

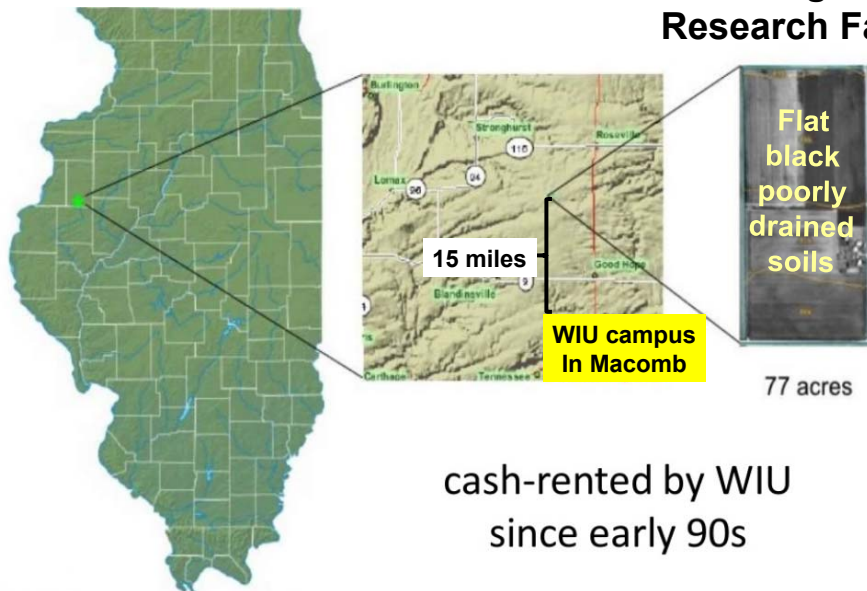
Introduction to organic weed management

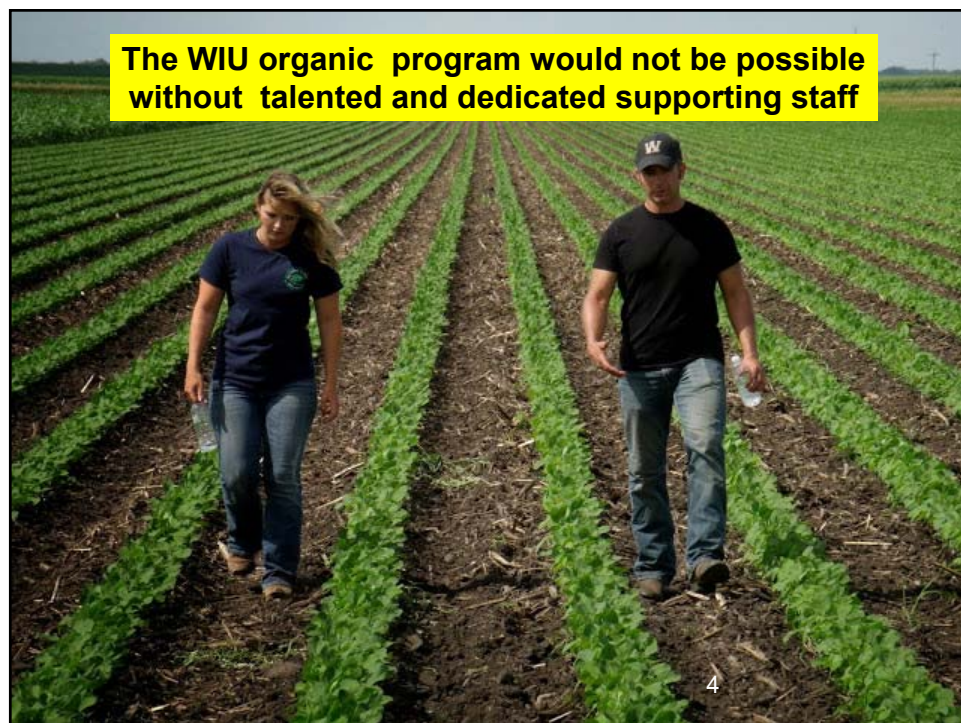
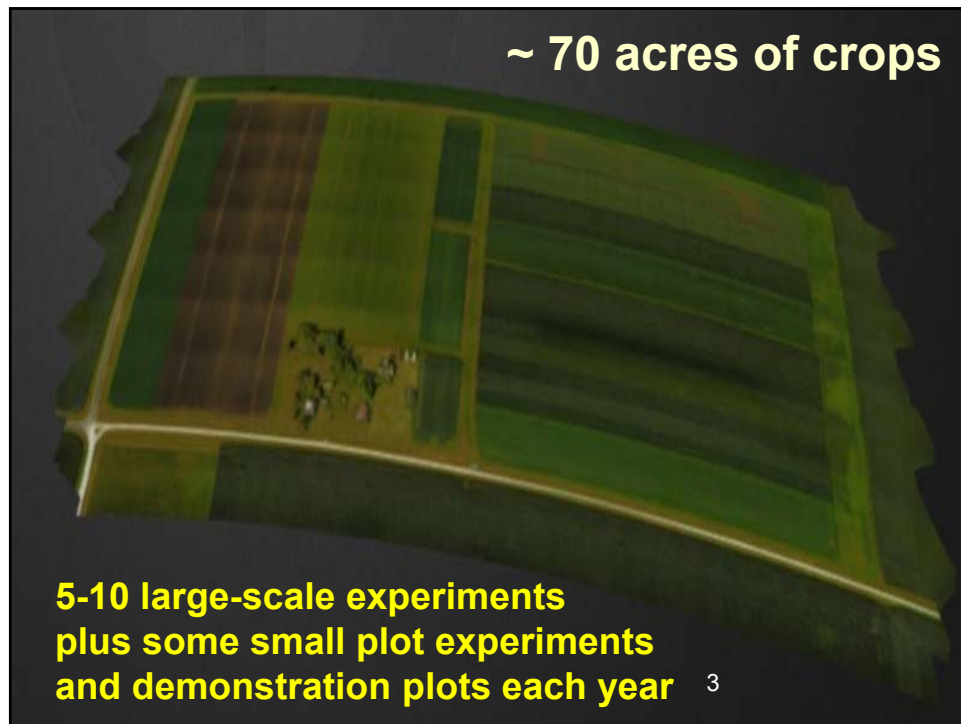
Joel Gruver
School of Agriculture
Western Illinois
University

