What would you do without herbicides?
Weed Control in Organic Systems
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What are weeds?
- Dr. Beal, Michigan State University- “a plant out of place”
- Ross and Lembi (1985)- “plants that are competitive, persistent, and pernicious. They interfere with human activities and as a result are undesirable”
- Unknown- “plants whose virtues have not yet been discovered”

My weed definition
• “Any organism that produces carotenoids and gets in my way”……Greg Armel

Of course I am being slightly facetious ……
but the bottomline: a weed is a weed through the ‘eye of the beholder’ …..unless of course, legality supersedes the situation…..

How do you separate benefits vs. detriments of wild plants…..are they all weeds?
- Yellow starthistle
  - Con: Problem weed in pasture/rangeland, cereals, and other crops in Pacific northwest. Also, can cause the neurological disorder nigropallidal encephalomalacia in horses.
  - Pro: Contributes $150,000 - $200,00 to honey industry because its pollen and nectar are incorporated in the diet of 150,000 bee colonies in California (Maddox et al. 1985)
- Downy brome
  - Pro: Grown as a forage grass in certain areas of the world like the Pacific Northwest
  - Con: 1) Can cause significant yield reductions (30 to 80%) to cereal crops like wheat. 2) When completing its life cycle dry plants can create a significant fire hazard.
- Countless examples of ornamental plants that have become aggressive weeds in other areas…..exotic invasives and noxious weeds
- Is there any type of plant that can never be considered a weed?

Why Control Weeds?
- If not controlled certain weeds can….
  - Compete with native plants, crops or ornamental plants for nutrients, water, and sunlight.
  - Reduces US agriculture yields by 12% ($36 billion in lost agricultural revenue) (USBC 1998); $4 billion spent annually on herbicides…an additional $3 billion on management through cultural practices (Pimentel et al. 1999).
  - Also serve as hosts for viral, fungal, or insect pests of other plants.
  - Produce allelochemicals that can impact growth of certain species.
  - Interfere with transportation and infrastructure
  - Safety issues: railroads, roadway visibility, waterways, etc.
  - Interferes with aesthetics and recreation
  - Can poison humans, livestock, wildlife, or pets.
  - Allergens, rashes, oral poisoning, etc.
  - Old adage that does hold true…..1 year of letting it seed will give you 7 more years of fighting those weeds!!!!!!!

Characteristics of annuals:
- Adaptable to many environments
- Long seed life
- Variable seed dormancy habits
- Rapid growth
- High seed production
- Effective seed dispersal

Single plant = 100,000 seeds
Characteristics of perennials:
- Adaptable to many environments
- Long seed life
- Variable seed dormancy habits
- Regenerating parts
- Food storage

Choice of tool depends on:
- Weed composition
- Weed population
- Weather conditions
- Soil type

Tools for the box:
- Reduce weed pressure
- Diversify
- Cover cropping
- Feed the crop, not the weeds
- Selective cultivation
- Precise field prep
- Flaming
- Mulching
- Alternative products
- Timing, timing, timing
- Combinations
- Experimentation

Reduce Weed Pressure
- Compost carefully
- No seed threshold
- Maintain field edges
- Wash equipment between fields

Diversify Crop Rotation
- Different crops support different weed compositions and populations
- Shallow rooted vs. deep rooted
- Crop families
- Reduce pest pressure

Cover Cropping
- Weed suppression through:
  - Competition
  - Oats
  - Allelopathy
  - Rye
  - Sweetpotatoes
  - Mustards
- Provide thick stand:
  - Seed at high rate
  - Drill, if possible
  - Irrigate
- Added benefits
Influence of Tillage and Cover Crop on Weed Populations

<table>
<thead>
<tr>
<th>Tillage</th>
<th>Cover Crop</th>
<th>Weeds/ft²</th>
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<tr>
<td>Conventional</td>
<td>None</td>
<td>12</td>
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<tr>
<td>None</td>
<td>None</td>
<td>5</td>
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<tr>
<td>None</td>
<td>Rye</td>
<td>0.9</td>
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<tr>
<td>None</td>
<td>Wheat</td>
<td>0.3</td>
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<tr>
<td>None</td>
<td>Barley</td>
<td>0.8</td>
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(Putnam et al., 1983)

Feeding the Crop

- Apply fertilizer near the row
- If using bagged organic fertilizers:
  - Band
  - Sidedress
- Avoid broadcasting nutrients for utilization by weeds

Selective Cultivation

- Steel in the Field
- Choice of cultivation implement depends on:
  - Size of weeds
  - Size of crops
  - Experience
  - Resources
  - $$$
  - Labor

Precision in Field Prep

- Uniformity in row spacing
- Straight crop rows
- Adjusting equipment right the first time, for the whole season
**Flaming**

