Weed Management

NEW MEXICO AGRICULTURE SUSTAINABILITY WORKSHOP

Brian Schutte

College of Agricultural, Consumer and Environmental Sciences Department of Entomology, Plant Pathology & Weed Science



BE BOLD. Shape the Future.* New Mexico State University

Session Outline

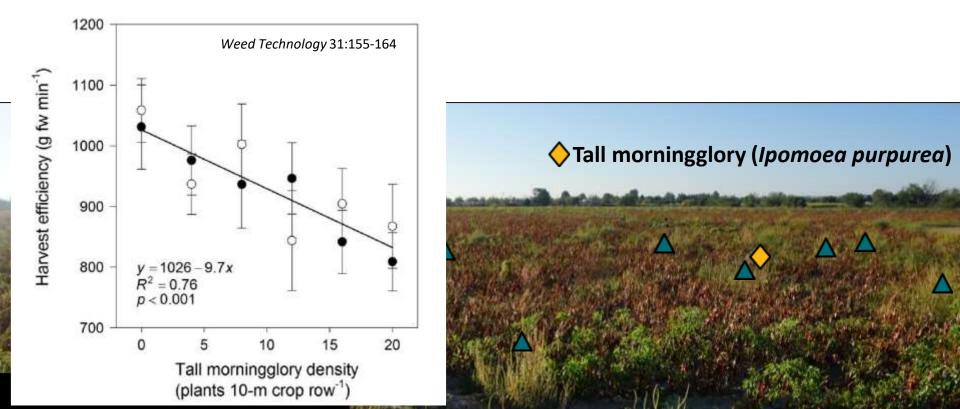
1. Evidence supporting the concept of INTEGRATED WEED MANAGEMENT

2. General recommendations and possible tactics for INTEGRATED WEED MANAGEMENT PROGRAMS

*PLEASE NOTE: Mention of trade names is solely for the purpose of supplying information and does not imply recommendation or endorsement by NMSU.



- Weeds reduce crop yield & crop quality
- Weeds potentially harbor pathogens
- Weeds reduce harvest efficiency



- Weeds reduce crop yield & crop quality
- Weeds potentially harbor pathogens
- Weeds reduce harvest efficiency
- Weeds produce seeds and propagules that perpetuate the problem



F.Y.I. Weedy species can be beneficial

Morningglories attract **insect pollinators** that also pollinate flowers on crop plants.

Annals of Botany 94:269-280 HortScience 19:580-582









https://growiwm.org/weed/morningglory-annual-species/

FOUNDATIONAL PRINCIPLES:

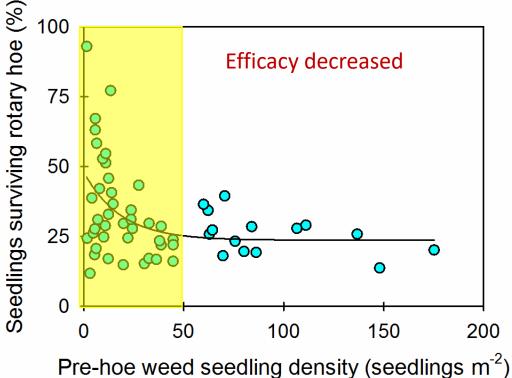
- 1. Weed control costs increase as weeds become more abundant
- 2. Over time, weed population densities are reduced by *INTEGRATED* strategies

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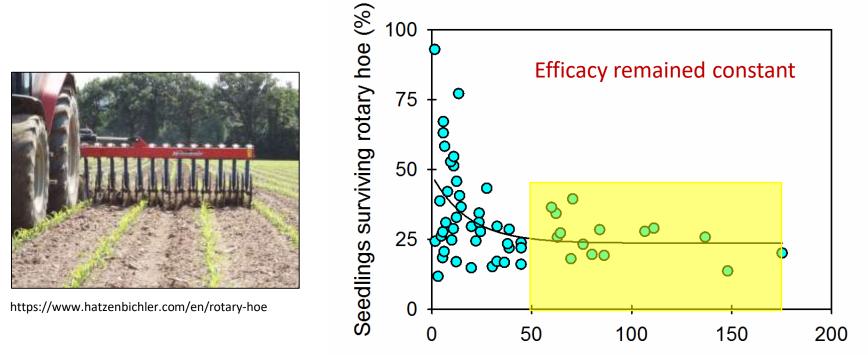
SUPPORTING EVIDENCE FOR FOUNDATIONAL PRINCIPLE 1: Weed control costs increase as weeds become more abundant





Weed Science 55:502-507

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Pre-hoe weed seedling density (seedlings m⁻²)

