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CALIFORNIA WEED SCIENCE SOCIETY

"Exploring the Diversity of Weed Management in California"

January 19-21, 2022
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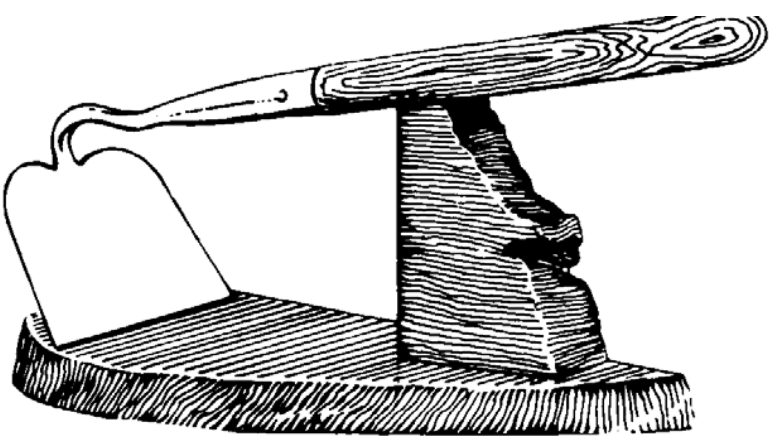

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2022 Proceedings of the California Weed Science Society

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January 19-21, 2022

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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 2022 AWARD RECIPIENTS
Presented by Anil Shrestha, CWSS President

This year's recipients have made tremendous contributions to the society mission in the following areas: the 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.

Awards of Excellence

Dave Blodget

Dave Blodget's experience in the aquatic plant management industry has spanned over forty years. As an Area Manager with Baker Petrolite, Dave led a team of aquatic specialists supporting the irrigation canal market in the U.S. and internationally. As the Pacific Southwest Aquatic Specialist for SePRO, Dave was responsible for providing technical and business support of SePRO's aquatic solutions for water and irrigation districts, professional applicators, government resource managers and their agent and distribution partners. As the Regional Manager- West for Alligare LLC based in Redding, CA he supervised a team of three Territory Sales Managers across the Western US. Currently, Dave is the Sales Manager overseeing all aspects of MAGNACIDE™ H herbicide both domestically and internationally. Dave is a Pest Control Advisor in California, Arizona and Oregon.

Dave served for 4 years on the Board of Directors for El Dorado Irrigation District, with 2 years as Board President. He has been an active member of CA Weed Science Society since 1980 and is currently the Finance Director.

A native to northern California, Dave graduated from the California State University, Chico with a B.S. Degree in Agricultural Business in 1979.

John Madsen, PhD

Dr. John D. Madsen is Research Biologist with the US Department of Agriculture, Agricultural Research Service, Invasive Species and Pollinator Health Research Unit on the campus of University of California-Davis. Previously, he was a faculty member at Mississippi State University for ten years, and a Research Biologist with the US Army Engineer Research and Development Center. Dr. Madsen has a Bachelor of Science degree from Wheaton College, Wheaton, IL, and Master of Science and Doctor of Philosophy degrees in Botany from the University of Wisconsin-Madison.

Honorary Member Award

Chuck Synold

Chuck Synold is vice president and regional manager for Agri-Turf Distributing's Central Coast and Central Valley markets. He is responsible for operations and sales in this region.

After graduating from CSU Chico with a B.S. in Agricultural Business, Chuck began his career in the specialty ag chemicals industry in 1980 as a field representative for a California-based distributor. He has been very active in the pest control, vector, and vegetation management markets throughout his region. He has served as past president of the California Weed Science Society, is a member of the Pest Control Operators of California and a licensed Pest Control Advisor. Annually, he provides technical and regulatory compliance CEU training to hundreds of professional applicators.

Chuck enjoys spending time with his wife Heidi, two children and grandchildren. He is an avid waterfowl hunter, surf fisherman and golfer.

CWSS Student Contest Winners
Thomas Getts, CWSS Director, Student Liaison

It's 2022 and the California Weed Science Society was back in person at the Hyatt in Sacramento!

It was touch and go leading up to the conference, but after it started everything seemed to go off without a hitch. There were lots of good exhibitors and a great lineup of speakers to listen to.

My favorite part of the conference is the student presenters. This year we had a great turnout, with 5 graduate students participating in the oral contest, and 12 students in the poster contest (10 graduate, and 2 undergraduate).

Pic1: Picture of many of the student posters presented at the conference

All of the students did an excellent job, making the final decisions by the judges quite difficult! Two independent judging panels compiled scores and delivered prizes. Below is a list of the Winners!!

Undergraduate Poster Contest Winner
First Place: Jennifer Valdez Herrera presented- Potential of Roller-Crimper Technology for Weed Suppression in Annual Crops. (Fresno State)

Graduate Poster Contest Winners
First Place: Wenzhuo Wu-The Comparative Flower development of Palmer Amaranth: Male vs. Female (Davis)
Second Place: Sarah Marsh- Weed Control and Rice Response to Pyraclonil, A New Broad-Spectrum Herbicide in California Rice (Davis)
Third Place: Aaron Becerra- Alvarez-Screening for Herbicide Resistant Weeds in California Rice Fields (Davis)

Pic2: Poster Contest Winners Left to Right- Wenzhuo Wu, Sarah Marsh, Aaron Becerra- Alvarez, and Jennifer Valdez Herrera

Graduate Paper/Oral Winners
First Place: Wenzhuo Wu-Sterile Pollen Technique as a Novel Weed Management Tool (Davis)
Second Place: Liberty Galvin-Pre-emergent Oxyfluorfen Application to Control Weedy Rice in California (Davis)
Third Place: Margaret Fernando-Impacts of Native and Introduced Cover Crops on Soil Health and Weed Populations in a Table Grape Vineyard of the San Joaquin Valley (Fresno State)

Pic 3: Paper Contest Winners Left to Right-Wenzhuo Wu, and Liberty Galvin.
(Margaret Fernando gave a virtual presentation and is not pictured.)

I would like to thank all of the students who participated and attended the conference this year!

If you know any students in weed science, keep your eye out for the upcoming CWSS Scholarship program, and encourage them to participate in the contest at next year's conference in Monterey!

Origins of *Amaranthus tuberculatus* (Waterhemp) in Central Valley Agroecosystems: A Population Genetics Approach Using Genotyping-By-Sequencing. Alexander J. Lopez*[1], Dr. Anil Shrestha[2], Dr. Lynn M. Sosnoskie[3], Dr. Katherine E. Waselkov[1]. Department of Biology, California State University Fresno, Fresno, California, USA, [2]Department of Viticulture and Enology, California State University Fresno, Fresno, California, USA, [3]School oflntegrative Plant Science, College of Agriculture and Life Sciences, Cornell University, Ithaca, New York, USA. Corresponding author: alexsteelerl 7@mail.fresnostate.edu

Native to the Mississippi valley, *Amaranthus tuberculatus* (waterhemp) began invading agricultural cropping systems in the 1950's and has since become a widely troublesome weed throughout the Midwestern United States. Waterhemp has not been reported to be a common weed in the agriculturally intensive Central Valley of California; however, in the last decade waterhemp has been increasingly observed invading agroecosystems within Merced County. The aim of this study is to (1) document and map the distribution of these recent waterhemp infestations in the Central Valley, (2) genetically characterize and determine the geographic origin of the source(s) of this invasion, and (3) evaluate likely evolutionary route(s) that may have facilitated this invasion. Seven (7) populations of waterhemp were identified in 2019 invading various agricultural fields (almond, com, hay, rice) within Merced County between Highways 140 & 152; DNA samples were collected from each population and then sequenced on the Illumina HiSeq4000 platform using the genotyping-by-sequencing library construction method. To determine the origin of this invasion, we compared allelic variation in these populations to potential source populations from across the species' native range in the Midwest using the genetic clustering method *STRUCTURE* 2.3.4. Clustering results suggest K=2 clusters as the most likely, with population assignments aligning closely geographically with an eastern and western subunit. Merced populations cluster predominantly with the western cluster, suggesting they were introduced from this region. Evolutionary history and routes of this invasion will be evaluated through demographic modeling using approximate Bayesian computation with DIYABC 2.1.0 software.

Pre-Emergent Oxyfluorfen Applications to Control Weedy Rice in California.

Liberty B. Galvin*, K. Al-Khatib. University of California, Davis. Department of Plant Sciences, Davis, CA, USA. *Corresponding author (lbgalvin@ucdavis.edu)

Weedy rice (*Oryza sativa spontanea*) is a concerning pest in California rice crops. Progress toward managing this pest has made significant strides, however, chemical control options currently do not exist for this weed. ROXY rice, a trait-based technology, is oxyfluorfen tolerant and poses an opportunity for controlling weedy rice. Field trials occurring at the Rice Experiment Station in Biggs, CA, suggest that the ROXY program and associated pre-emergent oxyfluorfen provide exemplary weed control, however, these trials did not incorporate weedy rice. The objective of this experiment was to determine if pre-emergent oxyfluorfen could be a viable option for controlling weedy rice. The experiment was repeated in time on UC Davis campus in a greenhouse facility. Weedy rice types 1, 2, 3, and 5 as well as M206, a medium grain, medium maturity cultivar, were planted at 0.5- and 1-inch soil depths. Oxyfluorfen was applied to the soil as a pre-emergent application at rates of 0, 0.5, 1, 2, and 4 lbs ai/acre within a 20 gal/Acre applicate volume. Once seeds were planted and pots were sprayed, blocks were flooded incrementally over 48-hours to a final 4-inch depth. Treatments were arranged within a in a randomized block design with a single herbicide rate for each block. Necrosis and stunting were the selected metrics for visual injury ratings based on field observations. Total emergence was recorded each day for the duration of the 28-day experiment. Weedy rice as well as M206 successfully emerged from all treatments, regardless of oxyfluorfen rate. There was less total emergence from treatments that were buried at 1 inch compared with 0.5 inches. There was significantly less emergence, 24%, from seeds exposed to 4 lbs ai/acre compared with 0.5 lbs ai/acre, 29%, but no significant difference in total emergence between seeds exposed to 0.5, 1, and 2 lbs ai/acre. All weedy types, as well as M206, exhibited significantly more stunting compared with the untreated control groups and were completely necrotic by the end of 28 days, regardless of application rate. Results suggest that oxyfluorfen could be used as a pre-emergent chemical control option for weedy rice in California.

Integrating Deep Learning and Google Street View for Novel Weed Mapping.

Tong Zhen[1] (tzhen@ucdavis.edu), Kassim Al-Khatib[1] (kalkhatib@ucdavis.edu) and Mohsen Mesgaran[1] (mbmesgaran@ucdavis.edu). [1]Department of Plant Sciences, University of California, Davis.

