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Row Spacing, Yields and the Bottom Line – How wide can we go?

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- **Agriculture and Agri-Food Canada**
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Why the interest in wide row spacing?



No-till



- **No-Till means working with standing stubble and surface residues**
- **Surface residues create unique challenges at seeding**



**•No-till and Narrow spacing = more openers,
more draft, more energy, more costs,
more maintenance, more residue
clearance problems, narrower seeders,
longer seeding periods**



A photograph of a cornfield. The corn plants are mostly dry and yellowish-brown, indicating they are past their peak. A central aisle of the field is filled with lush, green weeds, which are significantly taller and denser than the surrounding corn. This visual contrast is used to illustrate the concept of wider row spacing, suggesting that more space between rows allows for better weed management and potentially higher yields.

**Much more is possible
with wider row spacing...**



Questions of Interest

- **Can we go beyond 12"?**
- **What are the implications for side-banded nitrogen fertilizers?**
- **What are the implications for weed growth?**



Recent Results
10", 12", 14" and 16"
Row Spacing Studies

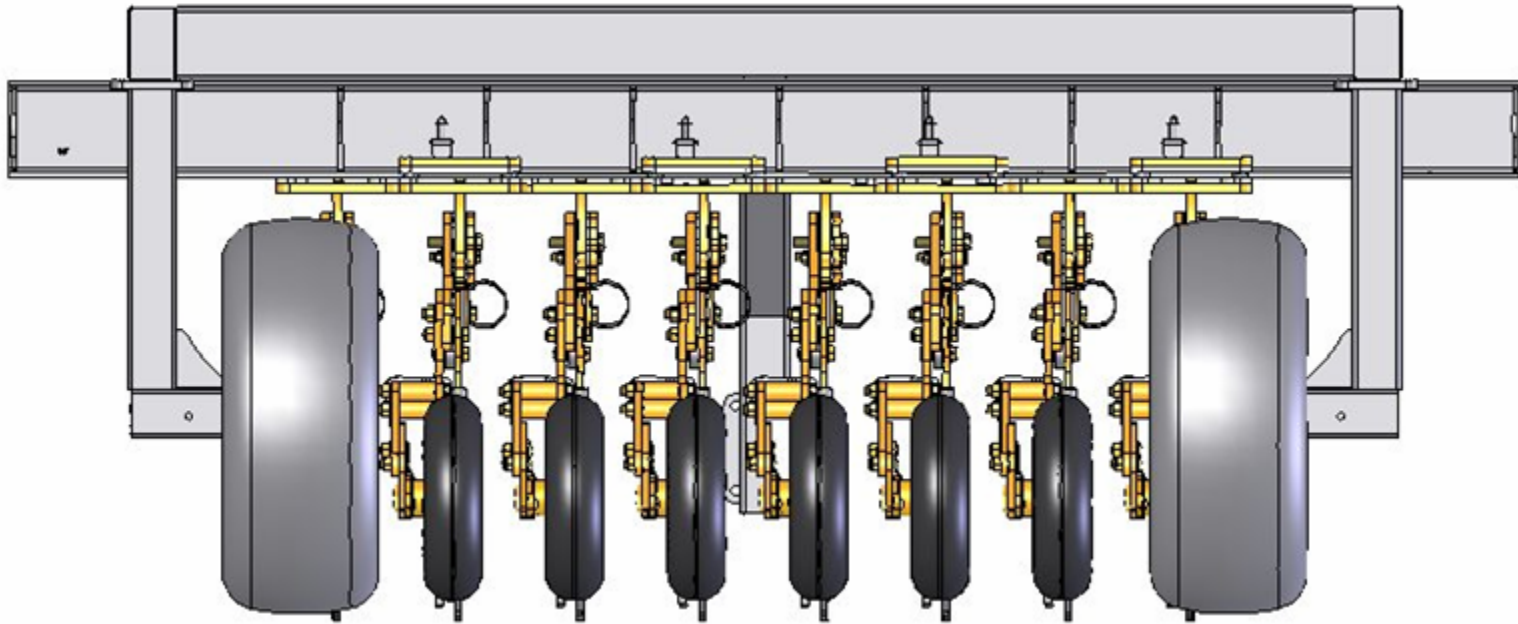
An aerial photograph of a large agricultural field. The field is divided into numerous parallel rows of crops. The crops alternate in color between a vibrant yellow and a lush green, creating a rhythmic, striped pattern across the landscape. The rows are densely packed and extend far into the distance, suggesting a large-scale farming operation. The lighting is bright, casting soft shadows between the rows.

