



2023 Ontario Bean Growers Research Day

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Common Bacterial Blight

- *Xanthomonas axonopodis* pv. *Phaseoli* (XAP/CBB)
- Major disease in dry beans
 - Yield (defoliation)
 - Seed quality (seed coat lesions)
- Seedborne
 - Pedigree seed production in Idaho
- Warm, wet environment
- Major focus of disease resistance breeding efforts in Ontario
 - Success in navy beans
 - Resistant germplasm
 - Molecular marker development



Bacterial Brown Spot

- *Pseudomonas syringae* pv. *syringae* (PSS/BBS)
- Overwinters in crop debris and in/on infected seed
 - Alternate host is corn (Holcus leaf blight)
- Development favours cool, wet conditions
- Genetic resistance



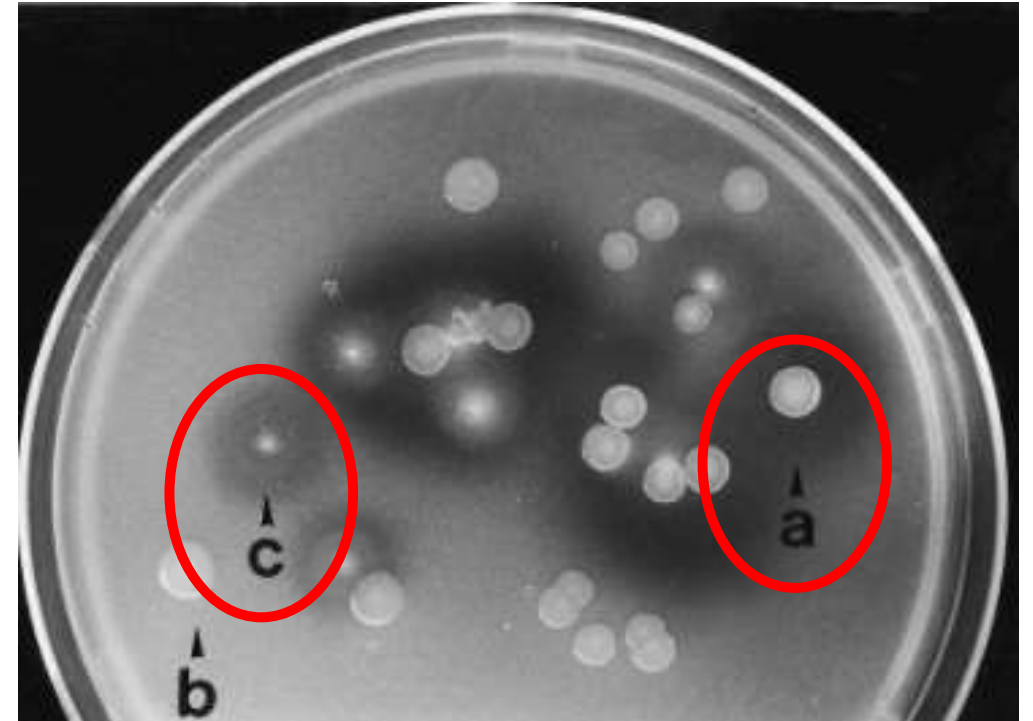
How We Know

Differentiate species through semi-selective Milk-Tween media

a= PSS/BBS clear zone around white colony, fluorescent

c= XAP/CBB two zones around yellow colony, non-fluorescent

- Used for pathogen detection in Ontario surveys
 - CBB and BBS found to be common across the province



From: Goszczynska and Serfontein 1998

Bacterial Blights-Why this Research Matters

- Bacterial blights cause issues for bean farmers in many ways:
 - Increased seed costs: **~\$25/acre**
 - Decreased seed security: **US production**
 - Increase “pick” at the elevator
 - Reduce yield: **40% yield loss**
 - Peter Sikkema mathematics says BB resistance is worth \$46 million to the industry (valued at ~115 million) or \$365/acre!
- That’s why we keep working at it (+40 years)

