Sacramento Valley Field Crops Newsletter

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University of California
Agriculture and Natural Resources | Cooperative Extension

Save the Date

UC Dry Bean Field Day

August 5th, 2023
9:30am - 11:30am
UC Davis Plant Sciences Field Station

UCD and UCCE will provide updates on dry bean research and management. We hope you will join us at the field day!

In This Issue

Submitted by:
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Climate-Smart Irrigation for Field Crops

Isaya Kisekka, UC Professor, Agricultural Water Mgmt. and Irrigation Engineering
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Introduction: Climate-smart irrigation is an innovative approach that seeks to optimize water usage, reduce greenhouse gas emissions, and enhance crop productivity and economic outcomes. By combining cutting-edge technologies, precision farming techniques, and scientific knowledge, climate-smart irrigation offers a promising solution to the challenges of increased competition for fresh water from various beneficial uses, increased regulation of water use in agriculture (e.g., Sustainable Groundwater Management Act (SGMA), and Irrigated Lands Regulatory Program (ILRP)), and multi-year droughts associated with climate change. In this article, we will explore the concept of climate-smart irrigation, its key components, and the potential benefits for field crop production systems (e.g., alfalfa, corn, sunflower, beans, processing tomatoes, sorghum, etc.).

Climate-smart irrigation goes beyond traditional irrigation methods by integrating climate data, advanced sensors, crop simulation models, artificial intelligence, and automation to optimize water use in agriculture while minimizing environmental impacts. It encompasses a range of techniques and approaches tailored to specific production systems, ensuring that irrigation practices align with local climate conditions. The fundamental principles of climate-smart irrigation include water conservation, improved water productivity, and adaptive management strategies. For example, for field crop production systems climate-smart irrigation involves making strategic decisions about land-water-crop allocation before the season even starts to optimize production goals while minimizing risks to potential climate extremes such as droughts. Climate-smart irrigation is well suitable for field crops because of the flexibility to decide which crops to grow on an annual basis and the amount of land irrigated can also be increased or decreased to match available water, unlike permanent crops that offer limited flexibility. Once the crop to plant is decided, technical decision-making involves making day-to-day decisions about irrigation scheduling.

Climate-Smart Irrigation Components:

Crop Selection and Management: Climate-smart irrigation promotes the selection of crop varieties that are better adapted to local climate conditions, including drought-tolerant and heat-resistant varieties. Climate-smart irrigation also involves stacking of conservation practices, such as crop rotations, conservation tillage, cover cropping, residue management, and soil amendments that improve soil health, enhance water infiltration, and enhance the resilience of the crop production system to climate extremes.

Precision Irrigation Systems: Precision irrigation technologies, such as drip irrigation, and low-pressure overhead sprinkler systems (Fig. 1) that can achieve high application efficiency and distribution uniformity. These systems deliver water directly to the plant's root zone, minimizing evaporation and ensuring targeted water application. These precision irrigation systems are also capable of variable rate application of water to adapt soil water variability or other sources of spatial variability. Climate-smart irrigation also emphasizes the use of efficient pumping plants and well-designed water distribution pipes. Upgrading to energy-efficient pumps (e.g., converting fuel-powered pumps to electric or solar). CDFA's State Water Efficiency and Enhancement Program (SWEEP) provides financial assistance in the form of grants to implement irrigation systems that reduce greenhouse gases and save water on California agricultural operations (https://www.cdfa.ca.gov/oefi/sweep/).

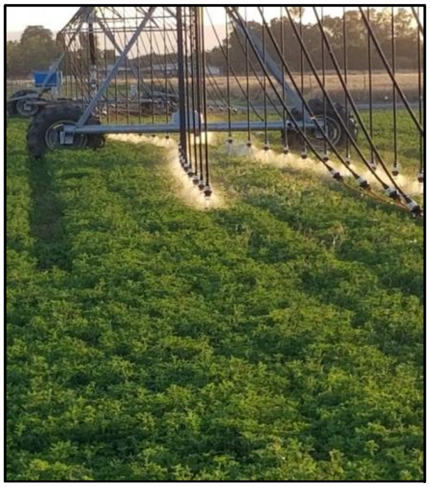


Figure 1. Precision linear move overhead sprinkler irrigation system water alfalfa at the UC Davis research farm.