Mapping roadside weedy and invasive species can assist in developing species population models, designing proper weed management strategies, and tracking potential herbicide-resistant species spreading. The versatility of an accurate species population map will benefit future studies of weed sciences and ecology. However, the traditional road survey requires massive human labor and time to collect the location information of the target species. We developed a novel weed mapping system to retrieve species location data by integrating the Google Street View imagery and image detection network based on deep learning algorithms. The target species to be detected is johnsongrass (*Sorghum halepense*). We trained the detection network, You Only Look Once (YOLOv2), with about 1000 johnsongrass roadside images retrieved from the Google Street View. The network takes the image as input and outputs bounding boxes and the probability of the target species being detected inside the bounding boxes. Then the probability values and the location data of each image were used to create a map of the johnsongrass population using ArcGIS. The accuracy of the network was calculated based on a confusion matrix. Our current deep learning network has a true positive rate greater than 85%. However, we still have a high false positive rate of about 25% to 30%. Work is in progress to reduce the incorrect detection. We mapped the target species along the primary and secondary roads of 135,000 km in length in four US states: California, Oregon, Washington, and Nevada. We selected sampling points at 500 m intervals along these roads corresponding to 269,489 images, and the network detected about 2000 new johnsongrass records along roads in these four states. Using our novel AI-based method, the estimated cost of the weed survey in four states is $1700, while the traditional road surveys with the same scale cost at least $42,000 without considering risks associated with a car survey such as accidents. Besides that, traditional road surveys require six months, but the automated weed survey only requires a few days if we have the trained network. The automated mapping scheme can apply to other weedy and invasive species, and it is possible to map this weed (and others) on a much larger scale, which is the focus of our future work.

Sterile Pollen Technique: A Novel Weed Management Tool. Wenzhuo Wu[1], Mohsen B. Mesgaran*[1]. [1]Plant Science Departments, University of California, Davis, CA, USA.
*Corresponding author (mbmesgaran@ucdavis.edu)

In this study we examined the possibility of using sterile pollen as means of disrupting seed production in weeds in a similar way to the Insect Sterile Technique (IST). We hypothesized that pollen irradiated at a specific dosage can maintain its physiological functioning but will not be able to fertilize the egg-cell to produce seeds. We tested this new technique using Palmer amaranth (*Amaranthus palmeri*) which is a dioecious weed, and its seed production totally depends on cross-pollination. The objectives of study are to 1) determine optimal irradiation dose for pollen sterilization and pollen storage conditions and 2) determine an ideal powder formulation and pollen mixed ratio for large scale application. Male and female plants were isolated and grew in separate greenhouses when they reached the flowering stage. The fresh and mature pollen from male plants were collected and irradiated with gamma ray from Cesium-137 at dosages of 0,100, 200, 300, 400 and 500 Gy. Irradiated and untreated pollen were immediately used for two experiments: hand-pollination and pollen viability study. For hand-pollination study, each dosage had six treatments with five replications. On each female plant, six lateral inflorescences of similar size were selected, which received 1) no pollen, 2) only non-irradiated pollen, 3) only irradiated pollen, 4) non-irradiated pollen after irradiated pollen, and 5) irradiated pollen after non-irradiated pollen. The inflorescences were bagged immediately after pollination. The sixth inflorescence was not bagged to allow for 6) open pollination. Flower number and seed number were measured after harvesting. Pollen viability was assessed using 2,5-diphenyl monotetrazolium bromide (MTT) on irradiated pollen immediately after irradiation and after one week, 1 month, 3 months, and 6 months storage under -80, -20, 4, and 20 ºC respectively.
Results showed 300 Gy is the most effective irradiation and -80 ºC is the optimal temperature to maintain the viability of irradiated pollen. In addition, as applying small volumes of pure pollen under real field conditions is difficult, it therefore needs to be diluted with inert materials and delivered as an easy-to-release formulation for large scale applications. Wheat flour and talc powder were tested. Preliminary study showed applying pure wheat powders or talc powders on female plants can reduce seed production, but talc powder is more efficient to decrease seed production. Mixing the powder with sterile pollen probably not only can be delivered as an easy-to-release formulation for large scale applications and can improve the efficacy of reducing seed production. Future work will be determining an ideal dry dilute at a most effective mixed ratio for large scale application and finding the optimal timing and frequency of sterile pollen application. Although the focus of this project is a single weed, the method can be extended to address the problem of multiple weed species (broad-spectrum weed control), where sterile pollen from multiple weed species can be mixed and released in a single application. The sterile pollen technique can be particularly helpful for managing herbicide resistant weeds that have withstood in-season control and hence ready to produce seeds.

Impacts of Native and Introduced Cover Crops on Soil Health and Weed Populations in a Table Grape Vineyard of the San Joaquin Valley. Margaret R. Fernando*[1], Dr. Lauren Hale[2], Dr. Sharon Benes[1], and Dr. Anil Shrestha[1]. [1]California State University, Fresno, CA, USA,[2]USDA ARS, Parlier, CA, USA.
*margierfernando@mail.fresnostate.edu

Issues of resource depletion and landscape degradation are products of agricultural management practices developed to feed the growing population. Strategies, such as the use of cover crops, may enhance the sustainability of farm management by providing resource efficient and cost-effective solutions while addressing food demands. Cover crops have been shown to impact vineyard water and herbicide requirements, but few studies have assessed the impacts of cover crops on soil moisture content and weed pressure in table grape vineyards of the Eastern San Joaquin Valley. In this project, native species cover, introduced species cover, and bare cover were assigned as treatments in a table grape vineyard. During the first two years of establishment, soil structural, chemical, and biological properties were monitored, Additionally, weed populations were evaluated in the vineyard alleyways under the mowed cover crops and in the vine rows under the grapes. In the first year, vine row soils in the native and introduced cover crop treatments had higher soil moisture content compared to the bare treatment. In addition, weed surveys were performed after the cover had been mowed, and in the most recent weed survey (summer 2021), the native cover treatment and introduced cover treatment had higher percent weed cover compared to the bare treatment. Cover crops, in general, give evidence that the sustainability of agricultural production systems may be enhanced. However, determining the timing of potential benefits is complex and should be studied further. To determine whether cover crops reduce weed pressure during the active season of cover growth, new weed surveys will be performed using ratios of cover crop to weed biomass. With more time and experiments, the relationship between cover treatment, soil moisture, and weed populations will become more apparent.

The California Pesticide Registration Branch Responsibilities. John E. Inouye, Department of Pesticide Regulation, Registration Branch, 1001 I Street, P.O. Box 4015, Sacramento, CA 95812

The Department of Pesticide Regulation's (DPR) Pesticide Registration Branch is responsible for enacting the California Food & Agricultural Code and the California Code of Regulations when addressing the registration of pesticide products in California. The Registration Branch has registered over 13,000 products. The Registration Branch is the primary liaison to registrants, issues public notices, coordinates scientific evaluations by other DPR branches, makes final decisions, and communicates with other stakeholders such as federal and state agencies, and other interested parties. The Registration Branch also maintains various databases to assist DPR staff and outside stakeholders and implements various programs such as Special Local Need registrations, Emergency Exemptions, Adverse Effects, Reevaluations, and Risk Assessment.

In the quest to be more efficient, the Registration Branch is implementing a California Pesticide Electronic Submission Tracking (CALPEST) system, and a formalized training program for new regulatory scientists, in addition to updating policy and procedures, and regulations.

Herbicide Trials to Control Water Hyacinth, Water Primrose, and Alligatorweed. John D Madsen, USDA ARS ISPHRU. Davis. CA

Invasive aquatic weeds are a widespread problem throughout California, including the Sacramento-San Joaquin River Delta. In particular, the species water hyacinth (*Eichhornia crassipes*), water primrose (*Ludwigia* spp.), and alligatorweed (*Alternanthera philoxeroides*) have had particular attention. Herbicides are an effective and relatively cost-efficient method of control for these species. Herbicide trials have been completed in California and elsewhere in the United States. Many more trials have been done for water hyacinth than the other two species. A recent trial in the Delta indicated that four herbicides provided greater than 80% control of water hyacinth: 2,4-D (82%), glyphosate (87%), imazamox (93%), and penoxsulam (94%). Another trial found that tank mixes with carfentrazone or flumioxazin were no more effective than glyphosate or imazamox alone. Nationwide, herbicides that have been effectively used on water hyacinth include bispyribac, diquat, glyphosate, imazamox, imazapyr, penoxsulam, triclopyr, 2,4-D and florpyrauxifen-benzyl). Trials on water primrose in Mississippi found 2,4-D (88%), glyphosate (68%), and triclopyr (93%) to have significant efficacy on water primose at 12 WAT, while imazamox (57%) and penoxsulam (0%) did not. Alligatorweed is a widespread aquatic weed around the world. It has been most common in the Gulf Coast states of the US, but is more recently seen in northern California. A trial in Mississippi found that these herbicides had greater than 80% control of alligatorweed at 12 WAT: diquat (94%), glyphosate (95%), imazamox (96%), imazapyr (99%), penoxsulam (87%), triclopyr (95%), and 2,4-D (94%). Carfentrazone was 56% effective at 12WAT. California has more extensive regulations on herbicide use in water, with multiple agencies exerting some level of control.

Use of Preemergence Herbicides in California Orchard and Vineyard Systems. Andres Contreras Jr and Brad Hanson. Department of Plant Sciences. University of California, Davis. ancontreras@ucdavis.edu

As new herbicides are evaluated for potential registration in California orchard and vineyard crops, crop safety and performance data are needed by both the herbicide registrant and regulatory agencies. Preemergence herbicides are commonly used in most orchard and vineyard production systems. Most herbicides in this group work by inhibiting the growth of roots, shoots, or both of emerging seedling, depending on the mode of action (MOA). A series of bare ground and orchard and vineyard trials were carried out to evaluate the crop safety and performance of an unregistered preemergence herbicide relative to commonly used standards. Most experiments included: flumioxazin (Chateau) a group 14 MOA (inhibitor of protoporphyrinogen oxidase), indaziflam (Alion) a group 29 MOA (inhibitor of cellulose biosynthesis), pendimethalin (Prowl H_2O) a group 3 MOA (inhibitor of plant cell division and cell elongation), rimsulfuron (Matrix) and penoxsulam (Pindar GT) both of group 2 MOA (inhibitor of acetolactate synthase), along with Exp-82 a group 15 herbicide (inhibitor of very long chain fatty acids). Exp-82 is currently used as preplant incorporated or preemergence herbicide, for use in corn, soybean, and cotton in Midwestern states of the United States. The herbicides were evaluated for crop safety and control of grasses and broadleaf weeds. Trials were initiated in fall of 2020 and spring of 2021. Evaluations were done visually and carried out up to 150 days after application. Data were analyzed using analysis of variance in ARM 2021. Thus far, Exp 82 performed similarly to commercial standards in the field trials. No significant difference was in found weed control among treatments in any of the trials. No crop injury was observed in any of the orchard or vineyard trials. Similar research will continue through 2022 to evaluate additional weed species and crop safety with repeated treatments of the experimental herbicide and commercial standards.

