

Organic Weed Management and Emerging Technologies

Clebson G. Gonçalves, Ph.D.

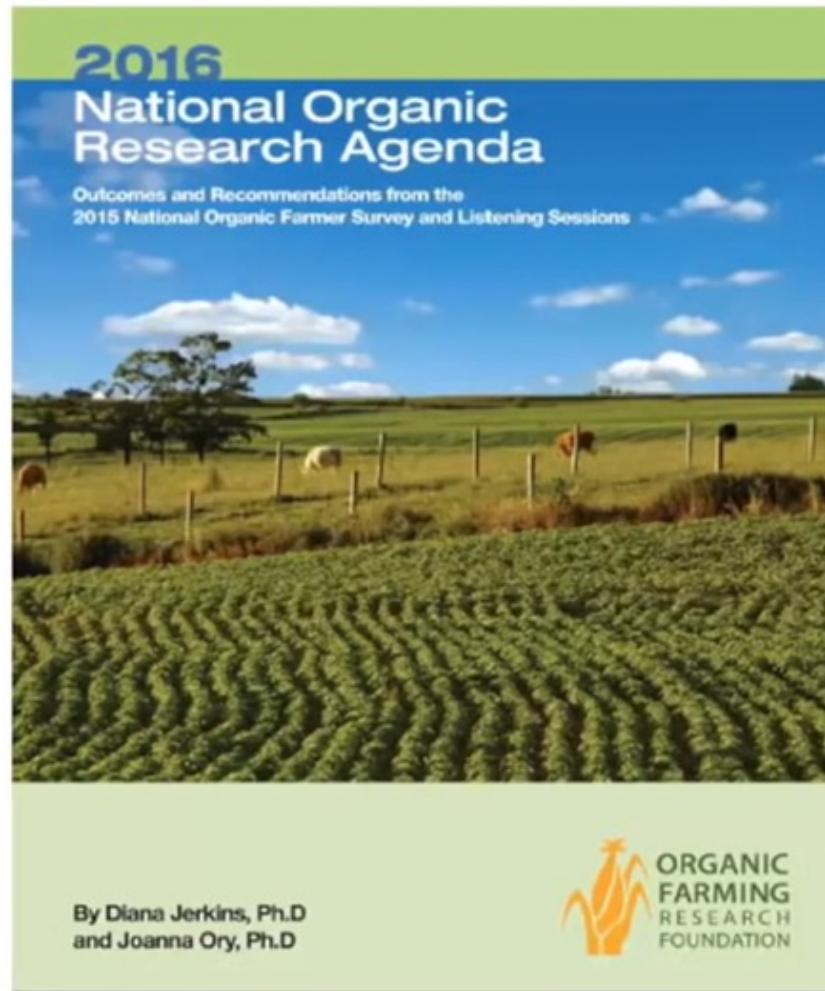
Diversified Agriculture Advisor



UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources

■ Cooperative Extension

Research Priorities Identified by Western Region Organic Farmers



63% - Weed Management
71% - Soil Health

<https://ofrf.org/>

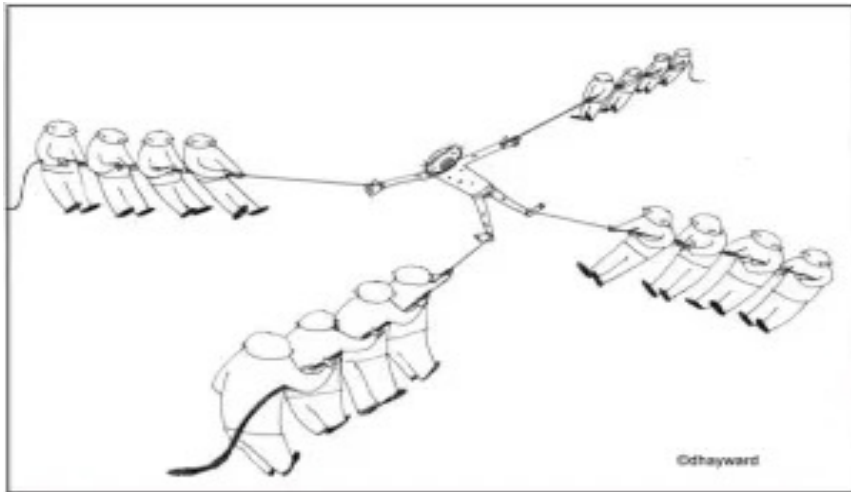
Weed Management Research Priorities

- **Managing Invasion Weeds;**
- **Crop Rotations to Decrease Annual and Perennial Weed Pressure;**
- **Effects of Tillage Regimes and Plant and Animal Rotations on Soil Health and Weed Pressure;**
- **Managing Weed Through Grazing and Crop-livestock Integration;**
- **Cost-effective Organic Weed Management Method and Products;**
- **Emerging Weeding Technologies;**

Thinking about goals

Weed management (short- and long-term)

- Crop productivity and quality
- Production system efficiency
- Economic considerations
- Site and system sustainability

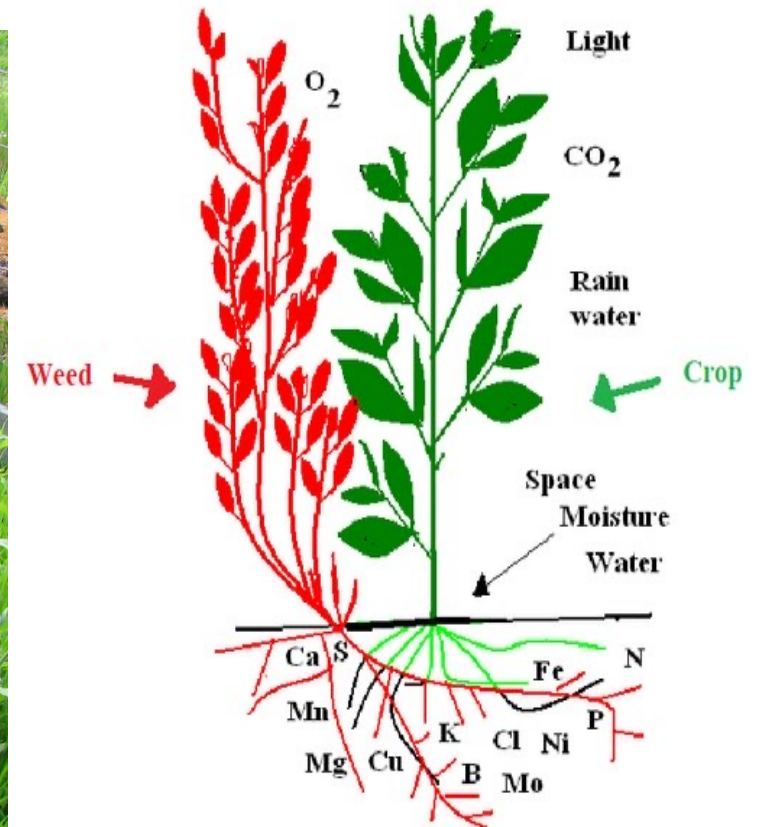


<https://staywellfireyourdoctor.files.wordpress.com/2011/06/tug-of-war.jpg>



Why Control Weeds?

- Competition



https://www.researchgate.net/publication/357528176_Understanding_Organic_Weed_Management/figures?lo=1

Why Control Weeds?

- Competition
- Impact human health



Why Control Weeds?

