PROCEEDINGS

WESTERN SOCIETY OF WEED SCIENCE

Volume 78, 2025

ISSN: 0091-4487

These proceedings are dedicated to those whose livelihood was affected by the 2024/2025 federal budget turmoil.

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2025

PROCEEDINGS

OF

THE WESTERN SOCIETY OF WEED SCIENCE

VOLUME 78

PAPERS PRESENTED AT THE ANNUAL MEETING

MARCH 10 - 13, 2025

The Westin Seattle

Seattle, Washington

PREFACE

The Proceedings contain the written abstracts of the papers and posters presented at the 2025 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.

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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. Carl Coburn*; Bayer CropScience, St. Louis, MO (155)

Abstract not available

WSWS Presidential Address. Tim Prather*; University of Idaho, Moscow, ID (156)

From Nuisance to Nourishing: A Sea(weed) to Soil Climate Solution for the Pacific Northwest. Sarah Collier*; University of Washington, Seattle, WA (157)

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Washington DC Update. Lee Van Wychen*; Weed Science Society of America, Alexandria, VA (158)

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POSTER SESSION

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

Agroecological Importance of Smooth Brome (*Bromus inermis*) in Hosting Braconid Parasitoids Associated with the Insect Pest Wheat Stem Sawfly. Jackson R. Strand, Robert K. D. Peterson, Tracy M. Sterling*, David K. Weaver; Montana State University, Bozeman, MT (063)

Smooth brome (*Bromus inermis* Leyss.*)* is a Eurasian cool-season, rhizomatous grass, found in Canada and most of the United States. It forms monocultures that outcompete native plants, yet holds ecological and economic value due to a prolonged growing season and late senescence. It is also an effective sink for the wheat stem sawfly (*Cephus cinctus* Norton) (WSS), a major pest of wheat in the Northern Great Plains of North America. Adult female WSS deposit eggs in stems where the hatched larvae feed. Economic damage is due to larvae disrupting grain filling and girdling stems which cause lodging. We have found that behaviorally-active compounds attract more WSS females toward smooth brome vs. wheat and that smooth brome possesses antibiosis properties against WSS larvae. *Bracon cephi* (Gahan) and *B. lissogaster* Muesbeck (Hymenoptera: Braconidae) are native parasitoids that suppress WSS populations and limit their damage. To better understand the ecology of the system, we examined smooth brome as a multi-year, host refuge for WSS parasitoids. When grown in WSS-inclusion cages, 67% of smooth brome was infested by WSS larvae and only 6% of those larvae survived. At two field sites in central Montana, WSS infested 51-65% of smooth brome stems and 39-66% of wheat stems. Year-end WSS larval mortality in infested stems was 44% greater in smooth brome compared to wheat at both field sites, but both hosted similar numbers of WSS parasitoids. Therefore, smooth brome is providing a sustainable host refuge for WSS parasitoids and likely supporting the economics of wheat production.

2024 Weed Survey: Common and Troublesome Weeds in Aquatic and Non-Crop Areas. Joshua Miranda*[1], Sarah Chu[2], Lee Van Wychen[3]; [1]Oregon State University, Corvallis, OR, [2]Texas A&M, College Station, TX, [3]WSSA, Washington, D.C., DC (064)

The 2024 Weed Survey for the United States and Canada collected responses from 140 experts across 37 states to identify the most common and troublesome weeds in aquatic and non-crop areas. Common weeds are frequently observed, while troublesome weeds are difficult to control but may not be widespread. The survey covered seven categories: (1) irrigation & flood control, (2) lakes, reservoirs, rivers, (3) ponds, (4) forestry, (5) natural areas (parks, wildlife refuges), (6) ornamentals (nurseries, outdoor containers, Christmas trees), and (7) rights-of-way (railways, roads, public utilities). In lakes, reservoirs, and rivers, watermilfoils (*Myriophyllum* spp.) and pondweeds (*Potamogeton* spp.) were the most common, while hydrilla (*Hydrilla verticillata*) and watermilfoils were the most troublesome. In irrigation and flood control areas, pondweeds and cattails (*Typha* spp.) were the most common, with pondweeds also the most troublesome. In ponds, naiad (*Najas* spp.) was the most common and troublesome weed. For ornamentals, woodsorrel (*Oxalis* spp.), bittercress (*Cardamine* spp.), and spurge (*Euphorbia* spp.) were the most common, with spurge also the most troublesome. In rights-of-way, johnsongrass (*Sorghum halepense*) was the most common, while kochia (*Bassia scoparia*) was the most troublesome. In forests, honeysuckles (*Lonicera* spp.) were the most common, while kudzu (*Pueraria montana*), honeysuckles, and privets (*Ligustrum* spp.) were the most troublesome. In parks and wildlife

refuges, brome (*Bromus* spp.) and Canada thistle (*Cirsium arvense*) were the most common, while knapweed (*Centaurea* spp.) were the most troublesome. The survey helps researchers, land managers, and policymakers prioritize weed control efforts, support research funding and sustainable management strategies.

Kochia Control on Roadsides in Northern California, with Possible Herbicide Resistant Populations. Thomas Getts*[1], Deniz Inci[2], Simarjeet Singh[3], Kassim Al-Khatib[2]; [1]University of California Coopertive Extention, Susanville, CA, [2]University of California Davis, Davis, CA, [3]University of California Extention, Alturas, CA (065)

Recently, Kochia (*Kochia scoparia*) biotypes from Surprise Valley have not been effectively controlled by sulfometuron. There have been numerous documentations of ALS-resistant Kochia throughout the western United States but not in northern California. A felid trail was conducted at two locations on roadsides in Suprise Valley, with applications being made at two separate timings Fall and Spring. Treatments were applied at 40 gal water per acre with boomless nozzles, replicated four times in a randomized complete block design. Applications of Sulfometuron at 315g ai ha^{-1} gave less than 25% kochia control the summer following treatment, where other herbicides like flumioxazin at 357g ai ha^{-1} offered greater than 90% control for both application timings. Populations of kochia were collected from Surprise valley and other areas of NE California to investigate resistance levels in greenhouse trials. Kochia populations were grown in the greenhouse under the condition of day/night temperature of 30/25C with a 12 h photoperiod up to five cm tall and treated with chlorsulfuron, imazamox, and glyphosate at the 0×, 1/2×, 1×, 2×, and 4× rates of the field use rates. Experiments were designed as a randomized complete block with four replicates where an individual pot was the experimental unit. Visual injury and plant height were rated at 7, 14, 21, and 28 days after treatment (DAT). Plants were harvested at 28 DAT from the soil surface, dried at 65C for 72 h, and weighed. The preliminary results indicate that some Kochia biotypes collected from Surprise Valley were not adequately controlled with chlorsulfuron at a 52 g ai ha^{-1} rate, which may suggest ALS resistance. Studies will be repeated to confirm the resistance.

Understanding Challenges to Eurasian Watermilfoil *(Myriophyllum spicatum*) Control in Bear Lake. Tia Lawrence*, Olanrewaju Adeyemi, Francielli Santos de Oliveira, Eric Westra, Mirella Ortiz; Utah State University, Logan, UT (066)

Eurasian watermilfoil (*Myriophyllum spicatum*, EWM) is an invasive aquatic plant that disrupts freshwater ecosystems by reducing native biodiversity, altering water quality, and impacting recreation. Hybridization between EWM and native Northern watermilfoil (*M. sibiricum*) can further exacerbate these impacts, as hybrids often exhibit increased vigor, invasiveness, and reduced sensitivity to commonly used herbicides. Bear Lake, a key freshwater resource in northern Utah and southern Idaho, has faced persistent milfoil infestations despite repeated chemical control efforts. In collaboration with the Utah Division of Forestry, Fire, and State Lands, 23 milfoil samples were collected in 2024 to genetically identify species composition. Results confirmed the presence of both invasive and native milfoil species. To assess factors influencing control efficacy, we conducted greenhouse experiments evaluating the degradation and effectiveness of 2,4-D and florpyrauxifen-benzyl in Bear Lake versus tap water. Herbicide degradation was assessed in ten 2 L tanks (five per water source), with samples analyzed via HPLC-DAD at eight time points over

72 hours. Efficacy was tested by applying field rates of each herbicide to tanks containing 25 established EWM plants, with biomass collected 28 days after treatment. Herbicide concentrations declined similarly in both water sources, but treatments were less effective in Bear Lake water. Additionally, plants grown in Bear Lake water exhibited faster growth than those in tap water. These findings suggest that water chemistry may influence herbicide performance, underscoring the need for site-specific management strategies to improve EWM control in Bear Lake.

Fire Modeling of Techniques to Manage Linear Fuel Breaks Suggest Moderation of Fire Behavior. Madeleine Touchette*, Timothy Prather, Eva Strand, Lisa Jones; University of Idaho, Moscow, ID (067)

Climate projections for the mid-century (2030-2059) anticipate warmer, drier summers, which are expected to intensify fire behavior in arid grasslands and shrublands in the Great Basin, USA. In response, fuel breaks have emerged as a crucial wildfire management tool. Fuel breaks are intentionally modified landscapes designed to disrupt the continuity of combustible vegetation. When properly managed, fuel breaks provide a safer operational area for firefighters to contain and suppress wildfire. This study evaluates modelled fire behavior of green strips (maintained fuel breaks) and adjacent landscapes (unmaintained surrounding areas) within the Jarbidge Field Office of the Bureau of Land Management fuel break system. We combined data from 2021 (a dry year) and 2022 (normal year) to represent anticipated climate conditions for the future and simulated three fuel break treatments: herbicide trials, mowing, and a combination of both. Herbicide applications target invasive annual grasses and forbs to disrupt fine fuel continuity, while mowing treatments reduce fuel bed height and overall fuel load. Simulations were run under four different fuel moisture scenarios (uncured, 1/3 cured, 2/3 cured, fully cured) and three wind speed scenarios (~30 kph, ~15 kph, ~6kph). Results indicate that while individual treatments reduced fire behavior, the combination of herbicide and mowing most effectively decreased flame length and rate of spread. These findings, derived from the Fuel Characteristic Classification System (FCCS) fire modeling framework, suggest insights for moderating fire behavior, though the model's limitations in capturing the actual complexity of fire dynamics should be considered.

WSWS Project 2. Weeds of Horticultural Crops

Exploring Pulse Electric Field for Weed Control in Nursery. Pamela Medeiros dos Santos*, Tatiana Benedetti, Marcelo Moretti; Oregon State University, Corvallis, OR (054)

Methyl bromide is a fumigant pesticide used by the nursery industry to control pests and weeds. Due to its toxicity and federal restrictions on its use, alternatives such as pulse electric field weed management (PEF) are needed. PEF applies high-voltage pulses to nursery beds to kill weed seeds and soil pathogens. This study evaluates soil-applied PEF weed control and crop response in a nursery using a two-factor factorial design with three energy levels (0, 200, 400 Jcm^{-3}) at two depths (7, 18 cm). PEF was applied once at pre-plant in the fall of 2023 with a commercial device. The field was sown with *Acer spp*, seedlings within a week of treatment. Weed density was assessed monthly. At harvest, weed biomass, crop height (CH), stand (CS), and trunk cross-sectional area (TCSA) were collected. PEF reduced weed density across most of the evaluation dates compared to a nontreated control, with the $400Jcm^{-3}$ at 18cm treatment achieving the highest

weed reduction (87%). However, the treatments did not affect weed density at 270 DAT for grass, broadleaf weeds, or weed biomass (38.3 g m^{-2}). No differences in CH (83.4 cm), CS (20 plant/treated area), nor TCSA (0,057 cm^3) were recorded, supporting the safety of PEF to the crop. These findings suggest that while PEF may offer some potential for weed management, further investigation of timing and application method is necessary to confirm the viability of this technology as a viable alternative to methyl bromide.

Evaluating Crop Safety and Weed Control Using Ethalfluralin in Highland Blueberries. Marcelo Moretti, David King*; Oregon State University, Corvallis, OR (055)

The herbicides pendimethalin and oryzalin, inhibitors of microtubule assembly, were commonly used for weed control in new and established blueberries to control annual grasses and broadleaves. However, these herbicides are no longer available in blueberries, and there is a need to find alternative options to these herbicides. This study aimed to evaluate crop safety and weed control of ethalfluralin in highbush blueberries. Two field experiments were initiated in 2024; the first study was conducted in a mature field cv 'Duke'. The second evaluated the effect of ethalfluralin applied pre- or post-transplanting in a newly transplanted field of cv 'Elliot.' Ethafluralin did not injure the mature highbush blueberry regardless of the rate tested (1.68 to 6.7 kg ai ha-1), and its response was similar to pendimethalin (4.5 kg ai ha-1). The treatments also did not affect crop yield, which averaged 3.17 kg plant-1. Fruit weight averaged 1.17 g fruit-1. In the newly planted highbush blueberry field, ethalfluralin was also safe to plants regardless of the rate applied (1.68 to 6.7 kg ai ha-1) or if applied pre- or post-transplanting with no observed injury or effect on plant size. Barnyard grass control was significantly higher when treatments were applied pre-transplanting, ranging from 45 to 100% control up to 90 DAT. The greater control was observed with pendimethalin and ethalfluralin at 3.3 and 6.7 kg ai ha-1. Application placement likely reduced efficacy in the post-transplant treatments. These studies indicate that ethalfluralin is a safe and effective option in highbush blueberries.

Promising Herbicides for Use in Perennial Peanut, an Emerging Crop in the United States. Chanz Robbins*; New Mexico State University, Las Cruces, NM (056)

Phytotoxicity effects of 3 pre-emergent herbicides were evaluated on perennial peanut (*Arachis sp.*) var. EcoTurf for 2 applications separated by 6 weeks. Phytotoxicity ratings were rated visually by images taken at the 1st, 2nd, and 4th week after the first application and the 1st and 2nd week after the 2nd application for each of the pre-emergent herbicides: a dual-active dimethenamid-p + pendimethalin, and single actives dimethenamid-p, and pendimethalin. Plant heights were measured at the 4th week after the 2nd application by grouping trailing runners and measuring the longest runner. The only significant phytotoxicity differences were observed for dimethenamid-p treatment (1X; 21 fl.oz. A^{-1}) at 2 and 4 weeks ($p < 0.05$ and $p < 0.001$, respectively) following the first application. Interestingly, this treatment showed significantly less phytotoxicity compared to all other treatment and the negative control ratings. These data suggest all tested herbicides may be safely used on *Arachis sp.* var EcoTurf.

Electric Weed Management in Organic Blueberry Fields: Efficacy, Species Shifts, and Soil Health. Luisa Baccin*, Marcelo Moretti; Oregon State University, Corvallis, OR (057)

Weed management in organic blueberry production is challenging, typically relying on synthetic mulches or sawdust, mowing, or organic herbicides, each with limitations. This study evaluates electrical weed control (EWC), a nonchemical method using high-voltage electricity to disrupt weeds, in combination with various mulching practices. A two-factor factorial design tested three mulch types: bare ground, sawdust, and synthetic mulch. Weed management was performed using either traditional mowing or EWC at two energy levels (15 and 75 MJ ha^{-1}), with an untreated control included to document natural weed dynamics. EWC treatments were applied six and five times from May through October in 2023 and 2024, respectively, using a tractor-powered electrical weeder (EH30 Thor, Zasso). In 2024, EWC achieved an average of 95% weed control 28 DAT, with both energy levels showed similar performance. EWC reduced weed biomass by 95%. In contrast, mowing provided 5% weed control and reduced weed biomass by 42%. Furthermore, the number of weed species in EWC plots reduced to two, versus seven in mowing and control plots. Notably, EWC treatments also elevated potential mineralizable nitrogen levels to 2.9–3.6 times the initial levels of mowing, suggesting increased nitrogen availability. Other soil health indicators, including organic matter, CO_2 respiration, and nutrient levels, remained unaffected. Leaf porometer/fluorometer analysis revealed a 47–55% reduction in stomatal conductance in blueberry leaves from EWC-treated plots indicating transient stress, however overall crop growth parameters remained unaffected. These findings support EWC as an effective, sustainable alternative for weed management in organic blueberry production.

Fewer Suckers, More Nuts: The Effect of Sucker Pruning Regime on Hazelnut (*Corylus avellana*) Growth and Yield. Austin Frewert*,* Marcelo Moretti; Oregon State University, Corvallis, OR (058)

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 treatments: (1) control - no sucker removal, (2) sucker-free; (3) winter sucker removal; (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.

Cost-Benefit Comparisons Between Cover Crop and Herbicide Methods for Controlling Early-Season Weeds in Chile Pepper. Brian Schutte*,* Ram Acharya; New Mexico State University, Las Cruces, NM (059)

Barley (*Hordeum vulgare* L.) cover crops that are mowed and incorporated into the soil (herein "barley green manure") suppress early-season weeds and reduce hand hoeing requirements in spring-seeded chile pepper (*Capsicum annuum* L.). This study aimed to determine the impacts of barley green manure and a preemergence herbicide on gross returns from chile pepper production. To address this objective, we conducted a partial budget analysis using data collected from a field study. The field study involved factorial combinations of barley green manure (+/-) and preemergence applications of napropamide at 2.24 kg ha^{-1} (+/-). For each combination of green manure and herbicide, the gross return was determined as total revenue minus the costs for hand hoeing, green manure, and herbicide. Total revenues and hoeing costs were calculated using plot-scale data on fruit yield and hoeing time scaled to an acre. The per acre expenditure for green manure included costs for cover crop seed, irrigation, and tractor expenses for seeding and termination. The per acre expenditure for herbicide included the costs for formulated product and tractor operations for application and incorporation. Results indicated that the barley green manure generally reduced hand hoeing costs, with hand hoeing costs minimized by the combination of barley green manure and preemergence napropamide. Total revenue was greatest for chile pepper grown without barley green manure and with preemergence napropamide. These results suggest that barley green manures in chile pepper may cause reductions in gross return that are not offset by barley-induced reductions in hand hoeing expenditures.

Developing a Practical Guide to Grower Decision-Making in Herbicide Drift and Carryover Situations in Sugarbeet. Clarke Alder*[1], Albert Adjesiwor[2]; [1]Amalgamated Sugar Company, Boise, United States, [2]Univers142ity of Idaho, Kimberly, ID (060)

Each year agronomists and consultants are contacted by growers concerned about chemical carryover and/or herbicide drift in their sugarbeet fields. Carryover often occurs as growers move crops to rented ground and are unfamiliar with the history on that piece of ground. Inaccurate records can also lead to potential problems with carryover in the rotation. Herbicide drift often occurs when sensitive crops are downwind from an application or during an inversion. One question posed by growers is whether to keep or abandon an affected crop. These decisions have historically been based on visual evaluations of the field and with herbicide labels and anecdotes from past experience. These trials aim to show growers the relationship between residual product within the plant and potential for yield loss to the crop. Having additional quantifiable data regarding the potential for impacts of carryover or drift on sugarbeets will aid both consultants and growers in making management decisions that could save the grower significant time and money.

Four studies in three locations were conducted looking at the effects of multiple modes of action in both carryover and drift scenarios. Residual samples were taken from the crop and dose response curves developed to correlate potential yield loss to the crop. In sugarbeet, yield was most affected by both carryover and drift. Sugar content was minimally affected. While some chemistries are very detrimental to a sugarbeet plant, overall, sugarbeets appear to be able to persist through many different modes of action and still produce a viable crop.

Control of Silverleaf Nightshade (*Solanum elaeagnifolium*) in Olives (*Olea europaea*). Jorge Angeles*, Elizabeth Fichtner; University of California Cooperative Extension, Tulare, CA, (061)

Silverleaf nightshade, *Solanum elaeagnifolium*, is a perennial weed that is difficult to control in orchard crops. This weed is a problem in young orchards because it competes with developing

tress for resources such as water, nutrients and light. Because silverleaf nightshade can reproduce from seeds and rhizomes, it is difficult to fully control with mechanical cultivation and mowing. Pre-emergent herbicides are ineffective on controlling established silverleaf nightshade because most plants sprout from underground rhizomes and not seeds. To fully control silverleaf nightshade, it is important to use post-emergent herbicides that can kill the plants and the rhizomes. A field study was conducted in an olive orchard in Tulare County, California to evaluate the efficacy of post-emergent herbicides that are commonly used in orchard crops to control silverleaf nightshade. The herbicides tested were glyphosate, glufosinate, carfentrazone, and pyraflufen-ethyl. Combination treatments of these herbicides with different spray adjuvants were also tested to evaluate their compatibility and efficacy. The herbicides were sprayed at their recommended label rates for olives. All herbicide treatments had more than 50% control of silverleaf nightshade 14 days after treatment except a treatment consisting of only glyphosate. All treatments containing glufosinate had more than 75% control of silverleaf nightshade after 14 days after treatment. Silverleaf nightshade in all treatments began to regrow at 50 DAT. The long-term level of weed control of post-emergence herbicides on silverleaf nightshade is unknown and needs to be ascertained.

Herbicide Programs for Weed Control in Washington State Onion Production. Rui Liu*[1], Timothy Waters[2]; [1]Washington State University, Prosser, WA, [2]Washington State University, Pasco, WA (062)

Abstract not available

WSWS Project 3. Weeds of Agronomic Crops

Weed Seedbank Management in Cereal Crop Rotations. Chandra Montgomery, Albert Adjesiwor*, University of Idaho, Kimberly, ID (001)

Herbicide-resistant weed populations are evolving rapidly and threatening the sustainability of crop production. A 4-year crop rotation study was initiated in 2021 at Kimberly, Idaho to evaluate weed control and seedbank dynamics in wheat-alfalfa vs wheat-annual crop (corn and dry bean) rotations. There were three herbicide treatments: untreated, postemergence (POST) only, and preemergence (PRE) + POST. It was observed that weed seedbank density was reduced from 11,304 to as low as 196 seeds m^{-2} in some treatments. Weed seedbank density tended to be higher in the nontreated checks and there was a trend of preemergence (PRE) + postemergence (POST) treatments reducing weed seedbank density compared to POST-only treatment. Including alfalfa in the crop rotation significantly reduced weed seedbank density, irrespective of the herbicide treatment. On the contrary, dry bean in the rotation significantly increased weed seedbank density. Weed density within the crops during the growing season was influenced by the type of crop as well as the herbicide treatment. Both POST-only and PRE + POST treatments reduced weed density compared to the untreated and the PRE + POST treatments reduced weed density in nearly all the crop rotations compared to the POST-only treatment. Weed control treatments did not affect alfalfa yield. However, herbicide application (POST only and PRE + POST) improved corn, dry bean, and wheat yield. The combination of fewer weeds and greater crop yield in the PRE + POST

treatments holds promise for reducing weed seedbank and potentially improving crop productivity and economics.

Herbicide Mixtures for Horsetail Control: Evaluating Tolpyralate, Tiafenacil, Flazasulfuron, and Florpyrauxifen-benzyl. Davi de Carvalho Fiedler*, Marcelo Moretti; Oregon State University, Corvallis, OR (002)

A field experiment was conducted in the summer of 2024 in Corvallis, Oregon, to evaluate the efficacy of herbicide mixtures containing tolpyralate as an alternative to glufosinate. Seventeen treatments were tested, incorporating tolpyralate, flazasulfuron, tiafenacil, and florpyrauxifen-benzyl, ranging from applications of a single product to mixtures of up to four herbicides. The field was naturally infested with horsetail (*Equisetum arvense* L.). Tolpyralate (26.3 g ai ha^{-1}) had limited efficacy, achieving a maximum of 31% control at 42 days after treatment (DAT), whereas glufosinate (1680 g ai ha^{-1}) provided 71% control up to 28 DAT, though regrowth was observed later. Treatments containing flazasulfuron (20 g ai ha^{-1}), either alone or in mixtures with tolpyralate and other herbicides, were the most effective. Herbicide combinations generally performed better, with the triple mixture showing a slight advantage. The treatment containing tolpyralate and flazasulfuron achieved 65% control at 42 DAT, performing better than its triples and quadruple mixtures. However, the most effective treatment overall was glufosinate, which achieved an 81% biomass reduction at 28 DAT. Biomass data did not indicate a significant difference between treatments with multiple active ingredients. In conclusion, the combination of tolpyralate and flazasulfuron (double mixture) proved more effective than its triples or quadruple mixtures. However, despite presenting efficacious results, this combination was not as effective as glufosinate control levels.

Herbicide Resistant Wild Oat (*Avena fatua*) Survey in Northern Idaho and Eastern Washington. Tracy Rauch*, Joan Campbell, Albert Adjesiwor; University of Idaho, Moscow, ID, (003)

The Pacific Northwest of the United States is a productive wheat growing region with significant yield loss from annual grass weeds. Persistent use of herbicides with the same modes of action has resulted in the selection of many herbicide-resistant weeds. Resistance to herbicides used for annual grass control is a problem for farmers in the region. A survey in 2023 of 59 fields in northern Idaho and eastern Washington was conducted to determine the extent of wild oat resistance to grass herbicides commonly used in winter wheat-cropping systems. Plants were grown from collected seed samples in a greenhouse and were tested for resistance to mesosulfuron, quizalofop, fenoxaprop, pinoxaden, clethodim, triallate, ethalfluralin and glyphosate. Mesosulfuron is an ALS-inhibiting herbicide used in wheat and resistance was observed at 34% in populations tested. Quizalofop, an ACCase-inhibiting non-selective herbicide in grass crops, is used in rotational broadleaf crops and quizalofop resistant wheat. Resistance occurred in 17% of the tested populations. Fenoxaprop and pinoxaden are ACCase-inhibiting herbicides used in wheat and barley and resistance was observed at 22 and 15%, respectively. Triallate, a pre-emergent lipid synthesis inhibiting herbicide used in wheat and legume crops, had 4% resistant populations. All populations tested were susceptible to clethodim and ethalfluralin, both herbicides are used in wheat-cropping system rotational crops. Populations susceptible to all four ACCase inhibiting

herbicides occurred at 63%. Populations are still being screened with glyphosate. Currently, 41% of populations tested are susceptible to all 8 herbicides.

A New Method for Analyzing Replacement Series Competiton Studies. Erik Lehnhoff*, Ciro Velasco-Cruz; New Mexico State University, Las Cruces, NM (004)

Plant competition studies in weed science commonly employ a de Wit replacement series experiment. The results of such studies are often used to produce graphs which facilitate visualization of relative biomass production and inter-species performance under a given set of conditions. However, comparison of competitive outcomes between numerous different experimental factors is difficult and largely qualitative. The lack of a quantitative method limits interpretation of experimental factor effects on competition. We have developed a quantitative method of comparing replacement series studies outcomes based on assessment of the relative yields. For any given set of treatments, the point where species' relative yields are equal (intersection point of de Wit curves) is defined in Cartesian space. This point can be compared to the relative yield intersection point from any other treatment. Each pairwise comparison is represented by the magnitude and direction of a vector connecting the intersection point in one treatment (the "from" treatment) to the intersection point in another treatment (the "to" treatment). The magnitude of the vector is calculated by the Pythagorean Theorem as the Euclidian distance between pairs of intersection points. The x-component of the vector represents the change in competitiveness, and the y-component is the absolute value of relative yield change between two sets of treatments. The vector bearing (from 0^{o} to 360^{o}) indicates the direction of relative yield change and which species is the dominant competitor. This new method allows for easy interpretation of the effects of treatment factors in replacement series studies.

Volunteer Winter Wheat as a Cover Crop for Weed Suppression in Sugar Beet. Adam Kennedy*, Albert Adjesiwor; University of Idaho, Kimberly, ID (005)

Planting glyphosate-resistant sugar beets has allowed growers to rely heavily on glyphosate for weed control, resulting in widespread glyphosate-resistant weeds. To investigate additional tools for integrated weed management in sugarbeet, this study evaluated volunteer winter wheat as a potential cover crop. A factorial combination was used of six cover crop treatments (no cover crop, volunteer wheat, volunteer wheat + broadleaf cover crop, low density volunteer wheat + broadleaf cover crop, broadleaf cover crop, and fall-planted winter wheat) and three herbicide treatments (glyphosate applied once, glyphosate followed by glyphosate, and glyphosate + s-metolachlor + ethofumesate). Volunteer winter wheat with or without the broadleaf cover crop mix produced 20x more biomass compared to the fall-planted winter wheat. At cover crop termination, the treatments with volunteer wheat reduced weed biomass by 89% compared to the no cover crop treatment. While the fall-seeded winter wheat did not reduce sugarbeet stand count, the volunteer wheat and the volunteer wheat + broadleaf cover crop reduced stand count by 35% to 40%. This resulted in up to a 44% reduction in sugarbeet root yield and a 34% reduction in sugar yield. Additionally, applying glyphosate once together with residual herbicides resulted in similar weed biomass as applying glyphosate twice. This shows that volunteer wheat as a cover crop combined with residual herbicides could reduce the number of glyphosate applications and thereby slow the selection for glyphosate-resistant weeds.

Herbicide Strategies to Control Waterhemp (*Amaranthus tuberculatus*) in Wheat. Ethan Mewes*, Kirk Howatt; North Dakota State University, Fargo, ND (006)

Waterhemp (*Amaranthus tuberculatus* (Moq.) J. D. Sauer) is a highly competitive weed that threatens wheat development, yield, and profitability. With increased herbicide resistance, effective control strategies are critical. This study assessed the efficacy of post-emergence herbicide treatments for managing 4–6-inch waterhemp in wheat. Treatments included bromoxynil + tolpyralate, bromoxynil + bicyclopyrone, bromoxynil + pyrasulfotole, 2,4-D-e, MCPA-e, and halauxifen. The study, conducted at three North Dakota locations over one year, was established in a randomized complete block design with four replicates to assess individual herbicide performance, tank mixes, and sequential applications. Data collection included visual control ratings and biomass. Data were analyzed using ANOVA, followed by mean separation with Fisher's protected LSD at α=0.05. Bromoxynil + tolpyralate provided greater than 95% control at all three locations 14 days after application. Bromoxynil + pyrasulfotole applied with Group 4, synthetic auxins, herbicides did not show signs of antagonism and offered greater than 75% control across all locations at 28 days, which outperformed solo applications of bromoxynil + bicyclopyrone and bromoxynil + pyrasulfotole at the Casselton location. Treatments that included 2,4-D-e provided over 80% control at 28 days whether applied alone, tank mixed, or sequentially. In conclusion, bromoxynil + tolpyralate consistently delivered the greatest waterhemp control. Tank mixes and sequential applications of bromoxynil + pyrasulfotole and Group 4 herbicides across diverse environments provided control similar to or better than bromoxynil + pyrasulfotole alone.

Palmer Amaranth in the Pacific Northwest: Glyphosate Resistance Confirmation and Response to Selected Herbicides. Laura Rodriguez*[1], Joel Felix[2], Clarke Alder[3], Pamela Hutchinson[4], Rui Liu[5], Olivia Landau[6], Albert Adjesiwor[7]; [1]University of Idaho, Moscow, ID, [2]Oregon State University, Ontario, OR, [3]Amalgamated Sugar, Boise, ID, [4]University of Idaho, Aberdeen, ID, [5]Washington State University, Prosser, WA, [6]USDA Wheat Health, Genetics and Quality Research Unit, Pullman, WA, [7]University of Idaho, Kimberly, ID (007)

Palmer amaranth (*Amaranthus palmeri*) has recently been introduced into the Pacific Northwest (PNW) and some populations have survived applications of commonly used herbicides. Greenhouse experiments were conducted in Kimberly, ID, during the summer of 2024 to confirm glyphosate resistance (GR) and assess the response of Palmer amaranth populations to selected preemergence (PRE) and postemergence (POST) herbicides. The objectives were to (1) confirm GR in PNW Palmer amaranth populations through dose-response bioassays and 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) gene amplification, and (2) evaluate the response of PNW Palmer amaranth populations to selected PRE and POST herbicides. Based on the dose response bioassays, the effective dose required to provide 90% control (ED_{90}) of the suspected GR populations was 20.5 to 63.3-fold compared to the susceptible biotype. EPSPS gene amplification was present in the GR populations from the PNW with 38 to 98 EPSPS gene copies compared to the susceptible biotype. There was reduced sensitivity of Palmer amaranth populations to 2,4-D, dicamba and mesotrione. Both glufosinate and saflufenacil provided effective control of PNW Palmer amaranth populations. Nearly all PRE herbicides (dimethenamid-p, EPTC, ethalfluralin, flumioxazin, fomesafen, linuron, metobromuron, metribuzin, pendimethalin, pyroxasulfone, and s-metolachlor) provided similar control of the susceptible

biotype and PNW Palmer amaranth populations. There was reduced sensitivity of all nine PNW Palmer amaranth populations to rimsulfuron. Further research would evaluate the degree of resistance to 2,4-D, dicamba, mesotrione and rimsulfuron in the PNW Palmer amaranth populations, and assess the economic impact of confirmed glyphosate-resistance biotypes on crop yields.

Effect of Soil Active Herbicides on the Critical Time of Weed Removal in Establishment Alfalfa. Kaitlyn Hoberg*, Clint Beiermann; University of Wyoming, WY (008)

Weeds compete with alfalfa, in the establishment year, causing a decrease in forage yield. Employing weed control tactics during the establishment period can be crucial for successful establishment. We initiated an experiment in 2024 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} when alfalfa reached the desired stage for weed removal timing. In the first harvest, alfalfa yield was reduced from 2593 to 274 kg ha^{-1} in the no-PPI plots and from 2648 to 1204 kg ha^{-1} in the PPI plots, as weed removal timing was delayed. The CTWR for first harvest, estimated at 5% yield reduction, occurred at 504 GDD base 10C after alfalfa emergence when no-PPI was applied and at 839 GDD in the PPI herbicide treatment. Alfalfa plant density at first harvest was reduced by increasing duration of weed competition where no-PPI was applied. Weed competition reduced crude protein content and leaf area of alfalfa when no-PPI was applied.

Adjuvant Effects on Canola Desiccation with Diquat. Jim Daniel*[1], Kirk Howatt[2], Joseph Mettler[2]; [1]Daniel Ag Consulting, Keenesburg, CO, [2]North Dakota State University, Fargo, ND (009)

Abstract not available

Chemical Control of Panicle Willowweed (*Epilobium brachycarpum*) in Wheat Cropping Systems of the Pacific Northwest. Jennifer Gourlie*, Judit Barroso; Oregon State University, Adams, OR (010)

Growers in the semi-arid region of Pacific Northwest are experiencing problems to control panicle willowweed (*Epilobium brachycarpum*), also known as panicle willowherb, in fallow and roadsides with glyphosate. In an effort to assist growers in determining whether the poor control observed in this species was due to herbicide resistance, we conducted a greenhouse study where we worked with glyphosate to determine resistance and with other potential alternative options to provide some solutions. The screening consisted in using two herbicide rates per herbicide, 0X (untreated) and 1X (label rate), replicated four times. The studied treatments included bromoxynil at 214 g ai ha^{-1} + pyrasulfotole at 38 g ai ha^{-1} (Huskie®), glufosinate at 594 g ai ha^{-1} (Forfeit® 280), pyraflufen at 2 g ai ha^{-1} (Vida®), glyphosate at 1134 g ai ha^{-1} (Gly Star 5 Extra®), metribuzin at 315 g ai ha^{-1} (Metribuzin 75), and saflufenacil at 50 g ai ha^{-1} (Sharpen®) as 1X for all these herbicides. Results indicated that visual control with 1X was lower with glyphosate (78%) than

with the other herbicides (94% with pyraflufen and 100% with the others). Regarding dry weight, results did not show significant differences among sprayed treatments (1X), ranging from a low of 0.05 g (with glufosinate and saflufenacil) to a high of 0.19 g (with glyphosate). While glyphosate showed lower control of panicle willowweed than the alternative herbicides, we could not confirm glyphosate resistance in this species when treated at seedling stage.

Comparing Paraquat and Alternative Herbicides for Spring Weed Control in Established Alfalfa. Sushmita Sharma*[1], Chandra Montgomery,[1], McKenna Carnahan[2], Earl Creech[1], James Gomm[1], Albert Adjesiwor[3]; [1]University of Idaho, Moscow, ID, [2]Utah State University, Logan, UT, [3]University of Idaho, Kimberly, ID (011)

Paraquat has been used heavily for weed burndown in alfalfa (Medicago sativa), but new safety measures introduced by United States Environmental Protection Agency to reduce the risks associated with the use of paraquat has left most growers seeking safer alternatives. This study aims to identify effective alternatives to paraquat for weed control in established alfalfa. Field studies were conducted in Idaho and Utah during 2023 and 2024 to assess weed control efficacy, as well as growth and yield response of established glyphosate-resistant alfalfa to selected herbicides. Treatments included low and high use rates of carfentrazone, diuron+hexazinone, pyraflufen, saflufenacil, and tiafenacil. Glyphosate, paraquat, and a nontreated check for comparison. After 3 weeks of treatment, the alfalfa height was similar across all the treatments in both locations. The yield ranged from 1163 kg ha-1 to 2431 kg ha-1 with no significant difference between paraquat and treatments in Idaho. In Utah, yield ranged from 1848 kg ha-1 to 4984 kg ha-1 with higher yield in pyraflufen compared to paraquat, but carfentrazone and tiafenacil had similar effects as paraquat. In Idaho, tiafenacil, saflufenacil, diuron+hexazinone and carfentrazone provided better shepherd's-purse, flixweed and dandelion control compared to paraquat. In Utah, diuron+hexazinone, salflufenacil were significantly more effective in controlling shepherd's purse than paraquat. The efficacy of pyraflufen was similar to paraquat in both locations. This study showed that diuron+hexazinone, tiafenacil, carfentrazone, pyraflufen, salflufenacil can be used as safer and effective alternatives to paraquat for weed control in established alfalfa.

Pre-Emergence Herbicide Activity on Volunteer Barley in Spring Wheat. Jace Heiman*, Kirk Howatt, Joseph Mettler; North Dakota State University, Fargo, ND (012)

Volunteer barley (*Hordeum vulgare* L.) has become an issue for wheat farmers in North Dakota via two methods: (1) barley cover crop that survived the winter or was not terminated properly and (2) late emergence of volunteers. The efficacy of pyroxasulfone to reduce barley establishment was investigated in a greenhouse twice during the winter of 2025. Pyroxasulfone at 0, 19.5, 24.2, 39, and 48.2 g ai ha^{-1} was applied to a sandy loam or silty clay soil and incorporated mechanically before seeding. Percent visible injury and emergence counts were recorded every 7 days, and biomass was collected 21 days after application. The data were analyzed in JMP using Tukey's mean separation at α=0.05. The labeled wheat rates of 19.5 and 24.2 g ha^{-1} provided excellent control of barley of at least 90% in the sandy loam soil, while in the silty clay soil, control was less than 50%. Biomass results affirmed visible injury ratings of pyroxasulfone efficacy to barley in both soils. If a wheat farmer is worried about volunteer barley, they will likely be able to control it with pyroxasulfone if they farm on sandy soil, likely not in clay soil types. Future research should be done to evaluate additional soil types to characterize efficacy in more environments.

Assessing Kochia (*Bassia scoparia*) Populations for Resistance to PPO-Inhibitors and Auxin-Mimic Herbicides in Northeast Montana. Devanshi Het Desai*[1], Het Samir Desai[1], Lovreet Shergill[2], Tim Seipel[1]; [1]Montana State University, Bozeman, MT, [2]Colorado State University, Fort Collins, CO (013)

Herbicide resistant (HR) kochia (*Bassia scoparia* A. J. Scott) poses a threat to cropping systems in Montana. In the northeastern counties, crop rotations have spring wheat or durum in rotation with pulse crops. Herbicides used in the wheat phase are synthetic auxins (group 4) and, during the pulse phase PPO inhibitors (group 14). Producers observed a decline in herbicide efficacy, so we surveyed kochia populations in September 2024. We surveyed 42 fields post-harvest and collected seeds from 38 kochia populations, representing the most problematic fields in the region. Herbicide screenings were conducted in a greenhouse with POST-emergence applications of dicamba (560 g ae ha^{-1}), fluroxypyr (157 g ae ha^{-1}), and saflufenacil (50 g ai ha^{-1}). Of the 38 populations, 15 readily germinated and were screened to determine their resistance. Kochia populations were categorized based on percent survival, susceptible (0%), developing resistance (1–20%), and resistant (20–100%). All 15 populations tested were resistant to dicamba and fluroxypyr. Seven populations of kochia were susceptible to saflufenacil, but five had developing resistance, and three populations were resistant. We confirmed the PPO resistance through genetic testing based on the koPPO test from the National Agricultural Genotyping Center. This is the first documented case of PPO resistant kochia in Montana and is similar to resistance found in North Dakota. The results of this study highlight the need for developing integrated weed management strategies for kochia.

