Weed Management

Minnesota Hop Growers Assn.
2017 Annual Mtg.
Shakopee, MN

Roger Becker
University of Minnesota

University of Minnesota
Extension
Driven to Discover℠

Weed Control in Hops

Site prep

Mulch

Hand pulling

Herbicides (a few)

Weed Control in Hops

Slide set by:

Diane Brown

Extension Educator,

Consumer Horticulture and Commercial Fruit

Michigan State Univ. Extension

Ingham County MSUE

http://www.ipm.msu.edu/uploads/files/IPMA/Weed_management_in_hops.pdf

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Why control weeds?

- Compete for water, nutrients and light
- Can harbor diseases and insect pests
- Reduce crop quality and yield
- Make harvest more difficult

Diane Brown, MSU Extension Educator

http://www.ipm.msu.edu/uploads/files/IPMA/Weed_management_in_hops.pdf

Identify the weeds

- Grass or broadleaf,
- annual, biennial, perennial
- Why it matters…
- Affects the treatment choices and timing

Diane Brown, MSU Extension Educator

http://www.ipm.msu.edu/uploads/files/IPMA/Weed_management_in_hops.pdf

If at all possible-CONTROL PERENNIAL WEEDS BEFORE PLANTING A HOPYARD

Diane Brown, MSU Extension Educator

http://www.ipm.msu.edu/uploads/files/IPMA/Weed_management_in_hops.pdf

Mechanical weed control

- Mulch has been shown to suppress weeds in hop systems and over time can increase moisture retention and improve long-term soil quality

Diane Brown, MSU Extension Educator

http://www.ipm.msu.edu/uploads/files/IPMA/Weed_management_in_hops.pdf

Mechanical weed control

- In mechanically cultivated systems, tillage (4 to 6 inches) should begin as weeds appear,
- followed by shallow cultivation (2 to 4 inches) until after lateral hop branches have developed.
- Over time, cultivation has been shown to decrease soil quality, and in hilly areas, it can lead to erosion problems.

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http://www.ipm.msu.edu/uploads/files/IPMA/Weed_management_in_hops.pdf

WEED MANAGEMENT IN WISCONSIN HOPS

D. HEIDER AND J. COLQUHOUN, UNIVERSITY OF WISCONSIN-MADISON

A number of herbicides are registered on hops in the Pacific Northwest only. This guide includes the herbicides that are registered for use on hops in Wisconsin as of March 2016. Pesticide labels change often. This guide is not a substitute for the label. Always read the pesticide label prior to use.

Herbicide active ingredient	Commercial product rate/A	Application timing	Days to harvest	Remarks and suggestions
norflurazon	2.5 – 5.0 lbs Solicam DF	PRE	60	Controls several broadleaves and grasses. Apply as a directed spray. Wait at least 6 months after planting hops before applying. Apply to clean soil surface either in fall after tillage or in spring. Use lower rate on coarse soils and higher rate on fine soils.
trifluralin	Several trade names, such as Treflan	PRE		Controls several annual grasses and a few broadleaf weeds. Apply and incorporate 1 to 2 inches when crop is dormant. Do not spray over hop crowns. Will not control emerged weeds. Rate varies by soil texture.
flumioxazin	6.0 oz Chateau SW	PRE and sucker control	30	Controls several broadleaf weeds and some annual grasses. Sucker control: Apply as a directed spray after hops are at least 6 ft tall. Direct spray to the lower 2 ft of hops. PRE weed control: Apply to dormant hops November through February as a 1 to 1.5 ft band to each side of the hop row. Don't apply with an adjuvant or allow spray to contact green stems (unless for sucker control), foliage, flowers or cones or unacceptable injury may occur.

UW-Madison. Heider and Colquhoun **https://counties.uwex.edu/buffalo/files/2011/01/Hop-herbicides-3-16.pdf**

carfentrazone	2.0 fl oz Aim EC	POST and sucker control	7	Available in Wisconsin through December 31, 2019 as a Special Local Needs (24c) label. For sucker management and control of some young, actively growing broadleaf weeds. Sucker control: Apply to the bottom 1.5 ft of the hop plant and to the sucker mat that extends from the base of the plant to 1.5 to 2 ft into the row. See label for adjuvant requirements. POST weed control: weeds need to be newly emerged and actively growing. Apply using shielded or hooded sprayers. Avoid upward spray drift to new hop growth. Avoid applications until newly trained hops have developed sufficient barking and are high enough up the string to avoid contact with the apical bud. Allow 14 days between applications and don't exceed 7.6 fl oz per acre per season.
glyphosate	Several trade names, such as Roundup	POST	14	Apply to actively growing weeds as a row middle, shielded, wiper, directed or spot treatment application. Glyphosate will injure or kill hops. Do not allow contact of spray with green hop stems or foliage.
2,4-D	Several trade names, such as Weedar 64	POST	28	Make directed applications to row middles for control of small broadleaf weeds. Up to three applications per season are allowed with at least 30 days between applications. Avoid drift – do not allow spray to contact hop foliage or apical buds.
clethodim	Several trade names, such as Select, Select Max	POST	21	Controls most annual grasses and several perennial grasses, but not broadleaves. Apply to actively growing grasses, including appropriate adjuvant as directed by the label. Rate depends on targeted grass species. Wait at least 14 days between applications and don't exceed total seasonal maximum use rates.

UW-Madison. Heider and Colquhoun **https://counties.uwex.edu/buffalo/files/2011/01/Hop-herbicides-3-16.pdf**

Weed Control in Hops

Trifluralin EC or G (Treflan, Trust, many)

HOPS

Apply and incorporate TRUST HERBICIDE to established crop during dormancy. Use incorporation equipment that will insure thorough soil mixing with minimal damage to crop stand.

Broadcast Application Rates/Acre:

Soil Texture	TRUST HERBICIDE
	(pints)
Coarse	1.0
Medium	1.25 - 1.5
Fine	1.5

- Soils with 2% to 10% organic matter - 1.5 pints

PPI, prevents seedling establishment

Group 3 Mitotic inhibitor

Weed Control in Hops

Norflurazon (Solicam DF)

Broadleaves and some grasses PRE, seedling

6 months after planting Group 12 Phytoene Inhib.

Table 1: Maximum Solicam DF Rates (Lbs. of Product per Treated Acre per Year) by Soil Texture

Crop	Coarse		Medium	Fine	Months after Planting to First Allowed Application (West/East of the Mississippi River)	Months after Application to Planting of Replacement Crop (West/East of the Mississippi River)	Special Use Directions & Exceptions (see list below)	Pre-Harvest Interval (PHI) (Days)
	Sand, Loamy Sand	Sandy Loam	Loam, Silt Loam, Silt, Sandy Clay Loam	Sandy Clay, Clay Loam, Silty Clay Loam, Silty Clay, Clay				
Citrus	2.5 - 5.0	2.5 - 5.0	3.75 - 5.0	5.0	0/0	0/0	2	30
Irrigated Citrus (FL and TX only)	2.5 - 10.0	2.5 - 10.0	3.75 - 10.0	5.0 - 10.0	0/0	0/0	1, 2	30
Apples	2.5 - 5.0	2.5 - 5.0	5.0	5.0	0/0	0/0	3	60
Hops / Blueberries	2.5	2.5	3.75	5.0	0/6*	12/12	3, 11	60
Avocados	2.5	2.5	3.75	5.0	6/6	12/12	3	60

Weed Control in Hops

Flumioxazin (Chateau SW)

Sucker control: 6 oz/A POST directed lower 2 feet after hops have reached a minimum of 6 ft

Weed control: 6 oz/A PRE

- Broadleaves and some grasses PRE
- dormant hops Nov through Feb to ensure time for rain incorporation and activation
- 1 to 1.5 ft. band to each side of the hop row

Group 14 PPO

Weed Control in Hops

Panther D POST

- 0.26 lb / gal flumioxazin & 4 lb / gal 2,4-D
- 1 pt. directed row middles, up to 3 applications per year at 30-day intervals
- Flumioxazin provides some residual and more rapid burndown
- 30 day PHI
-Group 4 Auxin and 14 PPO
-(NOT sucker control due to auxin)

Weed Control in Hops

Aim EC 2.0 lb / gal - National Label in 2017

2 fl oz product/A (0.03 lb ai) POST + NIS or COC

- to manage sucker growth, some broadleaves

- to lower 1.5 ft of plant and 1.5 to 2 ft. in to the row of the sucker mat

- Broadleaf control in between rows (use hoods)

- Apply 1 day before transplanting for burndown

Up to 7.6 fl oz/A per season, min. 14 day intervals

7 day PHI Group 14 PPO

Weed Control in Hops

Clethodim POST (Select 2EC, Arrow 2 EC, numerous)

6 to 8 fl oz/A add 1% COC

32 fl oz/A per season, 14-day intervals

21 day PHI

Group 1A ACCase

Weed Control in Hops

Glyphosate (Roundup, Touchdown, many)

- vine crops group

- **Rates vary: 22 fl oz/ A weeds < 6 in., 16-40 gal water**

Site prep, directed sprays

Avoid contact green stems, suckers, etc.

14 day PHI

Group 9 EPSP synthase

Weed Control in Hops

Minnesota Pesticide Data Searches

Minnesota Department of Agriculture
625 Robert Street North; St. Paul, Minnesota 55155-2538
Fax: 651-201-6117

Search by Multiple Criteria

Enter/select a Site(Crop): Hops (foliar Treatment) (open search-window for sites/crops) and

Enter/select a Pest: (open search-window for pests) and

Enter/select Ingredient: (open search-window for AI's) and

Select Pesticide Type: Herbicide and

Select Formulation: (None) and

Restricted Use (RUP) Only ?

(you may leave any of the above options blank to leave them out of the search)
(if no results are found, use the 'select' functions to make sure that pest, site and AI are spelled accurately)

Search for Products that Exactly Match All these Criteria

Product Name	EPA Reg. No.
SECTION THREE HERBICIDE	66330-414-1381
SELECT MAX HERBICIDE WITH INSIDE TECHNOLOGY	59639-132
SHADOW 3EC HERBICIDE	66330-414
SHADOW HERBICIDE	66330-353
SHADOW ULTRA HERBICIDE	66330-395
TAPOUT	5905-578
WILLOWOOD CLETHODIM 2EC	87290-11

If you find erroneous data, please e-mail the department at matthew.sunseri@state.mn.us. We will respond to all inquiries as soon as possible.

Database Last Updated: 2/27/2017

Home KellySolutions.com Search By: Company Name Company ID Product Name Product EPA ID Active Ingredient Pest Site Formulation Pest-type RUP Multiple Criteria

Read our Privacy Policy

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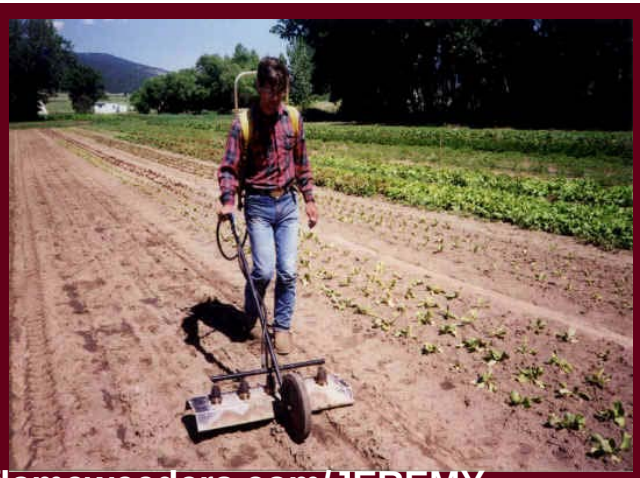
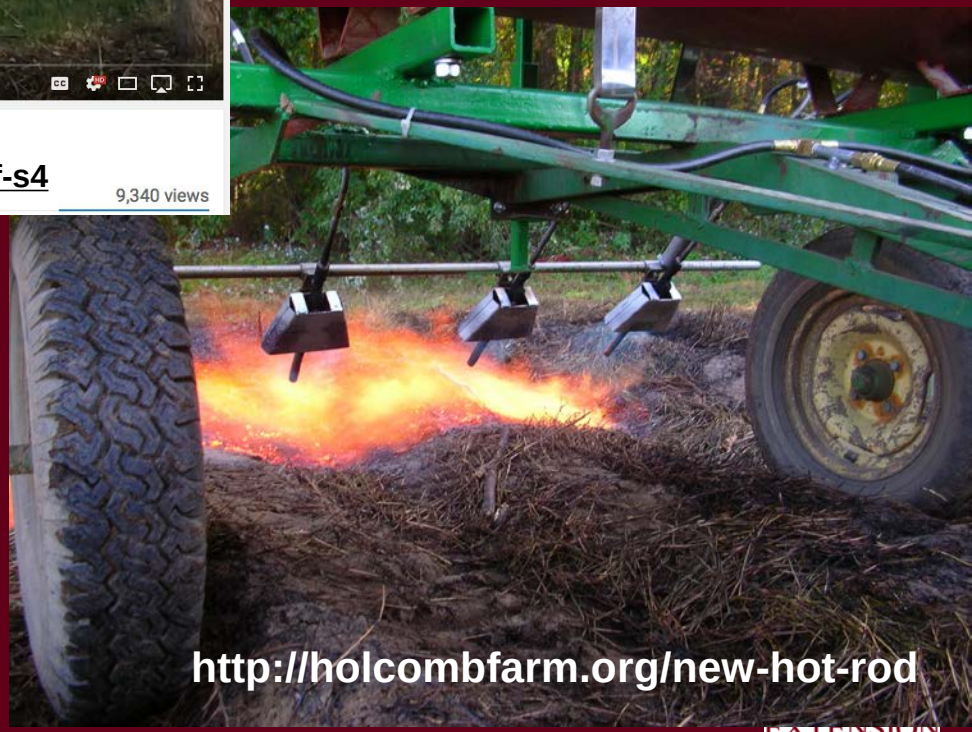
Weed Control in Hops - Flaming



http://flameweeders.com/JEREMY.JPG



http://holcombfarm.org/new-hot-rod

Weed Control in Hops

Finalsan Total Vegetation Killer

-ammoniated soap of fatty acids- spot treatment

OMRI listed

Weed Control in Hops

Strategies for Weed Management in Organic Hops, a Perennial Crop

Krista M. Delahunty* and Jason C. Johnston

ABSTRACT

To investigate the best weed management practices in small-scale, organic northeastern U.S. hop production, we conducted an experiment that addressed the following: is straw mulch or tilling a better non-herbicide practice to control weeds and is a cover crop effective in reducing weed populations and thus worth delaying hops planting by a year. In 2012, we established a new hopyard with about half the area planted in four varieties. We implemented three cultural approaches to weed management: straw mulch, tilling, and nothing (control). The other half of the hopyard was cover cropped in rapeseed (*Brassica napus* L.), and a smaller control area was left fallow. In the spring of 2013, the overwintered rapeseed was tilled in and hop rhizomes were planted where previously had been either rapeseed or fallow. We measured hop plant linear growth in both years, as well as cone mass for the 2-yr-old plants. To assess weed growth, we measured total weed biomass and percent cover for each weed species. We found that rapeseed did not have a positive effect on plant growth or weed suppression, and there was little evidence that waiting a year to plant hops was beneficial. Straw cover showed better measures of weed suppression, but hops wet mass in 2-yr-old plants was actually higher in the tilled plots. Weed management should address persistence and establishment of perennial weeds like goldenrod (*Solidago* spp.). The best practice may involve a mixed approach of intensive springtime tilling and weed management, followed by summer straw mulching.

