Sweat, Brain-Power, Horsepower, and Time -
*The Keys to Controlling Weeds*

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Weeds the universal pest - all crops and all cropping systems

• Weeds do not discriminate and cause losses wherever they are found:
  - From the smallest of home gardens to the largest of corporate farms
  - From alfalfa to zucchini
  - From America to Zimbabwe
  - In both conventional and organic crop production systems
Cost of weeds

- Reduce crop yield
- Lower crop quality
- Significantly add to the cost of crop production

Should handweeding be considered a viable, realistic weed control option?

It is obvious which onion came from a weedy field.
Why are weeds so difficult to control?

- Weeds will capitalize on a niche
- Multiple weed species are present in any given field
- Weeds quickly respond to selection pressure — any form of selection pressure
  - ‘Introduction’ of a new species
  - Genetic diversity of weed increase chances for ‘survivors’

At least 6 different weed species in this picture. Which is the worst weed of the mix? All are potentially devastating species.
The *how* and *why* of weeds being a problem is the topic of our next speaker, my co-worker Dr. Ted Webster.
My topic of discussion is how to manage weeds

- Traditional approach to discussing integrated weed management
  - Cultural weed control
  - Physical/mechanical weed control
  - Substituted inputs for weed control

Cultural weed control

Physical/mechanical weed control (cultivation, tillage)

Substitution inputs (herbicides, solarization)
A different approach to explaining weed management ……

• Sweat
• Brain-power
• Horse-power
• Time
In this presentation, there will be data presented on weed management in organic peanut. Consider peanut to be a ‘case-study’ crop and these results are generally applicable to other crops.
Sweat

- Associations when I hear the word ‘sweat’
  - Perspiration due to hard work
  - Intense pressure
  - Drudgery
- Weed control is all of these and there is no separation between ‘sweat’ and ‘weed control’.
Sweat From *Hard Work*

- To date, none of my research results suggest that handweeding can be totally eliminated from an organic crop production system.
  - Best performing cultivation treatments
    - 8 man-hours/A of handweeding (about $56/A).
  - Mediocre performing cultivation treatments
    - 54 man-hours of handweeding ($375/A)
  - In this experiment, 64% of the plots were too weedy to consider handweeding to control escapes.
  - There is no escaping the ‘sweat-factor’ of handweeding.
  - We try to *minimize* handweeding.
Sweat From Intense Pressure

• *Intense pressure* from having to successfully manage weeds in organic cropping systems, otherwise there will be a crop failure.

• *Intense pressure* to be timely.

• *Intense pressure* to abide by the National Organic Standards.

• *Intense pressure* to succeed in an extraordinarily high risk venture.
The Pressure to be Timely

Timing of the first cultivation is the single most important action for weed control in organic peanut. 

If you see weeds, it is too late!!!!

<table>
<thead>
<tr>
<th>Time of first cultivation</th>
<th>Crabgrass control (visual control estimates %)</th>
<th>Peanut yield (lbs./A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
<td>2009</td>
</tr>
<tr>
<td>At peanut emergence</td>
<td>90</td>
<td>89</td>
</tr>
<tr>
<td>1-wk later</td>
<td>60</td>
<td>84</td>
</tr>
</tbody>
</table>
Proper timing is essential when cultivation is the primary method of weed control in organic crop production.

If you see weeds, it is probably too late.

Begin cultivating at this stage of crop growth.

.....which is this stage of weed growth – weed seed have sprouted, but have not emerged.
# Pressure From Needing to Succeed

<table>
<thead>
<tr>
<th></th>
<th>Peanut yield (lbs./A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008</td>
</tr>
<tr>
<td>Our best cultivation regime</td>
<td>3080</td>
</tr>
<tr>
<td>No cultivation</td>
<td>1880</td>
</tr>
</tbody>
</table>

- Failure to cultivate in a timely manner resulted in a 47% yield reduction.
- In practice, yield loss should have been 100%. Most growers would not have bothered to harvest the weedy plots. We harvested the very-weedy plots for the purpose of science.
Our Best Cultivation Regime in Organic Peanut