Lewis Flax (*Linum lewisii*) Injury Response from Grass and Broadleaf Herbicides. Greta Gramig*[1], Brent Hulke[2], Waqas Ahmad[1]; [1]North Dakota State University, Fargo, ND, [2]USDA-ARS, Fargo, ND (014)

Lewis flax (*Linum Lewisii*) is a perennial species native to North America with potential to be grown as an agronomic oilseed crop. Because Lewis flax is weakly competitive with weeds, integrated weed management approaches, including herbicide options, are needed. During 2024, we conducted field and greenhouse experiments to assess Lewis flax herbicide injury. In the field, we tested two preemergence options (Dual II Magnum and Zidua SC) and four postemergence options (Stinger HL + Accent, Kyro, and Cadet). In the greenhouse, tested several group 4 options (2,4-D amine, MCPA, Stinger HL, and Curtail) as well as Cadet; all broadleaf herbicides were combined with Accent for grass control potential. For the field experiment, Lewis flax treated with Kyro displayed the greatest herbicide injury compared to the untreated weedy check (chlorosis and stunting, ranging from 15% at 14 DAT to 25% at 21 DAT). Other herbicides resulted in negligible injury. Flax stand density at 56 DAT was not impacted by herbicide treatments. At 56 DAT, Kyro was associated with reduced flax height compared to weedy and weed-free checks (11.7 vs. 30.2 and 20.0 cm, respectively). For the greenhouse study, at 7 DAT, flax treated with Cadet, Curtail, and 2,4-D displayed greater herbicide injury (epinasty, chlorosis) than the untreated control (46, 53, and 90%, respectively), whereas flax treated with Stinger HL and MCPA displayed minimal injury (<15%). At 21 DAT however, only flax treated with 2,4-D showed reduced shoot height (12 vs. 19 cm) and none of the herbicides resulted in reduced biomass.

Weed Management Options in Lupin in the Canadian Prairies. Breanne Tidemann*[1], Robyne Davidson[2], Shaun Sharpe[3]; [1]Agriculture and Agri-Food Canada, Lacombe, AB, Canada, [2]Lakeland College, Lacombe, AB, Canada, [3]Agriculture and Agri-Food Canada, Saskatoon, SK Canada (015)

The Canadian Prairies are a significant producer and exporter of pulse crops. That production has recently been under threat due to the prevalence aphanomyces which causes severe and plant death to many pulse crops. Lupin is a pulse crop that is resistant to aphanomyces and so significant effort has been extended to investigate the suitability of this crop for growth in western Canada. While herbicide products are registered in other regions, little is known about lupin tolerance to these products in western Canada, or control of western Canadian weeds. A 3-year study was initiated at Lacombe and Edmonton, AB, and Saskatoon, SK to investigate crop tolerance and weed control. Pre-emergence herbicide products showed limited injury, however, trial sites experienced limited rainfall. In-crop applications of topramezone and fomesafen have caused severe crop injury. The crop did recover, but the injury would be unacceptable. However, fomesafen is one of the few products, aside from the current industry standard of metribuzin, that suppressed volunteer canola. Topramezone also caused injury and reduced crop biomass. With drought like conditions, only the in-crop clethodim provided suppression of wild oat, however, increased control with PRE products would be expected in years with more moisture. Crop yield was maximized in the hand-weeded check, followed by a combination of pyroxasulfone and flumioxazin. Herbicide control in lupin, particularly of volunteer canola, will be a challenge to adoption of the crop in western Canada.

Identification of *Orobanche minor* Parasitism Using Hyperspectral Remote Sensing in Red Clover Seed Production in the Willamette Valley, Oregon. Iram Mujahid Iqbal*, Jing Zhou, Carol Mallory-Smith, Pete Berry; Department of Crop and Soil Science, Oregon State University, Corvallis, OR (016)

Red clover (*Trifolium pratense* L.) is an important seed crop grown in Western Oregon. It is also the preferred host of small broomrape, *Orobanche minor* Sm. Small broomrape seeds found in red clover seed lots can lead to their rejection. A study was conducted to assess if parasitized red clover plants could be identified based on their spectral profiles. Leaf spectra were collected with a spectroradiometer from parasitized and non-parasitized plants grown in greenhouse and field studies. Spectral match/no match analysis was conducted using Mahalanobis (M-distance) between parasitized and non-parasitized plants. Principal component analysis (PCA) and independent t-tests were conducted to extract spectral regions that could be used to identify broomrape parasitism. Match analysis detected *O. minor* parasitism in 100% and 92% of the spectra in greenhouse and field plants (M-distance of >3), respectively. Greenhouse plants had higher M-distance values (range 6-36) compared to field plants (range 0-11) indicating more spectrally distinct characteristics in greenhouse grown plants. PCA captured 88% (PC1=0.54; PC2=0.34) and 83% (PC1=0.58; PC2=0.25) of the total variance between parasitized and non-parasitized plants from the greenhouse and field, respectively. Two spectral bands, containing 70 wavelengths within the green (503-582 nm) and red-edge (687-718 nm) regions were identified as common spectral regions in greenhouse and field grown parasitized red clover plants. The study demonstrates the potential for spectral discrimination of *O. minor* parasitism in red clover, but further analysis is needed to refine the spectral wavelengths and improve detection for timely control measures.

Inter-Row Electrocution Improves Glyphosate-Resistant Kochia (*Bassia scoparia*) Control. Waqas Ahmad*, Greta Gramig; North Dakota State University, Fargo, ND (017)

Glyphosate-resistant kochia poses a challenge to soybean production. Electrical weeding, alone and in combination with glyphosate (Gly), was applied to inter-row glyphosate-resistant kochia in a greenhouse. A small-scale electrocution device was designed to electrocute kochia plants via contact, while soybeans were shielded with glass covers. An initial experiment evaluated two voltages (9kV or 18kV), travel speeds (20 or 40-seconds $tray^{-1}$), and kochia biotypes (resistant or susceptible). Twenty kochia seedlings grown in potting soil were electrocuted at 5-8 cm tall. A second experiment evaluated seven treatments: 18kV, 9kV, Gly+18kV, Gly+9kV, Gly alone, weedy check, and weed-free check. The travel speed was 40-seconds $tray^{-1}$. Glyphosate was applied at 1680 g ae ha^{-1} with AMS at 2.5% v/v. Glyphosate-resistant soybeans (AG009X8) were planted in the center of the tray. Kochia plants were electrocuted at 5-10 cm during first and 13-15 cm tall during second run. Kochia control and soybean injury were determined at 7, 14, and 21 days after treatment (DAT), and dry biomass was quantified at 21 DAT. In the initial experiment, kochia control at travel speed of 40-second $tray^{-1}$ was increased (85%) compared to 20-second $tray^{-1}$ (70%). In the second experiment, Gly+18kV and Gly+9kV treatments provided greater kochia control (100%) compared to 18kV, 9kV and Gly alone (88%, 81% and 25%, respectively) in the first run, with similar pattern in the second run. No soybean injury occurred and Gly+18kV produced greater soybean biomass compared to weedy check. Overall, electrocution combined with glyphosate maximized control of inter-row glyphosate-resistant kochia and soybean biomass.

Timing of Application and Rate Influence Response of Rydrich MZ Winter Wheat to Metribuzin. Jessica Kalin*, Ian Burke; Washington State University, Pullman, WA (018)

Metribuzin effectively controls annual grass and broadleaf weeds in winter wheat but has not been widely adopted in the Pacific Northwest due to concerns regarding crop safety. Growers have modified their metribuzin use by lowering rates, regardless of wheat variety. This makes metribuzin less effective at controlling problematic weeds and can contribute to herbicide resistance. The tolerance of Rydrich MZ winter wheat was evaluated against a known sensitive variety, Crescent, across five field trials over three years in different soil and climatic conditions in eastern Washington. Metribuzin was applied at four rates, ranging 157 to 628 g ai ha^{-1}, at preemergence, two leaf, and three to five tiller stages. Preemergence applications were the most injurious, leading to stand loss and yield reduction, particularly under conditions of activating rainfall during germination. Postemergence applications, however, indicated that Rydrich MZ maintained yields similar to nontreated controls at rates up to 628 g ai ha^{-1}. Rydrich MZ wheat demonstrated consistent tolerance to metribuzin, with yield loss only observed at off-label application timings. These findings support the use of the entire range of metribuzin rates allowed on metribuzin labels on Rydrich MZ.

Spot Spraying Between Crop Rows to Minimize Application Volume and Maximize Herbicide Efficacy. Prayusha Bhattarai*, Andy Branka, Pete Berry; Oregon State University, Corvallis, OR (019)

Abstract not available

Evaluating the Prevalence of Herbicide Resistance of Most Troublesome Grass Weeds in Oklahoma Wheat Fields. Amna Dar*, Liberty Galvin, Swati Shrestha; Oklahoma State University, Stillwater, OK (020)

Annual Italian Ryegrass (Lolium *perenne ssp. multiflorum*) is one of the most troublesome weeds in winter wheat production. The lack of new modes of action and overreliance on herbicides has led to suspected herbicide resistance, of which documentation is lacking in Oklahoma. To assess the distribution of resistant Italian ryegrass biotypes, a systematic statewide survey was conducted across 9 counties within active wheat fields in Oklahoma. In each field, seeds of 15-20 plants were collected and pooled. A total of 80 biotypes of Italian ryegrass were screened for resistance to quizalofop, imazamox, and glyphosate. Results revealed resistance to imazamox detected in 52% of samples tested, followed by 33% resistance to quizalofop and 10% resistance to Glyphosate. Cross-resistance to two or more herbicide modes of action was confirmed in 11 of the 19 counties surveyed, with a higher prevalence localized in the north-central Oklahoma. These findings underscore the urgent need for diversified weed management strategies to prevent the further spread of multiple herbicide-resistant populations.

Effect of Deficit Irrigation on Herbicide Activity in Cotton Production System. Jasleen Makkar*, Rupinder Saini, Sukhbir Singh, Lindsey Slaughter, Glen Ritchie; Texas Tech University, Lubbock, TX (021)

Paper withdrawn

Establishing the Maximum Control Height of Common Lambsquarters (*Chenopodium album*) in Glufosinate, Glyphosate, and Dicamba-Resistant Sugarbeet in the Western United States. Abraham Akuoko*[1], Albert Adjesiwor[2], Joel Felix[3], Andrew Kniss[4], Nevin Lawrence[1]; [1]University of Nebraska-Lincoln, Lincoln, NE, [2]University of Idaho, Kimberly, ID, [3]Oregon State University, Ontario, OR, [4]University of Wyoming, Laramie, WY, (022)

A triple-stacked sugarbeet (*Beta vulgaris*) trait resistant to glufosinate, glyphosate, and dicamba is under development, but not yet commercially available. When commercialized this will provide sugarbeet growers additional herbicide options for management of difficult-to-control weeds like common lambsquarters (*Chenopodium album*). Regulated field trials were conducted to estimate the maximum control height of common lambsquarters by POST application of dicamba (0.57 kg ae ha^{-1}), glyphosate (1.26 kg ae ha^{-1}), glufosinate (0.66 kg ai ha^{-1}), and glyphosate (1.26 kg ae ha^{-1}) + glufosinate (0.66 kg ai ha^{-1}) near Scottsbluff, NE; Lingle, WY; and Ontario, OR, and dicamba (0.57 kg ae ha^{-1}), glyphosate (1.26 kg ae ha^{-1}), and glufosinate (0.66 kg ai ha^{-1}) near Kimberly, ID in 2024. All POST herbicide programs reduced 10 cm-tall common lambsquarters biomass by >70%. At 2 weeks after application (WAA), glyphosate + glufosinate applied to 25 – 58 cm-tall common lambsquarters was effective for reducing common lambsquarters biomass (91 – 99%) compared to glufosinate alone (50 – 92%), depending on the location. In Scottsbluff, NE, dicamba applied to 80 cm-tall common lambsquarters reduced biomass 11% compared to the non-treated check. Glyphosate reduced 60 – 80 cm-tall common lambsquarters biomass by >90% across all study sites.

First Report of Quizalofop-P Resistance in Cheatgrass (*Bromus tectorum*) in Washington. Marija Savic*[1], Samuel Revolinski[1], Ian Burke[2]; [1]University of Kentucky, Lexington, KY, [2]Washington State University, Pullman, WA, (023)

Cheatgrass (*Bromus tectorum* L.) is winter annual grass and one of the most damaging weeds with the distribution of over 20 million hectares in the western United States. Widespread herbicide resistance to different herbicide groups identified in Pacific Northwest further complicates cheatgrass management. In 2022 cheatgrass was collected from 80 sites in central and eastern Washington. Two individual plants (R1 and R2) from the same site survived a field rate of quizalofop-P during initial screening experiments. To confirm suspected resistance, we conducted a dose-response study with 9 treatments of quizalofop-P (736, 368, 184, 92, 46, 23, 11.5, 5.75, and 0 g ai ha^{-1}) and three genotypes (R1, R2, and S). Results confirmed resistance in two lines with GR50 values of 116.3 and 94.2 g ai ha^{-1} for R1 and R2 respectively while the GR50 for susceptible (S) genotype was 16.7 g ai ha^{-1} based on plant fresh biomass weight. To further investigate the mechanism underlying the resistance we sequenced the ACCase gene and tested for known mutations. None of the previously reported mutations were found in the CT region of ACCse gene. Nontarget site resistance was examined by CYP inhibition applying malathion at 2000 g ai ha^{-1} 3 h before quizalofop-P at 92 and 187 g ai ha^{-1}. There were no differences between treatments with and without malathion regardless of herbicide rate indicating that the resistance is not conferred by cytochromes inhibited by malathion treatment. Further research and experiment repetition is necessary to confirm/identify resistance mechanism to quizalofop-P in cheatgrass.

Interseeding Annual and Perennial Forage Species with Corn. Michael Atiemo*, Jenna Meeks, Andrew Kniss; University of Wyoming, Laramie, WY (024)

Paper withdrawn

Dry Edible Bean Response to Metamitron Soil Residue. Jenna Meeks*, Andrew Kniss; University of Wyoming, Laramie, WY (025)

Metamitron provides preemergence control of several important weed species in sugar beet. If a sugar beet crop fails due to environment or pest pressure early in the season, producers may plant dry edible beans. Dry edible bean response to metamitron soil residues applied at sugarbeet planting is unknown. A field study was conducted near Lingle, WY to evaluate dry edible bean response to soil residues of metamitron herbicide. Metamitron was applied 7 d before dry bean planting with and without ethofumesate at 1x, 0.5x, 0.25x field use rate. Dry bean visual injury and stand count 18 d after planting was not significantly different between metamitron and metamitron+ethofumesate at any rate. However, dry bean stand 28 and 47 d after planting was reduced by metamitron and metamitron plus ethofumesate. Based on nonlinear regression, approximately 895 g metamitron ha^{-1} (27% of the recommended field use rate) was required to reduce dry bean stand by 5%. Based on reported soil half-life of metamitron, more studies are required to determine whether dry edible bean can be planted safely after a failed sugar beet crop.

Kochia (*Bassia scoparia*) Management with Dichlorprop-p Based Herbicide Mixtures in Fallow and Small Grains. Daniel Beran*, Joe Vassios; Nufarm Americas, Inc., Eldora, IA, (026)

Dichlorprop-p is a group 4 phenoxy herbicide developed by Nufarm that has benefits for the management of herbicide resistant plants. Efficacy studies conducted from 2019 to 2024 have indicated promising levels of kochia (*Bassia scoparia*) control, including biotypes resistant to 2,4-D, dicamba and fluroxypyr. Scorch EXT, a premix combination of dichlorprop-p, dicamba and 2,4-D is registered for noncropland use and is pending registration for fallow and preplant usage. Special Local Needs (SLN) labels for the use of Scorch EXT in fallow are currently approved in CO, MT, and KS. Trials conducted in 2022-2023 evaluated the impact of kochia size and tank mixtures on control with Scorch EXT. Averaged across 11 sites, Scorch EXT at 24 oz ac^{-1} (0.5 lb dichlorprop-p + 0.25 lb dicamba + 0.25 lb 2,4-D) provided 85% control 2-4" kochia. Control at this timing improved to 95% when Panther SC at 2 fl. oz ac^{-1} (0.063 lb flumioxazin) was tank mixed with Scorch EXT. In contrast, control of 4-8" kochia was 76% and 92% when Scorch EXT was applied alone and with Panther SC, respectively. A premix of dichlorprop-p plus bromoxynil (Maestro EXT) has also been developed for use in wheat and barley. Maestro EXT has demonstrated excellent kochia control, averaging 91% when applied at 20 fl. oz ac^{-1} (0.5 lb dichlorprop-p + 0.25 lb bromoxynil) and 95% when applied at 30 oz ac^{-1} (0.75 lb dichlorprop-p + 0.375 lb bromoxynil). Further studies in small grains have indicated that dichlorprop-p has excellent compatibility with grass herbicides and crop safety.

Status of Kochia (*Bassia scoparia*) Herbicide Resistance in Utah. Olanrewaju Adeyemi*, Eric Westra, Corey Ransom, Earl Creech, Mirella Ortiz; Utah State University, Logan, UT (027)

Kochia (*Bassia scoparia* (L.) A.J. Scott) is a troublesome weed in the western U.S., infesting agricultural fields, roadsides, and other disturbed areas. Herbicide resistance in kochia poses a significant challenge, reducing the efficacy of chemical control programs. While herbicide-resistant kochia has been reported across the western and midwestern U.S., recent data on its status in Utah is limited, with the last report dating back to 1998. This study aimed to update the status of kochia herbicide resistance in Utah and investigate potential resistance mechanism. In 2024, kochia seeds were collected from 13 locations across eight Utah counties, including ten roadsides, one industrial site, one wheat field fence line, and one ranch. Seeds were propagated in plug flats at the Utah State University Research Greenhouse, and seedlings were transplanted into pots (3.5 x 3.5 cm) for screening. Plants were screened for resistance to glyphosate at a field rate of 1,731.4 g ae ha^{-1} (Roundup PowerMax 3) mixed with 20.4 g L^{-1} ammonium sulfate. Herbicide was applied using a spray chamber, and plant survival was assessed 28 days after treatment. Plants were classified as susceptible (<2% survival), having low resistance (2 to 19% survival), or resistant (>20% survival) to glyphosate. From the screened populations, glyphosate resistance frequency ranged from 0% to 33%. Of the total populations, 15% were classified as resistant, 46% exhibited low resistance, and 39% remained susceptible. Combining resistant and low-resistance populations, 61% of the screened kochia populations are no longer susceptible to glyphosate.

Stale Seedbed for Weed Management in Sugar Beet. Newman Teye-Doku*[1], Nevin Lawrence[2], Jenna Meeks[1], Ramawatar Yadav[3], Andrew Kniss[1]; [1]University of Wyoming, Laramie, WY, [2]University of Nebraska, Lincoln, NE, [3]Ohio State University, Columbus, OH (028)

Weeds in sugar beet fields are currently known to exhibit resistance to glyphosate, ALS-inhibitors, and dicamba, as well as other herbicides. Widespread herbicide resistance requires an integrated weed management program that reduces reliance on herbicides. Field studies were conducted near

Lingle, WY and Scottsbluff, NE in 2024 to evaluate the effectiveness of a stale seedbed approach to weed management in sugar beet. Treatments included four different sugar beet planting dates ranging from April 15 to May 31, and three weed control treatments. The effect of weed control treatment on midseason weed biomass and sugar beet yield depended on the planting date ($P < 0.001$). The PRE mixture of ethofumesate and metamitron reduced kochia biomass in Lingle in the first planting date, but the effect of the PRE was less important as planting was delayed. At Scottsbluff, the PRE herbicide treatment was more effective against common lambsquarters for later planting. Although delayed planting reduces yield in weed-free sugar beet, delaying sugar beet planting to prepare a stale seedbed can increase sugar beet yield if weeds cannot be effectively controlled after crop emergence.

Alberta Survey of Herbicide-Resistant Weeds in 2023. Charles Geddes*[1], Mattea Pittman[1], Breanne. Tidemann[2], Julia Leeson[3]; [1]Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB, [2]Agriculture and Agri-Food Canada, Lacombe Research and Development Centre, Lacombe, AB, [3]Agriculture and Agri-Food Canada, Saskatoon Research and Development Centre, Saskatoon, SK (029)

Herbicide-resistant weeds are a growing concern for Alberta farmers. The percentage of annual-cropped fields occupied by herbicide-resistant weeds in Alberta increased from 20% in 2001 to 40% in 2007 to 59% in 2017. Continued monitoring of the occurrence, distribution and impact of herbicide-resistant weeds is essential to understand how best to mitigate and manage this increasing threat to cropping systems. A randomized-stratified survey of 253 fields under annual crop production in Alberta was conducted in 2023; 22 years after the baseline survey of the province. Fields consisted of randomly-selected quarter sections (65 ha) stratified based on the area under crop production in each ecodistrict and the seeded area of crops in 2023. The fields were visited shortly before harvest and mature seeds were collected from visible patches of uncontrolled weeds. The samples were planted in the greenhouse and the plants were treated with glyphosate (Group 9) or tier 1 acetyl-CoA carboxylase (ACCase)- and acetolactate synthase (ALS)-inhibiting (Groups 1 and 2) herbicides. Plant survival was evaluated 21 days after treatment. Overall 1,843 bioassays were conducted on 997 samples representing 51 weed species. Herbicide-resistant weed patches occupied 2.3 million ha across 64% of the fields surveyed. ACCase inhibitor-resistant wild oat (*Avena fatua* L.) was found at greatest frequency and occurred in 93% of fields where the species was collected and tested (51% of all fields surveyed). ALS inhibitor-resistant wild oat were found in 73% of the fields where the species was tested (40% of all fields surveyed). Most of the fields with ALS inhibitor-resistant wild oat also had ACCase inhibitor resistance. ACCase inhibitor-resistant green foxtail [*Setaria viridis* (L.) P. Beauv.] and several ALS inhibitor-resistant broadleaf weed species were also documented. Among these, ALS inhibitor-resistant kochia [*Bassia scoparia* (L.) A.J. Scott] was found at greatest frequency and was present in all kochia samples tested (23% of all fields surveyed). Based on previous grower estimates combined with the area where herbicide-resistant weeds were present in Alberta, herbicide-resistant weeds cost Alberta farmers about $238 million CAD annually.

Extent of Residual Activity of the HPPD Inhibiting Herbicides Bicyclopyrone, Pyrasulfotole, and Tolpyralate. Jessica Kalin, P. Weston Maughan*, Marija Savic, Ian Burke; Washington State University, Pullman, WA (030)

Inhibitors of 4-hydroxyphenylpyruvate dioxygenase (HPPD) can vary in their soil residual activity. Bicyclopyrone, pyrasulfotole, and tolpyralate are registered for use in wheat and control many of the same weeds when applied postemergence, but may differ in their preemergence activity. This study seeks to examine the residual control of various HPPD-inhibiting herbicide premixes at different assessment intervals. At two sites in eastern Washington, three replications of four treatments were applied in a RCBD. The main plot treatments were bicyclopyrone, pyrasulfotole + thenincarbazone-methyl + bromoxynil, tolpyralate + bromoxynil, and nontreated control. The 3 m x 15 m plots were split into three subplots, a nontreated control and two treated with glyphosate at 14 and 28 days after the main plot treatments, respectively, to assess residual activity. Biomass from each set of subplots was collected 60 days after the main treatment using 2 x 0.5 m^2 quadrats, dried, and analyzed for each species using a generalized linear mixed model with a gamma distribution, and a Tukey HSD post-hoc test. At both sites, residual control of most dicot species relative to the nontreated control was greatest with bicyclopyrone. However, no premix provided improved long-term control of *Amaranthus albus* or *A. retroflexus* compared to the nontreated control. The findings indicate that while bicyclopyrone has stronger residual control of dicot species than other HPPD inhibitors, broad-spectrum premixes should incorporate additional modes of action, and postemergence applications will be necessary for certain species.

Palmer Amaranth Survey Reveals Widespread of Glyphosate Resistance in Colorado. Lucas Soares Rosa*, Andre Araujo, Amber Pelon, Todd Gaines;[1]Colorado State University, Fort Collins, CO (031)

Palmer amaranth (*Amaranthus palmeri*) has become an increasingly troublesome weed in Colorado, with reports of herbicide resistance emerging in several regions. Understanding the distribution and extent of herbicide resistance is critical for implementing effective management strategies and preventing further spread. The objective of this study was to conduct a herbicide resistance survey for glyphosate, dicamba, and glufosinate to assess resistance levels and inform weed management recommendations. Palmer amaranth seeds were collected from sites across Colorado, Wyoming, and Nebraska, with latitude and longitude recorded. Seeds were planted in a greenhouse, and at the 4 to 6 leaves stage, herbicide applications were conducted separately: glyphosate (840 g ae ha^{-1}), glufosinate ammonium (590 g ai ha^{-1}), and dicamba (560 g ae ha^{-1}). Survival was evaluated 28 days after application, and populations were categorized based on their survival rate: susceptible (<2% survival), low resistance (2–19% survival), and resistant (>20% survival). Of the tested populations, 20 sites exhibited suspected resistance to glyphosate, while one site showed suspected resistance to glufosinate. For dicamba, all sites were classified as susceptible, allowing the development of a geographical map pinpointing the locations of potentially resistant biotypes. These findings highlight the continued evolution of resistance in Palmer amaranth and the necessity of diversified management strategies to mitigate further resistance development. Further studies will investigate the target-site resistance mechanisms associated with resistant populations, providing valuable insights for sustainable weed control practices.

Enhancing Pre-Emergence Herbicide Performance Using a Soil-Applied Adjuvant in Grape Vines. Bianey Medina[1], John Breen[2], Anil Shrestha[1]; [1]Department of Plant Science, California State University, Fresno, CA, [2]Nutrien Ag Solutions (032)

In the recent years, the potential of soil-applied adjuvants is being investigated for various aspects in agricultural cropping systems. These adjuvants have been developed to enhance soil water holding capacity. We hypothesized that soil surfactants may also prolong the efficacy of a soil-applied preemergence herbicides. A two-year study (2022/2023 and 2023/24) was conducted at a winegrape vineyard in Fresno CA to assess the potential benefits of Infuse®, a soil-applied adjuvant, with the pre-emergence herbicides indaziflam, orthosulfamuron, and rimsulfuron. The experimental design was a split-plot with herbicide type as the main plot, and inclusion or absence of Infuse as sub-plot. A control treatment with no herbicides but with and without Infuse was also included. Each treatment was replicated four times, and each plot was 10.7 x 1.8 m. The herbicides were applied using a backpack sprayer at (3.5 fl oz/acre of indaziflam, 8.6 oz/acre of orthosulfamuron, 4 oz/acre of rimsulfuron). Infuse® was applied at 0.005 per acre/plot. Weekly evaluations of total weed emergence were recorded per plot. In 2024, a weed emergence in a random 0.25m² area under the drip-irrigation emitter was also recorded. Data was analyzed separately for each year due to the interactions ($P<0.05$). Adjuvant had no effect on total weed emergence, but some effects were observed under the emitters. Indaziflam plots consistently had the lowest weed emergence, followed by rimsulfuron and orthosulfamuron in both years.

Evaluation of Fall- and Spring-Applied Herbicides for Weed Control in Field Pea. Caleb Dalley*, Daniel Guimaraes Abe; North Dakota State University; Hettinger Research Extension Center, Hettinger, ND (033)

Weed control in field pea is accomplished primarily through at-planting preemergence application of soil active herbicides. Pyroxasulfone was recently labelled for use in field peas. Pyroxasulfone, due to its low water solubility, requires 15 to 30 mm of rainfall to activate this herbicide into the soil profile. Springtime rainfall in western North Dakota is not always reliable, therefore, the option fall application was explored through trials conducted in 2022-23 and 2023-24. Pyroxasulfone was compared with other standard herbicides used in field pea in North Dakota, along with glyphosate alone applied in the fall and spring and a non-treated control. Selected trial locations were infested with the winter annual cheatgrass (*Bromus* spp; a mixture of *B. tectorum* L. and *B. arvensis* L.). Wild buckwheat (*Polygonum convolvulus L.*) was also present at the 2022-23 location; kochia (*Bassia scoparia* (L.) A.J. Scott, and common lambsquarters (*Chenopodium album* L.) were present at the 2023-24 site. Glyphosate (860 g ae ha^{-1}) plus AMS (10 g L^{-1}) was tank-mixed with all herbicide treatments. Fall treatments included: glyphosate, pyroxasulfone + carfentrazone (131 + 9.3 g ai ha^{-1}), and pyroxasulfone + flumioxazin at three rates (90 + 71, 112 + 88, and 134+106 g ai ha^{-1}). Spring treatments included glyphosate, pyroxasulfone + carfentrazone (131 + 9.3 g ai ha^{-1}), and sulfentrazone + metolachlor (196 + 1760 g ai ha^{-1}). Two split applications treatments were fall and spring pyroxasulfone + carfentrazone (81 + 5.8 followed by 65 + 4.7 g ha^{-1}) and fall pyroxasulfone + carfentrazone (131 + 9.3 g ai ha^{-1}) and spring sulfentrazone + carfentrazone (139 + 15.4 g ai ha^{-1}). Cheatgrass control was more consistent (96-100%) with fall applications that included pyroxasulfone. Spring applied glyphosate controlled cheatgrass 86-87%. Spring glyphosate did not control wild buckwheat in 2023, but provided 45% control of kochia and 66% control of common lambsquarters in 2024 as these weeds had begun to emerge prior to application. Wild buckwheat control was best (91%) with split applications of fall pyroxasulfone + carfentrazone followed by spring sulfentrazone + carfentrazone. Fall pyroxasulfone + flumioxazin at the two higher rates resulted in similar control (86-92%). Kochia

control was best with spring sulfentrazone + metolachlor (94%). Common lambsquarters control was best with spring sulfentrazone + metolachlor (89%) and spring pyroxasulfone + carfentrazone (87%). In 2024, pea stand was reduced with fall glyphosate alone and with the spring pyroxasulfone + carfentrazone likely due to interference from cheatgrass. In 2023, pea height was reduced only in the untreated control. In 2024, pea height was lower in most of the spring applied treatments or withe glyphosate alone likely due to cheatgrass interference. In both years, pea yield was greatest with split application of fall pyroxasulfone + carfentrazone followed by spring sulfentrazone + carfentrazone. Fall herbicide application helps reduce weed populations in the spring which can improve establishment of peas and reduce weed interference during crop establishment. Fall treatments do not provide complete weed control and will likely benefit from a complimentary herbicide application made at planting.

Agronomic and Economic Impacts of Integrating Fall-planted Cereal Cover Crops and Herbicides for Weed Control in Dry Beans. Prayusha Bhattarai*[1], Albert Adjesiwor[2]; [1]Oregon State University, Corvallis, OR, [2]University of Idaho Kimberly Research and Extension Center, Kimberly, ID (034)

Field experiments were conducted in Parma and Kimberly, ID, in 2023 and 2024 to determine the weed suppression ability of fall-planted cover crops in dry beans (*Phaseolus vulgaris* L.) based on the termination practice and herbicide programs. Economic analysis was also conducted to determine the economic impacts of combining cover crops and herbicides for weed control in dry bean. Treatments included three cereal cover crops (barley, *Hordeum vulgare* L.; triticale, *Triticosecale rimpaui* L.; and wheat, *Triticum aestivum* L.) and no cover crop. Cereal cover crops were either terminated chemically with glyphosate or harvested for forage. There were three pre-emergence herbicides, one post-emergence, and a nontreated check. Haying treatments reduced dry bean stand density by 38% in Parma but had no significant impact on dry bean seed yield. Chemically terminated cover crop treatments, on the other hand, reduced dry bean stand density in Kimberly by 37% and seed yield by 49% because of high forage production in 2024. Cover crops reduced weed biomass by 65 to 80% in Parma and 14 to 54% in Kimberly. All herbicides (except dimethenamid-p + EPTC) reduced weed biomass by 25 to 75% in Parma and 33 to 76% in Kimberly. The dry bean seed yield was reduced by 31% in Parma and 67 to 72% in Kimberly in the nontreated check when compared to herbicide treatments. Economic analysis revealed that most of the cover crops and herbicide combinations were profitable, except for a few combinations where dry bean seed yield was reduced.

Evaluating the Impact of Seeding Rate, Nitrogen, and Disease Pressure on *Bromus tectorum* (cheatgrass; downy brome) and Winter Wheat Competition. Laura Berrios*[1], Lovreet Shergill[2], Alan Dyer[1], Fabian Menalled[1]; [1]Montana State University, Bozeman, MT, [2]Colorado State University, Fort Collins, CO (035)

Paper withdrawn

Balancing Spray Deposition and Weed Control Among Glufosinate Formulations. Jeff Golus*, Adam Balic, Laura de Souza Viera, Vuk Stamenovic, Kasey Schroeder, Milos Zaric; [1]University of Nebraska-Lincoln, North Platte, NE (036)

The emergence of herbicide-resistant weed species has intensified the need to evaluate and optimize existing herbicide choices and application strategies. Among these, glufosinate use has increased due to its broad-spectrum efficacy, development of tolerant crops and growing availability of diverse formulations in the marketplace. Several studies were conducted the University of Nebraska-Lincoln West Central Research and Extension Center in North Platte, NE to evaluate glufosinate formulations. These included spray droplet size, spray deposition and coverage, spray drift potential, spray solution physical properties, and biological efficacy on Palmer amaranth, common lambsquarters, velvetleaf and non-glufosinate tolerant corn. Although some specific differences existed among the formulations tested, in general the formulations performed similarly across the types of evaluations performed.

Regrowth Potential of Palmer Amaranth, Kochia, and Common Lambsquarters in Response to Glufosinate and Acifluorfen Applications. Kasey Schroeder*, Jeffrey Golus, Milos Zaric; University of Nebraska Lincoln, North Platte, ND (037)

Effective weed control requires considering multiple parameters to optimize pesticide application outcomes. One critical yet often overlooked factor is the height of weeds at the time of application. Treating weeds that exceed the label-designated target height can reduce herbicide efficacy, increase the likelihood of regrowth and selection pressure, potentially accelerating resistance development. The objective of this study was to evaluate the effectiveness and regrowth potential of three weed species: *Amaranthus palmeri, Bassia scoparia,* and *Chenopodium album* treated at three different heights (5, 10, and 20 cm) with glufosinate at 656 g a.i. ha^{-1} with the addition of ammonium sulfate at 3362 g ha^{-1} and acifluorfen at 280 g a.i. ha^{-1}. Applications were made using AIXR11004 and TTJ6011004 nozzles (TeeJet, Wheaton, IL, USA) in a multi-nozzle spray chamber (Devries Manufacturing, Hollandale, MN, USA). The sprayer operated at a pressure of 276 kPa with a travel speed of 17.1 km h^{-1} to achieve a carrier volume of 187 L ha^{-1}. Efficacy was assessed through visual evaluations using a percentage scale from 0 (no injury) to 100 (complete plant death) for up to 28 days post-application. To supplement these assessments, Brinno TLC200 Pro HDR time-lapse cameras (Brinno Inc., Taipei City, Taiwan) were deployed to capture images at 60-minute intervals, providing a continuous visual record of plant response over time. Weed control efficacy was species-dependent, with nozzle selection improving herbicide deposition and control. However, weed height at application significantly influenced the outcome, as taller weeds showed reduced efficacy and greater regrowth potential, highlighting the importance of timely application.

WSWS Project 4. Teaching and Technology

Strategic Messaging for Herbicide Resistance Management: Focusing on the Value of Product Stewardship. Liberty Galvin*, Swati Shrestha; Oklahoma State University, Stillwater, OK (048)

Herbicide resistance in weeds is a major concern among scientist, industry representatives, commodity groups, and crop consultants, but less so with crop producers. Major barriers to adopting herbicide resistance technology and practices have been identified and must be considered when delivering extension messages on proper pesticide stewardship and the

importance of longevity of existing technologies. These barriers include a "techno-optimism" mindset around industry technologies, household income and land ownership, conflicting messages between retailers and pesticide advisors, and complexity of resistance management. Having a greater understanding of the misconceptions around resistance, financial realities of producers, will allow extension messages to become clearer and more readily adoptable.

Identifying Historical Knowledge Gaps in Wheat-Herbicide Resistance Reporting Across the US. Conner Cox*, Swati Shrestha, Liberty Galvin; Oklahoma State University, Stillwater, OK (049)

Herbicide-resistant grassy weeds in wheat and small grains are an escalating concern in Oklahoma. This study identifies knowledge gaps by comparing herbicide resistance research, reporting practices, and extension outreach programs in Oklahoma with those in the Pacific Northwest and Central Great Plains, two major U.S. wheat-growing regions. This review of published and unpublished literature, using both digital and state-level resources, focused on herbicide resistance trends and outreach efforts, revealing that many states employ herbicide screening programs and resistance maps to manage resistant weeds and guide management decisions. For Oklahoma farmers to effectively address herbicide resistance, implementing a state-specific screening program and developing resistance maps are essential. These tools will monitor resistant weed populations, identify emerging resistance patterns, and align with other states in tracking resistance trends. Although no direct causal relationship was found between outreach efforts and resistance management outcomes, expanding Oklahoma's extension services could reduce herbicide-resistant weed populations by improving awareness. Strategies such as using resistance maps, promoting integrated weed control, and enhancing communication will help farmers make more informed herbicide management decisions. Future research could explore how integrating herbicide screening and resistance maps can improve statewide resistance management.

Engaging the Public: King County's Dynamic Approach to Noxious Weed Education. Rahel Stampfer, Skye Pelliccia: King County Noxious Weed Control Program, Seattle, WA (050)

Abstract not available

White Plum Farm Ag Learning Center Year 1 - Field of Weeds, Undergrad Interns, and Lessons Unlearned: An Extension Story. Kat Caswell*[1], Erica Bassett[2]; [1]Colorado State University Extension, Greely, CO, [2]Colorado State University, Fort Collins, CO (051)

Description: White Plum Farm is a homestead from 1881 owned by the City of Greeley Museums as an agriculture learning center. After decades, the soil has become eroded and weedy. A cover crop, compost system, native forbs, and apiary will improve pollinator abundance, decrease erosion, and improve tilth.

Cooperator Roles: City of Greeley Museums – Mr. Havens and Dr. Bowles are the curators who directly oversee the White Plum Farm site. The museums staff is responsible for the maintenance of the site and associated buildings. The City of Greeley Museums will work collaboratively with CSU Extension to meet the long-term goal of White Plum Farm being used for agriculture education. Museums staff will provide support through equipment use, assistance in field

operations, and general operations. Havens and Bowles will ensure that the site continues to harken back to its origins as a homestead and preserve the historic structures.

Priorities for Plant Protection Undergraduate Education. Randa Jabbour, Clint Beiermann*; University of Wyoming, Laramie, WY (052)

Plant protection includes academic disciplines such as entomology, weed science, plant pathology, and wildlife. We wanted to identify the most important knowledge and skills that undergraduate students should learn related to plant protection. We developed a competency inventory for our lab and field-based Applied Plant Protection course at the University of Wyoming. One example of a relevant competency would be "I can identify insects to the order level." In 2024, we presented this competency inventory as an interactive poster at meetings of both the Western Society of Weed Science and the Entomological Society of America-North Central Branch. Attendees "sticker-voted" on the competencies deemed most important, and they could also add competencies to the list. At the weed science meeting, the top competencies were to use software to build maps of invasive weeds, apply pesticides, identify weeds, and to present results to various audiences. At the entomology meeting, the top priorities were to use multiple sampling methods for insects and plants, scout for pests in crop fields, identify insects, and to summarize data. In summary, weed scientist and entomologist communities had distinct priorities for plant protection-related competencies. This finding highlights the importance of an interdisciplinary undergraduate education with exposure to each of the plant protection disciplines.

