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# Hybrid Fall Rye-Examining Grain Yield Under Different Management Systems

J. Larsen

Agriculture and Agri-Food Canada

Lethbridge Research and Development Centre



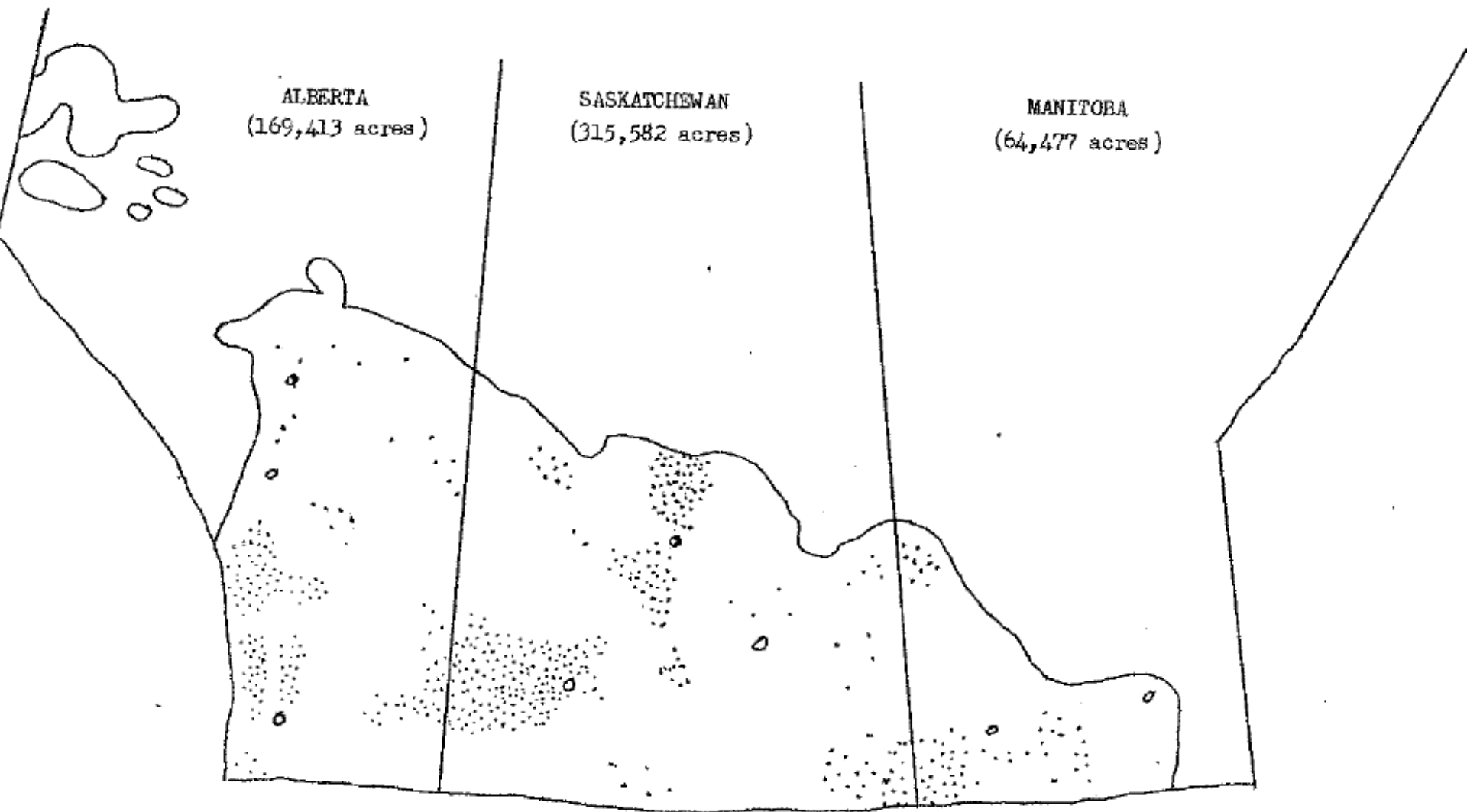
# Outline

- Background and reasons for optimism in fall rye
- Open pollinated and hybrid fall rye yield comparisons from a Western Canada perspective
- Comparison of OP and hybrid fall rye under “conventional” and “intensive” management practices
  - Experimental setup
  - Grain yield and yield component analysis
  - Grain quality analysis
- Summary

Distribution of Rye Acreage - 1957

(based on Canadian Wheat Board  
acreage data)