Agron. J. 107:634-640. 2015.

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Weed Management

- The Basics

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Why Weeds Drive Us Mad!

- The Basics - Weed Truths
- The Annuals - Show Up at Every Party
- Future Shifts - We Shape Our Destiny
- The Poop - Messy Business and Survival
- Competing - Free Trade of Resources
- The Perennials - How Hard It Is

Over-arching Weed Science Principles

- Weed ecology and biology basic to all systems
- Weed species cross over cropping boundaries
- Perennial, biennial, or annual - disturbed or undisturbed - the same underlying principles apply

Weed Management- the basics

No free lunch concept

- **Weed management options:**
  - **Hand Labor (pulling, cutting)**
  - **Physical (Tillage/Mowing/Burning)**
  - **Chemical (Herbicides)**

Is there anything else?

Weed Management- the basics

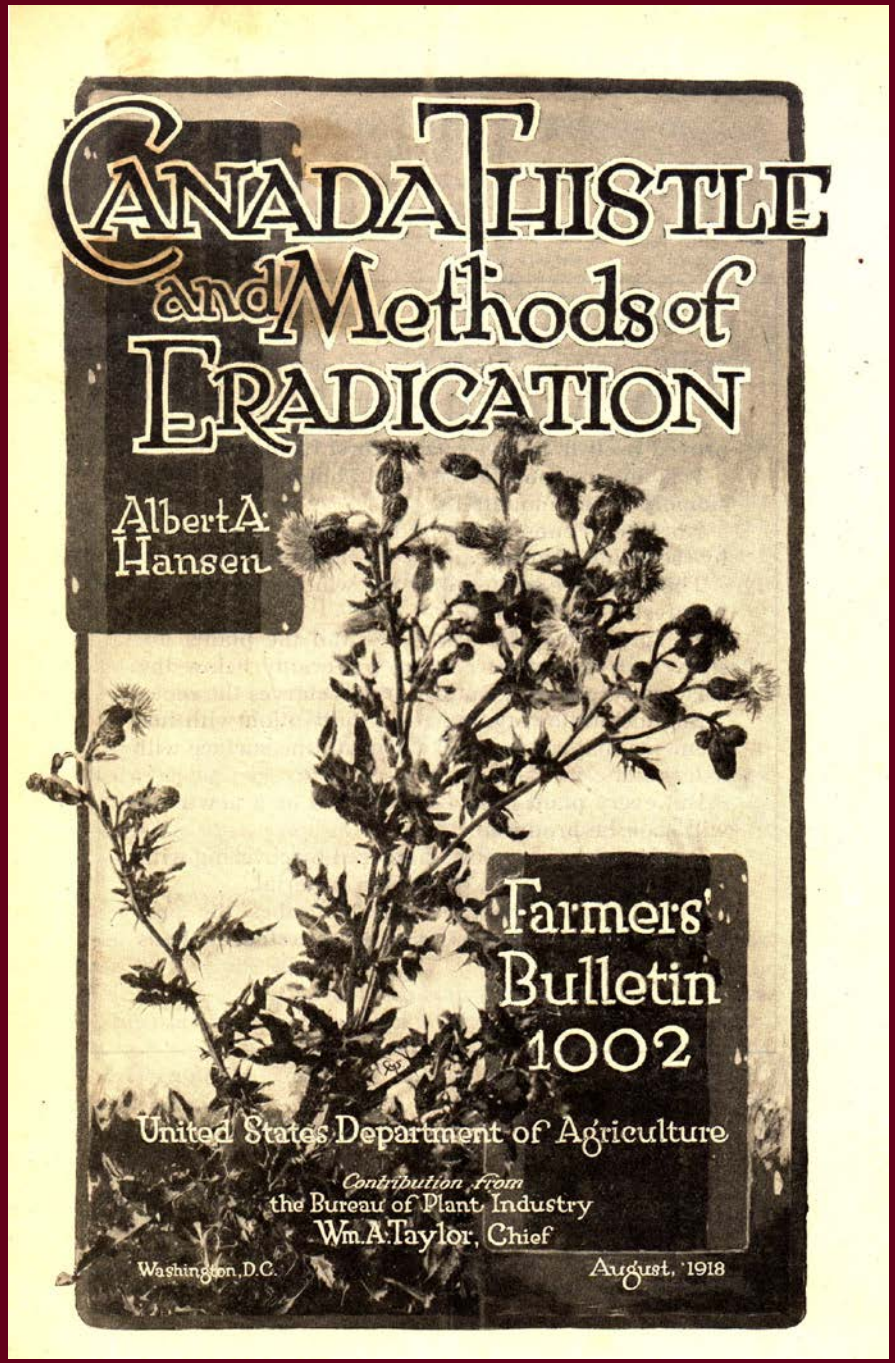
- There is a weed for every occasion
- There is a weed species that is adapted to your management, no matter what it is

Weed Management- the basics

- Therefore, repeated use of the same management will result in a few species that are out of control
- Goal should be to get as many species as possible, but few of any one species
  - Means you are using diversified weed management

The Elusive Holy Grail of Weed Management

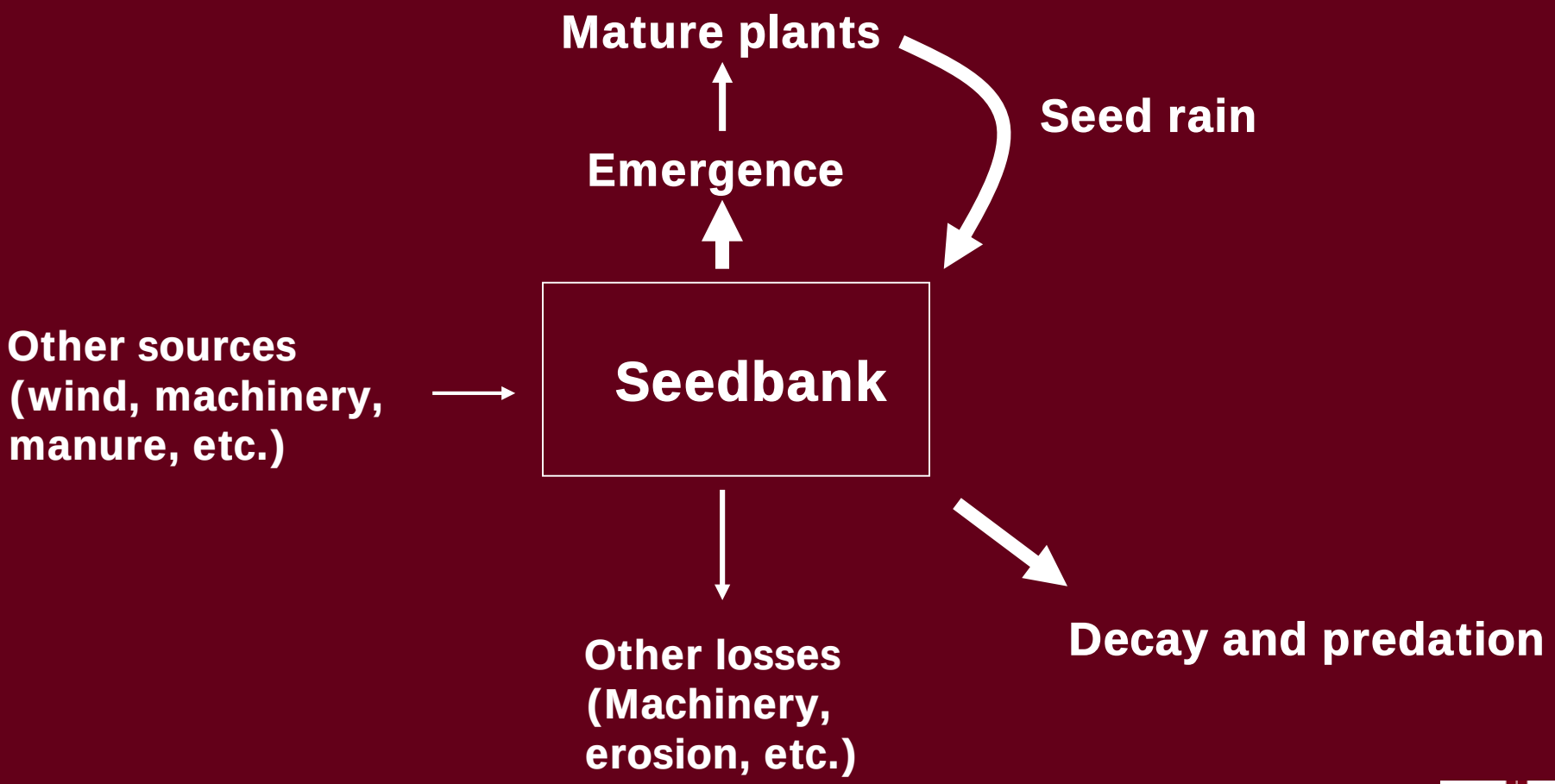
- Eradication!



Annuals - the dilemma

- **Prominent in disturbed soil**
- **Colonizers (voted most likely to succeed)**
- **Seedbanks (long-term memory)**

The Seed Cycle



In Risk Management Guide for Organic Producers

Photos Steve Hurst USDA ARS

Weed seed come in many shapes and sizes with many different mechanisms to cause us headaches.

Breaking Dormancy

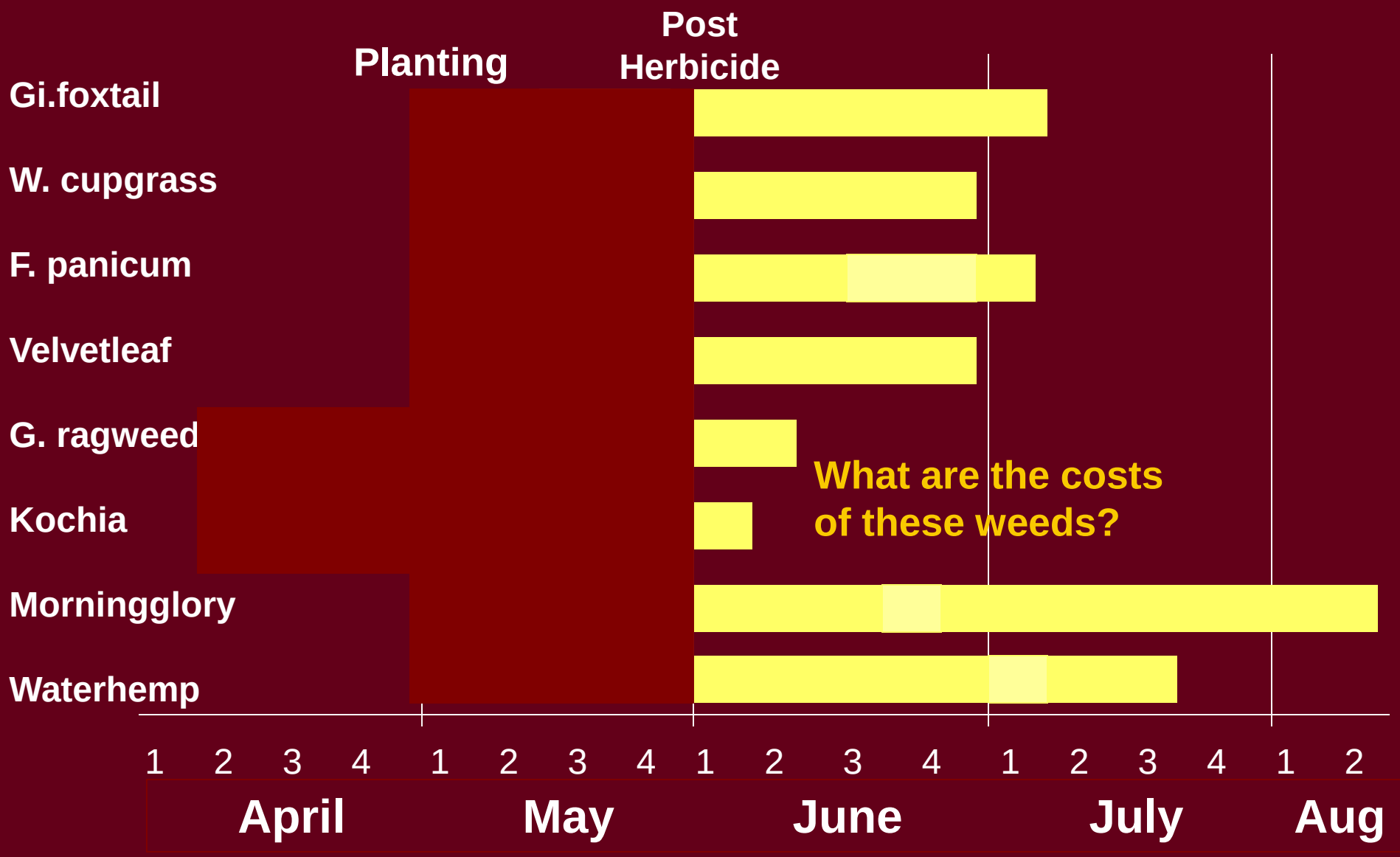
- Light
- Temperature
- Moisture
- Gases
- Aging
- Chemical

Weed Emergence Periods

- **Different species have different optimal emergence periods**

- **Time production practices to minimize impacts of weeds you have**

Weed Emergence Patterns



Sandell, Hartzler and Buhler. Iowa State University.

