"We never should have waited this long ... Now the weeds have completely taken over."
Today’s Goal: to develop a broad understanding of weeds and ways to manage them

I. **Weed Biology and Ecology**
   - weed impacts, propagation, and identification

II. **Principles of Weed Management**
   - rational used in selecting weed control techniques

III. **Weed Management Strategies**
   - methods of control
   - considerations when using herbicides
I. Weed Biology and Ecology
What’s a weed?

It depends. It’s in the eyes of the beholder:

“Any plant that is objectionable or interferes with the activities or welfare of people” (WSSA)
Wild blackberry

Common purslane

Yellow nutsedge
Impacts of weeds on home and garden landscapes:

Users of water, nutrients, light, and space
Not very pleasing to the eye and can reduce the value of property
Can pose a hazard to life and property
Health concerns for people and animals
Habitat for rodents, insects, and pathogens
Suck the life out of desirable plants
How we classify (ID) weeds:

1. Botanical classification
2. Life-cycle
3. Morphological characteristics
4. Habitat (or venue)
5. Regulatory
6. Physiological characteristics
7. Day-length
1. Botanical Classification
   (most reliable method of ID)

Kingdom > Division > Class > Order > Family > Genus > Species

- **Family** - assemblage of genera that closely resemble one another
- **Genus** - closely related plants that usually include more than one species
- **Species** - a group of plants that are different from other similar species

**Benefits of using botanical classification to ID weeds:**

- Gives us the ability to determine specific ancestry of individual plants
- Plants are more “predictive” in their attributes towards growth and control
Horseweed – based on botanical classification:

Family – Asteraceae (Sunflower)
Genus – Conyza
Species – canadensis

Conyza canadensis
How many plants are really considered weeds?

», More than 350,000 plant species in the world.

», About 1000 (<0.3%) are classified as weedy.

», About 200 (<0.05%) pose 95% of the problems.
The 12 major weed families:

<table>
<thead>
<tr>
<th>Family</th>
<th>Order</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grass – Poaceae</td>
<td>Poaceae</td>
<td>Annual bluegrass, Crabgrass</td>
</tr>
<tr>
<td>Sedge – Cyperaceae</td>
<td>Cyperaceae</td>
<td>Yellow nutsedge, Green kyllinga</td>
</tr>
<tr>
<td>Sunflower/Composite –</td>
<td>Asteraceae</td>
<td>Dandelion, Cudweed</td>
</tr>
<tr>
<td>Buckwheat – Polygonaceae</td>
<td>Polygonaceae</td>
<td>Knotweed, Curly dock</td>
</tr>
<tr>
<td>Pigweed – Amaranthaceae</td>
<td>Amaranthaceae</td>
<td>Prostrate pigweed</td>
</tr>
<tr>
<td>Mustard – Brassicaceae</td>
<td>Brassicaceae</td>
<td>Shepherd’s-purse, Wild radish</td>
</tr>
<tr>
<td>Legume/Pea – Fabaceae</td>
<td>Fabaceae</td>
<td>Birdsfoot trefoil, Burclover</td>
</tr>
<tr>
<td>Morningglory – Convolvulaceae</td>
<td>Convolvulaceae</td>
<td>Dodder, Field bindweed</td>
</tr>
<tr>
<td>Spurge – Euphorbiaceae</td>
<td>Euphorbiaceae</td>
<td>Spurge, Turkey mullein</td>
</tr>
<tr>
<td>Goosefoot – Chenopodiaceae</td>
<td>Chenopodiaceae</td>
<td>Lambsquarters, Goosefoot</td>
</tr>
<tr>
<td>Mallow – Malvaceae</td>
<td>Malvaceae</td>
<td>Cheeseweed, Velvetleaf</td>
</tr>
<tr>
<td>Nightshade – Solanaceae</td>
<td>Solanaceae</td>
<td>Black nightshade, Jimson weed</td>
</tr>
</tbody>
</table>

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The 3 largest flowering plant families in the world are:

- Sunflower (24,000 species)
- Orchid (20,000 species)
- Legume/Pea (18,000 species)
2. Life-Cycle (from germination to death)

- **Annual**: lives for <1 year
  - summer annuals
  - winter annuals

- **Biennial**: lives <2 years

- **Perennial**: lives >2 years
Life-cycle of winter annuals:

(mustard, nettle, bur clover, annual bluegrass)

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Life-cycle of **summer annuals**: 
(spurge, pigweed, puncturevine, crabgrass)

- **Spring**: Active (plant)
- **Summer**: Dormant (seed)
- **Fall**: Active (plant)
- **Winter**: Dormant (seed)

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Life-cycle of biennials:
(sweet clover, wild carrot, bristly oxtongue)

Year 1:
Rosette, leaves, and stores food

Year 2:
Bolts, produces fruit and seed
Life-cycle of perennials:
(bermudagrass, tree of heaven, field bindweed)

Spring (Active) Summer
Spring (Dormant) Fall
Winter
3. Morphological Characteristics
(easily identifiable plant parts)

- **Broadleaves (dicots)**
  - leaves broad with netted veins
  - pair of seed leaves at emergence
  - opposite and/or alternating leaves

- **Grasses (monocots)**
  - leaves narrow with parallel veins
  - stems round to flattened
  - single narrow leaf at emergence

