

Straw Management and Crop Rotation Alternatives to Stubble Burning: Year 2

Co-Principle Investigators

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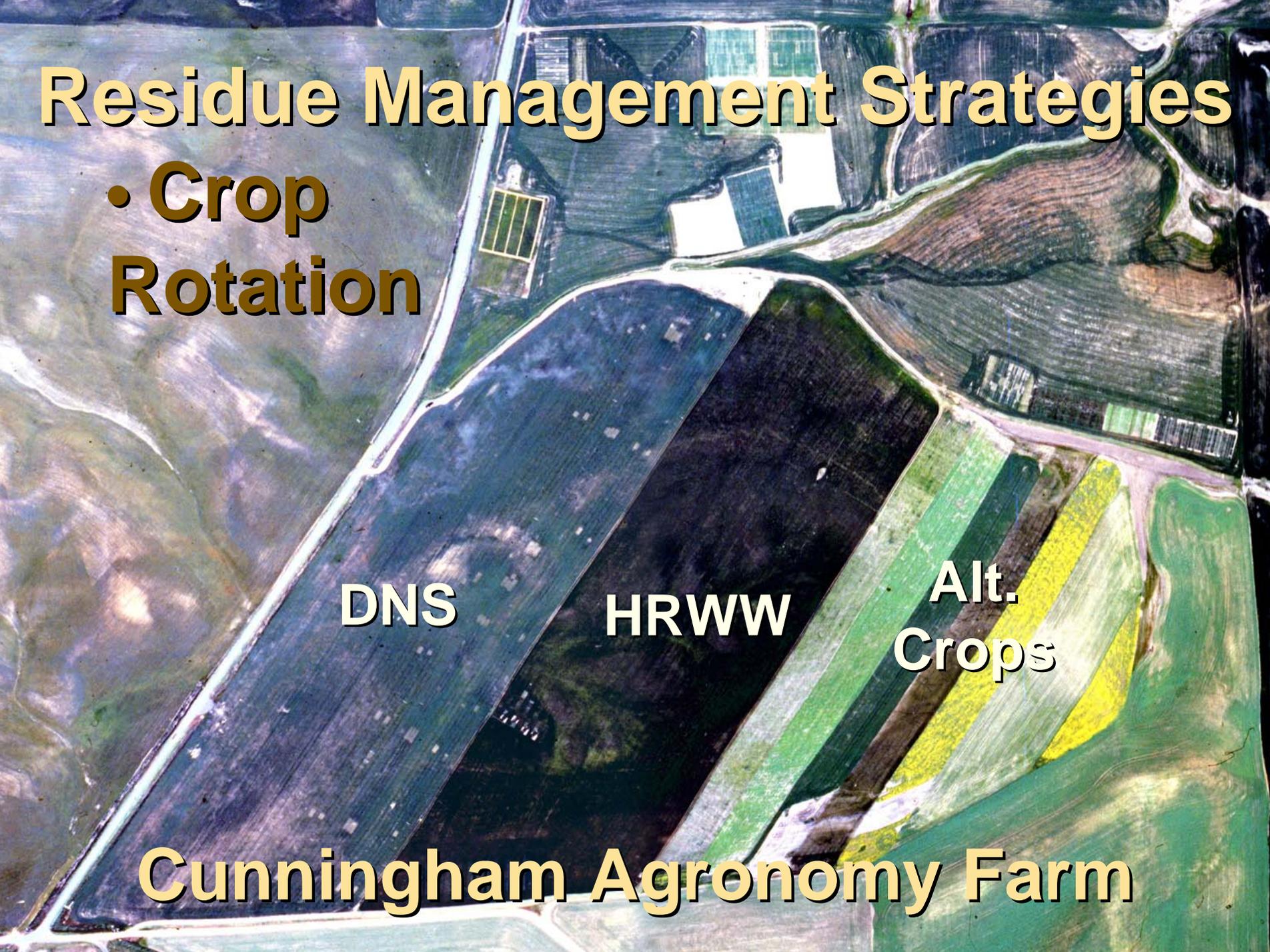
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Residue Management Strategies

An aerial photograph of a farm showing three distinct plots for residue management. The left plot is a large, dark brown field labeled 'DNS'. The middle plot is a smaller, dark brown field labeled 'HRWW'. The right plot is a large, multi-colored field labeled 'Alt. Crops', showing various shades of green and yellow. The farm buildings and other structures are visible in the upper right corner.

- **Crop Rotation**

DNS

HRWW

**Alt.
Crops**

Cunningham Agronomy Farm

Crop Rotation

- # Residue Management Tool
- # Green Bridge Control
- # Disease Mgmt.
- # Soil Temperature Mgmt.

Winter Wheat--**Alt. Crop**--Spring Wheat

HRSW, 2004

<u>Pre. Crop</u>	<u>Yield</u>
Canola	83 bu/A
Barley	87 bu/A
Peas	88 bu/A

Protein: 12.7%

HRSW, 2003

<u>Pre. Crop</u>	<u>Yield</u>
Canola	55 bu/A
Barley	51 bu/A
Peas	56 bu/A

Protein: 13.7%



HRSW, 2002

<u>Previous crop</u>	<u>Yield</u>	<u>Protein</u>
Canola	68 bu/A	13.5%
Barley	73 bu/A	13.0%
Peas	75 bu/A	14.0%



HRSW—Residue/Landscape Study

<u>Residue</u>	<u>Aspect</u>	<u>Yield (bu/A)</u>
Pea	South	92
Barley	South	76
Pea	North	106
Barley	North	88

Projects/Objectives:

Spring Wheat Straw Management for Production of Winter Wheat Without Burning



Winter wheat, direct-seeded into spring
wheat stubble—Lincoln Co. June, 2003

Residue Management Strategies

- **Mechanical Treatment**



Hard red winter wheat direct-seeded into HRSW stubble—after heavy harrow

Fall



Harvest



Spring



‘Falcon’ HRWW

	<u>2002</u>	<u>2003</u>	<u>2004</u>
Yield:	80 bu/A	82 bu/A	94 bu/A
Protein:	11%	10.7%	10.6%

Extended Rotation Effects on Winter Wheat??

