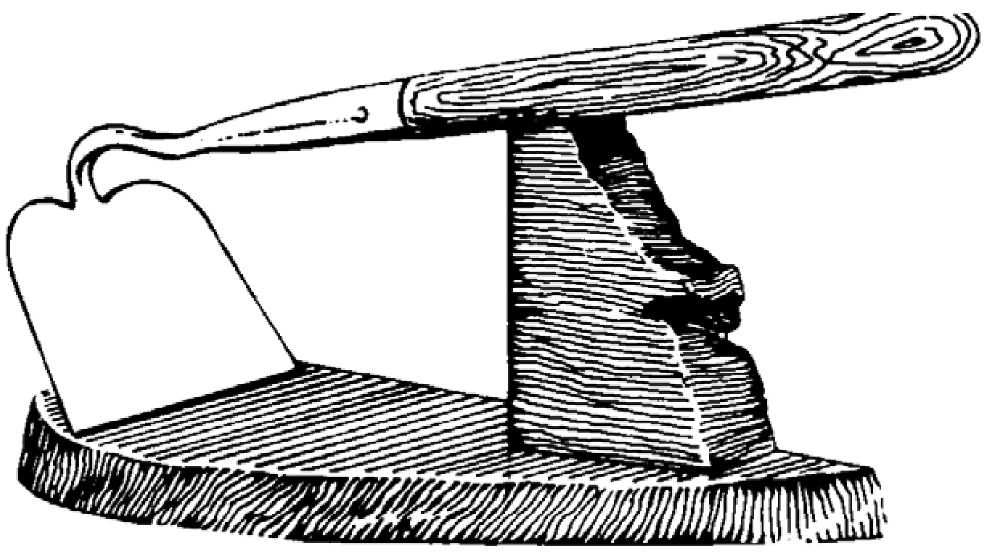
Proceedings

77th ANNUAL CONFERENCE OF THE CALIFORNIA WEED SCIENCE SOCIETY

"Meet Us at the Capital"

January 22-24, 2025



CWSS 1948 - 2025

2025 Proceedings of the California Weed Science Society Volume 77

Papers Presented at the Annual Conference

January 22-24, 2025

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Preface

The proceedings contain contributed summaries of papers and posters presented at the annual conference, year-end financial statement, award winners, and sponsors.

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CWSS 2025 AWARD RECIPIENTS

Presented by Kristina Madden, CWSS President

This year's recipients have made tremendous contributions to the society mission in the following areas: information exchange through research, publications, facilitating cooperation amongst individuals, encouraging careers in weed science, and promoting professional growth for members. I am proud and honored to present these awards to the worthy recipients.

Honorary Member Award

Dave Blodget

Honorary Member Award

Anil Shrestha

Honorary Member Award

Rick Miller

CWSS 2025 Student Contest Winners!

In the middle of January, the California Weed Science Society celebrated its 77th anniversary with a meeting in Sacramento, California. We had a good number of attendees with nearly 550 people registering and attending our conference. There were lots of great presentations made during the sessions. As well as much good discussion in between the breaks, and around the bar. We had an excellent showing of students who presented during the meeting. Overall, this was fantastic participation and representation. I would like to thank all of our students for attending, the judges who scored the competition, and all of the members of the society who engaged and listened to the students. We look forward to learning about all of their hard work in weed science at next year's conference!

Winners!!

Undergraduate Student Poster:

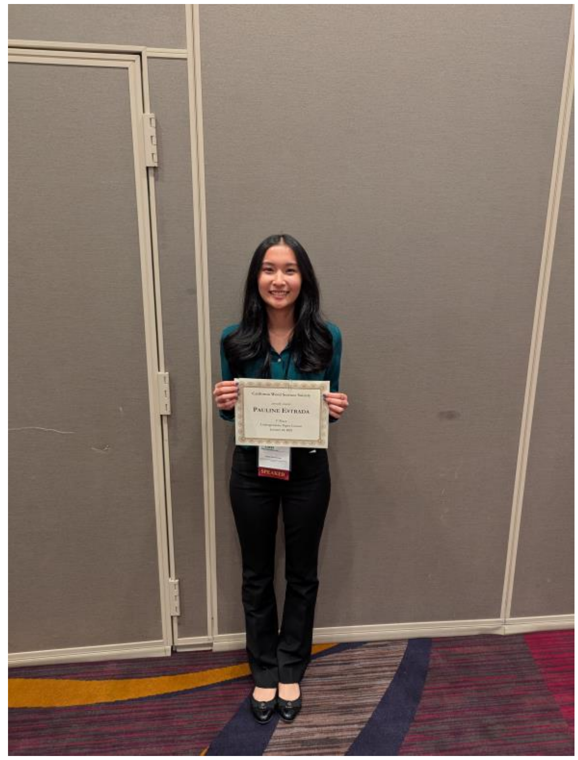
- 1st Place Ni Tang

Graduate Student Poster:

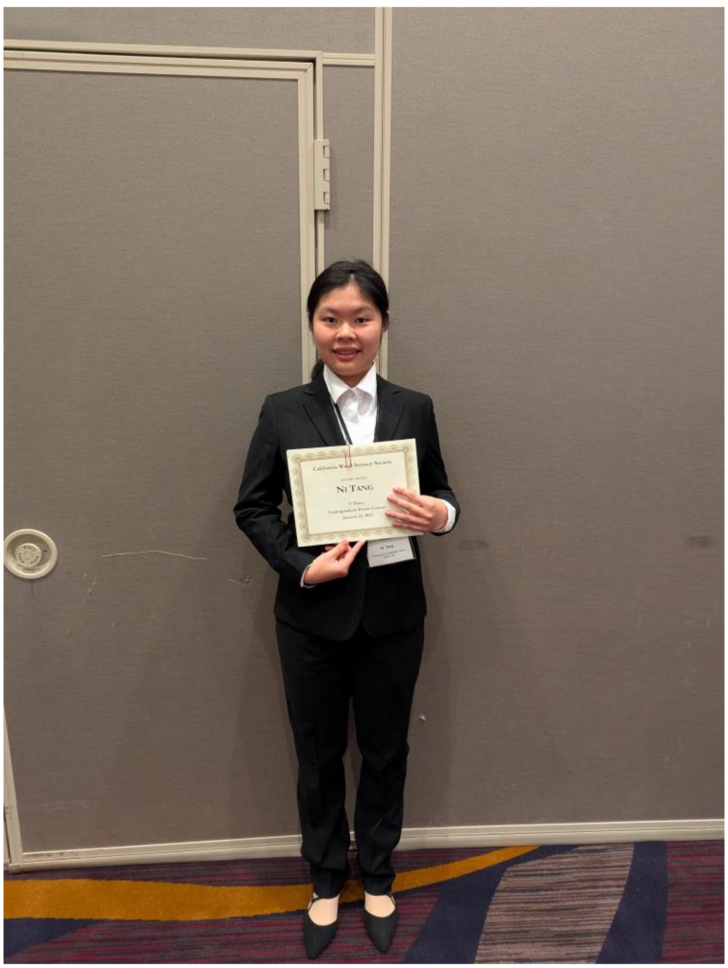
- 1st Place- Valeria Galetti
- 2nd Place- Michael J. Lynch

Graduate Student Paper:

- 1st Place Undergraduate – Pauline Victoria Estrada
    - 1st Place Graduate – Mayra Hernandez



PAULINE ESTRADA
SPEAKER



NI TANG

VICTORIA GALETT
MICHAEL LYNCH

Symptomology of Different Modes of Action Herbicides

Kassim Al-Khatib
University of California, Davis

Herbicide chemistry and physical properties usually determine how herbicides interact with plants. Herbicide symptoms vary depending on the herbicide, the rate of application, stage of growth, type of exposure, and the plant species receptor involved. In general, herbicides with the same mode of action produce similar injury symptoms, because the outward appearance of injury is a function of herbicide effect on the plant at the cellular level. Therefore, it is much easier to diagnose symptoms belonging to different herbicide modes of action than herbicides within the same modes of action. In addition, diagnosing herbicide symptoms can be difficult because herbicide symptoms may look very similar to symptoms caused by diseases, nutrient deficiencies, environmental stress, and soil compaction. While sometimes it is not possible, by visual observation alone, to determine what particular herbicide from the same mode of action may have caused plant damage, it is possible to do so with some other modes of action. For example, there are five types of herbicide chemistry that inhibit acetolactate synthase. Herbicide chemistries, and the individual herbicides within them, may have different physicochemical properties, biological activities, weed control spectrums, soil activities and half-lives but all generally produce similar injury symptoms on nontargeted plants. On the other hand, there are 11 types of herbicide chemistries that inhibit photosynthesis; however, some of these herbicides may cause specific symptoms that can be identified. Furthermore, herbicides from the same mode of action or chemistry may cause different symptoms and injury on the same species. For example, pyridine carboxylic acid herbicide picloram causes different symptoms on cotton compared to other pyridine carboxylic acids such as clopyralid and triclopyr.

In general, annual plants that rapidly translocate herbicide are more susceptible to herbicide damage and may show more injury symptoms. Conversely, perennial plants tend to translocate herbicide slower than annual plants and are also able to dilute herbicide in larger biomass systems, resulting in less injury. Several herbicide injury symptoms, such as general and interveinal chlorosis, mottled chlorosis, yellow spotting, purpling of the leaves, necrosis, and stem dieback, may result from causes other than herbicide exposure. If herbicide damage is suspected, the progression of symptoms and the study of herbicide symptomology in its entirety are critical.

Accurately diagnosing plants that show herbicide injury symptoms is difficult. In many cases, other biotic and abiotic causes may be involved, or it may be unclear what herbicides were applied. Trained researchers, however, may be able to confirm or discount the possibility of herbicide injury by examining plant symptoms, injury progression, and studying other information such as type of herbicide used and history, herbicide rates and application timing, injury patterns, plant species affected, weather data, and soil conditions. However, positive confirmation of herbicide symptoms requires lab testing of the live plant tissue and/or the soil while the chemical is still present at detectable levels. In cases investigating herbicide symptoms, it is easier to accurately diagnose these symptoms from contaminated tanks, soil carryover, misapplication, or sprayer overlapping than from herbicide drift.

Weed species identification: Does it matter?

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Many weeds are non-native plants introduced to North America from Europe and Asia. Some of these weed species: cause economic yield reduction of crops, are poisonous to humans and livestock, cause allergies, are breeding grounds for insect pests, cause damage to the ecosystem, while some are edible, and some have medicinal properties and.

Importance of weed identification

Weed identification is important because:

- No single management technique equally controls all weed species. Effective management of weeds usually requires a combination of techniques.
- A common reason for herbicide failure is applying materials that do not control the particular weed species. Therefore, the skill in choosing the right herbicide is identification of the problematic species.
- All weeds do not cause equal damage to crops. Some species are more competitive and cause greater crop losses than others.
- Different weed species, and even variants (e.g. herbicide-resistant types) within a single weed species, respond to management tactics very differently.
- Different weed species may have different modes of reproduction. Annual weeds produce seeds within a growing season while perennial weeds can reproduce vegetatively from plant parts and care should be taken not to disperse these parts with field equipment.

Difference between native plants, invasive weeds, and common weeds

Native plants are species that are indigenous to the region. They comprise the ecosystem and occur in an area oftentimes prior to the arrival of human settlers. There are cases of native plants becoming problematic in agricultural fields. This could be because of native areas being cleared to plant crops or the actual encroachment of the native plants into the crop fields.

Invasive weeds are those species that are not native to the area. These species usually originate from other countries or other areas within the same country. Invasive weeds are more localized in non-crop areas than in crop fields and cause more ecosystem damage than crop losses.

Common agricultural weeds are those that infest crop lands. They can be of foreign or local origin. These species are categorized as weedy pest species.

How to identify weeds

Weeds can be divided into three main categories, broadleaves, grasses, and sedges.

Broadleves are dicots and the shape of cotyledon can help in their identification. The shape of the cotyledon may be linear, oblong, oval, round, or butterfly shaped. The true leaves are attached to the stems in an alternate pattern or opposite of each other. The shape of the leaf base, round, clasping, etc.; the shape of the leaf apices or tips, round, acute etc.; the texture of the leaves, waxy or hairy, thick or thin; color of the leaves, light green, dark green, bluish, purplish, etc. can all be identifying features.