Weed Seed Production

Few weeds achieve genetic potential

- **Cocklebur – Arkansas**
  - **7000 seeds without competition**
  - **1100 seeds with competition**
- **Pigweed in corn**
  - **24,000 seeds with even emergence**
  - **3,000 seeds with four week delay**

via Hartzler, ISU

Table 5-7. Percent reduction of weed seed production *when weeds emerge after crop emergence as compared to when weeds emerge with crop. The amount of seed is dramatically reduced when weeds emerge after the crop. Adapted from Sprague, MSU Extension, 2008.*

WEED	CROP	WEED EMERGENCE (# WEEKS AFTER CROP)	% WEED SEED REDUCTION
Waterhemp	Corn	3	95
Waterhemp	Soybean	3	81
Giant ragweed	Corn	6	99
Giant ragweed	Soybean	6	78
Velvetleaf	Corn	3	60

In **Risk Management Guide for Organic Producers. Adapted from Sprague. 2008. MSU Ext. Bull. E-3065**

Seed Longevity

- Potential to survive in the soil for long periods of time
  - Most seeds die within 2 to 3 years
  - Est. 2/3 of the seedbank turns over annually

William Beal Buried Seed Study

- **Botanist at Michigan State University**
  (Then Michigan Agricultural College)

- **Buried seeds in 1879**
  - **20 glass bottles**
  - **50 seeds of each of 20 species mixed in sand**
  - **buried 20 inches deep with the mouths pointing downward to avoid water accumulation**

Frank Telewske, curator of the Beal Botanical Garden, inspects the most recent germination results in an experiment initiated by botanist William J. Beal 120 years ago.

William Beal Buried Seed Study

Originally, bottles dug every 5 years

- **1929 switched to every 10 years**
- **1980 switched to every 20 years**

One species, Moth Mullein (*Verbascum blattaria*) still germinated at the 120 year mark

Five bottles remain on MSU campus to be recovered in 2020, 140 years after burial

Photo: Andrew Medichini. Associated Press.

A hardy palm tree seed from ancient Judea, found at the Masada excavation site, above, is thriving, so far.

New York Times, June 12, 2005.

Date palm seed recovered from the Masada fortress site, radio carbon dated at 1990 yrs old (35 BC to 65 AD)

Dr. Sarah Sallon, Louis L. Borick Natural Medicine Research Center

Dr. Elaine Solowey, Arava Institute for Environmental Studies

The 1990 yr old palm seed germinated and is growing. Old seed occasionally can be coaxed to germinate, but usually die as seedlings. This one seemed to gain strength after the 3rd leaf emerged.

Photo: Guy Eisner.

At eight weeks, the persistent seed nicknamed Methuselah was still going strong. Most ancient seeds produce plants that soon die.

New York Times, June 12, 2005.

Lotus seeds in China est. at 1200 yrs sprouted. Seeds in London's Natural History Museum est. to be 500 yrs old germinated after the Germans bombed the museum in WWII and water was applied to extinguish the flames.

Photo: Associated Press.

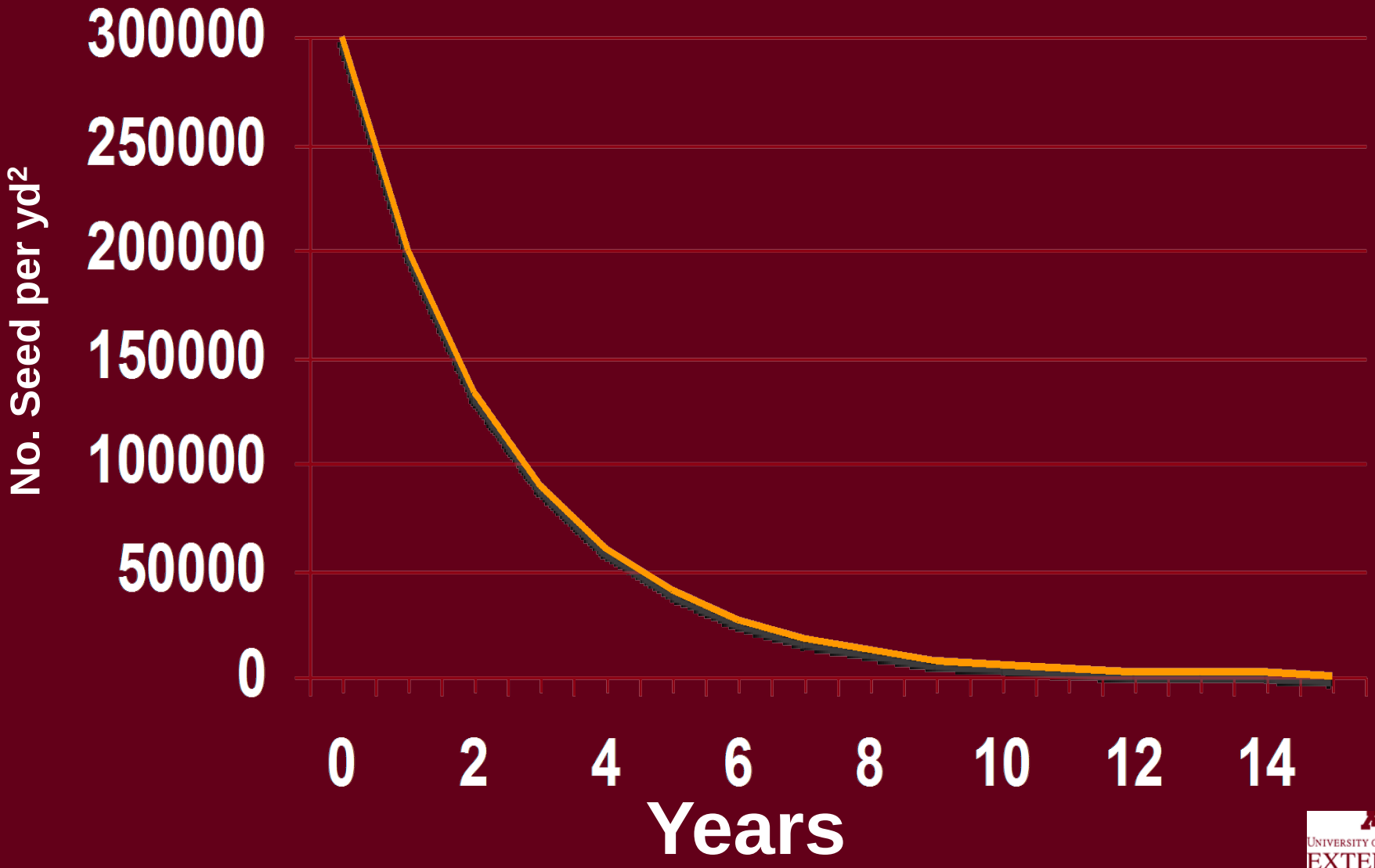
SFGate, Feb. 21, 2012..

http://www.sfgate.com/cgi-in/object/article?f=/c/a/2012/02/21/MNKU1NA41R.DTL&object=/n/p/2012/02/20/9c6f3bcd-3a5b-4e59-a0bd-1db7b7f24dfb.jpg&type=science

Sylene stenophylla **plant regenerated from tissue recovered from a squirrel's chamber in buried sediments in Siberia est. to be over 30,000 yrs. old**

Institute of Cell Biophysics of the Russian Academy of Sciences

Seedbank Decay 2/3 Annual Turnover



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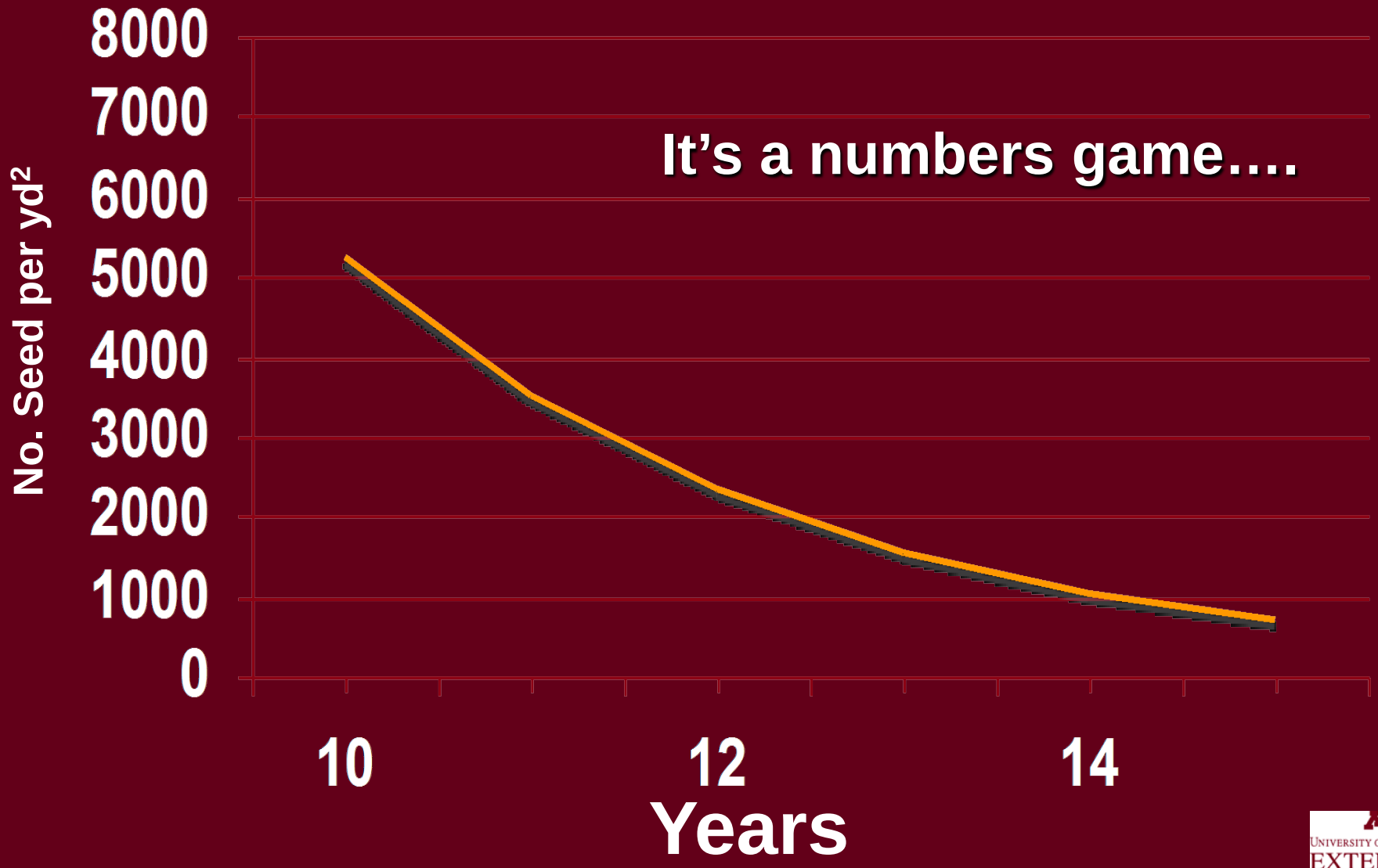
Seedbank Decay 2/3 Annual Turnover