- **Sedges (monocots)**
  - leaves narrow with parallel veins
  - leaves in sets of 3’s
  - stems triangular in cross section
4. Habitat or Venue
(where they’re growing)

- **Terrestrial**: on land (turf, garden, fence line, etc.)
- **Aquatic**: in water (ponds, lakes, streams, etc.)
How do weeds propagate?
(means of carrying on)

- Vegetative propagation
- Seed production
Vegetative propagation: (perennial weeds)

- **Rhizomes** – horizontal underground stems

1 plant = 85’ of rhizomes in 14 weeks
• **Stolons** – horizontal aboveground stems

*Bermudagrass*
**Tubers or Nutlets** – swollen end of root or rhizome with compacted nodes and internodes

1 yellow nutsedge tuber = 1,918 plants in 1 year
• **Bulbs** – leaf bud usually with fleshy scales

False garlic
Roots – axillary buds on the roots

Tree of heaven
Seed production:
(“One year’s seeding makes seven years’ weeding”)

Aspects of seed production:
- Annuals and biennials reproduce only by seed
- Perennials reproduce by seed and/or vegetative propagation
- A characteristic of weeds for high reproductive capacity

Seed characteristics aiding in weed survival:
- Production
- Survival
- Dispersal
- Dormancy
- Seed banks
## Seed characteristics - production

<table>
<thead>
<tr>
<th>Common weed name</th>
<th># of seeds/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horseweed</td>
<td>250,000 – 1,000,000</td>
</tr>
<tr>
<td>Common mullein</td>
<td>~220,000</td>
</tr>
<tr>
<td>Tumble mustard</td>
<td>~129,000</td>
</tr>
<tr>
<td>Redroot pigweed</td>
<td>~112,400</td>
</tr>
<tr>
<td>Common lambsquarters</td>
<td>~72,450</td>
</tr>
<tr>
<td>Purslane</td>
<td>~52,300</td>
</tr>
<tr>
<td>Broadleaf plantain</td>
<td>~36,150</td>
</tr>
<tr>
<td>Dandelion</td>
<td>~15,000</td>
</tr>
<tr>
<td>Barnyardgrass</td>
<td>~7,160</td>
</tr>
<tr>
<td>Yellow nutsedge</td>
<td>~2,240</td>
</tr>
<tr>
<td>Wild oat</td>
<td>~250</td>
</tr>
</tbody>
</table>
Seed characteristics - dispersal

- Wind
- Water
- Animal and birds
- Man (self, equipment, etc.)
## Seed characteristics - survival

<table>
<thead>
<tr>
<th>Common name</th>
<th>Years viable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horseweed</td>
<td>&lt;2</td>
</tr>
<tr>
<td>Barnyardgrass</td>
<td>5</td>
</tr>
<tr>
<td>Puncturevine</td>
<td>15-20</td>
</tr>
<tr>
<td>Shepardspurse</td>
<td>15-35</td>
</tr>
<tr>
<td>Velvetleaf</td>
<td>15-40</td>
</tr>
<tr>
<td>Common purslane</td>
<td>20-25</td>
</tr>
<tr>
<td>Eastern black nightshade</td>
<td>40+</td>
</tr>
</tbody>
</table>
Seed characteristics – seed bank

Seed Bank Dynamics

Seed fall

Weeding, herbicides

Dormant

Non-dormant

Germination and emergence

Fumigants

Steam

Death
All this weed ecology and biology stuff helps us to determine which specific weed(s) we’re dealing with and how they grow and reproduce, so we can develop an effective management strategy.
Some practical weed ID resources:

- **Broadleaf Weed Identification**
  J.M. DiTomaso
  contact jmditomaso@ucdavis.edu

- **Grass Weed Identification**
  J.M. DiTomaso
  contact jmditomaso@ucdavis.edu
WEED ID EXERCISE 1:

Test your ability to recognize some weeds common to home and garden settings.
1. Common groundsel
   Annual sowthistle
   Dandelion
2. Prickly lettuce  
Mare’s-tail  
Horseweed
3.
Cudweed
Hairy fleabane
Prickly lettuce
4.
Yellow nutsedge
Bur clover
Green kyllinga
5.
Crabgrass
Bermudagrass
Cupgrass
Annual ryegrass
Annual bluegrass
Dallisgrass
7. Bur clover
Oxalis
Black medic
8. Oxalis
Bur clover
Black medic
9.
Black mustard
Fiddleneck
Pineappleweed
11.
Bermudagrass
Crabgrass
Dallisgrass
12.
Spotted spurge
Milkweed
Knotweed
Goatheads
Purslane
Puncturevine
14.

Redstem filaree
Whitestem filaree
Broadleaf filaree
15.
Common purslane
Spurge
Duckweed
ANSWERS
1. Common groundsel
Annual sowthistle
Dandelion
2. Prickly lettuce
   Mare’s-tail
   Horseweed
3.

Cudweed
Hairy fleabane
Prickly lettuce

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4.
Yellow nutsedge
Bur clover
Green kyllinga
5. Crabgrass

Bermudagrass

Cupgrass
6. Annual ryegrass
   Annual bluegrass
   Dallisgrass
7.