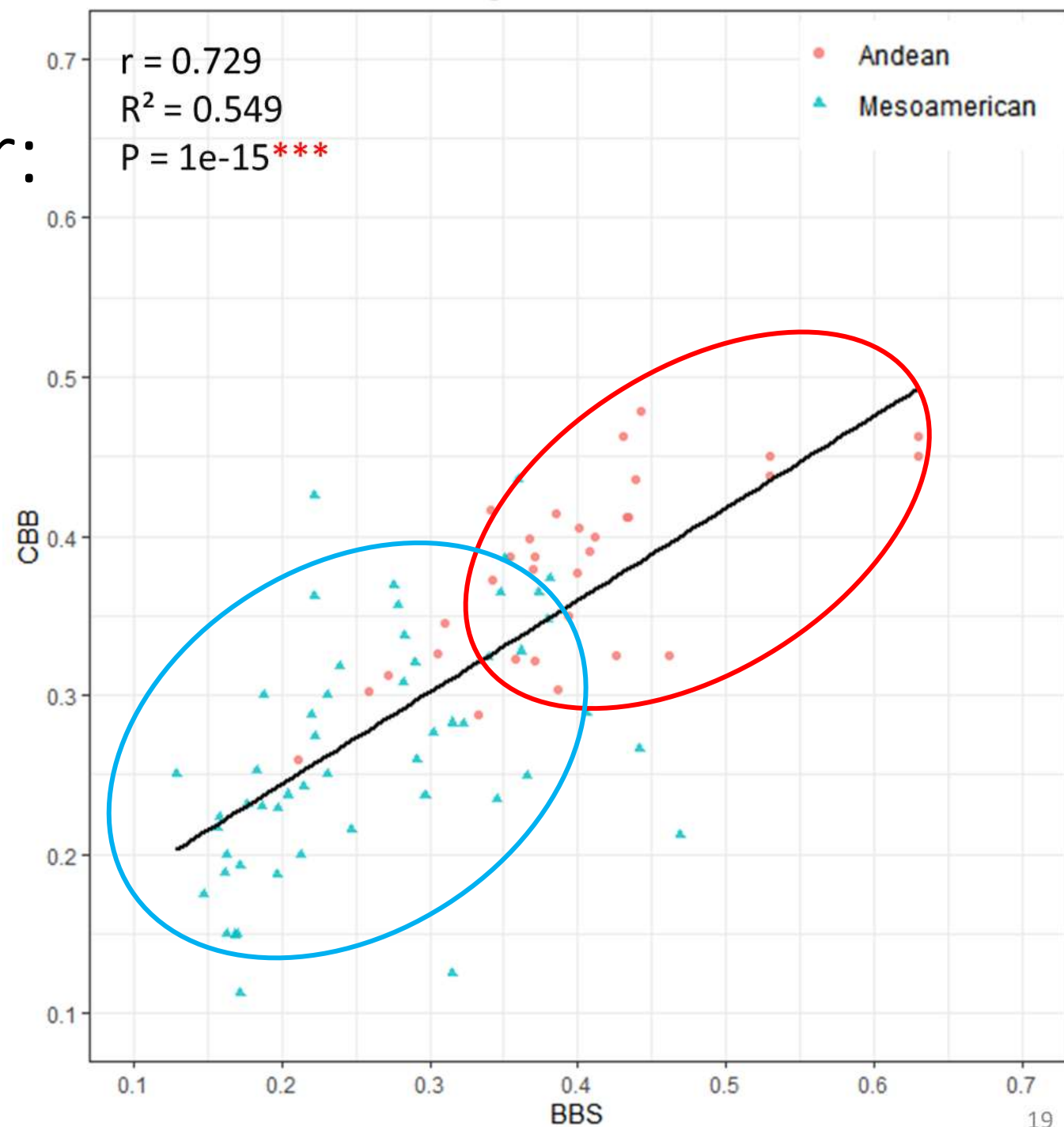


Vs.

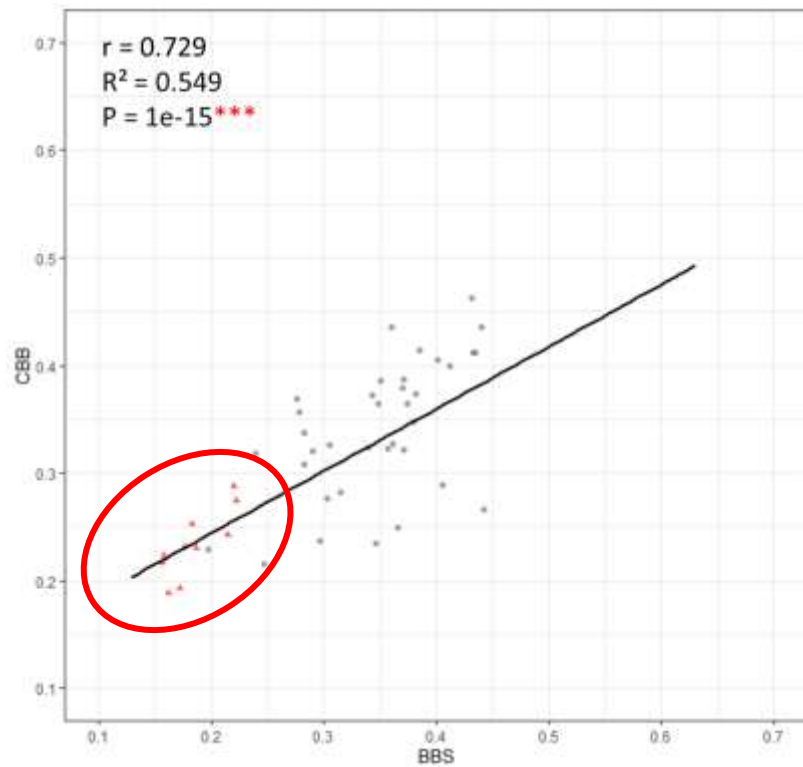


What I Told You Last Year:

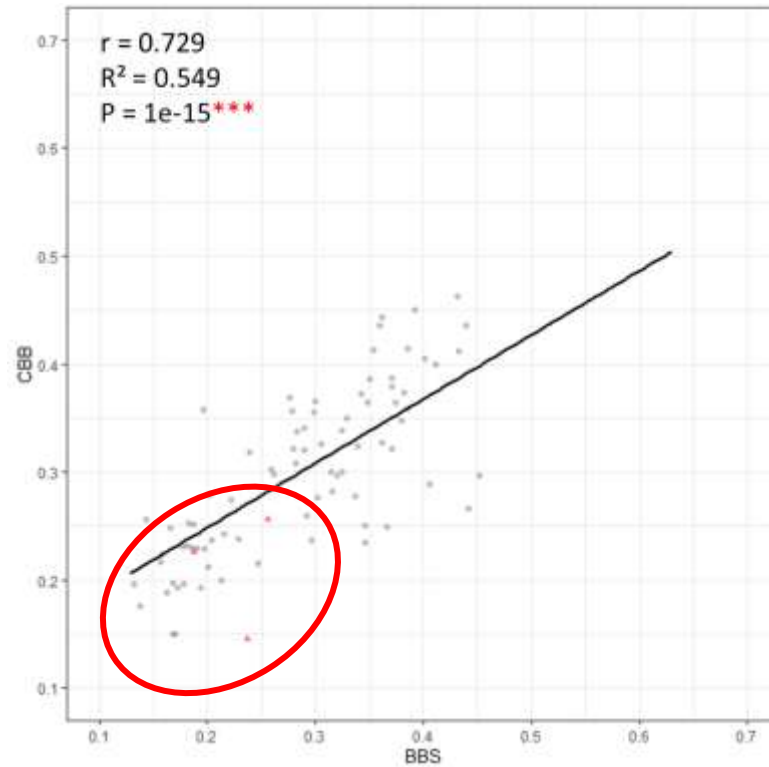
- Overall resistance to CBB and BBS is correlated
- If it has CBB resistance, it is resistant to BBS...sort of...