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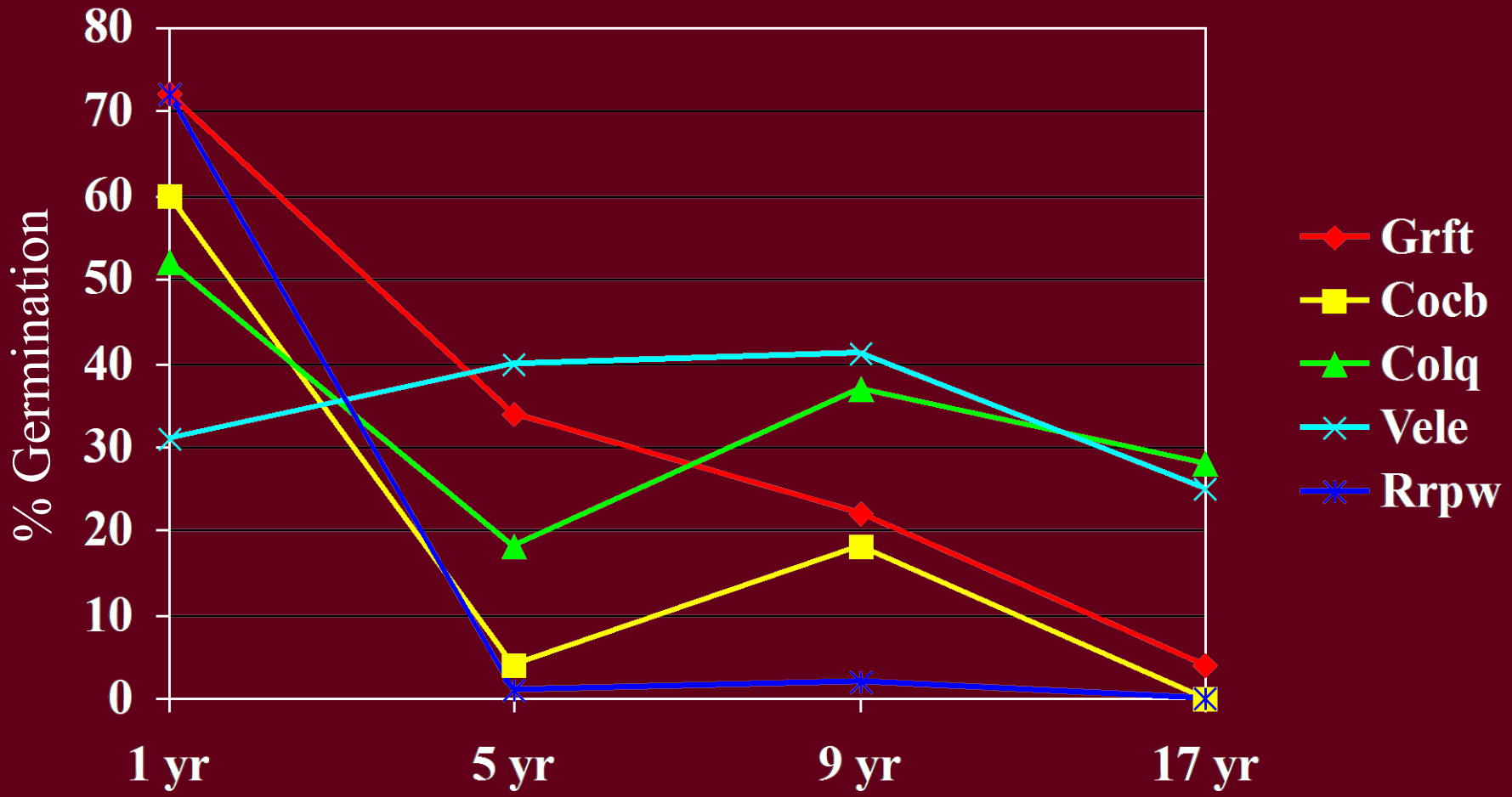
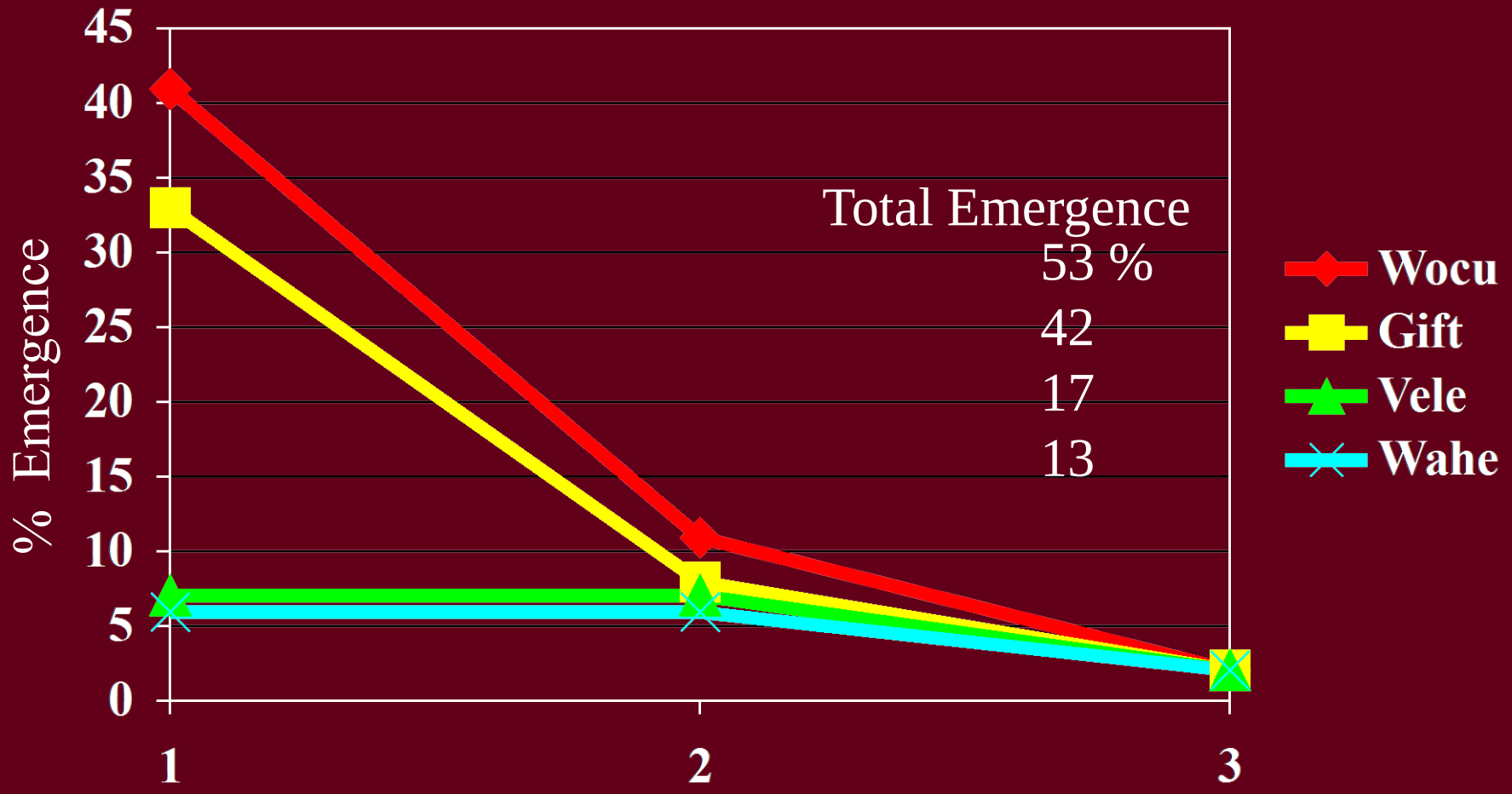
Longevity of Weed Seed at 20-cm Depth, NE



Burnside et al. Weed Sci. 1996.

Annual Weed Seedling Emergence
Years After Seed Rain



Hartzler and Buhler. ISU. 1997.

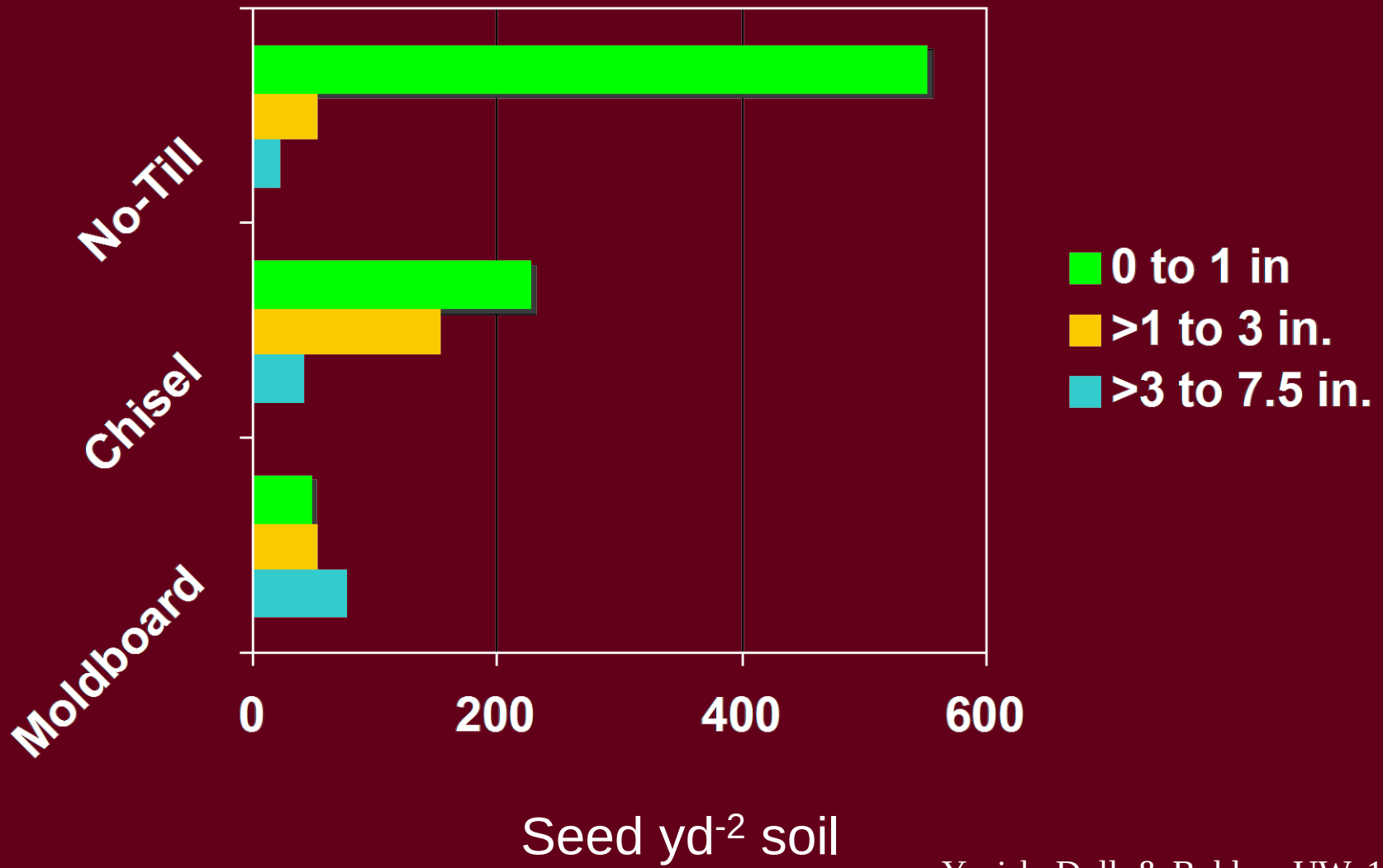
Table 5-9. Weed and crop seed persistence in soil. The approximate number of years it takes to reduce weed seed populations by 50 and 99 percent.

Adapted from Michigan State University, 2005.

		50% REDUCTION	99% REDUCTION
	SPECIES	----------YEARS----------	
Broadleaves	Lambsquarters	12	78
	Velvetleaf	8	56
	Cocklebur	6	37
	Pennsylvania smartweed	4	26
	Redroot pigweed	3	20
	Shepardspurse	3	19
	Curly dock	3	17
	Waterhemp	2	16
	Common ragweed	1.5	10
	Wild mustard	1	7
	Common sunflower	0.5	2
	Hemp dogbane	0.5	2
	Giant ragweed	0.5	2
	Kochia	0.5	2
Grasses	Yellow foxtail	5	30
	Barnyardgrass	2	10
	Large crabgrass	1.5	8
	Giant foxtail	1	5
Crops	Wheat	1	2
	Canola	2	4
	Soybean	1	2
	Corn	2	4

***In* Risk Management Guide for Organic Producers.**
Adapted from MSU Ext. Bull. E-2931. Integrated Weed Management: One year's seeding. Feb. 2005.

Influence of Tillage on Weed Seed Distribution in the Soil Profile



Yenish, Doll, & Buhler. UW. 1992.