Crop Rotation

2004 WW Yield

WC-SW-WW

96 bu/A

WP-SW-WW

106 bu/A

SB-SW-WW

93 bu/A

Crop Residue Management: The Combine



**Second sickle-bar added
(Ron Kile, Pine City)**

Objective

- # **Winter wheat straw management for direct-seeding alternative crops into winter wheat residue without burning**
 - **Winter and spring peas**
 - **Spring canola (drilled and broadcast)**
 - **Winter and spring barley**
 - **Stubble trimmed or cut normal**
-

Alternative Crop Performance following Winter Wheat (2004)

Direct-Seeded

Spring Canola (Drilled)	2747 lb/A
Spring Canola (Broadcast)	2439 lb/A
Winter Peas	1329 lb/A
Spring Peas	1946 lb/A
Winter Barley	4314 lb/A
Spring Barley	4797 lb/A

June 11, 2002

A man with a mustache, wearing a maroon long-sleeved shirt, blue jeans, and a brown hat, stands in the middle of a lush green pea field. The field is densely packed with pea plants, many of which have small white flowers. In the background, the field extends to a gentle rise under a clear blue sky. To the left, a strip of yellow-flowered plants is visible.

**Winter Green Peas 'Nutrigrreen' Direct-
Seeded into Winter Wheat Stubble**

Winter Lentils (Morton)

Feb. 9, 2005





Winter Peas, Feb. 9, 2005



Objective

- **Direct-seed spring wheat into 2003 winter wheat stubble with:**
 - 1. Stubble cut normal**
 - 2. Stubble trimmed with 2nd sickle bar**
 - 3. Stubble cut normal/harrowed**
 - 4. Stubble trimmed with 2nd sickle bar and harrowed**
-