Weed Science 55:502-507

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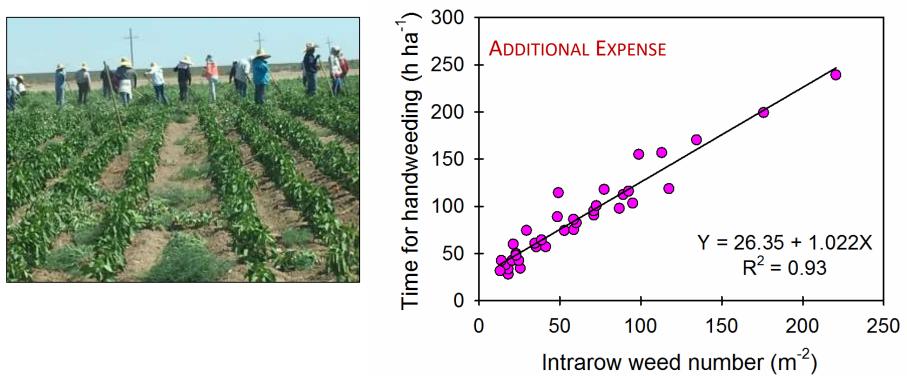
Pre-hoe weed density	% surviving rotary hoe	Post-hoe weed density
50 seedlings m ⁻²	25	13 seedlings m ⁻²
175 seedlings m ⁻²	25	44 seedlings m ⁻²



Escapes need to be controlled.

Weed Science 55:502-507

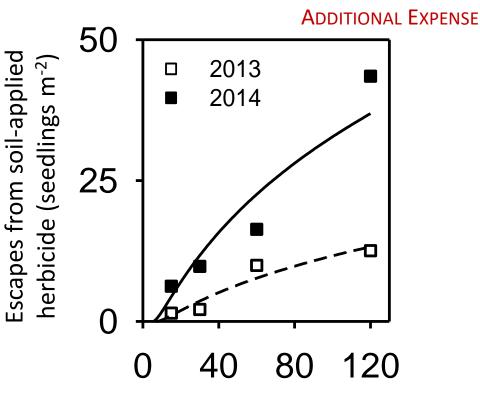
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Weed Research 41:491-508

SUPPORTING EVIDENCE FOR FOUNDATIONAL PRINCIPLE 1: Weed control costs increase as weeds become more abundant

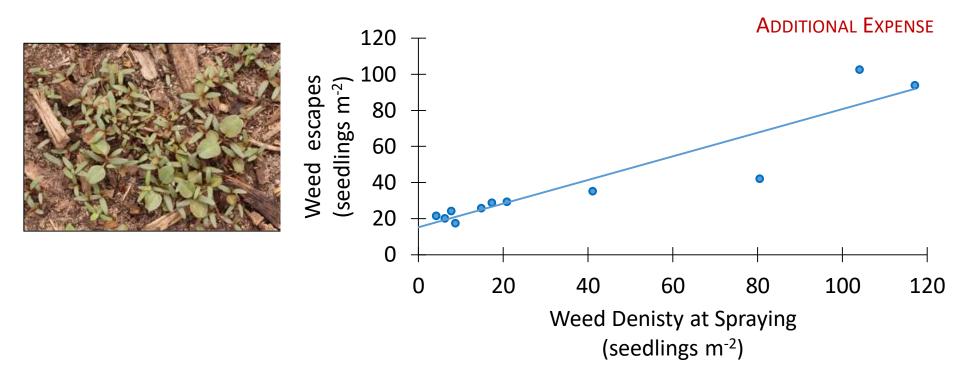




Seedbank addition (seeds m⁻²)

Weed Technology 29:844-853

SUPPORTING EVIDENCE FOR FOUNDATIONAL PRINCIPLE 1: Weed control costs increase as weeds become more abundant



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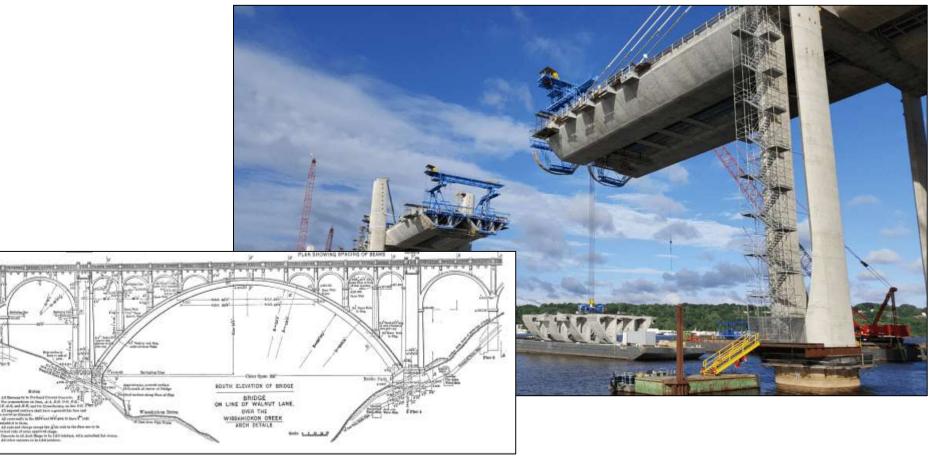
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 - INTEGRATED approach safeguards against control failures

