

# Weed Management

## NEW MEXICO AGRICULTURE SUSTAINABILITY WORKSHOP

Brian Schutte

College of Agricultural, Consumer and  
Environmental Sciences

Department of Entomology, Plant Pathology &  
Weed Science

The logo for New Mexico State University, featuring the letters "NM" stacked above "STATE" in a white serif font, enclosed within a white square that is itself centered within a larger maroon square.

NM  
STATE

**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**

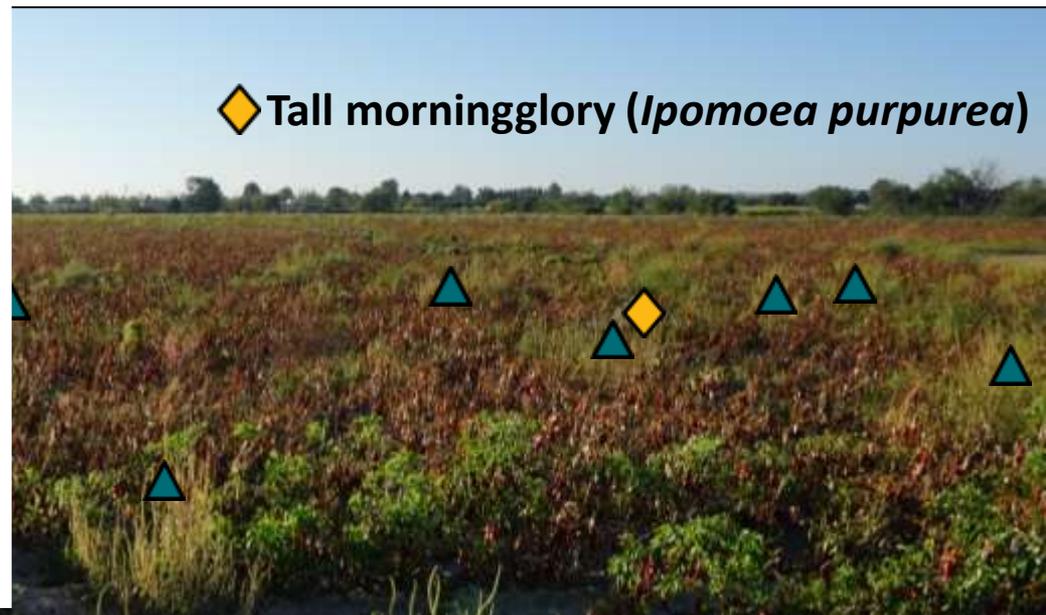
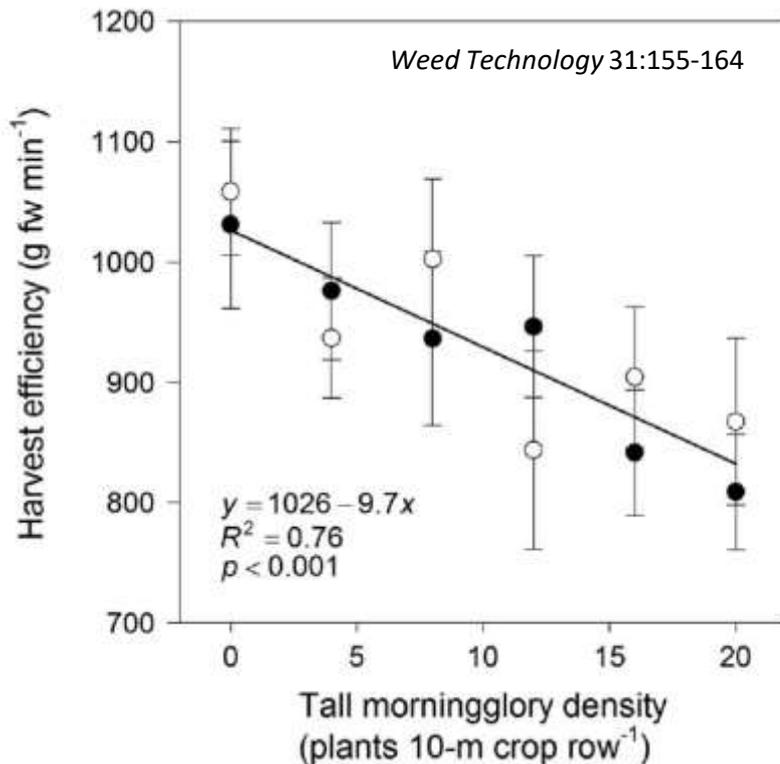
\*PLEASE NOTE: Mention of trade names is solely for the purpose of supplying information and does not imply recommendation or endorsement by NMSU.



~~Integrated~~ Weed Management – Why is it  
necessary?

# ~~Integrated~~ Weed Management – Why is it necessary?

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



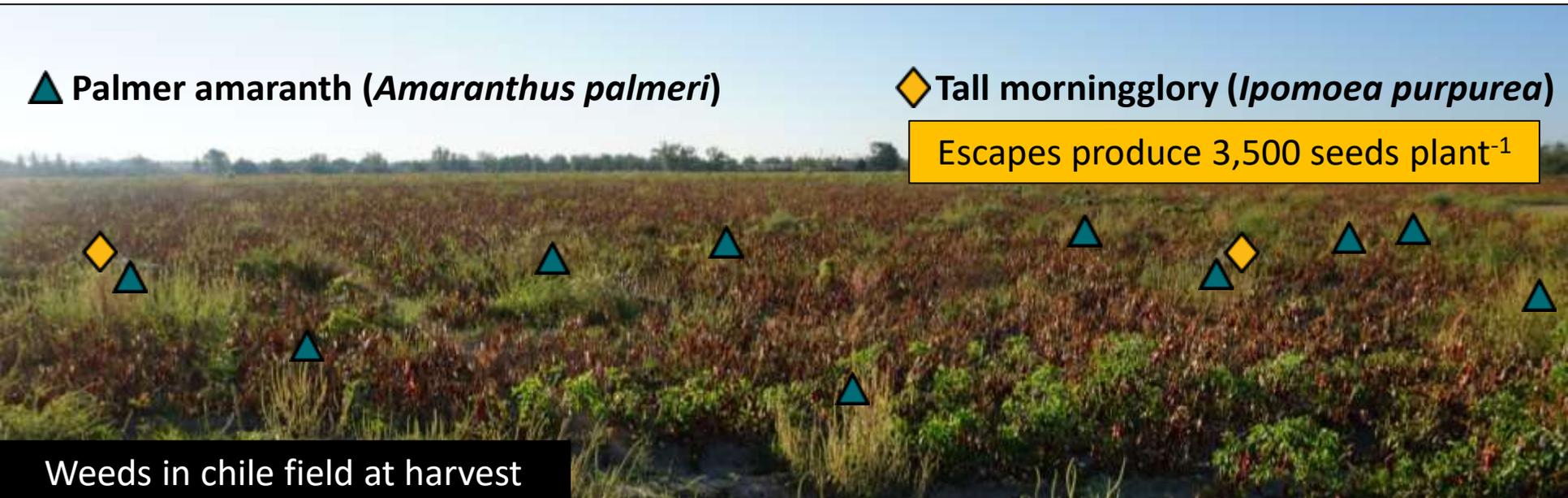
# ~~Integrated~~ Weed Management – Why is it necessary?

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

▲ Palmer amaranth (*Amaranthus palmeri*)

◆ Tall morningglory (*Ipomoea purpurea*)

Escapes produce 3,500 seeds plant<sup>-1</sup>



Weeds in chile field at harvest

# *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





# ~~Integrated~~ Weed Management

## FOUNDATIONAL PRINCIPLES:

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

# ~~Integrated~~ Weed Management

## FOUNDATIONAL PRINCIPLES:

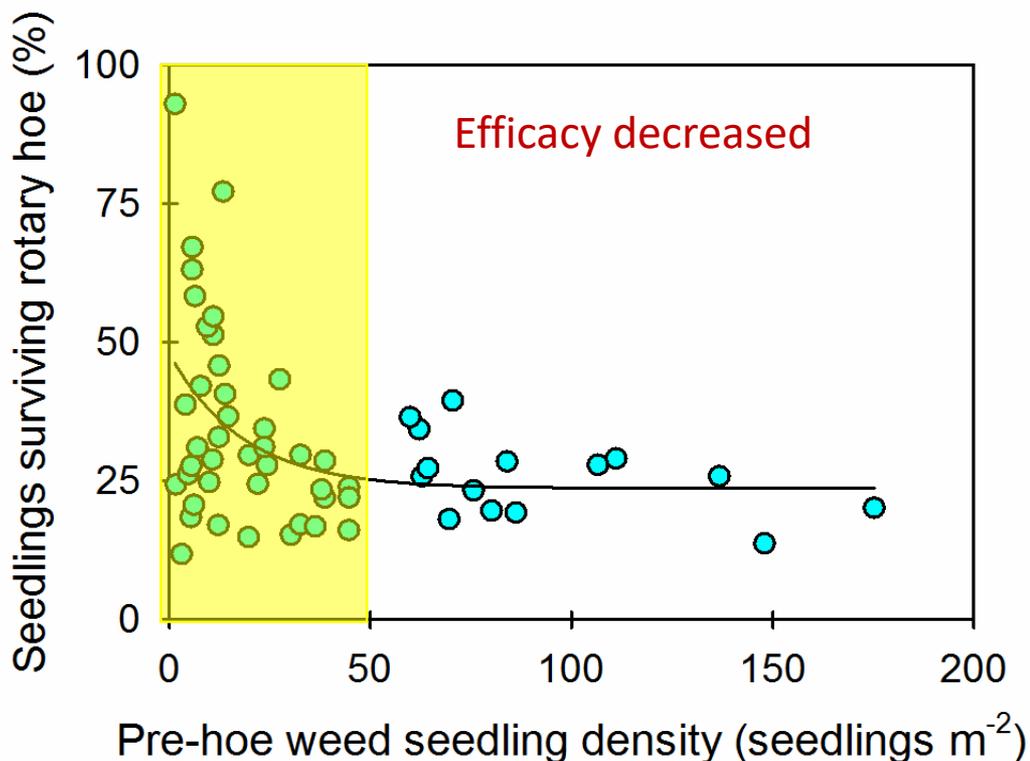
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# ~~Integrated~~ Weed Management