Stubble Management: Winter Wheat Residue Fall, 2003



**Normal
WW stubble
(control)**

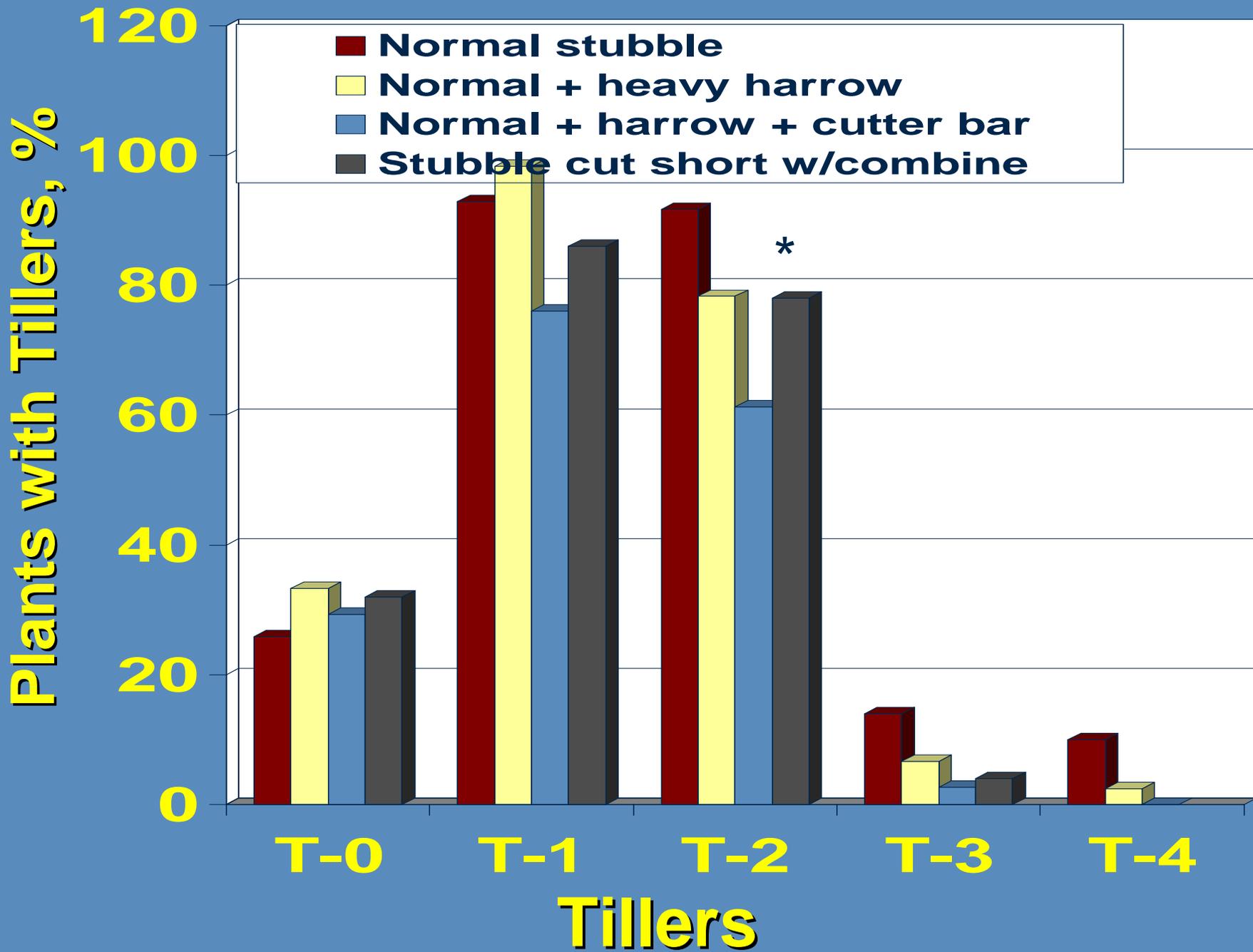
**Harrowed
WW stubble**



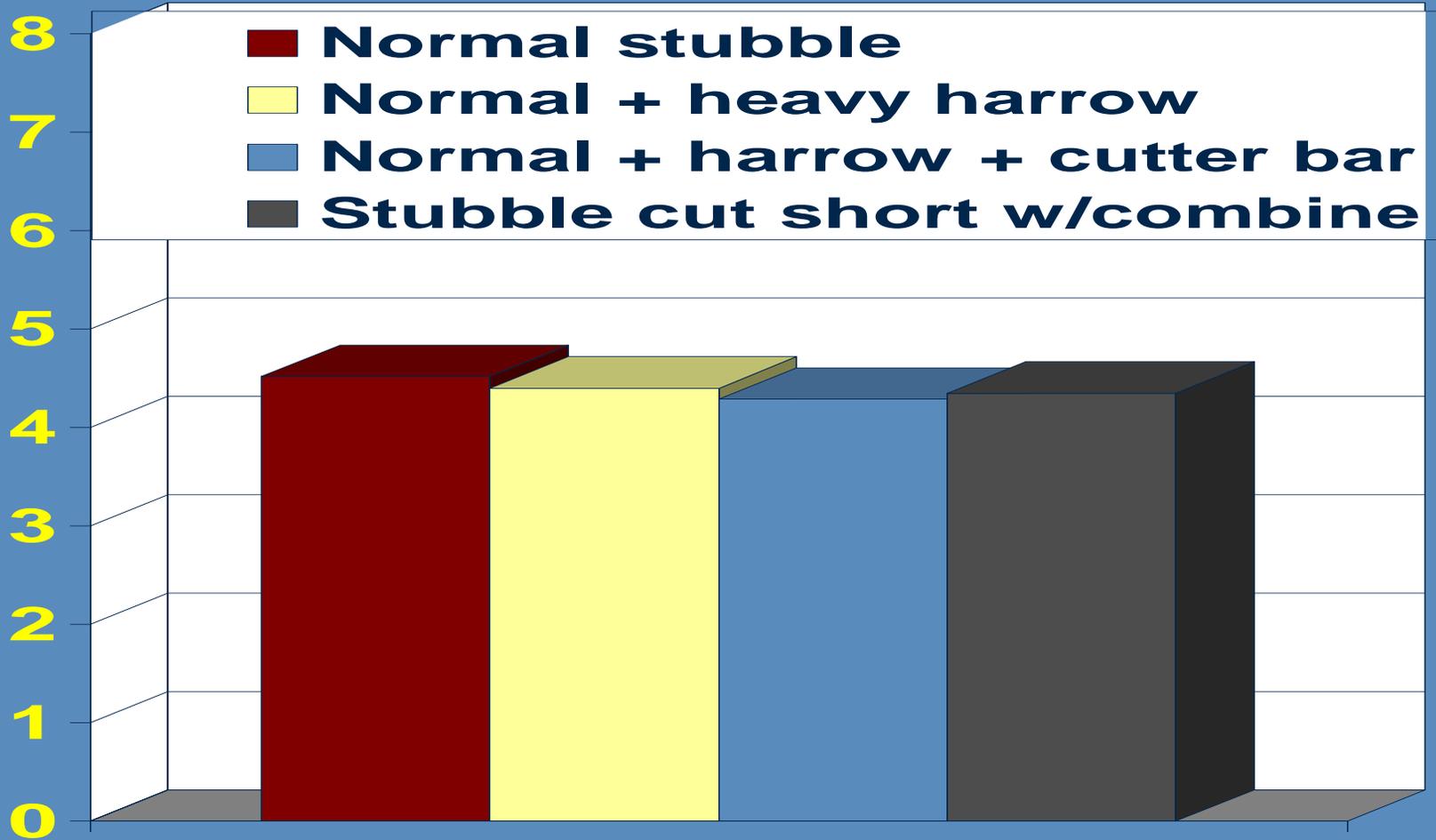
**Harrowed
WW stubble**

