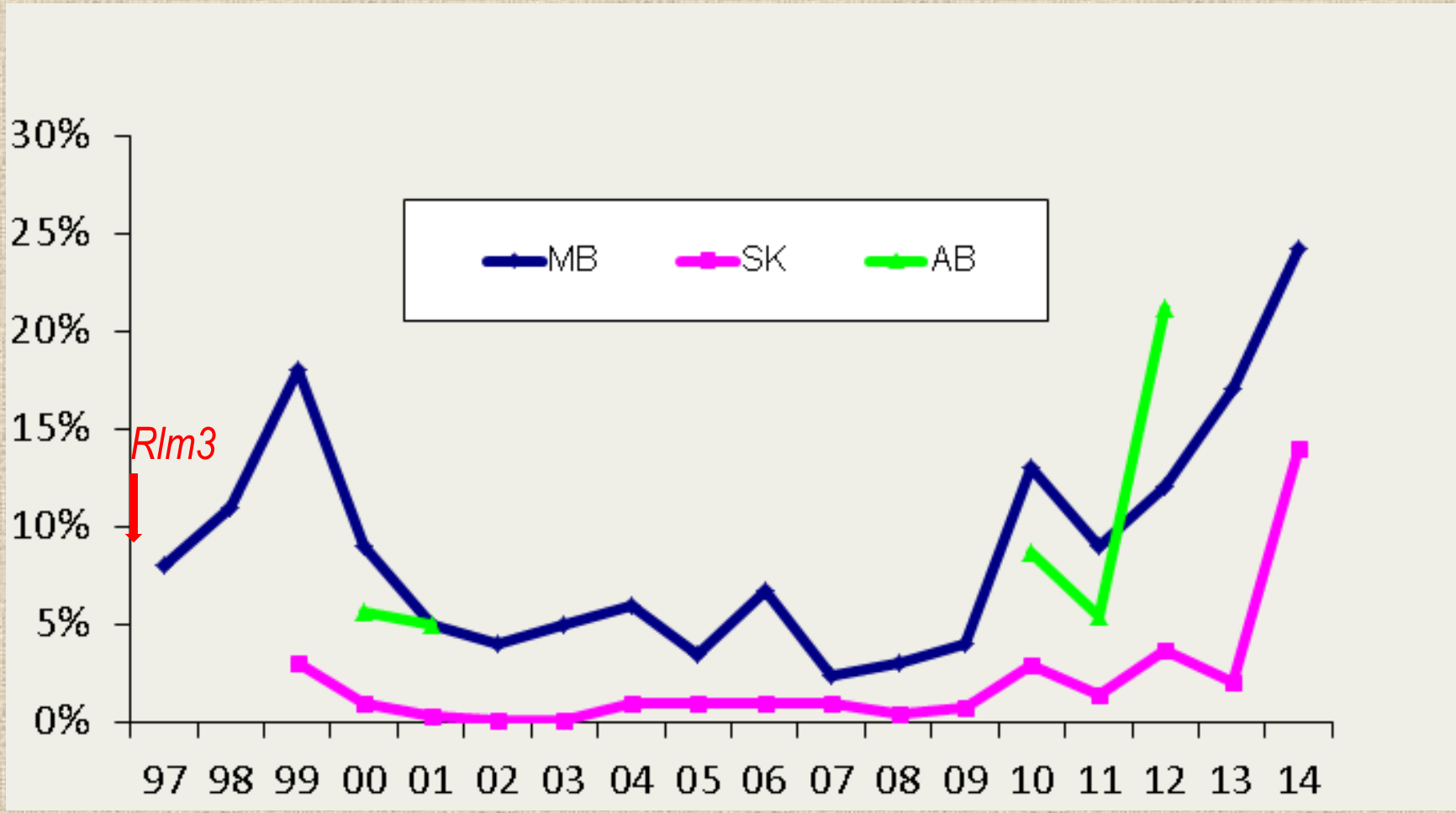
Is blackleg creeping back?

–what we know/don't know and how to mitigate the risk?

