Ecologically based weed management: insights and applications

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Adaptive management

- Know your weeds
- Design rotation to optimize weed suppression
- Make cultural practices work for you
- Get your timing right

Adaptive management

- **Know your weeds**
  - Perennial weeds

http://www.ontariowildflower.com/wildflower_waste.htm


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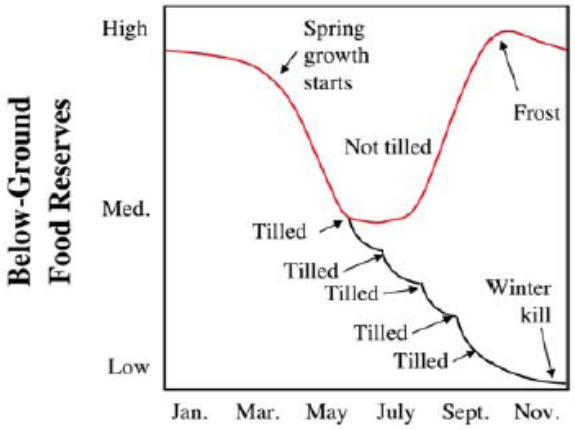
http://www.sdstate.edu/
http://www.forestryimages.org/images/768x512/1559010.jpg


1-gram rhizome segments 65 days ago

Timing of Tillage[8]

In the absence of tillage, quackgrass relies on below-ground food reserves (carbohydrates) to support early-season vegetative growth. If young quackgrass plants are allowed to grow three or four leaves, they will begin to send out new rhizomes, and also reach sufficient photosynthetic capacity to begin accumulating new stores of sugar in the roots.

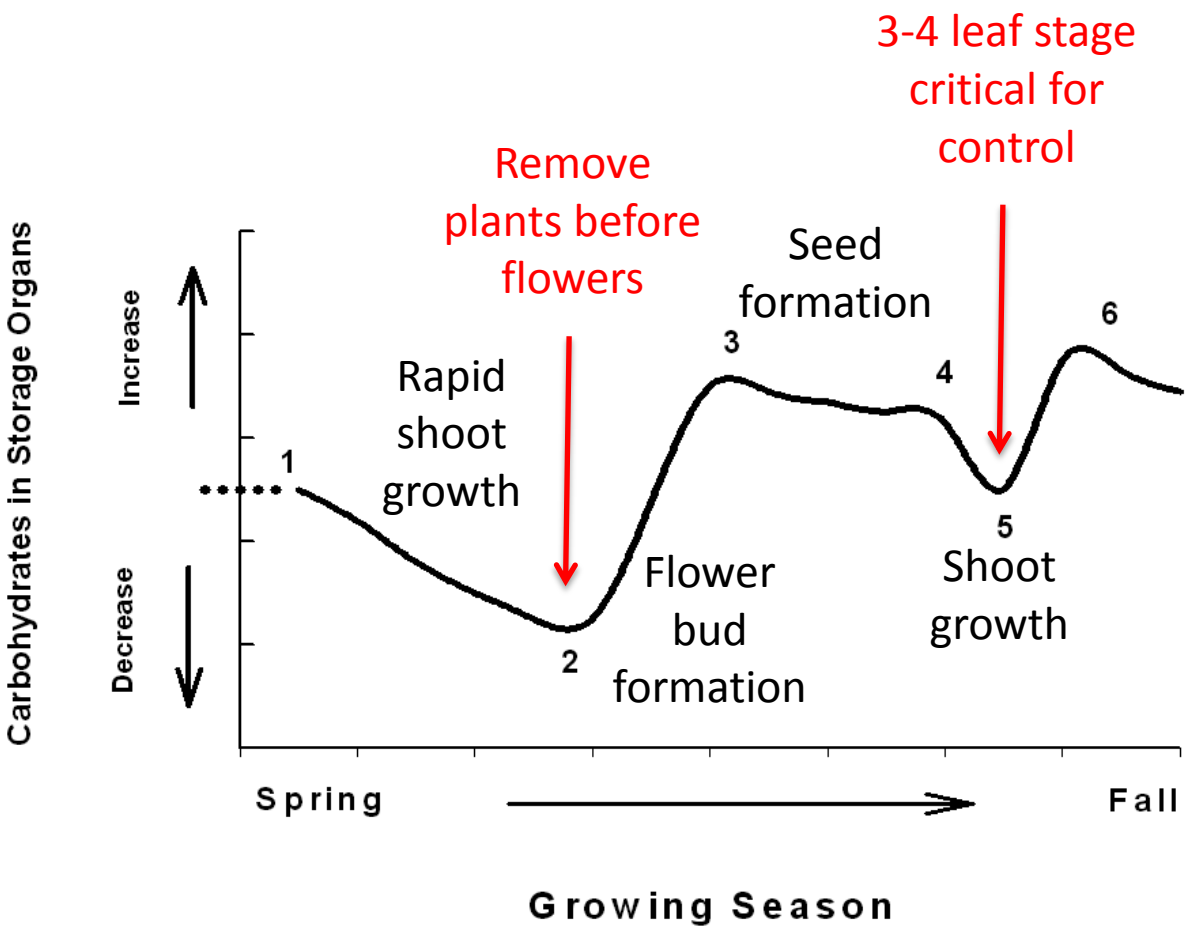


Tillage should begin in the spring, when carbohydrate reserves have been expended on new growth, but before they are rebuilt through new photosynthetic activity. Each tillage operation removes the new shoot growth and forces the plant to sprout again, until its below-ground food reserves are completely exhausted.

3-4 leaf stage critical for control

Quackgrass Management on Organic Farms. Heather Westwood, Kara Cox and Eric Gallandt. University of Maine Sustainable Agriculture Program

