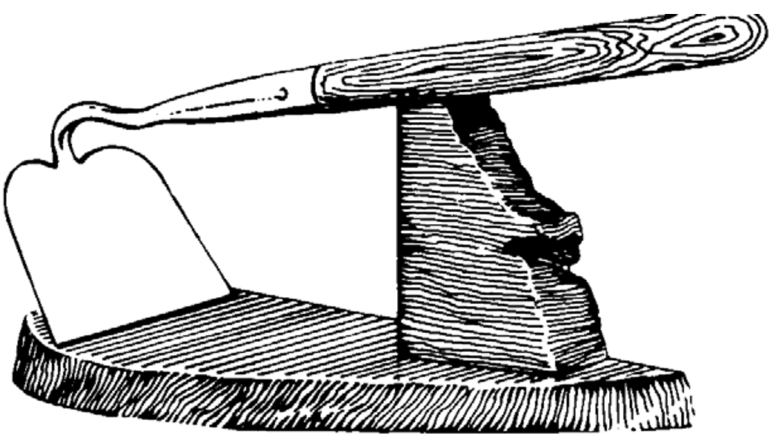
Proceedings

75th ANNUAL CONFERENCE OF THE

CALIFORNIA WEED SCIENCE SOCIETY

"Metal, Mixing and Microchips: 75 Years of Weed Science"

January 18-20, 2023



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Preface
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In Memoriam – Honoring Dr. Albert Fischer

(reprinted with permission of author Trina Kleist, UC Davis Department of Plant Sciences)

Albert Fischer, a professor emeritus of weed ecophysiology in the UC Davis Department of Plant Sciences, was recently named recipient of the Outstanding International Achievement Award by the International Weed Science Society.

Shortly after the award was announced, Fischer passed away on Nov. 22 in Davis, Calif. He was 72. Former student Whitney Brim-DeForest accepted the award on Fischer's behalf at the society's quadrennial meeting Dec. 8 in Bangkok.

"Albert set me on the path to my current career," wrote Brim-DeForest, now the UC Cooperative Extension advisor for Sutter and Yuba counties. "He left huge shoes to fill in the California rice industry in weed science. I am so honored to be able to accept the IWSC award on his behalf."

Former student Dave Cheetham remembered Fischer for his strong leadership, work ethic and dedication, which Cheetham credited with his own success. "Even more important were our personal times together and the great friendship we built – fishing in streams in Northern California, working on his boat on the weekends, the great lunches and schooners of beer at Sudwerk Brewing Co. and even an elaborate trip to Italy to present our work on geneflow in rice," wrote Cheetham, now a marketing and research manager for Helena Agri-Enterprises, LLC.

Students and colleagues remembered Fischer for his sense of humor, his ability to put people at ease and his powerful mentoring. "As his student, I always felt he wanted the best for me, and he never doubted my abilities, pushing me to try things I thought I couldn't do," Brim-DeForest added.

Passion for the world's needs

Born in Montevideo, Fischer earned his bachelor's degree in crop science and animal husbandry from the University of the Republic of Uruguay; and his master of science and Ph.D. from Oregon State University in crop science. He had a lifelong passion for ending hunger in developing countries and collaborated extensively with colleagues around the world.

He started his career in weed research and extension at the Plant Protection Center, Uruguay, in 1975. He was a professor at the Autonomous University of Chapingo, Mexico, from 1979 to 1981. He was a rice and weed physiologist at the International Center for Tropical Agriculture (CIAT) in Cali, Colombia, from 1989 to 1996. During that time, he also was a visiting weed biologist at North Dakota State University, Fargo.

Fischer joined the faculty at UC Davis in 1997 and spent his time there specializing in weed ecology, competition of weeds in rice and integrated weed management until his retirement in 2016. During that period, he mentored more than 15 graduate students and six postdoctoral researchers, and he hosted short-and long-term visiting scholars from many countries. Fischer and his colleagues published more than 80 papers in peer-reviewed journals and more than 300 non-refereed scientific documents, reports, and presentations at scientific meetings. His writings were mostly in the areas of weed physiology and management.

His research and scientific service were highly regarded, both in California and internationally. He held the Melvin D. Androus Professorship for weed research in rice for most of his career. In 2017, the Cooperative Rice Research Foundation awarded him the Marlin Brandon California Rice Industry Award for his impact on weed management. His peers elected him vice-president of the IWSS, which he served as president in 2014. His students and colleagues remember him as a good scientist and collaborator, an outstanding mentor, and a man of sharp wit and humor.

Fischer spoke English, Spanish, German and French, and had a working knowledge of Portuguese and Italian. He was known for his love of sailing, reading, music and other hobbies. More recently, he enjoyed editing and sharing his lifetime of photography from numerous trips to Africa, Central and South America, Europe and Asia.

Fischer is survived by his wife, Madeleine, and sons Patrick and Eric. A celebration of life

A celebration of life was held at 11 a.m. Saturday, Feb. 11, at the Walter A. Buehler Alumni Center on the UC Davis campus.

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.

<u>Awards of Excellence</u>

Whitney Brim-DeForest, PhD

Whitney Brim-DeForest is the County Director for University of California Cooperative Extension Sutter-Yuba, and the UCCE Rice and Wild Rice Advisor for Sutter, Yuba, Placer, and Sacramento counties. She holds a M.S. in International Agricultural Development and a PhD in Horticulture and Agronomy from the University of California, Davis. She also holds a dual BA in Biology and Music from Brown University. Whitney has been working in rice for more than 15 years, with her research and extension activities focusing primarily on the identification and management of weeds in rice and wild rice systems. She was also a Sustainable Agriculture Volunteer with the United States Peace Corps in Senegal, West Africa, where she served three years. She started working in rice systems in Senegal.

Over the past 7 years as an Extension Advisor, her research has focused on weedy rice, an emerging and important pest in California rice systems. She currently holds the UC ANR Presidential Endowed Fellowship in California Rice, serves on several WSSA committees, and she has served California Weed Science Society Board since 2017. She also teaches plant science and agriculture courses at California State University, Chico.

Kate Walker

Kate Walker is a Technical Service Manager with FMC covering coastal and northern CA. Previously, she was with BASF as a Technical Service Rep in California and Arizona from 2010 to 2022 and an Ag Biologist on the Plant Pathology Team in Raleigh, NC from 2006 to 2010. Kate has a Bachelor of Science and Master of Science from Pittsburg State University. Kate has been an active member of the CWSS, serving on the CWSS Board of Directors and as a session chair.

Honorary Member Award

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.

CWSS 2023 Student Contest Winners!

Author: Thomas Getts, CWSS Director, Student Liaison

In the middle of January, the California Weed Science Society celebrated its 75th anniversary with a meeting in Monterey, California. We had a good number of attendees with nearly 550 people registering and attending our conference. There were lots of great presentations made during the sessions. As well as much good discussion in between the breaks, and around the bar.

We had an excellent showing of students who presented during the meeting. We had two undergraduate poster presentations, seven graduate poster presentations, and five graduate students competing in the oral section! Additionally, there were two graduate students who were the invited speakers for our breakout sessions and a handful of students who attended the conference but did not present.

Overall this was fantastic participation and representation.

Photo One: UC Davis Students. From left to right: Stephen Chang, Emily Chou, Liberty Galvin, Aaron Bercerra-Alvarez, Andres Contreras, Deniz Inci, Guelta Laguerre and Matthew Lombardi

Photo Two: Fresno State Students and CWSS Past president Professor Anil Shretha, From left to right: Robert Wilmont, Kelsey Galvan, Anil Shrestha, Kiera Searcy and Margaret Fernando

I would like to thank all of our students for attending, the judges who scored the competition, and all of the members of the society who engaged and listened to the students.

We look forward to learning about all of their hard work in weed science at next year's conference!

Winners

Undergraduate Student Poster:

- 1st place Kiera Searcy - Fresno State -Weed Control in Nursery Container Lathe House

Graduate Student Poster:

- 1st Place- Robert Willmott - Fresno State - Cover Crops used in conjunction with Strip Tilling to reduce Herbicide usage in Silage Corn
- 2nd Place- Deniz Inci - UC Davis - Cattail, Typha L., Control in Delta Rice with Florpyrauxifen-benzyl, Loyant® CA
- 3rd Place- Aaron Becerra-Alvarez - UC Davis -Spot treatment of clethodim for control weedy rice

Photo Three: Student Poster Winners. From left to right: Aaron Becerra-Alvarez (3rd), Robert Willmott (1st), Kiera Searcy (1st undergrad), and Deniz Inci (2nd)

Graduate Student Oral Session:

- 1st Place- Matthew Fatino - UC Davis - Evaluating in-season management strategies for branched broomrape control in California processing tomatoes.
- 2nd Place- Guelta Laguerre - UC Davis - Evaluation of weed control efficacy and crop safety of the new PPO-inhibiting herbicide, tiafenacil in California orchard cropping systems
- 3rd Place- Kelsey Galvan - Fresno State - Germination of Common Waterhemp (Amaranthus tuberculatas) Seeds as Influenced by Soil Environmental Factors and Tolerance to Common Post Emergence Herbicides and Soil Salinity.

Photo Four: Student Paper winners. From left to right: Kelsey Galvan (3rd) and Guelta Laguerre (2nd). Matthew Fatino (1st) not pictured as he presented virtually.

Effect of Drought and Heat on Weeds and Weed Management. Kassim Al-Khatib, Plant Sciences Department, University of California, Davis.

Changes in climate can have complex and serious effect on pest management including weed control. While climate changes have occurred in the past, recent climate changes have received more attention because of the radical changes that have occurred over a short period of time. In general, environmental conditions not only affect weed growth and development, but also affect the efficacy of weed control including the interactions between herbicide and plants. For example, the efficacy of postemergent herbicides is influenced by environmental conditions before, during, and after the time of application. Research shows that relative humidity (RH) and temperature influence herbicide efficacy by changing absorption and translocation of herbicide especially the foliar-applied herbicides. High RH enhances absorption and translocation by increasing cuticle hydration and by prolonging the drying time of the droplets. Research results showed that low relative humidity decreased control of palmer amaranth, redroot pigweed, and common waterhemp by glufosinate. However, control increased as application rates increased at low relative humidity. Amaranth species grown under 21/16, 26/21, and 31/26 °C day/night temperature regimes responded differently to glufosinate. At 26/21 °C, glufosinate at 820 g/ha controlled redroot pigweed less effectively than it controlled Palmer amaranth and common waterhemp, whereas at 410 g /ha, glufosinate controlled common waterhemp more effectively than it controlled the other two species. Warm conditions generally improve weed control of postemergent herbicides. Our research showed that control Palmer amaranth, redroot pigweed, and common waterhemp increased at higher relative humidity and warmer temperatures. Our research also showed that the toxicity of foliar-applied atrazine to redroot pigweed was maximized by warm temperatures through an increase in absorption and through greater affinity of atrazine for the binding site.

What are the Impacts of Warmer and Drier Conditions on Orchard Weed Management? Brad Hanson, UC Cooperative Extension Specialist, University of California, Davis, CA. bhanson@ucdavis.edu

Environmental conditions before, after, and during herbicide applications can have a dramatic impact on the performance of the herbicide and on the environmental fate of the product. The environmental condition that is most on people's minds the past couple seasons is drought. While specific weed management situations will be affected differently by drought, it's useful to think about how drier and warmer climate conditions can impact weeds management.

Under drought conditions, we typically have fewer weeds, however, those weeds that do establish because of timely germination relative to rain or irrigation or those that are in low spots that hold water longer may actually be more competitive because they have less competition with other weeds for resources. Dry conditions can also affect the proportion of the various weed species present in a field – some weeds do better than others under dry conditions.

The performance of preemergence herbicides can be affected in several ways by drought conditions. First, to be effective, these herbicides must be incorporated into the soil, in many permanent crops and non-crop situations, winter rains incorporate or "activate" the herbicide. Lack of incorporation or delayed incorporation can lead to poor performance with many PRE herbicides because most of them have activity on the germinating seed or the very small seedling. In these instances, weeds that germinate below the herbicide layer at the soil surface may be able to grow roots and push shoots through the herbicide zone before it can be moved into the layer of soil where germination occurs.

In some cases dry conditions can extend herbicide life in the soil. The primary mechanism for the degradation of most herbicides in the soil environment is microbial activity. Conditions like drought and excess heat or cold that are not good for microbial life often lead to slower herbicide degradation while conditions such as warm, moist soils can increase microbial activity and lead to faster degradation.

If possible, timing applications ahead of even a small rain event will help reduce these problems. Second, if solid set sprinkler or microspray irrigations can be used, even a very short irrigation set can greatly improve herbicide efficacy. Finally, in drip-irrigated orchards or vineyards, pre-emergent herbicide applications can be delayed until late winter rains are predicted, or post emergent herbicides may also be applied to pick up any weeds that emerge before the PRE herbicides are incorporated. Pre-emergent herbicides may not be used at all in really dry years.

Weed emergence and growth, herbicide performance and longevity, and weed/herbicide interactions all can be affected by California's seasonal moisture availability as well as the dramatic drought conditions currently impacting the state. Understanding how drought can affect weed management can lead to informed decisions on technology and practices to minimize herbicide performance problems.

Why are certain annual weeds, hairy fleabane, and horseweed being observed year-round in the San Joaquin Valley?

Anil Shrestha, Department of Plant Science, California State University, Fresno, CA 93740

Hairy fleabane (*Erigeron bonariensis*) and horseweed (*E. canadensis*) are common weeds found in low-disturbance annual, perennial, and non-crop systems in the San Joaquin Valley (SJV) of California. Although these species are classified as summer annuals in California, they are often observed emerging year-round in a range of environmental conditions in the SJV. However, very little information is available on the reasons for this observation. Studies were conducted to assess the effect of temperature, water potential, salinity, pH level, and dormancy periods on hairy fleabane and horseweed germination. The phenological development of these two species were also modeled using growing degree days (GDDs) for fall and spring emerging populations. Results showed that both species had the potential to germinate above 41°F but maximum germination occurred at a day/night temperature of 77/68°F. Light was a necessity for their germination, however. Germination was reduced by 50% at a water potential of -0.2 MPa, but 42% of the seeds germinated at an E.C. of 15 dS m^{-1} (using sodium chloride). Germination was similar between pH levels of 5 to 9. Thus, these two species can germinate in a range of soil environmental conditions that commonly occur in the SJV. Many seeds germinated the day they were collected from the mother plant, indicating a very short seed dormancy requirement. Hairy fleabane plants grew and reproduced at 25% of field capacity (FC) similarly to plants grown at FC, which indicates high drought tolerance. The phenological development data showed that the fall and spring emerging populations differed in the number of GDDs required to develop. The spring emerging population generally required less GDDs to complete their life cycle. These findings could explain why these two species have been observed emerging year-round and at different phenological stages throughout the year in the SJV. Such characteristics can make it difficult to control these species with postemergence herbicides. However, seeds of these species fail to emerge when buried even a tenth of an inch and emergence is greatly reduced with light soil disturbance. This probably explains why they are observed in greater numbers in the undisturbed areas of perennial cropping systems compared to annual cropping systems where greater soil disturbance frequently occurs. Postemergence herbicide applications should be timed before the 10-12 leaf stage as the level of control decreases when they get to the rosette stage.