Integrated Weed Control For Cereal Grain Cropping Systems. Aaron Esser*; Washington State University, Ritzville, WA (053)

I believe weeds and herbicide resistant weeds are the single greatest barrier farmers face in today's agriculture and is a large threat to conservation tillage moving forward. I have dedicated a large portion of my time to providing and facilitating research and outreach to this significant challenge farmer face. In my region downy brome resistant to Group 2 and Group 9 herbicides is the biggest issue, however, my program is focused on the larger problem across eastern Washington. My efforts include using the WSU Wilke Research and Extension Farm and large-scale research to 'show-and tell' farms how they can economically use a long-term cropping plan to get multiple effective herbicides onto the ground, and how to use targeted tillage to enhance winter annual weed control for an integrated approach. My program is also looking at biological (Battalion Pro) weed control for enhanced long-term control in a series of large-scale demonstrations across the dryland wheat producing region of Adams County. This barrier farmers face will truly take a combination of chemical, physical and potentially biological methods to maintain economically viable winter wheat production.

WSWS Project 5. Basic Biology and Ecology

Germination Moisture and Temperature Requirements of Italian Ryegrass. Chandra Montgomery*, Albert Adjesiwor, Tracy Rauch, Joan Campbell; University of Idaho, Moscow, ID (038)

The changing climate is impacting weed ecology and growth patterns in agricultural production systems. General understandings of temperature and moisture requirements have been documented for different weed species, however, there is evidence that production practices and environmental factors affect weed species response to temperature and moisture. Laboratory studies were initiated in 2023 at the University of Idaho Research and Extension Center to determine the germination temperature and moisture requirements of Italian ryegrass (*Lolium multiflorum*) and spring wheat (*Triticum aestivum*) collected in Idaho and Washington. For the germination temperature requirement experiments, weed populations and wheat cultivars were grown on a thermogradient table with 10 varying temperatures between 4 C and 35 C. In the germination moisture requirement experiments, polyethylene glycol (PEG 8000) obtain 10 different osmotic potentials (0 to -2 MPa) at temperatures >12 C, there were no differences in germination speed and maximum germination between the Italian ryegrass and spring wheat. However, Italian ryegrass had faster germination speed and greater maximum germination at temperatures <10 C. Most Italian ryegrass populations had approximately 50% germination at 4 C while the spring wheat had <5% germination. At osmotic potentials of 0 to -0.2 MPa, germination was 80 to 100% for both Italian ryegrass and spring wheat. Italian ryegrass germination was at least 1.5x greater than spring wheat at osmotic potentials of -0.4 to -0.8 MPa. These results demonstrate that Italian ryegrass is very likely to germinate faster and be more competitive with spring wheat under cooler temperatures and dry conditions.

Survey of *Poa annua* Herbicide Resistance in the Willamette Valley of Oregon. Joshua Miranda*, Marcelo Moretti; Oregon State University, Corvallis, OR (039)

Poa annua (annual bluegrass) has evolved resistance to 12 herbicide modes of action worldwide, posing a significant challenge to weed management. In the Willamette Valley of Oregon, hazelnut growers have recently observed survival of *P. annua* after treatment with commonly used herbicides, including glyphosate, paraquat, clethodim, and pendimethalin. This study aimed to assess the prevalence and levels of herbicide resistance in *P. annua* accessions from this region. Single-seed descendants from putative herbicide-resistant accessions were developed from plants that survived discriminating herbicide rates for up to two generations. Resistance was confirmed through seed- and/or whole-plant dose-response assays. Glyphosate resistance was found in one accession, with LD_{50} values 6 times higher than in susceptible accessions based on seed assays. Paraquat resistance was found in three accessions, with LD_{50} values for resistant plants 42–48 times higher than the susceptible accession also based on seed assays. Clethodim resistance was confirmed in three accessions, with LD_{50} values 160–410 times higher in the resistant populations compared to the susceptible one, based on seed assays. Whole-plant assays showed resistant accessions surviving >10% clethodim at 270 g ha^{-1}. Pendimethalin resistance was identified in two accessions, with resistance levels ranging from 2.7 to 8.8 times higher than the susceptible accession (LD_{50} and LD_{90} of 393 and 1,892 g ha^{-1}). Pendimethalin is a commonly used preemergence herbicides in hazelnuts, while clethodim and paraquat are two of the most effective herbicides for grass control. These are the first reports of glyphosate, paraquat, clethodim, and pendimethalin resistance in Oregon, underscoring the growing challenge of herbicide resistance and the urgent need for new herbicides and integrated weed management strategies. Future research will validate seed assay results at the whole-plant level and focus on understanding the resistance mechanisms and evaluating strategies for effective control.

Development of a Rapid Throughput Screen Bioassay for Quizalofop Tolerance to Experimental CoAxium Wheat Seed Lines. Amber Pelon*, Franck Dayan, Todd Gaines; Colorado State University, Fort Collins, CO (040)

Abstract not available

Evaluating Glufosinate for Hop Spring Pruning. Greeshmanth Alluri*, Marcelo Moretti; Oregon State University, Corvallis, OR (041)

Carfentrazone and paraquat are commonly applied to hops (*Humulus lupulus* L.) during early spring to remove emerged shoots for sanitation against downy mildew, powdery mildew, and for weed control. Alternative herbicides may reduce the rising regulatory and safety concerns and provide better weed control. Four field studies were conducted in Oregon and Washington (2022–2024) to evaluate potential alternatives. Glufosinate efficacy was compared to a nontreated control and carfentrazone. Glufosinate was applied at the labeled rate (1147.5 g ai ha^{-1}) and twice the labeled rate, with one application or two applications spaced 14 days apart. Hop shoots were 5 to 8 cm long at herbicide application. At 42 days after treatment, carfentrazone did not control basal shoots, while glufosinate control ranged from 20% - 90% in Corvallis (2022) and Toppenish (2022), showing slower recovery from the treatment. No treatment controlled basal foliage in Independence (2024) or Toppenish (2023). At 90 days, no treatment controlled basal shoots except in Corvallis where some hops, younger at application, were killed. Cone dry weight was predominantly unaffected, except in Toppenish (2023) where two applications of glufosinate at twice the label rate reduced yields by almost 30% compared to nontreated. On the same site, glufosinate controlled kochia (80%–100%) better than carfentrazone (27%–70%). We conclude that glufosinate is an effective alternative for hop shoot removal and weed control in spring, although considering plant age and training dates may minimize crop injury.

Effect of Germination Time and Crop Competition on Biomass, Fecundity, and Seed Viability of Downy Brome (*Bromus tectorum* L.) in Spring Wheat. Fernando Oreja[1], Vhuthu Ndou[2], Jennifer Gourlie[2], Judit. Barroso*[2]; [1]Clemson University, Clemson, SC, [2]Oregon State University, Adams, OR (042)

Downy brome is a significant winter annual weed that substantially reduces wheat grain yield in the Pacific Northwest. This study aimed to assess the effects of different spring germination times and spring wheat competition on biomass, fecundity and seed viability of downy brome. A field experiment was established in mid-March 2023 in a naturally infested area at the Columbia Basin Agricultural Research Center (CBARC) (Adams, OR), using a randomized complete split-plot block design with four replications. The main plots were the presence or absence of spring wheat, and the sub-plots included different weed emergence times (April 5, April 12, April 19, April 26, and May 6). Downy brome plants were marked at weekly intervals, and their fresh aerial biomass and seed viability were evaluated at various collection times (June 7, June 21, July 5, July 18, and August 1). Results indicated that plants collected in July and August had more biomass than those collected in June, with no differences observed between wheat and fallow situations. Early-emerging plants (April 5, 12, and 19) produced seeds rapidly during June. However, seed production was minimal for plants that emerged on May 6. Seeds from plants growing in fallow had higher viability compared to those growing in spring wheat across all emergence timings.

However, no significant differences in seed viability were found among emergence timings. The maximum seed germination percentage was around 10%, suggesting low seed viability for downy brome emerged in spring compared to plants emerged in fall.

Inheritance of Paraquat Resistance in Sumatran fleabane (*Conyza sumatrensis*): Genetic Analysis and Identification of a Major Quantitative Trait Locus. Andre Araujo*[1], Ana Beatriz Amaral[2], Jessica Leal[3], Camila Ferreira de Pinho[2], Todd Gaines[1]; [1]Colorado State University, Fort Collins, CO, [2]Universidade Federal Rural do Rio de Janeiro, Seropedica, Brazil, [3]United Phosphorus, Moema, Brazil (043)

Conyza sumatrensis is a troublesome weed species that significantly reduces crop yields in diverse cropping systems, particularly in the United States and Brazil. A population of this species identified in Brazil has developed resistance to paraquat, a broad-spectrum herbicide widely used for controlling annual and perennial weeds. Herbicide resistance poses a major challenge for weed management and crop production. Understanding weed resistance mechanisms is crucial for developing effective management strategies and potentially reversing resistance. This study aimed to determine the inheritance of paraquat resistance in this population of *C. sumatrensis* and to identify quantitative trait loci (QTL) potentially associated with the observed resistance. Susceptible (S) and resistant (R) individuals were selected for parental crosses, resulting in the F1 generation from R♂ x S♀ crosses. F1 plants were treated with paraquat at a dose of 400 g ae ha^{-1} mixed with 0.5% non-ionic surfactant at the 10-12 cm growth stage, and all individuals survived. The F2 generation was then treated with paraquat at both 200 and 400 g ae ha^{-1} doses. Chi-squared goodness-of-fit tests revealed a 3:1 segregation ratio ($p > 0.05$), likely indicating a single-gene association with resistance. Bulk-segregant analysis conducted on F3 plants identified a single quantitative trait locus (QTL) on chromosome 3C that could potentially be linked to paraquat resistance, corroborating the F2 segregation results. Further research, including fine mapping and gene validation, will be performed to pinpoint candidate genes related to resistance.

Effect of Cover Crop Presence on Herbicide Efficacy. Madison Wright*, Ramawatar Yadav, Andrew Kniss; University of Wyoming, Laramie, WY (044)

Shade avoidance syndrome is a plant response to neighboring vegetation. We hypothesized cover crops could alter herbicide efficacy due to the relationship between shade avoidance and herbicide injury pathways. Field experiments in sugar beet and dry edible bean using a split-plot randomized complete block design were completed in 2023 and 2024 near Lingle, WY. A wheat cover crop (presence or absence) was the whole-plot, and herbicide treatments were applied as the split-plot, allowing herbicide injury to be evaluated in the presence or absence of wheat. Wheat was terminated with glyphosate when sugar beet reached the two true-leaf stage and 7 d after planting (before emergence) in the dry bean study. The herbicides acifluorfen, clopyralid, and a pre-mix of phenmedipham, desmedipham, and ethofumesate were applied in the sugar beet study at the 2-4 true-leaf stage. Bentazon, imazamox, and fomesafen were applied in the dry bean study at the 1-2 trifoliolate stage. Weeds were removed to exclude confounding effects of weed competition. In 2023 and 2024 wheat presence reduced sugar beet biomass by 28% and 41% respectively. Acifluorfen was the only herbicide that reduced sugar beet biomass in 2023, and no herbicide significantly reduced sugar beet biomass in 2024. Without herbicides, dry bean yield was reduced 16% in the presence of wheat in 2023 and wheat had no significant effect in 2024. In 2023 when

no wheat was present, no dry bean herbicides reduced yield significantly compared to the nontreated control; however, imazamox reduced dry bean yield if the wheat was present.

Polyploidization Effects on Seed Dormancy and Herbicide Resistance in Common Lambsquarters (*Chenopodium album* L.). Jonah Ziyaaba*[1], Ramawatar Yadav[2], Donna Harris[1], Andrew Kniss[1]; [1]University of Wyoming, Laramie, WY, [2]Ohio State University, Wooster, OH (045)

Common lambsquarters (*Chenopodium album* L.) is a troublesome weed, due in part to its persistent seed bank, seed dormancy, and resistance to herbicides, particularly those in the triazine and ALS-inhibitor families. Polyploidization is common in Chenopodium, but its ecological advantages, particularly regarding herbicide resistance and seed dormancy, are unclear. This study assessed 46 *C. album* accessions to determine if polyploidy enhances weedy characteristics. Ploidy levels were determined using flow cytometry. Among the accessions, four diploids (9%), three triploids (6%), and thirty-nine tetraploids (85%) were identified. Germination tests were conducted to assess primary dormancy under red light, and after two years of dry storage and cold stratification to break primary dormancy, germination was tested under both red light and high-intensity far-red (FR) to assess FR-enforced dormancy. Triploid accessions germinated poorly regardless of light environment. There was no significant relationship between ploidy and primary dormancy ($\chi^2 = 1.20$, $p = 0.550$). Chi-square tests revealed a significant relationship between ploidy and FR-enforced dormancy ($\chi^2 = 9.03$, $p = 0.0109$), but this was likely influence by poor germination in the triploid accessions; there were no clear differences between diploid and tetraploid types. Herbicide resistance was tested with atrazine (photosystem II inhibitor) and thifensulfuron-methyl (ALS-inhibitor). All accessions were susceptible to thifensulfuron-methyl. Atrazine resistance was identified in six accessions; among these, one accession was diploid, while the remaining five accessions were tetraploid ($\chi^2 = 1.22$, $p = 0.543$) Polyploidization does not confer consistent advantages for herbicide resistance or seed dormancy,

Soil Multivariate Analyses Reveal Signals of Rotational Crop Life History and Fertilizer Source in the Weed Seedbank. Brendan Alexander, Benjamin Ellert, Paul DeMaere, Charles Geddes*; Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB (046)

Proliferation of troublesome and herbicide-resistant weeds warrants development of diverse integrated weed management (IWM) strategies with an array of selection pressures on the weed community. Overreliance on herbicides for chemical weed control represents low diversity weed management that can reduce the evenness and diversity of weed species, thereby affecting ecosystem services offered by a diverse plant community. Cultural weed management techniques like crop rotation, crop life cycle diversity, and fertilization methods represent important components of an IWM program. This research assessed the impact of annual (corn-wheat-corn-wheat-barley), predominantly perennial (alfalfa-alfalfa-alfalfa-wheat-barley), and complex (corn-wheat-corn-wheat-barley- alfalfa-alfalfa-alfalfa-wheat-barley; i.e., annual and predominantly perennial rotations combined) crop rotations and check (i.e., none), triple superphosphate (TSP; 75 kg P_2O_5 ha^{-1} in the first year of each rotation and 17 kg P_2O_5 ha^{-1} in years 4 and 5), and cattle manure (33.5 t ha^{-1} in the fourth year of each rotation) phosphorus fertilizer sources on the germinable weed seedbank. A century-old irrigated long-term experiment was established in 1911

near Lethbridge, AB. The initial experiment was unreplicated, and modified in 1989 to establish 3 replicates of the 2-way factorial treatment structure (i.e., crop rotation by phosphorus fertilizer source). The treatments in their current form have remained consistent since 2004. Soil core samples were collected in the fall of 2022 and 2023 when the crops aligned with wheat and barley, respectively, across all rotation treatments. The germinable weed seedbank was assessed following successive rounds of cold stratification (-20 C) followed by seedling establishment and identification in the greenhouse until the seedbank was exhausted. We hypothesized that the complex rotation would allow for an increased number of species in the germinable seedbank and also improve weed control resulting in lower total weed seed density and higher species richness, diversity, and evenness. A crop rotation by phosphorus fertilizer source interaction was observed that exacerbated differences between the annual and the other two (predominantly perennial and complex) crop rotations as the fertilizer source went from no phosphorus fertilizer to TSP to manure. The interaction indicated that both the predominantly perennial and complex rotation weed communities were less sensitive to changes in phosphorus fertilizer source. Redundancy analysis revealed that *Chenopodium album* (CHEAL), *Bassia scoparia* (KCHSC), *Thlaspi arvense* (THLAR), and *Setaria viridis* (SETVI) were strongly related to specific environments induced by the treatments suggesting options for selective cultural management. Specifically, CHEAL densities were greater in the annual rotation with manure, KCHSC and THLAR densities were greater in the predominantly perennial rotation with TSP or manure, and SETVI was elevated in the no phosphorus fertilizer treatment. This exploratory analysis suggests that a complex crop rotation with diverse crop life cycles and cattle manure as a phosphorus fertilizer source could mitigate these species from dominating the weed community in the germinable seedbank.

Optimized Robotic Workflow for DNA and RNA Extraction in Downy Brome (*Bromus tectorum*) Using the KingFisher System: From Germination to Quality Control. Shahbaz Ahmed*, Marija Savic, Ian Burke; Washington State University, Pullman, WA (047)

Downy brome (*Bromus tectorum*) is a highly invasive weed in the Pacific Northwest (PNW) wheat-fallow system, with rising instances of herbicide resistance contributing to reduced crop yields. Performing whole-genome sequencing and transcriptomic studies are needed to improve understanding of the genetic mechanisms underlying resistance, which requires high-quality methods for DNA and RNA extraction.

We developed a high-throughput system for downy brome growth, tissue processing and nucleic acid extraction. Downy brome seeds were incubated in a dew chamber at 8°C and 100% relative humidity for 10 days. Once plants reached the tiller stage, leaf tissue was collected and lyophilized. DNA was extracted using the KingFisher™ Flex system following the BioSprint 96 DNA Plant Kit protocol, which yielded an average of 80 ng/µL with a 260/280 ratio of 2.01 and demonstrated excellent performance in downstream PCR amplification. For RNA extraction, leaf tissue was collected in 1.5 mL tubes, flash-frozen in liquid nitrogen, and stored at -80°C until processing. Samples were homogenized and extracted following the manufacturer's protocol from the MagMAX™ Plant RNA Isolation Kit with the KingFisher™ Apex. The extracted RNA had an average yield of 60 ng/µL with a 260/280 ratio of 2.22 across samples.

The lack of standardized high-throughput methods has limited cheatgrass research. This workflow overcomes those challenges by ensuring high yield, consistency, and scalability, making it ideal

for large-scale genetic studies. By streamlining DNA and RNA extraction, it enables comprehensive genomic and transcriptomic analyses of downy brome, advancing herbicide resistance research and weed biology.

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

Evaluating Herbicides for Managing Invasive Annual Grass Infestation in Nevada's Mojave Desert. Cody Beckley*, Mirella Ortiz, Eric Westra, Corey Ransom; Utah State University, Logan, UT (074)

Red brome (*Bromus rubens*) and schismus grass (*Schismus barbatus*) are non-native invasive annual grass (IAG) species with wide distribution in the desert southwestern United States. These species are prominent members of blackbrush communities within the Mojave Desert. In 2023, a field trial was conducted to evaluate indaziflam and imazapic for reducing non-native IAG and to determine effects on native plants in Trout Canyon in Clark County, NV. Plots measured 3 by 9 m and were arranged in a complete randomized block design, with four replications. Herbicide treatments consisted of PRE and POST applications of indaziflam and imazapic, alone and in combinations at various rates. Visual cover of invasive and desirable species was collected prior to treatment and 1 year after treatment (YAT). At 1 YAT, visual cover estimates in untreated control plots showed red brome cover had increased by 4.1% and schismus grass by 19.6%. PRE treatments of indaziflam at rates > 14.6 g ai ha-1 alone and in combination with imazapic provided 52 to 67% IAG control. Numerous POST treatments reduced IAG cover 42 to 73% compared to the untreated control. Treatments containing imazapic reduced Deseret trumpet (*Eriogonum inflatum*) cover by 77 to 88%. No negative effects of herbicide treatments were observed on woody native species at the site. While reducing fire risk is important, understanding impacts on native plants utilized by desert tortoise is also critical.

From Grass to Grouse: Indaziflam Application Increases Greater Sage-Grouse (*Centrocercus urophasianus*) Habitat Use in Idaho Rangelands. Kirby Lau*[1], Timothy Prather[1], Yvette Ortega[2], Tracey. Johnson[3]; [1]University of Idaho, Moscow, ID, [2]U.S. Forest Service Rocky Mountain Research Station, Missoula, MT, [3]University of Idaho, Boise, ID (075)

Greater sage-grouse (*Centrocercus urophasianus* B.) rely on sagebrush steppe plants for nutrition and cover, making them vulnerable to changes caused by invasion of exotic annual grasses. Pre-emergent herbicides, such as indaziflam, can control annual grasses and have been proposed for use in natural areas. To determine how application affects grouse, we examined sage-grouse habitat use after indaziflam treatments in southcentral Idaho at Rinker Rock Creek Ranch. To estimate relative habitat use, we conducted grouse pellet surveys along 50-m treatment and control transects (n = 48 transects) during June – August 2023 and 2024. We surveyed for pellets eight times per transect. To determine the effect of indaziflam on grouse habitat, we conducted vegetation cover surveys using a quadrat frame along the pellet transects. We used mixed effects models to: 1) evaluate treatment effects on various aspects of the plant community, focusing on dietary forbs preferred by sage-grouse, and 2) determine whether treatment influenced grouse habitat use. We found that treated transects had on average a 59% decrease in annual preferred forb cover (p<0.001) and a 67.5% decrease in *Bromus* spp. cover (p<0.001). Annual preferred forb

diversity decreased by 47.6% on treated transects (p<0.001), whereas bare ground increased by 422% in treated sites in 2023, and by 87.5% in 2024 (p<0.001). Other vegetation community characteristics, including overall preferred forb cover, were similar between treatment and control transects. Sage-grouse habitat use was 98.7% higher in indaziflam-treated sites, with treated transects averaging 0.85 more pellet piles (p = 0.02).

Aerial Applications of Indaziflam Control Annual Grasses in Pasture and Rangeland. Lisa Jones*[1], Christie Guetling[2], Kirk Davies[2], Timothy Prather[1]; [1]University of Idaho, Moscow, ID, [2]USDA Agricultural Research Service, Burns, OR (076)

Restoration of perennial vegetation in annual grass-invaded rangelands is a high priority, particularly in areas that still have co-occurring perennial vegetation. Indaziflam and imazapic, applied as pre-emergent herbicides, have both been used for this purpose. Indaziflam often has less than desired control in the first year but can control annual grasses for multiple years. In contrast, imazapic has effective control the first year, but control is short-lived. Land managers have recently started tank-mixing these two herbicides to potentially alleviate their individual shortcomings and theoretically achieve more effective, long-term annual grass control. However, little is known about the effectiveness of applying these herbicides in tandem, particularly compared to just applying indaziflam, and the effects on non-target vegetation. We investigated the effects of applying indaziflam individually and in combination with imazapic at three rangeland sites (two in Oregon and one in Washington). Three years after treatment, annual grass cover was more than 2-fold greater in the nontreated control than either herbicide treatment. Applying indaziflam and imazapic in tandem provided better control of annual grasses and resulted in greater cover and density of perennial vegetation, though it appears site differences influenced treatment effects. Applying indaziflam individually controlled annual grasses, but did not generally illicit a response from perennial vegetation. Tank-mixing indaziflam and imazapic improved first year control compared to only applying indaziflam, but control was still better in the second year after treatment, suggesting that a greater rate of imazapic than used in this study may be needed to achieve better first year control. The results of this study suggest that applying indaziflam and imazapic in tandem may be an effective strategy for controlling invasive annual grasses and promoting co-occurring perennial vegetation.

Balancing the Scales: Efficacy of Cheatgrass (*Bromus tectorum*) Management Versus Response of Native Plants. Erin Teichroew*, Jane Mangold, Lilly Sencenbaugh, Lisa Rew; Montana State University, Bozeman, MT (077)

Many rangelands in the western United States are heavily degraded and have subsequently been invaded by annual grasses like cheatgrass (*Bromus tectorum* L.). Management often relies heavily on herbicides, and new approaches are needed to improve efficacy and sustainability. In this study we assessed two novel management options, a biofumigant (mustard seed meal) and a micronutrient soil amendment (Nutrafix), and a traditional strategy – the preemergent herbicide indaziflam. We compared these treatments to non-managed controls at three semi-arid rangelands in southwestern Montana. Our objective was to quantify the impacts of these novel and traditional management approaches on both cheatgrass and perennial grass cover. Our concern with perennial grasses stems from evidence that rangelands with greater perennial grass cover are more resistant to cheatgrass invasion. We monitored the experiment for four growing seasons post treatment and

assessed changes in cheatgrass and perennial grass cover. All our control methods reduced cheatgrass cover, albeit to differing amounts and longevity. The mustard seed meal initially provided control but cheatgrass cover increased over time. This increase was accompanied by a reduction in perennial grass cover. Nutrafix controlled cheatgrass for two years at two of our three sites but did not have any meaningful positive impacts on perennial grass cover. Indaziflam provided three years of control and increased perennial grass cover at two of our sites. These variable results highlight the need for site specific research and monitoring of the surrounding plant community to provide the most accurate interpretations of management impacts and guide future recommendations.

A Look at One Year After: Forb Response to Florpyrauxifen-benzyl, Aminopyralid, and Clopyralid in Natural Areas. Jodie Crose; Corteva Agriscience, Indianapolis, IN (078)

A growing need exists to improve our understanding of herbicide tolerant native species to preserve our diverse prairie and rangeland systems. Encroachment of weedy or invasive species results in competition for resources, which ultimately may lead to a reduction in native plant populations. Controlling these undesirable species in a matrix of diversity is difficult, however herbicides remain the most efficient tool to do so. In 2013, several studies were carried out with applications of aminopyralid at either 88 or 123 g ae Ha^{-1} that evaluated a total 90 forb species, 71 of which recovered by 2 YAA. New products have been introduced to the market since and these were evaluated in the current study to understand their role in preserving native forbs. In 2023, the following treatments were applied: aminopyralid (88 and 123 g ae Ha^{-1}), florpyauxifen-benzyl (27 g ai Ha^{-1}), clopyralid (263 g ae Ha^{-1}), and the premix of florpyrauxifen-benzyl + aminopyralid (96 and 129 g ae Ha^{-1}) at three different locations in Wisconsin. At 1 YAA, native forb cover was evaluated to determine whether species had recovered in order to better understand how these applications affected the plant community. Across all three locations, the greatest number of tolerant and moderately tolerant species were observed in the florpyauxifen-benzyl (27 g ai Ha^{-1}) treatment.

Microtopography and Climate Interact Across Spatial Scales to Influence Invasive Annual Grass Control in Wyoming. Morgan Frost*[1], Jaycie Arndt[2], Brian Mealor[2], Kelsey Brock[1], Paige Copenhaver-Parry[1]; [1]University of Wyoming, Laramie, WY, [2]University of Wyoming, Sheridan, WY (079)

Invasive annual grasses (IAGs), such as cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), medusahead (*Taenatherium caput-medusae*), and ventenata (*Ventenata dubia*), pose significant threats to ecosystems in Wyoming by altering fire regimes, reducing biodiversity, and degrading habitat for wildlife and livestock. Effective management strategies are critical to mitigating their spread, yet the success of herbicide treatments often varies due to environmental heterogeneity. This study evaluates how aspects of environmental variability, particularly microtopography and climate, interact to influence the effectiveness of herbicide treatments for IAG control across spatial scales. Using a hierarchical Bayesian model, we assess the effects of seasonal and annual climate variables (e.g., precipitation, temperature) at an 800-meter resolution and fine-scale microtopographic features (e.g., slope and aspect) at a 1-meter resolution on IAG abundance following herbicide application. Our dataset includes 16,719 plots treated with 18 herbicides across 10 projects in Wyoming (2010–2024). By integrating data across these scales,

we aim to identify key drivers of variability in treatment outcomes and explore how interactions between climate and topography influence herbicide efficacy. Preliminary results suggest that microtopography modulates climate effects on herbicide success. Our findings will provide valuable insights for adaptive management strategies, helping land managers optimize herbicide applications under diverse environmental conditions to improve IAG control. This cross-scale approach underscores the need to consider both broad climatic patterns and fine-scale topography in IAG management, ultimately improving long-term control strategies for invasive grass populations.

Evaluating Pyraflufen-ethyl on Leafy Spurge Management at Two Rangeland Sites. Beth Fowers*[1], Jaycie Arndt[1], Brian Mealor[1], Jane Mangold[2]; [1]University of Wyoming, Sheridan, WY, [2]Montana State University, Bozeman, MT (092)

Pyraflufen-ethyl is a contact herbicide (group 14 PPO inhibitor), commonly used on difficult to control broadleaf weeds. It is safe for riparian zones and has no grazing restrictions. Previous research shows that pyraflufen-ethyl + 2,4-D may control leafy spurge (*Euphorbia esula* L.) when applied once per season for three consecutive years. We evaluated leafy spurge control in replicated trials in Montana and Wyoming. We applied pyraflufen-ethyl (5.2 g ai ha^{-1}) + 2,4-D (1120 g ai ha^{-1}), aminocyclopyrachlor (105 g ai ha^{-1}), picloram (1120 g ae ha^{-1}), imazapic (105 g ai ha^{-1}) + saflufenacil (25 g ai ha^{-1}), and quinclorac (840 g ai ha^{-1}). We applied all herbicides in June 2022, all herbicides (excluding a duplicate plot of pyraflufen-ethyl) were reapplied in June 2023, and again in June 2024. We evaluated treatments throughout summer 2022 and at the beginning and end of summer 2023 and 2024. Leafy spurge control varied between Wyoming and Montana. In the year of initial application pyraflufen-ethyl + 2,4-D showed 80-100% leafy spurge control 2 WAT, but by mid-September visual control of all treatments was less than 70% at both sites. In 2023, Wyoming had less than 50% control while Montana had greater than 70% control across all treatments. Wyoming had better control with three treatments of pyraflufen-ethyl + 2,4-D in September 2024 (90%) vs. low control (28%) in Montana. In Montana, aminocyclopyrachlor had the best initial (83%) and best final (81%) control. In Wyoming, pyraflufen-ethyl + 2,4-D had the best initial control (63%) and imazapic + saflufenacil had the best final control (93%). Repeating pyraflufen-ethyl + 2,4-D applications every year improved leafy spurge control over treating every other year. We will conduct further treatment monitoring to assess long-term leafy spurge impacts.

Updated Colorado Front Range Research on Long-term Invasive Annual Grass Control with Rejuvra. James Sebastian*, Joe Swanson; Boulder County Parks and Open Space, Longmont, CO (093)

Boulder County Open Space (BCPOS) manages properties in the lowland, foothills and mountains of Colorado that provide critical wildlife and pollinator habitat with highly diverse ecosystems. A major concern of BCPOS ecologists is the loss of critical wildlife habitat, ecosystems, and dynamic diversity of native plant species due to cheatgrass and cheatgrass-fueled wildfires. Invasive winter annual grasses, such as cheatgrass (Bromus tectorum L. and Bromus japonicus) are considered serious threats to regional biodiversity. This is a summary of long-term as well as newly discovered benefits of long term cheatgrass control with Rejuvra (Indaziflam from Envu) conducted on BCPOS properties.

Indaziflam Treatment Effects on Live Fuel Moisture Content (LFMC) in Colorado Front Range Grasslands Invaded by Annual Grasses. Jacob Courkamp*, John Watson; Colorado State University, Fort Collins, CO (094)

Invasive annual grasses like cheatgrass (*Bromus tectorum* L.) are a major concern for rangeland managers tasked with mitigating wildfire risk in the western United States. Live fuel moisture content (LFMC), a key driver of wildfire behavior, is often reduced in plant communities dominated by cheatgrass because it dries out earlier in the season compared to native plants. Reductions in LFMC after cheatgrass invasion increase the likelihood of uncharacteristically frequent and fast-growing wildfires that pose risks to human health, property, and native plants. While the impacts of cheatgrass invasion on fire regimes in sagebrush shrublands are well-understood, it is necessary to evaluate the impacts of cheatgrass invasion and management in different rangeland plant communities, including grasslands along Colorado's Front Range. The herbicide indaziflam (Rejuvra®,Envu) is widely used to manage cheatgrass in Front Range grasslands and several studies have verified its effectiveness for reducing cheatgrass abundance. We evaluated the effects of indaziflam treatment on LFMC and plant community composition (cover) at six grassland study sites in Boulder and Jefferson County, Colorado during summer 2024. Because study sites consisted of operational treatment areas with nearby untreated control plots, the exact details of treatment (timing, application rate, tank mix partner) varied, but cheatgrass abundance was greatly reduced by indaziflam treatment at all sites when sampling occurred. Bi-weekly LFMC data suggest that indaziflam treatment increased LFMC in treatment plots for most of the summer fire season, likely due to more abundant perennial vegetation. Our results suggest that indaziflam treatment reduced the risk of ignition and rapidly spreading wildfires at our study sites.

Current Status of Noxious Weed Management in South Dakota. Eric Jones*[1], Krista Ehlert[2], Philip Rozeboom[1], Jill Alms[1], Dave Vos[1]; [1]South Dakota State University, Brookings, SD, [2]South Dakota State University, Rapid City, SD (095)

An online survey was distributed to South Dakota stakeholders to understand how noxious weeds are currently being managed. The response rate was 26%; 129 stakeholders completed the survey of the 491 stakeholders who opened the survey. Eighty percent of respondents stated noxious weeds were a problem. Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*) and absinth wormwood (*Artemisia absinthium*) were the most common and troublesome but all statewide noxious weeds were reported. Herbicides alone (25%) was the most common singular response to manage noxious weeds, but respondents utilized two (27%) to three (24%) other tactics as well. Most respondents (47%) were somewhat satisfied with management tactics while others were completely satisfied (9%), neither satisfied nor dissatisfied (20%), somewhat unsatisfied (11%), or very unsatisfied (15%). A covariate analysis showed that the more management tactics a stakeholder utilized, the less satisfied they were with control ($P < 0.0001$). The most common barrier of adopting new tactics was effectiveness (26%) followed by a combination of effectiveness + current production practices + cost + labor (13%). An additional covariate analysis showed that the increase of management tactics increased the barriers of adoption ($P = 0.04$) and increasing the number of barriers of adoption resulted in stakeholders being dissatisfied with control ($P = 0.0003$). Overall, the results of the survey suggest that statewide noxious weeds remain a problem, and

multiple tactics are used to manage these weeds. However, Extension efforts need to address how to use current and implement new management to increase effectiveness.

Leafy Spurge Management (*Euphorbia esula*) with Broadcast Applications of 2,4-D Followed by Wiper Applications of Glyphosate. Eric Jones*, Jill Alms, Dave Vos; South Dakota State University, Brookings, SD (096)

Outdoor studies were conducted to determine the extent of leafy spurge biomass reduction resulting from broadcast application of 2,4-D (2,244 g ae ha^{-1}) with and without wiper-applied glyphosate. Glyphosate (575 g ae L^{-1}) was applied at 0%, 33%, 50%, and 75% diluted concentrate with a wiper 24 h after 2,4-D was broadcast-applied. Injury estimates and shoot biomass did not differ between plants treated with 2,4-D only or when glyphosate was wiper-applied 21 d after treatment. Shoot regrowth biomass of plants treated with 2,4-D only was approximately 560% greater than nontreated plants 3 mo after treatment. Plants treated with wiper-applied glyphosate exhibited shoot regrowth biomass of less than 10% compared with nontreated plants 3 mo after treatment. Root biomass of plants treated with 2,4-D only (160% of nontreated plants) exhibited a similar pattern of shoot regrowth biomass. Root biomass of plants treated with wiper-applied glyphosate exhibited approximately 50% reductions compared with nontreated plants. All vegetative metrics were equally reduced with all tested concentrations of glyphosate; therefore, all labeled concentrations should be effective. The results of the experiment indicate that broadcast-applied 2,4-D is more effective at reducing leafy spurge biomass with the addition of wiper-applied glyphosate.

The Mullet Strategy: Using Short and Long Residual Herbicides to Improve Native Perennial Establishment. Jaycie Arndt*, Brian Mealor; University of Wyoming, Sheridan, WY (097)

Indaziflam is a herbicide commonly used for cheatgrass (*Bromus tectorum* L.) control, especially suited for sites with sufficient desirable species presence prior to indaziflam application. When desirable species are absent, invaded rangelands may require active seeding to meet management objectives. However, seeding projects often fail from competition with cheatgrass. To address short term survival and long term invasive annual grass control, we assessed the establishment of native vegetation using short and long residual herbicides in four degraded sites in Northeast Wyoming. The sites varied in invasive annual grass cover, presence of existing desirable vegetation, and soil characteristics. We planted a mix of western wheatgrass (*Pascopyrum smithii* (Rydb.) Á. Löve), green needlegrass (*Nassella viridula* (Trin.) Barkworth), prairie junegrass (*Koeleria macrantha* (Ledeb.) Schult.), and prairie coneflower (*Ratibida columnifera* (Nutt.) Wooton & Standl.) on May 3rd, 2023. We compared seeding, seeding + glyphosate, seeding + glyphosate + indaziflam at 3 timings, and no seeding + glyphosate + indaziflam. Glyphosate was applied on planting day and indaziflam was applied on planting day, 1 month after seeding (MAS), or 2 MAS. We evaluated establishment 1 year after planting (YAP) and analyzed establishment frequency and species cover for a randomized complete block design using ANOVA with sites as blocks. Treatment and site were significant for establishment frequency and cover of seeded species ($p<0.05$). Glyphosate alone improved seeded species frequency relative to the nontreated check ($p<0.05$), but did not affect seeded species cover compared to other treatments. Overall, the treatment with indaziflam 2 MAS had the highest establishment frequency and highest seeded

species cover. All treatments with indaziflam had the lowest cheatgrass cover 1 YAP ($p<0.05$). Further assessment will be completed in 2025 and 2026 to evaluate long-term seeding success and cheatgrass control.

Longer-term Responses of Cheatgrass and Desired Species to Integrated Weed Management in Southwest Montana. Lisa Rew*, Christian Larson; Montana State University, Bozeman, MT (116)

Cheatgrass (downy brome, *Bromus tectorum*) is a widespread non-native plant management challenge across the western United States. Herbicide and targeted grazing often fail to provide adequate long-term control or promote desirable species. Integrating herbicide and grazing may provide better control than either method alone by providing multiple stressors. We studied the impacts of herbicide, targeted sheep grazing (2 seasons) and integrated herbicide plus grazing on downy brome and the plant community in southwestern Montana from 2015 – 2017 and again in 2023. Unfortunately, we observed no additional benefit of combining targeted grazing with sheep and herbicide. Individually grazing reduced cheatgrass levels over the course of the study. Similarly, herbicide had an impact. We evaluated five herbicides plus a non-spray control, spring glyphosate + fall imazapic had the lowest cheatgrass cover a trend which continued over time, but none of the other treatments (fall applied imazapic, rimsulfuron, glyphosate and spring glyphosate) differed from the non-sprayed treatment. In all treatments cheatgrass declined from the first couple years to 8 years after. One of the most interesting findings was that cheatgrass reduction was greatest in plots that initially had the highest cheatgrass levels and did not change much at low infestation levels (<5%). The results also showed that the reduction of cheatgrass was greater where native grasses were initially more dominant suggesting that we should tailor management recommendations to both cheatgrass and native grass cover levels in southwest Montana.

Remote Sensing for Mapping Invasive Annual Grasses and Sagebrush in Carbon County, Wyoming. Chloe Mattilio*, Brian Mealor, Jaycie Arndt; University of Wyoming, Sheridan, WY (117)

Rangelands of Carbon County are critical habitat for Wyoming wildlife. Large-scale, strategic invasive annual grass management projects are being planned and implemented by Carbon County Weed and Pest District. Significant monitoring data was collected in 2023 and 2024 to map cover of invasive annual grasses, big sagebrush, and other rangeland vegetation for project planning. Monitoring data was also applied to train remote sensing models for the 2023 and 2024 growing seasons to predict invasive annual grass and sagebrush cover across Carbon County. Categorical cover models were predicted for standalone cheatgrass (*Bromus tectorum* L.), combined cheatgrass and Japanese brome (*Bromus japonicus* Thunb.), and big sagebrush (*Artemisia tridentata* Nutt.). Model and class accuracy assessments were calculated, and monitoring data was compared to predicted cover models as well as cover estimates from the Rangeland Analysis Platform (RAP) for 2023 and 2024. Standalone cheatgrass models were most accurate while sagebrush models had the most misclassifications. All 2024 models outperformed 2023 models, which generally predicted higher cover of classified vegetation across Carbon County. RAP estimates were much higher in 2023 than in 2024, with little predicted invasive annual grass absence in 2023. Though not a perfect comparison between our models and RAP, our models tended to underestimate cover while RAP overestimated cover across both years. We recommend that managers carefully

compare multiple years of invasive annual grass and sagebrush spatial products with their local knowledge when making plans or decisions, as products continue to be improved to better capture rangeland conditions and complexity.

