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Will Public Wheat Breeding Remain Pertinent in Canada?

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Canada

My Background

- 1987 Saskatchewan Wheat Pool – spring wheat
  - Program started in mid-1970s – screening lines
  - “3-M” crosses around 1978
  - CWRS crosses in 1980
  - Program closed in 1994
  - Developed partnerships with CDC in 1995 and 1996
  - Registered McKenzie, Prodigy and Journey (1997 – 2001)

- 1999 Agriculture and Agri-Food Canada – winter wheat
  - Lethbridge Research & Development Centre

Wheat In Canada

Wheat: ~10% total Canadian total cash farm receipts in 2013

- Total: $54.74 B Wheat: $5.35 B
- 5 Year Average: Total: $49.80 B Wheat: $3.78 B (7.6%)

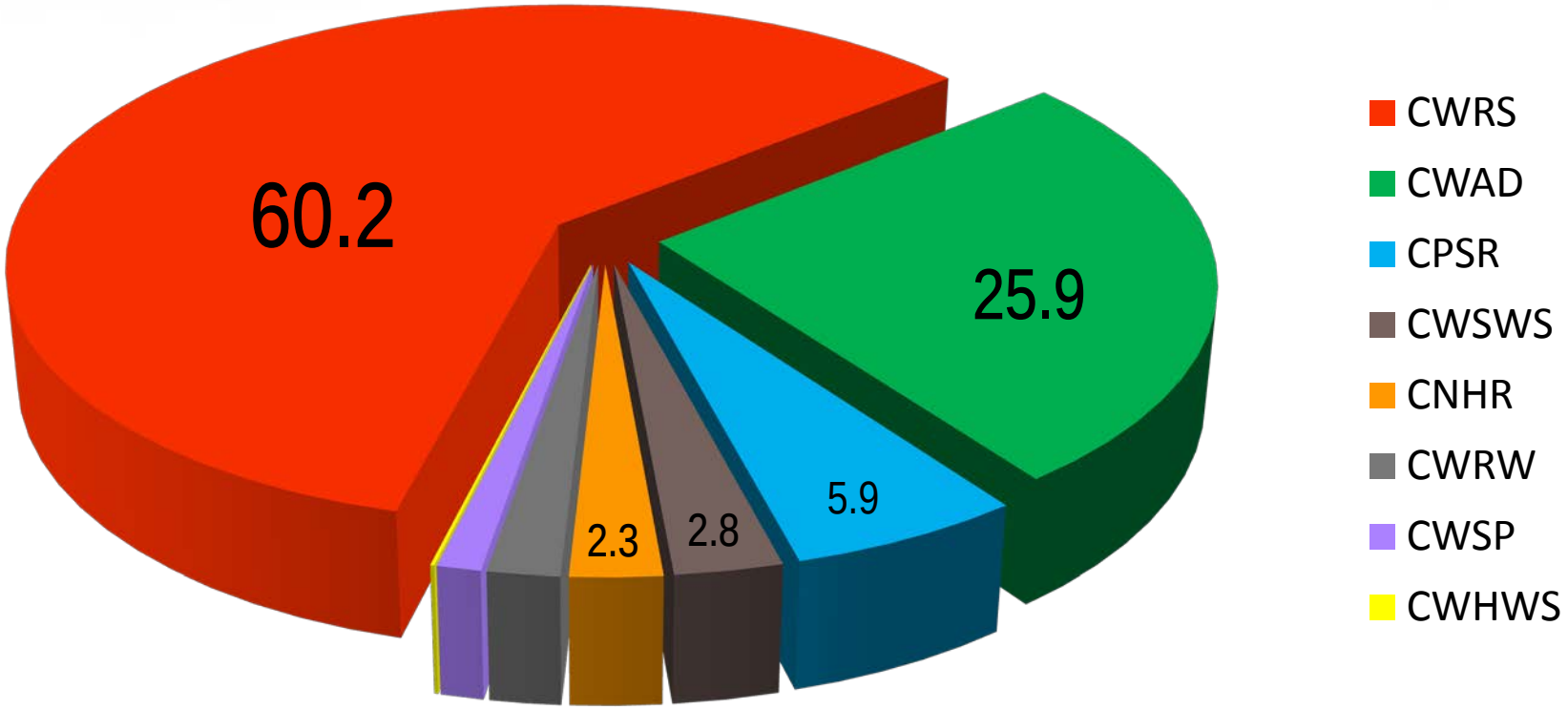
Western Canada (2005/06 – 2014/15):

- Grown on 9.1 M hectares (22.5 M acres)
- 95% of Canadian wheat production area
- 92% of Canadian wheat production (27.1 M tonnes)

- 95%+ of W. Canadian wheat is spring wheat + durum

Distribution of W. Canada wheat classes

Percent Insured Acres 2016



Where Do Varieties Originate?