Methodology

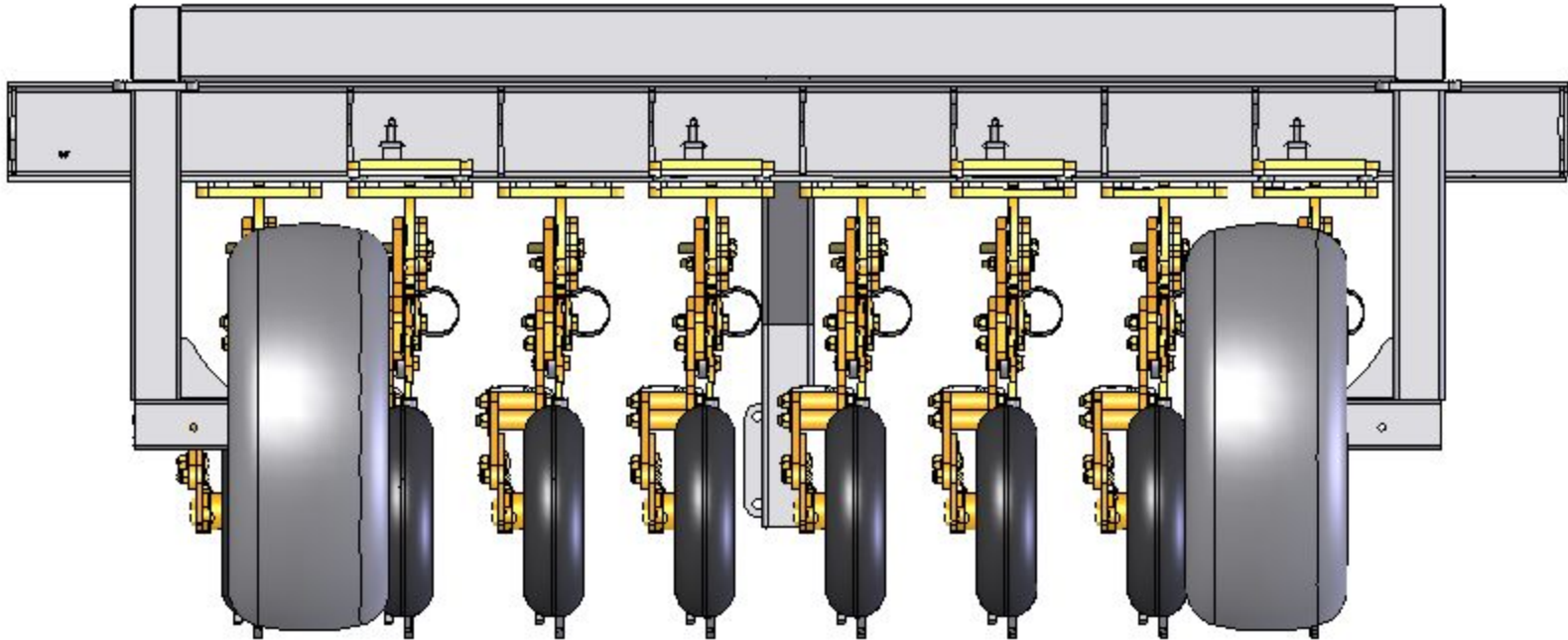


8 SeedMaster Openers on Two Ranks

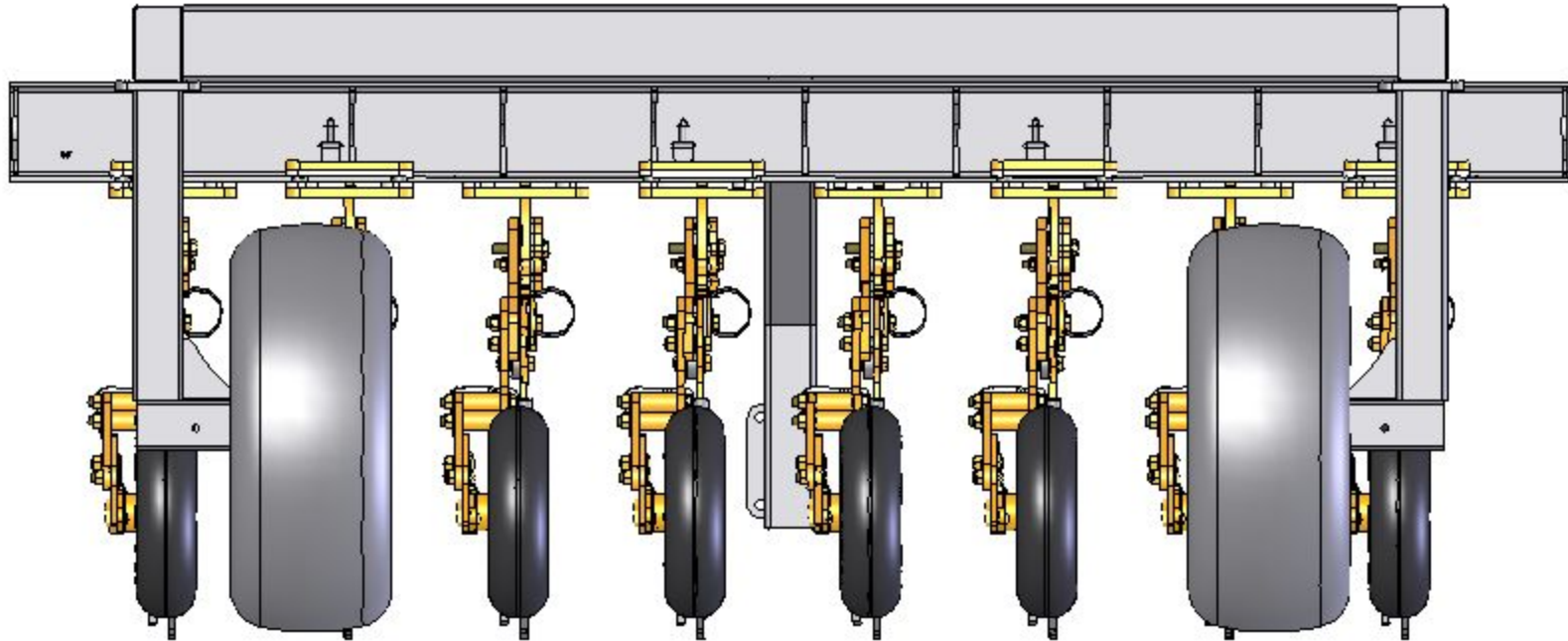
10 " spacing



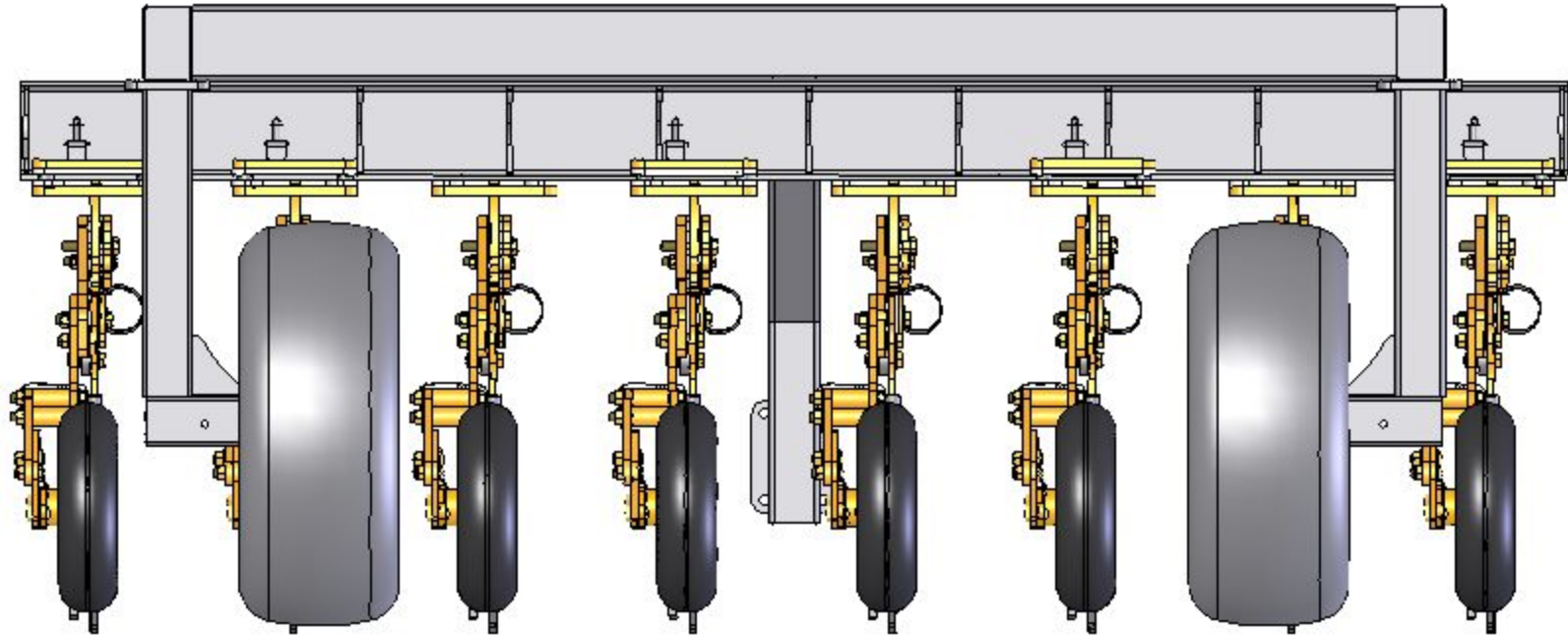
12" spacing



14" Spacing

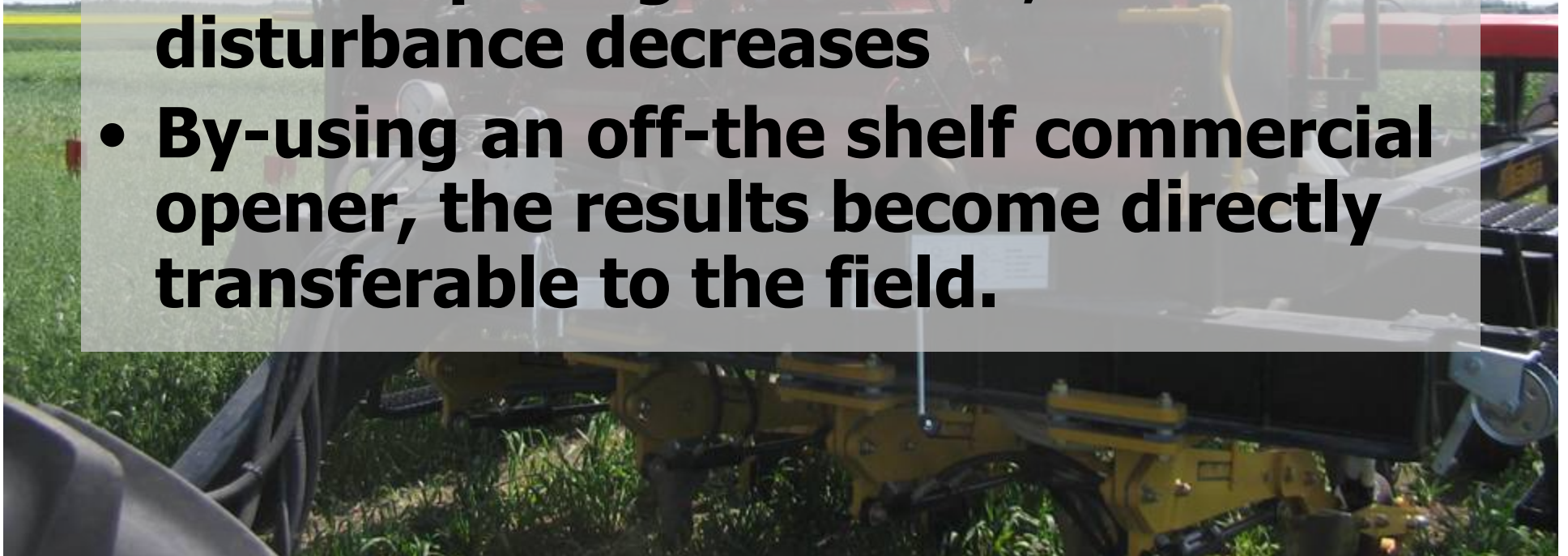


16" Spacing



Importance of this Plot Seeding Equipment

- **Avoids important confounding effects**
- **As row spacing increases, fertilizer gets more concentrated**
- **As row spacing increases, soil disturbance decreases**
- **By-using an off-the shelf commercial opener, the results become directly transferable to the field.**



Treatments

- **Years: 2009 and 2010**
- **Crop: Oat** (target plant population **300** plants per meter square)
- **Nitrogen rates: Urea**
 - 20, 40, 60, 80, 120 kg N/ha
- **One rate of 14-20-10-10**
 - 143 kg N/ha (127 lbs/acre)
- **Four row spacing**
 - 10", 12", 14" and 16"

Fertilizer Products (lbs/acre)