Crop Rotation for Rice Systems in California: Baseline Assessment of Barriers and Opportunities. Sara Rosenberg[1]*, srosenberg@ucdavis.edu, Amanda Crump[1], Whitney Brim-DeForest[2], Bruce Linquist[1], Luis Espino[3], Kassim Al-Khatib[1], Michelle M. Leinfelder-Miles[4], Cameron M. Pittelkow[1]

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For California rice production systems, weed management challenges, and herbicide resistant weed species are a major threat to the long-term sustainability of California rice production systems. While crop rotations represent an IPM tool for weed management, rotations are limited in the Sacramento Valley due to the prevailing notion that heavy clay soils restrict the production of crops other than rice. However, little research has investigated the decision-making process and experiences of growers to understand current rotation practices and barriers to adoption. Interviews with rice growers (n=42) showed that perceived benefits depended on the type of operation. Roughly 47% of the growers interviewed were considered rice only growers. Twenty-eight percent were considered to rotate using conventional methods and another 24% were considered organic producers. Growers who rotated with conventional methods identified multiple benefits including weed management, soil health, economics, conservation, and input reductions. However, rice-only growers discussed rice land conservation and weed management as leading potential benefits, while most organic growers identified soil health and weed management alone. Although poor soil drainage was a dominant limitation mentioned by all growers, logistics for switching to other crops, profitability, limited market access, and limited resources such as production contracts, equipment, labor, and experience all pose additional challenges. This research provides insights into the limited feasibility of rotations in California rice systems, while helping inform future field-based research experiments.

A Review of the Potential of the Stale-drill Method for California Rice: Challenges, Opportunities, and Lessons. Alex Ceseski, Kassim Al-Khatib, Plant Sciences Department, University of California, Davis

The California rice industry faces many challenges, most notably water availability, strong flood-adapted weed pressure, limited herbicide availability, and widespread herbicide resistance. Various alternative methods of stand establishment -as well as water and herbicide management- exist to address these issues singly, but there are not many tools available to address them together. We have been developing a new cropping strategy for California rice that incorporates two uncommon practices for weed control and stand establishment, which has the potential to be a viable rotational option for some growers: the “stale-drill” method.

Stale-drill rice cropping combines a stale seedbed with deep drillseeding to permit a safe burndown application of nonselective herbicides to early-emerging weeds, just prior to stand emergence. This method allows the use of novel modes of action on weeds that may be resistant to existing rice herbicides, while avoiding planting delays that a traditional stale seedbed requires.

We have found that California rice cultivars possess suitable seedling vigor to emerge rapidly and evenly from seeding depths of up to 6cm, under favorable conditions. Using glyphosate as a postplant-preemergent burndown (PPB) treatment, timed to the date of first observed rice emergence, we are able to control 50-90% of grasses, while avoiding lasting crop injury. We also found that using flush-irrigation for the first 30-40 days of the season provided adequate water for rapid rice stand growth, yet suppressed the growth of algae, broadleaf weeds, ricefield bulrush, and late watergrass. This method can also result in yields competitive with standard water-seeded rice practice.

Under less-favorable conditions, however, we found that rice emergence can be delayed by low temperatures and overly damp soils. Delaying rice emergence under these conditions can result in uneven emergence, as well as reduced rice stand density and vigor. As PPB treatment is timed to rice stand emergence, delaying treatment in this manner can allow competitive grass weeds to grow too large or dense to control adequately, creating conditions for reduced rice competitiveness, as well as potentially causing significant rice injury.

This novel rice cropping method will continue to be studied and refined, as the parameters and favorable conditions for this method are discovered. We believe that stale-drill holds promise as a future alternative rice cropping strategy for California.

New Rice Herbicides to Control Herbicide Resistant Weeds. Kassim Al-Khatib, University of California, Davis

Lack of crop and herbicide rotation in California rice continuous flooding system resulted in wide spread of herbicide resistance weeds that may threaten the sustainability of the rice cropping system in California. Almost all weed species in California rice fields developed at least resistance to one herbicide modes of action. One of the main objectives for the rice weed science program at the University of California is to develop new tools and techniques to control herbicide resistant weeds.

Several studies were conducted to study four new herbicides for weed control in California continuous flooding rice cropping system including pyraclonil (Zembu), florpyrauxifen-benzyl (Loyant), oxyfluorfen (ALB 2023) in Roxy Rice, and the grass control herbicide tetflupyrolimet (TVE29).

Pyraclonil (Zembu), a PPO-inhibitor, is a granular formulation currently under development for weed control in CA rice by Nichino America, Inc. PPO-inhibitors are important for weed control in California rice because no confirm weed resistance to this mode of action has been reported in rice fields. In addition, Zembu provide good control of broadleaf weeds and grasses. Our research over the last five years demonstrated that Zembu would be best used as part of a comprehensive weed control program. Zembu is less effective on sprangletop (*Leptochloa fascicularis*), smallflower sedge (*Cyperus difformis*) and rice bulrush (*Schoenoplectus mucronatus*). In 2021 growing season, a field study examined Zembu (a granular formulation of 1.8% pyraclonil) at rate 14.9 lbs/A applied day of seeding (DOS) in conjunction with later application propanil, Butte, Cerano, thiobencarb, Regiment, Granite, and Clincher, all applied according to label. Weed control and crop phytotoxicity were recorded throughout the growing season.

Rice injury with Zembu was minimal. The other herbicides in the Zembu programs caused no additional injury than what is typically expected from these herbicides. The herbicide programs of Zembu followed by Butte plus propanil; propanil plus Loyant; and Clincher plus Granite showed exceptional control of all weeds present in the field at 42 DAS (100% control). The program consisting of Zembu followed by propanil was similarly effective in controlling all weeds except Echinochloa grasses (<89% control) and ricefield bulrush (87% control).

Roxy rice, a new technology developed at the California Rice Experiment Station. This rice is resistance to oxyfluorfen (ALB 2023). We have conducted research to determine the efficacy of ALB2023 for use with the ROXY Rice Production System® and ROXY®trait rice for weed control and crop safety. ROXY® rice was planted into shallow flood waters at 300 grams seed per plot on June 1, 2021 at the Rice Experiment Station in Biggs, CA. All ALB2023 applications (0.5, 0.75, 0.875, 1, and 1.125 lb ai/A) were made to bare ground prior to flooding and seeding with additional herbicides applied at 5 LSR or 30-35 days after seeding (DAS). The crop was visually evaluated for chlorosis, bleaching, stunting and stand reduction at 3, 7, 14, 28, and 60 DAS. Weed control was also visually rated at 7, 14, 28, and 60 DAS. Key weed species included watergrass

(*Echinochloa crus-galli*), sprangletop, rice field bulrush, smallflower umbrella sedge, ducksalad (*Heteranthera limosa*), *Monochoria sp*p., water hyssop (*Bacopa sp*.), and redstem (*Ammannia sp*.).

Slight rice stunting was observed at 7 DAS but stunting occurrences improved by 14 DAS; all treated plots were comparable to the control plots by 28 DAS. Weed control at 60 DAS, especially for grass species *Echinochloa crus-galli* and *Leptochloa fascicularis*, was superior (≥ 92%) for all treated plots compared with 2019 and 2020. There was a noticeable amount of *Echinochloa* growing in untreated plots, but no weeds present in any treated plots regardless of application rate or treatment. All ALB2023 plots had more than 94% control of all weeds at 60 DAS except *Schoenoplectus mucronatus* where control ranged from 43 to 76% depending on the rate. All plots were harvested on October 16. Treatments of ALB2023 at 1 lb ai/A followed by 13 lb/A of Granite GR at 5 leaf stage, had the highest yield compared with other treatments.

Tetflupyrolimet FMC new grass control herbicides (TVE29) is a new herbicide with new mode of action. It is a grass control herbicide that inhibits dihydro-orotate dehydrogenase enzyme (DHODH) in the pyrimidine synthesis pathway. No herbicide with this mode of action is commercialize on any crop worldwide. Our 2021 study showed that tetflupyrolimet provide outstanding grass control when applied at both day of seeding or after rice established. This herbicide gave complet grass control. In addition This herbicide cause slight rice stunting but plant quickly recovered from stunting.

Loyant (florpyrauxifen-benzyl) is a new aryl picolinate herbicide developed by Corteva. Loyant is a synthetic auxin herbicide, the same mode of action of triclopyr herbicide that has been used on California rice for more than 20 years; however, Loyant is a new structural class of synthetic auxin herbicides. Loyant has broad window of application timing that range from 2-rice leaf-stage to 60 days before harvest. It is more effective, however, when it uses on small weeds that were not covered by water. Loyant can be used in both dry direct-seeded and water-seeded.
Generally, Loyant has a broad-spectrum weed control activity. In rice, it controls selected grasses sedges, and broadleaf weed species. Our research showed while Loyant provide good control of barnyardgrass, it is less effective on other *Echinochloa* species. Loyant, however, provide good sedges and broadleaf weed control. Loyant usage rate may dependent upon the target weed species and geography.

Biology and Control of Native and Invasive Grasses. Dan Wickham, Wilbur-Ellis Company (dwickham@wilburellis.com)

The presentation discusses basic biology of grasses, including variations of morphological characteristics. Identification, history, and growth characteristics that allow survival of select invasive species can offer insights into control or management strategies. Although grasses are economically important for food and fiber, invasive species cause significant ecosystem alteration, leading to detrimental habitat modification, reduction in distribution and availability of water, and severe shortening of wildfire cycles.

Integrated Vegetation Management can include combinations of chemical, biological, cultural, mechanical, or manual treatments. Where bare ground is necessary, rights-of-way are most effectively managed through use of pre-emergent and post-emergent herbicides. Important considerations for herbicide performance include proper rate, spray volume for effective coverage, weather conditions, and soil type in relation to potential leaching and length of residual control. Monitoring weed populations can help identify weed shifts, new introductions, possible herbicide resistance, and determination of an economic threshold for treatment.

Fire Risk Management with Multiple Tools Including Herbicides. Jerome Otto, Corteva Agriscience, jerome.otto@corteva.com

Recent wildfires over the past 10 years have increased in both frequency and severity. Root causes are many, with climate change, stem density increase, more people living in our forests and wildlands, fuel load increase (particularly ladder fuels) and fire suppression. Fire suppression over the last 100 years has significantly changed forest structure. Historically, ground fires would occur approximately every 5 years, resulting in lower stem densities and reduction of ladder fuels. With fire being suppressed, ladder fuels buildup has resulted in fires changing from slow-moving ground fires (which recover quickly post- fire) to devastating, fast-moving crown fires which kill all trees in the forest, requiring reforestation efforts.

Herbicides can be an effective tool to assist with fire mitigation and prevention when used to maintain fuel breaks and shaded fuel breaks. In addition, herbicides are a key component in maintaining roadsides, including zone 1 (Total Vegetation Control), zone 2 (grass-friendly areas with no trees or brush) and zone 3 (trees and brush with a well-maintained stem density). After fires have been controlled, herbicides are a key component in reforestation efforts, both in site preparation (prior to seeding) and conifer release. Experience has shown that reforestation efforts with no herbicides result in very high seedling mortality due to competition with invasive brush, longer grow-in times and poorer stand establishment.