Blackleg at harvest time –premature ripening

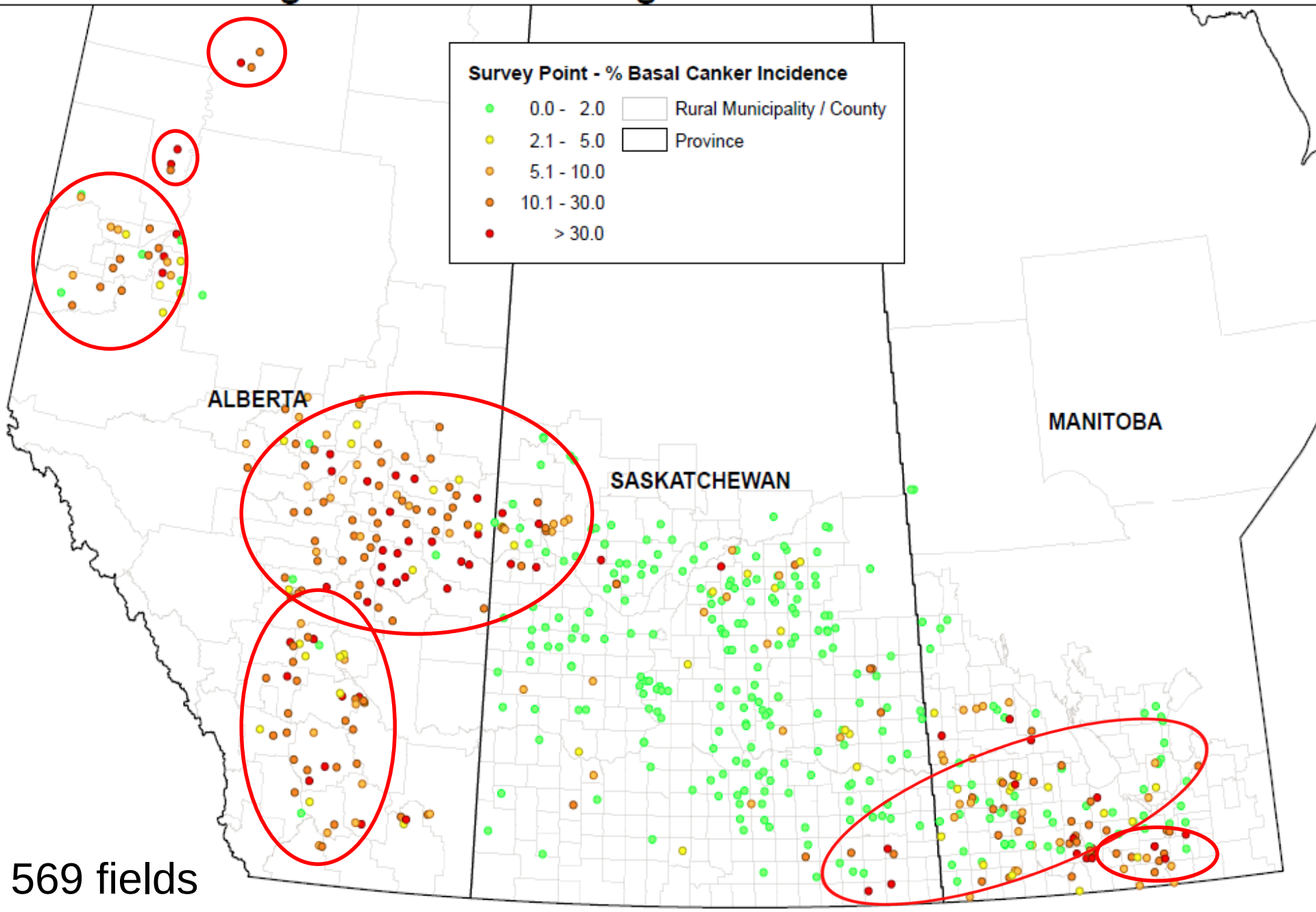
Blackleg incidence since 1997

(based on provincial canola disease surveys)



Source: CCC

Average Percent Blackleg Incidence in Canola - 2012



569 fields

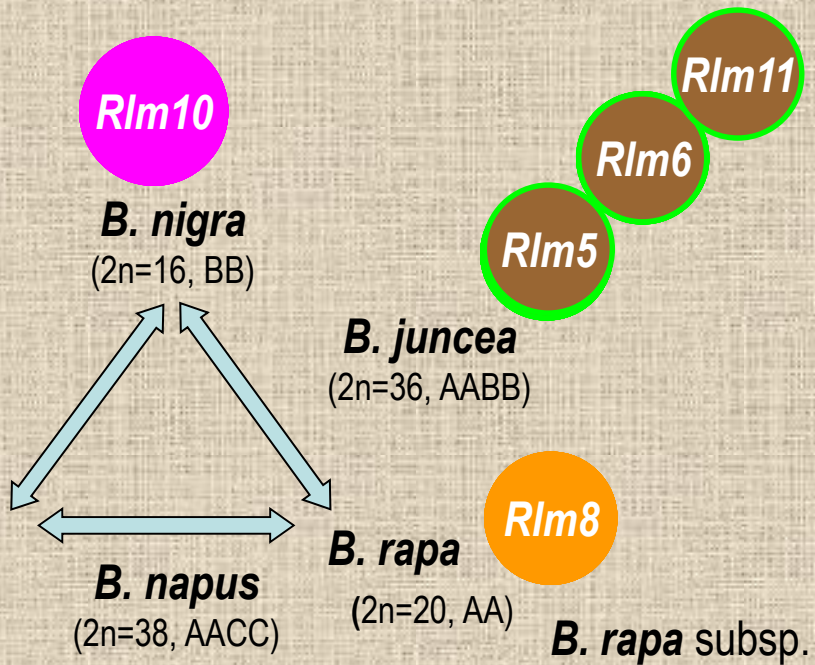
Factors causing blackleg increase

- **Host:** Resistance erosion (*R* genes are overcome)?
- **Pathogen:** Lack of *Avr* alleles in *L. maculans* that can be recognized by corresponding *R* genes in host

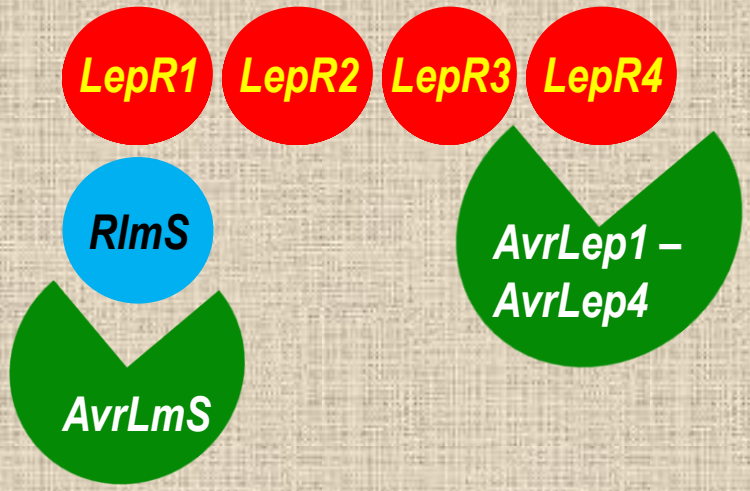
Other factors:

- Short crop rotations
- Root rot /maggots
- Hail damage
- Other injuries

Major-gene resistance (expressed at seedling stage)



B. rapa subsp. *sylvestris*



Resistance to blackleg: Both major-gene and quantitative resistance have been identified

Major-gene resistance:

- Expressed on cotyledons
- *Rlm* or *LepR* genes

Quantitative resistance:

- Adult-plant resistance
- Multi-genetic, resistance mechanisms not well known

Pros and cons ……

Surpass 400 (2003)

Australian experience

- Major-gene resistance eroded rapidly (Surpass 400)
- Quantitative resistance ineffective -longer season, stressful environ.