Food reserves in Canada thistle rhizomes

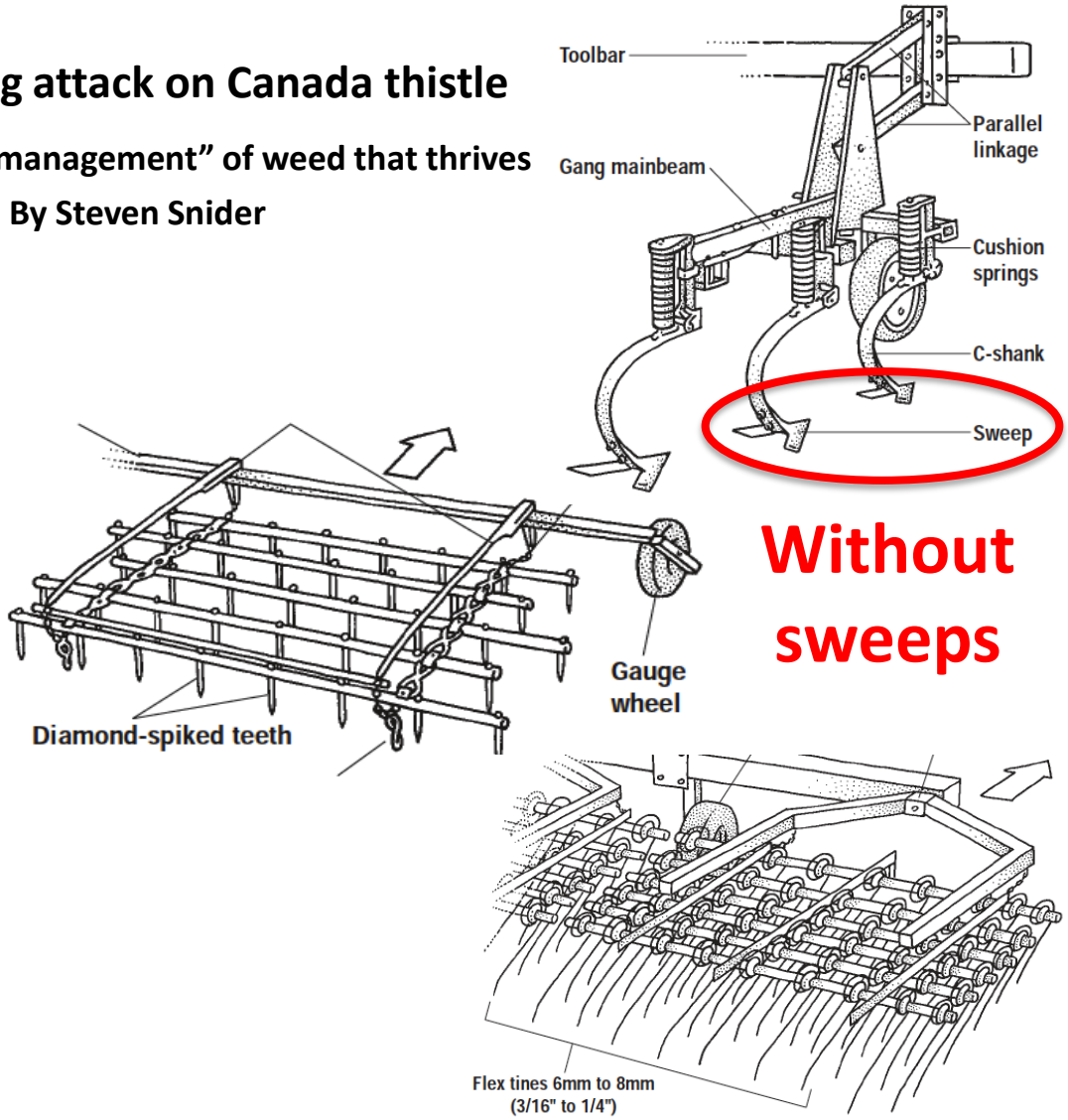


Cultivation for perennial weeds

Canadian farmer shares his two-prong attack on Canada thistle

Tools, technique, cropping sequence optimize "management" of weed that thrives on slicing and dicing of cultivation with sweeps. By Steven Snider