Seedbank summary

- **Size of seedbank affects efficacy of management efforts**
- **Seedbanks are dynamic**
  - **Pop. density fluctuates widely depending on input, germination, mortality, predation**
  - **Most turn over in 2 to 3 years**
  - **Small % survive for long periods**

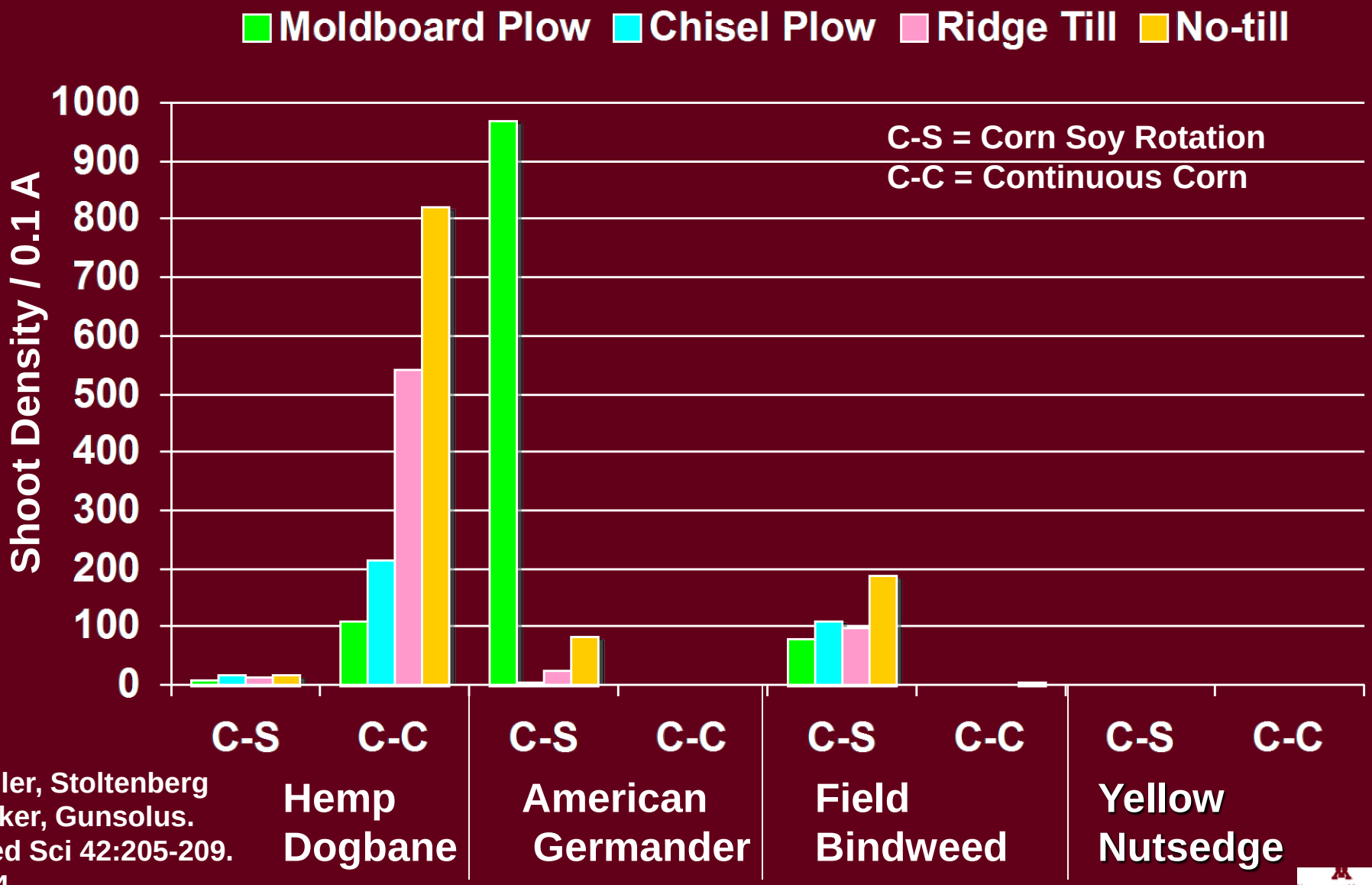
Historically, Species Shift

- Burning
  - Tall grass prairies
- Tilling the prairies
  - Field bindweed
- 2,4-D and N fert
  - Bdlfs to grasses
  - Triazine, acetanilides grasses
- Planting dates
  - Earlier dates to cooler species

Historically, Species Shift

- Rainy or droughty periods
- Reduced or no tillage
  - small seeded species and increased perennials
- Treflan + Sencor t.m. 70's and 80's
  - Eastern Black Nightshade
- Imidazolinones 90's
  - Waterhemp
- Glyphosate 2000's
  - Mares Tail
  - Waterhemp
  - Ragweeds

Perennial Weeds, 14 Year Study, Nashua IA



Buhler, Stoltenberg Becker, Gunsolus. Weed Sci 42:205-209. 1994.

It Takes a Village for Weeds Too!

- **What your neighbors do**
  DOES impact you

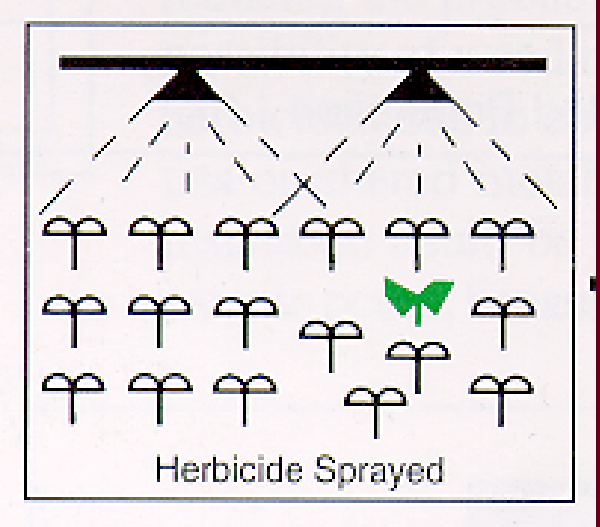
  – **Roundup Ready world will shift the species you face in the non-GMO world**

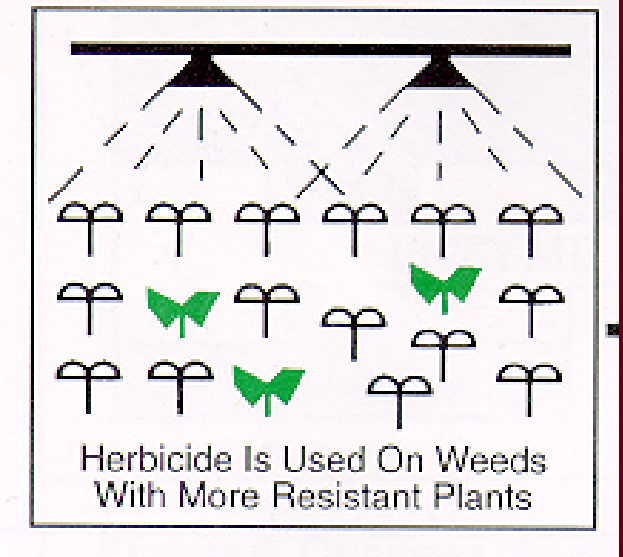
Waterhemp: Rochester, MN

- *Two applications of Roundup Ultra: 34 oz/A and 40 oz/A*
- *Numerous survivors*
- *Initial burndown*
- *Loss of tap root*
- *Prolific re-growth just above and below soil level*

- *Photo: Duane Rathmann*

Selection

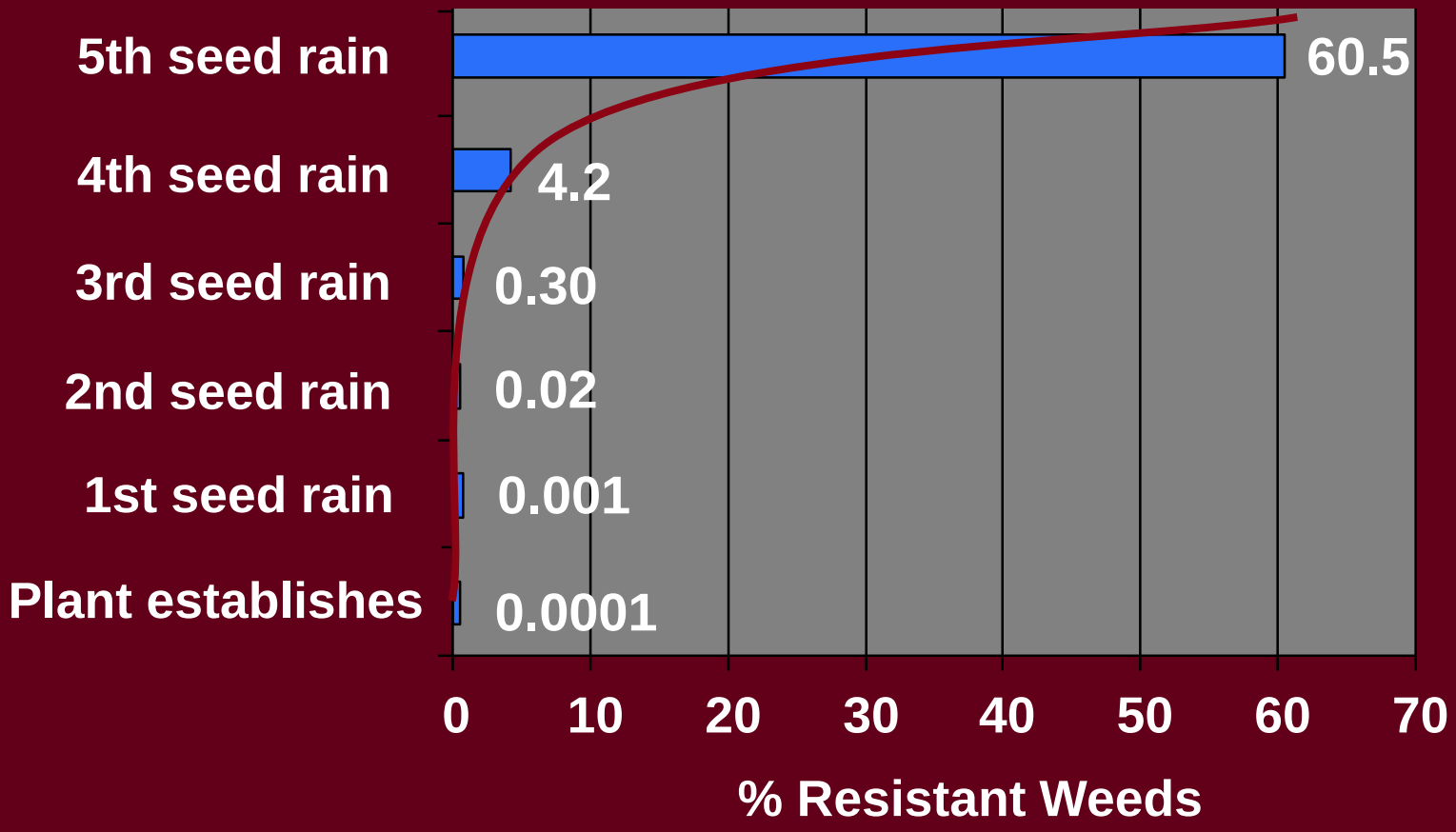




= Resistant Biotype

= Susceptible Or Wild Biotype

Hypothetical Development of Weed Resistant Populations with Repeated Control Methods / Seed Rain



Adapted from resistance development graphic

Weeds To Watch

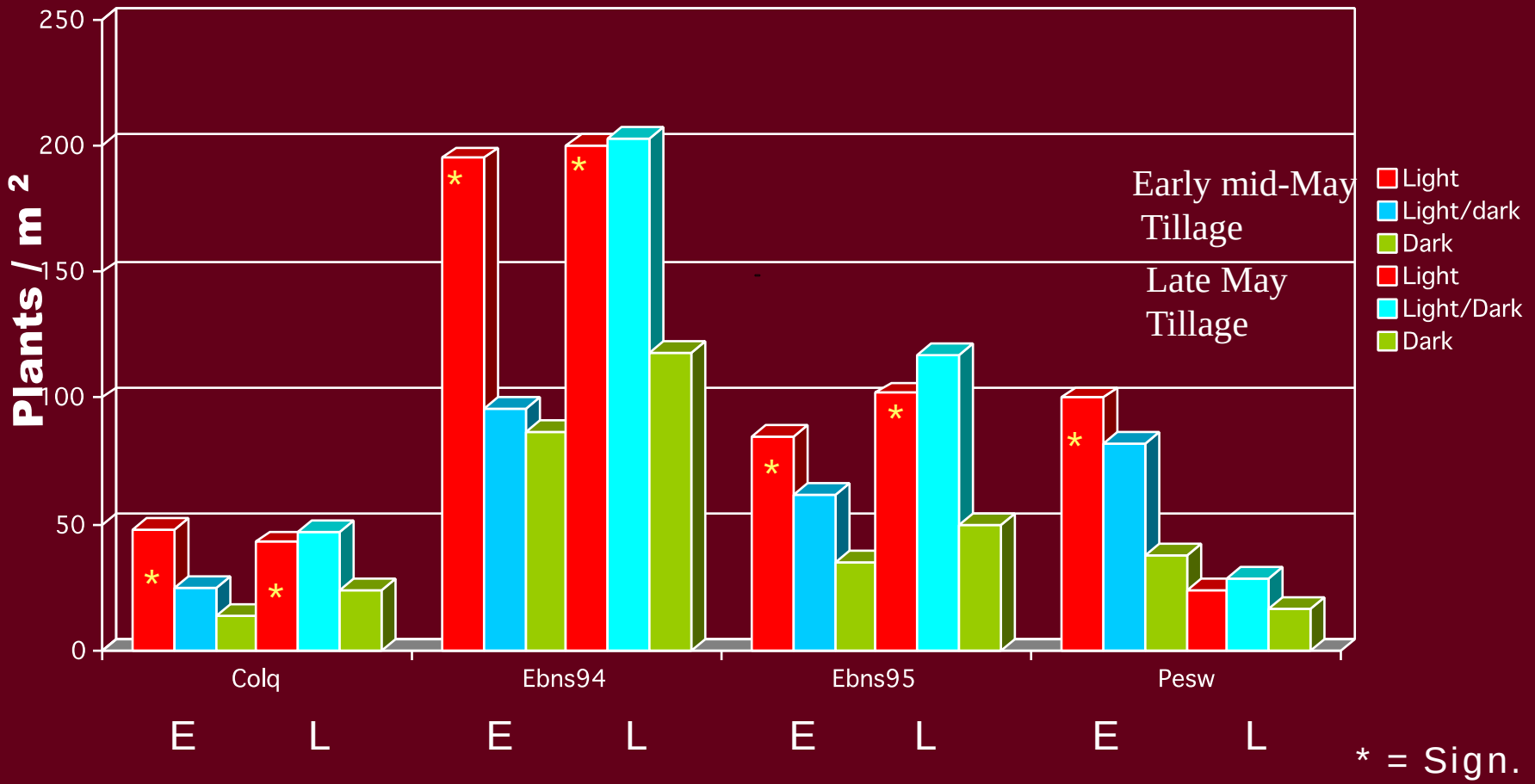
Weed communities continually shift in response to management practices.