Grasses are monocots and can be identified by key structures in the collar region, auricles and ligules. The shape of the leaf blade, presence or absence of hairs on the blades, the presence or absence of keel, and shape of leaf tips also help in identification. Other identification features include the presence or absence of hairs on the sheath, shape of the sheath, flatness and roundness of the stem etc.

Sedges have triangular stems and are generally perennial with asexual reproductive structures.

There are various resources for weed species identification including books, pictures, CDs, herbariums, interactive websites, and computer and phone apps.

In recent years, considerable research is being conducted on the beneficial aspects of weeds such as medicinal properties, beneficial physiological mechanisms, and culinary value.

In conclusion, identification of species is important to determine whether they are native, invasive, or common agricultural weeds. It is equally important to know their biology, reproductive mechanisms, and competitiveness to develop effective management strategies.

Long Term Effects of Fire Retardants on Grassland Ecosystems

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Wildfire frequency and magnitude are increasing in California. Fire retardants represent a widely used and depend on mode of combating wildfires. PhosChek, PC (monoammonium phosphate and ammonium polyphosphate) and Fortress ($MgCl_2$) are the two most widely used retardants in California recently. Grass dominated rangeland field trials were established in the Summer of 2023 at Cal Poly San Luis Obispo to compare and assess the environmental effects including vegetation ecology impacts of the two retardants. Both retardants were tested at three different application rates: a zero application for controls, the label rate (1x), and a 2x label rate. Prior to receiving 4" of rainfall, vegetation height was significantly increased for PC treated plots and significantly decreased for $MgCl_2$ treated plots. The $MgCl_2$ plots recovered to near control levels after total rainfall surpassed 4", but vegetation in PC plots remained significantly taller. Plots treated with $MgCl_2$ maintained a higher amount of plant diversity compared to PC treated plots which yielded a disproportionate majority makeup of annual exotic grasses. Although there were trends, an analysis of biomass, photosynthetic efficiency, and leaf area index in the field did not show any statistically significant relationships in the first year of application. Based on the data trends, we may see significant differences after two additional years of data collection in this three-yr study. A greenhouse experiment was conducted over the summer of 2024 to evaluate retardant effects on more detailed physiological performance measures for the most common native grass, Purple Needlegrass, PNG (*Nassella pulchra*) and the most dominant annual exotic grass, Italian Ryegrass (*Lolium perenne spp. multiflorum*). Treatments were made to match the retardant and rate applications in the field. The greenhouse trial focused on early development stages of the grasses. $MgCl_2$ was the only significant suppressor of germination for both grasses, yet PC did reduce germination for PNG beginning at label rate. Dry weight and leaf area both followed the same declining pattern as application rates were increased. Ryegrass was most sensitive to $MgCl_2$ in contrast with PNG which was most sensitive to PC. The findings of this study will inform wildfire management decisions associated with vegetation ecology in grass-dominated rangelands.

Rapid Detection of Acetolactate Synthetase Inhibitor Resistant Weeds Utilizing Novel Full-Spectrum Imaging and a Bayesian-Optimized Hyperparameter-Tuned Convolutional Neural Network (CNN)

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Global loss from weed infestations amounts to approximately $95 billion annually. Herbicide- resistant (HR) weeds are rapidly contributing to this problem and are a significant threat to sustainability of crop production. Late detection of HR weeds further aggravates economic losses and can cause environmental damage. Traditionally, genetic sequencing and herbicide dose - response studies are used to detect HR weeds, but these are expensive and slow processes. To address this problem, an artificial intelligence (AI) based HR weed identifier program (HRIP) was developed to quickly and accurately distinguish acetolactate synthetase inhibitor (ALS)-resistant from susceptible common chickweed (*Stellaria media*) plants. A regular camera was converted by removing the built-in hot mirror filter to capture spectral light wavelengths from 300 to 1,100 nm. The converted camera was used to obtain full spectrum images. The full spectrum images obtained from a two-year experiment were then used to develop a Bayesian-optimized, hyperparameter-tuned, convolutional neural network (CNN) model utilizing a train from scratch method. This novel approach exploits the subtle differences in the spectral signature of ALS-resistant and susceptible common chickweed plants as they react differently to the ALS herbicide treatments. The HRIP was able to identify ALS-resistant common chickweed plants as early as 72 hours post treatment at an accuracy of 88%. It has broad applicability due to its ability to distinguish ALS- resistant from susceptible chickweed plants regardless of the type of ALS herbicide or dosage rate used. Utilizing tools such as the HRIP will allow farmers to make timely interventions and develop more effective and safer weed management practices that can optimize yield, reduce herbicide use, minimize environmental harm, and improve overall public health. It can also prevent herbicide - escape plants from completing their life cycle and adding to the weed seedbank.

Evaluation of Electrical Weed Control in California Orchards.

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[1]Plant Sciences Department, University of California, Davis

Managing weeds is challenging in sustainable and organic tree crops in California. Electrical weed control (EWC) might be a new alternative for growers. The Zasso™ Tractor-Based electrical weeding unit controls orchard weeds by physical contact with the applicator electrodes, which can pass electrical current to the target vegetation. This project aims to evaluate the weed control efficacy and crop safety of EWC in California almond orchards. In April 2023, a crop safety study was initiated at UC Davis to examine how newly planted almond trees, and the soil microbial community respond to four EWC applications in two growing seasons. 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, and traditional hand weeding and mowing were used as routine maintenance. 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 7 DAT after every application. Tree trunk diameters and heights were recorded at the end of the 2023 and 2024 seasons. Soil samples were sampled and analyzed in October 2023 and November 2024 to measure soil microbial respiration. The highest power EWC treatment can provide 100% weed control for up to 40 days. The tree growth and soil respiration data showed insignificant treatment effects, suggesting EWC did not impact tree growth and biological soil health in the 2023 and 2024 growing seasons.

Utilizing Integrated Vegetation Management Techniques to Protect Electric Utility Assets and Provide Ecosystem Benefits in the Upper American River

Hanna L. Franklin (hanna.franklin@smud.org). Vegetation Management Student Staff Assistant for Electric Delivery and Operations, Sacramento Municipal Utility District (SMUD).

From Folsom Lake to the Sierra Nevada mountains, resides a plethora of notable environmental features, such as the American River watershed that connects them, mineral-rich soils, and endemic rare plant species. This region also houses hydroelectric facilities and transmission lines that help generate and distribute power to over 1.5 million Sacramento Municipal Utility District (SMUD) customers/community owners. Thus, careful consideration is needed to ensure that electricity is delivered safely and reliably while maintaining the ecological resources that support this effort. A pivotal part of this strategy involves managing and monitoring noxious weeds that have the potential to compromise these goals. Specifically, SMUD utilizes a site-specific integrated vegetation management approach, which is a combination of biological, cultural, manual, mechanical, chemical, and other targeted treatment methods, to control invasive vegetation and promote native low-growing early successional plant populations. To monitor the effectiveness of the treatments, the ranges of weed species near SMUD assets in the Upper American River watershed were documented over five years. Weeds were categorized into three groups based on the Eldorado National Forest invasive plant rankings: group one (i.e., tree of heaven (*Ailanthus altissima*), perennial pepperweed (*Lepidium latifolium*), etc.), which are highly invasive and are the highest priority to address, followed by groups two (i.e., yellow star-thistle (*Centaurea solstitialis*), French broom (*Genista monspessulana*), etc.) and three (i.e., black mustard (*Brassica nigra*), Himalayan blackberry (*Rubus armeniacus*), etc.). Results show that all noxious weed species recorded in the baseline survey (in 2016) displayed reduced coverage anywhere from 59 to 100% in the final survey (in 2021). A total of seven new invasive plant species were discovered in the final survey; however, the ranges of these were relatively minimal (median of 0.06 acres). Collectively, weeds in group one (n = 4) showed an expansion of 0.06 acres (353.8% change), species in group two (n = 8) were reduced by 364.12 acres (98.6% change), and group three (n = 11) populations decreased by 1,058.24 acres (79.6% change). Note, that the range of the sole group one species documented in the initial survey shrunk by 58.6% by the final survey. These findings point to the effectiveness of utilizing IVM techniques to manage undesirable vegetation within utility corridors in the Upper American River. Importantly, the emergence of new high- priority noxious weed species emphasizes the necessity of implementing a data-driven, adaptable utility vegetation management program. Overall, this data demonstrates the potential for utility vegetation management to be conducted both responsibly and sustainably.

Response of desert-native perennials to inoculum from invasive weeds and native annuals

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Anthropogenic disturbances have led to the degradation of ecosystems across the globe and contributed to the spread of invasive weeds. Invasive weeds may displace native species and alter biotic and abiotic conditions to their benefit, necessitating human intervention to restore native species. However, restoring invaded ecosystems remains a significant challenge and there is a strong need for successful and cost-effective restoration techniques. Research in plant-soil feedback has shown potential applications in restoration, specifically the symbiosis between plant roots and arbuscular mycorrhizal fungi (AMF). Our study seeks to increase the success of restoration by utilizing inoculum that can be created in-situ using fast-growing native annuals.

We were also interested in evaluating if conditioning soil microbial communities with native annuals could increase subsequent performance of native perennials compared to soils conditioned by invasive weeds.

Inoculum was created by conditioning soil from a mine site within the Mojave Desert with monocultures of native annuals and invasive weeds, and a native annual polyculture. The resulting inoculum was then used to grow native perennial species representing two life-forms, desert needlegrass (*Stipa speciosa*) and eastern Joshua tree (*Yucca jaegeriana*). Plant biomass and root infection were measured after three months of growth. Both perennials, desert needlegrass and eastern Joshua tree, exhibited increased shoot growth when grown in soils with desert plantain (*Plantago ovata*) inoculum. Desert needlegrass also exhibited greater shoot growth in soils with inoculum from the native polyculture. However, eastern Joshua tree exhibited reduced growth in soils with inoculum from the invasive weeds red brome (*Bromus rubens*) and Saharan mustard (*Brasssica tournefortii*). Desert plantain has been recognized in previous literature for successfully establishing relationships with AMF and many mustard weeds have been noted to not form relationships with AMF. Using native annuals to condition soils may serve as a cheap and effective approach to enhance native plant restoration, especially in disturbed and previously invaded soils.

Growth and response of four *Vallisneria* taxa to aquatic herbicides.

Jens Beets[1*], Erika Haug[2], Benjamin Sperry[3], Ryan Thum[4] and Robert Richardson.
[1]USDA-ARS; [2]North Carolina Division of Water Resources; [3]US Army Engineer Research & Development Center; [4]Montana State University; [5]North Carolina State University.
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Greenhouse mesocosm experiments were conducted in 2023 to investigate herbicide efficacy on two native eelgrass species (*Vallisneria americana* Michx. and *V. neotropicalis* Vict.) and two nonnative taxa (*V. australis* S.W.L. Jacobs & Les and *V. spiralis* × *V. denseserrulata* Makino). Herbicide applications included endothall, diquat, florpyrauxifen-benzyl, flumioxazin, and fluridone, at select combinations of these herbicides. Endothall alone provided 90-100% aboveground biomass reduction at 3000 µg/L with at least 24 hours of continuous or intermittent exposure. Florpyrauxifen-benzyl applied alone resulted in minimal aboveground biomass reduction.
Fluridone applied at 10 µg/L with 45 days of exposure resulted in 94.5% biomass reduction on *V. americana* and 7.1 to 47.9% on other tested taxa. The combination of flumioxazin and florpyrauxifen-benzyl resulted in 90- 100% aboveground biomass reduction and endothall combined with florpyrauxifen-benzyl resulted in 93-100% aboveground biomass reduction.
Reductions in belowground biomass mirrored trends observed in aboveground biomass. No selective treatments were identified between native and invasive *Vallisneria* tax and all treatments were effective on *Hydrilla* bioindicator plants. These insights provide a basis of understanding differences (or lack thereof) between these *Vallisneria* taxa for researchers moving forward with selectively targeting *Hydrilla* in the presence of native *Vallisneria* staxa and two new exotic *Valisneria*. Future research should expand treatment and concentration exposure scenarios, increase the study period past six weeks, as well as identify potential integrated plant management strategies for field scenarios.

Evaluating the Effect of Endothall-treated Irrigation Water on California Crops.

Stephen C. Chang* and Bradley Hanson. Department of Plant Sciences, University of California, Davis, CA, USA. *Corresponding author (stephenchang2017@gmail.com).