**2nd cutter-bar
and harrowed
WW stubble**





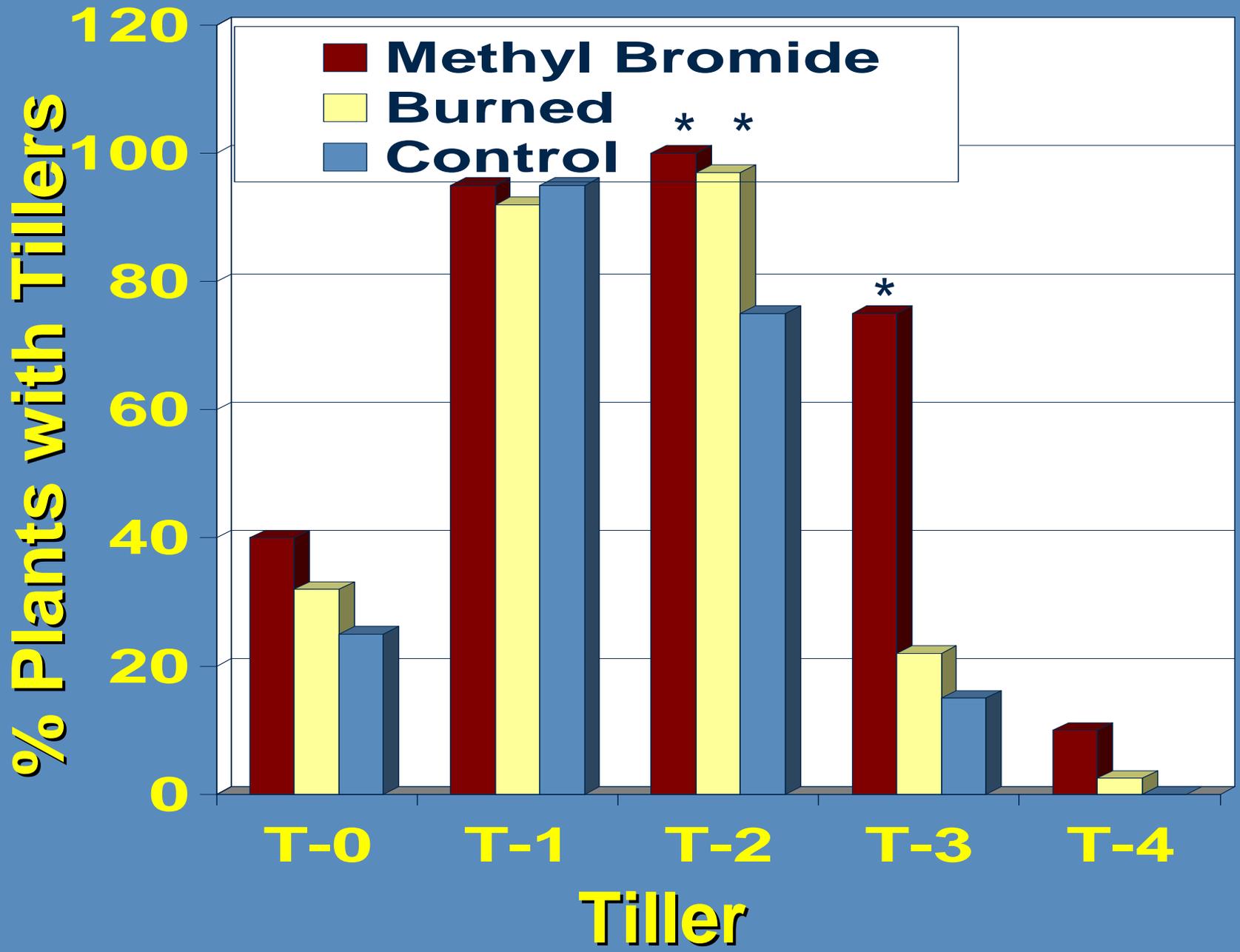
Ave. Haun Rating

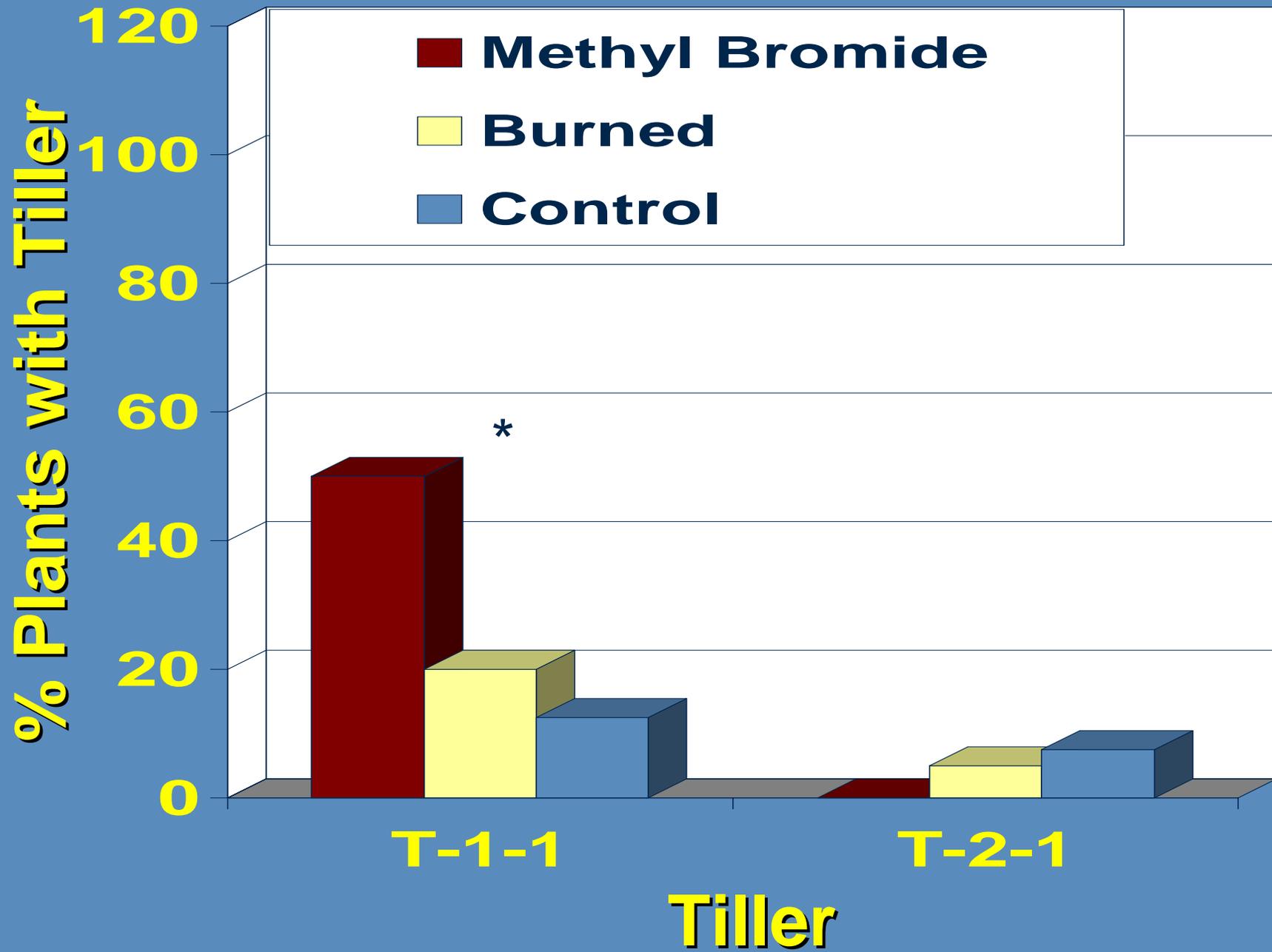


Yield 62a 59a 63a 61a
(bu/A) "Zak" Spring Wheat

Residue Management Alternatives to Stubble Burning