http://www.rodaleinstitute.org/2006810/snider



Steel in the Field. Greg Bowman.http://www.sare.org/publications/steel/steel.pdf

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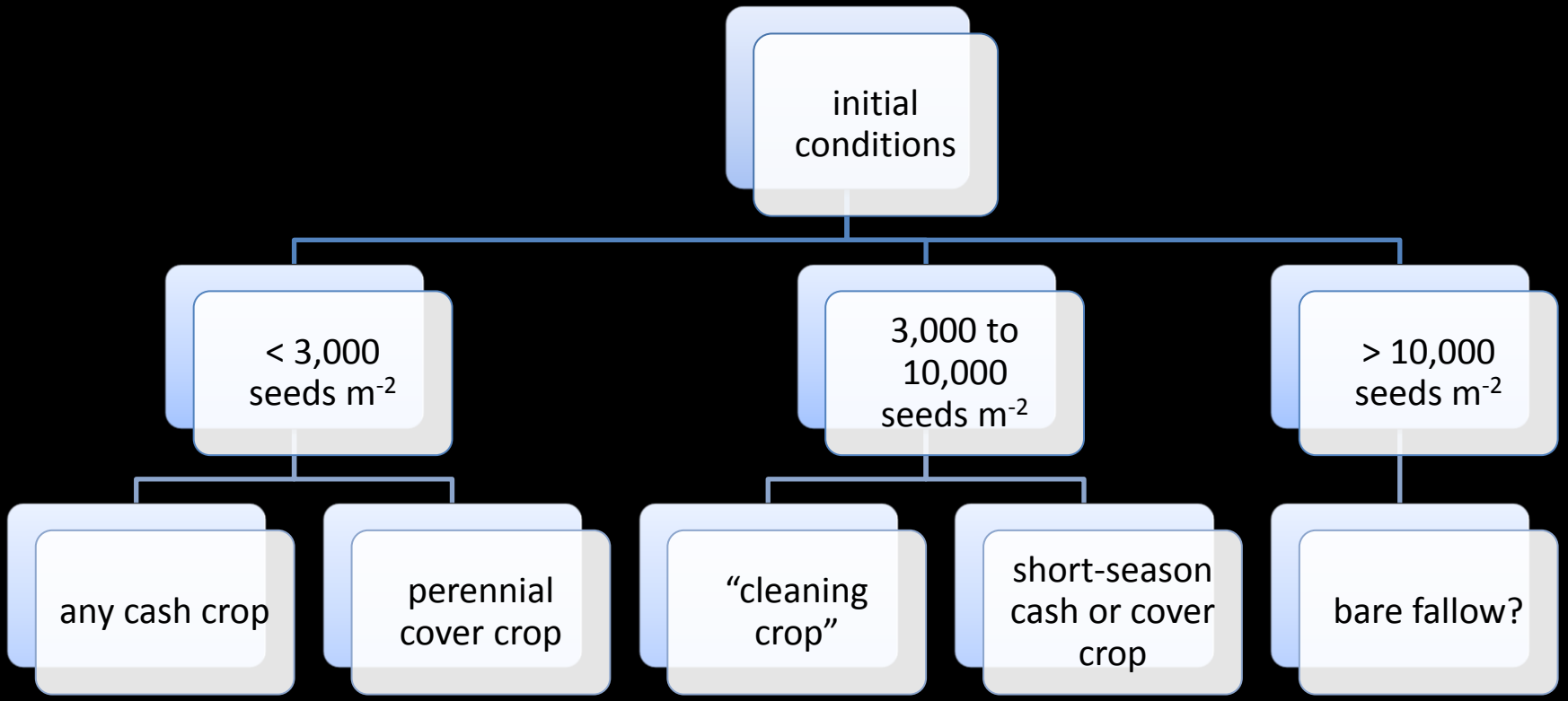
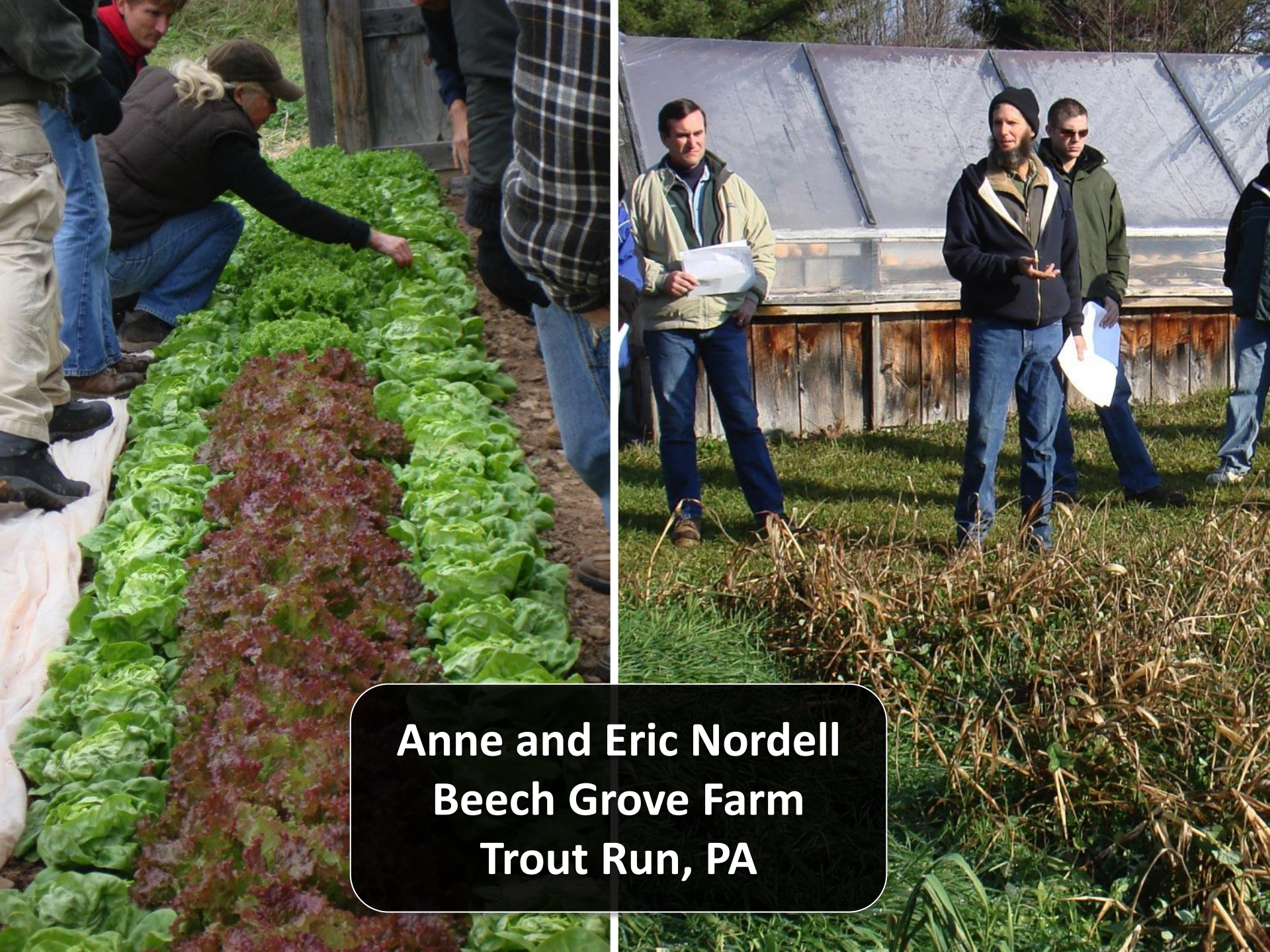
- **Design rotation to optimize weed suppression**
  - Sequences, false seedbed, 2 x 2 rotation



1. *What are my cash or cover crop options?*
2. *What are the planting and harvest dates in relation to emergence and seed rain of primary weed species?*
3. *How effective are available cultivation programs?*
4. *What is the likelihood of abundant seed rain? Of preempting seed rain?*



Anne and Eric Nordell
Beech Grove Farm
Trout Run, PA

“Weed the soil, not the crop”

- Zero tolerance for weed seeds
- Skim plowing
- Rotational cover cropping
  - cover crop / fallow / cover crop
  - timing of fallow alternates: spring / summer
  - fallow events include harrowing & cultipacking
- Intercropping
  - e.g., hairy vetch cover crop in onion, leek

Soil weed seed banks

Dixmont, ME Durham, ME Trout Run, PA

Eric Gallandt, University of Maine. www.gallandt.wordpress.com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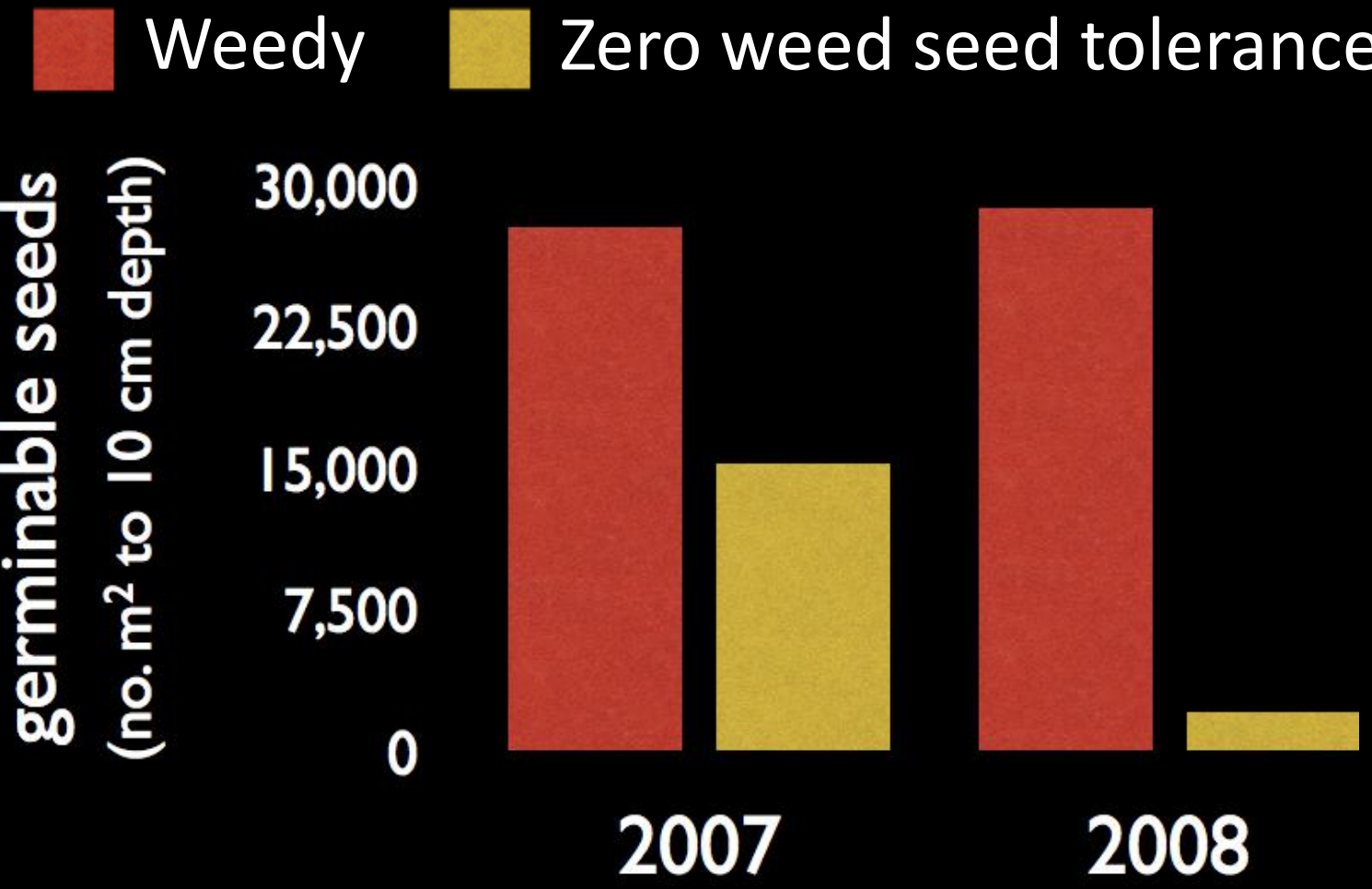
Effects on next year's seed bank