Working Toward Thresholds: Rush Skeletonweed (*Chondrilla juncea*) Control After Aerial Herbicide Treatment Improves as Perennial Herbaceous Foliar Cover Increases. Timothy Prather*, Lisa Jones; University of Idaho, Moscow, ID (118)

Rush skeletonweed, estimated at 3 million acres in early 2000's, continues to expand in Idaho. Considered both a crop and range weed, its expansion has been greatest in rangelands. Establishing a plant community threshold where rush skeletonweed moves from a dominant to a subordinate would allow land managers to manipulate plant communities and reduce rush skeletonweed's impact. An early field experiment suggested a threshold of 16% to 18% foliar grass cover would result in low rush skeletonweed cover. We conducted large-scale control efforts (using aminopyralid, florpyrauxifen, imazapic, and indaziflam), in west-central Idaho that revealed a similar but more intricate pattern. Areas treated with aminopyralid + florpyrauxifen, 2 years after treatment, rush skeletonweed cover was 4 to 6% regardless of perennial grass cover and areas not sprayed had 14 to 10% cover when perennial grass cover was below the previous established threshold but above the threshold, cover was 10% at the threshold and 2% above the threshold. Perennial forb cover had an even greater effect at and above the threshold where rush skeletonweed cover was 2 to 7% regardless of treatment. Perennial grass cover (25%) declines to 3% as annual grass cover increases, suggesting annual grasses may push perennial grasses below a threshold value that allows rush skeletonweed to dominate. Combining control of rush skeletonweed and annual grasses may be required to increase perennial grass and forb cover over a threshold value to relegate rush skeletonweed to subordinate roles in plant communities.

Evaluating Herbicide Impacts in a Greenhouse Setting: Native Seedling Emergence, Biomass, and Injury Responses. Ian McRyhew*[1], Virgil Dupuis[1], Jane Mangold[2], Tim Seipel[2]; [1]Salish Kootenai College, Pablo, MT, [2]Montana State University, Bozeman, MT (119)

Invasive annual grasses (IAG) threaten grasslands in northwestern Montana that are integral to the well-being of the Séliš, Ksanka, and Qlispé Tribes. A greenhouse study with four trials was conducted to evaluate the response of 12 native grasses and forbs to four herbicides commonly used to control IAG, assessing potential combinations for restoration seeding. Species were selected based on cultural and ecological importance. Herbicides were applied to sterilized soil in 10 cm^3 cones, followed by planting five seeds of a single species per cone. After 36-40 days, seedling emergence and biomass were measured and plant injury was rated using a 0-4 scale, ranging from no injury (0) to 100% necrosis (4). All herbicides reduced emergence and biomass for most species compared to the non-sprayed check. *Gaillardia aristata* Pursh decreased from 3.6 seedlings per cone in the non-sprayed check to 2.8 seedlings per cone. *Leymus cinereus* (Scribn. & Merr.) Á. Löve demonstrated the highest emergence at 4.4 seedlings per cone in the non-sprayed check and had similar emergence under sulfosulfuron, imazapic, and rimsulfuron (3.6-3.7). Injury rankings were high for all forbs except *Lupinus argenteus*, which ranked moderate across treatments. Grasses were also highly injured across herbicides except *Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey, which had the lowest injury of all species under sulfosulfuron. Although *T. intermedium* and *G. aristata* showed some emergence in indaziflam-treated soil,

indaziflam prevented the emergence of all other species. To effectively integrate seeding with herbicide application, planting of specific native species to improve establishment is recommended to minimize non-target impacts, and including Tribal stakeholders to align management with cultural and ecological goals.

Maintaining Effective Weed Management, in the Wildland Urban Interface. Joe Swanson*, James Sebastian; Boulder County Parks and Open Space, Longmont, CO (120)

It is becoming increasingly more difficult to maintain effective weed management in the face of anti-herbicide sentiment in ever growing urban settings. For local governments who engage in open space or natural areas preservation and conversation, maintaining effective weed management is essential. Serious challenges to this management can arise when updating management plans with effective noxious weed management strategies. These challenges usually arise when local environmental groups resist the use of herbicides. Here is a look at the 18-month process of working with the public in creating a an effective integrated weed management plan.

Where Does the Woad End?: Population Dynamics During Dyer's Woad (*Isatis tinctoria*) Management. Maloree McDonald*[1], Erin Hettinger[2], Mirella Ortiz[1], Eric Westra[1], Tom Monaco[1], Corey Ransom[1]; [1]Utah State University, Logan, UT, [2]U.S. Fish and Wildlife Services, Ibapah, UT (121)

Dyer's woad (*Isatis tinctoria* L.) is an invasive biennial forb that plagues many Western states, often requiring costly repeat herbicide applications that may damage desirable vegetation. Our study assessed the long-term effectiveness of indaziflam, a preemergent herbicide, alone and combined with postemergent herbicides. Two research sites were established in Collinston, Utah using plots arranged in a complete randomized block with four replicates. Data was collected through seedling and rosette counts and point line transects over 48 months (2020 trial) and 36 months (2021 trial). There were significant treatment by evaluation date interactions, illustrating the effect of differences in annual precipitation and longevity of herbicide effectiveness. Cover data collected over 48 months (2020 trial) showed that every herbicide treatment significantly controlled dyer's woad populations. Combinations of indaziflam with postemergence herbicides provided the most significant control. Count data showed that combinations of every post-emergent herbicide with indaziflam suppressed dyer's woad rosettes through the spring of 2024, correlating with midsummer cover data. Significant rosette control by herbicide decreased in the fall of 2024. Cover data collected over 36 months (2021 trial) demonstrated that 2,4-D and metsulfuron combined with indaziflam maintained significant control of dyers woad, while indaziflam alone has never significantly reduced cover. Many desirable plant community members were not significantly affected by herbicide treatment, aside from desirable annuals which significantly increased in plots treated with indaziflam, imazapic, and metsulfuron + indaziflam. Many herbicide treatments create long-term changes to dyers woad populations and overall plant communities, which should be monitored by land managers.

WSWS PROJECT 2: WEEDS OF HORTICULTURAL CROPS

Electric Weed Control — What Works, What Doesn't, and What We've Learned. Luisa Baccin*, Marcelo Moretti; Oregon State University, Corvallis, OR (098)

Given the increasing demand for nonchemical weed control strategies, we are exploring Electrical Weed Control (EWC) as an alternative for weed management. Plant factors including size, moisture content, architecture, and root system complexity play a crucial role in determining EWC effectiveness. In this study, we compiled field data to evaluate EWC performance, highlighting its applications and limitations. In organic blueberry, EWC achieved over 95% weed control at 28 DAT compared to 50% control with conventional mowing. With EWC, weed species shifted from seven in control plots to two perennial species (*Convolvulus arvensis* L. and *Cirsium arvense* L.) with reduced density. For instance, mowing reduced yellow nutsedge (*Cyperus esculentus* L.) tuber viability by 20%, whereas a single EWC application, between 0.5 and 3 km h^{-1}, reduced tuber viability by 27 to 43%. Similarly, EWC reduced Canada thistle shoot stand by 72% while clopyralid at 277 g ai ha^{-1} reduced it by 43%, illustrating EWC's potential as a viable nonchemical option. However, our findings also reveal important limitations. Although combining EWC with sawdust mulching enhanced overall weed suppression, EWC may damage plastic mulches. Moreover, there is a fire hazard risk when treating dry vegetation, and wet soil conditions diminish EWC performance. These factors highlight the importance of timing EWC application according to soil conditions. In summary, while EWC shows promise as a nonchemical weed management tool, its success depends on understanding and managing the interplay between plant characteristics, soil conditions, and operational parameters.

A Multi-Year Study on the Effects of Electric Weed Control on Hazelnut (*Corylus avellana*) Growth and Yield. Juliano Ricardo Marchi Sulzback*, Marcelo Moretti; Oregon State University, Corvallis, OR (099)

Ninety-nine percent of US hazelnuts (*Corylus avellana* L.) are Oregon grown. Herbicides are used to control adventitious buds growing from roots ("suckers") and weeds, but overreliance leads to herbicide resistance. Electrical weed control (EWC) is a nonchemical alternative to herbicides that delivers energy to the weed foliage, resulting in cell wall disruption and cell death. This study, initiated in 2021, evaluated hazelnut response to EWC and was a two-factor factorial design. Cultivar ('McDonald' and 'Yamhill') was the first factor, and six weed control treatments were the second factor. Treatments included weed free, power harrow cultivation, EWC low energy without suckers, EWC low energy with suckers, EWC high energy without suckers, and EWC high energy with suckers. Operation speed defined energy levels (0.4 and 2 $km.h^{-1}$ as high and low, respectively). Treatments were applied up to five times a year over four years. Treatment effect was cultivar-dependent ($p = 3.47\times10^{-5}$) but was unaffected by treatments or interactions ($p > 0.05$). 'McDonald' and 'Yamhill' had average canopy volumes of 6.6 ± 2.1 m^3 and 8.7 ± 2.8 m^3, internodal lengths of 2.9 ± 0.1 cm and 3.1 ± 0.1 cm, trunk cross-sectional areas of 94.1 ± 5.3 cm^2 and 115.6 ± 7.9 cm^2, and yields of 894.8 ± 89.6 g/tree and 679.1 ± 65.2 g/tree, respectively. No detrimental effects on hazelnut suckers were noted with EWC at any energy level, supporting the conclusion that electrical energy does not interfere with tree's roots system. These results support that EWC is safe for hazelnuts.

Management of Yellow Nutsedge in Pacific Northwest Potato Production. Rui Liu*[1], Joel Felix[2], Timothy Waters[3] ; [1]Washington State University, Prosser, WA, [2]Oregon State University, Ontario, OR, [3]Washington State University, Pasco, WA (100)

Abstract not available

Evaluation of Electrical Weed Control in California Orchards. Tong Zhen*, Bradley Hanson; University of California, Davis, Davis, CA (101) (101)

Due to limited organic weed control methods, managing weeds in California is challenging for sustainable and organic tree crops. Electrical weed control (EWC) is a new alternative for growers. The Zasso^{TM} Tractor-Based electrical weeding unit controls orchard weeds by physical contact with the applicator electrodes, which can pass electrical current to the target vegetation. In 2023, a study was initiated at UC Davis to examine how EWC impacts crop safety and soil health. A total of six treatments were included in an RCBD experimental design with four replications. Four EWC treatments were applied at different speeds, power settings, and number of pass combinations. Two standard weed control treatments were included, where traditional hand weeding and mowing were used. EWC treatments were applied four times in 2023 and seven times in 2024. Standard weed control treatments were applied every two weeks during growing seasons. Weed control data were recorded as weed cover 3 and 30 DAT after every application. At the end of the 2023 and 2024 seasons, we measured tree height and trunk diameter as crop growth indicators and sampled soils in the highest power EWC treatment and one standard treatment to run a series of soil health analyses. The highest power EWC treatment can provide 100% weed control for up to 40 days. The tree growth and soil health data showed insignificant treatment effects, suggesting EWC did not impact tree growth and soil health in the 2023 and 2024 growing seasons.

Weed Control in Potatoes With the Anthem Flex PreMix - Do I Still Need to Tank Mix? Pamela Hutchinson*, Brent Beutler; University of Idaho, Aberdeen, ID (102)

Anthem flex is a pre-mix of two different herbicide active ingredients and Sites of Action (SOA): pyroxasulfone (Group 15) and carfentrazone ethyl (Group 14). Even though Anthem Flex has two SOA, are tank mixtures needed for Overlap, an important herbicide resistance management practice of targeting a weed species with at least two different herbicide SOA? Other factors could be level of herbicide effectiveness e.g., “suppression” or “partial control;” are appropriate rates being used; and are the pre-mix herbicides soil and/or foliar active. Weed control trials were conducted at the University of Idaho Aberdeen Research and Extension Center in 2023 and 2024 with preemergence-applied, sprinkler incorporated Anthem Flex at two rates alone or the low rate tank mixed with other herbicide SOA’s: metribuzin (Group 5), pendimethalin (Group 3), or linuron (Group 7). There was no Overlap with the Anthem Flex pre-mix applied alone. Carfentrazone ethyl is foliar-, not soil-active. No weeds had emerged at application. Therefore, only the pyroxasulfone was providing control season-long. All tank mixtures provided greater than 90% of weeds present in the trial area. Redroot pigweed (Amaranthus retroflexus) had Overlap with all tank-mixtures; linuron provided Overlap on hairy nightshade (Solanum physalifolium). Control of that weed unexpectedly increased with the metribuzin and pendimethalin tank-mixes, so those mixtures may also have Overlap. Anthem Flex alone unexpectedly had activity on common lambsquarters

(Chenopodium album), so all mixtures provided Overlap. Level of effectiveness for CHEAL and SOLPS might be playing a role. True Overlap might not be occurring.

Two Applications of Post-Emergence Herbicides in Sorghum Maximize Reductions of Broadleaf Weeds in Chile Pepper Grown the Following Year. Ram Singh Insa*, Brian Schutte, Erik Lehnhoff; New Mexico State University, Las Cruces, NM (103)

Broadleaf weeds in chile pepper may be reduced with rotational grass crops, provided such crops encourage weed emergence and feature effective weed control methods that permit rotation to chile pepper the following growing season. To test this hypothesis, we studied the effects of post-emergence, non-residual herbicides applied in sorghum grown with 102 cm row spacing (wide-row sorghum) on weeds and weed management in chile pepper grown on the same land as sorghum in the subsequent year. Treatments were 1) sorghum non-treated control, 2) a premix combination of 2,4-D (0.35 kg ha^{-1}), bromoxynil (0.35 kg ha^{-1}), fluroxypyr (0.14 kg ha^{-1}) applied at the 4-leaf stage of sorghum, 3) the aforementioned premix combination followed by bromoxynil (0.28 kg ha^{-1}) applied at the 6-leaf stage of sorghum, and 4) sorghum weed free control using hand hoeing. Response variables included percentage cover for broadleaf weeds in sorghum at harvest, and broadleaf weeddensity and handhoeing time cumulative across the growing seasons for chile pepper. Results indicated broadleaf weeds covered less than 10% of ground in sorghum treated with herbicides. Two herbicides applications in sorghum caused 62% reductions in broadleaf weeds in chile pepper, and 10% reductions in hand hoeing time, compared to the one herbicide application. These percentage reductions caused by herbicides in sorghum were similar to percentage reductions caused by sorghum weed free control treatments. Results of this study suggest sorghum treated with two applications of post-emergence, non-residual herbicides are an effective method for reducing broadleaf weeds in chile pepper grown the following year.

Evaluating Herbicide Combinations and Sequences for Season-long Weed Control in Onion. Harlene Hatterman-Valenti*, Collin Auwarter; North Dakota State University, Fargo, ND (128)

Onion cannot tolerate prolonged weed competition and has repeatedly been shown to have a strong negative correlation between relative yield and the duration of weed competition. In fact, one study reported that of the 27 crop species tested, onion was the least competitive against weeds. Much of the research conducted at NDSU has investigated early-season weed control since the lack of weed control at this stage can cause total crop loss. Weed control and crop safety early in the season is important, but onion injury when applying herbicides at the onion two- to four-leaf stage can also reduce onion yield. The current study evaluated both early- and mid-season herbicide treatments by including 12 treatments from 2023 that resulted in the highest yields after the weed-free control along with 12 treatments that altered herbicides applied delayed PRE (ethafluralin), at the two-leaf stage (bicyclopyrone), and the four-leaf stage (bentazon, clopyralid, and pyroxasulfone). Two onion cultivars (Delgado and Legend) were direct-seeded on April 24. The PRE treatments were applied 5 days after planting (DAP), the delayed PRE treatments were applied 14 DAP and the early POST treatments were applied at the flag leaf stage, 28 DAP. The two-leaf POST applications occurred 45 DAP, while the four-leaf POST applications occurred 57 DAP and the six-leaf POST applications occurred 70 DAP. As in 2023, the weed-free plots had the highest yield. Both bicyclopyrone and oxyfluorfen applied at the two-leaf stage caused visible

injury which was attributed to applications very early in the morning with air temperature in the 50's and high humidity. This resulted in the pendimethalin+glyphosate delayed PRE followed by bicyclopyrone+bromoxynil (2-leaf) treatment going from the third highest yielding treatment in 2023 to the lowest yielding treatment in 2024. The second-best yielding treatment for both years was when pendimethalin+bromoxynil was applied delayed PRE followed by oxyfluorfen (2-leaf) and flumioxazin (6-leaf). However, this yield was approximately a 25% decrease compared to the yield from weed-free plots. Ethofumesate applied PRE followed by pendimethalin delayed PRE, oxyfluorfen two-leaf, and flumioxazin at six-leaf had the third highest onion yield in 2024 but was the 10th highest in 2023 and was approximately a 26% decrease in yield compared to weed-free plots. The study will be repeat in 2025 to evaluate consistency and with more focus on POST herbicides application timing.

Hydromulches Reduce Weed Pressure in Organic Broccoli Production. Waqas Ahmad*[1], Greta Gramig[1], Ben Weiss[2], Sharon Weyers[3], Lisa DeVetter[2], Alice Formiga[4], Suzette Galinato[5], Dilpreet. Bajwa[6]; [1]North Dakota State University, Fargo, ND, [2]Washington State University Northwestern Washington Research and Extension Center, Mount Vernon, WA, [3]USDA-ARS North Central Soil Conservation Research Laboratory, Morris, MN, [4]Oregon State University, Corvallis, OR, [5]Washington State University, Pullman, WA, [6]Montana State University, Bozeman, MT (129)

Polyethylene (PE) mulches suppress weeds in organic horticulture production, but contribute to plastic pollution. In 2024, cellulosic biodegradable hydromulches (HMs) were evaluated as alternative to PE mulch in broccoli. HMs were made from shredded newsprint, water, and two tackifiers: guar gum (GG) and camelina meal (CM) at 3% and 6% of the dry matter (DM). HMs were applied at 5,765 kg DM ha^{-1} as liquid slurries. HMs were compared with PE, a weedy check (WC), and a weed-free check (WFC) at Absaraka and Fargo, ND. Weed density was determined at peak weed emergence and peak broccoli harvest (PBH), and weed biomass was evaluated at PBH. Mulch deterioration (as percent soil exposure) and broccoli yield were also quantified. PE had zero weeds and differed from all HMs. GG (3% and 6%) HMs were associated with reduced weed density compared to CM (3% and 6%) HMs and WC (48 and 27 vs. 161, 188, and 981 plants m^{-2}, respectively) across sites and sampling periods. All HMs were associated with similar weed dry biomass (4-13 g m^{-2}) and differed from WC (126 g m^{-2}). At Absaraka, CM HMs showed greater deterioration compared to GG HMs. At Fargo, mulch deterioration was similar across HMs. Broccoli yield was similar for all HMs (7,641-8,857 kg ha^{-1}) but was reduced compared to PE and WFC (16,382 and 14,099 kg ha^{-1}). GG HMs effectively suppressed weeds, so broccoli yield reduction may be related to water-saturated soils. Conversely, PE mulch may have protected broccoli seedlings by shedding excess precipitation.

Weed Control and Response of Onion Cultivar 'Vaquero' to Post-emergence Applied Pyraflufen-Ethyl Herbicide. Joel Felix*[1], Rui Liu[2]; [1]Oregon State University, Ontario, OR, [2]Washinton State University, Prosser, WA (130)

Field studies were conducted near Ontario, OR and Pasco, WA during summer 2024 to evaluate the response of onion cultivar ‘Vaquero’ and ‘Legend’, respectively, to pyraflufen-ethyl herbicide and associate level of weed control. Treatments were arranged in a randomized complete block design with 4 replications. Pyraflufen-ethyl was applied at rates from 1.82 to 10 g ai ha^{-1} when

onion seedlings were at the 2-leaf growth stage. Each treatment included a non-ionic surfactant at 0.25% v/v. A grower standard comprised of a tank-mixture of bromoxynil 0.21 plus oxyfluorfen 0.14 kg ai ha^{-1} and untreated control were included. Treatments were applied in 280 L ha^{-1} of water. Onion plant injury was visible as early as 24 hrs after herbicide application. The injury was characterized by scorched leaves and necrotic tissue on treated leaves. Injury increased with pyraflufen-ethyl herbicide rate increase at both sites. At 7 days after application (DAA), injury ranged from 14 to 39% across pyraflufen-ethyl treatments compared to 14% for the grower standard at Ontario, OR and 23 to 42% at Pasco, WA. At 21 DAA, onion injury had abated to 5 to 18% across pyraflufen-ethyl treatments compared to 5% for the grower standard. At 14 DAA, control for common lambsquarters (*Chenopodium album*), pigweed species (*Amaranthus* spp), and hairy nightshade (*Solanum sarrachoides*) at the Ontario, OR site ranged from 95 to 100%, 92 to 100%, and 78 to 99% across pyraflufen-ethyl rates compared to 98%, 94%, and 93% for the grower standard, respectively. At the Pasco, WA site, the major weed species were common lambsquarters, puncturevine (*Tribulus terres*), pigweed species, as well as grass species (*Poaceae* spp). All treatments, except pyraflufen-ethyl at 1.82 g ai ha^{-1}, provided 80-95% control for all broadleaf weed species at the Pasco, WA site. Transitory early-stage injury did not affect onion yield at the Ontario, OR site that ranged from 133 to 137 MT ha^{-1} across the pyraflufen-ethyl rates compared to 127 MT ha^{-1} for the grower standard. These results indicated that pyraflufen-ethyl could be used to manage weeds in onion cultivars 'Vaquero' and 'Legend'. However, the response of many other onion cultivars remains to be explored.

Differential *Circulifer tenellus* Acceptance of Allelopathic Barley and Brown Mustard Cover Crops. Caroline Toth*, Brian Schutte; New Mexico State University, Las Cruces, NM (131)

Paper withdrawn

Refining Use of Chemigated Rimsulfuron for Branched Broomrape (*Phelipanche ramosa*) Management in California Processing Tomato. Matthew Fatino*, Bradley Hanson; University of California, Davis, Davis, CA (132)

Branched broomrape management is of increasing concern to California processing tomato growers. Research was conducted in 2024 in a small-plot herbicide trial to evaluate various application timings of chemigated rimsulfuron alone, chemigated sulfosulfuron alone, preplant incorporated (PPI) sulfosulfuron paired with chemigated rimsulfuron, foliar maleic hydrazide alone and paired with PPI sulfosulfuron and chemigated rimsulfuron. All rimsulfuron treatments reduced broomrape emergence 68-86% compared to the control. Emergence tended to decrease with more applications of lower rates of rimsulfuron, but these treatments did not separate statistically. PPI sulfosulfuron paired with rimsulfuron reduced emergence versus control but was not significantly better than rimsulfuron alone. There were no significant differences in broomrape emergence among different application timings of chemigated rimsulfuron, and a simpler calendar-based schedule calling for applications at around 20, 30, and 40 days after transplant will be recommended to growers. Chemigated sulfosulfuron had very positive results, significantly reducing broomrape emergence versus control, and will be pursued in field trials in 2025. Applications of foliar maleic hydrazide had mixed results: the split rate treatment reduced emergence versus control while the constant rate had slightly higher emergence and did not separate statistically versus control. These treatments were highly effective in 2023, but in 2024

had a clear break in efficacy around 6 weeks after the last treatment; future research will seek to optimize rates and timing. The best treatment overall was the combination treatment of PPI sulfosulfuron, chemigated rimsulfuron, and foliar maleic hydrazide, which resulted in fewer than 4 broomrape clusters per plot, a reduction of over 95% versus control.

In addition to the small-plot trial, a larger scale grower demonstration trial was also conducted during 2024. In this trial, three or four sequential applications of chemigated rimsulfuron totaling the annual maximum of 70 g ai ha^{-1} were evaluated and both programs reduced broomrape emergence 83-89% versus control. Tomato fruit yield was measured for these replicated 1200-ft plots and there were no differences in yield between plots treated with chemigated rimsulfuron and control plots.

A planting date study was conducted in the small-plot site to evaluate the effect of delayed transplanting on broomrape emergence. Three planting dates were evaluated: early season (April 9), mid-season (May 1), and very late season (June 10). The early planting had the most broomrape emergence with 91 clusters per plot, while the mid-season planting had significantly less emergence with 10 clusters per plot. The very late season planting had no broomrape emergence; however, this was extremely late for the region.

Overall, chemigated rimsulfuron applied at various timings and rates totaling the annual maximum use rate of 70 g ai ha^{-1} reduced broomrape emergence by two-thirds or more versus control plots in both small- and large-plot studies. Under a recently approved 24(c) Special Local Need label, California growers can use three applications totaling 70 g ai ha^{-1} of rimsulfuron applied via chemigation to suppress broomrape in known infested fields or to reduce the risk of broomrape establishment in fields of concern for this quarantine pest.

Interseeding Cover Crops to Manage Weeds in Organic Vegetables. Sophia Lattes*, Reilly Stack, Fabian Menalled, Mac Burgess; Montana State University, Bozeman, MT (133)

Weed management is a top concern identified by organic vegetable producers, particularly in densely seeded crops like carrots (*Daucus carota*) and onions (*Allium cepa*). Cover crops are widely touted for their weed management and soil improvement benefits. However, their adoption in the Northern Great Plains has been hindered by high land prices and short growing seasons. Interseeding cover crops in late-season vegetables is a potential solution that could allow farmers to adopt them without compromising their commercial enterprise. Interseeded cover crops may act as a biological barrier against weeds by filling space that would otherwise be used by more competitive species. However, little work has assessed the establishment of interseeded cover crops, and their potential as a weed management tool in horticultural systems. Thus, we ran preliminary trials of three interseeded cover crops in *D. carota* and found successful establishment and continued growth after harvest, with no impact on crop yields. We also observed some evidence of a shift in weed communities. These promising results motivate expanded studies in which we will investigate the best timings of interseeding white clover (*Trifolium repens*) and common oats (*Avena sativa*) in fall harvested *D. carota*, *A. cepa*, and *Brassica oleracea*. Timings for interseeding will be based on competition studies of critical weed-free periods for the crops. Partner farms will also trial this approach to weed management on their land. Results will allow producers to adopt best practices for interseeding cover crops to improve the sustainability of organic vegetable production.

WSWS PROJECT 3: WEEDS OF AGRONOMIC CROPS

Effect of First Cutting Timing on Weed Competition in Establishment Alfalfa. Clint Beiermann; University of Wyoming, Laramie, WY (068)

Annual weeds compete with alfalfa in the establishment year. The first cutting of alfalfa is an opportunity to disrupt weed growth and alter the competitive dynamic between alfalfa and weeds. Some alfalfa growers do not regularly utilize herbicides in the establishment year, relying on first cutting as a means of weed control. A trial was initiated near Lingle, WY in 2024 to investigate the effects of first cutting timing on weed competition, in alfalfa establishment. The trial was arranged as a split-plot with 4 replications. Herbicide treatment (non-treated and glyphosate 1261 g ai ha^{-1} + acetochlor 1051 g ai ha^{-1}) and first cutting timing (Week 1, 2, 3, 4) were main- a sub-plot factors, respectively. Herbicide treatment glyphosate + acetochlor was intended to make plots weed free up to first harvest and was applied when alfalfa reached the V1 growth stage. Cutting timing treatments started on July 10 and followed in weekly intervals. All treatments received a second cutting, 4 weeks following the first cutting. Delaying first cutting in alfalfa with no herbicide treatment reduced alfalfa yield from 715 to 429 kg ha^{-1}. While delaying first cutting in alfalfa treated with glyphosate + acetochlor increased yield from 1341 to 3051 kg ha^{-1}. Alfalfa yield in the second cutting was increased by delaying first cutting in both herbicide treatments. Weed biomass in the second cutting was reduced in both herbicide treatments by delaying first cutting. Results suggest that early first cutting increases weed biomass in following cuttings in the establishment year.

Evaluating Corn Herbicide Programs That Allow for Rotation to Dry Edible Bean and Sugarbeet. Abraham Akuoko*, Nevin Lawrence; University of Nebraska-Lincoln, Lincoln, NE (069)

Corn (*Zea mays*), dry bean (*Phaseolus vulgaris*), and sugar beet (*Beta vulgaris*) are common rotation crops within the Panhandle of Nebraska. The two biggest weed challenges are Group 2 and 9 resistant Palmer amaranth (*Amaranthus palmeri*) and kochia (*Bassia scoparia*). Options for controlling both weeds are limited in dry bean and sugar beet, and many corn herbicides cannot be used in rotation with sugar beet and dry bean due to carryover restrictions. A study was conducted in 2022, 2023, and 2024 to evaluate corn herbicide efficacy, cost, and rotational flexibility. Up to 15 different corn herbicide programs were screened each year. Single pass at V2 of Glyphosate (1.26 kg ae ha^{-1}) + Dicamba (0.28 kg ae ha^{-1}) + Acetochlor (1.68 kg ai ha^{-1}) provided improved weed control and crop yield compared to the non-treated check, glyphosate at V2, or glyphosate + dicamba at V2. More expensive herbicide treatments which included additional application timings and MOAs may have provided additional herbicide-resistance management benefits in the long-term, but provided no improvements in corn yield or weed control.

Optimizing Glufosinate Efficacy: The Role of Humectant-Based Adjuvants and Time-of-Day Applications. Het Samir Desai*[1], Franck Dayan[2], Fabian Menalled[1], Lovreet Shergill[2]; [1]Montana State University, Bozeman, MT, [2]Colorado State University, Fort Collins, CO (070)

Glufosinate, a highly hydrophilic herbicide, requires a relative humidity (RH) of ≥60% for optimum efficacy. In the semiarid regions of the U.S. Great Plains, where RH usually ranges from

25% to 40%, growers frequently experience suboptimal efficacy with glufosinate applications. A greenhouse study was conducted using a split-split plot design with three replications and two glufosinate-susceptible *Bassia scoparia* and *Chenopodium album* populations. Seven RH levels [elevated humidity (≥60%) for 0.5, 1, 2, 4, 6, and 8 h, and 21 d, and ambient humidity (25-35%) for 21 d], two nozzles [e.g., TeeJet-XR8002VS (finer droplets) and TTJ60-110025 (coarser droplets)], and two populations of each weed species were assigned to the main-plots, subplots, and sub-subplots, respectively. Glufosinate-treated plants [0.6 kg ai ha^{-1} + 20 g L^{-1} ammonium sulfate (AMS)] were exposed to their respective RH levels. For optimum glufosinate activity, *B. scoparia* required only 0.5 h of post-application exposure to elevated RH, while *C. album* did not respond effectively even after 8 h of elevated RH exposure. A field study in a split-plot design with four replications was also conducted to evaluate the effects of time-of-day applications and adjuvants on glufosinate efficacy. The main-plot treatments included: (1) glufosinate (0.6 kg ha^{-1}) + AMS (20 g L^{-1}), (2) glufosinate (0.6 kg ha^{-1}) + alcohol ethoxylate and sodium lauryl ether sulfate (0.25% v/v) + AMS (20 g L-^{1}), (3) glufosinate (0.6 kg ha^{-1}) + alcohol ethoxylate (0.25% v/v) + AMS (20 g L^{-1}), (4) glufosinate (0.6 kg ha^{-1}) + decyl octyl glycoside (0.5% v/v) + AMS (20 g L^{-1}), (5) glufosinate (0.6 kg ha^{-1}) + OR-468a (humectant-based adjuvant) (0.5% v/v), and (6) glufosinate (0.6 kg ha^{-1}) + triethylene glycol (5% v/v) + AMS (20 g L^{-1}). Subplot treatments include time-of-day glufosinate applications from 3:00 am to 9:00 pm at every three-hour interval plus untreated. Glufosinate + OR-468a (humectant-based adjuvant) and glufosinate + triethylene glycol + AMS provided 100% *B. scoparia* control at all time-of-day except 9:00 pm. Other herbicide treatments provided 100% *B. scoparia* control when applied at 6:00 am. However, they provided suboptimal control (0-50%) of *B. scoparia* when applied at other times-of-day. Our preliminary results suggest that integrating humectant-based adjuvants with targeted time-of-day applications can enhance glufosinate efficacy, particularly in low-humidity environments, offering more consistent weed control.

Enhancing Weed Control Using Light-Activated Sensors and Mapping in Chem-fallow. Devanshi Het Desai*[1], Paul Nugent[1], Tim Seipel[1], Lovreet Shergill[2]; [1]Montana State University, Bozeman, MT, [2]Colorado State University, Fort Collins, CO (071)

Summer fallow is the common practice in no-till systems across the semiarid U.S. Great Plains. Effective weed management during the fallow phase is crucial, as weed infestations can replenish seedbank and deplete soil moisture and nutrients, reducing subsequent crop yields. Current weed management relies on broadcast herbicide applications regardless of weed abundance, leading to the overuse of herbicides. To address these challenges, a field study aimed at minimizing herbicide usage and effective *Bassia scoparia* control was conducted in a randomized complete block design with four replications and six treatments during the summer 2024. The treatments included combinations of broadcast application, WeedSeeker® spot-spraying technology, and customized double boom (i.e., broadcast application with 0.33×label dose and WeedSeeker® application with label dose) with herbicides applied in two timings: 1st (glyphosate + dicamba) and 2nd (glyphosate + carfentrazone). In addition, one treatment also had flumioxazin in 1st window. Unmanned aerial vehicle-based high-resolution weed mapping was used to assess spot spraying accuracy. Flumioxazin treatment had only 1st timing, which provided effective control (~100%) for up to 60 days due to its residual activity. However, residual effects decreased over time, leading to higher biomass (~450 g m^{-2}) and seed production (~30000 seeds m^{-2}). Comparable to the broadcast

method, double boom and Weedseeker® applications resulted in similar levels of control (>90%) and biomass accumulation (1-2 g m^{-2}). Notably, Weedseeker® used 33% and 38% lower herbicides than broadcast and double boom applications, respectively. These findings highlight the potential of sensor-based precision spraying for sustainable and efficient weed management.

Rapidicil(R), a Novel Non-Selective Herbicide for Burndown Weed Control - Summary of Tank-Mixture Efficacy when Applied with Burndown and Residual Herbicides. Pat Clay*; Valent U.S.A. LLC, Fresno, CA (072)

Rapidicil® (epyrifenacil) is a novel, low-use rate PPO-inhibitor currently being developed as a preplant burndown by Valent USA LLC. Rapidicil demonstrates unique characteristics compared to other PPO's, as it can be translocated via both the xylem and phloem. At a proposed rate range of 20 to 40 g ai ha^{-1}, Rapidicil has exhibited fast-acting broad-spectrum control of both broadleaf and grass weed species. Field and greenhouse trials conducted with Rapidicil throughout the West and broader U.S. have shown excellent activity against difficult to control weeds including Palmer amaranth (*Amaranthus palmeri* S. Watson), waterhemp (*Amaranthus tuberculatus (*Moq.) J. D. Sauer), morningglory (*Ipomea* spp.), barnyardgrass (*Echinochloa crus-galli* (L.) P. Beauv), and winter annuals. Rapidicil has also been shown to have efficacy on confirmed PPO-, glyphosate-, and ALS-resistant weed species. Rapidicil has also shown strong activity as part of a cover crop termination program. Currently, commercialization of Rapidicil is focused on preplant burndown uses in corn, soybean, wheat, and non-crop uses. It is recommended that Rapidicil be utilized as part of an integrated weed management strategy including the use of cultural practices and multiple modes-of-action to mitigate the development of resistance. Rapidicil is currently under review and pending EPA registration.

Evaluation of Adjuvants for use with Tolpyralate + Bromoxynil Premix Herbicide in Cereal Crops. Joe Yenish*[1], Ryan Humann[2], Kevin Falk[3], Rory Degenhardt[4]; [1]Corteva Agriscience, Billings, MT, [2]Corteva Agriscience, Fargo, ND, [3]Corteva Agriscience, Oak Bluff, MB, Canada, [4]Corteva Agriscience, Edmonton, AB, Canada (073)

Tolvera™ is the newest post-emergence cereal herbicide developed by Corteva Agriscience. Tolvera herbicide is an EC formulation containing the Group 27 active ingredient tolpyralate, a novel active ingredient in cereals, and the Group 6 active ingredient bromoxynil. The Tolvera label recommends application with a methylated seed oil (MSO), crop oil concentrate (COC), or high surfactant oil concentrate (HSOC) at 0.5 to 1.0% v/v. These adjuvants ensure that Tolvera delivers more consistent weed control, especially when weeds are stressed by environmental conditions and when weed populations are high or at an advanced growth stage. However, the use of MSO surfactants is not common with cereal pesticides. Safety with MSO and tank mixes is not entirely defined. Trials were conducted in the northern US cereal production region to determine best adjuvant for crop safety when tank mixing Tolvera with common broadleaf or grass herbicides and fungicides. Treatments included Tolvera alone at 220 g ai/ha with 1.0% v/v MSO, tank mix products alone with their recommended adjuvants, tank mix products plus 220 g ai Tolvera/ha with the adjuvant recommended for the tank mix product, and tank mix products plus 220 g ai Tolvera/ha with 1.0% v/v MSO. No crop injury or yield loss differences were detected in either spring wheat or durum at any of the locations. The same results were observed with barley at two locations. While it is still a best management practice to use the most conservative

recommendation regarding adjuvant for a tank mix, the current results indicate no adverse crop response when a more aggressive adjuvant is used with the selected tank mix partners. Tolvera herbicide will be an excellent tool for cereal growers, providing excellent crop safety and flexibility in adjuvant choice to ensure effective control of problem weeds even under severe environmental stress.

Fluroxypyr Control of Kochia (*Bassia scoparia*) With and Without MCPA. Newman Teye-Doku*, Anderew Kniss; University of Wyoming, Laramie, WY (086)

Kochia (*Bassia scoparia* (L.) A. J. Scott) has developed resistance to commonly used herbicides including glyphosate, ALS-inhibiting herbicides, and dicamba. Fluroxypyr-resistant kochia biotypes have been reported in Kansas, Montana, and Saskatchewan, but not previously in Wyoming. In 2023, a farmer in Wyoming was unable to control kochia with a pre-mixture of fluroxypyr plus MCPA. A greenhouse study was conducted to investigate the efficacy of fluroxypyr to control kochia when applied alone or in a mixture with MCPA. Fluroxypyr at rates from 0 to 320g ha-1 was applied alone or in a mix with MCPA-mine or MCPA-ester. The potentially resistant biotype and a known susceptible control were sprayed when kochia was 10 cm tall at 187 L/ha total volume in a CO_2-pressurized spray chamber. Plant mortality data and dry biomass was collected 30 days after spraying. No significant differences in biomass were observed regardless of herbicide rate. Mortality of the susceptible kochia biotype increased as fluroxypyr rate increased (LD_{50} = 25 g ai/ha), whereas the Worland kochia biotype survived at the highest rates applied (LD_{50} > 500 g ai/ha). There were no synergistic or antagonistic effect of the fluroxypyr + MCPA mixtures compared to fluroxypyr alone.