1 dot = 1000 acres

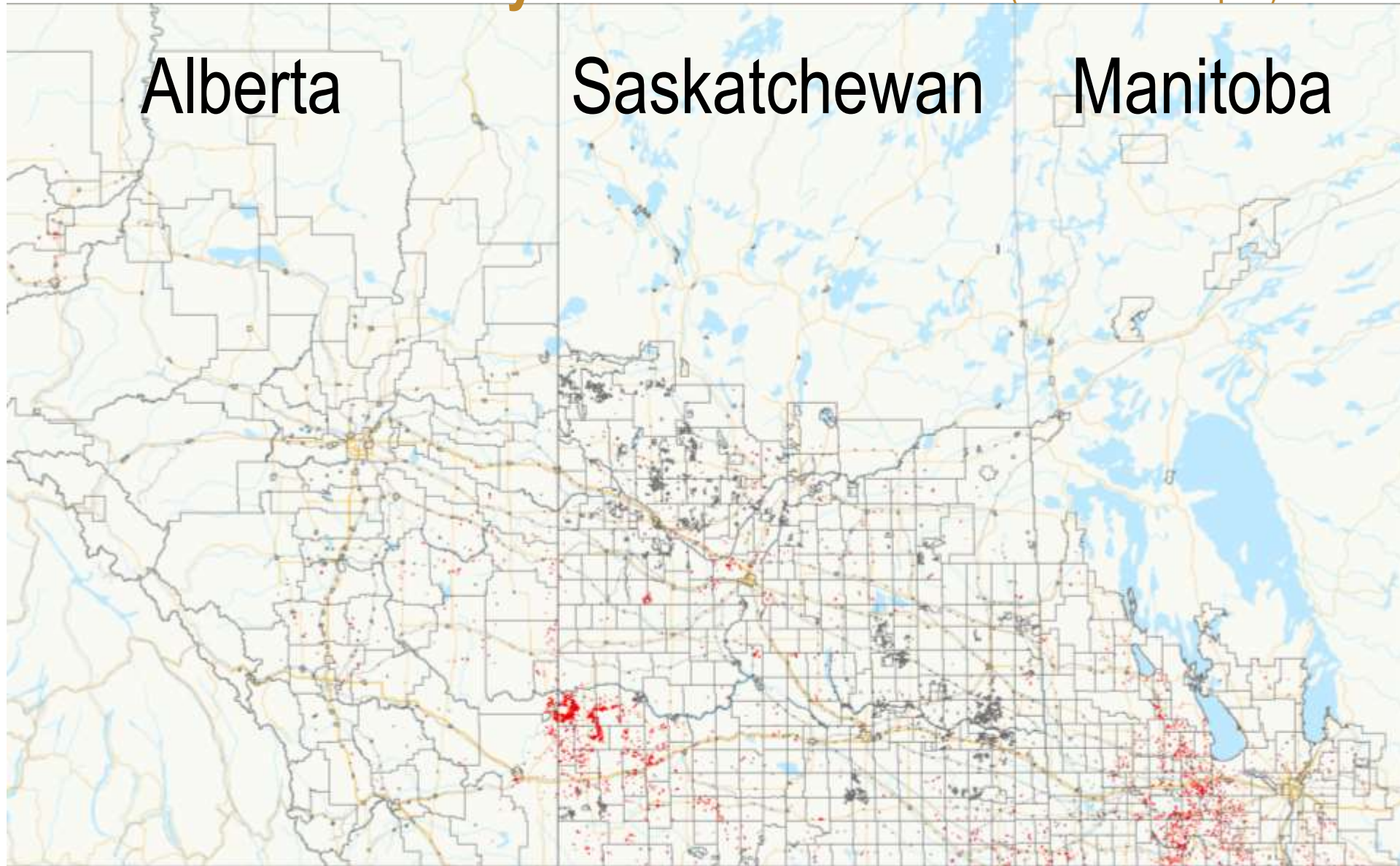


# Distribution of Rye Acres: 2009-2014 (Davidson and Campbell)

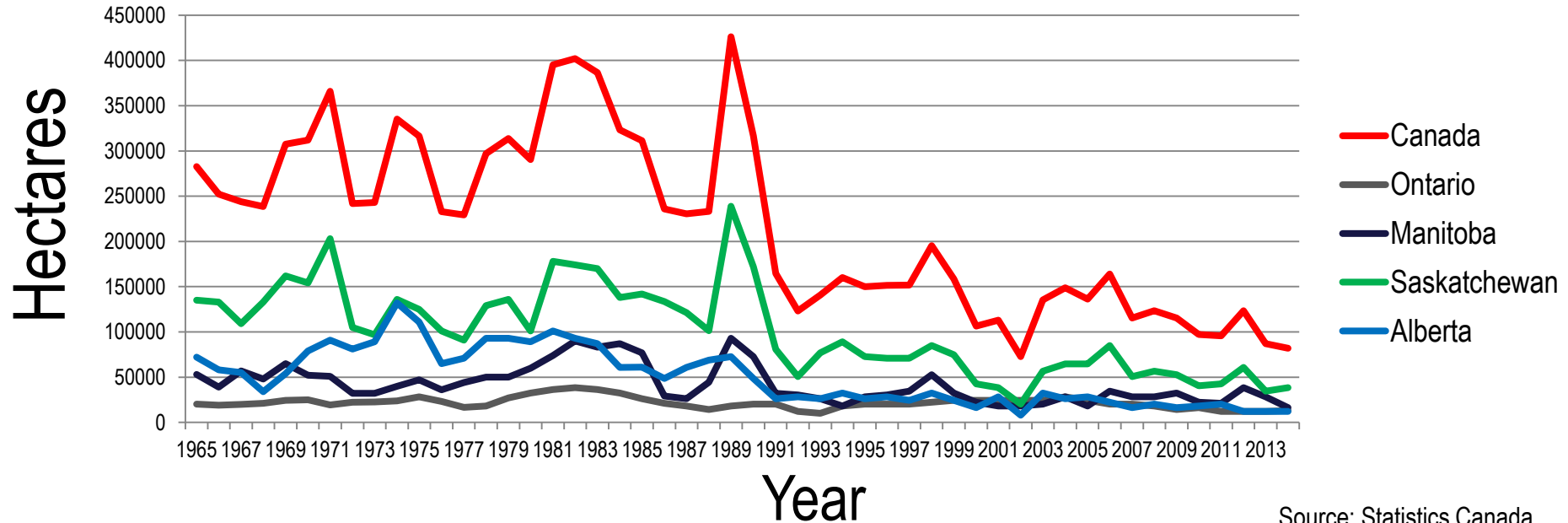
Alberta

Saskatchewan

Manitoba



# Rye Hectares for Major Rye Production Areas in Canada (1965-2014)



Source: Statistics Canada

Reasons for the decrease in rye acres is complex:

- Chemical herbicides
- Other valuable crop options (canola, pulses, etc.)
- Limited marketing options

# Registration of Hybrid Rye in Western Canada

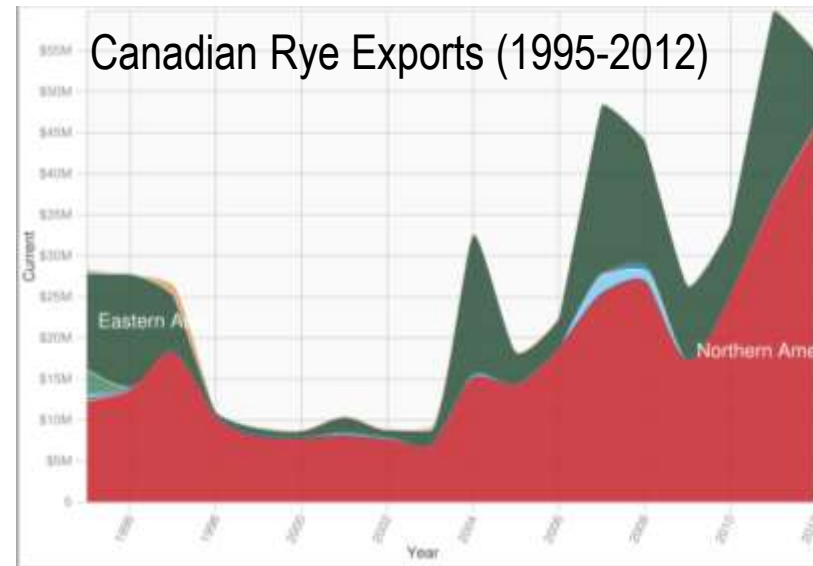
- Support for full registration of Brasetto and Guttino for Western Canada in 2015
- Support for interim registration of KWS Bono in 2015
- Considerable curiosity around the crop
- Identity preserved production programs are at capacity



The screenshot shows the top of a news article on the website 'THE WESTERN PRODUCER'. The site logo is in blue and red, with a 'SUBSCRIBE & SAVE' button. Navigation links include 'All articles', 'News', 'Crops', 'Livestock', 'Markets', 'Weather', 'Farm Living', 'Opinion & Blogs', and 'Classifieds'. The article title is 'Spotlight falls on forgotten crop' and it is dated 'Jun. 18th, 2014' by 'Barb Glen'. The article text begins with 'Rye has arrived | Crop is first successful hybrid cereal to be registered in Canada' and 'Rye is a rock star in cereal circles. It's the first hybrid cereal registered for commercial release in Canada, in a crop breeding world where much attention is being paid to hybrid wheat and other cereal development.'