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



<https://www.hatzenbichler.com/en/rotary-hoe>

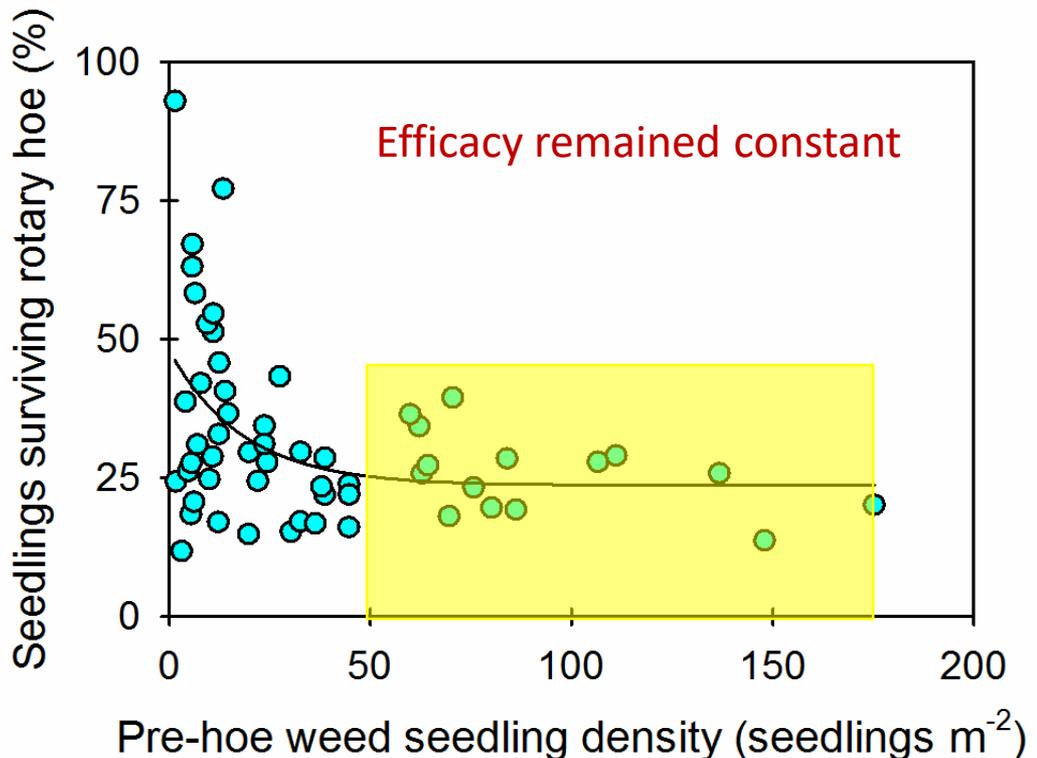


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# ~~Integrated~~ Weed Management

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

Pre-hoe weed density	% surviving rotary hoe	Post-hoe weed density
50 seedlings m <sup>-2</sup>	25	13 seedlings m <sup>-2</sup>
175 seedlings m <sup>-2</sup>	25	44 seedlings m <sup>-2</sup>



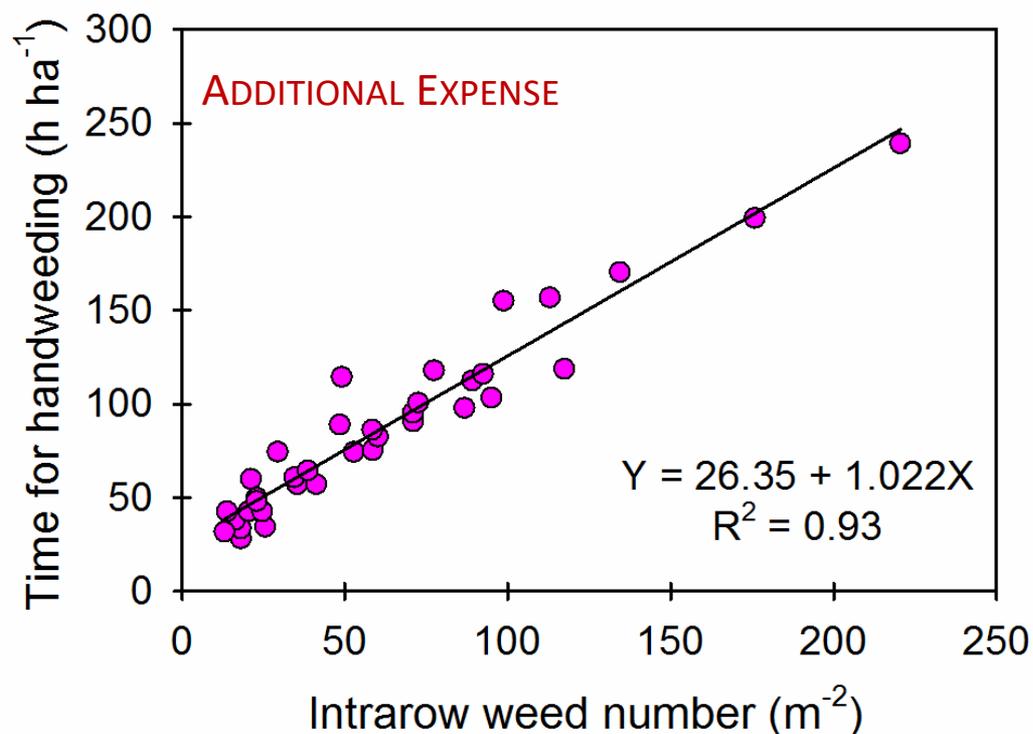
Escapes need to be controlled.

**ADDITIONAL EXPENSE**



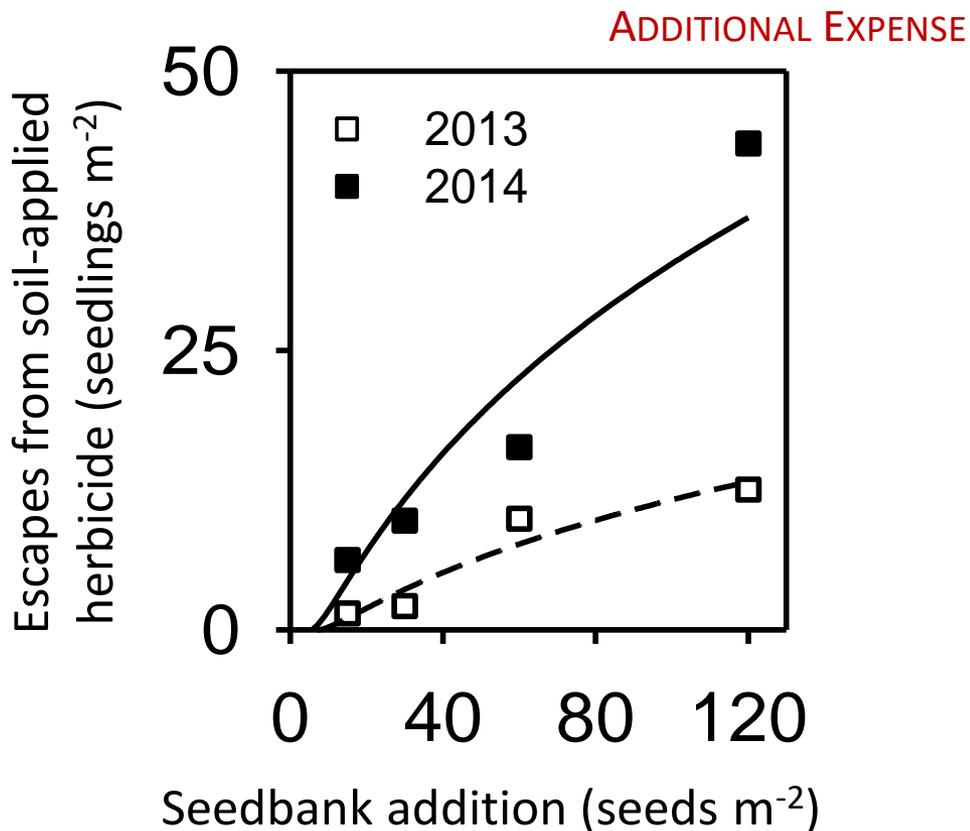
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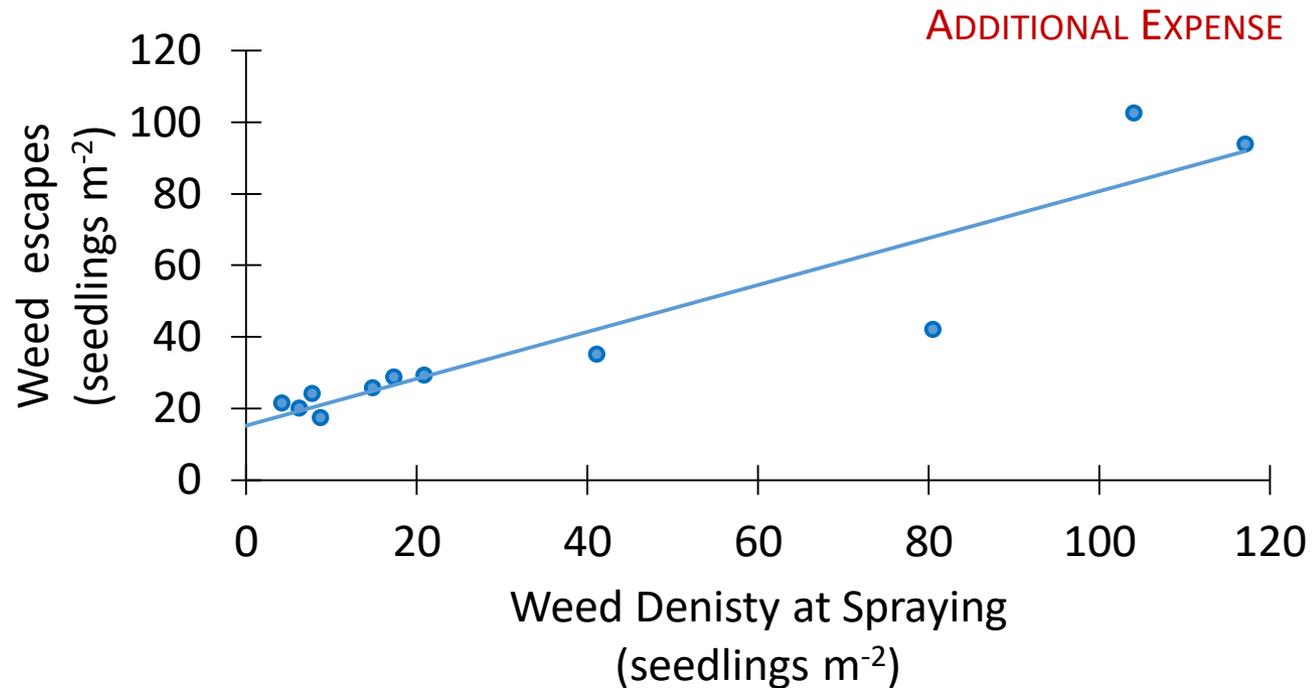
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# Integrated Weed Management – Why is it necessary?

