



# **Crop Yield & Production Trends in Western Canada**

**R.J. Graf**

**March 2013**

# Crop Yield and Production Trends in Western Canada

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- Data from Canada Grains Council (Statistics Canada).
  - Examined crop production, area harvested and yield of canola and spring wheat from 1964/1965 to present.
  - Actual yield results – takes everything into account!
  - YIELD GAINS = better genetics + improved agronomic practices + improved farm machinery + better pesticides + environment, etc.
  - Major publicity on how much wheat yields need to increase in the next 20+ years...
    - ... often only the rate of genetic gain is mentioned.
- Yield increases represent much more than just genetic gain!
- What are the on-farm trends in western Canada?

# Data Collection: Statistics Canada – Field Crop Reporting Series

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- Data collection 6 times per year
  - Area, Yield, Production: March, June, July, September, November.
  - Stocks: December, March, July/August.
- Target Population
  - All farms in Canada enumerated in Census of Agriculture.
  - Not institutional, First Nations, farms in NWT, YT, NU & Atlantic.
- Cross-sectional design
  - Sampling stratified into homogeneous groups: farm size, crop area, etc.
- Sample Size:

March: 13,000	June: 25,000	July: 15,000
Sept.: 11,700	Nov.: 29,000	Dec.: 10,500

(2012)
- Response is mandatory. Refusal rate = 8-9%

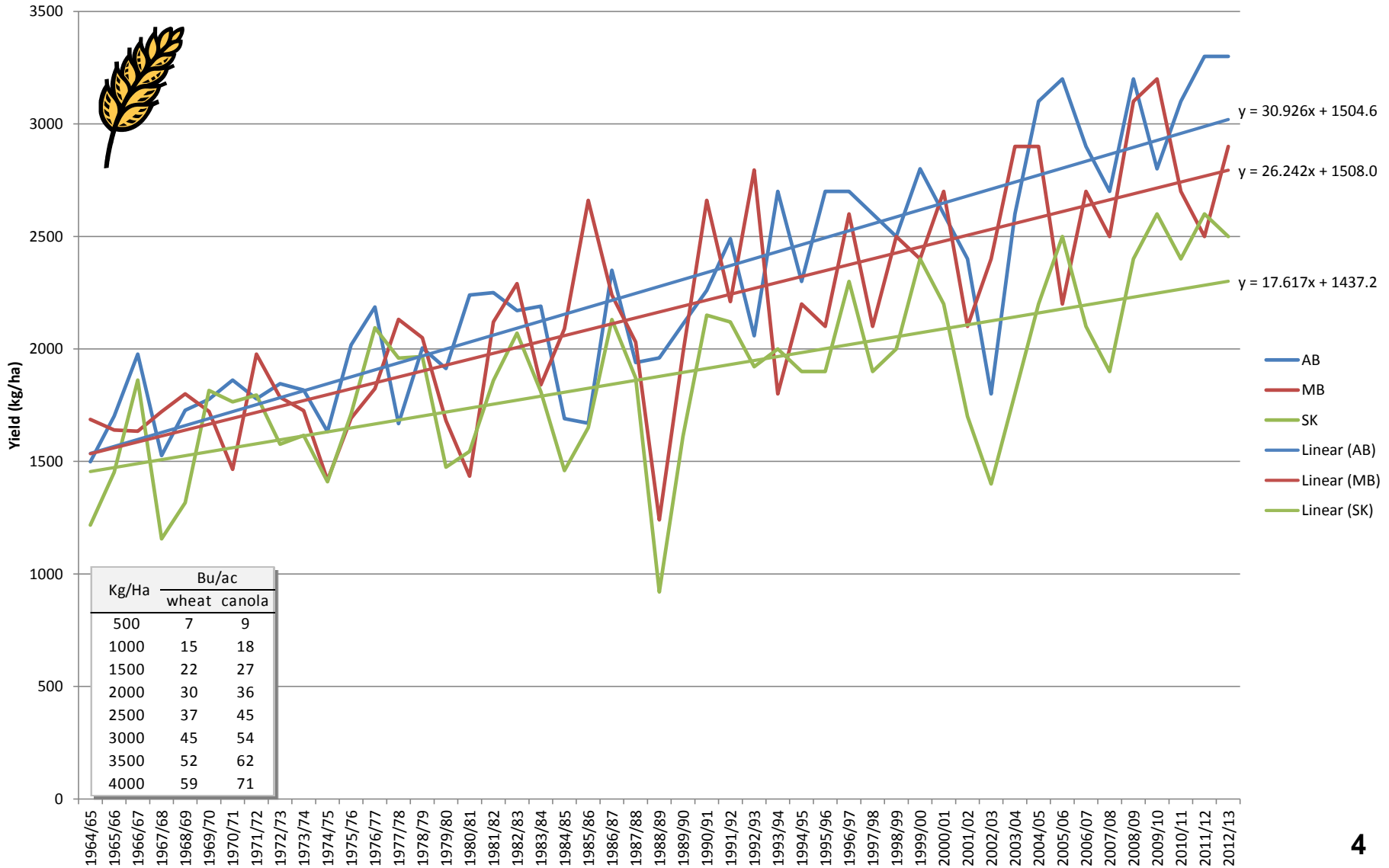
## In this study:

- Verified reported **Yield** by dividing **Production** / **Harvested Area**
- **1981/82 to Present: Difference usually within 30 kg/ha (about 0.5 bu/ac).**

# Spring Wheat Yields by Province (1964/65 - 2012/13)

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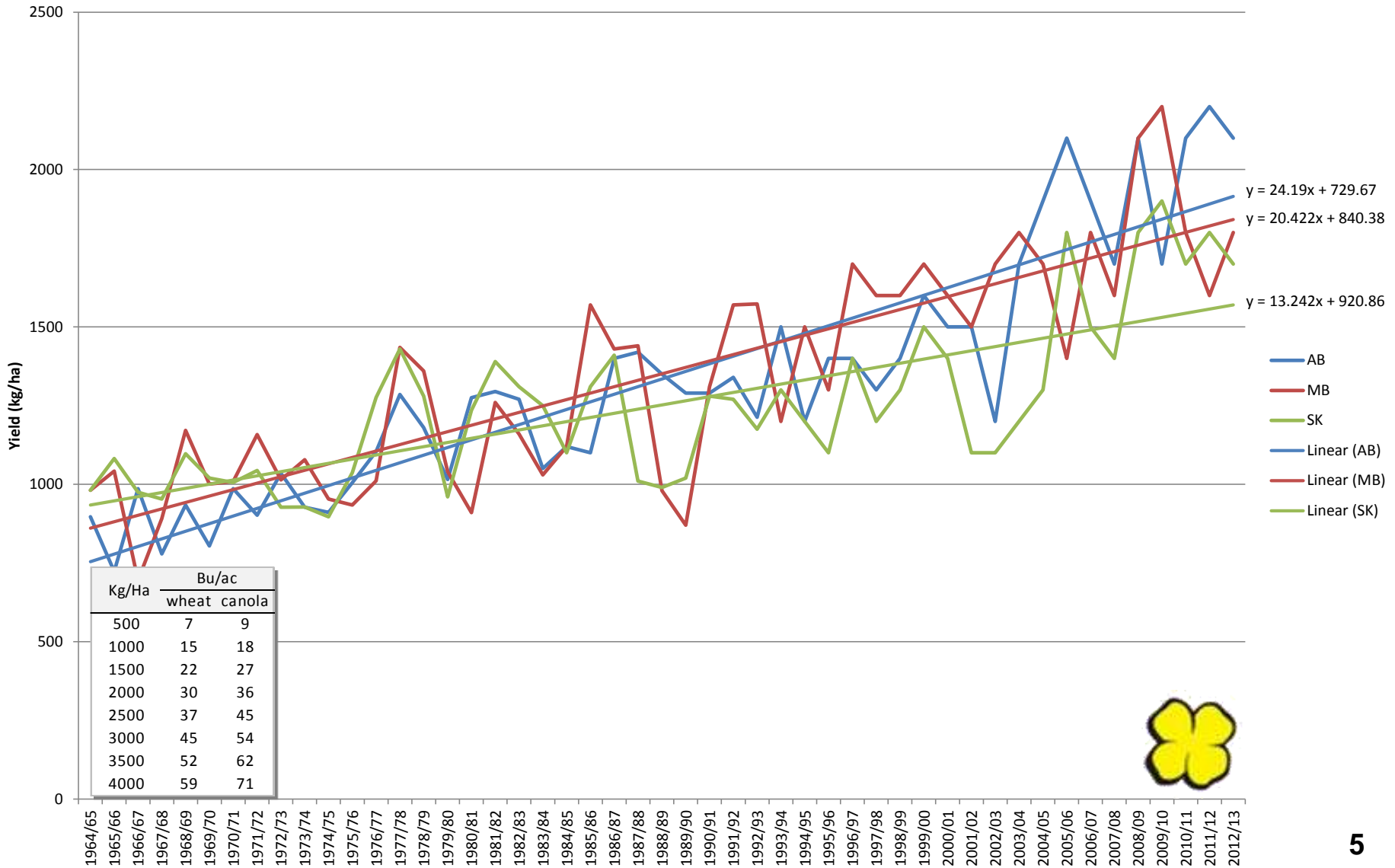
## Spring wheat yield, 1964/65 - 2012/13



# Canola Yields by Province (1964/65 - 2012/13)

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## Rapeseed / Canola yield, 1964/65 - 2012/13



# Trend Line Analysis

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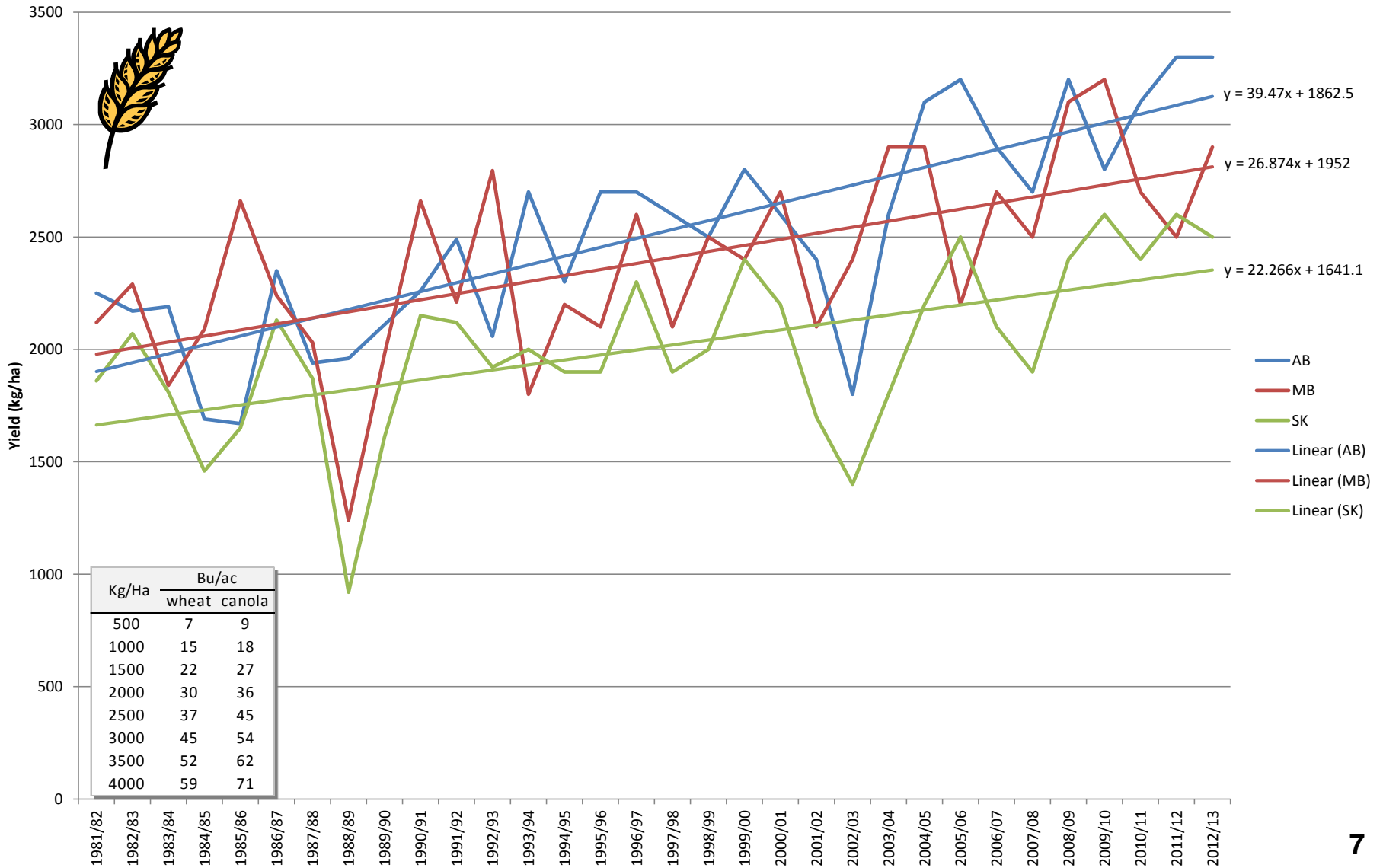
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- 1981/1982 – good starting point.
  - 1981: registration of Katepwa CWRS wheat.
  - 1982: registration of Westar *B. napus* canola.
  - Yield penalty associated with canola quality now overcome.
  - Canola well adapted and agronomic systems established.
- Another break at 2000/2001.
  - WGRF wheat investment (1994) starts producing varieties.
  - Hybrid canola starting to be introduced – not yet popular.
  - Herbicide tolerant canola on about 50% of acres.
- Location of “break” is somewhat arbitrary and will affect results.
- Trend from 1981/1982 to present is most robust.
- What changed during the two periods?

# Spring Wheat Yields by Province (1981/82 - 2012/13)

Graf 2013

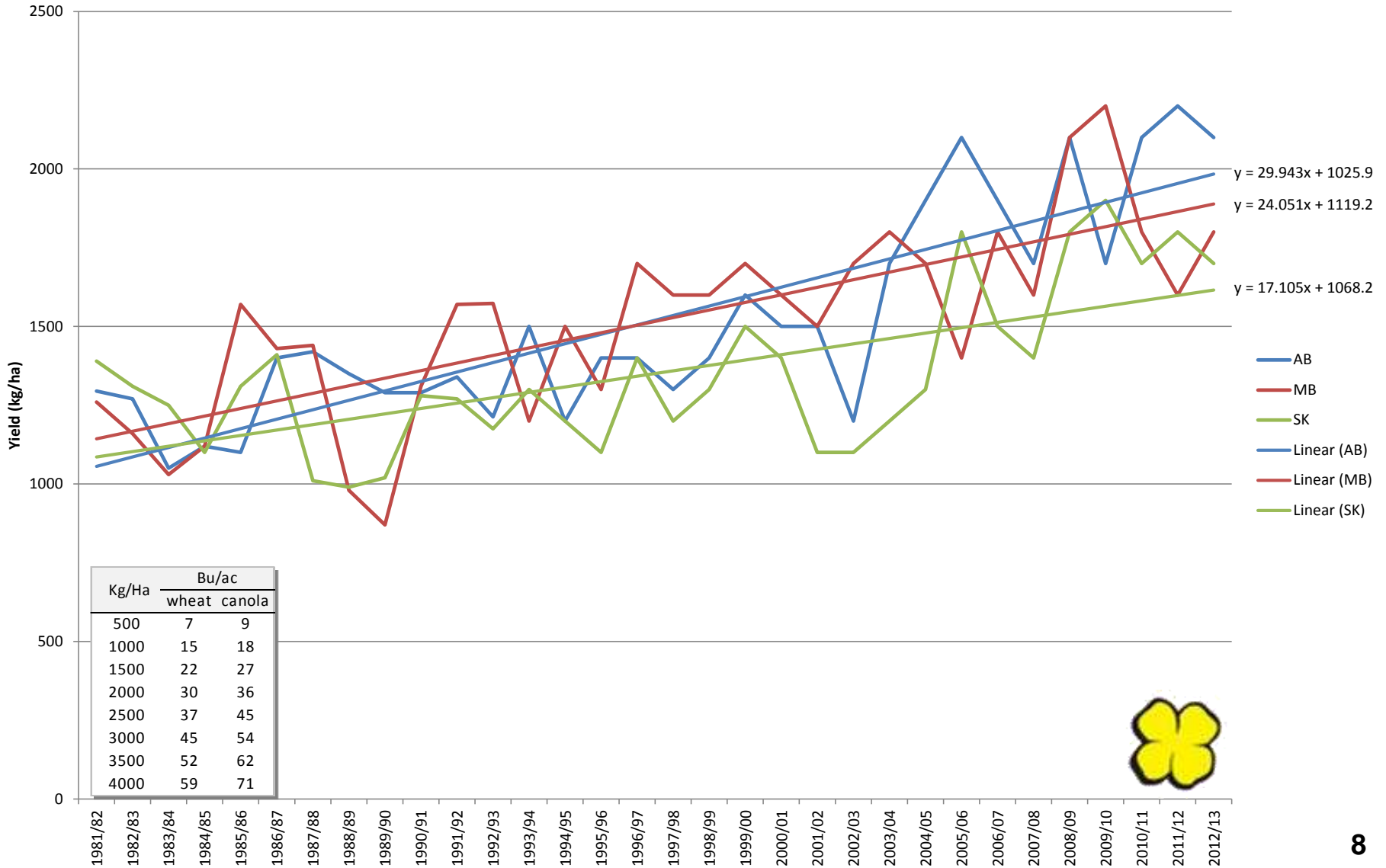
## Spring wheat yield, 1981/82 - 2012/13



# Canola Yields by Province (1981/82 - 2012/13)

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## Canola yield, 1981/82 - 2012/13





# Yield Increases over Time

Based on exponential curve fitting

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		<b>AB</b>	<b>SK</b>	<b>MB</b>	<b>PP</b>
1981/82 to 2012/13	Spring wheat	63%	42%	43%	43%
	Canola	80%	45%	66%	56%

# Yield Increases over Time

Based on exponential curve fitting

Graf 2013

		<b>AB</b>	<b>SK</b>	<b>MB</b>	<b>PP</b>
1981/82 to 2012/13	Spring wheat	63%	42%	43%	43%
	Canola	80%	45%	66%	56%
1981/82 to 1999/00	Spring wheat	40%	26%	14%	25%
	Canola	21%	5%	42%	18%

# Yield Increases over Time

Graf 2013

Based on exponential curve fitting

		<b>AB</b>	<b>SK</b>	<b>MB</b>	<b>PP</b>
1981/82 to 2012/13	Spring wheat	63%	42%	43%	43%
	Canola	80%	45%	66%	56%
1981/82 to 1999/00	Spring wheat	40%	26%	14%	25%
	Canola	21%	5%	42%	18%
2000/01 to 2012/13	Spring wheat	42%	49%	17%	42%
	Canola	50%	60%	17%	36%

Using percentage increase can be misleading...

- Number of data points and type of curve fitting affects results.
- Yield of canola is lower than wheat.
- E.g.: a 5¢ increase in a penny stock represents a large % increase compared to a 5¢ increase in a high value stock.

# Yield Increase per Year

Based on exponential curve fitting

Graf 2013

		<b>AB</b>	<b>SK</b>	<b>MB</b>	<b>PP</b>
1981/82 to 2012/13	Spring wheat	1.6%	1.1%	1.2%	1.2%
	Canola	1.9%	1.2%	1.7%	1.4%

# Yield Increase per Year

Based on exponential curve fitting

Graf 2013

		<b>AB</b>	<b>SK</b>	<b>MB</b>	<b>PP</b>
1981/82 to 2012/13	Spring wheat	1.6%	1.1%	1.2%	1.2%
	Canola	1.9%	1.2%	1.7%	1.4%
1981/82 to 1999/00	Spring wheat	1.9%	1.3%	0.7%	1.3%
	Canola	1.1%	0.3%	2.0%	0.9%

# Yield Increase per Year

Graf 2013

Based on exponential curve fitting

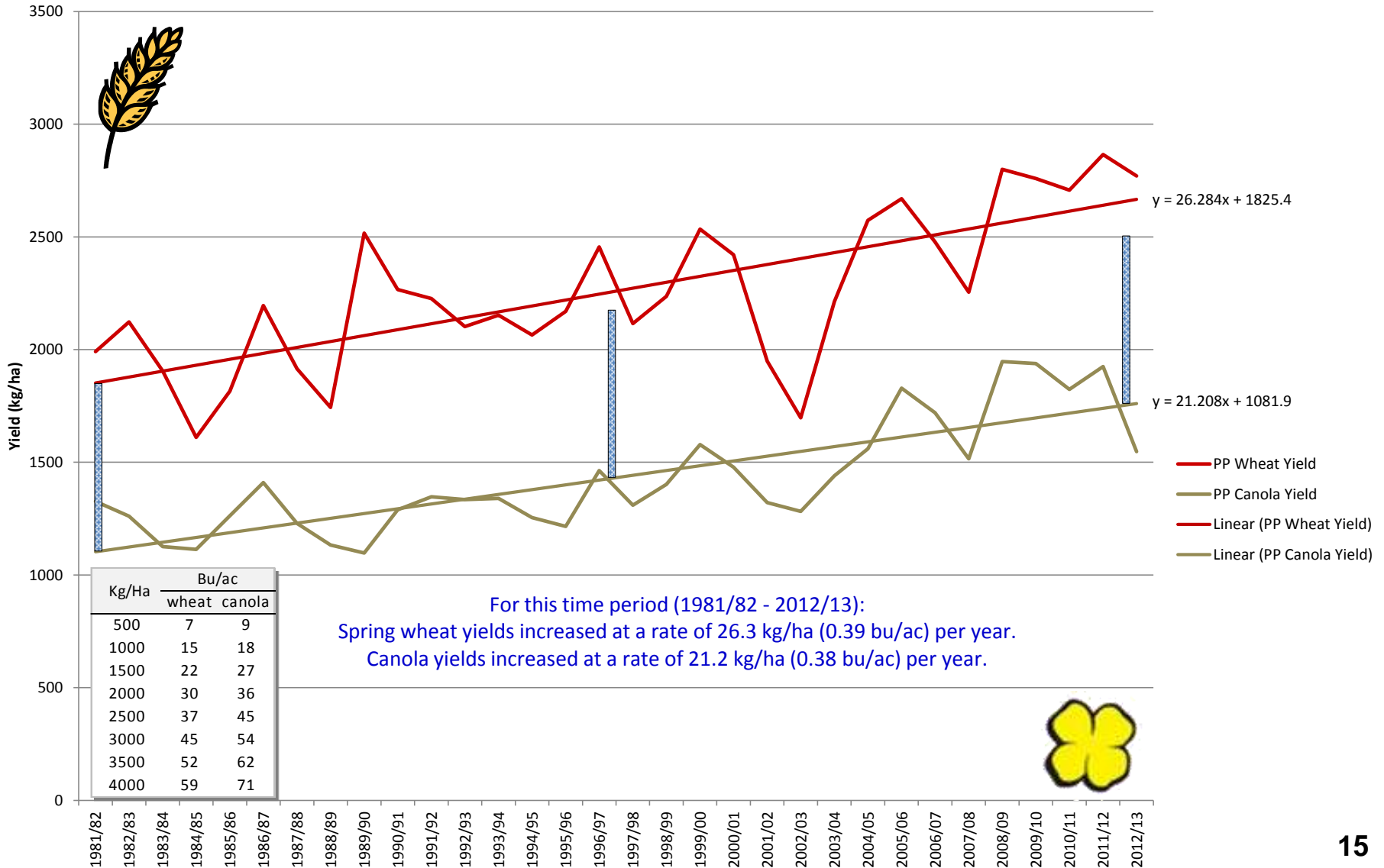
		<b>AB</b>	<b>SK</b>	<b>MB</b>	<b>PP</b>
1981/82 to 2012/13	Spring wheat	1.6%	1.1%	1.2%	1.2%
	Canola	1.9%	1.2%	1.7%	1.4%
1981/82 to 1999/00	Spring wheat	1.9%	1.3%	0.7%	1.3%
	Canola	1.1%	0.3%	2.0%	0.9%
2000/01 to 2012/13	Spring wheat	3.0%	3.4%	1.3%	2.9%
	Canola	3.4%	4.0%	1.3%	2.6%

Remember that using percentage increase can be misleading...

