

# Assessing Switchgrass Varieties in a Northern Environment

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Agriculture, Pêcheries  
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Québec



McGill

# Introduction

- Switchgrass (*Panicum virgatum*) is a warm-season C<sub>4</sub> grass native to Eastern North America
- An important constituent of the formerly expansive tallgrass prairie ecosystem

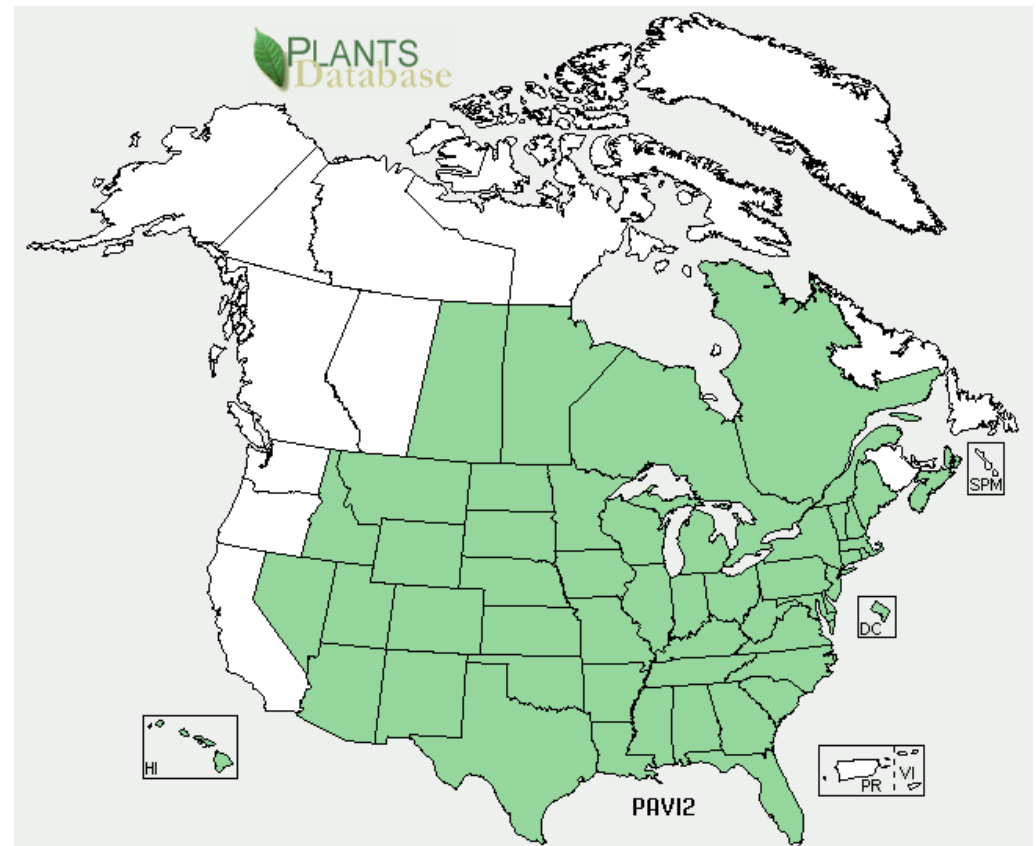


# Range

- Switchgrass is distributed East of the Rocky Mountain range from Central Mexico to ~55°N (Vogel et al., 2011)

## Applications:

- Livestock bedding and forage
- Energy
  - Combustion
  - Pyrolysis/gasification
  - Cellulosic ethanol
- Biocomposite materials
- Mushroom production



# Beneficial characteristics

- Perennial and harvestable using standard hay equipment
- Cold and heat hardiness
- Drought resistant
- High yields on marginal lands
- Increase soil organic C through various processes (Liebig et al., 2005)



# Project rationale

- Rapid growth in Eastern Canada's planted area illustrates a producer need for well-adapted varieties/selections

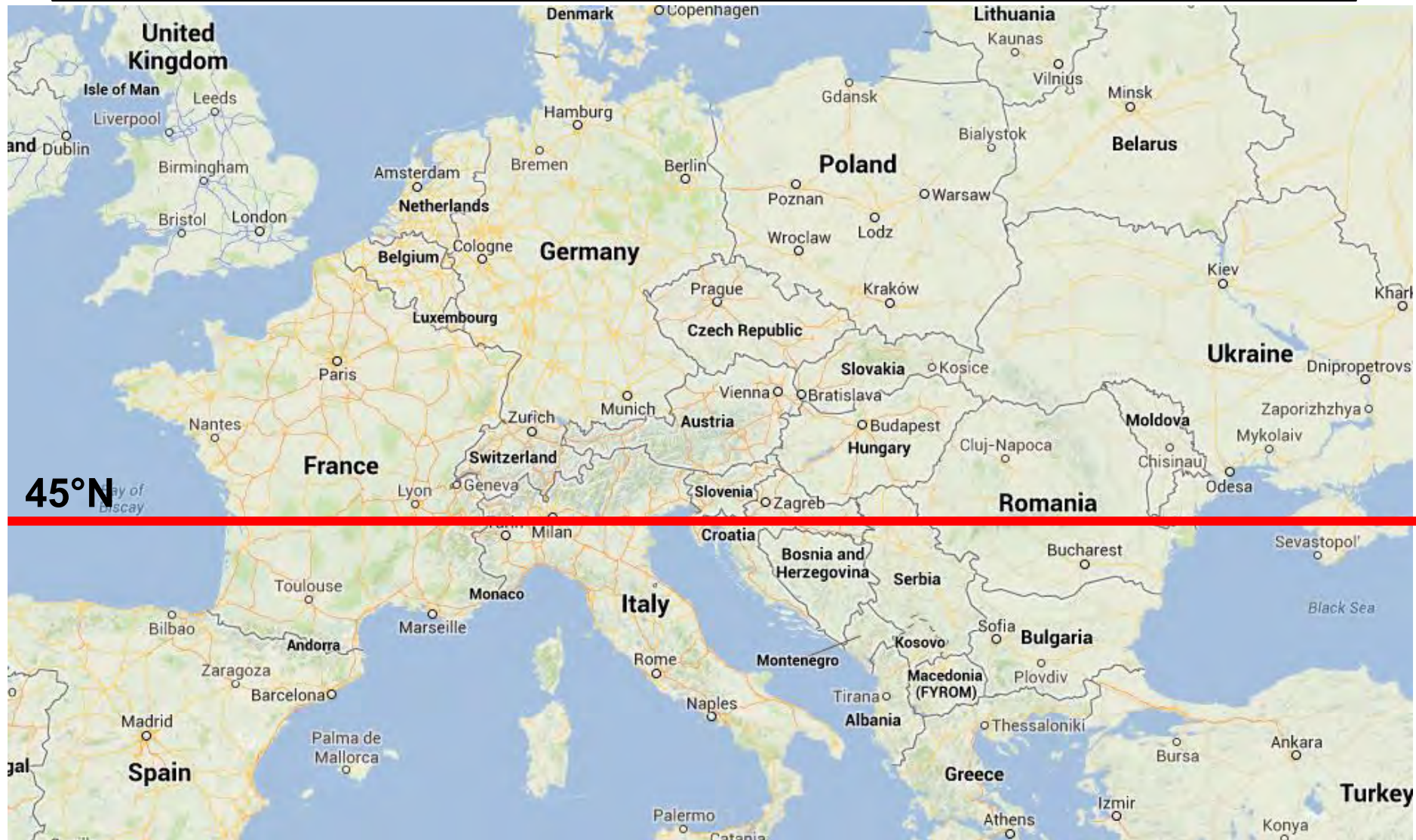


# European context

- Several trials since initiation of European switchgrass productivity network (Netherlands, Germany, UK, Greece, Italy)
- Results indicate promising potential for switchgrass for biomass production, but further research needed on adapted varieties (Lewandowski et al., 2003)