Australia experience

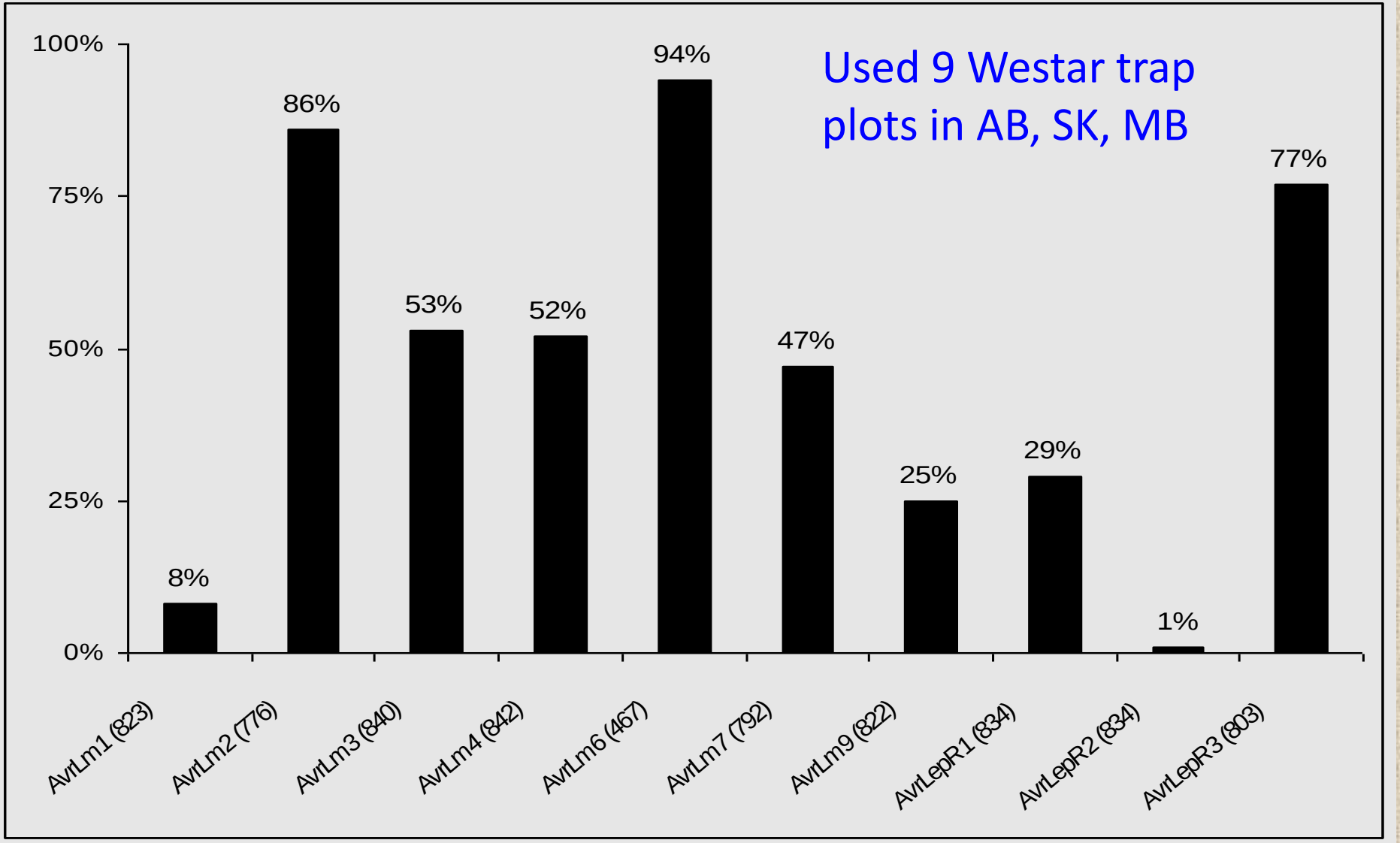
Table continued from previous page				
Genotype	Blackleg resistance rating bare seed	Blackleg resistance rating + fluquinconazole (Jockey®)	Resistance group	Type
Clearfield® system varieties				
Hyola® 575CL	R	R	E	
Hyola® 474CL	R (P)	R (P)	E	
XCEED™ OASISCL	R-MR	R-MR (P)	DG	Juncea canola
Pioneer® 46Y83 (CL)	MR	R-MR (P)	Not screened	
Pioneer® 43Y85 (CL)	MR		A	
Pioneer® 45Y82 (CL)	MR-MS	MR (P)		
Pioneer® 44Y84 (CL)	MR-MS	MR (P)		
Pioneer® 43C80 (CL)	MS	R-MR (P)		
Pioneer® 44C79 (CL)	MS	MR-MS (P)		
Roundup Ready® varieties				
Hyola® 505RR	R	R (P)	D	
Hyola® 404RR	R	R	D	
CB™ Frontier RR	R-MR (P)	R (P)	D	
IH50 RR	R-MR (P)	MR (P)	A	
GT Mustang◊	MR	R	F	
Pioneer® 43Y23 (RR)	MR		F	
Victory® V5002RR	MR (P)	R-MR (P)	AB	High stability oil
GT Cobra◊	MR (P)	MR (P)	A	
GT Cougar◊	MR	R-MR	AC	
GT Viper◊	MR (P)	MR (P)	F	
Pioneer® 46Y20 (RR)	MR	MR	ABC	
GT Scorpion◊	MR-MS	MR		
GT Taipan◊	MR-MS	R		
Pioneer® 45Y21 (RR)	MR-MS	MR (P)		
Pioneer® 45Y22 (RR)	MR-MS	MR (P)		
Victory® V5001RR	MS	MR		High stability oil
CB™ Eclipse RR	MS-S	MS		

<u>Strategy</u>: Resistance gene grouping, labelling and rotation; annual testing against the pathogen population (*Avr* allele) regionally

Recent research initiative in western Canada

- Understand the *Avr* gene profile (race structure) in the pathogen population on the prairies –which *R* genes will be effective?
- Determine what *R* genes are carried in commercial cultivars – which cultivar should be used? where?
- Fungicide and application timing –if the resistance of canola cultivar is being eroded rapidly

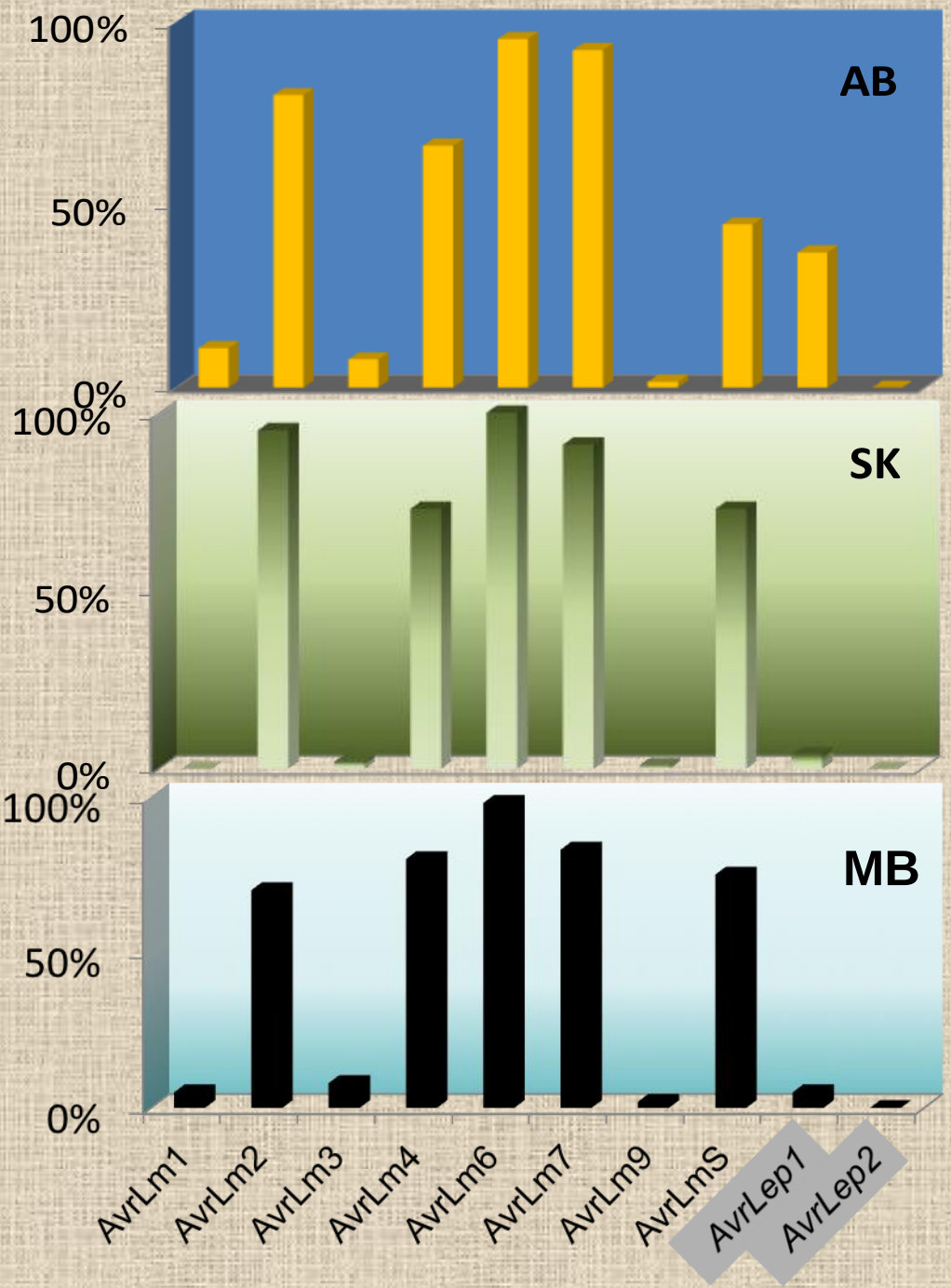
Avr-gene profile in *L. maculans* on the prairies (2007)