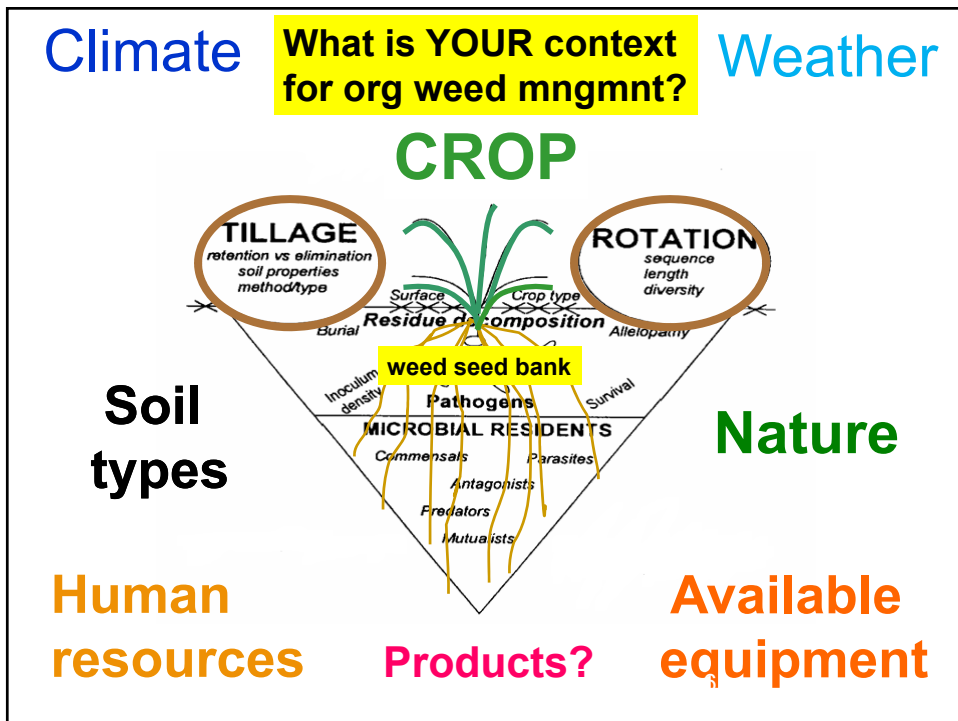
1

250 miles SW of Madison, WI

**WIU Organic
Research Farm**



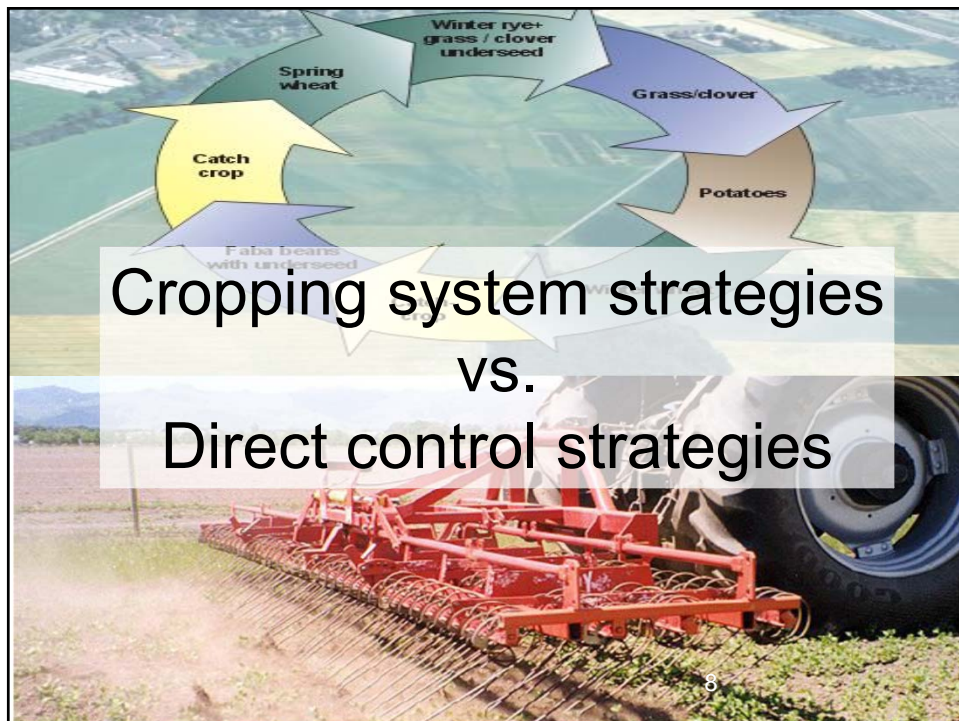




Practices >>> Products

Effective
organic weed
management = Integration of
many little hammers

No one practice or product will **consistently**
provide acceptable organic weed control