# Origins of commercial cultivars



# Selection lineages

Sunburst → Bluejacket I → Bluejacket

Summer



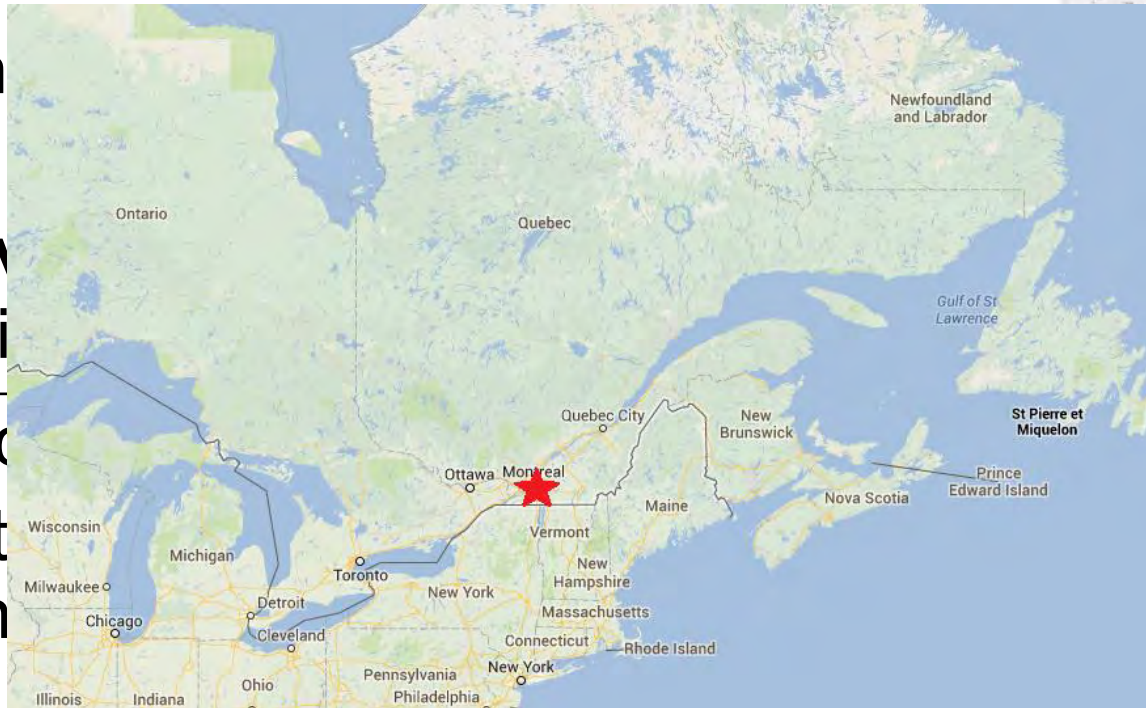
**R.E.A.P.**  
**Canada**

Resource Efficient Agricultural Production

Cave-In

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# Objectives

- Evaluation of the performance and agronomic characteristics of several new selections made *in situ* at two sites in Southern Quebec
- Evaluation of effects on yield and biomass quality of a fall or spring harvest date
- Hypotheses:
  - 1. Locally made selections will perform better than their parent cultivars in the Southern Quebec environment
  - 2. A spring harvest will reduce yields but increase biomass quality

# Methods: Sites

- Ste-Anne-de-Bellevue: McGill University experimental farm



# Methods: Sites

- Cookshire-Eaton: Ferme Madeléo



# Methods: Experimental design

		A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C	A B C							
Rep 4	B	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	B	20m				
		401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416						
Rep 3	O	11	3	6	14	5	8	1	9	2	13	7	16	4	15	10	12	O	20m				
		301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316						
Rep 2	D	11	2	5	7	4	14	13	1	6	15	10	8	9	16	12	3	D	20m				
		201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216						
Rep 1	R	8	16	3	2	9	15	6	10	5	11	14	7	13	1	12	4	R	20m				
		101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116						
										65.1m													
																				4.06m			
1		CIR I			9	Tecumseh II																	
2		Summer			10	Tecumseh III early																	
3		Sunburst			11	CIR II																	
4		Prairie View			12	CIR Early																	
5		Bluejacket I			13	Prairie View II																	
6		Bluejacket II			14	Prairie View Early																	
7		Bluejacket Early			15	Sand Lover																	
8		Tecumseh I			16	High Tide II																	

- 2 sites, RCBD with 4 reps
- Sites seeded in 2010, sampling in 2011 and 2012

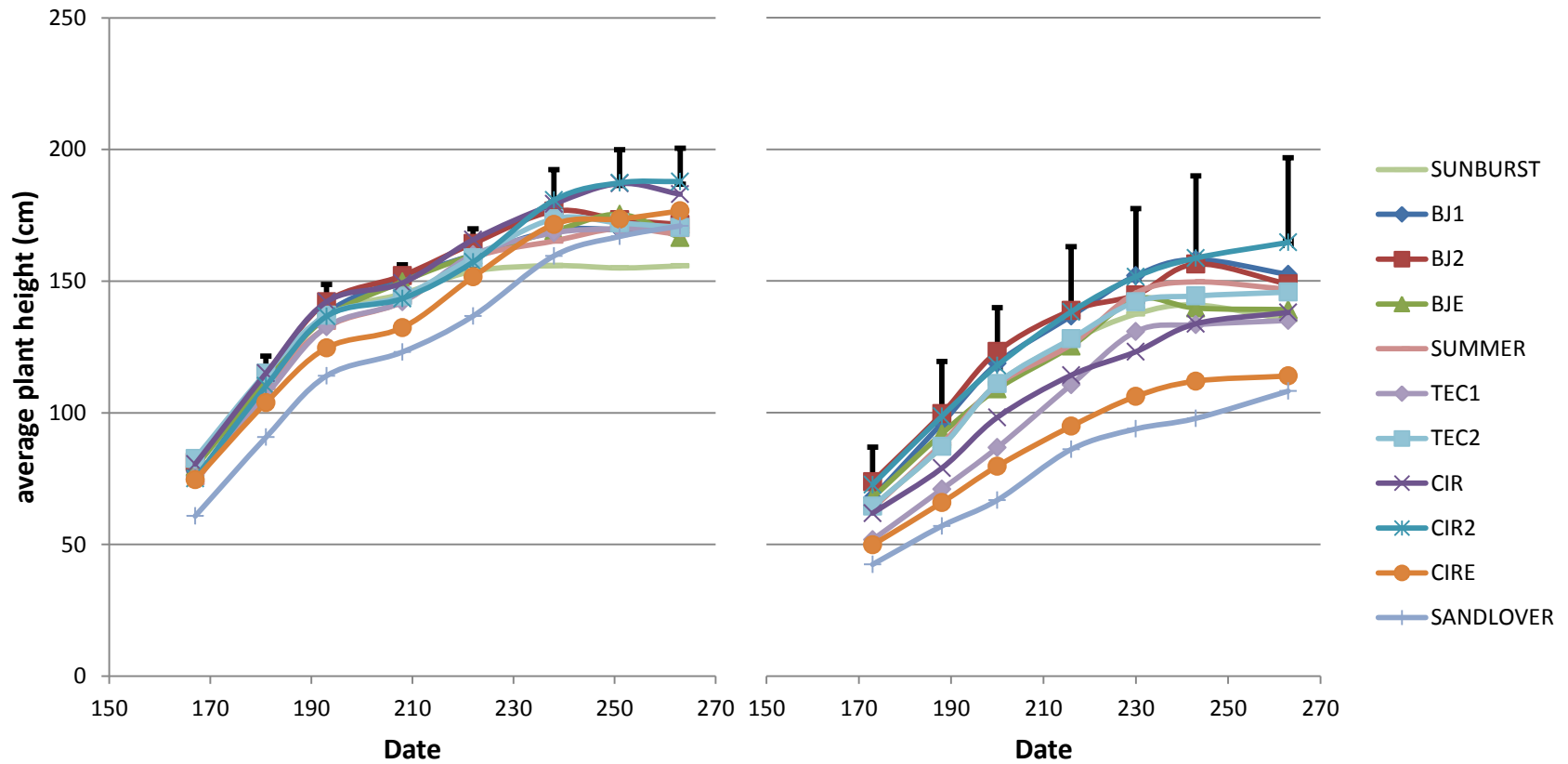
# Methods: Data collection

- Variables evaluated throughout the season:
  - Height
  - Tiller density
  - Phenology (maturity)
- Variables evaluated at harvest:
  - Yield
  - Moisture content
- Spring and fall harvest date:
  - Yield, moisture content
  - Fiber analysis (cellulose, hemicellulose, lignin)
  - Ash
  - Energy content (HHV)