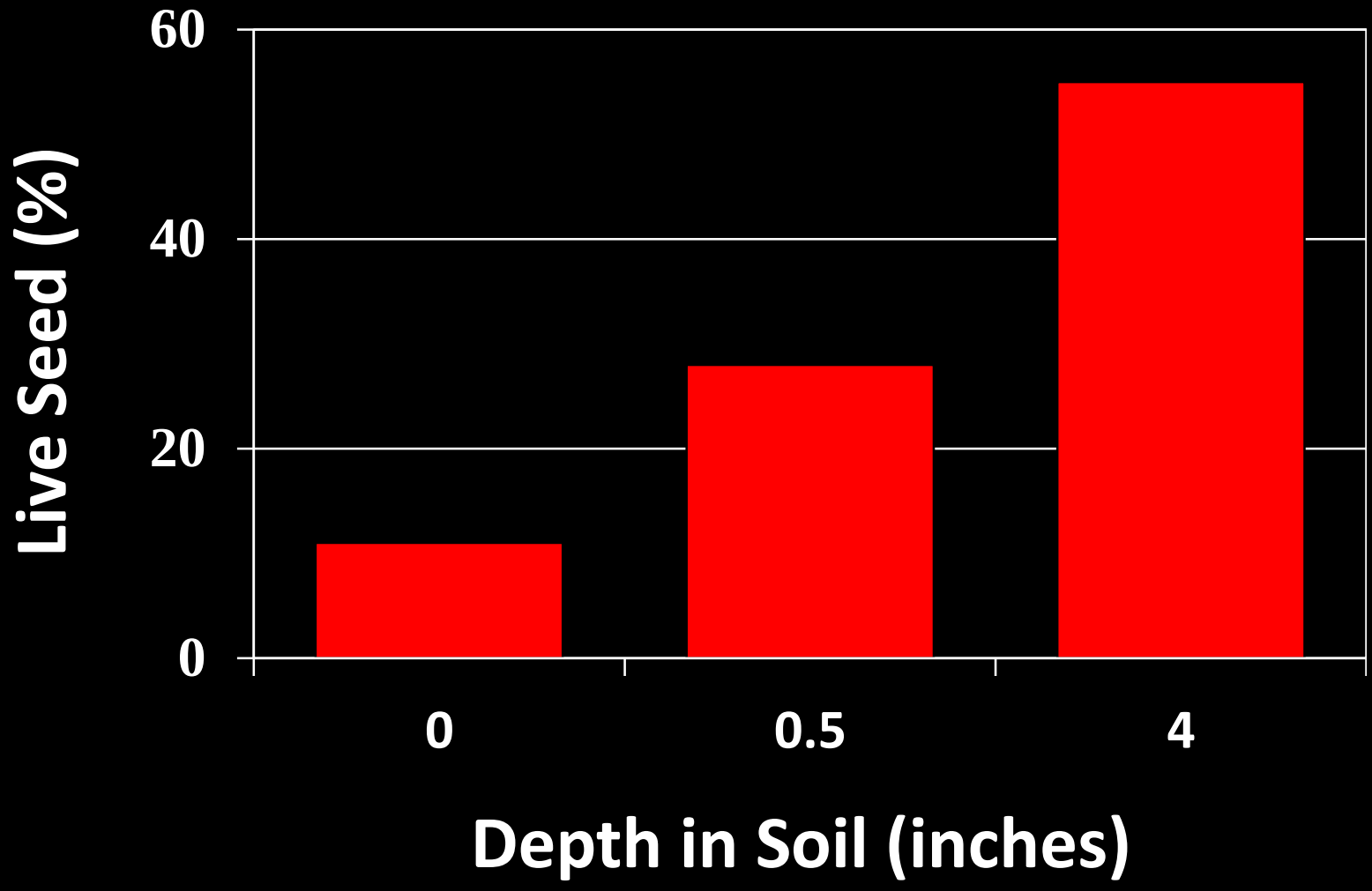
Eric Gallandt, University of Maine. www.gallandt.wordpress.com

Is 1 year's seeding really 7 years weeding?

Weed species	Year to 50% reduction	Years to 99% reduction
Common lambsquarters	12	78
Field pennycress	6	38
Common cocklebur	6	37
Yellow foxtail	5	30
Prostrate knotweed	4	30
Shepherd's purse	3	11
Giant foxtail	< 1	5

Davis, A., K. A. Renner, C. Sprague, L. Dyer, and D. Mutch. 2005. *Integrated Weed Management "One Year's Seeding…" Extension Bulletin E-2931. East Lansing, MI. Michigan State University.* and Fabian Menalled. **Weed Seedbank Dynamics & Integrated Management of Agricultural Weeds. MT200808AG Reprint 10/08.**