Endothall (7-oxabicyclo [2.2.1] heptane-2,3-dicarboxylic acid) is widely used as an aquatic herbicide to control submerged aquatic weeds. Two formulations of endothall are registered for application in irrigation canals: the dipotassium salt (Cascade®) and the mono (N, N-dimethylalkylamine) salt (Teton®). To address grower concerns that endothall-treated irrigation water could have phytotoxic effects on California crops, experiments were conducted in the greenhouse in 2023 and in the field in 2023 and 2024 at UC Davis to characterize potential phytotoxicity. Concentrations used in the experiments were selected referencing the maximum application rate of endothall of 5 ppm ai within a seven-day window for use in irrigation canals. In the greenhouse studies, foliar applications of Cascade® and Teton® were applied at a spray volume of 20 GPA at varying concentration ranges (0.31 to 160 ppm ai) on corn (*Zea mays*) and kidney bean (*Phaseolus vulgaris*) to simulate exposure via sprinklers in an orchard. No crop injury was observed from foliar applications at the tested concentrations. A subsequent greenhouse study was conducted with substantially higher concentrations of Cascade® and Teton® (5 to 20,480 ppm ai) in a 20 GPA carrier volume. Necrosis and defoliation were observed at concentrations of 1,280 ppm and above on leaves that were directly treated with the herbicide. However, newer leaves that formed after treatments were unaffected. Further greenhouse studies were conducted to evaluate the effect of drench applications of endothall to simulate flood irrigation. Cascade® and Teton® at nine concentrations (5 to 1,280 ppm ai) were applied to the soil as an 8.45 oz mix in 1-gallon pots containing three corn or kidney bean plants at the vegetative growth stage. An injury in the form of slight wilting in kidney bean was observed at 40 ppm endothall. Kidney bean leaves had chlorosis and corn leaves were slightly wilted at 160 ppm. Defoliation was observed from kidney beans at concentrations of 320 ppm and above and both species exhibited necrosis. In a field study conducted on established (7-year-old) almond (*Prunus dulcis*) trees, berms were erected to create 9 by 11 ft plots around each tree to contain a simulated flood irrigation with endothall-treated water. Treatments included five endothall concentrations (1.25 to 20 ppm ai) and three volumes of water (1, 2, and 4 acre-inches) applied in July 2023 as Cascade® and again in September 2023 as Teton®. These trees were re-treated in 2024 with Cascade® in June and Teton® in August. No signs of injury to established almond trees were observed following either application in either year. In a field study conducted in 2024, endothall treatments were applied as a simulated flood irrigation to one-year-old almond trees. The almond trees were planted on April 2024 into sites prepared with a 36-inch auger and holes alternately backfilled with Delhi sand or the native clay loam soil. After planting, a plastic landscape edging barrier was inserted around each tree to define a 3-foot diameter plot to contain the flood irrigation treatments in the amended-soil root zone of each tree. Endothall was applied at four concentrations (2.5 to 20 ppm ai) in two volumes of water (1 and 2 acre-inches). The treatments were applied four times during 2024: Teton® in late May and Cascade® in late June, early August, and early September. No signs of injury were observed with any of these treatments during the 2024 growing season. In a field study conducted in 2024, individual rows of corn, kidney bean, tomato (*Solanum lycopersicum*), and sunflower (*Helianthus annuus)* were planted on May 2024. Cascade® at four concentrations (2.5 to 20 ppm ai) were applied in 2 ac-in of water in July 2024 to simulate a furrow irrigation event. No injury to the listed crops were observed. No injury was observed on established almonds treated with up to 20 ppm endothall in up to 4 acre-inches of water four times over a two-year period or on newly planted almonds treated with up to 20 ppm endothall in 2 acre-inches of water applied four times in the first season after planting. On annual crops treated in the greenhouse, necrosis was observed on some plants but only at concentrations eight or more times greater than the 5-ppm target application in canal treatments. On annual crops treated in the field, no injury was observed following treatments of up to 20 ppm endothall in 2 ac-in of water. Our research results indicate that irrigation water treated within the allowable application rate (up to 5 ppm) of either formulation of endothall was not injurious to crops tested in this series of experiments.

Navigating New EPA Pesticide Regulations and the Endangered Species Act (ESA)
- Josie Hugie, December 2024, CWSS Article

EPA Signals Major Shifts in Pesticide Application for Agriculture

Early estimates suggest that up to 50% of agricultural land currently using crop protection chemicals may need adjustments to pesticide application methods to comply with the Endangered Species Act. This development is significant, leaving many wondering what changes lie ahead as the EPA addresses these obligations.

Why Now? A Look Back at the Endangered Species Act

The Endangered Species Act (ESA), a federal law in place since 1973, mandates protection of threatened and endangered species, or 'listed' species. Traditionally, pesticide registrations regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) have focused on evaluating toxicity, environmental effects, and risk through using a generalized set of non-target species in required tests and models.

When a pesticide poses potential risks to an endangered species, the EPA is required to consult with the U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS) to strategize mitigation efforts. However, these consultations often stretch over several years, delaying protections for vulnerable species after the FIFRA registration process has concluded. Because the historical process for registration of new pesticides has been out of alignment with the ESA requirements specifically addressing listed species and their habitats, environmental groups and even some federal agencies have pushed for change. Although the ESA has not changed, lawsuits against the EPA related to actual or potential harm from pesticides to listed species have accelerated a response to address ESA obligations in a more proactive approach.

The Shift: Integrating ESA with FIFRA

The ultimate goal? Aligning ESA protections with FIFRA's registration process is critical. This integration is no small task, and it requires the EPA to reevaluate many existing pesticides while still working to keep the registration process as efficient as possible. The EPA has started implementing this shift through the "Balancing Wildlife Protection and Responsible Pesticide Use" Workplan, first published in 2022 and updated regularly. It highlights high-priority areas, such as habitat loss from herbicides and pollinator threats from insecticides. To address these concerns, the EPA has recently introduced a draft strategy for insecticides and a finalized strategy for herbicides, both aiming to reduce risks to endangered species from potential pesticide exposure or from damage to their critical habitat. Importantly, evaluations of products resulting in buffer zone requirements will have language incorporated into its FIFRA-registered pesticide label.

Scope of Impact and the Driving Forces Behind the Change

Currently there are over 1,600 species[1] in the United States that are listed as threatened or endangered. In 2023, 21 species were declared extinct and removed from the list, highlighting the need for stronger protection for listed species. Ample protection includes, but is not limited to, ensuring the safe use of pesticides near and within sensitive ecosystems. Regions like Hawaii, California, and the southeastern U.S., home to many of threatened or endangered species, may see the most significant impacts of updated pesticide labels.

To identify the areas where risks to endangered species are greatest, the EPA has examined over 3,000 U.S. counties, focusing on three key routes of off-target pesticide exposure: runoff, erosion, and spray drift.

Pesticide Use Limitation Areas (PULAs)

Geographical areas critical to endangered species may be designated as Pesticide Use Limitation Areas (PULAs), where growers must take additional steps to prevent off-target pesticide impacts. Growers and applicators can use the EPA's Bulletins Live Two (BLT) website to determine if individual fields are within a PULA for specific products, though the EPA's online training may be necessary to use the tool effectively.

Buffer Zones and Mitigation Strategies

Within PULAs, risk reduction practices such as buffer zones around fields may be required based on risk levels and will be identified on updated product labels. Buffer sizes will depend on species and exposure risk and can be reduced by applying mitigation strategies—practices that help offset potential impacts. Just like PPE protects people handling pesticides, these buffers serve as "environmental PPE," shielding threatened species or habitat from pesticide exposure.

The EPA has developed a "Mitigation Menu" that lists measures to offset buffer zones. A few examples include:

- Annual application rate reduction
- Conservation tillage and contour farming
- Ground cover, vegetative filter strips, and mulching
- Drift reduction techniques like low-boom sprayers, coarse droplet nozzles, and downwind windbreaks

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1 https://ecos.fws.gov/ecp/report/boxscore

Now, here are a couple hypothetical examples in Jennifer and Heather's Fields

1. Jennifer's almond orchard has moderate runoff risk and requires a 100-foot application buffer with her chosen pesticide. By using no-till practices in her low-sloped field (<3% grade) and planting vegetative filter strips (mowed cover crop within and outside of the tree rows), Jennifer earns enough mitigation points to avoid the buffer altogether.

2. Heather's vineyard is adjacent to a high-risk habitat and her high-impact herbicide choice requires a 230-foot buffer due to spray drift potential. She can reduce the size of the required buffer by 90% through using a low boom equipped with nozzles producing a course droplet size and using a drift-reducing adjuvant. The day of application, due to spraying during high humidity (>60% RH), she recovers the last 10% of the required buffer—allowing her to spray up to the field edge.

Looking Forward: Continued EPA Updates and Mitigation Tools

The EPA plans to incrementally implement ESA protection, focusing on high-risk species first. They are also reviewing the effectiveness of drift-reducing agents (DRAs) and consulting experts to establish qualifying criteria for adjuvants that could help growers further reduce spray drift risk and minimize buffer requirements.

With resources like the "Mitigation Menu" and websites to track updates, growers can stay informed on approved techniques for managing risks under the new ESA requirements. The full implementation process will take time, allowing the EPA to focus on protecting endangered species while minimizing disruptions to agricultural practices.

Supporting Applicators and Farmers through Change

These regulations will reshape pesticide application practices, more so in some areas than others. By staying informed and helping others navigate these changes, agricultural experts can play a vital role in fostering sustainable farming practices that protect both crops and our nation's endangered species.

Links to Key resources:

EPA Main Page for Endangered Species Act Protections
EPA's Balancing Wildlife Protection and Responsible Pesticide Use Workplan Draft Insecticide Strategy and Final Herbicide Strategy
Bulletins Live Two and Tutorial EPA's Mitigation Menu
WSSA – Herbicides and ESA

Aquatic Weed NPDES Permit Update

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Since 2001, treatment of aquatic weeds or algae with algaecides or aquatic herbicides requires an NPDES permit if applications are made to or discharged to Waters of the United States (WOTUS). The definition of WOTUS has changed over the last few years with the issuance of a Final WOTUS Rule by U.S. Environmental Protection Agency and the Supreme Court's Sackett Decision. It is critical to understand whether or not a Discharger's project activities could result in the discharge of pesticide or residual pesticide to a WOTUS when evaluating if permit coverage is needed. The Aquatic Weed NPDES Permit provides legal protection from citizen lawsuits under the Clean Water Act and allows for the application or discharge of approved residual pesticides. Dischargers must prepare an Aquatic Pesticide Application Plan, complete a Notice of Intent and go through a 30-day public comment period to enroll in the permit. Once enrolled, the permit requires implementation of BMPs, water quality monitoring and the submission of annual reports to maintain compliance.

The current Aquatic Weed NPDES Permit is being re-written by the State Water Resources Control Board (SWRCB) to consolidate the four existing aquatic pesticide permits - Weed Control, Vector Control, Aquatic Animal Invasive Species and California Department of Food and Agriculture – into one combined permit. The SWRCB's stated goal with the combined permit is to reduce staff workload when it comes to permit reissuance and streamline enrollment for dischargers. SWRCB staff anticipates circulating a public draft of the permit in the second half of 2025, which will then be sent to the Board for approval in 2026.

CDFA Noxious Weed Regulations & Hydrilla eradication

Trevor Fox
California Department of Food and Agriculture

The California Department of Food and Agriculture has housed the Hydrilla Eradication Program since 1977. Eradication of hydrilla is a cooperative state effort, sharing resources between several sister agencies including the U.S. Bureau of Reclamation and California Department of Water Resources and California Department of Parks and Recreation Division of Boating and Waterways. Since the Hydrilla Eradication Program's inception it has achieved some of the Department's greatest successes by keeping California effectively free of this destructive weed. While conducting Hydrilla surveys and eradication projects staff regularly encounter and map additional aquatic weeds. This presentation will focus on the identification, ecology and biology of Hydrilla plants in California and the regulations and permitting governing CDFA's noxious weed removal operations.

Hulk™ Herbicide with Rinskor™ Active: A New Post-Emergent Herbicide for Broadleaf Weed Control in Tree Crops.

