



UNIVERSITY OF ILLINOIS  
EXTENSION

GROWING A NEW GENERATION  
OF ILLINOIS FRUIT AND VEGETABLE FARMERS

# INTEGRATED PEST MANAGEMENT: WEED MANAGEMENT

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# Define a “Weed”

- “A plant growing where it is not desired” (*WSSA*)
- “A plant whose virtues have not yet been discovered” (*Emerson, 1878*)
- “Plants that are competitive, persistent, and pernicious. They interfere with human activities and as a result are undesirable. ” (*Applied Weed Science, Ross and Lembi*)

# Today's Objectives

- Understand Basic Biology of Weeds
- Learn about different management tactics
- Discuss specific herbicides and uses
- How will you manage weeds on your farm????

# Characteristics of Weeds

- Germinate over a wide range of environments
- Seed dormancy and longevity
- Rapid growth and extensive seed production
- Effective seed dispersal
- Competitive
- Disease/Insect tolerance

# Importance of Weeds

- Disadvantages
  - Crop yield loss
    - Weeds are commonly more limiting to yield than insects or diseases!!
  - Host for disease and insect pests
  - Reduces produce quality
  - Produce seeds for future generations (seed bank)
  - Cost of control
  - Human health (ie. poison ivy)













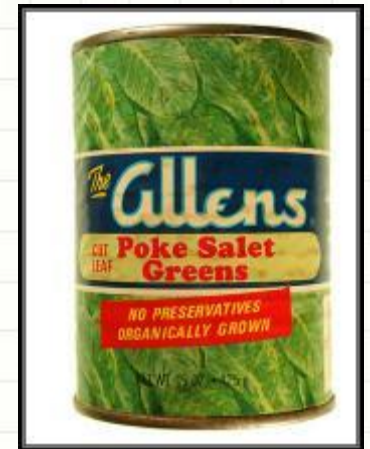






# Importance of Weeds

- Advantages
  - Reduce soil erosion
  - Contribute to soil organic matter
  - Edible
  - Aesthetic value
  - Contribute to global genetic diversity





# Weed Classification: Types

**Grass**



**Broadleaf**



**Sedge**





# Weed Classification: Life Cycle

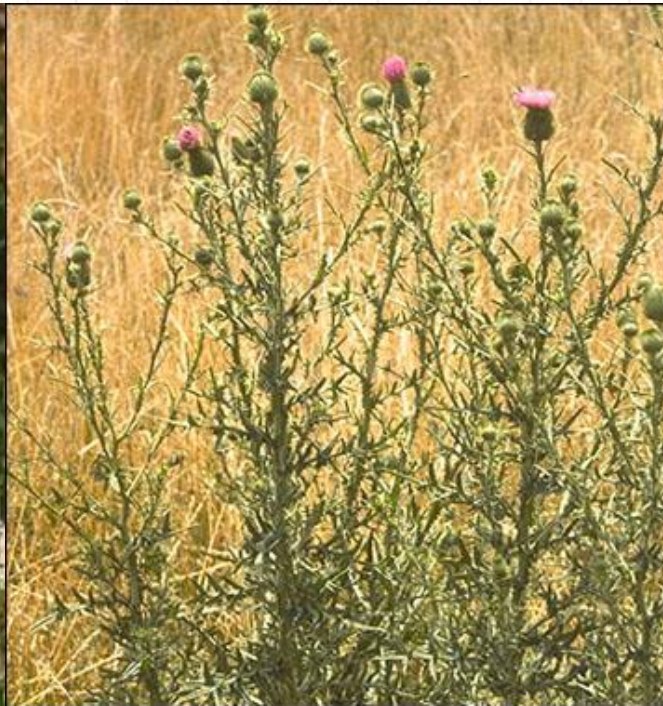
- Annual – complete life cycle in one growing season
  - Summer annuals (waterhemp, giant foxtail)
  - Winter annuals (henbit, chickweed)





# Weed Classification: Life Cycle

- Biennial – complete life cycle in two growing seasons
  - Wild carrot, bull thistle, common mullein





# Weed Classification: Life Cycle

- Perennial – live for two or more years
  - Dandelion, pokeweed, johnsongrass, wild garlic