N rate kg N/ha	14-20-10-10	Urea	Total
20	127		
40	127		
60	127		
80	127		
120	127		

Fertilizer Products (lbs/acre)

N rate kg N/ha	14-20-10-10	Urea	Total
20	127	0	127
40	127	39	166
60	127	77	204
80	127	116	243
120	127	193	320

Visual Representation – Amount of various fertilizers per foot of row



Row Spacing

14-20-10-10
143 Kg/ha

(127 lbs/acre)

Product per foot of row

10"
(25 cm)



3.6 g

12"
(30 cm)



4.4 g

14"
(36 cm)



5.1 g

16"
(41cm)



5.8 g

Row Spacing	46-0-0 40 Kg/ha	46-0-0 60 Kg/ha	46-0-0 80 Kg/ha	46-0-0 120 Kg/ha
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Actual Urea Product per foot of row

10"
(25 cm)



2.2 g



3.3 g



4.4 g



6.6 g

12"
(30 cm)



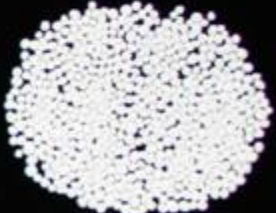
2.6 g



4.0 g



5.3 g



8.0 g

14"
(36 cm)



3.1 g



4.6 g



6.2 g



9.3 g

16"
(41cm)



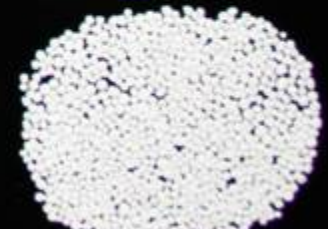
3.5 g



5.3 g



7.1 g



10.6 g

Row Spacing

46-0-0

60 kg N/ha

Actual Urea Product per foot of Row

10"
(25 cm)



12"
(30 cm)



14"
(36 cm)



16"
(41cm)



46-0-0

120 kg N/ha

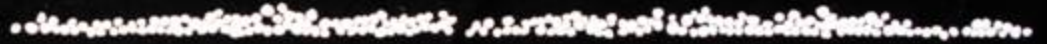
Row Spacing

Actual Urea Product per foot of row

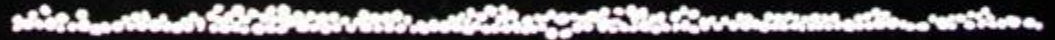
10"
(25 cm)



12"
(30 cm)



14"
(36 cm)



16"
(41cm)



Results

2009-2010

16"
80 kg N / ha
(71 lbs N / acre)



Row Spacing Effects on Plant Populations



Plant per Meter Square

Row Spacing	2009	2010
10"		
12"		
14"		
16"		
<i>p-value</i>		

Plant per Meter Square

Row Spacing	2009	2010
10"	414 (100)	
12"	415 (100)	
14"	388 (94)	
16"	379 (92)	
<i>p-value</i>	0.05	

Plant per Meter Square

Row Spacing	2009	2010
10"	414 (100)	390 (100)
12"	415 (100)	355 (91)
14"	388 (94)	316 (81)
16"	379 (92)	320 (82)
<i>p-value</i>	0.05	0.0001
<i>Row Spacing x N Rate</i>	ns	ns

Note: Target Plant Population was 300

Nitrogen Effects on Plant Populations



Plant per Meter Square

N Rate Kg/ha	2009	2010
20		
40		
60		
80		
120		
<i>p-value</i>		

Plant per Meter Square

N Rate Kg/ha	2009	2010
20	388	
40	413	
60	415	
80	389	
120	390	
<i>p-value</i>	ns	

Plant per Meter Square

N Rate Kg/ha	2009	2010
20	388	346
40	413	347
60	415	345
80	389	344
120	390	344
<i>p-value</i>	ns	ns

Grain Yield (bus/acre)

Row Spacing	2009	2010	Mean
10"			
12"			
14"			
16"			
<i>p-value</i>			

Grain Yield (bus/acre)

Row Spacing	2009	2010	Mean
10"	154		
12"	154		
14"	163		
16"	155		
<i>p-value</i>	ns		

Grain Yield (bus/acre)

Row Spacing	2009	2010	Mean
10"	154	152 (100)	
12"	154	146 (96)	
14"	163	138 (91)	
16"	155	126 (83)	
<i>p-value</i>	ns	0.0001	

Grain Yield (bus/acre)

Row Spacing	2009	2010	Mean
10"	154	152	153 (100)
12"	154	146	150 (98)
14"	163	138	151 (99)
16"	155	126	141 (92)
<i>p-value</i>	ns	0.0001	

A wide-angle photograph of a large agricultural field filled with mature, golden-brown grain crops, likely sorghum or a similar cereal. The plants are densely packed and reach a height of several feet. In the background, a flat horizon line is visible under a sky filled with soft, white and grey clouds. A thin line of trees and a small building can be seen on the horizon. The overall scene is a typical rural landscape during harvest time.