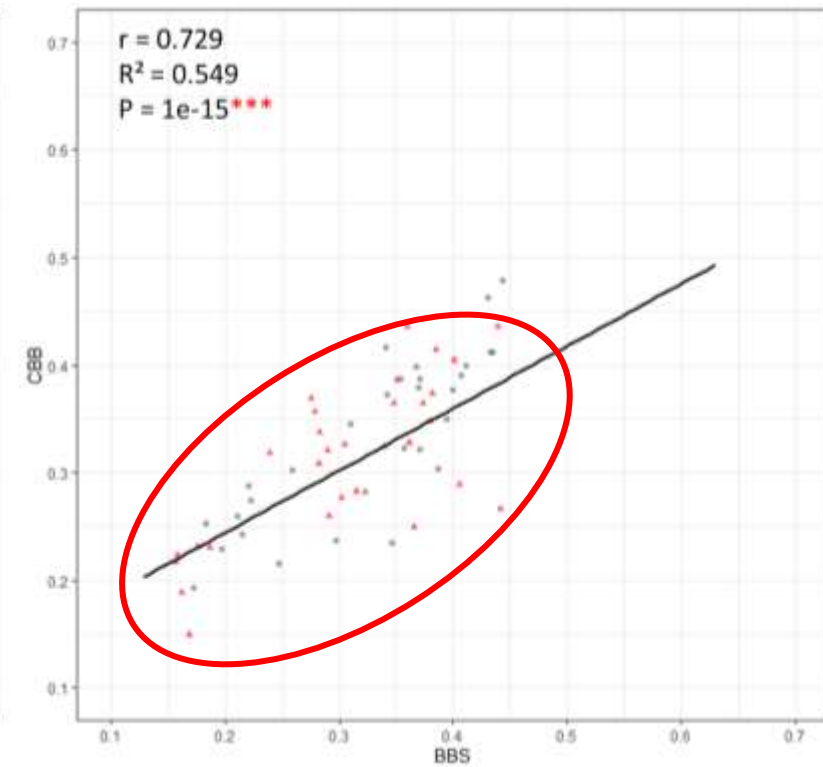
What I Told You Last Year: Molecular marker-CBB resistance genes



BC420-CG9



G7-NPP

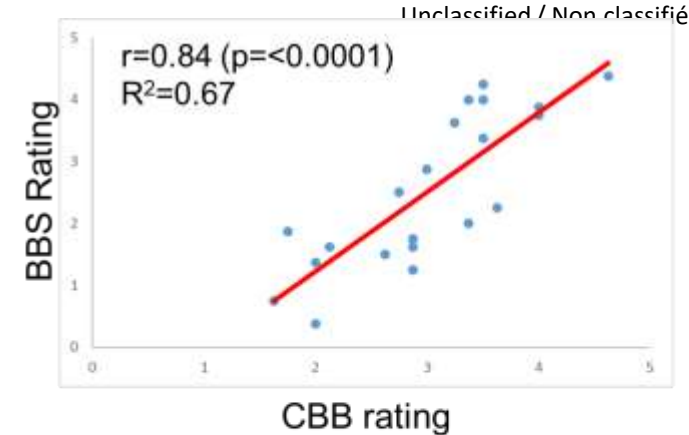


SAP6

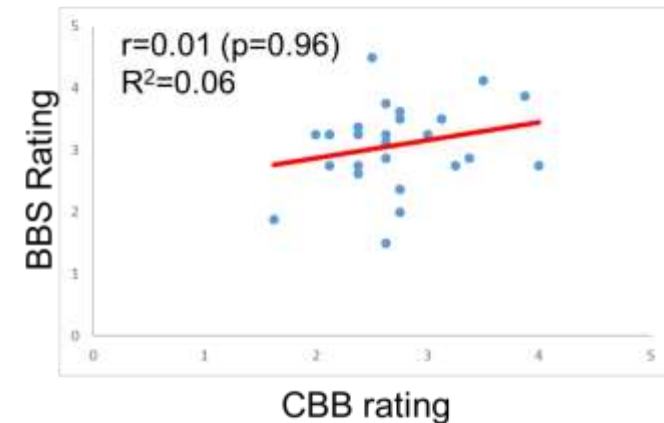
A Look at the Genetics

- BB resistance is working in the small seeded beans
- It's pretty iffy in large seeded beans (Kidney's and Cran's) and the correlations don't hold up that well
 - Not many large seeded beans have BB resistance bred into them
 - Is there something else going on?