Green foxtail seed survival after 2 year in soil



Randy Anderson, USDA-ARS

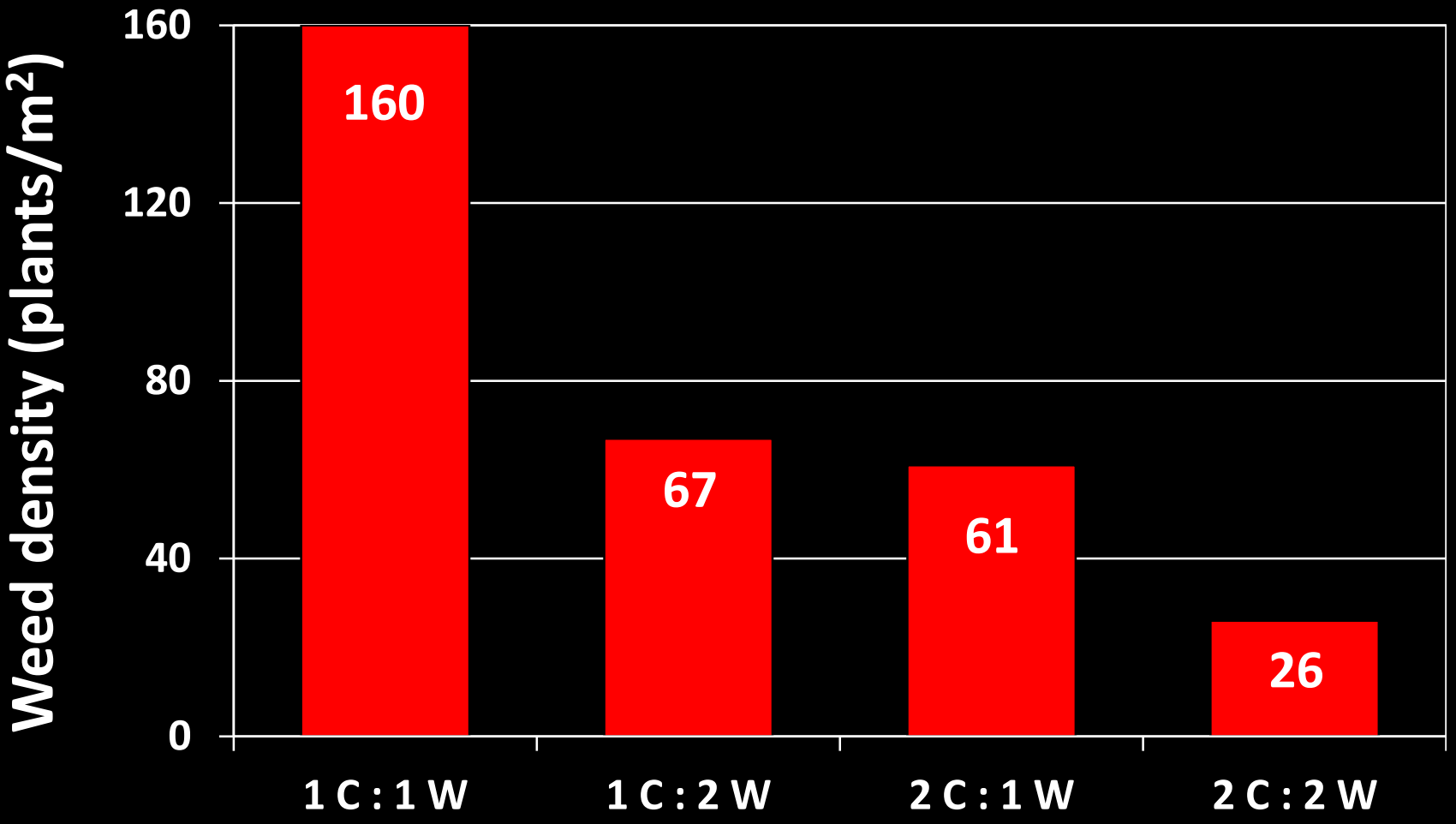
60-80% loss of seeds

The longer the seeds remain on the surface, the more predation

http://www.weeds.iastate.edu/mgmt/2006/seedpredators.shtml

Regnier et al. http://weedeco.msu.montana.edu/class/LRES443/Lectures/Lecture60/lecture5.htm

Effect of crop rotation on weed abundance: Ratio of cool (C) to warm (W) season crops



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Adaptive management

- **Know your weeds**
  - Perennial weeds
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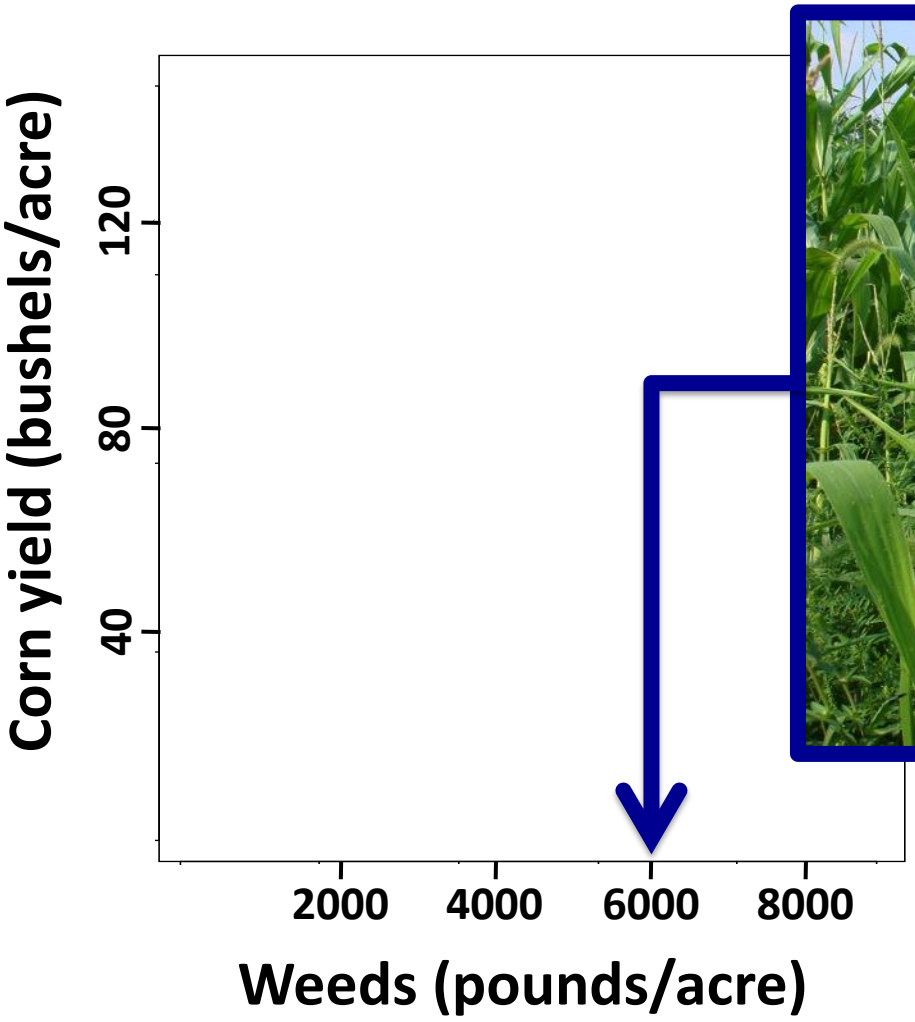
  - Sequences, false seedbed, 2 x 2 rotation
- **Make cultural practices work for you**
  - Many little hammers, density dependence, and niche