Percent of seeded acreage by class (2016):

CWRS:	Public:	95%	
	Private:	5%	
CPSR:	Public:	77%	
	Private:	23%	
CNHR:	Public:	--	
	Private:	100%	(public varieties from ND)
CWSP:	Public:	20%	
	Private:	80%	

Canadian Grain Commission 2016

Canadian Wheat Board 2006

Where Do Varieties Originate?

Percent of seeded acreage by class (2016):

CWRS:	Public:	95%	
	Private:	5%	(2006 = 16%)
CPSR:	Public:	77%	
	Private:	23%	(2006 = 46%)
CNHR:	Public:	--	
	Private:	100%	
CWSP:	Public:	20%	
	Private:	80%	

Canadian Grain Commission 2016

Canadian Wheat Board 2006

Wheat Breeders in Western Canada

11 Public Sector wheat breeders

Spring wheat

Bread (CWRS, CPSR, CNHR, CWHWS): 6.1 BE

Durum: 1.7 BE

Other (CWSWS, CWSP): 0.3 BE

Winter wheat

Bread (CWRW): 1.2 BE

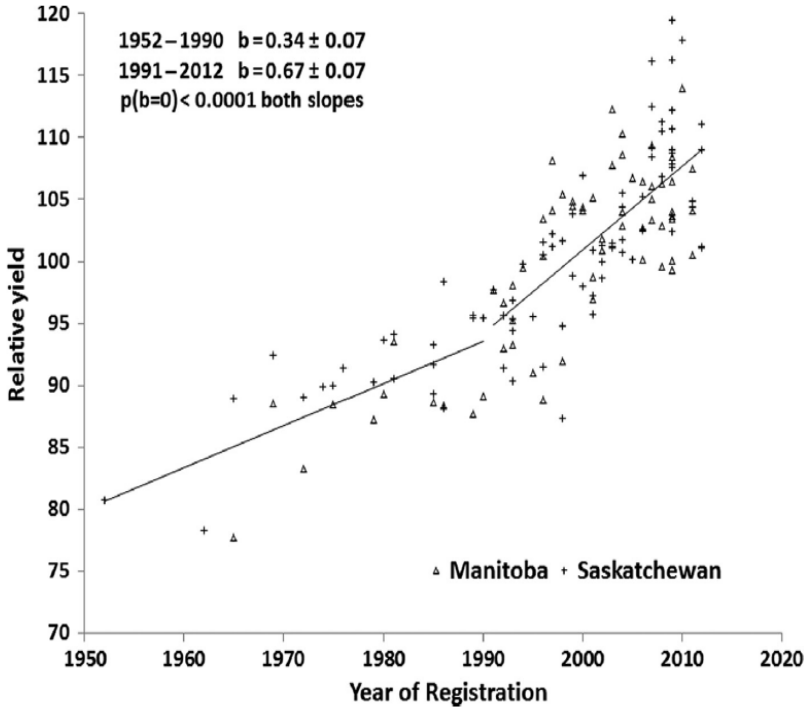
Special Purpose (Feed): 1.0 BE

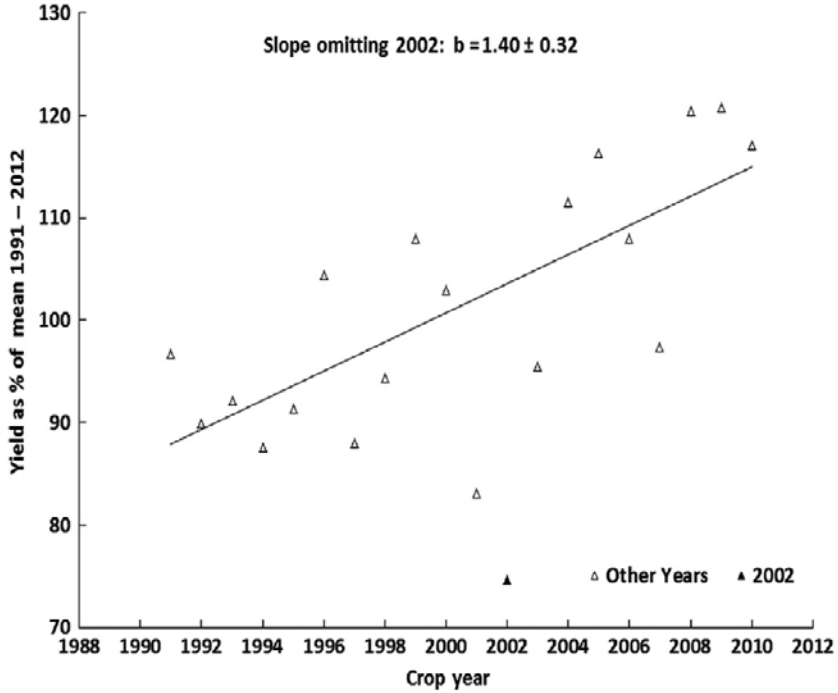
4+ Private Sector wheat breeders

Syngenta, Bayer, Limagrain, WFGD Coop

Rate of Yield Increase

- Genetic gain CWRS: 0.7% per year (1991-2012)
- On-farm yield increase: 1.4% per year (1991-2012)





Thomas & Graf, CJPS 2014

Summary #1 … and some Conclusions

- Public sector cultivars are popular with W. Canadian farmers
- Public sector wheat breeding directed towards finished cultivars are currently vital to the industry.
- Breeders have been very effective in increasing yield and other productivity traits
- Long term, stable, well-funded programs an effective strategy
- Canada has a low Breeder to Seeded Acreage ratio

  11 Public Breeders for 9.1 M ha (1 per 0.93 M ha)

  22.5 M acres (1 per 2 M acres)
- Ample of room for private sector involvement

Emphasis of Breeding Programs

	Public	Private
CWRS	✓	✓
CWAD	✓	
CPSR	✓	✓
CNHR	✓	?
CWHWS	✓	
CWRW	✓	
CWSP	✓	✓

- Little (no?) private interest in durum
- Little interest in minor spring wheat classes & winter wheat

Goals of Public and Private Plant Breeding

	Public	Private
Producer Profit	✓	✓
Program / Company Profit	--	✓
Partner Profit	✓	--
Agronomics	✓	✓
Quality	✓	✓
Disease Resistance	✓	?