## FOUNDATIONAL PRINCIPLES:

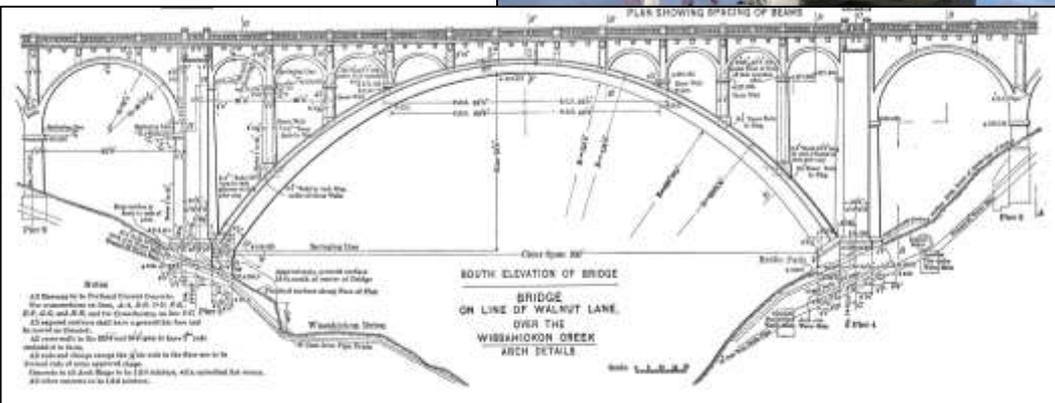
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2. Over time, weed population densities are reduced by *INTEGRATED* strategies
  - *INTEGRATED* approach **safeguards against control failures**

# Integrated Weed Management (IWM) - What is it?

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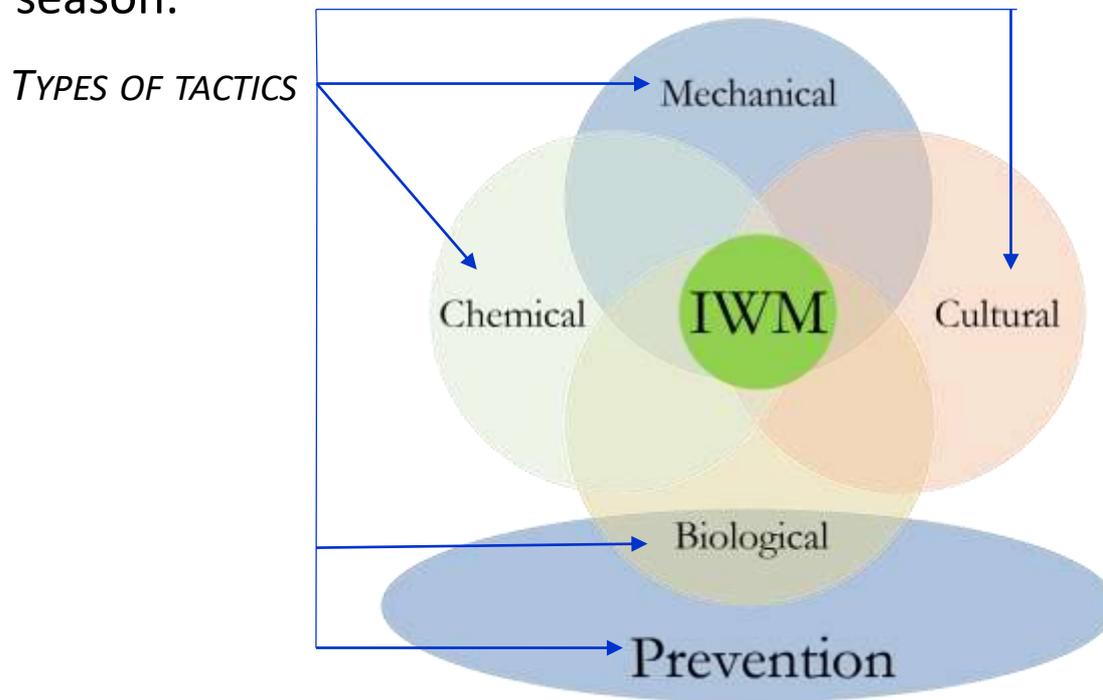


Diagram from:  
<http://integratedweedmanagement.org/>

# Integrated Weed Management (IWM) - What is it?

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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.**



Stacked Cultivation



Narrow rows

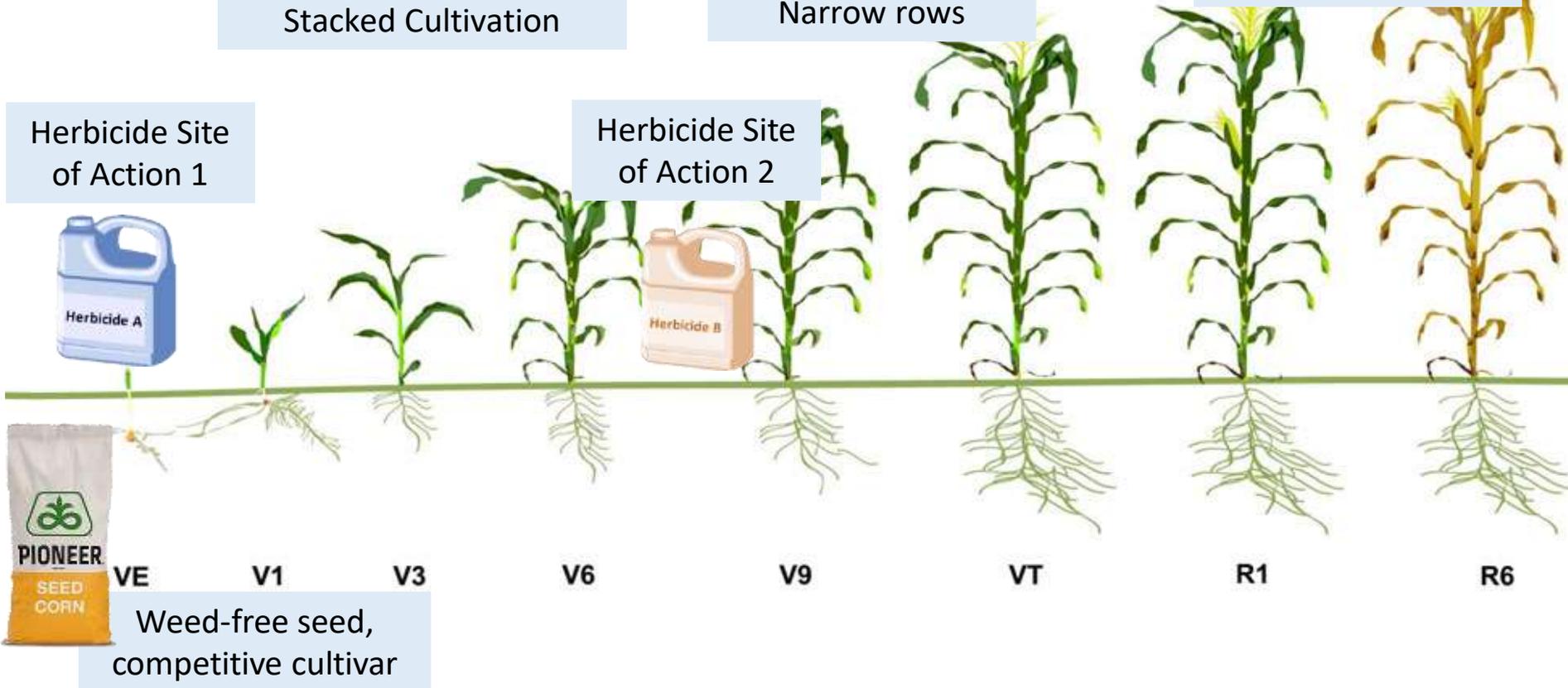


Equipment cleaning

Herbicide Site of Action 1



Herbicide Site of Action 2



Weed-free seed, competitive cultivar

# MANY LITTLE HAMMERS



Stacked Cultivation



Narrow rows



Equipment cleaning

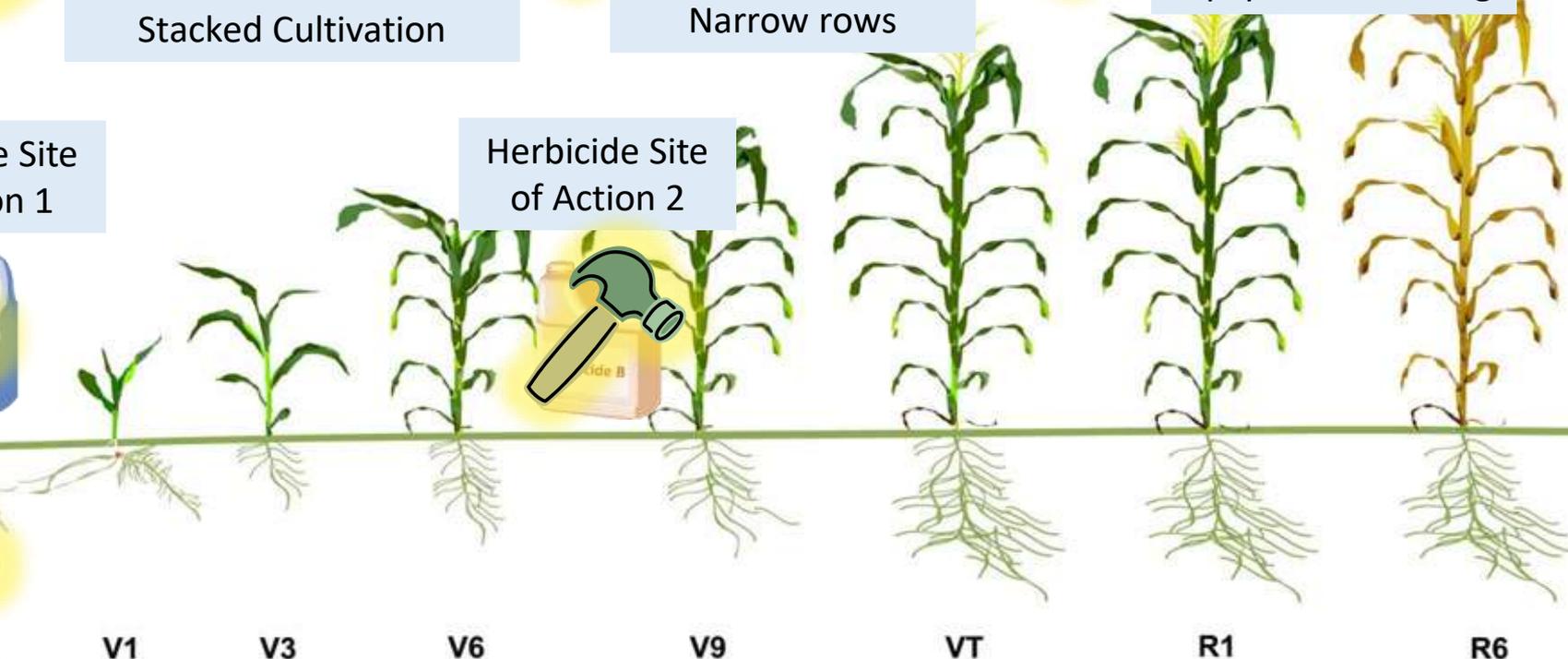
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Weed-free seed, competitive cultivar