Methiozolin and Cumyluron: Two Novel Herbicides for *Poa annua* Control in Turf. James H. Baird* and Pawel M. Orlinski**.** University of California, Riverside, CA, USA. *Corresponding author (jbaird@ucr.edu)

Annual bluegrass (*Poa annua*) is one of the most ubiquitous grass species in the world and is managed either as a desirable turfgrass species or problematic weed in other preferred turfgrass stands. Although annual bluegrass, especially perennial biotypes, can provide a superior surface for golf courses, athletic fields, and other sports, the species is more susceptible to biotic and abiotic stressors that often lead to greater inputs of pesticides, fertilizer, and water to maintain health and survival. Historically, there have been very few herbicides registered for selective control of annual bluegrass in creeping bentgrass golf course putting greens, mainly because of potential bentgrass injury and subsequent liability issues on such intensively managed and economically important surfaces. Until recently, bensulide was the only herbicide registered for annual bluegrass control in bentgrass greens as a preemergence only. Certain plant growth regulators (PGRs) can suppress annual bluegrass in bentgrass greens; however, their use must be halted during colder temperatures when annual bluegrass is able to proliferate. Methiozolin (PoaCure™) herbicide from Moghu USA LLC is newly registered in the U.S. except for California where registration is pending. This isoxazoline herbicide provides both pre- and postemergence control of annual bluegrass in creeping bentgrass and bermudagrass putting greens and taller cut turf of most all commonly used cool- and warm-season turfgrass species. It also has activity against roughstalk bluegrass (*Poa trivialis*) and preemergence activity against crabgrass (*Digitaria* spp.) and goosegrass (*Eleusine indica*). Recommended use rates are 0.5 and 1.0 lb a.i./A (0.6 and 1.2 oz./1,000 ft^2) for greens and taller cut turf, respectively, applied sequentially every 2 to 3 weeks for a total of 3 to 6 applications per year. Cumyluron herbicide from Marubeni Corporation is under development for registration in the U.S. This urea herbicide also provides both pre- and postemergence control of annual bluegrass in creeping bentgrass and bermudagrass putting greens and taller cut turf of most all commonly used cool- and warm-season turfgrass species. It also has preemergence activity against crabgrass and annual sedges (*Cyperus* spp.). Recommended use rates are 4 to 8 lb a.i./A (3 to 6 oz/1,000 ft^2) for both greens and taller cut turf. Only two applications of cumyluron are required per year in spring and fall. In comparison, both herbicides are root active and require irrigation following application. Methiozolin has stronger postemergence activity whereas cumyluron has stronger preemergence activity. Both herbicides should be applied when desirable turfgrass roots are not compromised by stressful weather or cultural practices. When used properly, both herbicides provide slow, seamless transition from *Poa*-infested to *Poa*-free turf in 1 to 3 years, depending on antecedent populations. Ultimately, when both herbicides are registered, turf managers will have two very effective chemical tools for achieving and maintaining *Poa*-free turf, especially on putting greens. Rotating among conventional practices (PGRs, hand-picking, etc.), methiozolin, and cumyluron will avoid overuse of a single active ingredient and prevent or delay the likelihood of *Poa* developing resistance to these new herbicides.

Control of Quinclorac-Resistant Smooth Crabgrass in Bermudagrass Turf.

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Smooth crabgrass (*Digitaria ischaemum*) is a summer annual grassy weed widespread in lawns and other turfgrass areas including golf courses and athletic fields. It is a low-growing, warm-season grass spreading mostly by seeds and germinating in areas where grass is thinner and soil is exposed. While growing, it crowds out desirable turfgrasses affecting aesthetic and functional turf quality. When not controlled, crabgrass dies in late fall leaving space for new infestation by winter annuals. For a long time, quinclorac was the standard herbicide for control of crabgrass in various turfgrass species, but overuse of this herbicide has resulted in appearance of crabgrass populations resistant to this active ingredient. Two studies were conducted in Riverside, CA to evaluate and compare the efficacy of various herbicides for smooth crabgrass (*Digitaria ischaemum*) control in hybrid bermudagrass (*Cynodon* spp.) maintained as a golf course fairway or athletic field. In the first study, nine treatments were tested against an untreated control. Five treatments were applied at the 1 to 3 tillering stage of crabgrass and four treatments were applied at the 5-tiller stage. Although crabgrass cover following two quinclorac treatments was never significantly different from the control, populations were lower. This was caused by successful eradication of susceptible plants, hence reducing number of plants present. Unfortunately, the majority of plants was not injured and soon increased in size, rapidly taking over the plots. Pinoxaden herbicide treatments, regardless of timing of application, were successful in controlling smooth crabgrass, reducing cover of this weed to 3-6% by September 1, 2021. The second study was initiated on mature crabgrass and first applications were made on August 19, 2021. Nineteen herbicide treatments were tested against an untreated control. Most of treatments did not provide sufficient control of smooth crabgrass. Treatments including pinoxaden or dithiopyr provided partial control reducing crabgrass cover by almost half within first month after application. Best control out of single active ingredient herbicides was provided by mesotrione and topramezone. Usually, tank-mixing herbicides provided better control than individual products.

Tiafenacil: A New Postemergence Herbicide - Efficacy and Crop Safety of in Ornamental Trees. Marcelo L Moretti, Department of Horticulture, Oregon State University, Corvallis, OR 97331.

Oregon leads the nation in the production of several ornamental nursery products, including shade trees, flowering trees, and conifers. It is third in the production of deciduous and broadleaf evergreen shrubs. Weed control is essential to quality nursery stock production and is primarily based on preemergence and postemergence herbicides. These multi-species production systems present challenges for chemical weed management; crop tolerance must be evaluated for each species. The objective of this study was to evaluate the tolerance and efficacy of tiafenacil, a protoporphyrinogen inhibitor herbicide. Two field studies were conducted in 2021 at the OSU Lewis Brown Research Farm in Corvallis, OR. The first experiment evaluated crop tolerance to postemergence basal-directed applications of tiafenacil. The second study evaluated crop safety of tiafenacil applied as a pre-plant to estimate carry-over effect. Fields were a Chehalis silt loam soil under overhead irrigation. For each study, nine species were evaluated: *Acer rubrum, Cersi canadensis, Fraxinus latifolia, Gleditsia triacanthos, Picea sitchensis, Prunus laurocerasus, Quercus rubra, Thuja occidentalis,* and *Tilia americana.* For tolerance to the POST application, plants were transplanted on May 26, 2021. They were arranged in two rows, 1.5 ft apart, with 0.75 m between plants. Tiafenacil was applied at 75 and 150 g ai ha^{-1}. Tiafenacil was also applied in a mixture with tolpyralate (39 g ai ha^{-1}) or florpyrauxifen benzyl (5.5 g ai ha^{-1}). A non-treated control was included. Treatments were applied by a CO_2 backpack sprayer equipped with a shielded boom and two nozzles (DG8003) calibrated to deliver 20 GPA. The application was directed to the base of the plants to minimize foliar uptake. Treatments were applied two months after planting. Plots were retreated in later summer and again in late fall. In the carry-over study, tiafenacil was applied at two rates, 75 and 150 g ai ha^{-1}, applied once at one of the four application timings including 28-, 14-, 7-, and 1-day before transplantation. A nontreated control and an application of twice the flumioxazin field rate (425 g ai ha^{-1}) were included as references. The treatments were applied with a CO_2 backpack sprayer equipped with a six-nozzle boom (AI 11002 TeeJet) calibrated to deliver 187 l ha^{-1} and cover 3 m per pass. A single pass at the center of the plot was made. Two plants of each species were planted on May 26, 2021, in the central 1.5 m of the plot. Assessments included monthly visual estimates of crop injury and weed control. In the summer, leaf chlorophyll and canopy size were measured. The studies were organized as two-factor factorials in a randomized complete block design with four replicates. The first factor was the ornamental species, and the second factor was the treatments. Each plot consisted of two subsamples of each species; results were averaged within each plot. The crop tolerance study showed no effect on plant injury with tiafenacil at 75 or 150 g ai ha^{-1}, and also when in mixture with tolpyralate or florpyrauxifen. Neither plant weight nor chlorophyll content were affected by treatments. Tiafenacil provided 80% Italian ryegrass control when applied at 50 to 150 g ai ha^{-1}. Control increased to nearly 100% when tank-mixed with glufosinate. In the carry over study, neither tiafenacil rate nor treatment time affected crop injury or plant height. Treatment affected plant fresh weight only for *P. laurocerasus* and *Q. rubra*. Tiafenacil rate did not affect *P. laurocerasus*, based on contrast results. Fresh weight increased with tiafenacil applications at 14 and 7 days before transplantation compared to nontreated. This is likely a result of improved weed control and reduced competition. In, an effect of tiafenacil rate was noted. Fresh weight of *Q. rubra* was reduced at tiafenacil applied at 150 g ai ha^{-1} compared to 75 g ai ha^{-1}. This study is the first report the tolerance of ornamental crops to tiafenacil. Based on initial results, tiafenacil seems to have adequate crop safety and efficacy for use in tree nursery production. This project will continue in 2022. Funding was provided by the Oregon Association of Nursery.

Fraise Mowing: A Non-Chemical Tool for Controlling *Poa annua.*

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Fraise mowing is a cultivation practice that removes turfgrass verdure, thatch, organic matter, and soil, including weed seed, that can be used as a non-chemical means of controlling *Poa annua* L. In 2019, a field experiment was conducted in Knoxville, TN and repeated in space in Jay, FL to assess bermudagrass (*Cynodon* spp.) regrowth and *P. annua* control following fraise mowing. Turfgrass was common bermudagrass (*Cynodon dactylon*, cv. 'Vamont') maintained at a 3.2 cm height of cut in Tennessee and 'TifSport' hybrid bermudagrass (*C. dactylon* x *C. transvaalensis* Burtt Davy) maintained as a golf course fairway at a 1.3 cm height of cut in Florida. In both locations, fraise mowing was conducted in mid-June at depths of 1.5 and 3.0 cm. A non-fraise mowed control (0 cm) was included for comparison. The experiment was arranged as a randomized complete block design with four replications of plots (6 x 2.4 m). Bermudagrass cover was rated visually every two weeks following fraise mowing. *Poa annua* cover was quantified monthly the spring following fraise mowing in 2020 by assessing the number of plants present within a grid and converting values to percentages. In both locations, bermudagrass recovered most quickly when fraise-mowed to 1.5 cm rather than at 3.0 cm. In Tennessee, turfgrass fully recovered 98 days after treatment (DAT) when fraise mowed to 1.5 cm; comparatively, the 3.0 cm fraise mowing did not recover until 129 DAT. Bermudagrass recovery occurred much quicker in Florida than in Tennessee with the 1.5 cm treatment fully recovering 52 DAT and the 3.0 cm treatment completely recovering 106 DAT. In both Tennessee and Florida, fraise-mowing effectively controlled *P. annua*. No differences in *P. annua* control between fraise mowing depths were observed on any rating date in either study location. In Tennessee, fraise mowing resulted in 93 to 97% control throughout the spring. Comparatively, *P. annua* control in Florida ranged from 41–78%, with peak control observed in January and a decline thereafter. A qualitative study was also conducted in spring 2021, which engaged eight turfgrass managers from Tennessee and Florida via individual interviews to understand barriers and challenges to fraise mowing application. Turfgrass managers had positive views of fraise mowing but described challenges in implementation for weed control including cost, labor, area closure, and debris removal. This work indicates fraise mowing is a viable non-chemical weed control tool but presents unique challenges for turfgrass managers compared to traditional herbicides.

Alfalfa Weed Control in the Intermountain Region.