- Both sectors are focused on industry sustainability
- Greater public sector focus on genetic disease resistance (?)
- How long does patience last if no product?

Hybrids

- Primarily a means of value capture
- Major challenges:

HETEROSIS

- 15% maximum in feed wheat; lower in quality wheat

RATE of YIELD GAIN

- After heterotic “boost” rate of yield gain slower than traditional inbreds
- Yield from traditional inbreds will overtake hybrids over time

SEED PRODUCTION & SEED COST

- 15% more yield sounds BIG ...
- Saskatchewan 2012/13: 2.4 t/ha 15% = 0.36 t/ha (5.4 bu/A)
- Alberta & Manitoba 2013/14: 3.9 t/ha 15% = 0.59/ha (8.7 bu/A)

QUALITY

Summary #2 … and some Questions

- Private sector interested in big acreage spring wheat
  - CWRS CPSR?, CNHR?
- Public sector will need to continue breeding "minor" classes *
- As quality increases, private sector success has decreased
- Hybrid wheat has significant challenges. Many unknowns.
  - Hybrids not for everyone
  - How long will it take?
  - What if hybrids don't deliver?

Towards a Balanced Public / Private Approach

- Long-term and stable funding through partnerships

  Nothing new: only limited by imagination: 2P, 3P, 4P, P^X

  - CDC / SWP Partnership (1995): CWRS, CPS, Durum
  - Public Breeding programs / WGRF (1995): All wheat classes
  - AAFC / SWP (1997): Extra-strong gluten durum
  - AAFC / AWC / Canterra Seeds (2014): CPSR

- Producer involvement / voice
- Joint public:private projects – all benefits shared
  - Technological hurdles
  - Germplasm development

Germplasm Development Strategies

- Part of all breeding programs: public or private
- Best germplasm is an adapted cultivar
  - Readily taken up by others
- Traditional “germplasm lines”
  - Often to incorporate new pest resistance
  - Linkage drag: yield / agronomics / quality
  - Invaluable resource
  - Unless urgent need unlikely to be used by others
- Germplasm development in-house as a continuum towards field-ready cultivars most effective
  - Partnerships!

