Mechanical Weed Management in Organic Crops

John Masiunas
University of Illinois
Mechanical Weed Management in Organic Crops

- Necessary to understand in a system context
  - What role does tillage play in your farming system?
  - What tillage tool is critical for your farming system?
- Tillage or lack of tillage affects vertical and horizontal distribution of weed seed and vegetative propagules
Tillage and cultivation

- Timing and weed size are critical
- Tilling in fall can eliminate winter annuals and biennials along with injuring perennials
- Spring tilling can eliminate first flush of summer annuals
- Most effective methods are burial to ½ inch or cutting at soil surface
Tillage and selectivity

• Selectivity is the ratio between weed control and crop injury
• Selectivity greatest when crops differ from weeds in:
  – Growth habitat
  – Emergence time
  – Maturity time
• Weeds with short emergence period better controlled than those with longer emergence period
Tillage and cultivation

• Vary your tillage and cultivation tools to fit the situation
• Cultivation is best done when weeds are small
• Shallow tilling when weeds are in the white thread stage will avoid bringing up weed seed
• Burial versus uprooting versus cutting
  – Burial works best for small weeds especially in the crop row
  – Burial best done when crop is larger than the weed
  – If burying small weeds soil must be dry
Tillage and cultivation

• Burial versus uprooting versus cutting
  – Aim of uprooting is to eliminate soil-root contact
  – Uprooting weeds works best when the soil is damp
  – Remove as much grass roots as possible because growing point is near soil surface
Tillage and cultivation

- Burial versus uprooting versus cutting
  - Slicing or cutting can effectively destroy shoot-root connection
  - Best done when soil is dry
  - Some hoes such as stirrup hoe are designed to be pulled over soil surface to cut off weeds
  - Some weeds such as purslane and crabgrass will reroot
Stale seedbed

• Soil tilled early
  – Encourages early weed flushes
• Delay cropping until main flush of weed emergence has passed
• Emerged weeds killed with shallow tillage, flaming, or organic herbicides
  – Do not till below $\frac{1}{4}$ to $\frac{1}{2}$ inch
Blind tillage

- Shallow tillage of entire field after crop seeded
- Stirs soil above level of crop seed placement
  - Causes desiccation and death of tiny germinating seed
- Most effective when soil fairly dry and weather warm
- Provides the crop after emergence about a 10-day weed free period
- Examples: rotary hoes, flex-tine harrows, chain link harrows
Example 1: Rotary hoe

- Rotary hoes designed for low or high residue fields
- Can be used PRE or POST as long as crop more deeply rooted than weed
Rotary hoe

- **Advantages**
  - Rapid to use

- **Disadvantages**
  - Large seed crops only
  - Don’t hoe bean crops in crook stage
  - Will not kill green weeds
Example 2: Flex-tine harrows

- Used broadcast over and between crop rows
- Most efficient when weeds are in white thread or cotyledon stage
- Rely on differences in emergence and rooting depth of crop versus weed
- Small seeded weeds best control
Flex-tine Harrows

- Advantage
  - Operated at fast speed
  - Do not require much modification
  - Break soil crusts
  - Sections over crop row can be lifted to avoid injury
Flex-tine Harrows

• Disadvantages
  – Primary action of postemergence harrowing is weed burial
    • Need to cover 1 to 1.5 inches
  – Cultivation timing is critical
    • Does not control grasses at any stage
    • Only controls broadleaves less than 4 leaves
  – Must be integrated with more aggressive cultivator
  – Can reduce stand when used before crop well-rooted
Between-row cultivation

• Should not be primary weed control
• Selectivity can be low
• Implement when weeds one inch tall and crop large enough to not be covered by dirt
• Usually requires more than one pass
• Examples: finger weeders, brush hoe, spyders + tension weeders
Finger Weeder

- In row weed control
- Three pairs of ground-driven rotating fingers
  - Front two pairs push soil and uproot weeds away from row
  - Rear pair pushes soil into row covering missed weeds

Finger wheels tilted downward
Slow speeds and adjusted so very near crop row
Finger Weeder

• Advantages
  – Excellent in-row weed control
  – Lightweight tool can be used with small tractor

• Disadvantages
  – Timing critical – very small weeds (up to 1 inch), crop must have sufficient stem strength
  – Between-row weed control poor
  – Slow, precise tillage is necessary
  – Manufacturer: Buddingh Weeder Co.
    7015 Hammond Ave., Dutton, MI
    Phone: (616) 698-8613
Brush Hoe

- PTO-driven plastic bristles rotate on horizontal plane, ripping weeds from soil
- Very aggressive
  - Shields above soil to protect crop row
  - Operator on rear seat required to steer shields over crop row

Source: European Weed Research Society
Brush Hoe

- Advantages
  - Can control weeds up to ten inches tall
  - Effective on slightly moist soils
  - Soil passing under shields smoothes weeds in crop row
  - Dust layer from brushing delays new weed germination
Brush Hoe

• Disadvantages
  – Requires two operators
  – Cultivated crops must have same spacing
  – Implement is costly

• Manufacturer
  – Baertschi FOBRO, 1715 Airpark, Grand Haven, MI 49417, Phone: (617) 847-0300, Fax: (616) 842-1768
Summary

• Integrate mechanical weed management with farm goals and systems
• Maximize selectivity
• Minimize weeds emerging with crop through blind tillage
• Do not use cultivation as primary weed management method