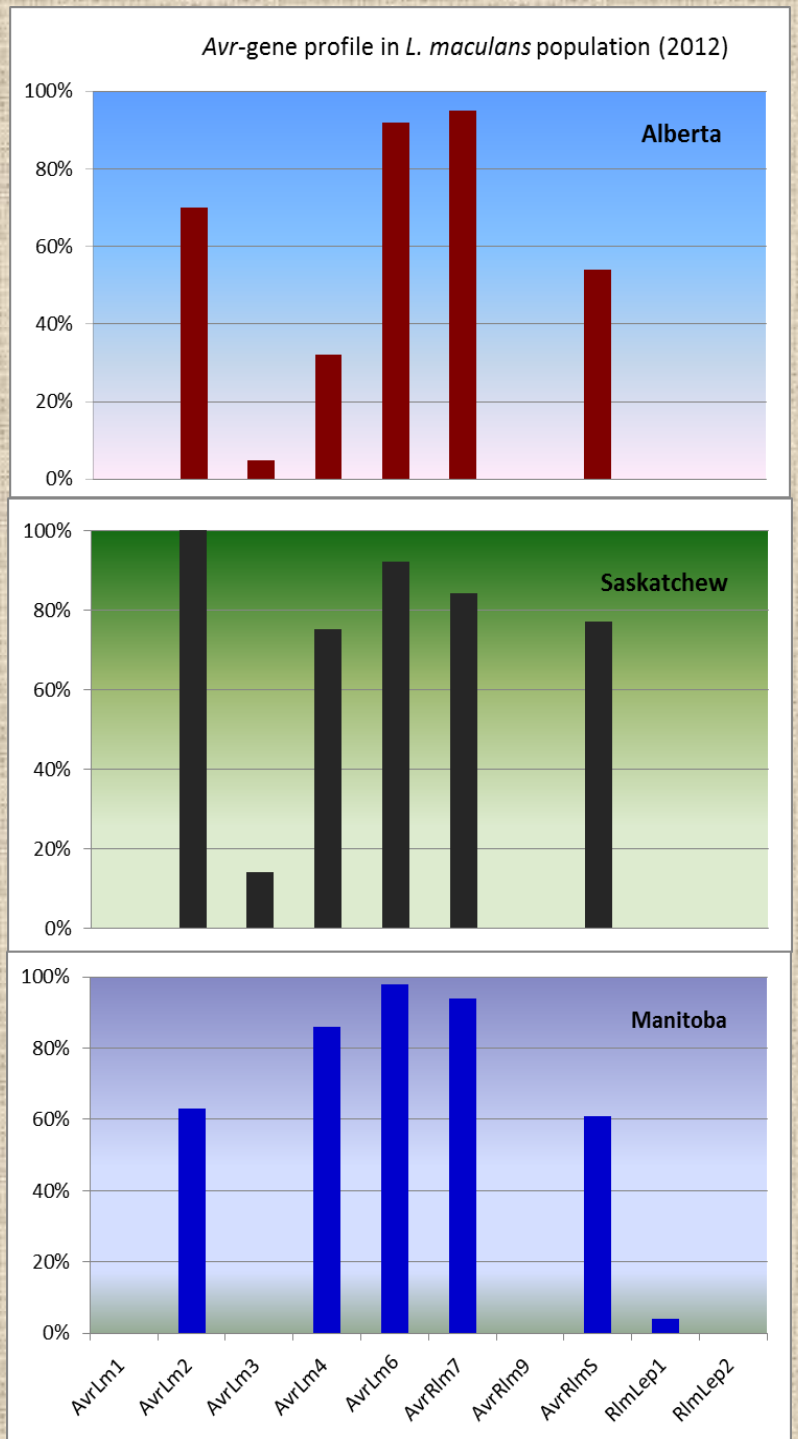


Kutcher et al. 2011

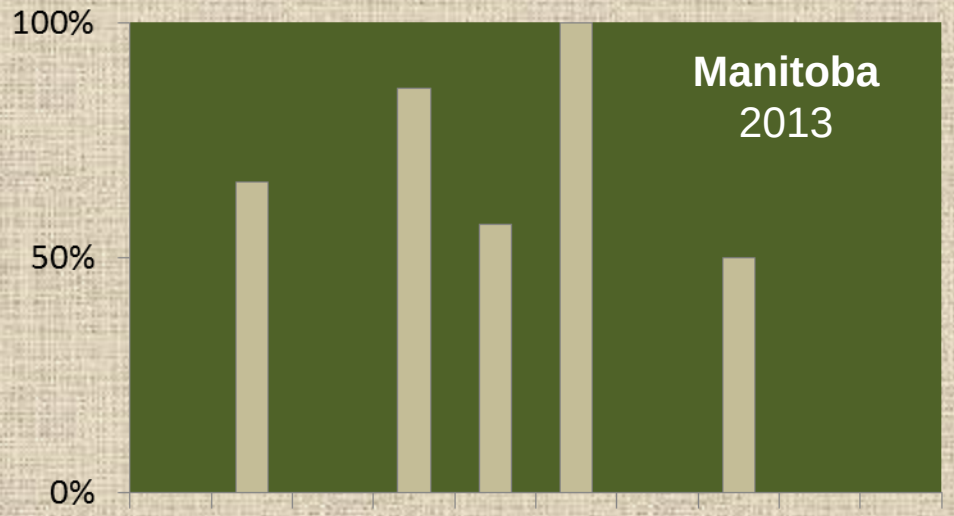
Avr-gene profile in *L. maculans* population on the prairies (2010-2011)