- Can be used when soil too wet for cultivation
- No soil disturbance to stimulate weed emergence
- Also, added insect or disease control
- Exposure times of 65-130 milliseconds kill many annuals (Thomas, 1964)

**Can the crops take the heat?**

- More injury in cabbage
- 4 kph most damaged 5 DAF

**Injury not evident 20 DAF**

**Weed Control 2002**

- All flaming treatments more effective than control
- 5 DAF, weed control most effective in 4 & 8 kph
- 20-50 DAF, 4 kph provided better control than all other treatments, with nearly 70% control 50 DAF

**Weed Control 2003**

- 5 DAF, 4 kph most effective in tomato with >70% control
- 15 DAF, control in the 4 kph treatment reduced to ~20%
Freeze those Weeds

- Can cryogenic liquids kill weeds?
  - Answer: yes
- Can cryogenic liquids kill weeds safely and economically?
  - Answer: maybe
- Research continues........

Mulching

- Earlier crop production (7 to 21 days earlier)
- Higher yields per acre (2 to 3x higher)
- Cleaner produce
- More efficient use of water resources
- More efficient use of fertilizers
- Reduced soil and wind erosion
- Better management of certain pests
- Fewer weeds
- Reduced soil compaction
- Opportunity for efficient double or triple cropping

From ‘What are the components of a plasticulture vegetable system?’ by Bill Lamont, PSU, in HortTechnology, 1996.

Plastic - What does it do?

- Changes the micro-climate of the soil
- Or the ability to absorb or reflect the sun’s heat
- Can be used to warm soil earlier in the Spring/maintain warmth in Fall
- Cool down soil in Summer
- Mulch color determines how it will change the environment

Bio- or Photodegradable Mulches

- Made with plant starches
- Broken down by microbes or the sun
- More expensive than plastics
- Easier disposal than plastics
- Sometimes do not hold up throughout the season → weed problems popping up later in season
- Technology rapidly developing

How do you dispose of it?

- Made with plant starches
- Broken down by microbes or the sun
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**Paper Mulch**

- Can provide similar benefits to plastic mulch
- Can improve yields
- Recycled paper available for low cost
- Adheres well to soil when wet
- Sometimes breaks down too soon

**Whatever the color or type...**

- Apply mulch after fields have been leveled, smoothed, and fertilized, and when there is good soil moisture
- With black mulch, uniform soil contact is essential as the soil is warmed by heat conduction
- Apply film with a mechanical mulch layer
- Hand application can be difficult and time consuming

**Alternative Products**

- [www.omri.org](http://www.omri.org)
- Corn gluten meal
- Herbicidal soaps
- Vinegar
- Clove oil

**Organic herbicides...do they actually work**

- Common short answer.......yes, with an if.....no, with a but......
Common Organic Materials Used as Herbicides

- Table salt
  - Safe to celery and asparagus
  - Difficult to remove from soil and herbicidal to many crops.
- Clove Oil
- Cinnamon
- Vinegar
- Lemon/Lime Juice
- Corn gluten meal
  - Discovered at Iowa State
  - 12-30 lbs/1000 sq ft. controls grasses and certain small seeded broadleaf weeds

Advantages/Disadvantages to Contact Organic herbicides

**Advantages:**
1. Vinegar (20% acetic acid solution), clove oil, and lime/lemon juice alone and/or in combinations have demonstrated potential for 80-100% control of top growth control of key weeds. Activity generally appears within 2 hr after treatment.
2. No residual activity, therefore, crops can be planted very soon behind applications.
3. Because they are “natural” there is a perception they are safer than synthetic pesticides.

**Disadvantages:**
1. Non-selective to crops
2. No residual activity to stop secondary flushes of weeds
3. Rapid response to weeds is only temporary…complete regrowth can appear within 3 weeks after treatment
4. Materials are extremely caustic…improper applications can lead to severe eye injuries (especially with vinegar).
5. No lasting control of perennial weeds.

Timing, timing, timing

- The younger you can catch the weeds the better
- “White thread” stage
- You can’t plan the weather, so have more than one option at all times!

Experimentation

- What works for your neighbor may not work on your farm!
- Start small
- Compare your combinations side-by-side
- Leave a “control” or untreated row
- Be on the lookout for new things!

Does it belong in the toolbox?
Resources

• Sustainable Agriculture Research and Education Program, www.sare.org
  – Steel in the Field
  – Managing Cover Crops Profitably

Resources
• Appropriate Technology Transfer for Rural Areas, www.attra.ncat.org

• Pfeiffer, 1970, Weeds and What They Tell You, Biodynamic Farming Association

• The Organic Weed Management Website, http://www.css.cornell.edu/weedeco/WeedDatabase/index2.html

Thank you!
Questions?
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