Bur clover

Oxalis

Black medic
8. Oxalis
   Bur clover
   Black medic
9.
Black mustard
Fiddleneck
Pineappleweed
10. Crabgrass
    Dallisgrass
    Bluegrass
11.

Bermudagrass

Crabgrass

Dallisgrass
12.

Spotted spurge
Milkweed
Knotweed
13. Goatheads
Purslane
Puncturevine

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14. 
Redstem filaree
Whitestem filaree
Broadleaf filaree
15. Common purslane, Spurge, Duckweed

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WEED ID EXERCISE 2:

Using important plant structures to help ID grassy weeds
Ligule
Sheath
Blade (Lamina)
Auricle (absent)
Hairs
Collar
Sheath
Cultivated Oat

No auricles

Large papery ligule
Hare Barley

Long, clasping auricles

Long, clasping auricles and a papery ligule
All *Bromus* have a closed collar/closed leaf sheath, at times it can split open so look carefully. Our *Bromus vulgaris* will be more hairy.

*Brachypodium sylvaticum* Leaf sheath open but overlapping all the way to the node/joint. *B. sylvaticum* is much more hairy.

Leaves folded in the bud (i.e. goosegrass) leaves rolled in the bud (i.e. smooth crabgrass)
# Vegetative Grass Weed Identification

**Ligule absent**  
Leaves green throughout – *Echinochloa crus-galli* (barnyardgrass)  
Leaves with purple cross-stripping on leaves – *Echinochloa colona* (junglerice)

**Ligule present**  
**Leaf folded in bud**

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Life cycle</th>
<th>Ligule</th>
<th>Ligule length (mm)</th>
<th>Auricles</th>
<th>Hairs</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Dactylis glomerata</em></td>
<td>orchardgrass</td>
<td>P</td>
<td>Membranous</td>
<td>2-5</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><em>Eleusine indica</em></td>
<td>goosegrass</td>
<td>A</td>
<td>Membranous</td>
<td>0.6-1.0</td>
<td>No</td>
<td>Collar and top of sheath</td>
</tr>
<tr>
<td><em>Eleusine tristachya</em></td>
<td>perennial goosegrass</td>
<td>P</td>
<td>Ciliate above, membranous below</td>
<td>0.5</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><em>Lolium perenne</em></td>
<td>perennial ryegrass</td>
<td>P</td>
<td>Membranous</td>
<td>0.4-0.6</td>
<td>Yes-small</td>
<td>No</td>
</tr>
<tr>
<td><em>Pennisetum clandestinum</em></td>
<td>kikuyugrass</td>
<td>P</td>
<td>Ciliate</td>
<td>1.5</td>
<td>No</td>
<td>Blade and sheath</td>
</tr>
<tr>
<td><em>Poa annua</em></td>
<td>annual bluegrass</td>
<td>A</td>
<td>Membranous</td>
<td>1-2</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Leaf rolled in bud**  
**Ligule ciliate**

