Integrated Weed Management in Conventional and Organic Horticultural Crops

Carlene A. Chase
Horticultural Sciences Department

Integrated pest management (IPM)
- An ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques

Integrated Weed Management
- Use of multiple approaches to suppress weeds and reduce herbicide use.
- Useful for:
  - conventionally grown horticultural crops with limited chemical control options
  - organic crops

Prevention
Limitation of Human Dispersal of Seeds and Vegetative Propagules

Preventive Methods

<table>
<thead>
<tr>
<th>Dispersal</th>
<th>Prevention Strategy</th>
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</thead>
<tbody>
<tr>
<td>1) Deliberate plant introductions</td>
<td>1) Laws to limit invasive species</td>
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<tr>
<td>2) Weed contaminated crop seed</td>
<td>2) Laws: purity standards</td>
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<tr>
<td>3) With manure, feed, and transported animals</td>
<td>3) Keep infested materials out of fields</td>
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<td>4) With plant parts</td>
<td>4) Cover harvested commodities</td>
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Preventive Methods

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<tr>
<td>1) In soil</td>
<td>1) Weed-free planting materials</td>
</tr>
<tr>
<td>2) In commodities such as wool</td>
<td>2) Inspection, quarantine, heat</td>
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<tr>
<td>3) Machinery</td>
<td>3) Clean equipment between fields</td>
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<tr>
<td>4) Irrigation water</td>
<td>4) Screens. Control weeds along irrigation canals and ditches</td>
</tr>
</tbody>
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Cultural Practices

How you grow your crop

- Select species and varieties with traits that enhance competitiveness vs. weeds:
  - rapid growth, uniform emergence, height, growth habit.

- Row spacings that promote rapid canopy closure.

- Field selection to ensure the crop grows well:
  - soil considerations eg tilth, organic matter content, salinity, drainage.

Produce a healthy vigorous crop

- Use transplants
  - crop gets a head start on weeds.

- Crop rotation

- Limit water and nutrients for weed growth
  - Drip irrigation: restrict water to the vicinity of the plant.
  - Subsurface drip irrigation - keeps soil surface dry.
  - Apply fertilizer in a band instead of broadcasting.

Subsurface Drip Irrigation
Tomatoes grown with subsurface drip irrigation

Cover crops and living mulches occupy niches normally filled by weeds

**Suppress weed germination & establishment**
- Change in soil physical environment
- Crop/weed competition
- Allelopathy

**Provide residues for weed suppression in subsequent crops**

**Provide habitat for weed seed predators**

Furrow irrigation

Tomatoes grown with furrow irrigation

**Sunn hemp**

**Sorghum sudangrass**

A biculture of pearl millet and sunn hemp
Living mulches with squash and broccoli

Hairy vetch/rye living mulch
Crimson clover living mulch

Synthetic mulches

- **Landscape fabric:**
  - used under bark or rock

- **Polyethylene film:**
  - black, white-on-black, infrared transmitting, transparent for soil solarization.
  - Planting holes - weed emergence.
  - Removing film is difficult, disposal is difficult.

Mechanical & Physical Control

Natural mulches: straw, leaves, paper, cardboard, compost, shredded bark

Differential susceptibility of synthetic mulches to penetration by nutsedges

Flame weeding

Tractor-mounted weeds or hand-held propane burners used for searing weeds

- Preemergence
- Postemergence in tolerant crops
  - Corn, onions
Tillage and Cultivation
Use of implements to uproot, dismember, and bury growing weeds and dormant perennating organs

Tillage:
• Plowing, disking, harrowing
• During fallow period
• Preplant for seed bed preparation

Cultivation occurs after planting and can be pre-emergence or postemergence to the crop

- Broadcast, interrow, intrarow.
- Most effective on smaller weeds.
- Dry soil to allow desiccation
  - Weather can affect timeliness.
- Not appropriate for large farms
  - Labor and machinery not sufficient for timely operations.

Mowing
- Cutting weeds to prevent seed set.
- Effective for tall annuals and perennials.
- Depletes underground organs.
- Repeated mowing needed.
- Misses prostrate weeds.
- Shifts to rosette and matforming

Hand weeding refers to weeding by hand pulling or using a hoe

- Usually supplements other techniques.
- Expensive - high value crops only.