Relationship between corn yield and weed biomass in the Rodale Farming Systems Trial (1981-2007)



6000 lbs/a
is a lot of weeds

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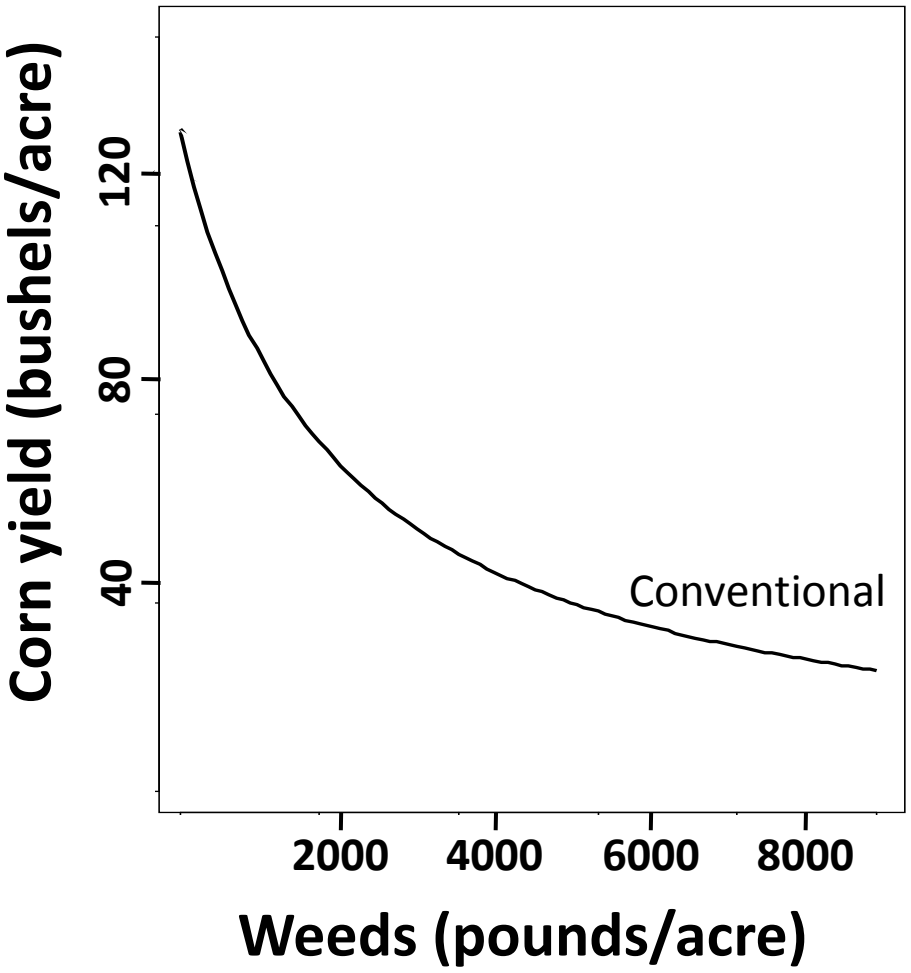

Weeds in organic corn were less competitive

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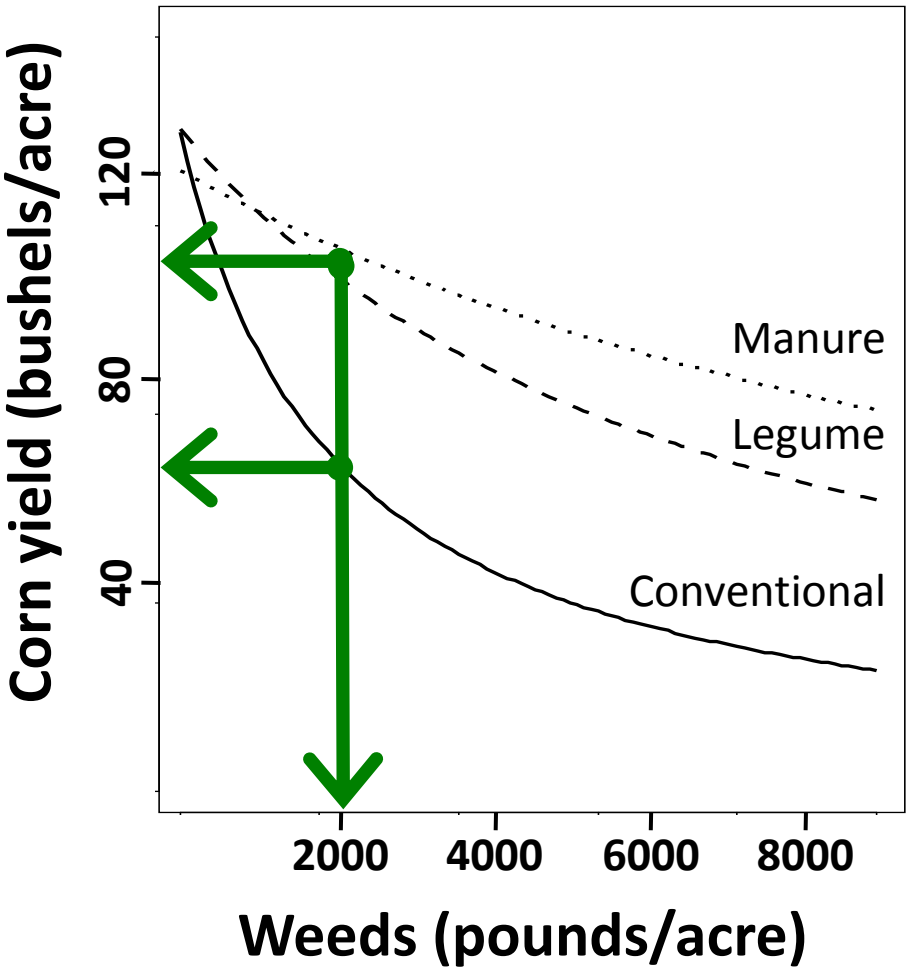
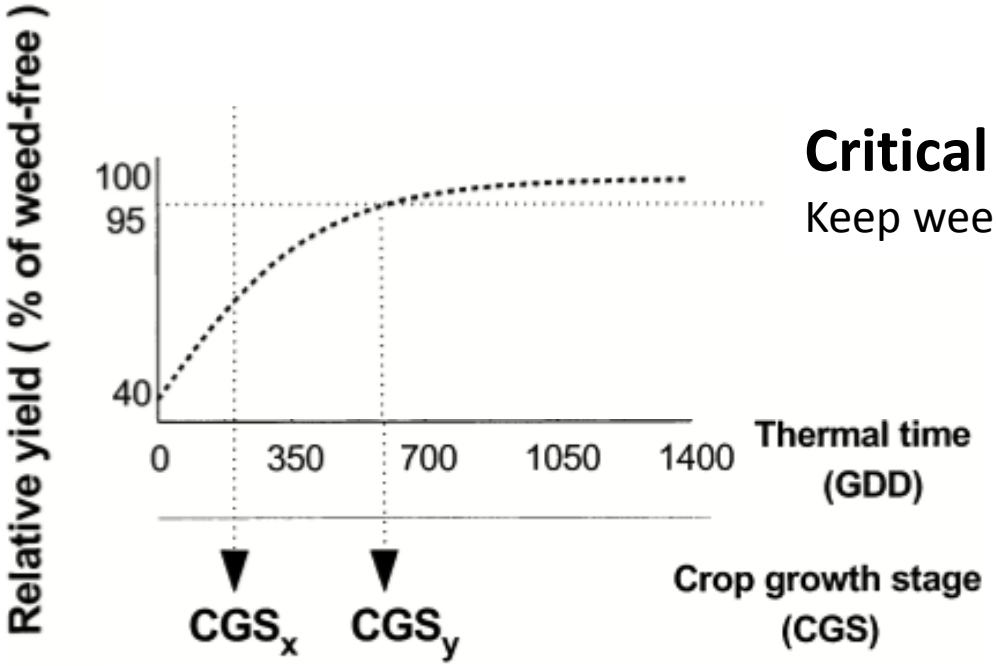