# Weed Identification

- The key to a successful weed management program.
  - Many herbicides only control certain weeds
  - Even important in mechanical or cultural methods
- The more similar the crop and weed the more difficult it is to control
  - It is much easier to control a grass weed in a broadleaf crop than a grass crop

# Weed Identification:



Dandelion



Curly Dock



Buckhorn Plantain



Broadleaf Plantain



Yellow Woodsorrel



Sonchus asper



Canada thistle



Milky thistle



Perennial sow thistle



Common thistle



# Weed Identification:



Common chickweed



Mouse-ear chickweed



Purslane



Prostrate Spurge



Knotweed



Common violet



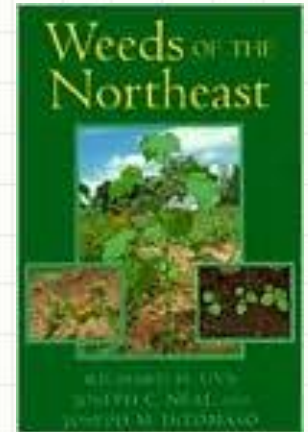
White clover



Ground ivy

# Weed ID Resources

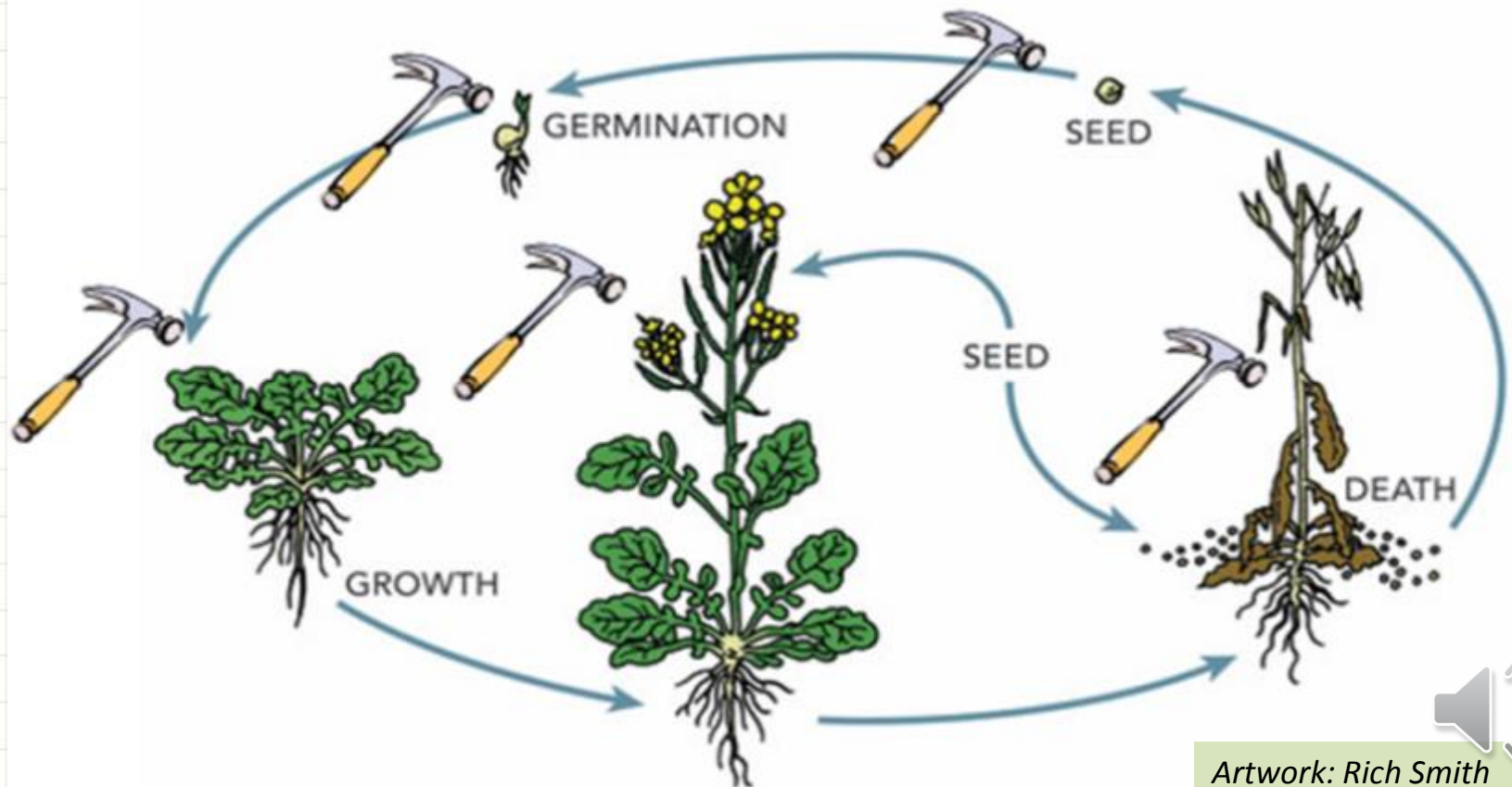
- University of Missouri Weed ID
  - <http://weedid.missouri.edu/>
- USDA Plants Database
  - <http://plants.usda.gov/java/>
- Practical Weed Science for the Field Scout
  - <http://extension.missouri.edu/p/ipm1007>
- Weeds of the Northeast (book)
  - Uva, Neil, and DiTomaso
- Weeds of the Midwestern United States and Central Canada (book)
  - Bryson and DeFelice





