expenses to attend the annual WSWS meeting. This scholarship was not awarded in 2026.

WSWS 2026 RITA BEARD ENDOWMENT STUDENT SCHOLARSHIP

The Rita Beard Endowment Foundation Board of Trustees has selected Elise Bakke and Angeline Bahe, both North Dakota State University Students, for a travel scholarship to attend the North American Invasive Species Management Association's Annual Conference in Stateline, Nevada. The Rita Beard Endowment Foundation is a 501 (c) (3) non-profit that was created from a generous donation by Rita Beard's family and friends. Funds are awarded to support educational opportunities of students and early career invasive species managers by providing registration and travel to professional meetings including Society for Range Management, Western Society of Weed Science, Western Aquatic Plant Management Society, and the North American Invasive Species Management Association. To read more about the Foundation, learn how to apply for the 2027 scholarships, or make a donation go to: **Rita Beard Endowment – Western Society of Weed Science**.

Desiree McGraff

Desiree McGriff is a young professional employed as a Research Technician at the Oklahoma State University Weed Science program. They assist graduate students on integrated weed management projects in wheat systems. Desiree also conducted an independent project on how Santa Maria feverfew (*Parthenium hysterophorus*), a potentially invasive species in Oklahoma, may influence native plant communities and soil function. Desiree will soon begin a master's degree in Rangeland Ecology at Oklahoma State University, focusing on how management decisions influence plant community dynamics, water quality, and habitat resilience. They plan to continue working in applied research and on-the-ground management, contributing to solutions that protect and restore western landscapes.

Haley Monahan

Haley Monahan is pursuing a master's degree in Ecology at Colorado State University. Within the Restoration Ecology Lab, Haley is researching how to increase biodiversity by controlling non-native pasture grasses using herbicides followed by reseeding in degraded rangeland. She is also investigating the longevity of seedbanks of native ruderal species at different soil depths to explore options for revegetation when using soil-applied herbicides that rely on selectivity by placement in the soil (i.e., indaziflam). Haley plans to continue contributing to weed management and revegetation efforts in the western U.S. as an ecological restoration practitioner through coordination with government agencies as well as private landowners. Her goal is to create an LLC that provides ecologically-informed weed management and revegetation services.

Ashton Sellke

Ashton Sellke is pursuing a master's degree in Plant Sciences at the University of Idaho. Her research incorporates geospatial analysis and remote sensing data to predict areas of susceptible habitat for Turkish thistle (*Carduus cinereus*), a relatively new and problematic invasive weed. Through the development of a habitat susceptibility model, monitoring can be prioritized in areas

determined to have a high degree of likelihood for invasion, to conserve time, energy, and resources. This approach may allow for early detection, rapid response, and potential eradication of Turkish thistle. Ashton hopes to apply her experience and obtain responsibility for environmental decisions as a federal land manager or research scientist. She plans to dedicate her life and career to the protection of the environment from invasive weeds.

President Carl Coburn pictured with the 2026 Rita Beard Scholarship recipients Desiree McGraff, Ashton Sellke, & Haley Monahan (from left to right).

WSWS 2026 GROWING THE FUTURE OF WEED SCIENCE STUDENT SCHOLARSHIP

The WSWS and the Diversity and Inclusion Committee are pleased to announce the Growing the Future of Weed Science Scholarship. The scholarship will support undergraduate students from diverse backgrounds to attend our annual meeting. The goal is to foster a more inclusive and representative future for the weed science discipline by ensuring our society continues to reflect the diverse world we serve.

Beyond financial support, this scholarship is a vital opportunity to introduce young scientists—many of whom may not yet be aware of our field or our society—to the exciting and important work we do. In doing so, we aim to not only increase participation but also inspire new talent and ideas, serving to revitalize our membership and ensure the long-term health of the WSWS.

A total of $1,000 will be awarded to one outstanding undergraduate student assisting with research relevant to weed science. The scholarship money must be used on expenses related to attending the WSWS annual meeting (e.g., travel, lodging, registration).