References:

Shrestha, A., V. Maier, K.M. Steinhauer, T. Frnzyan, and I. Navarro. 2022. Hairy fleabane germination in response to temperature, osmotic potential, pH, salinity levels, and seed dormancy periods. Agron. J. 114:2552-2561.

Improving Weed Management in Hot or Dry Conditions: Low Desert Experience Over the Decades. Steve West, Research Director, Research Designed for Agriculture, Yuma AZ

The Earth's climate is ever changing. While we are not likely to get as warm as the Cretaceous Period where there were forests and dinosaurs on the Poles, the (typically) warmer and drier summers we are experiencing these days force us to re-think how we manage weed control. In Yuma AZ, where the average summer afternoon is 107, and we receive 2.7 inches of rain annually, we deal with such conditions constantly. The key points for consideration for weed control in these conditions are: Pre-season choices are critical-weed free fields, plastic or not, the right combination of Pre herbicides on to HOT soil, water to incorporate, etc all need extra consideration. In season, better or more frequent cultivation, early and often herbicides at the right rates—roots and tops grow faster!!! and understand that weather toughness and resistance are one in the same at times. When it is DRY, getting herbicides into the target is more problematic. There are new adjuvants which can help with either penetration or "hang time" on the plant and these can be very helpful. However heat / crop stress exacerbates Phyto, and if an herbicide is selective for your crop, understand how it is resistant to the herbicide. Adjuvants are designed for very specific situations so using the right one in the right place at the right time is crucial.

The biggest take away? BE ON IT as timing is more critical than ever. Be decisive as you do not have the time you used to for decision making ... You Snooze You Lose, as they say.

Evaluation of Weed Control Efficacy and Crop Safety of the PPO-Inhibiting Herbicide Tiafenacil in California Orchard Cropping Systems. Guelta Laguerre and Brad Hanson, Department of Plant Sciences, University of California, Davis

Tiafenacil is a protoporphyrinogen oxidase (PPO) inhibitor that blocks chlorophyll biosynthesis and causes protoporphyrin accumulation, a highly photodynamic intermediate. Glufosinate inhibits glutamine synthetase (GS), a key enzyme for amino acid metabolism and photorespiration. Both herbicides ultimately lead to plant death through accumulation of reactive oxygen species (ROS). Field studies were conducted to determine the crop safety of tiafenacil on young almond, walnut, prune, and pistachio trees, as well as the weed control efficacy of broadleaf weeds and grass weeds relevant to California orchards. Tiafenacil was applied at 74 and 148 g ha^{-1} three times a year as a tree row strip treatment in prune, walnut, and pistachio that were less than one-year-old at the time of the first application. Tiafenacil was applied at 74, 148, and 222 g ha^{-1} to the tree row of one-year-old almond trees. Treatments were imposed in the spring of 2020, then reapplied in 2021 and 2022 such that all plots received a total of 7 treatments over a two-year period. Although no yield measurement was taken, fruits appear to be normal. There was no visual injury on any of the young trees between 30 and 700 days after initial treatment. Similarly, there was no treatment effects on tree trunk diameter among treatments even at the highest rate of tiafenacil. In a separate efficacy study on weed control efficacy, tiafenacil at 12 g ha^{-1} performed similarly with tiafenacil plus glufosinate in most instances, but control of both broadleaf and grass weeds numerically improved when tiafenacil was in mixture with glufosinate. In a greenhouse efficacy study, tiafenacil at 12 g ha^{-1} alone provided 98-100% control of barnyardgrass and 95-98% control of junglerice. There was no significant difference among tiafenacil alone or tiafenacil plus glufosinate. Results indicate that tiafenacil is an effective tool to help manage broadleaf and grass weeds relevant to California orchards. Orchard crop safety appears adequate with rates equivalent to 3-fold commercial use rates in almond and 2-fold in prune, walnut, and pistachio not affecting plant growth.

Behavior of Three Pendimethalin Formulations in Water After an Application onto Flooded Rice. Aaron Becerra-Alvarez*[1] and Kassim Al-Khatib[1]. [1]Department of Plant Sciences, University of California, Davis, CA, USA. *Corresponding author (abecerraalvarez@ucdavis.edu)

Water-seeded rice is the predominant method for rice production in the Sacramento and San Joaquin Valleys. A continuous flood up to two months before harvest is typical. Water-holding periods after an herbicide application is important in flooded rice to reduce off-target exposure and influence herbicide activity. Formulation type may affect the herbicide's persistence in water. Three pendimethalin formulations, a capsule suspension (CS), emulsifiable concentrate (EC), and granular (GR), were applied onto flooded rice field plots at three rates. Then, water samples were collected sequentially at 1, 3, 5, 10, and 15 days after treatment (DAT) and analyzed for pendimethalin residue via high performance liquid chromatography-mass spectrometry methods. Rate and sampling time had an effect on the amount of pendimethalin residue in the flood water. While formulation alone did not have an effect on pendimethalin residue, interaction across formulation and sampling time was observed. At 1 DAT, on average, the EC formulation recorded 135 µg L^{-1}, the CS formulation recorded 15 µg L^{-1}, and the GR formulation recorded 5 µg L^{-1} of pendimethalin residue at the 3.57 kg ai ha^{-1} rate. By 5 DAT, the EC and CS formulations all recorded below 7 µg L^{-1} of pendimethalin residue at all three rates, while the GR formulation, only at the 1.12 kg ai ha^{-1} and 2.25 kg ai ha^{-1} rates. The GR formulation had a prolonged activity in the flood water when compared to the other formulations, and even a delayed increase at 3 DAT from the 3.57 kg ai ha^{-1} rate. Formulation and rate do affect the dissipation of pendimethalin in rice flood water. Results from this study support the use of pendimethalin in water-seeded rice and may indicate a water-holding period of at least five days after an application onto a flooded rice field, but should be reconsidered if the GR formulation is applied.

Can Cover Crops Suppress Weeds and Reduce Seedbanks? A Case of a Table Grape Vineyard. 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

Cover crops are deemed as a valuable component of sustainable agriculture systems. However, compared to other states, their adoption is very low in California primarily due to the concern of water use by the cover crops. A study was conducted to determine the impacts of cover crops on weed populations in a newly established Autumn King table grape vineyard in at the USDA-ARS research station in Parlier, CA. The impacts of native species cover crops (*Phacelia tanacetifolia*) and introduced species cover crops (*Secale cereale* L. 'Merced') were studied. The cover crop species were selected based on characteristics deemed beneficial to vineyards in the San Joaquin Valley such as ease in establishment, ability to attract beneficial insects, and low or non-competitiveness for soil water. These cover crops were planted in the center 6 ft of the 12 ft inter-row space of the grapevines, and both treatments were compared to a standard management practice of bare ground without cover crops in the inter-row spaces. Weed populations in the inter-rows of the treatment plots were assessed by taking measurements of percent cover, weed density, weed biomass, weed species composition, and weed seedling emergence from soil seedbank samples. Weed population differences between the treatments varied from season to season; however, in two of the seasonal samplings, percent weed cover was lower in the Phacelia plots compared to the Merced Rye or the no cover crop treatment. During the active growing season of the cover crops, the Phacelia plots also had lower weed biomass and higher cover:weed biomass compared to the Merced Rye plots, but the soil seedbank had greater weed seedling emergence in the cover crop than in the no-cover crop plots. In summary, cover crops showed some weed control benefits in this study and could be an effective tool in integrated weed management during the establishment phase of table grape vineyards. However, cover crops may need to be supplemented with other weed management practices because they may increase the size of the seedbank.

Evaluating in-season management strategies for branched broomrape control in California processing tomatoes. Matthew Fatino[1]*, Bradley Hanson[1]. [1]Plant Sciences Department, University of California, 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 management strategies 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 within 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, while branched broomrape's regulatory status as quarantine pest does not incentivize accurate reporting.

A study was conducted in 2022 to evaluate broomrape control with several herbicide programs based on the PICKIT decision support system developed in Israel for Egyptian broomrape control. These programs included chemigated imazamox and rimsulfuron alone and paired with preplant incorporated sulfosulfuron, as well as foliar rimsulfuron alone. Additionally, a planting date experiment was nested within this trial. This trial was conducted in a commercial tomato field heavily infested with branched broomrape in Yolo County, CA.

There was significant broomrape emergence throughout the trial and there were differences among treatments. In general, chemigated treatments had lower broomrape emergence than non-chemigated or control treatments. Chemigated imazamox at all rates and timings resulted in severe injury on tomatoes. Chemigated rimsulfuron alone and paired with sulfosulfuron were safe on tomatoes and tended to have lower broomrape emergence than control treatments. The late planted treatment (May 20) tended to have lower broomrape emergence than the control treatment (May 3), and although more work will need to be done to quantify the effects of planting date on broomrape parasitism, it is a promising first step. Given the injury from imazamox in this experiment, the best treatment was chemigated rimsulfuron paired with preplant incorporated sulfosulfuron. This is very promising considering the recent CDPR approval of a 24c label for chemigated rimsulfuron which means that growers with suspected or at-risk fields can use this treatment protocol during the 2023 season. Further research will need to be conducted to quantify and understand imazamox injury before it can be recommended for registration for broomrape management. The planting date study had promising results, and further studies evaluating planting dates will be conducted in the future.

Germination of Common Waterhemp (*Amaranthus tuberculatus*) Seeds as Influenced by Soil Environmental Factors, and Tolerance to Common Post-Emergence Herbicides and Soil Salinity. Kelsey B. Galvan*[1], Katherine Waselkov[1], John T. Bushoven[1], and Anil Shrestha[1]. [1]California State University, Fresno, CA, USA. *kelseygalvan@mail.fresnostate.edu

Common waterhemp (*Amaranthus tuberculatus*) is being reported in increasing numbers in recent years in the Central Valley. While it is classified as one of the worst weeds in agriculture in the US primarily because of herbicide-resistant populations, their presence has not been much of an issue in California. It is not known if these observed populations are local or have arrived here from other areas of the US, primarily with hay or animal forage. Regardless, the potential of this species to invade the semi-arid areas of the state with different soil environmental conditions needs to be determined before it becomes a more widespread problem. Since glyphosate-resistant populations of common waterhemp have been documented in 19 states in the US, the herbicide resistance status of the locally observed populations also needs to be determined. Therefore, studies were conducted to assess the effect of water potential, salinity, and pH level on its germination, salinity stress on its growth and development, and response of the plants to glyphosate, glufosinate, rimsulfuron, and caprylic acid. The seeds were collected from Merced County, CA. Germination tests were conducted under different water potential (0 to -4.17 MPa), salinity (0 to 25 dSm^{-1}), and pH (5 to 9) levels in growth chambers set to 25°C, with a 12-hour daylight period. Results showed that the local population was moderately tolerant to drought stress as 50% of the seeds germinated at -0.5 MPa. The seeds were also moderately sensitive to salinity, with a 55% germination rate at 10 EC. The germination rate was higher under neutral to alkaline conditions with no germination under pH of 5. About 96% of the plants died at an EC level of 10 and a 3 EC the aboveground biomass declined by 50%. Therefore, the common waterhemp population sampled locally may not invade in large numbers in the semi-arid, saline regions of the western Central Valley regions but the species does have the possibility to grow in some irrigated areas of this region, survive and reproduce and could be a concern. The local population could still be controlled by glyphosate, glufosinate, rimsulfuron, and caprylic acid as long as they are treated at the 4 to 6 leaf stage. Once they got to the 8 to 10 leaf stage, several plants escaped these herbicides, Also, no glyphosate resistance was observed in this particular local population collected from Merced, but this may not be the case in other common populations in California.

Implementation of the Control Management Test (CMT) at the Tahoe Keys Lagoons. Lars Anderson, Ph.D. Waterweed*Solutions*, Pt. Reyes, CA.
Co-Authors: Tahoe Keys Property Owners Association; Sierra Ecosystem Resources.

The planning, design, and implementation of the CMT is the result of a 5-year sustained collaboration among Tahoe Keys homeowners (Tahoe Keys Property Owners Association), regulatory agencies (Lahontan Reginal Water Quality Control Board and Tahoe Regional Planning Agency), The League to Save Lake Tahoe and other stakeholders, and with a high-level of public input and interest. Implementation of the CMT required coordination of multiple contractors coupled with necessary compliance with extensive regulatory requirements. This has achieved a successful multi-method management test that included the herbicides endothall and triclopyr applied in a tank mix with Rhodamine WT dye, as well as UV-C light and combinations of herbicides and UV-C. These treatments were applied in three replicates per treatment, including control sites. Double turbidity curtains were installed at strategic locations to mitigate movement of herbicides or degradant to Lake Tahoe proper. In addition to the extensive water quality and aquatic plant monitoring, herbicide residues were monitored pre-treatment and several weeks after application.

The results of the first year (2022) will determine where and how the second and third year will be conducted as non-herbicide treatments "Group B" methods. The Group B methods include diver-assisted suction removal, bottom barriers, UV-C light treatments. Monitoring will continue as in year 1; however, since no herbicides will be used in years 2 or 3, monitoring will not include monitoring for herbicides or degradants in the water.

How Understanding the Fundamentals of Aquatic Ecology Allows Managers to Identify IMP Tactics to Combat Algae and Nuisance Vegetation. Eli Kersh, CLM, PCA, President, Laketech, Inc.

Implementing an IPM program, for the management of aquatic pests relies heavily on having an understanding of the ecology of their habitats. Managers will learn how a nuanced understanding of pests' physiology and their habitat requirements allow them to manipulate the environment proactively to manage their ability to survive and thrive.

Herbicide studies to manage aquatic weeds in the Delta. John D. Madsen, Consulting Scientist, 34 Hiller Ct, Woodland, CA 95776, john.d.madsen86@gmail.com

The Sacramento-San Joaquin River Delta is an important water resource for the State of California, and is heavily infested with invasive aquatic weeds that cause significant nuisance problems. While several weed species (e.g., waterhyacinth, Brazilian waterweed) have been in the Delta, more recent introductions do not have appropriate herbicides identified for their management. Also, the tidal nature of the Delta creates situations with low water residence times. We examined four species in three studies to address these issues.

Australian ribbonweed (*Vallisneria australis*) has only recently (2018) been observed in the Delta. Widespread in the aquarium trade, it is a known invasive weed in numerous countries. We screened nine active ingredients (endothall, carfentrazone-ethyl, copper-ethylenediamine, diquat, endothall, florpyrauxifen-benzyl, flumioxazin, imazamox, penoxsulam) in eleven formulations. Each product was applied at the highest recommended rate with a static exposure to maximize possible herbicidal activity. Exposure times were either 4 weeks (for contact herbicides) or 12 weeks (for systemic herbicides). The study was conducted in 20 L buckets with one 1-L pot of ribbonweed planted in soil placed in each bucket. Four replicates of each rate were used. Only the three formulations of endothall (dipotassium salt of endothall in liquid and granular formulations, and the dimethylalkylamine salt of endothall in liquid formulation) provide better than 80% control. Therefore, the best herbicide for ribbonweed management in the Delta are either the liquid or granular formulation of endothall dipotassium.