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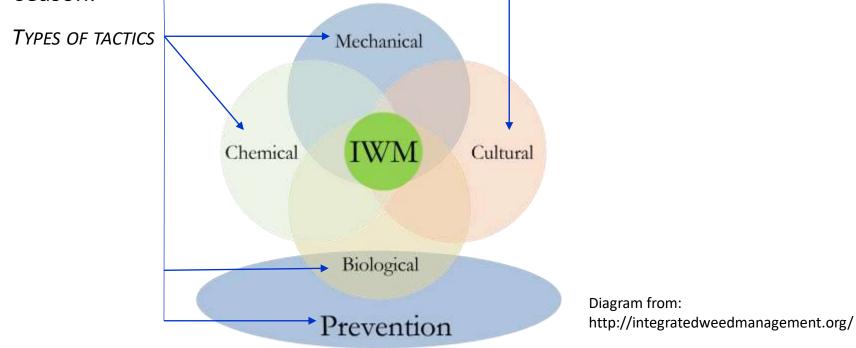


https://commons.wikimedia.org/w/index.php?curid=10256668

https://www.roadsbridges.com/bridge-construction-final-construction-begins-st-croix-crossing-bridge

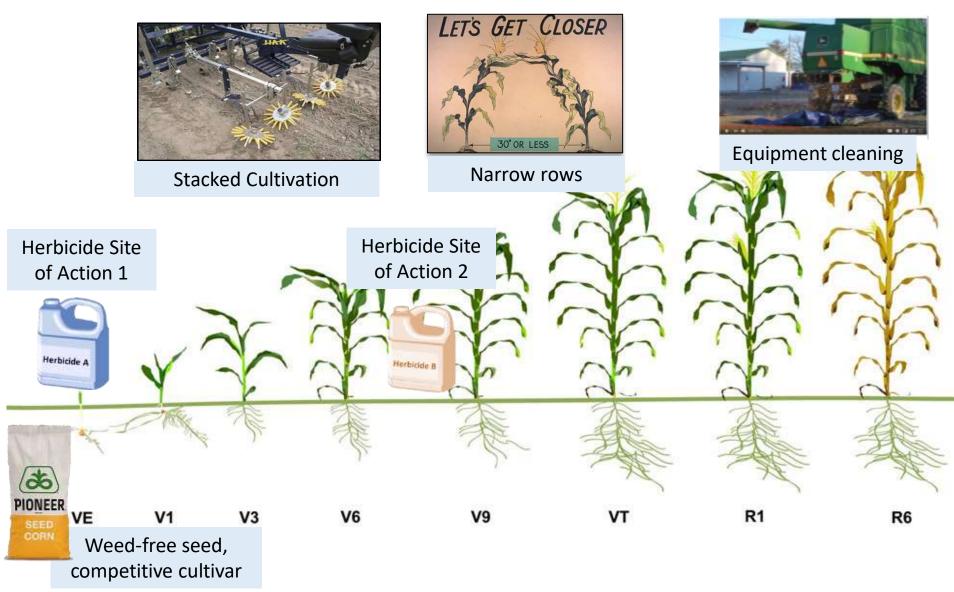
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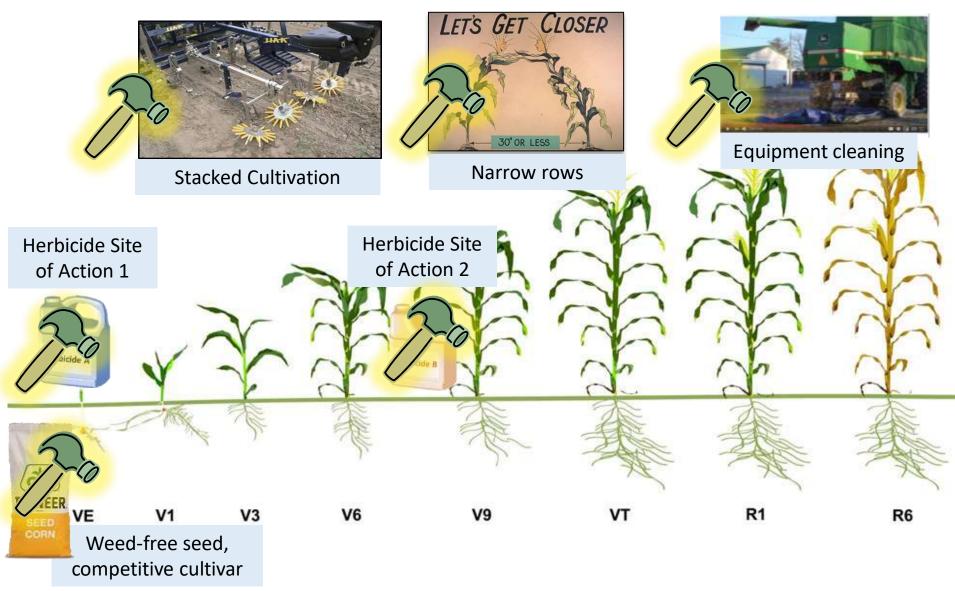
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INTEGRATED WEED MANAGEMENT: a systematic approach to managing weeds using multiple types of tactics **implemented at different times during a growing season**.