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Life cycle</th>
<th>Ligule length (mm)</th>
<th>Auricle</th>
<th>Hairs</th>
<th>Misc.</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Chloris virgata</em></td>
<td>feather fingergrass</td>
<td>A</td>
<td>0.25</td>
<td>No</td>
<td>No</td>
<td>Ligule ciliate above, membranous below</td>
</tr>
<tr>
<td><em>Cynodon dactylon</em></td>
<td>Bermudagrass</td>
<td>P</td>
<td>2-3</td>
<td>No</td>
<td>Sparse on sheath</td>
<td>Stolons well developed</td>
</tr>
<tr>
<td><em>Eragrostis cilianensis</em></td>
<td>stinkgrass</td>
<td>A</td>
<td>0.4-1.0</td>
<td>No</td>
<td>At top of sheath</td>
<td>Foul odor, glands on nodes and glandular depressions on leaves</td>
</tr>
<tr>
<td><em>Eriochloa contracta</em></td>
<td>prairie cupgrass</td>
<td>A</td>
<td>1</td>
<td>No</td>
<td>Dense short soft hairs on sheath and blade</td>
<td>Blade &lt;5mm wide</td>
</tr>
<tr>
<td><em>Panicum capillare</em></td>
<td>witchgrass</td>
<td>A</td>
<td>1</td>
<td>No</td>
<td>Blade and sheath</td>
<td>Hairs long, stiff, at 90° angle to stem</td>
</tr>
<tr>
<td><em>Setaria pumila (=S. lutescens)</em></td>
<td>yellow foxtail</td>
<td>A</td>
<td>1</td>
<td>No</td>
<td>Long at base of blade</td>
<td>Stem flattened, sheath keeled</td>
</tr>
<tr>
<td><em>Setaria viridis</em></td>
<td>green foxtail</td>
<td>A</td>
<td>0.8-1</td>
<td>No</td>
<td>On margin of sheath</td>
<td></td>
</tr>
<tr>
<td><em>Sorghum halepense</em></td>
<td>johnsongrass</td>
<td>P</td>
<td>3-6</td>
<td>No</td>
<td>No</td>
<td>Ligule ciliate above, membranous below</td>
</tr>
<tr>
<td>Scientific name</td>
<td>Common name</td>
<td>Life cycle</td>
<td>Ligule length (mm)</td>
<td>Auricle features</td>
<td>Hairs</td>
<td>Misc. features</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------------------------</td>
<td>------------</td>
<td>-------------------</td>
<td>---------------------------------------</td>
<td>--------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td><em>Aegilops cylindrica</em></td>
<td>jointed goatgrass</td>
<td>A</td>
<td>0.25</td>
<td>Usually evident</td>
<td>Sheath and blade margin</td>
<td>Closed sheath at base, can tear to appear open, auricles often present</td>
</tr>
<tr>
<td><em>Aegilops triuncialis</em></td>
<td>barb goatgrass</td>
<td>A</td>
<td>0.5</td>
<td>Usually evident</td>
<td>Mid to upper sheath and blade edge, long hairs to 2 mm</td>
<td>Closed sheath at base, can tear to appear open, auricles often present</td>
</tr>
<tr>
<td><em>Bromus catharticus</em> (=<em>B. wildenowii</em>)</td>
<td>rescuegrass</td>
<td>A</td>
<td>3-6</td>
<td>No</td>
<td>Short hairs on sheath, occasionally glabrous, blade sometimes hairy</td>
<td></td>
</tr>
<tr>
<td><em>Bromus diandrus</em></td>
<td>ripgut brome</td>
<td>A</td>
<td>3-5</td>
<td>No</td>
<td>Sheath and blade with long soft hairs, ciliate hairs on leaf margin</td>
<td></td>
</tr>
<tr>
<td><em>Bromus hordeaceus</em> (=<em>B. mollis</em>)</td>
<td>soft brome</td>
<td>A</td>
<td>1.2-1.7</td>
<td>No</td>
<td>Long hairs on sheath and blade</td>
<td></td>
</tr>
<tr>
<td><em>Bromus inermis</em></td>
<td>smooth brome</td>
<td>P</td>
<td>&lt;1</td>
<td>Yes</td>
<td>Usually no, sometimes with short hairs on blade</td>
<td></td>
</tr>
<tr>
<td><em>Bromus madritensis</em> ssp. rubens</td>
<td>red brome</td>
<td>A</td>
<td>0.8-1.2</td>
<td>No</td>
<td>Short soft hairs on sheath and blade</td>
<td></td>
</tr>
<tr>
<td><em>Bromus secalinus</em></td>
<td>cheat</td>
<td>A</td>
<td>1.2-2.5</td>
<td>No</td>
<td>Short hairs on blade, sheath lack hairs or only at base</td>
<td></td>
</tr>
<tr>
<td><em>Bromus tectorum</em></td>
<td>downy brome, cheatgrass</td>
<td>A</td>
<td>1.5-3</td>
<td>No</td>
<td>Short hairs throughout, long hairs at blade base and top of sheath</td>
<td></td>
</tr>
<tr>
<td><em>Polygono monspeliensis</em></td>
<td>rabbitfoot grass</td>
<td>A</td>
<td>5-6</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

**Sheath open at least half its length**

<table>
<thead>
<tr>
<th>Scientific name</th>
<th>Common name</th>
<th>Life cycle</th>
<th>Ligule length (mm)</th>
<th>Auricle features</th>
<th>Hairs</th>
<th>Misc. features</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Aegilops cylindrica</em></td>
<td>jointed goatgrass</td>
<td>A</td>
<td>0.25</td>
<td>Short, rounded with hairs along margin</td>
<td>Sheath and blade margin</td>
<td>Closed sheath at base, can tear to appear open, auricles often present</td>
</tr>
<tr>
<td><em>Aegilops triuncialis</em></td>
<td>barb goatgrass</td>
<td>A</td>
<td>0.5</td>
<td>Short, rounded with hairs along margin</td>
<td>Mid to upper sheath and blade edge, long hairs to 2 mm</td>
<td>Closed sheath at base, can tear to appear open, auricles often present</td>
</tr>
<tr>
<td><em>Elytrigia repens</em></td>
<td>quackgrass</td>
<td>P</td>
<td>0.2-0.4</td>
<td>Short</td>
<td>Short hairs on sheath and blade</td>
<td></td>
</tr>
<tr>
<td><em>Festuca arundinacea</em></td>
<td>tall fescue</td>
<td>P</td>
<td>1.2</td>
<td>Short with hairs</td>
<td>Occasionally hairs on collar</td>
<td>Wide (4-10 mm), shiny leaves,</td>
</tr>
<tr>
<td><em>Hordeum murinum</em> ssp. leporinum (=<em>H. leporinum</em>)</td>
<td>hare barley</td>
<td>A</td>
<td>1-2</td>
<td>Long, wraps around stem</td>
<td>Primarily on lower blade surface &amp; sheath</td>
<td></td>
</tr>
<tr>
<td><em>Lotium multiflorum</em></td>
<td>Italian ryegrass</td>
<td>A</td>
<td>1-2</td>
<td>Short</td>
<td>No</td>
<td>Narrow (&lt;4 mm), shiny leaves,</td>
</tr>
<tr>
<td><em>Taeniatherum caput-medusae</em></td>
<td>medusahead</td>
<td>A</td>
<td>0.5</td>
<td>Short</td>
<td>Blade and blade margin</td>
<td>Narrow leaves</td>
</tr>
</tbody>
</table>
Ripgut brome
II. Principles of Weed Management
1. **Use an organized, science-based effort:**
   - Know what weeds you have and ways to control them
   - Determine what your objectives are (is it just spray and pray)
   - Be realistic to limitations and technologies available