**Why the difference between
2009 and 2010 for row spacing
effects on grain yield?**

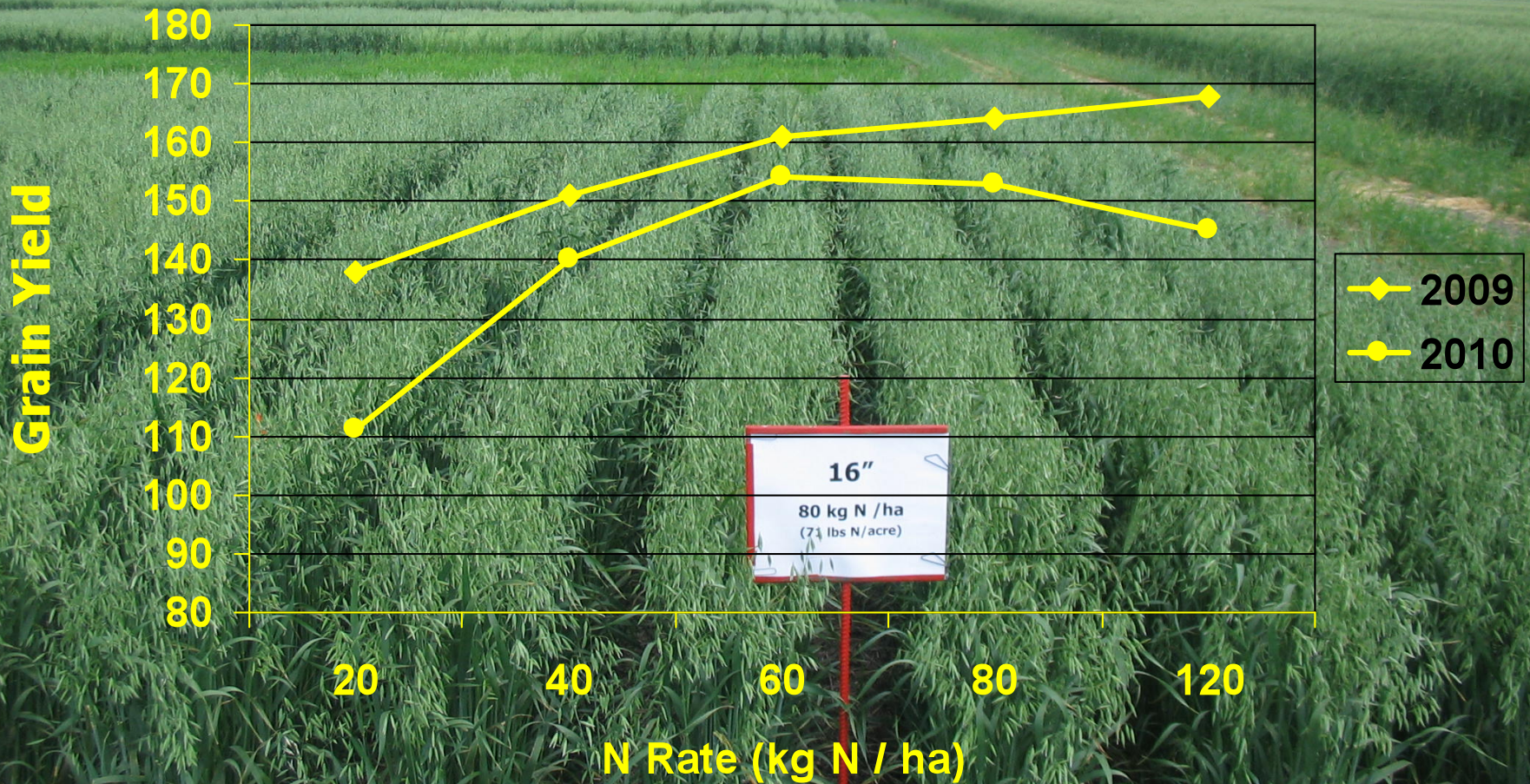
Possible reason(s)