- Competition
- Impact human health
- Fire



Why Control Weeds?

- Competition
- Impact human health
- Fire
- Promote other pests-i.e. Rodents, disease, insects



Common Weeds for Organic Farmers



Thistle



Redstem filaree



Nutsedge



Field Bindweed



Annual bluegrass



Common chickweed



Shepherd's Purse



Lambsquarters



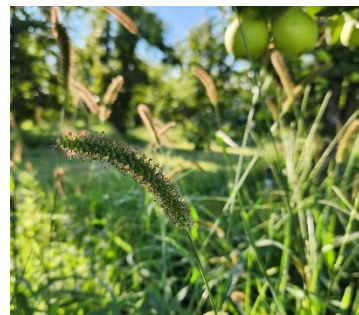
Common groundsel



Cheatgrass (*Bromus* sp.)



Bermudagrass



Foxtail

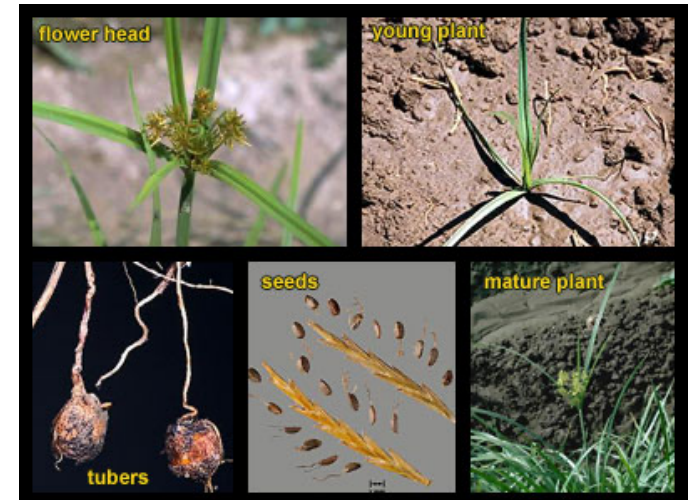
Get to Know the Weeds

- Broadleaves
- Grasses
- Sedges
- Annual weeds
- Perennial weeds
- Season
- Growth needs
- Germination
- SIMPLE vs CREEPING
- Weak points

Johnsongrass (*Sorghum halepense*)




Broadleaf plantain (*Plantago major*)



Yellow nutsedge (*Cyperus esculentus*)

How to Identify Weeds


<https://wric.ucdavis.edu/>



Weed Research & Information Center
UNIVERSITY OF CALIFORNIA • COOPERATIVE EXTENSION & AGRICULTURAL EXPERIMENT STATION

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» by Crop/Topic
» by Specific weed
» herbicide susceptibility
» herbicide symptoms
» weed identification



Purple starthistle (*Centaurea calcitrapa*)

The Weed Research and Information Center is an interdisciplinary collaboration that fosters research in weed management and facilitates distribution of associated knowledge for the benefit of agriculture and for the preservation of natural resources.

WHAT'S NEW

- » Mechanical weed control under the vine
- » Assessing the potential invasion risk of ornamental plants
- » Bivalent nightshade - nearly indistinguishable
- » Wildland weeds - Have you heard of WeediT?
- » Parasitic weed seed biology
- » Herbicide Mode of Action updates
- » Presentations from Weed Management for Small Acreages workshop
- » Weeds to watch out for in rice in 2021: watergrass and weedy rice (with some management tips)
- » Conventional mow on weed management in the Sacramento Valley
- » Biological characteristics that make broomrape a threat to California crop production systems
- » Weed control information for weeds in natural areas (western U.S.)

Weed Control in Natural Areas in the Western United States publication available at

- » UC ANR (UC ANR Publ. 3547)
- » UCCE Control Store office
- » "DISCOUNTED" (while supply lasts)
- » Cal-IPQ (U.S. sales only)

CALENDAR

2021

- » July 12-15: Aquatic Plant Management Society (APMS) in-person annual meeting - New Orleans, LA
- » July 27-28: Aquatic Plant Management Society (APMS) virtual annual meeting
- » Aug. 3: Weed Rice Workshop 2021 in-person event - Yuba City, CA
- » Aug. 25 - CA Rice Field Day in-person event - Biggs, CA
- » Sept. 10 - Rice Pest Management Course in-person event - Biggs, CA (More information to come)
- » Oct. 26-28 - California Invasive Plant Council (Cal-IPC) Symposium - online

2022

- » Jan. 19-21 - CA Weed Science Society (CWSS) annual meeting - Sacramento, CA
- » Feb. 21-24 - Weed Science Society of America (WSSA) annual meeting organized jointly with the Canadian Weed Science Society (CWSS) - Vancouver, Canada
- » Mar. 7-10 - Western Society of Weed Science (WSWS) annual meeting - Newport Beach, CA
- » Mar. 7-11 - Western Aquatic Plant Management Society (WAPMS) annual meeting - Tucson, AZ
- » June 20-23 - European Weed Research Society (EWRS) symposium - Athens, Greece

HERBICIDE SYMPTOMS

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WEED SCIENCE BLOG

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New!

Weeds of California and Other Western States

This encyclopedic yet easy-to-use guide covers 262 individual entries, including a full description of 451 species and another 361 plants comprised as similar species, representing 53 plant families.

13 Shortcut Identification Tables for groups that share similar, unusual, or relatively uncommon characteristics

2 grass identification keys - a key to all characteristics including inflorescences and reproductive parts and a key to vegetative characteristics only

67 tables comparing important characteristics of difficult-to-distinguish weedy species

Color photos of over 700 weeds including seeds, seedlings, flowers, and mature plants

CD of all of the photographs from the book suitable for use in PowerPoint presentations - over 3000 images!

Appendix of non-native plants rarely or occasionally naturalized in California

Glossary of botanical terms

Bibliography of some of the most pertinent publications

Index to common names, scientific names, and synonyms

Each entry describes the plant category, family name, common name, and synonyms, along with a summary of the important aspects of the plant's life cycle, size, growth form, impact, method of introduction, and toxicity. You'll also find a description of the seedling, mature plant, roots and underground structures, flowers, fruits and seeds, spores and spores, spore-bearing structures, and post-germination characteristics for each entry. Also includes a description of the habitat where each is typically found, distribution in California, other states, and worldwide, along with maximum elevation at which the species is found.

Rounding out each entry is a description of the methods of reproduction, seed dispersal, germination requirements and conditions, seed survival and longevity, early establishment characteristics and requirements, cultural practices and management options that have proven effective or ineffective in controlling infestations, and a notation of inclusion on federal or state noxious weed lists. 2007, 2 volumes, 648 pp., 912 pp.

3488 ISBN 978-1-879066-69-31 \$100.00
Call: 1-800-994-8849 or 510-642-2431 Click: <http://anrcatalog.ucdavis.edu>
Or visit your local UC Cooperative Extension office




UC IPM Resources
173 Pest Notes



Pest Notes, Publication 7469
Integrated Pest Management for Home Gardeners and Landscape Professionals

Dandelion

Dandelion, *Taraxacum officinale* (Figure 1), also known as lion's tooth, puftail, blowball, and commoner's leaf, is a major problem for home gardeners, and more and more crops. The genus *Taraxacum* consists of about 40 species worldwide, but only one species is found in California. *Taraxacum officinale* is found as a weed throughout California and is particularly a rare and endangered species, to find it in its native range.