https://www.pioneer.com/home/site/us/agronomy/library/staging-corn-growth/%23defined

MANY LITTLE HAMMERS



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EVIDENCE BEHIND CONCEPT INTEGRATED *vs* NON-INTEGRATED strategies for wild oat (Avena fatua) in Canadian small grains

Wild Oat: A Severe Weed in Canadian Small Grains

- Lifecycle: Annual
- Environmental tolerances:
 - Optimal environment moderately fertile soil under full sun.
 - Plants tolerate drought, frost
 - Plants do not tolerate shade

Seedbanks:

- Produce up to 9950 seeds m⁻²
- Once dispersed, wild oat seeds can "self bury"
- Seed persistence: 4 to 5 yrs





• Integrating Cropping Systems with Cultural Techniques Augments Wild Oat (*Avena fatua*) Management in Barley. *Weed Science* 57:326-337

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- Strategies for suppressing wild oat:
 - 1. Diverse crop rotation
 - 2. Tall cultivars
 - 3. Increased crop seeding rates

OBJECTIVE: Determine how combined strategies (1-3 above) repeated over several years impact wild oat

- Integrating Cropping Systems with Cultural Techniques Augments Wild Oat (*Avena fatua*) Management in Barley. *Weed Science* 57:326-337
- Treatments: Factorial arrangement of four treatments:
 - Crop rotation (Continuous barley vs Barley-canola-barley-pea)
 - Barley cultivar (short vs tall)
 - Barley seeding density (low vs high)
 - Herbicide rate (quarter, half, full recommended rate)

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NON-INTEGRATED MANAGEMENT

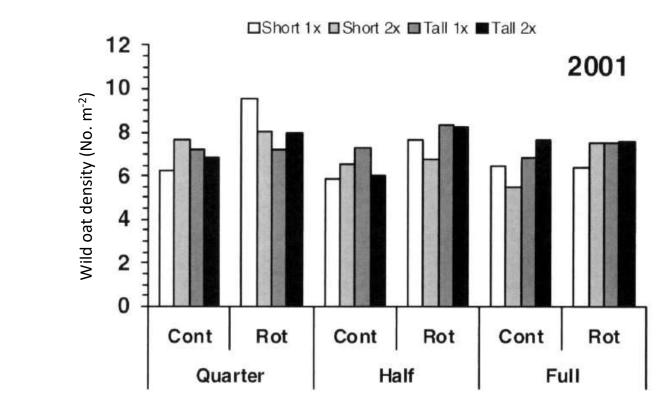
http://masterstrack.com/wp-content/uploads/thad-hurdles.jpg

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HIGHLY INTEGRATED MANAGEMENT

http://www.lohud.com/story/sports/high-school/track/2014/04/25/thad-wilson-sr-still-clearing-every-hurdle/8168873/



Abbreviations:

"Cont" – Continuous barley

"Rot" - rotation

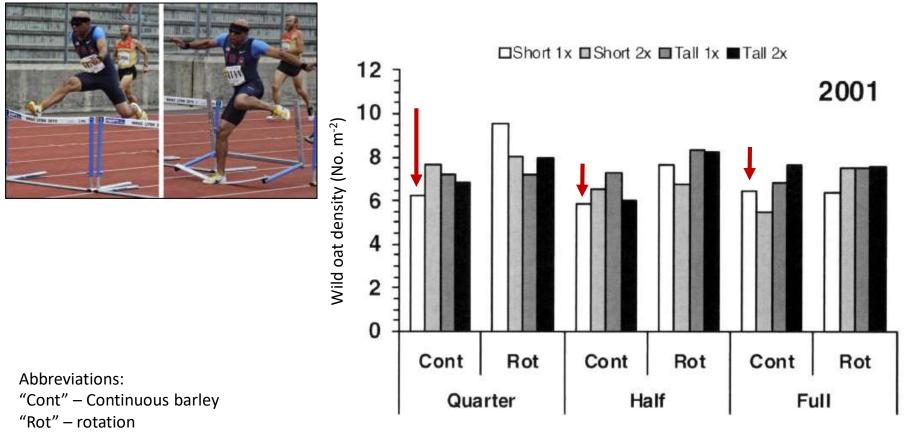
"Quarter" – 0.25 x recommended herbicide rate