# PP Spring Wheat and Canola Yield (1981/82 – 2012/13)

Graf 2013

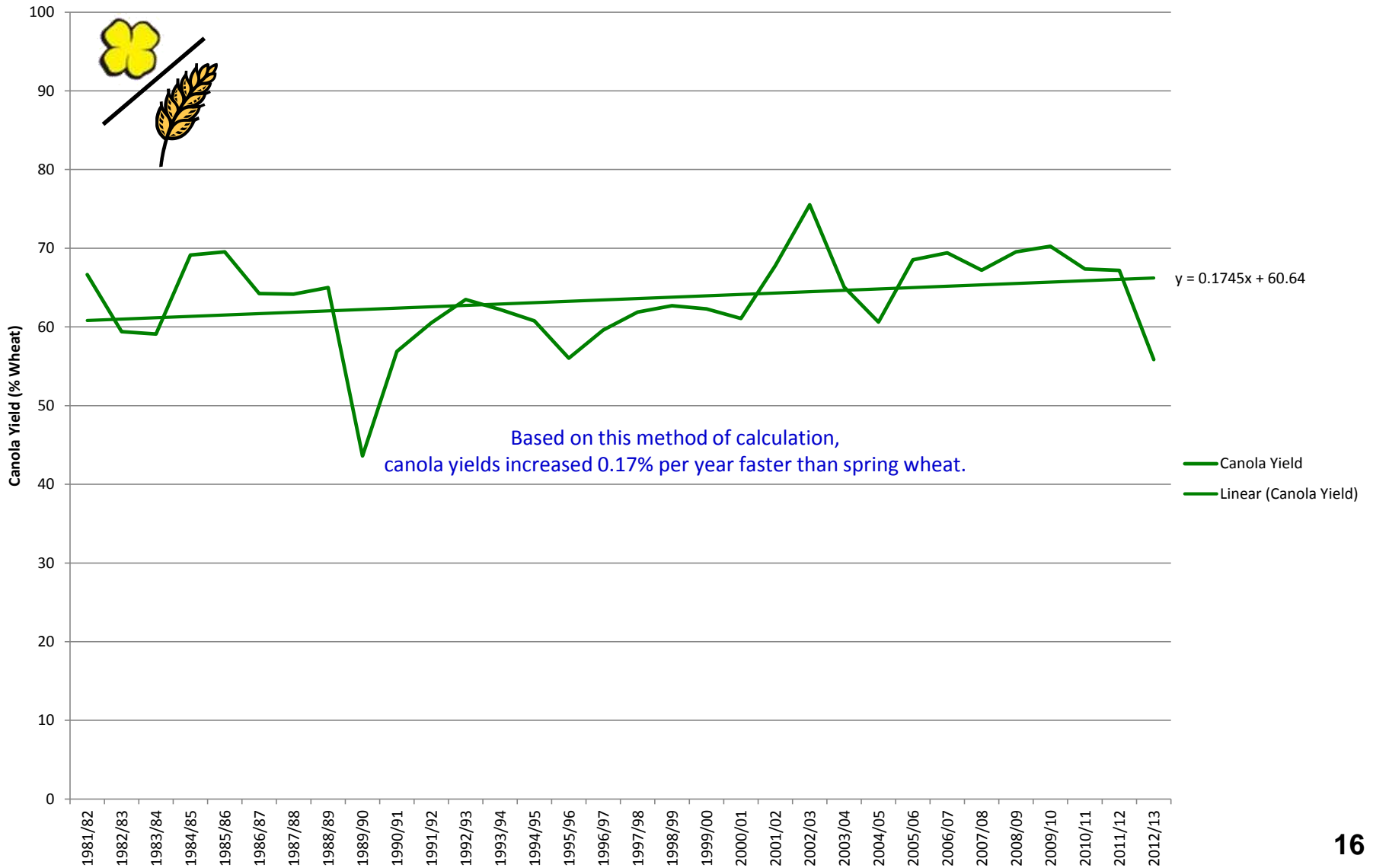
Prairie province spring wheat and canola yield, 1981/82 - 2012/13



# PP Canola Yield relative to Spring Wheat (1981/82 - 2012/13)

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## Prairie canola yield as a percent of wheat yield, 1981/82 - 2012/13





## Comments: Spring Wheat

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1981/1982 to 1999/2000 versus 2000/2001 to present:

- What influenced the rate of gain?
- What was the yield gain per dollar invested?
  - 2011/12: Total Wheat Investment = approx. \$25 Million.

Source: AAFC

### Spring Wheat:

- WGRF supported varieties start be registered.
- First CWRS varieties with ND germplasm (McKenzie, Superb, etc.)
- First semi-dwarf CWRS varieties (Superb, CDC Go, etc.)
- Wheat midge resistance introduced (Unity, Goodeve, etc.)
- FHB resistance breeding reduced rate of progress.

# Comments: Canola

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Graf 2013

1981/1982 to 1999/2000 versus 2000/2001 to present:

- What influenced the rate of gain?
- What was the yield gain per dollar invested?
  - 2011/12: Total Canola Investment = approx. \$80 Million.

Source: CSTA

## Canola:

- Excellent weed control with herbicide resistance.
- Hybrids introduced and eventually predominate.
- Lower yielding *B. rapa* (Polish canola) phased out.
- Increased investment by private industry.

# Canola Grown and Managed in Preference to Wheat

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*Given that:*

- The input costs of canola (not just seed) are higher than wheat.
- There is good potential for excellent net returns from canola.

*The result has been:*

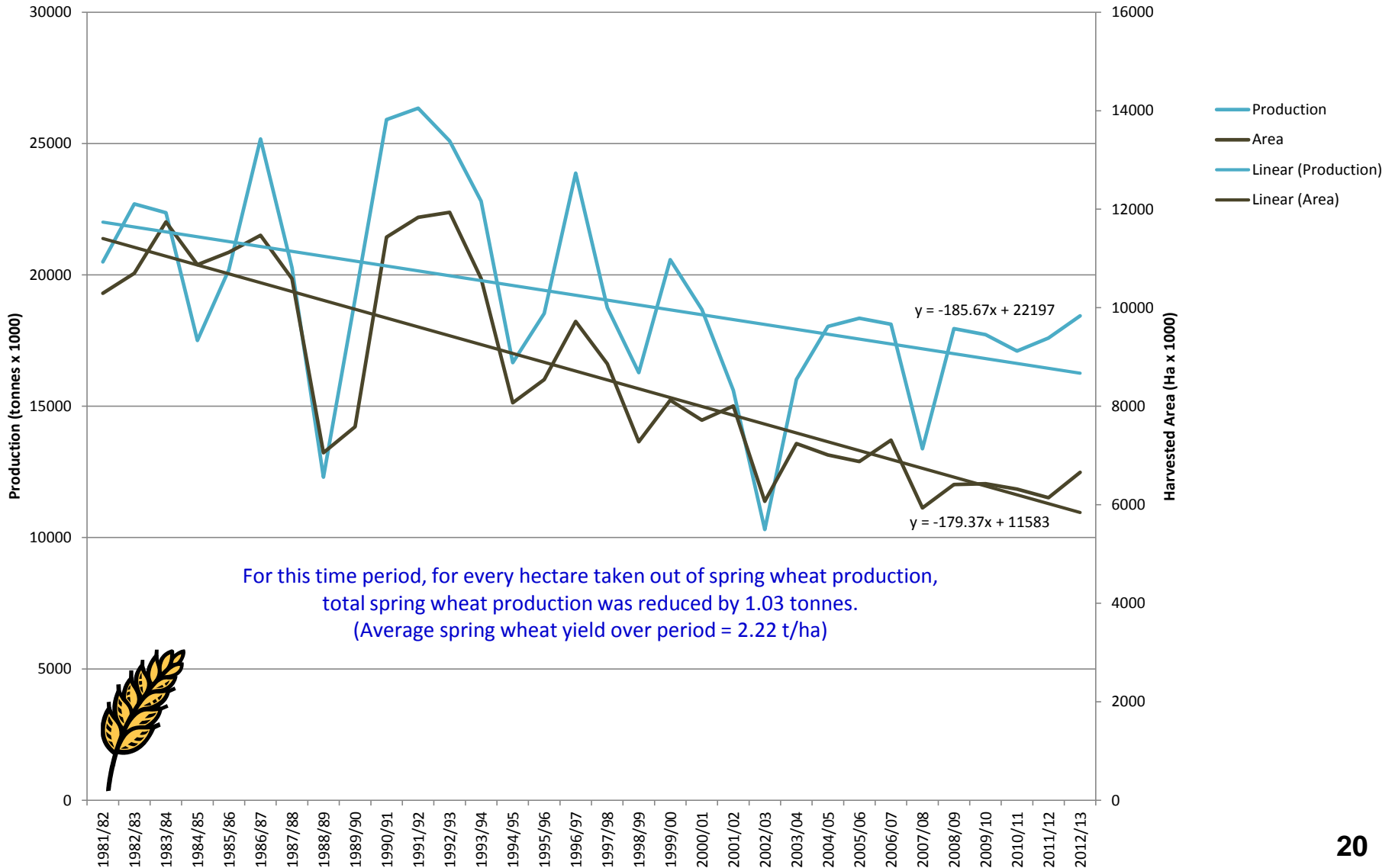
- Better (best?) management practices are applied to canola.
- Canola is usually seeded on the best land available.
- As canola acreage increases the “next best” available land is likely to be diverted away from wheat (and other crops).
- Wheat has become a “secondary” crop that does not necessarily receive the same care as canola.

This trend also reduced the observed rate of yield gain in wheat.

# PP Spring Wheat Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

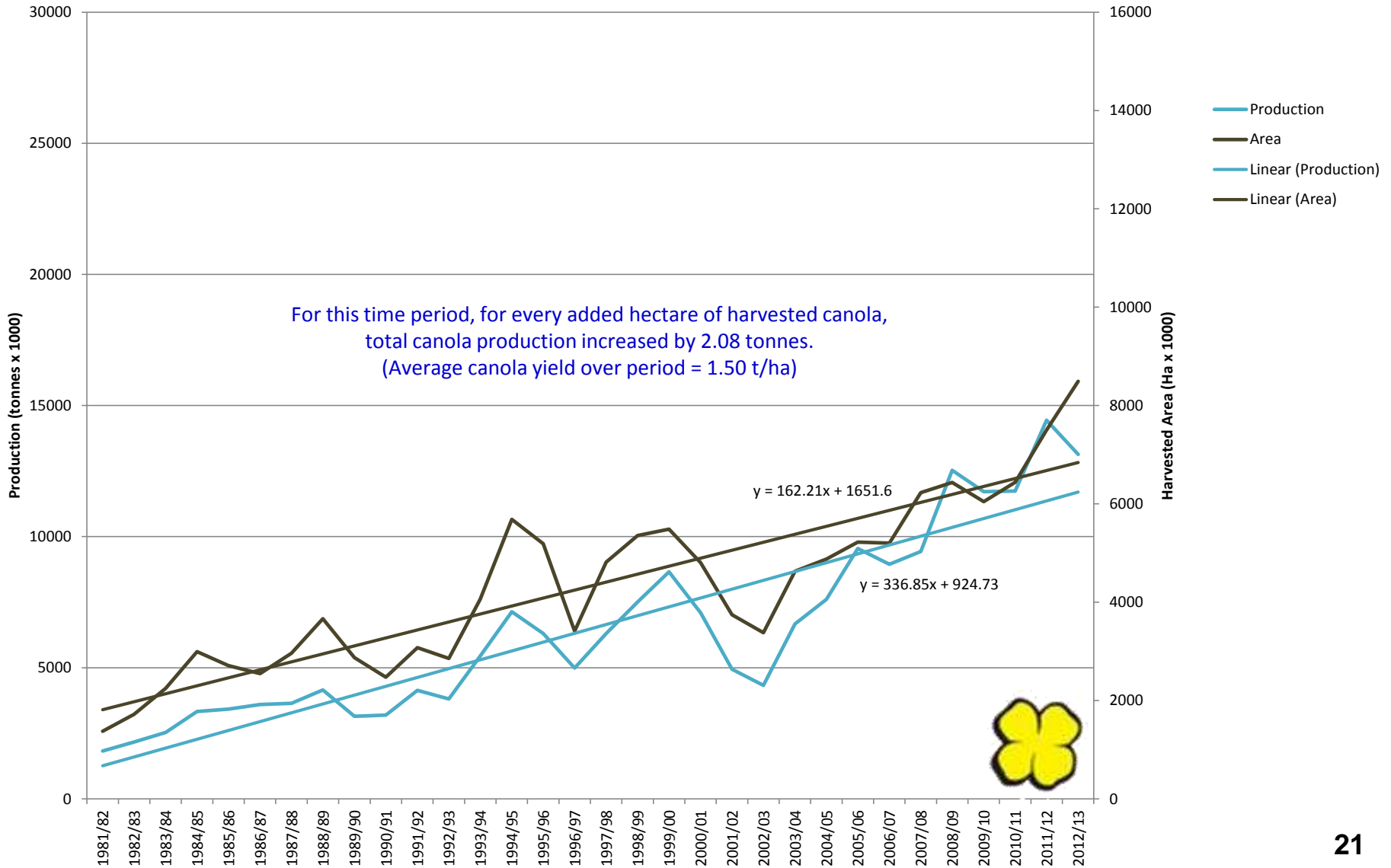
## Prairie Provinces: Total Production and Harvested Area - Spring Wheat



# PP Canola Production & Harvested Area (1981/82 - 2012/13)

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## Prairie Provinces: Total Production and Harvested Area - Canola



# Have Things Changed Since 2000/01?

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1981/82 to 1999/00:

- Average spring wheat yield = 2.10 t/ha (31.3 bu/ac).
- Rate of yield increase = 1.25% per year.
- Average canola yield = 1.30 t/ha (23.2 bu/ac).
- Rate of yield increase = 0.92% per year.

2000/01 to 2012/13:

- Average spring wheat yield = 2.47 t/ha (36.7 bu/ac).
- Rate of yield increase = 2.94% per year (1.08 bu/ac per year).
- Average canola yield = 1.37 t/ha (29.9 bu/ac).
- Rate of yield increase = 2.62% per year (0.78 bu/ac per year).

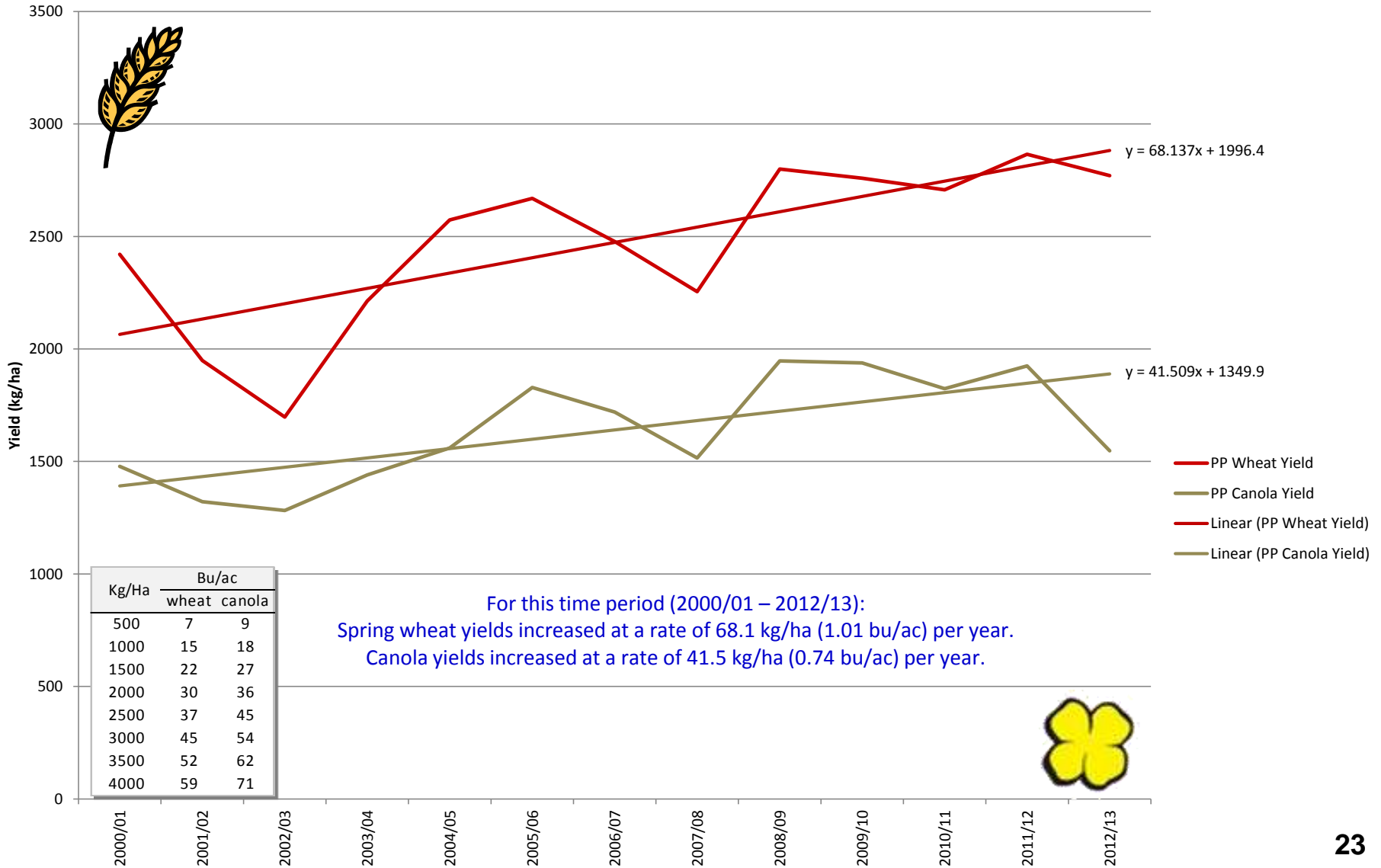
Plant breeding investment required to sustain current overall rates of yield increase (based on 2011/12 investments)

- **Wheat: \$25 Million per year.**
- **Canola: \$80 Million per year.**

# PP Spring Wheat and Canola Yield (2000/01 – 2012/13)

Graf 2013

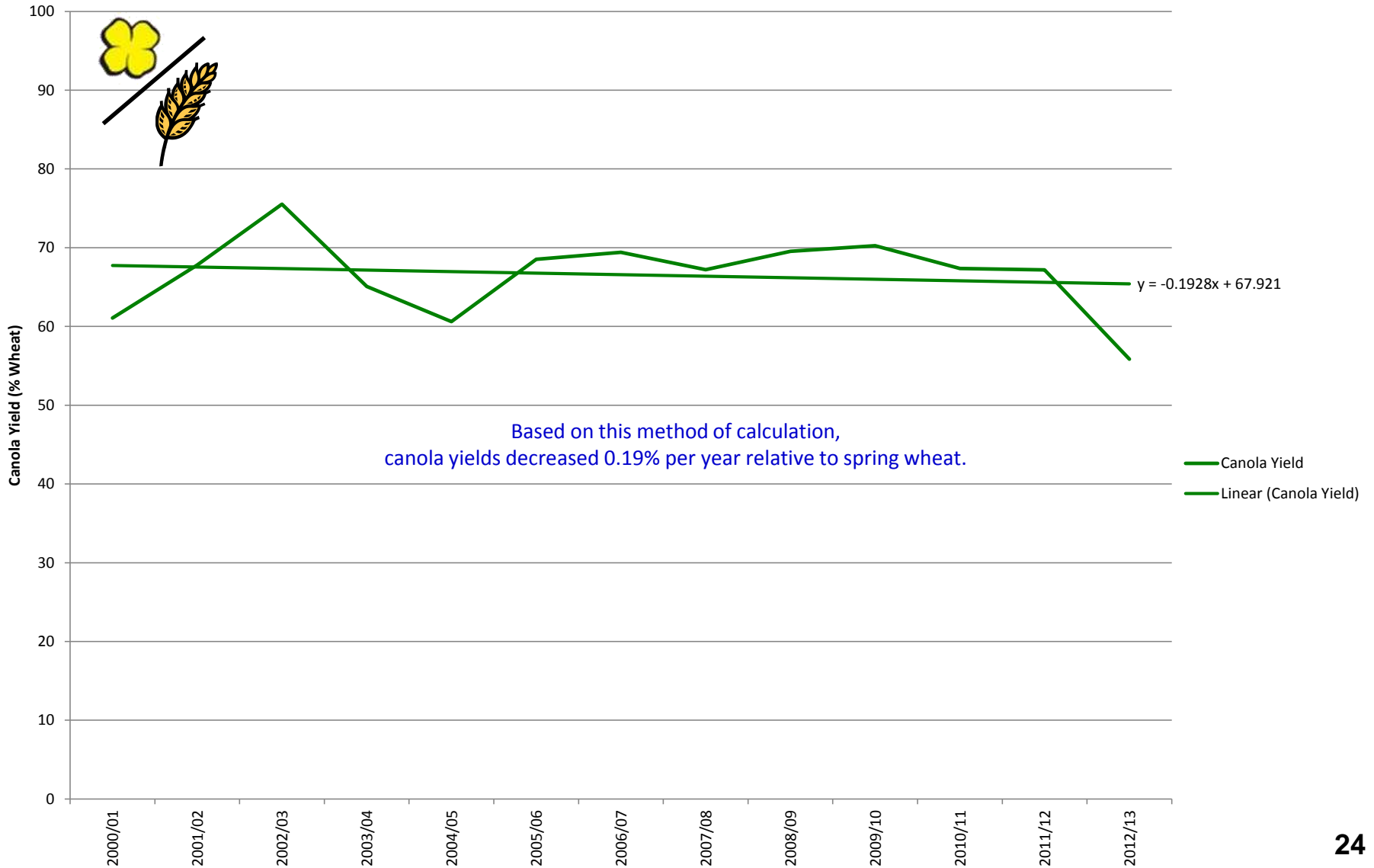
Prairie province spring wheat and canola yield, 2000/01 - 2012/13



# PP Canola Yield relative to Spring Wheat (2000/01 – 2012/13)

Graf 2013

## Prairie canola yield as a percent of wheat yield, 2000/01 - 2012/13

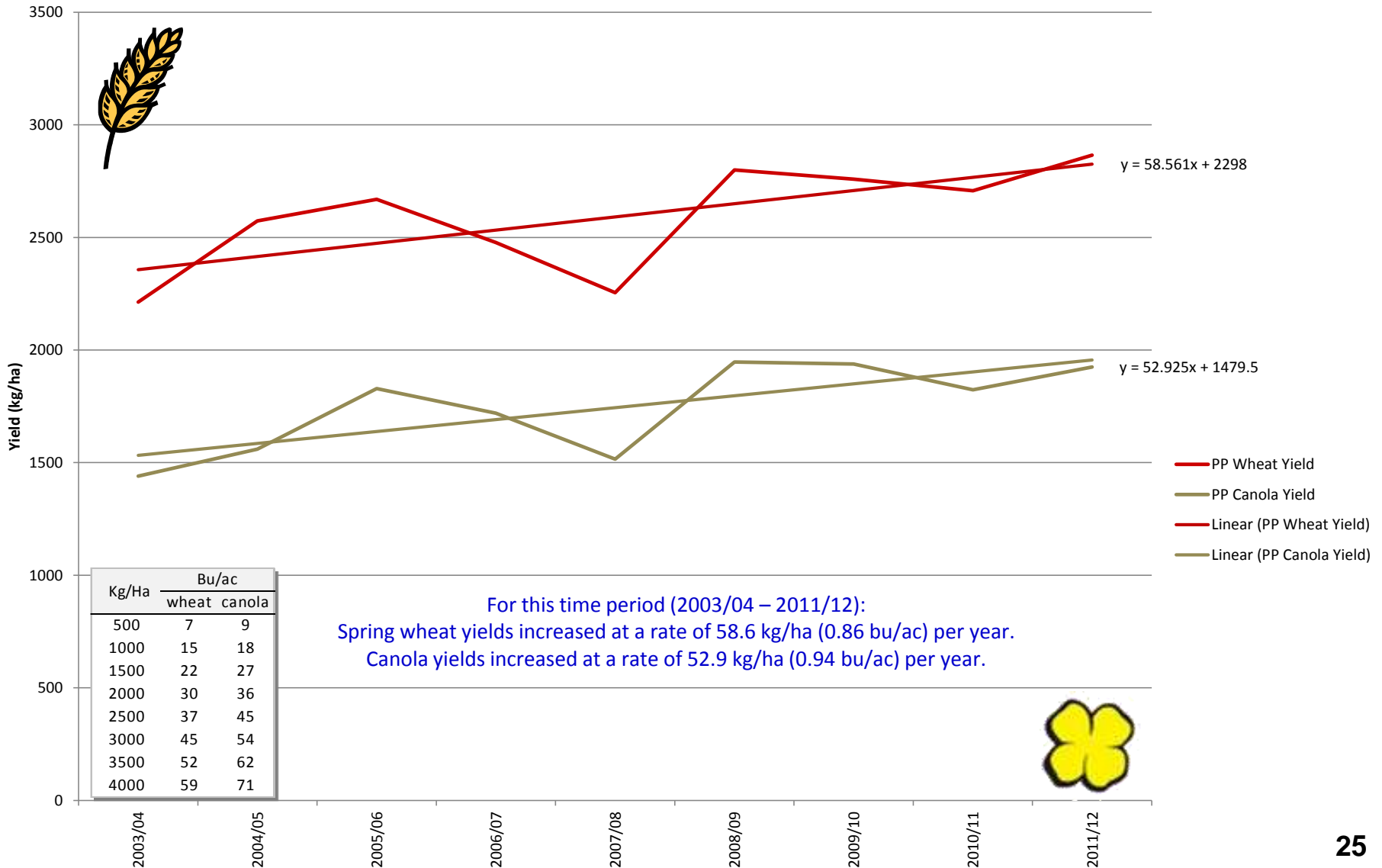




# Selective Data Mining: S. Wheat and Canola Yield (2003/04 – 2011/12)

Graf 2013

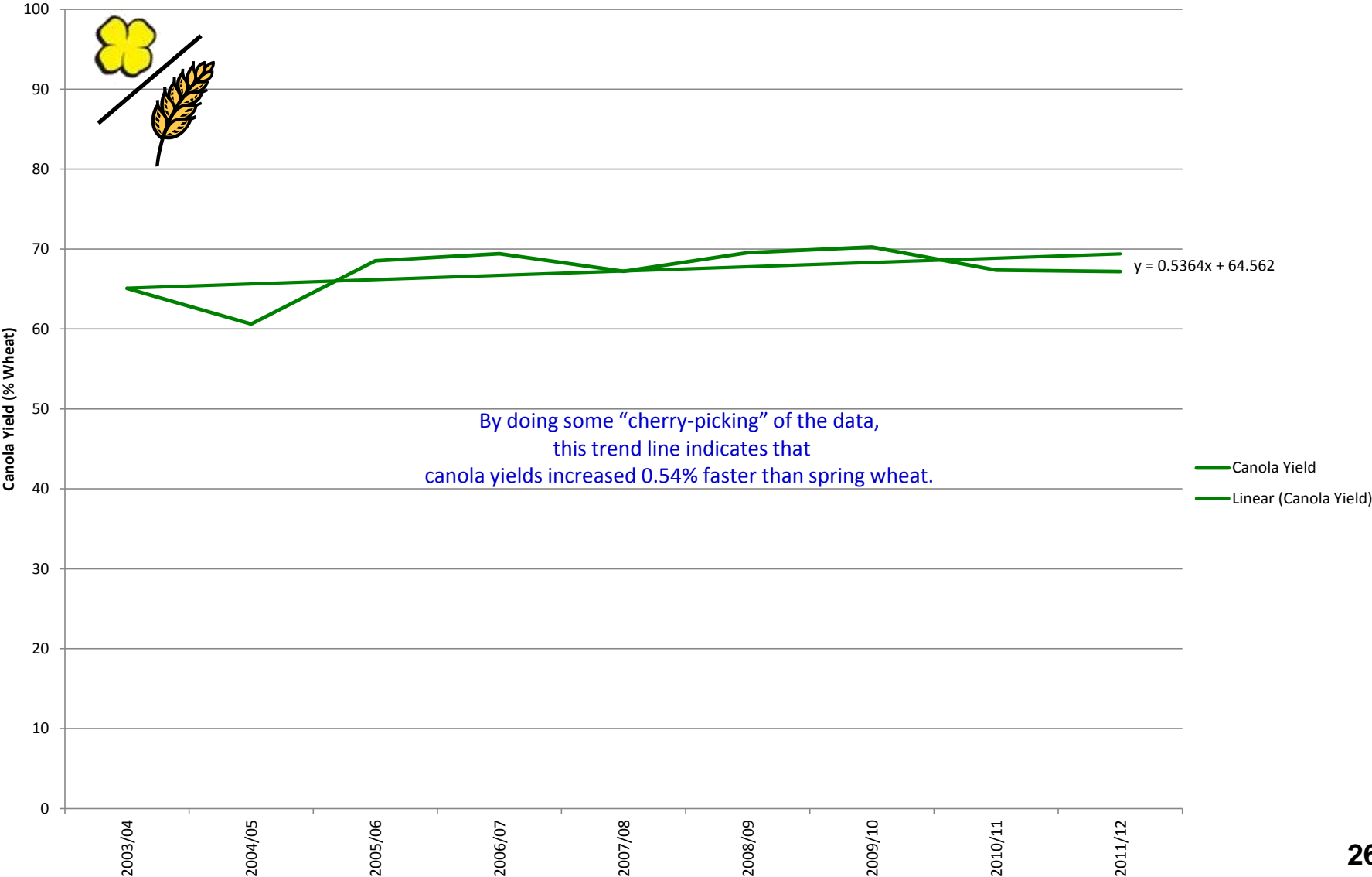
Prairie province spring wheat and canola yield, 2003/04 - 2011/12



# Selective Data Mining: Canola relative to S. Wheat (2003/04 – 2011/12)

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### Prairie canola yield as a percent of wheat yield, 2003/04 - 2011/12



## Questions to Ponder...

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*While ~~yield~~ net returns ultimately pay the bills...*

- What is disease resistance worth vs. the cost of fungicides?
- KVD reduced progress in wheat – effects of removal just starting.
- Wheat yield gains were made with current registration system.
  - More difficult to determine differences with less testing.
  - Can't tell the difference? Mediocrity increases.
  - **Is there a “problem” that needs fixing?**
- Yield may increase faster with fewer registration “impediments”.
  - Every trait added reduces effective population size.
  - What are some of these impediments?