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Established alfalfa is a good competitor with weeds especially during the summer, but winter annual weeds that emerge in fall, winter, and early spring often grow large enough to contaminate first cutting. For this reason, high quality conventional alfalfa grown in the Intermountain Region of Northeast California often requires yearly herbicide treatment to prevent winter annual weeds in first cutting. A common herbicide treatment for controlling winter annual weeds in established alfalfa is metribuzin plus paraquat applied in late winter shortly before alfalfa breaks dormancy in late February or early March. This herbicide combination has been widely used for more than twenty years with good results, but growers have recently reported more weed escapes after treatment due to large weed size, weed shifts, and weed resistance. Furthermore, there have been recent regulations implemented from the EPA regarding the use of paraquat, which can limit growers ability to use it. Studies conducted in Northeast California in 2020 and 2021compared herbicide treatments applied in late February when alfalfa was dormant and early April when alfalfa had 3 inches regrowth. Dormant treatments that included paraquat in combination with metribuzin, flumioxazin, or both provided greater than 95% control of winter annual broadleaf and grass weeds. Linuron (unregistered in alfalfa) plus paraquat also provided over 90% weed control. Substituting saflufenacil or carfentrazone plus a methylated seed oil (MSO) for paraquat in the herbicide mix provided excellent control of broadleaf weeds, but they provided significantly less hare barley (*Hordeum murinum*) and cheatgrass (*Bromus tectorum*) control compared to mixes with paraquat. Imazamox and impazethyapyr provided variable weed control across locations. In Tulelake, imazamox or imazethapyr applied in early April resulted in poor control of large flixweed (*Descurainia sophia*) and prickly lettuce (*Lactuca serriola*) and less than 50% control of total weeds. In the Honey Lake valley, late applications of imazamox or imazethapyr gave good control of tumble mustard (*Sisymbrium altissimum*), but they did not control prickly lettuce. Most herbicide treatments caused visual crop injury during early season green-up, but dormant herbicide treatments did not reduce 1st cutting alfalfa yield compared to the untreated control. Study results suggest flumiozazin or linuron are effective alternatives to metribuzin for growers wanting to rotate to another dormant herbicide mode of action. Imazethypyr or imazamox applied after alfalfa green-up had higher winter annual weed density compared to dormant treatments at most locations, but they are a possible option for controlling weeds after green-up and can provide suppression of perennial weeds such as dandelion. Substituting saflufenacil for paraquat in dormant treatments provided excellent control of broadleaf weeds, but paraquat or the addition of clethodim (if environmental conditions are conducive) are needed to control emerged winter annual grass weeds.

Herbicide Drift in Hemp. Sarah Light, CE Agronomy Advisor, Sutter-Yuba and Colusa
Brad Hanson, CE Extension Weed Specialist

Production of *Cannabis sativa ssp. sativa* (hemp) began in California after federal legalization with the passage of the 2018 Farm Bill. California is a state with many high value agricultural commodities and the introduction of a new crop into this landscape brings certain unknowns. This project evaluated the potential phytotoxicity when growing hemp in California. Herbicides selected are widely used in the state; are likely to be sprayed during the hemp production season (May to September); and are likely to be adjacent or near to hemp. Hemp plants that were 12-18 inches tall were sprayed on August 15th, 2019. This was three weeks after transplanting. Application rates were based on 25% and 50% of the common agricultural use rate of each herbicide. This is higher than a typical drift rate. The goal was to show distinct symptoms. Photos were taken over a two-week period after herbicide application. Materials included are used in row crops, in orchards and other permanent crops, and on roadways. Demonstrated herbicides included Gyphosate, Paraquat, Glufosinate, Saflufenacil, Carfentrazone, Oxyfluorfen, Propanil, Bispyribac-sodium, Rimsulfuron, Imazapyr, Trilopyr, 2,4-D, Mesotrione, Clomazone, Ammonium nananoate, Sethoxdim, and Cyhalofop. Methylate seed oil, a spray adjuvant, was also applied. Photos of symptoms will be shown. All material presented can be found in UCANR Publication 8689.

Biological Control of Yellow Starthistle with the Rosette Weevil, *Ceratapion basicorne*. Lincoln Smith*[1]. [1]United States Department of Agriculture, Agricultural Research Service, Albany, CA. *Corresponding author Link.smith@usda.gov

Yellow starthistle (*Centaurea solstitialis*) is an invasive annual forb adapted to Mediterranean climate that has invaded over 19 million acres of rangeland in the Pacific West. It costs California ranchers $17 million annually in lost forage and control expenses. It has been targeted for biological control since the 1960s, and six species of insects that attack the flower heads have been intentionally introduced between 1969 and 1992. The false peacock fly (*Chaetorellia succinea*) was accidentally introduced in 1991, but it does not significantly damage any nontarget species in California. The California Department of Food and Agriculture has distributed approved agents around California. The hairy weevil (*Eustenopus villosus*) and the false peacock fly have become widespread, and may be reducing yellow starthistle populations in some areas. A rust pathogen (*Puccinia jaceae* var. *solstitialis*) was introduced in 2003, but it does not persist in most parts of California apparently because it is too dry during the summer for it to produce resting spores.

The rosette weevil (*Ceratapion basicorne*) was approved for release in 2019. It was tested on 51 nontarget plant species and does not pose a risk to any except cornflower/bachelor's button (*Centaurea cyanus*). The adult weevils feed on leaves and larvae develop inside the root of yellow starthistle rosettes during spring, reducing their size and survivorship. Adults emerge in June and hide until the following spring. We have developed methods to multiply the rosette weevil on potted plants and are training others to multiply it for release. We made the first release in April 2020 in Solano County and a second release in El Dorado County in April 2021. Damaged plants indicated that the weevil multiplied at both sites, but we don't know if it has been able to survive through winter. We expect the rosette weevil to complement the other insects that attack the flower heads to help reduce yellow starthistle populations.

Targeted Grazing: The Art and Science of Using Livestock to Manage Weeds.

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Targeted grazing uses the application of a specific type of livestock at a pre-determined season, duration, and intensity to accomplish specific vegetation or landscape goals. The technique refocuses the outputs of well-managed grazing from livestock production to vegetation and landscape enhancement (Launchbaugh and Walker 2006). Targeted grazing is being used increasingly to manage weeds, reduce fuel load, and improve ecological function in a variety of settings in California.

Typically, targeted grazing can be cost-effective and appropriate alternative where other options (like herbicides, mechanical treatment or prescribed fire) are limited by terrain, remote location, or proximity to populated areas. Targeted grazing contractors use the three basic impacts of grazing livestock (grazing, trampling, and nutrient transfer/cycling) during the appropriate growth phase of the targeted vegetation. Unlike conventional livestock production, targeted grazing generates producer income from the service provided rather than from reproductive efficiency or animal weight gain.

This presentation compares and contrasts conventional livestock production with targeted grazing, provides plant- and habitat-specific examples of successful targeted grazing projects in California (including the use of grazing to control yellow starthistle (*Centaurea solstitialis*) on annual rangeland), and discusses the variables that influence cost and success.

Simulated Grazing and Prescribed Fire to Control Common Weeds. Robert Fitch*[1], M. Shapero[2], F. Davis[3], M. Mayes[4], K. Brande[3]. [1]Department of Ecology, Evolution and Marine Biology, University of California, Santa Barbara, CA, USA, [2]University of California Cooperative Extension, Ventura and Santa Barbara Counties, CA, USA, [3]Bren School of Environmental Science and Management, University of California, Santa Barbara, CA, USA, [4]Earth Research Institute, University of California, Santa Barbara, CA, USA. *Corresponding author (robertfitch@ucsb.edu)

In order for prescribed fires to be effective at weed control, the fire must generate hot enough temperatures and long enough exposure times to kill the seeds of the target weed species. However, prescribed burning does not always result in effectively reducing non-native annual grass cover, public concerns remain regarding the use of fire as a management tool, and there are unresolved ecological impacts involving soil heating. If land managers are able to time burns when fuel loads are appropriate for their goals and minimize undesirable ecological outcomes, and reduce risk, this would increase the effectiveness of prescribed burning as management tool. Yet, few studies have directly manipulated the amount of fuel on the landscape and related fuel load to fire temperature measured during the prescribed burn. Variation in grazing intensity alters the amount of biomass on the landscape providing an opportunity to measure temperatures of fires across different fuel loads. A prescribed burn was conducted at the University of California Natural Reserve, Sedgwick, Santa Ynez, CA on 20 October 2020. Prior to the burn, 12 vegetation strips (10m by 30m) were treated with one of four grazing treatments using a tractor-mower set to different blade heights in order to mimic different grazing intensities: heavy, medium, light, and un-grazed. To measure fire temperature, metal tags were painted with a series of Tempilaq paint strips and were placed on the soil surface. In order to measure seed bank density, soil cores were taken before and two days after the burn within the strips. Soil samples were sown in garden trays and allowed to germinate in the UCSB greenhouses. The prescribed burn was not effective at controlling non-native annual grasses. Grazing led to lower fire temperatures, and burning slightly enhanced germination. The strips without grazing were capable of producing hot enough temperatures (>200°C) to slightly reduce germination of non-native annual grasses which was obtainable at a fuel load of 1660 lbs/acre. Managers can use data like these to predict fire temperatures based on field measured fuel loads when planning prescribed burns.

Exploring Recent Research Trials for Perennial Pepperweed Control in the Mountains of Northern California. Tom Getts*- University of California Division of Agriculture and Natural Resources. (tjgetts@ucanr.edu)

Perennial pepperweed (*Lepidium latifolium*) is a difficult-to-control perennial weed with an extensive root system. In California it is problematic in a wide variety of ecotypes from coastal marshes to riparian areas in the Intermountain Region. Previous research has shown herbicide application of 2, 4-D or chlorsulfuron is most effective when made at the bud stage of growth. Two sets of trials will be presented, one investigating the drizzle method, and another investigating the lack of chlorsulfuron effectiveness on perennial pepperweed in Sierra Valley.

The "drizzle" method is an herbicide application developed in Hawaii by Philip Motooka. "Drizzle" entails herbicide applications at low carrier volumes of 18 L ha^{-1} to 45 L ha^{-1} made with a spray gun, as opposed to traditional broadcast applications of higher volumes (e.g. 185 L ha^{-1}). An added benefit of this application technique is that more acreage can be covered with a single backpack load. While the "drizzle" method has been tested and shown to be effective for other perennial weed species in California, it was unknown if perennial pepperweed could be controlled using this technique. This research tested the drizzle method of application, alongside the broadcast applications of effective products at two trial locations, one in 2017 and another in 2018. The trials were set up with four replications of 3 m by 6 m plots in randomized complete block design.

At the bud stage of growth, broadcast applications were made using a CO2 pressured backpack sprayer at 185 L per ha^{-1}, and drizzle applications were applied at 28 L ha^{-1} using a handgun. Twelve months after the 2017 trial, only one drizzle application tested (glyphosate 1570 g ae ha^{-1} + 2,4-D 729 g ae ha^{-1}) offered comparable control to a broadcast application of chlorsulfuron 52 g ai ha^{-1}. In the 2018 trial, various drizzle treatments (glyphosate 2241 g ae ha^{-1}, 2,4-D 1463 g ae ha^{-1}, and imazapic 210 g ae ha^{-1}) all offered comparable control to broadcast applications of chlorsulfuron 52 g ai ha^{-1} twelve months after application. No treatment offered 100% control of perennial pepperweed twelve months after treatment in either year.