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Weed management in California orchards is an intensive year-round effort critical to overall agronomics of a successful crop, from early establishment through maintenance of a mature orchard. Recent shifts toward continuous germination of problematic annual weeds have resulted in a wider range of weed stages often present at the time of post-emergent herbicide application. This limits utility of traditional burn-down post-emergent herbicides, which often result in less-effective control and regrowth of weeds that have advanced beyond the typical seedling and rosette stages. Hulk™ herbicide with Rinskor™ active (florpyrauxifen-benzyl) demonstrated highly efficacious post-emergent control of key broadleaf weeds in recent field trials, both alone and in tank mixtures. As opposed to burn-down options, Hulk herbicide's systemic mode of action allows for a slow but thorough kill of target broadleaf species, preventing regrowth even following treatment of weeds as advanced as early flowering stage. Hulk™ represents a new mode of action herbicide (HRAC4 subgroup) in California tree fruit and nut crops, with an excellent safety and sustainability profile.
Hulk™ herbicide is currently registered in 25 US states, while Hulk™ CA is undergoing regulatory review for registration in California.

Weed Management Using Organic Herbicides in Perennial Crops.

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Organic herbicides are available to control weeds in conventional and organic perennial crop systems. However, due to the non-systemic or non- residual characteristics of those organic herbicides, the traditional broadcast application systems are challenging to implement, and weed control effectiveness is highly dependent on weed growth stages, weed species, infestation pressure, and germination intensity. Although there are few products that are labeled as organic options for perennial crop systems, the viability, practicality, and efficiency of these alternative herbicides are poorly understood. Field trials were conducted during the 2023 and 2024 growing seasons on walnut orchards in Lake County, CA, to examine the efficacy of alternative organic herbicide application programs for walnut orchard weed management. Weed Pharm (Acetic acid), Suppress (Caprylic acid + Capric acid), and AXXE (Ammonium nonanoate), and Scythe (Pelargonic Acid) applied at single, two, or three sequential applications. In addition, Roundup PowerMax (Glyphosate) and Rely 280 (Glufosinate), were included as a standard treatment. The results showed that all organic herbicides tested in these studies presented similar responses in efficacy and provided high initial performance with control greater than 75 % at 3 DAIT. However, most weeds have the ability to recover very quickly, and acceptable threshold control only lasts a few weeks. Due to their non-systemic activity organic herbicides are more effective on small and medium-sized annual weeds. Our results indicated that two to four applications of these herbicides are needed to provide glyphosate or glufosinate-like control and keep the orchard floor weed-free throughout the growing season, but effectiveness changes by weed pressure, weed species, and weed growth stage at the time of application.

Trunk Injury Prevention: Revisiting Latex Paint as a Protectant

Ryan J Hill
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Tree trunks in young orchards are sensitive to injury from a variety of sources, including herbicide and sunburn. Physical barriers like trunk cartons and grow tubes are commonly used to protect young trees but these products come with unique challenges including carton deterioration, increased pest and disease pressure, and labor and material costs. Recent projects have tested whether white latex paint can protect young almond and hazelnut trunks from herbicide injury but resulted in conflicting conclusions. An interior formulation of latex paint increased herbicide injury symptoms in almond trees but an exterior formulation of latex paint protected hazelnut trees from herbicide injury. Typically, exterior formulations of white latex paint have not been recommended by UCCE advisors due to wide variation in the ingredients in these products, some of which may be phytotoxic. If exterior formulations of white latex paint provide protection from herbicide injury and are adequately safe to use on young trees the benefits may outweigh the risks of using these paints.

Several trials were conducted in the Sacramento Valley to assess how paint formulation differences affect tree growth, and preliminary results are reported here. In spring 2024 prune and walnut trees were planted and subjected to a set of eight trunk protection treatments including: bare trunk, trunk guard, diluted interior paint, interior paint, and four exterior paints.

Trees were monitored for symptoms of phytotoxicity, and tree growth measurements were collected at the end of the growing season. Results suggest that all treatments were an improvement over the unprotected bare trunks and that the interior and exterior paints tested were not injurious to young walnut and prune trunks. These trees will be monitored for at least one more growing season.

Fight between the cover crops and the weeds in an almond orchard floor: observations made over four years!

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Carefully managed cover crops can reduce and suppress unwanted plants in almond orchard floors, while improving soil quality and serving as food sources for pollinators in winter months. All the cover crop species do not provide similar benefits. Some are better for pollinators, but do not improve soil quality, while others are poor competitors with weeds. The four-year study found that most of the aforementioned benefits could be achieved with proper selection of cover crop species without impeding other orchard management activities.

The cover crops were initially planted in the winter of 2014-15 season. The species included PAm (Project Apis m) Mustard mix and Rapini seeds in the row middles of the almond orchard. The number of honeybees visiting the blooming cover crops and almonds (at 80% and 100% bloom) were counted and recorded hourly between 10 AM and 4 PM. The number of bees visiting on the almond flowers depended upon the air temperature rather than the presence of blooming cover crops.

In the second year of the study (2021-22), the objectives of the study were to determine: 1) the cover crop species best suited in a young almond orchard, 2) the best cover crop species improving the soil quality, and 3) if an herbicide could be used to terminate the cover crop. Three Project Apis m recommended cover crop mixes, mustard, clover and Soil Builder were planted in almond orchard row middles in a randomized complete block design with 4 replications. Each plot was 375 feet long and x 10 feet wide (115 m x 3 m). Four replications without cover crops were also included as control plots. The percentage of ground covered by weeds and cover crops within a 3.2 ft long x 6.5 ft wide (1 m x 2 m) randomly selected area within each plot was visually estimated. Twelve samples were taken per treatment (three cover crop species and control) and repeated four times between January and March of 2022. Honeybee's visits in the bloom were counted for 30 seconds in five locations per middle for a total of 20 locations per treatment. The process was repeated twice at 5% and 50% bloom of mustard and Soil Builder. Soil samples were taken at a depth of 0-6 inch (0-15 cm) before the cover crop seeds germination and at cover crop maturity before termination. The soil cores were taken at six different locations in each treatment plot. The samples were aggregated and mixed to make one sample per plot for a total of four samples per treatment. The samples were sent to AgVise lab (Northwood, ND) for total carbon, organic carbon, active carbon, soil organic matter, pH and a few other chemical moieties.

Results showed that the mustard mix treatment was the best for weed suppression, it provides 95% of ground cover, while the Soil Builder covered 80-90%. The clover mix treatment plots had slow germination and were mostly covered by weeds. The Soil Builder had the highest level of active carbon accumulation in the soil compared to other treatments in 2021-22. The number of honeybee visits corresponded with the percentage bloom. Two of the three cover crops provided good food sources to the pollinators (mostly honeybees, with different species of syrphid flies and a few bumble bees), but only one of them increased the soil organic matter and active carbon. The mustard and Soil Builder plots could not be terminated by herbicide applications mainly because of their size and height. On the other hand, if they were terminated sooner, it would have compromised the other benefits of cover cropping.

Therefore in 2022-23 season, both mustard and clover mixes were replaced with white clover (*Trifolium repens*) and Lacy Phacelia (*Phacelia tanacetifolia*) respectively.
The cover crops were terminated on April 5, 2023, when Phacelia were at full bloom and the plants were about 2 feet tall (~0.6 m). Some weeds were slightly taller than 2 feet at this time, but majority of them were short. Glyphosate (Roundup at 36 oz/ac) killed all the plants that came in contact with it leaving behind some plants like clover and very small weeds growing under the larger plants. Soil tests showed that Soil Builder had a long term (at least two years) positive effect on soil quality followed by Phacelia.
In the fourth year of study (2023-24), winter wheat was planted as a replacement for clover and Phacelia to determine if there would be any residual effects of treatments. Wheat plants were slightly taller in the plots where they were treated with glyphosate in the previous season. Not significant, but there were slightly more weeds in the untreated plots than in previously treated plots.
In conclusion, PAm Soil Builder and Phacelia are good cover crops in almond orchards for weed suppression with a possibility of at least one herbicide application reduction during the winter/spring season.
Furthermore, benefits included improvements in soil quality, increased water infiltration thus reducing waterlogging in the row middles, and the forage for the honeybees and other pollinators.

Herbicide Resistance Challenges and Characterization of Potential Herbicides in Water-Seeded Rice.

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Herbicide-resistant weeds are an ongoing management challenge in California water-seeded rice. Herbicide resistance is prevalent in nearly all common weed species present. Watergrasses (*Echinochloa* spp.) have resulted in suspected resistance to up to five modes of action. Survey screening methods where growers submit suspected resistant weed seeds for testing to the University of California allow for monitoring and support of herbicide resistance management. However, new herbicides are still necessary to support management of resistant populations. Pendimethalin was characterized by water-seeded rice through a series of studies from 2020 to 2024 including field studies, cultivar response, evaluation in herbicide mixtures, and water-seedling response to partitioning behavior in the environment. Pendimethalin is not registered in water-seeded rice; however, a post-emergence application after the 3- to 4-leaf stage at 2.0 lb ai/A rate demonstrated reduced crop injury. The rice seedlings absorbed 50% or more of applied pendimethalin, followed by soil adsorption, and below 10% was recovered in the water after application at three different rice growth stages. Management practices that promote rapid seedling establishment may provide greater tolerance to pendimethalin and an opportunity to integrate new herbicides for water-seeded rice.

Dodhylex™ active: A Novel Mode of Action Herbicide inhibiting Dihydroorotate Dehydrogenase (DHODH) enzyme for Effective Management of Herbicide-Resistant Grass Weeds Globally.

Scott Swanson FWC

The last new herbicidal modes-of-action holding commercial significance was introduced to the marketplace multiple decades ago. Serious weed resistance have since emerged with widespread use to the most herbicidal classes. Currently in development by FMC Corporation, Dodhylex™ active (tetflupyrolimet) is the first new mode of action (MOA) herbicide for season- long control of major grass weeds in rice globally. Dodhylex™ active belongs to a new herbicidal class of aryl pyrrolidinone anilides that interferes with de novo pyrimidine biosynthesis via inhibition of dihydroorotate dehydrogenase enzyme that is localized to the mitochondria in the plants. Dodhylex™ active is the first active ingredient in the HRAC/ WSSA Group 28. An extensive field program over the last 7+ years has shown that it provides season-long control of important grass weeds in the rice including *Echinochloa* spp, *Leptochloa* spp*, Digitaria* spp*, Ischaemum* spp, as well as key broadleaf weeds such as *Monochoria* spp. and sedges such as *Fimbristylis* spp. Dodhylex™ active has excellent crop safety to both *japonica* and *indica* rice biotypes as well as water or direct seeded rice under diverse soil and environments. Due to its novel mode of action, there is no evidence of Dodhylex™ active having cross-resistance with existing classes of herbicides. FMC anticipates launching Dodhylex™ active in both the water and direct-seeded rice markets worldwide starting in 2025.

Common cattail control in drill-seeded rice systems

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Cattails are perennial weeds that naturally occur in wet or saturated soils such as marshes, lakes, ponds, irrigation and drainage canals, and streams throughout North America. Recently, common cattail (*Typha latifolia*) has become an important problem for the drill-seeded rice systems in the Sacramento–San Joaquin River Delta of the Northern California. This research was conducted in 2022 and 2023 at three sites near Stockton, California to evaluate the efficacy of florpyrauxifen-benzyl, a newly registered auxin-mimic herbicide (Loyant CA), to control common cattail in drill-seeded rice. Florpyrauxifen-benzyl was applied alone at 1.33-pint acre^{-1} and 2.66-pt ac^{-1} on 0–3 feet and 3–6 ft tall common cattail and in a sequential application of florpyrauxifen-benzyl at 1.33-pt ac^{-1} followed by 1.33-pt ac^{-1} between 14 d intervals on 0–3 ft and 3–6 ft tall common cattail. Triclopyr, another auxin-mimic rice herbicide (Grandstand CA) widely used in California, was applied alone at 1-pt ac^{-1} on 0–3 ft tall common cattail for comparison. Triclopyr was also applied in combination with florpyrauxifen- benzyl at 1.33-pt ac^{-1} on 0–3 ft tall growth stage. The injury symptoms on common cattail started within 3 days after treatment (DAT) for the florpyrauxifen-benzyl plus triclopyr mixture treatment and within 7 DAT for all other florpyrauxifen-benzyl applied treatments. All florpyrauxifen-benzyl treatments controlled 100% of common cattail at 28 DAT regardless of application rate and timing. Common cattail height and dry biomass at 28 DAT were lower at all treatments compared to the nontreated control. While the common cattail control was excellent for all florpyrauxifen-benzyl applications, rice injury was minimal. This research indicates, common cattail up to 6 ft tall stages can be effectively and rapidly controlled with florpyrauxifen-benzyl in rice fields using a 1.33-pt ac^{-1} rate.