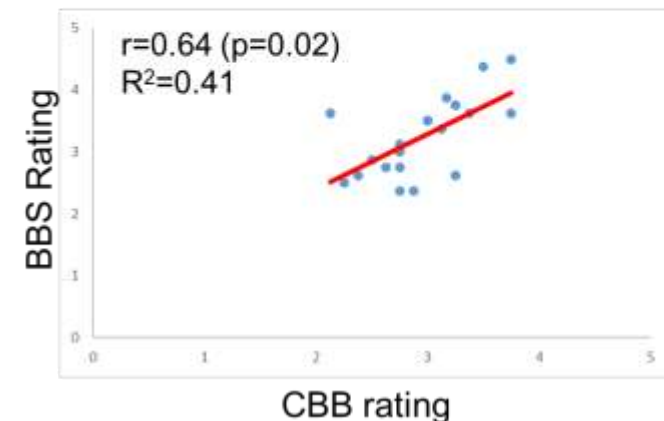
White Bean



Large Seeded Coloured



Small Seeded Coloured



What I Told you Last Year:

Improving CBB/BBS Resistance in Kidney Beans

- Newer Kidney bean varieties have improved resistance
- USDK CBB-15 has two resistance genes (additive effect)
- Ontario adapted germplasm is more resistant
- Population development, disease screening and molecular marker analysis & development (GBS)
- Improved resistance in new cultivars

Cultivars	Market Class	Rating		Molecular Markers	
		CBB	BBS	SAP6	G7-NPP
Cultivars showing levels of CBB and BBS resistance					
Gallantry	DRK	2.4	2.4	S	R
OAC Snowshoe	WK	3.1	3.4	R	S
OAC Firebrand	LRK	2.5	2.2	S	R
Check cultivars and parental lines					
Dynasty	DRK	3.9	4.1	S	S
OAC Inferno	LRK	3.6	2.8	S	S
Yeti	WK	3.5	4.1	R	S
USDK CBB-15	DRK	2.9	2.6	R	R
Argosy	Navy	2.0	2.0	R	R

Population Development

- Gallantry x USDK-CBB-15
- OAC Snowshoe x USDK-CBB-15
- OAC Firebrand x USDK-CBB-15



X



Ontario-adapted
Gallantry (DRK)

USDK-CBB-15 (DRK)

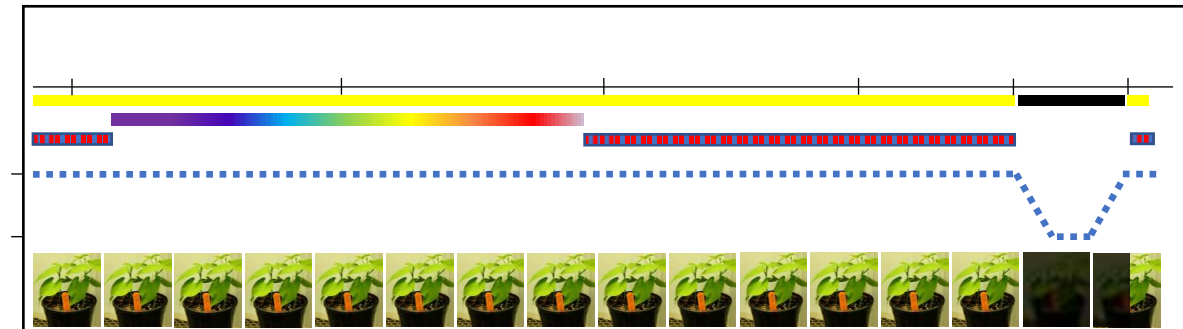
OAC Snowshoe (WK)

OAC Firebrand (LRK)

