Cultivation tools and techniques

Sam Hitchcock Tilton
Lakeshore Technical College

Practical Farmers of Iowa Conference
January 16, 2020
The Big Picture

- Seedbed preparation
  - Tillage
  - Layout
  - Size difference between crop and weed
    - Low weed seed bank
  - Stale seedbed
  - Blind cultivation
  - Planting
  - Between-row cultivation
  - In-row cultivation

Ecological

Metallurgical
Ecological weed management - Reduce your weed seedbank

What is 20% of 10?

vs

What is 20% of 1000?

Eric Gallandt, UMaine
A model to understand crop, weed, and cultivator

Our mechanical tools will apply an even force - that’s the best they can do . . .

But neither crop nor weed are uniform sizes

Adapted from Kurstjens, 2004
A crop with a **Size Difference** allows us to tune-in the cultivator more precisely.

Adapted from Kurstjens, 2004
A crop with **Uniformity** allows us to tune-in the cultivator more precisely.

- Crop population to be as even as possible - similar root length and top height
- So that tool force can be dialed in right at the sweet spot
- Being as aggressive as possible while preserving our crop

Adapted from Kurstjens, 2004
False Seedbed - a **Size Difference** for your crop

Seed bed preparation  \rightarrow  Stimulate weed seed germination  \rightarrow  Kill Weeds (Till or flame)  \rightarrow  Plant crop

Key Goal: Drain Weed Seeds from Soil Surface

Don’t cultivate below ~1.5” or you’ll bring these seeds to surface!

Merfield, C. N. (2013). The BHU Future Farming Centre
False Seedbed - Results

Even in performing a False seedbed, uniformity is important - soil moisture
Flame weeder – for a Stale seedbed

Seed bed preparation

Stimulate weed seed germination

Kill Weeds (Flame or cultivate)

Plant crop

Weed seed

Crop seed

Key Goal:
Drain Weed Seeds from Soil Surface

1.5”

Don’t cultivate below ~1.5” or you’ll bring these seeds to surface!

Merfield, C. N. (2013). The BHU Future Farming Centre
Seedbed - **Uniformity** for your crop

An uniform seedbed is the first step in a uniform crop

You don’t want half of your crop twice as big as the other half - now you have two different crops to manage

You know that seeds want oxygen and moisture to germinate - the better tilth your soil has, the more even conditions you will have

Prepare your field so that your planter can place seeds precisely and uniformly, leaving every seed in the field in as similar conditions as possible.

- Supply even soil moisture for all plants
- Clods will let weeds survive in their ‘shadow’
Planting - **Uniformity** for your crop through population

Plant your seeds at the same depth, so that they emerge at the same time and are rooted with the same force.

Who is recommending your population?

For mechanical cultivation, especially blind harrowing - increase seeding rates by 5-10% from conventional.

Question conventional row spacing - in Organic we want canopy closure as quickly as possible.
Seeder - Set-up

Don’t just measure at the toolbar - measure at the business end

½ inch!
## Planting - Match seeder to cultivator

<table>
<thead>
<tr>
<th>Planter rows</th>
<th>Cultivator rows</th>
<th>Ok?</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6</td>
<td>![thumbs-up]</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>![warning]</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>![thumbs-up] ![warning]</td>
</tr>
<tr>
<td>6</td>
<td>12</td>
<td>![warning]</td>
</tr>
</tbody>
</table>

John Deere Co.
Planting - Guidance (Now or later)

Location of Tractor axle vs. Location of implement
Planting - Special considerations for small grains

Wider rows so that tools can fit
Planting - Special considerations for small grains

Band Sowing

Source: Kolb, Mallory, and Gallandt
Pre-emergence Harrowing - Get that Size Difference

To maximize blind harrowing, plant as deeply as possible to maximize time between crop and weed emergence and to give you more play with tool working depth.

Source: Cornell University Horticulture
First Steel in the Field!

Rotary Hoe

- Needs a soil crust - poor in sand or tight clay
- 1-2 day effective window
- Poor with residue (options)
- Only tool to cultivate corn at 1-2 leaf stage
- Must be used at high speeds - 6-12 mph
- Wear out faster than flex-tine

Flex-tine harrow

- More aggressive than Rotary Hoe
- Better in light soil without crust
- Holds value
First Steel in the Field!