Dandelion was introduced from Europe where it has been used as an herb and medicinal plant since the time of the Roman Empire. The leaves and flowers are eaten and used to make salads, beer, dandelion wine, and other products. Home gardeners can use it as a cover crop, or dried and used for various medicinal purposes, including as a mild diuretic.

While dandelion does have its benefits, in this publication dandelion is described as an undesirable weed in residential landscapes with options on how to manage it.

Author: Ashli A. Bannerman, UC Cooperative Extension, Yuba City

Reviewers: a University Extension, published by UCCE and UCCE

IDENTIFICATION AND LIFE CYCLE

Dandelion is a perennial (Figure 2) that grows from a taproot (Figure 3) and produces up to 2000 seeds per plant. The seeds are dispersed by the wind, and the plant can regrow from the taproot. Dandelion grows from seed in California from the central state coast to the mountains, where it is more common in the mountains.

It produces a strong taproot (Figure 3) that can regenerate from the taproot if the taproot is not removed. Dandelion has a long life cycle, producing seeds that can remain viable for up to 20 years. Dandelion is a common weed in residential landscapes, and its presence can be a nuisance for homeowners.

There are many ways to manage dandelion in residential landscapes, and the best method is to remove it completely.

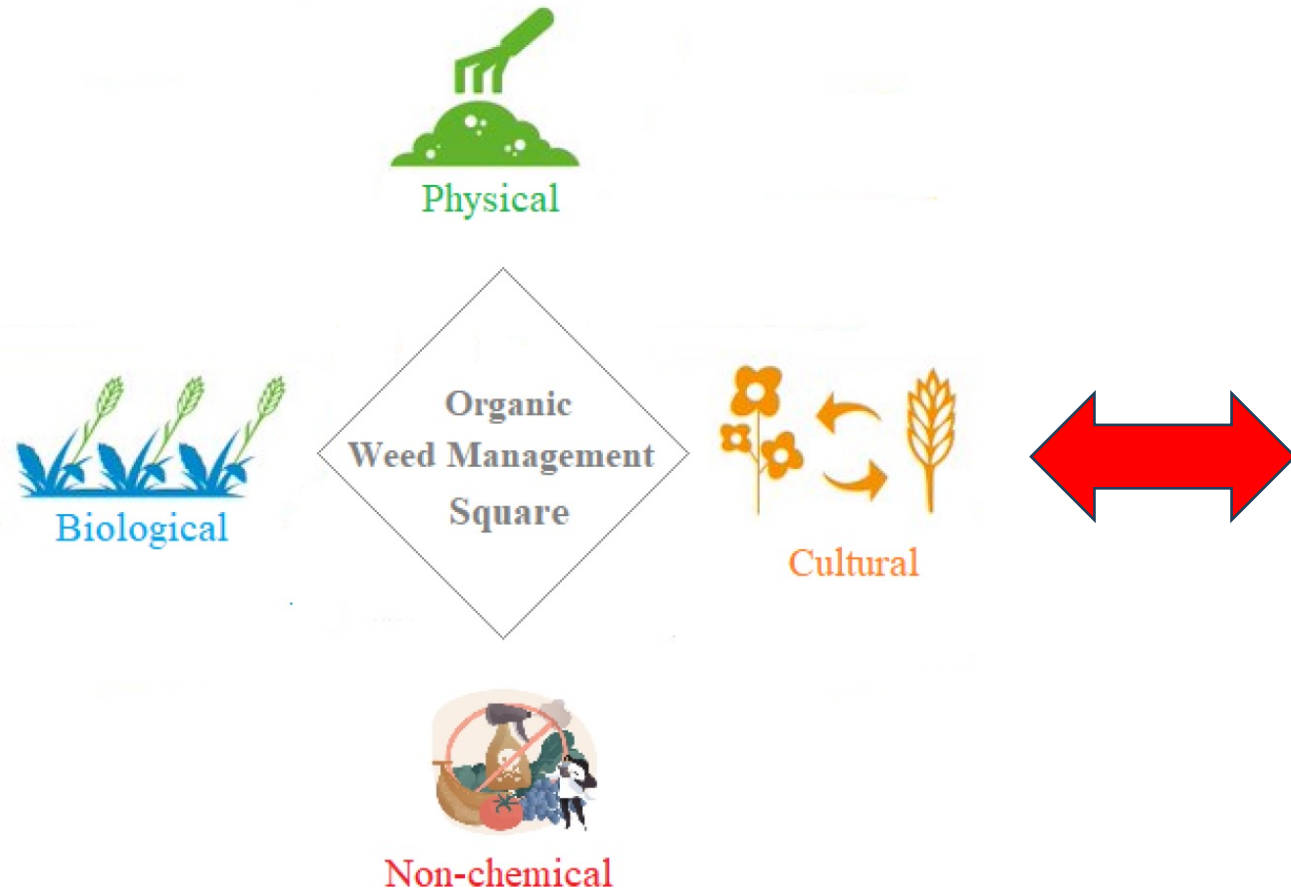
Why should I care what it is if it's a weed?

Proper method of control:

- a. Chose right Management strategies
- b. Physical Control:
 - Will I spread it by cultivation?
 - Can I pull it?
 - Need to dig it out?
 - Can I use a 'weed eater'?
 - Will mulch control it?
 - Will I make it worse?