Selective Herbicides used to manage invasive weeds and undesirable species in the Utility Corridor.

Eric A. Brown, Vegetation Management Manager, Sacramento Municipal Utilities District.

Sacramento Municipal Utility District (SMUD) will share all facets of our Utility Vegetation Management (UVM) program focused on standards of excellence use IVM, cultural, mechanical, chemical, biological and manual methods of control of incompatible undesirable and noxious species while promoting environmental stewardship, community engagement, and reducing wildfire risk along and adjacent to electric corridors & hydro generation assets. SMUD will also share successes with private, state and federal landowners, and finally share the value of using forward thinking technology to quantify and drive operational excellence programs.

Federal Lands and Utility Partnerships, Herbicide Results and Looking to the Future

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In a small town in El Dorado County called Rescue, lies big history and rich resources. This region, perhaps most widely revered as the epicenter of gold discovery in California, possesses other valuable ecological features, such as rare endemic plant species. The land that supports these populations, now recognized as the Pine Hill Preserve, also serves as a corridor for an important abiotic resource, electricity. More specifically, transmission lines in the area help provide power to over 1.5 million Sacramento Municipal Utility District (SMUD) customers/community owners. SMUD has worked with federal landowners and other state and local agencies to develop a plan to manage vegetation within and in some cases adjacent to this right-of-way that is conducive to both maintaining safe/reliable electrical conditions and protecting those sensitive status plant species. This strategy centers on an integrated vegetation management (IVM) approach, or a site-specific combination of manual, mechanical, cultural, chemical, biological, and other treatment methods, to control undesirable/incompatible plant species and promote native low-growing early successional ones. For the first time in decades, herbicides were a part of this portfolio at this federal (BLM) preserve site. After the first year of implementation, plant population surveys suggest that these treatments do not adversely impact these rare plant populations, and therefore support the prospect of establishing more robust, long-term research efforts. These future studies will provide invaluable data that will influence vegetation management practices in utility rights-of-way and federal preserves.

Looking for Bare Ground Results in Tumbleweed Alley

Alex J. Spence, CMO, Allied Weed Control, Livingston, CA

Controlling Russian Thistle, Salsola spp., with herbicides is extremely challenging. It is much better to control it with pre-emergent than to let it get started as it is very hard to control once it emerged and hardened off. Using pre-emergent herbicides to control weeds is much more of an advantage than using post-emergent herbicides. It takes less herbicide to control the weeds before they germinate and keeps the unsightly weeds from appearing. This helps with aesthetics and greatly reduces fire hazard.

It is very important to understand which weed species you are targeting to help select the correct product for the job. All herbicides have their place, but if you choose the incorrect product for the weed you are targeting, you may be disappointed with the results. Timing is also very important with pre-emergent weed control. The soil needs to be moist to begin with. This keeps the herbicide from blowing off in case winds come up before it is incorporated into the soil with rain. It is also very important that enough rainfall occurs to incorporate the products into the soil.

Using the drone technology to review our test plots is helpful as it shows us a much clearer picture of what the plot looks like vs just having a conventional photo. It also provides a very nice overview of the entire test plot so we can look at several plots at once to compare data. By gleaning this information, we can make much more informed decisions in the field saving us time and money. After reviewing our test plots, we determined that the best products for controlling Russian Thistle with pre-emergent herbicides are TerraVue™ and Method™. The least expensive 3-way combo was Milestone™, Imazapyr 4L™, and Oust XP™. This particular mix is something we will be evaluating on a larger scale in the near future. It provides very nice control at a relatively inexpensive price.

Stadium Wetland Mitigation Project: Habitat Restoration and Herbicide Application in an Urban-Wildland Interface Setting

Erik McCracken, Construction Project Manager, Helix Environmental Construction Group

HELIX led a 57-acre habitat mitigation project within the San Diego River channel, between Interstate I-15 and I-805, south of the former Qualcomm Stadium, in the Mission Valley area of San Diego. The restoration project serves as advanced permittee-responsible mitigation to generate mitigation credits for current and future projects implemented by the City of San Diego (City). Work is being performed in accordance with regulatory permits for the Regional Water Quality Control Board (R9-2013- 0124), California Department of Fish and Wildlife (1600-2014-0192-R5), and United States Army Corps of Engineers (SPL-2014-00416-DB).

The project area includes a one mile stretch of river and ranges in width from 300 to 800 feet. The goals of the mitigation effort were to: 1) enhance approximately 32.2 acres of riparian habitat by promoting growth of a more complex and diverse native riparian system removing target invasive species and removing anthropogenic trash; 2) restore (rehabilitate) approximately 20.8 acres of riparian habitat by improving topographical complexity to reduce urban runoff, removing invasive vegetation, and establishing native plant communities; 3) transform 39.3 acres of non- wetland waters of the U.S. to United States Army Corps of Engineers (USACE) wetlands by promoting growth of a more diverse wetland plant community through the rehabilitation of 15.3 acres and the enhancement of 24 acres of USACE jurisdictional resources; and 4) remove illegal encampments and trash, install additional site protection barriers, and increase management activities to protect the area from anthropogenic stress.

HELIX provided preliminary planning and permitting support to the City's Public Utilities Department during the mitigation site planning efforts. HELIX conducted a California Rapid Assessment Method (CRAM) assessment for the site as part of the development of the Habitat Mitigation Plan. Following agency approval of the mitigation site and mitigation plan, the City awarded HELIX a contract through a competitive bid process to implement the habitat mitigation effort. Initial implementation phases of the project included the development and implementation of a SWPPP, removal of over 27 acres of non-native and invasive vegetation within the river channel, primarily using heavy equipment, and contouring of the riverbed to aid the dispersal of flood flows across a larger portion of the floodplain.
Removal of non-native vegetation and contouring occurred during the winter of 2016 to 2017–one of the wettest years on recent record with frequent flooding of the project site–which HELIX performed under a tight schedule to remove invasive vegetation before bird nesting season. After removing non-native species, HELIX installed an overhead temporary irrigation system across approximately 30 acres, followed by native plant and seed installation. The native plant material aids with the stabilization of the disturbed areas within the river channel and provides native habitat for species such as the least Bell's vireo.

Over a five-year maintenance period, HELIX performed herbicide treatments to regrow non-natives, including but not limited to tamarisk, Arundo, mustard, thistle, fennel, pepper trees, ash trees, sticky snakeroot, and water primrose. Given the site was in an active riverbed, and surrounded by public infrastructure, extreme care was needed in the planning, signage posting, handling, application and reporting of herbicide to meet state and federal requirements. While most of the vegetation that was treated occurred outside of running water, water primrose grew within the active channel. HELIX worked with a Pest Control Advisor (PCA) to determine the appropriate chemical treatment and application method for the species, which included pulling the invasive up onto the adjacent bank to spread out and treat with herbicide. Over the course of the five-year maintenance effort, HELIX's recurring maintenance events occurred monthly to treat non-natives below a required threshold of 5% total cover.

The mitigation effort is so successful that the site is being used as a case example by the Regional Water Quality Control Board (RWQCB) for mitigation sites, having conducted multiple site visits for agency staff to showcase the approach and the project. It was also awarded the 2024 Project of the Year by the American Public Works Association.

Weed Control in Landscapes to Maximize Efficiency and Plant Safety

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Due to the high visibility of a diverse mix of cultivated ornamental species and broad range of weed species, effective weed control in ornamental landscapes is highly significant and challenging. The variation in landscapes and management/control practices options pose both challenges and opportunities depending upon weed control methods (hand- weeding, post-emergent herbicides and pre-emergent herbicides) selected for a programmatic approach. To determine the agronomic and economic productivity of weed control in the landscapes, the objective was to review a collection of research-based projects, case studies, observations and theories to provide best management practices for practitioners to be successful in planning landscape weed control programs.

To determine agronomic and economic productivity of a landscape weed control programs, review of projects focused on the weed control method and influential factors; Application, the price, method, product and labor cost; Area – area of effective weed control, species tolerance and Duration – length of time of acceptable weed control. Other factors were also considered that influenced the aforementioned influential factors.

Upon completion of the reviewed projects and influential factors, outcomes displayed that no single individual weed control method provided the best agronomic and economic impact on landscape weed control. A combination of methods, in conjunction with limitations and opportunities of operations will result in providing the most effective weed control and economic possibilities. Although a combination of methods is realistic, pre- emergent herbicides, when correctly selected and applied, do provide increased flexibility in environmental, economic and operational conditions, acceptable efficacy, and plant safety for cultivated ornamental species in the landscape.

Lessons from Data-Driven and Personalized Consumer Lawn Care

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Sunday is a direct-to-consumer lawn care company that uses tech and ecommerce to provide lawn care products tailored to a specific lawn's needs. Analysis of Sunday's customer service data from 2023 to 2024 showed that weed-related inquiries were 7.1% of all customer contacts ("tickets") across more than 300 possible topics. These tickets included any customer communication via email, text, or voicemail to the customer service department. Among technical lawn care queries (excluding subscription-related questions), weed control was the primary concern nationwide. In California, there were more weed-related queries than water- related inquiries. This was surprising considering the state's water challenges. Within weed control, the dominant subtopics were herbicide efficacy and photo submissions for weed identification or assessment (Table 1). The most frequently mentioned weeds in California lawns were crabgrass, clovers, dandelion, and spurge. Another common weed control situation was clumping tall fescue and invasive grasses like bermudagrass or kikuyugrass.

Subtopic	Proportion
Herbicide efficacy and selection	34% of tickets
Photo submission	29% of tickets
Lawns with more weeds than grass	23% of tickets
Sunday product instructions	22% of tickets
Lawn repair after weed removal	21% of tickets
Broadleaf weeds	18% of tickets
Grassy weeds	18% of tickets
Long term weed prevention	14% of tickets
Crabgrass weeds	10% of tickets
Herbicide safety and toxicity	7% of tickets
Weed issues during seeding	7% of tickets
Herbicide quantity and equipment	6% of tickets

Table 1. Distribution of subtopics in weed control customer service tickets from California. Subtopic clusters were identified through natural language processing models. Note that percentages sum to greater than 100% due to multi-topic tickets.

Communicating Weed Control and Herbicides with Non-Professional Audiences

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Extending science-based pest information to residential audiences and landscape managers on weeds and their management is a challenge. Attitudes by the general public toward controlling weeds, pesticide application, and glyphosate especially can be difficult to address since the majority of urban audiences are not trained and knowledgeable about pesticides. California continues to experience new regulations, troublesome weeds, new invasive weed species, new herbicides on the market, as well as changing public opinion about herbicides and use of organic products and homemade concoctions for pest control.

The University of California Statewide Integrated Pest Management Program's (UC IPM) Urban and Community IPM unit focuses efforts on reaching the ever-growing urban population in California, to help protect human health and the environment by reducing risks caused by pests and their management, especially the use of pesticides. UC IPM has been training UC Master Gardener, retail store employees where people purchase herbicides, and landscape professionals. Some training hands-on weed identification training for various audiences; increasing weed-focused publications and educational tools in English and Spanish; and enhancing tools on our home, garden, and landscape web pages.

Selective Control of Sedges and Annual Bluegrass in Bermudagrass Turf

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Bermudagrass (*Cynodon spp.*) is the recommended turfgrass species for most warmer climatic regions in California because of its superior turf quality and functional traits including drought, heat, salinity, traffic, and pest tolerance. Weeds are the most significant pest challenge in Bermudagrass turf. Research was conducted in Carmel, Sacramento, and Riverside to determine the most effective herbicides for control of annual bluegrass (*Poa annua*) in bermudagrass during fall and winter. When commonly used herbicides such as Specticle (Indaziflam) were no longer as effective on annual bluegrass, our research showed that Barricade (prodiamine) + Monument (trifloxysulfuron) + Princep (simazine) provided the best preemergence control. Princep alone or Roundup (glyphosate) provided the best postemergence control. In Riverside, a two-year study was conducted to evaluate herbicides for postemergence control of green kyllinga (*Kyllinga brevifolia*), yellow nutsedge (*Cyperus esculentus*), and purple nutsedge (*Cyperus rotundus*) in bermudagrass turf. Herbicides were tested on weeds and turf that were unmowed in comparison to freshly mowed (i.e., less leaf area for uptake). In general, mowing did not have a significant effect on weed control except for green kyllinga, where increased leaf area resulted in greater herbicide efficacy in 2023. Overall, Celero (imazosulfuron), Monument (trifloxysulfuron), and Katana (flazasulfuron) provided the most effective control of all three species when herbicides were applied twice, six weeks apart during the summer months.