"Half" – 0.5 x recommended herbicide rate

"Full" – 1 x recommended herbicide rate

Weed Science 57:326-337

NON-INTEGRATED MANAGEMENT



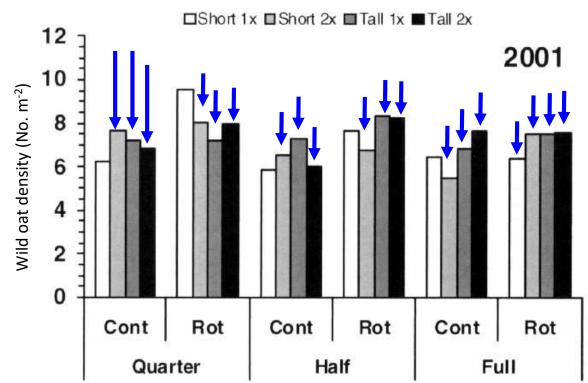
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INTEGRATED MANAGEMENT





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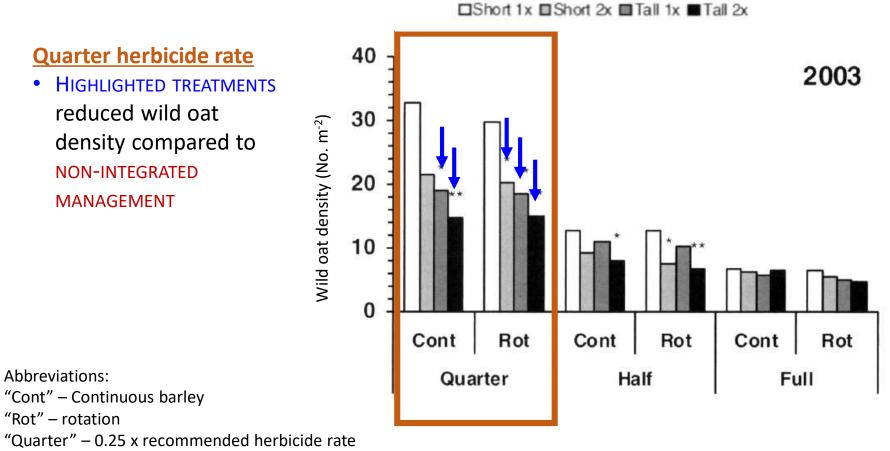
□Short 1x ■Short 2x ■Tall 1x ■Tall 2x 12 Initial wild oat 2001 10 densities identical Wild oat density (No. m^{-2}) across treatments 8 6 4 2 0 Rot Rot Rot Cont Cont Cont Abbreviations: "Cont" – Continuous barley Quarter Half Full "Rot" - rotation "Quarter" – 0.25 x recommended herbicide rate

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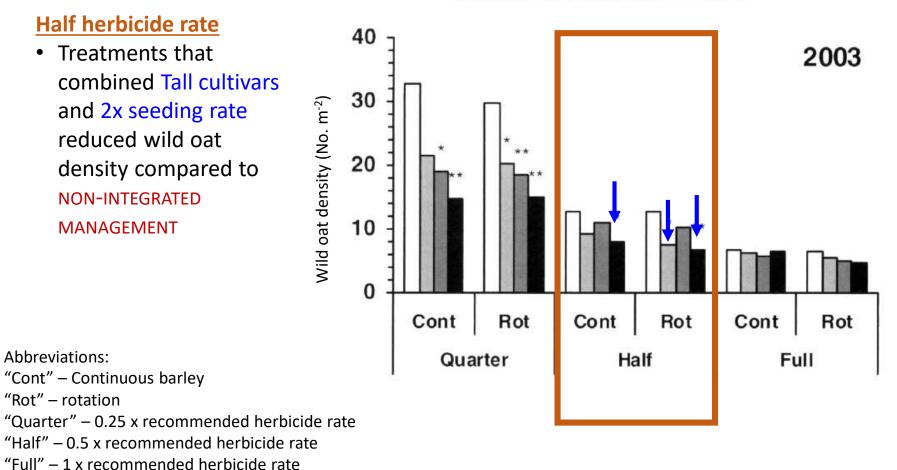
RESULTS: Wild oat density, 2 yrs of treatment