N Response

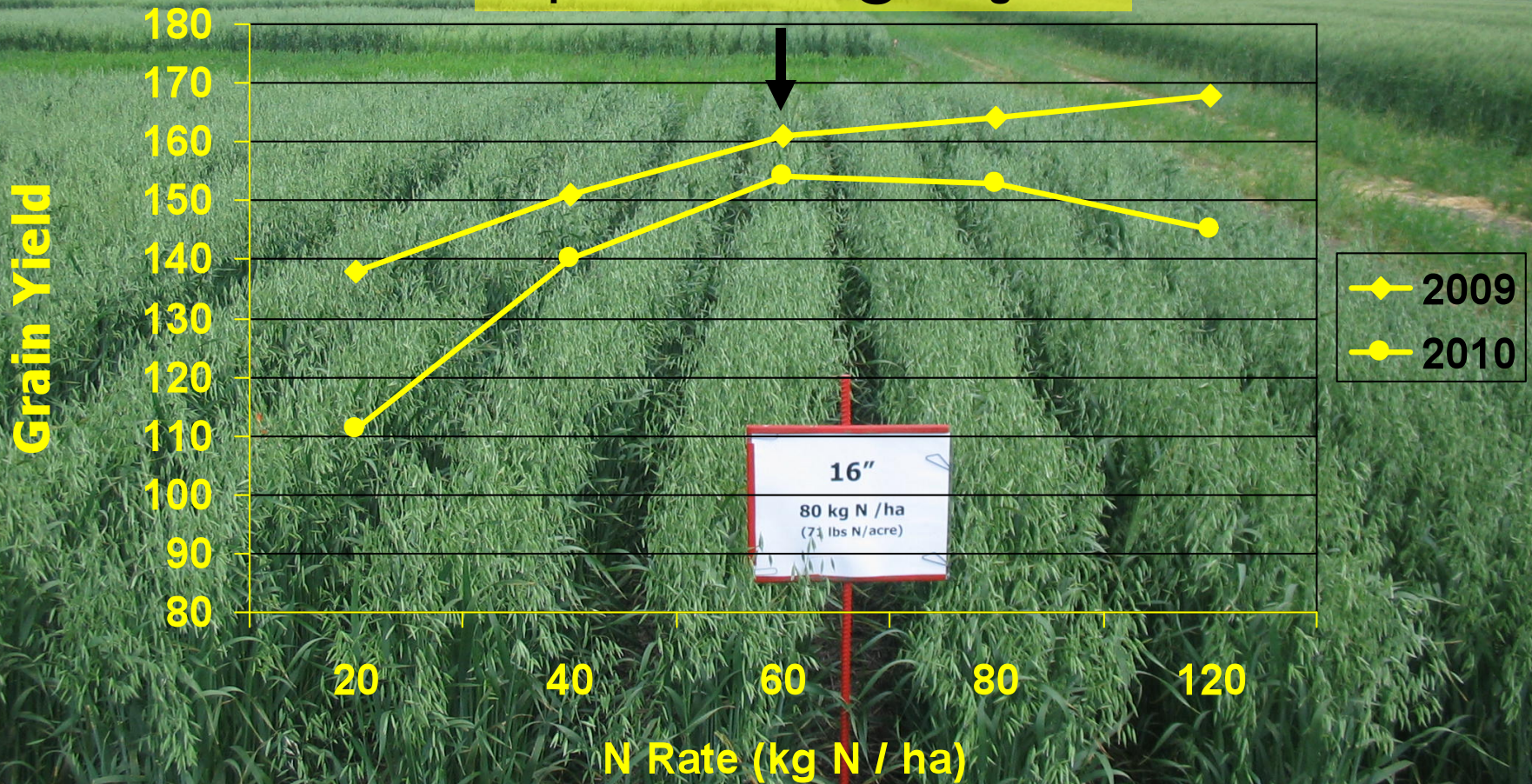


Grain Yield (bus/acre)



Grain Yield (bus/acre)

~Optimum N Rate @ 60 kg N/ha



Grain Yield @ 60 kg N / ha (bus/acre)

Row Spacing	2009	2010
10"		
12"		
14"		
16"		
<i>p-value</i>		

Grain Yield @ 60 kg N / ha (bus/acre)

Row Spacing	2009	2010
10"	158	
12"	161	
14"	170	
16"	155	
<i>p-value</i>	ns	

Grain Yield @ 60 kg N / ha (bus/acre)

Row Spacing	2009	2010
10"	158	159
12"	161	160
14"	170	159
16"	155	138
<i>p-value</i>	ns	0.0001

Some Conclusions Regarding Plant Density and Grain Yield

- **Some decrease in plant populations going from 10" – 16"**
- **N rate had no effect on plant population indicating that fertilizer placed 1.5" to the side and $\frac{3}{4}$ " below the seed is a safe configuration**
- **Grain yield at optimum N rates were equal between 10", 12" and 14" but some decrease at 16" observed in 2010**

Some additional observations...



Seeding Depth

- **Same setting in both years i.e $\frac{3}{4}$ "**
- **Speed of travel ~ 4 MPH**
- **In 2009, we chose the plants at random in the plots**
- **In 2010, we made sure to choose plants from the same row and from the front rank**

Seeding Depth (mm)

Row Spacing	2009	2010
10"		
12"		
14"		
16"		
<i>p-value</i>		

Seeding Depth (mm)

Row Spacing	2009	2010
10"	39	
12"	36	
14"	29	
16"	30	
<i>p-value</i>	0.0001	

Seeding Depth (mm)

Row Spacing	2009	2010
10"	39	46
12"	36	37
14"	29	36
16"	30	35
<i>p-value</i>	0.00001	0.00001

Plant Development



- **Conducted a Plant Development Score**
- **Quantified tiller production**
- **In 2009, we chose the plants at random in the plots**
- **In 2010, we made sure to choose plants from the same row and from the front rank**

Plant Development in 2009

Frequency of Tillers (%)

Row Spacing	T0	T1	T2	T3	T11
10"	2	17	4	0	0
12"	2	19	5	0	0
14"	1	18	6	0	0
16"	1	12	15	0	0
<i>p-value</i>	ns	ns	0.05	-	-

Plant Development in 2010

Frequency of Tillers (%)

Row Spacing	T0	T1	T2	T3	T11
10"	0.5	6	0	0	0
12"	0.3	4	0.3	0	0
14"	0.3	7	1.3	0	0
16"	0.3	9	1.5	0	0
<i>p-value</i>	Ns	ns	ns	-	-

Panicles per meter Square

	2009		2010	
Row Spacing	Estimated	Actual	Estimated	Actual
10"				
12"				
14"				
16"				
Mean				
<i>p-value</i>				

Panicles per meter Square

	2009		2010	
Row Spacing	Estimated	Actual	Estimated	Actual
10"	503	497		
12"	504	512		
14"	478	502		
16"	481	510		
Mean	492	505		
<i>p-value</i>	ns	ns		

Panicles per meter Square

	2009		2010	
Row Spacing	Estimated	Actual	Estimated	Actual
10"	503	497	413	565
12"	504	512	371	530
14"	478	502	344	495
16"	481	510	353	502
Mean	492	505	370	523
<i>p-value</i>	ns	ns	0.001	0.001



Some Conclusions Regarding Actual Depth of Planting and Tillering

- **Resulting depth always greater than setting on drill**
- **Tiller production was the same regardless of row spacing**
- **Estimated panicles at the 5-6 leaf stage were the same as actual panicles at maturity in 2009 but lower in 2010**