- Cultivate at least 3X at weekly intervals with a tine weeder, starting just prior to peanut (and weed) emergence.
- Continue cultivating with tine weeder, if needed, until 6 weeks after emergence.
- Replace the tine weeder with a sweep cultivator if needed.
- Experience tells me that this general regime is equally applicable in other organic agronomic crops.
Brain-Power for Weed Control

- **Common sense** is a valuable tool for weed control.
- **Examples of using innate knowledge to assist with weed control.**
  - Use proven crop production practices to capture the benefits of crops competing with weeds \((\textit{cultural weed control})\)
  - Deplete weed seed in the soil
  - Prevent weed seed production
Brain-Power as a Weed Management Tool – Cultural Weed Control

- **Row spacing to shade weeds**
  - Quicker canopy closure to shade soil surface and suppress weeds
  - Narrow row patterns make cultivation more difficult
Brain-Power as a Weed Management Tool – Cultural Weed Control

• Seeding rate/plant spacing to shade weeds
  – *Intra-row* plant spacing is equally important as *inter-row* spacing.
  – Uniformity of plant spacing is crucial
Skippy Crop Stands and Weed Problems are Directly Related

It is impossible to manage weeds in organic peanut with a skippy stand.
Intra-Row Plant Spacing Effects on Weed Control

Twin rows, 3 seed/ft.  
Twin rows, 6 seed/ft.

Which is less costly: More seed or additional weed control, like hand-weeding?
Horsepower for Weed Control

• ‘Horsepower’ and ‘Sweat’ in many ways have the same connotation.
• ‘Horsepower’ expanded also refers to tillage and seedbed preparation necessary to promote crop growth and weed suppression \((\text{cultural weed control})\)
Horsepower for Weed Control

- Conventional tillage systems, *horsepower* allows us to:
  - Manage the placement of soil amendments
  - Prepare an optimum seedbed
  - Cultivate for weed control

- No-tillage systems, *horsepower* allows us to:
  - Plant high-residue cover crops
  - Manage the cover crop for maximum weed suppression
  - Prepare an optimum seedbed
Horsepower for Weed Control

• Deep tillage to bury weed seed
  - It is scientifically proven that deep tillage buries more seed that it exhumes.

• Stale seedbed tillage
  - Prepares a seedbed with good soil-seed contact.
  - Multiple shallow tillage partially depletes numbers of viable weed seed before planting.
Horsepower

Of course, horsepower means cultivation for weed control.

Cultivation has been the most consistent and effective weed management tool in our research program.
The Time Factor for Weed Control

- Time is the most valuable input in organic crop production.
  - Weed control must be the No. 1 priority during the early growing season.
  - Time required to actually control weeds.
  - Time needed to sustain weed control across many growing season.
### Time and the Costs of Time to Use Supplemental Handweeding in Organic Peanut Cultivation

<table>
<thead>
<tr>
<th>Cultivation regime</th>
<th>Man-hours</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>VE/1-wk</td>
<td>22 hrs/A</td>
<td>$154/A</td>
</tr>
<tr>
<td>VE/2-wk</td>
<td>42 hrs/A</td>
<td>$294/A</td>
</tr>
<tr>
<td>VE/1-wk/2-wk</td>
<td>8 hrs/A</td>
<td>$56/A</td>
</tr>
</tbody>
</table>

- **VE** - cultivation beginning when peanut emerges.
- Assumes labor cost of $7/hr.
- This is handweeding to supplement cultivation for weed control.
- A point of comparison: Handweeding a nontreated control took 185 hrs./A, costing $1,300/A.
Time Required to Sustain Intense Weed Control and Reduce Numbers of Weed Seed

- **Pigweed**
- **Lambsquarters**
- **Total weeds**
What Happens Over Time if Intense Weed Control is Halted?

If weed control is halted, it does not take very long for weed seed numbers to rebound and erase years of hard work.
Weed Control in Organic Crop Production

- There is not a package approach to weed control. Weed control will never be that easy.
- “No one size fits all”.
- Academically, this is how we describe organic weed control:

- Cultural weed control
- Physical/mechanical weed control (cultivation, tillage)
- Substitution inputs (herbicides, solarization)
However, organic growers do not live in the world of academia.

They live in the very real world of trying to make an organic crop production enterprise succeed, where the stakes are high and the challenges daunting.
Time

Sweat

Successful Weed control

Brain-power

Horsepower