"Half" – 0.5 x recommended herbicide rate

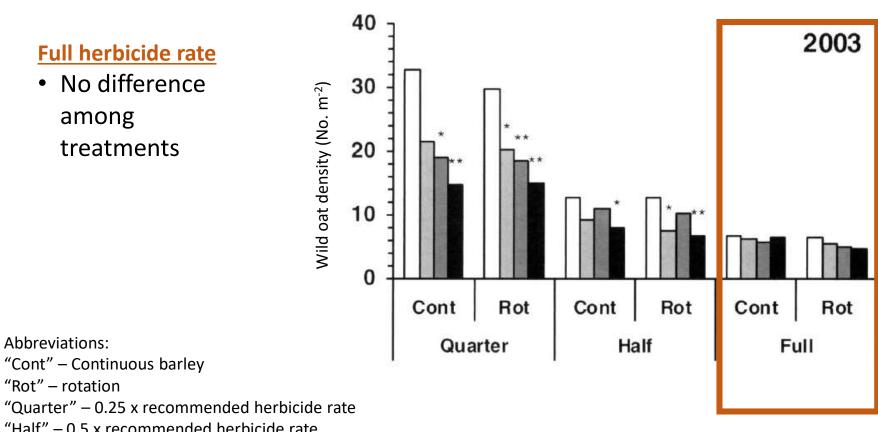
"Full" – 1 x recommended herbicide rate

RESULTS: Wild oat density, 2 yrs of treatment



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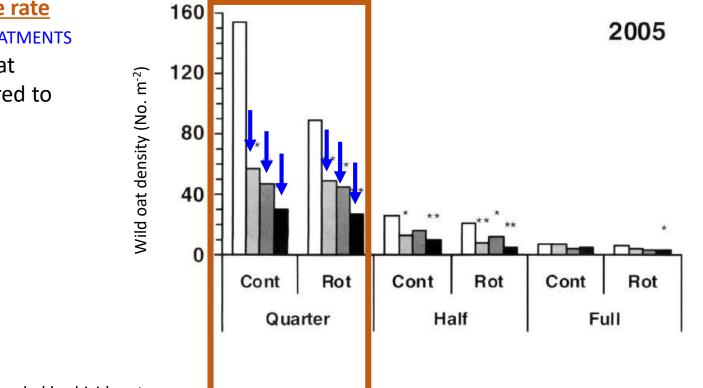
"Rot" - rotation

"Half" – 0.5 x recommended herbicide rate

"Full" – 1 x recommended herbicide rate

RESULTS: Wild oat density, 4 yrs of treatment

□Short 1x ■Short 2x ■Tall 1x ■Tall 2x



Quarter herbicide rate

 HIGHLIGHTED TREATMENTS reduced wild oat density compared to NON-INTEGRATED MANAGEMENT

Abbreviations:

"Cont" – Continuous barley

"Rot" – rotation

"Quarter" – 0.25 x recommended herbicide rate

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RESULTS: Wild oat density, 4 yrs of treatment

Half herbicide rate 160 2005 HIGHLIGHTED TREATMENTS reduced wild oat 120 Wild oat density (No. m⁻²) density compared to NON-INTEGRATED 80 MANAGEMENT 40 0 Rot Cont Rot Cont Rot Cont Half Full Quarter

□Short 1x ■Short 2x ■Tall 1x ■Tall 2x

Abbreviations:

•

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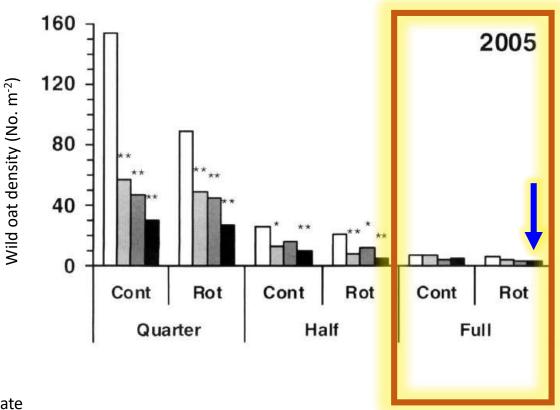
"Full" – 1 x recommended herbicide rate

RESULTS: Wild oat density, 4 yrs of treatment

□Short 1x ■Short 2x ■Tall 1x ■Tall 2x

Full herbicide rate

 The combination of HIGH SEEDING RATE, TALL CULTIVAR and CROP ROTATION reduced wild oat density compared to NON-INTEGRATED MANAGEMENT



Abbreviations:

"Cont" – Continuous barley

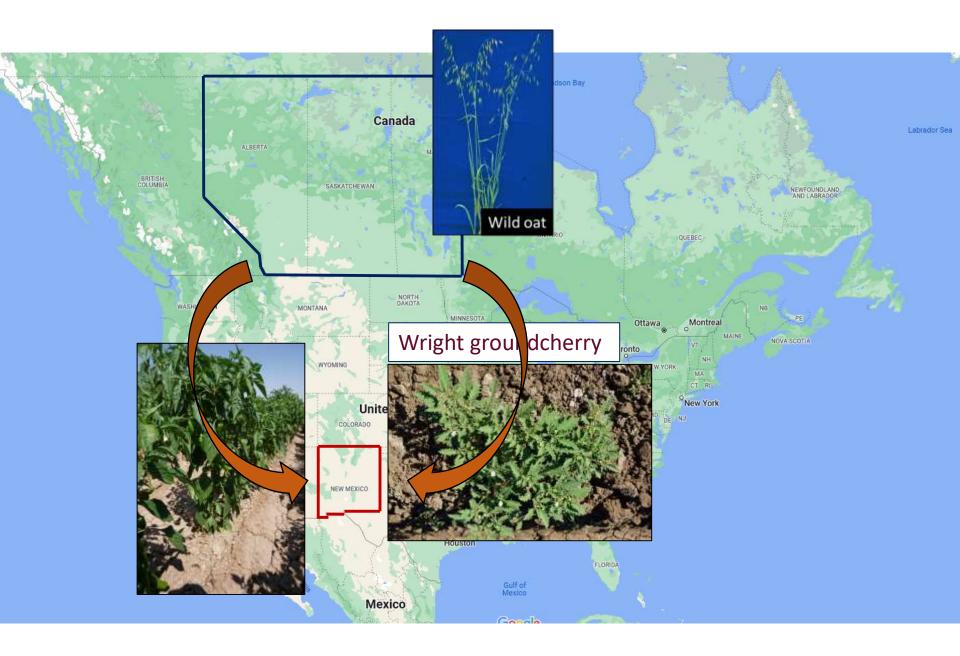
"Rot" - rotation

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Additional Results

- Combinations of CROP ROTATION, HIGH SEEDING RATE and TALL CULTIVAR generally suppressed:
 - Wild oat biomass
 - Wild oat seed production
- Combinations of CROP ROTATION, HIGH SEEDING RATE and TALL CULTIVAR generally promoted:
 - Barley biomass
 - Barley yield
- TIME STRENGTHENED THE EFFECTS OF ROTATION, SEEDING RATE AND CULTIVAR HEIGHT.



- SCOUT BEFORE & AFTER CONTROL INTERVENTIONS
- Protocols:

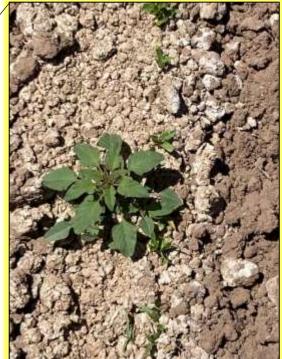
https://www.canr.msu.edu/resources/pest_scouting_in_field_crops_e3294



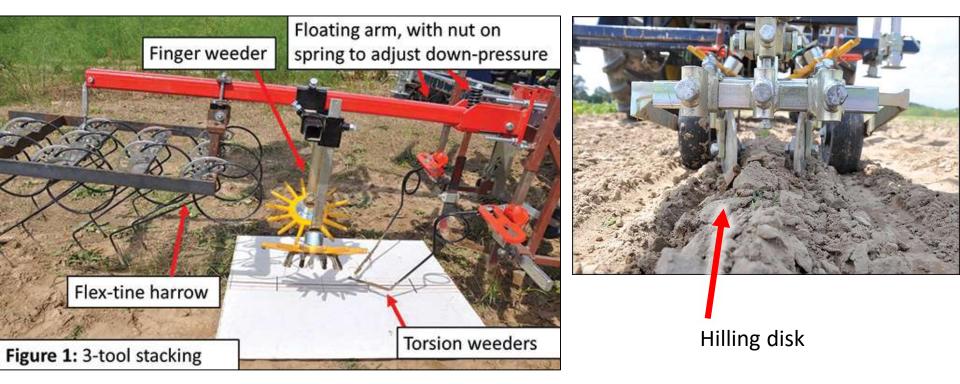


• TARGET IN-ROW WEEDS with "stacked cultivation" or other inrow technologies





"Stacked Cultivation" – sequence of multiple tools in a single pass



http://carrotcountry.com/fall-2018/carrots-weeds-and-steel/

- Sequences or mixtures of HERBICIDES WITH DIFFERENT SITES OF ACTION
 - Site of Action enzyme or binding site that directly interacts with herbicide active ingredient

* SITE-OF-ACTION O NUMBER OF				1194	CHERT		COMP.	Contract of the local division of the local		
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https://ag.purdue.edu/btny/weedscience/Documents/52689_5_TA_HerbClassPoster_2016_Master_LR.pdf

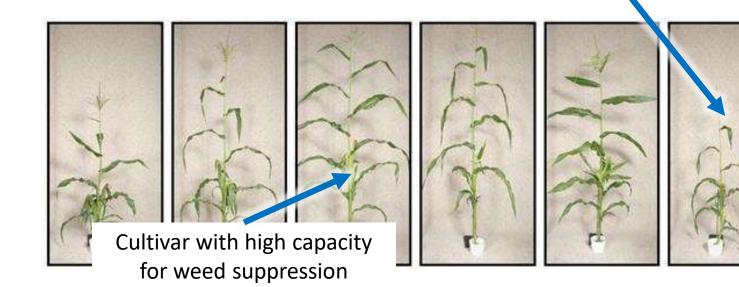
Utilize sequences of herbicides with different SITES OF ACTION