Vulnerable stages of weeds

- **ROTARY HOE**
  - Annual grass
  - Lamb's quarters
  - Wild buckwheat

- **FLEX-TINE HARROW**

Claude J. Bouchard and Romain Néron. Direction des services technologiques, MAPAQ.
• Start scouting after just 3 days

• Best window for pre-emergence pass is when the corn has sprouted but is still 3/8” from the surface

• Flex-tine is best here 6-9 mph

• Make Rotary Hoe pass when most corn is spiked and healthy

Source: Mechanical Weeding of Corn, Douville and Coulombe
Harrowing - Timing for Beans

Source: Mechanical Weeding of Soybeans, Douville
Blind Harrowing (post-emergence)

Adjust tine angle from pre-emergence to post-emergence

Goal for harrowing or Rotary Hoe - 4% crop death or less

If you’re too aggressive with the flex-tine, try raising the tines right over the row (then steering becomes important)
Flex-tine 2.0 - Dealing with uneven ground

- Hydraulic cylinders - Einbock
- Springs - Treffler
Mounting - Anatomy of a 3-point linkage

Photo: Walterscheid GmbH
Cultivator - The spectrum of improvements - Level 1
How tight, thine sway bars?

Available coulter steering kits

Photo: Gary McDonald
Mounting Sweeps - Vibro Shanks

Photo: Schmotzer

ca. 2 - 3 cm

kapillares Bodenwasser

200mm - 410mm
Knives - Move less soil

Side-knives, with ‘cranked’ shanks

T-blades, or slashers

Low rake angle
Cultivation philosophy - European vs. American

Killing weeds through soil movement

versus

Killing weeds through cutting and uprooting
In-row tools: The Final Frontier

Kill current weeds by uprooting and prevent future weeds by breaking capillary action.

Forward hip angle moves soil out of the row.

Backward hip angle moves soil into the row.

Photo: KULT-Kress
Finger weeders - crumble the soil in a narrow band
Cultivator - The spectrum of improvements - Level 2

New tools solve problems
AND may create others
Cultivator - The spectrum of improvements - Level 3

Retro-fit a 6-row cultivator
6 finger weeder assemblies
12 vibro-springs
12 sweeps and shanks

~$7,000

But how will you steer it?

KULT-Kress, Brainard Lab, MSU
Cultivator - Guidance, RTK

What does RTK steer?

Limitations of RTK

Get the accuracy that you’re paying for

How tight, thine swaybars?

Direct-seeded onions

Guidance on Cultivator

Steketee
Cultivator - Guidance nuts and bolts

I. Camera

II. Look

III. Row

IV. Crop

Source: Gallandt, and Garford Co.
Cultivator - Guidance, Camera on cultivator

Number of rows relates to number of cameras needed

Limitations - tractor shadow, lighting, wind, weed size, stand

2.5mph first pass
Later 5-7mph

Side-shift hitch with one camera
$30-40k

Photo: KULT-Kress
Camera Guidance - Will not erase previous sins

Must have a minimum height difference of ~4” between crop and weed

Manual override
Cultivator - Guidance, other options

- Mirrors
- Go-pro camera to cell-phone
- Older wand steering system
- Mid-mount cultivator
- A stick - really
Beyond Steel - Erasing previous sins
Beyond Steel - Erasing previous sins
The Cultivation Progression

- **False or Stale seedbed**
  - (7-10 days before planting)

- **Pre-emergence Flextine or Rotary Hoe**
  - (~2-3 days after planting)

- **Post-emergence Flextine or Rotary Hoe**
  - (~3-4 days after emergence)

- **Between row Cultivator - Knives only**
  - (~15-21 days after planting)

- **Between Row Cultivator w/ finger weeders**
  - (~21-28 days after planting)

- **Between row Cultivator w/fingers, perhaps hilling**
  - (If necessary, ~28-40 days after planting)
Come see all these tools in action!

Wednesday, September 16th 2020
Pheasant Ridge Farm
Cedar Rapids, IA

National Geographic

Acknowledgments - Dan Brainard & Bernie Zandstra (MSU), Christian Kirchoff & Michael Smith & Kim Haug (KULT-Kress), Leonard Mol (Steketee), Hans and Dave Bishop (PrariErth Farm), Theo Remij (Frato), Clyde Morter (Guy Machinery), Charles Merfield, Peter Seely