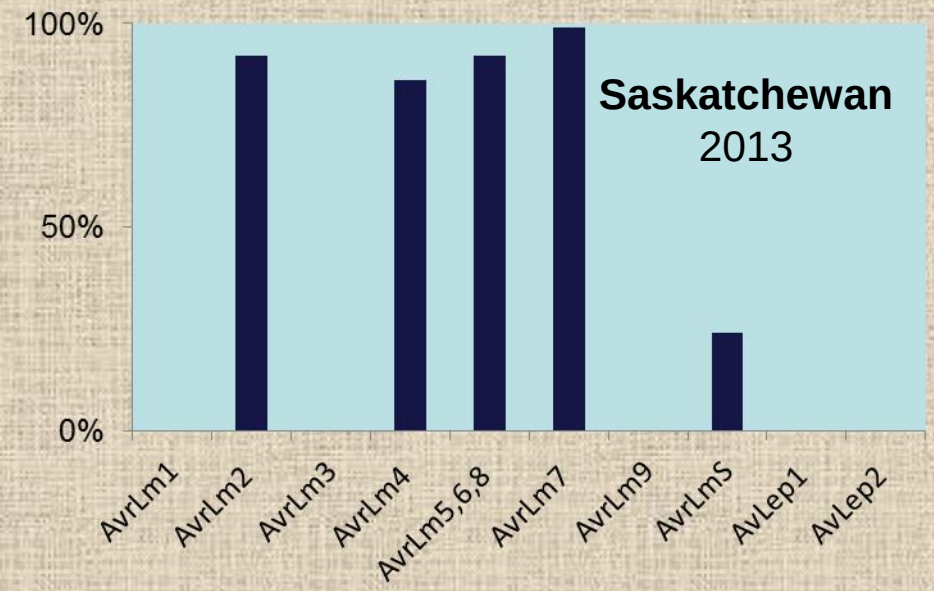
- 673 isolates from provincial surveys
- Similar pattern as that of 2007, except *AvrLm1, 3, 9* and *AvrLep2* were at even lower levels or missing
- *AvrLm2, 4, 6, 7* were present at high at high levels in each province





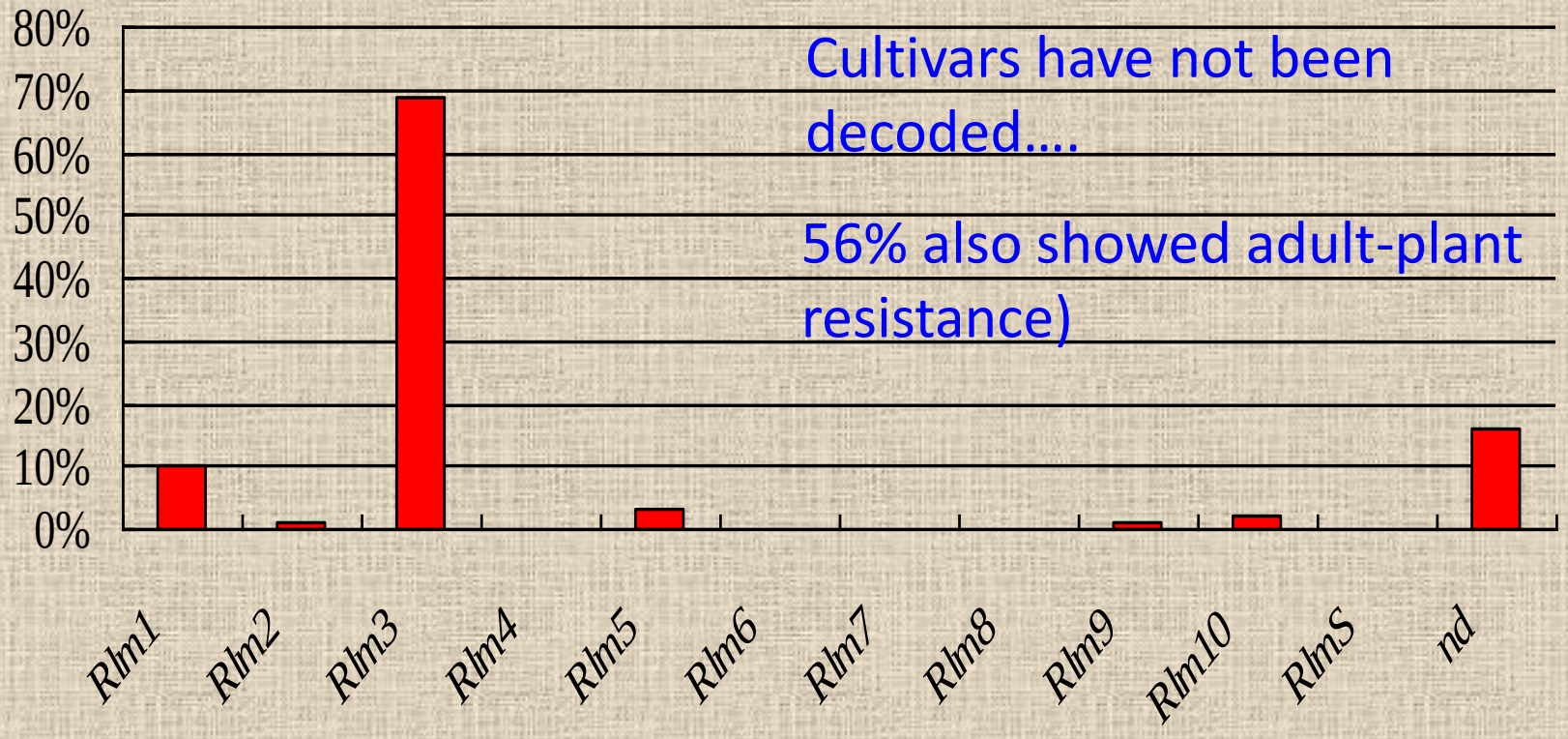
Avr-gene profile in the *L. maculans* population on the prairies (2012 - 2013)