# Results: Height

## Ste-Anne 2011

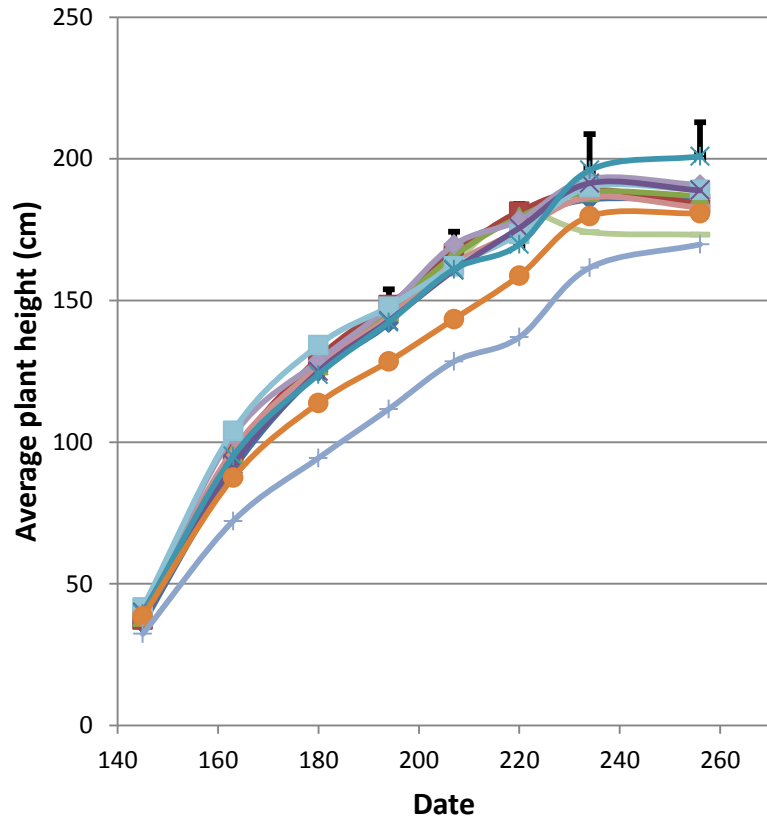
## Cookshire-Eaton 2011



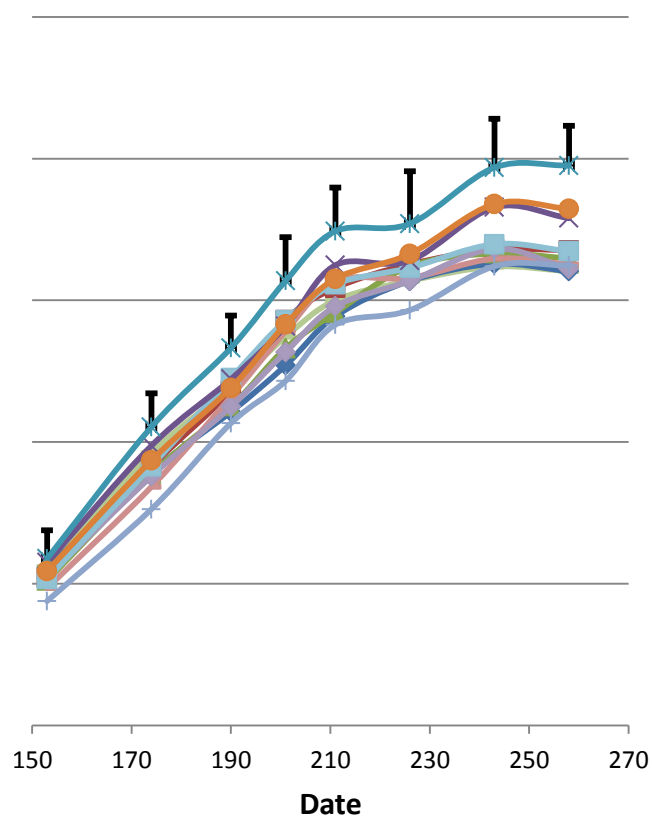
1<sup>st</sup> production year

# Results: Height

## Ste-Anne 2012



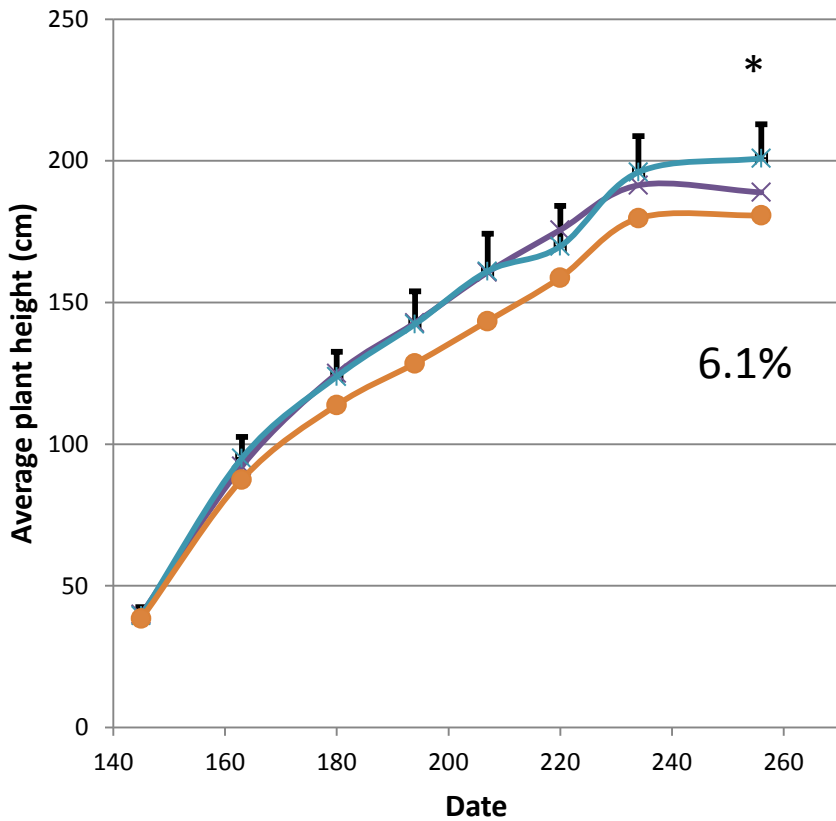
## Cookshire-Eaton 2012



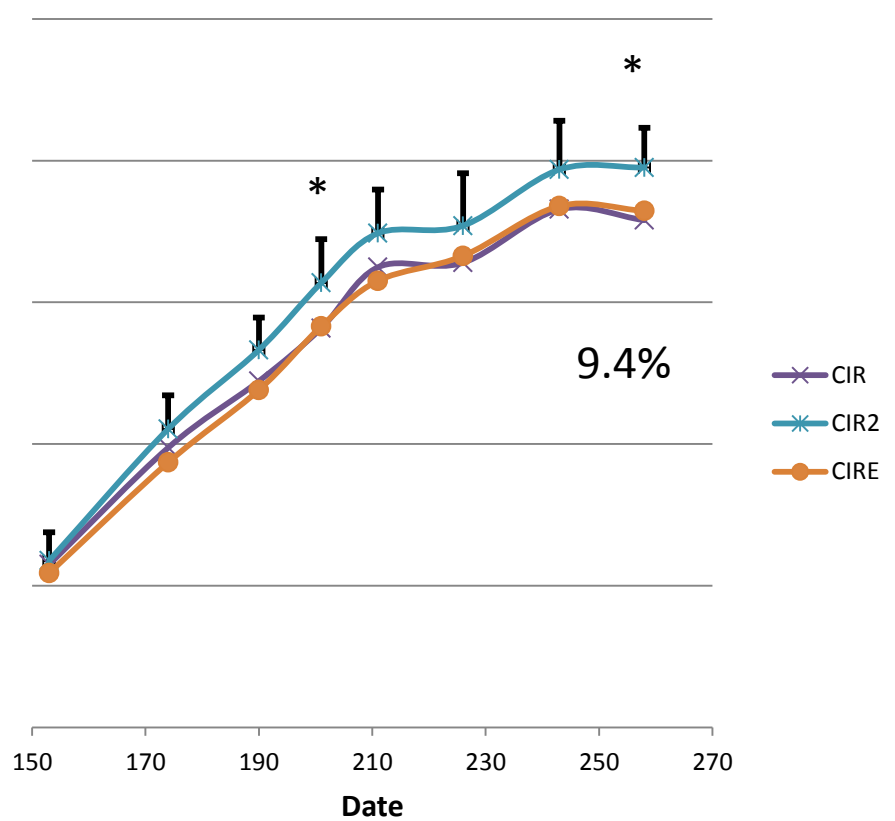
2<sup>nd</sup> production year

# Results: Height

## Ste-Anne 2012



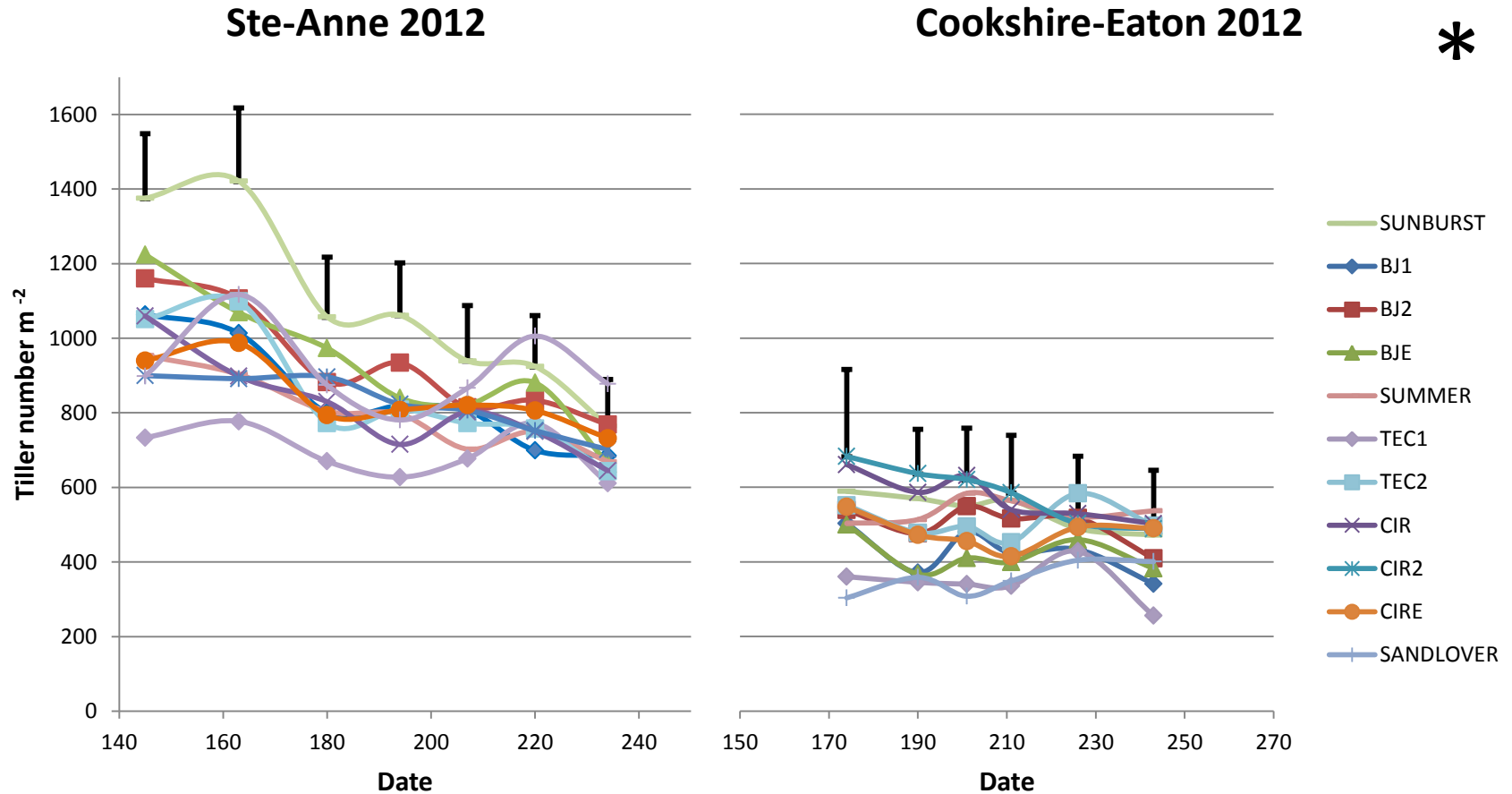