# When to Manage Weeds

- There are many times you can manage weeds but regardless if you are conventional or organic the **smaller the weed the easier it is to manage**



# Methods of Weed Control

- **Cultural**
  - the management of the crop to make it more competitive with the weeds (without tillage or chemicals)
- **Mechanical**
  - the use of physical forces to control weeds
- **Chemical**
  - the use of herbicides to manage weeds
- **Biological**
  - the use of natural enemies (insects, pathogens, or animals) to control weeds or reduce seed bank
- Most successful weed control programs utilize as many of these methods as possible!



# Cultural

- Planting date
- Seeding rate/row spacing
- Cover crops
- Fertility
- Irrigation management
- Crop rotation
- Plant vigorously growing cultivars
- Mulching (Organic or Inorganic)
- Integrate Pest Management
  - Promotes the health and rapid growth of crop

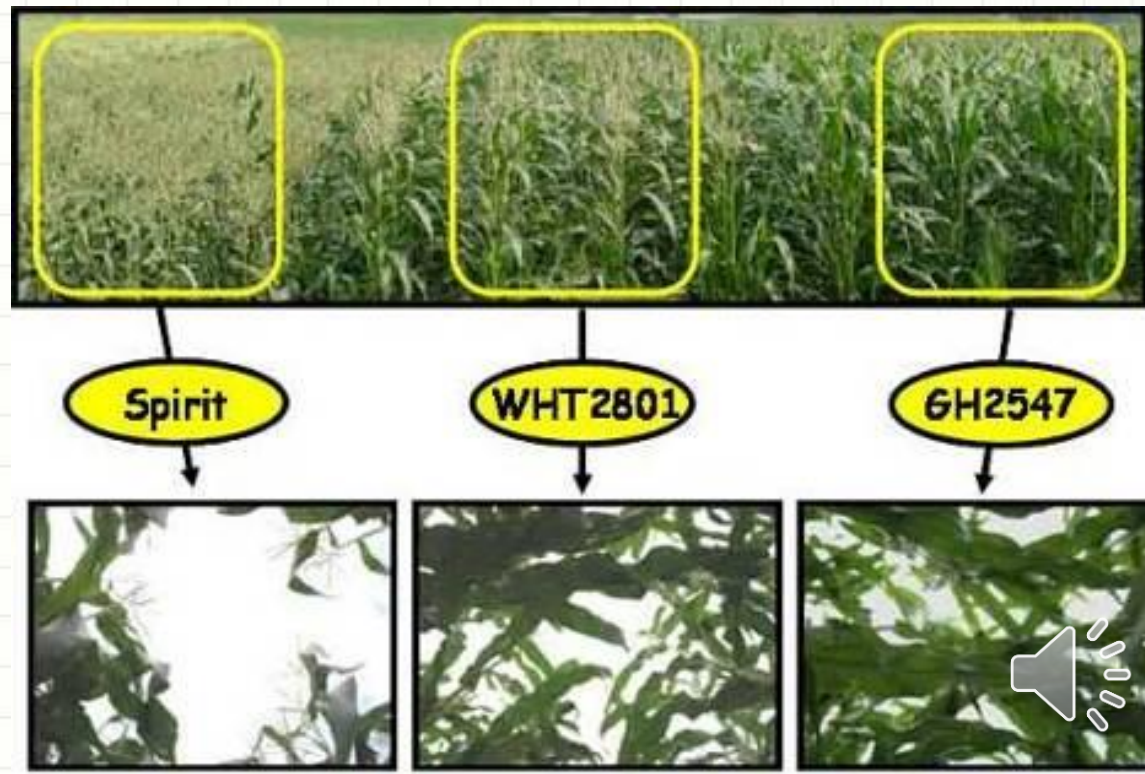


# Plant Varieties/Hybrids that are Competitive with Weeds

- Different varieties provide a different level of crop canopy greatly changing their competitiveness with weeds

Williams et al. 2008

– Sweet corn