GROUP		4	HERBICIDE		
Specimen Labe	nces	treatment advice. Have p Do not induce vomiting un or doctor. Do not give any Have the product containe control center or doctor, o	n control center or doctor immediately for erson sip a glass of water if able to swallow. less told to do so by a poison control center thing by mouth to an unconscious person. er or label with you when calling a poison r going for treatment. You may also or emergency medical treatment information.		
Remedy	Ultra	where surface water is pres- high water mark. Do not or disposing of equipment wa This chemical has propertie chemicals detected in grou where soils are permeable, may result in groundwater of Directions for Use	es and characteristics associated with ndwater. The use of this chemical in areas particularly where the water table is shallow, contamination.		
SPECIALTY HERBICIDE	²⁰) or an affiliated	with its labeling. Read all Directions for Use	carefully before applying. equirements		
Trademark of The Dow Chemical Company ("Dow company of Dow or the control of woody plants and broa angeland, permanent grass pastures, an eserve program (CRP) acres (including for on-Irrigation ditch banks within these an GROUP 4 ctive Ingredient:	dleaf weeds on d conservation ence rows and	Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.			
Triclopyr: 2-[(3,5,6-trichloro-2-pyridinyi)oxy] acetic acid, butoxyethyl ester ther Ingredients tal cid Equivalent: triclopyr – 43.46% - 4 lb/gal		Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours. PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:			
Precautionary Statements Hazards to Humans and Domestic A PA Reg. No. 62719-552	nimals	 Coveralls Waterproof gloves Shoes plus socks Protective eyewear 			

- CREATE ENVIRONMENT THAT GIVES CROP AN ADVANTAGE OVER WEEDS
 - Crop rotation
 - Narrow row spacing
 - Increased seeding rate
 - Fast growing cultivar
 - ...

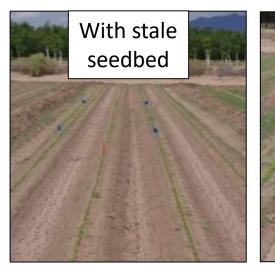


Cultivar with low capacity for weed suppression



- CREATE ENVIRONMENT THAT GIVES CROP AN ADVANTAGE OVER WEEDS
 - Allelopathic green manures
 - Stale seedbed
 - .







Mowing & incorporating cover crop prior to cash crop

Chile field with and w/out stale seedbed implemented August before seeding

• CLEAN EQUIPMENT

Safety First! Read and understand all manuals and wear recommended personal protective equipment

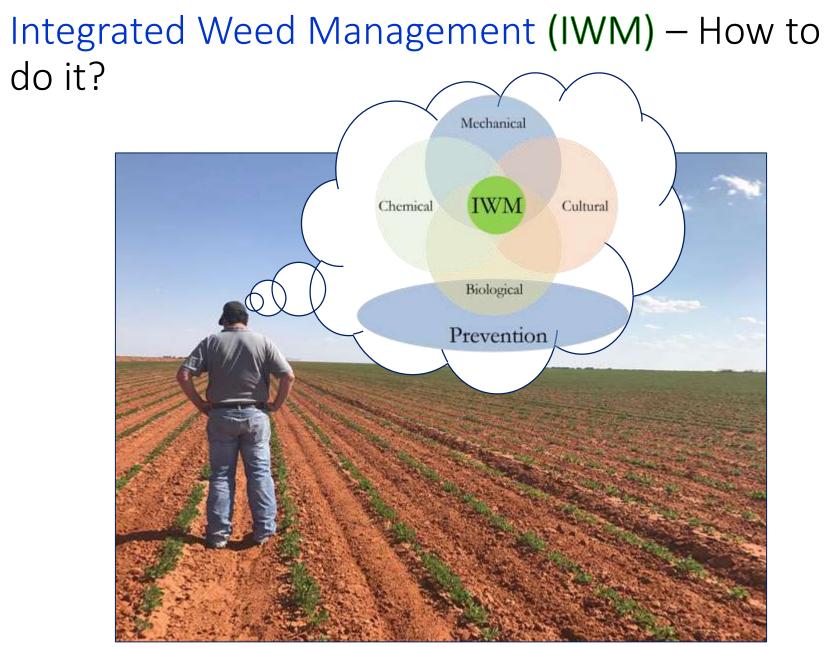
Species	Seeds combine ⁻¹	
Pigweed	3,100	
Morningglory	300	
Velvetleaf	1,000	
Fall panicum	3,100	
Crabgrass	56,000	
Total	63,500	
	The Straw Bale Methodol	logy for Cleaning Weed Seeds Out of a Combine

Seeds collected from combine at end of season

The Straw Bale Methodology for Cleaning Weed Seeds Out of a Combine

129 views

https://growiwm.org/wp-content/uploads/2019/03/The-Straw-Bale-Methodology-for-Cleaning-Weed-Seeds-Out-of-a-Combine.pdf



https://www.myjobdependsonag.com/the-american-farmer/

Integrated Weed Management – Why is it necessary?

FOUNDATIONAL PRINCIPLES:

- 1. Weed control costs increase as weeds become more abundant.
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 - INTEGRATED approach safeguards against control failures

Questions?

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