2. **Take a problem-solving approach:**
   - Diagnose the problem
   - Select the most appropriate or best option available
   - Implement the strategy
   - Make a follow-up evaluation to see if further action is needed
Four weed management principles:

3. **Be realistic in your expectations:**
   - A single option won’t work for all weeds or situations
   - Once a weed is established, it will likely always be an issue
   - Weeds will vary in their susceptibility to control
   - More than one control method may need to be used
   - Is it a short-term or long-term approach

4. **It’s always venue-based:**
   - Many options may be available for any given weed(s), but will likely vary between particular locations (turf, garden, fence line, a few fruit trees, etc.), depending on registered herbicides and non-chemical tools.
III. Weed Management Strategies
Weed control recommendations are based on two concepts:

1. **Prevention**: keeping weeds out
   - Don’t let the weeds set seed
   - Clean off boots, shoes, gloves, and equipment
   - Use good composted materials that are free of weed seeds

2. **Management**: steps taken to reduce the weed problem
   - Biological
   - Cultural
   - Mechanical or physical
   - Chemical
Weed management options:

- Biological
- Physical
- Cultural
- Chemical

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**BIOLOGICAL:**

Bological control - intentional use of a living organisms to reduce the density of weeds; may or may not be host specific.

Why do insects make good bio-control agents?

- Present in great variety and often specific to certain plants
- Intimate adaptation to host’s life cycle
- Various stages of insect’s life cycle feed on different parts of host
Stem and seed boring weevils: (Puncturevine)

*Stem weevil*
*Microlarinus lypriiformis*

*Seed weevil*
*Microlarinus lareynii*
Very effective on large PV populations:

1. Find them
2. Bag them
3. Release them

Kurt Hembree, UCCE, Fresno County – March 9, 2017
Vertebrate critters that can also be used for weed control:

- **Grass Carp**: sterile non-native aquatic feeders
  - *Hydrilla verticillata*
  - useful in small enclosed ponds
  - fish cannot reproduce on its own, preventing unchecked spread

- **Goats**: they’re browsers
  - goats grazing in brushy or very weedy areas (e.g. pasture)
Cultural:

Cultural control – conditions that favor desired plants over weeds.

- Don’t over-water or over-fertilize… weeds like it like that.
- Burying drip tape 8-10” deep can keep summer weeds out of ornamentals (keep the top 2” dry).
- For vegetable gardens; “water, wait, then cultivate”.
- Maintain a vigorous, healthy lawn; check for insects (grubs), diseases, fertility, water frequency, mowing height, etc.
- Use a dense plant spacing on shrubs to shade out weeds.
Physical or Mechanical:

Physical control - direct elimination by hand or equipment.

- Maintain 4-6” organic mulch to keep sun from reaching weed seeds.
- Use fabric mulch to keep the sun from reaching weed seeds.
- Solarize soil for 4-6 weeks with clear plastic mulch during summer to superheat the soil to kill most annual weed seeds.
- Mow certain upright growing annual broadleaves (close to soil line).
- Rototill to bury weed seeds and destroy small annual weeds.
- Hand hoe or pull weeds at below the soil line.
Organic mulches:

Clean (no weeds)

Not thick enough or not replenished (weeds)
**Synthetic mulches:**

<table>
<thead>
<tr>
<th>Weed barrier</th>
<th>Terra mat</th>
<th>Duon</th>
<th>Typar</th>
<th>Weed arrest</th>
</tr>
</thead>
</table>

[Image of synthetic mulches]
Soil solarization:

- Remove weeds, rocks, sticks
- Smooth out soil
- Water area
- Apply 1-4 ml clear plastic
- Keep in place 4-6 weeks during summer to reach a temp of 140 °F.
Rototill to destroy small weeds:
Hand remove below the soil line:
Chemical control - herbicides (organic or synthetic) used to suppress, kill, or interrupt a weed’s growth pattern. A successful herbicide program depends on the target plant(s), the herbicide(s), and the environment.
Terms you need to know about herbicides:

1. **Herbicide selectivity**: degree of response among plants

   - “Selective” – more toxic to some plant types than others. For example: 2,4-D, Grass-B-Gone, etc.

   - “Non-selective” – toxic to a large variety of plant species. For example: Roundup, Pendulum, etc.
Terms you need to know about herbicides:

2. **Herbicide movement**: degree of movement within a plant

   - **“Contact”** – causes localized injury to plant tissue where contact occurs and does not move within the plant. For example: Acetic acid, Finale, Safer Soap, etc.

   - **“Systemic”** - moves within the plant (e.g. xylem or phloem) to a specific area or areas to kill the plant. For example: Roundup, 2,4-D, Fusilade, etc.
Terms you need to know about herbicides:

3. **Herbicide placement**: applied to the plants or the soil
   
   ▶ **“Foliar Applied”** – must come in contact with leaves and stems for absorption to render a phytotoxic effect, often called “postemergents”.
   For example: Sedgehammer, Weed-B-Gon, etc.

