**Alternative Weed Control Strategies**

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**Talk Overview**

- Why Manage Weeds?
- Herbicide costs and benefits
- Integrated weed management
- Weed management tactics
- Weed management resources at MSU

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**Why Manage Weeds?**

- **Yield Loss**
- **Harvest Interference**
- **Pest Interactions**

Estimates of average crop yield losses due to weeds range from 12-25% (Pimentel et al 2000; Parker and Fryer 1975).

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Pepper Harvest in Saginaw MI (Brainard Lab, MSU).

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**Why Manage Weeds?**

- **Yield Loss**
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Meadow Voles girdling dwarf trees

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**Herbicide Use**

<table>
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<tr>
<th>Total pesticide use on major crops, 1964-2001</th>
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<td>Million pounds of ai</td>
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<td>&gt;60% Total Applied Pesticides!!!</td>
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Source: Economic Research Service
Herbicide Costs and Benefits

**Pros**
- Can be Cheap!
- Low Labor!
- Broad Spectrum!

**Cons**
- Can be expensive
- Crop Damage
- Human Health Risk
- Resistance Susceptible

Herbicide Crop Damage

- Overspray: Roundup on apples
- Drift: Dicamba on tomatoes

Herbicide Resistance

- Overspray: Roundup on apples
- Drift: Dicamba on tomatoes

Integrated Weed Management

- Apply knowledge of pest life cycles to identify and target weak points
- Prevention better than treatment
- “Many little hammers”: Use multiple tactics to maximize effectiveness and minimize risks

Annual weed life cycle

- Emergence
- Seed germination
- Establishment and growth
- Seed production
- Seed dispersal
- Seed burial

Future costs of seed production

- “One year’s seeding, seven years weeding”

Brainard 2002
“Many little hammers”

1. Mechanical
2. Cultural
3. Biological
4. Chemical

Mechanical/Physical: Cultivation

Rotary Hoe
Inter-row cultivation

Direct Mortality: Cultivation

Establishment and growth
Seed production
Seed dispersal
Seed germination
Seed burial
Emergence

“Weed seedbank”

Methods: Preliminary Exp.

- Sites cultivated once per month May-August
  - Sparta and Flushing sites cultivated with a Wonder Weeder implement
  - Potterville site cultivated with a grower built implement
- Monthly weed measurements on 3 rows cultivated & 3 rows grower standard practice
- Also collected soil samples in June and August, leaf nutrient samples in June, mite counts in July and terminal growth of trees

“Wonder Weeder”

Yr 1 Results: Weed Coverage

- Cultivation greatly reduced ground cover compared to no treatment
- Cultivation was comparable to burn down herbicides
- Pre-emergent herbicides had less ground cover

% Bare Ground

0 20 40 60 80 100
05/12/10 05/28/10 06/10/10 08/06/10 09/06/10


Graph showing weed coverage over time with different treatments.
Cultivation greatly reduced ground cover compared to no treatment.

Cultivation was comparable to burn down herbicides.

Pre-emergent herbicides had less ground cover.

Yr 1 Results: Weed Coverage

Biomass significantly reduced compared to no herbicides.

Biomass comparable to herbicide treatments.

Herbicides Applied

Cultural Weed Control

- Select competitive resistant varieties
- Provide optimal growing conditions
- Irrigate and fertilize crop, not weeds
- Transplant to give crop head-start
- Increase planting density and planting uniformity

"Many little hammers"

1. Mechanical
2. Cultural
3. Biological
4. Chemical
Manipulating competition: Cover Crops

Manipulating weed seed germination

“Stale seed bed”: stimulate germination and kill weeds BEFORE crop emergence

“Many little hammers”

Crop rotation: Downy brome in wheat

“Seed production”

Seed

“Seed germination”

Establishment and growth

Seed dispersal

Seed burial

Emergence

“Seedbank”

Seed bed preparation

Stimulate weed seed germination

Kill weeds

Plant crop

Too deep for most weed emergence!

http://www.steamweeding.co.nz/information/index.html
Red clover effects on weed seed predation

Davis & Liebman 2003

“Many little hammers”

1. Mechanical
2. Cultural
3. Biological
4. Chemical

Some key points

- Prevention is critical. Easier to avoid seed production than to promote seed predation and decay.
- Knowledge of the biology and ecology of weeds is useful for determining optimal management strategy.
- Mechanical control (cultivation) has been foundation of alternative weed management, but has limitations.
- Cultural practices like crop rotation, planting density etc have great potential.
- “Many little hammers” necessary for successful management.

Organic Herbicides

- Citrus and other essential oils
- Citric/Acetic acid
- Some have crop restrictions
- All are contact post emergent herbicides

Integrated Weed Management: One Year’s Seeding

1. Weed life cycles and seedbank dynamics
2. Soil properties
3. Soil organic amendments
4. Tillage
5. Integrated crop and weed management
6. Crop rotation
7. Physical weed management
8. Herbicide management
9. Biological weed management
10. Prevention: a key to long-term management

Appendices: Weed Profiles: The Dirty Dozen, IWM on 4 Mich. Farms...

MSU Resources

Integrated Weed Management: Fine Tuning the System

Fine Tuning the System

2006
- Survey of “One Year’s Seeding...”
- On-farm trials- SARE Grant
- Received funding for “Fine Tuning”
- 10/F
- Project GREEN

2008
- On-farm trials continued
- Flaming time of day
- Green interviews & rotations
- Bulletin writing and design
MSU Resources: MSU Diagnostics

http://www.pestid.msu.edu/

Weed Management Talk Wed. 2/19/2014

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- MSU Project GREEEN

MSU OPM Lab

Michigan Apples
GREAT LAKES, GREAT FLAVORS