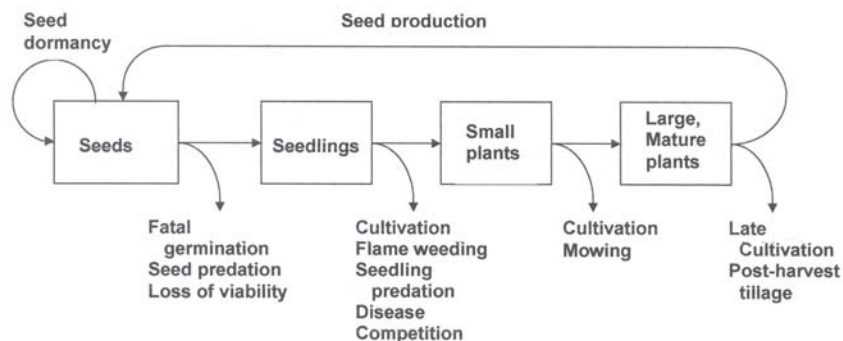


Cropping system strategies *aka cultural practices*

Crop rotation
Tillage rotation
Cover cropping
Crop management
Water management
Nutrient management
Field/equipment/seed sanitation

Effective CS strategies

increase crop competitive advantage



and **disrupt weed life cycles**

Increasing crop competitiveness

**Select well adapted genetics (maximum leafiness
and rate of canopy closure)**

**Delay field work (soil must be warm enough for
rapid crop emergence)**

Prepare a good seed bed (start out clean)

Increase crop populations / reduce row spacing?

Optimize planter performance

Apply starter fertilizer???

Delay planting to allow at least 1 good flush of weeds

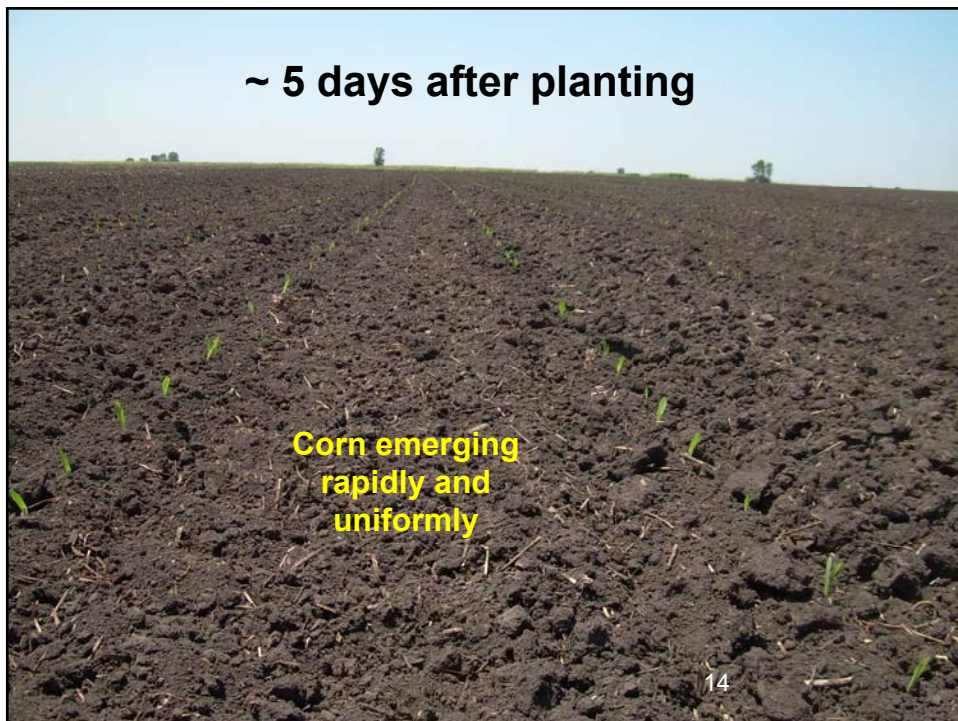


Should we have waited a few more days?



~ 5 days after planting

**Corn emerging
rapidly and
uniformly**



**Establishing a good stand is our primary
weed control strategy in small grains**



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**High weed pressure in a spring planted oat field
where a strip was left unplanted**



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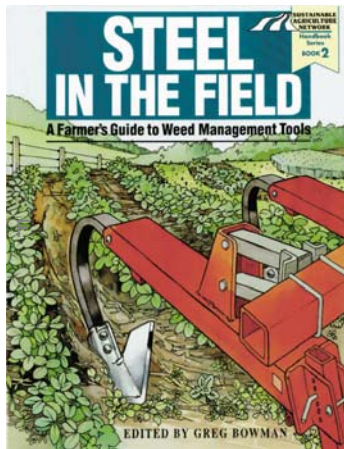


Depleting the soil seed bank

- Understanding seed longevity (e.g., most grass seeds only survive a few years) and dormancy mechanisms
- Preventing seed production
 - walking fields, pulling the plug on excessively weedy crops
- Promoting seed predation & decay
 - delaying tillage, maintaining cover
- Fallow periods (bare vs vegetative)
- Ley rotations (alternating annual crops w/ sod)

Over application of manure

- Many weed species are highly responsive to soil fertility.
- Weeds often have 1.5 to 3 X higher N, P, K, & Ca concentrations than the crops they are growing with.
- Excess fertility increases weed growth rates and may enhance weed germination.



Free download

ABCs of mechanical and cultural weed management *Page 11 – Steel in the Field*

- A. Give the crop the advantage.
- B. Keep weeds on the defensive.
- C. Accept weeds that don't really matter.