Generation Adv.
F1-F4:5

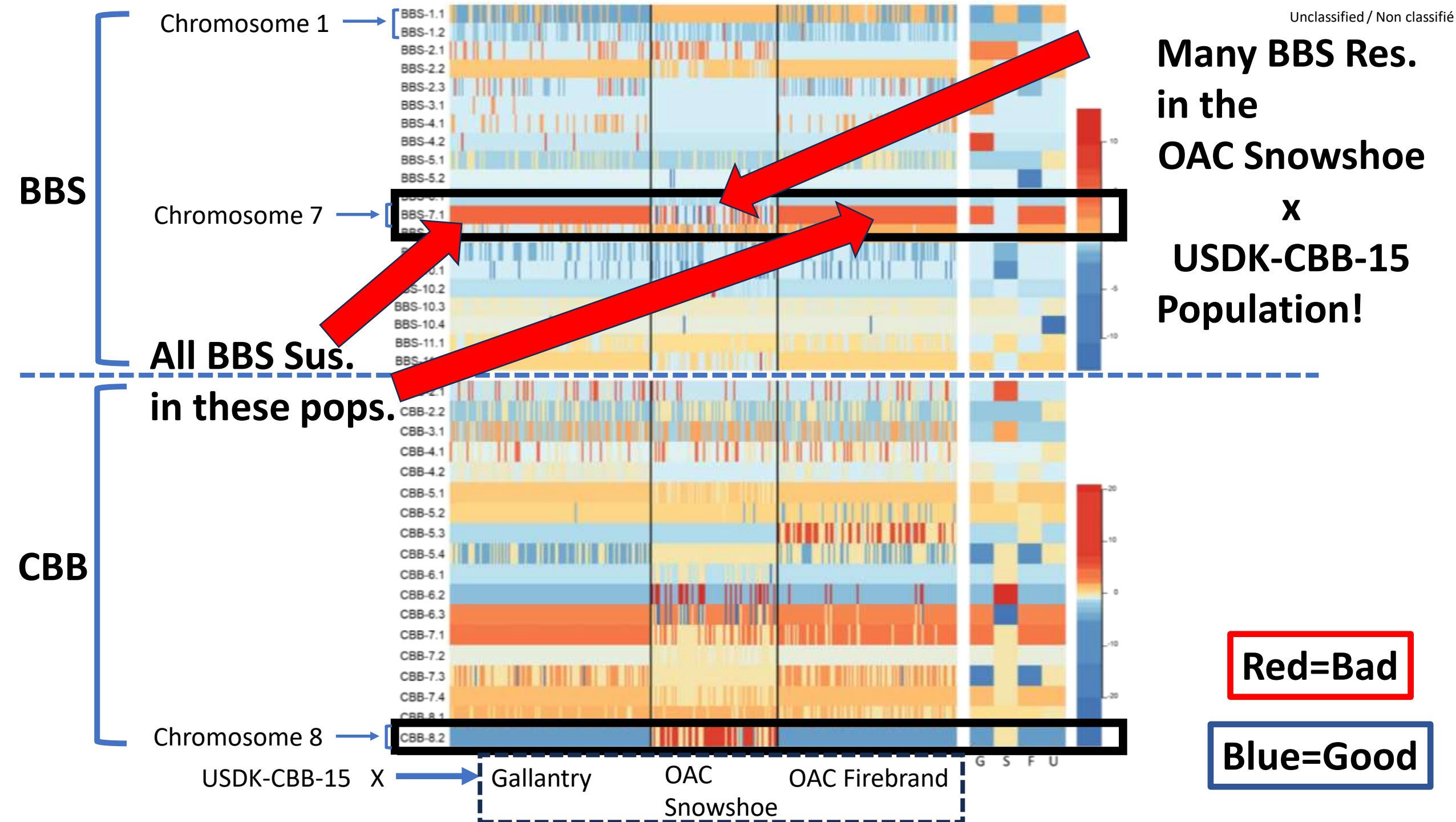


50%-93% genes fixed



DNA sequencing/Bioinformatic
analysis of populations

Field/Indoor testing for
BBS and CBB

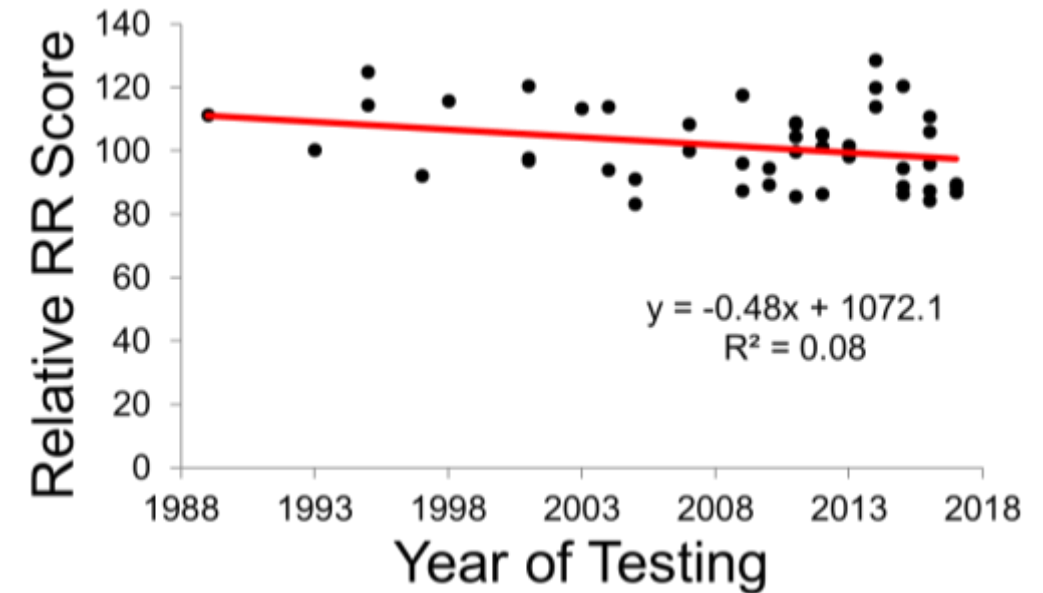


Next Steps

- Use the molecular marker data to select lines to do further experiments
 - Can we find the perfect line that has all of the resistance loci?
 - Build in more resistance from other sources to improve BB resistance
- Test more cultivars
 - We've (with Nick Larkan, AAFC-Saskatoon) sequenced over 400 cultivars, we just need to do the disease screening

Root Rot

- Previous analysis shows no progress in genetic improvement
- Focus on improving methods
 - Standardization of rating methods
 - Hill plots to increase number of cultivars tested
 - Root digger to increase rating speed
 - Increased replications
 - Smaller test area
 - Increased irrigation
- Methods still aren't perfect!