Row Spacing Effects on Weed Populations

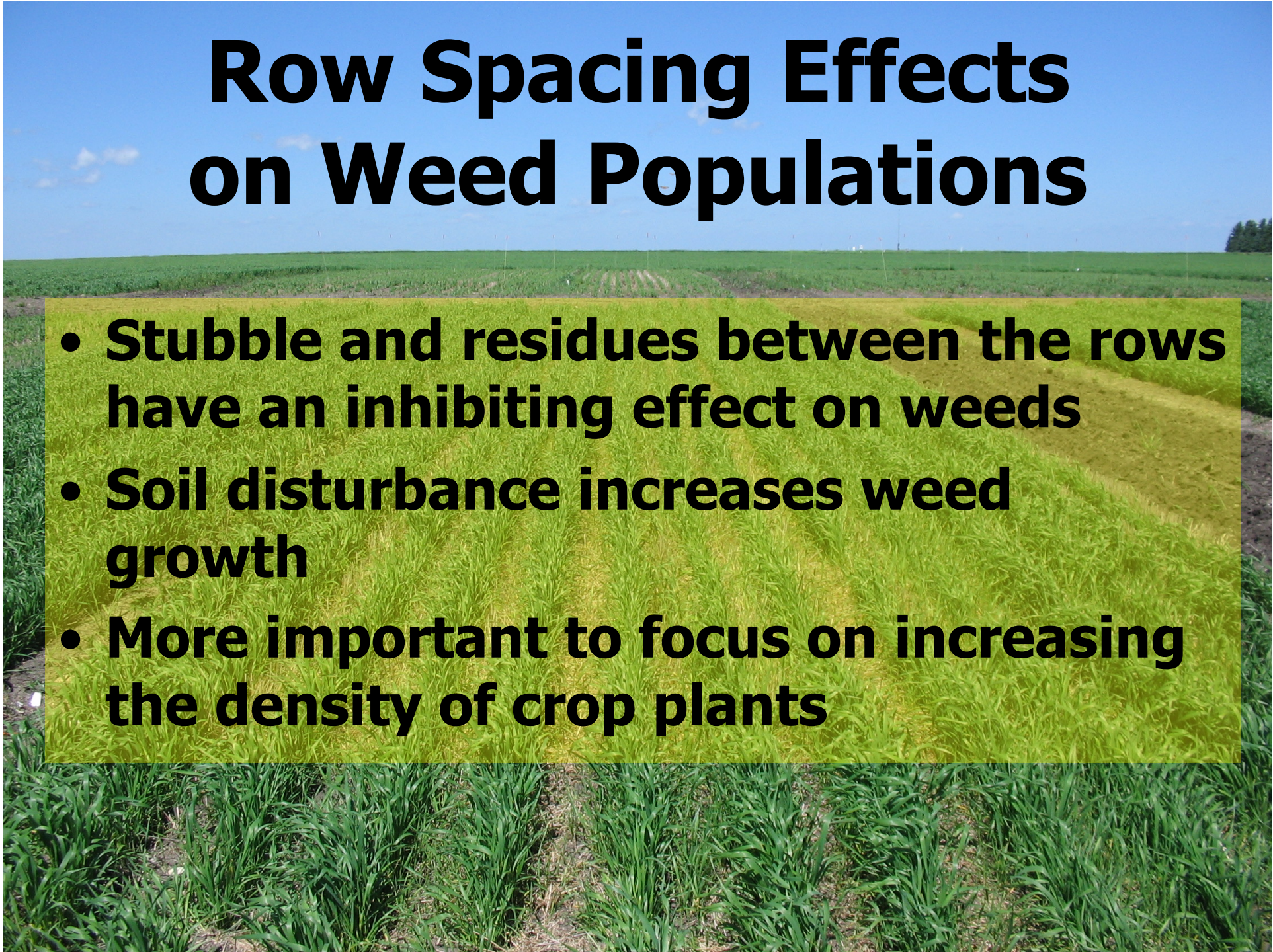


Row Spacing Effects on Weed Populations

- **Barley: No effect of row spacing (8" vs 12")** O'Donovan et al. 2001. *Weed Science* 49:746-754
- **Winter wheat: No effects of row spacing (4" vs 8" vs 12")** Roberts et al. 2001. *Weed Tech.* 15:19-25

Row Spacing Effects on Weed Populations

- **Stubble and residues between the rows have an inhibiting effect on weeds**
- **Soil disturbance increases weed growth**
- **More important to focus on increasing the density of crop plants**



A photograph of a field with rows of crops, overlaid with a yellow semi-transparent box containing text. The background shows a field of crops with a blue vehicle in the distance under a clear sky.

Row Spacing

- **Effects on seed distribution within the row**
- **Effects on plant development**

Plants per foot row at different plant population densities (# m⁻²)

Row Spacing	50	100	150	200	250
10"					
12"					
14"					
16"					

Plants per foot row at different plant population densities (# m⁻²)

Row Spacing	50	100	150	200	250
10"	4	8	12	15	19
12"	5	9	14	19	23
14"	5	11	16	22	27
16"	6	13	19	25	31

Plants per foot row at different plant population densities (# m⁻²)

Row Spacing	50	100	150	200	250
10"	4	8	12	15	19
12"	5	9	14	19	23
14"	5	11	16	22	27
16"	6	13	19	25	31

Impact of Seeding Rates on Weeds

- **Seeding rate has a much greater effect on weed densities than row spacing**
- **Always better to have higher than lower plant populations**