Season-Wide Weed Management with Florpyrauxifen-benzyl in Water-Seeded Rice. Deniz Inci*, Kassim Al-Khatib; University of California Davis, Davis, CA (087)

Florpyrauxifen-benzyl is an auxin-mimic herbicide recently registered for California rice systems. This research was conducted in 2023 and 2024 at California Rice Experiment Station and aimed to utilize florpyrauxifen-benzyl in a season-wide effective herbicide program; therefore, characterize the effects on crop safety and weed control when applied alone or combined with partner herbicides. Florpyrauxifen-benzyl applied alone at 40 g ai ha^{-1} and twice within 14-d intervals, or after a base application of benzobicyclon/halosulfuron-methyl, clomazone, or thiobencarb. Foliar treatments were applied on 4–5 leaf stage rice with MSO at 584 ml ha^{-1}. Rice injury from all florpyrauxifen-benzyl applications was minimal and insignificant. Florpyrauxifen-benzyl alone and as a sequential application provided greater than 95% control of watergrasses, sedges, and broadleaf weeds. Control of smallflower umbrella sedge, ricefield bulrush, ducksalad, and redstem increased to 100% as a post-emergence alone and in mixtures with bispyribac-sodium, penoxsulam/cyhalofop-butyl, or propanil. The highest yield—7,683 kg ha^{-1} in 2023 and 11,249 kg ha^{-1} in 2024—was observed with florpyrauxifen-benzyl sequential treatment without a base application. The research indicates florpyrauxifen-benzyl weed control can be improved when applied in a season-wide program or with an appropriate mixture partner.

Exploring the Effects of Environmental Conditions on Weed Emergence in the Inland Pacific Northwest P. Weston Maughan*, Jessica Kalin, Marija Savic, Ian Burke; Washington State University, Pullman, WA (088)

Effective weed management relies on accurately predicting weed emergence, which requires understanding the local environmental conditions. The objective of the research is to investigate how hydrothermal time affects weed emergence over a growing season. A field site near Pullman, WA, was divided into plots measuring 1.5 m x 3 m and arranged in a RCBD with 2 replications. Each plot was treated with 1135 g ai per ha to create weed-free spaces, starting April 2, 2024. Every two weeks, a new set of plots were sprayed. Six weeks after the treatment, weed density was assessed using 2 x 0.25 m² quadrants per plot. The last density assessment occurred August 15, 2024. Hydrothermal time at 5 cm soil depth was calculated with two soil moisture potentiometers, using a base temperature of 0°C, base moisture potential of -1500 kPa, and a cumulation starting date of January 1, 2024. Species densities were modeled using both linear and quadratic models and compared to determine if peak emergence timings were captured in the dataset. The study found peak emergence times for *Amaranthus* spp., *Chenopodium album*, and *Lolium multiflorum* occurred near 1358, 1358, and 1128 degree-days, respectively. *Anthemis cotula* and *Lactuca serriola* peak emergence timings could not be determined; the models had significant negative linear trends indicating that peak emergence was likely before 800 degree-days and may require larger management windows. These results indicate that there are strong correlations between hydrothermal time and weed emergence timings. When refined, these models could serve as valuable decision-support tools.

Introducing INTERLINE® MEGA Powered by L-tek™ for Optimized L-glufosinate Applications to Glufosinate-tolerant Row and Specialty Crops. Ryan Bryant-Schlobohm*[1], Ryan Henry[2], Cody Gray[3], Carlos Antonio Koury D'arce Junior[4]; [1]UPL NA, Inc., Amarillo, TX, [2]UPL NA, Inc., Fort Wayne, IN, [3]UPL NA, Inc., Peyton, CO, [4]UPL NA, Inc., Raleigh, NC (089)

Glufosinate is a reliable tool for the integrated management of key weed species in glufosinate-tolerant soybean, corn, canola, cotton, and other crops. Glufosinate is a racemic mixture of D- and L-enantiomers, where the herbicidal activity is isolated to the L-enantiomer. Through formulation innovation, the D-enantiomer has been removed, offering a purified formulation of L-glufosinate. Upon EPA registration, UPL will provide L-glufosinate under the brand name INTERLINE MEGA, for use in glufosinate-tolerant soybean, corn, canola, cotton and other traditional glufosinate use sites. Replicated field trials have been conducted across the United States in all relevant crops. Results document comparable performance and crop safety profiles of L-glufosinate when compared to traditional glufosinate. This efficacy is achieved with a 45% reduction in field use rate, while maintaining the standard agronomics associated with glufosinate applications.

Tradeoffs in the Use of Glyphosate-resistant Canola for Italian Ryegrass Management. Mark Thorne*, Drew Lyon; Washington State University, Pullman, WA (090)

Italian ryegrass (*Lolium perenne* L. ssp. *multiflorum*) is prevalent in the higher rainfall cropping areas of eastern Washington and northern Idaho. Glyphosate-resistant spring canola acres have increased during the past 10 years because glyphosate is still effective in controlling Italian ryegrass populations in this region. Italian ryegrass is very competitive with all crops grown in the region, and most, if not all, populations have developed resistance to Group 1 and Group 2 herbicides. Field trials were conducted 2021-23 near Pullman, WA to evaluate the effectiveness of using multiple mode of action herbicide strategies for Italian ryegrass control in spring canola

with the objective to delay development or manage glyphosate-resistant Italian ryegrass. Herbicide treatments included trifluralin and ethalfluralin as preplant incorporated Group 3 herbicides, and glyphosate and glufosinate as postemergence Group 9 and 10 herbicides, respectively. Group 3 herbicides reduced emergence of Italian ryegrass thus reducing the number of plants treated with post-emergence herbicides. Glufosinate was effective when Italian ryegrass densities were reduced by a Group 3 herbicide or tillage but required two applications in 2022 to control later flushes. Glyphosate was highly effective for controlling Italian ryegrass; however, glyphosate applications delayed flowering and reduced canola yields when applied later in the spring. Management strategies to delay development of glyphosate-resistant Italian ryegrass and to maximize Italian ryegrass control and canola yield include reducing early weed flushes with soil-applied herbicides, using more than one herbicide mode of action, and only applying glyphosate early in the crop growth cycle.

Control of Multiple Herbicide-Resistant *Amaranthus* Populations in Corn. Jose Nunes[1], Jesse Haarmann[2], Mark Kitt[3], David Belles[3], Tom Beckett[3], Ben Westrich*[4]; [1]Syngenta Crop Protection, Madison, WI, [2]Syngenta Crop Protection, Rochester, MN, [3]Syngenta Crop Protection, Greensboro, NC, [4]Syngenta Crop Protection, Loveland, CO (091)

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 in 2024 both in crop and in bare-ground situations to evaluate herbicide programs for the control of multiple herbicide-resistant *Amaranthus* spp. populations on LibertyLink ® and Roundup Ready ® Corn 2. Results show that integrated weed management programs consisting of preemergence followed by postemergence herbicide applications provided effective multiple herbicide-resistant *Amaranthus* spp. control on LibertyLink and Roundup Ready Corn 2.

Do AMS Replacement Adjuvants Replace AMS? Rich Zollinger*[1], Kirk Howatt[2], Albert Adjesiwor[3]; [1]AMVAC Chemical Company, Spokane, WA, [2]North Dakota State University, Fargo, ND, [3]University of Idaho, Kimberly, ID (108)

Cationic minerals in spray water antagonize POST weak acid herbicide efficacy. Ammonium sulfate (AMS) conditions the spray solution and increases herbicide efficacy. Chemical moieties and mode of action of both ammonium and sulfate are equally important. AMS replacement adjuvants are convenient to use, less concentrated (~50% ai), used at lower use rates (~0.5 % v/v), and vary in effectiveness. AMS replacement adjuvant active ingredients are diverse causing ambiguity identifying the adjuvant modes of action. Spray solution acidification may result when adding AMS replacement adjuvants. Field trials were conducted in 2024 at nine locations throughout the United States evaluating weed control from a premix of glufosinate & quizalofop-P and topramezone applied at labeled rates. Local natural hard water sources were used or the spray solution hardness was adjusted between 250 to 570 ppm. AMS was applied at 1.5 and 3 lbs/A and AMS replacement adjuvants were applied at 0.5% v/v. Adjuvant response was similar for both herbicides and were: AMS at 3 lbs/A > AMS 1.5 lbs/A > AMS replacement adjuvants. Increasing spray solution pH rather than acidifying pH increases the water solubility of some weak acid herbicides, including Group 1, 2, 27, others. Adjuvants which increase spray solution pH

combined with methylated seed oil may optimize several salt herbicides thereby increasing weed control. Combing herbicides with different physical properties, modes of action, and formulation properties into a tank mixture may make adjuvant choice difficult. Some herbicides may be optimized and not others.

Intercropping of Dryland Wheat Cropping Systems Affects Crop Establishment and Weed Suppression. Vhuthu Ndou*[1], Hero Gollany[2], Wayne Polumsky[2], Fernando Oreja[3], Jennifer Gourlie[1], Judit Barroso[1]; [1]Oregon State University, Adams, OR, [2]USDA-ARS, Adams, OR, [3]Clemson University, Clemson, SC (109)

Weed infestations pose a major constraint on the yield and quality of winter wheat (*Triticum aestivum* L.) in the inland Pacific Northwest. A field study was initiated in 2021 and conducted for three more years (2022, 2023, and 2024) to assess the potential of legume intercrops in wheat cropping systems to suppress weeds and reduce herbicide use. In 2021, a split-plot block design with four replications was established where the main plots were four legume intercrops [Frosty Berseem clover (*Trifolium alexanderinum* L.), Kentucky Pride Crimson clover or Dixie Crimson (DC) clover (*Trifolium incarnatum* L.), Icicle winter peas (*Pisum sativum* L.), and common vetch (*Vicia sativa* L.)] and the subplots, three wheat cultivars (Clearfield 102, Jet, and Bobtail). From 2022 to 2024, the experiment was a partially randomized block design with four replications, where the winter wheat main plot was inter-seeded with the same four legume intercrops. Results varied across years with clovers only surviving the winter in 2024. In 2021 and 2022, under high grass weed pressure, the peas and common vetch did not significantly suppress weeds. In contrast, in 2023, when the grass pressure was lower and the predominant weed species were broadleaves, the peas and vetch exerted some weed suppression. In 2024, DC clover suppressed weeds significantly more than the other intercrops. The use of legume intercrops in wheat showed weed suppression, particularly in 2023 and 2024. However, weed suppression was inconsistent across years and more research would be necessary to understand the variability found in this study.

Statewide Survey of Herbicide Resistance in Kochia (*Bassia scoparia*) and Pigweed (*Amaranthus* spp.) Populations Using Molecular Diagnostics and Volunteer-Based Collections. Zack Bateson*[1], Lindsey Fransen[1], Brian Jenks[2], Michael Christoffers[3], Megan O'neil[1], Joseph Ikley[3]; [1]National Agricultural Genotyping Center, Fargo, ND, [2]North Dakota State University - North Central Research Extension Center, Minot, ND, [3]North Dakota State University, Fargo, ND (110)

The herbicide resistance (HR) crisis in weed control is pushing agricultural systems to a breaking point. Unfortunately, farmers still struggle to confirm HR weeds, especially when field observations are the only readily-available method. To assist with confirmation, known target-sites for resistance can be screened through genetic tests, which complement and decrease demands for greenhouse trials. The National Agricultural Genotyping Center (NAGC) and North Dakota State University (NDSU) have launched a survey to assess the prevalence of HR markers in kochia (*Bassia scoparia* L.) and pigweeds (*Amaranthus* spp.) across North Dakota. So far, 57 collectors have submitted 520 leaf samples since August 2023. We evaluated three HR-related genetic markers: ALS-W574L (site-of-action Group 2), *EPSPS* gene copy number (Group 9), and PPO-210 deletion in pigweeds or a new PPO target-site in kochia (Group 14). We found a widespread distribution of HR markers across North Dakota, especially in kochia, which had the greatest

sampling efforts. There were multiple cases of stacked resistance, where individuals contained all three HR-related markers. Genetic tests reinforced the intensifying concern of Group 14 resistance among in-state kochia, initially detected in NDSU greenhouse trials. Among surveyed counties, 67% contained kochia with the novel Group 14 resistance-related marker. We plan to expand this survey to include more HR markers and weed species, aiming to provide data that lead to: (1) cost-saving benefits to farmers by avoiding ineffective (re)applications, and (2) long-term benefits to the industry by reducing indiscriminate herbicide use, which drives the evolution of resistance traits in weed populations.

Influence of Rainfall Timing on the Efficacy of PRE-Herbicides. Karina Beneton*[1], Liberty Galvin[1], Todd Baughman[2]; [1]Oklahoma State University, Stillwater, OK, [2]Texas A&M University, Lubbock, TX (112)

The lack of new mode-of-action herbicides and increasing resistant weeds highlight the importance of pre-emergence (PRE) residual herbicide performance. Rainfall activation is crucial for efficacy. Field trials at Oklahoma State University research stations (Bixby and Lane, OK) assessed herbicide performance under different activation timings. Simulated rainfall (0.5") was applied at 3, 7, and 14 days after PRE application (DAPRE). Treatments included flumioxazin (90 g ai ha^{-1}), pyroxasulfone (45 g ai ha^{-1}) alone and combined, and a three-way mix with metribuzin (420 g ai ha^{-1}). Weed control was visually assessed and analyzed using Tukey's test (P = 0.05). At Lane, tall waterhemp (*Amaranthus tuberculatus*) control remained at least 97% for most treatments, except pyroxasulfone alone (89%) at 14 DAPRE. Pyroxasulfone also provided weaker control of ivyleaf morningglory (*Ipomoea hederacea*). Large crabgrass (*Digitaria sanguinalis*) control at 4 and 8 weeks after PRE (WAPRE) was highest (99%) with flumioxazin alone or in the three-way mix when activated at 3 DAPRE. Pyroxasulfone alone maintained at least 85% control of large crabgrass and ivyleaf morningglory when activated at 7 or 14 DAPRE. At Bixby, Palmer amaranth (*Amaranthus palmeri*) control at 6 WAPRE was 100% across treatments, regardless of activation timing. The three-way mix provided superior early-season control of Palmer amaranth (97%) when compared with flumioxazin or pyroxasulfone alone (82%). These results highlight the importance of activation timing and environmental factors in herbicide performance. Delayed activation can reduce residual control, but two- and three-way combinations, particularly the three-way mix, consistently improved long-term weed suppression.

Spectral Discrimination of Weed Species in Grass Seed Production in the Willamette Valley, Oregon. Iram Mujahid Iqbal*, Jing Zhou, Carol Mallory-Smith, Pete Berry; Department of Crop and Soil Science, Oregon State University, Corvallis, OR (113)

Grass weeds pose a significant threat to grass seed production in the Willamette Valley by reducing the quality of certified grass seed due to weed seed contamination. Precision management improves weed control by identifying weeds for targeted spraying. This study assessed two different methods of spectral collection that could be used to discriminate between grass seed crops and grass weed species. The grass seed crops utilized in the study were tall fescue (*Festuca arundinacea* Vill.), fine fescue (*Festuca trachyphylla* (Hack.) Hack.), and perennial ryegrass (*Lolium perenne* L.). The weeds were Italian ryegrass (*Lolium multiflorum* Lam.) and rattail fescue (*Vulpia myuros* (L.) C.C.Gmel.). Canopy spectra (45 cm above plants) and leaf spectra (1 mm above leaf) of crops and weeds were collected from research fields. The reflectance data were

analyzed for discrimination using Mahalanobis distance (M-distance) and independent t-tests. Match analyses between perennial and Italian ryegrass showed that spectral discrimination was 35% and 100% accurate (M-distance>3), using the canopy and leaf collection methods, respectively. Spectral differences between grass species ($P < 0.001$) were found primarily in the short-wave infrared region. Perennial and Italian ryegrass discrimination occurred in 839 and 206 wavelengths when using the canopy and leaf methods, respectively. Similarly, fine fescue was spectrally discriminated from rattail fescue at 527 and 414 wavelengths for the canopy and leaf spectra collection methods, respectively. These findings indicate that spectral data from either canopy or leaf heights could be used to discriminate between grass seed crops and weeds.

Identifying Weed Species in Mint Using Aerial Imagery and Artificial Intelligence. Pete Berry, Andy Branka*, Jing Zhou; Oregon State University, Corvallis, OR (114)

The Willamette Valley of Oregon accounts for 35% of the United States' peppermint oil production (Mentha piperita L.). Weed control strategies in this region have relied on winter burn-down and residual herbicide applications, supplemented by manual spot treatments in the spring and summer before harvest. However, due to rising labor costs and advancements in application technology, there is an increasing demand for more efficient and cost-effective weed control strategies. This study evaluated the use of aerial imagery for identifying weeds in peppermint fields, comparing the performance of a multispectral sensor and red-green-blue (RGB) sensor. The RGB sensor, with high-resolution imagery, provided more detailed visual distinctions between the crops and weeds, leading to a more accurate weed identification rate of 72%. In contrast, the multispectral sensor achieved a 60% accuracy rate. The superior performance of the RGB sensor can be attributed to their ability to capture finer details and color variations within the fields, which can be lost in the spectral bands captured by multispectral sensors. These nuances facilitated more straightforward differentiation between peppermint plants and weed species. Based on these results, a weed identification model for Oregon's peppermint production was developed using RGB imagery as the sole data source for the training algorithm.

Community-Based Herbicide Resistance Management: A Participatory Action Research Approach to Improving Weed Management in North Central Washington. Nick Bergmann*[1], Ian Burke[1], Garett Heineck[2], Chloe Wardropper[3]; [1]Washington State University, Pullman, WA, [2]USDA-ARS, Prosser, WA, [3]University of Illinois, Champaign, IL (115)

Herbicide resistance is often conceptualized as a “wicked” transboundary resource problem. Consequently, social scientists argue that community-based approaches to herbicide management may offer a way forward in helping to create management solutions. Thus far scholarship has centered on the potential of common pool resource theory and area wide pest management to inform community-based herbicide resistance management. We offer a third possibility: community-based participatory research. Specifically, we posit that creating research partnerships with farmers and other local stakeholders focusing on the co-innovation of new management tools is a viable approach to address herbicide resistance at a community-scale. We illustrate how the weed science community is particularly well-positioned to lead such an effort because of this framework’s primary emphasis on research. To support our claim, we provide case study evidence from an ongoing collaboration in the Pacific Northwest that uses a community-based participatory

research approach to improve herbicide resistance management through diversification of crop rotations.

Evaluation of Acifluorfen and Lactofen for Management of Herbicide-Resistant Palmer Amaranth (*Amaranthus palmeri*) in Dry Edible Bean: Weed Control Efficacy and Crop Safety. Nevin Lawrence*; University of Nebraska, Scottsbluff, NE (134)

Group 2-resistant Palmer amaranth is the number one production challenge for dry bean (*Phaseolus vulgaris*) producers in Western Nebraska. Research began in 2023 to evaluate the soybean herbicides acifluorfen and lactofen for crop safety and weed control efficacy in dry edible bean. In all trials acifluorfen and lactofen were applied at 280 and 175 g ai ha^{-1}, respectively. In a crop safety trial acifluorfen and lactofen were applied to a single variety of pinto, great northern, light red kidney, yellow, and pink beans at the third trifoliate. Minor injury was observed with no loss of stand, yield, or quality. In a weed control efficacy trial acifluorfen and lactofen were applied at the third trifoliate to 10 cm tall Palmer amaranth, and failed to provide any control. In 2024 a crop safety trial was repeated but applications were made at both first and third trifoliate to a single variety of pinto, great northern, and light red kidney beans. Crop safety was observed at the third trifoliate application, but severe injury, stand loss, and yield loss was observed to the great northern and light red kidney beans at the first trifoliate application. A dose-response weed efficacy trial was also conducted in 2024 with applications of acifluorfen and lactofen applied to 1.3, 5.1, 13, 23, and 38 cm tall Palmer amaranth. A 90% reduction in Palmer amaranth biomass was estimated when acifluorfen and lactofen were applied at 14 and 5.8 cm, respectively.

Diflufenican: A New Preemergent Broadleaf Herbicide in Pacific Northwest Winter Wheat. Monte Anderson*; Bayer CropScience, Spangle, WA (135)

The absence of new modes of action in cereal production has resulted in considering herbicides that have been used elsewhere in the world that have not been registered in the U.S. Diflufenican as a Group 12 herbicide represents a different mode of action that is targeted for U.S. registration in corn and soybeans primarily for *Amaranthus* spp control. The Pacific Northwest represents a unique winter wheat production area with a weed spectrum that differs from most other areas of the U.S. As a preemergent, fall application diflufenican is active on a wide spectrum of broadleaf weeds in PNW winter wheat. In the Palouse region of eastern Washington and northern Idaho diflufenican alone is active on the most common broadleaf weeds, and in conjunction with Group 15 herbicide provides a broad spectrum of weed control. This particular combination enhances each other's activity and therefore reduces weed pressure on subsequent spring applied postemergence herbicides while introducing a new mode of action in winter wheat. Nine trials conducted over a three-year period revealed excellent winter wheat crop safety along with unique broadleaf activity that complimented the use of preemergent grass herbicide.

Mapping Resistant Weed Populations Across the Pacific Northwest; A Collaborative Approach. Pete Berry*[1], Albert Adjesiwor[2], Judit Barroso[1], Joan Cambell[3], Doug Finkelnburg[3], Olivia Landau[4], Drew Lyon[5], Victor Ribeiro[1], Ian Burke[5]; [1]Oregon State University, Corvallis, OR, [2]University of Idaho, Kimberly, ID, [3]University of Idaho, Moscow, ID, [4]USDA-ARS, Pullman, WA, [5]Washington State University, Pullman, WA (136)

The Pacific Northwest Herbicide Resistance Initiative (PNWHRI) is a collaboration among individuals from the University of Idaho, Oregon State University, Washington State University, and USDA-ARS to study herbicide resistance in the Pacific Northwest (PNW). The goal of the initiative is to develop system adaptive capacity by refining best management practices, determine socio-economic and policy-related opportunities, and develop an active and engaged extension and outreach program focused on herbicide resistance management. A challenge among the collaborators was determining the distribution of herbicide resistance throughout the PNW. To address this question, participating scientists contributed their previous weed surveys and herbicide screening results into a comprehensive database. Individual resistant populations were then classified by state, county, weed species, resistance to WSSA herbicide group number, and active ingredient(s). Utilizing the Environmental Systems Research Institute (ESRI) Experience interface, the data were published through the PNWHRI website (PNWHRI.org). Over 400 individual populations have been mapped within their respective state at the county level, with herbicide resistance information for each documented species. As additional weed surveys and herbicide screenings are conducted, the results will be added to the mapping tool to continue monitoring herbicide resistance throughout the PNW.

Herbicide-Resistant Common Chickweed [*Stellaria media* (L.) Vill.] Populations and Yield Losses in San Joaquin Valley Small Grain Dairy Crops. Jennifer Valdez-Herrera*, Anil Shrestha, Katherine Waselkov, Nicholas Clark; California State University, Fresno, CA (137)

In recent years, poor control of common chickweed [*Stellaria media* (L.) Vill.] with commonly used ALS-inhibitor herbicides in small grain crop production in California has led to suspicion of herbicide resistance. Some states have confirmed cases of ALS-resistant common chickweed predominantly target-site-resistance. The objective of this research was to confirm resistance to several ALS herbicides in local common chickweed populations and investigate the genetic basis of resistance. Seeds from suspected resistant and susceptible common chickweed populations were collected from three adjoining counties in California that had a history of ALS herbicide use or no herbicide use (organic farms). A dose-response herbicide assay, comprising of 0x, 0.5x, 1x, 2x, 4x, and 8x (where x=label rate), was conducted twice on greenhouse grown plants to determine the response of the populations to imazamox, tribenuron, mesosulfuron, pyroxsulam, and imazethapyr. A factorial experimental design with six replications was used with population, herbicide, and herbicide rate as factors. All suspected resistant populations were confirmed to be resistant to all the herbicides tested. Degree of resistance, however, differed between the herbicides.Two sections of the *ALS gene* from resistant populations was sequenced using Sanger sequencing to determine the presence of mutations. The sequence analysis confirmed target-site resistance to ALS inhibitors, conferred by documented point mutation Trp-574-Leu substitutions, in all three common chickweed populations that survived the dose response studies. This is the first case of ALS-resistant common chickweed west of the US Rockies. With few chemical families available to control chickweed, this should give growers some insights into how difficult multiple herbicide-resistant chickweed will be to manage.

Development of Convintro™ Brand Herbicides for Managing Amaranthus Species in Corn and Soybean: Field Performance Update. Charles Hicks*, Jody Gander, Katilyn Price, Carl Coburn, Richard Leitz, Zewei Miao, Emily Scholting; Bayer CropScience, St. Louis, MO (138)

The continued development and spread of herbicide resistance constitutes a major threat to corn and soybean producers. Weeds such as some Amaranthus species 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 a herbicide technology that features diflufenican, an active ingredient that is a new site of action for control of Amaranthus spp. in corn and soybean production systems in North America, 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.

Does Tank Mixing Palisade with Axial Bold Reduce Wild Oat and Control Lodging in Wheat? Hafiz Haider Ali*[1], Jared Spackman[1], Tom Jacobsen[2], Macy Rankin[2], Pamela Hutchinson[1]; [1]University of Idaho, Aberdeen Research and Extension Center,, Aberdeen, ID, [2]University of Idaho, St. Anthony, ID (139)

Wild oat (*Avena fatua* L.) is a persistent and competitive weed in spring wheat (*Triticum aestivum* L.) production that can reduce yields by more than 24% in heavily infested fields. Growers in Eastern Idaho have relied on the Axial Bold (pinoxaden) for wild oat control. Spring wheat lodging remains a significant concern, leading to using palisade (trinexapac-ethyl), a plant growth regulator that shortens internodes, strengthens stems, and improves standability. Many growers want to combine postemergence-applied products to save time and money, however, some have reported that tank mixing Palisade with Axial Bold results in reduced efficacy of both products, leading to inconsistent wild oat control and limited lodging reduction. A study was conducted at three locations (three site years) in Eastern Idaho in 2024 to evaluate the effects of tank mixing Palisade with Axial Bold on wild oat control and reduction of spring wheat lodging. Treatments included Palisade and Axial Bold applied in tank mixtures or separately – either alone or sequentially 24 hours apart. Application timing was Feekes 4 (late tillering) or Feekes 6 (first node detectable). Treatments were assessed for wild oat control, reduction in lodging, canopy height and grain yield. The results indicate that, regardless of timing, tank mixing Palisade with Axial Bold resulted in less wild oat control, crop lodging reduction, and yield compared to when Axial Bold and Palisade were applied separately. When comparing Axial Bold and Palisade applied alone versus sequentially (24 hours apart), no significant differences were observed in wild oat control, lodging reduction, or yield within the respective application timings. Wild oat control from Axial Bold was better when applied at Feekes 4 compared to Feekes 6, while sequential applications at Feekes 4 followed by Feekes 6 provided better overall control and reduced lodging. The highest yields and greatest lodging reduction occurred when Palisade was applied separately at Feekes 6, while tank-mixed applications produced variable effects. Palisade applied separately at Feekes 6 reduced plant height more than other treatments, with shorter plants exhibiting less lodging than those that were shortened but to a lesser extent. The findings suggest that application timing plays a crucial role in maximizing efficacy, and tank mixing Palisade and Axial Bold may not be optimal for simultaneously managing wild oat and lodging in spring wheat. These results will help refine weed and lodging management recommendations for spring wheat growers in the Pacific Northwest.

Dry Bean Development as Influenced by Soil Nitrogen and Neighboring Plants. Andrew Kniss*[1], Ramawatar Yadav[2]; [1]University of Wyoming, Laramie, WY, [2]Ohio State University, Columbus, OH (149)

Experiments were conducted in 2023 and 2024 in Laramie, WY to quantify the interaction between the presence of neighboring vegetation and nitrogen fertility on dry bean growth and development. The study design included a factorial arrangement of cover crop presence versus absence and nitrogen rates ranging from 0 to 224 kg ha^{-1}. Black plastic pails (19 L) were filled with a potting mix and nitrogen fertilizer. Kentucky bluegrass sod was used as neighboring vegetation. Dry bean was planted in the center of the pail surrounded by a cardboard tube to prevent early-season resource competition between the crop and grass. Shoots and roots of grass were trimmed as needed to prevent direct shading of dry bean and nitrogen uptake by the grass and the grass was removed when dry bean reached the one to two trifoliolate growth stage. Above- and below-ground dry bean growth parameters were influenced by the presence of neighboring vegetation, and the presence of neighboring vegetation altered dry bean response to applied nitrogen fertilizer.

Increasing Droplet Size Reduces Spray Droplet Adsorption. Cody Creech*[1], Amanda Easterly[2]; [1]University of Nebraska-Lincoln, Scottsbluff, NE, [2]University of Nebraska-Lincoln, Sidney, NE (150)

Off-target movement of growth regulator herbicides can cause severe injury to susceptible plants. Apart from not spraying on windy days or at excessive boom heights, making herbicide applications using nozzles that produce large droplets is the preferred method for reducing herbicide drift. We examined how different nozzles, pressures, and adjuvants impact spray droplet adsorption on the leaf surface of common lambsquarters and soybean. Plants were grown in a greenhouse and sprayed in a spray chamber. Three nozzles (XR, AIXR, and TTI) were evaluated at 138, 259, and 379 kPa, respectively. Dicamba (0.14 kg ae ha^{-1}) was applied alone and with methylated seed oil (MSO), a non-ionic surfactant, silicone-based adjuvant, crop oil concentrate, or a drift reduction adjuvant. A 1,3,6,8-pyrene tetra sulfonic acid tetra sodium salt was added as a tracer. Dicamba spray droplet adsorption when using the XR nozzle, which produced the smallest spray droplets, was 1.75 times greater than when applied with the TTI nozzle with the largest spray droplets. Applying dicamba with MSO increased adsorption on leaf surfaces nearly 4 times the amount achieved without an adjuvant. The lowest application pressure (138 kPa) increased dicamba spray volume retained by more than 10% compared to the higher pressures of 259 and 379 kPa. By understanding the impacts of these application parameters on dicamba spray droplet adsorption, applicators can select application parameters, equipment, and adjuvants that will maximize the amount of dicamba spray volume retained on the target leaf surface while minimizing dicamba spray drift.

Confirmation and Current Understanding of New Herbicide-Resistant Weeds in Western Canada. Charles Geddes*, Gaganpreet Dhariwal, Austin Jaster, Laura Kennedy, Mattea Pittman; Agriculture and Agri-Food Canada, Lethbridge Research and Development Centre, Lethbridge, AB, Canada (151)

Paper withdrawn

Impact of Desiccants on Crop Dry Down and Weed Management in Garbanzo and Lentils. Laura Berrios[1], Het Samir Desai[1], Lovreet Shergill[2]; [1]Montana State University, Bozeman, MT, [2]Colorado State University, Fort Collins, CO (152)

The time of crop desiccant application is essential to secure harvest uniformity and efficiency of indeterminate pulses like garbanzos (Cicer arietinum L.) and lentils (Lens culinaris Medik.). While proper application time can enhance weed control and reduce seed production, efficacy varies across herbicide formulations. Contact herbicides, such as paraquat and saflufenacil, provide better crop dry-down, but weed control is reduced; systemic herbicides, like glyphosate, have greater weed control, but poor crop dry-down. To improve herbicide use, we evaluated the combination of preharvest desiccants and application time in garbanzos and lentil crops to optimize harvest and reduce weed seed bank replenishment. To achieve this, we assessed the efficacy of pulse desiccants by comparing single and mixed herbicides: glyphosate (1900 g ai/ha), paraquat (11.66 g ai/ha), saflufenacil (50 g ai/ha), mixed glyphosate (950 g ai/ha) + saflufenacil (50g ai/ha) applied at three different times: crop anthesis, two weeks after anthesis, and four weeks after anthesis. We used a split block design study with four reps at two sites in Montana: the Arthur H. Post Research Farm near Bozeman and the Southern Ag Research Center near Huntley. The crop was the split plot, and treatments were a randomized factorial combination of herbicide treatment and application time plus an untreated control. We counted weed density and collected biomass ten days after each application, then dried it for two weeks. We evaluated treatment effects with an analysis of variance and pair contrasts. The three most recurrent species in Bozeman were field bindweed (*Convolvulus arvensis* L.), which was present in 89% of the plots, common mallow (*Malva neglecta* Wallr.) in 87%, and Russian thistle (*Salsola tragus* L.) in 70%. In Huntley, kochia (*Bassia scoparia* (L.) A.J. Scott) dominated 100% of the plots. A strong interaction between herbicide treatment and application time ($p=0.003$) suggests these factors should be considered simultaneously in weed management plans. On average, when herbicides were applied at anthesis, two weeks after anthesis, and four weeks after anthesis, weed biomass decreased by 69%, 76%, and 83%, respectively, compared to controls ($p=0.05$). At anthesis, the mix of glyphosate + saflufenacil reduced 17% more weed biomass than single applications; at 2 weeks, single applications had on average 2% better control than the mix, and at 4 weeks, the mix had 6% better control than single herbicides; however, these were not statistically significant ($p>0.05$). Weed biomass decreased by crop dry-down can be part of an integrated weed management program while improving harvest and enhancing pulse crops' sustainability and profitability.

Potential of Cover Crop Use, Termination With a Roller-crimper, and Weed Suppression in a Strip-Till Silage Corn Production System in the Central Valley of California. Robert Willmott[1], Jennifer Valdez-Herrera[1], Jeffrey Mitchell[2], Anil Shrestha*[1]; [1]California State University, Fresno, CA, [2]University of California, Davis, CA (153)

A four-year study explored the potential of terminating cover crops with a roller-crimper in a strip-till silage corn (*Zea mays* L.) production system in Fresno, CA. The first two years involved the selection of cover crop species and evaluation of appropriate timing for roller-crimping. In 2020/21 and 2021/22, five cover crop treatments [rye (*Secale cereale* L.) alone, ultra-high diversity mix, multiplex cover crop mix, fava bean (*Vicia faba* L.) + phacelia (*Phacelia tanacetifolia* Benth.), and rye + field pea (*Pisum sativum* L.) + purple vetch (*Vicia americana* Muhl. Ex Willd.) were planted in November, roller-crimped in April, and corn was strip-till planted in May. Cover crop

kill, soil cover by residue, weed cover, amount of organic residue, and silage corn yield were recorded. Data was combined over years and analyzed because of the lack of interactions (P>0.05) between the year and treatments for all the variables. The roller-crimper resulted in 95 to 100% kill of the cover crops. Soil cover at corn canopy-closure (mid-July) was approximately 90% in the rye plots while it was 30 to 70% in the other treatments. The fava bean and phacelia residue disintegrated the most rapidly. Weed cover was <5% in all the treatments till corn canopy-closure. The cover crops added 6.7 to 14 MT ha^{-1} of residue. Corn silage yield was similar in all the treatments. The study showed that cover crops could be successfully terminated with a roller-crimper allowing for successful strip-till corn production with reduced weed pressure and organic residue additions.

Lentil Tolerance and Weed Control with POST-Applied Pyridate and Metribuzin. Brian Jenks*[1], Ed Davis[2]; [1]North Dakota State University, Fargo, ND, [2]Davis Diversified Services Research, Bozeman, MT (154)

The following studies evaluated lentil tolerance to post-applied pyridate (350-876 g ai ha^{-1}) and metribuzin (105-158 g ai ha^{-1}). Rates used varied by study. Study 1 was conducted in Bozeman, MT to evaluate lentil tolerance at four growth stages to pyridate applied alone or with metribuzin. Herbicide treatments were applied 20, 29, 35, and 43 days after planting (DAP). Treatments caused low to moderate lentil injury; however, only treatments applied at 43 DAP caused a yield reduction. Study 2 was conducted in Bozeman, MT to evaluate tolerance of four lentil varieties to pyridate applied alone or with metribuzin. Herbicide treatments caused 0-22% crop injury. Only two treatments resulted in lower yield than the untreated check: Metribuzin applied alone to the variety Viceroy. Study 3 was conducted at Amsterdam, MT to evaluate kochia control with pyridate and metribuzin applied alone or together. Pyridate, metribuzin, and pyridate + metribuzin provided about 70, 78, and 90% kochia control, respectively. Study 4 was conducted at Minot, ND to evaluate weed control and lentil tolerance to pyridate applied alone or with Metribuzin. All treatments caused moderate to severe lentil injury 2 WAT. However, by 4 WAT, lentil injury in most treatments subsided to less than 10%. All treatments yielded more than the untreated check. The addition of metribuzin increased kochia control over pyridate applied alone, which provided only poor to fair control. Adding zinc increased crop injury and yield loss.

WSWS PROJECT 4: TEACHING AND TECHNOLOGY

MulcH2O: A Sprayable Biodegradable, Mulch Technology for Certified Organic Growers. Ben Weiss*[1], Lisa DeVetter[1], Greta Gramig[2], Sharon Weyers[3], Dilpreet Bajwa[4], Alice Formiga[5], Suzette Galinato[6], Waqas Ahmad[2]; [1]Washington State University: Northwestern Research and Extension Center, Mount Vernon, WA, [2]North Dakota State University, Fargo, ND, [3]USDA-ARS, Morris, MN, [4]Montana State University, Bozeman, MT, [5]Oregon State University, Corvallis, OR, [6]Washington State University, Pullman, WA (104)

Plastic mulch is a labor-saving technology that benefits crop microclimate, suppresses weeds, and increases yields. However, its use has growing sustainability concerns. Paper-based hydromulch (HM) is a potentially more sustainable, closed-loop alternative to plastic mulch because it is soil biodegradable. However, research on HM is limited within specialty crops. The objective of this

experiment was to compare various HM formulations to plastic mulch ("weedmat") in an established northern highbush blueberry planting (*Vaccinum corymbosum* 'Valor') in Eastern Washington. A randomized complete block design was used with four replications and four treatments, including: (i) HM with 4% guar gum, (ii) HM with no tackifier, (iii) HM slurry, and (iv) weedmat control (woven polyethylene/polypropylene plastic mulch). The experiment was conducted in 2023 and 2024. Logistical constraints necessitated the discontinuation of the HM slurry treatment in 2024. Dicot weed number and dried shoot biomass were low across treatments (< 3.1 dicots and 7.9 g per 1.2 m^2 subplot), with dicot weed number and overall pressure lowest in weedmat. Monocot weed density and shoot biomass were highest across all HM treatments (> 17.4 monocots and 13.9 g per 1.2 m^2 subplot) relative to the weedmat. Yellow nutsedge (*Cyperus esculentus*) and grasses were the dominant species. End of season percent soil exposure (a measure of mulch degradation) was over 10 times greater in HM treatments than weedmat. Yield and fruit quality variables, including pH, total soluble solids, firmness, and titratable acidity, were similar across treatments. Future research should focus on improving HM ability to suppress monocots.

Ask Artificial Intelligence (AI): How Good are AI Chatbots in Answering Pest Management Questions? Albert Adjesiwor*[1], Randa Jabbour[2]; [1]University of Idaho, Kimberly, ID, [2]University of Wyoming, Laramie, WY (105)

Artificial intelligence (AI) has become integral to our everyday lives, and this technology will revolutionize how we work, our interaction with technology, among other things. The main goal of this project was to evaluate how AI chatbots respond to common pest management questions farmers have or may ask extension or agricultural specialists. There are several AI chatbots available but for this project, we focused on three general-purpose chatbots (ChatGPT, Copilot, Gemini), Norm (an AI developed specifically to provide answers to common agricultural questions), and ExtensionBot (an AI chatbot developed specifically to provide answers to agricultural extension questions). To test the capability of AI chatbots to answer common agricultural questions, we asked each chatbot questions categorized as 1) statement of fact, 2) simple recommendations, and 3) complex recommendations. Responses to statements of fact questions were scored on a binary scale: 0 = wrong, 1 = correct. Responses to simple and complex recommendation questions were scored on a 3-point scale: 0=poor or wrong, 1= good (would work), 2 = excellent (similar to a specialist). With questions relating to weed management, ChatGPT provided the most accurate answers followed by Copilot and Norm. ChatGPT, Copilot, and Gemini were the best-performing chatbots for recommendation-type questions. ExtensionBot was the worst-performing chatbot in answering weed management questions. Detail reponses to weed and insect pest management questions would be discussed during the oral presentation.