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Stacked Cultivation



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Equipment cleaning

Herbicide Site of Action 1



Herbicide Site of Action 2



Weed-free seed,  
competitive cultivar

## Integrated Weed Management:

- Reduce opportunities for control failures
- Overtime, reduce weed densities

## 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<sup>-2</sup>
  - Once dispersed, wild oat seeds can “self bury”
  - Seed persistence: 4 to 5 yrs



Wild oat “seed”



Twisted awns

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

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

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

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

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

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- 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



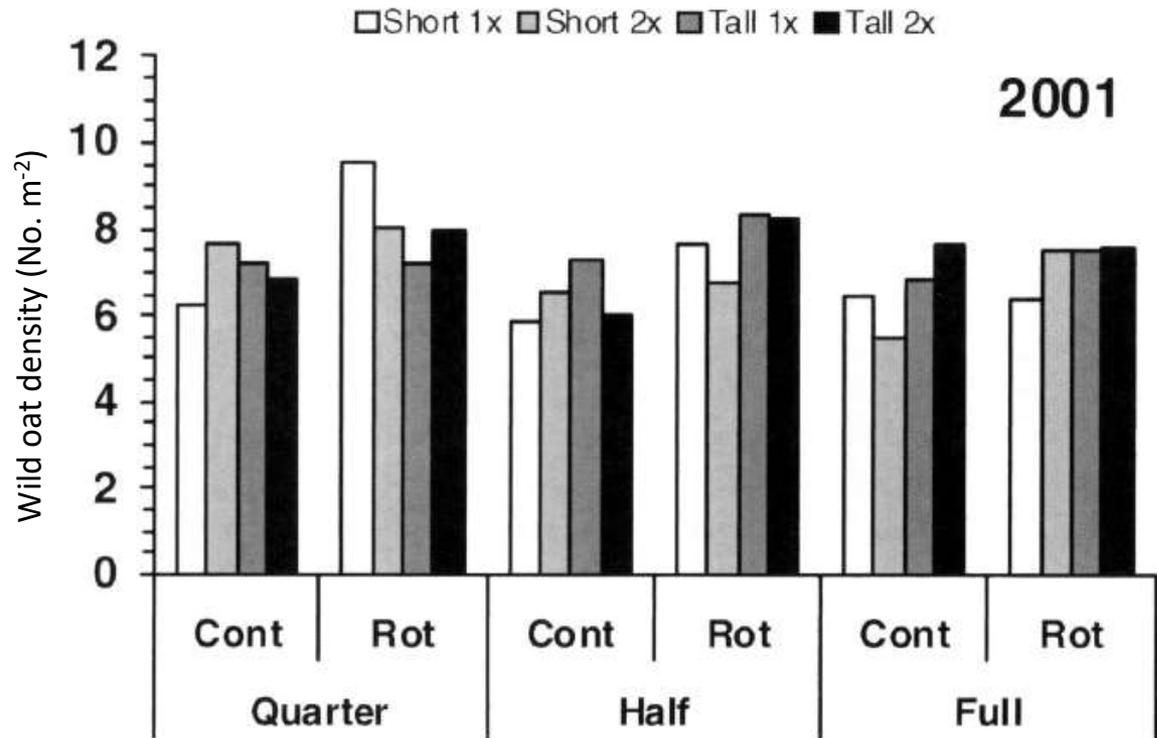
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## HIGHLY INTEGRATED MANAGEMENT



# RESULTS: Wild oat density prior to start of study



## Abbreviations:

“Cont” – Continuous barley

“Rot” – rotation

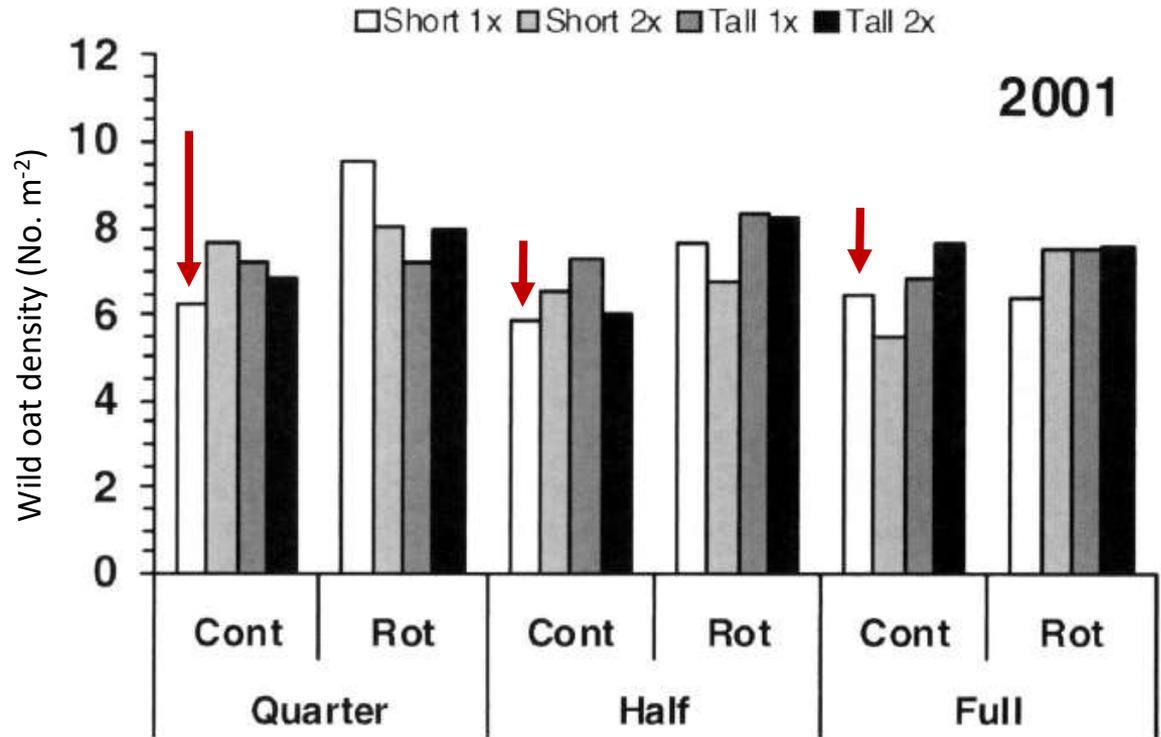
“Quarter” – 0.25 x recommended herbicide rate

“Half” – 0.5 x recommended herbicide rate

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## NON-INTEGRATED MANAGEMENT



Abbreviations:

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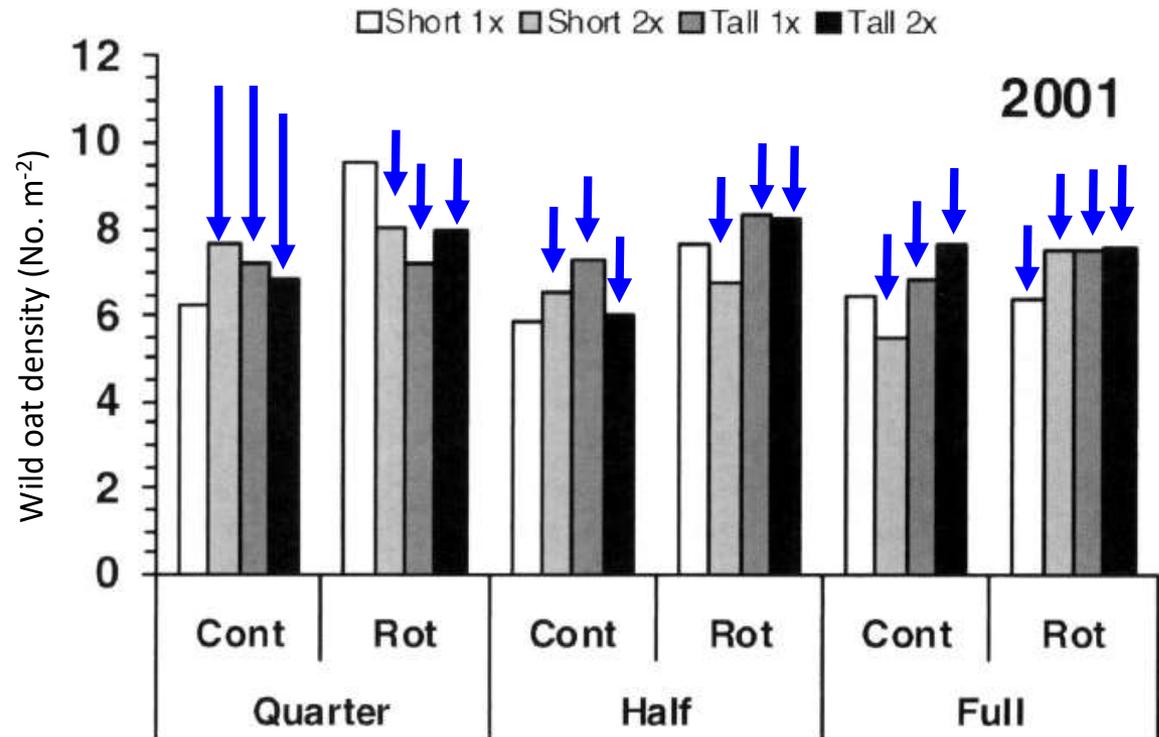
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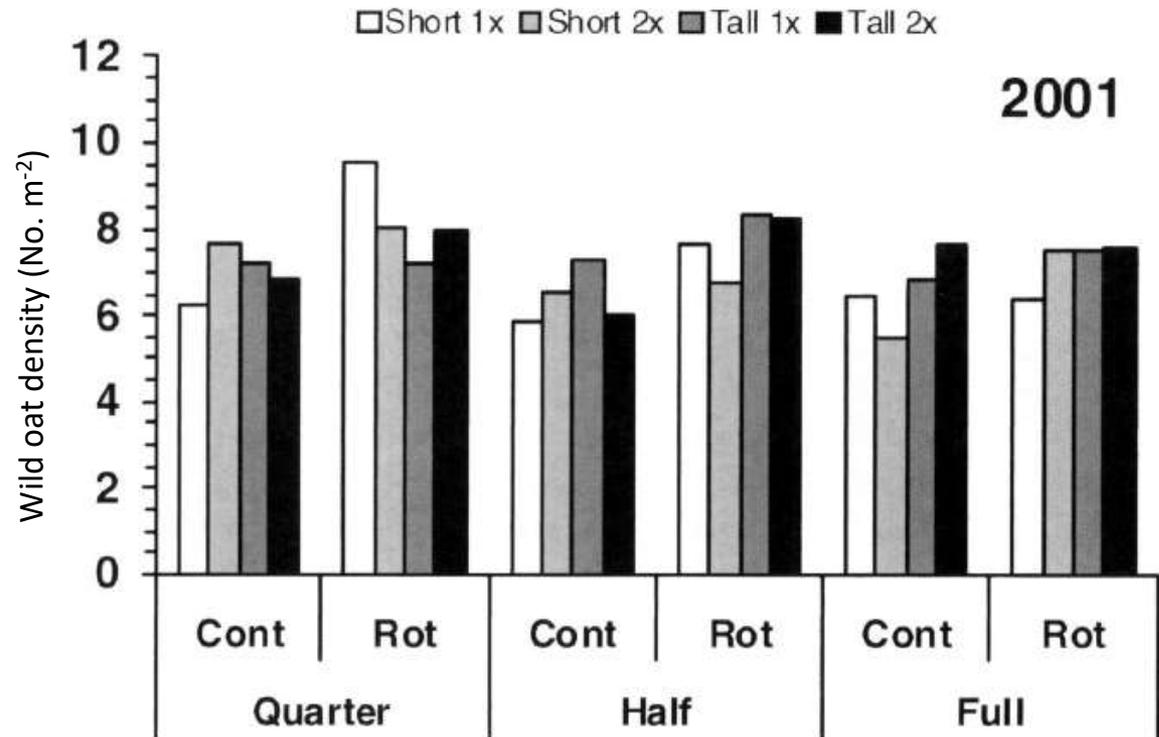
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# RESULTS: Wild oat density prior to start of study

- Initial wild oat densities identical across treatments



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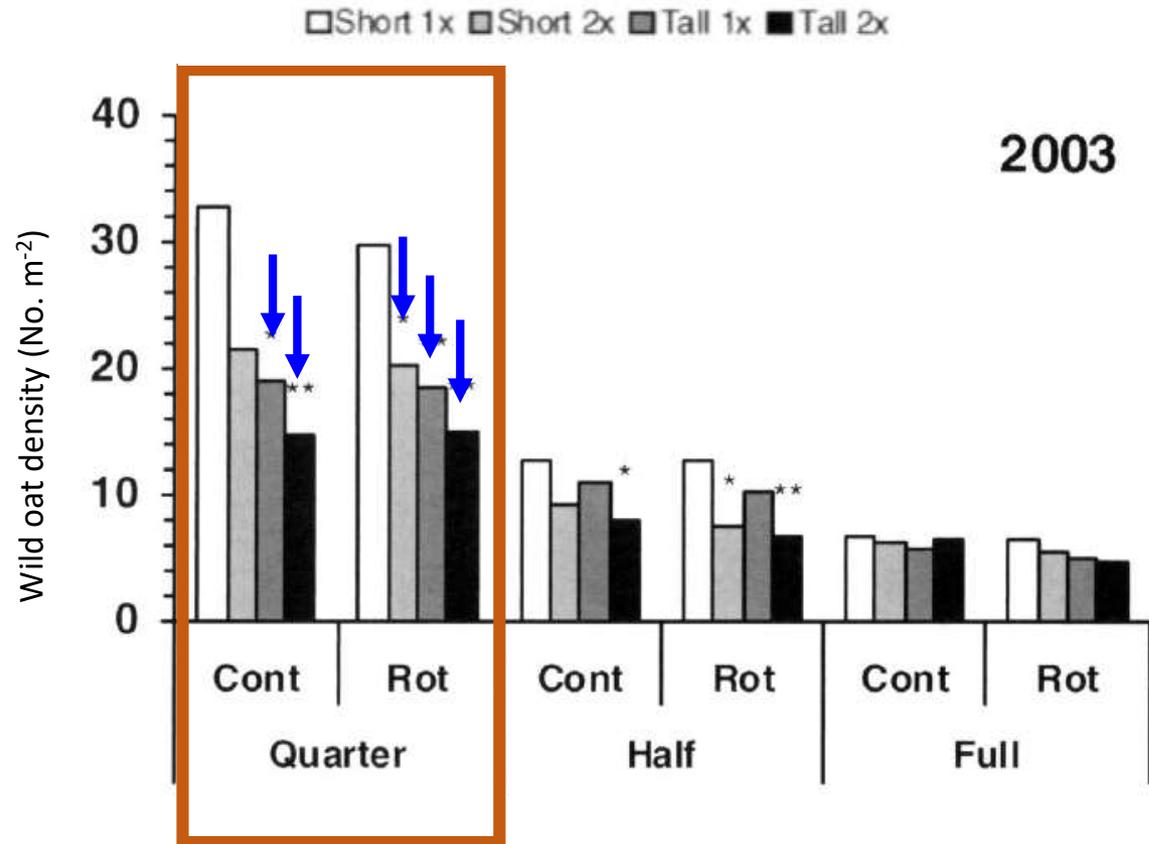
“Half” – 0.5 x recommended herbicide rate

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# RESULTS: Wild oat density, 2 yrs of treatment

## Quarter herbicide rate

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



Abbreviations:

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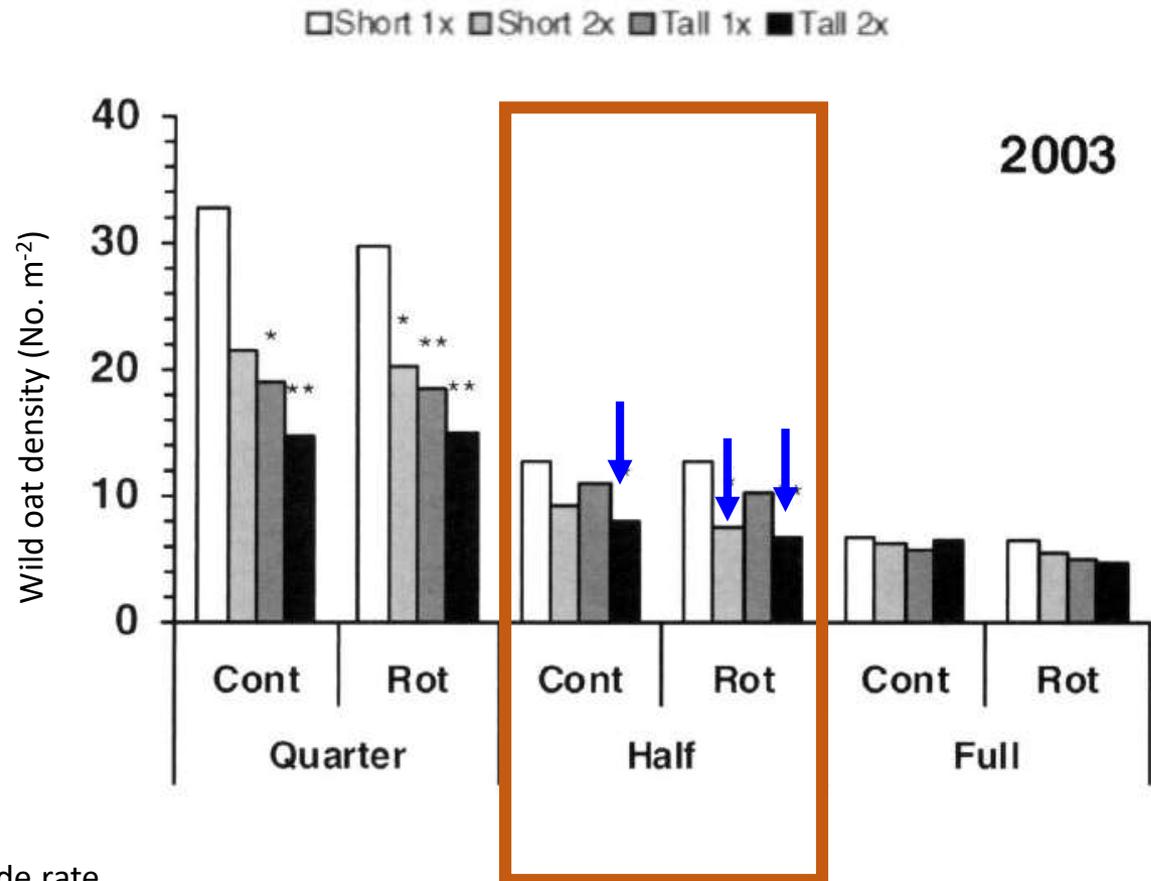
“Half” – 0.5 x recommended herbicide rate

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# RESULTS: Wild oat density, 2 yrs of treatment

## Half herbicide rate

- Treatments that combined Tall cultivars and 2x seeding rate reduced wild oat density compared to NON-INTEGRATED MANAGEMENT



