Why control weeds?

- Compete for water, nutrients, and light with trees
- Interference is especially problematic during establishment years
- Can affect crop management, irrigation, and harvest operations
- Impacts on other pest problems
- Crop quality concerns?

Complex populations

- Rarely just one weed species present
  - Annual vs perennial vs biennial
  - Grass vs sedges vs broadleaf
  - Time of emergence
    - Fall vs spring emergence vs year-round
  - Reproductive strategy
    - Seed vs vegetative
Factors affecting orchard weeds

- Orchard age and arrangement
  - Shading and space capture
- Irrigation type, timing, and amount
  - Furrow, sprinklers, micros, drip
- Tillage practices
  - Berms, cross-disking, etc.
- Herbicide options
- Orchard access

Integrated weed management

- Using all available strategies to manage weed populations in a manner that is economically and environmentally sound.
  - Cultural
  - Mechanical
  - Chemical

Goals of IWM

- Both short- and long-term goals
  - Prevent or reduce weed spread
  - Delay and/or suppress weed growth
  - Prevent or suppress weed seed production
  - Reduction of weed seed bank in soil
**Weed identification**

- Unknown weeds cannot be properly managed
  - No technique controls all weed species
  - Not all weeds cause equal damage (thresholds)
  - Species respond differently to control strategies
    - Even variants within a species (i.e. herbicide resistant biotypes)

**Weed ID books and pamphlets**

A number of weed books are available

**Weed ID - software**

Several available,
I use a set by XID Services
- UC Davis
- WSSA
- WSWS
- others
A few online (FREE) resources are available:

**UC Davis Weed Research and Information Center**
www.wric.ucdavis.edu

**UC Integrated Pest Management Program**
http://ipm.ucdavis.edu/PMG/menu.weeds.html

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**Online weed ID resources**

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**Weed management**

- Orchard and vineyard floors divided into two management zones: middles and crop row
  - Zones may have very different strategies
  - Also may differ during the life of the orchard
How do we manage weeds?

- A few broad categories
  - Exclusion/sanitation
  - Cultural
  - Mechanical
  - Biological
  - Chemical

Sanitation

- Weed management should be an ongoing concern
  - Scout and manage in the orchard
  - Manage weeds on field margins and access roads
  - Clean equipment between sites
  - Scout and prevent seed set of “new” problems

Cultural practices

- Irrigation and fertilizer management
- Canopy management
- Cover crops
- Mulches
- Flaming
- Animals
Cover crops

ADVANTAGES
- Winter orchard access
- Reduced soil erosion
  - And pesticide and fertilizer runoff
- Addition of OM
- Soil structure and water/root penetration
- Competes with weeds

DISADVANTAGES
- Need to manage 2nd crop
- More equipment
- Competes for water and nutrients
- Frost concerns
- Vertebrate and insect pests
- Addition of nutrients (N) may be unwanted (vineyard)

Cover crop issues

Flaming / heating

- Non-chemical
- High fuel cost
- Just need to “heat” not “burn” weeds
- Best on young broadleaf
- No residual control
- Danger of damage to young trees or vines and irrigation systems
**Animals**

- Animals can be used to manage vegetation in some cases
  - Can work very well ... or very poorly
  - Expensive (own or rent?)
  - Management effort
  - Animal health and welfare limits weed control
  - Can damage trees or vines (buds) if left too long
  - Food safety concerns

**Mechanical control**

- Tillage / cultivation
- Mowing
- Hand labor
- T&V rows vs middles
  - equipment options and costs

**Cultivation**

**ADVANTAGES**

- Non-chemical tactic
- Organic matter additions and nitrogen release
- Reduces competition for water
- Reduces frost potential
- Easy control in middles
- No “resistance”

**DISADVANTAGES**

- Fuel and time costs
- Trunk and root injury
- Dust
- Erosion
- Compaction
- Can spread seed and fragments
- Weeds near tree difficult
- Effects on tree vigor?
Mowing

- **Advantages.**
  - Suppresses weeds, reduces seed set
  - Orchard access and erosion benefits

- **Disadvantages.**
  - Frost potential
  - Weeds still use water and nutrients
  - Favors low growing and perennial weeds
  - Favors grasses (advantages or disadvantages?)
  - Cost of repeat operations (slow and frequent)

Chemical control

Herbicides

- CA orchards and vineyard herbicides usually applied to “strips” under the tree/vine row
  - 2-20 ft strip, may treat 20-50% of the floor
  - Middles managed with mowing, tillage, or less intensive herbicide program
  - Often with a “preharevest” broadcast application
Types of herbicides

- Preemergence (PRE)
  - Applied to bare soil and affect germinating seeds and seedlings
  - Provide residual effects (weeks or months)
- Postemergence (POST)
  - "Burn down" treatments applied to the foliage of emerged weeds
  - Can be "contact" or "translocated" materials
  - Some products have residual control, some do not