Changing Trends in Northeast California Alfalfa Weed Management Rob Wilson*[1], Thomas Getts[2]. [1]University of California Cooperative Extension, Intermountain Research and Extension Center, CA, USA, [2]University of California Cooperative Extension, Lassen County, CA, USA. *rgwilson@ucanr.edu

Northeast California alfalfa producers have experienced reduced winter annual weed control in recent years with paraquat and metribuzin combinations especially with shepherdspurse, (*Capsella bursa-pastoris*).
Several factors seem to explain the poor weed control including changes in weed growth, weather, and crop management. Weed control trials conducted near Tulelake, CA from 2021 to 2024 evaluated herbicide performance in established alfalfa. Fall applied paraquat or saflufenacil with or without a preemergent herbicide, late winter applied flumioxazin + paraquat or saflufenacil and fall and spring applied imazamox gave significantly better control of shepherdspurse compared to late winter applied paraquat + metribuzin. Flumioxazin + paraquat or saflufenacil gave over 90% control of flixweed (*Descurainia Sophia*) and prickly lettuce, (*Lactuca serriola*). Spring applied imazamox provided less than 50% control of both weeds. A major downside to using flumioxazin and saflufenacil in established alfalfa is they do not control emerged grass weeds. Paraquat is the only labeled herbicide for controlling small, emerging broadleaf and grass weeds in established conventional alfalfa.

Weed Control Challenges in Small Grain Crops of the Southern San Joaquin Valley

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Small grain cereals, including wheat, triticale, rye, oats, and barley, are essential crops in California, covering approximately 550,000 acres statewide. These crops primarily serve as dairy cattle feed, which is integral to California's dairy industry, valued at over $7.6 billion in 2021. Despite their economic importance, small grain producers face significant agronomic challenges, particularly in weed management, which adversely affects both yield and quality.

Over the past ten years, ALS inhibitor herbicides have been widely used to control weeds in small grain crops. However, the overreliance on herbicides with similar modes of action has created selection pressure for herbicide- resistant weed populations, particularly in the Southern San Joaquin Valley. One weed that has become increasingly difficult to manage in small grain fields is common chickweed (*Stellaria media*), a winter annual broadleaf that has developed resistance to ALS inhibitor herbicides.

Herbicides from the protoporphyrinogen oxidase (PPO) inhibitor and synthetic auxin groups have shown partial control of common chickweed. To evaluate the efficacy of herbicides registered for use in small grain crops on ALS-resistant common chickweed, a field study was conducted. The herbicide treatments included pyraflufen-ethyl, dicamba, carfentrazone, pyroxsulam, tribenuron-methyl, bromoxynil, MCPA, and metosulfuron.

Tank-mix combinations of pyraflufen-ethyl with other herbicides were also tested. All herbicides were applied at the recommended label rates for small grain crops.

Weed control efficacy were assessed for five weeks after application.

Results from the study showed that pyraflufen-ethyl treatments provided over 80% control of common chickweed. In contrast, ALS inhibitor herbicides and synthetic auxin herbicides offered less than 35% and 30% control, respectively. The tank-mix combinations with ALS inhibitor herbicides provided the best overall control of common chickweed.

Pyraflufen-ethyl is an effective herbicide for controlling common chickweed but needs to be used in combination with other herbicides to increase its weed control spectrum.

Flumioxazin and pendimethalin as potential tools for preemergent, selective weed management in maize intercropped with *Urochloa ruziziensis*

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Consortium cultivation between maize (*Zea mays* L.) and forage species is widely used to generate food for cattle or straw under no-till systems.
Weed management constitutes an issue in this system due to the need for herbicide selectivity to both cultivated species. In order to evaluate new chemical weed management tools for maize and *Urochloa ruziziensis* (URORI) consortia, field experiments were carried out in Piracicaba, SP/Brazil in the 2018/19 and 2019/20 growing seasons, in loamy (2018/19) or clay (2019/20) soils. Eleven herbicidal treatments and two untreated controls were evaluated (weedy and weed-free checks). S-metolachlor (1.68 kg ai ha-1), flumioxazin (0.04 kg ai ha-1), saflufenacil (0.098 kg ai ha- 1), pendimethalin (1.6 kg ia ha-1), mesotrione (0.24 kg ia ha-1), atrazine (2.5 kg ia ha-1), and isoxaflutol (0.06 kg ai ha-1) were sprayed in pre-emergence (PRE), whereas tank-mixtures of atrazine+S-metolachlor (1.48+1.16 kg ia ha-1), nicosulfuron+atrazine (0.016+0.9 kg ia ha-1), mesotrione+atrazine (0.09+0.9 kg ai ha-1), and mesotrione+nicosulfuron+atrazine (0.09+0.016+0.9 kg ai ha-1) were sprayed in post-emergence. Experiments followed a split-plot design with four replications, in which herbicides constituted the main factor (A), and vegetation (maize growing either alone or intercropped with URORI) as factor B. Weed control efficacy and phytotoxicity to both maize and forage were assessed between 0-28 days after treatment application, as well as URORI biomass and maize yields (2019/20 only). Results indicated the absence of significant phytotoxicity to maize regardless of herbicides, as these allowed for similar yield levels in the absence of URORI plants.
Interestingly, when URORI plant growth was suppressed via herbicide applications, maize yields were found to be similar to those obtained in URORI-free conditions. Across both experiments, applications of flumioxazin, atrazine, or pendimethalin in PRE, as well as an atrazine+s- metolachlor tank-mix sprayed at the V4 maize growth stage incurred in low phytotoxicity to URORI, leading to elevated biomass accumulation. Among all treatments, the consistency and selectivity of flumioxazin and pendimethalin applications in pre-emergence stood out as potential new tools for insertion in the maize-URORI consortium, allowing for the rotation of herbicide modes of action while increasing the spectrum of action of the herbicides available in this system.

Organic Herbicide Dose–response Using Hyper-precise Pinpoint Spray Technology.

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Weed management in an organic crop production system is one of the most labor-intensive and expensive operations, and the workload depends on how much manual weeding must be done. Postemergence organic herbicides are considered contact or burndown (non-selective) herbicides that kill weeds by directly affecting leaf epidermal cells. Due to the non- selective characteristic of those organic herbicides, they cannot be applied in traditional broadcast application systems post-crop emergence. Also, traditional broadcast foliar spray technologies available on the market usually lack accuracy, leading to resource wastage and potential dangers to both humans and the environment. The advent of hyper-precise pinpoint spray technologies delivers unprecedented precision, ensuring that applications are precisely targeted as intended. Greenhouse research trials were conducted to assess different dose-response (0.75, 1.5, 3, 6, and 9 % v/v) of organic herbicide Suppress (Caprylic acid + Capric acid) with and without adjuvant Oroboost (alcohol ethoxylate), for better coverage and improve application effectiveness. Large crabgrass (*Digitaria sanguinalis*), palmer amaranth (*Amaranthus palmeri*), and common purslane (*Portulaca oleracea*) were submitted to the herbicide treatments at different weed growth stages (9, 18, and 27 days after germination - DAG).

Results from these trials indicate better organic herbicide effectiveness when applied in the initial weed growth stage (9 DAG). Weed control was greater than 90 % with a rate of up to 1.5% v/v of organic herbicide when sprayed at 9 DAG, while when sprayed at 18 DAG, at least a rate of up to 3 % v/v was needed to provide similar control. For both weed growth stages (9 and 18 DAG), our results indicate that an added adjuvant in the organic herbicide solution increases herbicide effectiveness. Additionally, our data suggests that hyper-precise pinpoint spray technologies provide high weed control effectiveness like the traditional broadcast foliar spray system and may enable the use of non-selective organic herbicides in systems post- crop emergence.

Lessons learned from two decades of weed management in the world's largest urban national park

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Invasive plants pose a growing threat to native species and ecosystems, including protected areas. For example, at Santa Monica Mountains National Recreation Area – the world's largest urban national park – weed invasion has been implicated in the decline of the park's iconic wildflowers and increase in wildfires. Weed control is therefore a critical component of efforts to protect the park's flora, fauna, and natural and cultural resources. However, weed management is challenging, and monitoring data is essential for evaluating control success and identifying factors that facilitate or inhibit such success. To this end, we compiled nearly twenty years of monitoring and treatment data from 280 infestations within the park. We also re-surveyed each of these infestations in 2023 to evaluate long-term management outcomes. We used multiple statistical approaches to identify management inputs and site characteristics that are predictors of eradication, invasive plant cover, and native species recovery. We found that the greater the initial size or percent cover of an infestation, the lower the probability of eradication. We also found that weed infestations on steeper slopes in areas that have burned more frequently are less likely to be eradicated. Promisingly, our results also showed that greater reductions in invasive plant cover benefited native diversity. These analyses also highlighted that persistence is key; more frequent treatment (both chemical and nonchemical) and greater investment of labor resulted in larger reductions in invasive plant cover. The results of this project will be used to develop the best practices for weed management and monitoring.

Best Management Practices (BMPs) to Prevent Non-Target Impacts from Herbicide Applications.

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Herbicides are often an essential component of invasive vegetation management in agricultural, urban and wildlands settings, but their use can have unintended consequences. Some products have demonstrated impacts to non-target organisms such as pollinators, aquatic species, and wildlife. This presentation will outline a suite of resources, tools, and Best Management Practices (BMPs) designed to minimize these non-target effects. We will discuss key considerations including existing environmental restrictions, the selection of the most effective and least impactful tools, and recommended application techniques and avoidance measures. This presentation will provide a practical framework for implementing effective BMPs to protect non-target organisms and ensure the sustainable use of herbicides in all land management contexts.

Investigation of Herbicide Resistant Weed Populations in the Intermountain Region of California.

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Over the past five years there have been numerous complaints about the lack of control of various weed species in the intermountain region with ALS inhibiting herbicides (Group2). One such instance has been in Sierra Valley, where perennial pepperweed (*Lepedium latifolium*) does not appear to be controlled by chlorsulfuron, and another is in Surprise Valley where kochia (*Kochia scoparia*) has not been effectively controlled by sulfometuron.
There have been numerous documentations of ALS resistant Kochia throughout the Western United States, however not in NE California.
Unlike kochia there has been no observed herbicide resistance of perennial pepperweed. Trials were conducted to investigate resistance for both species. Roadside applications of various herbicides were applied at different timings throughout Modoc county (Summer, Fall, and Spring), and plots were visually evaluated during the growing season, and the following growing season. At two locations in Surprise Valley sulfometuron applied in the fall at 315.8 g ai/ha gave no Kochia control, and had 70% cover of Kochia, and 0% cheatgrass cover. Where the untreated check had 63% kochia cover and a 14% cover of cheatgrass, indicating the kochia was not controlled by the sulfometureon but the cheatgrass was. Adding flumioxazin 357g ai/ha + sulfometuron 315.8g ai/ha resulted in a 100 percent reduction in kochia cover compared to the untreated check for the fall applications, indicating the kochia was susceptible to the flumioxazin but not the sulfometuron. A dose response study was conducted on four populations of kochia with chlorsulfuron at UC Davis, finding populations from Susanville and Tuelake to be susceptible to all rates tested, where kochia from Surprise Valley treated with chlorsulfuron at 52 g ai/ha survived treatments and only showed a 25 percent injury 21 days after treatment, confirming ALS resistance. Perennial pepperweed has no documented cases of herbicide resistance worldwide, however, there have been complaints of populations in Sierra Valley not susceptible to chlorsulfuron which research has shown to be one of most effective herbicides to control it. Initial replicated field trials showed that applications of chlorsulfuron at the maximum labeled rate of 136 ga ai/ha applied to the same plants two years in a row did not cause a significant reduction in pepperweed growth or vigor. Populations of perennial pepperweed from Sierra Valley and from the Honey Lake Valley (susceptible to chlorsulfuron in previous research) were established in pots for an outdoor dose response trial with five replications in each treatment. The season following treatment all perennial pepperweed plants form the Honey Lake Valley treated with 68g, 136g, or 273 g ai/ha were killed and did not show any growth. Where plants from Sierra Valley survived all treatments including the 273g ai/ha which is twice the labeled rate of chlorsulfuron. Additional research is needed to confirm the ALS resistance in this perennial pepperweed population.