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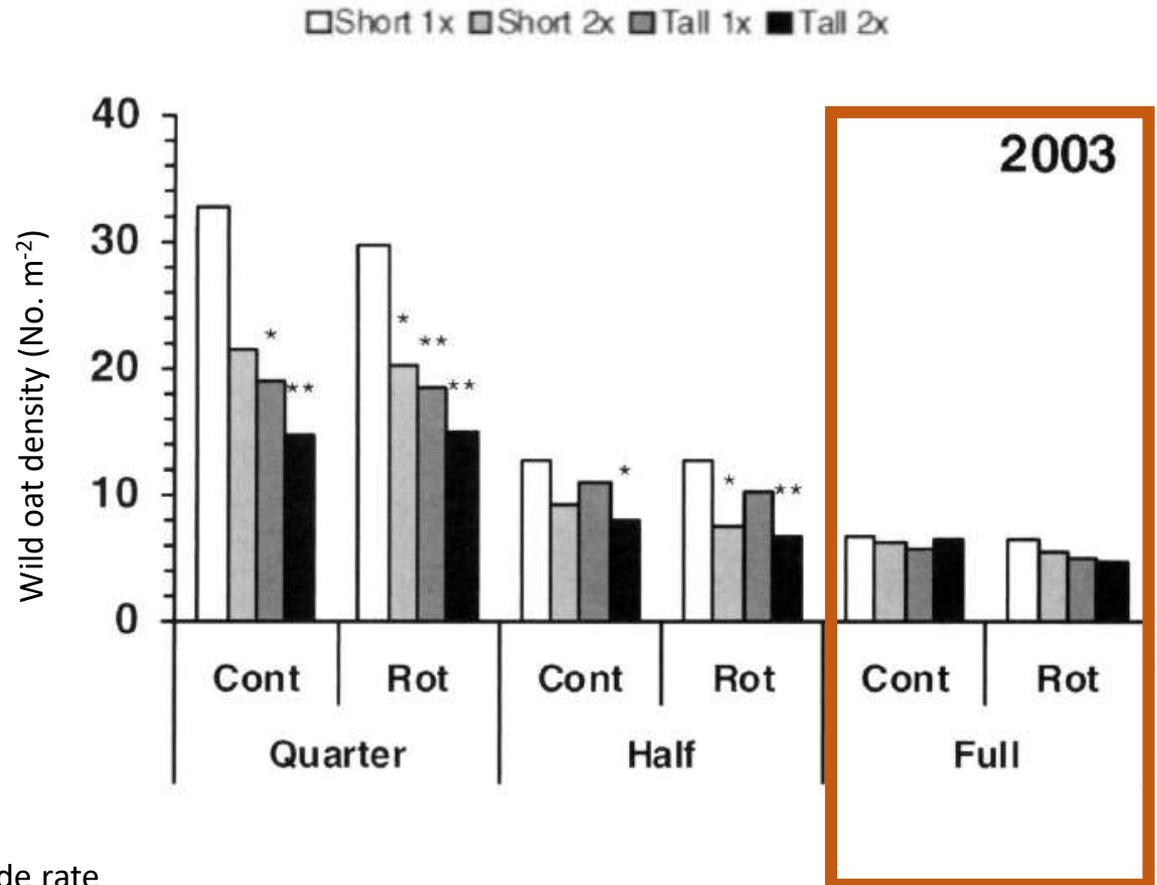
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“Full” – 1 x recommended herbicide rate

# RESULTS: Wild oat density, 2 yrs of treatment

## Full herbicide rate

- No difference among treatments



Abbreviations:

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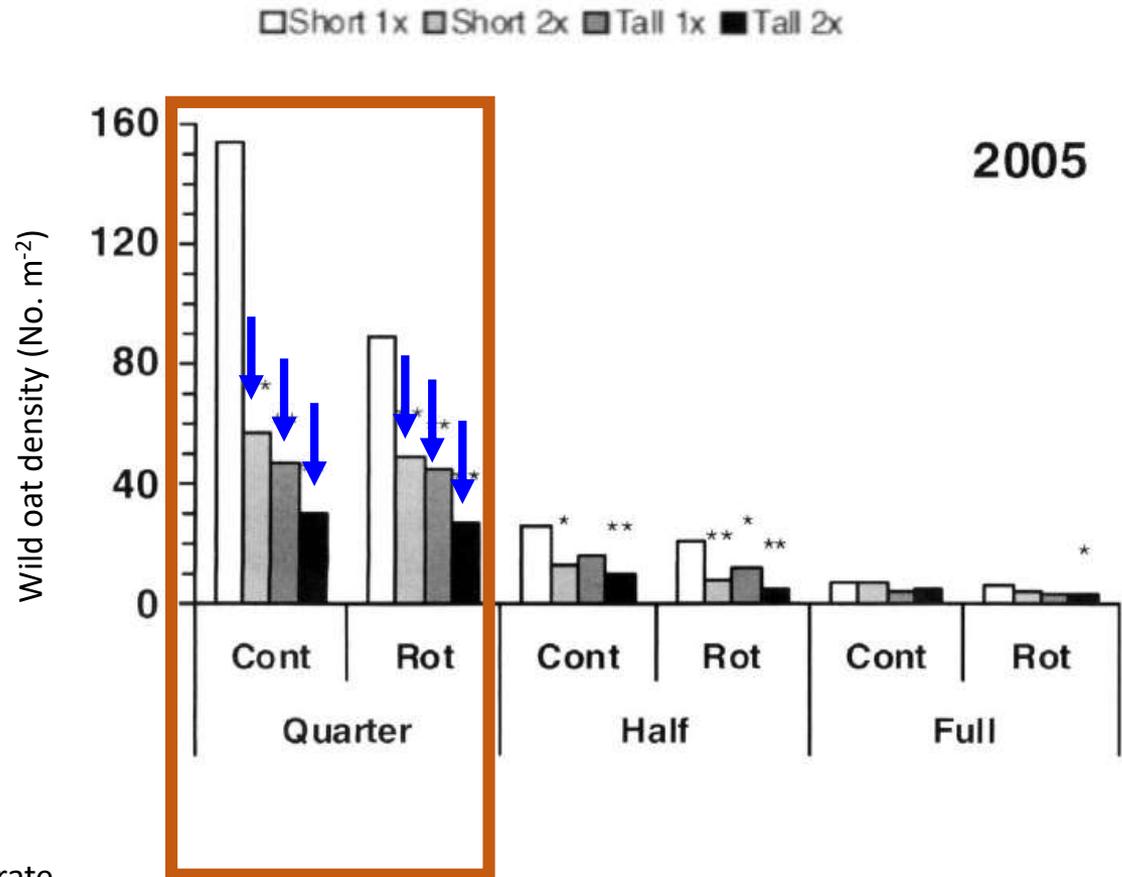
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# RESULTS: Wild oat density, 4 yrs of treatment

## Quarter herbicide rate

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



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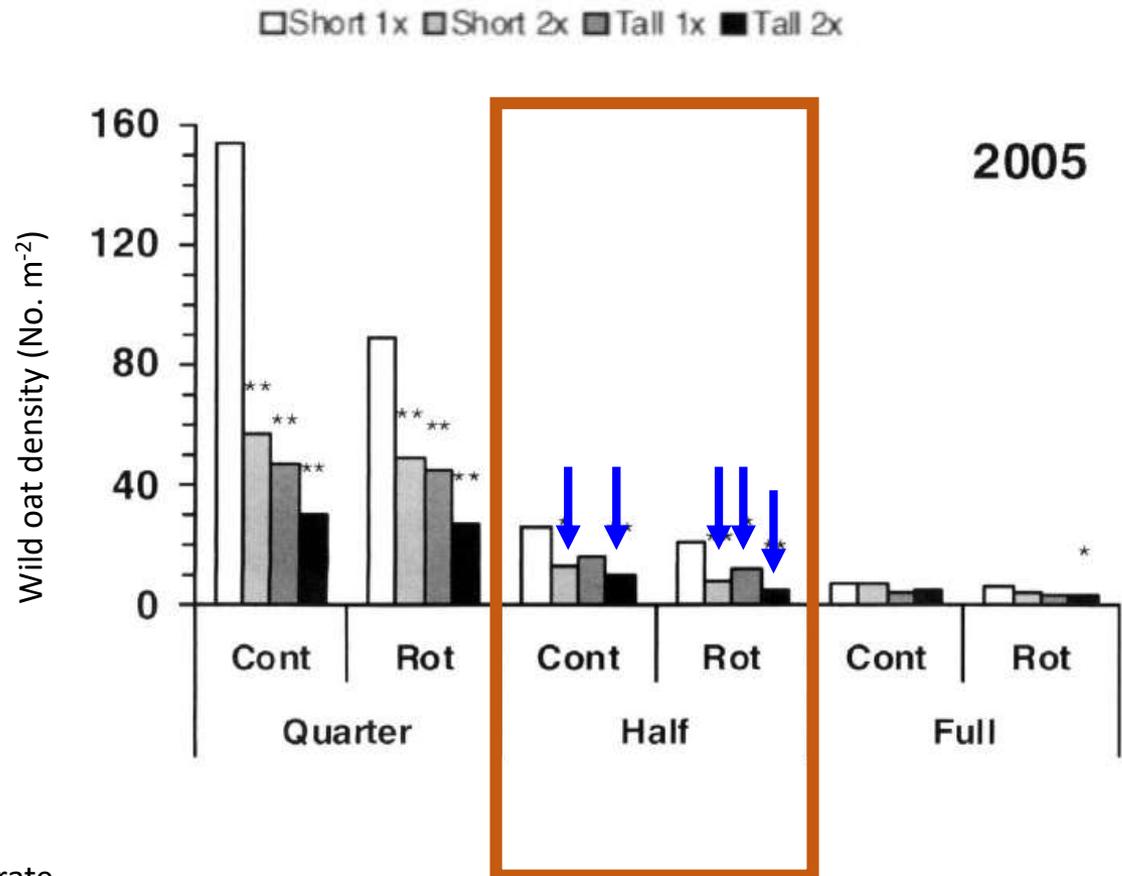
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# RESULTS: Wild oat density, 4 yrs of treatment