Does Dual-Boom Application Alleviate 2,4-D Antagonism of Quizalofop-P? Kirk Howatt*[1], Joseph Mettler[1], Rich Zollinger[2]; [1]North Dakota State University, Fargo, ND, [2]AMVAC Chemical Company, Spokane, WA (106)

Wheat (*Tritucum aestivum* L.) seed technology has been commercialized to enable use of quizalofop-P-ethyl for improved grass control in resistant wheat cultivars. However, efficacy of quizalofop-P-ethyl to several grass species has been substantially antagonized by tankmix with 2,4-D to control broadleaf weeds. Researchers in other geographies have alleviated antagonism by implementing a dual-boom system to keep the products separated during mixing. Field research

was established to evaluate the influence of 2,4-D formulation and application sequence on quizalofop-P-ethyl efficacy in separate experiments under North Dakota environment. Quizalofop-P-ethyl (with oil adjuvant) control of wild oat (*Avena fatua* L.) was not visible when tankmixed with 2,4-D amine, 28% with 2,4-D acid, and 78% with 2,4-D ester compared with over 90% when applied alone. Oil adjuvant enhanced control with quizalofop-P-ethyl more than NIS. Control of volunteer wheat followed similar trends of antagonism and adjuvant benefit but to a lesser degree. Control of barley (*Hordeum vulgare* L.) with quizalofop-P-ethyl was greatest, 97%, when applied the day before 2,4-D. Separating the herbicide applications by at least an hour resulted in 89% control regardless of order. Immediate application with separate booms gave 76% control when 2,4-D was applied first but 91% control when quizalofop-P-ethyl was first on the barley. Inclusion of 2,4-D of any formulation type is not recommended in tankmixes with quizalofop-P-ethyl because of reduced grass control. And while dual-boom application systems can be used to reduce antagonism of quizalofop-P-ethyl by 2,4-D, quizalofop-P-ethyl should be in the front boom and grass control might still be reduced.

Be Out Standing in the Field!! The Critical Role of Field Research Scientists in Developing, Launching, and Supporting Crop Protection Products. Byron Sleugh*, Rory Degenhardt, David Simpson, Craig Alford, Norbert Satchivi, Kelly Backscheider, John Wiles, Andrew Leader; Corteva Agriscience, Indianapolis, IN (107)

Field research scientists are critical to the success of crop protection products. The discovery, development, launch, and support of products requires collaboration of scientists with strong technical and business acumen. Field scientists need an understanding of science and business strategy to bridge the gap between research and commercialization, ensuring that new products are not only scientifically sound but also market-ready and economically viable. They contribute technical insights and valuable perspectives on product positioning, market potential, and help prioritize research resources. Regulatory processes are complex and require scientists to design, conduct, and author study reports that support regulatory submissions. They understand the importance of time-to-market, and the impact of launch timelines on product success. They translate technical results into effective marketing strategies and collaborate to create educational materials and provide technical support and grower engagement. Their ability to communicate the technical benefits and economic value of a product helps drive adoption and builds trust among growers. Their combination of scientific expertise and business insight ensures that products meet the standards of efficacy, safety, fulfill market needs, and generate sustainable business value. This presentation will explore the critical role field scientists play in the lifecycle of crop protection products, demonstrate their scope, influence, and impact, and share examples of academic requirements, job activities, responsibilities, attributes, and skills required to succeed in this highly exciting and rewarding career path. Real-life career profiles and guidance on what experiences will help prepare you as a candidate for a field scientist role will be shared.

WSWS PROJECT 5: BASIC BIOLOGY AND ECOLOGY

Utilizing the Phenospex TraitFinder to Phenotype Pre-emergence Herbicide Injury. Luigi Peracchi[1], Raissa Na-Ah[1], Olivia Landau[2], Ian Burke*[1]: [1]Washington State University, Pullman, WA, [2]USDA-ARS, Pullman, WA (080)

Herbicide dose-response (DR) assays are a quantitative approach for measuring herbicide sensitivity that utilizes biomass from plants subjected to a spectrum of herbicide doses to estimate GR_{50} values, which can be compared among herbicide-resistant and sensitive plant populations. While this method effectively identifies herbicide-resistant populations, biomass collection is time-consuming and tedious. The Phenospex TraitFinder is a digital phenotyping system that offers a high-throughput, non-destructive approach to phenotyping by collecting digital biomass (DB), which is an intuitive replacement for fresh biomass (FB). However, comparisons of DB and FB in DR assays have not been performed. Furthermore, the Phenospex TraitFinder collects 19 other parameters that have not been assessed for potential utility in DR assays. To evaluate Phenospex TraitFinder data, pre-emergence DR assays with fomesafen and atrazine were implemented with a sensitive population of common lambsquarters (*Chenopodium album*). At 21 days after treatment, plants were scanned with the Phenospex TraitFinder and FB was collected. Between both experiments, FB, DB, and four other morphological parameters (3D leaf area, convex hull area, projected leaf area, and voxel volume total) exhibited significantly high correlations of 0.97 or greater and generated highly similar DR curves and GR_{50} estimates. Results indicate these 5 parameters collected by the Phenospex TraitFinder can be utilized instead of FB to accurately estimate GR_{50} values for common lambsquarters to measure fomesafen and atrazine sensitivity. Future experiments with other herbicides and weed species need to be performed to assess whether Phenospex TraitFinder can be relied upon for accurate data measurements.

Kernza Intermediate Wheatgrass Tolerance to PRE and POST Herbicides. McKenzie Barth*, Jenna Meeks, Andrew Kniss; University of Wyoming, Laramie, WY (081)

Intermediate wheatgrass (*Thinopyrum intermedium*) is a perennial species bred to be a commercial grain crop (trademarked as 'Kernza'). There is a critical need to evaluate herbicides for crop tolerance and weed control because of widely reported high weed pressure in the establishment year. Field studies were conducted in Wyoming in 2024 to evaluate Kernza intermediate wheatgrass tolerance to both preemergence (PRE) and postemergence (POST) herbicides. These studies evaluated 11 PRE herbicides applied at spring planting, 13 POST herbicides applied 6 weeks after spring planting, and 16 POST herbicides applied to an established stand planted in 2021. In newly planted intermediate wheatgrass, measurements included stand counts, visual injury evaluations, and end-of-season weed biomass. In established intermediate wheatgrass, measurements included mid- and end-of-season biomass production and end-of-season grain production. PRE herbicides including mesotrione, pendimethalin, and acetochlor caused minimal damage to newly planted intermediate wheatgrass stands and maintained low injury ratings throughout the growing season. Multiple POST herbicides including fenoxaprop + pyrasulfotole + bromoxynil, dicamba, pyrasulfotole + bromoxynil, bromoxynil, tribenuron, and mesotrione also demonstrated minimal impact on newly planted intermediate wheatgrass. In established stands, no herbicide treatments significantly affected biomass or grain production ($P \geq 0.29$). Multiple herbicide options have been identified that may control weeds while maintaining crop safety but additional testing under different environments is necessary.

Harnessing Stress Memory: Transcriptomic Insights into Multigenerational Crop-Weed Interactions in Spring Wheat. Albert Kwarteng*, Albert Adjesiwor; University of Idaho, Kimberly, ID (082)

This study examines multigenerational crop-weed interactions and their effects on the transcriptomic responses of spring wheat, focusing on stress memory and adaptive versus maladaptive responses. RNA sequencing was used to profile leaf samples from six generations (G0–G5) of wheat under four treatments: wheat-only, wheat-kochia, wheat-ryegrass, and wheat-wheat. Differential gene expression and gene ontology (GO) enrichment analyses revealed significant generational shifts in transcriptional responses, highlighting distinct adaptations and maladaptations.

In the wheat-only treatment, transcriptional changes peaked in generation 3, stabilizing in later generations, suggesting acclimation. The wheat-kochia treatment exhibited increased differentially expressed genes in later generations, indicating heightened adaptation to prolonged weed competition. Adaptive shifts in nutrient transport and photosynthesis in the wheat-ryegrass treatment suggest mechanisms enhancing resilience and reducing reliance on chemical inputs. In contrast, the wheat-wheat treatment showed variable gene expression, with early intense responses, a decline, and subsequent rebound.

GO analysis identified pathways related to stress signaling, photosynthesis, and hormone regulation, suggesting shared adaptive mechanisms across generations. Hierarchical clustering revealed dynamic expression of key gene families, such as ERF, MYB, and WRKY, highlighting their roles in stress adaptation. While adaptive responses were prominent, maladaptive effects, including reduced photosynthetic capacity and structural integrity, were observed in some treatments.

These findings underscore the molecular basis of stress memory in wheat and its potential to enhance crop resilience, emphasizing the importance of leveraging adaptive responses for sustainable agriculture. Maladaptive effects underscore challenges in optimizing stress responses for long-term improvement.

Understanding Indaziflam Resistance in *Poa annua*: Recent Findings and Future Directions.
Joshua Miranda*, Marcelo Moretti; Oregon State University, Corvallis, OR (083)

Poa annua (annual bluegrass), a ubiquitous allotetraploid weed, has evolved resistance to 12 herbicide modes of action globally. Recently, Oregon hazelnut growers reported *P. annua* survival following indaziflam applications. Seeds were collected from 11 sites to assess indaziflam resistance. Eight of these accessions germinated in soil treated with 25 or 50 g ha^{-1} indaziflam, equivalent to the field rate. Single-seed descendants from the surviving accessions were developed over three generations for resistance confirmation. Whole-plant dose-response assays confirmed resistance in three accessions, with LD_{50} values 2.5 to 10.7 times higher than those of susceptible accessions (LD_{50} = 1.0 and 1.3 g ha^{-1}). When indaziflam was applied as early postemergence, resistance levels ranged from 9.2 to 179 times that of susceptible accessions (LD_{50} = 1.9 and 3.4 g ha^{-1}). Seed assay dose-response tests further confirmed indaziflam resistance across all accessions, with LD_{50} values 1.4 to 19 times greater than the susceptible controls (LD_{50} = 0.07 to 0.09 µM). Environmental conditions influenced indaziflam tolerance: all *P. annua* accessions showed greater tolerance to indaziflam when tested at a 9°C/1°C (day/night) compared to 25°C/12°C (day/night), with LD_{50} values increasing on average 6-44 times in seed assays and 1.3-2.4 times in whole-plant assays. Resistance mechanisms appear independent of metabolic detoxification via CYP450 or GST pathways, as inhibitors targeting these enzymes (1-aminobenzotriazole, malathion,

tebuconazole, 4-chloro-7-nitrobenz-2-oxa-1,3-diazole, and ethacrynic acid) did not affect plant survival in seed assays. Multiple resistance was observed: all resistant accessions survived postemergence applications of flumioxazin at 430 and 860 g ha^{-1} and pronamide at 1,160 and 2,310 g ha^{-1}. Additionally, six resistant accessions survived simazine at 2,240 g ha^{-1}, and two resistant accessions survived clethodim at 135 g ha^{-1}. However, resistant accessions remained susceptible to glyphosate at 2,060 g ha^{-1}, glufosinate at 1,680 g ha^{-1}, and rimsulfuron at 210 g ha^{-1}. The specific mechanisms conferring resistance remain unclear, but most resistant accessions resist two or more herbicide modes of action. Future research will focus on RNA-seq to identify differentially expressed genes and candidate genes associated with indaziflam resistance.

Does Climate Change Alter Weed Management Recommendations? Evaluating the Impact of Elevated CO_2 on Plant Growth and the Critical Period of Weed Control. Emma Kubinski*, Kevin Sheridan, Fabian Menalled; Montana State University, Bozeman, MT (084) 84

Climate change creates challenges to crop production, driving rising temperatures and extreme weather events. Additionally, increased atmospheric CO_2 alters competitive dynamics between crops and weeds. While previous research has examined individual plant responses to elevated CO_2, its direct impact on weed management recommendations remains understudied. To address this knowledge gap, we assessed how elevated CO_2 influences the critical period of weed control (CPWC). Using radish (*Raphanus sativus* L.) as a model crop and buckwheat (*Fagopyrum esculentum* Moench) as a model weed, we conducted growth chamber experiments evaluating CO_2 driven shifts in individual plant growth and CPWC duration.

In two trials, elevated CO_2 increased radish root biomass ($p = 0.037, 0.009$), while shoot biomass remained relatively unchanged ($p = 0.649, 0.128$), leading to a higher root: shoot ratio. In contrast, buckwheat exhibited greater aboveground biomass under elevated CO_2 ($p < 0.001$, both trials), while belowground biomass was unaffected ($p = 0.695, 0.160$). As a result, CPWC shifts under elevated CO_2 depended on the harvested plant part. For radish root yield, the CPWC decreased by 112 GDD (Trial 1) and 135 GDD (Trial 2), suggesting that less time is required to manage weeds to sustain an acceptable yield. Conversely, for radish leaf, the CPWC increased by 186 GDD (Trial 1) and 150 GDD (Trial 2), requiring maintaining a longer weed-free period.

These findings suggest that CO_2 driven shifts in biomass allocation could alter the CPWC and weed management timing. Understanding these changes is critical for developing adaptive, climate-resilient weed management strategies.

Getting a Grip on False Cleavers (*Galium spurium*). Breanne Tidemann*[1], Charles Geddes[2], Sara Martin[3], Shuan Sharpe[4]; [1]Agriculture and Agri-Food Canada, Lacombe, AB, Canada, [2]Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, [3]Agriculture and Agri-Food Canada, Ottawa, ON, Canada, [4]Agriculture and Agri-Food Canada, Saskatoon, SK, Canada (085)

False cleavers (*Galium spurium* L.) is a problematic species throughout the Canadian Prairies, particularly in the black soil zone. A facultative winter annual, emergence, phenology, and morphology of the weed in Canadian cropping systems is incredibly diverse. A common garden experiment was conducted in two locations in Alberta and one in Saskatoon to examine phenology. In the following year, selected populations that were grown in all three locations were again placed in a common garden environment to examine the impact of maternal environment on phenology.

Collected populations were also screened for evidence of quinclorac resistance. We were able to confirm that all collected populations were *Galium spurium*, and not a mixture of with *G. aparine* indicating that false cleavers are the common species on the Prairies. Moisture is a clear driver of false cleavers emergence. However, there is also an impact of maternal environment on population density and seed weight per plant, but not seed number per plant or biomass per plant. Genetic diversity is low, but there are still differences in phenology by population. Quinclorac resistance was not confirmed but an interaction with weather and an interaction by biotype is apparent. The response differs from the 1990s quinclorac resistant biotypes. The impact of the maternal environment allows us to better understand the expected phenology of cleavers, to understand which growing seasons they will be problematic in, but also how to devise management strategies accordingly. Understanding interactions between environment and population for susceptibility to herbicides also changes suggested management strategies.

Friend or Foe: Exploring Competition and Plant-soil Feedbacks Between Cheatgrass (*Bromus tectorum*) and Ventenata (*Ventenata dubia*) in an Addition Series Study. Lilly Sencenbaugh*, Lisa Rew; Montana State University, Bozeman, MT (122)

Competitive interactions between co-occurring invasive species can have detrimental impacts on native communities, which may be influenced by the soil microbial community through plant-soil feedback (PSF). The goal of this study was to determine if there was a PSF impacting competitive interactions between the invasive annual grasses *Bromus tectorum* (cheatgrass) and *Ventenata dubia* (ventenata). We performed a competition study over two experimental phases with these species in three field soils (Neutral, *B. tectorum*, and *V. dubia*), and measured per capita aboveground biomass: Phase 1 (first study) evaluated responses in field conditioned soil, Phase 2 (second study) determined species responses when grown in soil conditioned by the previous experiment. We used generalized linear mixed models to determine if biomass was impacted by soil or plant density. We derived intraspecific and interspecific competition coefficients using non-linear analysis and bootstrapping to quantify differences. In Phase 1, both species were negatively impacted by intraspecific competition regardless of soil type, but by Phase 2 the effects of intraspecific competition were weakened in conspecific soil, suggesting a positive PSF for both species. For *B. tectorum* the effect of competition was dampened in its own soil. *Ventenata dubia* did not demonstrate this response, however, the impact of *B. tectorum* competition declined as the density of *V. dubia* increased. These results demonstrate positive PSFs which may alter the strength of competition in a biculture. Understanding the competitive interactions between these species provides insight into invasive species impacts and management.

Parrotfeather (*Myriophyllum aquaticum*) Biology and Management Options in Utah. Francielli Santos de Oliveira*, Tia Lawrence, Eric Westra, Mirella Ortiz; Utah State University, Logan, UT (123)

Parrotfeather (*Myriophyllum aquaticum* (Vell.) Verdc.) is a noxious invasive aquatic weed listed in seven Western states, including Utah, as of July 2024. This heterophilic species has submerged leaves lacking stomata and cuticles, while emergent leaves develop a thick waxy cuticle and stomata. A population was identified in Cache County, UT, and treated in September 2024 via drone application of AquaSweep® at 128 oz/ac (2,4-D 3,116 g ae ha^{-1} + triclopyr 1,199 g ae ha^{-1}). Pre-treatment biomass was collected from five locations, and post-treatment biomass was collected

at 14, 21, and 28 days after treatment (DAT). Samples were dried at 60ºC for seven days to achieve constant weight. From April to September, parrotfeather formed dense mats along the shore, resulting in 5,044 g m^{-2} of dry biomass pre-treatment. By 14 DAT, biomass decreased by 31.5%, with necrosis and epinasty observed. However, plants showed regrowth at 21 and 28 DAT. To identify more effective control strategies, we are evaluating glyphosate, 2,4-D, and endothall 2 mg ai L^{-1} via in-water applications on fully submerged and emergent leaf-type plants, as well as foliar applications on emergent plants. We hypothesize that in-water applications on submerged plants will be the most effective treatment due to higher herbicide absorption in the absence of a cuticle. Findings from this study will inform management strategies to prevent parrotfeather spread in Utah's aquatic ecosystems.

Germinability of Annual Bluegrass (*Poa annua*) in Western Oregon. Clint Mattox*; USDA-ARS FSCRU, Corvallis, OR (124)

Paper withdrawn

Impact of Different Herbicides on Microbial Activities in Cotton Production Systems. Jasleen Makkar*, Rupinder Saini, Lindsey Slaughter, Sukhbir Singh, Glen Ritchie; Texas Tech University, Lubbock, TX (125)

Paper withdrawn

Palmer Amaranth (*Amaranthus palmeri*), Kochia (*Bassia scoparia*), and Russian Thistle (*Salsola tragus*) Applied and Basic Research Updates from Colorado. Philip Westra*; Colorado State University, Fort Collins, CO (126)

Grower field research on Palmer amaranth control in corn showed that glufosinate has good activity on Palmer amaranth with excellent crop safety. Previous year research revealed a high level of glyphosate resistance in Palmer amaranth in this field, documented by a high level of gene amplification. No resistance to glufosinate was observed in 2024. Multiple years of basic molecular and genomic research with kochia showed added detail on the genetic mobile element factors that also lead to EPSPS gene amplifaction which causes glyphosate resistance in kochia. A mechanism of dicamba resistance in kochia has also been determined. In a MS thesis project, the full genome of a tetraploid Russian thistle plant was sequenced revealing 2 haplomes both of which were successfully sequenced as a part of the International Weed Genome Consortium global weed sequencing project. The results of this Russian thistle genome sequencing project has been published.

Dose Response of Tolpyralate & Bromoxynil on Weedy Grasses and Green Foxtail (*Setaria viridis*) Resistance Management. Hayden Lee*, Kirk Howatt; North Dakota State University, Fargo, ND (127)

In small grains, post emergence grass weed control is limited to Group 1 and/or 2 herbicides. Grass weeds like green foxtail (*Setaria viridis* (L.) P. Beauv.) have developed resistance to these sites of action (SOA). Tolpyralate (Group 27) mixed with bromoxynil (Group 6) is used in wheat and barley for broadleaf weed control; however, grass activity has also been observed. Two greenhouse experiments were conducted in the winter of 2023-2024 to characterize grass weed control using tolpyralate and bromoxynil. Both experiments used a randomized complete block design with

visual evaluations at 21 DAT, supplemented with a biomass collection. The first experiment screened green foxtail submissions for resistance to various Group 1 and Group 2 herbicides as well as, evaluating their response to tolpyralate and bromoxynil. Out of 37 problematic biotypes, 29 biotypes showed resistance to at least one Group 1 herbicide whereas, 11 biotypes showed resistance to at least one Group 2 herbicide. All populations were susceptible to tolpyralate and bromoxynil. The second experiment evaluated the response of eight grass species to topyralate and bromoxynil. Dose response curves were generated from topyralate and bromoxynil rates ranging from 2.2 to 2200 g ai ha^{-1}. Tolpyralate and bromoxynil at 220 g ha^{-1} controlled four of the eight grass species at 90% or above. Research shows tolpyralate and bromoxynil has broad spectrum activity on grass weeds. With its alternative SOA, it could also be utilized as a resistance management tool for POST grass weed control in wheat and barley.

SYMPOSIUM: Innovative Approaches for Weed Science Education and Communication

Innovative Approaches for Weed Science Education and Communication. Fabian Menalled*; Montana State University, Bozeman, MT (140)

Abstract not available

Rethinking the Extension Weed Science Paradigm. Jane Mangold*; Montana State University, Bozeman, MT (141)

Extension weed science programs take many forms, including publications, seminars, and on-farm trials. Most Extension educators conduct numerous in-person programs for stakeholders across their state annually. The typical format is the Extension educator acting as the "sage on the stage," transmitting information through a slide presentation to audience members who are passive learners. At the end of the presentation, the Extension educator may field questions before yielding the stage to the next educator on the agenda who repeats a similar process. Audience members then return home and are expected to apply their new-found knowledge to weed management activities. We should re-think this Extension weed science paradigm from the "sage on the stage" to the "guide on the side," building interactive programs that challenge audiences to integrate new knowledge with their existing knowledge and commit to applying it to their weed management. Programs should be built upon cognitive neuroscience, which is the study of how the brain takes in, stores, retrieves, and uses information. We learn best by moving, talking, writing, and storytelling. Furthermore, content is best learned when broken into short chunks (10-15 minutes) and conducted in a variable learning environment. Designing Extension weed science programs that employ cognitive neuroscience principles will improve the experience of both educator and audience and increase the likelihood that audience members will adopt new approaches, an aspirational goal of Extension programming. Designing interactive programs requires extra time and creativity on the part of the Extension educator, though, and audiences may resist interactive programs because they are conditioned to be passive. Extension educators should re-think the Extension weed science paradigm with courage and flexibility as we motivate our audiences to engage with us in new ways.

Breaking the Cycle: Educating for Effective Herbicide Resistance Management. Pete Berry*[1], Albert Adjesiwor[2], Judit Barroso[1], Joan Campbell[3], Doug Finkelnburg[3], Olivia Landau[4], Drew Lyon[5], Victor Ribeiro[1], Ian Burke[5]; [1]Oregon State University, Corvallis, OR, University of Idaho, Kimberly, ID, [2]University of Idaho, Moscow, ID, [3]Oregon State University, Pendleton, United States, [4]University of Idaho, Kimberly, United States, [4]USDA-ARS, Pullman, WA, [5]Washington State University, Pullman, WA (142)

Herbicide resistance in weeds poses a significant threat to sustainable agricultural systems, particularly in cropping regions where limited precipitation exacerbates management challenges. Addressing this growing issue requires innovative and accessible educational platforms tailored to farmers, agronomists, and stakeholders. This presentation explores the development and application of web-based tools designed to enhance knowledge transfer and empower decision-making for herbicide-resistant weed management.

Key tools include a **regional interactive herbicide resistance map** that provides real-time data on the prevalence and spread of resistant weed populations. This map enables users to visualize localized resistance patterns, facilitating proactive and site-specific management strategies. Accompanying this resource are **short educational videos** that deliver practical, science-based guidance on managing resistant weeds within regional cropping systems. These videos combine expert knowledge with field demonstrations, making complex concepts accessible to diverse audiences.

Additionally, the platform offers streamlined **access to scientific research** on herbicide resistance, curating peer-reviewed studies, case examples, and best practices. By integrating these tools, the platform fosters a collaborative learning environment that bridges the gap between research and application.

This innovative approach highlights the potential of digital education to promote sustainable weed management, reduce herbicide reliance, and support long-term agricultural productivity. By breaking the cycle of herbicide resistance through education, we can safeguard the viability of our cropping systems and ensure a resilient future for global food security.

Putting Weed Research to Work: Farmers Leading the Way. Sophia Lattes*; Montana State University, Bozeman, MT (143)

Extension has traditionally followed a top-down approach, where researchers and consultants host field days and provide recommendations to farmers. However, a disconnect often exists between these “experts” and those applying the information. A 2018 survey analysis in Montana revealed distinct differences in the priorities and perspectives of researchers, consultants, organic growers, and conventional growers. Bridging this gap requires increased communication and placing farmers at the forefront of research and outreach. One successful example is our investigation of cultivation tools for organic vegetables. We designed field trials based on farmers’ interests and partnered with six growers that tested new equipment and reported labor savings and yields compared to historical practices. These farmers also co-presented at our annual field days, sharing their firsthand experiences. Another example of farmer-led extension is the development of our research on interseeding cover crops in organic vegetables. This idea emerged from discussions with a local farmer who wanted to integrate cover crops but needed to maintain profitability in all

his fields. To assess broader interest, we surveyed Montana's organic horticultural producers in 2023 and found strong enthusiasm for interseeding. By prioritizing farmer-driven research in weed ecology, we ensured that our work remains relevant to our stakeholders. Engaging farmers as active participants, not just recipients, strengthens the impact of our research and fosters more effective, applied solutions for sustainable agriculture.

Weed Science is Boring: Innovative Ways to Engage Undergraduates. Fabian Menalled*; Montana State University, Bozeman, MT (144)

Teaching weed science in the context of sustainable and resilient systems requires a transformative reconstruction. Not only do weeds need to be assessed as integral and inevitable components of healthy managed systems, but engagement and active learner participation are fundamental when training the next generation of weed scientists. Yet, at the beginning of a semester, students arrive at a class with preconceived notions and pre-existing knowledge regarding critical concepts of the curriculum. This pre-existing framework can, in turn, influence students' progress and learning outcomes. Thus, we must question whether our methods for teaching and communicating weed science keep pace with the field's progress. Are our approaches advancing, or are they lagging and leaving future generations of professionals behind? How do we foster the critical thinking to address the complex socio-ecological questions associated with weed and invasive species management? How can we create a more equitable and inclusive discipline? While answering these questions will require significant inter- and trans-disciplinary contributions, simple-to-implement activities can help us achieve that goal. This presentation explores successful teaching approaches and activities we implemented at Montana State University to engage students and assess the degree to which they increased their understanding of critical chemical, biological, and ecological concepts such as integrated weed management, plant invasions, plant competition, herbicide resistance, and biodiversity.

Teaching Ecological Weed Management: A Laboratory Exercise on Weed Community Assembly. Emma Kubinski*; Montana State University, Bozeman, MT (145)

To prepare future weed scientists and managers to navigate the complexities of agroecosystem management, building a strong foundation of ecological-based weed management and systems-level thinking for weed science students is essential. To address this need, we developed a laboratory exercise, Weed Communities and Management, designed to demonstrate the influence of agricultural management on weed community assembly. This exercise was incorporated into weed science courses at Cornell University and Montana State University, engaging over 100 undergraduate and graduate students in 2023 and 2024.

To complement the lectures, students conducted a greenhouse experiment simulating the impact of three systems (organic vegetable, conventional wheat, and unmanaged) on weed communities. The simulated cropping systems received different nutrient inputs (organic vs synthetic N), weed management practices (clipping vs herbicide treatment), and crops (spinach and wheat in a fallow/crop phase). Students recorded data on the weed species present before and after weed management to evaluate the effects on weed diversity and composition. By analyzing species richness, abundance, and biodiversity indices, students observed firsthand how management decisions act as ecological filters shaping weed communities. Additionally, students wrote lab reports structured as research manuscripts, reinforcing their ability to integrate ecological theory

with weed science research and management. Survey results demonstrated growth in student confidence and perceived knowledge of weed ecology and scientific writing concepts.

By fostering experiential learning and critical thinking, this laboratory exercise equips weed science students with the necessary tools to develop sustainable, ecologically informed weed management solutions, strengthening the future of weed science.

Lessons Learned from Teaching Herbicide Physiology Collaboratively and Online. Tracy M. Sterling*; Montana State University, Bozeman, MT (146)

To address the limited availability of Herbicide Physiology courses at land-grant universities, weed science faculty from multiple institutions partnered to develop and co-teach a rigorous, online, three-credit graduate-level course. This award-winning team with diverse expertise in weed science developed 20 eLessons which now serve as a digital textbook; the eLessons remain freely available at University of Nebraska's Plant & Soil Sciences eLibrary (https://passel2.unl.edu). Over $200k in NSF, USDA and internal university sources helped cover eLesson developmental and website costs. Thousands of new users from over 250 countries accessed the eLessons in 2019. The course PSPP 546 - Herbicide Physiology was developed by the faculty team to blend these interactive eLessons with seminal and current literature synthesis, quizzes, and asynchronous discussions. The course is hosted at Montana State University. Topics covered include herbicide classification and modes of action, resistance mechanisms, and practical diagnosis of field situations. PSPP 546 has been co-taught 10 times since 2006 by faculty from six U.S. Land-Grant Universities. Over 100 students have taken the course, with annual enrollment of 6 to 16 MS and PhD students from a dozen U.S. Land-Grant and Canadian Universities, as well as agency, industry and Extension professionals from across the U.S. Participation of multiple instructors with varied backgrounds has successfully complemented insights from students who work in multiple, varied agricultural systems. Lessons learned will be discussed in terms of the evolution of course content and online delivery methods to provide the weed science community with a rigorous learning experience.

Frequent Low-Stakes Assignments to Teach Quantitative Skills in an Undergraduate Weed Science Course. Brian Schutte*; New Mexico State University, Las Cruces, MT (147)

Dimensional analysis is a method for solving unit conversion problems and trains students to organize and evaluate data. It also helps students to understand the principles behind the calculations and conversions that are common in both applied weed science and commercial plant production. To promote proficiency in the dimensional analysis method, an introductory weed science course was restructured to include twice-weekly mini lectures on dimensional analysis and frequent low-stakes assignments with unit conversion problems. Throughout the semester, feedback was delivered to students using an online grading tool, and student performance on low-stakes assignments guided week-to-week changes in instructional materials. The effectiveness of this teaching method was determined by evaluating class performance on two summative assessments. Specifically, summative assessment scores (SA scores) were compared against SA scores from semesters when students were assessed only at the end of a course unit. This previous course unit featured dimensional analysis instruction once a week for three consecutive weeks. After the course restructuring, mean SA score increased 2.8 to 22.1%, suggesting the introduction of twice-weekly mini lectures and frequent low-stakes assignments improved student proficiency.

Minimum SA score increased as much as 132%, suggesting the combination of short, routine presentations and frequent assignments can help students who would otherwise struggle with the dimensional analysis method. Although further research is needed, the results from this study indicate formative assessments can improve instruction of a foundational quantitative skill in an introductory weed science course.

Edible Weeds – Experiential Learning in Sustainable Food Systems and Weed Science. Roland Ebel*; Montana State University, Bozeman, MT (148)

Experiential, interdisciplinary learning opportunities enhance student understanding of the complex interplay between weed management, sustainable farming, and the broader food system. The Sustainable Food and Bioenergy Systems program (SFBS) at Montana State University (MSU) is committed to interdisciplinary experiential learning, linking plant production with innovative uses in nutrition and food processing. In collaboration with the MSU Land Resources and Environmental Sciences program (LRES), SFBS explores the culinary and nutritional potential of edible wild and weed species in Montana. In this context, junior and senior students in the Ethnobotany (SFBS) and Weed Ecology and Management (LRES) courses organize the "Edible Weeds Feast." This assignment requires students to explore edible wild plants and weeds, develop recipes, identify and gather plants, create presentations on their ecological, nutritional value and uses, and prepare dishes made of selected plants. The final class culminates in a festive dinner where students sample diverse courses and learn from each other's presentations. In 2023 and 2024, student feedback was collected via an online survey (SFBS, n=21; LRES, n=18), including Likert-scale, multiple-choice, and open-ended questions on the assignment and its learning outcomes. Results indicated increased knowledge in plant identification, nutritional benefits of weeds, and local food systems. Among Ethnobotany students, we found significant correlations between participation and perceived gains in weed identification ($\tau=0.56$, $p<0.01$) and food preparation ($\tau=0.76$, $p<0.001$). Similar trends were observed for Weed Ecology students. This collaborative, experiential assignment encourages interdisciplinary system thinking and helps reframe how weed science is taught.

DISCUSSION SESSIONS

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

Moderator: Jaycie Arndt

Notes prepared by: Jake Courkamp

Topic: *Recent Changes in Weed Science and How to Adapt Management.*

Bob Finley: One big change is the use of drones to spray weeds. They are very useful for difficult areas to treat and help increase efficiency (time).

Corey Ransom: Are drone treatments effective?

Bob Finley: Yes in Fremont County, Wyoming at least. They help with more accurate and uniform application.

Scott Nissen asks Joe Swanson: Would using drones instead of helicopters have prevented public skepticism of weed management in Boulder County?

Joe Swanson: Maybe, but probably not. Opposition more about large scale application, not application method.

Scott Nissen: Drones work well in Colorado for small orchards. In this setting, they are highly cost-effective.

Bob Finley: Important to note that helicopters are still more precise/better, but they are not cost-effective for smaller treatments. They currently have a drone specialist on staff in Fremont County, Wyoming, and this has helped.

Joe Swanson: In terms of public skepticism, application method not important because pushback is not grounded in any type of science. It doesn't matter what we do.

Shannon Clark: We are in the process of a learning experience with new technology (drones). Need to see how things play out/develop.

Jake Courkamp: Have proposal ready to go for drone-based management, need regional collaborators. Was a Western IPM center proposal that was not funded due to lack of regional scope. Proposal was intended to demonstrate detection to treatment pipeline using drones for hairy willowherb, but could address other weeds.

Chloe Mattilio: Detection to treatment pipeline is feasible.

Jaycie Arndt: Teton County uses drones to treat very rugged terrain (aligns with Bob's earlier comment).

Tim Prather: Good to integrate drones with other types of remote sensing to maximize effectiveness.

Chloe Mattilio: Seconds Tim's thoughts.

Tim Prather: Could have a workshop or symposium on drones for weed management at future WSWS.

Sandra McDonald: How do we get drones on labels? There are labeling concerns with drones.

Shannon Clark/Will hatler: No clear guidance on use of drones. Aerial application language may or may not apply. No aerial label, no drones.

Beth: Do we need a drone training for applicators?

Sandra: Drone applicators already need aerial applicators license.

Greg Dahl: Lots of interest in drones nationally, but regulators are holding things back.

Tim Prather: Drones can also be used for reseeding.

Joe Swanson: Drone seeding has worked great in Boulder County.

Scott Nissen/Joe Swanson: Opportunities for drone training is increasing.

Corey Ransom: Are spot treatments with drones cost-effective? Could drones also be used to resupply backpack sprayers?

Greg Dahl: Drones are working great in aquatics. Could really be highly effective for areas with rough topography.

Corey Ransom: We also need to talk more about perennial herbicide resistance.

Tom Getts: Seen lots of perennial pepperweed resistance to chlorsulfuron in CA. Need to think about tools being taken away in the context of developing resistance.

Scott Nissen: Need to look into resistance more in natural area weed management.

Shannon Clark: Some weeds have been treated forever (e.g., white-top and leafy spurge). Need to think more about these populations.

Jane Mangold: Also need to consider how resistance would manifest in a resprouting perennial?

Scott Nissen: One similar case might be fluridone resistance in hydrilla, which is based on somatic variation.

Jane Mangold: Interest in resistance is growing. How does resistance influence weed management in natural areas?

Beth Fowers: Should we also think about annual resistance in natural areas?

Corey Ransom: It may be more important for perennials because we have limited treatment options for these weeds (ALS inhibitors and auxin herbicides).

Jane Mangold: Overall less integrated weed management since she has been involved in weed management research.

Greg Dahl: People jump to chemicals because they are so much more cost-effective than other tools. Younger researchers need to help figure out alternatives.

Kelly Uhing: We (Kelly and Jake Courkamp) have an integrated weed management project starting this summer looking at using combinations of grazing and herbicide to manage reed canarygrass.

Tim Prather: Also need to think about thresholds in weed management. How does co-occurring vegetation contribute to resistance to reinvasion?

John Coyle: Nobody calls consultants/applicators until they have big problems that require chemicals. Need chemicals initially, but maybe focus on mechanical treatments for follow-ups?

Bob Finley: Chemicals are a good reset option. Then management can prevent reinvasion in some cases at least.

Corey Ransom: Non-chemical options could be useful for resistance management? But, need life history info to better understand balance of sexual/asexual reproduction.

Overarching ideas: (1) symposium on drone use in weed management; (2) return to basic biology/ecology of weeds to better understand potential for resistance in range/natural areas.

Nominations for 2027 Section Chair (2026 Section Chair is Jake Courkamp)

Sandra McDonald nominates Kelly Uhing for 2027 section chair.

Scott Nissen moves to close nominations. Everyone is in favor, nominations closed. Kelly Uhing is the 2027 section chair for Weeds of Range, Forestry and Natural Areas.

Chair 2025:
Jaycie Ardnt, University of Wyoming Extension, Sheridan, WY
jarndt1@uwyo.edu

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

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

Near Complete List of Attendees: Jane Mangold, Morgan Trust, Greg Dahl, Hannah Kuhns, Chloe Mattilio, Peter Cole, Shannon Clark, Joe Swanson, James Jackson, Will Hatler, Bob Finley, Jana Finley, Jim Sebastian, Beth Fowers, Sandra McDonald, Corey Ransom, Tom Getts, Cody Beckley, Josh Wagner, Ben Peterson, Kelly Uhing, Scott Nissen, Tia Lawrence, Dirk Baker, Tim Prather, Lisa Jones, Jake Courkamp, John Coyle

Project 2 Discussion Session: Weeds of Horticultural Crops

Moderator: Craig Alford

Topic: *Building Synergy Through Weed Science Collaborations in the West*

Summary:

Industry wise – IR4 has help tremendously. Looking into how to use old products in new ways has also helped. Collaboration between university and industry has also helped by having joint projects. This has been important for minor crops since we have many crops with few products registered for them.

-IR4 trials are a good way to be impactful, especially for early career professionals. Marcello Moretti is a good example of how to leverage these funds/projects for specialty crops.

-The more areas that get involved with a given project/nominate these projects the more they get support for IR4 projects. It's good to communicate with one another about what we would like to see backed.

-Something that's missing is when companies invite researchers for a new product information to see how we can apply them in research programs. Another point is that although the private sector is focused on chemical weed management, it would be good to collaborate more on non-chemical control tactics used with chemical control to decrease rates of resistance.

-How do we develop a systems approach that can help protect the lifecycle of any product. Resistance is going to get worse before it gets better. There are new chemistries entering the market but they might stop working before we can create these systems of incorporating non-chemical and chemical control tactics.

-An opportunity might be drone operation in specialty crops. How do we go forward with this?

-There are only about 2 products in the US that say anything on the label related to drones, how can we move forward if drone applications haven't been established in most herbicide labels. It's a big ask and there's a lot of interest in drone application, but we don't have the foundation to work with them well yet. We need applicators who can fly drones, not drone operators who want to apply herbicides.

-From coordination, on WSSA Endangered Species act committee, ESA might have a better idea on how to coordinate messaging related to the ESA as there's a drone aspect to this too. Unfortunately, this is still with EPA in terms of application methods/abilities.

-ESA can help us reduce mitigation or reduce buffer area and so on. It would be a good way to generate more of these essential discussions.

-As a part of the ESA committee it's been good hearing from the group directly as the changes won't be as taxing as we might expect. WE need to share this information with others.

-There's been an effort to create a standard on the herbicide label with these ESA changes and to make reading and interpreting herbicide labels much easier. Much input was asked from WSSA for this.

-It's good that collaborators understand the constraints of traveling and getting together. This is a strength of specialty crops as most are open to meeting online and those involved are usually few so it's easy to get everyone together.

-Mailing lists can also be helpful ways to stay connected. People can post questions or concerns to groups and those who have input/suggestions can reply via email opposed to meeting.

-The UC has a Workgroup that is very robust. This is open to those that are not only in UC. Brad Hanson stated that he would be happy to set up a WSWS page. This can also pass down institutional knowledge.