South American spongeplant (*Limnobium laevigatum*) is a Class A state noxious weed. While it has been in California longer than ribbonweed, it has not been widespread yet and thus has few appropriate measures for management. We collected plants from the Delta, and placed spongeplant into 20 L buckets for treatment in a spray chamber. All herbicides were used at the maximum recommended rates, with a 1% surfactant added. Water was exchanged three hours after treatment, and buckets transferred to a greenhouse. Plants were harvested 6 weeks after treatment (WAT). Nine active ingredients (2,4-D, glyphosate, imazamox, penoxsulam, carfentrazone-ethyl, flumioxazin, triclopr, florpyrauxifen-benzyl and imazapyr). Herbicides that produced 80% or more control were glyphosate, imazamox, imazapyr, and flumioxazin.

Eurasian watermilfoil (*Myriophyllum spicatum*) and Brazilian waterweed (*Egeria densa*) are widespread nuisance problems in the Delta, with the egeria being the greater nuisance. Many locations in which they grow have short water residence times, which makes for a more technically difficult management challenge. We studied these two weeds in concentration / exposure time studies with the potassium salt of endothall and diquat. Endothall concentrations ranges from 1 to 5 ppm and exposure times of 3 to 24 hours. Diquat concentrations were either 90 or 190 ppb at 0.5 to 12 hours. Endothall was effective on Eurasian watermilfoil at concentrations above 3 ppm and exposure times of more than 12 hours. In contrast, no endothall concentration / exposure time scenarios controlled egeria. Diquat controlled Eurasian watermilfoil at both concentrations and exposure times of more than 3 hours. Egeria was controlled consistently at the higher concentration and 3 hours exposure, and both concentrations with 6 hours exposure.

Pre-emergent Weed Control in and Around Irrigation Canals. Russell Spence, Allied Weed Control, 10218 Liberty Ave, Livingston, CA 95334 russell@alliedweed.com

Managing aquatic weeds and algae in canals and weeds along ditch banks can be extremely challenging. If weeds are allowed to grow unchecked, problems arise inside the canal by restricting the flow of water and causing the water levels to rise. Weed seeds can easily spread with the water flow to fields and then germinate.

Mechanical removal and various aquatic herbicides have been used for many years, in-season to control aquatic weeds and algae in canals. Greater control may be achieved by de-watering dirt lined canals and applying pre-emergent herbicides in the winter months. Other post-emergent herbicides and in-season aquatic herbicides can then be used to treat as needed during the irrigation season.

Chemical resistance to herbicides can be a problem if the same herbicide is used repeatedly. A tank mix of herbicides with different modes of action can help alleviate this issue. It is important to be aware of which products can be used both in the canal and on canal banks. There are less herbicides available for these types of applications than with terrestrial weed treatments. Nonaquatic herbicides cannot be allowed to get into a flowing canal either at time of application or from runoff.

Canal bank applications are time sensitive and should have received rainfall prior to applying pre-emergent products so that herbicides will be affixed to soil. This will reduce the risk of herbicide movement caused by wind or vehicle traffic onto non-target sites. Applications should also be made when rain is forecast within a three-week period.

This presentation will discuss the importance of managing aquatic weed, algae, and vegetation growth in and along irrigation canals and the practices involved. Additional topics will include how to develop a good weed control program, and application techniques.

References:

Alligare
SePro Corporation

Post-Emergence Control of Alkaliweed in Pistachio Orchards. Phoebe Gordon, UCCE Orchard Crops Advisor, Merced/Madera Counties

Alkaliweed is a native plant species that has been found in pistachio orchards. It has been reported to be very difficult to control with herbicides. Three different pistachio orchards in the southern San Joaquin Valley with significant alkaliweed populations were selected to examine the efficacy of nine different post-emergent herbicide treatments. Repeated applications were applied at three different times from 2021 to 2022. No product or product combinations provided long term control, and control was variable across sites. 2,4-D and glyphosate were the most effective, though control in general was poor. Glyphosate tank mixed with glufosinate had variable results. Sulfonylurea herbicides were no better than the control. More work needs to be done incorporating other methods of control or treating on larger scales.

The impact of supply chain issues on resistance management of weeds in conventional and organic production systems. Lorianne Fought, Western Crop Research Manager, Wilbur-Ellis Company

The crop protection industry in the US is part of a global supply chain. Finished products, active ingredients, raw ingredients, inert coformulants, and even packaging materials are subject to disruptions that can affect weed management options and prices in California orchards. This presentation focused on how supply chain disruptions during the COVID-19 pandemic impacted the agricultural pesticide supply chain. Herbicide resistance management in conventional orchards and materials registered for use in the organic orchard crop sector were both affected by these challenges. Farm operations and retailers with better longer range planning and viable backup plans for orchard weed control are often better able to weather the challenges of interconnected supply chains.

Considerations for Yellow Nutsedge Control without Utilizing Paraquat.

A. Ben Duesterhaus, Mid Valley Agricultural Services, Inc., 5225 Oakdale California, 95361, bduesterhaus@midvalleyag.com

Paraquat is a herbicide active ingredient that has been utilized in newly developed tree and vine plantings for control of broadleaf and grass weeds. The use pattern was developed and used widely because the herbicide is safe to the treated crop and provided economical weed control when applied correctly. Even though it is safe for the crop, there are human health risks associated with paraquat. Due to increased regulatory scrutiny on the herbicide paraquat that make it more difficult to recommend and utilize, different herbicides and application strategies are being explored to provide commercially acceptable burndown of emerged yellow nutsedge. Herbicide active ingredients that can provide acceptable burndown of yellow nutsedge and be used on new plantings of most tree and vine crops, other than paraquat, include glyphosate and glufosinate. These active ingredients are not as safe for the crop if applications are made improperly. However, if properly utilized, they can provide commercially-acceptable results. Other herbicides in the ALS Mode of Action category and the HPPD Mode of Action category have varying activity on yellow nutsedge and can be used when the plantings are older, typically in the second or third year of establishment depending on crop and soil type. In our experience, there are three practical actions that can be taken to optimize yellow nutsedge burndown when using alternatives to paraquat. First, we suggest that application speeds be reduced. By reducing application speed, this reduces the potential for drift onto the sensitive crop and provides the best opportunity for uniform coverage of the yellow nutsedge foliage. Our experiences have shown that 2.5-3 mph application speeds provide very consistent results for weed burndown and crop safety. By reducing groundspeed, we can reduce our application water volume to 20-30 GPA and obtain good coverage. This reduced water volume fits into the second recommendation of increasing your surfactant rate. We find better performance with a combination spreading and penetrating type surfactant when using paraquat alternatives. We do not suffer spray runoff of the foliage with slow ground speeds, reduced water volumes and increased surfactant rates compared to scenarios where we travel faster and have high water volumes that cause applied herbicide to run off the foliage and result in reduced weed control. Finally, we recommend a more aggressive water conditioning regiment. Adding an acidifying water conditioner to standard water conditioning agents like ammonium sulfate will provide better burndown of yellow nutsedge, provided we have slow application speeds, modest water application volumes and use elevated surfactant rates.

Evaluation of pyroxasulfone and other PRE herbicides in California orchard crops. Andres Contreras Jr. and Brad Hanson. Department of Plant Sciences. University of California, Davis. ancontreras@ucdavis.edu

Identification of potential tools for California tree and vine cropping systems management is an important aspect in the weed science discipline. This includes evaluating nonregistered preemergence herbicides in California, such as pyroxasulfone and Exp-82. Pyroxasulfone and Exp-82 are both group 15 herbicides; inhibitors of very long-chain fatty acids (VLFCAs). Pyroxasulfone is registered as a preplant incorporated or preemergence herbicide, for use in corn, soybean, and cotton in some Midwestern states of the United States. However, there is limited published literature on the use of pyroxasulfone in orchard systems. Crop safety and weed efficacy trials were carried out for the characterization of pyroxasulfone and Exp-82. Exp-82 was evaluated in a series of fallow ground trials initiated in fall 2020 and carried out into summer 2022 near Davis, CA. Trials evaluated the weed control efficacy of Exp-82 at rates of 0.130, 0.195, and 0.261 lb a.i. A^{-1}. An additional fallow ground trial was conducted in the summer of 2021 to evaluate herbicide efficacy differences in response to two irrigation incorporation timings. Orchard and vineyard trials evaluated single and sequential application weed control programs including the use of pyroxasulfone or Exp-82 at multiple rates in comparison to commercially used standards such as flumioxazin, indaziflam, pendimethalin, rimsulfuron, and penoxsulam. Orchard and vineyard trials were conducted near Arbuckle, Davis, and Winters, CA in spring 2021 and 2022. A crop safety study evaluated Exp-82 at 1.07 lb a.i. A^{-1} and s-metolachlor at 12.5 lb a.i. A^{-1} on 1-2 yr. old almonds, walnuts, and pistachios trees which were sprayed in spring 2021 and 2022. Pyroxasulfone and Exp-82 performed similarly to commercial standards with up to 95% control of broadleaf and grass weeds. No significant differences were found in weed control among treatments in the incorporation timing trial. Crop injury was not observed in the vineyard, mature orchard, or young orchard trials and there were no treatment effects on tree trunk diameter in the young tree crop safety study. These results indicate a potential for these new herbicides for California vineyard and orchard systems.

Update on Organic Production and the New UC Organic Agriculture Institute. Houston Wilson, Director, UC Organic Agriculture Institute.
houston.wilson@ucr.edu

California leads the nation in total organic farms, production acres and crop value – in fact, we more than double the next leading state in each category. Organic production practices have many known environmental benefits, and in this way can help contribute to climate-smart farming systems. As demand for organic agriculture continues to expand, there is a pressing need for strong institutional infrastructure to support this growing sector. As such, in early 2020, the University of California Division of Agriculture and Natural Resources (UC ANR) established the UC Organic Agriculture Institute (OAI) to provide high quality research and extension support to current and transitioning organic growers across the state. In this session, we will provide an overview of the scale, value and geography of organic production in California, as well as provide an update on current and upcoming UC OAI activities.

Laserweeding: The Future of Weed Control. John Mey, VP of Product at Carbon Robotics. johnm@carbonrobotics.com

Since its founding in 2018, Carbon Robotics has been dedicated to creating and refining an efficient and sustainable way for farmers to manage the weeding of their fields. The company's revolutionary weeding method, laserweeding, provides an eco-friendly and cost-effective way for farmers to weed, saving them time and money while increasing crop yields and consistency.

Traditional weeding methods such as herbicides, mechanical weeding and hand pulling are known to be extremely laborious, costly, harmful to the environment and disruptive to soil and crop health.

Carbon Robotics was eager to develop a new method and turned to AI, deep learning models, computer vision and lasers to produce the only commercially available laserweeding implement. Earlier this year, Carbon Robotics debuted the LaserWeeder, a pull-behind robot that seamlessly attaches to the back of tractors, that reaches 20 feet across and weeds up to two acres per hour. The LaserWeeder uses computer vision and AI to identify weeds and directs its 30 CO_2 lasers at the meristem of the weed, destroying them with millimeter accuracy.

So far, the LaserWeeder has successfully eliminated 100 million weeds in fields with onions, carrots, lettuce, spinach, cauliflower, broccoli, chards and kale row crops.

Laserweeding is a precise, organic and cost-effective weed control solution for large-scale specialty row crops that solves common problems associated with herbicide spraying, tilling and hand weeding.

Evaluation of Electrical Weed Control Machine in Organic Orchard. Tong Zhen*[1], Brad Hanson[2]. Department of Plant Sciences, University of California, Davis, CA.
* tzhen@ucdavis.edu

Weed control is challenging in California's organic systems since traditional control options are limited and expensive. With funding from the Organic Agriculture Research and Extension Initiative (OREI), UC Davis weed scientists recently initiated research with collaborators at Oregon State University and Cornell University to evaluate an electrical weed control device in orchard and berry crops. An EWC machine generates high voltage electric current, and by foliar contact with the weeds, both plant cells in foliar and underground parts can be damaged in a short period. This presentation will provide first impressions of the machine and share the latest data from blueberry and almond orchard field experiments.

Organic Weed Control in Carrots. Kimberly G. Horton, Agronomy Manager, Taylor Farms, Salinas, CA. khorton@taylorfarms.com

Farmers face numerous and continuous challenges to grow healthy crops. This is especially true of organic growers where the number of tools available is limited to non-synthetic, natural fertilizers and non-selective herbicides. For organic farms in California, the ever-increasing cost of labor and cost of weeding are two of the largest crop expenditures. Organic carrots are planted densely and often in an irregular pattern, which makes weeding between the plants difficult. In addition, seedlings are sensitive to disturbance and easily removed when weeds near them are removed. Other challenges include the type of weeds present in diverse growing regions; the seasonality of weeds; large acres to remove weeds from in a small window of time; and environmental concerns, such as wind when treating weeds with herbicides and optimum soil moisture to remove weeds by hand. The volume and broad spectrum of weeds is another concern. When grass weeds are present in organic carrot fields, they are extremely difficult to remove, and when left in the field, they compete with carrots for resources resulting in lower yields. Traditionally, weed removal is done manually with a group of workers slowly walking through the field removing weeds and putting them in the furrow or in bags to carry out of the field. This is an arduous and expensive process which can have inconsistent results. There are numerous mechanical technologies available to remove weeds in row or transplanted crops, such as finger weeders and vision based robotic hoeing (Robovator, Stout and FarmWise), but they do not work in high density crops like carrots. Technologies that are performing in high density crops include weeders that use lasers and spot spraying. Additional methods for reducing weed seed populations in fields include injecting steam into the beds where carrot seeds will be planted to kill weed seeds, as well as coating carrot seeds so that the weeds emerge before the crop emerges, which allows the weed seedlings to be flamed and killed.

Welcome to the Confusing World of Tank-Mix Adjuvants. David Bower, Brandt Consolidated and 2023 Chairman, Council of Producers and Distributors of Agrotechnology

Adjuvants are not pesticides, although they are registered as such for use in California by the Department of Pesticide Regulation, one of six boards and departments of the California Environmental Protection Agency. "Different adjuvants do different things in different application"— Dr. Peter Holloway, Cambridge University, ISAA Conference, 1992. An adjuvant is a substance that is added to a pesticide product or pesticide spray mixture to enhance the pesticide's performance or improve properties of the spray mixture. Adjuvants can reduce or even eliminate spray application problems and improve overall pesticide effectiveness.

Adjuvant use is growing. In 1976, only three herbicides required the addition of a tank-mix adjuvant for optimal performance. Today, there are over 1,000 pesticide labels requiring an adjuvant and more than 2,500 adjuvants from which to choose. Choosing the right adjuvant can impact the performance of the product by up to 50% so user education is essential for optimizing every spray application.