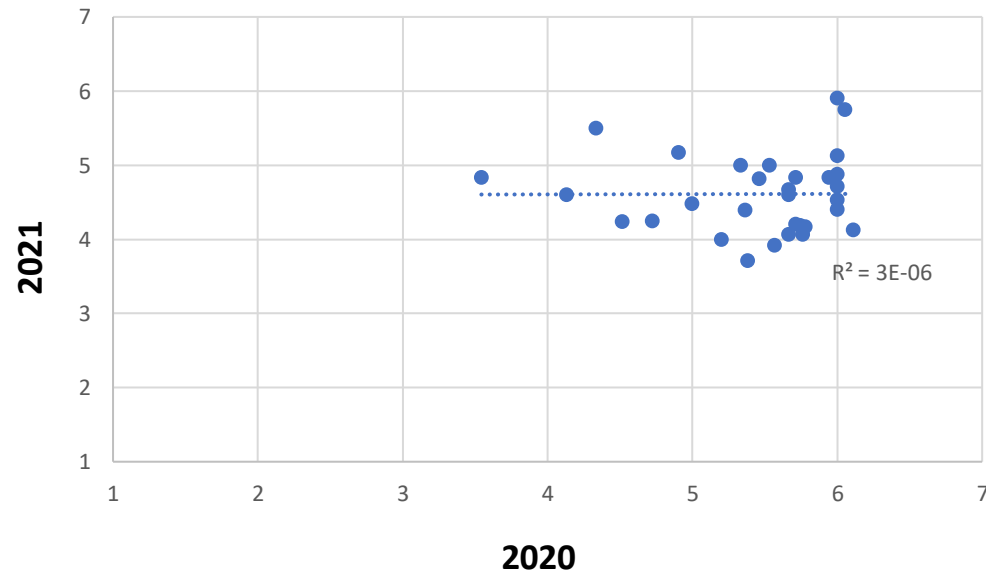
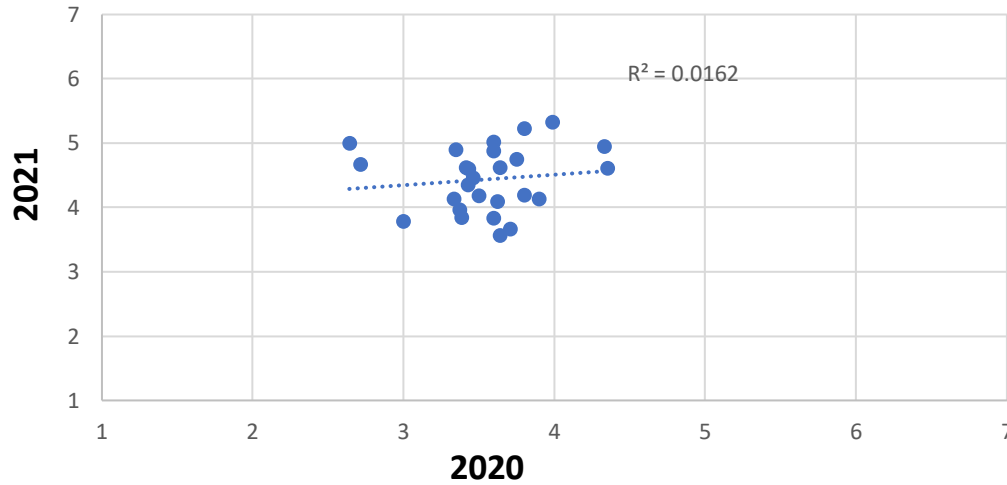


Rating Scale-Root Rot



Data from 2020 & 2021

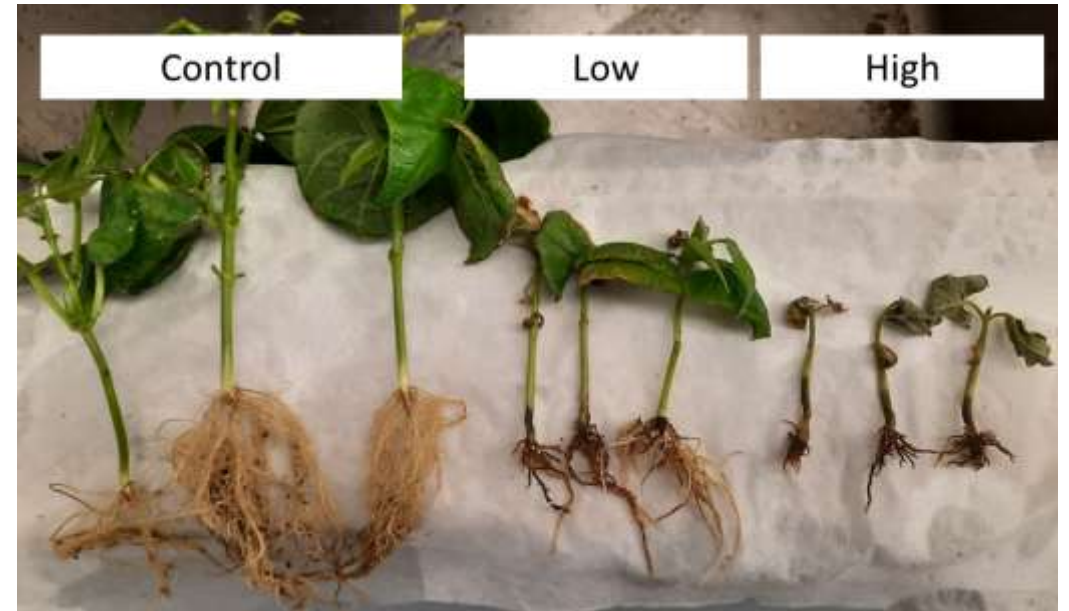
Variety	Rating
Indi	3.4
OAC Award	3.6
Armada	3.7
Apex	3.7
Lighthouse	3.7
Rogue	3.7
OAC Plasma	3.7
T9905	3.8
AAC Shock	3.9
OAC Charm	4.0
OAC Thunder	4.0
Nautica	4.0
AAC Argosy	4.0
OAC Fusion	4.1
Blizzard	4.1
Bolt	4.2
OAC Equinox	4.3
OAC Marker	4.3
HMS Medalist	4.5
Rexeter	4.6
Mean	4.0