# A Double-Edged Sword

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Fewer registration “impediments” may mean faster progress:

- Every trait added reduces effective population size.
- What are some of these impediments?

## Disease resistance:

- *Stem rust?*
- *Leaf rust?*
- *Stripe rust?*
- *FHB?*
- *Bunt?*
- *Loose smut?*
- *Leaf spots?*

## Agronomics:

- *Early maturity?*
- *Sprouting tolerance?*

## Pest resistance:

- *Wheat stem sawfly?*
- *Wheat midge?*
- *Wheat curl mite?*

## Quality:

- *Sprouting resistance?*
- *Protein content?*
- *Milling yield?*
- *Consistency?*

- Every trait added will slow down progress in other traits.
- What are the benefits/costs for these and other traits?
- Is the added cost of fungicides, potential grade loss, etc. offset by higher yields?

# A Few Basic Conclusions

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- Spring wheat yields have not stagnated in western Canada.
- On-farm spring wheat and canola yields have increased substantially, particularly since 2000/01.
- Observed rates of on-farm yield increase were faster from 2000/01 – 2012/13 than 1981/82 – 1999/00 for both crops.
- 1981/82 – 1999/00: S. wheat yields increased faster than canola.
- Since 2000/01: Rate of canola yield increase is faster than wheat.
- Environment plays a large role in observing yield potential.
- Greater breeding investment resulted in higher rates of progress.
- The registration system for wheat has not been a major “bottleneck” to the introduction of superior genetics.

# Thank You

**Dr. Robert Graf**

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# Supplementary Information





**1981/82 - 2012/13**

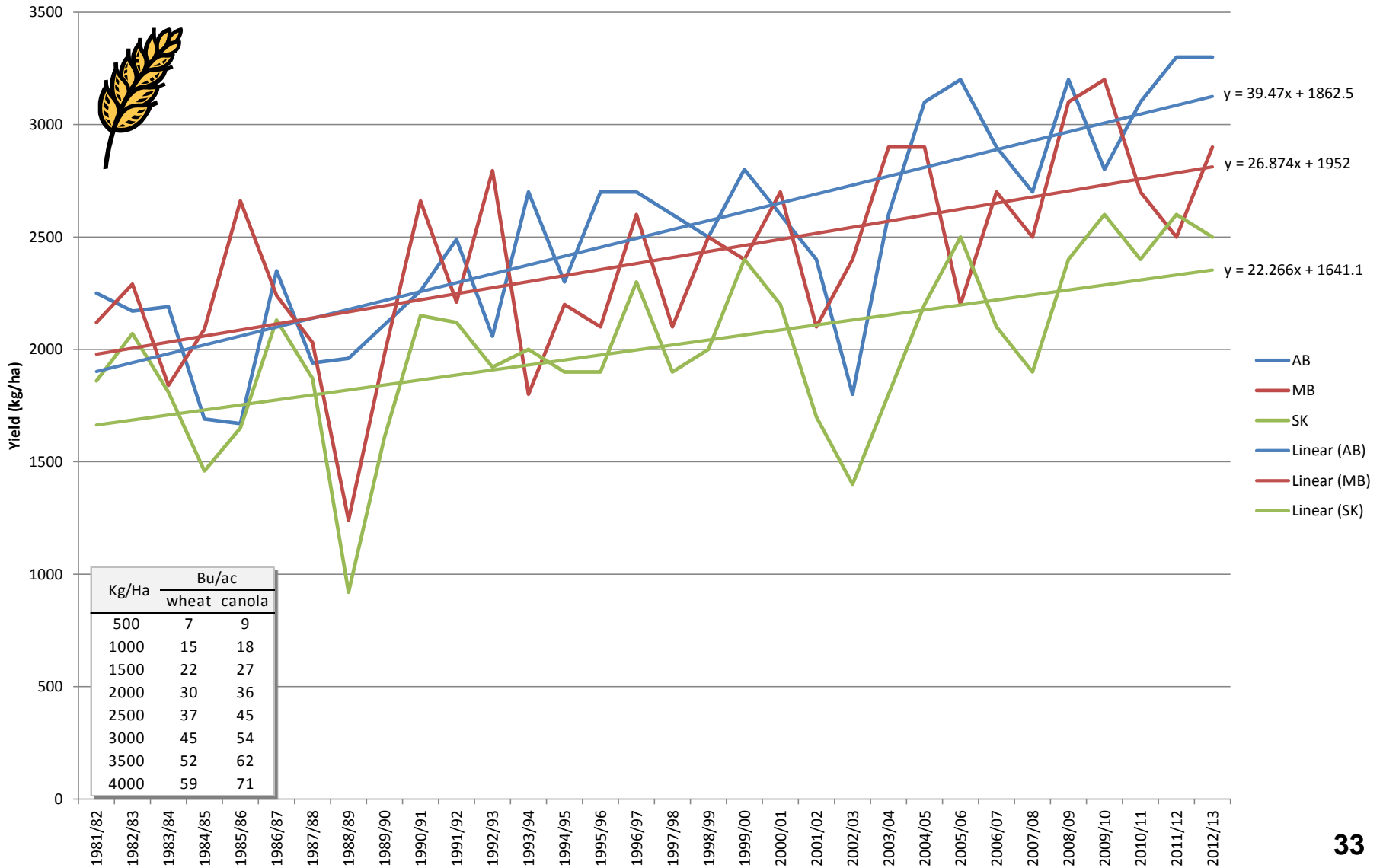
**complete set of graphs**



# Spring Wheat Yields by Province (1981/82 - 2012/13)

Graf 2013

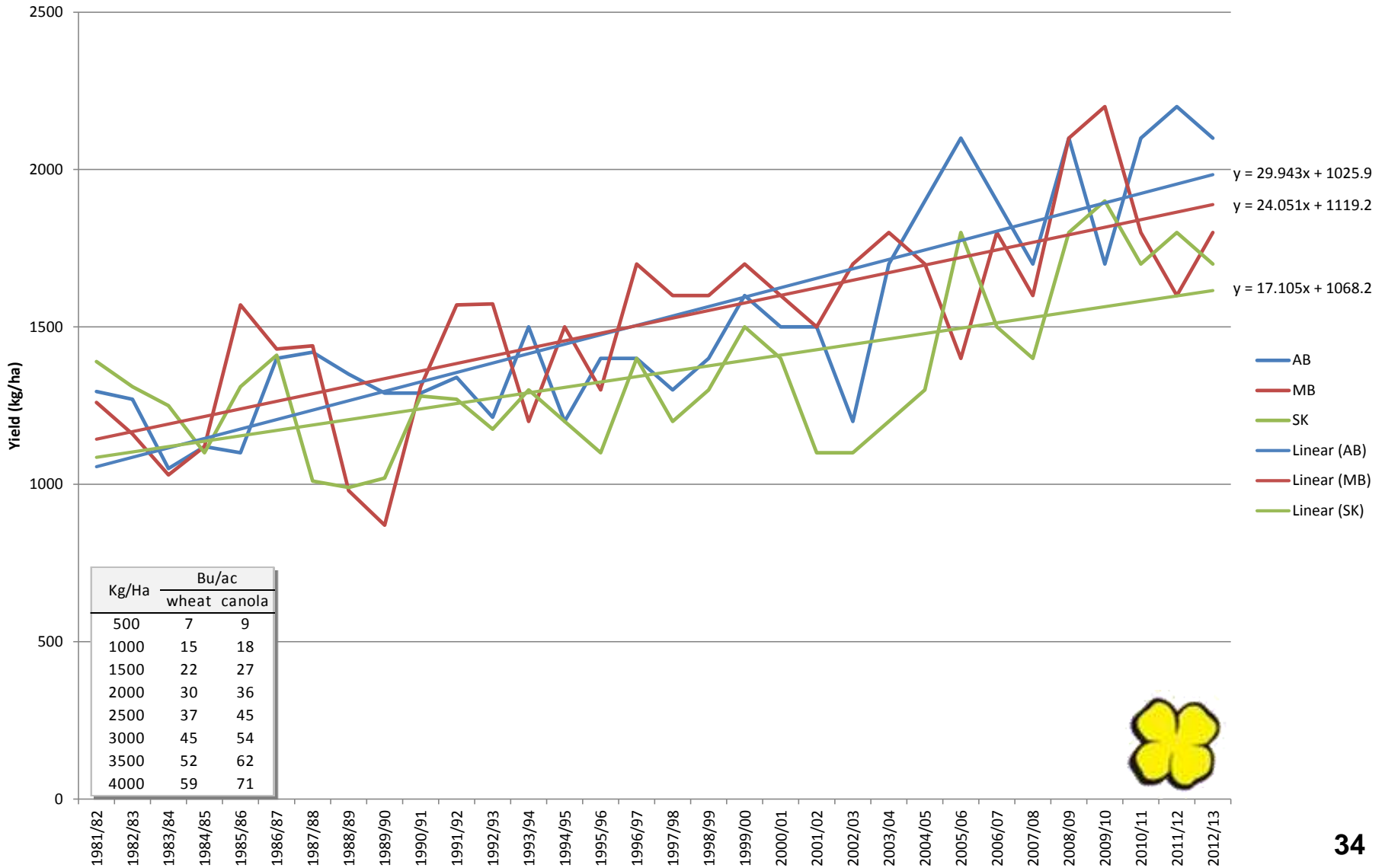
## Spring wheat yield, 1981/82 - 2012/13



# Canola Yields by Province (1981/82 - 2012/13)

Graf 2013

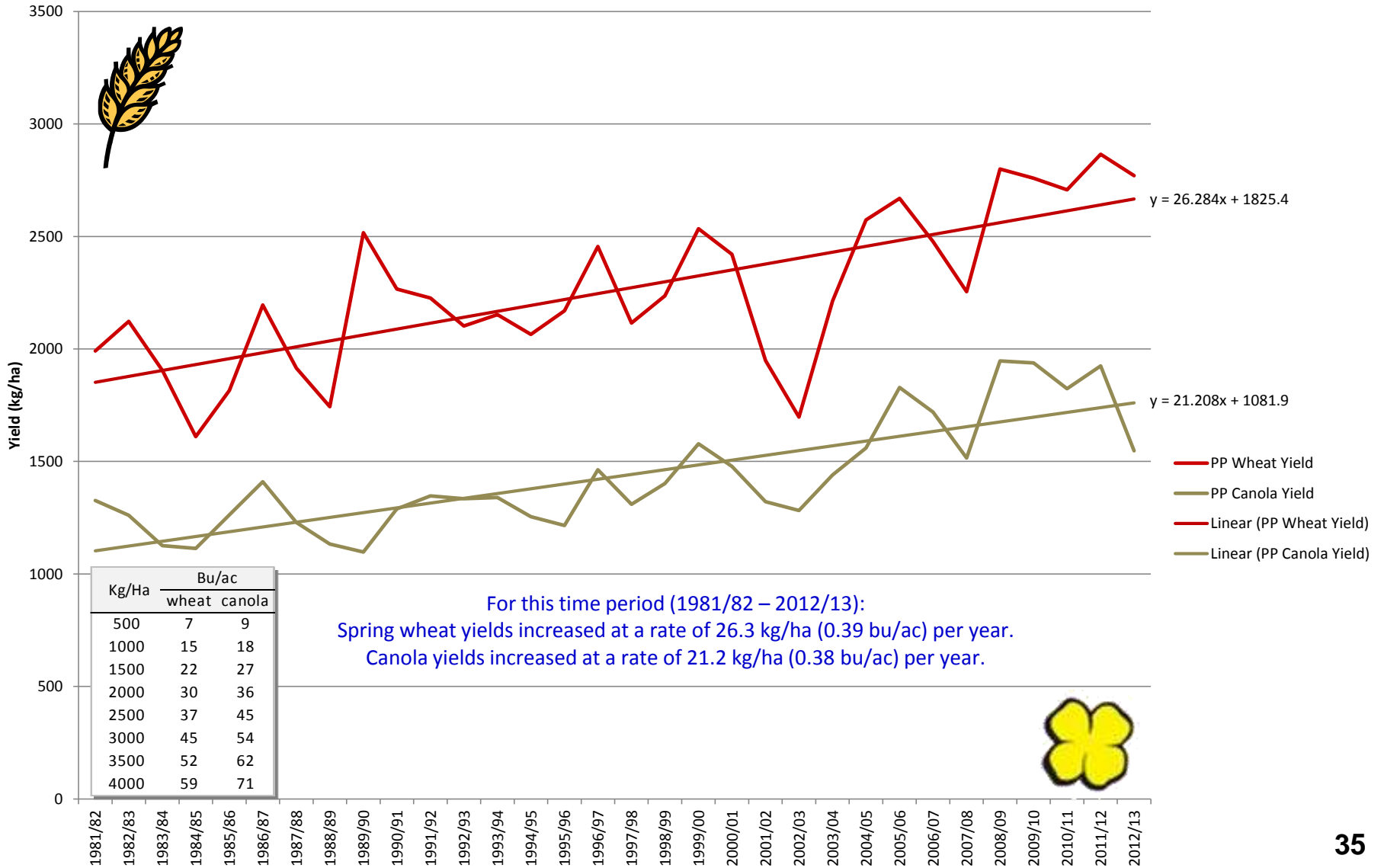
## Canola yield, 1981/82 - 2012/13



# PP Spring Wheat and Canola Yield (1981/82 - 2012/13)

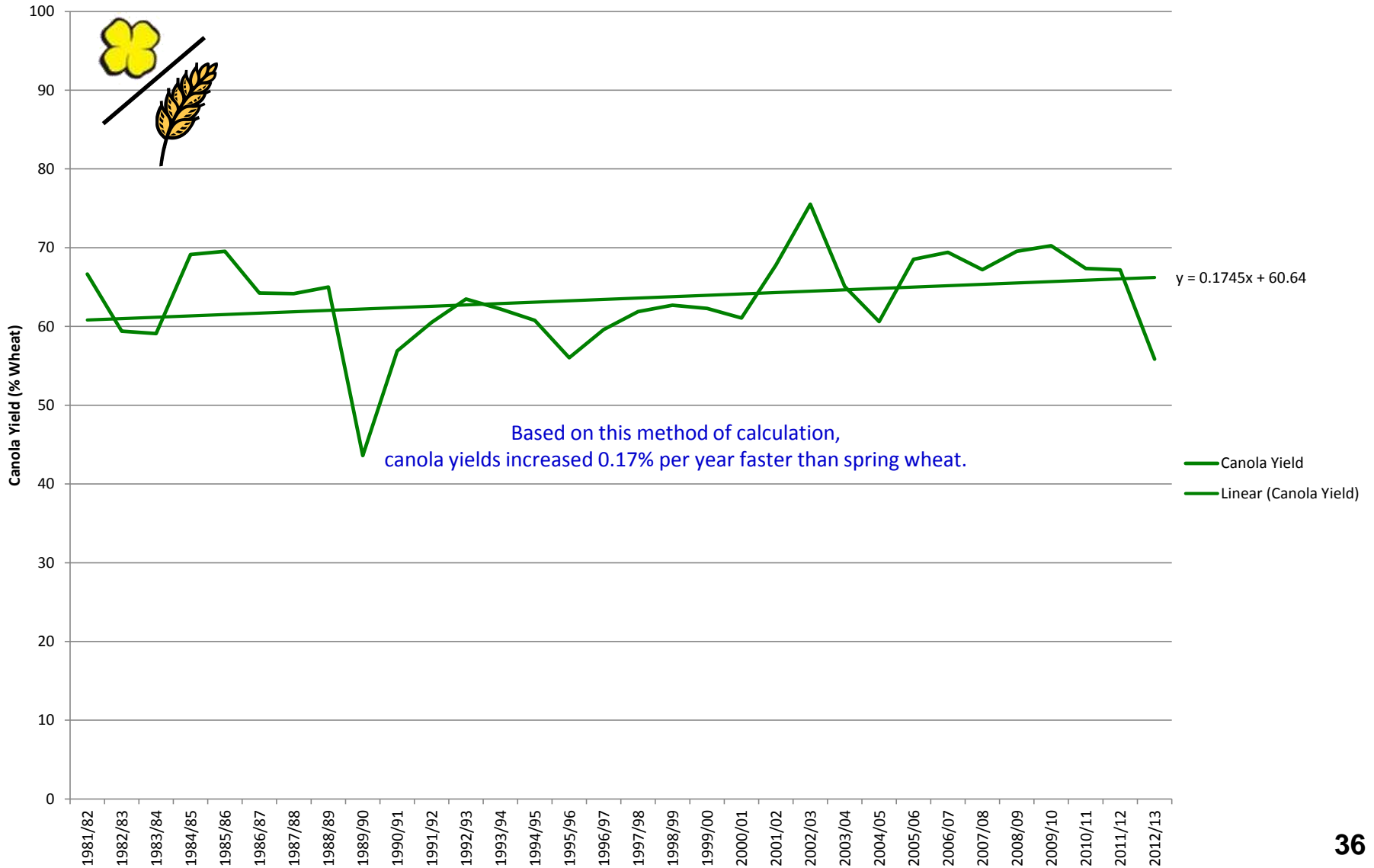
Graf 2013

Prairie province spring wheat and canola yield, 1981/82 - 2012/13



# PP Canola Yield relative to Spring Wheat (1981/82 - 2012/13)

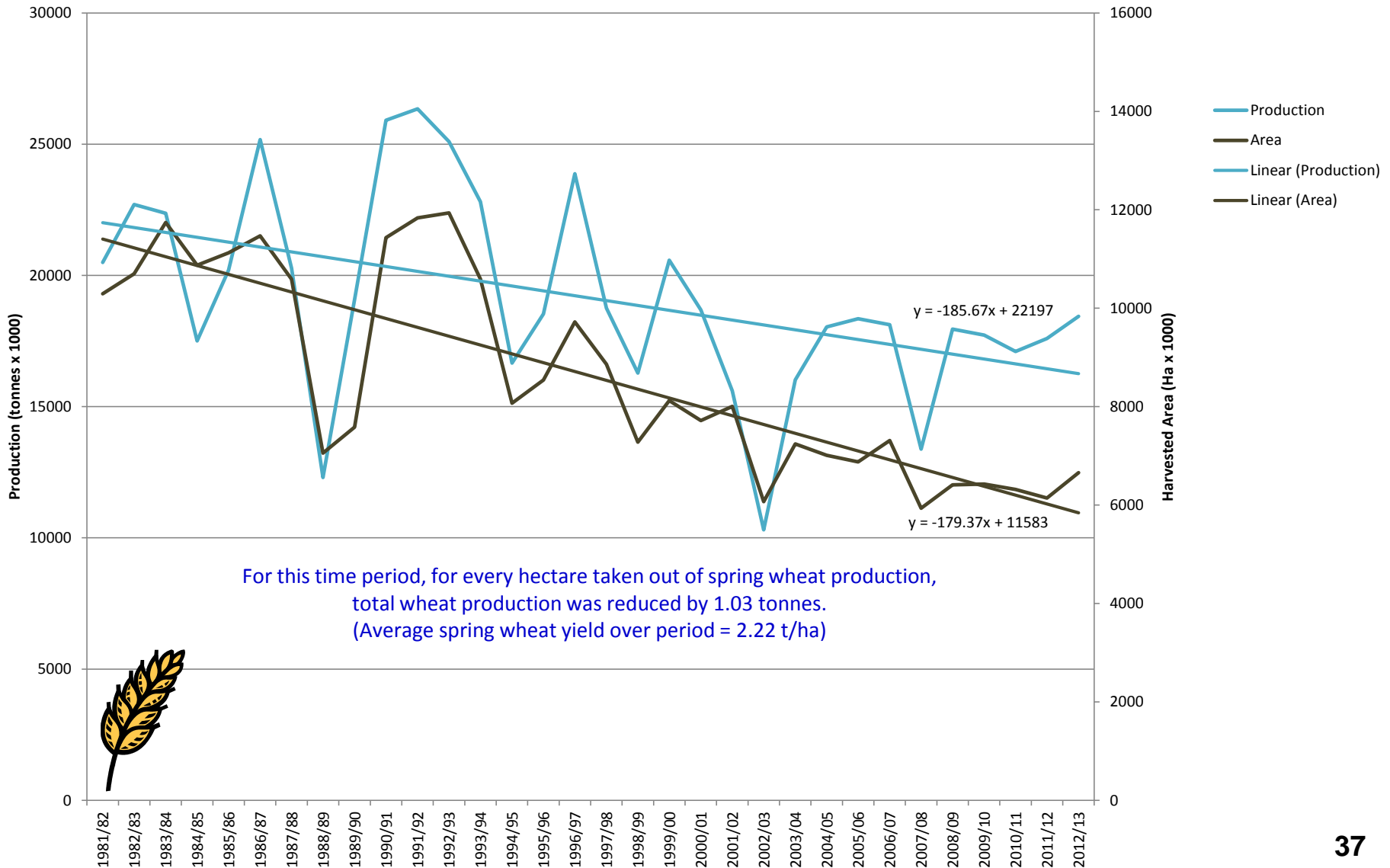
Prairie canola yield as a percent of wheat yield, 1981/82 - 2012/13



# PP Spring Wheat Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

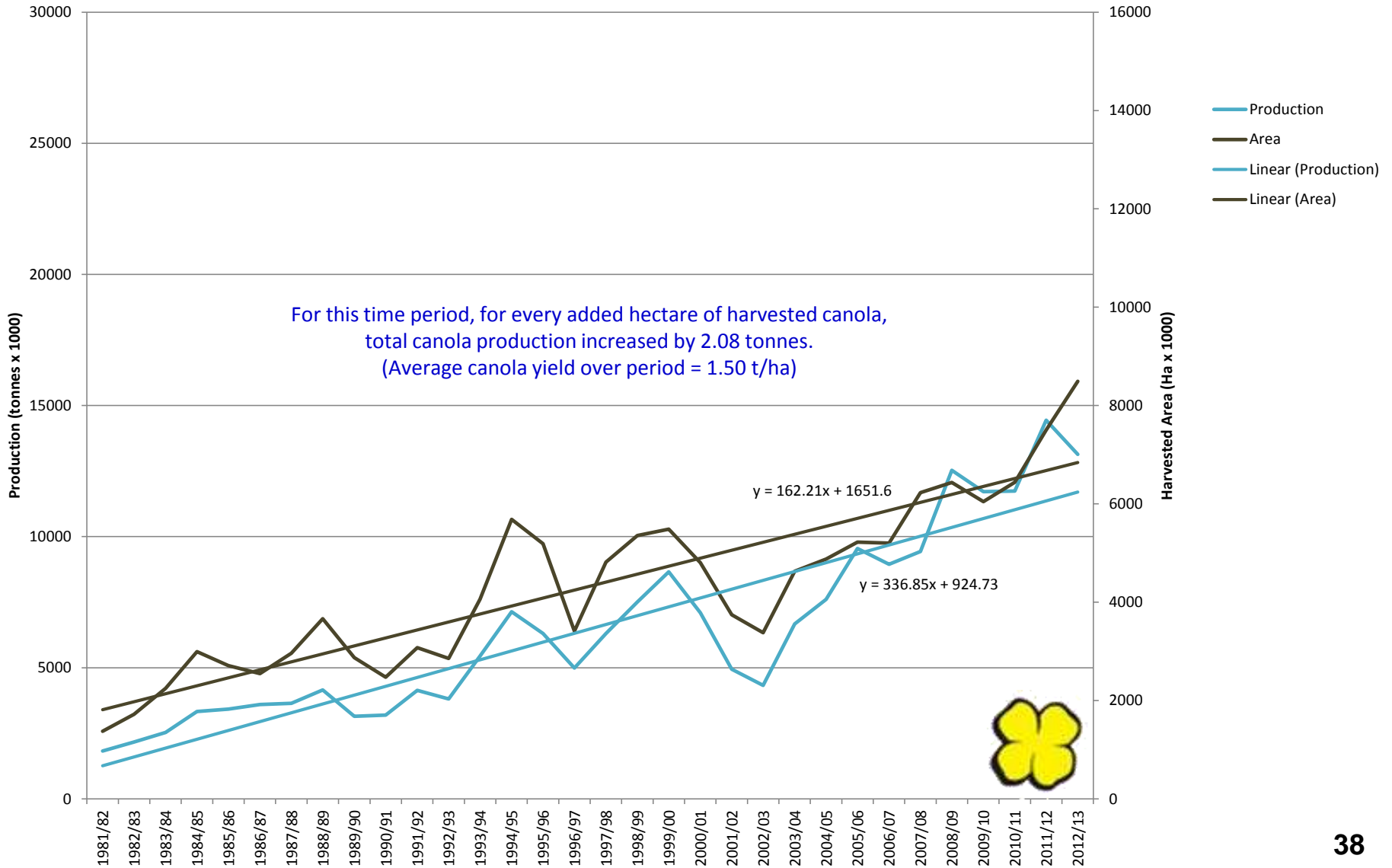
## Prairie Provinces: Total Production and Harvested Area - Spring Wheat