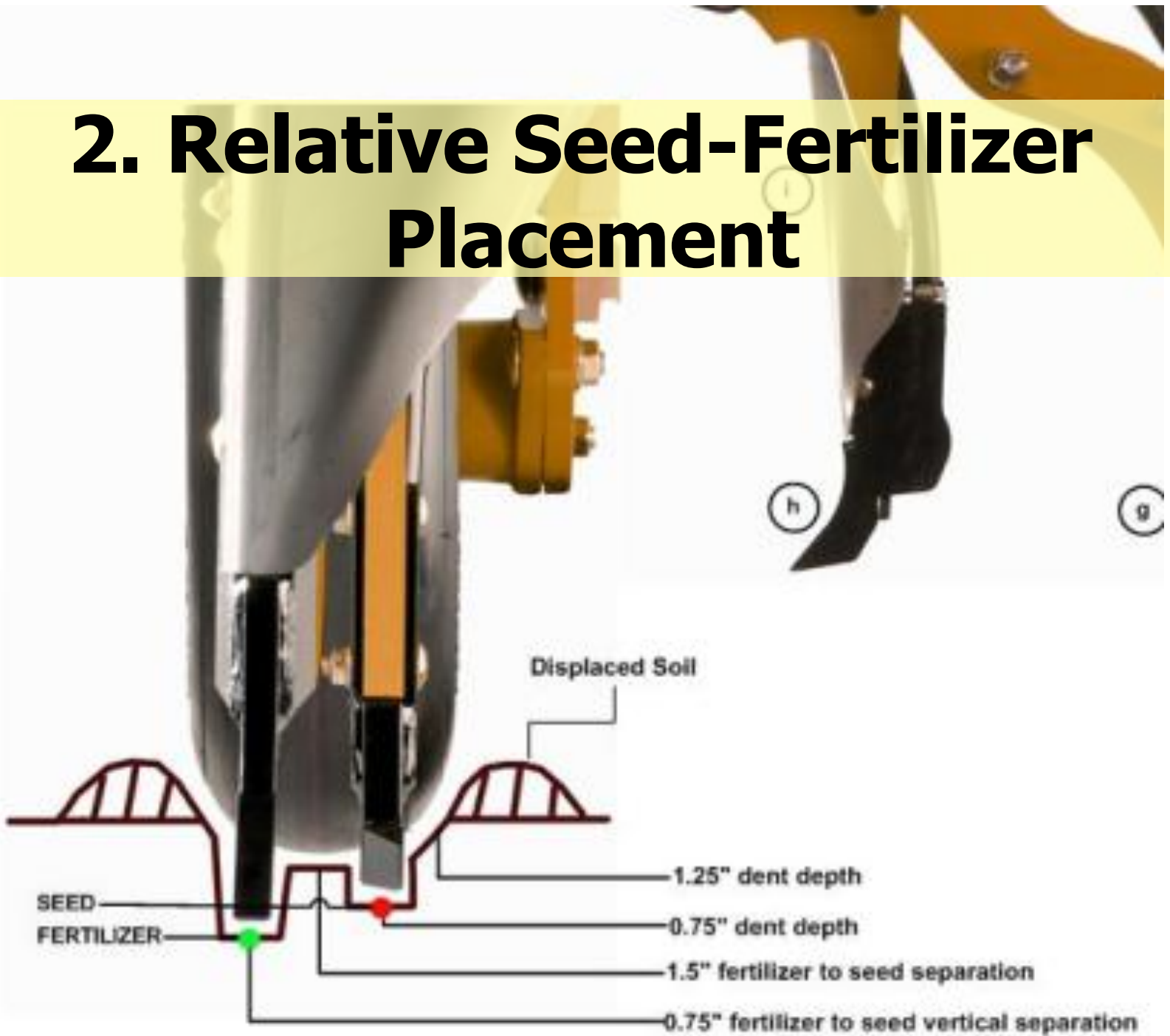
**Other Important
Considerations Regarding
Weeds and Row Spacing in
the context of the
SeedMaster opener**



1. Soil Disturbance



2. Relative Seed-Fertilizer Placement



3. Time of Weed Removal



**4. Experience from Owners
using 14" spacing – Were
weeds worst in 2010 because of
the higher than normal rainfall?**



Some Conclusions Regarding Wide Row Spacing and Weeds


- Until we collect actual data with 14" spacing, one can assume that it won't be any different than with 12" spacing based on actual producer experience with 14".**





Opportunities with Wide Row Spacing

- Make use of the micro-climatic benefits of tall stubble**
- Improve snow trapping with tall stubble**
- Ability to cut stubble taller at harvest to accelerate grain harvest and reduce fuel use and hours on combine**
- Ability to pull a wider seeder with the same horsepower increasing timeliness of seeding operations.**

A photograph of a cornfield. The corn plants are mostly dry and brown, indicating they are past their peak. A central path of green weeds is visible, growing between the rows of corn. The text "What is possible with wider row spacing..." is overlaid on the image in a large, bold, black font.

What is possible with wider row spacing...

Study Description



30 cm

15cm

Stubble Effects: Spring wheat

Treatments	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	309		
Short	314		
Tall	309		
Significance	ns		

Cutforth et al. 1997. Can. J. Plant Sci. 77:359-366

Stubble Effects: Spring wheat

Treatments	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	309	2255b (100)	
Short	314	2418ab (107)	
Tall	309	2560a (114)	
Significance	ns	*	

Cutforth et al. 1997. Can. J. Plant Sci. 77:359-366

Stubble Effects: Spring wheat

Treatments	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	309	2255b (100)	7.5b (100)
Short	314	2418ab (107)	7.9ab (105)
Tall	309	2560a (114)	8.4a (112)
Significance	ns	*	*

Cutforth et al. 1997. Can. J. Plant Sci. 77:359-366

Stubble Effects: Field Pea, Lentil, Chickpea

Treatment	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	246		
Short	242		
Tall	240		
Significance	ns		

Cutforth et al. 2002. Can. J. Plant Sci. 82:681-686

Stubble Effects: Field Pea, Lentil, Chickpea

Treatment	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	246	1782 (100)	
Short	242	1858 (104)	
Tall	240	2008 (113)	
Significance	ns	*	

Cutforth and McConkey...

Stubble Effects: Field Pea, Lentil, Chickpea

Treatment	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	246	1782 (100)	7.49 (100)
Short	242	1858 (104)	8.06 (108)
Tall	240	2008 (113)	8.70 (116)
Significance	ns	*	*

Cutforth and McConkey...

Stubble Effects: Canola

Treatment	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	275		
Short	271		
Tall	274		
Significance	ns		

Cutforth et al. 2006. Can. J. Plant Sci. 86:99-107

Stubble Effects: Canola

Treatment	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	275	1239 (100)	
Short	271	1354 (109)	
Tall	274	1445 (117)	
Significance	ns	*	

Cutforth et al. 2006. Can. J. Plant Sci. 86:99-107

Stubble Effects: Canola

Treatment	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Cultivated	275	1239 (100)	4.51 (100)
Short	271	1354 (109)	4.85 (108)
Tall	274	1445 (117)	5.03 (112)
Significance	ns	*	*

Cutforth et al. 2006. Can. J. Plant Sci. 86:99-107

Stubble Effects: Canola

Treatment	Water Use mm	Grain Yield kg/ha	WUE Kg/ha/mm
Tall	274	1445 (117)	5.0 (112)
Tall + extra fertilizer	286	1680 (135)	5.8 (129)

Cutforth et al. 2006. Can. J. Plant Sci. 86:99-107

What's new on the horizon?





Harvested



Un-Harvested



How easy is it going to be to seed in-between the stubble rows?





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Thank-you

Canada 