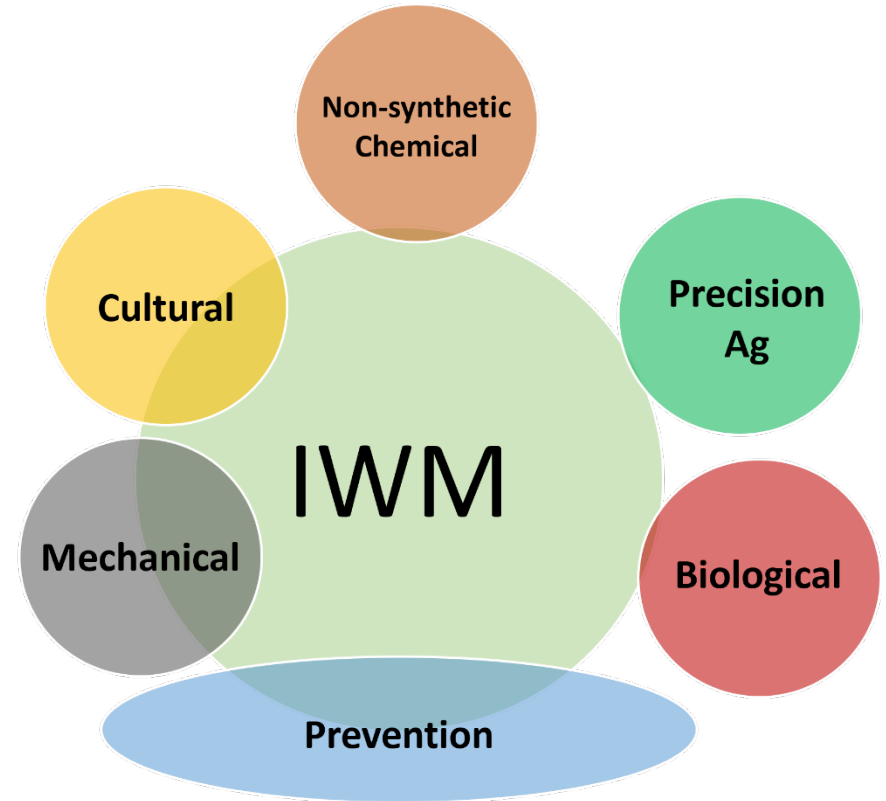


Organic weed management square



Non-synthetic chemical

Weed Management vs Sustainability



Key Organic Weed Management Practices

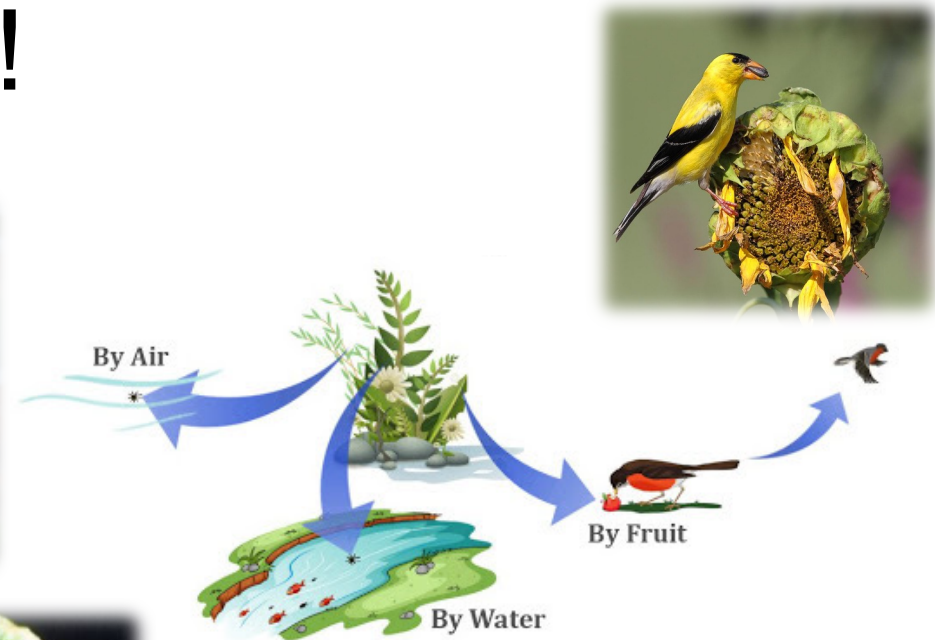
- Prevent weed introduction
- **Preventative** – excluding new weeds by careful selection of soil or other inputs.

Eclipta growing in and around nursery pots can be moved to ornamental beds. These pots should be avoided or carefully cleaned of all weed propagules.



Key Organic Weed Management Practices

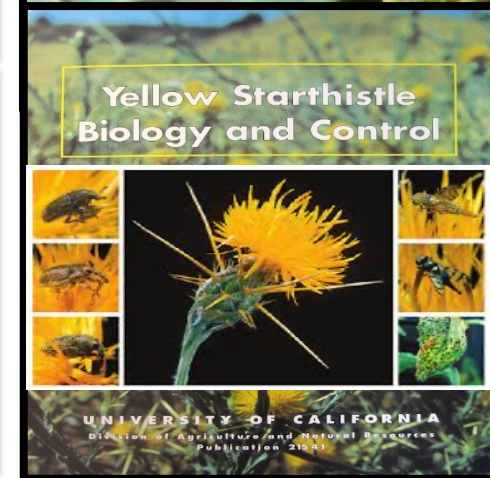
Never let weeds go to seed!



Seed dispersal

Key Organic Weed Management Practices

- **Biological** – use of living organisms to suppress or control weeds.



Key Organic Weed Management Practices

- **Cultural** – Anything done to “culture” or promote the growth of your crop.

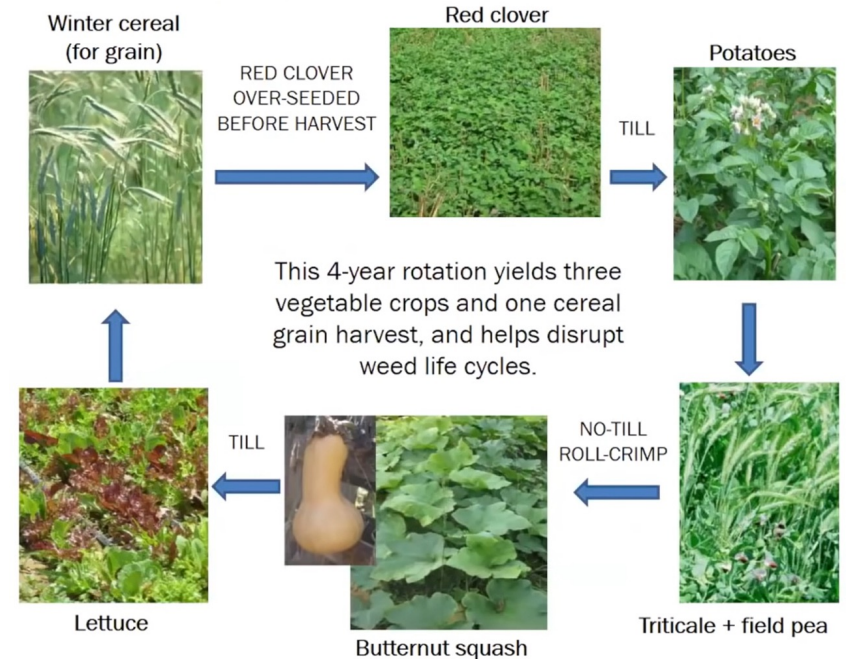
Examples include:

Adding compost, limiting the area for weeds to grow, variety selection, crop rotations, adding fertilizer, irrigation, pruning, etc.

Crop Rotations

Crop rotation is at the core of organic weed management:

- Establishing crops with different phenologies and morphologies creates unstable environments that discourage weed establishment.
- It is critical to vary crop growth periods (i.e., winter vs. spring crops; early vs. late spring planting) to keep weed communities off balance.



