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 picture from Steve Dewey, Utah State, found at http://www.invasive.org/browse/subject.cfm?sub=4390

- 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 like 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?**

* Pictures courtesy of the Virginia Tech Weed ID guide

Why Control Weeds?

www.weeds.crc.org.au/main/images/lg_sa viniai...

- **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.**

www.trainweb.org/rofyork/shrews2.jpg

  - **Interfere with transportation and infrastruture**
    - **Safety issues: railroads, roadway visibility, waterways, etc.**

z.about.com/...1/7/z/L/poison_ivy_rash.jpg

  - **Interferes with aesthetics and recreation**
  - **Can poison humans, livestock, wildlife, or pets.**
    - **Allergans, 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**

Picture courtesy of the Virginia Tech Weed ID guide

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

Tillage	Cover Crop	Weeds/ft^2
Conventional	None	12
None	None	5
None	Rye	0.9
None	Wheat	0.3
None	Barley	0.8

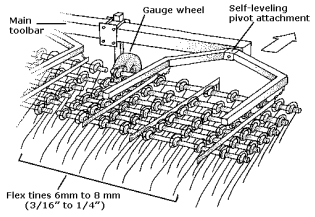
(Putnam et al., 1983)

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)**

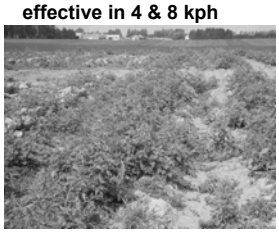
Can the crops take the heat?

- **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**

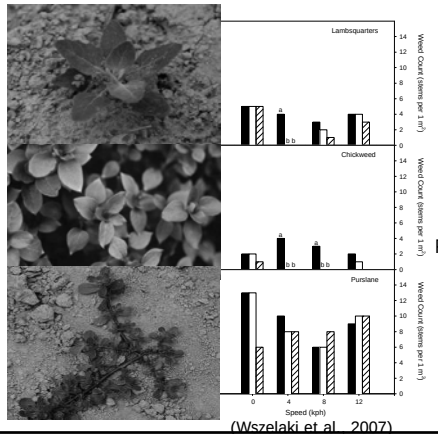


- **20-50 DAF, 4 kph provided better control than all other treatments, with nearly 70% control 50 DAF**

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%**



Weed Control in Tomato

Preliminary

4 DAF

15 DAF

(Wszelaki et al., 2007)

Freeze those Weeds

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

Picture found at http://www.chemistryexplained.com/images/chfa_03_img0622.jpg

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**

How do you dispose of it?

Bio- or Photodegradable Mulches:

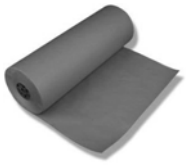
- **Made with plant starches**
- **Broken down by microbes or the sun**
- **More expensive than plastics**
- **Easier disposal than plastics**
- **Sometimes do not hold up throughout the season → weed problems popping up later in season**
- **Technology rapidly developing**


0.8 mil Mater Bi


50 days 75 days

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**
- **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**
  - **Generally multiple years of use create most lasting impact.**
  - **May cause respiratory allergies in some people**
  - **Trade name(s): Dynaweed, Dynaweed, Safe 'N Simple, Earth Friendly, W.O.W.!, Corn Gluten Meal Herbicide, Concern-Weed Prevention Plus, Luscious Lawn Corn Gluten, Propac, other.**

citric acid- LD_{50} 11,700 mg/kg

Gly-Ala and other dipeptides

Eugenol- LD_{50} 2680 mg/kg

NaCl

acetic acid- LD_{50} 3310 mgkg

Roundup (glyphsate LD_{50} 5,600 mg/kg)

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!**

Combinations

- **One tool may not do the job alone**
- **Combinations can provide greater efficacy**
- **Anticipate!**
- **Know your problem weeds!**
- **Know what is effective!**

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

- Grubinger, 2007, Ten Steps Toward Organic Weed Control, www.uvm.edu/vtvegandberry/factsheets/orgweedcontrol.html
- 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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