Variety	Rating
Vax1	4.2
OAC Inferno	4.4
Red Dawn	4.4
Dynasty	4.5
OAC Thunder	4.5
OAC Racer	4.6
Jester	4.7
Big Red	4.9
OAC Jasper	4.9
Gallantry	4.9
Vero	4.9
OAC Candycane	5.0
OAC Firebrand	5.0
OAC Snowshoe	5.0
Epic	5.1
Pink Panther	5.1
OAC Navabi	5.2
Red Rider	5.2
OAC Firestripe	5.2
Etna	5.3
Yeti	5.3
Rampart	5.3
Red Hawk	5.4
OAC Jewel	5.4
OAC Iceberg	5.4
Mean	5.0

Root Rot

- Need consistency so:
 - Using an indoor screening method developed by the Pulse and Soybean Pathology Lab (O. Wally)
 - *Rhizoctonia solani*
 - *Fusarium sp.*
 - Include inoculum in envelopes for field planting (C. Gillard)
 - Data was generated yesterday!



Pest Resistance-White Mold

- #1 Concern for bean growers in 2021 (and likely 2023!)
- Ontario bean growers typically apply 2-3 fungicide sprays per season
- Resistant germplasm/cultivars are available
 - Genetic
 - Avoidance (upright growth habit)
- Outdoor testing ~750 plots
 - Sclerotia spread in spring
 - Misting shortly after emergence until flowering is complete
 - Scored as incidence $((0-100) \times \text{severity } (0-10))/100$



Compiled data from 2020-22

White

Variety	Rating
Lighthouse	4.7
AAC Argosy	4.9
Nautica	5.8
Rexeter	6.1
AAC Shock	6.2
Indi	6.6
T9905	7.1
Blizzard	7.2
OAC Thunder	7.5
Armada	7.7
Medalist	8.2
Rogue	8.3
Bolt	9.1
Mean	7.2
LSD	2.3
P-value	0.0004



Small Coloured

Variety	Rating
Mist	3.1
OAC Rosito	4.9
Blackbeard	5.4
OAC Vortex	5.4
Spectre	5.5
G122	5.6
FR 266	5.9
Zorro	6.3
Dresden	6.6
Zenith	7.3
Viper	7.4
BlackTails	7.6
La Paz	9.8
Merlot	10.0
Mean	6.5
LSD	2.1
P-Value	<0.0001

Large Coloured

Name	Rating
Mist	4.5
G122	5.6
Red Rider	6.5
Dresden	7.2
OAC Inferno	7.3
Gallantry	8.1
Red Hawk	8.2
Jester	8.3
OAC Firebrand	8.3
Epic	8.3
Dynasty	8.3
Yeti	8.7
Red Dawn	8.8
OAC Navabi	8.9
Rampart	9.2
Big Red	9.5
Pink Panther	9.7
Etna	10.0
Vero	10.2
Mean	8.3
LSD	2.1
P-value	<0.0001

The Breeding Program: AAFC 21-2

Pedigree: HR144//AC Cruiser/OAC Rex///Bolt

Strengths:

Harvestability better than T9905

Early-Mid Maturity, similar to T9905

CBB Resistance- Moderately Resistant

High protein content 1% higher than checks

Acceptable Canning quality

Neutral:

Yield similar to the checks (T9905)

White Mold-Intermediate

Seed size similar to OAC Thunder (22g/100 seeds)

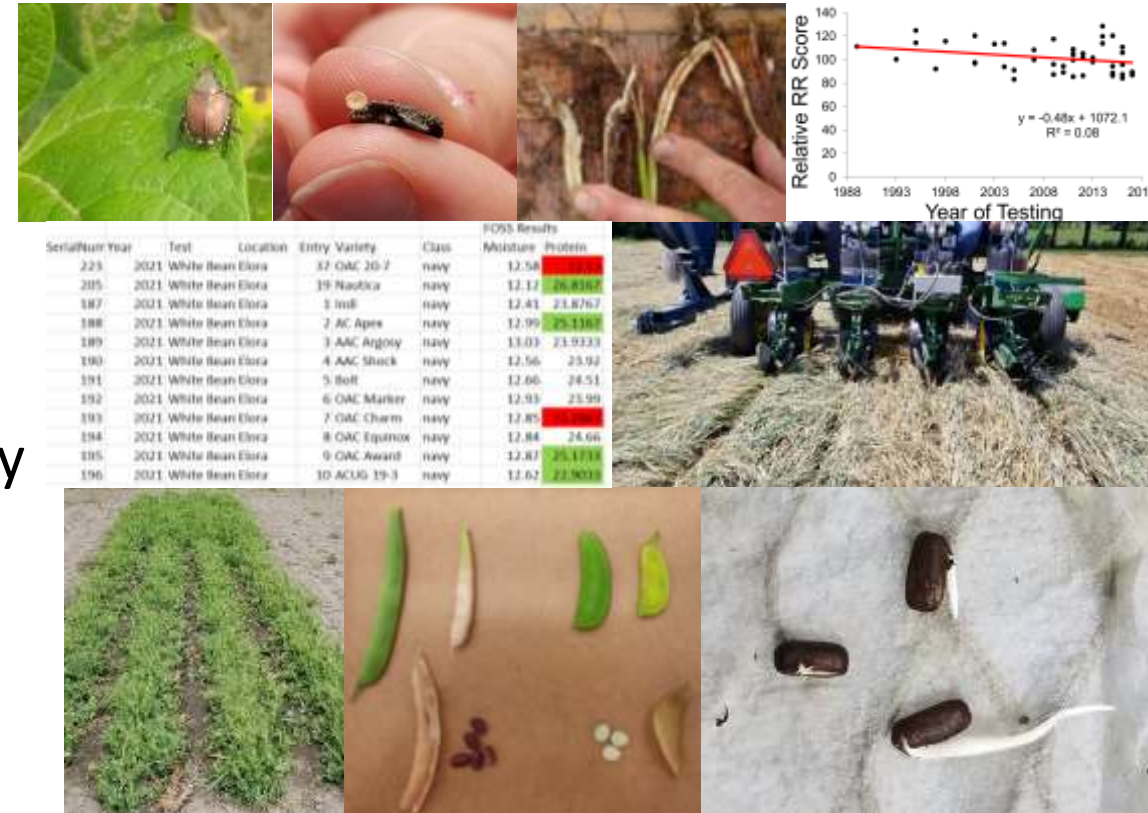
Weakness:

Lacks Anthracnose Resistance

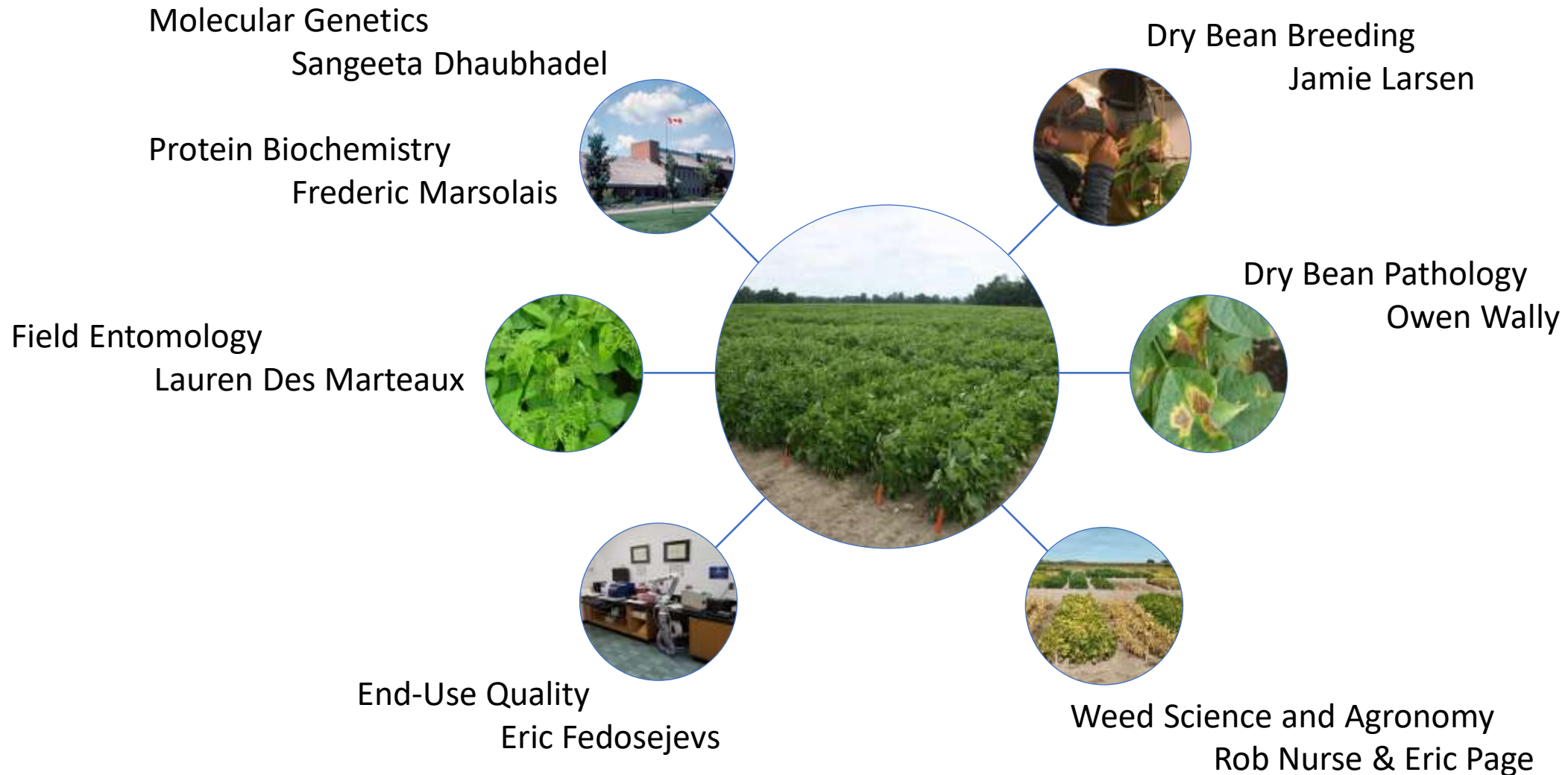


Looking Forward

- Dry beans:
 - Continued effort to improve pest resistance
 - Bring seed production to Canada
 - Build root rot resistance
 - Biological nitrogen fixation
 - Improve phenotyping/genotyping methodology
 - Bring new varieties to the market
- New Pulses:
 - Winter pulses for Canada
 - Dry White Baby Lima bean
 - Other spring pulses



The AAFC-Bean Research Group





Number of disease plot ratings: 24 230 (2022)



Number of km's driven for only field work: 19 825



32 trips to London

18 trips to St. Thomas

5 trips to Exeter

Total number of outdoor plots in 2022: 19 107



Thanks!

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