There are a broad range of tank-mix adjuvants, each performing a specific and distinct function. **Surfactants** physically change the properties of the spray solution and droplets. They help improve the pesticide's ability to emulsify, disperse, spread, and stick by reducing surface tension. Leaf surfaces and pesticides have a molecular charge. A surfactant's charge, or lack of a charge, will determine how it bonds to a pesticide, which in turn affects how the pesticide will bond to the leaf surface. The goal of this process is to reduce surface tension, which increases a spray droplet's ability to remain in contact with the leaf surface longer, allowing more of the product to be absorbed.

Deposition Agents, sometimes referred to as "stickers," increase a pesticide's ability to better adhere to a target's surface. This decreases the amount of pesticide that washes off the surface during an irrigation or rain. Deposition agents can also reduce a pesticide's evaporation rate and slow a product's degradation from ultraviolet rays. Many deposition agents also include wetting agents to make a premixed product that both spreads and sticks to target surfaces.

Spray drift is a function of droplet size, wind speed, and height of the spray boom. Small droplets tend to drift more than large droplets. **Drift reduction agents** improve on-target placement of sprays by increasing the size and uniformity of droplets.

Adjuvant selection considerations are essential. What does the pesticide label say? Is a specific adjuvant required? What type of active ingredient are you using? Contact or systemic? And lastly, what problems are you trying to solve, such as drift, water quality, or compatibility?

Pest Control Recommendation (PCR) Considerations for Preparing a Non-crop Pest Control Recommendation. R. K. Brenton, PCA, Brenton VMS, Folsom, CA

A Pest Control Recommendation (PCR) is defined as the giving of any instruction or advice regarding the application of a particular pesticide. They are required for all agricultural commodity and non-crop sites. There are key components or fundamentals to all pest control recommendations. These are basic considerations/instructions set forth by the department of Food and Agriculture (FAC12003). However, when considering non-crop uses there are some site situations and circumstances that may require going above and beyond the basics. PCR's provide direction and guidance for use. A well written PCR will fine tune the vague or broad versions of a label. They can prevent the misuse or abuse of a pesticide and ensure a successful application. A non-crop PCR is an adaptive, site-specific prescription for the use of an herbicide consistent with the surroundings and considerations for other such as endangered species, water quality, or other property constraints. These are CEQA and or NEPA consideration that need to be made. When considering the need for pest control, along with efficacy, the purpose of the overall vegetation management program should be considered whether it be fuel reduction, noxious weed, or habitat restoration. What a PCR should not be is a regurgitation of the label, vague, or inconsistent with the label. There are two basic types of Non-Crop PCRS: Site specific and Programmatic. Site specific PCRS have a focus on one site with detailed instruction and consideration for site constraints. This put more responsibility on the PCA. Programmatic PCRS have a broader set of instruction and constraints. The intent is to cover multiple sites with more general control measures. Often 2 or more PCRS are prepared for the program with decision making left to the applicator and based on constraints in the PCRS. Keep in mind that the definition of pest will vary with location, density and intent of the vegetation management. Constraints with reflect the surrounding environment and other applicable governing resource protection legislation.

When weed control really matters: Efficacy of organic herbicides on difficult to control weeds and sites. Chris McDonald, University of California, Cooperative Extension

Land managers regularly control weeds on a variety of sites. In addition to the usual locations, they work on difficult sites where high levels of weed control is imperative to their goals or on weed species that are difficult to control. These difficult sites and weeds might include roadsides, utility infrastructure, rights of way, or on sites with noxious weeds or early detection and rapid response sites. In many cases on these sites, allowing even a few weeds to establish might jeopardize management goals. Additionally, the public is interested in managing weeds with organic herbicides. However, land managers are reluctant to switch away from current practices on difficult sites and difficult species, without first knowing that the alternatives are as highly effective as current practices. This presentation will give an overview of organic herbicides and review if they fit into chemical control methods on difficult sites or species. There are several different types of organic herbicides, while most are contact herbicides, a few are pre-emergent herbicides, and others are based on iron or salts. One widely available organic pre-emergent herbicide uses corn gluten meal as an active ingredient and it has shown some promise in a variety of settings, most often in turf and landscape settings. Studies on these products show efficacy is lacking or highly variable for this pre-emergent herbicide, and are unlikely to provide high to very high levels of weed control. Salt and iron based organic herbicides, as well as contact herbicides, are used as post-emergent herbicides. Several studies have found that these herbicides have not shown consistent control across a variety of weeds, especially perennials, nor do treatments persist. Some research suggests that certain organic herbicides do have high efficacy on some weed species, especially when the weeds are small and newly established. When larger weeds are treated, and the weeds are established, efficacy is greatly reduced and variable between studies. These studies suggest that these types of organic herbicides will likely not meet land managers needs of providing high levels of control on a wide variety of weeds on difficult sites or difficult to control species.

The Glyphosate Update: What Does the Future Hold?

Rick Miller, Corteva Agriscience, Rescue, CA

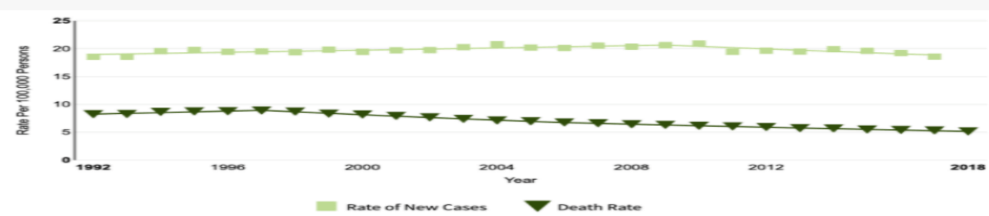
Glyphosate has long been a staple herbicide for use on ROW. The characteristics of the product are that it has a relatively high binding constant, meaning that it has no residual activity because it is immediately bound to organic matter, whereupon it slowly breaks down in soil. It kills many young weeds in the ROW and continues to be a valuable tool in a program approach, even with the known resistance and tolerance issues. In spite of the fact that glyphosate has been extensively studied for any statistical indication that it might be a carcinogen, California Dept of Pesticide Regulation, the Environmental Protection Agency and virtually every regulatory body around the world has indicated that glyphosate is "not likely to be a carcinogen". Even after publication of the controversial monograph from the International Agency for Research on Cancer (IARC, an arm of the World Health Organization, which is funded by the United Nations), other regulatory bodies reviewed this publication (a review of existing data) and it did not change their earlier conclusions that glyphosate can be used without any assertion of being a carcinogen. Except for the IARC, all other regulatory agencies assert that there is insufficient evidence of carcinogenicity for glyphosate in test animals (and insufficient or no evidence in humans). Thus, no causation (or correlation) has been established for the assertion made by IARC.

The following is a short excerpt from an NPR interview with epidemiologist, Dr. Geoffrey Kabat, March 16, 2021. Dr. Kabat asks whether there is any correlation between glyphosate use versus incidence of Non-Hodgkin's Lymphoma (NHL) in the US. In the excerpt below, Dr. Kabat asserts that over the past 30 years, while NHL incidence and death (each in cases per 100,000 persons) from NHL is flat or declining, glyphosate volume (usage) has increased by over 15 times. No correlation per se.

What does the science say?

Only then did I turn to my first slide and my points, which were these:

- NHL is rare – the 7th most common cancer;
- NHL is not one disease, but includes a number of different types of lymphoma;
- We know very little about what causes NHL;
- As shown in the slide, although spraying of glyphosate in the U.S. has increased 15-fold between 1996 and 2012 (lower panel), the incidence of NHL has remained completely flat over a 26-year period (upper panel), suggesting that there is little relationship between glyphosate and NHL.



New cases come from SEER 13. Deaths come from U.S. Mortality.
All Races, Both Sexes. Rates are Age-Adjusted.
Modeled trend lines were calculated from the underlying rates using the Joinpoint Trend Analysis Software.

New cases are also referred to as incident cases in other publications. Rates of new cases are also referred to as incidence rates.

To recap the trial lawyer saga: In spite of overwhelming evidence against the premise, civil lawsuits were filed alleging glyphosate causes non-Hodgkin's Lymphoma (NHL). Three big lawsuits in California were won initially by the trial lawyers. Bayer was ready to establish a large fund to pay off thousands of remaining lawsuits. Subsequently, Bayer quietly began to win the ensuing lawsuits - five at the time of this presentation (and now six in a row). According to Bayer, Bayer's trials lawyers began to use an emeritus professor from UC Davis as a professional witness and juries seem to be better assimilating the facts. There is a still a long way to go, but Bayer has decided to try the rest of the cases and the legal momentum certainly appears to have turned in Bayer's favor.

This is good news for our industry. It would be expensive and unfortunate to lose this commonly used herbicide from our ROW programs without due cause. In the meantime, a certain limited number of municipalities have banned glyphosate. So for these customers, we're able to provide programs that do not include glyphosate in our ROW segments.   There are herbicides that could fill the void left in a glyphosate-free program, but not at the price of glyphosate. In addition, depending upon the use site, it will likely take two products, one grass herbicide and one broadleaf herbicide to fill the void. The best set of replacements are going to depend upon the use site(s), breakthrough weed(s) and the budget of the municipality. Whether or not glyphosate is in your program, Corteva's Land Management business is ready to help our ROW customers design an effective weed management program, and we're glad that, for now, it appears that we'll have glyphosate in our toolbox.

Simulation-based nozzle density optimization for maximized efficacy of a machine-vision weed control system for applications in turfgrass settings. Paweł Petelewicz*[1], Qiyu Zhou[2], Marco Schiavon[3], Arnold W. Schumann[4], and Nathan S. Boyd[5]. [1]University of Florida, Agronomy Department, Gainesville, FL, USA; [2]North Carolina State University, Department of Crop and Soil Sciences, Raleigh, NC, USA; [3]University of Florida, Environmental Horticulture Department, Fort Lauderdale Research and Education Center, Davie, FL, USA; [4]University of Florida, Department of Soil, Water and Ecosystem Sciences, Citrus Research and Education Center, Lake Alfred, FL, USA; [5]University of Florida, Horticultural Sciences Department, Gulf Coast Research and Education Center, Wimauma, FL, USA. *Corresponding author (petelewicz.pawel@ufl.edu).

Precise spray application technologies have the capacity to drastically reduce herbicide inputs. To be successful we need to optimize the performance of both the machine vision (MV) based weed detection and actuator efficiency. This study assessed 1) the performance of spotted spurge [*Chamaesyce maculata* (L.) Small] recognition in 'Latitude 36' bermudagrass (*Cynodon* spp.) turf canopy using the You Only Look Once (YOLOv3) real-time multi-object detection algorithm, and 2) the impact of various nozzle densities on the model efficiency and projected herbicide savings under simulated conditions. The YOLOv3 model was trained and validated with a dataset of 1,191 images. The simulation design consisted of 4 grid matrix regimes (3 × 3, 6 × 6, 12 × 12, and 24 × 24) demonstrating respectively: 3, 6, 12, and 24 non-overlapping nozzles covering the 50 cm band width. Simulated efficiency testing was conducted using 50 images containing predictions (labels) generated with the newly trained YOLO model and, by applying each of the grid matrixes to individual images and manually collecting efficacy data. Our model resulted in prediction accuracy as indicated by the F1 Score of 0.62 precision of 0.65 and recall value of 0.60. Increase in nozzle density provided improved actuator's precision along with higher predicted herbicide use efficiency. There was no statistically significant difference between 24- and 12-nozzle scenario; thus, the optimal actuator's efficacy and herbicide savings (>80%) would occur by increasing nozzle density from standard 1 covering 50-cm band to 12 (providing ~5% false hits ratio, 18% area under simulated application).

Use of an Agricultural Spray Drone in Managed Turfgrass Systems. Daewon Koo*[1], Clebson G. Goncalves[2], Caleb A. Henderson[1], John M. Peppers[1], Navdeep Godara[1], Shawn D. Askew*[1]. [1]School of Plant and Environmental Sciences, Virginia Tech, Blacksburg, VA, USA, [2] Diversified Agriculture Advisor, UC Cooperative Extension, Lake and Mendocino Counties, CA, USA. *Corresponding author (dwkoo@vt.edu, saskew@vt.edu)

Agricultural spray drones (ASD) have become increasingly accessible in recent years, but little is known regarding their use for pest control in managed turfgrass systems. To improve efficiency and allow drones to span more than a few meters per pass, drone manufacturers equip drones with spray tips that generate fine droplets subject to dispersal by drone rotors. Our previous research showed that these fine droplets could drift up to 15 m away from the targeted spray swath and droplet deposition decreases up to 60% as drone height increased up to 10 m. In field trials conducted at the Glade Road Research Facility and the Turfgrass Research Center in Blacksburg, VA, quinclorac and topramezone herbicides controlled mature smooth crabgrass (*Digitaria ischaemum* (Schreb.) Schreb. ex Muhl.) equivalently when applied by ASD or ground equipment. In these experiments, the ASD was operated 2 m above the ground at 6 Km h^{-1} to deliver 28 L ha^{-1} spray solution through four 11001 XR spray tips in a targeted 4.6-m-wide spray swath. Additional demonstration plots suggest that quinclorac applied at drone heights between 4 and 10 m does not consistently control smooth crabgrass. Thus, ASDs can control weeds in turf when operated at 2 m above the ground and the assessed area comprises half of the intended spray swath and is located directly under the ASD. Future research will evaluate large plots that allow for multiple line passes of ASD and ground sprayers for consistency of weed control and turf response.

Integrated Pest Management Effects on Weed Populations Managed Without Herbicides in the Pacific Northwest. Emily T. Braithwaite[1]*, Tim Stock[1], and Alec R. Kowalewski[1]. [1]Oregon State University, Department of Horticulture, 4017 Agriculture and Life Sciences Building, Oregon State University, Corvallis, OR 97331-7304. *Corresponding authors (emily.braithwaite@oregonstate.edu)

Pesticide usage on public school grounds is a concern in the Pacific Northwest. In response to state laws restricting the use of pesticides in all K-12 schools across the state of Oregon, a series of trials were developed to determine how variations in primary cultural management practices (mowing, fertilization, and irrigation), in the absence of herbicide applications, can affect turfgrass quality, and weed populations. Three experiments were conducted beginning in 2017 at the OSU Lewis-Brown Horticulture Farm in Corvallis, OR on a mixed stand of cool-season turfgrass. Findings from the mowing study show that the higher weekly mowing heights resulted in significantly fewer weeds than plots maintained at lower heights. Results from the fertility study indicate that fertilization at low or high rates reduced weed populations as compared to non-fertilized plots. No differences in weed incidence were observed between treatments in the irrigation trial, but plots receiving irrigation at higher frequencies maintained acceptable turf quality throughout the trial.