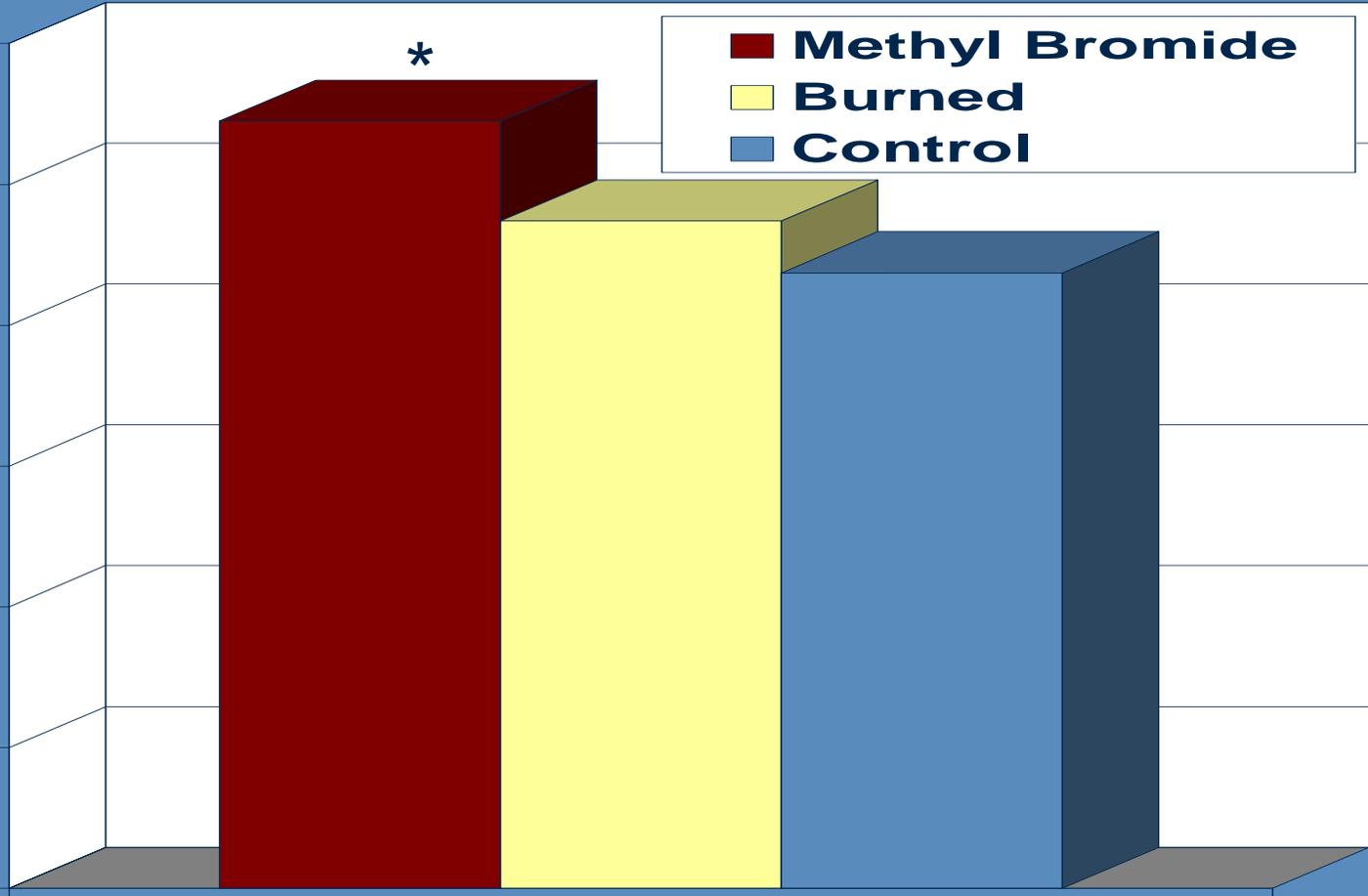






Ave. Haun Rating

6
5
4
3
2
1
0



Yield

56a

60a

54a

(bu/A)

“Zak”

Spring Wheat

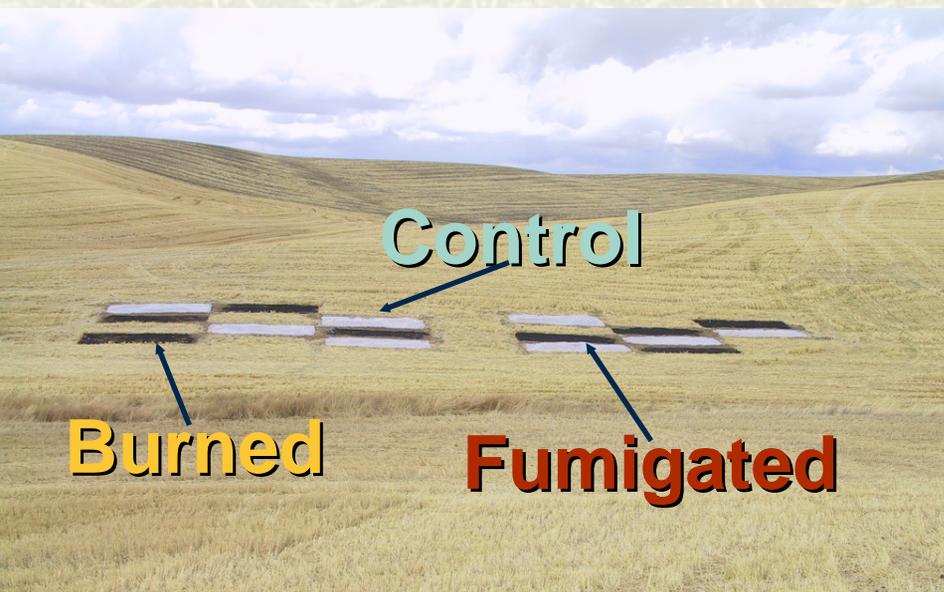
Winter Wheat (Feb. 9, 2005)