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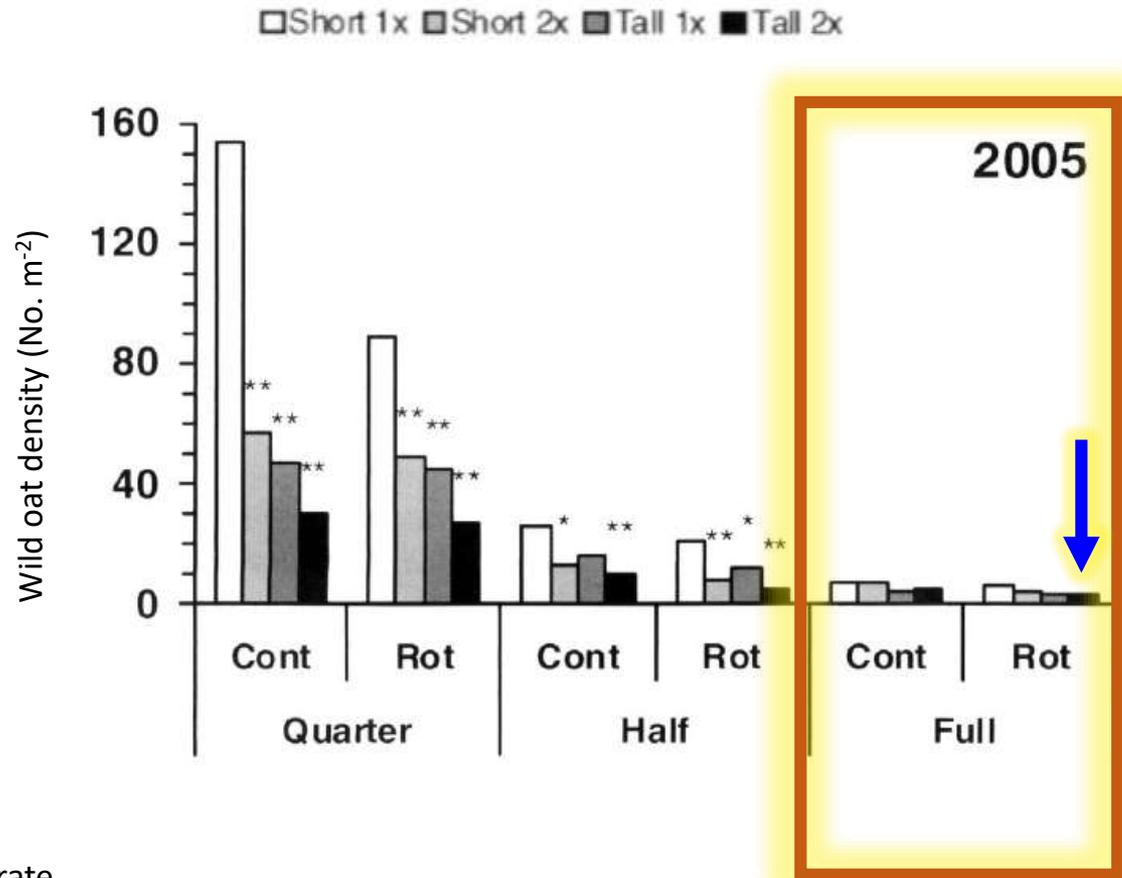
“Half” – 0.5 x recommended herbicide rate

“Full” – 1 x recommended herbicide rate

# RESULTS: Wild oat density, 4 yrs of treatment

## Full herbicide rate

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



Abbreviations:

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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.**



# Integrated Weed Management (IWM) – How to do it?

- **SCOUT BEFORE & AFTER CONTROL INTERVENTIONS**

- Protocols:

[https://www.canr.msu.edu/resources/pest\\_scouting\\_in\\_field\\_crops\\_e3294](https://www.canr.msu.edu/resources/pest_scouting_in_field_crops_e3294)



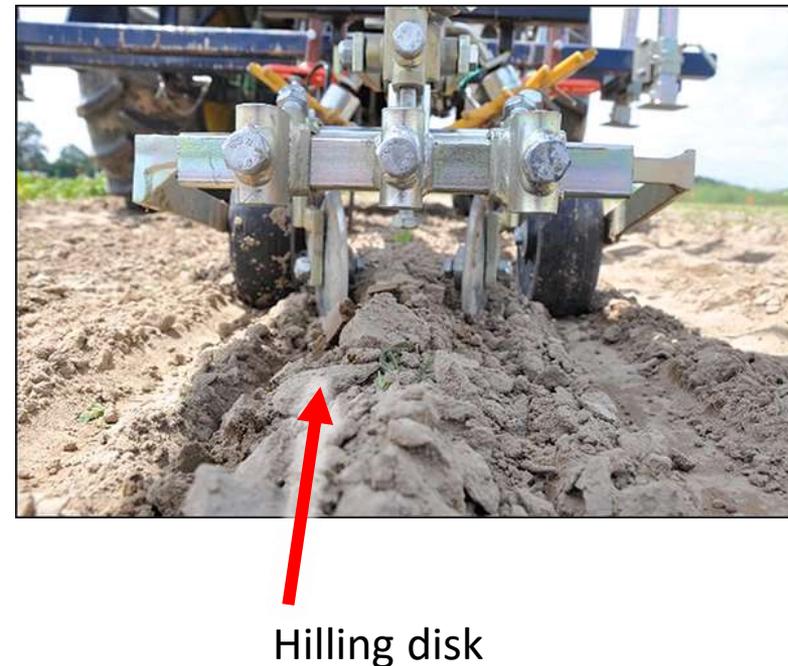
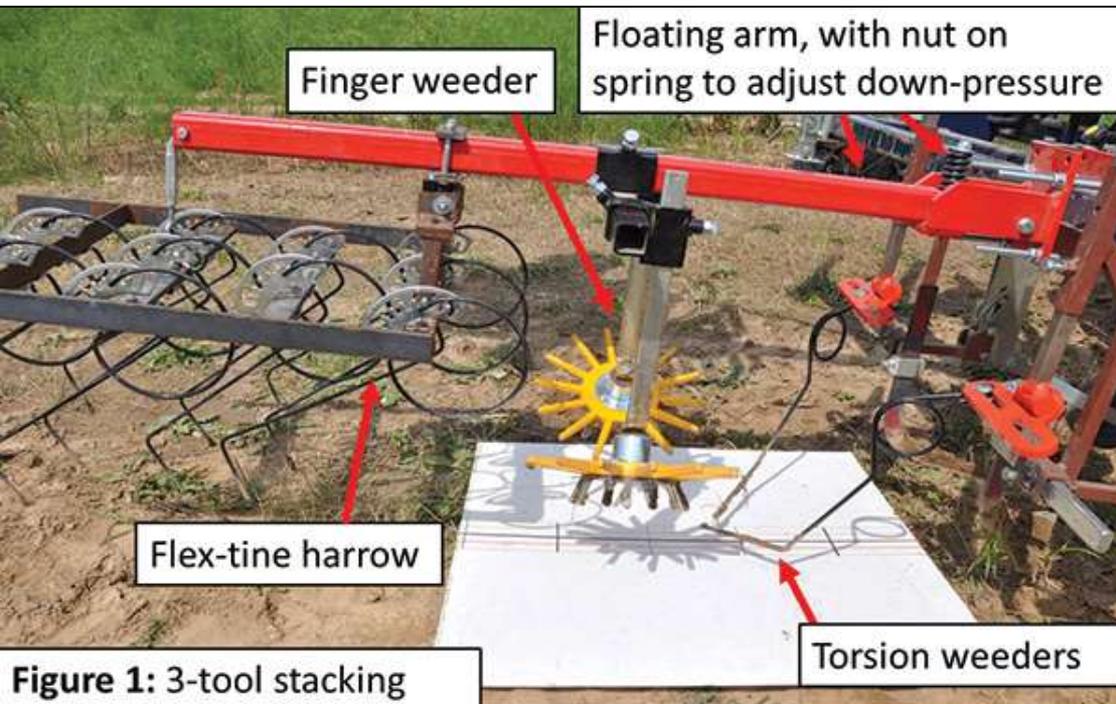
# Integrated Weed Management (IWM) – How to do it?

- **TARGET IN-ROW WEEDS** with “**stacked cultivation**” or other in-row technologies



# Integrated Weed Management (IWM) – How to do it?

“**Stacked Cultivation**” – sequence of multiple tools in a single pass

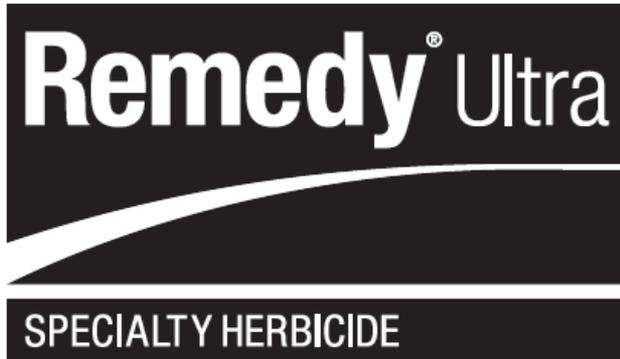




# Utilize sequences of herbicides with different SITES OF ACTION

<b>GROUP</b>	<b>4</b>	<b>HERBICIDE</b>
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## Specimen Label



®Trademark of The Dow Chemical Company ("Dow") or an affiliated company of Dow

**For the control of woody plants and broadleaf weeds on rangeland, permanent grass pastures, and conservation reserve program (CRP) acres (including fence rows and non-irrigation ditch banks within these areas).**

<b>GROUP</b>	<b>4</b>	<b>HERBICIDE</b>
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**Active Ingredient:**

triclopyr: 2-[(3,5,6-trichloro-2-pyridinyloxy)acetic acid, butoxyethyl ester .....	60.45%
Other Ingredients.....	39.55%
Total .....	100.00%

Acid Equivalent: triclopyr – 43.46% - 4 lb/gal

**Precautionary Statements**

**Hazards to Humans and Domestic Animals**

EPA Reg. No. 62719-552

**First Aid (Cont.)**

If swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control center or doctor. Do not give anything by mouth to an unconscious person.

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-992-5994 for emergency medical treatment information.

**Environmental Hazards**

This pesticide is toxic to fish. Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when cleaning equipment or disposing of equipment washwaters.

This chemical has properties and characteristics associated with chemicals detected in groundwater. The use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in groundwater contamination.

**Directions for Use**

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read all Directions for Use carefully before applying.

**Agricultural Use Requirements**

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.