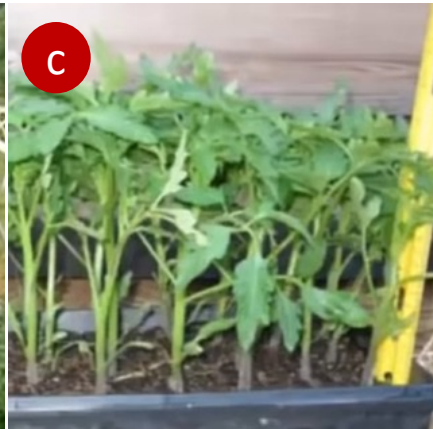
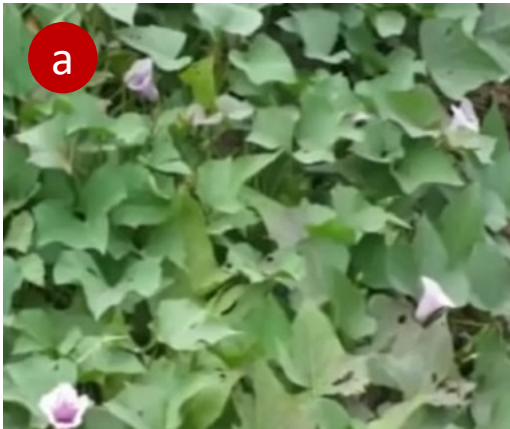
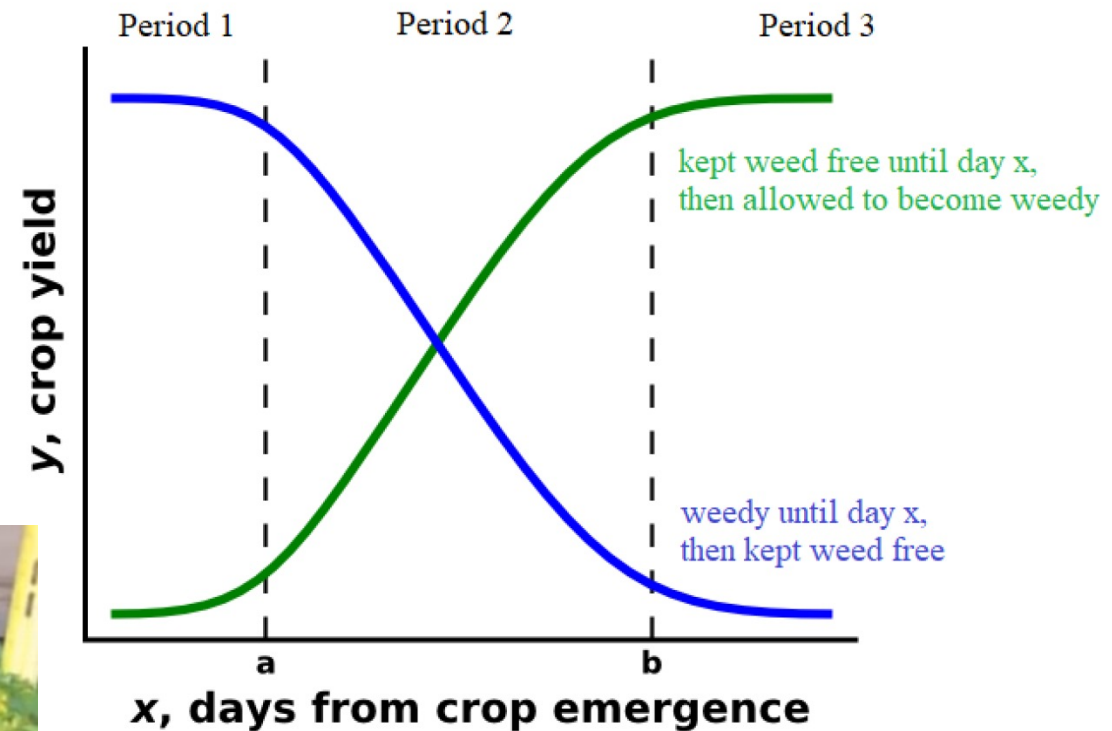
Menalled, F., Jones, C., Buschena, D., & Miller, P. (2009). From conventional to organic cropping: What to expect during the transition years. Bozeman, MT: Montana State University Extension Service MontGuide MT200901AG.

Grow competitive crops

- **Give Crops an Edge Over the Weeds**

1. Choose vigorous cultivars that rapidly cover the ground (a).
2. Use season extension to optimize environment for the crop (b).
3. Transplant vegetable "starts" (c).

Critical weed-free period



Grow competitive crops

- In-row **drip irrigation** and **fertigation** **delivers moisture and nutrients to crops**, leaving between-row weeds dry and unfed.
- Composting organic material at 140 °F kills weed seed. Use nutrient-rich compost in moderation, bands near crop row to avoid feeding weeds.



Weed triangle



Key Organic Weed Management Practices

- **Mechanical** – Targeting weeds with physical or nonchemical methods to achieve preemergence or postemergence suppression or control.



Pulling weeds, laying a fabric for a physical barrier, cutting weeds, burning weeds, shading weeds. These are all mechanical controls.

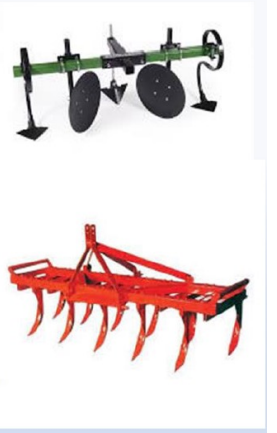
**Remember this:
Every weed can be controlled by hand...
All it takes is time and money...**





Cultivate effectively

- Cultivate shallowly (<1 in) when weeds are small.
- Select tools to remove between – and within – row weeds:
 1. **Crop stage of growth**
 2. **Weed species as size**
 3. **Soil condition**



Key Organic Weed Management Practices

Use of Flame for weed control



Key Organic Weed Management Practices

Steam Weeding

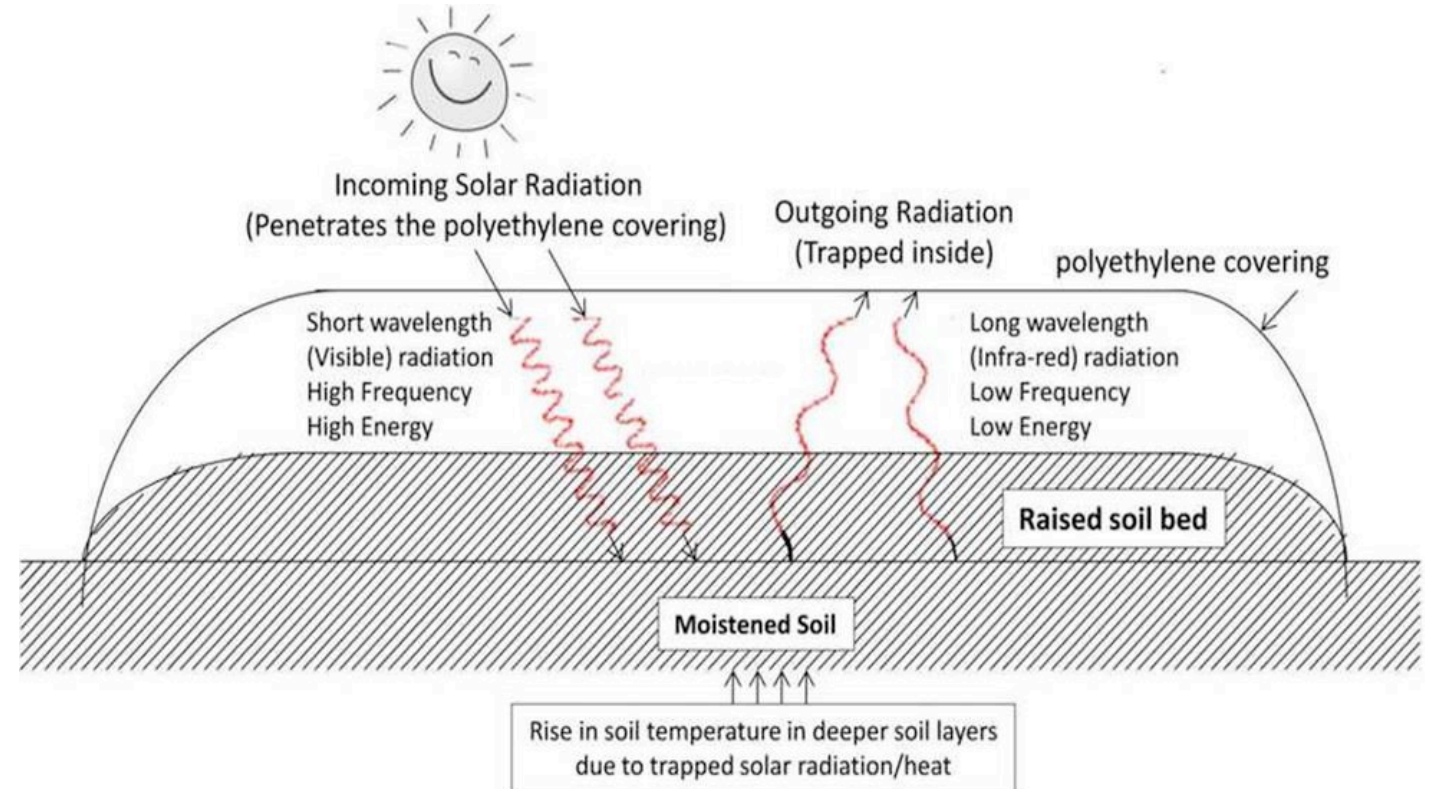


Foamstream (steam plus foamer)