Limited number of *R* genes were found in Canadian canola cultivars/lines

(Based on 206 genotypes)



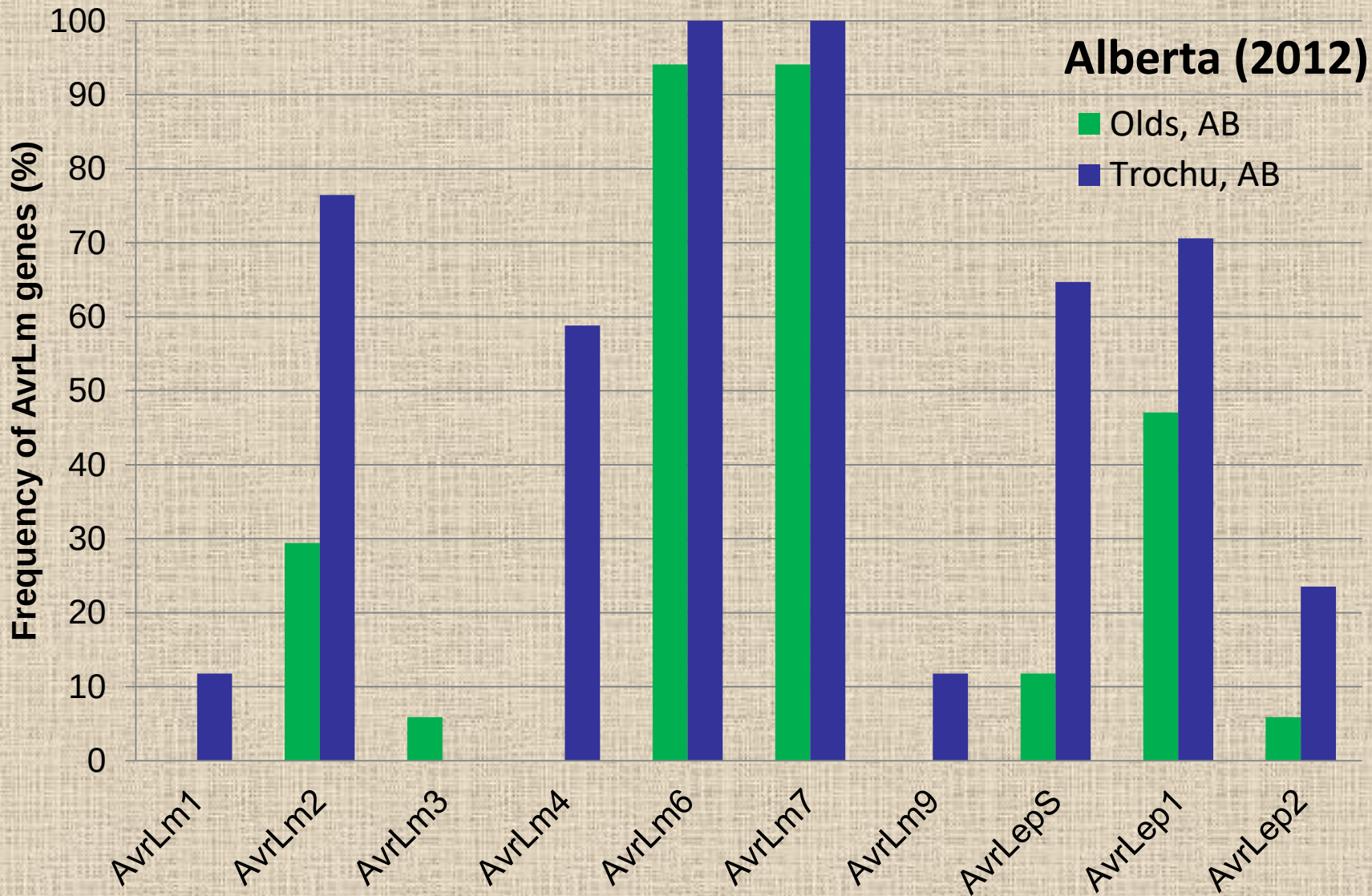
Percentage of cultivars/lines carrying known *R* genes

(Zhang, Fernando –U of M; Peng –AAFC)

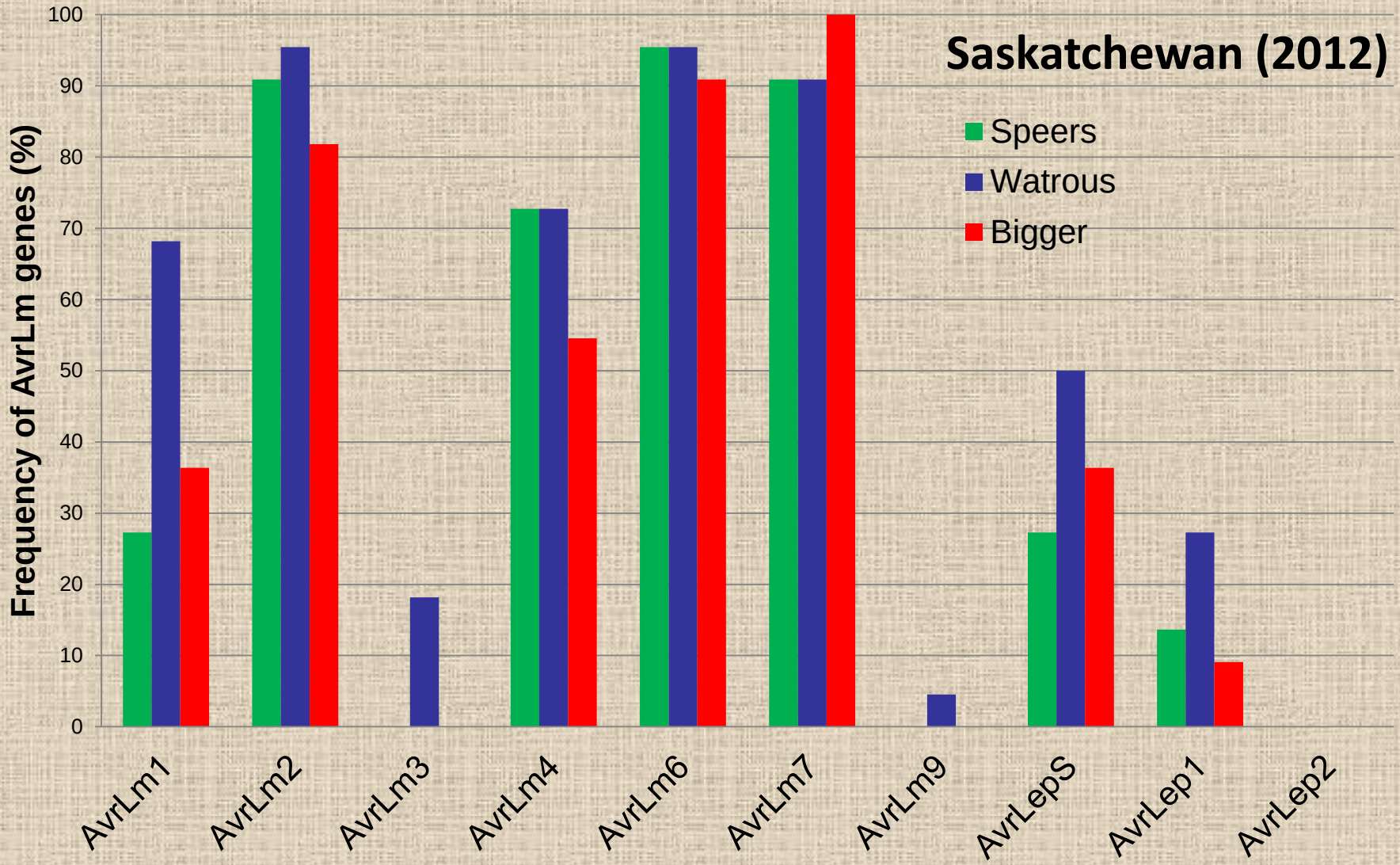
Rlm3 is no longer effective against the current *L. maculans* population