   ▶ **“Soil Applied”** - must come in contact with the soil and be absorbed by the roots and/or shoots of germinating weed seeds and/or emerging weeds to render a phytotoxic effect, often called “preemergents”.
   For example: Pendulum, Weed Impede, etc.
Factors affecting performance of foliar applied (postemergent) herbicides:

- Leaf contact and retention (hairiness, leaf area, spray volume, etc.)
- Leaf and stem absorption (cuticle, rain fastness, etc.)
- Translocation (phloem, xylem)
- Physiology (metabolism)
- Weed size and growth stage (smaller weeds are easier to kill)
- Weed health (droughty vs. vigorous)
- Environmental conditions (humidity, temperature, moisture, etc.)
Factors affecting performance of **soil applied (preemergent)** herbicides:

- Soil contact (open exposure to the treatment)
- Absorption (developing roots and shoots of seedlings)
- Translocation (phloem, xylem)
- Physiology (metabolism)
- Incorporation/activation (rainfall, sprinklers, mechanical)
- Soil characteristics (texture, organic matter, etc.)
- Herbicide solubility (movement in the soil water)
- Herbicide volatility (stability on the soil surface)
Preemergents need activation:

1. benefin (Balan): 1 day
2. bensulide (Bensumec): 1 day
3. oxadiazon (Ronstar): 1 day
4. dcpa (Dacthal): 4 days
5. dithiopyr (Dimension): 7 days
6. napropamide (Devrinol): 7 days
7. oryzalin (Weed Impede): 21 days
8. pendimethalin (Pendulum): 30 days
9. Combinations – trifluralin + benefin (Team): 2 days
Terms you need to know about how herbicides are applied:

► “Broadcast”: applied as a continuous sheet over the entire area.

► “Directed”: applied as precise treatment to weeds or soil to avoid contact with the desired plants.

► “Spot”: applied to individual patches of weeds within a large area.

► “Basal”: applied to encircle the stem of a plant above and at the ground level such that foliage contact is minimal.
Factors to consider before selecting herbicides to use:

1. “Venue”: the area being treated.

2. “Efficacy”: the degree of effectiveness of a particular herbicide on a particular weed or group of weeds (100% control is almost never achieved). Read the label.

3. “Weed Stage”: the development stage of the weeds at the time of treatment (seeds vs. established plants).

4. “Time of Year”: when you expect certain weeds to be a problem.

5. “Environment”: factors affecting the performance of herbicides (e.g. rainfall, windy, foggy, etc.).
Herbicide use checklist:

1. Have you properly identified the weeds being targeted?
2. What products are registered to control the target weeds in the specific site?
3. Will the product(s) be applied preemergent or postemergent?
4. Will the target weeds be sensitive to the product(s) at that time of the year?
5. Will conditions of the site influence the products performance?
6. How much product is needed to control the weeds?
7. Are there other plants nearby that might be sensitive to the product(s) used?
8. Will it be applied properly and as uniformly as possible?
Helpful weed and herbicide resources:

Pests in Gardens and Landscapes: Weeds

Chemical Control
Crabgrass is easy to control in both turfgrass and ornamental beds if you apply preemergent herbicides before it germinates in vegetable gardens because of the variety of crops grown and planted there. Read the label to make sure your landscape. The active ingredients listed below can be found under different brand names; for a partial list, see 1.

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Brand name</th>
<th>Homeowner or professional use?</th>
<th>For use on turf?</th>
</tr>
</thead>
<tbody>
<tr>
<td>benfotiamine</td>
<td>Bensulide, Pre-San</td>
<td>homeowner</td>
<td>yes</td>
</tr>
<tr>
<td>dichlofop</td>
<td>Dimension, Preem</td>
<td>professional</td>
<td></td>
</tr>
<tr>
<td>oryzalin</td>
<td>Surflan, Weed Impede</td>
<td>homeowner</td>
<td>yes</td>
</tr>
<tr>
<td>oxadiazon</td>
<td>Ronstar</td>
<td>professional</td>
<td></td>
</tr>
<tr>
<td>pendimethalin</td>
<td>Pendulum, Pre-M, Scotts</td>
<td>professional</td>
<td></td>
</tr>
<tr>
<td>proprazine</td>
<td>Barricade</td>
<td>professional</td>
<td>yes</td>
</tr>
<tr>
<td>s-metolachlor</td>
<td>Vegetable and Ornamental Weedher</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>simazine</td>
<td>Vegetative and Ornamental Weedher</td>
<td>no</td>
<td></td>
</tr>
</tbody>
</table>