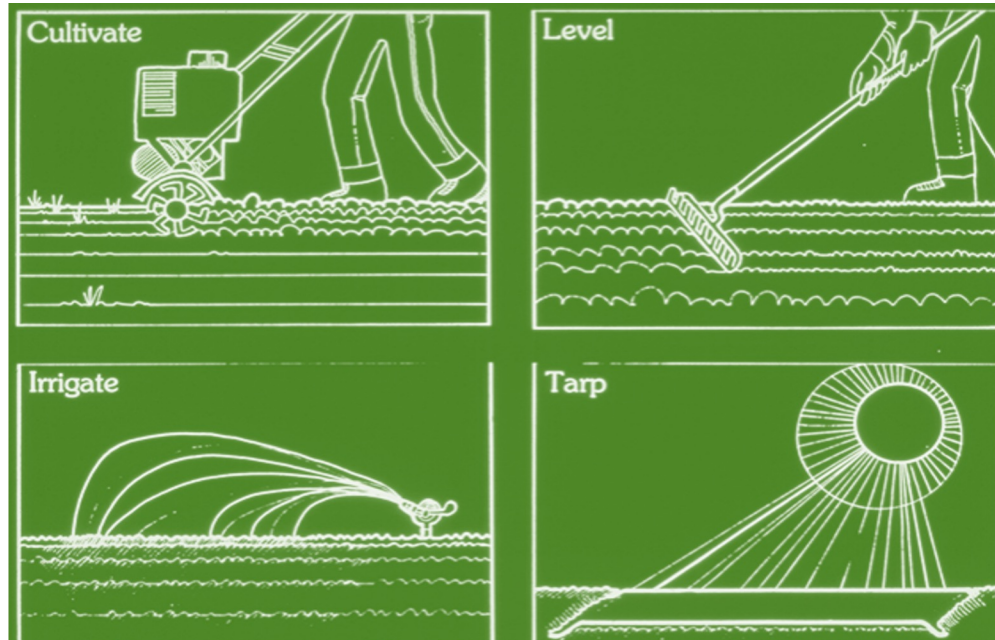


Soil Solarization

- **Passive solar heating induced by covering moist soil with transparent plastic.**
- **Heats up the soil**
- **Inactivating soil pests**
- **Remediating toxins and releasing nutrients.**



Beds or Flat



SOIL SOLARIZATION FOR GARDENS & LANDSCAPES

Integrated Pest Management for Home Gardeners and Landscape Professionals

Soil solarization is a nonchemical method for controlling soilborne pests using high temperatures produced by capturing radiant energy from the sun. The method involves heating the soil by covering it with a clear plastic tarp for 4 to 6 weeks during a hot period of the year when the soil will receive the most direct sunlight. When properly done, the top 6 inches of the soil will

speed up the breakdown of organic material in the soil, often resulting in the added benefit of release of soluble nutrients such as nitrogen (NO_3^- , NH_4^+), calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^+), and fulvic acid, making them more available to plants.

Plants often grow faster and produce both higher and better quality yields



Shading



Weed fabric



Plasticulture



Straw Mulch



Sheet Mulching



Pre-irrigation



- Reduces the number of weed seed that are ready to germinate in the top layer of the soil
- Can reduce weed emergence in subsequent crop by up to 50%

Shem Tov and Fennimore

Cover Cropping for Effective Weed Control

- Aim for rapid early growth and canopy closure;
- Include at least one such cover crop in mixes;
- Combine complementary growth habits;
- Use best seeding rate, method, and planting date for your region;
- Provide fertility or water as needed.



Buckwheat, 14 DAP



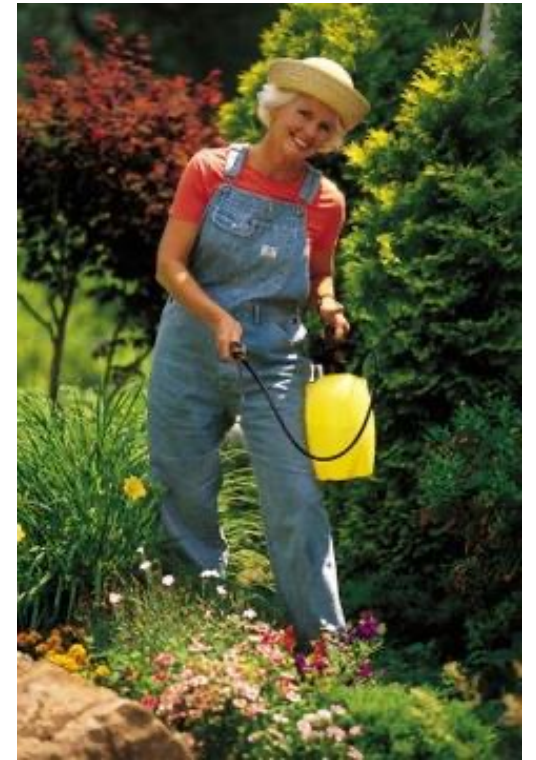
Rye, vetch, and peas

Non-synthetic chemical for Weed Control

Do you need herbicides?

Herbicides are pesticides that control weeds

- Mechanical and cultural approaches usually provide adequate control.
- Use for special situations.
- Personal Protective Equipment (PPE).



Organic Option: Postemergent Weed Control

- Acetic acid
- Citric acid
- Malic acid
- Caprylic acid
- Fatty acids
- Pelargonic acid
- Clove Oil
- Cinnamon Oil
- Iron HEDTA

Commercial products are formulated with different combinations and concentrations



Organic Options

Note that not all available organic herbicides are approved for use in organic food production systems.