## Cookshire-Eaton 2012



2<sup>nd</sup> production year



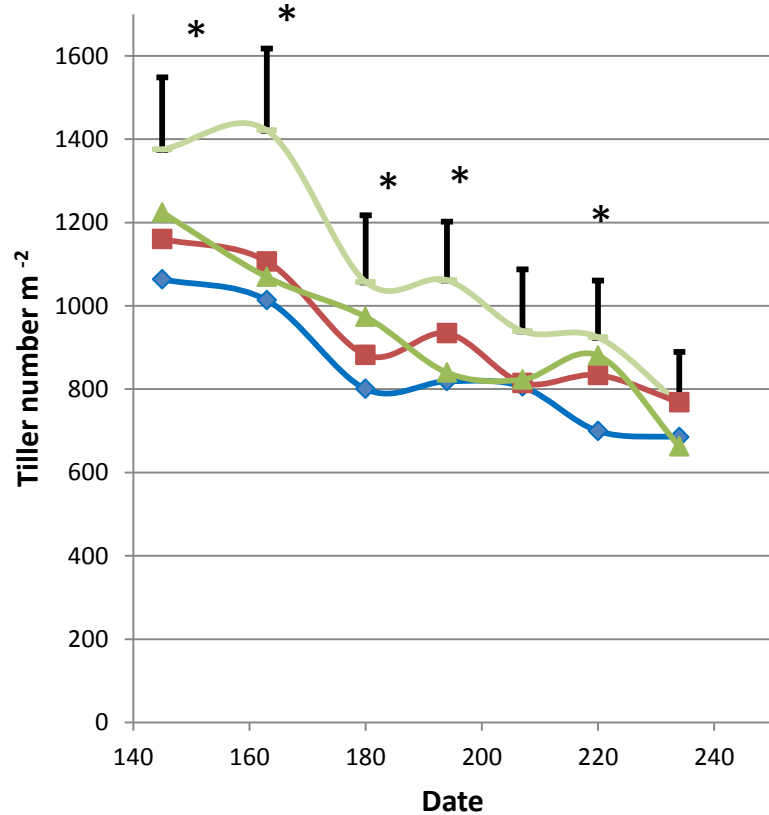
# Results: Tiller density



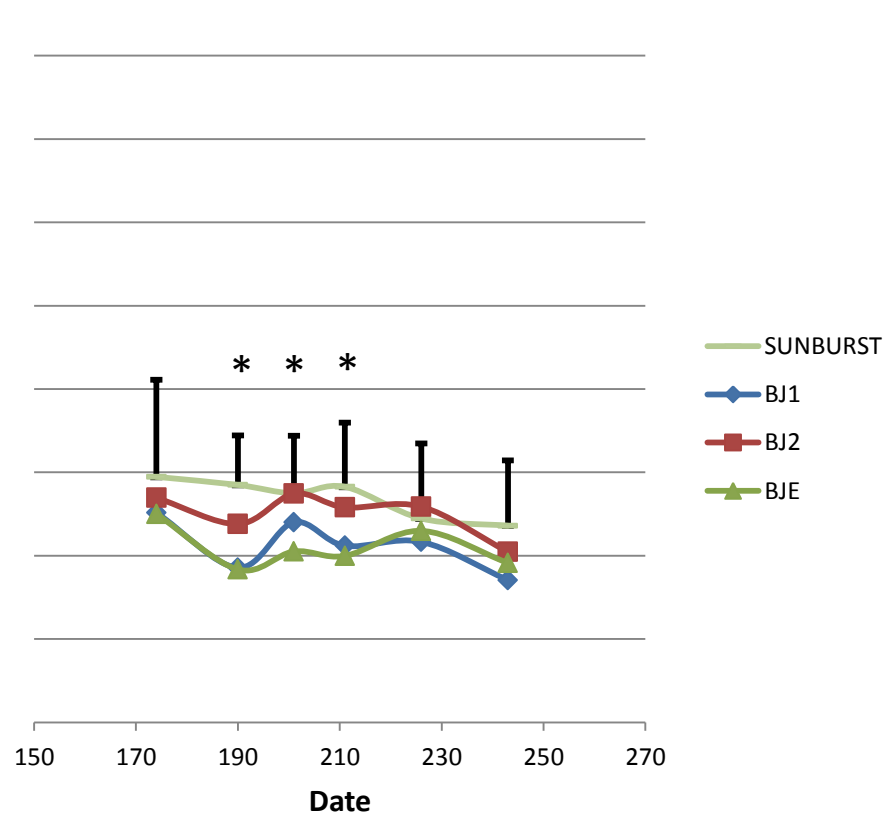
2<sup>nd</sup> production year

# Results: Tiller density

## Sunburst lineage Ste-Anne 2012



## Sunburst lineage Cookshire 2012

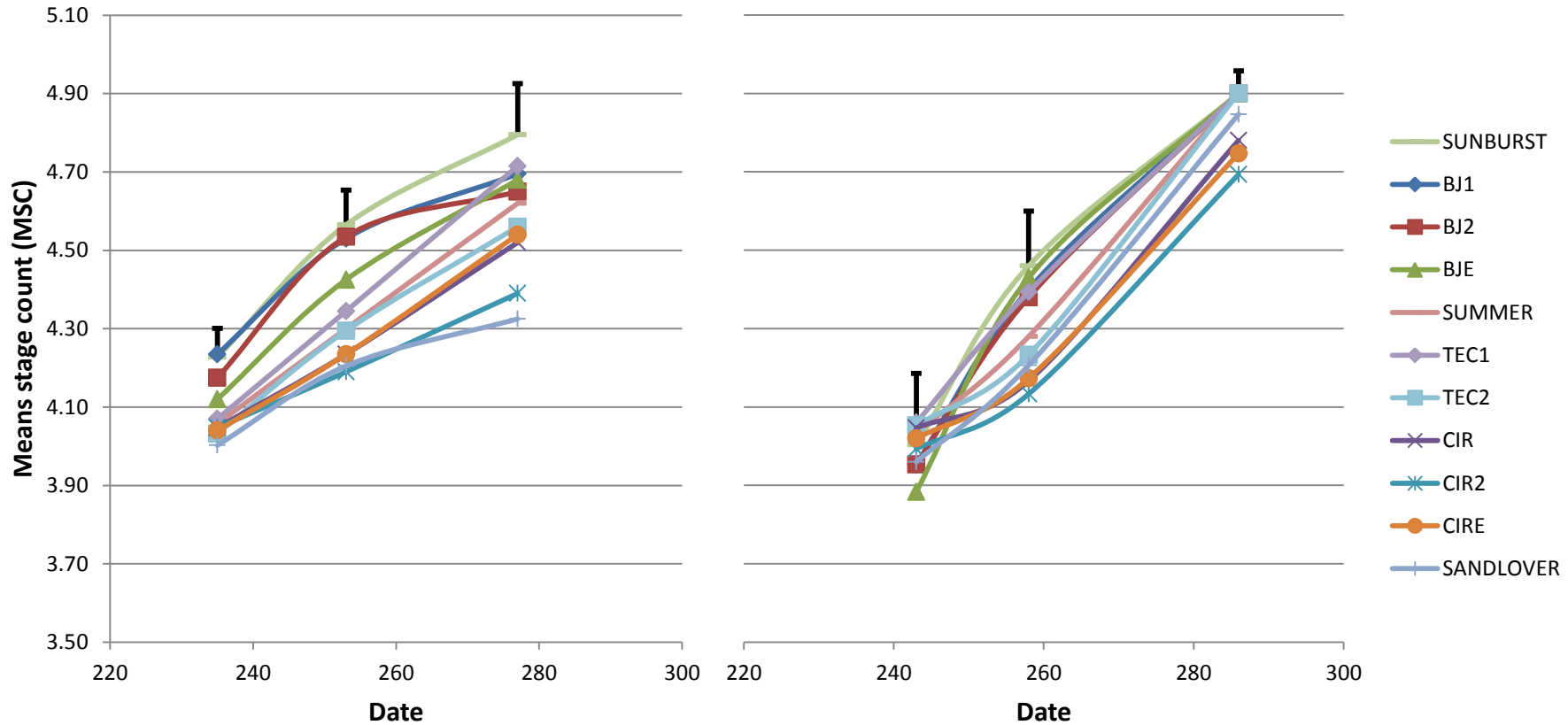


2<sup>nd</sup> production year