Objective 3

- # **Winter wheat straw management for direct-seeding winter barley into winter wheat residue without burning**
 - **Main plots: paired-row versus normal row configuration**
 - **Subplots: normal height stubble, burned stubble, fumigated stubble**
-

Wheat Stubble Mgmt. Fall 2003



**Row Configuration
(winter barley)**



Winter Barley 'Sunstar Pride' direct-seeded into HRWW Stubble



Winter Barley Growth and Development in Response to Straw Management Alternatives

Straw Management Treatment

<u>Response</u>	<u>Normal</u>	<u>Sickle Mow</u>	<u>Harrow</u>	<u>Burned</u>	<u>Fumigated</u>
Plants/m ²	329	365	412	457	321
Haun Stage	3.9	3.9	3.8	4.1	3.9
% T-0	0	0	0	0	0
% T-1	23	57	27	60	47
% T-2	30	30	23	40	40
% Rhizoc	9	19	3	3	0
Yield (lb/A)	5184	4717	5543	5449	6129
LSD_{0.05}	bc	c	ab	ab	a

Winter Barley "Sunstar Pride"

Feb. 9, 2005



Residue Management Strategies

- The Great Drill Debate



Projects/Objectives

Residue management and crop rotations as alternatives to burning for root disease management



Rhizoctonia root rot of peas, direct-seeded into heavy wheat residue—
Columbia Co

Cultural Practices That Affect Root Diseases

- **Tillage**
 - **Crop Residue**
 - **Crop Rotation**
-

How Does Tillage Affect Root Disease?

- # **Break down network of hyphae in soil**
 - # **Buries residue in soil**
 - # **Accelerates decomposition, compared to residue on surface**
-

How Does Crop Residue Affect Root Disease?

- # **Changes microclimate- higher relative humidity**
 - # **Mulching effect- prevents evaporation**
 - # **Delays heating of soil in spring**
 - # **Residue contains inoculum of foliar or crown pathogens**
-

How Does Crop Rotation Affect Root Disease?

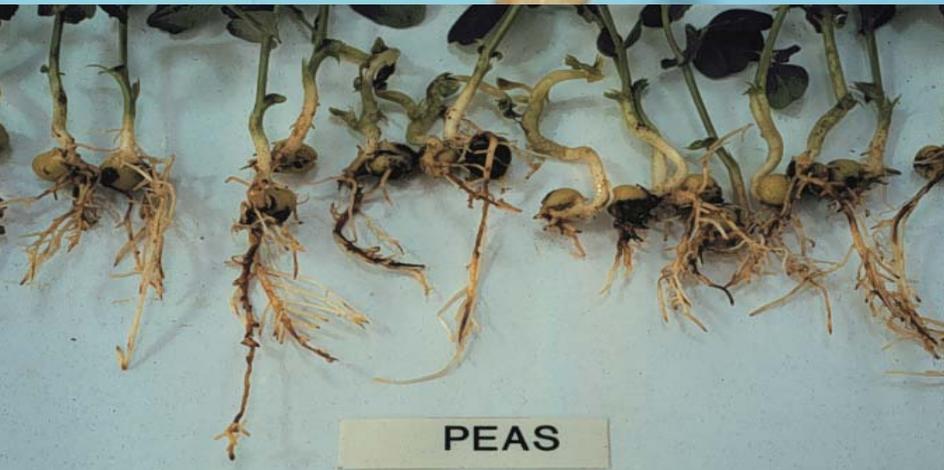
- # **Beneficial effect**
 - # **Breaks up inoculum formation by growing a non-host crop**
 - # **Only effective for pathogens with narrow host range**
-