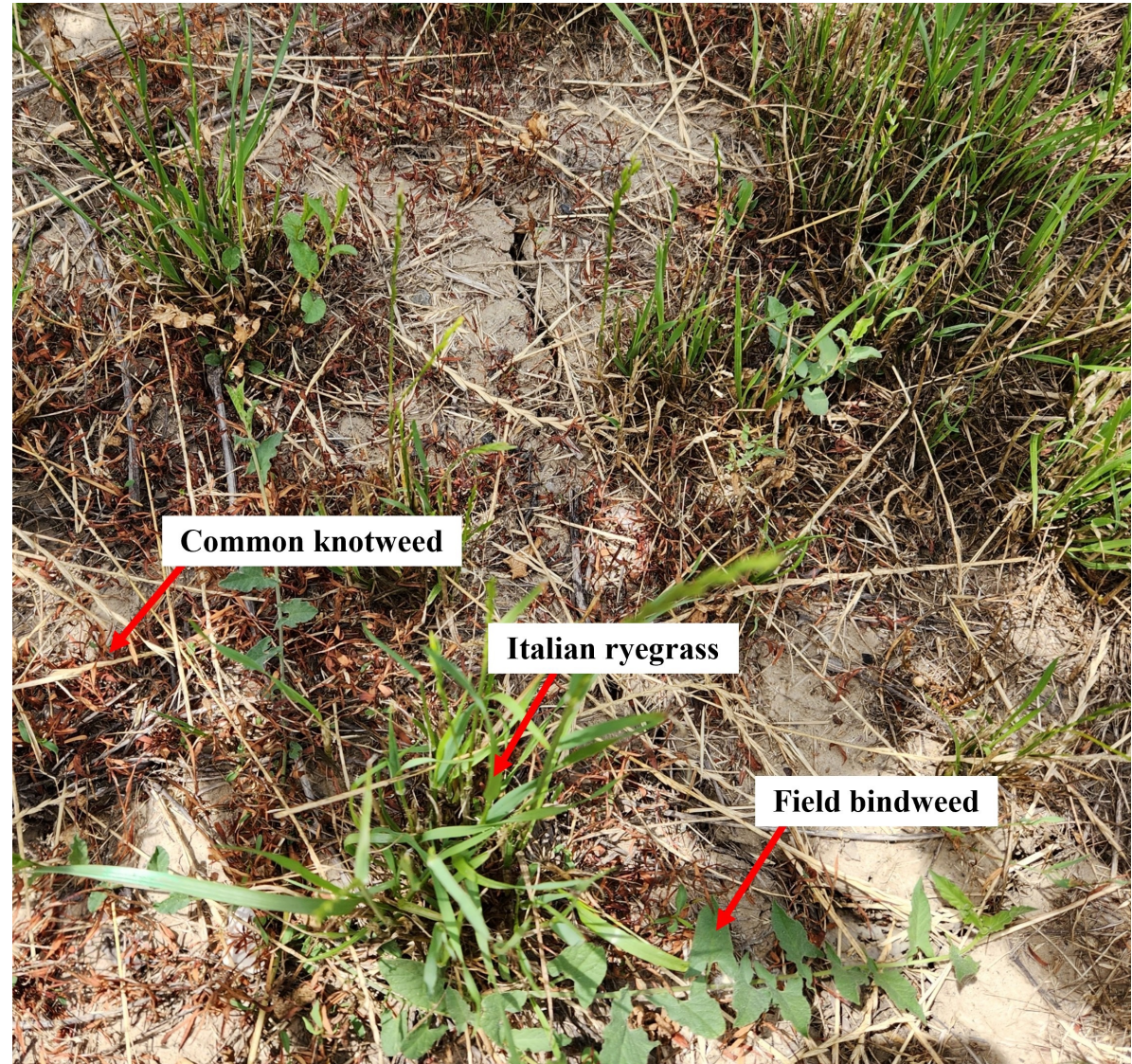
Caprylic acid + capric acid and **acetic acid** are

currently options labeled and acceptable for use as postemergence non-selective organic herbicides for use in and around food and non-food crop systems in California.



7 DAT

Organic herbicides are effective in controlling weeds when the weeds are small but are less effective on older plants.



Emerging Weeding Technologies

Next Generation Precision Weeding Tools

Next Generation Precision Weeding Tools

A premise

- ❖ Smart weeders are less regulated than herbicides.
- ❖ Less regulation will allow for more innovative weed management solutions than are possible with herbicides.



Stout Smart Cultivator



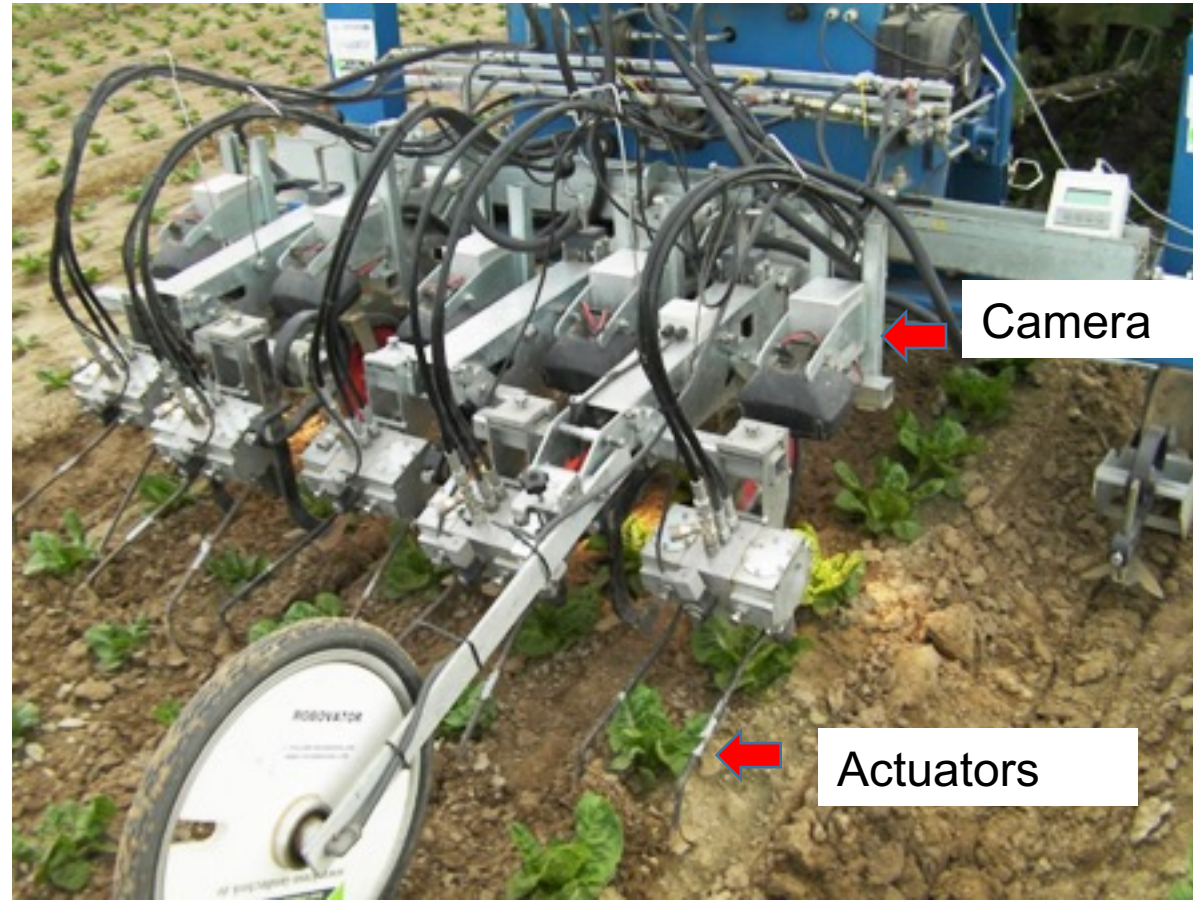
<https://www.stoutagtech.com/smart-cultivator/>