**Excellent reference describing
equipment for direct control of weeds**

<http://www.sare.org/Learning-Center/Books/Steel-in-the-Field>



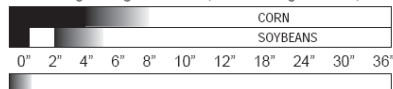
What is blind cultivation?

Blind cultivation occurs before the crop emerges or shortly after emergence



Standard Rotary Hoe

CROP height range estimate (must be large-seeded)

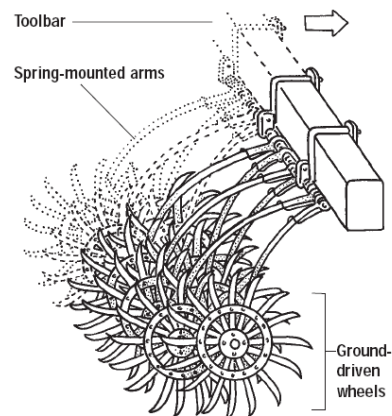


WEED height range (annuals) estimate

☒ suitable
 ☐ less suitable
 ☐ unsuitable

Match tillage timing, depth and location to crop root growth. Weed control varies with soil conditions and weed density.

Overview: In clean-tilled or low-residue fields, the sharp-edged, rounded teeth on rotary hoe spokes aggressively uproot weeds in the pre-emergent, white-root stage. Hoes work before or after crops are up, as long as crop seed is more deeply rooted than weeds and crop tissue damage is not too severe. Rotary hoes are used for "broadcast" cultivation, i.e. lightly tilling their full width at 1" to 2" deep without regard to crop rows. Faster speed enhances surface aggressiveness but decreases penetration. Rotary hoes have a vertical entrance and surface shattering action ideal for aerating crusted soils. Increase corn seeding rate about 2 percent per intended mechanical pass to compensate for possible plant population reductions.

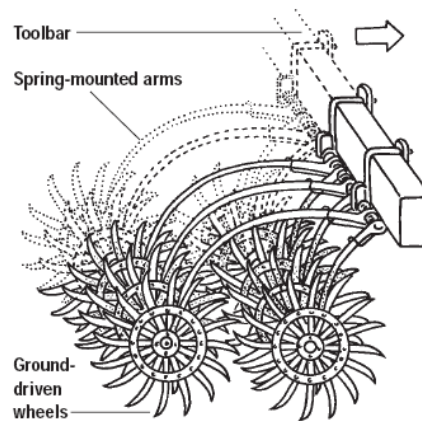


High-Residue Rotary Hoe

Working ranges same as for standard hoe

Overview: Same operating principles as standard rotary hoe (previous entry), but works in fields with up to 60 percent residue *as long as teeth still are able to penetrate into the soil surface*. Optional knives and spacers help to cut residue and reduce plugging. (See below.)

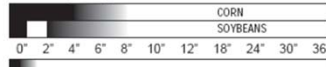
Design Features: Greater clearance for residue flow than standard hoe; built with more distance between front and rear wheels as well as between the toolbar and soil surface. Wheels are self-cleaning.



Flex-Tine Weeder

Overview: Spring wire tines scratch the soil surface to uproot tiny weed seedlings. Up to 25 tines per toolbar foot are mounted in a staggered fashion on three or six mounting bars, resembling the layout of a spike-tooth harrow. The bent tines vibrate rapidly and glide around or over obstructions. A tine weeder works in loose or lightly crusted soil with no long-stemmed residue. When used postemergence, crops must be well-rooted. Excellent within its limits for high speed, preemergence and early postemergence broadcast weeding. Stiffer tines break through heavier crusts but lose some of their vibrating action.

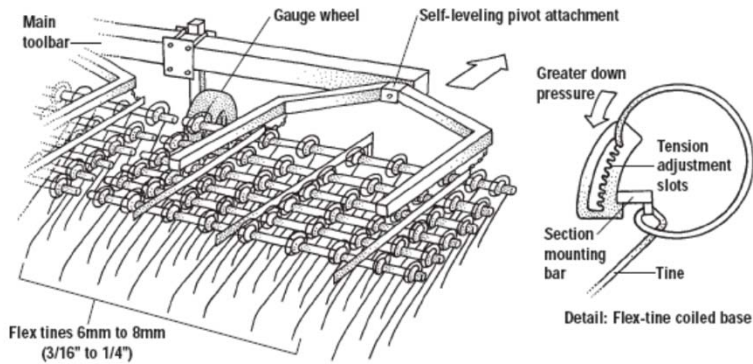
CROP height range estimate



WEED height range (annuals) estimate

■ suitable ■ less suitable □ unsuitable

Match tillage timing, depth and location to crop root growth.
Weed control varies with soil conditions and weed density.



Tine weeding has worked well for soybeans (pre- and post emergence). We have had much less success with corn.