Weeds in organic corn were less competitive

Why?

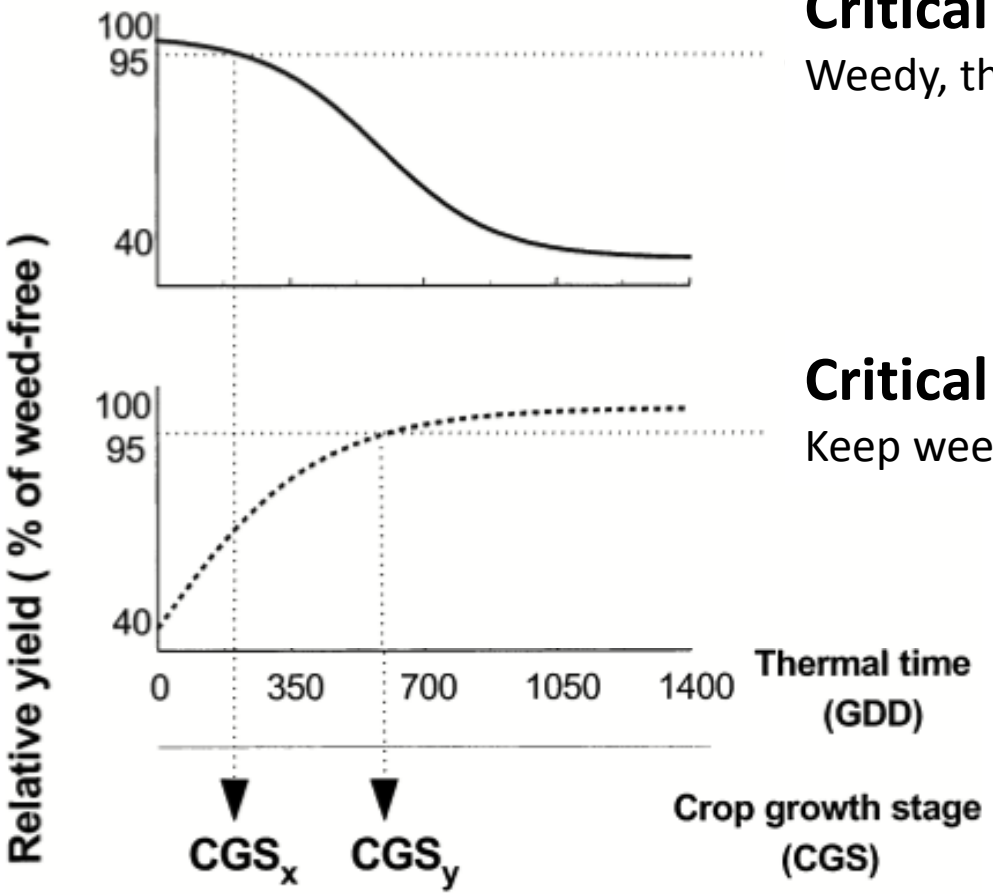
Possible reasons for difference in tolerance to weeds

- Later planting of organic crops
  - Warmer soil and fewer weeds
- Higher seeding rate in organic crops
  - Increase the relative competitive ability of crops
- Greater soil organic matter in organic plots
  - Cover crops, manure, and compost
- Soil nutrient availability more synchronized with crop demand
  - Mineralization of organic matter vs. mineral fertilizer
- Weeds growing after period when they compete with the crop