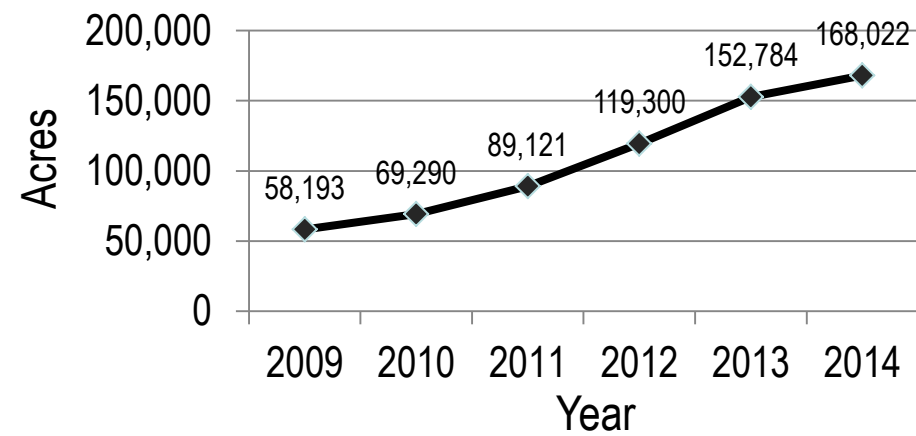
# Cover Cropping Market

- Cover cropping
  - Reduction of nutrient run off
  - Improved soil health
  - Weed control
  - Erosion control
  - Increased Corn and Soybean yields
- 2013-14 Cover Crop Survey Report
  - 8% of cover cropping associated with incentive payments
  - 73.4% of respondents used a winter cereal as a cover crop
  - Reports of farmers in Ohio paying \$17/bu for rye to use in cover cropping



Source: The Atlas of Economic Complexity ([atlas.cid.harvard.edu](http://atlas.cid.harvard.edu))

## U.S. Cover Crop Hectares by Year



# Fall Rye Co-operative Registration Trial

Alberta

Saskatchewan

Manitoba

✕ Beaverlodge

✕ Lacombe

✕ Olds ✕ Trochu  
✕ Morrin

✕ Vauxhall  
✕ Lethbridge

✕ Scott

✕ Swift Current

✕ Melfort

✕ Saskatoon

✕ Indian Head

✕ Brandon ✕ Winnipeg  
✕ Carman





# Results from the Fall Rye Registration Trials

## % Yields relative to Hazlet

Variety	2012-13	2013-14	2014-15
Prima	84.6	79.8	78.8
Hazlet	100	100	100
Brasetto	116.7	128.2	120.2
Guttino	120.1	126.8	118.0
Bono	134.9	132.9	125.3
Hazlet Mean (t//ha)	7.0	5.6	5.7
Hazlet Mean (bu/ac)	111.5	89.2	90.8
Year Range (t/ha)	13.3 - 2.2	10.5 - 2.1	12.9 - 2.2

## Results from Ducks Unlimited Trials 2013-14

- Compared Hazlet (OP) and Brasetto (hybrid) at seven locations across Western Canada
- 20 acre demonstration strips

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Variety	Yield (bu/ac)	% of Hazlet	Ergot (%)	Sprout (%)	Test Wt. (kg/hL)	Falling # (sec.)	Fusarium (%)	Grade
Hazlet	66.6	100	0.1	21.2	71.1	90	6.1	Fusarium/Sprout
Brasetto	77.7	117	0.4	13.7	71.4	130	1.1	Ergot

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- Issues with the trials
  - Treating rye like rye
  - Some cases the crop was in the field for over a year
  - Demonstrated by low falling numbers, sprouting and likely higher ergot

## Summary:

### What we know:

- Hybrids out yield OPs
- Fall rye agronomic production practices vary widely across Western Canada
  - Based on communications with farmers
  - Based on limited information from Ducks Unlimited trial

### What we don't know

- Why hybrids out yield OPs in Western Canada?
- What happens if we push the agronomic practices in OPs and hybrids?