Turfgrass Weed Management without Synthetic Herbicides. Clebson Gonçalves*[1], Edicarlos De Castro[2], James McCurdy[2], Shawn Askew[3], Chase McKeithen[4], Bryan Unruh[4], John Kaminski[5], and Tang Kaiyuan[5]. [1]Diversified Agriculture Advisor, UC Cooperative Extension, Lake and Mendocino Counties, CA, USA, [2]Mississippi State University, MS, USA, [3]Virginia Tech, VA, USA, [4]University of Florida, FL, USA, [5]Pennsylvania State University, PA, USA. *Corresponding author (goncalves@ucanr.edu)

Organic weed control options for turfgrass systems remain in high demand and strategies are poorly understood. ***Non-synthetic Herbicides.*** Field studies were conducted during the 2020 and 2021 growing seasons in the states of Pennsylvania, Virginia, Mississippi, and Florida, to assess potential non-synthetic herbicide products for annual weed control and turfgrass safety. Turfgrass species were on bermudagrass (*Cynodon dactylon* × *C. transvaalensis* Pers. L.), zoysiagrass (*Zoysia japonica* Steud.), 'Aloha' seashore paspalum (*Paspalum vaginatum* Swartz), 'Floratam' St. Augustinegrass (*Stenotaphrum secundatum* [Walt.] Kuntze), Creeping Bentgrass (*Agrostis stolonifera* L.), Perennial ryegrass (*Lolium perenne* L.), and Kentucky Bluegrass (*Poa pratensis* L.). This study included 14 products/compounds. These data demonstrate that most of the post-emergence non-synthetic herbicides used in this study exhibit a non-selective activity, causing injury to most of the target leaf tissues. Non-synthetic herbicides failed to provide long-lasting weed control. Effective weed control may require sequential applications or integration with other weed management strategies. ***Nonchemical Approaches.*** Field studies were conducted during 2020, 2021, and 2022 growing seasons at Virginia Tech and Mississippi State University, to examine the efficacy of alternative strategies for weed control in perennial ryegrass, tall fescue, bermudagrass zoysiagrass. Results from these trials indicate that manual weed control and sod replacement may be great options but may be costly. Solarization appears to be seasonally dependent such that cool, low-radiation conditions in spring will be less effective than warm, highly radiant summer conditions in Virginia. Solarization showed non-selective weed control of perennial ryegrass and tall fescue, and injury was greater than 95%; however, our data suggest that solarization can selectively control annual weeds in the bermudagrass lawn. Flaming and Boiling-water treatments also showed non-selective weed control.

Is ALS Inhibitor Herbicide Resistant Common Chickweed a Problem in California Small Grain Production? Nicholas E. Clark*[1], Anil Shrestha[2], Paola V. Villicana[2], Kiera Searcy[2], and Walter Martinez[3]. [1]University of California Cooperative Extension, Kings County, [2]California State University, Fresno, Plant Science Department, and [3]University of California Cooperative Extension, Tulare County. *Corresponding author (neclark@ucanr.edu, 680 N. Campus Dr., Ste. A, Hanford, CA 93230)

Common chickweed (*Stellaria media*) is a winter annual broadleaf weed affecting California small grain fields in winter and spring in the Central Valley of California. Pest control advisers alerted University of California Cooperative Extension of common chickweed acetolactate synthase (ALS) inhibitor herbicide escapes in small grains. Investigation in the field could not rule out herbicide resistance as a cause. Bioassays were conducted in a controlled environment testing for ALS-inhibitor resistance. Weed seeds were collected from fields where escapes occurred and from an organic field with no recent ALS-inhibitor applications. The latter seeds served as an ALS-inhibitor susceptible control. In two experimental runs, weeds were grown in pots under a shade structure and treated with ALS-inhibitor herbicides when plants were just under three inches tall. Treatments included five replicates of an untreated control and mesosulfuron-methyl, pyroxsulam, and tribenuron-methyl at 0.5x, 1x, 2x, 4x and 8x the label rate for California small grains with ammonium sulfate and non-ionic surfactant applied to susceptible and suspected ALS-inhibitor resistant plants. Mesosulfuron-methyl was only applied in the second run. Plant mortality evaluations were conducted weekly for four weeks. In the first run, mortality of susceptible plants four weeks after treatment (WAT) was 100% for all herbicides and rates. Mortality of suspected ALS-resistant plants was 0% for all rates of pyroxsulam and ranged from 26 to 98% for tribenuron-methyl at 1x and 8x the top label rate, respectively. In the second run, mortality of susceptible plants at four WAT ranged from 90 to 94%, 80 to 92%, and 78 to 92% in tribenuron-methyl, mesosulfuron-methyl, and pyroxsulam treatments, respectively. Mortality of the suspected ALS-inhibitor resistant plants ranged from 27 to 50%, 4 to 15%, and 3 to 17% in the tribenuron-methyl, mesosulfuron-methyl, and pyroxsulam treatments, respectively. These results lead us conclude there is an ALS-inhibitor resistant population of common chickweed in California small grain cropping systems. Research is planned to determine the geographic and economic scope of this problem for California agricultural producers.

Impacts of Simulated Non-Target Florpyrauxifen-Benzyl Drift in California Orchard and Vineyard Crops. Deniz Inci, University of California, Davis, CA

California produces more than 99% of almonds, peaches, pistachios, prunes, and walnuts in the US. Rice herbicides are generally applied in the Sacramento Valley from late May to early July when trees and vines are vulnerable to potential herbicide exposure. Florpyrauxifen-benzyl is a new synthetic-auxin rice herbicide recently registered in California. This research was conducted to develop data on the relative sensitivity of orchard and vine crops to simulated drift rates of florpyrauxifen-benzyl. Trees and vines were subjected to simulated drift treatments in mid-June in both the 2020 and 2021 growing seasons. Florpyrauxifen-benzyl was applied at four rates approximating drift: 0.5%, 1%, 3%, and 10% of the use rate in rice, 30 g ai/ha, to one side of the canopy in one pass from the top to the ground. Visual injury was rated at 7, 14, 21, 28, 35, 42, and 90 days after treatments. Florpyrauxifen-benzyl symptoms were more apparent as herbicide rates increased; however, the severity of symptoms was greatest on pistachio. Additionally, the time to develop symptoms was shorter with pistachio than the other species. General symptoms included chlorosis, excessive branching, leaf curling, leaf narrowing, leaf distortion, leaf malformation, leaf crinkling, shoot curling, stem discoloring, stunting, terminal bud death, and twisting. Shoot curling and stunting for pistachio; deformation and asymmetrical growth for grapes; leaf curling and necrosis for almond; epinasty and leaf discoloration for walnut; leaf curling and stunting for peach; and necrosis and excessive branching for prune were more apparent at higher rates. Pistachio was by far the most susceptible crop among the tree crops. Multi-year-treated pistachios were relatively shorter throughout the season. While most crops resumed growth and appeared normal at the end of the growing season, pistachio continued to show symptoms from the highest simulated rate for the remainder of the 2021 growing season.

Release and Establishment of New Biological Control Agents of Weeds of Forests, Rangelands and Natural Areas in California. Patrick J. Moran*[1], Lincoln Smith[1], Paul D. Pratt[1], Christopher J. Borkent[2] [1]U.S. Department of Agriculture-Agricultural Research Service (USDA-ARS), Invasive Species and Pollinator Health Research Unit (ISPH), Albany, CA, USA; [2]Biological Control Program, Integrated Pest Control Branch, California Department of Food and Agriculture (CDFA), Sacramento, CA. *Corresponding author (Patrick.Moran@usda.gov)

Biological control of invasive weeds is appropriate in natural environments, such as rangelands, forests and riparian habitats, targeting weeds against which other control methods are unsustainable at landscape scales. Biological weed control involves a scientific process to discover and evaluate candidate agents (mostly insects and mites) to determine their life cycles, verify that they cause damage sufficient to reduce weed populations, and verify that they are host-specific to the targeted weed. Since the 1940s, 40 weeds have been targeted with biological control in California, and 80 agents have been released. Two examples of projects completed recently include a study on tamarisk (*Tamarix* spp.) for which (*Diorhabda* spp. beetles) were verified as established in low-density, non-dispersing populations in northern CA; and a collaborative project with CDFA involving the 2014 release of a stem-boring weevil, *Mecinus janthiniformis*, for control of Dalmatian toadflax (*Linaria dalmatica* subsp. *genistifolia*) at a site north of Los Angeles. The weevil population increased 20-fold, and 100% of the stems were infested. By 2019, abundance of Dalmatian toadflax had declined by 99%. Major new releases have occurred in the past 5-6 years. In 2019 the first new insect agent in 30 years targeting yellow starthistle (*Centaurea solstitialis*), the rosette weevil *Ceratapion basicorne*, was approved, and it was released by ARS-ISPH between 2020 and 2022 at three sites in California. This insect is the first agent that attacks the roots and rosettes of yellow starthistle, complementing the impact of long-established flower head-feeders. Establishment is uncertain. CDFA scientists in Sacramento, CA and cooperators at three facilities in CO and ID are rearing weevils. A shoot-tip galling wasp (*Tetramesa romana)* and an armored scale insect that feeds on rhizomes (*Rhizaspidiotus donacis*) were released by ARS-ISPH against arundo (*Arundo donax*) at 11 sites in the Sacramento and San Joaquin River watersheds in northern California in 2017, and are established at seven and eight sites, respectively. A shoot-tip galling fly, *Parafreutreta regalis*, has been released by ARS-ISPH at 15 sites since early 2017 in coastal riparian and scrubland habitat targeting Cape-ivy (*Delairea odorata*), and establishment has been confirmed at seven sites. For other projects, establishment evaluations are ongoing. A leaf-feeding planthopper (*Megamelus scutellaris*) was released between 2018 and 2020 for biocontrol of waterhyacinth (*Eichhornia crassipes*) in the Sacramento-San Joaquin Delta. In 2020, ARS ISPH released a leaf-and stem-feeding thrips (*Sericothrips staphylinus*), provided by Oregon State University (OSU) researchers, for control of gorse (*Ulex europaeus*). In 2022, CDFA released a shoot tip-feeding psyllid (*Aphalara itadori*), provided by OSU researchers against knotweeds (*Fallopia* spp.) in Humboldt County, and expanded releases of a shoot-galling wasp (*Aulacidea acroptilinica*) and a shoot-galling midge (*Jaapiella ivannikovi*) targeting Russian knapweed (*Rhaponticum repens*) to southern CA. ARS ISPH is studying candidate agents targeting French broom (*Genista monspessulana*), Russian thistle (*Salsola* spp.), medusahead (*Elymus caput-medusae*) and other weeds. Biological control is a key tool for invasive weed control to protect water and soil resources in California.

Winter Annual Grass Control: Successes and Challenges in Northeastern California. Tom Getts*[1]. [1]Weed Ecology and Cropping Systems Advisor: Lassen, Modoc, Sierra, and Plumas Counties. *Corresponding Author (tjgetts@ucanr.edu)

Winter annual grasses are problematic throughout California, from red brome in the south to medusahead in the north. In Northeastern California the three main species of concern are cheatgrass, medusahead, and ventenata. These grasses have invaded millions of acres and numerous ecosystems from perennial bunch grasses, to shrublands, and forests. Increasing fire frequency, reducing native biodiversity and reduced forage are just a handful of winter annual grass impacts. Cultural and mechanical means of control are often not feasible or effective in the ecosystems they invade. Historically, chemical methods of control have provided a single season of suppression but have not offered a long-term solution. Over the past decade research from Colorado and throughout the Western United States has investigated a relatively new herbicide indaziflam for control. Trials have found multiyear control of cheatgrass and other annual grass species while safely releasing established perennials from competition. Beginning in 2016 multiple trials were initially implemented in Northeastern California to replicate this work, testing indaziflam against other currently registered herbicides for control of medusahead. Since 2016 numerous additional small plot trials have been implemented and monitoring larger-scale firebreaks has been conducted to investigate the fit of indaziflam for annual grass suppression while releasing desirable perennial plants. Results from the second wave of trials have been inconsistent, with some sites offering excellent multiyear control of annual grasses, with other sites offering limited control. This presentation will give an overview and highlights from the results of all these trials which may help shed light to the effectiveness of indaziflam for annual grass suppression in Northeastern California ecosystems, with potential lessons for other regions.

Examining the Potential Benefits of Dusting Rangelands with Compost for Weed Suppression. Scott Oneto, University of California Cooperative Extension, 12200B Airport Rd. Jackson, CA 95642 sroneto@ucanr.edu

Compost is like gold to a gardener. They rely on it for enriching the soil and making plants thrive. Even farmers know the value of compost using it on row crops and on perennial crops like orchards and vineyards. However, there is one sector of agriculture where we are just beginning to understand the potential value of using compost and that is rangelands. Rangelands cover more than half of California's land mass. These grasslands are comprised of mostly exotic annual grasses and forbs from the Mediterranean and they grow on a variety of soil types.

Recent studies have shown a direct benefit from the one-time application of compost to rangelands, including increases in water holding capacity, forage productivity, and carbon sequestration (Silver et al 2010, Ryals and Silver 2013). Based on these preliminary studies, this project is testing the one-time addition of compost to annual rangelands in an area that currently lacks localized data. By adding compost to the soil, we hope to see an increase in both soil fertility and water holding capacity which will ultimately increase the ability of desirable vegetation to be more resilient to climate variability and better able to compete against noxious weeds. In addition, the added fertility will make desirable forage more nutritious and more abundant for livestock, ultimately resulting in a financial benefit to the producer.

In the spring of 2019, research plots were established at five ranches in Amador County to determine if a one-time application of compost applied alone or in combination with a desirable clover seed mix, could increase range health by providing more nutritious feed while outcompeting the noxious weeds yellow starthistle (*Centaurea solstitialis*), barb goatgrass (*Aegilops triuncialis*), and medusahead (*Elmus caput-medusae*). At each location four treatments were tested: 1) one-time application of compost, 2) broadcast clover seed mix, 3) compost plus clover seed, and 4) untreated check. Treatments were 0.5 acre in size and setup in a CRBD with three replicates. A permanent transect was used to collect percent cover using a Daubenmire plot collected at peak standing. Forage samples were collected at peak standing for forage analysis and forage production values were collected from a forage exclosure in each plot.

Forage productivity is measured at peak standing crop when the plants have reached their maximum total biomass. Three years after treatment, the compost only and compost plus seed treatments were providing the greatest amount of forage, whereas the seed only treatment was similar to the untreated (Figure 1).