Precision irrigation scheduling: Weather-Based Irrigation Scheduling: Climate-smart irrigation relies on real-time weather data, including temperature, humidity, wind speed, and precipitation, to determine the crop's water requirements. Real-time soil moisture sensors provide valuable data on soil moisture levels, allowing farmers to determine when to initiate or determine an irrigation set. Understanding what the sensor is measuring and proper installation is critical for the use of soil moisture sensors. Remote sensing imagery from UAVs or satellites can provide qualitative information on the health of the crop (Fig. 2). By utilizing this information, growers can adjust irrigation schedules and amounts to match the specific needs of their crops, reducing water demand and improving overall water productivity.

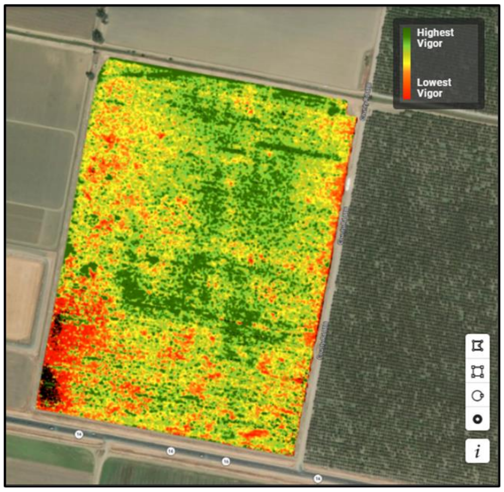


Figure 2. Showing spatial variability in processing tomato vigor measured using aerial multispectral remote sensing (Ceres Imaging) near Esparto CA, notice the dead plants on the southwest part of the field due to a disease infestation.

Reasons why you should consider Climate-Smart Irrigation:

Enhanced Water Use Efficiency: By optimizing water usage through precision irrigation and adaptive management, climate-smart irrigation can significantly improve water use efficiency. This is particularly crucial in groundwater basins with pumping restrictions imposed due to SGMA as it allows growers to produce more with less water.

Increased Crop Productivity: Climate-smart irrigation helps maintain optimal soil moisture levels, avoiding both water stress and waterlogging, leading to improved crop yields and quality. By matching irrigation schedules with crop water requirements, farmers can enhance their productivity and economic returns.

Climate Change Adaptation: As climate change brings unpredictable weather patterns such as prolonged droughts, climate-smart irrigation enables growers to adapt to these extremes. Real-time weather data and adaptive management strategies allow for timely adjustments in irrigation schedules, reducing vulnerability to climate-related risks.

Reduced Environmental Impact: Traditional irrigation practices can lead to excessive water use, and nutrient leaching to groundwater, contributing to environmental degradation. Climate-smart irrigation mitigates these impacts by optimizing water use, enhancing soil health, and reducing greenhouse gas emissions.

Examples of technologies for implementing climate-smart irrigation in California field crops.

The list below is not intended to be exhaustive but rather highlights available tools and systems to help growers implement climate-smart irrigation.

1. CropMange: Irrigation scheduling and nutrient management
2. FARMs: Land-Water allocation for corn and alfalfa
3. CIMIS: Weather data for irrigation scheduling
4. Soil moisture monitoring: Hortau, Sentek, Irrometer, CropX, etc
5. Remote sensing imagery: Ceres imaging, Manna Irrigation, IrriWatch, etc
6. Precision overhead linear move systems: Valley, Zimmatic Lindsay, Reinke, etc.
7. Subsurface drip irrigation systems: Netafim, NaanDanJain, Toro, etc.
8. Automation: Wiseconn, Jain, Rivulis, Netafim, Rubicon’s FarmConnect, Lindsay’s FieldNET,

Update on alfalfa weevil insecticide resistance: What is the situation, and what can be done?

Ian Grettenberger and Madi Hendrick
University of California, Davis; Dept. of Entomology & Nematology

While the cool weather may have slowed some weevil populations down and delayed peak activity, they still showed up in many fields this year. This is a good time to revisit the current management challenges with alfalfa weevil and to ponder longer-term management plans for this key pest.

Given that the primary means of management is insecticide applications, it is not surprising that growers have been faced with the challenge of insecticide resistance. Specifically, we are talking about resistance to pyrethroid insecticides, and lambda-cyhalothrin in particular. Resistance to pyrethroids has shown up in several regions across California and the Western United States more broadly. Unfortunately, there is a current lack of effective materials for managing alfalfa weevils. In reality, current options are functionally various pyrethroids or indoxacarb (Steward).