Rhizoctonia Root Rot and Bare Patch





Rhizoctonia root rot







Pythium Seedling and Root Rot



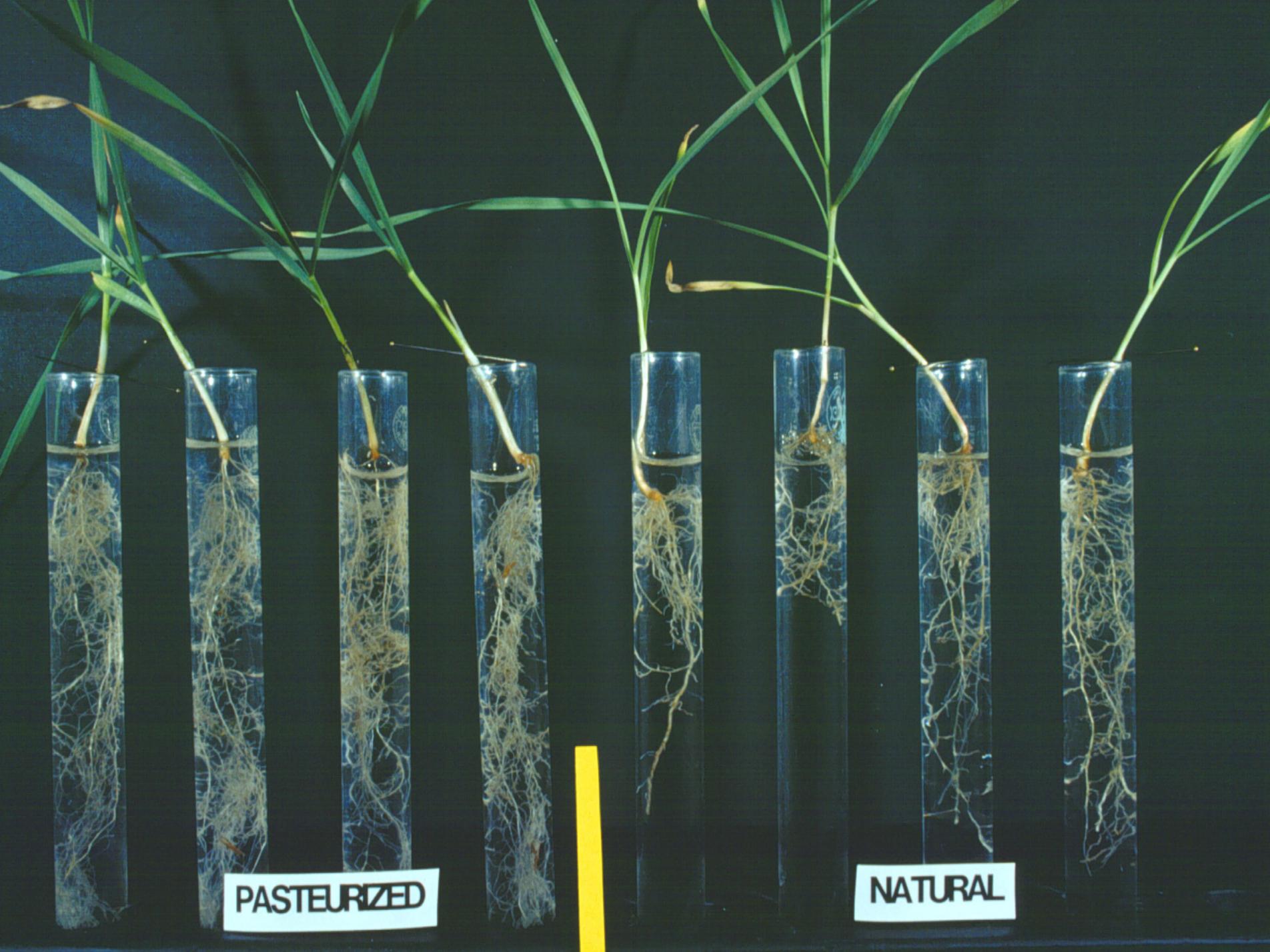


Pythium root rot



Check

Metaxyl



PASTEURIZED

NATURAL

Fusarium Dryland Foot Rot



Fusarium crown rot

=dryland foot rot

=Fusarium foot rot

F. pseudograminearum

F. culmorum



Fusarium root and foot rot in 2002 DNS



Take-All of Wheat

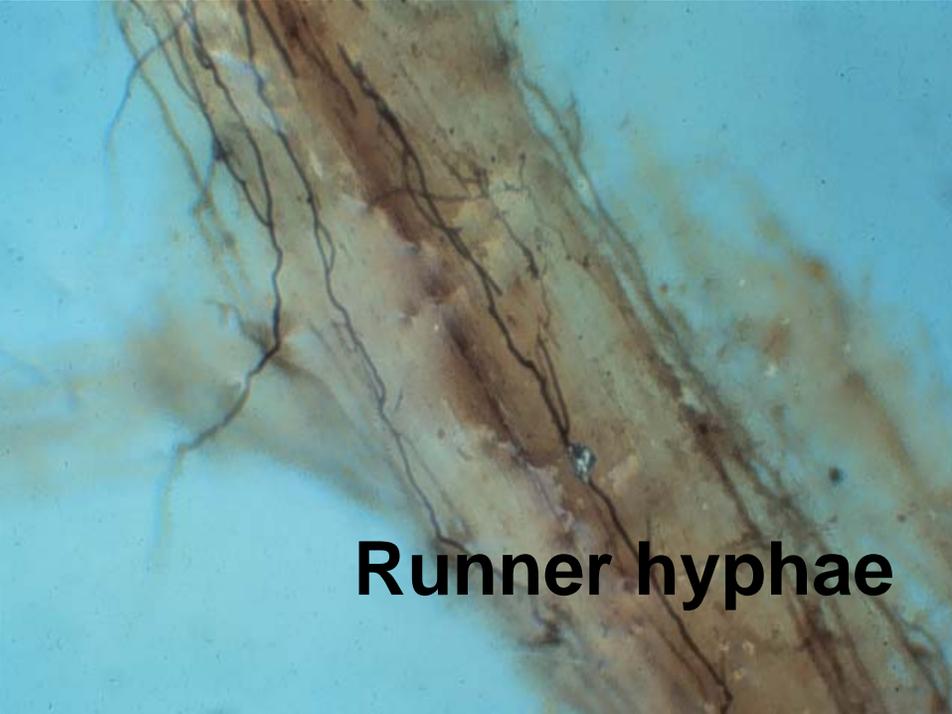




Take-all



Take-all



Runner hyphae

Objective

- # Document effects of cereal straw management and rotation alternatives on root pathogens.
 - DNA tests from soil (all pathogens)
 - Toothpick baiting for *Rhizoctonia*
 - Visual symptoms on roots (*Rhizoctonia*)
-