The Updated Online Weed Control User Tool (WeedCUT)

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The newly revised online decision support tool "WeedCUT"(https://weedcut-new.ipm.ucanr.edu/) has recently been released by UC IPM and the California Invasive Plant Council (Cal-IPC) to assist wildland weed managers in making management decisions about how to control wildland weeds. We now have 21 non-chemical methods, 18 biological control targets, and 18 herbicides described in detail for users to learn more about. WeedCUT, development for which was funded by the California Department of Pesticide Regulation, offers the ability to make a "first cut" at selecting effective herbicides and non-chemical alternative weed control techniques based on species, as well as by plant characteristics and site- specific characteristics. This presentation will describe the tool, how it was designed and how you can use it to improve your integrated pest management program in California.

Refining chemigated rimsulfuron treatments for branched broomrape management in California processing tomatoes.

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Branched broomrape management is of increasing concern to California processing tomato growers. Field 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, as well as foliar maleic hydrazide alone and paired with PPI sulfosulfuron and chemigated rimsulfuron. At this trial site broomrape pressure was higher than in previous years and 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 this year. There were no significant differences in broomrape emergence among different application timings of chemigated rimsulfuron this season, 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 additional field trials in 2025. Applications of foliar maleic hydrazide had mixed results in 2024: 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 application 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 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 an average of 91 clusters per 120 ft plot, while the mid- season planting had significantly less emergence with an average of 10 clusters per plot. The very late season planting had no broomrape emergence; however, this was extremely late for the region and would be very risky to do at a commercial scale.

Overall, chemigated rimsulfuron applied at various timings and rates totaling the annual maximum use rate of 70 g ai/ha reduced broomrape emergence by two-thirds or more versus control plots in both small- and large-plot studies. No crop injury was observed in any of the plots treated with rimsulfuron, sulfosulfuron, or maleic hydrazide in the small plot trial or with rimsulfuron in the grower-scale demonstration trial. Under a recently approved 24(c) Special Local Need label, California growers can use three applications totaling 70 g ai/ha 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. Promising results from sulfosulfuron and maleic hydrazide suggest that the registration of additional herbicides could help develop even more robust branched broomrape management programs.

Addressing Challenges of Using QAC Compounds in Field Equipment Sanitation to Reduce the Spread of Branched Broomrape (*Phelipanche ramosa*) Seed in California Processing Tomato Fields Pershang Hosseini*[1], Cassandra Swett[2], and Bradley D. Hanson[3]. [1]Postdoctoral Research Fellow, Department of Plant Sciences, University of California, Davis, Davis, CA, USA; [2]Associate Professor of Cooperative Extension, Department of Plant Pathology, University of California, Davis, CA, USA, and [3]Professor of Cooperative Extension, Department of Plant Sciences, University of California, Davis, CA, USA. *Corresponding author (perhosseini@ucdavis.edu)

Branched broomrape (*Phelipanche ramosa* L. (Pomel)), a parasitic weed with a broad host range, is a quarantine pest in California. Branched broomrape plants can produce thousands of tiny seeds, which are easily spread by farm equipment. The best management practices for reducing dispersal risk to non-infested fields include physical cleaning and disinfestation of farm equipment between fields but there is limited data on the efficacy of available sanitizers on weed seeds. As part of a larger equipment sanitation research effort in processing tomato production systems, a three-phase study was undertaken during 2022-23 to evaluate quaternary ammonium compound (QAC) sanitizer efficacy on branched broomrape seed. First, several individual QAC ingredients were evaluated at various concentrations (0-2.5% w/v) and exposure durations (1, 3, and 5 minutes) to develop initial seed mortality curves. Second, the experiments were conducted with three commercial QAC sanitizers (Mg4, FQ, and CQT) at the recommended dose (1% v/v) and a field-relevant exposure duration (1 minute). The final series of experiments evaluated commercial QAC sanitizer efficacy in the presence of several levels of plant and soil debris. The initial experiments showed that ADAC, DDAB, and DDAC effectively prevented branched broomrape germination but the effective dose for a 50% reduction in branched broomrape seed germination ranged from 0.001% w/v at 10 minutes with DDAC to 0.35% w/v at 1 minute exposure duration with ADAC. While all three commercial QAC sanitizers reduced seed germination 75-100% after a 1 minute exposure to the recommended dose (1% v/v), this treatment did not affect seed germination in the presence of soil (100 mg/ml; 100% germination) or fruit /plant tissue (40 mg/ml; 40-60% germination), emphasizing the importance of equipment cleaning before the sanitation step. At higher concentrations of Mg4 (8% v/v), branched broomrape seed germination was prevented (90-100% germination) even in the presence of soil and plant debris. Together, this study suggests that a combination of rigorous physical cleaning to remove most debris and QAC doses substantially higher than 1% v/v may be necessary to optimize the efficacy of field equipment cleaning methods aimed at preventing the movement of this quarantine pest to new fields.

Controlling in-row weeds with post plant applications of pre-emergent herbicides

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While the preemergent herbicides can be very effective, one of the challenges with their use is the need for incorporation, either mechanical or with sprinklers. Incorporation before planting is both efficient and effective, but often the movement of soil during planting/transplanting moves the soil and herbicides, resulting in little weed control in the plant row. The result is that hand weeding is often still required. An alternative is the finger weeder, a simple mechanical cultivator capable of removing weeds from the plant row. The system uses interlocking rubber fingers to remove small weeds in the plant row once transplants are established. Unfortunately, finger weeders are effective only if the weeds are very small, which limits their use to a very short period during the cropping season. However, finger weeders should be able to safely incorporate preemergent herbicides back into the plant row, which would greatly expand the amount of time they could be used. Trials were conducted in melons and processing tomatoes at the UC WSREC near Five Points, in Fresno County, and in a commercial field in Merced County, CA. In tomatoes, pendimethalin (Prowl), rimsulfuron (Matrix), napropamide (Devrinol), and metribuzin (Sencor) were applied as a directed spray two weeks after transplanting and then were incorporated with a Steketee finger weeder. Comparison treatments included a grower standard metolachlor + pendimethalin pre- plant incorporated followed by rimsulfuron post emergence at 4 oz/A, cultivation only, and untreated controls. In melons, metolachlor (Dual Magnum), bensulide (Prefar), halosulfuron (Sandea), pendimethalin (Prowl), and ethalfluralin (Curbit), were band applied after transplanting/emergence, and then incorporated using the finger weeder.
An untreated control was used for comparison. A randomized block split plot design with four reps was used for each trial; plot size was 1 bed by 50 ft. Research in 2024 showed good crop safety and improved weed control when the finger weeder was used with pre-emergent herbicides. In-row weed control at 2, 4, and 6 weeks after treatment (WAT) was significantly improved as compared to the untreated control in both tomatoes and melons where the finger weeder was used; weed pressure was reduced an additional 50% when the pre-emergent herbicides were used in conjunctionwith in-row cultivation from the finger weeder. In general, all the herbicides provided similar levels of weed control when incorporated. As a result, hand weeding times and costs were also significant less in herbicide + finger weeder treatments. While there was only slight and temporally crop damage from the herbicides, the finger weeder caused a significant 15% stand reduction in one melon and one tomato trial, however, this reduction had no significant impact on yield. The significant improvement in weed control when pre-emergent herbicides were incorporated with the finger weeder is not surprising, as these herbicides need water or mechanical incorporation to work effectively. In general, the cultivation x herbicide interaction was not significant in these trials, which indicates that the benefits of the finger weeder apply equally across all herbicides evaluated in these trials.

Physical and Cultural Weed Control for Carrot, Lettuce and Onion Steve Fennimore University of California, Davis, and UC Cooperative Extension. safennimore@ucdavis.edu

Steam injected into soil so that temperatures reach 158°F for 15-20 minutes will control most soilborne pathogens and weed seed in the treated zone. Steam applied only where needed in the seedline is an efficient method of steam application. We have built and evaluated three versions of the Band Steam applicator and verified the performance of these machines in carrot, lettuce, and onion. Band steaming in lettuce reduced hand weeding times and suppressed *Fusarium* spp. Steam applied before planting is classified as a sanitation treatment for organic fields. Steam disinfestation of lettuce and onion beds could reduce risk of loss due to soilborne diseases and lower hand weeding costs by over 80%. Steam treatment of soil causes minor impacts on beneficial soil microbial communities and favors beneficial organisms such as the Firmicutes. We have built a new applicator that will be able to treat the two 6-inch bands in the seedlines of 40-inch carrot beds. This technique will be useful in carrots specifically to address the high weeding expense and disease risk in organic carrots.

Labor use efficiency improvement is essential to the long-term viability of vegetable production. This research included Farmwise' s Titan weeder and Stout's tractor mounted automated weeder. These cultivators are capable of weeding lettuce plants around the seedline. The Farmwise machine is controlled by an operator remotely and the Stout cultivator is guided by the tractor driver. Successful development of this technology may lead towards "teams" of these machines – for example, three autonomous weeders moving through a lettuce field, supervised by one person, could potentially do the work of a handweeding crew of 15 people. We evaluated the efficacy of these cultivators on weed control and hand weeding in lettuce as well as lettuce yields. Both cultivators-controlled weeds better than the standard cultivators in on-farm and field station trials. The cultivators are safe to lettuce and did not reduce yields.

DPR's Endangered Species Program and Its Connection to EPA's Endangered Species Protection Program

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Under the Endangered Species Act, the registration of a pesticide by the United States Environmental Protection Agency (EPA) is considered an action which must be evaluated for its potential to affect or jeopardize endangered species, their habitat, or both. EPA must assess potential risks and consult with the U.S. Fish & Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS) to obtain mitigation or restoration measures.

Since 1988, the California Department of Pesticide Regulation (DPR) has provided an interim program called the Endangered Species Program – with EPA's approval – for the protection of endangered species, under Section 7(a)(1) of the Endangered Species Act. Local plans developed in public meetings with the participation of growers, applicators, county agricultural commissioners, state agencies, and federal agencies, became DPR's Pesticide Use Limitations. These use limitations are advisory, not enforceable, but provide applicators with a thorough analysis of the environmental sensitivities of the species, the pesticide's mode of action, and use patterns that in turn determine potential routes of exposure and potential hazards. In early 2005, DPR implemented a Web-based Database known as Pesticide Regulations Endangered Species Custom Realtime Internet Bulletin Engine (PRESCRIBE) that includes all federal- and state- listed species and pesticides registered for use in California. This was followed in 2013 by a mobile platform-based Website allowing users to identify local habitat for listed and sensitive status species and obtain direction on use limitations.

In 2022, EPA announced the implementation of its Workplan to Improve Outcomes for Listed Species. At its core, this workplan speeds up consultation with USFWS and NMFS to contemplate early mitigation measures for pesticide runoff/erosion and spray drift. This new approach has also expedited the development of pesticide use limitations to be added to pesticide labels, which will be enforceable under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA).

In August of 2023, six pesticide active ingredients were issued FIFRA- enforceable bulletins to complement their labels. The pesticide uses limitations specifically in those bulletins and the species included – three Salmonid species – supersede the use limitations in PRESCRIBE for the six specific pesticides, DPR updated PRESCRIBE's pesticide search section, informing users that if they were to use any of the six pesticides with EPA bulletins, they had to continue their query in EPA's Bulletins Live! Two websites, which PRESCRIBE provides an active link to. If users intend to use other pesticide, then they continue their query through PRESCRIBE.

Pesticide Registration and Regulation in California

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The sale and use of pesticides in California is regulated by the California Department of Pesticide Regulation. One of the primary means of regulation is through the registration of pesticide products, which must be completed by both the U.S. Environmental Protection Agency and the California Department of Pesticide Regulation prior to their distribution and use in the state. During registration, pesticide products undergo a comprehensive and rigorous evaluation process to ensure these products do not pose an unacceptable risk to human health or the environment.