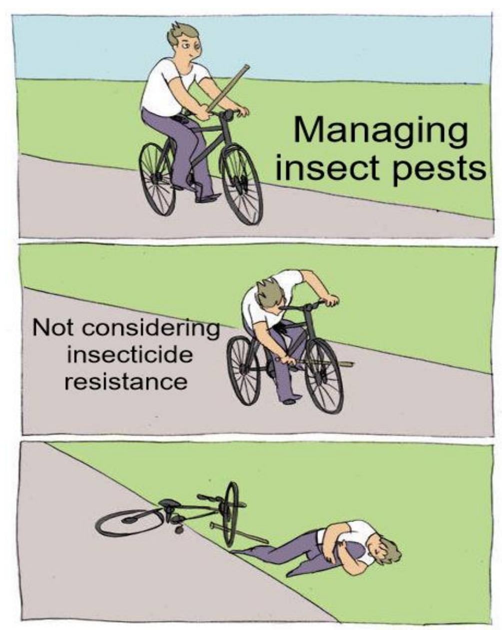
To address this issue of insecticide resistance, we’ve been conducting a project in close collaboration with researchers out of Montana State University and numerous collaborators within California. As a team, we have surveyed a large number of populations within and outside of CA. Broadly, we have found that resistance is geographically widespread in the sense that all states surveyed have populations highly

resistant to lambda-cyhalothrin. There were also a number of populations that are moderately resistant. However, there is still plenty of susceptibility out in the landscape. We must remember that resistance can be viewed as a continuous scale; even within the moderately resistant category, some were close to becoming highly resistant, while others could become susceptible again if resistance were to revert. Similarly, some populations were *extremely* susceptible to lambda-cyhalothrin. Others, while still within the susceptible category, were nevertheless less susceptible and likely inching towards moderately resistant. This latter situation was the case with a number of populations within the Sacramento Valley.

Meanwhile, we found that for the limited populations we tested, indoxacarb is still highly effective and there appears to be few changes in susceptibility. This is not unexpected given the fairly light use we have seen so far. However, as history has shown us, alfalfa weevil can develop insecticide resistance. Repeating history with indoxacarb as well should be avoided.

What can you do?

First, resistance must be addressed within a given year, but also across years. Alfalfa weevils are primarily single-generation-within-a-year pests. When we talk about managing resistance by rotating insecticides, we are therefore talking about rotating across years. Now is the time to 1) address the worsening issue with pyrethroids in some areas, 2) avoid problems with pyrethroids, and 3) manage resistance against indoxacarb.



If you are still using only pyrethroids, strongly consider rotating indoxacarb in. It is more expensive, but rotation is the key to managing resistance when using insecticides. The data we have gathered suggest even though field rates of lambda-cyhalothrin may still provide sufficient control, that could soon change with more applications. If you have already started using indoxacarb, ensure that you still use pyrethroids in rotation. The only caveat would be if you have a resistance issue, in which case you'd need to allow your weevils to become susceptible again (assuming that this happens) before adding pyrethroids back into the rotation.

Overall, remember that *NOT* applying an insecticide (or perhaps making one, not two, applications targeting weevils) is one of the most effective resistance management tactics. Ensure that applications are needed based on scouting and are properly targeted.

Hopefully, we can maintain the current tools in the toolbox for managing alfalfa weevil, as well as protecting any new materials that might be registered. The current resistance situation is clearly indicative that our grasp on this may be a bit tenuous. Resistance management is the key!

UCCE Resources on the Economics of Cover Cropping in Annual Rotations

Sarah Light, UCCE Farm Advisor
Ellen Bruno, UCCE Specialist Quantitative Policy Analysis
Margaret Lloyd, UCCE Small Farms Advisor

Soil health is defined as the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans (USDA). This includes providing space for root growth and respiration; moving water rapidly and allowing water to infiltrate in the soil profile; storing water for future crop use; and providing habitat for soil organisms, including soil microbes. When we build soil health, we are increasing the capacity of our soil to do the jobs we need it to do, which can improve crop production.

Cover crops are plant species selected and grown for their protective and beneficial contributions to soil health. They help meet three of the soil health principles: maintaining a living root; increasing plant diversity in the rotation; and maintaining soil coverage. Cover crops help keep ground productive in the long term by physically protecting the soil from erosion, maintaining soil structure, and building soil tilth and fertility. Above and below ground, cover crop biomass builds soil organic matter, which can improve nutrient cycling and retention, water holding capacity, water penetration and infiltration. Both cover crop residue and roots provide essential sources of food for soil macrofauna and microbial life. Soil microbial communities contribute toward disease suppression and nutrient cycling, especially nitrogen. Soil organisms are also essential for building and maintaining soil structure including aggregate stability and soil porosity. Improved soil structure in the form of better soil water holding capacity may reduce irrigation applications in future years.