Biological Control
Use of living organisms and their products to reduce pest populations and their effects

Mycoherbicides

DeVine:
- Phytophthora palmivora
  - kills strangler or milkweed vine in citrus.

LockDown retro:
- Colletotrichum gloeosporioides
  - controls northern jointvetch in rice.

Smolder:
- Alternaria destruens strain 059.
  - control of dodder in agricultural fields, dry bogs, and ornamental nurseries.
Biological Control - Livestock

Weeder geese
- remove grass weeds from broadleaf crops

Pigs
- perennial storage organs.

Herbicides and soil fumigants inhibit biochemical processes essential for plant growth

Herbicides: phytotoxic pesticides used for managing weeds & undesirable vegetation
- Contact, systemic
- Selective, nonselective
- Foliar or soil applied
- Synthetic, nonsynthetic

Grazers and browsers
- Pasture
- Rangeland
- Orchards and vineyards

Chemical Control
The use of herbicides and soil fumigants for managing weeds

Soil fumigants: volatile liquids or gases applied to soils for broad spectrum control of soilborne pests and pathogens

Effect of dimethyl disulfide-chloropicrin on nutsedge control

Untreated VIF
Untreated TIF
Paladin: Pic 20 gal/acre

Photo credit: Josh Freeman

Weed Management in Organic Production
**Pertinent regulations**

Subpart C - Organic Production and Handling Requirements

- § 205.206: Crop pest, weed, and disease management practice standard.


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**Crop pest, weed, and disease management practice standard**

- Promotes a holistic approach to pest management.
- Discourages product substitution.
- Crop management practices must be used to limit buildup of and to manage crop pests, weeds, and diseases.
- Three levels of pest management.

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**Level A - Design a System Resilient to Pests**

1. Preventive measures
2. Crop rotation
3. Soil and crop nutrient management
4. Cultural practices that enhance crop health

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**Level B**

Mechanical, physical and biological methods

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**Weed Management Practices - Level B**

1. Mulching with fully biodegradable materials
2. Mowing
3. Livestock grazing
4. Hand weeding and mechanical cultivation
5. Flame, heat, or electrical techniques
6. Plastic or other synthetic mulches:  
   - Must be removed from the field at the end of the growing season.

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**Level C**

Biopesticides and National List Allowed Materials

- Biological or botanical substance
- Materials from the National List of Allowed and Prohibited Substances
- Document conditions for use in the organic system plan
**Biological or Botanical Substances**

**Nonsynthetic herbicides**

Citric acid types, vinegar included as an inert ingredient:

- Alldown
- Ground Force

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**Biological or Botanical Substances**

**Nonsynthetic herbicides**

**Organisms or their extracts:**

- **Corn Gluten Meal**
  - Byproduct of the corn wet-milling process.
  - Potential as a natural pre-emergence herbicide.
  - Inhibits root growth of germinating plants.
  - Contains 10% nitrogen.
Synthetic substances allowed for use in organic crop production

1) Herbicides, soap-based for use in farmstead maintenance (roadways, ditches, right of ways, building perimeters) and ornamental crops.

2) Mulches
   i. Paper
   ii. Plastic mulch
      iii. Biodegradable biobased mulch film

Allowed Synthetic Substances

Mulches

- Plastic mulch and covers [petroleum-based other than polyvinyl chloride (PVC)]

- Biodegradable biobased mulch film as defined in §205.2.
  - Must be produced without organisms or feedstock derived from excluded methods.
  - Mulch and pigment made from Mater-Bi corn starch.

- Newspaper or other recycled paper, without glossy or colored inks.
Concluding Remarks

- IWM is used in both conventional & organic cropping systems
- **Conventional:** Reduces the need for chemical control addresses herbicide resistance.
- **Organic:**
  - Highly regulated and requires preventive and cultural approaches as primary measures.
  - Herbicides are restricted to biologicals and botanicals.
  - Soap-based herbicides only for non-crop areas or ornamentals.

Thank you!