For managers, this indicates that regardless of chemistry or application method, follow up with control tactics will be required. These trials indicate the "drizzle" method could be an option for Perennial Pepperweed control in certain instances, but research is needed to confirm under what conditions it is most effective. The second trial investigated the lack of pepperweed control in Sierra Valley with chlorsulfuron in 2019. A similar trial was implemented on a patch of perennial pepperweed using the same application technique making broadcast applications to three replications of 3 m by 4.5 m plots at the bud stage. Plots were treated with 136 g ai ha^{-1} of chlorsulfuron and 2,4-D 1463 g ae ha^{-1}. One year after application 70 percent suppression was achieved with 2,4-D, but little suppression was achieved with chlorsulfuron. The same plots were retreated in the summer of 2020, and then again very little control was observed in the chlorsulfuron treated plots in 2021. It's currently unknown why chlorsulfuron did not offer effective Pepperweed control at the Sierra Valley location and is to be investigated.

Evaluation of Chemical Control Strategies for Branched Broomrape in California Processing Tomatoes. Matthew Fatino*[1], Bradley Hanson.[1] [1]Department of Plant Sciences, UC Davis. *Corresponding author (mfatino@ucdavis.edu)

Recent detections of branched broomrape (*Phelipanche ramosa*) in California tomato (*Solanum lycopersicum*) fields have led to increased interest in herbicide treatment programs to control this regulated noxious weed. Broomrapes (*Phelipanche spp.* and *Orobanche spp.)* are parasitic weeds that pose a significant risk to the processing tomato industry for several reasons: California's Mediterranean climate is similar to that of branched broomrape's native range, California agronomic practices (wide variety of host species cultivated, successive tomato crops, shared equipment) make the proliferation and spread of broomrape in and among fields highly likely, and broomrape's phenological development makes it difficult to monitor and inaccessible to conventional weed control practices. In addition, California's regulatory environment make soil fumigation difficult and costly and herbicides unavailable, while branched broomrape's regulatory status as quarantine pest does not incentivize accurate reporting.

A decision support system and herbicide treatment program, known as PICKIT, was developed over two decades of research in Israel, and has been proven to provide successful management of Egyptian broomrape (*P. aegyptiaca*) in tomato. The PICKIT system uses a thermal time model to forecast the belowground development of the parasite in order to precisely time the application of ALS inhibitor herbicides to target specific broomrape life stages. Research began in 2019 to determine if the PICKIT system could be adapted to manage branched broomrape in California processing tomatoes and to provide herbicide registration support data.

Treatment programs based on the PICKIT system were evaluated in 2019 and 2020 for crop safety on processing tomato. Treatments included several combinations of preplant incorporated (PPI) sulfosulfuron applications paired with different rates of imazapic either injected into the drip system (chemigation) or applied as foliar treatments. There were no significant differences in phytotoxicity or tomato yield among herbicide treatments in the three experiments. Additionally, a rotational crop study was conducted in which a tomato crop received PICKIT treatments in 2019 and several common rotational crops were planted and evaluated in 2020. Corn planted after the sulfosulfuron treatment suffered chlorosis and stunting, however, safflower, sunflower, melons, and beans were not injured by any of the treatments.

An efficacy study was conducted in 2020 to evaluate the efficacy of a modified PICKIT system in California growing conditions. The study took place in a commercial field in Yolo County reported to be infested with branched broomrape in 2019. This trial examined the efficacy of the sulfosulfuron and imazapic as well as imazapyr, imazethapyr, and imazamox for control of branched broomrape.

There were 12 treatments replicated four times, and 47 out of 48 plots (45 m^2) had broomrape emergence. On average, non-PICKIT treatments had 38 broomrape clusters per plot while PICKIT treatments had 13 clusters per plot. There was a trend in which the PICKIT treatments had fewer broomrape shoots per plot than the non-PICKIT treatments, however, there were no significant differences in the number of broomrape shoots among PICKIT treatments and none of the treatments completely eliminated broomrape emergence.

Imazapic faces a difficult registration pathway in California, and in 2021, another imidazolinone herbicide, imazamox, was evaluated in place of imazapic in a chemigation program. Two crop safety studies were conducted in 2021 to evaluate several combinations of preplant incorporated sulfosulfuron applications paired with different rates of chemigated imazamox. An additional efficacy study focused on imazamox was conducted in the same Yolo County infested commercial field in 2021. Imazamox injury was observed in the crop safety studies and included stunting, chlorosis, and leaf and stem discoloration; however, there were no significant differences in tomato yield among treatments in the two crop safety studies. There were no broomrape emergences in the efficacy study; the study was planted late (6/11/21) and followed by a severe heat wave, which may have contributed lack of broomrape emergence. Severe injury was observed in the efficacy study and there were significant differences in tomato yield, with the two highest rates of imazamox significantly reducing yield. Additionally, a rotational crop study initiated with tomato in 2021 will have rotational crops planted in 2022.

Upcoming Changes to Eyewash Station and Decontamination Site Requirements. Emily D. Bryson, California Department of Pesticide Regulation, 1001 I Street, Sacramento, CA 95814, Emily.Bryson@cdpr.ca.gov

The California Department of Pesticide Regulation is in the process of amending specific subsections of Title 3 of the California Code of Regulations pertaining to handler decontamination facilities. The proposed regulations will extend decontamination site availability to all employees handling pesticides, regardless of the use setting or toxicity category of the product(s) in use. Decontamination sites are already required in similar situations for employees handling pesticides for the commercial or research production of an agricultural plant commodity, so extending decontamination site availability to employees handling pesticides in other use settings ensures equitable protection for all pesticide handlers. The proposed changes also aim to improve and standardize eyewash stations for workers who use products that increase their risk of ocular injury. To achieve this goal, employers will be required to provide an eyewash station to specific employees who handle pesticides with a high potential for eye injury that conforms to the requirements found in the American National Standards Institute Z358.1-2014 standard.

U.S. EPA's Paraquat Interim Decision and Future Labeling Changes: How They May Affect Paraquat Use in California. Nathanael E. Desjarlais, Senior Environmental Scientist (Specialist), Department of Pesticide Regulation, Enforcement Headquarters Branch, 3077 Fite Circle, Suite 100, Sacramento, CA 95827

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) establishes the United States Environmental Protection Agency (U.S. EPA) as the primary authority to regulate pesticides in the United States and FIFRA mandates continuous review of existing pesticides. In 2011, U.S. EPA initiated its registration review for paraquat dichloride (paraquat), which has both herbicide and crop harvest aid (desiccant) uses. In July 2021 U.S. EPA issued its Paraquat Dichloride Interim Registration Review Decision to allow the Agency to move forward with those areas of the registration review that are complete and begin implementing product labeling changes to mitigate hazards. Significant proposed labeling changes in the Interim Decision included:

- changes to closed system exemption language,
- limits on aerial application acreage per pilot per 24-hour period (no limit for cotton desiccation),
- requiring an enclosed cab for applications greater than 80 acres or wearing a respirator for smaller applications,
- increasing the Restricted Entry Interval (REI) for most uses to 48 hours,
- increasing the REI for cotton desiccation uses to seven (7) days,
- adding a residential area drift buffer for aerial applications, and
- new mandatory spray drift language.

The potential California impacts of each of these restrictions was discussed. After U.S. EPA accepts labeling changes submitted by the registrant the registrant must submit the revised labels to DPR; DPR must accept the changes before the product can be sold or used in California.

Screening for Herbicide-Resistant Weeds in California Rice Fields. Aaron Becerra-Alvarez[1], Saul Estrada[1], Amar S Godar[1] and Kassim Al-Khatib[*1]. [1]Department of Plant Sciences, University of California, Davis, CA, USA. [*]Corresponding author (kalkhatib@ucdavis.edu)

California grows approximately 500,000 acres of rice in the Sacramento Valley. The continuous flood system is the most common production system in California, where rice seeds are air-seeded onto flooded fields that remain flooded until nearing harvest. Many pests are constraints in achieving optimal yields, but weeds are considered the major impediment in rice production. Herbicides are a major tool for weed management, but continued use along with no crop rotations, has led to a large incidence of herbicide-resistant weeds in California rice. In support of managing herbicide-resistant weeds, the University of California (UC) Rice Weed Group and the California Rice Research Board created the Herbicide Resistance Weed Screening Survey in order to confirm or disprove suspected herbicide resistance in growers' fields. Grower submitted weed samples are tested against all registered herbicide modes of action for each species using a whole-plant assay method. The results are then sent to the submitters as a report before the next growing season and assist with developing future weed management plans for their particular fields. Survey data from 2015 to 2020 demonstrates watergrass species (*Echinochloa* spp.), smallflower umbrella sedge (*Cyperus difformis* L.) and bearded sprangletop [*Leptochloa fusca* (L.) Kunth] have been the most prominent species submitted, indicating their increased difficultness to manage. The group 2 (ALS-inhibitors) and group 5 (PSII-inhibitors) herbicides had the highest frequency of resistance with greater than 83% of samples demonstrating resistance to each herbicide. The majority of resistant samples were resistant to only one or two modes of action, but the watergrass species recorded greater occurrence of multiple resistance with resistance to up to five modes of action. The Herbicide Resistance Weed Screening Survey allow UC researchers to better track herbicide-resistant weeds and discover emerging biotypes. This community-based approach for assessing herbicide-resistant weeds reveals an allied collaborative effort by the UC and the California rice industry in addressing grower issues.

Application Timing of Florpyrauxifen-benzyl to Smallflower Umbrellasedge in California Water Seeded Rice. Deniz Inci*, Kassim Al-Khatib. Department of Plant Sciences, University of California, Davis, CA, USA. *Corresponding author (inci@ucdavis.edu)

Weeds are major problems in California rice production. The continuous use of herbicides and the lack of crop rotation in rice fields have resulted in wide spread of herbicide resistant weeds with different modes of action. The necessity of novel herbicide discoveries has become more significant than ever. Florpyrauxifen-benzyl is a new auxin type rice herbicide to control broadleaf weeds, grasses, and sedges. Thus, it is likely anticipated to be widely used by rice growers as it is soon to be registered in California. Smallflower umbrellasedge, *Cyperus difformis* is a troublesome sedge weeds in California rice fields. A field study was conducted in the growing season of 2021, at California Rice Experiment Station in Biggs, CA to determine the effects of florpyrauxifen-benzyl when applied at different growth stages to smallflower umbrellasedge. To evaluate sedge weeds control, Clomazone at 12 lb/A was applied to all plots to control watergrass, *Echinochloa* species at day of seeding. Florpyrauxifen-benzyl was applied at 1.33 pt/A, 40 g ai ha^{-1} to 1-leaf stage, 4-, 6-, 8-, and 10-inches sedge stages to determine the most effective application timing on smallflower umbrellasedge. A backpacked, CO_2-pressurized six nozzle spray boom with XR8003VS(AI) nozzles at 30 PSI pressure delivers 20 GPA were used. Additionally, methylated seed oil at 0.5 pt/A was added to all treatments. The studies were conducted as randomized complete block design with four replicates. All plots were evaluated for weed control and crop injury ratings at 7, 14, 21, 28, and 42 days after treatments. Weed plant count was conducted 28 DAT in 0.125 m^2 in each plot. Rice grain was harvested and weighed. The greatest rice chlorosis and necrosis were 12% and 10% at 7 DAT at 1-leaf sedge stage treatment. Rice gradually recovered from injury and appeared normal at 21 DAT. Florpyrauxifen-benzyl applied at 1-leaf sedge stage was the most effective treatment to control watergrass with 100% control at 42 DAT. At 28 DAT, ricefield bulrush and smallflower umbrellasedge was controlled 98% at 1-leaf sedge stage. All treatments achieved 100% control of ducksalad at 28 DAT. Rice grain yield were significantly higher in all treatments compare to nontreated control. The highest rice grain yield of 11,092 lb/A was with the latest florpyrauxifen-benzyl treatment that applied at 10-inches sedge growth stage application. Florpyrauxifen-benzyl had good control of smallflower umbrellasedge when applied at 1-leaf, 8-, and 10-inches growth stages resulting in the highest yield at 10-inches stage application. This study suggest that florpyrauxifen-benzyl is safe and effective to be used at late in the growing season up to 10-inches smallflower umbrellasedge tall.