# Mulching



**Bark**



**Straw**



**Fabric**



# Mulching



**Cultivation**



**Hand Weed Ctrl**



**Weedy Ctrl**



# Mechanical

- Cultivation/Tillage
  - Preplant tillage
  - Row cultivation after planting and emergence
- Hoeing/hand pulling
- Mowing
- Fallow
- Flaming/Burning
- Heat (steaming, solarization) – good for controlling reducing weed seed bank population



# Chemical

- The use of herbicides to either kill emerged weeds or prevent them from germinating
- Why are many herbicides on the market but only a limited number are labeled for many specialty crops?
  - Due to the diversity of specialty crops
  - High value crops (\$/Acre)
  - Specialty crops are a smaller market share compared with agronomic crops.
  - Herbicide clearance major problem on small acreage crops:
    - Value IL vegetable & fruit crops - ~\$115 million
    - Value IL grain production - ~\$10 billion
    - Companies not too interested because cost same to clear herbicide on vegetable as a grain crop



# Biological

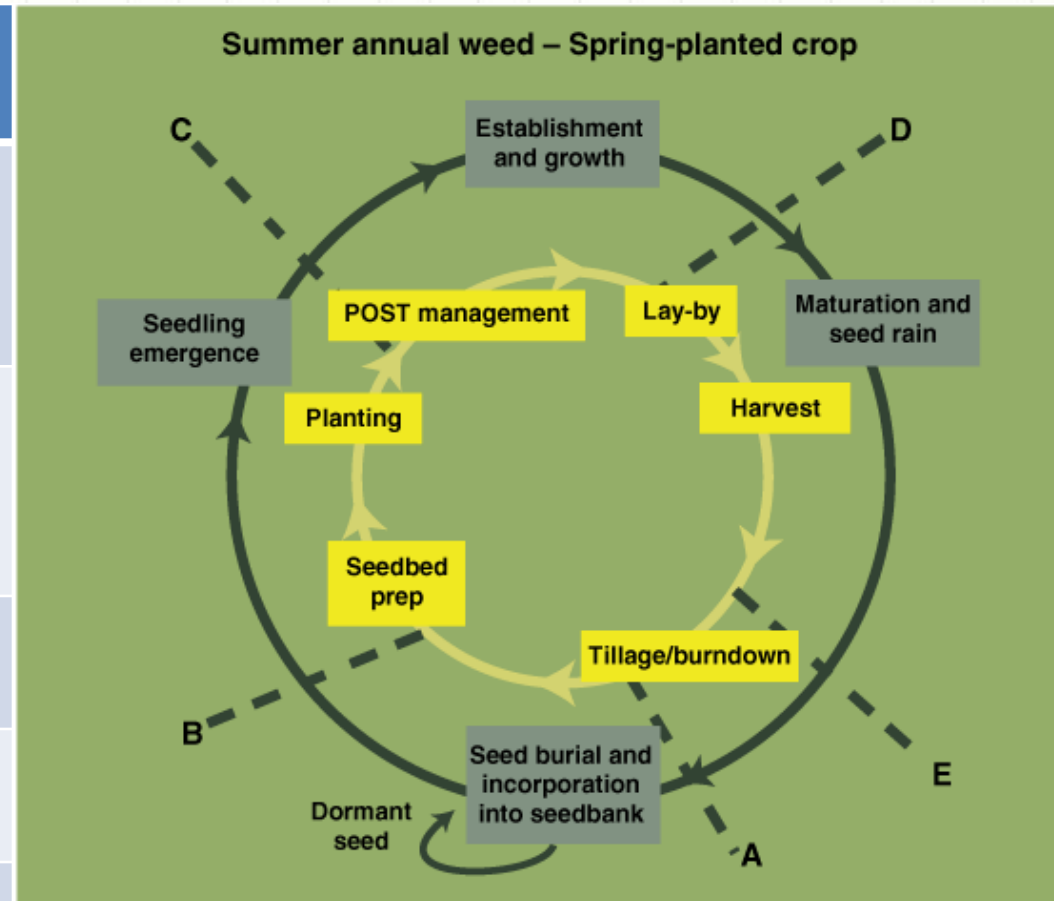
- Often too specific to be effective in cultivated crops
  - More practical for in natural settings such as forest, rangeland or prairies
- Can benefit from natural seed predation by rodents, insects, and pathogens which can deplete the weed seed bank in the soil