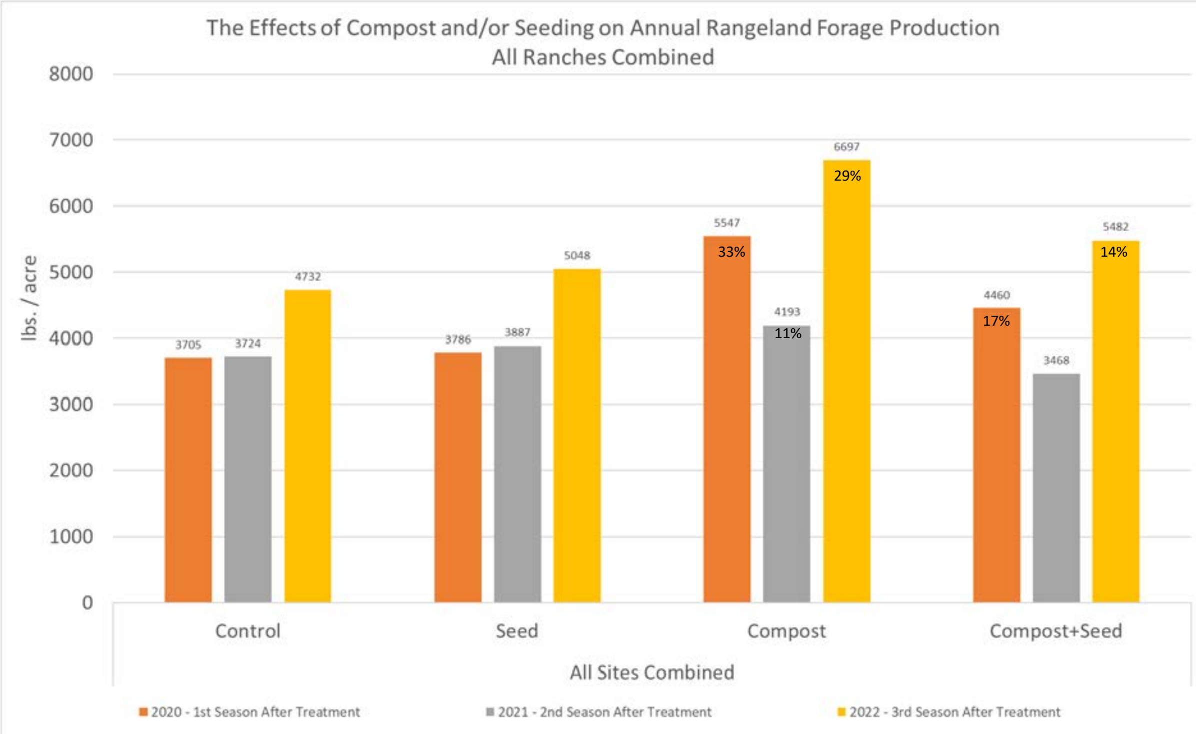


Figure 1: The Effects of Compost and/or Seeding on Annual Rangeland Forage Production

Plant diversity was measured for three years along transects calculating percent cover of each species using the Daubenmire method. Plant species were then grouped based on plant functional group into the following categories: Broadleaves, Grasses, Clovers, and Weeds. Three years after treatment, all treatments were providing some level of weed suppression with the compost plus seed treatment providing the greatest suppression with a 49% reduction in weed species cover. Similarly, the compost plus seed treatment also provided the greatest increase in clover cover across all sites. Three years after treatment the compost plus seed treatment contained 44% clover cover compared to the untreated control with 15% clover (Figure 2).

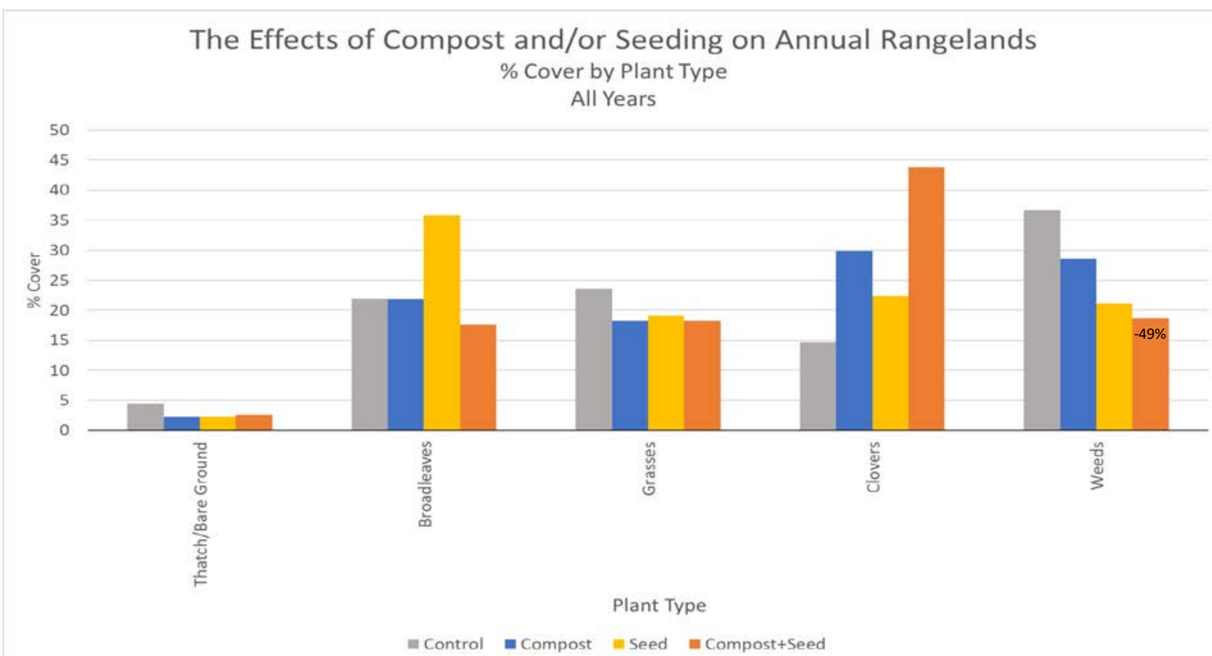


Figure 2: The Effects of Compost and/or Seeding on Annual Rangeland Plant Community

Compost applications on annual rangelands provide several benefits including increased water holding capacity, carbon sequestration, forage quality, forage quantity, and when combined with a desirable seed mix, has the potential to outcompete several noxious weeds. This work was made possible through a grant from the Western Sustainable Agriculture Research and Education Program and collaboration from the Amador Resource Conservation District, the USDA Natural Resource Conservation Service, and the support by local ranchers.

The Essential Role of Dacthal (DCPA) in Onions. Richard Smith, Emeritus Vegetable Crop and Weed Science Farm Advisor, University of California Cooperative Extension, Monterey County, 1432 Abbott Street, Salinas, CA 93901; rifsmith@ucdavis.edu

Dacthal (DCPA) was first registered for use in 1958. It is a key preemergent herbicide used in onion production in Monterey County. Effective weed control in conventionally produced onions is a four-step process: 1) cultural controls prior to planting (e.g. rotations, preirrigation), 2) an effective preemergent herbicide, 3) effective post emergent weed control with herbicides and 4) follow-up hand weeding. Mechanical cultivation does not play a big role in weed control in onions given the high-density planting configurations that preclude its use. Dacthal has been an important cornerstone tool in onion production because it effectively controls key weeds such as lambsquarters (*Chenopodium album*), nettleleaf goosefoot (*C. murale*), purslane (*Portulaca oleracea*) and redroot pigweed (*Amaranthus retroflexus*). However, it also suppresses the growth of key weeds such as nightshades (*Solanum nigrum, S. sarrachoides*), sow thistle (*Sonchus spp.*) and shepherd's purse (*Capsella bursa-pastoris*) which keeps these weeds small through the second true leaf stage and allows the post emergent herbicides, oxyfluorfen and bromoxynil, to effectively control them. In a summary of 15 weed control trials conducted on onions from 1999 to 2019, preemergent applications alone of Dacthal controlled 73% of the weeds, but when combined with post emergent herbicides applied at the second true leaf stage, 93% of weeds were controlled; these levels of weed control resulted in the following average hand weeding times: Dacthal alone, 5.3 hours/A; Dacthal plus post emergent herbicides, 2.8 hours/A; as compared to the untreated control which averaged 38.2 hours/A. Dacthal plays a key role in onion production on the Central Coast is not equaled by other materials registered for preemergent weed control.

DCPA, S-Metolachlor and Sulfentrazone Herbicide Efficacy in Brassica Vegetables. Steven A. Fennimore and John Rachuy, University of California, Davis, at Salinas CA, Corresponding author email safennimore@ucdavis.edu

Small acreage Brassica vegetables need additional herbicide options. Among the vegetables grown in California are a number of niche crops such as bok choi and brussels sprouts that have a limited number of registered herbicides such as DCPA. Sulfentrazone and *S*-metolachlor have food use tolerances for use on brassica head and stem group 5-16, which includes crops such as bok choi and brussels sprouts as well as brassica leafy greens subgroup 4-16B, which includes crops such as kale. However, there is a lack of data for *S*-metolachlor and sulfentrazone on a wide variety of seeded and transplanted brassica vegetables. *S*-metolachlor applied preemergence (PRE) was evaluated on six direct-seeded brassica vegetables during 2019 and 2020 including bok choi, broccoli raab, collard greens, mizuna, radish, and mustard greens. *S*-metolachlor and sulfentrazone were both evaluated PRE in transplanted brussels sprouts and kale. The results indicate that most of the seeded brassica vegetables were tolerant of *S*-metolachlor and that transplanted brassica vegetables were tolerant of both *S*-metolachlor and sulfentrazone. Broccoli raab was moderately injured in 2020, but yields did not vary among treatments either year.

Nutsedge management in plasticulture production systems.

Oleg Daugovish*[1] and S. Fennimore[2]. [1]University of California Cooperative Extension, Ventura County, CA, USA. [2] University of California-Davis, Salinas, CA, USA.

Yellow nutsedge (*Cyperus esculentus*) is a predominant nutsedge species in coastal California. It has been increasingly difficult to control cost-effectively even in high value crops due to loss of fumigants and lack of effective herbicides available in strawberry, a top value coastal crop. Opaque plastic mulch (totally impermeable film, TIF) customary used in berry crops, peppers and tomatoes allows nutsedge shoot penetration and establishment. In a series of trials, we evaluated end-season bed fumigation, pre-plant use of *S*-metolachlor and anaerobic soil disinfestation (ASD) for suppression of nutsedge germination from tubers. The tubers were collected locally and placed in permeable bags at four bed locations prior to treatment. These replicated trials were conducted in strawberry and we assessed crop injury on a 0 (none) to 10 (dead) scale. Metam sodium at 50 gal/A, applied via two drip line buried in soil at 5-7 cm completely inhibited nutsedge germination from tubers at 15 and 30 cm directly under the line and reduced germination from tubers in-between drip lines 86%. This suggests that this fumigant was effective, but its concentrations were likely sublethal in bed areas most distant from drip emitters that delivered metam. *S*-metolachlor at 0.33 and 0.66 lbs ai/A applied 35 d before planting of summer or fall bare-root strawberry caused slight, but significant injury (1.5-3), compared to untreated plants. Yet, in both seasons cumulative fruit yields over the first ten harvests were similar among herbicide treatments and untreated soil. Both rates of *S*-metolachlor provided 63-100% reduction in nutsedge germination, suggesting their value for pre-plant bed application. In an organically managed soil, ASD for two weeks with 7 t/A of wheat middling or dried distiller grain provided 80% reduction in tuber germination compared to untreated soil. However, there were no differences in germination among treatments after tubers have been removed from soil, indicating that ASD was only effective on suppressing germinating shoots but sub-lethal to tubers. No crop injury was detected in this ASD trial, which showed promise in controlling the first cohorts of nutsedge shoots, a benefit in organic plasticulture systems where this perennial weed is particularly difficult to manage.

Dacthal® Registration Review – Registrants Perspective. Anne Turnbough, VP Global Regulatory Affairs, Amvac Chemical Corp., 4695 MacArthur Court, Suite 1200, Newport Beach, CA 92660; AnneT@amvac.com

Update on the recent actions resulting from the DCPA data call in. Review of the process, explanation of the complex studies requested, timelines and response that resulted in NOITS and subsequent lawsuits. Review of stakeholder and registrant actions and current and planned tactical path forward endeavoring for a successful defense of the registration.

Santa Cruz County Pesticide Notification Pilot Project – What We Learned.

Juan C. Hidalgo – Santa Cruz County Agricultural Commissioner/Sealer of Weights and Measures, 175 Westridge Drive, Watsonville, CA 95076 juan.hidalgo@santacruzcounty.us

In recent years agricultural communities across California have requested information and notification about the use of pesticides on commercial farms near their homes. In Fiscal Year 2021-2022 the California Department of Pesticide Regulation (DPR) received $10 million from the State General Fund to begin the development of statewide pesticide notification system. The goal of the system is to advance environmental justice, further protect public health, and provide communities with transparent and equitable access to information ahead of planned pesticide applications. As part of the development of the state notification system, DPR collaborated with four counties to pilot pesticide notification projects in 2022 to receive feedback that would help inform on the design and implementation of the statewide system. Santa Cruz County was one of the counties that participated in the pilot projects. The Santa Cruz County notification pilot project was limited to a small area of the City of Watsonville that included a senior community near commercial farms. The project run for six months and focused on specific notification for soil fumigant pesticides, a small group of pesticide active ingredients that are used seasonally by some growers from summer to fall to control soil pathogens prior to planting for next season. The pilot project explored the type of information to provide as part of the pesticide notifications as well as different methods to get the information out to the pilot community and public at large. Feedback and comments received from community members and growers was shared with DPR as they continue to develop a statewide notification system.

Monterey County Field Fumigation Overview. Sergio Flores Reyes, Agricultural Inspector/Biologist, Pesticide Use Enforcement, Monterey County Agricultural Commissioner's Office, 1428 Abbott Street Salinas, CA 93901 reyessf@co.monterey.ca.us

Soil fumigants are pesticides in a gaseous state that are applied to the soil as solids, liquids, or liquified gas. They volatilize in the soil to kill pests like weeds, nematodes, bacteria, fungi, and arthropods. Some common soil fumigants used in Monterey County are chloropicrin, 1,3-dichloropropene, and Metam sodium. They are used as pre-plant treatments for high value crops like strawberries. Pre-plant strawberry treatments account for most of the fumigated acreage in Monterey County. These fumigations mainly occur in the northern region of the county near Pajaro and Salinas areas where strawberries are planted. Soil fumigants are considered Restricted Materials by the State of California and require a permit for use that is granted by Monterey County Agricultural Commissioner's Office. Agricultural Inspectors/Biologists working in the Pesticide Use Enforcement issue these permits after reviewing proposed fumigation plans that are submitted. Growers and Pest Control Businesses looking to apply a fumigant to their field must follow laws and regulations as well as county permit conditions pertaining to soil fumigant use. These laws, regulations and conditions are meant to protect bystanders, homeowners, public schools, agricultural workers, and the environment. Soil fumigants are a valuable tool for farmers when used appropriately. Monterey County Agricultural Commissioner's Office is the regulatory agency ensuring these tools are used appropriately to mitigate risks to the public, agricultural workers and the environment.

PPE for Pesticide Application: Title 3 California Code of Regulation Section 6738. Rais Akanda*(rakanda@cdpr.ca.gov), C. Stonum, E. Bryson, and A. Schaffner. California Department of Pesticide Regulation, Worker Health and Safety Branch, Sacramento, California, USA.