# PP Canola Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

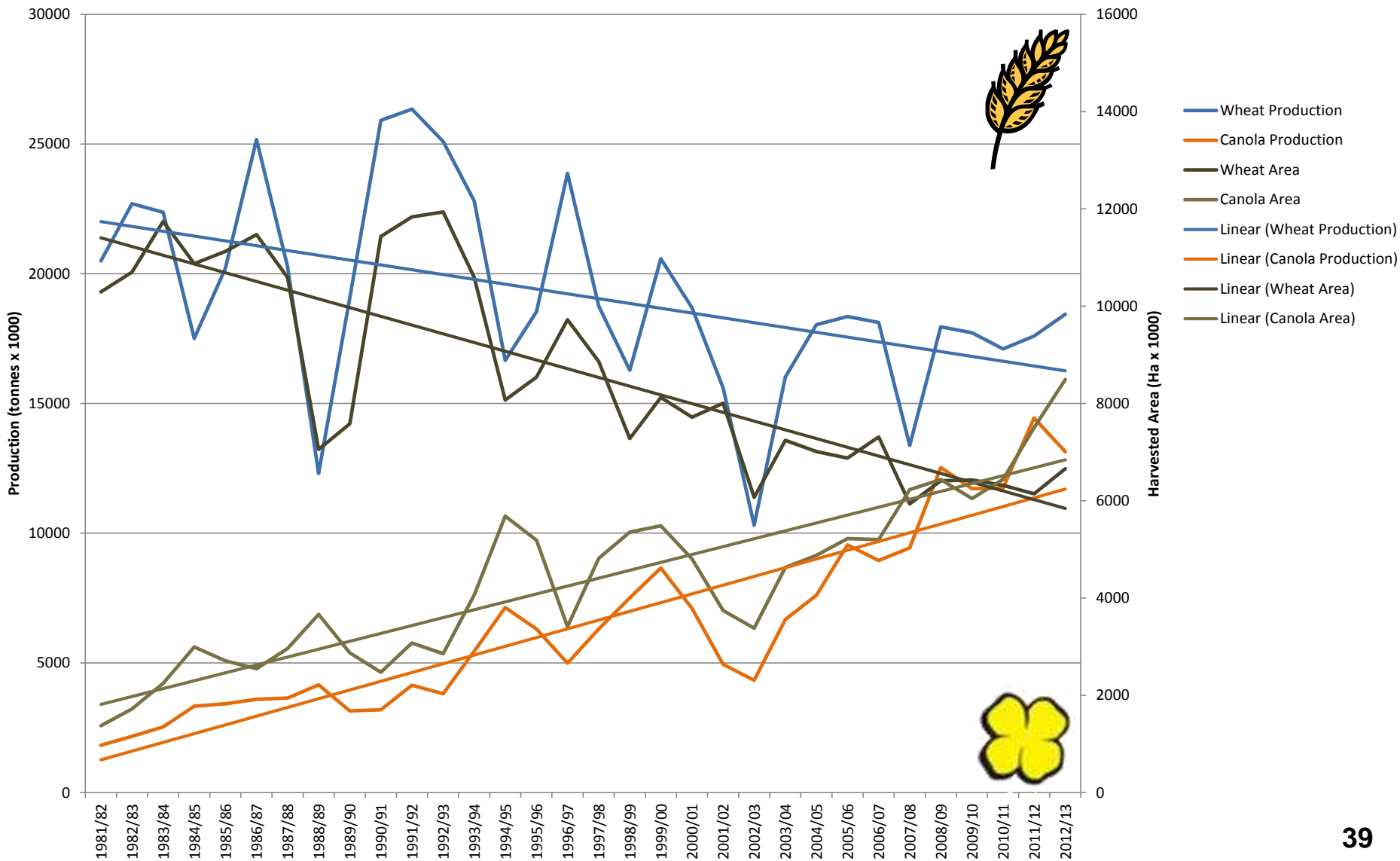
## Prairie Provinces: Total Production and Harvested Area - Canola



# PP Spring Wheat & Canola: Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

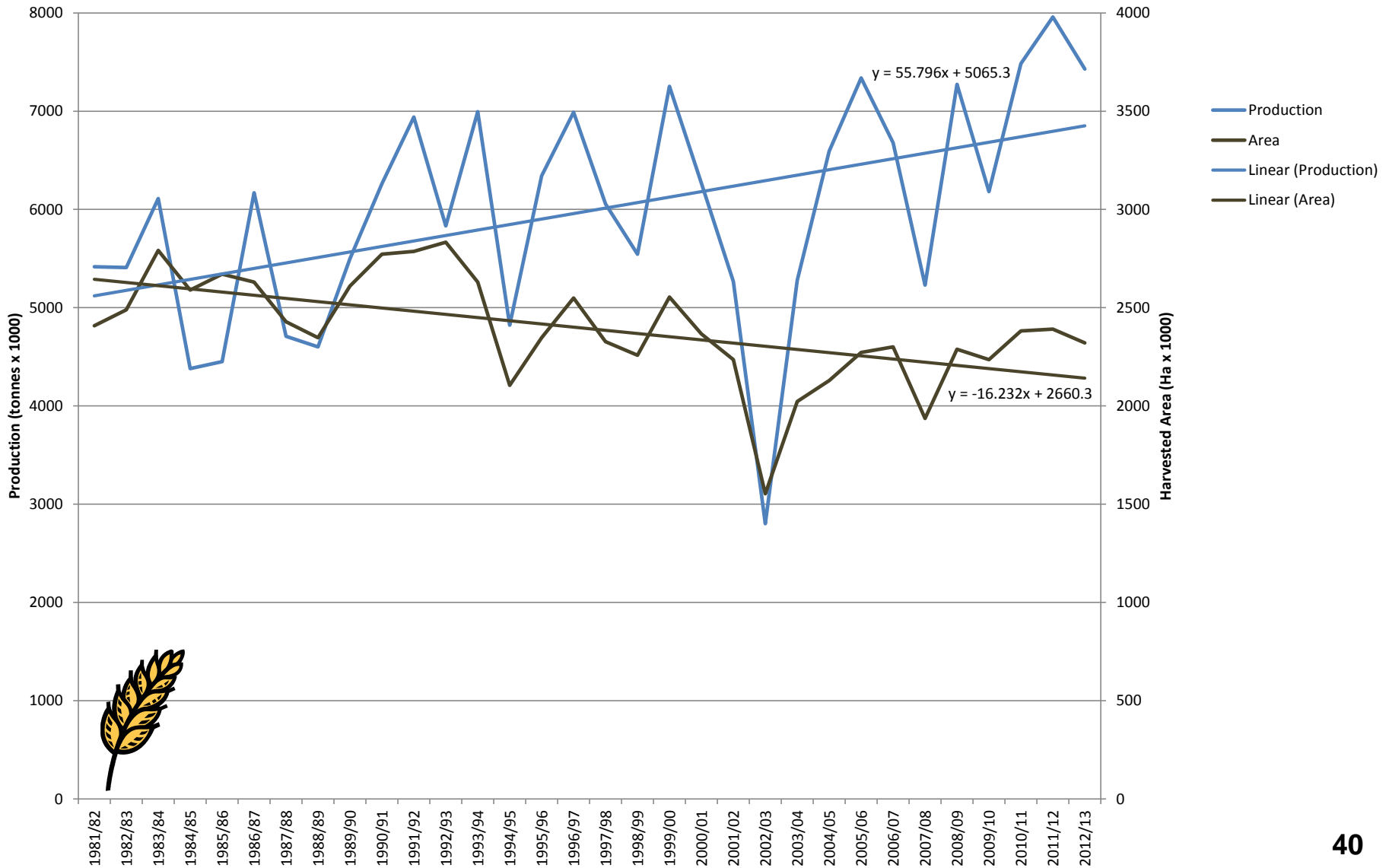
## Prairie Provinces: Total Production and Harvested Area - Spring Wheat & Canola



# AB Spring Wheat: Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

## Alberta: Total Production and Harvested Area - Spring Wheat

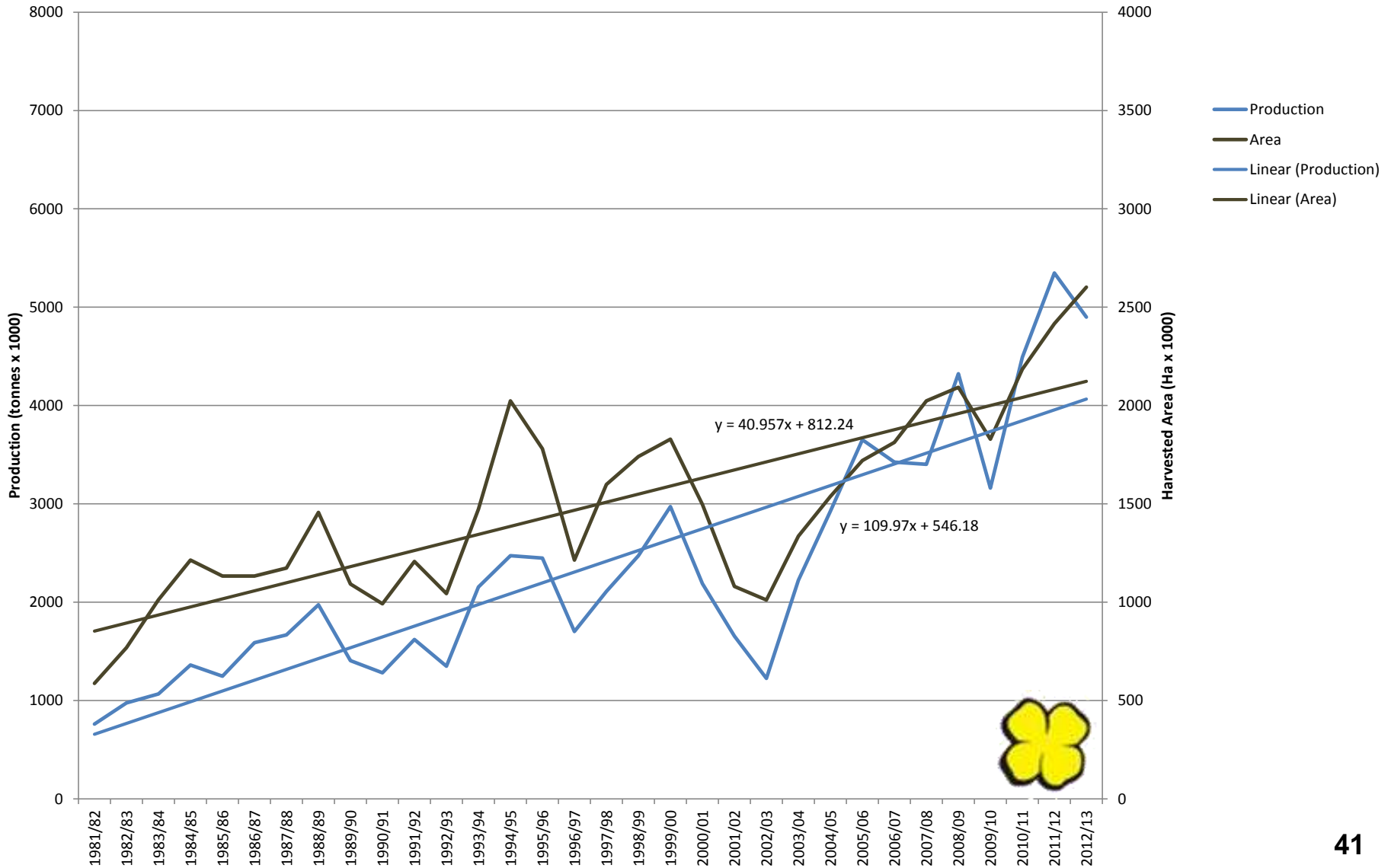




# AB Canola: Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

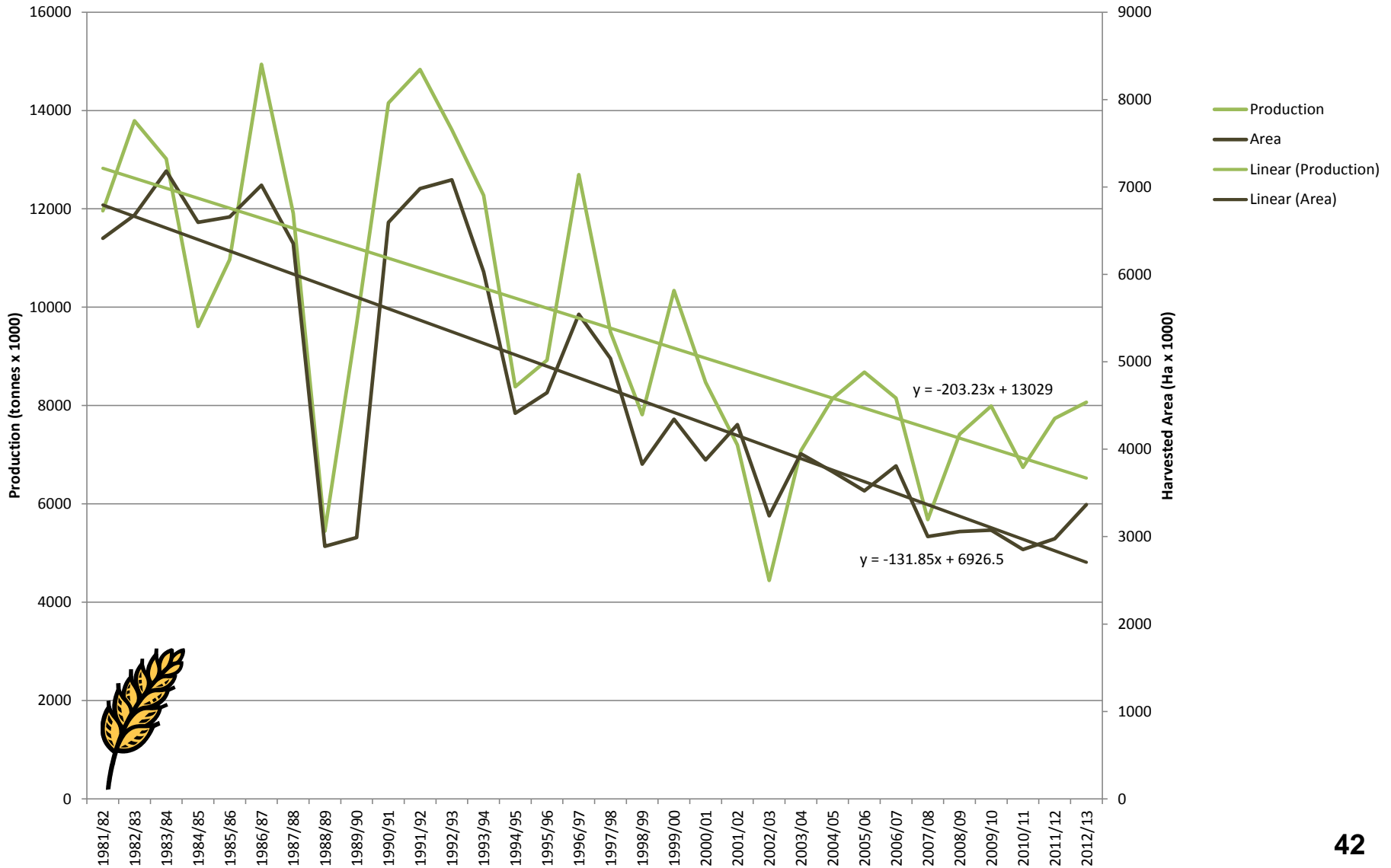
## Alberta: Total Production and Harvested Area - Canola



# SK Spring Wheat: Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

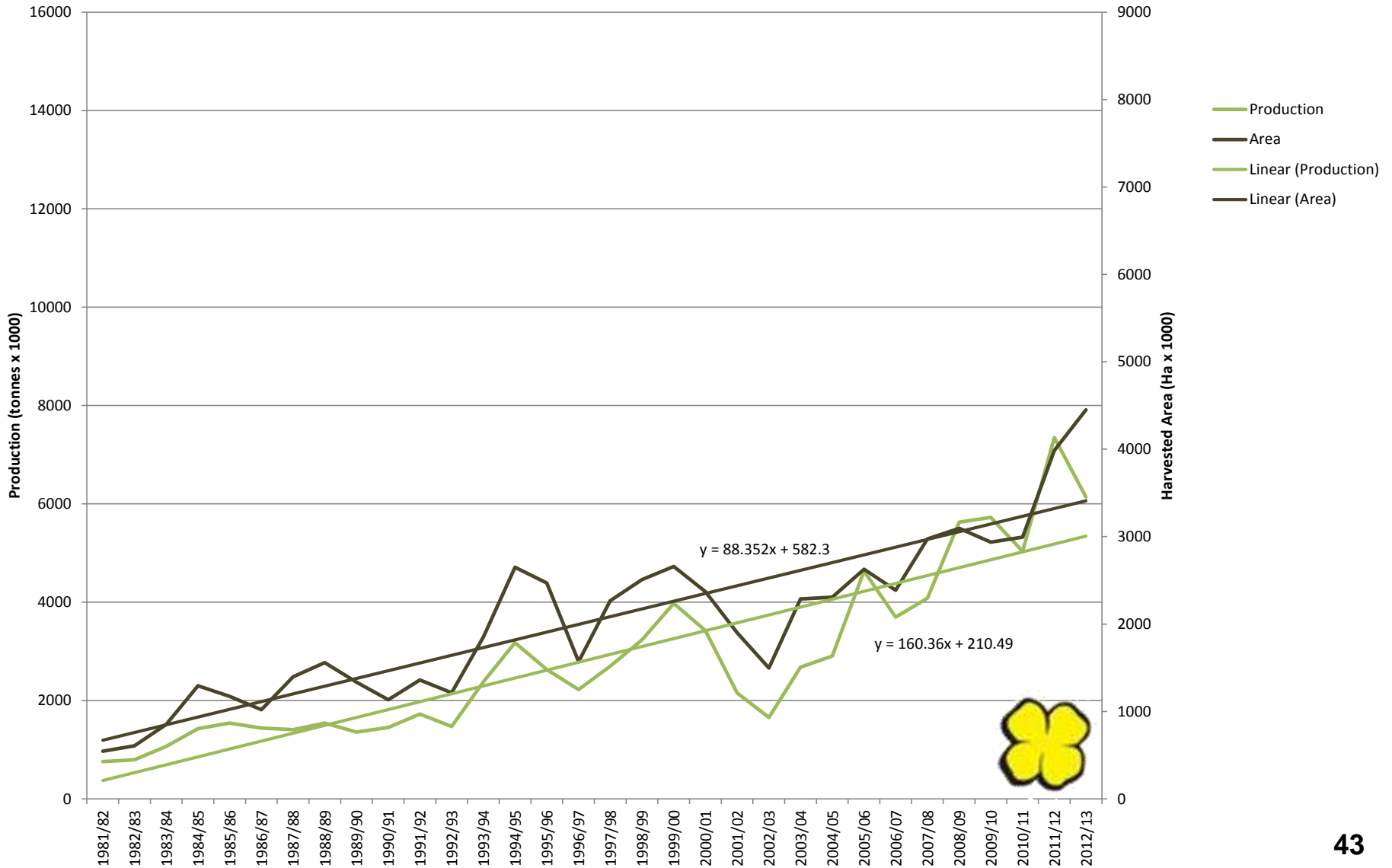
## Saskatchewan: Total Production and Harvested Area - Spring Wheat



# SK Canola: Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

## Saskatchewan: Total Production and Harvested Area - Canola



# MB Spring Wheat: Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

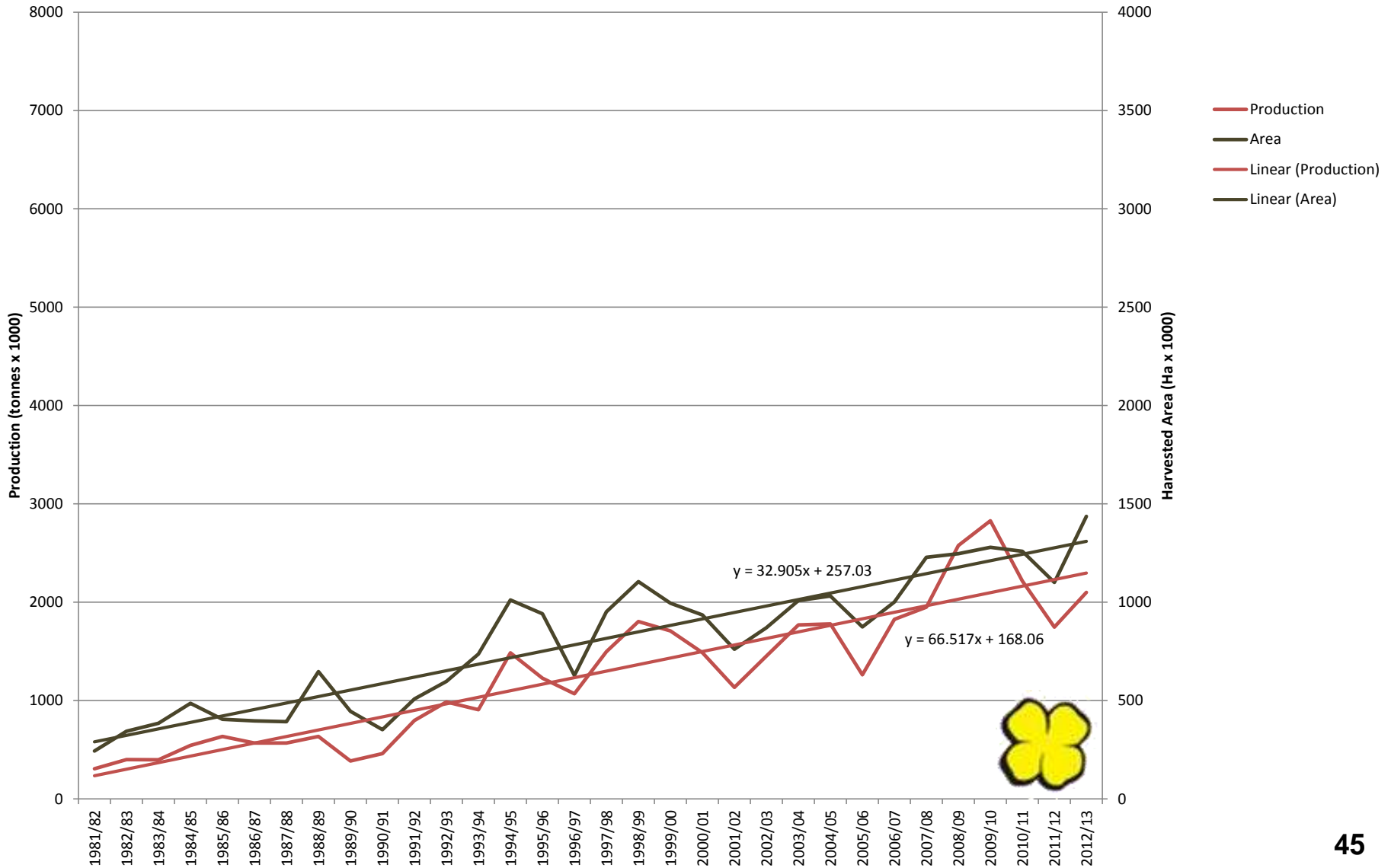
## Manitoba: Total Production and Harvested Area - Spring Wheat