Failure to properly identify new weeds when they first enter a field may result in the plant becoming permanently established and increase weed management costs.

This poster was a six state effort funded by
NC Region Pest Mgmt. Center

Light Effects on Annual Weed Emergence

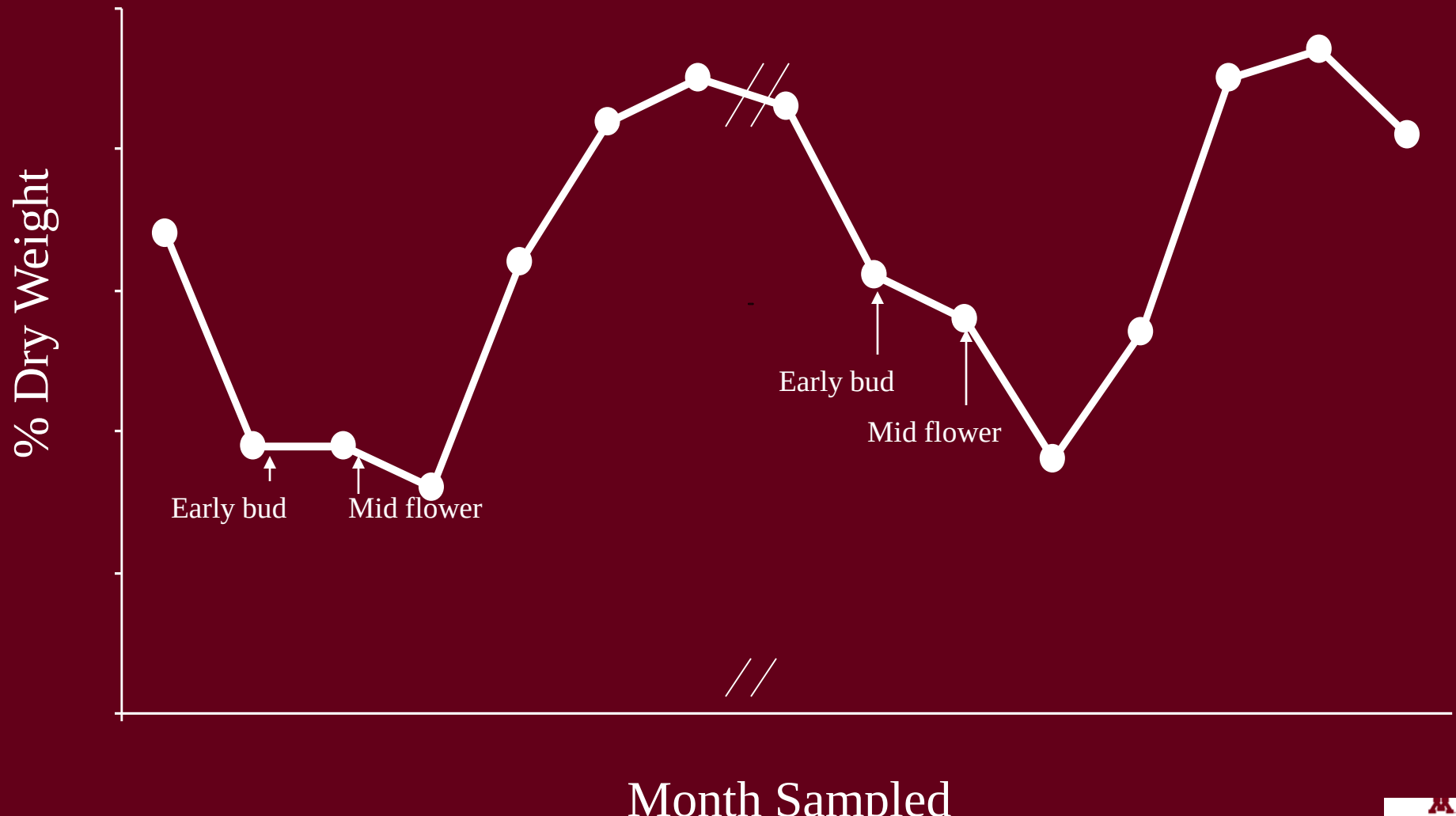
Buhler Weed Technol. 11:496-501. 1997



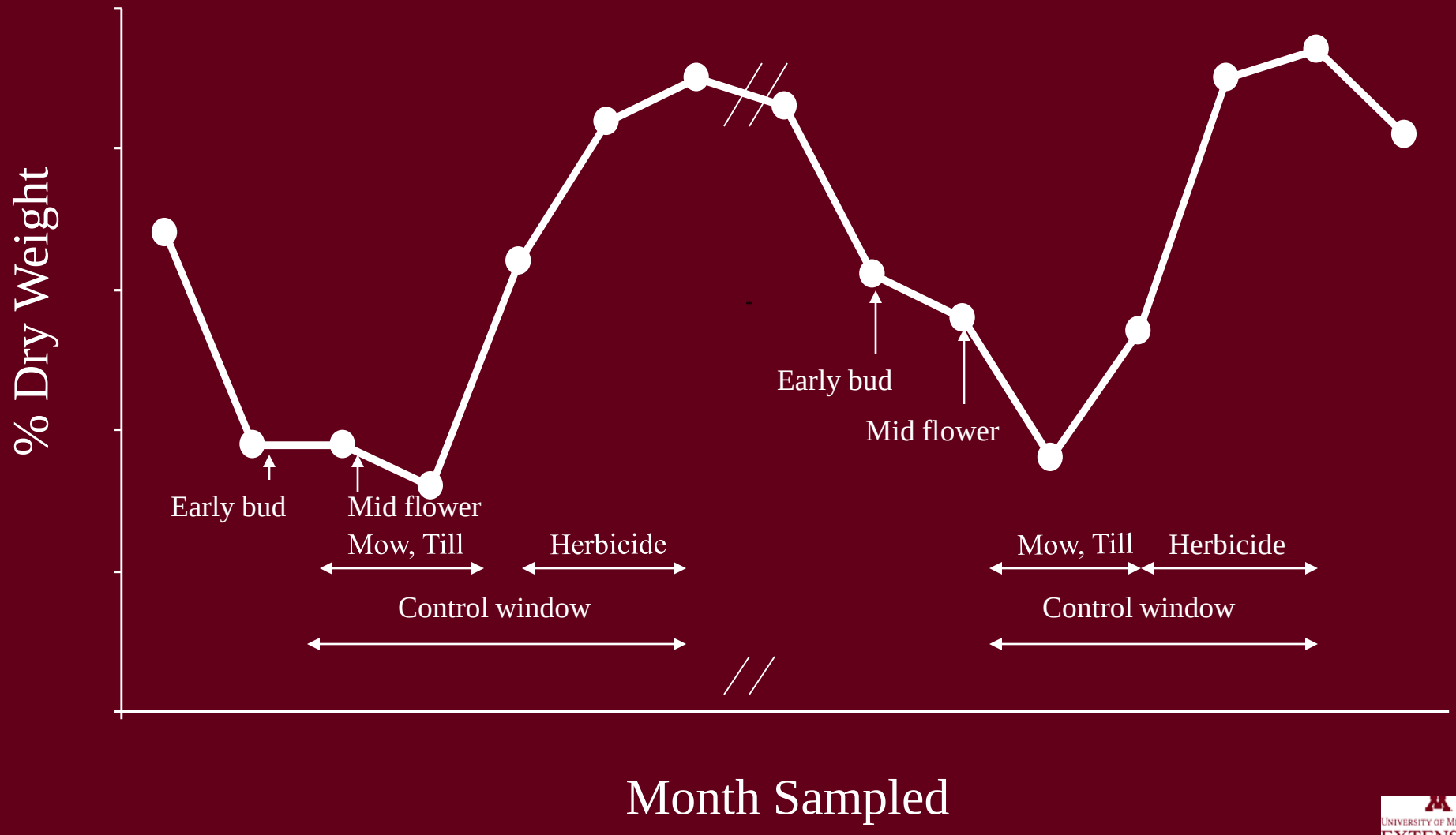
Perennial Weeds - the challenge

- Very difficult to control
- Repeated treatment is necessary
  - whatever it is
- Survivors
  - regrowth
- Carbohydrate depletion

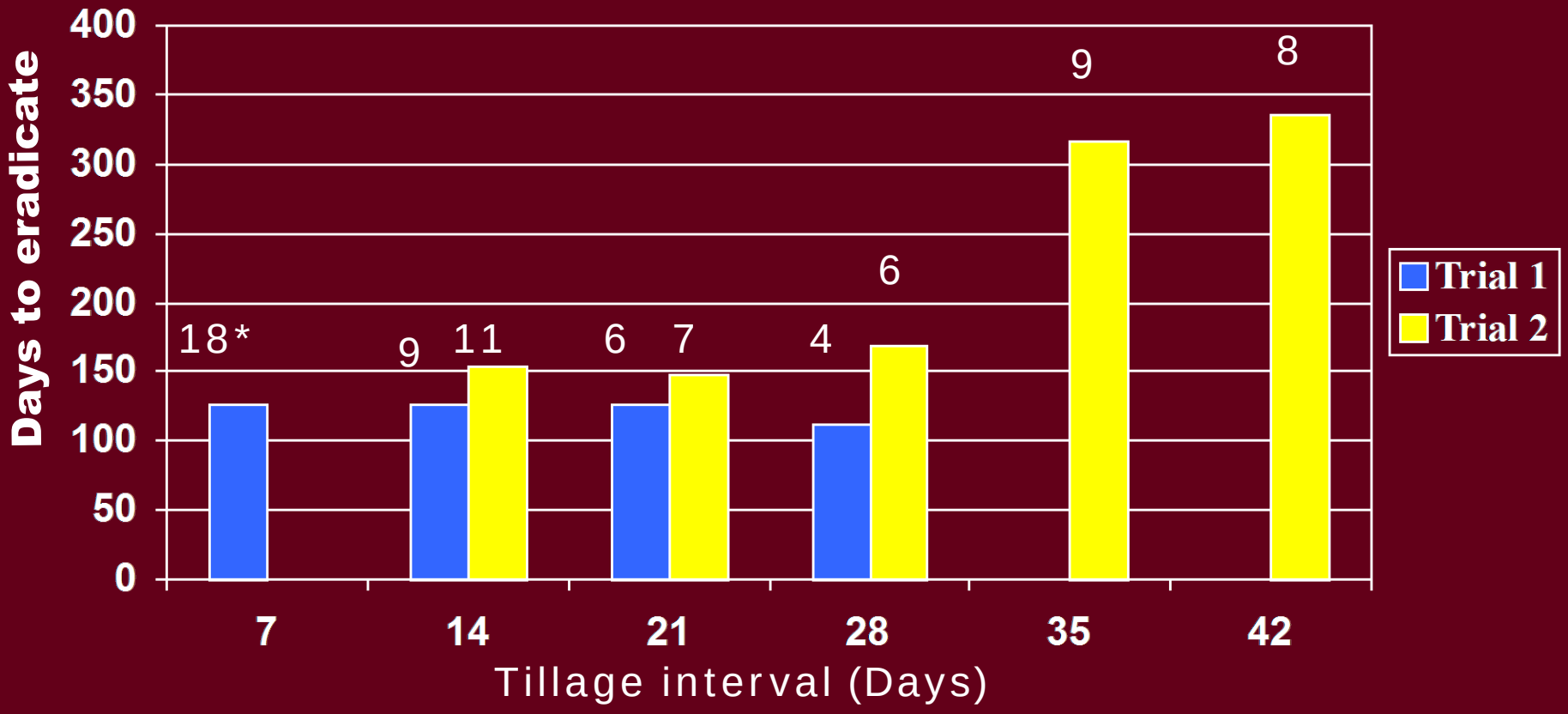
Seasonal Carbohydrate Levels In Hemp Dogbane Root Crowns



Seasonal Carbohydrate Levels In Hemp Dogbane Root Crowns



Tillage to Eradicate Canada Thistle



Adapted from Seely, C.I. 1952
Univ. Idaho Exp. Stat. Bull. 288

Plowed 6” deep when 5 ” tall, then duckfoot cult. 5“ deep rest of the tillage operations
* Indicates total no. of tillage events needed to eradicate

Hemp dogbane crowns develop below plow layer

Hemp dogbane shoot ascending from laterals at 44 inch depth

Canada thistle root mass after one season

Phil Westra, Colorado State

Herbicides for Canada Thistle

- Picloram
  - (Tordon, Grazon)
- Clopyralid
  - (Stinger, Transline, Curtail)
- Aminopyralid
  - (Milestone, Forefront)
- Aminocyclopyrachlor
  - (Perspective, Streamline)

Limitations of Bio-Control for Canada Thistle

- Significant weed problem in native range
- Several native *Cirsium* spp.
  - Specificity concerns

Bugs for Biocontrol??

Agents:

Seed-heed weevil	(*Rhinocyllus conicus*)
Rosette weevil	(*Trichosirocalus horridus*)
Defoliating beetle	(*Cassida rubiginosa*)
Gall fly	(*Urophora cardui*)
Stem-mining weevil	(Hadroplontus litura)

Non-Native Thistles:

Musk	(*Carduus nutans*)
Plumless	(*Carduus acanthoides*)
Bull	(*Cirsium vulgare*)
Canada	(*Cirsium arvense*)

Issues with native thistle susceptibility such as Flodman thistle (*Cirsium flodmani*) - to use or not??