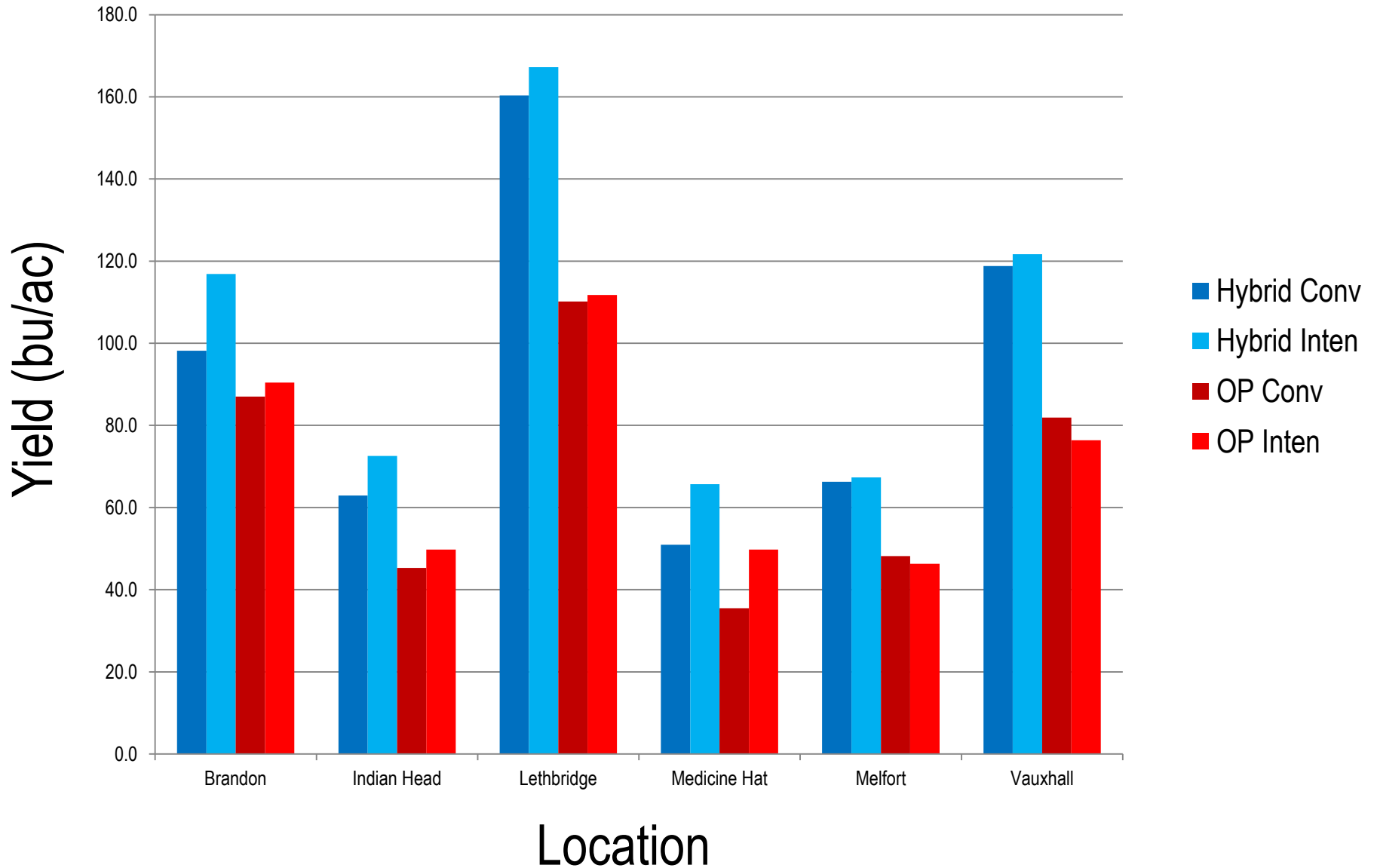
# Comparison of OP and Hybrid Fall Rye Under Conventional and Intensive Management Conditions

- Agronomy project developed to examine grain yield and grain quality parameters associated with:
  - Differences between open-pollinated (OP) and hybrid fall rye
  - Differences between conventional and intensive crop management
- Six locations
  - Lethbridge
  - Medicine Hat
  - Melfort
  - Vauxhall
  - Indian Head
  - Brandon
- Varieties:
  - Hazlet (OP)
  - AC Rifle (OP)
  - Brasetto (Hybrid)
  - Guttino (Hybrid)
- Planted in 2014 and 2015