*Photo: Adam Davis*

# Timing of Weed Control

Stage	Potential Sources of Weed Management Benefits
A	seed decay, seed predation, seed aging, depth placement of seeds, loss of seed dormancy
B	fatal germination, allelopathy, stale seedbed, mulch/cover crop, seed-soil contact, PRE herbicide
C	physical control, POST herbicide, crop competition
D	hand weeding, swathing, herbivory, crop competition
E	seed predation, seed removal with chaff, mowing, stubble burning, sanitation, fencerow maintenance



A. Davis, 2014



# Common Practices in Vegetables

- Tillage/cultivation
- Mulches
  - Black plastic or other colors (red, white, silver...)
  - Straw or other organic mulches
- Hand Hoeing/Pulling
- Cover Crops (cereal rye, oats, clovers, etc.)
- Herbicides
- Mowing (ie. between rows)

# Common Practices in Fruit (perennial) Production

- Control weeds before planting (especially perennial weeds)
- Herbicides
- Mowing
- Cover crops
- Mulches





# Herbicide Types

- Movement in the plant
  - **Contact:** does not move within the plant
    - Good spray coverage is important for effectiveness
    - Generally use higher spray volumes (>15 GPA)
  - **Systemic:** moves throughout the vascular system of the plant.
    - Coverage is not as important since it can move
    - Works well with lower spray volumes (<15 GPA)

# Herbicide Types

- Selectivity
  - **Non-Selective:** broadly controls most plants species
    - Roundup (glyphosate), Gramoxone (paraquat), Liberty (glufosinate), horticultural vinegar (acetic acid)
  - **Selective:** controls only certain plant species
    - Select (Clethodim) – controls only grasses
    - 2,4-D – controls only broadleaves



# Application Timings

- **Preplant Incorporated (PPI)** – applied before planting and worked into the soil by water or tillage
- **Preemergence (PRE)** – applied before crop or weeds emerge
- **Postemergence (POST)** – applied after crop or weeds have emerged
- **Post-Directed** – applied after emergence but spray is directed away from crop.
  - Ex. Used for spraying row middles with herbicides that would otherwise hurt the crop

# Herbicide Selection

- Crop Rotation Restrictions (Carryover)
- Preharvest Interval (PHI)
- Weed spectrum
- Rotate herbicide modes of action
  - Resistance management
- Soil type/Organic matter
  - Herbicide rate increases as amount of organic matter increases
- Rainfall amount and distribution



# Restricted Use Pesticides (RUP)

- Some herbicides are Restricted Use Pesticides (RUP)
- Requires attaining a pesticide applicators license from the IL Dept. of Ag
- Requires testing once every 3 years and small fee for license
- Tests dates are offered in most counties in the beginning of the year (around Jan. - April.)
- Study materials available at most extension offices and study sessions are available before testing.
- **Private Applicator** would be the classification of license needed for most growers applying pesticides only on land they farm.



# Herbicides

## Recommendations

- General recommendations
- Always read the label for specific rates and crops
- There are a few certified organic herbicides
- Again always be mindful of potential carryover to future crops and PHI!!