Pesticides are evaluated for such things as product chemistry, environmental fate, human health effects, efficacy, ecotoxicity/phytotoxicity to nontarget flora and fauna, and potential to contaminate surface and ground water and air. This presentation will provide a brief overview of the registration and evaluation process by California Department of Pesticide Regulation scientists, as well as touch on other activities that further regulate pesticide use in California.

Department of Pesticide Regulation, Licensing and Certification, Regulation Updates

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This presentation covers the process of renewals, adding categories, the new fumigant categories, additional regulation changes and an overview of DPR and the licenses offered. It will go over the licensing requirements of DPR and what the options are for business and individual licenses. Then, it will cover the regulation changes implemented in 2023 and 2024, including the new categories of L Soil Fumigation and M Non-soil Fumigation. Next, there will be a step-by-step process of the life of renewal for both individuals and businesses. At the end, there will be information about adding a category and checking on an application status and checking for valid licenses.

10 Common Pesticide Violations

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This presentation will describe 10 common violations observed during routine inspections conducted by the Sacramento County Agricultural Commissioner's Office. Slides in the presentation will be accompanied by photographs taken in the field by inspectors, with identifying names and faces edited out. The purpose of presenting these violations is to make pesticide applicators aware of common mistakes that are routinely observed by CAC officials, in hopes that they can avoid making similar mistakes while they are conducting applications. Violations to be discussed include:

FAC 11732: Failure to register pest control business
3 CCR 6738.1: Regulatory personal protective equipment Use. 3 CCR
6670: Failure to secure/attend pesticides
3 CCR 6682: Transportation of pesticides
3 CCR 6726: Emergency medical care posting displayed 3 CCR
6602: Labeling available at use site
3 CCR 6678: Service container labeling
FAC 12973: Pesticide use shall follow Registered label/labeling and/or permit conditions.
3 CCR 6739. Respiratory protection.
3 CCR 6627: Monthly Summary Pesticide Use Reports.

CWSS HONORARY MEMBER AWARDS

Walter Ball*
Lester Berry
Alden Crafts*
Marcus
Cravens*
Richard Dana*
Boysie Day*
Paul Dresher*
Bill Fischer*
Dick Fosse*
George
Gowgani Bill
Harvey*
Jim Koehler*
Oliver
Leonard* Jim
McHenry* Bob
Meeks Ralph
Offutt Martin
Pruett Murray
Pryor* Richard
Raynor
Howard
Rhoads*
Conrad
Schilling*
Leslie Sonder* & Stan Strew*
Robert Underhill
1977 – Warren Johnson*
1979 – Jim Dewlen* & Floyd Holmes
1983 – Harry Agamalian & Lee VanDeren* 1986 – Dave Bayer & Art Lange
1987 – Floyd Colbert & Butch Kreps
1988 – Harold Kempen, Stan Walton*, & Bryant Washburn 1989 – Huey Sykes
1990 – Floyd Ashton & Ruben Pahl 1991 – Ed Rose*
1992 – Edward Kurtz 1993 – Ken Dunster* 1994 – Clyde Elmore 1995 – Alvin Baber
1996 – Bob Mullen 1997 – Nelroy Jackson*
1998 – Norman Akesson & Dave Cudney
1999 – Jack Orr, Jack Schlesselman, & Tom Thomson 2000 – Jesse Richardson
2001 – F. Dan Hess* & Ron Vargas 2002 – Don Colbert & Robert Norris
2003 – Nate Dechoretz, Don Koehler, Vince Schweers, & Conrad Skimina*
2004 – Tad Gantenbein 2005 – Matt Elhardt 2006 – Rick Geddes 2007 – Steve Wright
2008 – Mick Canevari
2009 – David Haskell, Bruce Kidd, & Deb Shatley
2010 – Carl Bell & J. Robert C. Leavitt
2011 – Wayne T. Lanini
2012 – Stephen Colbert
2013 – Scott A. Johnson
2015 - Michelle Le Strange

2017 – Judy Letterman & Steve Orloff* 2018 – John Roncoroni
2019 – Steve Fennimore
2020 – Kurt Hembree & Richard Smith 2022 – Chuck Synold
2023 – John Madsen
2025 – Dave Blodget & Anil Shrestha & Rick Miller

CWSS AWARD OF EXCELLENCE MEMBERS LISTING

1985	June McCaskell, Jack Schlesselman & Tom Yutani
1986	Harry Agamalian, Floyd Colbert & Ed Rose
1987	Bruce Ames, Pam Jones, & Steve Orloff
1988	Bill Clark & Linda Romander
1989	Earl Suber
1990	Ron Hanson & Phil Larson
1991	John Arvik & Elin Miller
1992	Don Colbert & Ron Kelley
1993	Ron Vargas
1994	Jim Cook & Robert Norris
1995	Mick Canevari & Rich Waegner
1996	Galen Hiett & Bill Tidwell
1997	David Haskell & Louis Hearn
1998	Jim Helmer & Jim Hill
1999	Joe DiTomaso
2000	Kurt Hembree
2001	Steven Fennimore, Wanda Graves & Scott Steinmaus
2002	Carl Bell & Harry Kline
2003	Dave Cudney & Clyde Elmore*
2004	Michelle LeStrange & Mark Mahady

2005	Scott Johnson & Richard Smith
2006	Bruce Kidd, Judy Letterman & Celeste Elliott
2007	Barry Tickes & Cheryl Wilen
2008	Dan Bryant & Will Crites
2008	Ken Dunster* & Ron Vargas*
2009	Ellen Dean & Wayne T. Lanini
2010	Lars W.J. Anderson & Stephen F. Colbert
2011	Jennifer Malcolm & Hugo Ramirez
2012	Rob Wilson
2013	Rick Miller
2014	Carl Bell*, Brad Hanson & Anil Shrestha
2015	Deb Shatley & Barry Tickes
2016	Steven Fennimore
2017	Steven D. Wright*
2018	Kassim Al-Khatib & Scott Stoddard
2019	Josie Hugie & Scott Oneto
2020	Ben Duesterhaus & Lynn Sosnoskie
2021	Lisa Blecker
2022	Dave Blodget & John Madsen
2023	Whitney Brim-DeForest & Kate Walker

* Denotes President's Award for Lifetime Achievement in Weed Science

CONFERENCE	DATES HELD	LOCATION	PRESIDENT
1st	February 16, 17, 1949	Sacramento	Walter Ball
2nd	April 4, 5, 6, 1950	Pomona	Walter Ball
3rd	January 30, 31, Feb. 1, 1951	Fresno	Alden Crafts
4th	January 22, 23, 24, 1952	San Luis Obispo	Murray Pryor
5th	January 20, 21, 22, 1953	San Jose	Bill Harvey
6th	January 27, 28, 1954	Sacramento	Marcus Cravens
7th	January 26, 27, 1955	Santa Barbara	Lester Berry
8th	February 15, 16, 17, 1956	Sacramento	Paul Dresher
9th	January 22, 23, 24, 1957	Fresno	James Koehler
10th	January 21, 22, 23, 1958	San Jose	Vernon Cheadle
11th	January 20, 21, 22, 1959	Santa Barbara	J. T. Vedder
12th	January 19, 20, 21, 1960	Sacramento	Bruce Wade
13th	January 24, 25, 26, 1961	Fresno	Stan Strew
14th	January 23, 24, 25, 1962	San Jose	Oliver Leonard
15th	January 22, 23, 24, 1963	Santa Barbara	Charles Siebe
16th	January 21, 22, 23, 1964	Sacramento	Bill Hopkins
17th	January 19, 20, 21, 1965	Fresno	Jim Dewlen
18th	January 18, 19, 20, 1966	San Jose	Norman Akesson
19th	January 24, 25, 26, 1967	San Diego	Cecil Pratt
20th	January 22, 23, 24, 1968	Sacramento	Warren Johnson
21st	January 20, 21, 22, 1969	Fresno	Floyd Holmes
22nd	January 19, 20, 21, 1970	Anaheim	Vince Schweers
23rd	January 18, 19, 20, 1971	Sacramento	Dell Clark
24th	January 16, 17, 18, 19, 1972	Fresno	Bryant Washburn
25th	January 15, 16, 17, 1973	Anaheim	Howard Rhoads
26th	January 21, 22, 23, 24, 1974	Sacramento	Tom Fuller
27th	January 20, 21, 22, 1975	Fresno	Dick Fosse
28th	January 19, 20, 21, 1976	San Diego	Jim McHenry
29th	January 17, 18, 19, 1977	Sacramento	Les Sonder
30th	January 16, 17, 18, 1978	Monterey	Floyd Colbert
31st	January 15, 16, 17, 18, 1979	Los Angeles	Harry Agamalian
32nd	January 21, 22, 23, 24, 1980	Sacramento	Conrad Schilling

33rd	January 19, 20, 21, 22, 1981	Monterey	Lee Van Deren
34th	January 18, 19, 20, 21, 1982	San Diego	Dave Bayer
35th	January 17, 18, 19, 20, 1983	San Jose	Butch Kreps
36th	January 16, 17, 18, 19, 1984	Sacramento	Ed Rose
37th	January 21, 22, 23, 24, 1985	Anaheim	Hal Kempen
38th	January 27, 28, 19, 30, 1986	Fresno	Ray Ottoson
39th	January 26, 27, 28, 29, 1987	San Jose	Ken Dunster
40th	January 18, 19, 20, 21, 1988	Sacramento	George Gowgani
41st	January 16, 17, 18, 1989	Ontario	Ed Kurtz
42nd	January 15, 16, 17, 1990	San Jose	Dennis Stroud

CONFERENCE	DATES HELD	LOCATION	PRESIDENT
43rd	January 21, 22, 23, 1991	Santa Barbara	Jack Orr
44th	January 20, 21, 22, 1992	Sacramento	Nate Dechoretz
45th	January 18, 19, 20, 1993	Costa Mesa	Alvin A. Baber
46th	January 17, 18, 19, 1994	San Jose	James Greil
47th	January 16, 17, 19, 1995	Santa Barbara	Nelroy Jackson
48th	January 22, 23, 24, 1996	Sacramento	Dave Cudney
49th	January 20, 21, 22, 1997	Santa Barbara	Jesse Richardson
50th	January 12, 13, 14, 1998	Monterey	Ron Vargas
51st	January 11, 12, 13, 1999	Anaheim	Scott Johnson
52nd	January 10, 11, 12, 2000	Sacramento	Steve Wright
53rd	January 8, 9, 10, 2001	Monterey	Matt Ehlhardt
54th	January 14, 15, 16, 2002	San Jose	Lars Anderson
55th	January 20, 21, 22, 2003	Santa Barbara	Bruce Kidd
56th	January 12, 13, 14, 2004	Sacramento	Pam Geisel
57th	January 10, 11, 12, 2005	Monterey	Debra Keenan
58th	January 16, 17, 18 2006	Ventura	L. Robert Leavitt
59th	January 8, 9, 10, 2007	San Diego	Deb Shatley
60th	January 28, 29, 30, 2008	Monterey	Carl Bell
61st	January 28, 29, 30, 2009	Sacramento	Stephen Colbert
62nd	January 11. 12. 13 2010	Visalia	Stephen Colbert
63rd	January 19, 20, 21, 2011	Monterey	Dave Cheetham
64th	January 23, 24, 25 2012	Santa Barbara	Michelle Le Strange
65th	January 23, 24, 25 2013	Sacramento	Chuck Synold
66th	January 22, 23, 24 2014	Monterey	Steve Fennimore
67th	January 21, 22, 23, 2015	Santa Barbara	Rick Miller
68th	January 13, 14, 15, 2016	Sacramento	John Roncoroni
69th	January 18, 19, 20, 2017	Monterey	Katherine Walker
70th	January 24, 25, 26, 2018	Santa Barbara	Maryam Khosravifard
71st	January 23, 24, 25, 2019	Sacramento	Joseph Vassios
72nd	January 22, 23, 24, 2020	Monterey	Brad Hanson
73rd	January 25-February 26, 2021	Online Edition	Phil Munger
74th	January 19, 20,21, 2022	Sacramento	Anil Shrestha

75th	January 18, 19, 20, 2023	Monterey	William Patzoldt
76th	January 24, 25, 26, 2024	Santa Barbara	Scott Stoddard
77th	January 22, 23, 24, 2025	Sacramento	Kristina Madden