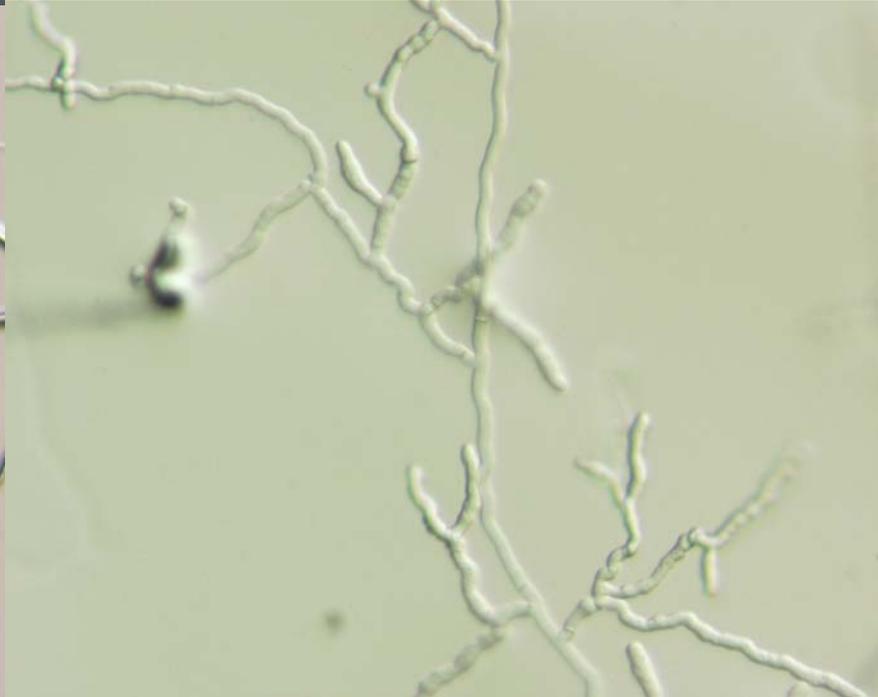




R. oryzae



***R. solani* AG-8**





**Rhizoctonia
root rot
of wheat**

Objective

- # Document effects of cereal straw management and rotation alternatives on root pathogens.
 - Symptoms of disease on crowns (*Fusarium*, take-all)
-

DNA from Soil

Samples were sent to Australia for DNA analysis using a PCR technology

***Take-all (*Gaeumannomyces graminis tritici*)**

***Crown rot (*Fusarium pseudograminearum*)
and *F. culmorum*)**

***Bare patch (*Rhizoctonia solani* AG-8)**

Effect of Tillage Treatments on DNA Levels of Take-All Pathogen in Winter Wheat

Treatment	DNA (pg/g soil)	Rating
<i>Continuous WW</i>		
Burn & Plow	30 B	2.0 A
<i>WW/SB/WC</i>		
Stubble Removed	19 AB	1.1 B
Stubble Burned	21 B	0.2 C
Standing Stubble	18 AB	0.2 C

Effect of Tillage Treatments on DNA levels of *Rhizoctonia solani* AG-8 in Winter Wheat

Treatment	DNA (pg/g soil)		Risk
<i>Continuous WW</i> Burn & Plow	31	A	low
<i>WW/SB/WC/WW</i> Stubble Removed	80	A	med
Stubble Burned	70	A	med
Standing Stubble	72	A	med

Deliverables

Develop viable residue management alternatives to burning

- Demonstrated value, if any, of re-designing crop rotation to aid residue management
- Demonstrated value, if any, of mechanical management of wheat stubble for direct-seeding
- Demonstrated value, if any, of paired-row spacing to offset adverse residue effects
- Documented effects of straw management and rotation alternatives on root pathogens

Convey project findings through electronic and print media, conferences and research site tours

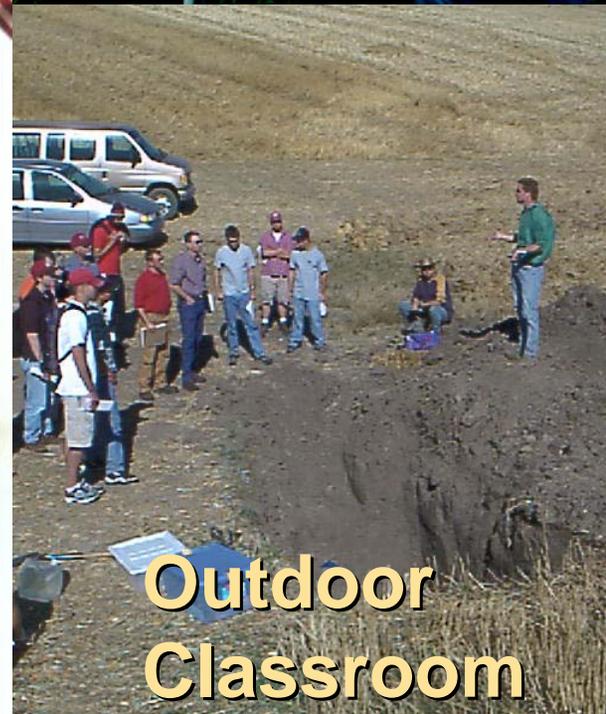
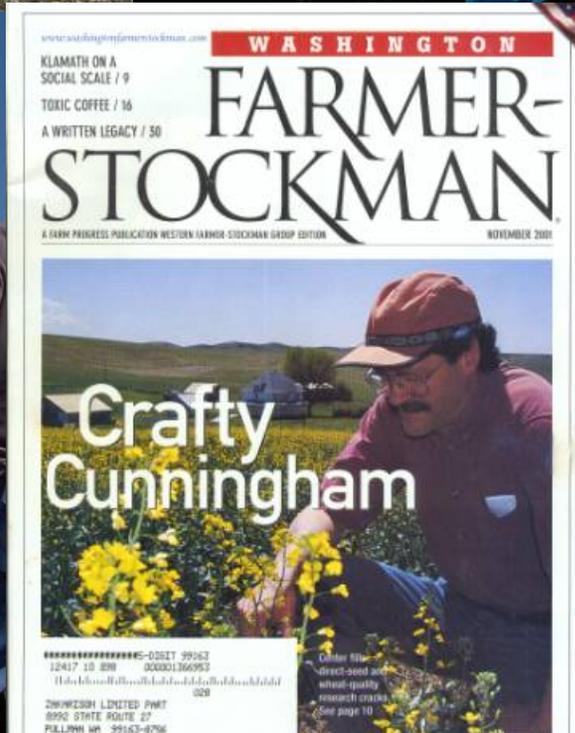
Outreach

Large-scale field studies
'Seeing is believing'



*People: creative force
behind global solutions*

Field Days



**Outdoor
Classroom**