# Conventional vs. Intensive Treatments

Production Variable	Treatment	
	Conventional	Intensive
Seeding rate	250 seeds/m <sup>2</sup>	250 seeds/m <sup>2</sup>
Nitrogen (split applied)	60 kg/ha	150 kg/ha
Fall (ESN)	0 kg/ha	50 kg/ha
Spring (Urea + Agrotain)	60 kg/ha	100 kg/ha
Seed treatment	none	Cruiser Maxx Cereals
Fungicide	none	Twinline
Herbicide	Fall only	Fall and Spring
Fall	2,4-D	2,4-D
Spring	none	Yes (grass and broadleaf)
Insecticide	none	if needed (insect threshold)
P <sub>2</sub> O <sub>5</sub> (based on soil test)	adjust to 40 kg/ha	adjust to 40 kg/ha
K <sub>2</sub> O (based on soil test)	adjust to 30 kg/ha	adjust to 30 kg/ha

# Results: Yield





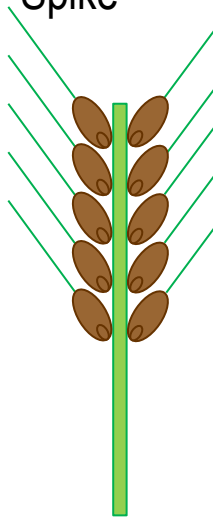
# Yield Components

Weight of  
One Kernel  
(g)



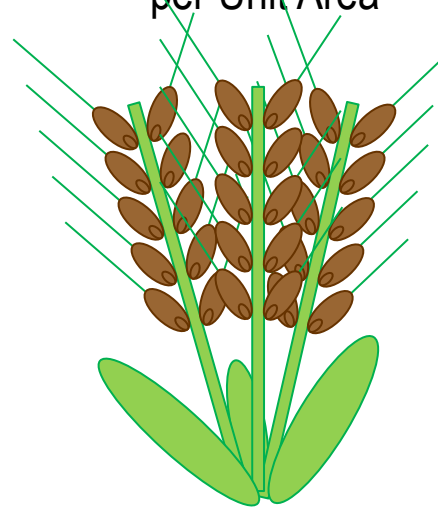
X

Number of  
Kernels per  
Spike



X

Number of  
Fertile Tillers  
per Unit Area



=

Grain Yield  
(kg/ha)



Agronomic  
Treatment

Variety	Agronomic Treatment	Weight of One Kernel (g)	Number of Kernels per Spike	Number of Fertile Tillers per Unit Area	Grain Yield (kg/ha)
Hybrid	Conv	0.0312	40.9	569.3	5841.6
Hybrid	Inten	0.0309	39.0	607.3	6406.3
OP	Conv	0.0296	32.2	526.2	4275.8
OP	Inten	0.0294	32.3	559.4	4446.9
Hybrid vs. OP		Sig	Sig	Sig	Sig
Conv vs. Inten		N.S.	N.S.	N.S.	Sig
Variety x Treatment		N.S.	N.S.	N.S.	N.S.