Effects of Florpyrauxifen-benzyl to Rice Panicles Development Under California Water Seeded Rice System. Deniz Inci*, Kassim Al-Khatib. Department of Plant Sciences, University of California, Davis, CA, USA. *Corresponding author (inci@ucdavis.edu)

Weeds are major problems in California rice production. The continuous use of herbicides and the lack of crop rotation in rice fields have resulted in extensive spread of herbicide resistant weeds with different modes of action. The necessity of novel herbicide discoveries has become more significant than ever. Florpyrauxifen-benzyl is a new auxin type rice herbicide to control broadleaf weeds, grasses, and sedges. Florpyrauxifen-benzyl will be registered to control weeds over wide range of timing. Because Florpyrauxifen-benzyl may be used at late rice growth stages, a field study was conducted in 2021 at California Rice Experiment Station in Biggs, CA to determine the effects of florpyrauxifen-benzyl on rice and weed control when applied after rice panicle initiation growth stage. Florpyrauxifen-benzyl was applied at 1.33 and 2.66 pt/A at after panicle initiation rice growth stage at 52 days after seeding. A backpacked, CO_2-pressurized six nozzle spray boom with XR8003VS(AI) nozzles at 30 PSI pressure delivers 20 GPA were used. Additionally, methylated seed oil at 0.5 pt/A was added to all treatments. The study was conducted as randomized complete block design with four replicates. All plots were evaluated for weed control and crop injury ratings at 7, 14, 21, 28, and 42 days after treatments. Weeds were counted at 28 DAT in 0.125 m^2, and plots were mechanically harvested, and grain yields were weighed. The highest rice plant necrosis was 32% at 7 DAT with florpyrauxifen-benzyl at 2.66 pt/A. Plants were gradually recovered over time and appeared normal at 28 DAT. Florpyrauxifen-benzyl applied at 2.66 pt/A controlled 93%, 91%, 83%, 96%, and 92% of watergrass, sprangletop, ricefield bulrush, smallflower umbrellasedge, and redstem at 42 DAT, respectively. However, the highest yield of 8,583 lb/A was achieved with florpyrauxifen-benzyl applied at 1.33 pt/A. Both florpyrauxifen-benzyl rates caused 8% rice grain blanking, however blanking with untreated control was 14%. The higher blanking in untreated control treatment may be due to heavy weed infestation. Seeds per panicles were 86, 83, and 82 for florpyrauxifen-benzyl treatments at 1.33, 2.66 pt/A, and untreated control, respectively. This study suggests that the late season applications of florpyrauxifen-benzyl at 1.33 pt/A even after rice panicle initiation is safe and results 47% higher yields compared to untreated control at harvest.

Temperature Thresholds of California Weedy Rice Germination. Maya Delong', Liberty Galvin[1], Kassim Al-Khatib [1]. [1]Department of Plant Sciences, University of California, Davis, CA

California weedy rice (*Oryza saliva spontanea)* is a persistent and recurrent pest in California rice cropping systems. Weed management is hindered by difficulty in differentiating weedy rice and cultivated rice as they appear similar in the field. Therefore, novel methods of determination between the two are required. This research seeks to understand the germination temperature thresholds of weedy rice with the aim to determine biological differences between pest and crop. This experiment used California weedy rice types 1, 2, 3, 5, and M206, a medium-maturity, medium grain cultivar, under saturated soil conditions (0 MPa) at temperatures ranging from l 0°C to 40°C at 5°C increments. Weedy rice seeds were prepared for experimentation by breaking dormancy in a dry, dark growth chamber for five days at 50°C. Once weedy seeds were prepared, all seeds, including M206, were placed in separate petri dishes containing filter paper and 5 mL of deionized water. Dishes were sealed with multiple layers of parafilm then placed in a dark growth chamber to mimic soil conditions. Each dish was examined daily to monitor seed germination. Preliminary results suggest that at temperatures between l 0°C and l 5°C, weedy types 2 and 5 had greater total germination than other weedy types. Similarly, at temperatures above 25°C, weedy types 1 and 3 had greater total germination than the other weedy types. However, compared to M206, weedy types 1, 2, and 3 had less total germination at l 0°C, and all weedy types had and greater total germination at 40°C. As a whole, weedy rice had more total germination at higher temperatures than at lower, despite differences in total germination between the assessed types.

Population Genomics of the Native and Invaded California Range of Palmer Amaranth. Josue Duque*, Alexander Lopez, Romy Lum, Chance Riggins, Katherine Waselkov, California State University, Fresno *duqu9804@mail.fresnostate.edu

Palmer amaranth (Amaranthus palmeri S. Watson), a dioecious, wind-pollinated annual native to the Southwestern United States, has become a significant challenge in modern weed management over the last three decades, recently establishing itself in agroecosystems within the Californian Central Valley in 2015. Palmer amaranth's range expansion potential is well-documented in the Eastern United States, where it went from a relatively unknown plant to a weedy species of major concern over a short period of time. The expansion into Central California warrants an examination of where the new weed infestations fit into the population structure of Palmer amaranth in the Western United States and what differences in population genetic statistics may be exhibited by the new California populations versus those in Palmer amaranth's native range. To this end, we have conducted population-level sampling from both these regions and generated genomic data to identify genetic variants (single-nucleotide polymorphisms) for population genetic analysis. STRUCTURE and ADMIXTURE analyses with an original dataset (n = 114)) appears to show little evidence of structure within these populations. ADMIXTURE analysis indicates scenario with K= 2 genetic clusters is most likely given the data. STRUCTURE analysis however appears to favor a scenario with K = 4.
STRUCTURE ancestry estimates indicate that Californian samples from outside of Palmer's native range do not possess a pattern of estimated ancestry atypical to the Southwestern US. ADMIXRTURE, in contrast, appears to indicate some populations in the invaded region cluster differently than the majority of individuals in the region.

Tracing the Origin of Central California *Amaranthus palmeri* Populations and Identifying Possible Genes of Adaptation. Kristine Fajardo, Biology Graduate Student, California State University, Fresno kjfajardo@mail.fresnostate.edu

Palmer amaranth *(Amaranthus palmeri),* a native to parts of the Southwestern United States, has become one of the most extensive agricultural threats in the Southeast, and has also established itself in parts of the Midwest and more recently in Central California. Anatomical and physiological adaptive traits characteristic to *Amaranthus* spp. and specifically *A. palmeri* such as herbicide resistance, have aided *A. palmeri* in becoming an extremely opportunistic plant in many agronomic settings. Yet, it is unknown how this Southwestern native began its invasion in Central California. Agricultural practices in the Central Valley of California are different from the Eastern U.S., and Palmer amaranth has begun appearing in orchard and vineyard crops (with shaded understories) and in saline soils, suggesting that adaptation to these new agricultural conditions may be evolving. Prior to this proposed study, no genome-wide evaluations have been done on Central California *A. palmeri* populations to explore possible invasion scenarios. As part of a larger population genetic investigation of these invasions, we are asking questions such as, "What is the origin of Palmer amaranth populations found in California's Central Valley? This study aims to investigate the genetic diversity and connectivity of Central California populations relative to native and nonnative populations in other parts of the U.S., to trace the origin of Central California populations using neutral markers and adaptive herbicide resistance genes via bioinformatic techniques. Additional genomic analysis will be done to identify any adaptive genes linked to local agricultural adaptation or range expansion. Support for different invasion scenarios will be evaluated via analysis of single nucleotide polymorphisms (SNPs) from across the genome using population genetic software and approximate Bayesian computation (ABC). In addition, SNP data from Central California populations will be screened for potential overlap in outlier loci, which could indicate genes involved in adaptation to this region. Implications of this study will suggest possible invasion scenarios of California *A. palmeri* populations and identify genes involved in adaptation. With the potential to facilitate future research identifying other weedy source populations and alternative strategies into more sustainable agronomic practices, and creating models for evolutionary adaptation applicable to invasiveness, evolution, and weedy plants.

Competitive Effects of Glyphosate-resistant and Susceptible Palmer Amaranth Plants with Grapevines During Vineyard Establishment. Takui Frnzyan[1], Dr. Waselkov[1] Chance Riggins[3] Anil Shrestha,[1] [1]California State University, Fresno, CA
[2] University of Illinois, Urbana-Champaign, IL

Palmer amaranth has been ranked as one of the worst weeds in US agriculture. This species has evolved resistance to several herbicides including glyphosate. Glyphosate-resistant (GR) populations of Palmer amaranth have also been documented in California. Glyphosate is also a common herbicide in perennial cropping systems in California. In recent years, the prevalence of this species has also been noticed in vineyards. However, it is not known if these are GR or glyphosate-susceptible types. Furthermore, it is not known if these two types are different in their competitive ability in vineyards, especially newly established vines, or if the GR type has an associated fitness penalty. Therefore, a study was conducted in 2020 and 2021 to assess the difference in the competitive ability of GR and GS Palmer amaranth with young grapevines and to compare the growth and biomass of GR and GS Palmer amaranth biotypes in a wine grape vineyard in Fresno, CA. Young Grenache 1A on Freedom Uber vines was transplanted on May 12, 2020 and March 19, 2021 in two vine rows spaced 11 ft and 6 ft apart within a row. GR and GS palmer amaranth seedlings were planted about 6 in close to some of the vines or by themselves alone. There were five treatments that included grape alone, grape + one GR palmer, grape + one GS palmer, GR palmer alone, and GS palmer alone. Each treatment was replicated five times and arranged in a randomized complete block design. GR and GS Palmer amaranth seedlings of similar height and size were chosen for transplanting. The plants were allowed to grow till August 27 in 2020 and July 19 in 2021. They were then harvested. The length of the mainstem of the grape plants was recorded and the leaves were separated from the stems. The weight of the stems and leaves were taken after drying them in a forced-air over at 60°C for 96 hours. Similarly, each palmer amaranth plant was also harvested, and the dry weight of the aboveground parts was recorded. Data on the mainstem length and dry weights were subjected to ANOVA and means were separated by Fisher's LST test when significant at a 0.05 level of significance. There were no interactions between year and treatment for any of the variables, therefore the data for the two years was combined. In comparison to grape-alone, the mainstem length and total grape biomass was reduced by 30% and 43%, respectively by the GR plants but the GS palmer amaranth had no effect. However, the GR and GS palmer amaranth alone had similar dry biomass. Therefore, this study showed that the GR palmer amaranth plants were more competitive than the GS plants with young grapevines and showed no fitness penalty despite being glyphosate resistance.