To read more about the Diversity and Inclusion Committee, learn how to apply for the 2027 scholarship, or make a donation go to: **https://wsweedscience.org/diversity-and-inclusion/**

Ethan Frager

Ethan Frager is a third-year undergraduate student in Crop Science at Oregon State University. He is researching herbicide resistance in Italian ryegrass (*Lolium multiflorum*), a common weed in wheat. This project involves greenhouse trials and isolating and cloning resistant target site genes. He is interested in the genetics and ecology of herbicide resistance, weed/native grass ecology, and developing more effective and sustainable cultural weed management strategies, especially for organic farming. Ethan plans to pursue a career in academia, focused on weed science research pertinent to the needs of Pacific Northwest farmers. He hopes to continue fostering diversity and inclusion efforts so that passionate and qualified people from all groups can contribute to the future of weed science.

President Carl Coburn pictured with Ethan Frager (from left to right).

WSWS 2026 STUDENT PAPER AND POSTER AWARDS

2026 Paper judging committee: Jake Courkamp (Past-Chair), Judit Barroso (Chair), and Jason Adams (Chair-Elect), Peter Westen Maughan (Student Representative). The incoming committee member is Shannon Clark.

In total, there were 46 entries in the 2026 WSWS Annual Meeting student competition. These entries included 26 posters and 20 oral presentations. From the total presentations, 89% were from graduate students and 11% from undergraduates. Twenty-two judges were recruited for the student competition, 77% of whom volunteered, while the remaining 23% graciously agreed to serve when approached.

David Clements
Jeffrey Golus
Avik Mukherjee
Clebson Gonçalves
Marty Schraer
Brian Schutte
Daniel Beran
Ryan Bryant-Schlobohm
Tom Getts
Austin Frewert
Noemi Codina-Pascual
Luisa Baccin
Vhuthu Ndou
Ryan Hill
Chloe Mattilio
Shannon Clark
Brianne Tidemann
Sohaib Chattha
Caleb Dalley
Jake Courkamp
Jason Adams
Judit Barroso

Sections with nine or more entries were awarded first, second, and third place. Sections with 5-8 entries were awarded first and second, and sections with 1-4 entries were awarded first only. The winners of the student competition were as follows:

Posters – Undergraduate Level

Weeds of Agronomic Crops (*3 entries*)

1st place: Ethan Frager

Weeds of Horticultural Crops (*2 entries*)

1st place: Madden Robertson

Posters – Graduate Level

Weeds of Agronomic Crops (*10 entries*)

1st place: Ian Waldeker

2nd place: Devanshi Het Desai

3rd place: Peter Weston Maughan

Weeds of Horticultural Crops (*5 entries*)

1st place: Davi Fiedler

2nd place: Greeshmanth Alluri

Weeds of Range, Forestry, and Natural Areas (*4 entries*)

1st place: Felipe Quatroni

Weeds of Basic Biology and Ecology (*2 entries*)

1st place: Renan Favera

Oral Presentations - Graduate Level

Weeds of Agronomic Crops (*9 entries*)

1st place: Ian Waldeker

2nd place: Renan Favera

3rd place: Laura Rodriguez

Weeds of Horticultural Crops (*3 entries*)

1st place: Pamela Medeiros dos Santos

Weeds of Range, Forestry, and Natural Areas (*4 entries*)

1st place: Claire Anderson

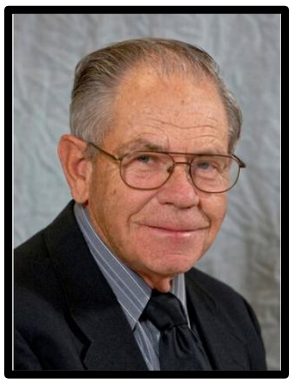
Weeds of Basic Biology and Ecology (*4 entries*)

1st place: Olanrewaju Adeyemi

WSWS 2026 ANNUAL MEETING NECROLOGY REPORT

At the Thursday business meeting, the WSWS honors members who pass away with a moment of silence. This year, our society lost one member:

Robert N. Klein



Robert Nicholas Klein (February 8, 1938-March 22, 2025)

Robert Nicholas Klein, 87, professor emeritus and Nebraska Extension cropping systems specialist, died March 22, 2025.

Klein dedicated more than 55 years of service to the University of Nebraska–Lincoln and was widely recognized for his research and outreach work in pesticide application, nozzle selection and weed management in no-till and reduced-till cropping systems. During his career, he watched farming transition from some producers using horse-drawn threshing machines to today's massive diesel-powered tractors.

Klein was born on Feb. 8, 1938, in Bellwood, Nebraska. Growing up on a farm near David City, he became interested in the details of growing crops and raising animals because of his daily farm chores. He attended grade school at Saint Mary's Catholic Church and high school at David City High. He was an active member of 4-H and showed livestock at local events, including Aksarben and the Nebraska State Fair.