**GROUP 1 HERBICIDE**

**VALENT**

**SELECTMAX**  
HERBICIDE  
WITH INNOVATIVE TECHNOLOGY™

Active Ingredient..... By Wt.  
 "Clothodim..... 12.6%  
 Other Ingredients..... 87.4%  
 Total..... 100.0%

Contains Petroleum Distillates  
 "(E)-2-[1-[[[3-chloro-2-propenyl(oxymethyl)oxy]propyl]-2-ethoxythio]propyl]-3-hydroxy-2-cyclohexen-1-one

Contains 0.97 lbs clothodim per gal  
 EPA Reg. No. 59639-132 EPA Est. 5905-GA-01

**KEEP OUT OF REACH OF CHILDREN**  
**CAUTION**  
 SEE BELOW FOR ADDITIONAL  
 PRECAUTIONARY STATEMENTS.

**FIRST AID (continued)**  
**If inhaled:** Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.

**HOT LINE NUMBER**  
 Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-852-0899 for emergency medical treatment information.

**NOTE TO PHYSICIAN**  
 Ingestion of this product or subsequent vomiting can result in aspiration of light hydrocarbon liquid, which can cause pneumonitis. If ingested, probable mucosal damage may contraindicate the use of gastric lavage.

**PERSONAL PROTECTIVE EQUIPMENT (PPE):**  
 Some materials that are chemical-resistant to this product are listed below. If you want more options, follow the instructions for category G on an EPA chemical resistance category selection chart.  
 Applicators and other handlers must wear: long-sleeved shirt and long pants, chemical-resistant

Table 1. CROP SPECIFIC USE DIRECTIONS, RESTRICTIONS AND LIMITATIONS FOR SELECT MAX (continued)

Crops <sup>(1)</sup>	Minimum Time From Application to Harvest (PHI)	Annual Grass Use Rate Per Acre <sup>(2)</sup>	Perennial Grass Use Rate Per Acre <sup>(2)</sup>	Adjuvant Recommendation <sup>(3)</sup>	Ammonium Sulfate Recommendation <sup>(4)</sup>	Special Use Instructions And Restrictions
Cotton	60 days	9 to 16 fl oz	12 to 32 fl oz	NIS at 0.25% v/v or COC/MSO at 1 qt/A or 1% v/v See tank mix label for specific adjuvant recommendations	2.5 to 4 lbs/A	Do not graze treated fields or feed treated forage or hay to livestock.  Do not apply more than 32 fl oz/A in a single application.  Do not apply more than 64 fl oz/A (6.5 lb ai/A) per season.  For repeat applications make on a minimum of a 14 day interval.
Cranberry	30 days	9 to 16 fl oz	12 to 16 fl oz	NIS at 0.25% v/v	None	Do not apply more than 16 fl oz/A in a single application.  Do not apply more than 64 fl oz/A (6.5 lb ai/A) per season.  Do not apply between the "hook" stage and full fruit set.  For repeat applications make on a minimum of a 14 day interval.
Cucurbits including: Cantaloupes (all) Cucumber Gherkin Honeydew Melon Muskmelons (all) Pumpkin Squash (all) Watermelon	14 days	9 to 16 fl oz	12 to 16 fl oz	NIS at 0.25% v/v	None	Do not apply more than 16 fl oz/A in a single application.  Do not apply more than 64 fl oz/A (6.5 lb ai/A) per season.  For repeat applications make on a minimum of a 14 day interval.

(continued)



# Roundup (glyphosate)

- Nonselective weed control
- Systemic (7-14 days for control)
- No Residual
- Good for many perennial weeds (especially grasses)
- Used before planting or as a directed spray between crop rows
- Can cause injury so be very careful to keep it away from crop leaves
- Registered on a wide range of fruit and vegetable crops
- Some issues with resistance (waterhemp, marestail and others)

# Gramoxone SL (paraquat)

- Nonselective weed control
- Contact (fast!! 2-3 days)
- No residual
- Good on grass; best on broadleaf weeds
- Can cause crop injury where it contacts crop leaves but does not move systemically to injure plant
- Restricted Use Pesticide (RUP)
- Labeled for use in: Potato, Pumpkin, Squash, Pepper, Tomato, Sweet Corn, Asparagus, Cabbage, many perennial fruit crops



# Select (clethodim) or Poast (sethoxydim)

- Selective Weed Control (controls grasses only)
- Systemic
- Little if any soil residual
- Label for use in most broadleaf crops
- PHI can be from 1 – 60 days
- Select is better on perennial grasses than Poast

# Dual II Magnum (metolachlor)

- Selective weed control (grasses and small seeded broadleaves)
- Soil residual activity; no foliar activity
- Labeled in selected vegetable crops including pumpkin, potato, tomato, sweet corn, horseradish.
- Does need rainfall to incorporate into the soil for maximum effectiveness.