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:

- Coveralls
- Waterproof gloves
- Shoes plus socks
- Protective eyewear

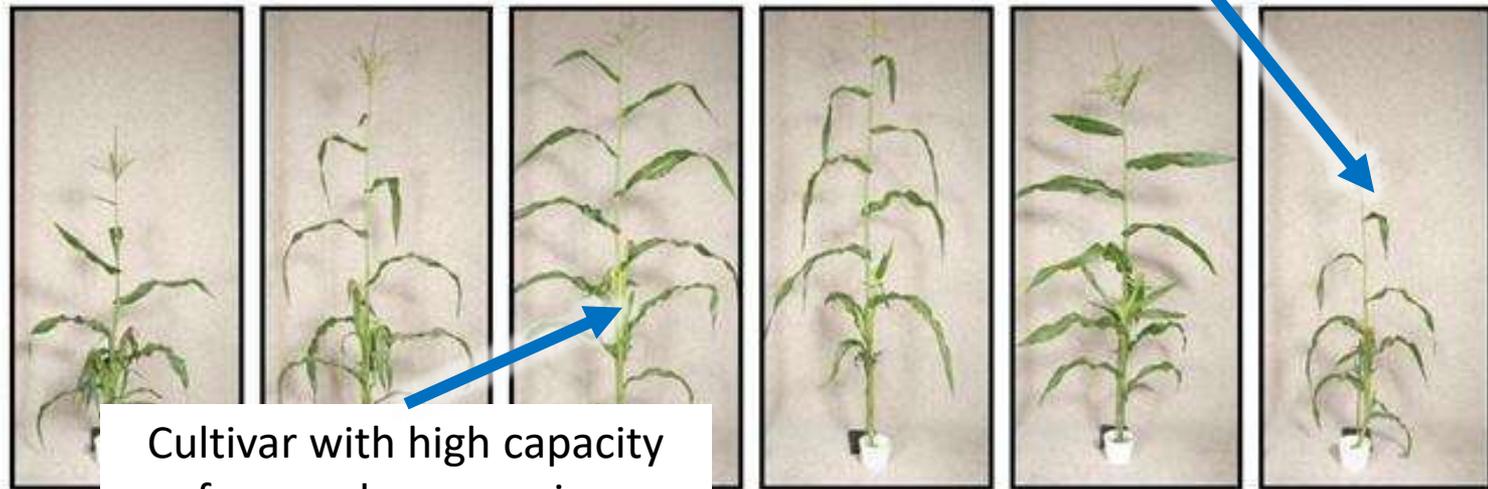
# Integrated Weed Management (IWM) – How to do it?

- **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



Cultivar with high capacity for weed suppression

# Integrated Weed Management (IWM) – How to do it?

- **CREATE ENVIRONMENT THAT GIVES CROP AN ADVANTAGE OVER WEEDS**

- Allelopathic green manures
- Stale seedbed
- ...



Mowing & incorporating cover crop prior to cash crop

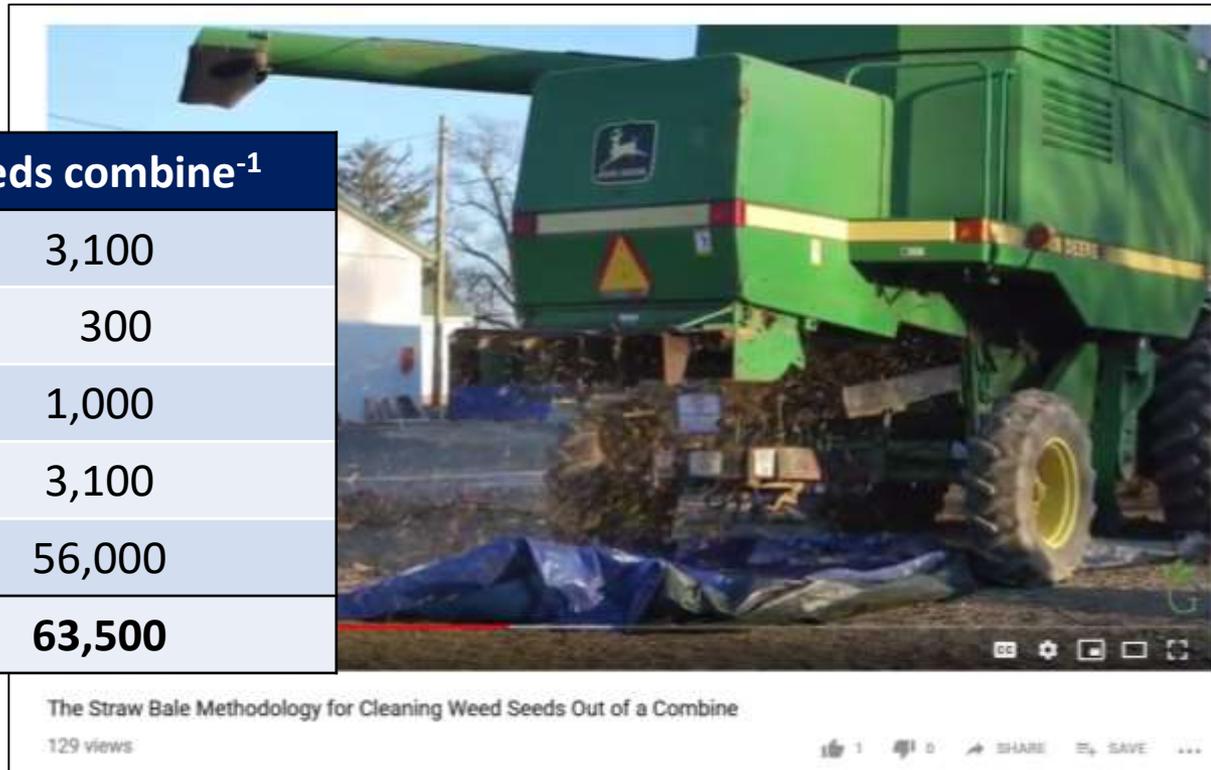


Chile field with and w/out stale seedbed implemented August before seeding

# Integrated Weed Management (IWM) – How to do it?

- **CLEAN EQUIPMENT**

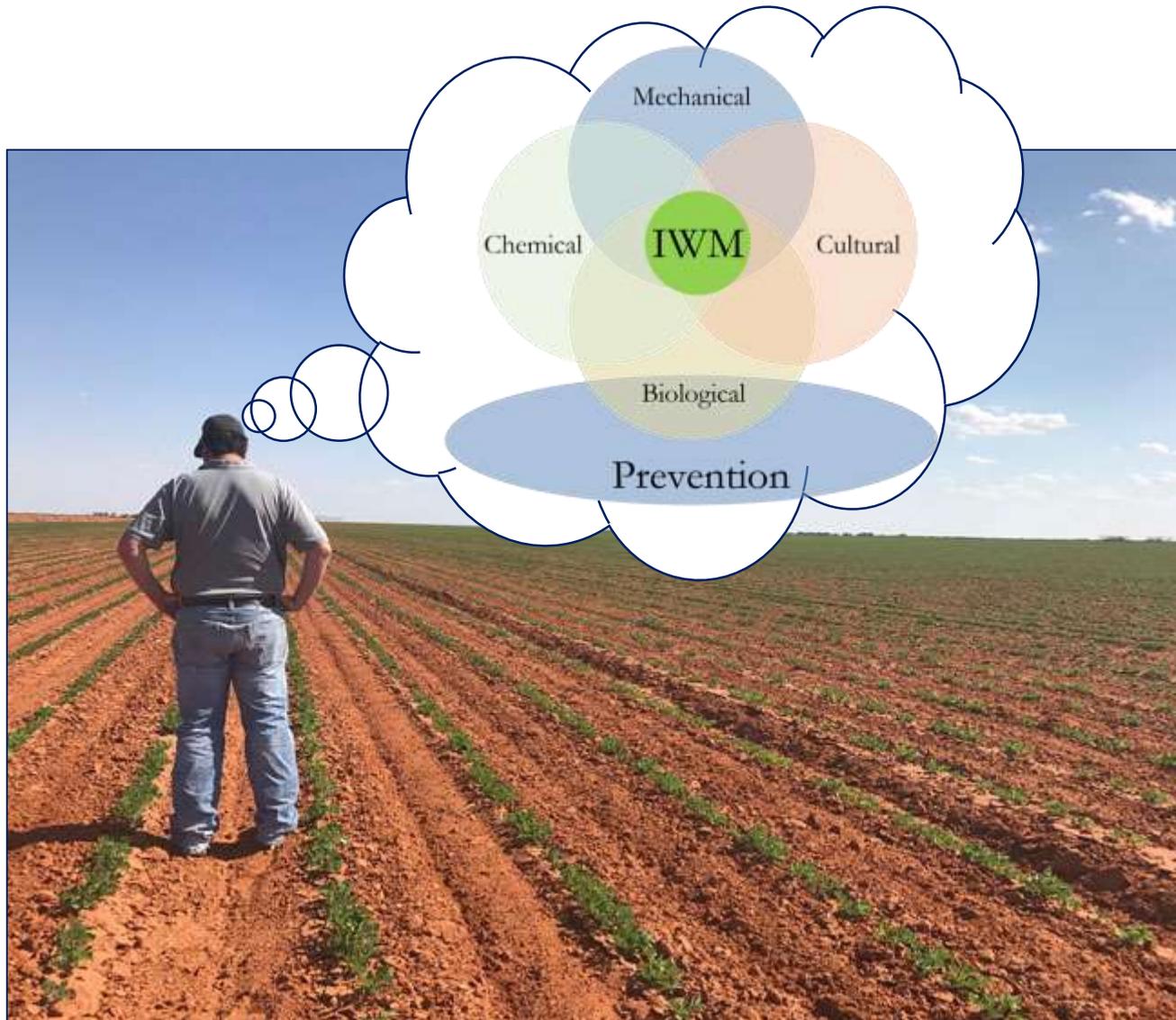
Safety First! Read and understand all manuals and wear recommended personal protective equipment



Species	Seeds combine <sup>-1</sup>
Pigweed	3,100
Morningglory	300
Velvetleaf	1,000
Fall panicum	3,100
Crabgrass	56,000
<b>Total</b>	<b>63,500</b>

Seeds collected from combine  
at end of season

# Integrated Weed Management (IWM) – How to do it?



# Integrated Weed Management – Why is it necessary?

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# Questions?



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