- Why aren't more widespread outbreaks of blackleg reported?
- Are quantitative (adult-plant) resistance doing the heavy lifting?
- How robust are current cultivars, when other *R* genes are not commonly used?
- Should/can *Rlm4, Rlm6* or *Rlm7* be considered in combination with quantitative resistance?

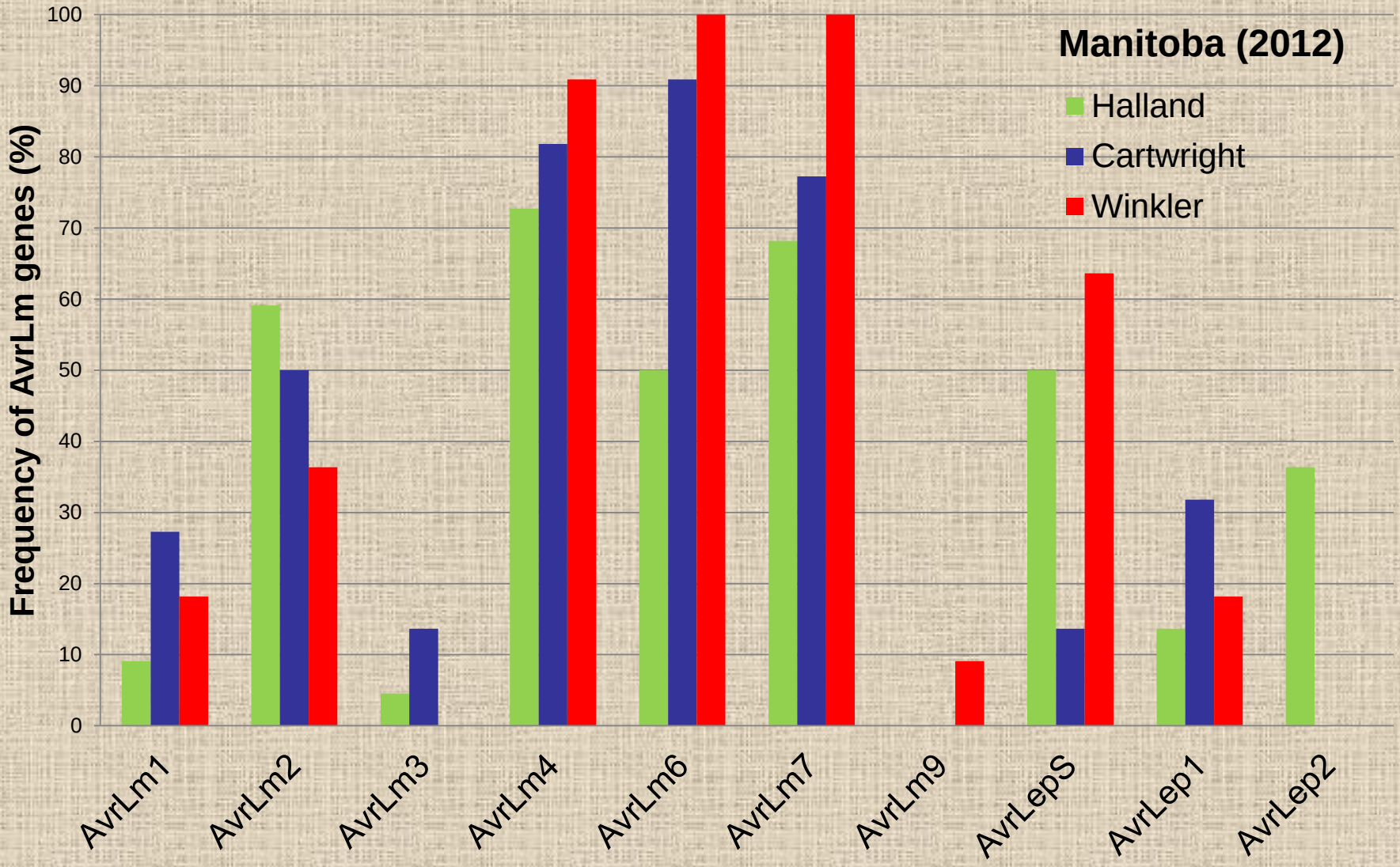
Avr gene profile in commercial fields with varying levels of blackleg