Further considerations

- Innovative value capture mechanisms for breeders
- Make germplasm exchange easy
  - Canadian Wheat Workers Code of Ethics
  - Wheat Workers Material Transfer Agreement
- Strong, transparent, merit based registration system
  - Balanced approach to sector requirements
  - Maintains importance of genetic disease / pest resistance
- Well-funded third-party post-registration performance trials

Thank You!

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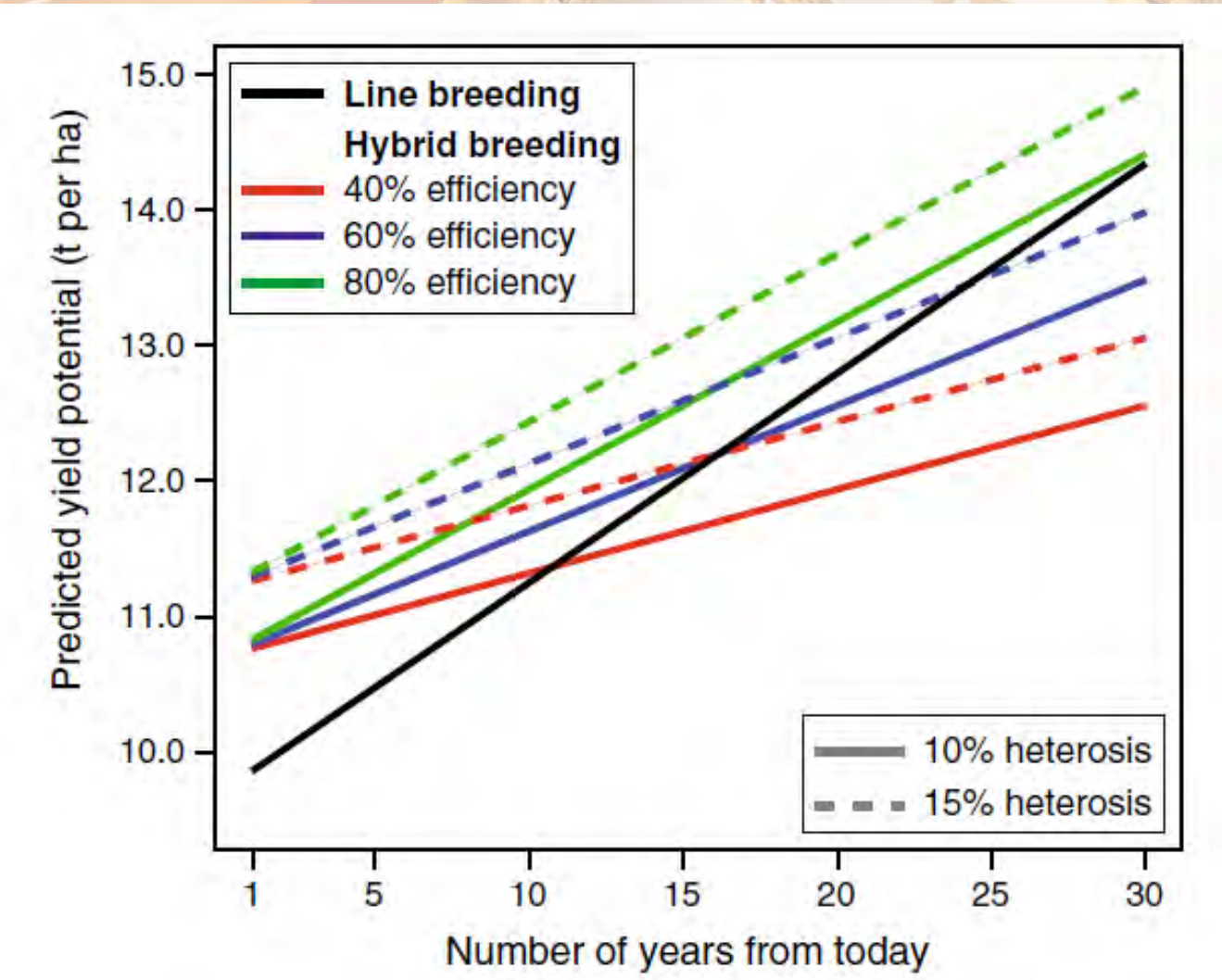
Canada

Predicted Yield for Line vs Hybrid Breeding



Longin et al., TAG 2014