1. Warm-season turf (bermudagrass and St. Augustine) only. Will injure cool-season species.
<table>
<thead>
<tr>
<th>Mfr</th>
<th>Product trade name</th>
<th>Form</th>
<th>Chemical</th>
<th>Active Ingredient (%)</th>
<th>Pre or Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectracide</td>
<td>Brush Killer Spray</td>
<td>liquid</td>
<td>2,4-D + dicamba</td>
<td>0.74+0.78+1.05</td>
<td>post</td>
</tr>
<tr>
<td>Monterey</td>
<td>Brush Buster</td>
<td>liquid</td>
<td>2,4-D + 2,5-DP</td>
<td>16.05+16.10</td>
<td>post</td>
</tr>
<tr>
<td>Gordon’s</td>
<td>All Season Brush N’ More</td>
<td>liquid</td>
<td>2,4-D + 2,4,5-DP + dicamba</td>
<td>0.74+0.78+1.05</td>
<td>post</td>
</tr>
<tr>
<td>Bayer Advanced</td>
<td>All-in-One Lawn Weed and Crabgrass Killer</td>
<td>liquid</td>
<td>2,4-D + dicamba + quinclorac</td>
<td>4.85+0.45+1.61</td>
<td>post</td>
</tr>
<tr>
<td>Gordon’s</td>
<td>Trimec Crabgrass Plus Lawn Weed Killer</td>
<td>liquid</td>
<td>2,4-D + dicamba + quinclorac</td>
<td>6.42+0.60+2.13</td>
<td>post</td>
</tr>
<tr>
<td>Green Light</td>
<td>Wipe-Out Crabgrass Killer Plus</td>
<td>liquid</td>
<td>2,4-D + dicamba + quinclorac</td>
<td>7.3+0.94+3.5</td>
<td>post</td>
</tr>
<tr>
<td>Ortho</td>
<td>Crab-E-Rad Plus</td>
<td>liquid</td>
<td>2,4-D + dicamba + quinclorac</td>
<td>0.59+0.60+4.00</td>
<td>post</td>
</tr>
<tr>
<td>Scotts</td>
<td>Total Turf Builder Plus 2 (29-3-3)</td>
<td>granular</td>
<td>2,4-D + MCP + dicamba</td>
<td>1.21+0.61</td>
<td>post</td>
</tr>
<tr>
<td>Monsanto</td>
<td>Green Sweep Weed &amp; Feed (20-0-0)</td>
<td>liquid</td>
<td>2,4-D + MCP 2,4,5-DP + dicamba</td>
<td>2.29+2.30+2.26</td>
<td>post</td>
</tr>
<tr>
<td>Monterey</td>
<td>Weed Whacker</td>
<td>liquid</td>
<td>2,4-D + MCP 2,4,5-DP + dicamba</td>
<td>4.55+4.59+4.53</td>
<td>post</td>
</tr>
<tr>
<td>Best</td>
<td>SL Augustine &amp; Bermudagrass Weed &amp; Feed (10-7-7)</td>
<td>granular</td>
<td>2,4-D + MCP + dicamba</td>
<td>0.64+0.18+0.075</td>
<td>post</td>
</tr>
<tr>
<td>Green Light</td>
<td>Wipe-Out Broadleaf Weed Killer 2</td>
<td>liquid</td>
<td>2,4-D + MCP + dicamba</td>
<td>1.9+3.33+0.81</td>
<td>post</td>
</tr>
<tr>
<td>Lilly Miller</td>
<td>Lawn Weed Killer</td>
<td>liquid</td>
<td>2,4-D + MCP + dicamba</td>
<td>0.59+143.066</td>
<td>post</td>
</tr>
<tr>
<td>Lilly Miller</td>
<td>Weed n’ Feed - Hose ’n Go</td>
<td>liquid</td>
<td>2,4-D + dicamba</td>
<td>5.67+1.370+0.629</td>
<td>post</td>
</tr>
<tr>
<td>Lilly Miller</td>
<td>Lawn Weed Killer</td>
<td>liquid</td>
<td>2,4-D + dicamba</td>
<td>9.41+2.27+0.04</td>
<td>post</td>
</tr>
<tr>
<td>Scotts</td>
<td>Lawn Pro Step 2 Plus Fertilizer (29-3-3)</td>
<td>granular</td>
<td>2,4-D + dicamba + quinclorac</td>
<td>1.25+0.62+0.05</td>
<td>post</td>
</tr>
<tr>
<td>Best</td>
<td>Weed &amp; Feed for Grass Lawns (15-5-7)</td>
<td>granular</td>
<td>2,4-D + dicamba + quinclorac</td>
<td>0.50+0.24+0.052</td>
<td>post</td>
</tr>
<tr>
<td>Bayer Advanced</td>
<td>Southern Weed Killer for Lawns &amp; Weed Killer for Lawns</td>
<td>liquid</td>
<td>2,4-D + MCP + dicamba</td>
<td>7.59+1.83+0.84</td>
<td>post</td>
</tr>
<tr>
<td>Gordon’s</td>
<td>Trimec Lawn Weed Killer</td>
<td>liquid</td>
<td>2,4-D + MCP + dicamba</td>
<td>7.59+1.83+0.84</td>
<td>post</td>
</tr>
<tr>
<td>Ortho</td>
<td>Weed-B-Gon Max for South Lawn</td>
<td>liquid</td>
<td>2,4-D + dicamba + carfentrazone</td>
<td>4.8+0.49+0.27+0.16</td>
<td>post &amp; pre</td>
</tr>
<tr>
<td>Gordon’s</td>
<td>Speed Zone Lawn Weed Killer</td>
<td>liquid</td>
<td>2,4-D + dicamba + carfentrazone</td>
<td>28.57+2.00+1.71+0.02</td>
<td>post &amp; pre</td>
</tr>
<tr>
<td>Preen</td>
<td>Lawn Step Saver</td>
<td>granular</td>
<td>2,4-D + dicamba + dicamba + dimethyl</td>
<td>0.64+0.14+0.06+0.16</td>
<td>post &amp; pre</td>
</tr>
<tr>
<td>Ortho</td>