The Personal Protective Equipment (PPE) regulations for pesticide applicators, mixers, loaders, other handlers, and reentry workers are designed to reduce or eliminate exposure to harmful levels of pesticides. PPE regulations are required for both agricultural and non-agricultural occupational handlers who handle, mix, load, transfer, apply, (including chemigation), or assist with the application (including flagging) of pesticides, and other activities listed in Title 3 CCR Section 6000. The routes of pesticide exposure are inhalation, dermal (skin contact), contact with eyes, injection, and oral ingestion, with dermal exposure accounting for the greatest route of pesticide exposures. Applicators and mixers/loaders are typically at the highest risk for exposure because they are working with either concentrate or application strength materials. Others may be occupationally exposed due to contact with residue (except in drift events, where persons with little to no PPE are exposed to application strength material from off-site movement). As per Title 3 CCR Section 6738, coveralls, chemical-resistant gloves, chemical-resistant apron, a NIOSH-approved respirator, and Z87.1 approved eyewear may be required, depending on pesticide label requirements and California regulatory requirements. Certain PPE is also required for reentry workers when they enter the treated fields during the reentry interval period. In California, employers are required to provide and assure the proper use of protective eyewear and chemical-resistant gloves when employees are mixing, loading, or applying pesticides by hand or ground rig, and when exposed to application, mixing, or loading equipment (such as but not limited to hoppers, tanks, or lines) that contains or is contaminated with pesticide.

Closed Systems in California. Harvard R. Fong*, Kelly M. Amodeo**. California Department of Pesticide Regulation. 1001 I St. Sacramento, CA. USA. *Author, **Presenter (Kelly.amodeo@cdpr.ca.gov)

Closed Systems are defined in Title 3 California Code of Regulation (3CCR) Section 6000: *Definitions* and in Section 6746: *Closed Systems* as engineering controls used to protect workers from exposure to pesticides with high acute dermal toxicity. The California Department of Pesticide Regulation (CDPR) recognizes four types of closed systems: suction extraction, container breaching, direct drop/gravity feed and, isolated hand pour. Complications when using closed systems poses a health and safety issue. Standardization, system simplification, container rinsing, and measuring capability help reduce risk to the worker from accidents and misuse. Proper use and maintenance of the closed system is essential to reliably protect the worker.

CDPR updated the classification of pesticides that require the use of a closed system and closed systems requirements in 2016. Under the updated Section 6746, the precautionary statement "Fatal if absorbed through skin" or comparable language requires the use of a Tier one closed system. A Tier one closed system must remove the pesticide from the container, rinse the container and extract rinsate without removal from the extract system. The precautionary statement, "May be fata if absorbed through skin" or "corrosive, causes skin damage" or other comparable language requires a Tier two enclosed system. A Tier two enclosed system must remove the pesticide from the container. Container rinsing is not required for a Tier two enclosed system. Other closed mixing system requirements include training, PPE, eyewear, pressure requirements, maintenance, and instructions.

Herbicide Resistance Prevalence in San Joaquin Valley Populations of Palmer Amaranth. Takui Frnzyan1, Katherine Waselkov1, Anil Shrestha1, 1California State University, Fresno, CA

Palmer amaranth (*Amaranthus palmeri*) is a summer annual weed that is ranked as one of the worst weeds in US agricultural cropping systems. This species is known for its diverse genetics resulting in resistance to different herbicides including glyphosate. Palmer amaranth populations that are glyphosate-resistant (GR) have spread beyond previous locations of Midwest US and all the way to California through its invasive species pathways. However, the extent of the spread of resistant populations are not known. Glyphosate and rimsulfuron are two common herbicides that are used for perennial cropping systems in California but the resistance status of this species to these herbicides is unknown. In order to test and understand the extent of the spread, a study was conducted in 2022 to assess various populations within California to gather data and analyze if Palmer amaranth has evolved resistance to glyphosate and rimsulfuron herbicides. The study was conducted in a greenhouse located at Fresno, CA. Approximately three hundred seeds from eight (8) different populations were stratified. The stratification process included placing seeds into petri dishes that were placed in a refrigerator set at -4 C for about a month. The seeds were then germinated on July 1, 2022 and transplanted into pots during the week of July 9, 2022. A potting mix (#3 Sunshine) was used, and the weeds were watered daily. In total there were sixteen plants from each suspected resistant population and four plants were used for each treatment level for each of the herbicides. When the plants reached 3-6 leaf stage, they were treated with 0, 1, 2, 4x rate of the two herbicides, where x = 48 fl oz/ac for glyphosate (Roundup Powermax®) and 4 oz/ac for rimsulfuron (Matrix®). The herbicides were applied with a CO_2 backpack sprayer at a volume of 40 and 20 gal/ac for glyphosate and rimsulfuron, respectively. Experiments were conducted separately for each herbicide. The plants were observed and monitored for 28 days after treatments and morality data was recorded. The experimental design was a split plot where main plot was herbicide rate and sub plot were population. Some plants from a Glenn county population survived the 2x and 4x rates of both glyphosate and rimsulfuron and hence were resistant to both herbicides. The other populations were either susceptible or showed resistance to glyphosate. Four populations were resistant to rimsulfuron. Therefore, this study showed that glyphosate-resistant Palmer amaranth is probably more widespread than previously believed. Additionally, there are populations of Palmer amaranth that are resistant to both glyphosate and rimsulfuron in California.

Cattail, *Typha* L., Control in Delta Rice with Florpyrauxifen-benzyl, Loyant® CA. Deniz Inci*[1], Michelle Leinfelder-Miles[2], Ben Leacox[3], Kassim Al-Khatib[1]. [1]Department of Plant Sciences, University of California, Davis, CA, USA, [2]University of California Cooperative Extension, Stockton, CA, USA, [3]Zuckerman Family Farms, Stockton, CA, USA. *Corresponding author (inci@ucdavis.edu)

Cattail, *Typha* L., is an aquatic weed that generally infests irrigation and drainage canals, lakes, marshes, ponds, rivers, ditches, and streams. It is a perennial plant growing up to 10 feet tall and is more prevalent as a weed in Europe and North America than in other regions. Cattail has recently become an important weed in drill-seeded rice in the Sacramento-San Joaquin Delta region of California. Florpyrauxifen-benzyl, Loyant® CA, is a new synthetic-auxin type rice herbicide that is newly registered in California. The objective of this research was to study the potential of using Loyant® CA for cattail control. Field research was conducted at McDonald Island during the 2022 growing season. Treatments were Loyant® CA 1.33 pt/A, Grandstand® CA 1 pt/A, Loyant® CA 1.33 pt/A plus Grandstand® CA 1 pt/A, and Loyant® CA 2.66 pt/A. Methylated seed oil at 0.5 pt/A was also added to all treatments. The study was a randomized complete block design with four replicates. Herbicides were applied on 80x80 inches plots to a range of cattails from two to three leaf stages up to six feet tall growth stages. Visual injuries were rated at 7, 14, 21, 28, 35, and 42 days after treatments using a scale where 0 means no injury and 100 means complete death. All Loyant® CA treatments achieved 100% control when cattails were up to three feet tall. However, when cattails were three to six feet tall, the efficacy was 75, 0, 78, and 96% for the listed treatments, respectively. This study showed that foliar applications of Loyant® CA would provide excellent control on cattail up to three feet tall growth stages.

Weed Control in Water Seeded Rice as Affected by Application of Pyraclonil Herbicide. Matthew A. Lombardi[1]*, Michael J. Lynch[1], Saul Reyes[1], and Kassim Al-Khatib[1].
[1]Department of Plant Sciences, University of California, Davis, CA, USA. *Corresponding author: malombardi@ucdavis.edu

California rice production has been facing two major challenges including a limited list of available herbicides and an increase of herbicide resistant weed populations. The development of a new broad-spectrum herbicide, pyraclonil, can help rice growers control weeds and retain high yields. Pyraclonil is a PPO inhibiting mode of action herbicide that has not shown any evidence of resistance in California rice weeds. A randomized complete block design experiment with three replications was conducted at the Rice Experiment Station in Biggs, California in 2022 to evaluate the efficacy of seven pyraclonil herbicide programs, a treatment of pyraclonil applied alone, and two untreated checks for comparison. Partner herbicides used with the base application of pyraclonil included propanil, benzobicyclon plus halosulfuron, clomazone, thiobencarb, bispyribac-sodium, penoxsulam and florpyrauxinfen-benzyl applied at their respective timing and rate stated on the label. Pyraclonil was applied on day of seeding at a rate of 0.267 lb ai/A. Weed control was assessed at 14, 28, and 42 days after seeding. Crop response was evaluated at 7, 14 and 21 days after treatment. Grain yield and moisture were determined. ANOVA was used to analyze data and means were separated using LSD (p=0.05). Pyraclonil herbicide programs gave excellent control of watergrass species (Echinochloa spp.), bearded sprangletop (Leptochloa fascicularis), ricefield bulrush (Schoenoplectus mucronatus), smallflower umbrella sedge (Cyperus difformis) and ducksalad (Heteranthera limosa). There were significant crop response injuries of stunting, stand reduction, and minimal chlorosis observed from the pyraclonil program treatments. Injuries could have been a result of abiotic factors, specifically colder weather in the early season. These responses later subsided and the rice was nearly fully recovered at 28 days after treatment. Yields were measured for all treatments; the highest preforming treatment was treatment 4 with an average yield of 8,591 lb/A compared to the untreated control's 3,350 lb/A. This season's study showed pyraclonil is a promising herbicide for weed control in California water-seeded rice cropping systems.

Biology and life cycle of Branched broomrape in tomato. Pershang Hosseini[1], Brad Hanson[1], Mohsen B Mesgaran[1] [1]Department of Plant Sciences, University of California, Davis
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Branched broomrape is a root parasite weed that undergoes a prolong (relative to its lifespan) period of belowground growth followed by rapid shoot growth and seed production. This parasite entirely depends on its host for nutrients and water and hence can cause significant damage to its host. A quantitative understanding of the growth and development of the parasite is required to manage this difficult-to-control weed as herbicides need to be applied at very particular times during the growth of the parasite. Using glass-fronted rhizotrons, we monitored the belowground and aboveground growth of branched broomrape growing on tomato (variety: Red Siberian) as the host. Throughout the experiments, the temperature was set at 25/18 ˚C (day/night). We divided the branched broomrape growth into three stages: Belowground tubercle, belowground shoot length, and aboveground shoot height. The first visible attachment of broomrape to the host roots occurred 18 days after tomato transplanting. These attachments then developed to tubercles that grew (increased in diameter) at 1.8 mm/day during the sigmoid phase of their growth. The belowground stalks originating from the tubercles started to form 28 days after transplanting, and these underground shoots attained a height gain rate of 5 mm/day during the sigmoid growth phase. Branched broomrape plants started to emerge from the soil 50 days after tomato transplanting, and the resulting shoots grew linearly at 13 mm/day. Branched broomrape completed its life cycle on tomato within 60-70 days since tomato transplanting under the controlled conditions of this study. The obtained data on the growth and development of branched broomrape will be used to guide the timing of herbicide applications or other potentially viable control measures.

Cover crops used in conjunction with strip tilling to reduce herbicide use in silage corn. Robert Willmott[1], Jennifer Valdez-Hererra[1], Jeffrey Mitchell[2], Anil Shrestha[1]
[1]California State University, Fresno; [2]University of California, Davis.

The potential of cover crops is being widely explored in California cropping systems. Furthermore, growers and researchers are exploring the potential of terminating cover crops with a roller-crimper. A study was conducted in a center pivot irrigated field at Fresno State, Fresno, CA in 2020/2021 and 2021/2022 to study the possibility of developing a roller-crimped cover crop-silage corn rotation system. In each year, five different cover crop treatments (rye-alone, ultra-high diversity mix, multiplex mix, fava bean + phacelia, and rye + pea + purple vetch) were planted in November, roller-crimped in April, and silage corn (Roundup + glufosinate ready variety) was strip-till planted in May in the residue. The experimental design was a randomized complete block with three replications. A tank-mix of glyphosate + glyphosate was applied in early June and the silage corn was harvested in September in each year. No pre-emergence herbicide was applied in the study. Soil cover, weed cover, cover crop kill, cover crop biomass, and silage corn yield data were taken. The study showed that cover crops eliminated the need for a pre-emergence herbicide and one application of post-emergence herbicide was sufficient for weed control. The cover crops were successfully terminated with the roller-crimper with very little regrowth. The cover crop biomass ranged from 3 to 6.25 t/ac at corn planting and the residue reduced weed cover to less than 5% up to the canopy closure period of corn. Corn silage yield was similar between the treatments and ranged from 26.2 to 32.4 t/ac. Although the conventional treatment was not a part of the experimental design, for comparative purposes, the average yield in this treatment was 23.7 t/ac. Therefore, it can be concluded that roller-crimped cover crops has the potential to reduce the need for herbicides, for silage corn production in the Central Valley. The technology also has the potential to result in similar or greater silage corn yield than the conventional production system.

Evaluation of PPO Inhibitors Tank Mixes in California Orchards. Tong Zhen and Brad Hanson, Department of Plant Sciences, University of California, Davis, CA. *Corresponding author (tzhen@ucdavis.edu)

Protoporphyrinogen oxidase (PPO) inhibitors with different active ingredients (a.i.) and formulations can be tank mixed and achieve better weed control. Tank mixing can provide both preemergence and postemergence weed controls with a broader weed spectrum. In this study, a field trial was conducted in fall 2022 to evaluate oxyfluorfen alone from 0.25 lb a.i./A to 1 lb a.i./A and tank mixed with other PPO inhibitors (carfentrazone-ethyl, flumioxazin, and saflufenacil). Thirteen treatments with four replications of each were arranged in a randomized complete block design for a total of 52 plots. Herbicide treatments were applied on October 6, 2022, using a CO2-pressurized backpack sprayer calibrated to deliver 20 gallons per acre (GPA) at 30 psi and 2.5 miles per hour (MPH) application speed. Ratings were made at 7, 14, 28, and 60 days after treatment (DAT). Data were analyzed using analysis of variance and Fisher's least significant difference (LSD) in R. All treatments provided 91% to 95% control of little mallow (*Malva parviflora*) at 7 and 14 DAT. By 28 DAT, the control of little mallow ranged from 70% to 95% and dropped to 68% to 90% by 60 DAT. Treatment with 0.25 lb a.i./A oxyfluorfen alone provided a 78% control of filaree (*Erodium spp*), while other treatments provided at least 90% at 7 DAT. At 28 DAT, the control of filaree ranged from 45% to 95% for all treatments. At 60 DAT, all treatments provided control of filaree ranging from 15% to 53%.