Critical weed-free period

Keep weeds out, then allowed to get weedy

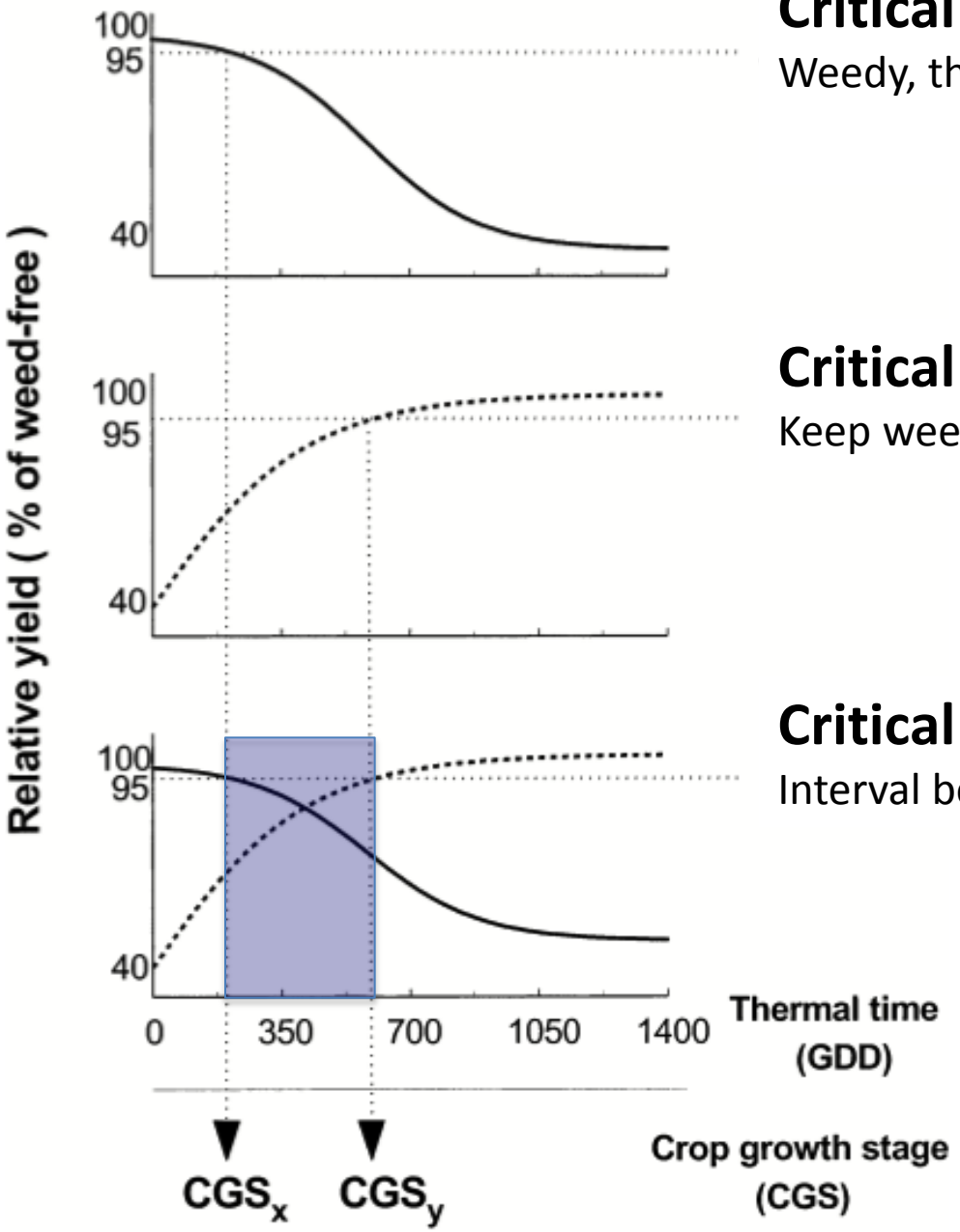


Critical timing for weed removal

Weedy, then kept weed-free

Critical weed-free period

Keep weeds out, then allowed to get weedy



Critical timing for weed removal

Weedy, then kept weed-free

Critical weed-free period

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Critical period for weed control

Interval between

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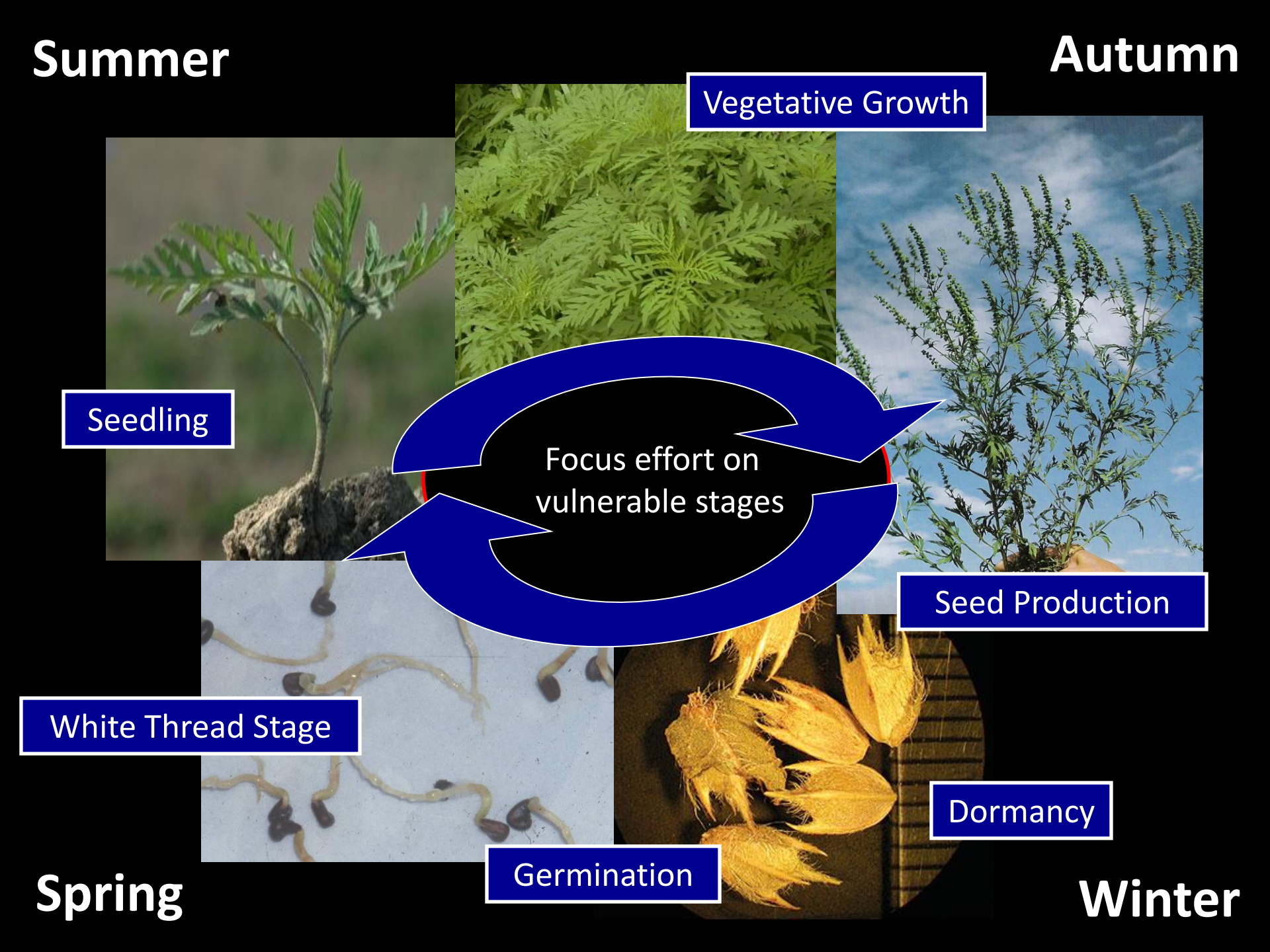
- **Get your timing right**
  - White thread stage and size hierarchy


Summer
Autumn
Vegetative Growth
Seedling
Focus effort on vulnerable stages
Seed Production
White Thread Stage
Dormancy
Germination
Spring
Winter


Before
After

Additional resources

- **Creating a weed management plan**
  - http://extension.psu.edu/start-farming/vegetables/creating-a-weed-management-plan-for-your-organic-farm/view
- **Quackgrass management on organic farms**
  - http://www.umaine.edu/weedecology/weed-management/fact-sheets/quackgrass-management.pdf
- **Managing Canada thistle in organic cropping systems**
  - Randy Anderson email: randy.anderson@ars.usda.gov
- **Integrated Weed Management "One Year's Seeding…"**
  - http://www.msuweeds.com/publications/extension-publications/iwm-one-years-seeding-e-2931/
- **Weeds of the Northeast**
  - http://www.cornellpress.cornell.edu/book/?GCOI=80140100077290