# MB Canola: Production & Harvested Area (1981/82 - 2012/13)

Graf 2013

## Manitoba: Total Production and Harvested Area - Canola





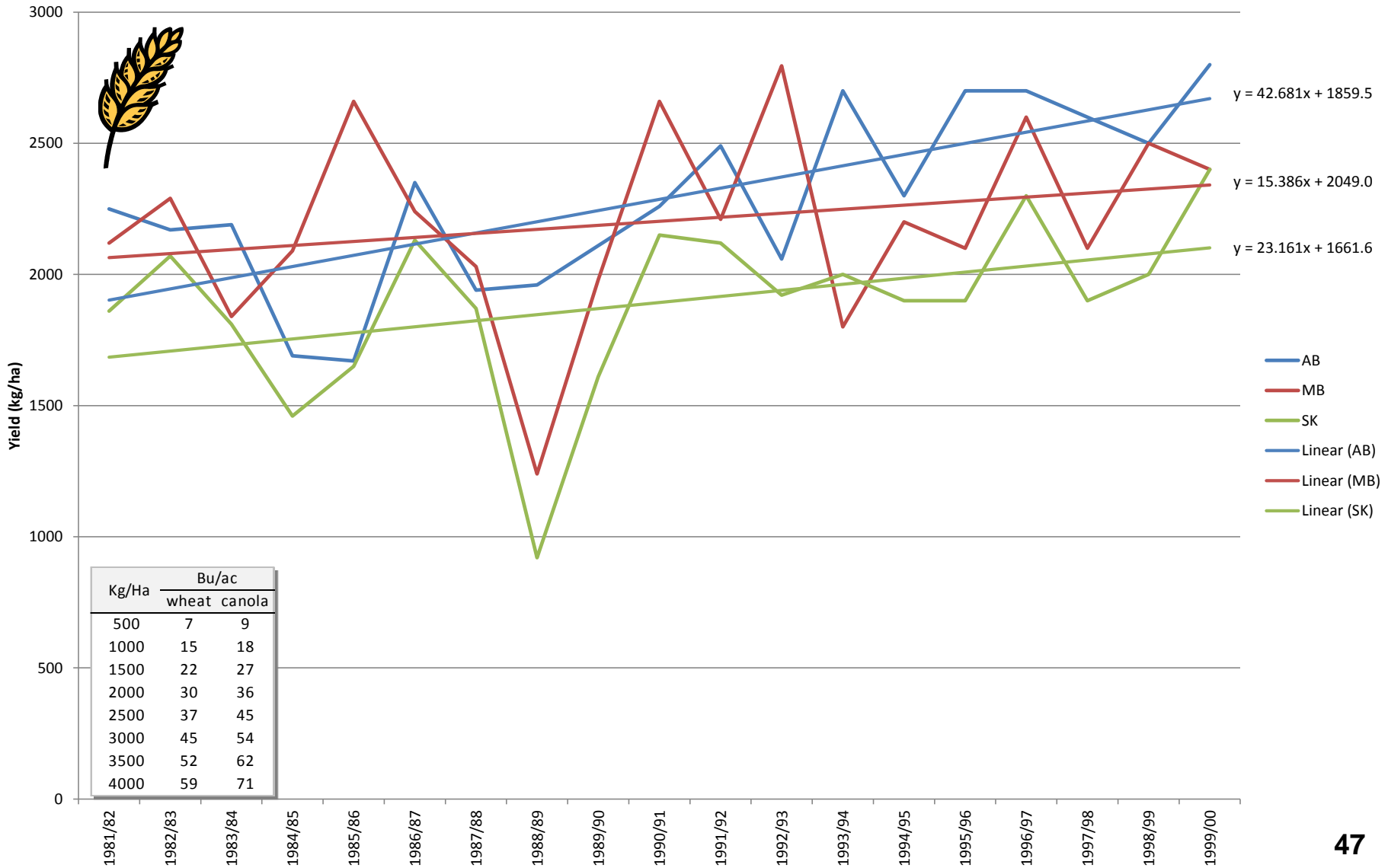
**1981/82 – 1999/00**

**complete set of graphs**

# Spring Wheat Yields by Province (1981/82 – 1999/00)

Graf 2013

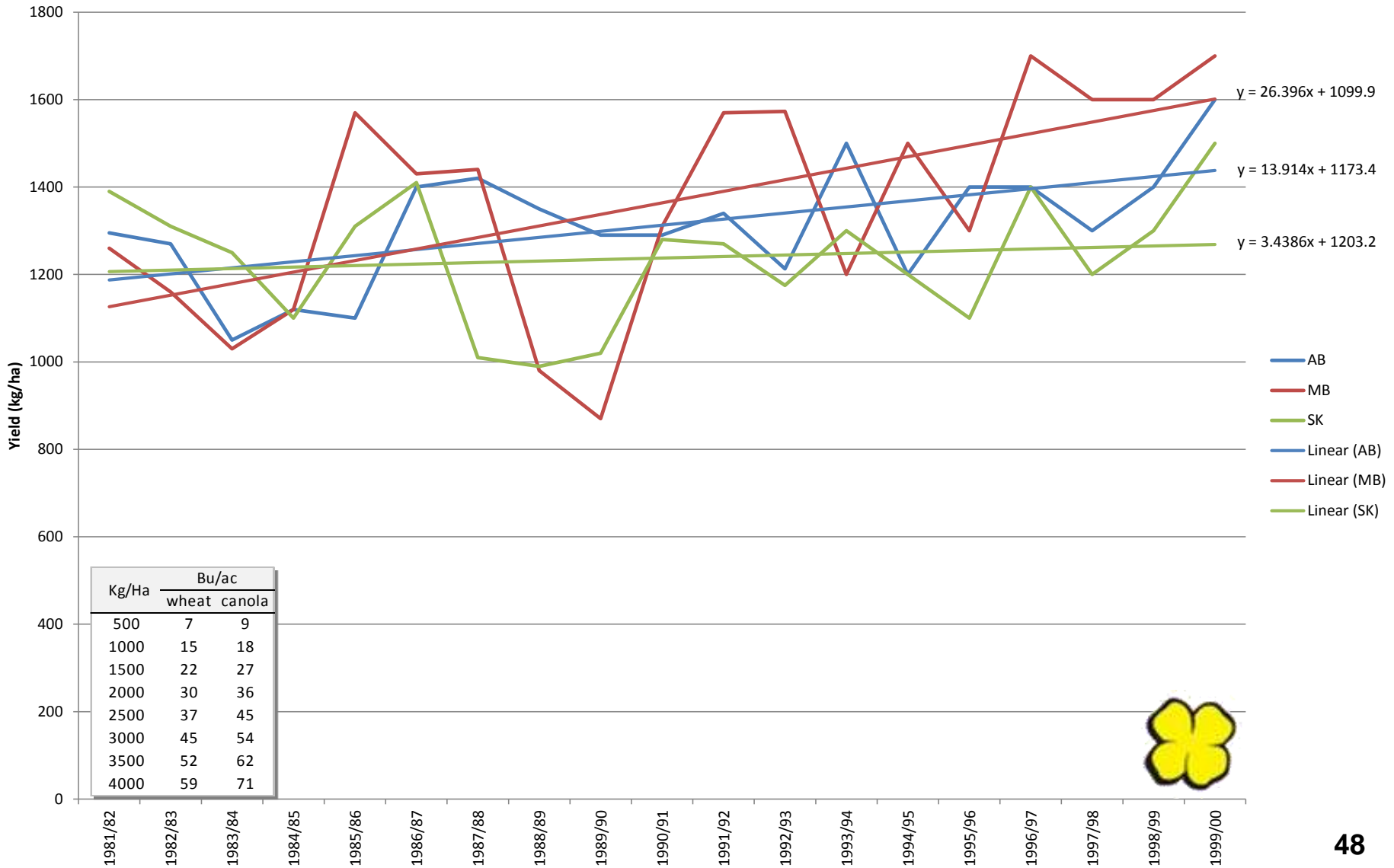
## Spring wheat yield, 1981/82 - 1999/00



# Canola Yields by Province (1981/82 – 1999/00)

Graf 2013

## Canola yield, 1981/82 - 1999/00

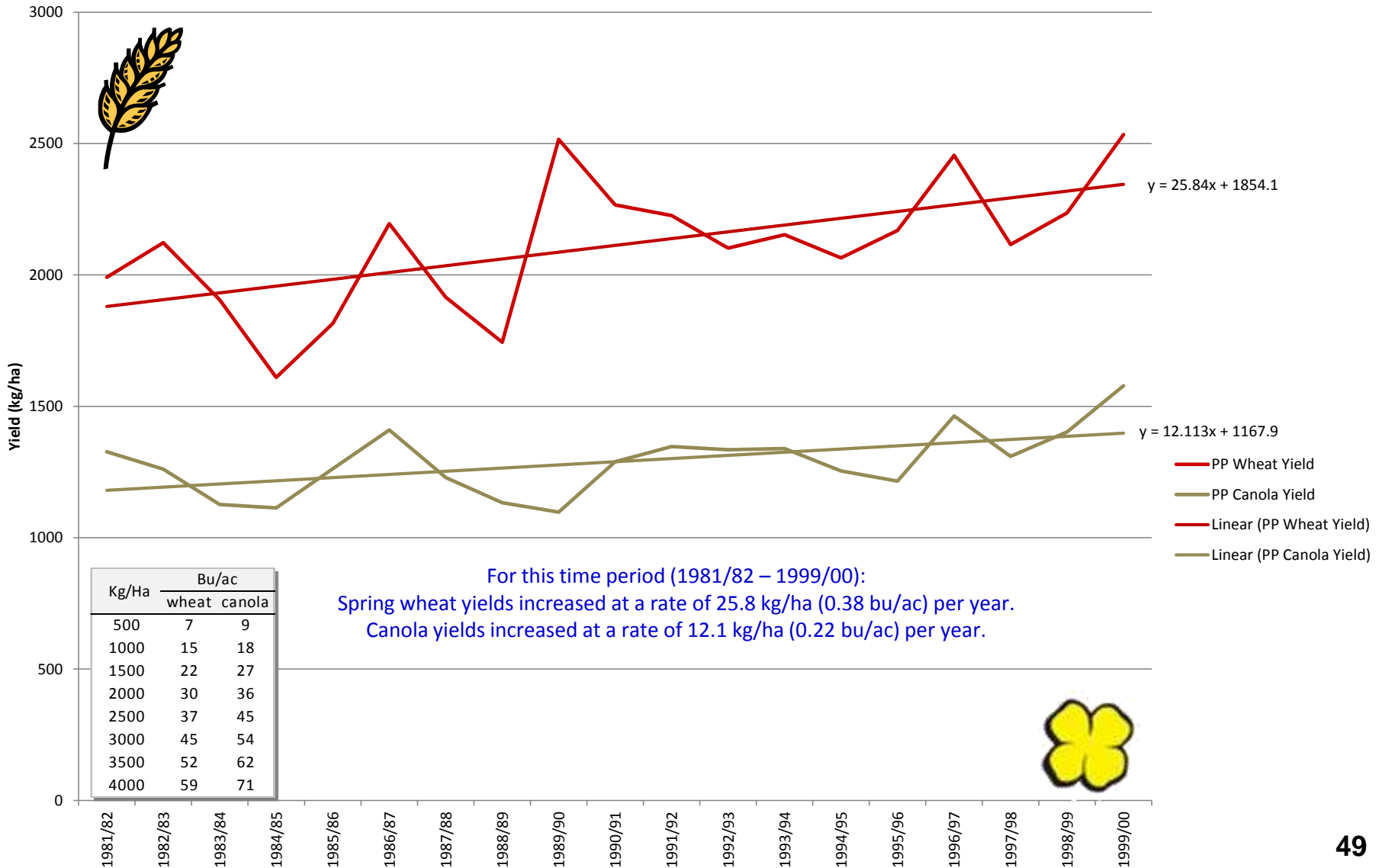




# PP Spring Wheat and Canola Yield (1981/82 – 1999/00)

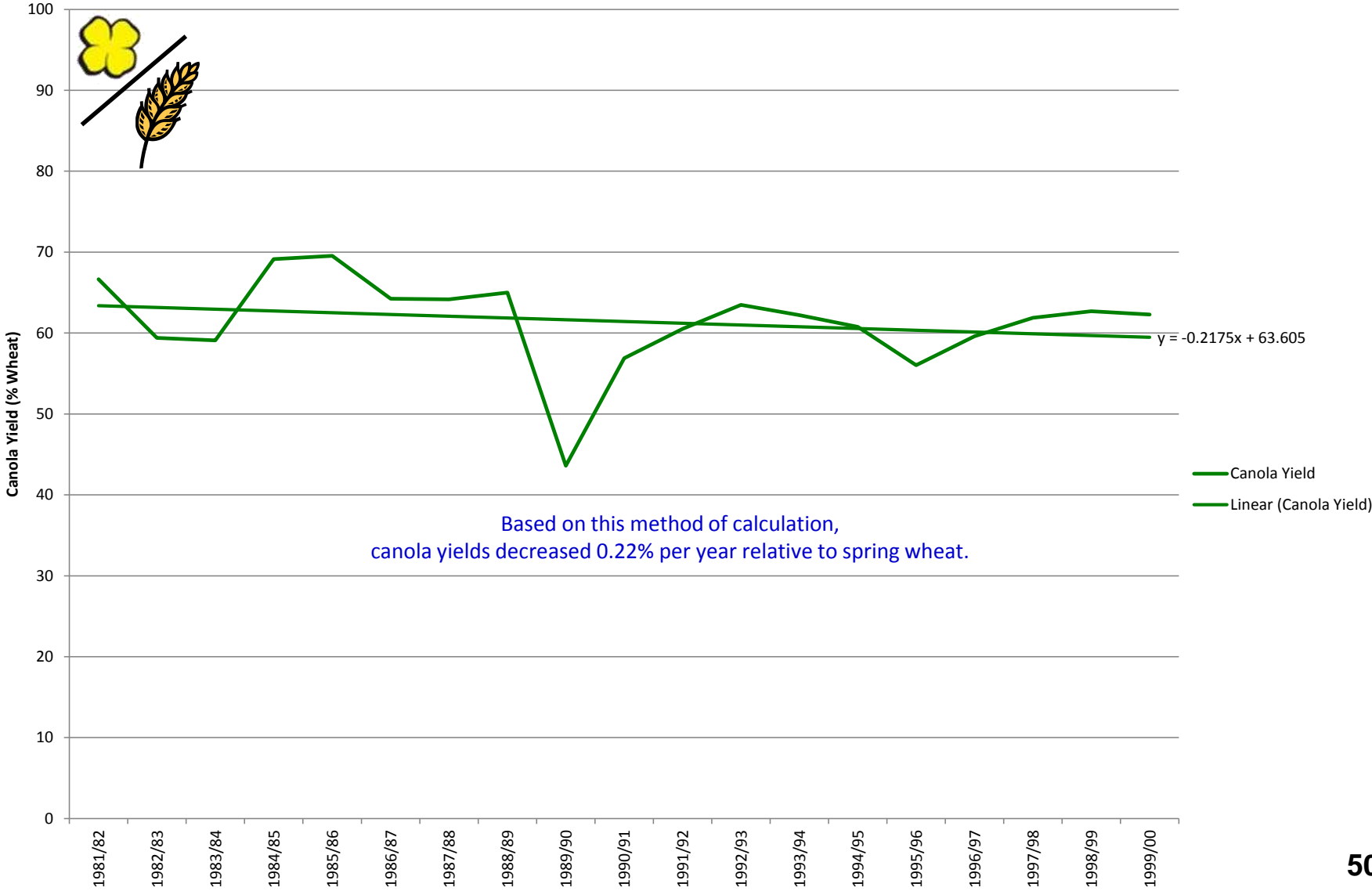
Graf 2013

Prairie province spring wheat and canola yield, 1981/82 - 1999/00



# PP Canola Yield relative to Spring Wheat (1981/82 – 1999/00)

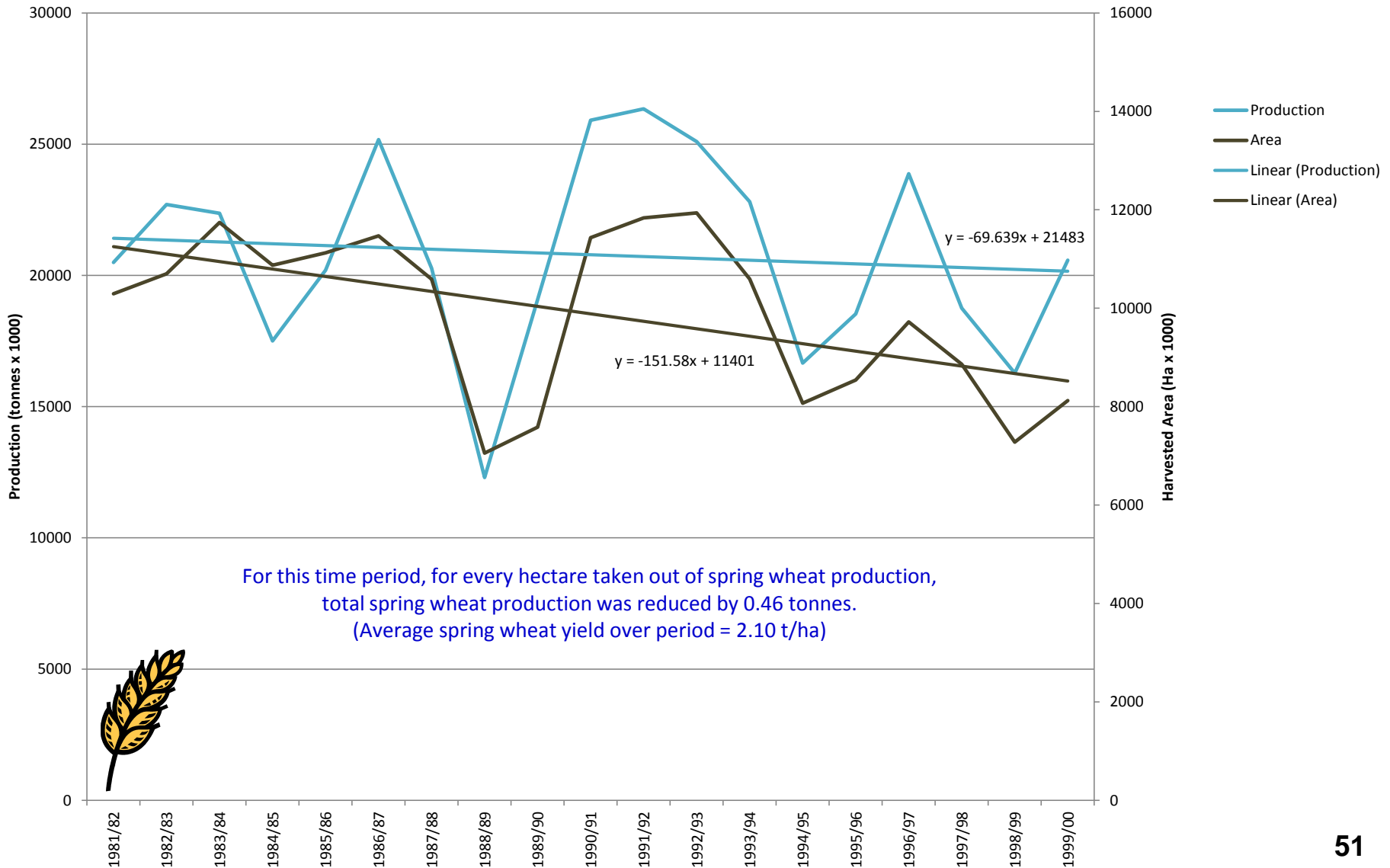
Prairie canola yield as a percent of wheat yield, 1981/82 - 1999/00



# PP Spring Wheat Production & Harvested Area (1981/82 – 1999/00)

Graf 2013

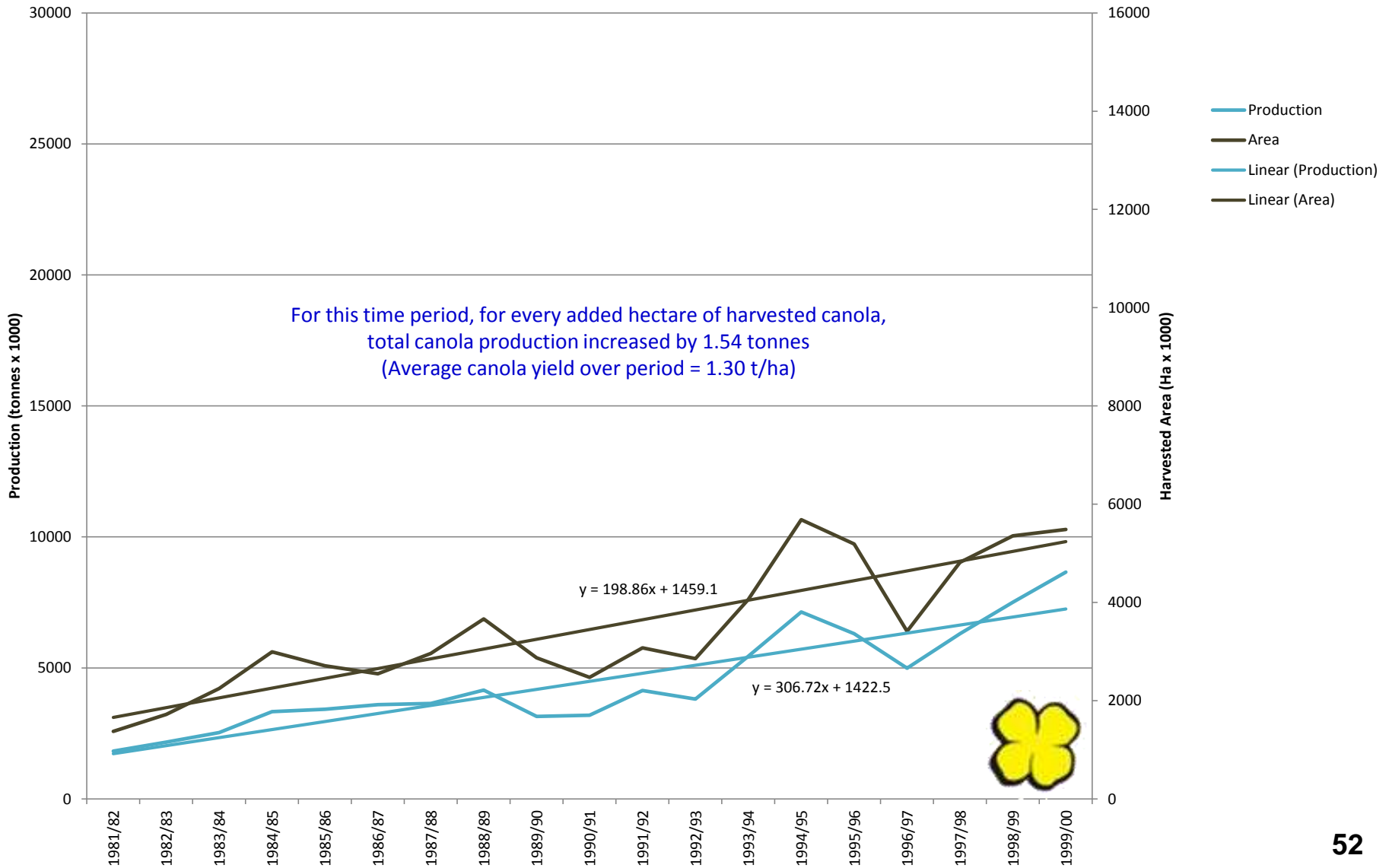
## Prairie Provinces: Total Production and Harvested Area - Spring Wheat



# PP Canola Production & Harvested Area (1981/82 – 1999/00)

Graf 2013

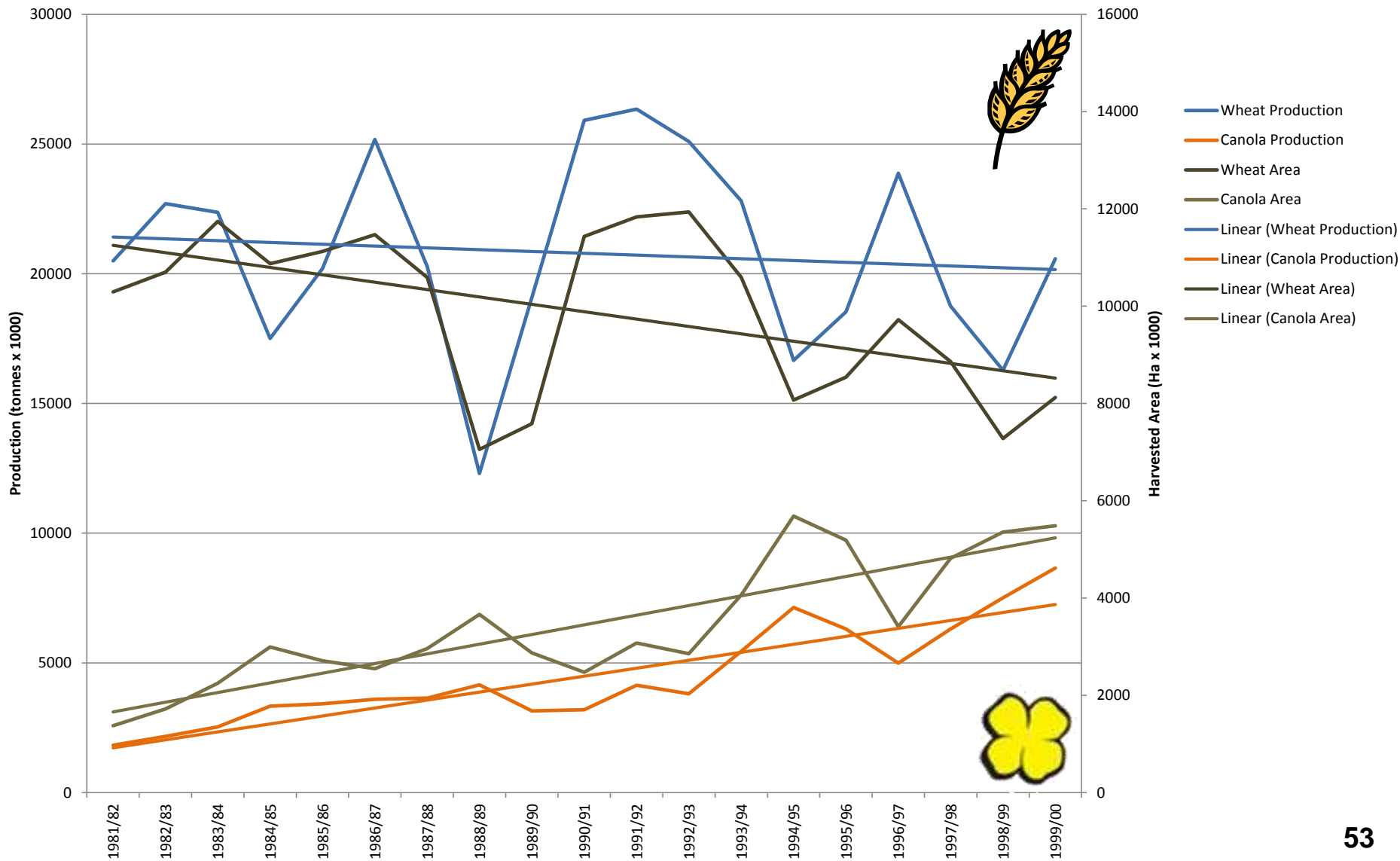
## Prairie Provinces: Total Production and Harvested Area - Canola