<td>Weed-B-Gon Max Plus Crabgrass Control</td>
<td>liquid</td>
<td>2,4-D + MCP + dicamba + quinclorac</td>
<td>0.12+0.22+0.05+0.10</td>
<td>post &amp; pre</td>
</tr>
<tr>
<td>Scotts</td>
<td>Liquid Turf Builder with Plus 2 (25-1-2)</td>
<td>liquid</td>
<td>2,4-D + MCP + dicamba + sulflurazone</td>
<td>2.29+1.15+1.13</td>
<td>post &amp; pre</td>
</tr>
<tr>
<td>Spectracide</td>
<td>Weed Stop 2X Killer for Lawns</td>
<td>liquid</td>
<td>2,4-D + dicamba + sulflurazone</td>
<td>0.75+2.73+0.71+0.18</td>
<td>post &amp; pre</td>
</tr>
<tr>
<td>Bayer Advanced</td>
<td>Season Long Weed Control for Lawns (also Southern)</td>
<td>liquid</td>
<td>2,4-D + MCP + dicamba + isoxaben</td>
<td>4.75+1.10+0.52+2.63</td>
<td>pre</td>
</tr>
<tr>
<td>Safer</td>
<td>Superfast Weed &amp; Grass Killer</td>
<td>liquid</td>
<td>ammoniated soap of fatty acids</td>
<td>3.0</td>
<td>post</td>
</tr>
<tr>
<td>Monterey</td>
<td>Herbicidal Soap</td>
<td>liquid</td>
<td>ammoniated soap of fatty acids</td>
<td>22.0</td>
<td>post</td>
</tr>
<tr>
<td>Bayer Advanced</td>
<td>Nutra Grass &amp; Weed Killer</td>
<td>liquid</td>
<td>ammoniated soap of fatty acids</td>
<td>3.68</td>
<td>post</td>
</tr>
<tr>
<td>Pre-Gard</td>
<td>Grit-X</td>
<td>liquid</td>
<td>ammonium thiosulfate</td>
<td>66.0</td>
<td>post</td>
</tr>
<tr>
<td>Ortho</td>
<td>Weed-B-Gon Spot Weed Killer for SL Augustine Lawns</td>
<td>liquid</td>
<td>atrazine</td>
<td>0.535</td>
<td>post</td>
</tr>
<tr>
<td>Green Light</td>
<td>Amaze Grass &amp; Weed Preventer</td>
<td>granular</td>
<td>benfor-d-cyrlinal</td>
<td>1.0+1.0</td>
<td>pre</td>
</tr>
<tr>
<td>Bandini</td>
<td>Pre-Sprout 2 (Stop Grass Weed Seeds)</td>
<td>granular</td>
<td>benfor-triflural</td>
<td>0.61+0.31</td>
<td>pre</td>
</tr>
<tr>
<td>Rest</td>
<td>Spurge &amp; Crabgrass Preventer (15-5-7)</td>
<td>granular</td>
<td>benfor-triflural</td>
<td>0.079+0.29</td>
<td>pre</td>
</tr>
<tr>
<td>Monterey</td>
<td>Nutgrass NInhibitor (only works on yellow nutsedge)</td>
<td>liquid</td>
<td>bentazon</td>
<td>42.0</td>
<td>post</td>
</tr>
<tr>
<td>Monterey</td>
<td>Starthistle Killer also sold as Kudzu Killer</td>
<td>liquid</td>
<td>clopyralid</td>
<td>40.9</td>
<td>post</td>
</tr>
<tr>
<td>Preen</td>
<td>VGC Garden Weed Preventer</td>
<td>granular</td>
<td>com gluten meal</td>
<td>ORGANIC</td>
<td>pre</td>
</tr>
<tr>
<td>Amvac</td>
<td>Dacthal W-75 for Turf (flammable also available)</td>
<td>liquid</td>
<td>dicamba</td>
<td>2.0</td>
<td>post</td>
</tr>
<tr>
<td>Lilly Miller</td>
<td>Casoron</td>
<td>granular</td>
<td>dicamba</td>
<td>2.0</td>
<td>post</td>
</tr>
<tr>
<td>OSH</td>
<td>Weed &amp; Grass Killer Concentrate</td>
<td>liquid</td>
<td>dicamba</td>
<td>1.84</td>
<td>pre</td>
</tr>
<tr>
<td>OSH</td>
<td>Weed &amp; Grass Killer liquid-RTS</td>
<td>liquid</td>
<td>dicamba</td>
<td>0.23</td>
<td>post</td>
</tr>
</tbody>
</table>
Read and follow label recommendations:

All-In-One Lawn Weed & Crabgrass Killer

ACTIVE INGREDIENTS:

2,4-D, dimethylamine salt ................................................................. 4.85%
Quinclorac ......................................................................................... 1.61%
Dicamba, dimethylamine salt ............................................................ 0.45%
OTHER INGREDIENTS ....................................................................... 93.09%

100.00%
Errors in application?
“For all the marbles”: What do these four weeds have in common?

Junglerice

Horseweed

Hairy fleabane

Italian ryegrass
The Bottom Line -

Weed control is almost never as simple as “spray-and-pray”. It’s better to develop a broad understanding of weeds and how they produce and survive, so we can then develop an effective management strategy.
We need to be proactive, not reactive...