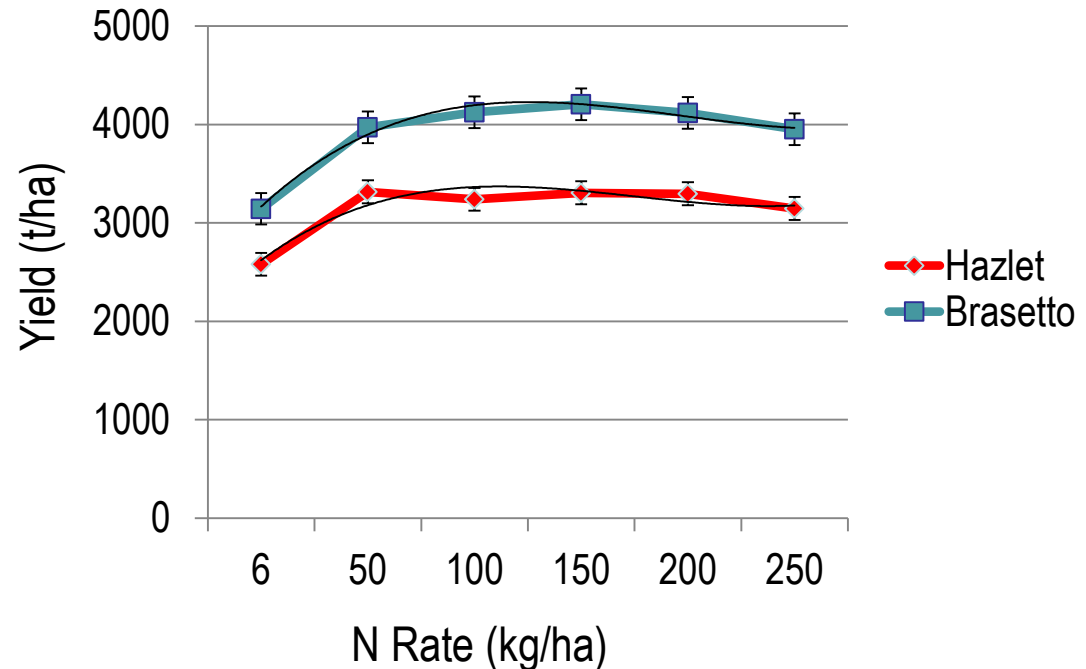


# Yield Components: % Difference from OP-Conv Treatment

Variety	Agronomic	<u>Location</u>			Mean		
	Treatment	Brandon	IH	Lethbridge			Vauxhall
<u>Thousand Kernel Weight</u>							
Hybrid	Conv	9.9	2.6	4.7	5.1	5.6	Variety: Sig Treatment: N.S. Variety x Treatment: N.S.
Hybrid	Inten	11.4	1.3	2.3	4.8	4.9	
OP	Conv	0.0	0.0	0.0	0.0	0.0	
OP	Inten	0.7	1.4	0.6	-6.5	-1.0	
<u>Kernels/Head</u>							
Hybrid	Conv	32.5	26.5	25.9	22.8	26.9	Variety: Sig Treatment: N.S. Variety x Treatment: N.S.
Hybrid	Inten	23.7	28.3	16.0	19.4	21.8	
OP	Conv	0.0	0.0	0.0	0.0	0.0	
OP	Inten	2.8	4.9	-1.9	-3.0	0.7	
<u>Heads/m<sup>2</sup></u>							
Hybrid	Conv	-1.1	15.0	7.3	12.1	8.3	Variety: Sig Treatment: N.S. (0.055) Variety x Treatment: N.S.
Hybrid	Inten	3.2	23.3	20.3	16.3	15.8	
OP	Conv	0.0	0.0	0.0	0.0	0.0	
OP	Inten	5.2	1.0	9.4	7.5	5.8	

# Results from Nitrogen Rate Experiments at IHARF

- Similar trend to intensive vs. conventional treatments
- No variety x treatment interaction (both types reacted similarly)
- Good response to N at low levels
- No significant difference > 50 kg/ha



## Yield and Yield Components: Summary

- Hybrids significantly out yielded the OPs
- Not all locations showed a significant response to the intensive management treatments
- Yield component analysis shows that the hybrids had significantly larger kernels and more kernels per head
- Differences in management practice had the highest influence on the number of tillers per unit area
- N-rate data showed that likely hybrids and OP respond similarly to N
- N response curve plateaus at relatively low levels of N

# Grain Quality: Summary Across Locations

Variety	Agronomic Treatment	Test	Falling		Protein	
		Weight (kg/hL)	Ergot (%)	Number (s)	Protein (%)	per ha (kg/ha)
Hybrid	Conv	72.0	0.5	324.9	8.9	544.83
Hybrid	Inten	72.1	0.6	317.1	9.7	633.96
OP	Conv	71.9	0.4	201.0	10.3	450.89
OP	Inten	71.5	0.5	190.5	11.0	492.47
Tukey <sub>(0.05)</sub>		N.S.	0.2	22.9	0.5	45.6
Hybrid vs. OP		N.S.	Sig	Sig	Sig	Sig
Conv vs. Inten		N.S.	Sig	N.S.	Sig	Sig
Variety x Treatment		N.S.	N.S.	N.S.	N.S.	N.S.