# PP Spring Wheat & Canola: Production & Harvested Area (1981/82 - 1999/00)

Graf 2013

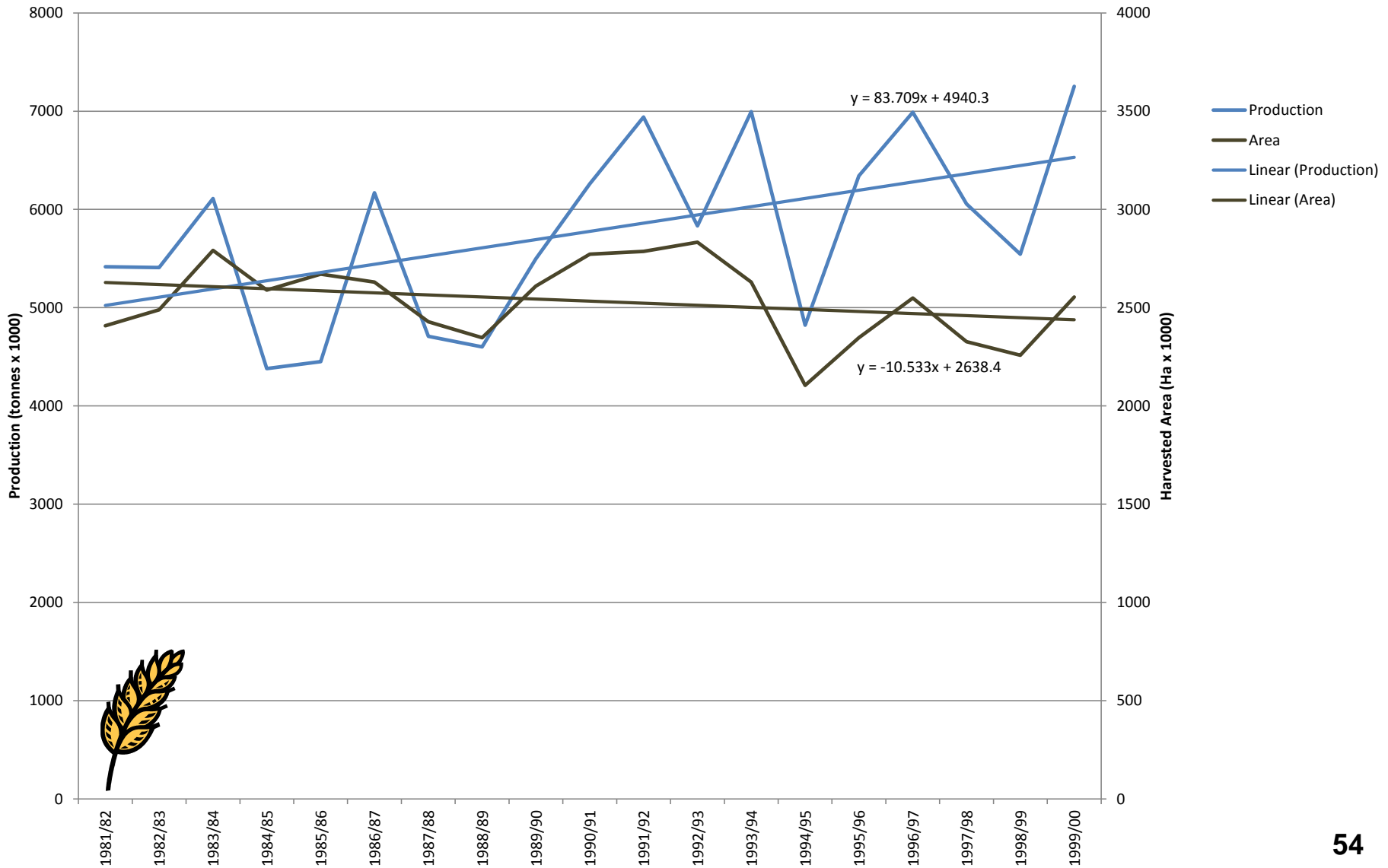
## Prairie Provinces: Total Production and Harvested Area - Spring Wheat & Canola



# AB Spring Wheat: Production & Harvested Area (1981/82 – 1999/00)

Graf 2013

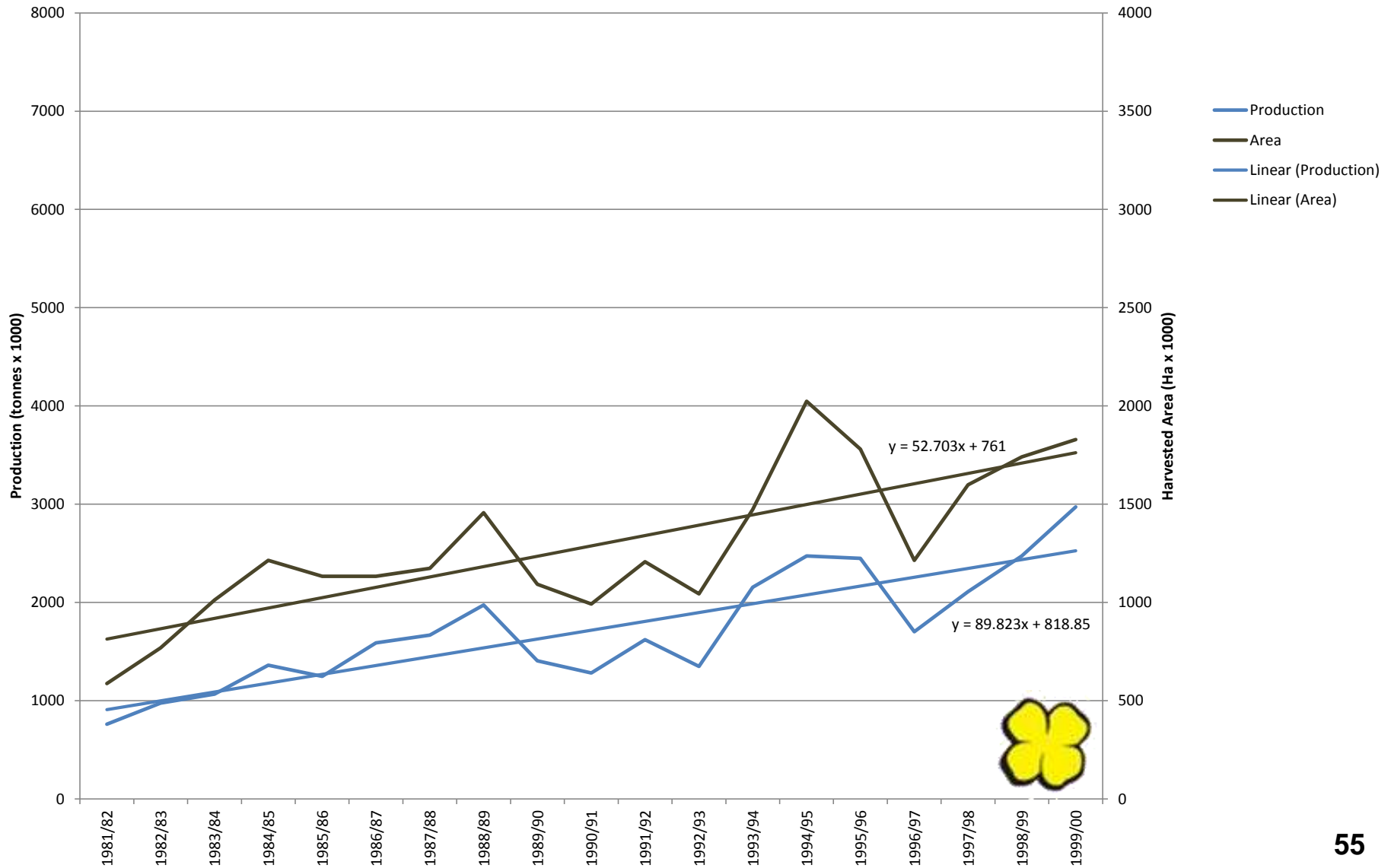
## Alberta: Total Production and Harvested Area - Spring Wheat



# AB Canola: Production & Harvested Area (1981/82 – 1999/00)

Graf 2013

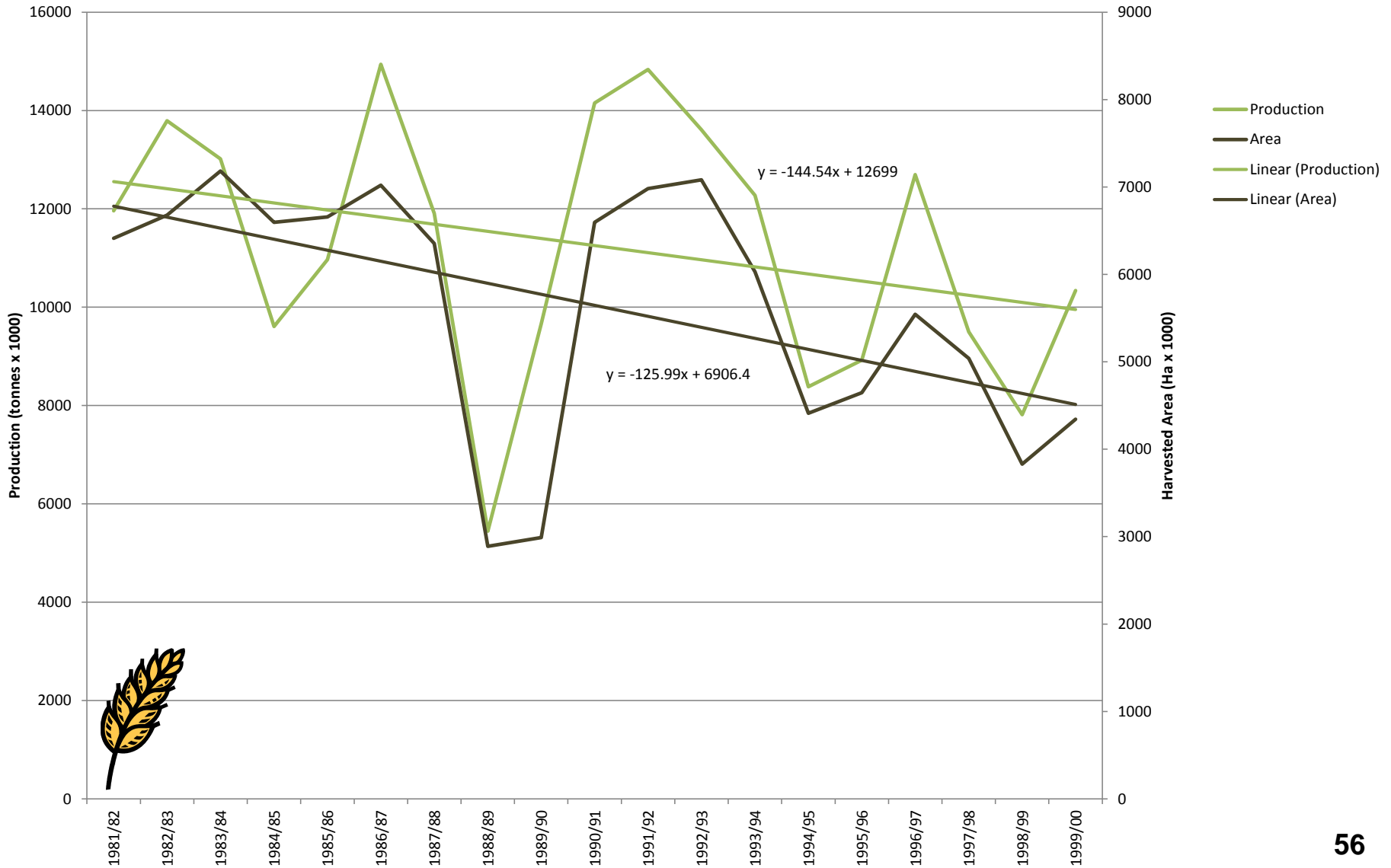
## Alberta: Total Production and Harvested Area - Canola



# SK Spring Wheat: Production & Harvested Area (1981/82 – 1999/00)

Graf 2013

## Saskatchewan: Total Production and Harvested Area - Spring Wheat

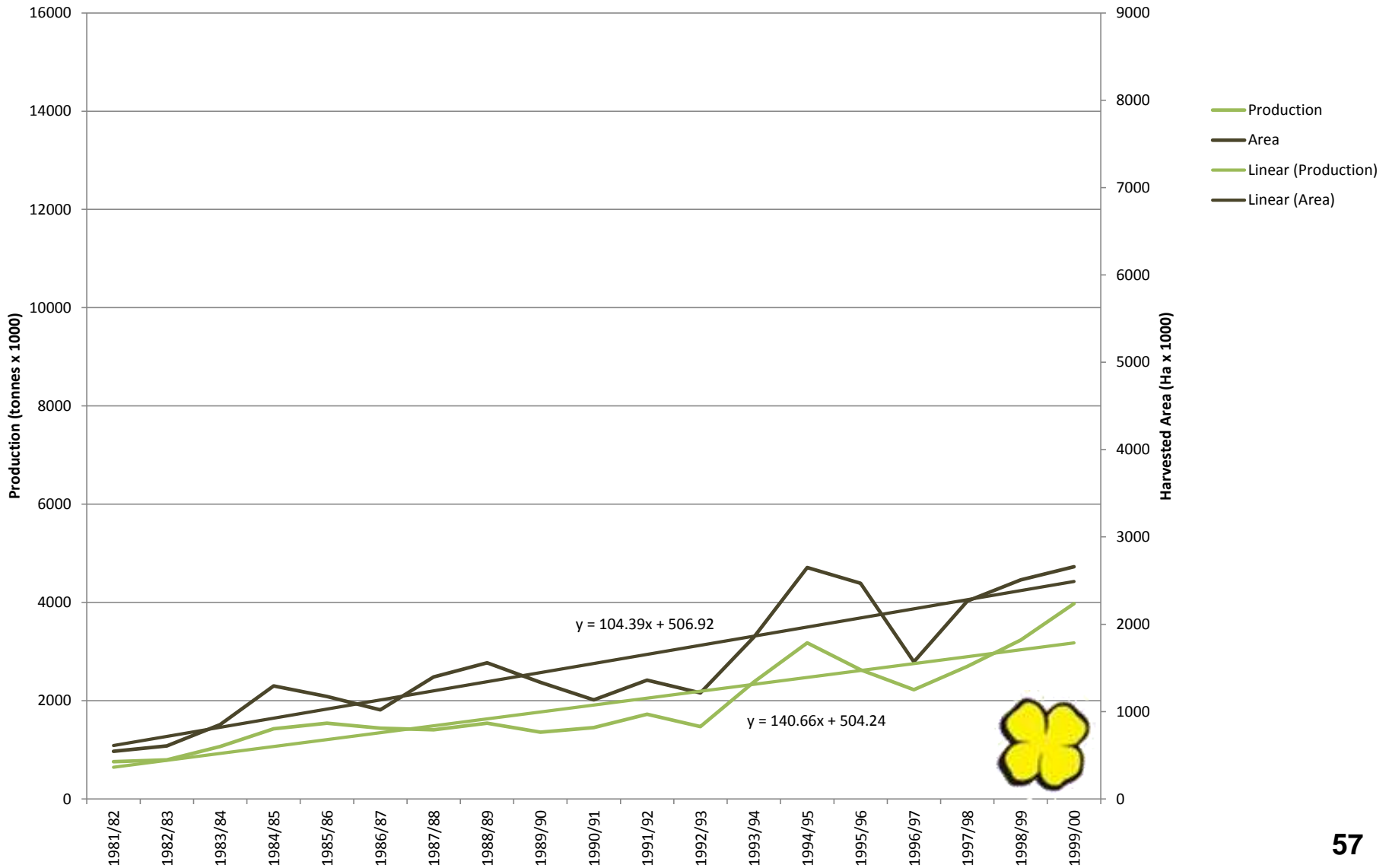




# SK Canola: Production & Harvested Area (1981/82 – 1999/00)

Graf 2013

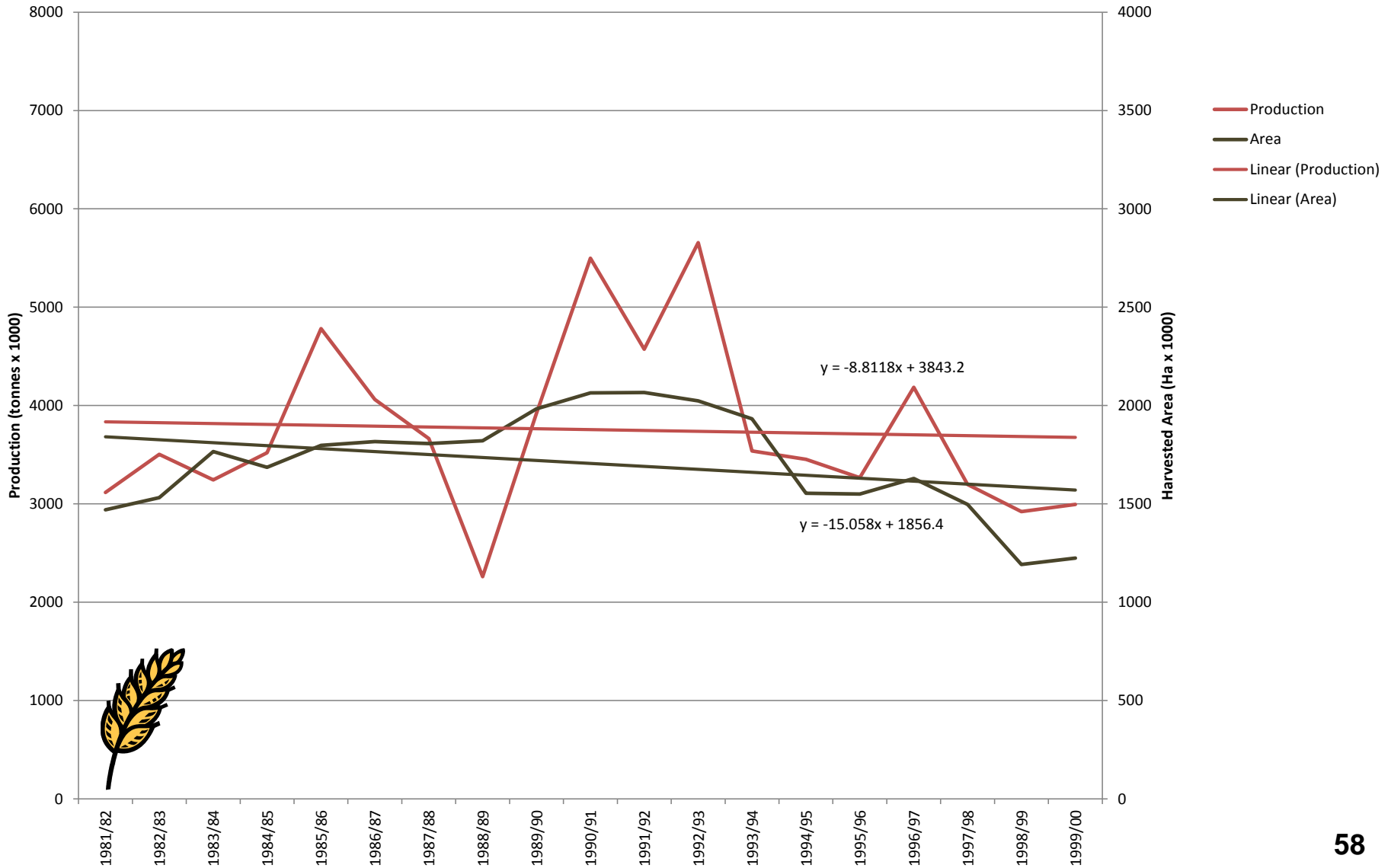
## Saskatchewan: Total Production and Harvested Area - Canola



# MB Spring Wheat: Production & Harvested Area (1981/82 – 1999/00)

Graf 2013

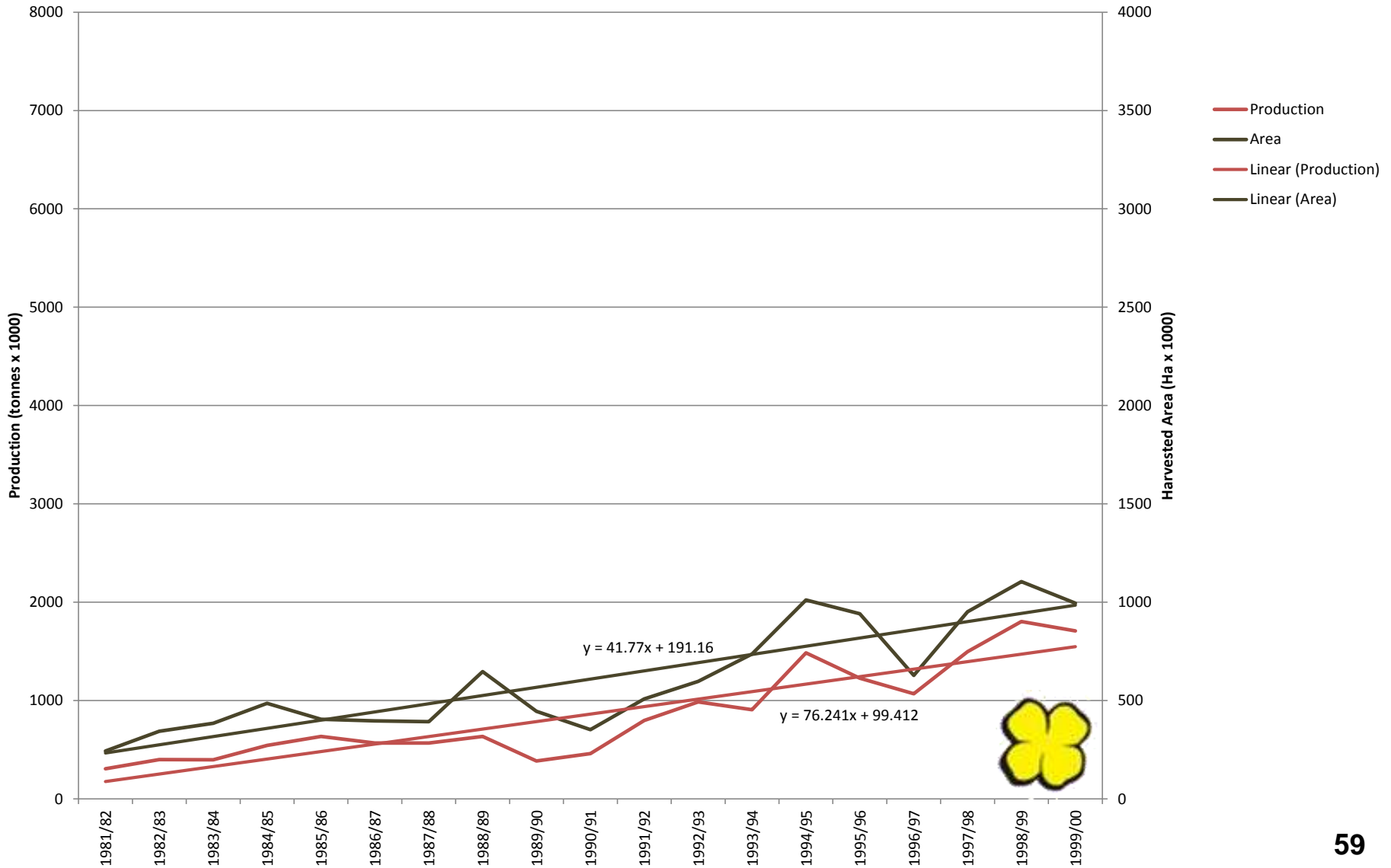
## Manitoba: Total Production and Harvested Area - Spring Wheat