Factors affecting herbicide choice

- Availability in the crop (registration)
- Weeds to be controlled (weed ID)
- Toxicity and safety (to crop and non-target)
- Soil type and texture
- Cost

Herbicides registered in pistachio

<table>
<thead>
<tr>
<th>Preemergence (PRE)</th>
<th>Postemergence (POST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission</td>
<td>Shark</td>
</tr>
<tr>
<td>Chateau</td>
<td>SelectMax</td>
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<tr>
<td>Alion</td>
<td>2,4-D</td>
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<tr>
<td>Trellis</td>
<td>Diquat**</td>
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<tr>
<td>Broadworks</td>
<td>Glyphosate</td>
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<td>Surfian</td>
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<td>Goal</td>
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<td>Matrix</td>
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<td>Zeus</td>
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<td>Rely H2O</td>
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<td>Sandea</td>
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<td>Gramoxone</td>
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<td>Pelargonic acid</td>
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<td>Venue</td>
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<tr>
<td>Treevix</td>
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<tr>
<td>Poast</td>
<td></td>
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<tr>
<td>+organic contact</td>
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<td>products</td>
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*Trade names for example only
** Registered in HB pistachio only
CA pistachio herbicide use

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<tr>
<th>Herbicide</th>
<th>2011 Acreage</th>
<th>2017 Acreage</th>
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<tr>
<td>Glyphosate</td>
<td>392,611</td>
<td>270,608</td>
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<td>Glyfosinate (Rely 2X)</td>
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<td>Glyphosate (Goal, GoalTender)</td>
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<td>104,900</td>
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<tr>
<td>Sulfentrazone (Trevino)</td>
<td>103,471</td>
<td>43,674</td>
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<tr>
<td>Paraquat (Homogenyx)</td>
<td>84,996</td>
<td>27,725</td>
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<tr>
<td>Paraoxyde (Trexol)</td>
<td>65,302</td>
<td>47,393</td>
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<tr>
<td>Rimsulfuron (Matrix)</td>
<td>42,921</td>
<td>21,791</td>
</tr>
<tr>
<td>Indaziflam (Alion)</td>
<td>40,691</td>
<td>6,552</td>
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<td>22,435</td>
<td>28,224</td>
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<tr>
<td>Penoxsulam (PindarGT)</td>
<td>20,459</td>
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<tr>
<td>Clethodim (SelectMax)</td>
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Acreage: 2011 ~226k; 2017~335k*

Conventional herbicides

ADVANTAGES
- Can be very cost effective (in some cases)
- Consistent results
- Ease of application (speed)
- Crop safety (generally)
- Erosion benefits (vs tillage)
- Season-long control with some products and combos
- Selectivity can be used to maintain desired cover

DISADVANTAGES
- Cost (in some cases)
- Potential for off-site movement with some products
- Regulations and record keeping
- Herbicide resistance can occur
- Crop injury can occur
- Some market sectors have preference against
- PRE, POST, or PRE/POST mix?
- Tank mixes
- Weed spectrum controlled
- Surfactants and adjuvants
- Coverage (GPA)
- Timing and weed size
- Sprayer calibration (esp. OC nozzles)
- Nozzle selection
- Litter and debris
- Check current herbicide labels
- Scouting and record keeping
- Training and PPE for handlers and applicators
- Potential for off-site movement?
- Double check calculations and recommendations!
Weed challenges in orchards

- Old favorites:
  - Normal mix of annual grasses and broadleaves
  - Challenge with perennial weeds, especially in new orchards or crops with fewer herbicide options
- New weed problems
  - Most of the "new" issues seem to be related to glyphosate resistance and/or shifting populations to tolerant species
  - Changing control options
    - Less tillage, some new herbicides, water issues

Extra challenges in young orchards

- Crop less competitive with weeds
- Greater sensitivity to weed competition
- Greater sensitivity to injury from weed control tactics
- Fewer herbicides registered on new plantings

Orchard weed management

- Weed ID
  - Understand the problem and biology
- Use integrated management tactics
  - Cultural and mechanical approaches
  - Chemical tactics
    - Right herbicide, right target, right time
    - Resistance management considerations
    - Environmental impacts
      - VOC, surface water, ground water
Manage “your” weeds

- Weed management is an annual concern and production cost that must be considered in a local context.
- No “one size fits all” solution for all orchards - integrated weed management requires systemic and long-term thinking.

T&V herbicide registrations

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UC Davis Weed Research and Information Center
http://wric.ucdavis.edu/
http://ucanr.org/blogs/UCDWeedScience/
@UCDWeedScience on Twitter

UC Davis Statewide Integrated Pest Management Program
http://www.ipm.ucdavis.edu/