# Horticultural Vinegar (acetic acid)

- Certified Organic nonselective weed control
- Contact control
- No soil residual
- Better control of broadleaves; suppression of grasses.
- Works best on small weeds
- Need higher concentrations (~20% solution) for control.

# Herbicide Application

- Know the rate per acre you desire to apply
  - $\text{Rate/A} * \text{Acres} = \text{total herbicide needed}$
- Make sure to calibrate the sprayer to know the output (gallons per acre [GPA])
  - Factsheets on calibrating sprayers
    - <http://extension.missouri.edu/p/G1270>
    - <http://ohioline.osu.edu/aex-fact/0520.html>
- Check Label for **adjuvant** recommendations
  - Adjuvants do not have any herbicidal properties but help the herbicide stick to the leaf, enter the leaf and/or spread on the leaf for better coverage
  - Examples: Nonionic surfactant (NIS), Crop Oil Concentrate (COC), Ammonium Sulfate (AMS), etc.





# Spray Volume

- How much water do I need to mix with the herbicide?
  - Sprayer Output (GPA) \* Acres
  - 15 GPA \* 5 acres = 75 gallons total carrier volume

# Sample Calculations

Area: 200' x 200' (40,000 sq ft.)

Herbicide Rate: Roundup PowerMax 22 fl oz/A

Spray Volume: 15 GPA

$$40,000 \text{ sq ft} / 43,560 \text{ sq ft/A} = 0.9183 \text{ ac}$$

$$0.9183 \text{ ac} * 22 \text{ fl oz/A} = \mathbf{20.2 \text{ fl oz}} \text{ Roundup PowerMax}$$

$$0.9183 \text{ ac} * 15 \text{ GPA} = \mathbf{13.77} \text{ gallons carrier volume}$$



# Sample Calculations

Area: 5 acres

Herbicide Rate: Gramoxone 2 SL 2 pt/A

COC 1% v/v

Spray Volume: 20 GPA

$5 \text{ ac} * 2 \text{ pt/A} = \mathbf{10 \text{ pt}}$  Gramoxone 2 SL

$5 \text{ ac} * 20 \text{ GPA} = \mathbf{100 \text{ gallons}}$  carrier volume

$100 \text{ gallon} * 1\% (0.01) = \mathbf{1 \text{ gallon}}$  COC

# Creating a Weed Management Plan

1. Identify your problematic weeds and where they are found!!
2. Chose method(s) of weed control (chemical, mechanical, etc.)
3. Chose a control method appropriate for the weed and cropping system
  - Consider current and future rotational crops
4. Document what you have done and its effectiveness for reference in future years



# Summary

- Weed competition can **severely** limit crop yield at any crop growth stage.
- The smaller the weed the easier it is to manage!
- Do not let weeds go to seed!
- Use multiple management strategies
- Limited herbicides are available, but do utilize those that are there they can help you!
  - Remember to watch for restrictions on future plantings, PHI, and to rotate different herbicide modes of action.
- Promote a healthy crop! If you can keep them clean while they are young many crops can form a canopy and compete with weeds.



# Resources

- Use your [Midwest Vegetable Production Guide](#), [Midwest Tree Fruit Spray Guide](#), and [Midwest Small Fruit/Grape Spray Guide](#) for specific recommendations
- Dry Pesticide Rates for Hand-Held Sprayers
  - <http://www2.ca.uky.edu/agc/pubs/ho/ho83/ho83.pdf>
- Product Labels
  - <http://www.cdms.net/LabelsMsds/LMDefault.aspx>
  - <http://www.greenbook.net/>
- Herbicide Mode of Action (Penn State Guide)
  - <http://extension.psu.edu/pests/weeds/control/introduction-to-weeds-and-herbicides/herbicides>

# To reach us

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