-Would it be beneficial to have a list serve with WSWS specifically, we can create specialized list serves for each of the areas our specialist focus on. This might be valuable to WSWS and other societies.

Elect New Chair-Elect
-Nominations:
Aaron Becerra-Alvarez – Oregon State University

Motion – Marcello Moretti

Second – Brad Hanson

Motion passed

Chair 2025:
Craig Alford – Corteva
craig.alford@corteva.com

Chair-Elect 2026:
Clint Mattox - USDA
clint.mattox@usda.gov

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

Craig Alford	Brad Hanson
Chanz Robbins	Joel Felix
Clark Alder	Carl Libbey
Pamela Hutchens	Marcelo Moretti
Brian Schutte	Aaron Becerra-Alvarez
Matthew Fatino	Tong Zhen
Rui Liu	Harlene Hatterman-Valenti

Project 3 Discussion Session: Weeds of Agronomic Crops

Moderator: Joseph Mettler

Topic: *Greenhouse Research Standards and Methods*

Notes: By Jace Heiman and Joseph Mettler

Discussion Summary:

A question was prompted to begin the discussion:

Do people use the standard field rate in the green house?

- The conversation started with Jason Adams saying in their greenhouse trials they often find that standard field rates are too affective, and they often reduce the rate. But it does vary depending on the weed species and the herbicide. This was for foliar only, and in all cases except for some resistance screenings.
  - Greg Dahl said he has usually done the same thing.
  - Other noted that sometimes more herbicide is needed to better reflect field response. It was also noted that researchers typically had a 1 to 2 susceptible checks when it came to resistance screening, as even checks can respond differently.

The discussion then moved to the fact that all greenhouses aren't the same and everyone needs to adapt to the conditions that are available. Nevin Lawrence brought up that there was a study done that looked at all the greenhouse factors that can affect plant sensitivity to herbicides:

  - Pot size, depth of pot, humidity, seeding depth, time of year, photo-period etc..

- Multiple people agreed it is very important to have multiple checks set up to prevent misrepresentation
- Breanne Tidemann brought up how no two rooms are the same and what conditions and setup worked for someone else might not work for you, or you might not be able to do.
- Nevin also brought up how he has brought seed of a herbicide resistant weed from the field and into the greenhouse where they screen it and it dies to the herbicide.
  - To combat this Nevin has brought weeds from the greenhouse outside, sprayed them, and then left them there for a day to make it as natural as possible before returning to the greenhouse

- Humidity was brought up next:
  - Very hard to manage, facility dependent and can fluctuate a lot.
- Light factors were the next topic of discussion
  - Some greenhouses are set up with measurement equipment high up in the greenhouse which is not an accurate measurement of the levels at plant canopy. Some different factors that were mentioned:
    - Light intensity, CO2 levels, Temperature
  - How do people measure the amount of light they are putting out in the greenhouse?
    - PAR measured at plant or bench height

        - day length and light type is a standard method of recording greenhouse conditions. Varied based on species growing and i's photo-period length
    - Most people are using high pressure sodium bulbs
        - Lots of variation in those bulbs:
            - Can be due to age of bulb, different bulbs emit different light
    - Lots of variation in how the light ions move into and through the greenhouse
    - In standardized lighting experiments the sides of the pots need to be blocked off to prevent outside influence
- Mineral soil vs peat moss use in the greenhouse:
    - Nevin said he has a small box contraption that heats up via steam and uses that to sterilize 2m^3 of soil at a time
        - It kills weed seeds, but uncertain about affects on biologicals, but for weed experiments works well.
    - It was noted that in heavier soils autoclaving can result in hydrophobic soil, but in lighter soils it does seem to be an issue.
    - Tim Prather mentioned that a colleague of his used a double solarizing tent to steam sterilize in the field. It gets very hot. Should be able to google solar tent for more information.
    - NDSU recently compared clay loam mineral soil to potting mix in regards to soil PRE herbicides and noticed that the mineral soil had a less consistent response to herbicides than the potting mix. This was perhaps due to more even emergence of weeds in the potting mix, comparatively.

The discussion then went to how researcher mixed or incorporated PRE herbicides into the soil. There was 3 different methods, all of which were deemed sufficient for herbicide activation.

1. Hand mixing with gloves and simply stirring in a large container
2. Pouring soil into large 1-2 gallon Ziplock bags and then turning end over end for a set amount of time.
3. Cement mixer for larger volumes of soil.

The type of pots researchers used varied significantly when doing dose response curves or herbicide resistance testing, ranging from cone-tainers, 6x4" flats, 18"x1' flats. Cone-tainers contained individual plants while pots containing multiples. Plants were often started in plugs before transplanting to cones or flats. Some researchers also seed in flats and then thin to desired number.

Majority of researchers did not utilize pseudo weeds in the greenhouse, but rather specific weed species themselves. Some of the pseudo weed species included:

- Orka = velvetleaf
- Quinoa = common lambsquarters
- Tame Amaranth = amaranth species
- Siberian foxtail millet = foxtail species

Comments of making our greenhouse research more repeatable with more detailed environmental information for journal publication was made.

Resolution: Greenhouse research is highly variable and methods are dictated by the capabilities of the greenhouse facility. Creation of widely used standards for common use would be rather difficult and not particularly accurate for individual researchers and facilities.

Section Election for Chair Elect:

Eric Westra motioned to elect Clint Beiermann as section chair elect of the Weeds of Agronomic Crops, Breanne Tidemann seconded the motion.

Voting on the motion was unanimous in the affirmative.

Kyle Roerig will serve as the Chair and moderator at the 2026 annual meeting.

Chair 2025:
Joseph Mettler, North Dakota State University
joseph.mettler@ndsu.edu

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

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

Attendees:

Name	Affiliation	Email
Joseph Mettler	North Dakota State University	Joseph.mettler@ndsu.edu
Phil Banks	Marathon Cunsulting	marathonag@zianet.com
Jill Schroeder	New Mexico State University	Jischroe1@gmail.com
Jace Heiman	North Dakota State University	Jace.heiman@ndsu.edu
Curtis Rainbolt	BASF	Curtis.rainbolt@basf.com
Tim Prather	University of Idaho	tprather@uidaho.edu
Greg Dahl	Retired WSSA	Slzdahl19@gmail.com
Byron Sleugh	Corteva	Byron.sleugh@corteva.com
Eric P Westra	Utah State University	Eric.westra@usu.edu
Mirella Ortiz	Utah State University	Mirella.ortiz@usu.edu
Caleb Dalley	North Dakota State University	Caleb.dalley@ndsu.edu
Kirk Howatt	North Dakota State University	Kirk.howatt@ndsu.edu
Connor Cox	Oklahoma State University	Connor.cox@okstate.edu

Jason Adams	Syngenta	Jason.adams@syngenta.com
Zack Bateson	National Agricultural Genotyping Center	Zack.bateson@genotypingcenter.com
Brain Jenks	North Dakota State University	Brian.jenks@ndsu.edu
Ian Berke	Washington State University	icburke@wsu.edu
Aaron Esser	Washington State University	aarons@wsu.edu
Nevin Lawrence	University of Nebraska Lincoln	Nlawrence2@unl.edu
Breanne Tidemann	AAFC	Breanne.tidemann@agr.gc.ca
Clint Beiermann	University of Wyoming	Clint.Beiermann@uwyo.edu

Project 4 Discussion Session: Teaching and Technology

Moderator: Harlene Hatterman-Valenti, Chair

Topic: *Read and follow the label – sounds easy, but is it?*

Discussion was led by Sandra McDonald with a presentation showing how some labels may not be easily understood. She shared snippets of example labels. And then started the discussion by asking the group to discuss how we can train on this and how we can work to improve labels. This resulted in a lively discussion.

It was pointed out that many labels still have language from the 1960's and 1970's (legacy language) remaining even though application technology has drastically improved over the past 50+ years. Discussion continued on the movement toward an electronic and uniform language but how that would primarily be for agronomic crops the main driver, and most likely overlook the needed changes for land management and right of way herbicide labels. Examples of legacy language include the herbicide "X" indicating that a spoon can be used to disperse the granular herbicide. Another example was how the EPA keeps accepting past label wording of a "water's edge application" and the vagueness of whether the herbicide could come in contact with the water or not. A comment indicated that reregistration will hopefully correct.

Another area of concern was label misuse, marketing, and enforcement. One comment indicated that if the label does not say "Do not" the state Department of Agriculture will not enforce. An example was given about how a non-restricted use (ready to use) herbicide is not labelled for homeowner use but is being used that way. Another example is the branding of "Roundup" for homeowner products that don't even contain glyphosate. The final example was the marketing of non-labeled products such as clopyralid for broadleaf weed control in turfgrass.

Attendees:

Harlene Hatterman-Valenti	h.hatterman.valenti@ndsu.edu
Sandra McDonald	sandra@mountainwestpest.com
Bob Finley	rfinley@dteworld.com
Kendrick Benander	kendrick@parrkcountyweeds.org
Morgan Frost	mfrost7@uwyo.edu
Hannah Kuhns	hadkuhns@gmail.com
Lauren Vorona	lvorona@kingcounty.gov
Ben Peterson	ben.peterson@kingcounty.gov
Corey Ransom	corey.ransom@usu.edu
Byron Sleugh	byron.sleugh@corteva.com
Maria Winkler	maria.winkler@montana.edu
Jane Mangold	jane.mangold@montana.edu
Mirella Ortiz	mirella.ortiz@usu.edu
Liberty Galvin	lbgalvin@okstate.edu

Connor Cox	connor@okstate.edu
Carl Coburn	carl.coburn@bayer.com
Cody Beckley	cody.beckley@usu.edu
Tim Prather	tprather@uidaho.edu
Aaron Esser	aarons@wsu.edu
Jill Schroeder	joscjrpe1@gmail.com
Phil Banks	marathonag@zianet.com

Project 5 Discussion Session: Basic Biology, Ecology and Technology

Moderator: Breanne Tidemann

Topic: *One of these Things is not like the other? Or are they?*

The discussion began with introductions of some ideas for discussion. Examples included how weed recognition software/efforts may select for crop mimics and how that might affect selective weed control over time. Examples were given of species that are closely related and often combined into one weed for the sake of management, where we really don't know if herbicide control differs because we don't often know which species is being worked with. Additionally some dichotomous keys are lacking and funding for this type of work is often limited. Discussion opened from there with some discourse on using genetic markers to distinguish species. Additionally it was mentioned that if the response to management practices is not different, managers don't really care. Where we are lacking is sometimes knowing how responses may vary. It may be beneficial to know rate of crossing among these species but to get funding we need to show the difference in response to management or resistance. Which can be a challenge when we don't specify to species in the first place. There are also fewer botanists and less financial support for studies like this.

Discussion then moved a bit more to how there has been a push for molecular tests or quick test for diagnosing herbicide resistance. Rapidity of information with whole plant bioassays can be a challenge and limits response or management to the following year. With species that have close relatives that can be difficult to differentiate, molecular results may be misleading (an example given here of a molecular test for glyphosate resistance in downy brome, with a sample submitted by a producer identified as downy brome that experts are not convinced is downy brome).

Crop mimicry evolution for weed detection was discussed with potential continuous imagery being proposed as a solution to help capture any of that evolution. Discussion that we will see more weed adaptation to weed management techniques and we need to ensure our managers recognize things like shifts in emergence timing, or early shattering as resistance.

Some discussion shifted to whether herbicide resistance will decrease if we decrease reliance on herbicides. Fitness penalties were discussed and triallate resistance in wild oat was given as an example. Sterile pollen technology was also discussed. We are aware that there's testing going on that suggests eventually some commercial application may be possible. Discussion then focused on a need to look for competitive genes in weeds to incorporate into crop germplasm, and the need for public scientists to potentially lead in this area. Also some discussion on limited breeding for weed competitiveness in comparison to insect or disease resistance. We ended with discussion on the shade avoidance response and ability to move that into crops.

Jenna Meeks was selected as the chair-elect of the section for next year.

Chair 2025:
Breanne Tidemann, Canada Agriculture and Agri-food Canada
breanne.tidemann@canada.ca

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

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

Attendees:

Attendee Name	Organization	Email Address
Wes Maughan	WSU	Peter.maughan@wsu.edu
Shambaz Ahmed	WSU	Shahbaz.ahmed@wsu.edu
Sophie Lattes	MSU	Sophia.lattes@student.montana.edu
Carl Coburn	Bayer	Carl.coburn@bayer.com
Connor Cox	OK State	Connor.cos@okstate.edu
Hilary Sandler	UMass/WSSA	hsandler@umass.edu
Mark Herz	CHS	Mark.herz@chsinc.com
Jenna Meeks	UWyoming	jmeeks@uwyo.edu
Andrew Kniss	UWyoming	akniss@uwyo.edu
Carol Mallory-Smith	Oregon State University	Carol.mallory-smith@oregonstate.edu
Joan Campbell	University of Idaho	jcampbell@uidaho.edu
Breanne Tidemann	AAFC (Chair)	Breanne.tidemann@agr.gc.ca
Albert Adjesiwor	University of Idaho	aadjesiwor@uidaho.edu

WSWS BOARD OF DIRECTOR'S BOARD POST ANNUAL MINUTES (2024)

Denver, Colorado
Thursday March 7, 2024

Lunch meeting started ~12:00pm; WSWS President Tim Prather called the meeting to order

- New and old board member self introductions
  - Most of the incoming board and many of the outgoing board members were present but attendance did not get recorded (new secretary!)
- Meeting debrief, comments, suggestions:
  - Eric – meeting attendance. 243 reg, 10 for Palmer symp, 1 for ESA symp.
    - Were student numbers up? Not sure, but seemed higher
      - Follow up. Yes 54 students in 2024 vs 40 (35 WSWS, 5 WAPMS) in 2023
  - Suggestion to move business breakfast to 7 from 6:30?
  - Have mods use hyperlink slides – Marcelo Moretti had a template
    - MM had a "best practice for moderator" appendix to share.
  - How to respect retirees at welcome? This year was better than some previous as far as noise and talking over the speakers.
  - Dirk Baker– were DEI recommendations put into student judging?
    - Yes. Some discussion and questions about the rubric
  - Brad Hanson - Necrology committee, needs clear instruction and guidance.
    - The necrology poster should be #1. Or right next to presentation desk (this is a good, easy idea to implement). Build a tab in the program for "admin posters"
      - They should just read the decedents name. Not a reading of an extended full obituary
      - Board contact should make this clear to Necrology Committee Chair (Follow up: this is the Secretary)
  - Attendees liked the archeology speaker
  - Curtis Rainbolt. Tim, as Program Chair, did a great job of involving the two section chairs in the program organization.
    - Tim will draft a BMP and get ideas from Marcelo and Dirk
  - WSWS President could introduce the session chairs at intro so speakers can find them easier.
    - Maybe a poster with the names and photos of the session chairs (name/face/contact info?)

- Could shorten general session? Some really liked, some thought was too long.
- Sandra McDonald: Noted an error in the awards section of the 2024 program. Vanelle Peterson is listed as receiving the Presidential Award of Merit but we actually created a new award for her called "Presidential Recognition of Service".

Old Business:

- Summer board meeting will probably be the week of July 15. TBD after confirm with hotel
  - Possibly Tues/Wed depart Thursday?
    - Site visit most important for program committee, others could travel around as needed.
- Discussion of ideas from last year
  - Idea about "practitioner and/or case study" in some sessions?
    - Session chairs could solicit?

New Business:

- Discussion of zoom vs in person board meeting. Seemed to be general preference for in person to build camaraderie.
  - Could have specific zoom discussions for specific topics as needed.
- Tim Prather- DEI committee. Tim wants to move this from ad hoc to standing committee.
  - Sandra McDonald – we have a process. Committee requests, Board agrees or not, then the committee has to write up operating procedures, then membership has to vote.
    - Elizabeth knows this and will write up procedures.
    - Invasive species committee may not know this.
  - They should write up docs, provide to Board this spring so we can discuss via zoom, then Board can vote at summer BoD meeting.
  - Tim will communicate this to DEI and Invasives committee
- Tim will assemble an ad hoc committee on ESA issues
  - Brad Hanson is on WSSA ESA committee and will chair this for WSWS as a natural link
    - Follow up: after the meeting, Tim asked Brad Hanson, Jolene Trujillo, Dan Tekiela, and Alan Helm to serve on this ad hoc committee
- Ryan Rapp – reminder that we'll have finance decisions to make at summer mtg.
  - Need a Profit and Loss statement for meeting (vs an annual society profit/loss)
  - Beneficiaries process for people that want to bequeath $
- Discussion of Tucson site for 2026 WSWS meeting
  - We need to have someone visit. Need to move ASAP since hotel may not hold too much

longer

- Curtis will talk to Jesse Richardson. Bill McKlosky also lives near
- Curtis moved to accept Tuscan Marriot with the proviso that someone visits site ASAP. Eric seconded
  - Some discussion about pre meeting concerns about our requirements
  - Vote: unanimous agreement

- Re 2025 WSWS meeting in Seattle- Rui Liu from WSU willing to be local arrangements in Seattle
- Carl Coburn comments as incoming program chair
  - WSWS practice has been to try and alternate private/public in the presidential rotation but not as many options for industry members to serve due to hassle and lack of company support. Carl suggested 2:1 instead of 1:1
  - The alternating president is a guideline not a rule; our guidelines allow discretion
    - Sandra – purpose was to alternative view points and perspectives
    - Sandra – don't forget non-ag-chem industry (not just manufacturers)
      - Curtis mentioned "green on green" spray companies. Etc
- Discussion of paying for travel for summer board meeting
  - Have us make our own travel and request reimbursement if needed
    - WSWS will pay for students. Others will request if desired
    - This is in operating procedures already
- Tim suggested a zoom meeting with previous Program Committee and current program committee to pass tips along.
- Reminder of awards. Fellow are not noted or selected as public/private. Other awards still get marked as normal (not a change, just a clarification)
- Dirk – do we need to codify passing info from committee chair to chair elect
  - Sandra – this is in the operating procedures. Do we need a brain dump?
  - Dirk – this is inconsistently done. How to remind chairs to keep chair elect in the loop? Maybe just cc on communications as a mentoring/training.
    - Tim's BMP doc might capture some of this.
    - Sandra – can put this in Operating Procedures "appendix"
- Beth Fowers – do we need "past chairs" of committees to preserve knowledge?
  - Nevin Lawrence – we can just reach out to past chairs if needed.
  - Communication seems key. This usually works out ok.
- Tim – suggestion has been made to start the business meeting at 7 vs 6:30

- Seems viable if our submission rates stay about the same.
- The 1:30 post lunch start to the sessions seemed to work better too (less conflict with student lunch and other lunches)

- Tim – as President is disbanding ad hoc committee on Federal agencies
- Meeting program app. Keep or not keep?
  - Most support for keeping.
    - Eric – we can get a QR code for a FAC about app
    - Dirk – some folks complained of slow loading. Maybe this was an android issue?
- Program Development Software. Eric – WSSA and other regions not happy with current program developing software
  - Have to download software which is a problem for more and more companies/universities
  - WSSA looking for a solution that has program builder and title upload etc in one program. What are pros and cons? What are costs?
    - We currently pay $1000/quarter
    - New program might be 5-10k per year? Might be ok for large societies but maybe not for us?
  - Eric – the programmer (David) really should make this a website or online tool rather than software download.
    - Sandra – how much would it cost to have David migrate to web?
    - Tim - WSWS could buy chromebooks or something similar if we need to have dedicated machines?
    - Sandra. Is that three machines (for program team), could these machines then be used to preload presentations for the sessions?
      - Ryan – some companies get good discounts on tech so maybe easy purchase of computers
    - MAKE THIS A TOPIC FOR SUMMER BoD MTG
- Sandra – Partnering with Colorado Weed Management Association?
  - CWMA interested in some kind of partnering
    - Sandra – what is our process for reaching out to these kind of groups to keep them aware of our meetings? Is this the legislative committee?
    - Program Chair can communicate this task to Legislative committee and agency groups?
      - Tim and Eric's effort re Fed/State may touch on this
- Motion to adjourn at 1:45.

The minutes were recorded by Brad Hanson, WSWS Secretary.

WSWS BOARD OF DIRECTOR'S SUMMER BOARD MEETING MINUTES (2024)

Seattle Westin - Seattle, Washington
July 17, 2024

8:20 am (PST) meeting called to order by Tim Prather

Board members and others introductions.

- *Present:* Tim Prather, Eric Gustafson, Ryan Rapp, Curtis Rainbolt, Brad Hanson, Dirk Baker, Carl Coburn, Alan Helm, Rui Liu, Albert Adjesiwor, McKenzie Barth, Wes Maughan. *Via zoom:* Sandra McDonald, Greg Dahl
- *Not present:* Derek Sebastian

Officer Reports:

Secretary - Brad Hanson

- March meeting minutes shared via email recently. Sandra suggested that someone move to accept the minutes with amendments. Moved by Ryan, seconded by Alan. Unanimous vote to accept.
  - Brad will resend final version after the meeting after further comment.

Business Office – Eric Gustafson

- No changes or updates since last meeting.

Treasurer – Ryan Rapp

- Details in committee report.
- Committee has requested Profit and Loss report statements for meetings by site/year (separate from the annual society financial statements to provide information about site- to-site conference profitability). Will address in September committee meeting.
- Discussion of how to handle donations to society, particularly bequests and estate gifts
  - Society and individual tax implications, how to honor donors while maximizing flexibility and transparency about how funds are used to support the society operations and initiatives.

President – Tim Prather

- Several activities, some to be address further under New Business
  - Exploring software for program development, discussion about following suit with WSSA and other regional societies
  - Endangered Species Act related
    - Established a WSWS ad hoc committee to liaise with WSSA ESA ad hoc committee. Brad Hanson is on the WSSA ESA committee and will chair the WSWS ad hoc committee.
    - Discussion to make sure WSWS interests in how ESA changes will affect range and pasture and similar areas (WSSA seems focused on ESA changes impacts on crops at this point)
  - Several actions and consultations with WSSA Science Policy Committee on WSWS

behalf
  - Including good visit to Washington DC with other regional presidents.
  - Committee assignments almost completed
  - Consultation with Tina Nabilone at HPN Global, potential resource to help the Society find meeting sites venues at no cost to the Society (service paid by venues). Could simplify our site selection and negotiations. Will discuss in new business.

Past President – Curtis Rainbolt

- No report. Some interactions with site selection committee, otherwise minimal activity.

President-Elect/Program Chair – Carl Coburn

- Call for symposia sent out and due at the end of July. None receive so far
- Appointed Derek Sebastian as Member-at-Large (private sector)
- Discussion of meeting program software. Is optimistic for fit.
- Discussion of program
  - Developing ideas for keynote speakers
  - Potentially shortening general session slightly vs 2024
- ESA topic raised as potential symposia. However, may overlap with WSSA plan for that symposia topic in 2025. Maybe use that for one of our discussion sections instead.

Education and Regulatory Section Chair – Albert Adjesiwor

- Call for symposia sent out

Member at Large, Public Sector – Erik Lehnoff

- Has drafted survey aimed at Federal and State agency members. Requests Board input.
- Tim noted potential for new meeting software to have "hybrid" sections that might allow agency folks to participate in symposia rather than the whole conference if agency approval for travel is a main barrier.

Research Section Chair – Dirk Baker

- Discussion of how to ensure involvement of section chair-elects to train and mentor before they chair. Could this be formalized? It is in some committee operating guides. Sandra will add this language into the Program Committee operating guide.
  - Tim noted that he sent the operating guide to each new committee chair.
- Discussion that the program committee might need to do more outreach to solicit symposia topics (people are busy, might need a push).

WSSA Representative - Alan Helm

- No report submitted. Activities already discussed including ESA work, program development software, etc.

CAST Representative – Greg Dahl

- Recently several good CAST publications, several more in process.
- Good meeting with the Society Presidents during Washington DC visit; Food and Ag Coalition, CAST reps from other Societies

- The call for NIFA Fellow is out again (to replace Jim Kells)
- Noted really good impacts of regional presidents signing letter related to drift reduction agents as a mitigation strategy for ESA compliance.

Student Liaison - McKenzie Barth

- Student night out went well, could use more mentors
- WSSA will hold a weed contest in Illinois summer 2024, not aware of any WSWS teams
- Discussion
  - Tim will reach out to Liaisons for students to serve on WSWS committees
  - Ryan we had WSWS polo shirt sale in 2024, only sold 16. But, we will give these to retirees instead of golf balls.
    - Also, will put a "buy it now" sheet for these in the silent action (preferably with a QR code to the vendor so they get drop-shipped to buyer)
    - Society will purchase these shirts for Board members to advertise and wear at retiree reception

Director of Science Policy – Lee Van Wychen

- Lee was not present, no report submitted.
- Discussion of how Lee contacts regional presidents for input. Sometimes short notice.
- Tim asked for Board input on how to handle these short notice requests.
  - If more than 6 days, Tim will seek Board input. If less than 6 days, Tim will contact an "advisory group" that includes Past President, Secretary, President Elect/Program Chair, and Treasurer for limited input.
    - Sandra will add to Operating Procedures

Constitution and Operation Procedures Representative – Sandra McDonald

- Actively cleaning up operation procedures and filling in gaps
- Communication with new committees (DEI) about drafting their OP info; DEI's draft is ready for Board input (draft in Committee's report)

Committee reports:

- **Publications Committee** – Carl Coburn, board contact
  - Carl Libbey is working on both proceedings and newsletter on normal timeframe.
    - Discussion of dedicating the proceedings. This is not required and has no formal process. Is at discretion of the president
  - Website. Nothing to report
- **Local Arrangements Committee** – Rui Lui chairperson (Carl Coburn, board contact)
  - Not a lot of activity so far. Meeting with Westin staff at this meeting.
- **Finance Committee** – Ryan Rapp, chairperson (Ryan Rapp, board contact)
  - Report submitted. Discussed most of this earlier.
- **Nominations committee** - Caleb Dalley, chairperson (Curtis Rainbolt, board contact)

- Report submitted.

- **Public Relations Committee** – Mirella Ortiz, chairperson (Albert Adjesiwor, board contact)
  - No report
  - Mirella agreed to be the chair again due to some gaps in filling this committee

- **Fellows and Honorary Members Committee** – Rich Zollinger chairperson (Curtis Rainbolt, board contact)
  - Report submitted
  - Taking more active role in soliciting nominators
  - Andrew Kniss agreed to serve on the committee

- **WSWS rep to WSSA Finance Committee** – Rich Zollinger, chairperson
  - Discussion that WSWS Treasurer should be the WSWS rep on the WSSA finance committee
  - Sandra will put this in the Operating Guide

- **Site Selection Committee** – Kyle Roerig, chairperson (Curtis Rainbolt, board contact)
  - Report submitted
  - Committee recommended to accept the Tucson Marriott for the 2026 meeting
    - Moved to accept (Curtis), Second (Alan)
      - Discussion about specific dates for this meeting and more generally. Sandra will insert language in OP to target dates last week of Feb to second week March with a preference for second week March.
    - Unanimous vote to accept motion. Tucson 2026 agreed.
  - Discussion of 2027 site. Previously talked about Albuquerque but this isn't much of a regional rotation.
    - Tabled for now. Will discuss service to help with site selection during New Business. 2027 site not decided at this point.
  - Greg Dahl noted that WSSA is interested in joint meeting possible in 2028 or 2029

- **Awards Committee** – Drew Lyon, chairperson (Tim Prather, board contact)
  - Report submitted
  - Tim noted that this committee has been taking a more active role in soliciting nominations and has been successful getting full slates of awards.

- **Poster Committee** – Lovereet Shergill, chairperson (Carl Coburn, board contact)
  - No report submitted
  - Discussion of transporting boards and easels from Utah to Seattle. Rui will check on storage
  - Need to get new number cards printed for the poster boards. Do we need new boards?
  - Discussion of whether we want to abandon providing/storing/transporting our boards and easels around the western US. That is logistically challenging and does have a cost, even if not to the WSWS.

        - Hiring this out to meeting-local providers would likely cost $2-4k per year. (was $2k when we were in SoCal in 2022)
        - Tabled for now. Will have email vote.

- **Student Poster Judging Committee** – Alix Whitener, chairperson (Carl Coburn, board contact)
    - Discussion about some judge feedback following 2024 meeting (some positive some neutral)
        - Could consider a judge's breakfast meeting to discuss judging standards and practices to get some greater consistency.
        - WSSA does this. Marty Schraer does this for WSSA and could be asked to do it for WSWS too.
    - Tim suggested the committee should be more proactive in recruiting judges beforehand to reduce the scramble.
    - Question about whether previous student poster contest winners could serve as judges since they can't participate. Quickly agreed this was too great of a potential conflict of interest and decided "no".

- **Necrology Committee** – Lesley Beckworth, chairperson (Brad Hanson, board contact)
    - No report.
    - Brad will coach the chair to remind the membership that the necrology poster has detailed obituaries. The reading at the reception is to be BRIEF – point out the poster but don't read obit.
    - Necrology Chair should submit a Poster title so there is a placeholder in the program and proceedings
        - Program chair can insert the title
        - Committee chair needs to make the poster. Brad will remind

- **Sustaining Membership Committee** – Ben Westrich, chairperson (Curtis Rainbolt, board contact)
    - Report submitted
    - Discussion about whether membership could/should include a registration.
        - Decided at this point to make no changes. (WSSA is the only weed society that currently does this and may change)
    - Discussion about how we solicit sustaining members and how we solicit sponsorship for the meeting
        - Should these be rolled together? Decided these are separate "asks" and better to keep separate.

- **Legislative Committee** – Ryan Edwards, chairperson (Alan Helm, board contact)
    - No report submitted

- **Herbicide Resistant Plants Committee** – Stephen Valenti, chairperson (Derek Sebastian – board contact)
    - No report submitted

- **Diversity and Inclusion Committee** – Elizabeth Mosqueda, chairperson (Tim Prather, board contact
  - Report submitted
  - Drafted language for Operating Procedures
  - Motion made and seconded to move from an ad hoc to a standing committee
    - BoD voted unanimously to accept. Will move this to a Society vote at the next business meeting
- **Invasive Species ad hoc Committee** – Mirella Ortiz/Lisa Jones, cochairs (Tim Prather, board contact
  - No report submitted
- **ESA ad hoc Committee** – Brad Hanson, chairperson (Tim Prather, board contact)
  - No report
  - Discussion about how this WSWS committee can provide input to WSSA ESA committee. Particular focus on rangeland, pastures, etc that are major areas of the west (in contrast to the "crops focus" of much of the WSSA effort to date)
  - Discussion of how WSWS can provide information to our members and stakeholders. Symposia? Webinars?

Unfinished Business

- **Site Selection**
  - Generally
    - Discussion of site selection criteria. Some sense that we have criteria that are out of date given current market conditions (number comp rooms, summer board meeting comp, etc)
    - Do we want the site selection committee to continue the solicitation and bid process or turn over to a service (and then "select" from the bids the service gets on behalf of the WSWS membership)
      - Would we get more "bites" with a professional service requesting bids? Probably "yes" as it's easier for the venues
    - Tim and Eric will meet this week with Tina from HPN Global to discuss
  - Site Selection re Albuquerque 2027
    - Do we really need to schedule 3 years out?
      - Not much benefit to 3 years (may lose some options); but 2 yrs ok.
    - If not Albuquerque, then where?
      - Denver, Reno, Salt Lake, Sacramento?
      - What about "Tier 2" cities? Might not reduce total costs to members if rooms are cheaper but travel is more expensive or difficult.
      - We should leave this to the Site Selection Committee, not BoD.
        - Curtis will followup with committee.
  - General discussion of what drives attendance at meetings. Room rates, registration costs, locations, etc all play in but hard to pinpoint to what extent (probably varies among

members).

- Tim noted that the **International Weed Science Society** is considering a US location in the future. Possibly a joint meeting with WSSA or WSWS?
  - Franck Dayan is working on this but we'll need more information as it develops.
- Resumed **tabled discussion on endowment funds**
  - Suggestion to have "bins" of funds with general areas of support (students, sponsoring early career professionals, society operations, etc)
    - Ryan – preference to have as few accounts as possible to ease handling and transparency.
    - We want to honor the wishes of the donor but our accounting and tax issues play into this
  - Moved (by Ryan and Finance chair?) to require a minimum initial endowment of $15k to start each endowment bin. Seconded by Eric.
    - Unanimous BoD vote to support this.
- Sandra previously noted an **error in the award section of the program** at the March post conference board meeting
  - Vanelle Peterson was listed as receiving the Presidential Award of Merit in 2022. However, what Sandra (as 2022 president) actually presented was a Presidential Recognition of Service as special recognition of her effort on the WSWS history project. This was included in Sandra's award writeups for the 2024 proceedings accurately but listed inaccurately in the meeting program.
    - The BoD should discuss how to remedy this inaccuracy since it was not an actual Award of Merit and is not one of our standing awards.

New Business

- **Abstract/Program Software**
  - Our existing software (WSSA abstracts) is clunky
  - WSSA is looking at new software (CONFEX System) and regionals can follow suit if they desire.
    - Likely to be more expensive but will be routinely updated since it's a broader platform and larger software company.
      - Likely cost to WSWS will be about $3500/yr
    - WSWS Abstracts would not go away (for now) but expect it to sunset if several regionals follow WSSA's lead to CONFEX
  - Some features
    - System will be web-based (not download) which will help many company and university IT safety concerns (downloading software is a deal breaker for many, currently)
    - Does program, proceedings, and can accept presentations. Should meet our needs
    - Good dynamic scheduling which should help program development (many competitor products did not do this well)
  - Motion to adopt the CONFEX system for WSWS meeting management software (Albert)

and second (Alan)
    - BoD vote unanimous in favor. Will adopt CONFEX system.

- **Remainder of this meeting**
    - Our business and reports ended for the summer board meeting. No business to conduct tomorrow.
    - We'll have breakfast and a facility tour with Westin staff tomorrow morning
- **Future Summer Board Meetings**
    - This meeting was scheduled as 1.5 days (all day Wed, half day Thurs). We didn't really need the full time.
    - Suggestion to change this to a 1-day meeting for future summer board meetings (afternoon of first day, morning of second day). Should allow many folks to travel on meeting day and save substantial costs by eliminating several room nights and meals.
        - BoD agreed to this change.

4:00 pm July 17, 2024. President Prather adjourned the WSWS summer board meeting

The minutes were recorded by Brad Hanson, WSWS Secretary.

WSWS PRE-CONFERENCE BOARD MEETING MINUTES (2025)

Seattle Westin - Seattle, WA
March 10, 2025

10am. Puget Sound Room.

WSWS President Tim Prather called the meeting to order at 10:05am

Welcome and Introductions: Board members and guests present included: Lovreet Shergill, Ryan Rapp, Albert Adjesiwor, Tim Prather, Lee Van Wychen, Nevin Lawrence, Hillary Sandler, (WSSA president), Ian Burke, Ben Westrich, Wes Mann, Alan Helm, Sandra McDonald, Beth Fowers, Greg Dahl, McKenzie Barth, Curtis Rainbolt, Erik Lehnhoff, Carl Coburn, Dirk Baker, Brad Hanson, Eric Gustofson (business manager), Mirella Ortiz, Drew Lyon.

Officer Reports

-*Secretary's note: we followed the agenda as bolded below; if there was no report or no significant discussion, it is noted as "limited or no discussion"*

Secretary – ***Brad Hanson***

-Approval of Summer Board Meeting Minutes

- Moved by Ryan Rapp, second by Curtis Rainbolt. No discussion
- Unanimous approval. Minutes approved.

Business Manager Report – Eric Gustafson

-199 registered as of this morning. Not doing refunds as of now.

Treasurer Report – Ryan Rapp

- Brief discussion of treasurer report as posted online.
- Finance committee will recommend changing financial advisor to same provider WSSA.
  Will be discussed further under "new business".

President – Tim Prather

- Tim outlined a few of his activities on behalf of the WSWS, including Presidents visit to Washington DC organized by Lee Van Wychen.
- Also outlined a few of the topics he wants to discuss later under new business. Primarily guidance on WSWS sign-on to letters of support/protest and the issue of how to address federal/state employee participation in WSWS

Past President– Curtis Rainbolt

- Retirees will be honored at reception tonight. Discussion of starting part of the program a bit earlier in the reception before conversations get too loud.

President Elect/Program Chair – Carl Coburn

- Carl discussed the extreme challenges with the CONFES meeting program software. We will discuss further under new business; WSSA and NCWSS had similar issues.

- There have been a number of papers withdrawn and a few other edits made to the program. The online, digital version is up to date and the most accurate. Will have QR code to the changes at registration desk

Education and Regulatory – Albert Adjesiwor

-limited or no discussion

Member-at-Large Public – Erik Lehnhoff

- Erik led an effort during 2024 to survey federal agency members of WSWS about needs/challenges related to attending the WSWS meeting. Survey had very limited (only 12 responses) but there were commonalities across the respondents. The main issue was they are not aware of the WSWS meeting.
- Tim will mention in his address at general session
    - Could the Western Weed Coordinating Committee be a potential link? Could we overlap with this meeting to facilitate fed/state participation in WSWS? Interest in workshops ("workshops" are in a different category than "meetings" for getting agency approvals)
- Further discussion of federal participation. Q: How is SRM affected? Erik says fed participation in SRM was also down significantly (this was held a few weeks ago). Nevin commented that a lot of Feds got their layoff emails (Trump administration mass purge during early 2025) on Friday of that week.

Member-at-Large Private – Derek Sebastian

-limited or no discussion

Research Section Chair – Dirk Baker

-Section chairs assisted Nevin with challenging program development (CONFEX issue)

WSSA Representative – Alan Helm

-limited or no discussion on Alan's update.

CAST Representative – Greg Dahl

- CAST report is available online. He reported on activities and impressions from recent CAST meeting near Tampa FL.
- Working on a CAST paper on annual grass weeds and fire frequency (Matt Bauer from WIPMC is co-leading this)
- CAST going through lots of changes including restructuring and moving to a new facility in Ames IA.
- Thank you to WSWS for supporting CAST; it is an important voice for agriculture.
- Next CAST national meeting at Mississippi State University in Fall 2027.

WSSA President – Hilary Sandler

-WSSA President Hillary Sandler gave an update on the WSSA's activities and noted that this was her first ever attendance at a WSWS meeting.

- WSSA will be reviewing issues with CONFEX

- Next WSSA meeting will be held Feb 9-12, 2026 in Raleigh NC
- Hillary raised the issue of a potential joint meeting in 2027 with WSWS. WSSA is considering sites in Hawaii. Will discuss further under new business.

Student Liaison – McKenzie Barth

- Student night out organization going well; there is a better balance of mentor/student this year.
- Discussion of mixing industry and academia and who pays the bill. Two issues discussed: one related to industry partners from different companies (can redflag internal accounting) and mix of industry and academic mentors (Need to encourage public sector folks to share the cost. But, it was also noted that academics largely do not have these kinds of expense funds).
- Silent auction is set up but with relatively few auction items relative to other years.

Director of Science Policy – Lee Van Wychen

- Lee sent his report recently to committee
- Q do any of you get USGS funding?
  - -Sandra indicated that USGS is a common source of pesticide sampling info? Odd that it comes from USGS?
- Lee ran through some highlights of his report
  - EPA and FWS tour re ESA was very successful in Wisconsin during 2024. Several-day bus tour. Hillary commented on positive experience as well.
    - There were only 24 folks on the bus, but there were two webinar follow-ups for agency members that was also really valuable
  - Tim – could crop consultant groups help edit bulletins live two (bulletins)? Some of those don't use "ag language" so not great fit for label users.
    - Sandra – the "services" write the mitigations (not EPA). Tim, but the users might be able to edit with language that makes sense.
      - Lee mentioned the label standardization effort. Discussion about how label, BLTwo, PULAs, mitigations. Etc.
      - Lee – insecticide final strategy due later this month
  - Re federal funding cuts
    - Realize now that commodities and constituencies need to fight for funds and positions (cannot just "wait and see").
      - Ian mentioned success in the PNW on herbicide resistance from Wheat commission. (esp when ARS cannot respond but Land Grants can respond faster).
        - Q. Specificity has been really helpful (relative to broad brush)
    - Lee outlined some of the federal office space elimination and "decentralization" of offices from DC area to other areas
    - Funding issues (most grant programs still pending). IDC calcs suggestions will have impacts (target is 30% IDC, even on existing funds)
  - BLM added 7 "new" (old) herbicide active ingredients. (Basically, took on the same list and environmental assessments of the Forest Service).