Early season weed control: Part 2

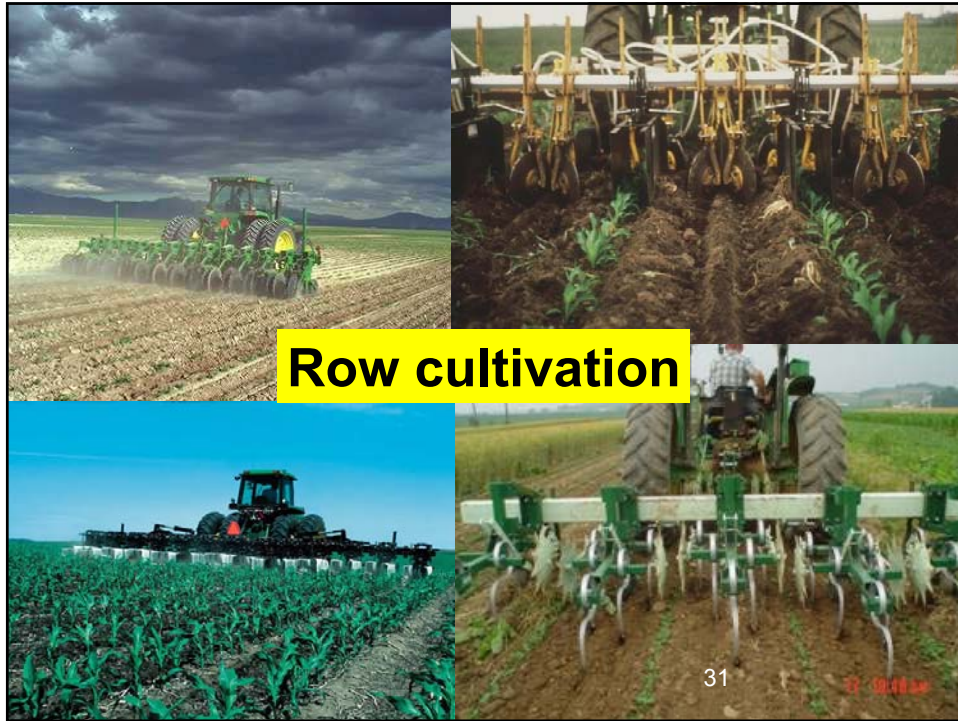
By Klaas and Mary-Howell Martens, Lakeview Organic Grain
Originally posted on February 10, 2005

The goal of blind cultivation is to remove the initial flushes of weeds when they are very small and most sensitive to disturbance. Blind cultivation takes advantage of the difference in size and sprouting depth between crop and weed seeds. Most weed seeds are smaller than crop seeds, and they germinate shallower in the soil. **Annual weeds are most sensitive to disturbance from after germination to emergence. At these early stages, breaking contact between the tiny roots and the soil will kill most weed seedlings.**

Blind cultivation works best when the soil is loose and in good physical condition and the crop is actively growing. By stirring and shaking the top inch of soil, early season weeding or blind cultivation creates a loose dry layer of soil that is too dry and airy for weed seeds to germinate or grow in. This layer also serves as a dry mulch that conserves soil moisture. The crop seeds are safely below this layer and are not hurt by a shallow weeding before emergence.

Blind cultivation
terminates white root
seedlings & creates a
soil surface environment
unfavorable for weed
germination





Low-Residue Cultivator

Intended for conventionally tilled, light to moderate soils with small stones and up to 20% tilled residue.

CROP height range estimate

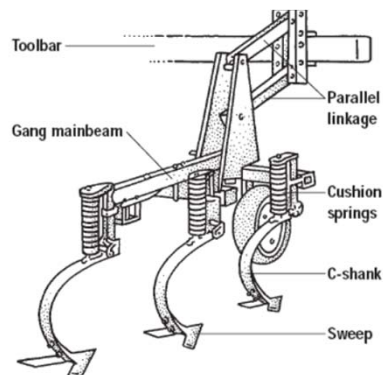


WEED height range (annuals) estimate

■ suitable ■ less suitable □ unsuitable

Match tillage timing, depth and location to crop root growth. Weed control varies with soil conditions and weed density.

Overview: Uproots or buries weeds between rows in a growing crop; because the shanks are usually closely spaced (less than 6" apart), residue flow is restricted. May be adjustable for row width, sweep depth, sweep pitch and toolbar height. Constructed for minimal soil movement, light draft and minimal surface residue. Operate 1" to 2" deep for best weed kill and for highest moisture retention. Cultivating more deeply after applying a preemergent herbicide will bring untreated soil to the surface.



Modified IH 153



When properly set, inter-row weeds are undercut and in-row weeds are buried

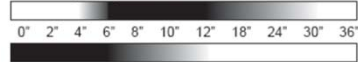
Extended spacing between sweeps improves residue flow



High-Residue Cultivator

Intended for no-till or ridge-till fields, tilled fields with up to 60 percent residue or untilled residue equivalent to a corn crop of up to 160 bushels/acre, moderate soils, stones up to 10 pounds.

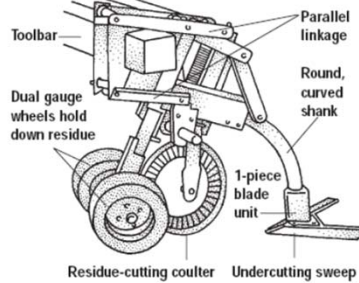
CROP height range estimate



WEED height range (annuals) estimate

■ suitable ■ less suitable □ unsuitable

Match tillage timing, depth and location to crop root growth.
Weed control varies with soil conditions and weed density.



Overview: Single-sweep cultivators were created in the '70s to work in substantial amounts of crop residue. Compared with S-tine units with multiple-shanks per gang, these tools can move more soil (including building ridges at last cultivation), work in tighter soils, and cope with more severe obstructions. Wide, flat sweeps of several designs undercut weeds and leave residue on the surface. Adjusting for more aggressive cultivation (tilting the sweep point downward) can push the sweep deep enough to disrupt incorporated herbicide layers in row middles, often releasing a new flush of weeds.

**Cultivating soybeans
planted on 30" into
standing cereal rye**



**Mechanical, GPS and sensor based
guidance systems can be used to
enhance cultivation**

Are you using a cultivator guidance system?