# Results: Maturity

**Ste-Anne-de-Bellevue 2012**

**Cookshire-Eaton 2012**

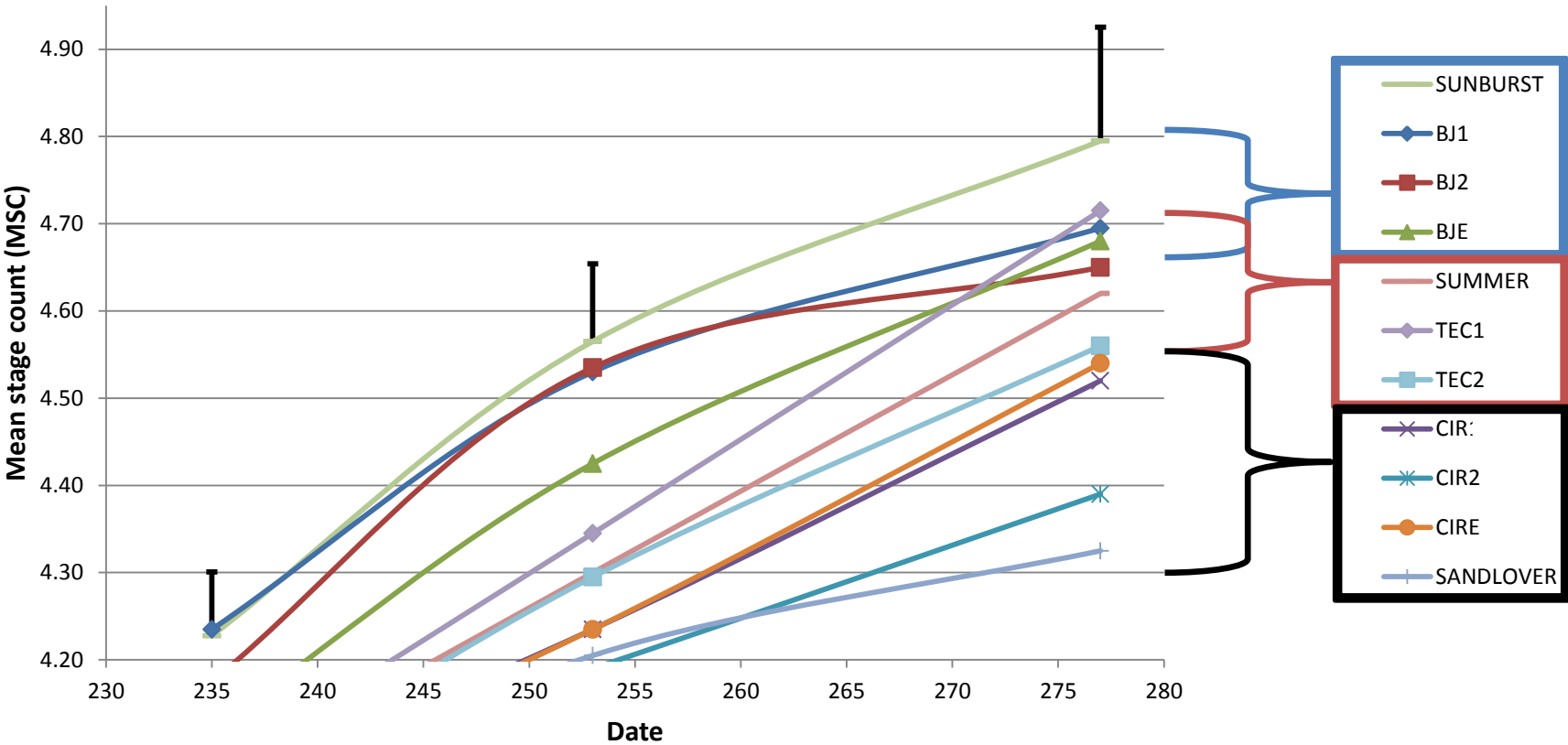


**2<sup>nd</sup> production year**

# Results: Maturity

Ste-Anne-de-Bellevue 2012

\*



2<sup>nd</sup> production year

# Results: Maturity



# Results: Yield

- Strip harvest (width 60cm) in fall and spring

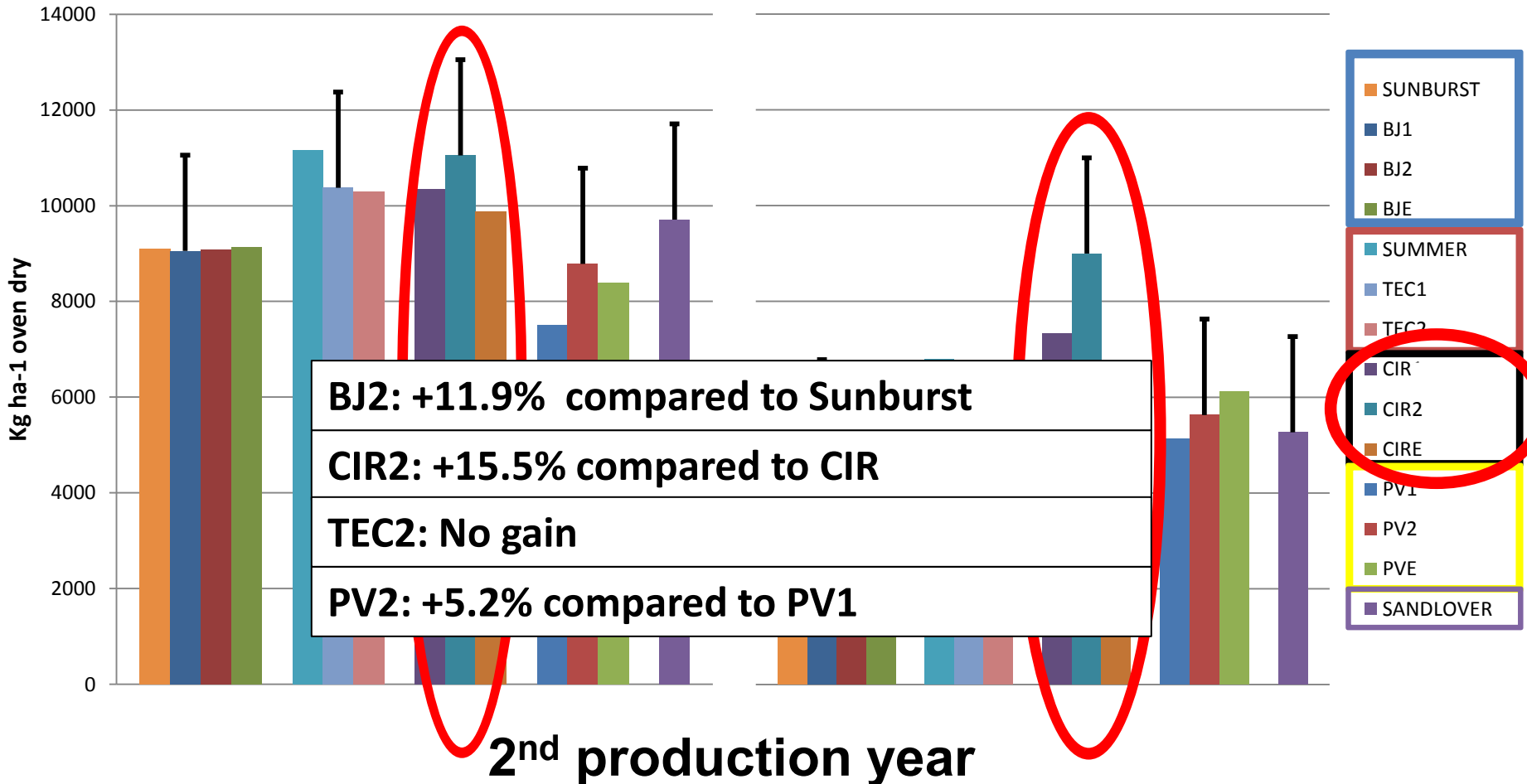