Assessment of anaerobic germination potential in California weedy rice (*Oryza sativa spontanea*) accessions. Emily K. Chou[1], Liberty B. Galvin[1]*, Kassim Al-Khatib[1]. [1]Department of Plant Sciences, University of California Davis *Corresponding author (lbgalvin@ucdavis.edu)

Weedy rice is a common and problematic pest in California rice production, and control can be difficult because of similarities between weedy rice and cultivated rice. Anaerobic conditions are often present in rice fields due to flooding of soil, and previous research alludes to anaerobic germination of some weedy rice accessions. This study aims to determine if certain accessions of weedy rice are capable of successful anaerobic germination. If anaerobic sensitivity is found, pest management practices can be developed accordingly to control weedy rice in commercial rice fields. The study was conducted on California weedy rice accessions 1, 2, 3, 5, and cultivar M206. Seeds of each accession were placed in 1"x 1"x 2" plug trays and buried at a depth of 0.5 inches in soil. The plug trays were nested in larger plastic tubs and flooded to 6 inches for anaerobic replicates, and 0.5 inches for aerobic replicates. Tubs were then placed into a dark growth chamber at 86F for fourteen days. Seeds were harvested from the trays, total number of seeds germinated for each accession were counted, and coleoptile and radicle lengths of each germinated seed were recorded. Our data illustrated that weedy accessions 3 and 5 were capable of germination in anaerobic conditions, while accessions 1 and 2 were not. Research will be expanded on to confirm these results and the assumptions that certain California weedy rice accessions would germinate anaerobically.

Weed Control in Nurseries and Lathe houses: Studies on Potted Lavender Plants and Lathe House Floor. Kiera S. Searcy* [1], Calliope Correia[1], Anil Shrestha[1]
[1]California State University, Fresno *kierasearcy@mail.fresnostate.edu

Weed control in ornamental nurseries and lathe houses can be a challenge due to the limited amount of herbicides and alternative management techniques. The herbicides available are not suited for mixed production. Furthermore, hand weeding is one of the main methods of weed control, but can be very expensive and cumbersome in potted nursery plants. While propane flaming is an option on lathe house floors, it can also be expensive as weeds tend to regrow, necessitating flaming to be done every two to three weeks. Therefore, alternatives to hand weeding in ornamental nurseries and lathe houses need to be explored. Studies were conducted in a lathe house at the Fresno State Horticulture Unit. Lavender (*Lavandula x intermedia 'Grosso')*plants were grown in pots with nursery soil media and the pots were treated four days after transplant with six different treatments. An untreated control treatment was also included. Thus, the treatments were: i) control, ii) Dimension 2EW @ 32 fl oz/ac, iii) Gallery SC @ 31 fl oz/ac + Dimension 2EW @ 32 fl oz/ac, iv) Gallery SC @ 23 fl oz/ac + Dimension 2EW @ 32 fl oz/ac, v) rice hulls, vi) shredded paper, and vii) Gallery SC @ 31 fl oz/ac. The herbicides were applied with a CO_2 backpack sprayer at a volume of 25 gal/ac. The rice hull and shredded paper treatments were also applied the same day as the herbicides. The experimental design was a randomized complete block with ten replications of each treatment. Weed emergence counts by species were taken every week for eight weeks. Results showed that rice hull and shredded paper were the best treatments because they had no weed emergence in the lavender pots. However, 50% of the lavender plants in these treatments died, most likely because of excess moisture in the root zone of the plants. The herbicides resulted in similar weed counts and were not significantly different from the control treatment. The weed species present were common lambsquarters (*Chenopodium album*), burning nettle (*Utrica urens*), annual sowthistle (*Sonchus oleraceus*), hairy fleabane (*Erigeron bonariensis*), henbit (*Lamium amplexicaule*), common chickweed (*Stellaria media*), panicle willowweed (*Epilobium brachycarpum*), and some grass species. Perhaps the effect of the herbicides would have been more pronounced if the experiment had been conducted for a longer duration. The herbicides did not show many phytotoxicity symptoms. Another study compared the use of a woven plastic weed barrier with no weed barrier. This was also designed as a randomized complete block with seven replications. The plot size for each treatment was four feet by 20 feet. Weeds in each plot were counted by species each week for eight weeks. By the end of the experiment, the total number of weeds in the no weed barrier plots was 614 (average of the seven plots) while there were no weeds in the weed barrier plots. Therefore, these experiments showed that although rice hulls and shredded paper mulch could be alternatives for weed control in potted plants, they may not be best suited to lavender. Herbicides did not perform as expected which could be because some of the Asteraceae species seeds landed on the soil surface of the pots after herbicide application. In the lathe house study, the weed barrier could result in effective weed control and cost savings in the long run; therefore, is a potential alternative method to the more traditional herbicide application.

Common chickweed (Stellaria media) populations from the Central Valley show cross-resistance to three ALS herbicides. Paola Vidales Villicana[1], Nicholas Clark[2], Anil Shrestha[1] [1]California State University, Fresno; [2]University of California Cooperative Extension, Fresno/Kings/Tulare Counties.

Poor or no control of common chickweed (*Stellaria media*) is being reported in several triticale and wheat fields in the southern San Joaquin Valley in recent years. Common chickweed control with post-emergence applications of acetolactate synthase (ALS)-inhibitor herbicides such as pyroxsulam (Simplicity®), tribenuron (Express TotalSol®), mesosulfuron-methyl (Osprey®), and, to a much lesser extent, chlorsulfuron (Glean®) is a common practice in small grain crops in the Central Valley. It is suspected that overreliance and repeated use of these common herbicides have resulted poor control of common chickweed due to evolution of resistance. Nearly 90% of all ALS inhibiting herbicides applied in small grains in CA from 2010-19 have been applied in the Central Valley. Herbicide-resistant populations of ALS-resistant common chickweed have been documented in other states in the US (primarily east of the Rockies) and in Canada, but it is not known if the local populations of the Central Valley are also resistant to these herbicides. Therefore, a study was conducted to assess the response of chickweed plants grown from seeds collected from three sites where ALS-inhibitor herbicide escapes occurred and from an organic pistachio farm. Treatments included 0, 0.5x, 1x, 2x, 4x, and 8x, where x= top-labeled rate of Simplicity, Express, and Osprey applied with a CO_2 backpack sprayer on approximately 3- to 4-week old potted plants. The experimental design was a randomized complete block with five replications. Some of the populations survived the 4x and 8x treatments, whereas the plants from the organic field seeds died at all rates of all the herbicides. Therefore, it seems that there are common chickweed populations in the Central Valley with cross-resistance to all three ALS herbicides. This is the first documented case of ALS resistant common chickweed west of the Rocky Mountains.

California Weed Science Society Financial Report

	Jul 1, '22 - Apr 4, 23
Ordinary Income/Expense	
Income	
4000 · Registration Income	142,670.46
4001 · Membership Income	875.00
4020 · Exhibit Income	20,250.00
4030 · Sponsor Income	6,400.00
4040 · CWSS Textbook Income	820.44
4065 · Orchid Fundraiser	760.00
4290 · Refunds	-530.00
Total Income	171,245.90
Gross Profit	171,245.90
Expense	
4300 · Conference Accreditation	220.00
4310 · Conference Facility Fees	1,000.00
4315 · Conference Bus Tour	2,573.50
4320 · Conference Catering Expense	61,746.56
4330 · Conference Equipment Expense	9,926.13
4360 · Student Awards/Poster Expense	2,500.00
4361 · Awards-Board/Special Recog.	207.18
4370 · Scholarship Expense	9,000.00
4380 · Conference Supplies	1,332.52
6090 · Advertising	1,000.00
6105 · Merchant Services Fees	8,633.29
6120 · Bank Service Charges	5.00
6180 · Dues & Subscriptions	599.83
6240 · Insurance - General	1,656.00
6280 · Mail Box Rental Expense	182.00
6307 · Outside Services - PAPA	46,875.00
6340 · Postage/Shipping Expense	6.88
6350 · Promotional Item Expense	5,974.00
6355 · Website Expense	2,724.64
6440 · Office Supplies Expense	19.29
6500 · Taxes - Other	1,100.00
6520 · Telephone/Internet Expense	21.17
6530 · Travel - Transport/Lodging	332.60
6540 · Travel - Meals/Entertainment	107.16
6545 · Student Travel - Transport/Lodg	1,535.92
6550 · Student Travel - Meals	180.02
6555 · Speaker Lodging/Travel Expense	375.90
Total Expense	159,834.59
Net Ordinary Income	11,411.31
	11,411.31

Bank of America Checking Account Balance 4/4/23 - $56,471.08

Edward Jones Investment Account as of 3/23/23 - $343,422.34

CWSS HONORARY MEMBER AWARDS

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1979 – Jim Dewlen* & Floyd Holmes
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2005 – Matt Elhardt
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2013 – Scott A. Johnson
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2017 – Judy Letterman & Steve Orloff*
2018 – John Roncoroni
2019 – Steve Fennimore
2020 – Kurt Hembree & Richard Smith
2022 – Chuck Synold
2023 – John Madsen

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1993	Ron Vargas
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2013	Rick Miller
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2019	Josie Hugie & Scott Oneto
2020	Ben Duesterhaus & Lynn Sosnoskie
2021	Lisa Blecker
2022	Dave Blodget & John Madsen
2023	Whitney Brim-DeForest & Kate Walker

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

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1st	February 16, 17, 1949	Sacramento	Walter Ball
2nd	April 4, 5, 6, 1950	Pomona	Walter Ball
3rd	January 30, 31, Feb. 1, 1951	Fresno	Alden Crafts
4th	January 22, 23, 24, 1952	San Luis Obispo	Murray Pryor
5th	January 20, 21, 22, 1953	San Jose	Bill Harvey
6th	January 27, 28, 1954	Sacramento	Marcus Cravens
7th	January 26, 27, 1955	Santa Barbara	Lester Berry
8th	February 15, 16, 17, 1956	Sacramento	Paul Dresher
9th	January 22, 23, 24, 1957	Fresno	James Koehler
10th	January 21, 22, 23, 1958	San Jose	Vernon Cheadle
11th	January 20, 21, 22, 1959	Santa Barbara	J. T. Vedder
12th	January 19, 20, 21, 1960	Sacramento	Bruce Wade
13th	January 24, 25, 26, 1961	Fresno	Stan Strew
14th	January 23, 24, 25, 1962	San Jose	Oliver Leonard
15th	January 22, 23, 24, 1963	Santa Barbara	Charles Siebe
16th	January 21, 22, 23, 1964	Sacramento	Bill Hopkins
17th	January 19, 20, 21, 1965	Fresno	Jim Dewlen
18th	January 18, 19, 20, 1966	San Jose	Norman Akesson
19th	January 24, 25, 26, 1967	San Diego	Cecil Pratt
20th	January 22, 23, 24, 1968	Sacramento	Warren Johnson
21st	January 20, 21, 22, 1969	Fresno	Floyd Holmes
22nd	January 19, 20, 21, 1970	Anaheim	Vince Schweers
23rd	January 18, 19, 20, 1971	Sacramento	Dell Clark
24th	January 16, 17, 18, 19, 1972	Fresno	Bryant Washburn
25th	January 15, 16, 17, 1973	Anaheim	Howard Rhoads
26th	January 21, 22, 23, 24, 1974	Sacramento	Tom Fuller
27th	January 20, 21, 22, 1975	Fresno	Dick Fosse
28th	January 19, 20, 21, 1976	San Diego	Jim McHenry
29th	January 17, 18, 19, 1977	Sacramento	Les Sonder
30th	January 16, 17, 18, 1978	Monterey	Floyd Colbert
31st	January 15, 16, 17, 18, 1979	Los Angeles	Harry Agamalian
32nd	January 21, 22, 23, 24, 1980	Sacramento	Conrad Schilling
33rd	January 19, 20, 21, 22, 1981	Monterey	Lee Van Deren
34th	January 18, 19, 20, 21, 1982	San Diego	Dave Bayer
35th	January 17, 18, 19, 20, 1983	San Jose	Butch Kreps
36th	January 16, 17, 18, 19, 1984	Sacramento	Ed Rose
37th	January 21, 22, 23, 24, 1985	Anaheim	Hal Kempen
38th	January 27, 28, 19, 30, 1986	Fresno	Ray Ottoson
39th	January 26, 27, 28, 29, 1987	San Jose	Ken Dunster
40th	January 18, 19, 20, 21, 1988	Sacramento	George Gowgani
41st	January 16, 17, 18, 1989	Ontario	Ed Kurtz
42nd	January 15, 16, 17, 1990	San Jose	Dennis Stroud

CONFERENCE	DATES HELD	LOCATION	PRESIDENT
43rd	January 21, 22, 23, 1991	Santa Barbara	Jack Orr
44th	January 20, 21, 22, 1992	Sacramento	Nate Dechoretz
45th	January 18, 19, 20, 1993	Costa Mesa	Alvin A. Baber
46th	January 17, 18, 19, 1994	San Jose	James Greil
47th	January 16, 17, 19, 1995	Santa Barbara	Nelroy Jackson
48th	January 22, 23, 24, 1996	Sacramento	Dave Cudney
49th	January 20, 21, 22, 1997	Santa Barbara	Jesse Richardson
50th	January 12, 13, 14, 1998	Monterey	Ron Vargas
51st	January 11, 12, 13, 1999	Anaheim	Scott Johnson
52nd	January 10, 11, 12, 2000	Sacramento	Steve Wright
53rd	January 8, 9, 10, 2001	Monterey	Matt Ehlhardt
54th	January 14, 15, 16, 2002	San Jose	Lars Anderson
55th	January 20, 21, 22, 2003	Santa Barbara	Bruce Kidd
56th	January 12, 13, 14, 2004	Sacramento	Pam Geisel
57th	January 10, 11, 12, 2005	Monterey	Debra Keenan
58th	January 16, 17, 18 2006	Ventura	L. Robert Leavitt
59th	January 8, 9, 10, 2007	San Diego	Deb Shatley
60th	January 28, 29, 30, 2008	Monterey	Carl Bell
61st	January 28, 29, 30, 2009	Sacramento	Stephen Colbert
62nd	January 11. 12. 13 2010	Visalia	Stephen Colbert
63rd	January 19, 20, 21, 2011	Monterey	Dave Cheetham
64th	January 23, 24, 25 2012	Santa Barbara	Michelle Le Strange
65th	January 23, 24, 25 2013	Sacramento	Chuck Synold
66th	January 22, 23, 24 2014	Monterey	Steve Fennimore
67th	January 21, 22, 23, 2015	Santa Barbara	Rick Miller
68th	January 13, 14, 15, 2016	Sacramento	John Roncoroni
69th	January 18, 19, 20, 2017	Monterey	Katherine Walker
70th	January 24, 25, 26, 2018	Santa Barbara	Maryam Khosravifard
71st	January 23, 24, 25, 2019	Sacramento	Joseph Vassios
72nd	January 22, 23, 24, 2020	Monterey	Brad Hanson
73rd	January 25-February 26, 2021	Online Edition	Phil Munger
74th	January 19, 20,21, 2022	Sacramento	Anil Shrestha
75th	January 18, 19, 20, 2023	Monterey	William Patzoldt