He attended the University of Nebraska, where he earned a bachelor's degree in agriculture extension. Between his junior and senior years in 1959, Klein participated in training to become an extension agent at the Dodge County Extension Service in Fremont. He graduated in 1960 and accepted a position as an extension agent in Douglas County in Omaha, where he worked for two years before enrolling in graduate school. He earned a master's degree in agricultural economics in 1964. On June 5, 1963, he married Janet Elizabeth Knust of Omaha.

In August 1963, he became the extension agent chair in Red Willow County, Nebraska, where he worked for 20 years. During his tenure he received several awards, including the United States Department of Agriculture Superior Service Award, Distinguished Service Awards from the National Association of County Agricultural Agents and the National Association of Extension 4-H Agents, the Agriculture Builder Award from the Greater McCook Area Chamber of Commerce, and a month-long trip to Southeast Asia, from Red Willow County businesses, farm organizations and service clubs.

He was also a member of the Nebraska Air Guard in Lincoln and rose to the rank of sergeant.

He moved to North Platte in 1983 to join the University of Nebraska West Central Research, Extension and Education Center as a cropping systems specialist. His work included, both as an extension agent and specialist, the development and implementation of ecofarming. He defined this as a system of controlling weeds and managing crop residues throughout a crop rotation with

minimal use of tillage, in order to reduce soil erosion and production costs, while increasing weed control, water infiltration, moisture conservation and crop yield.

A large part of Klein's career was teaching producers about conservation tillage and maintaining crop residue to reduce erosion and increase water retention in soil. He was a key contributor to an annual Nebraska Extension publication, "Guide for Weed, Disease, and Insect Management in Nebraska." Klein was a frequent and valued speaker at extension programs across Nebraska and beyond, leaving a lasting impact on producers, educators and colleagues alike.

Klein's awards as an extension specialist included the National Award for Agricultural Excellence, the Cooperative Extension Service Distinguished Extension Specialist Award, inclusion in Who's Who in Agricultural Education, election to the Nebraska Hall of Agricultural Achievement and being named a Fellow of the North Central Society of Weed Science.

Klein enjoyed his work and loved his family. His hobbies included gardening, fishing, hunting, water skiing, jet skiing, camping, golfing and traveling. Klein is survived by his wife, Janet; daughter Kimberly (Dan) Petsch of Grand Island; son Kendall (Madonna) Klein of Omaha; grandchildren Nicholas Petsch of Grand Island, and Kaylee Petsch of Omaha; Noah, Hope, and Evan Klein of Omaha; one sister, Sr. Rose Klein of Wichita, Kansas; and two brothers, George (Emily) Klein of Chadron, and Ronald Klein of Norfolk.

WSWS 2026 ANNUAL MEETING RETIREES REPORT

The following WSWS members are retired or retiring soon and were recognized during the WSWS Members Welcome Reception on March 2, 2026, in Tucson, Arizona.

- Monte Anderson, Bayer CropScience
- Charlie Hicks, Bayer CropScience
- Steve Valenti, Bayer CropScience

Submitted by: Timothy Prather, Immediate Past President

WSWS 2026 ANNUAL MEETING ATTENDEES

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WSWS 2026 ANNUAL MEETING – AUTHOR INDEX

Index of authors and their abstract numbers.

WSWS 2026 ANNUAL MEETING ABSTRACT NUMBER, PAGE NUMBER INDEX

079, 55
080, 55
081, 56
082, 56
083, 57
084, 62
085, 63
086, 63
087, 64
088, 64
089, 64
090, 50
091, 50
092, 51
093, 51
094, 52
095, 52
096, 75
097, 76
098, 76
099, 77
100, 77
101, 58
102, 58
103, 58
104, 58
105, 59
106, 65
107, 65
108, 65
109, 66
110, 66
111, 67
112, 53
113, 53
114, 53
115, 54
116, 67
117, 68
118, 68
119, 69
120, 69
121, 70
122, 79
123, 79
124, 79
125, 79
126, 79
127, 79
128, 74
129, 74
130, 75
131, 70
132, 71
133, 71
134, 71
135, 72
136, 72
137, 73
138, 73
139, 74
140, 78
141, 13
142, 13
143, 13
144, 13

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