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2 keys to successful cultivation

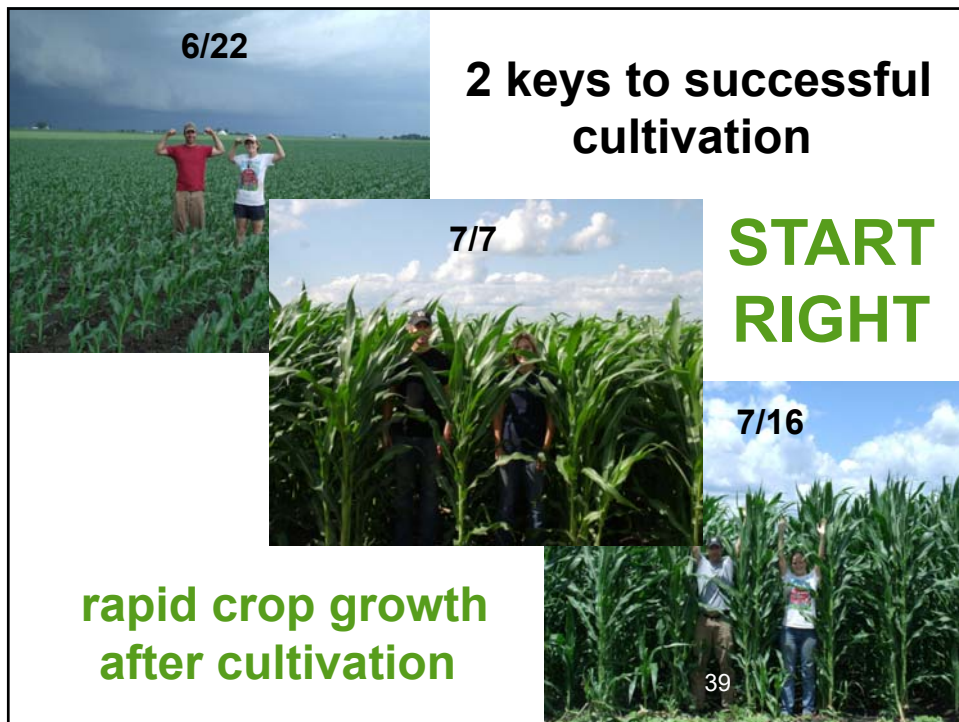
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START RIGHT

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rapid crop growth after cultivation



STARTING RIGHT

plant into a weed-free seed bed suitable
for your planter to establish a perfect stand

Plant high quality well adapted seed

Set planter carefully and check seed depth
and spacing multiple times

Plant the straightest rows possible

Take blind cultivation seriously

Take 1st row cultivation very seriously!!!





Has your farm been impacted
by increasing frequency of
extreme weather events?

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Are you using any weed control technologies
that are less sensitive to soil moisture?

Row-Crop Flamer

(standard U.S. LP-gas, liquid feed)

CROP height range estimate



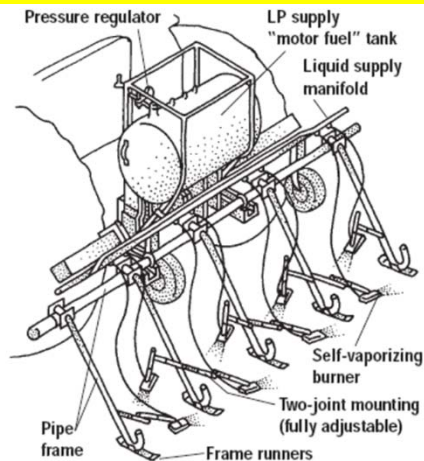
WEED height range (annuals) estimate

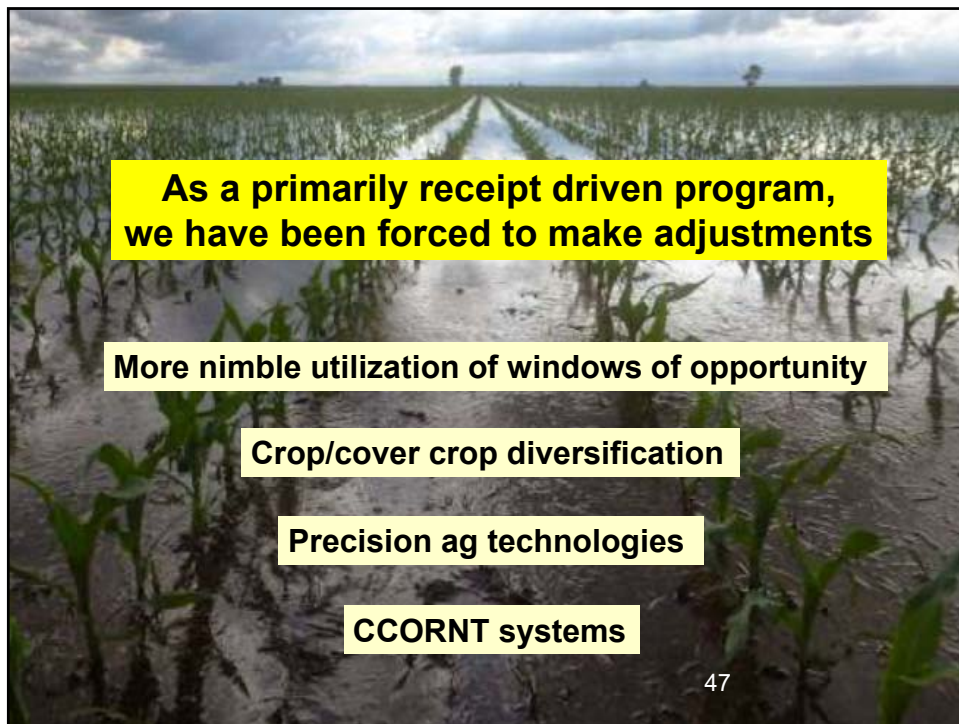
■ suitable ■ less suitable □ unsuitable

Match tillage timing, depth and location to crop root growth.
Weed control varies with soil conditions and weed density.