# Yield Components: % difference from OP-Conv Treatment

Variety	Agronomic Treatment	Location			Mean	
		Brandon	IH	Lethbridge		Vauxhall
<u>Thousand Kernel Weight</u>						
Hybrid	Conv	9.9	2.6	4.7	5.1	5.6
Hybrid	Inten	11.4	1.3	2.3	4.8	4.9
OP	Conv	0.0	0.0	0.0	0.0	0.0
OP	Inten	0.7	1.4	0.6	-6.5	-1.0
<u>Kernels/Head</u>						
Hybrid	Conv	32.5	26.5	25.9	22.8	26.9
Hybrid	Inten	23.7	28.3	16.0	19.4	21.8
OP	Conv	0.0	0.0	0.0	0.0	0.0
OP	Inten	2.8	4.9	-1.9	-3.0	0.7
<u>Heads/m2</u>						
Hybrid	Conv	-1.1	15.0	7.3	12.1	8.3
Hybrid	Inten	3.2	23.3	20.3	16.3	15.8
OP	Conv	0.0	0.0	0.0	0.0	0.0
OP	Inten	5.2	1.0	9.4	7.5	5.8

# Ergot: Percent Ergot per 500g sample

		Agronomic					
Variety	Treatment	Bran	IH	Leth	Melfort	Vaux	Mean
Hybrid	Conv	0.28	0.43	0.31	1.53	0.00	0.51
Hybrid	Inten	0.20	0.58	0.24	2.05	0.00	0.61
OP	Conv	0.07	0.43	0.24	1.05	0.00	0.36
OP	Inten	0.08	0.70	0.26	1.33	0.00	0.47
Mean		0.16	0.53	0.26	1.49	0.00	0.49
Tukey		0.16	0.33	N.S.	0.85	N.S.	0.17
Hybrid vs. OP		Sig.	N.S.	N.S.	Sig.	N.S.	Sig
Conv vs. Inten		N.S.	Sig.	N.S.	N.S.	N.S.	Sig
Variety x Treatment		N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

- Could be an interaction of moisture after heading and tillering associated with high fertility  
 -Melfort and Indian Head had high amounts of rain throughout July



# Disease Triangle-Ergot in Rye

Host

- Rye- susceptible
- Late tillering
- Long flowering period



Pathogen

- Abundant sclerotia from grasses

Environment

- Cool, wet
- Excess N?

# Rye Yields Relative to Other Crops

- 2014-15 data from irrigated trials at Lethbridge

Variety	Type	Yield (t/ha)	Rel. Yld Moats	Rel. Yld Hazlet	Winter Survival	Heading (Julian)	Height (cm)	Lodge (1-9)	Maturity (Julian)
Brasetto	Hybrid	9.9	139.2	131.7	100.0	144.0	128.3	1.7	207.5
Guttino	Hybrid	10.4	146.0	138.2	100.0	144.7	133.7	1.3	208.0
Bono	Hybrid	11.1	155.6	147.3	100.0	146.0	130.0	1.3	206.5
Hazlet	OP	7.5	105.7	100.0	100.0	143.0	151.7	2.0	205.5
Prima	OP	5.5	77.2	73.0	100.0	145.7	158.3	1.7	204.0
Elevate	WW	6.2	86.8	82.2	100.0	160.7	100.0	1.0	204.5
Moats	WW	7.1	100.0	94.6	100.0	160.0	111.7	1.3	204.5
LSD <sub>(0.05)</sub>		0.8			2.9	1.7	10.2	0.8	3.0
Luoma	WT	7.2	106.3	97.0	100.0		146.7	3.5	212.0
Exp3	WT	9.1	134.2	122.5	100.0		113.3	1.2	205.3
Corn		10.0-12.2							

## Summary

- Fall rye hybrids significantly out yielded the OP varieties
- Differences in grain yield potential of fall rye hybrids compared to OP varieties is driven by all three grain yield components with kernels per head being most important
- Agronomic management influences number of tillers in fall rye
- IHARF N-rate study showed OP and hybrids responded similarly with an early plateau in N response
- Hybrids had significantly higher falling numbers
- OP varieties had higher protein content in the grain, but hybrids yielded more protein on a per hectare basis
- The intensive management system led to higher levels of ergot (possibly associated with increased tillering)

# Collaborators and Funding Partners

## Collaborators

- Medicine Hat- Farming Smarter (Ken Coles)
- Indian Head- IHARF (Chris Holzapfel)
- Melfort- NARF (Stu Brandt)
- Brandon-AAFC (Ramona Mohr)
- Lethbridge and Vauxhall (Jordan Harvie and Allison Bors)

## Funding

- WGRF
- AAFC
- KWS Lochow
- Saskatchewan Winter Cereals Development Commission



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# Thank you!



[Jamie.Larsen@agr.gc.ca](mailto:Jamie.Larsen@agr.gc.ca)



@Jamie\_Larsen