Avr gene profile in commercial fields with varying levels of blackleg

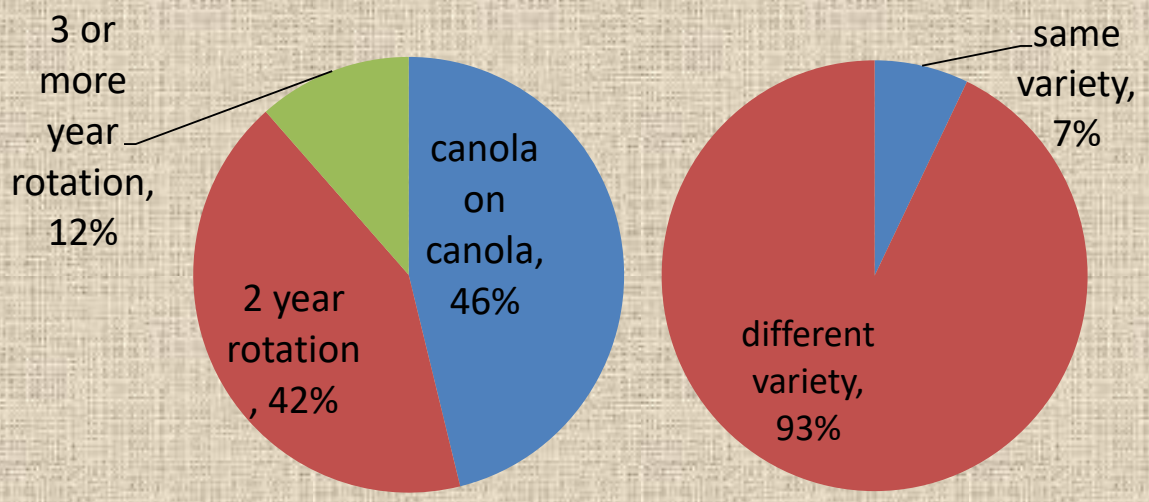


Avr gene profile in commercial fields with varying levels of blackleg

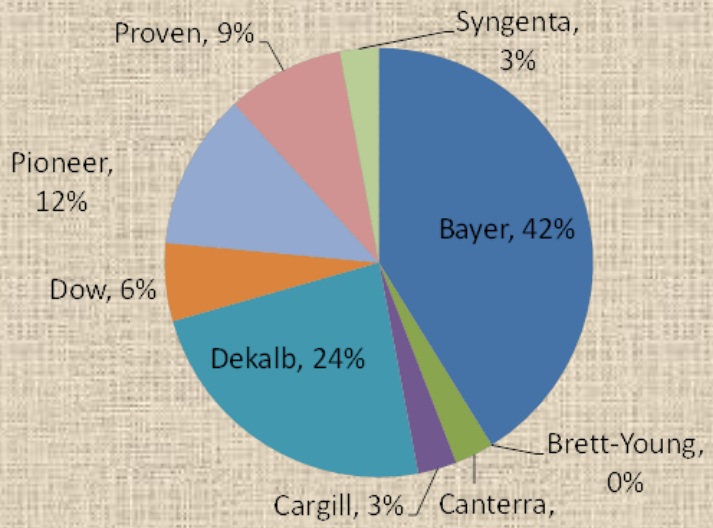


Blackleg in commercial fields (2013) (Provincial/industry canola disease surveys)

- 43 fields reported in the three prairie provinces
- Disease incidence >30%, disease severity >1.5
- 14 had 50% incidence & >2.0 severity



Crop/cultivar rotation?



Which cultivar?

N=43

Source: CCC

Fungicides and application timing

5 location on the prairies

All products were applied at label recommended rates

On Westar (no *R*-genes)

1. Non-sprayed control
2. Headline @ 2-4 leaf stage
3. Quadris @ 2-4 leaf stage
4. Tilt @ 2-4 leaf stage
5. Quilt @ 2-4 leaf stage
6. Headline @ just prior to bolting
7. Tilt @ 2-4 leaf, Headline @ pre-bolting
8. Headline @ 2-4 leaf, Tilt @ pre-bolting

On MR cultivar (43E01)

1. Non-sprayed control
2. Headline @ 2-4 leaf stage

On R cultivar (45H29)

1. Non-sprayed control
2. Headline @ 2-4 leaf stage

Fungicide efficacy (over 17 site-years)

Treatment (On Westar -S)	Dis incidence (%)	Dis severity (0-5)	Yield (bu/ac)
Non-treated control	54.1	1.5	26.4
Headline (2-4 leaf)	42.8 *	0.9 *	**30.4 ***
Quadris (2-4 leaf)	41.8 *	0.8 *	**30.2 ***
Tilt (2-4 leaf)	57.0	1.5	27.1
Quilt (2-4 leaf)	47.2	1.1 *	**30.5 ***
Headline (rosette)	49.4	1.3	28.1
Tilt (2-4 L) + Headline (bolting)	46.8 *	1.2 *	**29.4 ***
Headline (2-4 L) + Tilt (bolting)	41.6 *	0.9 *	**30.5 ***

* Treatments different from the non-treated control significantly (Dunnett's t test, $P < 0.05$)

None of the fungicide treatments was effective when disease severity was Low (DS<1, 9 site-years)

Treatment (on Westar -S)	Dis incidence (%)	Dis severity	Yield (bu/ac)
Non-treated control	29.7	0.5	31.8
Headline (2-4 leaf)	29.3	0.5	33.5
Quadris (2-4 leaf0	25.8	0.4	33.4
Tilt (2-4 leaf)	33.2	0.5	32.8
Quilt (2-4 leaf)	27.7	0.4	33.3
Headline (rosette)	27.1	0.4	32.3
Tilt (2-4 leaf) + Headline (rosette)	26.5	0.4	34.2
Headline (2-4 leaf) + Tilt (rosette)	26.5	0.4	33.6

Early fungicide application was beneficial under moderate disease (DS>1; 8 site-years)

Westar (Susceptible)	**Dis. incidence** (%)	**Dis. severity** (0-5)	**Canola yield** (bu/ac)
Non-treated control	81	2.5	20.5
Headline (2-4 leaf)	57 *	1.5 *	**27.0** *
Quadris (2-4 leaf)	59 *	1.4 *	**26.8** *
Tilt (2-4 leaf)	83	2.6	20.8
Quilt (2-4 leaf)	68 *	1.8 *	**27.4** *
Headline (rosette)	74	2.2	23.4
Tilt (2-4 leaf) + Headline (rosette)	69 *	2.1 *	24.2
Headline (2-4 leaf) + Tilt (rosette)	58 *	1.4 *	**27.1** *

* Treatments different from the non-treated control significantly (Dunnett's t test, $P < 0.05$)

No yield benefit for fungicide treatment on R or MR cultivars

45H29 (R)	**Dis. incidence** (%)	**Dis. severity** (0-5)	**Canola yield** (bu/ac)
Non-treated control	66	1.3	54.1
Headline (2-4 leaf)	47*	0.8*	55.3
43E01 (MR)			
Non-treated control	78	2.0	37.8
Headline (2-4 leaf)	53*	1.1*	34.6

Key message with fungicides for blackleg

- Fungicide “sweet spot”: beneficial when disease pressure is at least moderately high
- Fungicide effects more apparent if the resistance has been eroded, otherwise the benefit to yield is insignificant
- Early application (2-4 leaves) more effective than late (rosette) treatment
- Split/multiple applications did not improve efficacy

Strategies for managing blackleg
- lowering the risk

- Use only R-rated cultivars. Much research support for this aspect: Monitoring of *Avr* gene in the pathogen population, extensive field assessment over cultivar performances…
- Rotate crops (>2-yr break from canola) and cultivars
- Check blackleg incidence on your farm after swathing
- When blackleg risk is not high (low disease incidence in previous crop and using < 3-year ration), fungicide generally is not required

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