*Postemergent heights for crops with a heat-resistant stalk, such as corn or cotton, that allow cross-flaming in row. Flame contacts stalks. Optimum stages for in-row flaming corn are up to 2", 8" to 12", then 18" to 24."

Overview: Flames from LP-gas burners kill plants by rupturing cell walls, not burning plant tissue. Flaming is most effective on broadleaf weeds as small seedlings. It is less effective against grasses, and least effective on sedges and weeds that branch at ground level. **Broadcast flaming** can cover an entire bed or toolbar width prior to crop emergence. **Directed flaming** targets a specific zone between crop rows or in-row beneath plants after they develop a heat-resistant stem.





Weed Technology
Published by: Weed Science Society of America

« previous article : next article »

Weed Technology 27(1):193-203. 2013
<https://doi.org/10.1614/WT-D-12-00078.1>

Select Language ▼
translator disclaimer

Overcoming Weed Management Challenges in Cover Crop-Based Organic Rotational No-Till Soybean Production in the Eastern United States

Steven B. Mirsky, Matthew R. Ryan, John R. Teasdale, William S. Curran, Chris S. Reberg-Horton, John T. Spargo, M...

Received: May 10, 2013

[+] Author & Article Information

Abstract
Cover crop... from farmers, ...m to enhance ... traditional ... organic production. This system is based on the use of cereal rye cover crops that are mechanically terminated with a roller-crimper to create in situ mulch that suppresses weeds and promotes soybean growth. In this paper, we report experiments that were conducted over the past decade in the

Great article detailing opportunities and challenges in CCORNT systems

Planting corn



Jeff Moyer @
the Rodale Institute
has been investigating
and promoting
CCORNT systems
for more than a decade

**CCORNT systems
have improved soil
health, less field
work, far less weed
seed germination
& few options for
weed termination**

Planting soybeans

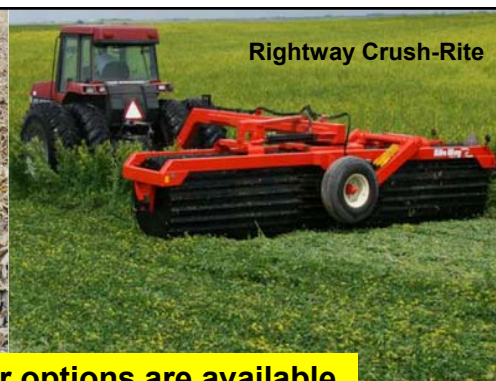


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“Swatting the hornets nest”

Tillage triggers the
germination of
weed seeds by
increasing exposure
to light, oxygen and
temperature
fluctuations.






A number of other options are available



IMHO
a roller/crimper is
the least important
component of a
CCORNT system!

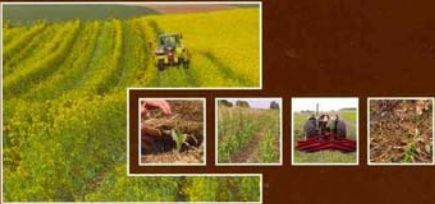
**ORGANIC
NO-TILL
FARMING**



**ADVANCING NO-TILL
AGRICULTURE**

► CROPS, SOIL, EQUIPMENT

JEFF MOYER



*"Too much about the roller
crimper and not enough
about no-till organic
farming."*

*A crimper is not the all-to
answer for organic no-till
farming...not by any
means.*

*In the right environmental
condition, it is a useful tool
to terminate some cover
crops, but the book makes
it seem as though it solves
the termination issue
mechanically."*

**Amazon review
by organic farmer in IA**

CCORNT crop rotation

Full
Nutrient
program
needed

Year 1: ^T ^T **Corn**

Year 2: **Field pea** ^T ^{volunteer peas} ^T **rye**

Year 3: **rye** → NT soybean

T = tillage

Options to add diversity

Year 1: **Corn**

Year 2: **Field pea** → **rye**

Year 3: **rye** → NT soybean

Year 4: **oat or sunflower**

More options to add diversity

Year 1: **spring CC** → Corn w/ **interseeded CC**

Year 2: **Field pea/small grain** → **summer CC** → rye

Year 3: **rye** → NT soybean

Year 4: **oat or sunflower w/ interseeded CC**

Summary of CCORNT research at the WIU Organic Research Farm					
Year	Cover crop variety, planting rate, date	Soybean variety, planting rate, date	Method/timing of crimping	No-Till yield	Conv-till Yield
2009	Aroostook rye, 60 lbs/a, 8/14	BRH 34A7, 250k/a, 6/6	cultimulcher 1 week prior to drilling	53.8 a	55.2 a
2010	Aroostook rye, 98 lbs/a, 9/30	BRH 34A7, 230k/a, 6/7	drilling, no crimping	44.4 a	37.0 b
2011	Aroostook rye, 100 lbs/a, 9/16	BRH 34A7, 220k/a, 6/8	farmer-made crimper after drilling	42.9 a	33.0 b
2012	Aroostook rye, 124 lbs/a, 10/8	BRH 34A7 220k/a, 5/10	double drilling	34.6	61.2
2015	Aroostook rye, 65 lbs/a, 9/8	BRH 34A7 218k/a, 5/28	cultimulcher after double drilling	61.0	57.7
2016	Fridge triticale, 76 lbs/a, 9/17	BRH 34A7 197k/a, 5/31	cultimulcher just prior to drilling	58 70.8	58.5

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2011	Aroostook rye, 100 lbs/a, 9/16	BRH 34A7, 220k/a, 6/8	farmer-made crimper after drilling	42.9 a	33.0 b
2012	Aroostook rye, 124 lbs/a,	BRH 34A7 220k/a,	double drilling	34.6	61.2
Studies were not conducted in 2013 & 2014 due to poor stands of CCs					
2015	Aroostook rye, 65 lbs/a, 9/8	BRH 34A7 218k/a, 5/28	cultimulcher after double drilling	61.0	57.7
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What does a good stand of soybeans look like in a CCORNT system?