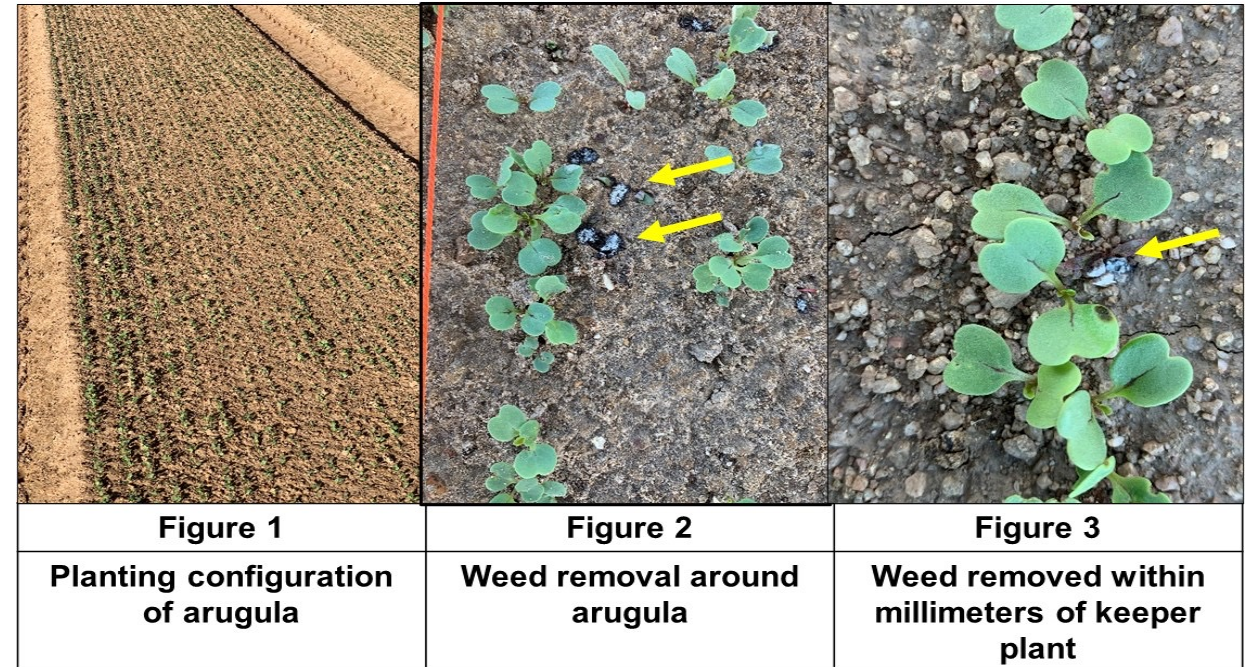
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Smart weeder components



Carbon Robotics Laser weeder



Richard Smith photos

Electroherb

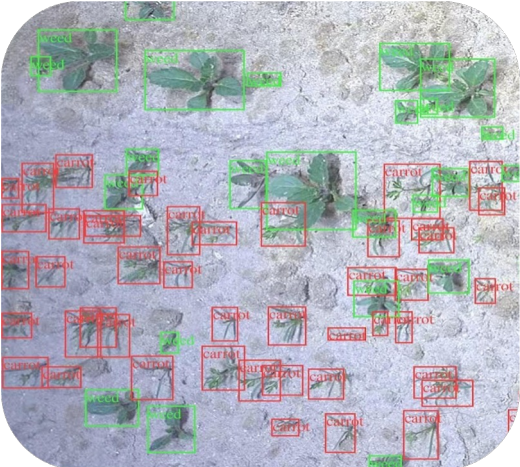
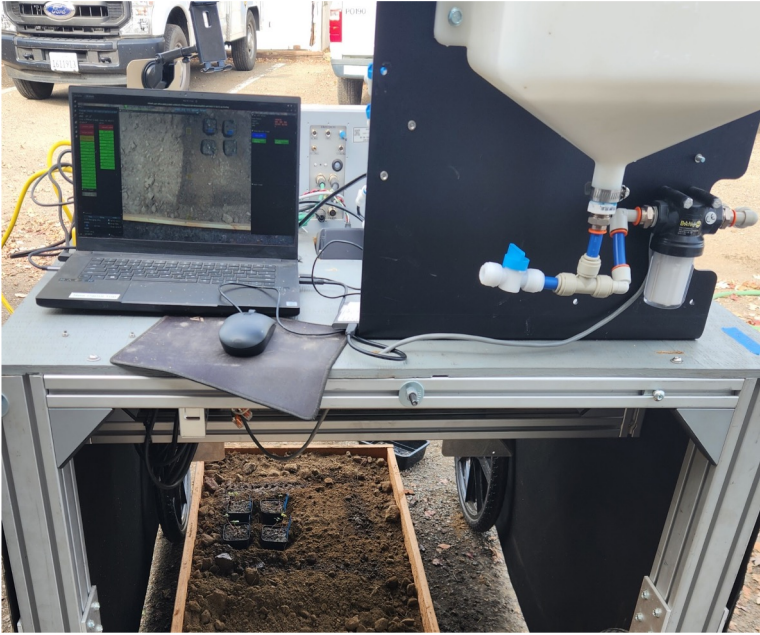
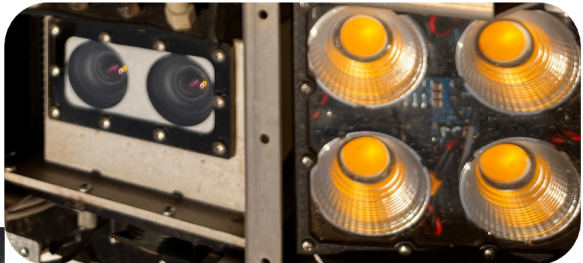
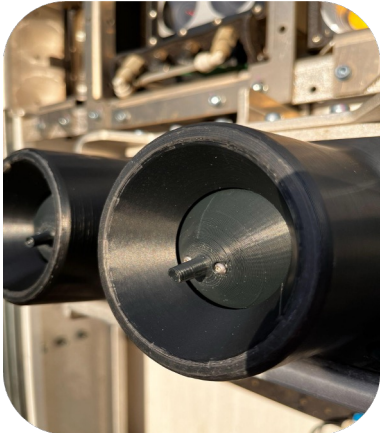


EWC machine running in an almond orchard (left) and desiccated burclover 3 DAT (right)



Injured hairy fleabane 7 DAT

Hyper-precise SharpShooter Smart Sprayer



Considering our approaches

- Weeds are Nature`s Cover Crop

Benefits

1. Protect and restore soil after tillage;
2. Nutrient recycling and;
3. Biological nitrogen fixation.
4. It is important to identify weeds correctly and understand their biology to manage them effectively and efficiently.



Keep soil covered



Diversify crops

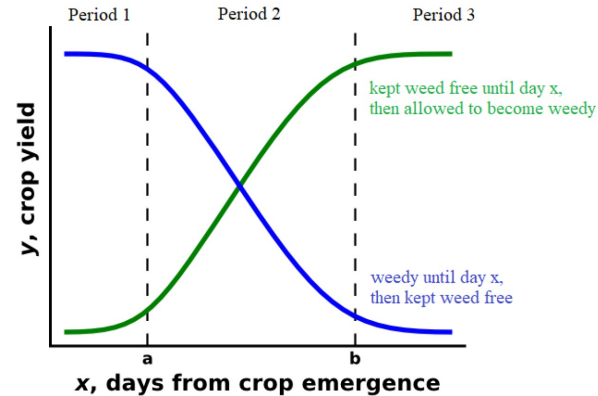


Maintain living roots



Minimize disturbance

Critical weed-free period



Use the right approach for the job at hand,
not just a bigger hammer

Thank you!

Questions?

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