# Results: Fall harvest

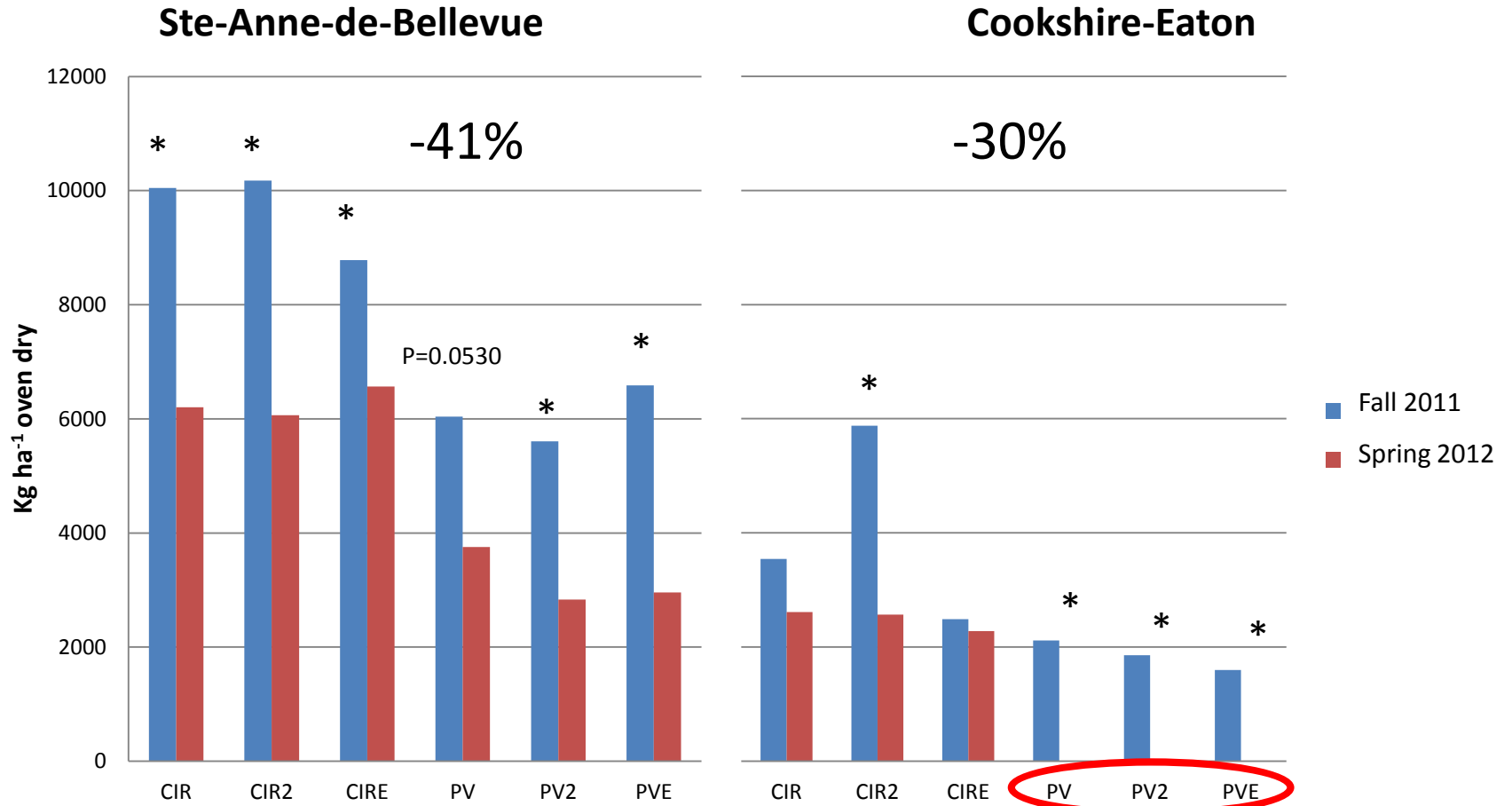
## Ste-Anne-de-Bellevue 2012

## Cookshire-Eaton 2012

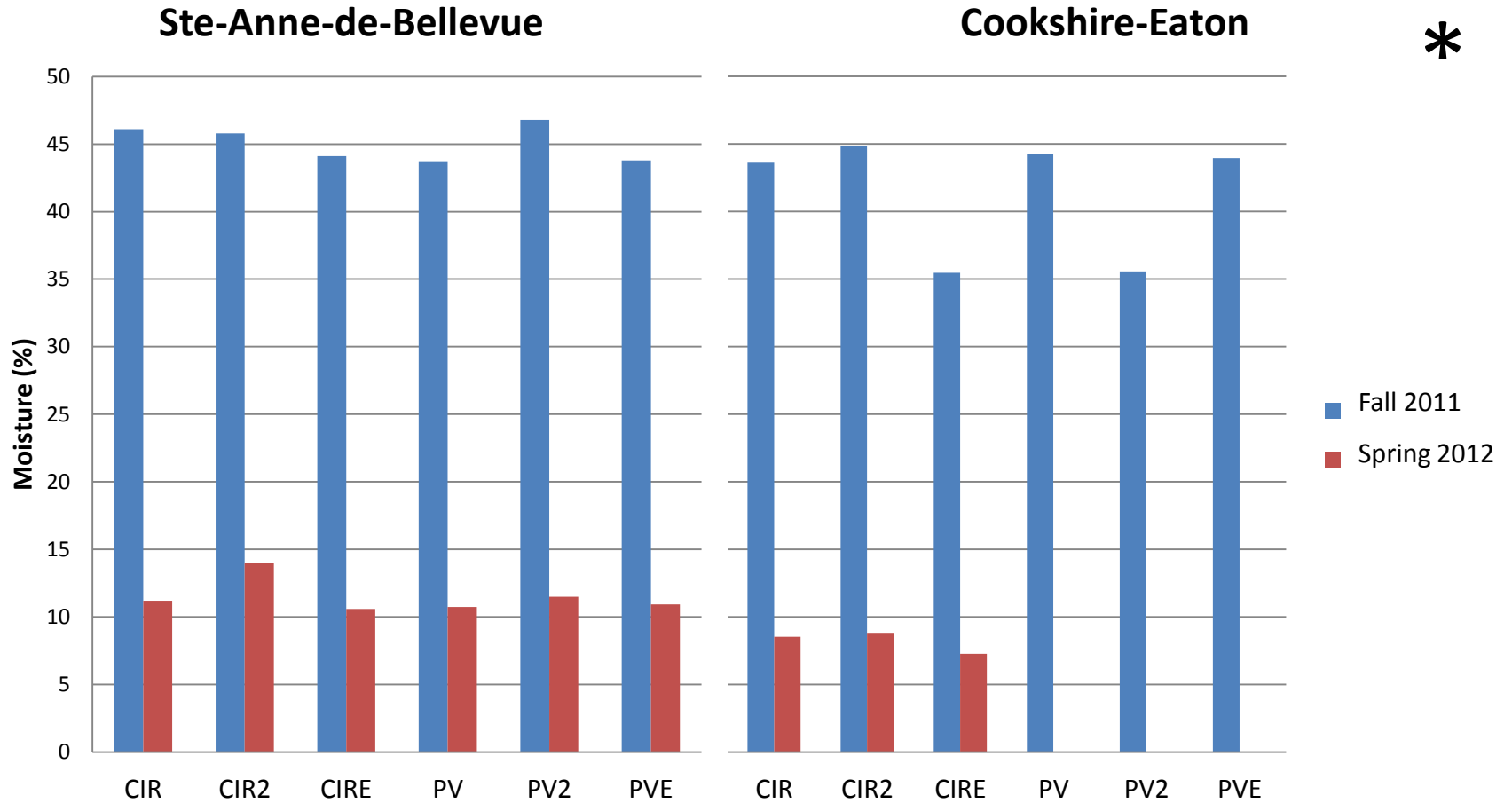




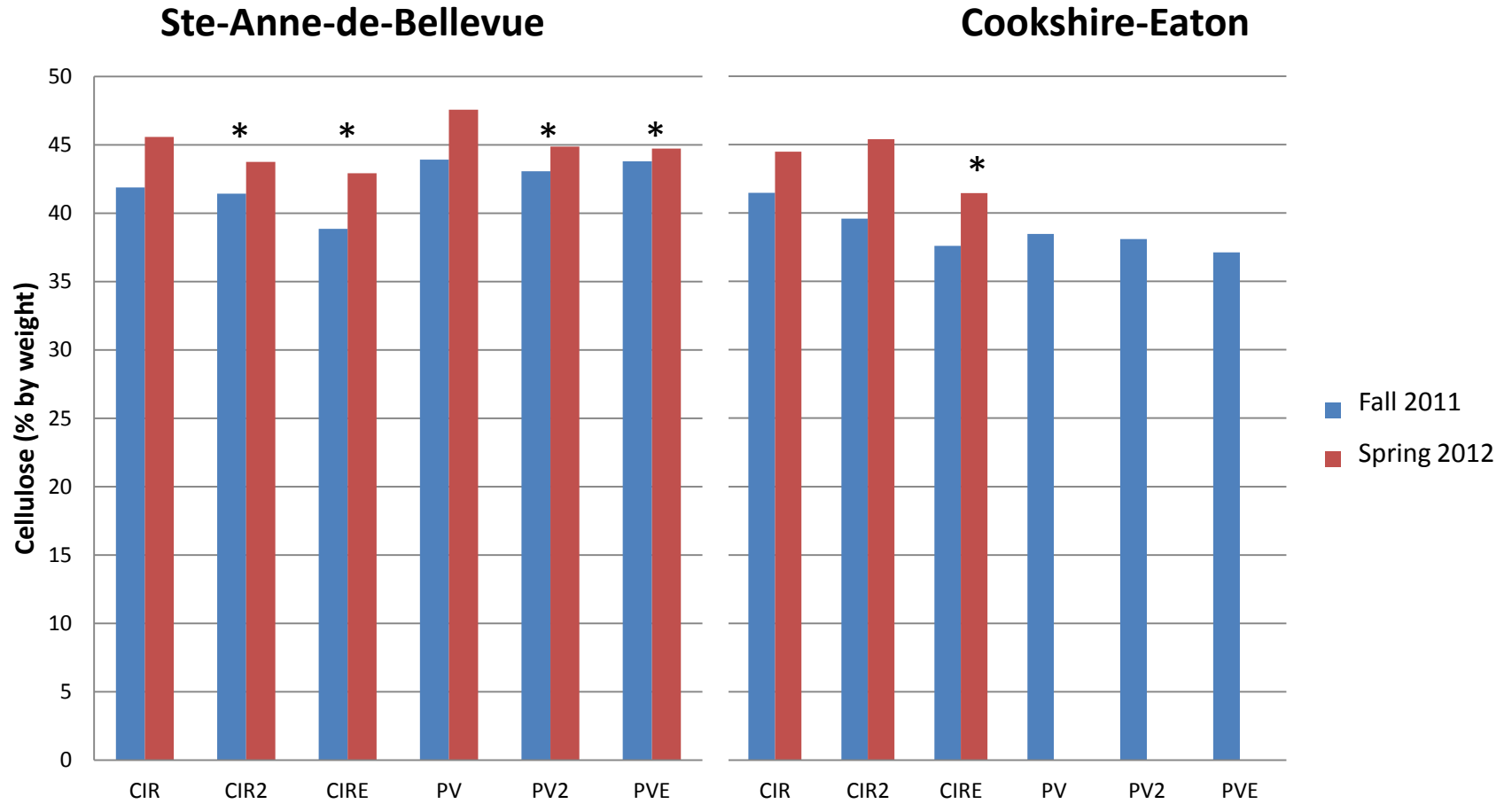
# Results: Spring yield



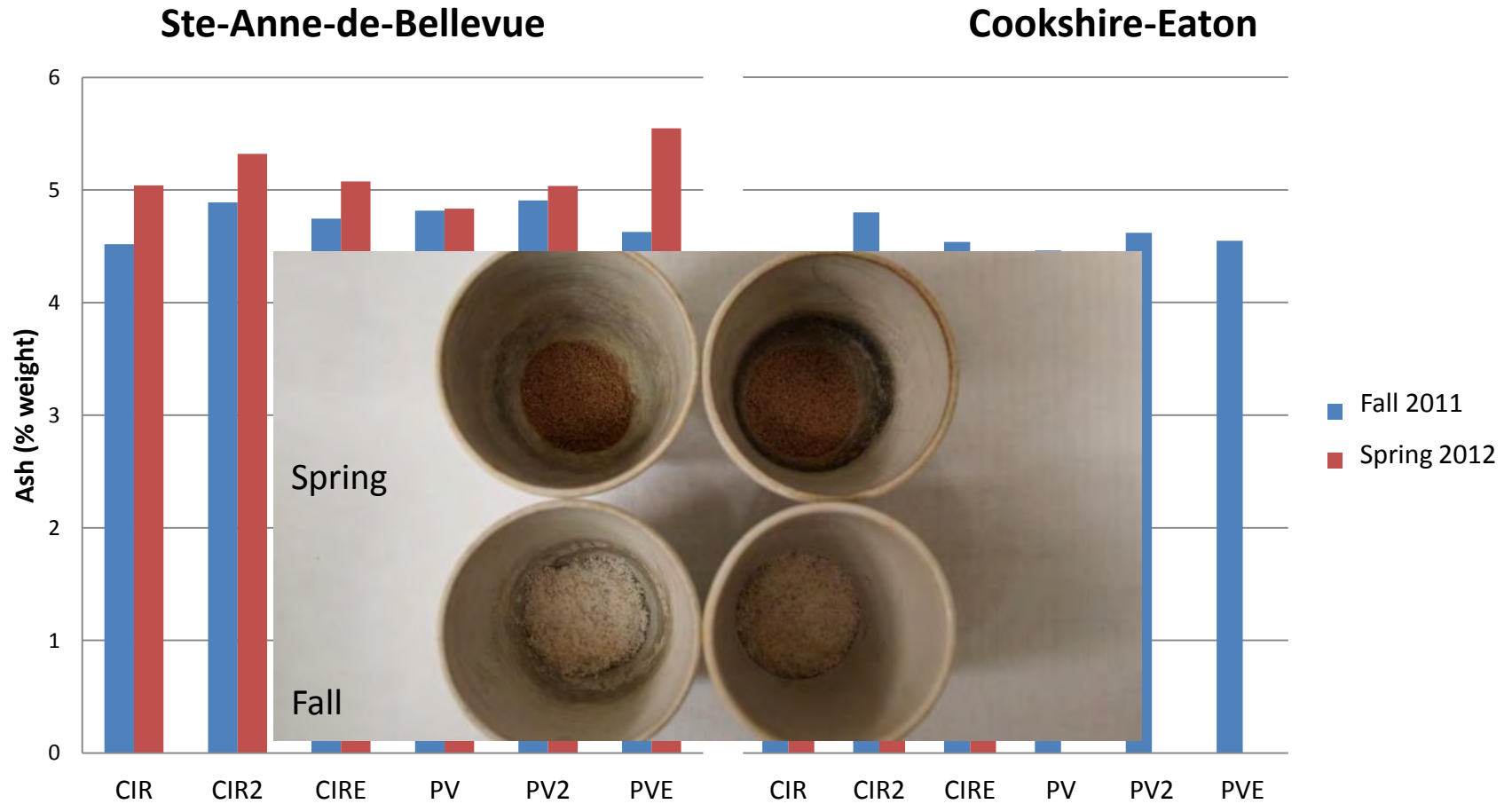
# Results: Moisture content



# Results: Cellulose



# Results: Ash content





# Results: Energy content

- Impact on energy content?

Table 1. Energy content (HHV) in fall and spring

		Mj/kg			
		Max	Min	Mean	SD
Cookshire	Fall	19.70	18.90	19.32	0.20
	Spring	19.60	19.09	19.35	0.15
Ste-Anne	Fall	19.20	17.83	18.85	0.27
	Spring	19.28	18.43	18.89	0.23

# Conclusions

- Selections: Significant differences for all variables evaluated
  - Differences often between selection lineages
  - Large variability present including between lineages and sites
  - Trends observed suggest that local selection programmes should be pursued to develop regionally appropriate cultivars
- Harvest date: spring harvest lowers moisture content and slightly increases cellulose levels, but not significantly enough to counter high losses of biomass
  - Soil contamination may be especially problematic in high snowfall or freeze-thaw cycle areas

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