All of these potential benefits come with a cost to manage. There are two UC Cooperative Extension resources that can be used to evaluate management costs associated with cover cropping in an annual rotation.

> Estimated Costs for a Winter Cover Crop in an Annual Crop Rotation:
> https://coststudyfiles.ucdavis.edu/uploads/pub/2022/09/28/2022covercropsbenefits.pdf
>
> This cost study models the planting and management of a winter cover crop in a summer crop rotation planted in the lower Sacramento Valley. This 2022 cost study estimates the cost to plant and manage a cover crop to be $156/acre. The rotation may include processing tomatoes, corn, sunflower, safflower, sorghum, and/or dry beans, as well as other summer annual crops. This study models a field following harvest of processing tomatoes in the fall and a planned rotation into a spring planted field crop.
>
> Interviews with growers who plant cover crops were used to create the scenario for this study. The cost study includes typical management practices that are being used in the region. In addition to estimating the costs of cover cropping, the cost study can also be used as a guide for farmers who want to know what typical farming operations are for planting and managing a cover crop. All farming operations are documented in the tables. The $156/acre costs include cash and labor costs associated with seed, legume inoculum, planting, and termination activities--mowing and discing (2x). Because cover crops are part of a rotation between cash crops, some soil preparation practices were not charged to the cover crop. Pre-plant practices including ripping the furrows, disking and rolling (2x) and landplaning are considered preparatory practices for the cash crop, not the cover crop. Each table has a "Your

Costs" column in which users can add or remove any additional costs for their operations.

Winter Cover Crop Calculator:
https://shiny.lawr.ucdavis.edu/shiny/cc_calculator/app.Rmd#section-tomato-calculator

A team at UC Davis developed an interactive calculator that estimates the expected changes in expenses and revenues associated with the introduction of winter cover cropping for a given farming operation. This tool is different than the cost study because users input all of their own costs and it is not based on a model scenario. This tool is also broader in geographic scope, as it is designed for the entire Central Valley of California. The tool estimates how much farmers can expect their profits to change after growing winter cover crops for a certain number of years.

All values used in the calculator are flexible and can be adjusted to match farm operations. The calculator assumes continuous cover cropping after the year of adoption (first year) and that all benefits of cover crops begin accruing within the first five years. The calculator is seeded with the average values for each cost and benefit component that we considered, but the user can easily adjust or remove any component. Importantly, the tool may not capture every potential benefit and cost from introducing cover crops into a farming operation. It simply serves as a guide to when a farm can expect to experience economic returns, based on the monetized benefits and costs.

Maintaining the viability of our California farmland is critical for our food supply and protecting our agricultural economy. Cover crops can play a pivotal role in building and maintaining soil health and ensuring land remains farmable for the long term. The true cost of cover crops is complicated given the hard-to-measure benefits that dominate the decision to grow cover crops. However, these two tools can be used to estimate expected management costs prior to planting a cover crop. There are federal (USDA EQIP) and state (CDFA Healthy Soils Program) incentives programs available for planting cover crops. Contact Agronomy Advisor Sarah Light (selight@ucanr.edu) with questions about cover crops or the tools described above.

Zon Gun Update from Sutter County Ag Commissioners Office

Best Management Practices for use of Propane Cannons (zon guns) in Production Agriculture

1. Operate zon guns between the hours of one hour (1) before sunrise to one and one-half hour (1 ½) after sunset.
2. If nighttime use is necessary, notify Agricultural Commissioner of crop/target species/date/time/location to ensure proper and swift mitigation if complaints arise. Nighttime should be limited to the last resort to save affected crop.
3. Limit use of zon guns to when wildlife damage is most prevalent.
4. Limit use to time of day when wildlife pressure is highest.
5. Aim zon guns away from neighboring residences and as far back from fence lines as feasible.

6. Find natural sound buffers to place the propane cannon between the intended control site and neighbors. This could include berms, hedge/tree rows, large buildings, or even a stack of hay bales.
7. Contact nearby neighbors to share your wildlife damage control strategies, include time of day the device will be in operation and the planned duration.
8. Implement varying wildlife management techniques when using a zon gun; thus, acknowledging how each pest and crop type should be handled individually to meet its unique scenario.
9. Consider frequency intervals the zon gun should be set. Attempt to maintain a pre-determined level of economic threshold* for control of wildlife pests.
10. Monitor the site frequently. Make notes and adjust use as changes occur.
11. Move zon gun, every 3-5 days, to keep wildlife from becoming accustomed to the sound.
12. Consult your Pest Control Advisor and local UC Farm Advisor for additional tactics and management ideas to effectively manage wildlife pressures preferably only using zon guns as a last resort.
13. Responsible use of zon guns will ensure that complaints from the public are limited and resolved timely.