Other Biocontrol??

Mycoherbicides

Thistle rust (*Puccinia punctiformis)*
- as early as 1923
- stunted, chlorotic
- symptoms resemble growth regulator herbicide

White mold (*Sclerotinia sclerotiorum* (Lib.))

Pseudomonas syringae pv. *Tagetis*
- tagetitoxin, inhibits RNA polymerase III

ALL have major consistency issues

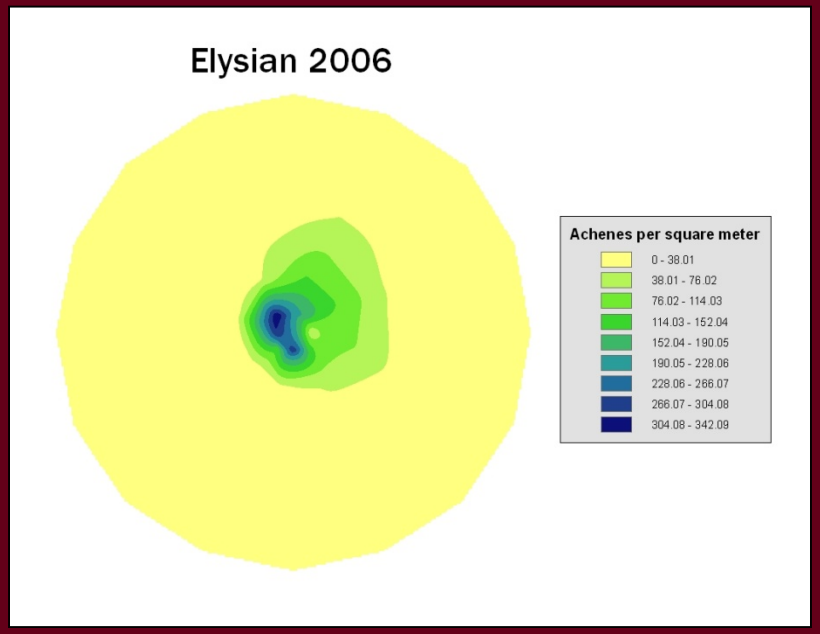
Rusts for biocontrol?
Thistle rust (*Puccinia punctiformis)*

Bacteria for biocontrol?
Pseudomonas syringae

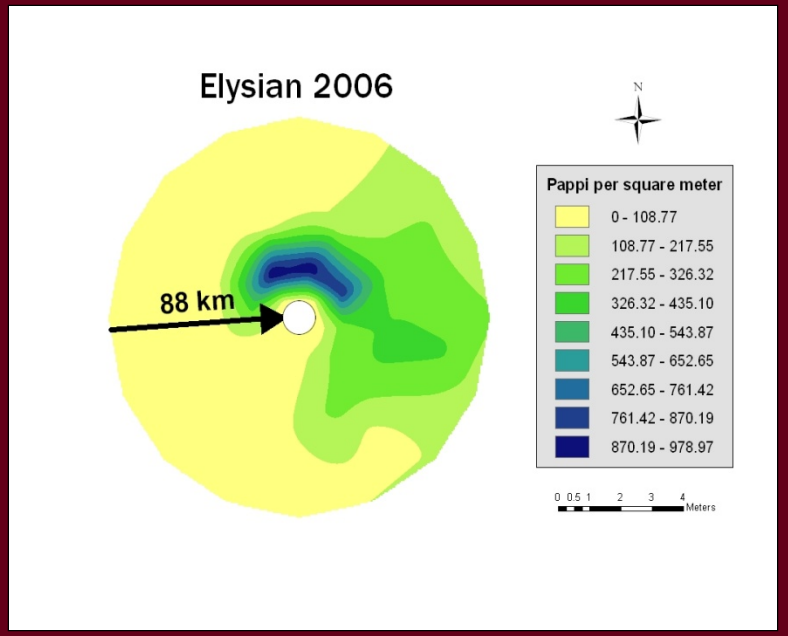
Varied biotypes

Seeds to Seedlings

Effect of Wind of direction and distance of Canada thistle dispersal



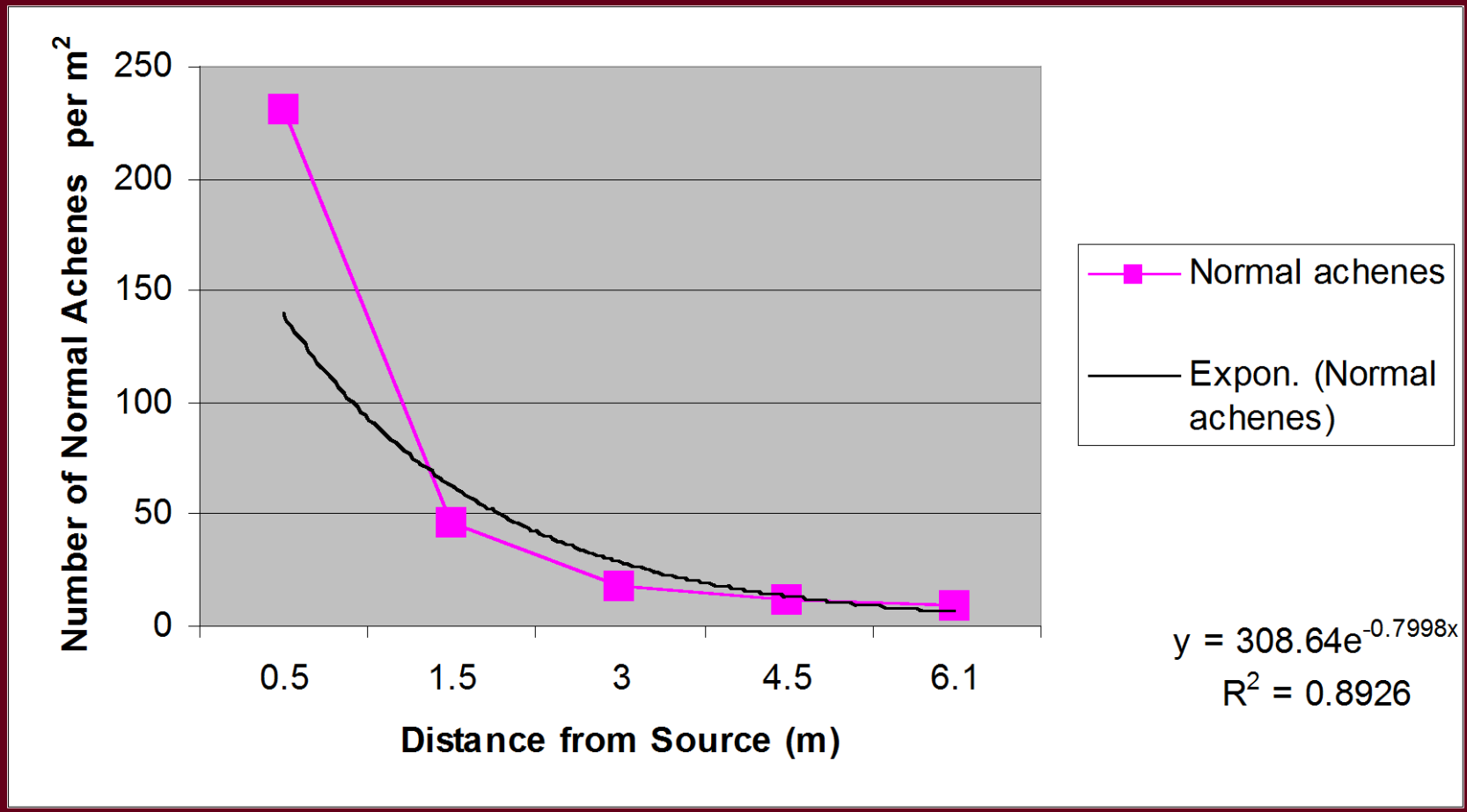
Seeds



Pappi

88 km average daily wind run

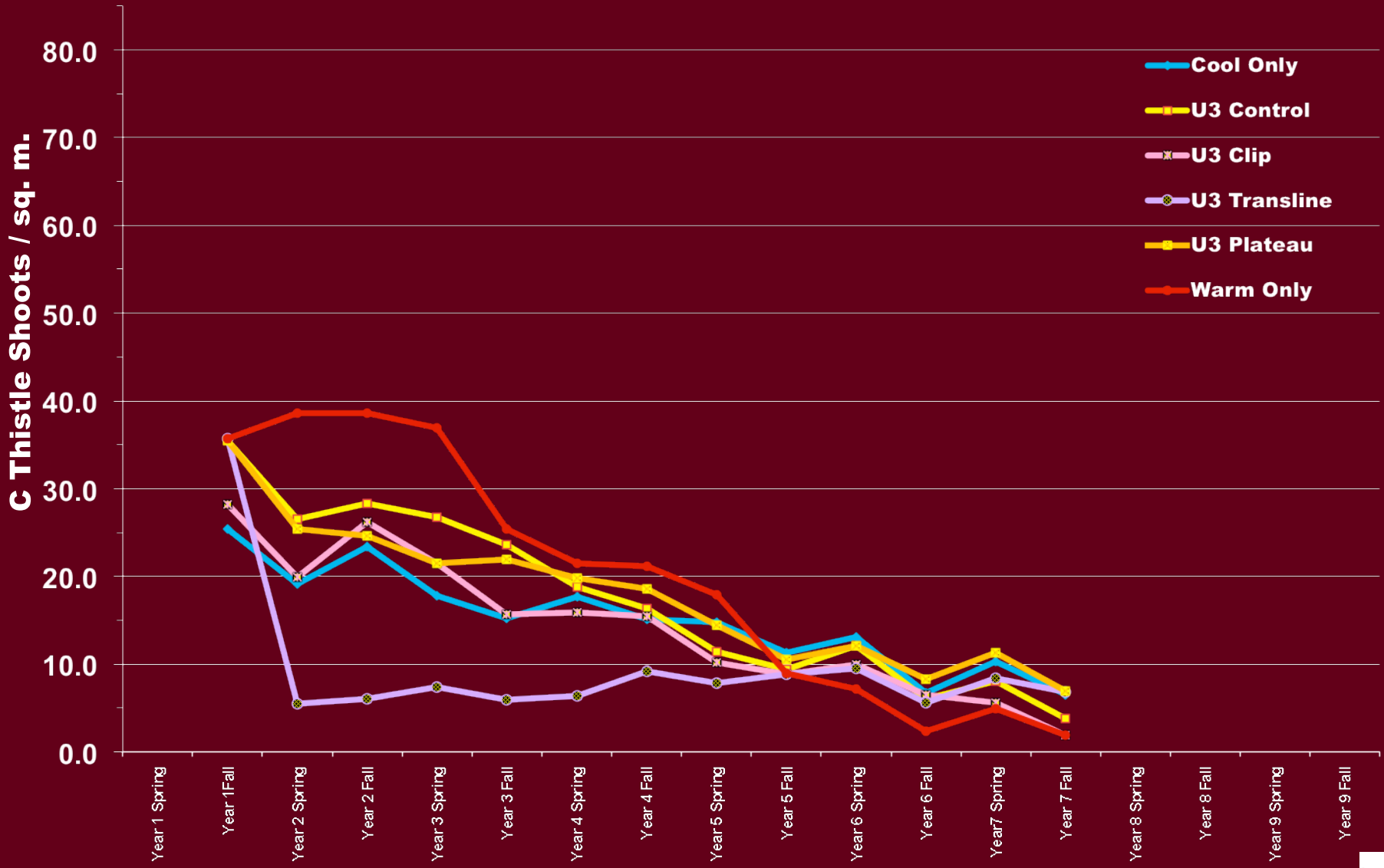
Dilution of seed and pappi as area expands



Functional Groups Research

Functional Group x Canada Thistle Est.

Lamberton, MN. Canth Shoot Cnts. All Seedings Combined.



n = 24. Counts are in the seeded center area. May not characterize entire plot in the early years.

Functional Group x Canada Thistle Est.