- New NIFA Fellow (Todd Bouman will replace Jim Kells)
  - USDA NPL position vacated recently; Marty Williams will be interim/acting

Constitution and Operating Procedures Representative – Sandra McDonald

-limited or no discussion

Committee Reports:

Publications Committee (Carl Coburn – board contact)

Proceedings – *Carl Libbey*

WSWS Newsletter – *Carl Libbey*

Website – *Eric Gustafson*

- limited or no discussion

Local Arrangements – Rui Liu – chairperson (Carl Coburn – board contact)

- limited or no discussion

Finance – *Scott Cook* **–** chairperson (Ryan Rapp - board contact)

- Largely covered under treasurer report. Else, limited or no discussion

Nominations – *Caleb Dalley* – chairperson (Curtis Rainbolt – board contact)

- limited or no discussion

Public Relations – *Mirella Ortiz* – chairperson (Albert Adjesiwor – board contact)

- WSWS will need to renew contract with social media contractor. Will address under new business

Fellows and Honorary Members – *Carol Mallory Smith* – chairperson (Curtis Rainbolt board contact)

- Committee report online. Fellows for 2025 will be Pat Clay and Marty Schrar. Else limited or no discussion

WSWS Rep to WSSA Finance Committee - *Rich Zollinger*

- limited or no discussion

Site Selection – *Kyle Roerig* – chairperson (Curtis Rainbolt – board contact)

- 2026 meeting will be in Tucson. Jesse Richardson has visited sites and all are acceptable and currently negotiating.
- Will discuss 2027 options further after lunch when Jesse is available to call in.

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

- limited or no discussion

Poster – *Shannon Clark* – chairperson (Carl Coburn – board contact)

- limited or no discussion

Student Paper/Poster Judging – *Jake Courcamp* – chairperson (Carl Coburn – board contact)

- limited or no discussion

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

- Two members who passed since last meeting will be honored: Roland Shirmin and Carl Bell. Else limited or no discussion

Sustaining Membership – *Ben Westrich* – chairperson (Curtis Rainbolt – board contact)

- Most companies that contributed in the past contributed this year even though budgets are tight

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

- limited or no discussion

Herbicide Resistant Plants – *Rui Liu* - chairperson (Clarke Alder – board contact)

- limited or no discussion

Diversity and Inclusion Ad-Hoc Committee – Elizabeth Mosqueda (Tim Prather – board contact)

- DEI committee report online.
  - Sandra, remember there is a DEI reception after general session
  - We will be voting at business meeting about making this a standing committee

Invasive Species Ad-Hoc Committee –Lisa Jones (Tim Prather – board contact)

- Tim: some discussion as to whether this committee should continue as ad hoc. Will punt this to Carl for decision. Suggest either dissolve as ad hoc or giving them a more clear charge and consider making standing committee.
- Lee W suggested rolling into WSSA committee. Invasive weeds are huge issue for the West. But, some challenge due to travel $
- Mirella: thinks the committee would like to continue and will suggest making a standing committee
- Sandra says committee will have to write a plan, get Board input/vote (in summer) then membership vote on that at next year's business meeting.

New Business:

1. **Proposals from board/committees**
   - limited or no discussion
2. **Marty Schaer – Fundraising efforts**
   - Discussion of the importance and value of what Marty does for WSWS funding raising ($20-50k each year)
     - Marty's report indicated fund raising covers 50-90% of food costs at meetings
   - Discussion of whether this should be a "committee" vs "Marty". Concern that there's no succession planning. However, both Pete Forester before and Marty recently have expressed that they feel that this is their service to the society.

- Sandra indicated Marty suggested having a link to the Board (Treasurer?) rather than being rolled into a committee. Personal relationships more important; a committee rotation would not be very helpful.
- Tim – we don't want to fix something that's not broken. Ryan Rapp – suggested getting Marty linked to Treasurer/Finance committee to keep him looped in.

- Ryan will come with a recommendation from the Finance Committee to add Marty to this committee. (Finance meets Wednesday – WSWS Board can vote on their recommendation at the POST meeting).

3. CONFEX Update

- Carl: was a very challenging year to build the program. Carl basically had to retype EVERYTHING manually. Hillary, Tim, and Eric were great help but it was pretty terrible.
- Hillary. The NCWSS and then WSSA had similar challenges in the fall and winter of 2023 before WSWS.
  - WSSA will be meeting with regional societies to debrief and decide what to recommend. Debrief scheduled for March 31st.
    - Do we go with a different vendor (and start over)? We should at least get a different service person/contact.
    - Dirk – CONFEX also does American meteorological society and the TriSocieties but without the same level of challenge? Who is their point of contact? What is different?
    - Erik Gustafson – one difference is that the weed groups wanted to have the system flexible and open (rather than locked doors at each step). Same problems NCWSS, then WSSA, then WSWS. Problems were known but didn't want to explode it in the middle of the weed meeting series.
      - APMS will use this in July 2025 – will this work any better for them?
  - Will need to get feedback after the WSSA debrief and revisit as WSWS BoD to decide on action.

4. Educational Outreach/Lobby Efforts at National Level (*italics part of agenda*)

- *WSSA response to USDA cuts, current research contracts halted, effects on research funding*
- *What issues do we want to address at a national level? Mechanism to bring to Board and/or Lee Van Wychen*
- *How do we respond to requests to endorse letters, support efforts at national level*
  - *Timeline for input, signatory only or input to document?*
  - *Suggestion: Minimum 5 days to obtain vote for support, 7 days to provide input*
  - *Presidential authority for 1 or 2 support/signatory when less time is provided than mentioned above*
  - *Impact statements provided to Lee Van Wychen*
  - Ian – WSSA board is still "wait and see" while federal reduction in force is still occurring. Discussion of how force reductions are similar/different from at-will employment in private sector. Ian also commented that even at individual university level there will be substantial budget impacts and layoffs.

- Tim – the strategy seems to be to confuse everything so that no one knows how to respond. Should we pick a fight and fight it?
  - Hillary – a proponent of 'good message' related to weed research value from commodity groups and stakeholders. Gather success stories.
- Tim will draft a WSWS letter that can be shared with BoD about concerns. Sandra agreed to provide input. (Tim says "after this week" when he rotates off as president)
  - Hillary suggested get 5-6 success stories from weeders in the western US
- Tim – what are key issues that we (WSWS) want Lee to take forward on our behalf? This is aside from current federal funding and related issues. Basically, opportunity for back and forth with Lee during the year to inform his activities on our behalf more regularly.
  - Lee – could really use those impact reports and statements.
  - Tim – we could have a standing agenda or SOP to solicit input from the BoD
    - Sandra, When something pops up, we do a fairly ok job. Not sure this is a major issue; we're probably not really missing important stuff.
  - Lee – the Science Policy Fellows are doing a helpful job. See checkered spot butterfly impact from 2024.
- Tim. How do we want to respond to requests to endorse letters etc at national level?
  - Sandra – suggested either "text" strings to speed up and/or to have a subset of the board to consult in really tight situations
  - Sometimes the time line is short. Tim mentioned one example that had "inflammatory" language that he wasn't comfortable signing off on without Board input.
  - Greg and Hillary suggested a triage approach. Handle the easy/non-controversial ones, ask for specific input if objection,
  - Erik G. said sending "high priority" email pretty good response for WSSA Board when needed.
- Tim will draft out some "guidelines" and get input from Sandra and run it past BoD too.

5. **Governmental Agency Participation: Way forward? - Erik Lehnhoff**
   - limited or no discussion here since we covered it earlier in the agenda
6. **Site Selection Effort - Jesse Richardson and/or Tim Prather** *(italics part of agenda)*
   - *Hotel selection for 2027, given our current situation, do we want to consider joining WSSA in 2027 and having Tina work on 2028?*
   - *Site selection support discussion, how is working with Tina going?*
   - *We need to work on 2028 now in order to gain flexibility for smaller venues*
   - Called Jesse for input regarding working with Tina

- Tim reminded that Tina looked at smaller venues in central CA and most places were booked for 2027 other than Santa Barbara. Will we need to look 3-4 years out in advance if these smaller venues are more competitive.
- Jessie. Indicated that he was not a fan of the idea of working with Tina's company beforehand. But, after going through the process he is very much a fan of the service that Tina provided.
    - Tim. We might just be a smaller society than we're used to being. That might be our new normal.
    - Jessie: Tina is a master negotiator. Played three venues against one another. He really liked the process and service.
- Jesse. Site selection committee has a decision. But, not yet a contract signed so all three are still in the running. Two in Orange County probably still have an edge Hyatt Irvine (near airport and newly remodeled) and Hyatt Newport Beach (we've been there twice before, more beach vibe). The Hilton Long Beach is a long ways from an airport.
    - If we want to go to Irvine, this is the time to do it (newly remodeled facility will get out of our price range once discovered). But,WSWS also really liked Newport Beach when we've been there.
    - Site selection committee recommended both of these.
- Discussion of restaurant availability within walking distance of hotels. Long ride from airport vs having to Uber every time go out to dinner.
- Tim: WSSA is considering Hawaii for 2027 which could impact WSWS 2027 in CA.
    - Maybe wouldn't want to upend work that Tina did on our behalf if we joint with WSSA
    - We didn't really resolve the issue about joint 2027 WSSA meeting. Will bring up again at BoD meeting after the conference.

- Moved (Curtis) seconded (Alan) to accept site selection recommendation of Hyatt Irvine for 2027. Unanimous agreement.

  What about 2028? What direction do we want to give Tina and Site Selection committee. (Tuscan in 2026, Irvine in 2027). What region/location for 2028 and behind?

    - Ideas: Coeur d'Alene / Spokane. Boise. What about Montana? (Tim said Boise-Billings). What about Salt Lake City?
- What about 2029? Give Tina two years to work with. Might give Tina option to work two years with venues (e.g Spokane and SLC over two years).

7) Program Chair Elect? *(italics part of agenda)*

We work on trial by fire, perhaps we should be proactive and have our process start with a program chair-elect, then program chair, then president, then past president

- Tim's idea was to make a four year commitment instead of three. (add program chair elect), Program Chair, President, Past-President.
  - Sandra – that is recommended in the operations guides
  - Lee - WSWS is one of the only societies that has a 3-yr rotation. Most have a 4 yr rotation.
- Nevin noted that elected person finds out in ~Nov but then program stuff starts almost immediately (December).
- Curtis noted that you really need the new person present for the previous summer board meeting.
- Erik noted that an issue is the Program Chair is busy doing program stuff and doesn't get to learn how to be president. Would really be more helpful to add it in the middle (have the president elect not also be the program chair)
- Dirk wondered if the Past President could help coach the program chair elect.
- If four year term is too much, could chop off the Past President board position. That would be a constitution change, though.
  - Discussion of how much of a burden would a 4 year commitment be anyway?
- Sandra – suggested that Tim appoint an ad hoc committee (of mostly past presidents) to discuss what this might look like.
  - Curtis, Sandra, and Andrew Kniss. Ask them to develop a proposed change for discussion at the summer 2025 board meeting vote.

8) Social Media contractor

- Need to renegotiate or renew the contract with Amy at AquatStem Consulting
  - Her cost to WSWS is $3,875/yr.
- Erik shared social media analytics. LinkdIN, X, Insta, etc.
  - Tim suggested also "Blue Sky" twitter alternative with lots of science participants
- Sandra – need to remind the membership to get WSWS info via other methods (Amy is a multiplier, not a creator of info)
- Tim called for a motion
  - Alan moved, Ryan seconded continuation of this contract.
  - Unanimous agreement.

2:00 pm Adjourn:

Meeting adjourned 2:02.

The minutes were recorded by Brad Hanson, WSWS Secretary.

WSWS ANNUAL BUSINESS MEETING MINUTES (2025)

WSWS Annual Business Breakfast
Westin Seattle – Seattle, Washington
March 13, 2025

Call to Order at 7:02 AM by President Prather

Welcome and Recognition of Incoming and Outgoing Officers- Tim Prather

Officer Reports:

(Secretary's note: to expedite the meeting, President Prather suggested that officers and committee chairs indicate "no report" if they did not feel an oral summary of their posted reports was necessary). Secretary recorded as-such in these meeting notes but in the written reports are available online if they were provided to the business manager.)

Secretary – Brad Hanson

- Presented that 2024 Annual Business Meeting minutes have been posted online. President called for a motion to accept minutes.
  - Moved by Scott Cook, seconded by Sandra McDonald
  - Voice vote: all in favor, no votes against. Minutes of the 2024 business meeting are accepted.

Business Manager Report – Eric Gustafson

- This year's meeting 213 registered (with a late bump in the days prior to the meeting).
  - Significantly reduced compared to 243 registered in 2024.

Treasurer and Finance Committee Report – Ryan Rapp

- Scott Cook will rotate off the committee.
- Full report available online

President – Tim Prather

- Acknowledged officers and committee members rotating off after terms ended.

Past President– Curtis Rainbolt

- Nothing additional to report

President Elect/Program Chair – Carl Coburn

- Oversaw the program committee and worked on assembling the program
  - Carl recognized specifically the efforts of Albert Adjesiwor and Dirk Baker as Research Section and Education/Regulatory Section Chairs on the program
  - Also Tim Prather, Eric Gustafson, and Hillary Sandler (WSSA Pres) for assistance

- This year was the first year using the Confex system.
    - It was a somewhat of a disaster; similar challenges that NCWSS and WSSA had.
    - WSWS will join other societies in a debrief meeting in a few weeks to discuss how/whether to continue with this software in the future.
        - WSSA President Hillary Sandler will lead this discussion
- For 2025, regular and student registrations totaled 213 attendees
    - 154 presentations. 67 posters and 87 oral papers submitted
        - Vs 167 total in 2024 and 121 total in 2023

Education and Regulatory – Albert Adjesiwor

- Nothing additional to report

Member-at-Large Public – Erik Lehnhoff

- Nothing additional to report

Member-at-Large Private – Derrick Sebastian

- Not present

Research Section Chair – Dirk Baker

- Reminded everyone to include the chair-elects in the process to facilitate planning and training.
- Reminded Project-Chairs to get discussion reports to Dirk within the next few weeks

WSSA Representative – Alan Helm

- Nothing additional to report

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
- Jill Schroeder was the Liaison for a CAST publication on Invasive Species
- CAST is working on a 2025 paper on invasive grasses and wildfire; led by Matt Bauer Western IPM Center
- CAST is reorganizing and recently moved to new offices at Iowa State University

Student Liaison – McKenzie Barth

- Wes Mann from WSU will be Student Liaison next year
- Silent action so far has ~$1350 in bids (including a $1000 donation)
    - Thank you to those that donated items to the silent auction
- Student night out had 43 students and 27 mentors participating.
- Olanrewaju (Ola) Adeyemi from Utah St 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"
- Can 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 but was unable to attend the Business Breakfast

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 – Rui Liu

- nothing to report

Nominations – Caleb Dalley

- Nothing additional to report

Public Relations – Mirella F Ortiz

- Social Media Manager reports show growth in all account following. She posts approximately 3x per week on multiple platforms.
- Content for social media accounts from WSWS members is needed. Can provide directly to Amy or to Mirella or Eric to forward to Amy

Fellows and Honorary Members – Andrew Kniss

- Recognized those that nominated members for awards, and encourage other members to do the same
- Fellows for 2025 are Pat Clay and Marty Schrar.
  - Marty was unable to attend this year due to a family emergency. Andrew suggested we give him moment at the 2026 meeting to acknowledge the award.

WSWS Representative to WSSA Finance Committee – Ryan Rapp

- Society is financially sound
- Nothing additional to report

Site Selection – Craig Alford

- Nothing additional to report
- Tim Prather summarize that the Site Selection committee recommended to the Board that we go to Irvine, CA with Long Beach, CA as a second acceptable location for the 2027 meeting location
    - Reminder 2026 will be in Tuscan, AZ
    - Working to get back to scheduling at least two 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

Awards – Drew Lyon

- Awardees were honored at Luncheon. Awards committee has been more proactive in recent years soliciting nominations which has been helpful for getting full slates of nominees
- Awardees:
    - Marcelo Moretti, Outstanding Weed Scientist, Early Career Public
    - Kyle Roerig, Outstanding Weed Scientist, Early Career Private
    - Will Hatler, Outstanding Weed Scientist, Private Sector
    - Ian Burke, Outstanding Weed Scientist, Public Sector
    - Lisa Jones, Professional Staff
    - Seth Flanigan, Weed Manager
- Thanks to those who nominate and support nominations

Poster – Shannon Clark

- Thank you to volunteers to set up and tear down poster room
- 67 total posters submitted this year

Necrology – Tim Prather summarized for Earl Creech

- Recognized members who passed away during the past year: Carl Bell and Roland Schirman

Sustaining Membership – Ben Westrich

- Thank you to Sustaining Members for supporting WSWS

Legislative – Lisa Rew

- Nothing additional to report

Herbicide Resistant Plants – Stephen Valenti

- In past year, the committee worked on a tri-fold brochure on Herbicide Resistance
- This is complete and ready to be loaded on the WSWS website

Diversity and Inclusion Ad-Hoc Committee – Elizabeth Mosqueda

- Approximately 70 members attended the DEI "social hour" held on Tuesday morning
- Discussed the language changes made to Operating Procedures and the recommendation for this committee to be moved to a Standing Committee
    - This will be voted on during "new business"
- Committee has been ad hoc since 2019
    - Change to standing committee and associated language changes intended to show WSWS support for inclusivity of all members

Invasive Species Ad-Hoc Committee – Lisa Jones

- Committee has been ad hoc for 3 yrs
- Committee will start working on suggested changes to Operating Procedures for a future request to change to a standing committee
    - BoD can discuss in summer 2025 Board meeting; WSWS membership can vote at a future (2026?) annual business meeting

Student Paper/Poster Judging and Awards – Jake Courkamp

- There were 41 student presenters (23 posters, 18 oral presentations).
- Thank you to students and judges.
- Winners:
    - Agronomic Crops (poster) – Newman Teye-Doku, WYO (1), Ola Adeyemi, Utah St (2), Abraham Akuoko, UNL (3)
    - Basic Biology/Technol (poster) – Andre Araujo, CSU (1), Jonah Ziyaaba, WYO (2)
    - Hort/Range combined (poster) – Tia Lawrence, Utah St (1)
    - Agronomic Crops (oral) – Abraham Akuoko, UNL (1)
      Basic Biol/Technol (oral) – Hayden Lee, NDSU (1)
    - Hort Crops (oral) – Waqas Ahmad, NDSU (1), Sophia Lattes, Montana St (2)
    - Range/Teaching combined (oral) – Erin Teichroew, Montana St (1)

New Business:

- Tim Prather: motion from the Board of Directors to move DEI committee from ad hoc to a WSWS Standing Committee
    - Discussion: Jill Schroeder thanked Elizabeth Mosqueda for her extensive service on this committee.
    - Tim called for a voice vote.
        - All members presented voted in favor, none voted in opposition.
        - Motion passes to make DEI committee a WSWS standing committee
- Ceremonial "passing of the gavel" from outgoing president Tim Prather to incoming president Carl Coburn

    - Tim included a new gavel box, handmade from paduk and maple wood
        - Tim also noted a completely peaceful transfer of power
    - Carl thanked Tim for his service to the WSWS
- President Coburn called for a motion to adjourn
    - Moved by Ryan Rapp, seconded by Nevin Lawrence
    - **Meeting adjourned at 7:55am**

The minutes were recorded by Brad Hanson, WSWS Secretary.

WESTERN SOCIETY OF WEED SCIENCE NET WORTH REPORT

April 1, 2024 through March 31, 2025

ASSETS	
Cash and Bank Accounts	
American Heritage Checking	$146,185.05
American Heritage Money Market	$78,965.45
CD#4	$26,398.41
CD#7	$27,135.56
TOTAL Cash and Bank Accounts	$278,684.47
Investments	
RBC Dain Rauscher Account	$108,469.72
RBC Unified	$128,247.15
TOTAL Investments	$236,716.87
TOTAL ASSETS	$515,401.34

WESTERN SOCIETY OF WEED SCIENCE CASH FLOW REPORT

April 1, 2024 through March 31, 2025

INFLOWS ($)	
Annual Meeting Income	141,350.10
Interest Income	4735.01
Dividend Income	14,716.87
Membership Dues	2000.00
Miscellaneous Income	64.95
Royalty for Proceedings - RPR	100.00
Security Value Change	2724.94
Rita Beard Endowment	1100.00
Student Travel Account	1765.00
Steve Miller Donation	1130.00
Roland Schirman Travel	1000.00
Sustaining Member Dues	14,050.00
TOTAL INFLOWS	**184,736.87**
OUTFLOWS ($)	
Annual Filing Fee	25.00
Annual Meeting Expense	105,523.98
Bank Charge	4329.22
CAST Annual Dues	1,500.00
Copies	35.00
Fee Charged	4895.33
Insurance	500.00
Management Fees	32,349.96
Miscellaneous	412.64
Proceedings/Publications	750.00
Postage	1029.28
Summer Meeting	11,520.04
Student Awards	5016.81
Supplies	668.69
Taxes	425.00
Travel to Summer Meeting	5396.86
Travel to WSWS Meeting	360.74
Weed Olympics	140.53
Social Media	7925.00
Web Site Hosting	4000.00
WSSA Rep Travel	2962.60
TOTAL OUTFLOWS	**189,766.68**
OVERALL TOTAL	**$-5029.81**

WSWS 2025 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. Pat Clay and Stephen Marty Schraer selected as 2025 Fellows

This year's committee members were Andrew Kniss, Carol Mallory-Smith, Richard Zollinger

Pat Clay, Valent USA – Fresno, California

Pat Clay is a Product Development Manager for Valent USA LCC located in Fresno, California. Pat earned a BS in Agronomy from Louisiana Tech University and a MS in Weed Science from Louisiana State University. He worked for the University of Arizona Cooperative Extension from 1999-2006. He joined Valent in 2007 as a Field Market Development Specialist and then moved to Manager, Field Development for the West before taking his current position Product Development Manager.

Pat Clay (right) receives the WSWS Fellowship Award from President Tim Prather (left).

Pat has a long history of service to WSWS including serving as President in 2020. He has served on numerous WSWS committees including Nominations, Public Relations and Sustaining Membership, and as Section Chair of the Weeds in Horticultural Crops and the Education and Regulatory. He has served a judge for student papers and as a host for Student Night Out. These activities illustrate his dedication to supporting and growing our Society.

Pat received the Outstanding Weed Scientist (Early Career) Award from WSWS in 2008.

Beyond his service to WSWS, some of Pat's other contributions include Grant Reviewer for Future Farmers of America, Agriculture Future America Speaker and Tour Lead, and Valent/IR-4 Liaison. Pat has had numerous other roles that exemplify his willingness to give his time and energy to agriculture.

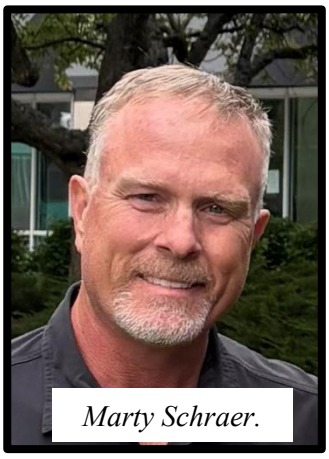
Comments from his letters of support included:

Pat's extensive body of work includes co-authoring and presenting numerous research papers and posters at WSWS meetings. His regular participation in the "What's New in Industry" sessions further exemplifies his dedication to sharing knowledge and promoting collaboration between researchers and industry professionals. His contributions to the field of weed science have been far-reaching and impactful.

An objective of the WSWS is "to aid and support commercial, private and public agencies in the solution of weed problems". Pat is the personification of this objective because he has made numerous contributions that have directly led to weed management solutions.

Pat is a model of professionalism and collegiality. His collaborative spirit, innovative mindset, and commitment to excellence embody the qualities of a WSWS Fellow.

Marty Schraer, Syngenta Crop Protection, Meridian, Idaho



Marty Schraer.

Stephen Marty Schraer is a Senior Research & Development Scientist, Syngenta Crop Protection. Marty earned BS and MS degrees in Entomology from Texas A&M University and a Phd in Weed Science from Mississippi State University. Marty began his career with Syngenta (Zeneca) in 1999 and has held several positions within the company. Since 2001, all of the positions have been in Research and Development. Some of the herbicides that Marty developed include Envoke, Suprend, Touchdown, Sequence, Callisto and Axial.

Marty Schraer has been a member of WSWS since 2004. He served on the board as WSWS Representative to WSSA from 2015 to 2020. Marty has served as WSWS Fund Raising Chair since 2022. Marty has been actively involved with judging student weed, paper and poster contests throughout his career. He serves as chair of the student judging committee. Marty is recognized by many society members for his dedication to mentoring graduate students. He regularly participates in the Student Night Out event. He is also an active member of the Weed Science Society of America where he has been involved with the Graduate Student Contest and as a host for Graduate Student Travel Enrichment Experience.

Marty has presented multiple papers at WSWS and participates in What's New in Industry. Marty was awarded the 2020 WSWS Outstanding Weed Scientist Award, Private Sector and the Presidential Award of Merit in 2022.

Comments from his letters of support included:

Marty is an ardent promoter of the WSWS within Syngenta and routinely promotes the mission of the Society and extols the benefits of professional society involvement, which is paramount for agricultural scientists to broaden their networks and deepen their knowledge of the discipline of weed science. As one of Syngenta's most well-respected Senior Scientists, Marty often reminds early career scientists at Syngenta to be active in the WSWS by encouraging committee work and networking with the many brilliant public and private sector scientists active in WSWS. Marty 'walks the walk and talks the talk' as referenced by his many activities to promote the mission of WSWS and further the advancement of weed science technologies to benefit Western producers.

Marty is also an excellent mentor to all those around him. Within Syngenta, I have been a particular beneficiary of his mentorship. As a younger scientist I have gained insight from Marty on professional development, trialing methods and processes, and brainstorming future ideas. I am not the only beneficiary of his mentorship, many other younger scientists within Syngenta have benefited from working with Marty, several of whom are also members of the WSWS.

WSWS 2025 HONORARY MEMBER

This award was not conferred in 2025.

WSWS 2025 OUTSTANDING WEED SCIENTIST AWARDS

Outstanding Weed Scientist, Early Career, Public Sector: Marcelo Moretti

Dr. Marcelo Moretti, Associate Professor, Horticultural Weed Specialist, Oregon State University in Corvallis. Marcelo's program focuses on perennial horticultural crops, primarily tree fruits and nuts, bush berries, and grapes and he provides weed science support in other aspects of the diversified specialty crop production systems of western Oregon. To quote from the nomination package: "Dr. Moretti is a trailblazer in the examination of non-chemical weed control technologies for perennial cropping systems."

The Outstanding Weed Scientist, Early Career, Private Sector: Kyle Roerigan

Mr. Kyle Roerig, Research Agronomist, Pratum Co-op in Salem, OR. Kyle specializes in designing, implementing, and analyzing field experiments across diverse crops, focusing on weed management and herbicide efficacy. To quote from the nomination package: "Kyle has established himself as a remarkable weed scientist in both academic and private sectors, which testifies to his broad knowledge, innovative and unique approaches to solving problems in weed science, and his ability to clearly communicate with clientele and facilitate learning in a range of cropping systems."

The Outstanding Weed Scientist, Public Sector: Ian Burke

Dr. Ian Burke, R.J. Cook Endowed Chair of Wheat Research and Professor, Weed Science, Washington State University in Pullman. Ian's program focuses on basic aspects of weed physiology, biology, and ecology with the goal of integrating such information into practical economical methods of managing weeds in the environment. To quote from the nomination package: "Dr. Burke's papers regularly produce interesting, novel insights informed by the wide-ranging scientific experience he possesses. All of Dr. Burke's research that I am familiar with aims to solve real-world weed management problems and does so with rigorous scientific methods."

The Outstanding Weed Scientist, Private Sector: Will Hatler

Mr. Will Hatler, Field Scientist, Corteva Agriscience, in Meridian, ID. Will is responsible for product R&D for the Western U.S. Pasture & Land Management business, as well as technical support for commercial teams. To quote from the nomination package: "Will Hatler is the consummate professional when it comes to his role as a research scientist in general, and an industry research scientist to be more specific. He has been focused on doing applied research that answers questions that make a difference for farmers, ranchers, and land managers across the western half of the US for over a decade."

WSWS 2025 PROFESSIONAL STAFF AWARD

The Outstanding Professional Staff: Lisa Jones

Ms. Lisa Jones, Research Associate, University of Idaho in Moscow. Lisa contributes valuable support and independent research in weed science and rangeland restoration. To quote from the nomination package: “Lisa’s knowledge of her field, including the design, implementation, analysis, and interpretation of experiments, is on par with early-career researchers who are tenure-track faculty at other institutions and research entities. Lisa’s contributions to invasive weed management and rangeland restoration work at the University of Idaho and her participation in the WSWS make her a shining star worthy of recognition as Outstanding Professional Staff in 2025.”

The Outstanding Weed Manager: Seth Flanigan

Mr. Seth Flanigan, Senior Natural Resource Specialist for Invasive Species, BLM National Invasive Species Program, in Boise, ID. To quote from the nomination package:” Seth always conducts himself with utmost professionalism and is the type of person that doesn’t shy away from difficult situations. In his role at BLM he was instrumental in the 2024 completion of the programmatic Environmental Impact Statement for Vegetation Treatment Using Herbicides. Field staff will now have access to new tools to gain ground on some of the most devastating invasive species such as cheatgrass, medusahead, and ventenata.”

WSWS 2025 PRESIDENTIAL AWARD OF MERIT

André Lucas Simões Araujo

André Lucas Simões Araujo received the Presidential Award of Merit from Tim Prather. He is a PhD Student at Colorado State University, whose major advisor is Todd Gaines. André has demonstrated an enthusiasm to contribute through service to WSWS. He has served the society through his photography service at the annual meetings. Recognizing and valuing our young scientists for their efforts in service presents a model for involvement in the society.

André Lucas Simões Araujo (right) accepts the Presidential Award of Merit from the WSWS President Tim Prather (left).

WSWS 2025 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 2025 scholarships were:

Andre Lucas Simoes Araujo, Ph.D. candidate, Colorado State University, Dr. Todd Gaines advisor.

Luisa Carolina Baccin, Ph.D. candidate, Oregon State University, Dr. Marcelo Moretti advisor.

Het Samir Desai, Ph.D. candidate, Montana State University, Drs. Lovreet Shergill and Fabian Menalled advisors.

WSWS 2025 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. The 2025 winner was:

Aaron Esser, Regional Extension Agronomist, Washington State University, in Ritzville, Washington (*right*) accepts the grant from WSWS President Tim Prather (*left*).

WSWS 2025 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 2026 scholarships, or make a donation go

Elise Bakke

Pursuing a master's degree in Natural Resource Management at North Dakota State University. Elise is studying herbicide effectiveness on Dame's Rocket at Knife River Indian Villages, a National Historic Site near Stanton, North Dakota. In addition, she is characterizing the understory plant community and analyzing the current seedbank of the forest. Elise's research is part of a larger project aimed at restoring the Green Ash forest, which has been severely degraded due to multiple invasive species. Elise's future plans include a career in invasive species management and restoration ecology, with a preference towards prairie restoration.

Angeline Bahe

Graduate Research Assistant at North Dakota State University pursuing a master's degree in Natural Resource Management. Her research project focuses on various herbicide rates and combinations to control Kentucky bluegrass, smooth brome, and leafy spurge as a pretreatment for restoration on rangelands. Prior to entering graduate school, Angeline worked for the National Park Service as a Biological Science Technician responsible for invasive species management along the St. Croix National Scenic Riverway. Following the completion of her master's degree, Angeline plans to seek employment in the field of natural resource management in either the public or private sector.

WSWS 2025 STUDENT PAPER AND POSTER AWARDS

2025 Paper judging committee: Alix Whitener, Jake Courcamp, Judit Barroso, and Tong Zhen

In total, there were 41 entries in the 2025 WSWS Annual Meeting student competition. These entries included 23 posters and 18 oral presentations. Due to low numbers of entries in some sections, the weeds of horticultural crops and weeds of range, forestry and natural areas poster sections were combined, and the teaching and outreach and weeds of range, forestry, and natural areas oral sections were combined. The winners of the student competition were as follows:

Poster - Weeds of Agronomic Crops (14 entries)

First - Newman Teye-Doku, *University of Wyoming*
Second - Olanrewaju Adeyemi, *Utah State University*
Third - Abraham Akuoko, *University of Nebraska-Lincoln*

Poster - Basic Biology, Ecology and Technology (6 entries)

First - Andre Araujo, *Colorado State University*
Second - Jonah Ziyaaba, *University of Wyoming*

Poster - Weeds of Horticultural Crops and Teaching & Outreach (combined; 3 total entries)

First - Tia Lawrence, *Utah State University*

Oral - Weeds of Agronomic Crops (4 entries)

First - Abraham Akuoko, *University of Nebraska-Lincoln*

Oral - Basic Biology, Ecology and Technology (4 entries)

First - Hayden Lee, *North Dakota State University*

Oral - Weeds of Horticultural Crops (6 entries)

First -Waqas Ahmad, *North Dakota State University*
Second - Sophia Lattes, *Montana State University*

Oral - Weeds of Range, Forestry and Natural Areas and Teaching & Outreach (combined; 4 total entries)

First - Erin Teichroew, *Montana State University*

WSWS 2025 ANNUAL MEETING NECROLOGY REPORT

At the Thursday business meeting, the WSWS members who passed away this year were honored with a moment of silence. Those members were:

Roland D. Schirman

Roland D. Schirman (Nov. 1, 1937-Mar. 22, 2024)

Dr. Roland D. Schirman, 86, of Dayton, WA, went home to be with his Lord and Savior on Friday, March 22, 2024, after a brief but aggressive infection, while attending the Western Society of Weed Science meetings in Denver, CO. Roland was born in Salem, OR on November 1, 1937, and was raised on a berry and dairy farm. He received his Bachelor of Science Degree in Agriculture from Oregon State University. Roland then attended the University of Wisconsin where he completed an M. S. in Agronomy and a Ph. D. in Agronomy with a minor in Plant Physiology.

After graduating from the University of Wisconsin, he began his professional career in Product Development with Chevron Chemical Company located in Fresno, CA. With Chevron he covered 11 states. After two years, Roland accepted employment with the USDA-ARS in Pullman, WA, so he could find more time for his budding family. While working for ARS, Roland conducted research on weed management in No-Till farming in the Palouse Region and also conducted research on the biology and control of rush skeletonweed. Roland always had the best interest of the producers in mind when he conducted his research.

In 1979, Roland accepted a position with Washington State University in Dayton, WA, where he was Extension Agent and County Chair for Columbia County. Roland was an excellent agronomist and weed scientist and had the deep respect of the growers in Columbia and neighboring counties in southeast Washington. He conducted numerous herbicide trials, evaluated alternative crops, worked extensively with direct seeding and minimum or no-till, and he distributed bio-agents for the control of weeds. He worked closely with the Columbia County Noxious Weed Board and served as their Advisor.

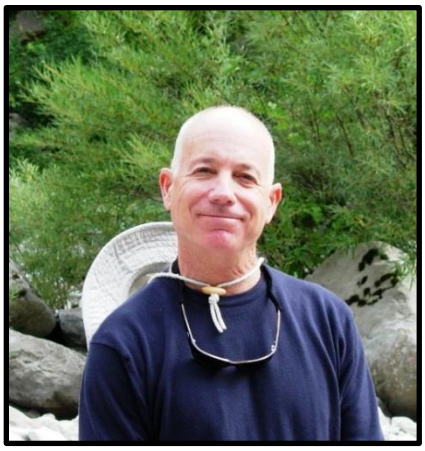
Roland attended every meeting of the Western Society of Weed Science in the past 60 years. He served on numerous committees within WSWS, including Finance, Resolutions, Necrology and Nominating. He was chair of the Physiology/Chemical section. Roland published numerous articles in the WSWS Research Progress Report and made several presentations. Roland frequently volunteered his time to help with the registration desk at the WSWS meetings and help run the meetings. In 2005, Roland received the WSWS Fellow Award.

Roland was a long-time member of the Washington State Weed Association and served on the Board of Directors. In 1992, he was named “Weed Warrior of the Year”, the highest honor awarded to a member. Roland was famous for organizing and running the annual weed identification quiz at the annual meetings.

Roland received many other awards for his contributions to agriculture. They included two notable extension awards, the "Kenneth J. Morrison Award" from the WSU Department of Crop and Soil Sciences and the "Excellence in Extension Award" from the National Association of Wheat Growers. He also received the "Professional Service Award" from the Washington Association of Conservation Districts.

Roland was preceded in death by his parents, Samuel and Lydia Schirman of Salem, OR, his wife, Carol, of over 48 years and his second wife, Betty, of 10 years. He is survived by his children, Steve (Donna) Schirman of Denver, CO; Susan (Shayne) Ganz of Corning, CA; and Jane (Edward) Kover of Eagle River, AR along with grandchildren, Billy Paterson, Jack (Samantha) Kover and Ellen Kover.

Carl E. Bell



Carl E. Bell (October 19, 1951 — July 25, 2024)

Carl Eugene Bell, aged 75, passed away on July 31, 2024 in San Diego. He was born on October 8, 1938, in Los Angeles, to Ellen and Kenneth Bell.

He was a proud resident of California throughout his entire life. He graduated from Alhambra High and attended Cal State Long Beach. He worked for the University of California Agriculture and Natural Resources in Imperial County, finding ways to control weeds and invasive species in agricultural crops. He retired as the Regional Advisor for Invasive Plants in 2014.

Bell began his 35-year UCCE career in 1979 as a weed science advisor in Imperial County, where he advised growers and production consultants on weed management on large farms as well as small-scale and organic produce operations. His research proved solarization was very successful at controlling weeds in organic winter vegetables at a reasonable cost.

In 2000, he was reassigned to Southern California to advise land managers on controlling non-native plants that invaded natural habitats. As UCCE invasive plants advisor, he served San Diego, Orange, Los Angeles, Riverside, Ventura and San Bernardino counties. Later in his career with UC ANR, he served for a period as UCCE director in San Diego County, in addition to his research and extension work. In retirement, he started his own consulting business, So Cal Invasives, to continue providing advice on managing invasive plants. Bell, who was born in Los Angeles, earned his bachelor's degree in botany and master's degree in plant biology from California State University, Long Beach.

"From early on, I realized how lucky I was to be working as a weed scientist, both with UC and with the larger world of weeds outside the ivy-covered walls," Bell wrote in a 2014 blog post announcing his retirement. "Weed scientists and practitioners have always been inclusive, supportive and interesting; and populated by fun-loving, intelligent, hard-working and egalitarian colleagues."

Carl was fun-loving, incredibly intelligent, a great cook, a nature lover, and he worked with passion. He was a snowboarder, surfer, and dancer. Carl enjoyed backpacking and car camping, and visited as many National Parks as possible. He did a sabbatical in Greece at the American farm school in Thessaloniki, where he fell in love with all things Greek. Later in life, Carl enjoyed traveling Europe, visiting botanical gardens all over the world. He became very interested in tai chi, kung fu, and meditation.

He is survived by his wife Judy Bell, sons Nicholas and Gregory, grandson Ocean, and brothers Franklin and Richard.

WSWS 2025 ANNUAL MEETING RETIREES REPORT

The following WSWS members are retired or retiring soon and were recognized during the WSWS Members Welcome Reception on March 10, 2025, in Seattle, Washington.

- Richard Lee, Bureau of Land Management and New Mexico State University
- Glen Letendre, Syngenta Crop Protection
- Tracy Sterling, Montana State University
- Pam Hutchinson, University of Idaho
- Joe Yenish, Corteva Agriscience
- Drew Lyon, Washington State University

Submitted by: Curtis Rainbolt, Immediate Past President

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