**Economic threshold is defined as the pest density at which management action should be taken to prevent an increasing pest population from reaching the economic injury level.*

These BMP's were developed by the Sutter & Yuba County Agricultural Commissioner's offices and the Yuba-Sutter Farm Bureau in April 2023. Currently there are no regulations prohibiting the use of zon guns in Sutter & Yuba Counties. We ask for your voluntary cooperation to minimize the impacts to nearby neighbors. Questions or concerns related to the use of zon guns should be directed to:

Sutter County Agricultural Commissioner's Office
(530) 822-7500 or sutteragpue@co.sutter.ca.us

Grazing Cover Crops in Annual Cropping Systems

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For more information: srwilliams@ucdavis.edu

A 2022 UCCE focus group with local growers (n=8) and ranchers (n=5) found that both groups

- see **some to many advantages** of grazing on cropland
- would like **grazing on cropland encouraged, adopted, and expanded**

What are the potential benefits to growers of grazing cover crops?

- Increased land use efficiency, forage value
- Increased nitrogen (N) availability
- Increased soil health and microbial activity
- Decreased weed pressure and biomass control
- Reduced reliance on fossil fuels/herbicides

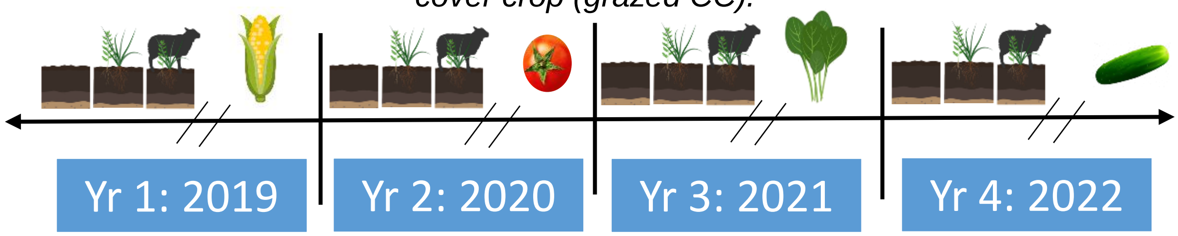
What concerns might growers have about grazing cover crops?

- Soil compaction risk
- Nitrate leaching risk
- Food safety risk
- Positive soil outcomes take too long to achieve
- Logistical complexity within operation cycle

2019-2022 winter cover crop grazing experiment

Objective: Investigate impacts of cover crops and cover crop grazing on soil health, soil carbon pools, soil nutrient cycling & foodborne pathogen risk in an organic vegetable system

We implemented a maize-tomato-spinach-cucumber rotation on tilled, organic plots at Russell Ranch at UC Davis. *There were three different winter treatments: fallow, ungrazed cover crop (ungrazed CC) and grazed cover crop (grazed CC).*



What have we found so far?

- Increase in *soil nitrate* in grazed CC plots
  - At vegetable planting in Yr3: fallow- 9 lb N/A , ungrazed CC- 28 lb N/A, grazed CC- 27 lb N/A
  - At peak nutrient uptake in Yr3: fallow-22 lb N/A, ungrazed CC- 59 lb N/A, grazed CC- 85 lb N/A
- *Nitrate leaching* wasn't significantly higher in grazed CC plots, though there were hotspots
- Trends toward higher *microbial activity* (respirable carbon) in grazed CC plots
  - At peak nutrient uptake in Yr3: 35% increase from fallow, 9% increase from ungrazed CC
- No difference in *soil structure* or *soil compaction* (bulk density) between treatments in Yr3
- Emergence of barnyard grass (a summer weed) was suppressed in grazed CC plots
- Higher rainfall and lower soil temperature are associated with greater generic *E.coli* risk in all treatments - USDA's National Organic Program 90-120 day wait-period between manuring/grazing and harvesting should take into account environmental factors.

Future Research Questions

- What are the *long term effects* of cover crop grazing on soil health in CA?
- What specific *N credits* from grazing can be used to guide nutrient management?
- Does *grazing intensity* affect soil health outcomes and crop yield?
- What are the *economics* of implementing grazing on annual land for ranchers and growers?

Thanks to the growers and ranchers who participated in the UCCE Focus Group on 3/1/2022

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