# MB Canola: Production & Harvested Area (1981/82 – 1999/00)

Graf 2013

## Manitoba: Total Production and Harvested Area - Canola





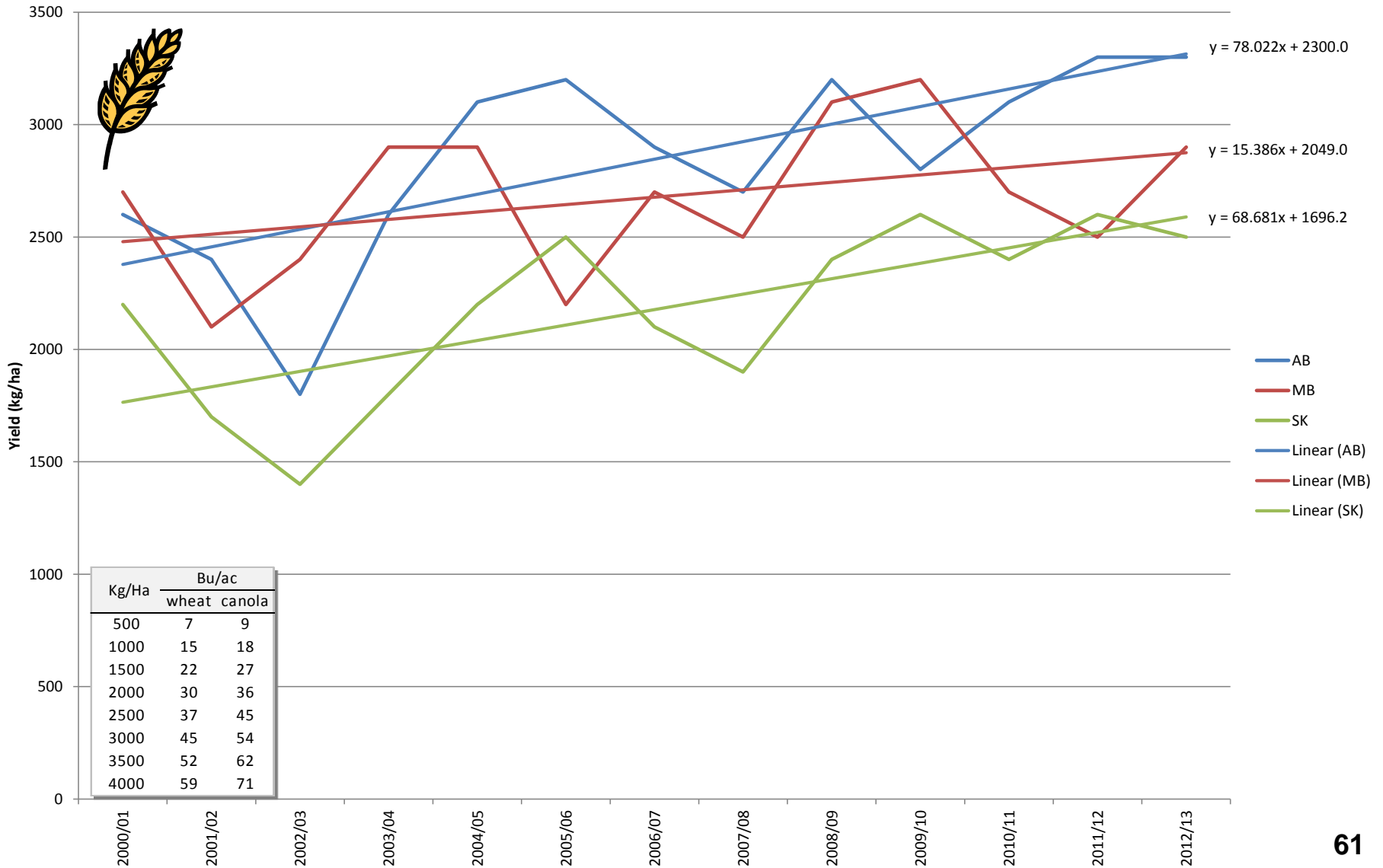
**2000/01 - 2012/13**

**complete set of graphs**

# Spring Wheat Yields by Province (2000/01 – 2012/13)

Graf 2013

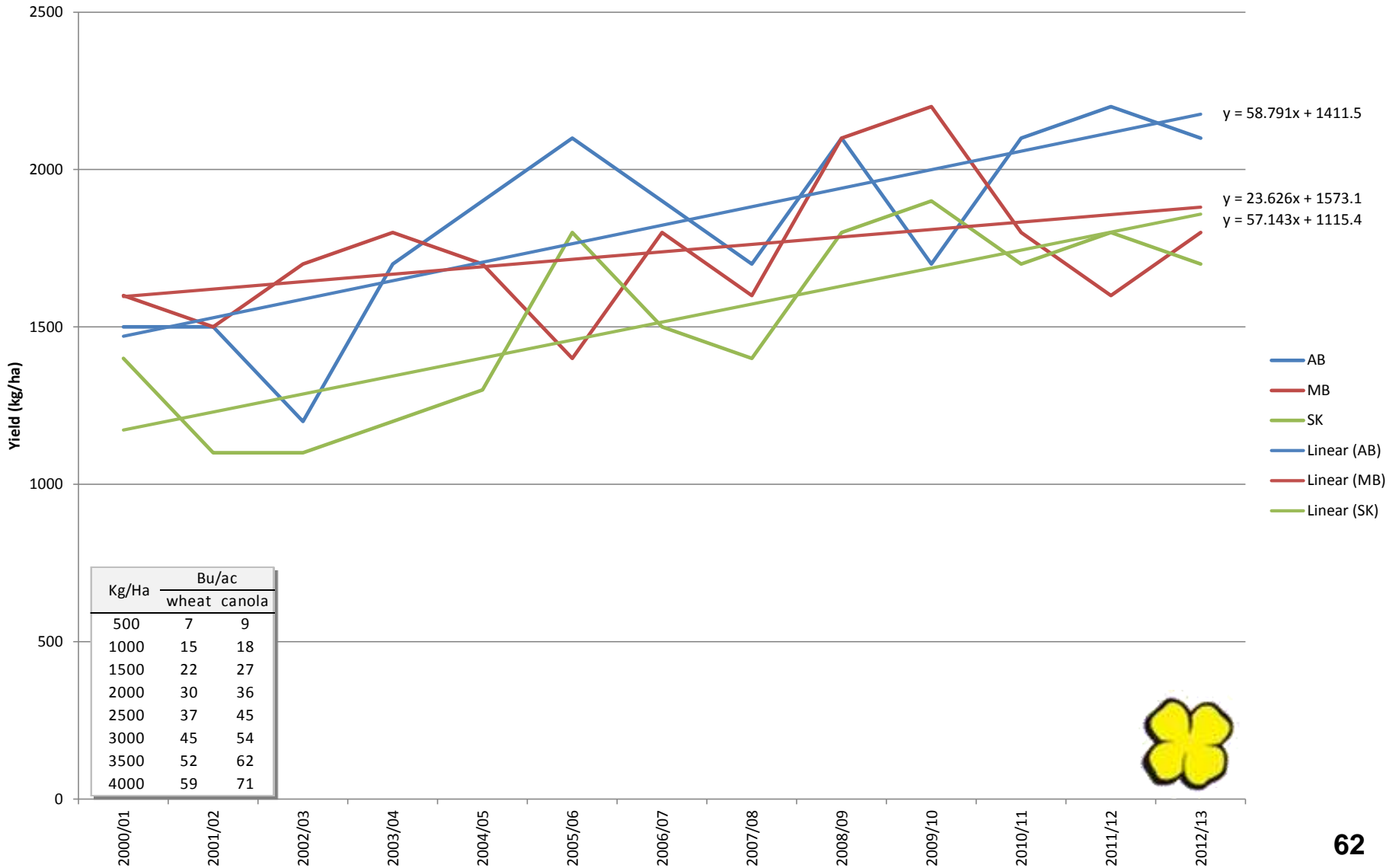
## Spring wheat yield, 2000/01 - 2012/13



# Canola Yields by Province (2000/01 – 2012/13)

Graf 2013

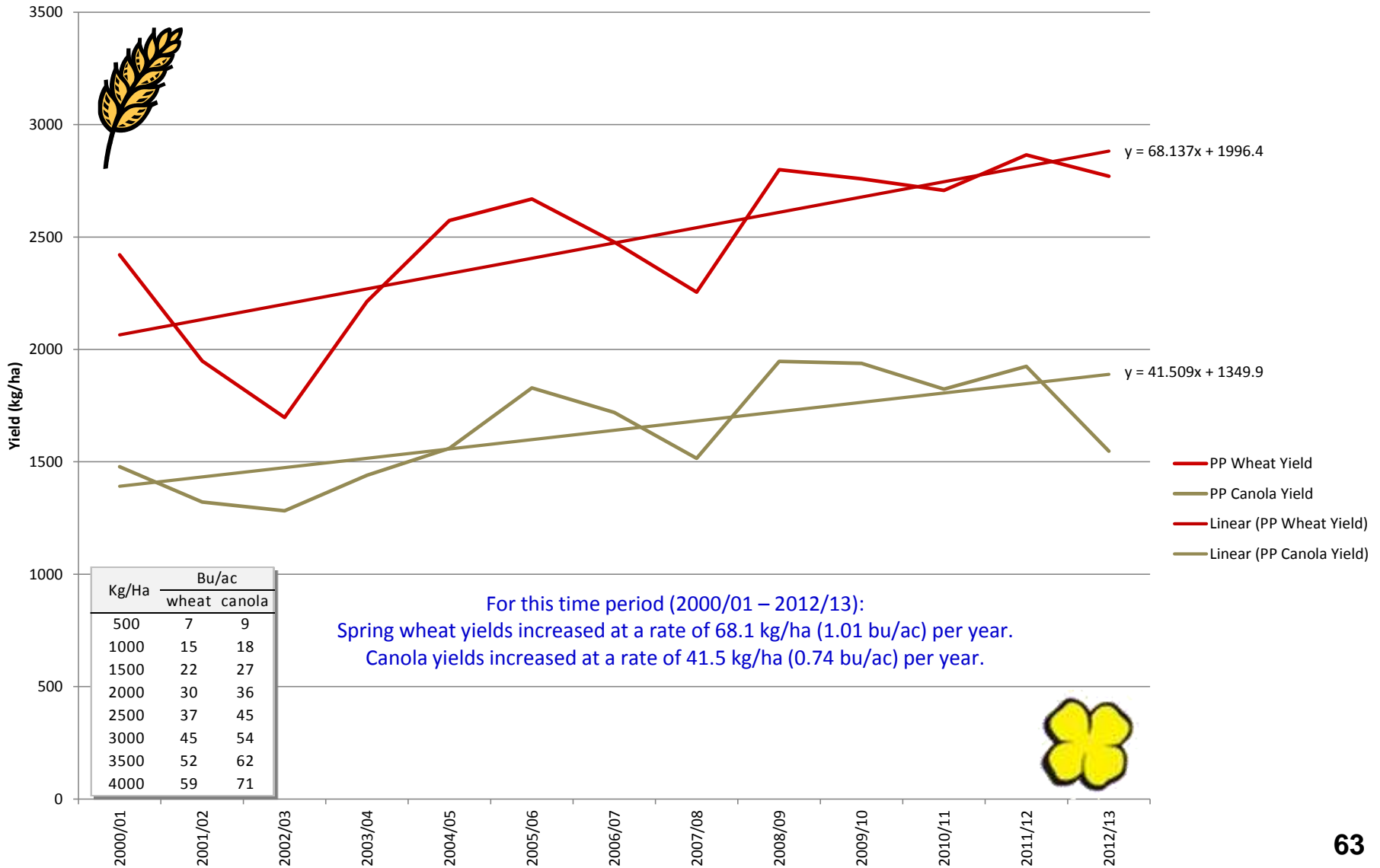
## Canola yield, 2000/01 - 2012/13



# PP Spring Wheat and Canola Yield (2000/01 – 2012/13)

Graf 2013

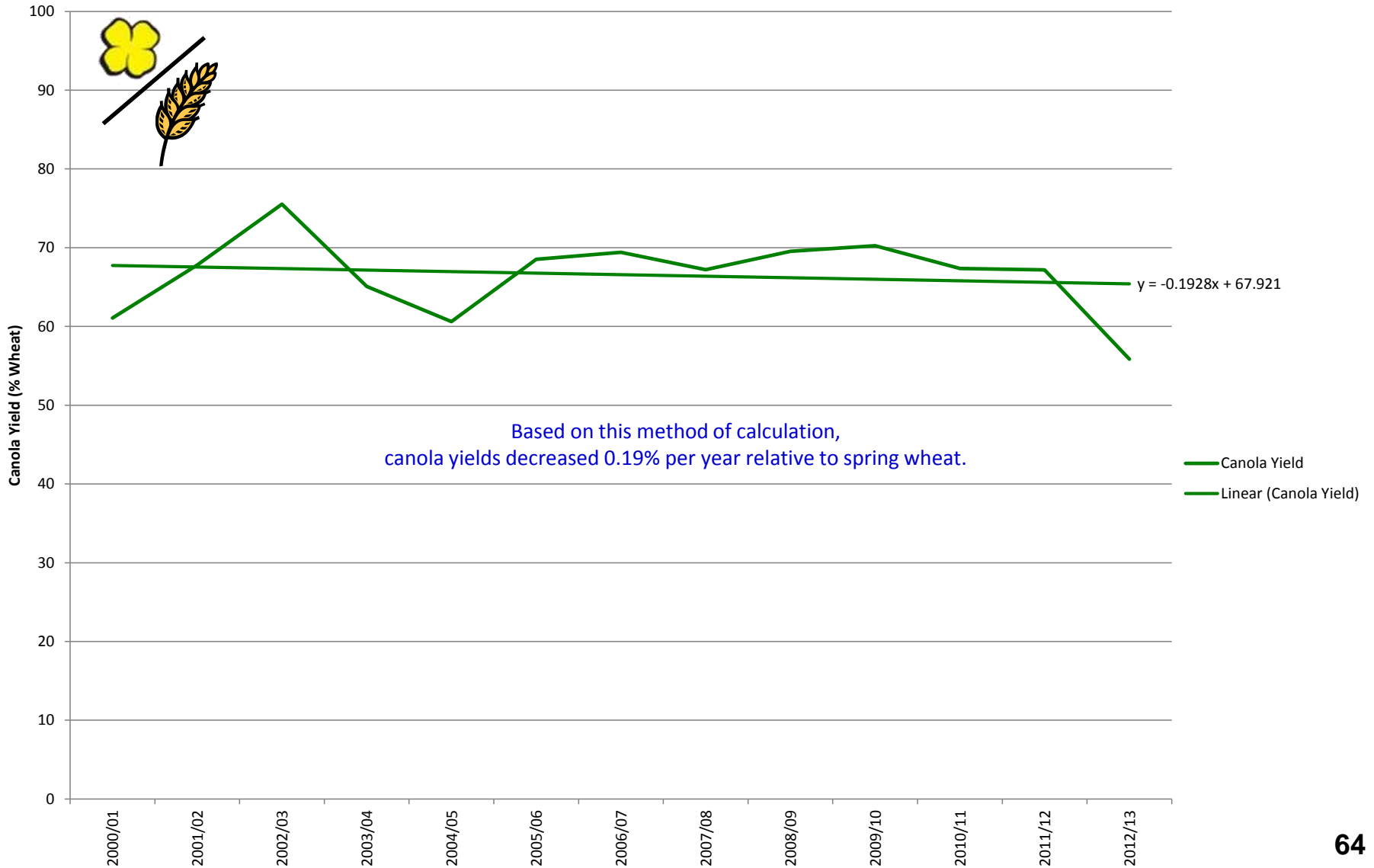
Prairie province spring wheat and canola yield, 2000/01 - 2012/13



# PP Canola Yield relative to Spring Wheat (2000/01 – 2012/13)

Graf 2013

## Prairie canola yield as a percent of wheat yield, 2000/01 - 2012/13

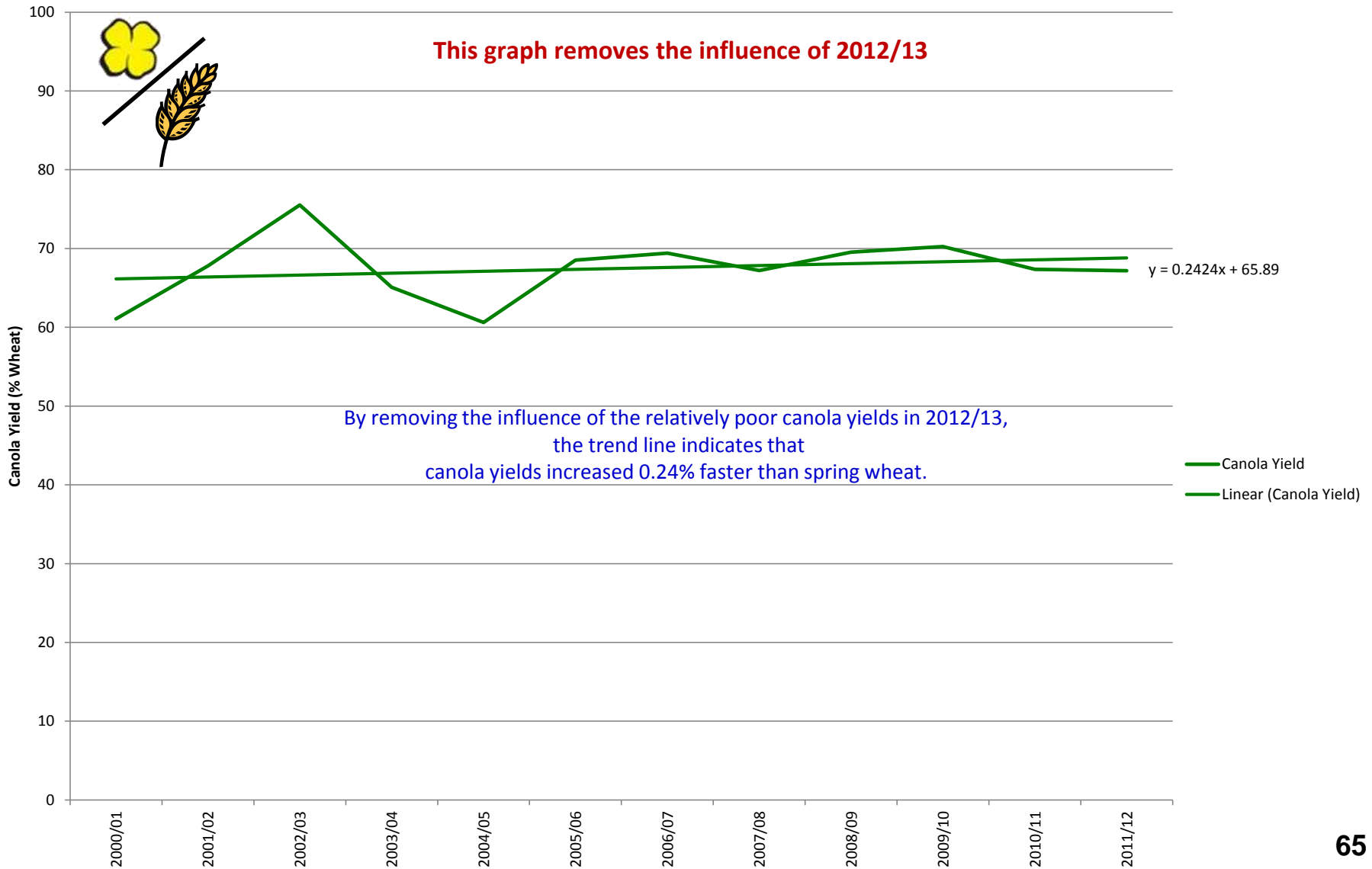




# PP Canola Yield relative to Spring Wheat (2000/01 – 2011/12)

Graf 2013

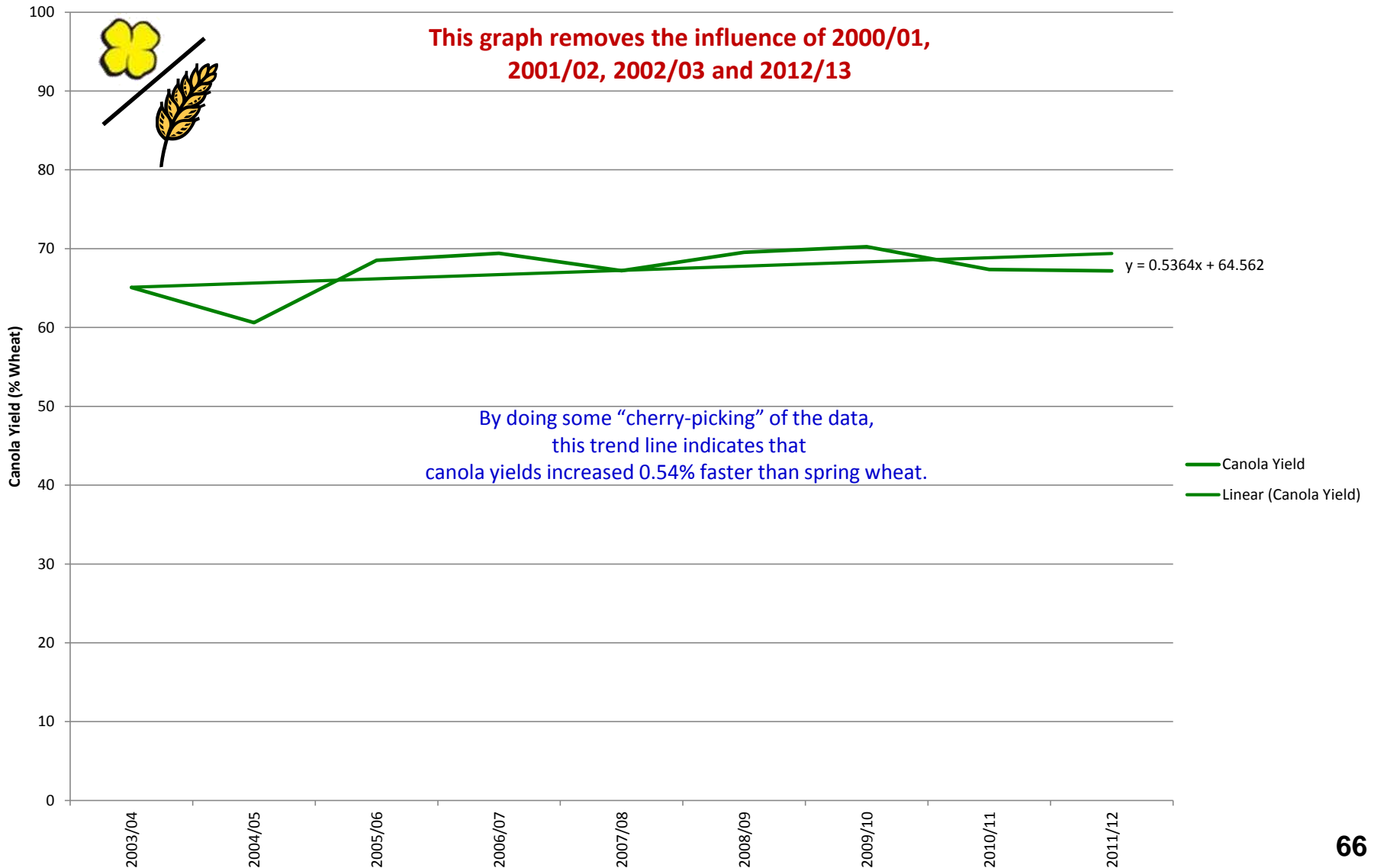
## Prairie canola yield as a percent of wheat yield, 2000/01 - 2011/12



# PP Canola Yield relative to Spring Wheat (2003/04 – 2011/12)

Graf 2013

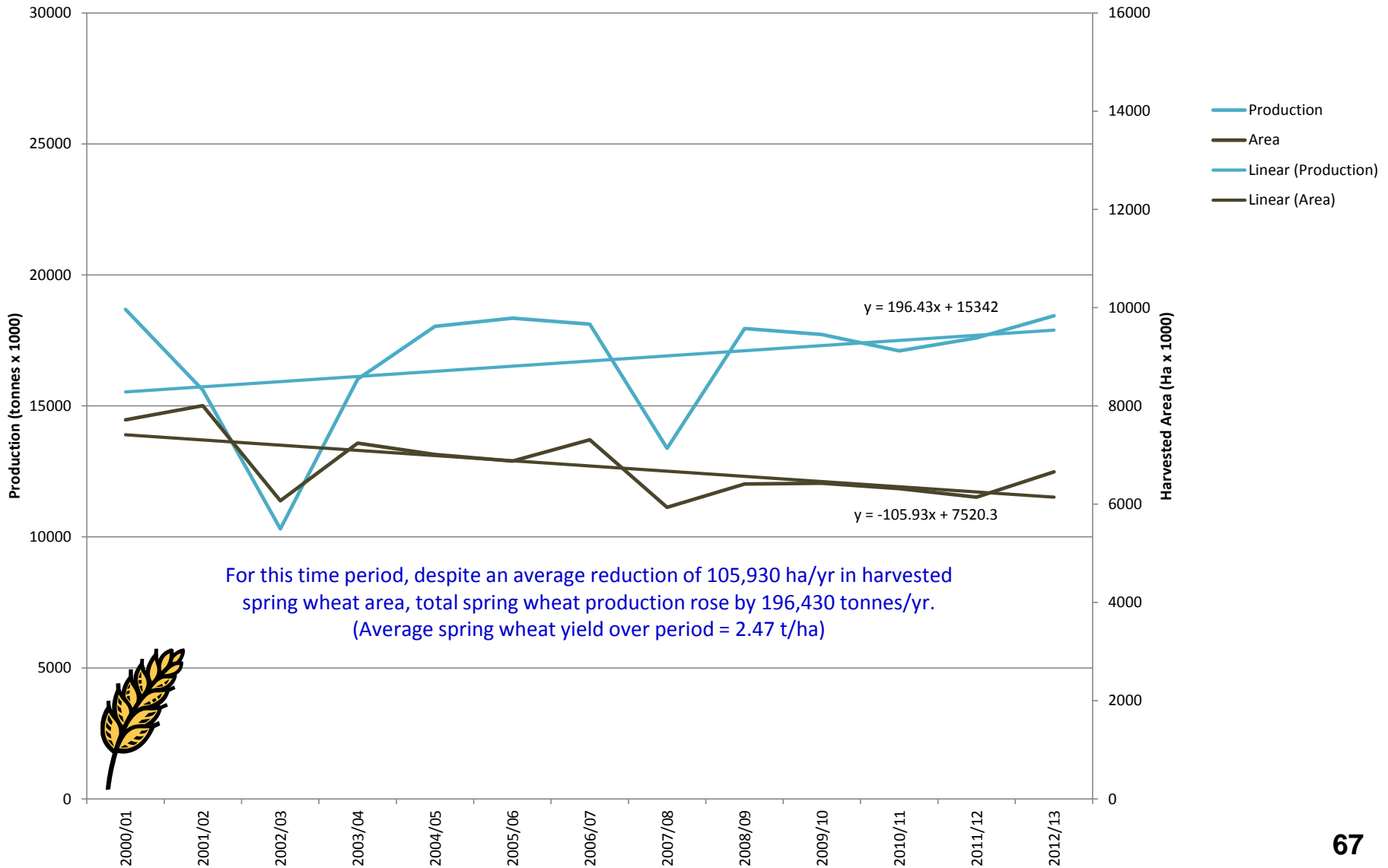
## Prairie canola yield as a percent of wheat yield, 2003/04 - 2011/12