Precision planting into standing CCs more consistently places seed in a favorable environment for germination



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**Planting on wider rows
also provides
opportunities for high
residue cultivation**



Organic site (Allison farm)	Variety	Group	Company	Organic site (Allison farm) Yields (bu/a)	Significance groups ($\alpha = 0.05$)
	34A7	3.4	Blue River Hybrids	65.0	a
	GH 232	2.3	Great Harvest Organics	62.1	a
	LVF 3507	3.5	Lakeview Farm	62.0	ab
	LVF 3924	3.9	Lakeview Farm	61.1	ab
	GH 349	3.4	Great Harvest Organics	60.9	ab
	389F.Y	3.8	Blue River Hybrids/eMerge	60.0	ab
	30C3	3.0	Blue River Hybrids	55.5	bc
	32F0	3.2	Blue River Hybrids	50.0	cd
	29AR9	2.9	Blue River Hybrids	48.8	d
D = 6.57					
We evaluate 10-15 soybean varieties every year					
Conventional site (WIU farm)	Variety	Group	Company	Conventional site (WIU farm) Yields (bu/a)	Significance groups ($\alpha = 0.05$)
	GH 232	2.3	Great Harvest Organics	47.4	a
	389F.Y	3.8	Blue River Hybrids/eMerge	44.7	ab
	34A7	3.4	Blue River Hybrids	44.4	ab
	LVF 3507	3.5	Lakeview Farm	42.4	b
	GH 349	3.4	Great Harvest Organics	41.5	bc
	LVF 3924	3.9	Lakeview Farm	41.3	bc
	30C3	3.0	Blue River Hybrids	40.1	bc
	29AR9	2.9	Blue River Hybrids	36.9	cd
	32F0	3.2	Blue River Hybrids	36.2	d
LSD = 4.73					

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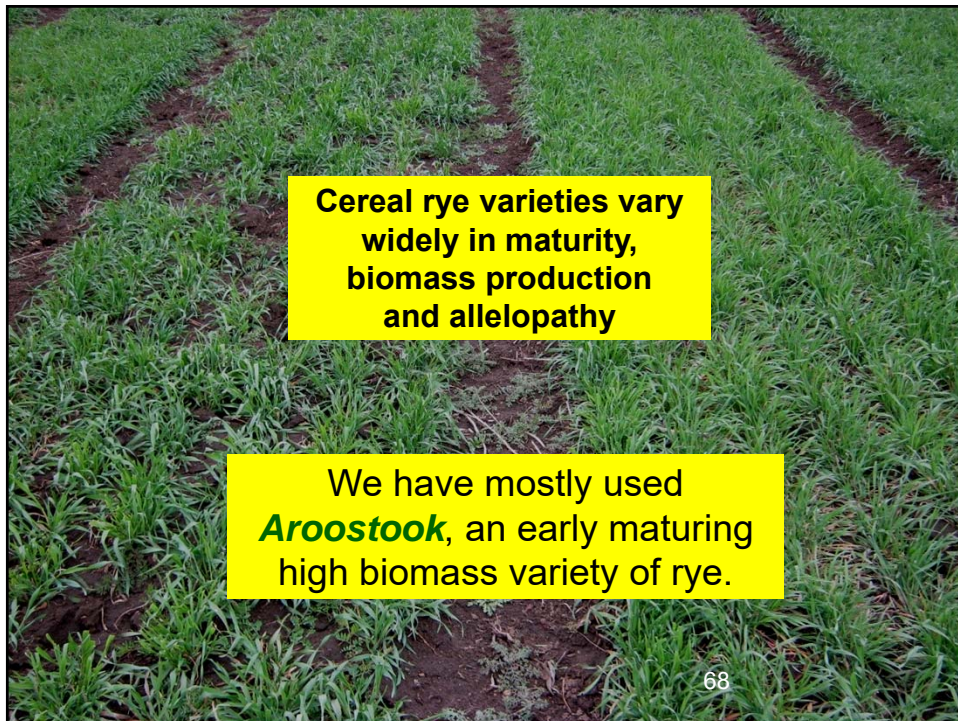
**We compared multiple soybean varieties
in CCORNT systems (2015-2017)**



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**Cereal rye varieties vary
widely in maturity,
biomass production
and allelopathy**

We have mostly used
Aroostook, an early maturing
high biomass variety of rye.



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High % cover in early fall and spring seems to be more important than total biomass

seeding rate (kg/ha)	stem density (stems/m ²)	stem weight (g/stem)	OD biomass (Mt/ha)
224	1108 a	0.61 b	6.83 a
112	603 b	1.15 a	7.00 a

High seeding rates only result in high biomass when soil fertility and moisture are adequate

70

11/9/2016

Both varieties (34A7 & 39C4) averaged just over 70 bu/a

There are many opportunities to fine-tune
CCORNT systems to increase yield, reduce
risk and increase adoption by farmers

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We are finally taking multispecies CC mixes seriously

Sunn hemp/sunflower/oat/radish/mustard mix planted 8/15/16 following peas

72