Seed Mortality Responses of Branched Broomrape (*phelipanche ramosa*) to Different Sanitation Chemicals. Pershang Hosseini*, O. Adewale Osipitan, Mohsen B. Mesgaran, University of California, Davis perhosseini@ucdavis.edu

Branched broomrape, an obligate root parasitic weed recently re-emerged in California tomato field in several counties. California is the biggest tomato producer in the US, and the outbreak of this noxious weed could deal a fatal blow to the agricultural economy. Preventive measures must be taken to stop the spread of broomrape seeds to other areas. *Ph. ramose* can produce thousands of tiny seeds, which can easily spread in various ways. Humans and their farm machinery is the most common way of seed dispersal. Sanitation and disinfection of all farm equipment, machinery, and implements before entering a new farm is necessary to prevent the broomrape seed dispersal. Various ammonium compounds are used for sanitation in food science, agriculture, and veterinary. In this work, we tested five ammonium compounds (Didecyl dimethyl ammonium chloride (DDAC), Alkyl dimethyl benzyl ammonium chloride (ADBC), Didecyl dimethyl ammonium bromide (DDAB), Ammonium bromide (AB), Ammonium chloride (AC)) to kill branched seeds. The result show that three chemical products ADBC and DDAB (1% v/v) 1 and DDAC (10% v/v), could destroy branched broomrape seeds. 10 minutes of exposure in maximum dose was enough for killing branched broomrape seeds. A prolonged exposure is needed for lower doses.

Evaluation of Tiafenacil Tank-mixed with Glufosinate for Annual and Perennial Weed Control in California. Guelta Laguerre and Brad Hanson, Department of Plant Sciences, University of California, Davis

Tiafenacil is a new protoporphyrinogen IX oxidase-inhibiting (PPO) pyrimidinedione herbicide that is under consideration for registration to control grass and broadleaf weeds in California orchards. In winter 2021, an experiment was conducted to evaluate weed control with tiafenacil alone and tank-mixed with glufosinate. Thirteen herbicide treatments were evaluated in an 8-year-old almond orchard, using single-tree plots in a randomized complete block design with four replicates. Herbicide applications were made on February 5, 2021, using a CO_2 backpack sprayer with a 4-nozzle boom delivering 30 GPA. Ratings were made 7, 14, 28, and 35 days after treatment. The weed species present were ryegrass (*Lolium perenne ssp. multiflorum*), California burclover (*Medicago polymorpha*), little mallow (*Malva parviflora*), filaree (*Erodium spp*), common chickweed (*Stellaria media*), and annual bluegrass (*Poa annua*). Data were analyzed using analysis of variance in ARM 2021, with mean comparisons using protected least significant difference. At 7 DAT, most treatments provided less than 50% of the weeds present. By 14 DAT, all tank-mixed treatments provided at least 90 or 100% on both little mallow and California burclover, at least 63% control on filaree, 58% on ryegrass and annual bluegrass, and 77% on common chickweed. Tiafenacil tank-mixed with a high rate of the product Rely 280 (at least 22 fl oz/A) resulted in the greatest control of little mallow and California burclover. Tiafenacil alone and tank-mixed with glufosinate performs better on broadleaves than grasses due to its mode of action and controlled at least 58% of ryegrass and annual bluegrass.

Weed Control and Rice Response to Pyraclonil, A New Broad-Spectrum Herbicide in California Rice. Sarah L. Marsh*[1], Aaron Becerra-Alvarez[1], Alexander Ceseski[1], Saul Estrada[1], and Kassim Al- Khatib[1]. [1]Department of Plant Sciences, University of California, Davis, CA, USA.
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California rice (*Oryza sativa*) production faces more herbicide-resistant weeds than any other crop or region in the United States, and there is a need for new weed management tools. Pyraclonil is a new PPO-inhibiting active ingredient which is being evaluated in California water-seeded rice and should be commercially available soon. This new chemistry has activity on a broad spectrum of rice weeds. In this study, NAI-1883 (a granular formulation of 1.8% pyraclonil) was evaluated in combination with other herbicides to access the efficacy and rice response of a season long herbicide program. The programs included NAI-1883 at 300 g ai/ha applied the day of seeding in combination with propanil, clomazone, benzobicyclon+halosulfuron, thiobencarb, bispyribac- sodium, penoxsulam, florpyrauxifen-benzyl, and cyhalofop at their respective timing later in the season. It is known that the standalone application of NAI-1883 is effective in controlling weeds such as early and late watergrass (*Echinochloa spp.*), smallflower umbrellasedge (*Cyperus difformis*), ricefield bulrush (*Scirpus mucronatus*), and ducksalad (*Heteranthera spp.*) present in California rice fields. Rice injury from NAI-1883 was only minimal. The herbicide program of NAI-1883 followed by benzobicyclon+halosulfuron and propanil showed exceptional control of all weeds by 45 days after seeding (100% control). All other treatments showed effective weed control. The program consisting of NAI-1883 followed by propanil was effective in controlling a majority of weeds but recorded reduced control of early and late watergrass (<89% control) and ricefield bulrush (87% control). Harvest evaluations recorded acceptable yields for all pyraclonil treatments, ranging from 10913.73 kg/ha to 12179.17 kg/ha. As an additional tool for California weed control, pyraclonil shows effective weed control and minimal injury on rice.

Potential of Roller-Crimper Technology for Weed Suppression in Annual Crops. Jennifer Valdez-Herrera', Robert Willmott', Jeffrey Mitchell[2], and Anil Shrestha [1].
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The use of roller-crimper for termination of cover crops is a fairly new technology in annual cropping systems in Cali fornia. A replicated field study was conducted at Fresno, CA in 2020/21 to evaluate the potential of this technology on biomass generation and weed suppression in a strip-till silage com system. Five cover crop treatments were planted in November, roller-crimped in late April, and silage com was strip-till planted in early May. The biomass of cover crops before com planting, the percent kill of the cover crops, the percent soil cover by the cover crops, and percent weed cover in the treatment plots were monitored bi-monthly over the com growing season The cover crop treatments had the potential to add 3 to 6.25 t/ac of dry biomass with rye producing the greatest biomass. One pass with the roller-crimper resulted in 95 to 100% kill of the cover crops and no supplementary herbicides were necessary. Rye biomass provided up to 90% soil cover till mid-July, while other cover crops provided 30 to 70% soil cover. The fava bean + phacelia cover crop disintegrated the most rapidly among the treatments. There were some weeds and cover crop regrowth as volunteer weeds in some plots for which an application of glyphosate was made in early June. No other herbicide applications were made and weed cover was less than 5% in all the plots during the entire growing season. These findings suggest that roller-crimper technology can be used successfully in strip-till silage com systems and will provide good weed control and reduce the need for herbicides, provided the cover crops are termination in properly timed (close to seed production but before seed maturity of the cover crops. However, one herbicide application may be necessary during the growing season.

The Comparative Flower Development of Palmer Amaranth: Male vs. Female. Wenzhuo Wu[1], Judy Jernstedt[1], Mohsen B. Mesgaran*[1]. [1]Plant Science Departments, University of California, Davis, CA, USA. *Corresponding author (mbmesgaran@ucdavis.edu)

In this study, we attempted to study the reproductive biology of a dioecious weed, *Amaranthus palmeri.* "Baker's law" suggests that weedy species are mostly capable of uniparental reproduction whilst Darwin predicted that dioecious species must be poor colonizer. However, the performance of *A. palmeri* contradicts these two predictions. Here we use *A. palmeri* as a model system for not only studying the dioecy breeding system in weediness and how it may be manipulated for weed management, but also for understanding the biological traits of one of the worst weeds in the United States. The objectives are 1) to compare organogenesis of flower development in female and male plants and 2) characterize stages of flower development in Palmer amaranth. Flower buds from both male and female plants were individually dissected and visualized with Scanning Electron microscopy (SEM) and Light Microscopy (LM). Results showed staminate flowers initially develop both androecium and gynoecium, but eventually become functionally male with a central bulge instead of a fertile gynoecium whereas pistillate flowers do not develop an androecium. This result indicates the evolution of Palmer amaranth from a cosexual ancestral state to dioecy is at an early or intermediately stage, which is consistent with cytological and whole genome sequencing analysis. This study can aid in the development of agronomic strategies and to reduce herbicide resistance and weed population by incorporating ecological principles into weed management practices. Future work will be finding the optimal time window and method to manipulate the sex of staminate flowers.

California Weed Science Society
Custom Summary Report
July 2021 through June 2022

	Jul '21 - Jun 22
Ordinary Income/Expense	
Income	
4000 · Registration Income	106,151.00
4001 · Membership Income	805.00
4020 · Exhibit Income	21,999.00
4025 · Session Speaker	350.00
4030 · Sponsor Income	2,000.00
4040 · CWSS Textbook Income	785.29
4065 · Orchid Fundraiser	460.00
4290 · Refunds	-2,889.00
Total Income	129,661.29
Gross Profit	129,661.29
Expense	
4300 · Conference Accreditation	205.00
4310 · Conference Facility Fees	6,000.00
4320 · Conference Catering Expense	58,825.81
4330 · Conference Equipment Expense	15,660.89
4360 · Student Awards/Poster Expense	2,500.00
4361 · Awards-Board/Special Recog.	247.84
4370 · Scholarship Expense	10,000.00
4380 · Conference Supplies	1,889.05
6090 · Advertising	775.90
6105 · Merchant Services Fees	6,940.89
6130 · Board Meeting Expenses	181.55
6180 · Dues & Subscriptions	12.95
6240 · Insurance - General	1,651.76
6270 · Legal & Accounting	20.00
6280 · Mail Box Rental Expense	146.00
6300 · Office Expense	39.71
6307 · Outside Services - PAPA	54,903.90
6340 · Postage/Shipping Expense	5.91
6345 · Printing Expense	523.26
6355 · Website Expense	1,862.05
6440 · Office Supplies Expense	296.67
6500 · Taxes - Other	1,000.00
6530 · Travel - Transport/Lodging	1,069.05
6545 · Student Travel - Transport/Lodg	242.85
6550 · Student Travel - Meals	121.38
6555 · Speaker Lodging/Travel Expense	3,287.04
Total Expense	168,409.46
Net Ordinary Income	-38,748.17
Net Income	**-38,748.17**

B of A Checking Account Balance 6/30/22 - $45,496

Edward Jones Investment Account 6/30/22 - $351,000

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

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CONFERENCE HISTORY

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 HISTORY

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