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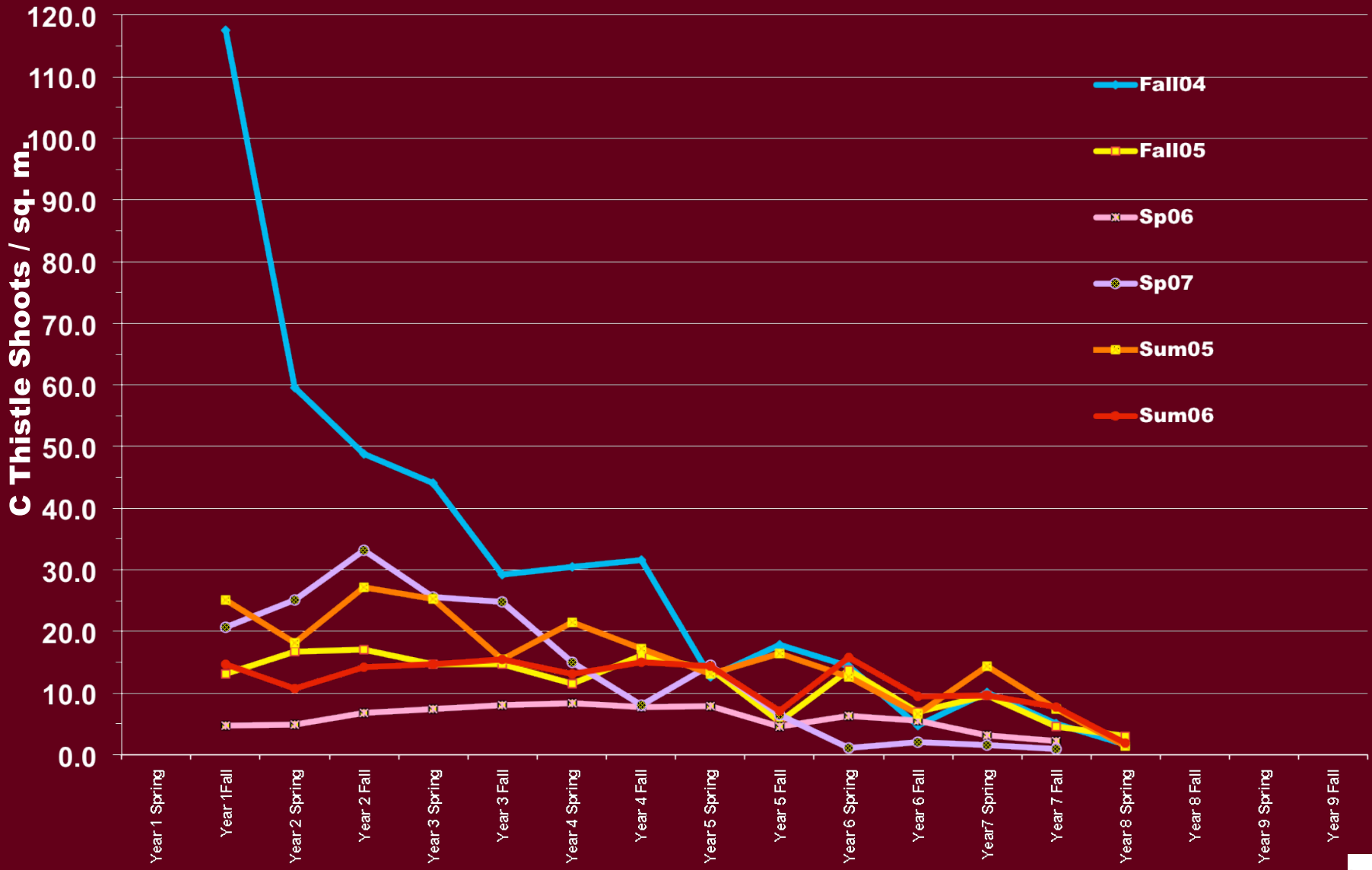


n = 24. Counts are in the seeded center area. May not characterize entire plot in the early years.

Effect of Animal Digestive Tract on Weed Seed Viability

- Animals tested:
  - Calves, horses, sheep, hogs & chickens

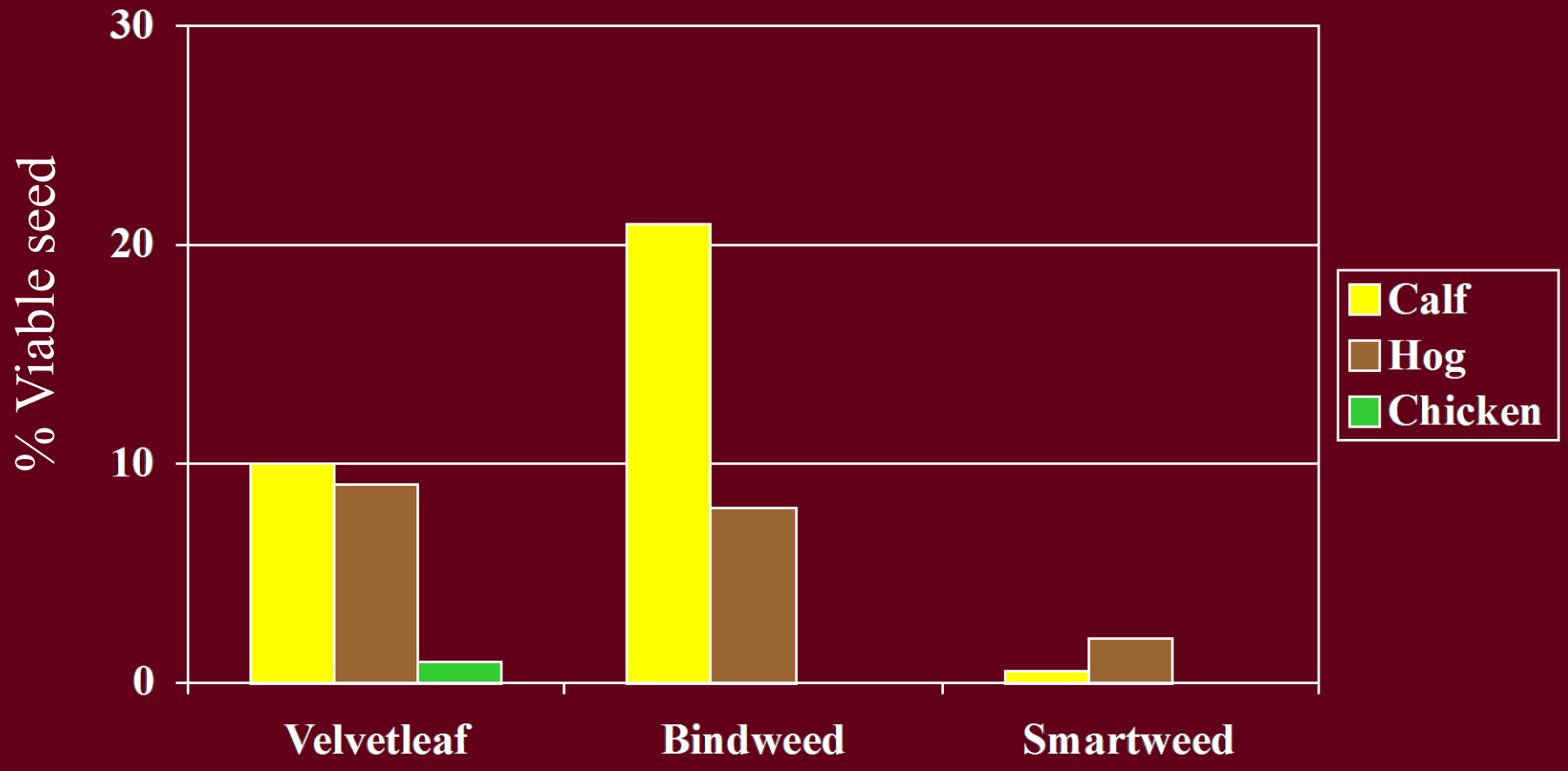
- Weeds evaluated:
  - Velvetleaf, field bindweed, sweet clover, smooth dock, smartweed, wild rose, and pepperweed.

Effect of Animal Digestive Tract on Weed Seed Viability

- Results:
  - Weeds with soft seed coats had greater mortality than weeds with hard seed coats
  - Calves passed 96 viable seeds/1000 seeds fed
  - Hogs and horses passed 88 viable seeds/1000 seeds fed
  - Sheep passed 64 viable seeds/1000 seeds fed
  - Chickens passed 12 viable seeds/1000 seeds fed

Jerry Doll, Univ Wisconsin

Digestion Effects on Weed Seeds



Adapted from Harman and Keim. 1934.

Effect of Animal Digestive Tract on Weed Seed Viability

- In a study of fresh droppings of dairy cow manure in upstate New York; 13 grass and 35 broadleaf weed species were found
- Common weeds found in survey of 20 farms include;
- Common lambsquarters (50% of farms)
- Yellow foxtail (35% of farms)
- Dandelion (30% of farms)
- Wild mustard, pigweed, barnyardgrass (25% of farms)

Jerry Doll, Univ Wisconsin

Effect of Animal Digestive Tract on Weed Seed Viability

- Of the 20 Farms:
  - One farm had 400,000 seeds/ton of manure (mostly common lambsquarters)
  - Four farms had no weed seeds
  - Fifteen farms averaged 75,000 seeds/ton
  - Therefore for 30 tons of manure/acre at 75,000 seeds/ton = 2.25 million seeds/acre
  - The cleaner the field the more noticed the impact. Also, consider addition of new species

Jerry Doll, Univ Wisconsin

Manure as Seed Source

- Most sees killed by digestion
- Small percentage can survive
  - NY dairy farms, 34 seeds/ft^2 applied to fields in manure
  - Insignificant number compared to existing seedbank
- Site specific issues (chicken or the egg)

via Hartzler, ISU

Effects of Manure Composting on Weed Seeds

- Study of Manure Pile Temperatures:
  - Horse manure = 201^{o} F
  - Cow manure = 168^{o} F
  - Mixture = 188^{o} F
  - After 60 days all seeds died during the fermentation period in all manure piles

Jerry Doll, Univ Wisconsin

Effects of Manure Composting on Weed Seeds

- Key ingredients appear to be temperature and moisture
- Texas A&M study:
  - barnyardgrass, pigweed, kochia, and bindweed
  - beef cattle at 35% moisture
  - All species (except bindweed) killed after 3 or more days at 160^{o} F. Bindweed needed 7 days at 180^{o} F
  - In dry air at 140^{o} F for 30 days; no effect
  - In dry air at 160^{o} F for 3 days; most all killed

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Effects of Manure Composting on Weed Seeds

- Nebraska study:
  - Foxtail, smooth brome, pigweed, common sunflower, and cocklebur and velvetleaf
  - Normal composting facility for one week
  - Dry dairy manure; most seed viable
  - Dry beef manure; most seeds viable
  - Wet beef manure; all seeds dead

  - Dry dairy manure after 4- to 5- months killed all seeds except velvetleaf (max. temp 140^{o} F)

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Effects of Manure Composting on Weed Seeds

- Key ingredients to effective composting appear to be temperature and moisture
  - Need temperatures above 140^{o} F (160^{o} - 180^{o} F)
  - Moist compost increases seed kill
  - To reduce viability of hard seed coats such as mustards, field bindweed and velvetleaf both temperature and moisture are necessary

Jerry Doll, Univ Wisconsin

Weed Seed Survival in Anaerobic Digesters

By Elizabeth J. Katovich and Roger L. Becker
Agronomy and Plant Genetics, University of Minnesota

Jerry Doll, University of Wisconsin

MANURE IS AN IMPORTANT SOIL AMENDMENT PROVIDING valuable nutrients. However, many assume manure is always rich in weed seeds. The opposite is probably the case as most of our harvested forage is relatively free of weed seeds. Exceptions obviously exist. There is no simple method to extract weed seeds from feed or manure and to then test them for viability. So the best advice is to understand current knowledge about weed seeds in manure and how they may impact your operation. Key factors that determine the potential for weed seed problems from livestock systems are feed sources, type of animals, and type of feed and manure handling systems.

Feed Sources

Weed seeds enter livestock systems from forages, grain, and palletized feed products. Cash *et al.* (1998) estimated that for palletized products, less that 1% of weed seed survive feed grinding and palletizing. Though small in number, feed pellets can be a source of introduction of new weed species to a farm, and if one considers the volume of palletized feed fed, can be a significant source of weed seed. The biggest contribution of weed seed can come from contaminated hay and grain, however. A portion of weed seed present in feed can remain viable after passing through an animal's digestive tract. Weed seed present in bedding or in spilt-feed bypasses the animal directly entering the manure stream. Both of these weed seed sources may result in manure containing viable weed seeds. A study conducted in New York State (Mt.Pleasant and Schlather 1994) showed that farms with low amounts of weed seed in dairy manure used feed with low numbers of weed seeds. Farms with high manure weed seed counts either harvested feed from weedy fields or imported feed containing weed seeds. A California study (Cudney *et al.* 1992) showed that dairy manure from producing cows had fewer weed seeds than manure from dry cows, presumably because the dry cows received lower quality (weedier) feed.

Type of Animals, Ensiling, Digestion, and Manure Handling

The animal source of manure can be important. Two studies in Nebraska characterized the effects of the digestive tract and manure on weed seeds (Harmon and Keim 1934). Weed seeds were fed to calves, horses, sheep, hogs, or chickens. Nearly 25% of the seeds fed to hogs and cattle were recovered in the manure, while only 10 to 12% were recovered from horses and sheep. Chickens were the most effective in destroying weed seeds with only 2% of the velvetleaf seeds fed recovered, while none of the bindweed, sweet clover, smooth dock, smartweed, wild rose and pepperweed seeds fed were recovered.

Of the seeds recovered from calves, horses, sheep or hogs, an average of 25% germinated. Although few in number, 62% of the velvetleaf seeds that survived the trip through a chicken germinated, suggesting that the gizzard may have actually scarified the seed and stimulated germination. Combining seed recovered and germination of weed seeds fed, sheep, horses, pigs, and calves passed 6, 9, 9, and 10% viable seeds, respectively, while poultry passed only 1%

For more information, please contact:

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Knowledge for a changing world

University of Minnesota Extension Service

Online Bulleting on Weed Seeds in Livestock Systems

http://appliedweeds.cfans.umn.edu/

Number of weed seed germinating in a field germination assay for two seasons following 30 days storage in different manure storage systems at Haubenschild Farms

Manure system	Weed species					
	VELE	COLQ	RRPW	LTSW	GIFT	WIPM
Anaerobic digestion	16	12	1	0	0	0
Lagoon storage	12	18	5	0	0	0
Inorganic fertilizer	14	11	4	0	0	0
LSD	NS	NS	NS	NS	NS	NS

VELE = velvetleaf
COLQ = common lambsquarters
RRPW = redroot pigweed
LTSW = Ladysthumb smartweed
GIFT = giant foxtail
WIPM = wild proso millet

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