# PP Spring Wheat Production & Harvested Area (2000/01– 2012/13)

Graf 2013

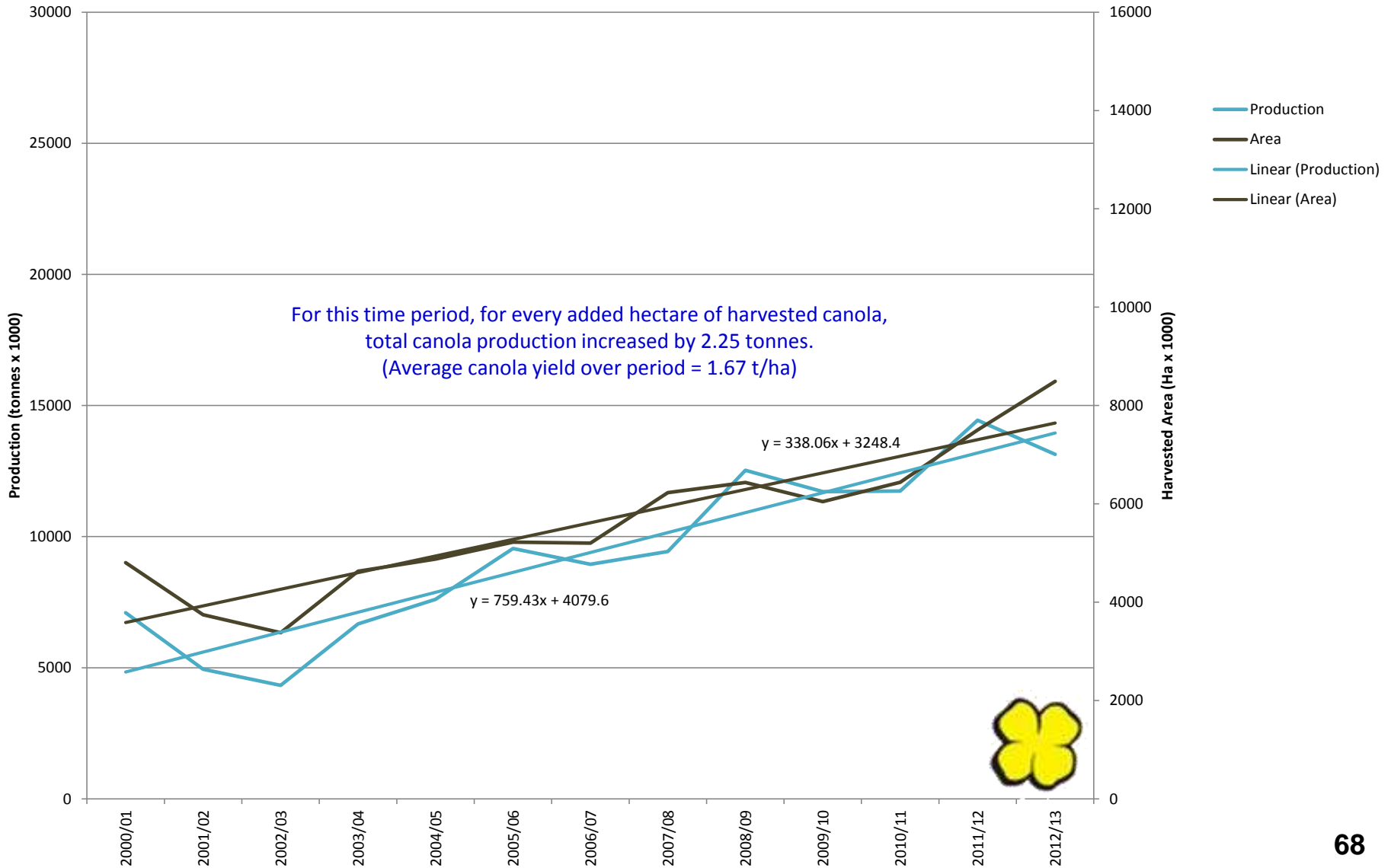
## Prairie Provinces: Total Production and Harvested Area - Spring Wheat



# PP Canola Production & Harvested Area (2000/01– 2012/13)

Graf 2013

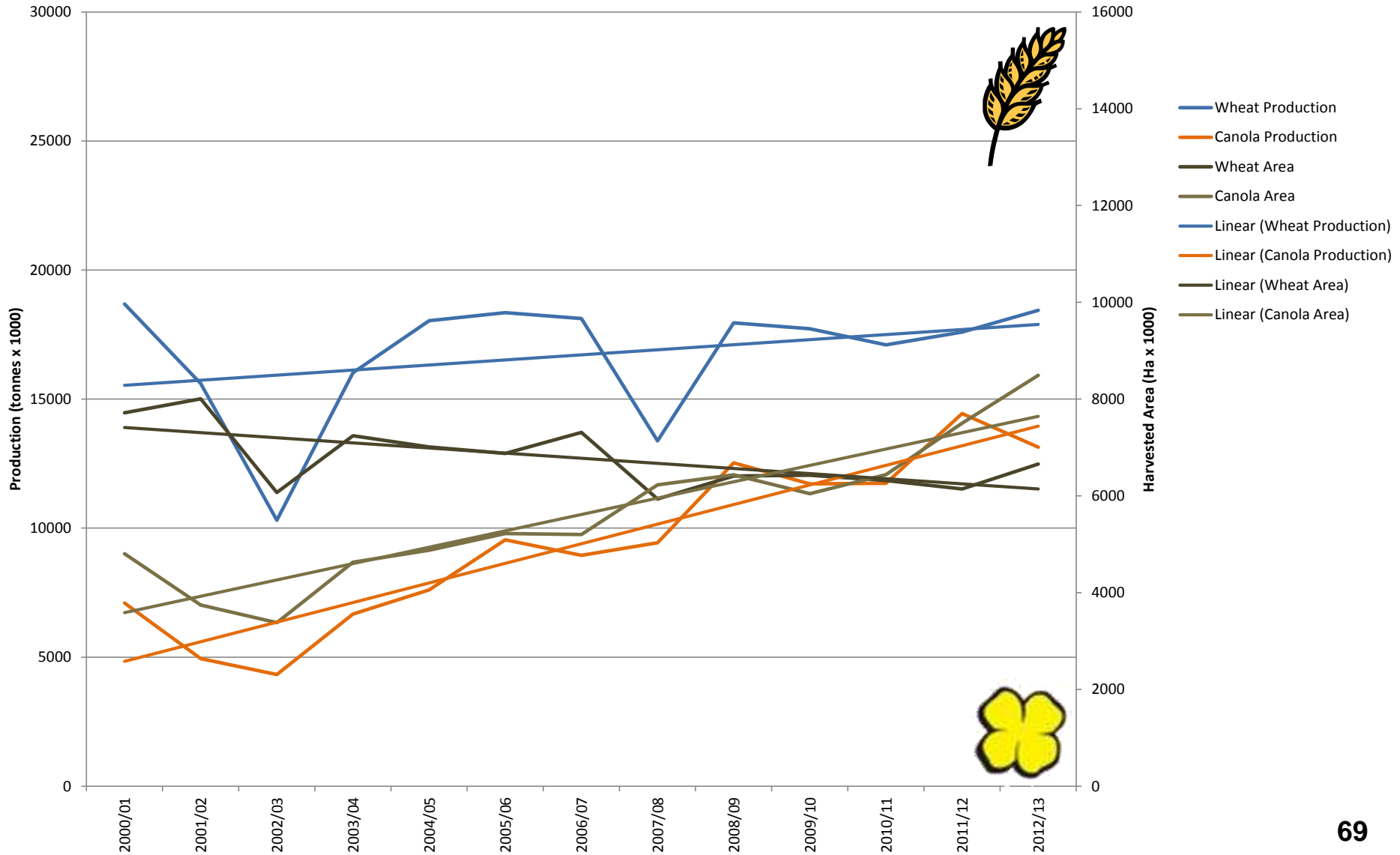
## Prairie Provinces: Total Production and Harvested Area - Canola



# PP Spring Wheat & Canola: Production & Harvested Area (2000/01 - 2012/13)

Graf 2013

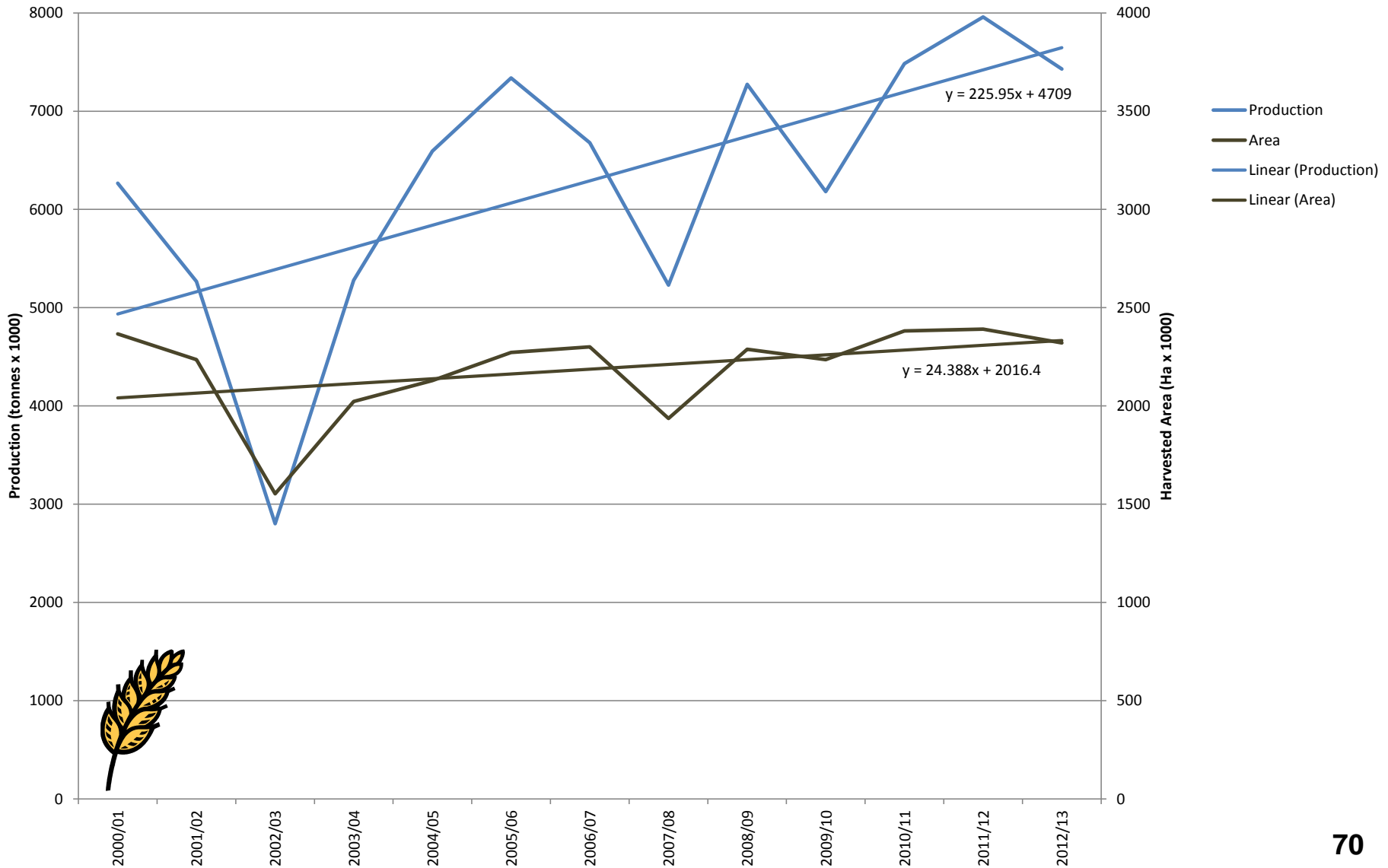
## Prairie Provinces: Total Production and Harvested Area - Spring Wheat & Canola



# AB Spring Wheat: Production & Harvested Area (2000/01 – 2012/13)

Graf 2013

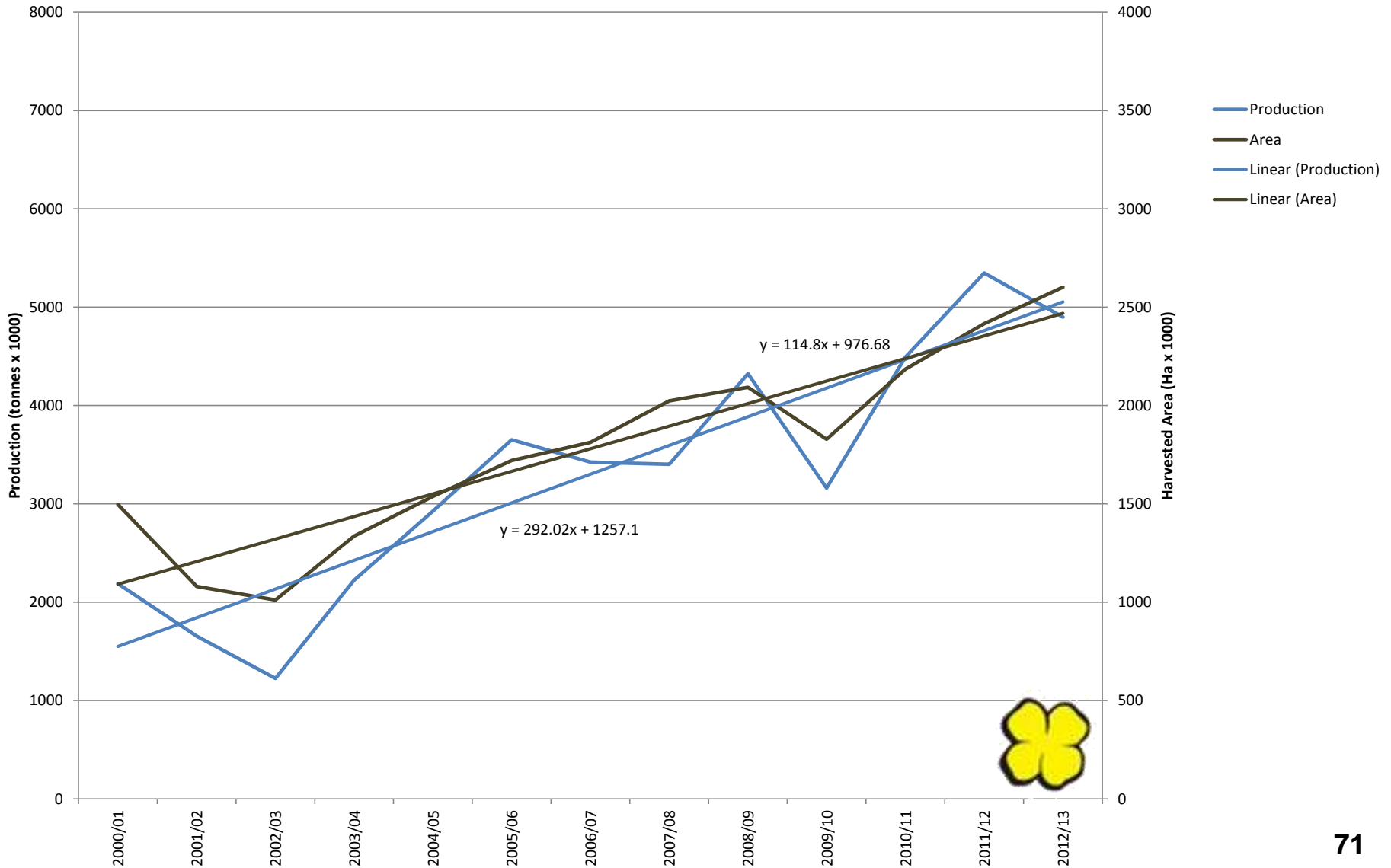
## Alberta: Total Production and Harvested Area - Spring Wheat



# AB Canola: Production & Harvested Area (2000/01 – 2012/13)

Graf 2013

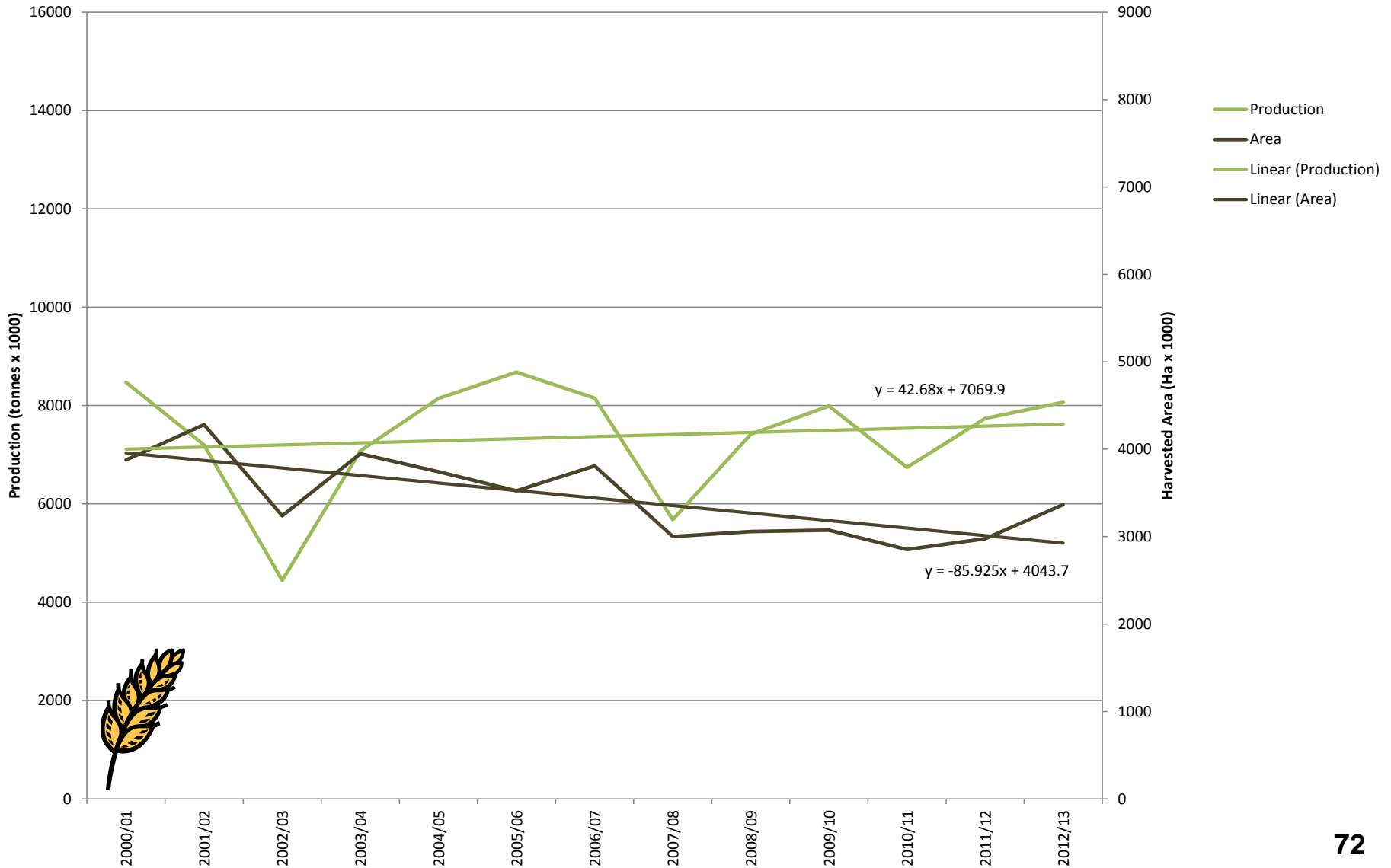
## Alberta: Total Production and Harvested Area - Canola



# SK Spring Wheat: Production & Harvested Area (2000/01 – 2012/13)

Graf 2013

## Saskatchewan: Total Production and Harvested Area - Spring Wheat

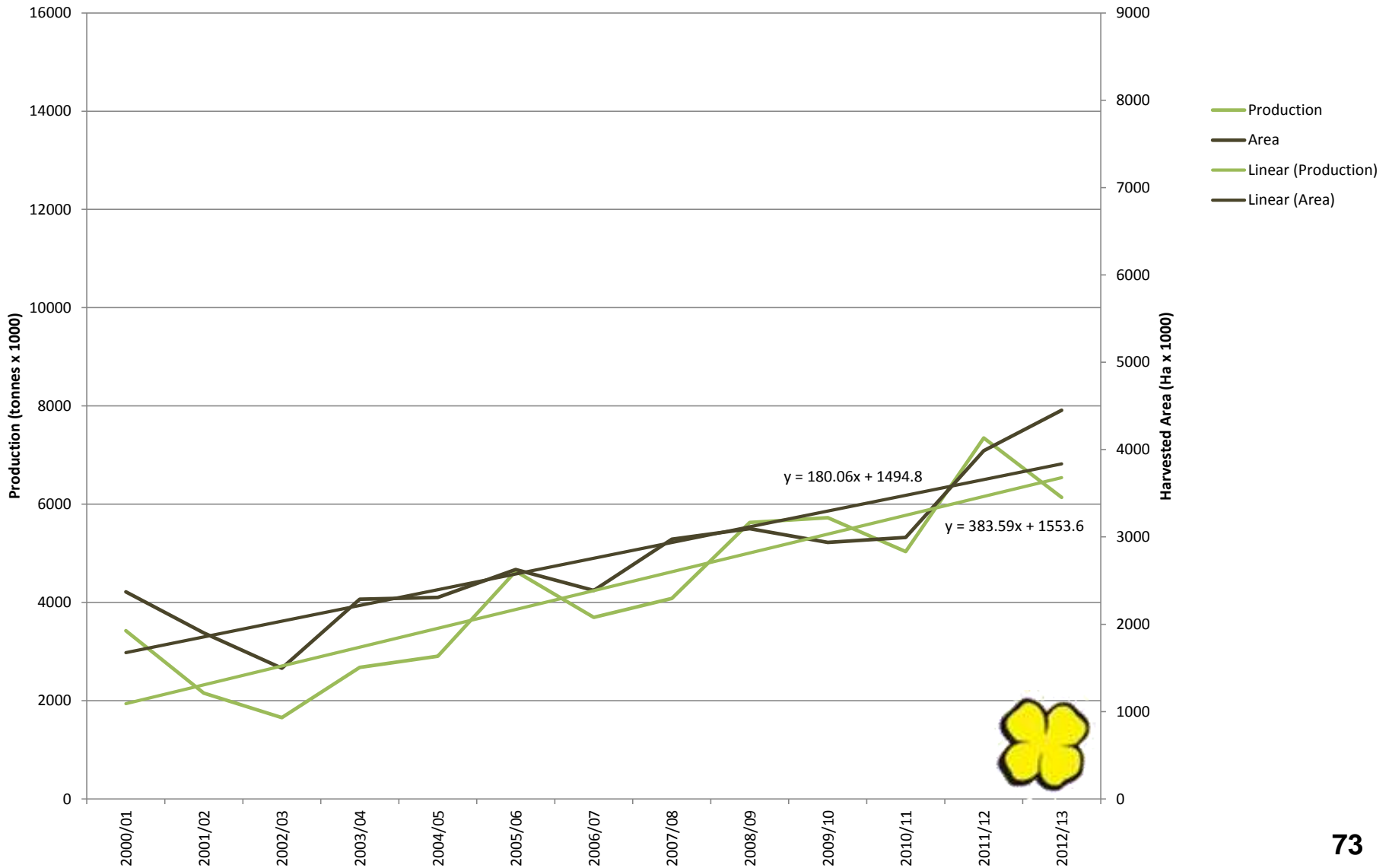




# SK Canola: Production & Harvested Area (2000/01 – 2012/13)

Graf 2013

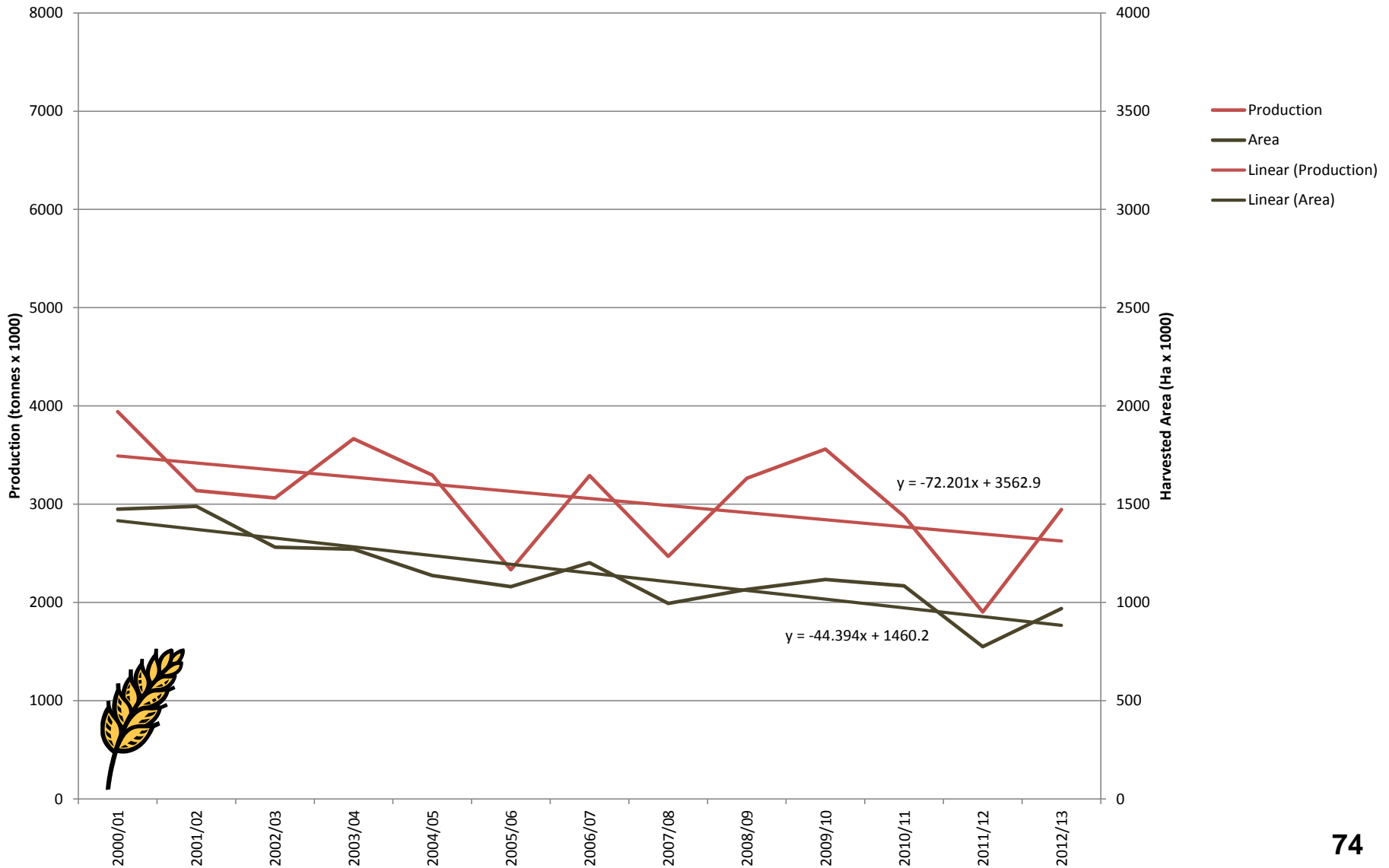
## Saskatchewan: Total Production and Harvested Area - Canola



# MB Spring Wheat: Production & Harvested Area (2000/01 – 2012/13)

Graf 2013

## Manitoba: Total Production and Harvested Area - Spring Wheat



# MB Canola: Production & Harvested Area (2000/01 – 2012/13)

Graf 2013

## Manitoba: Total Production and Harvested Area - Canola

