Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Forage breeding in Canada

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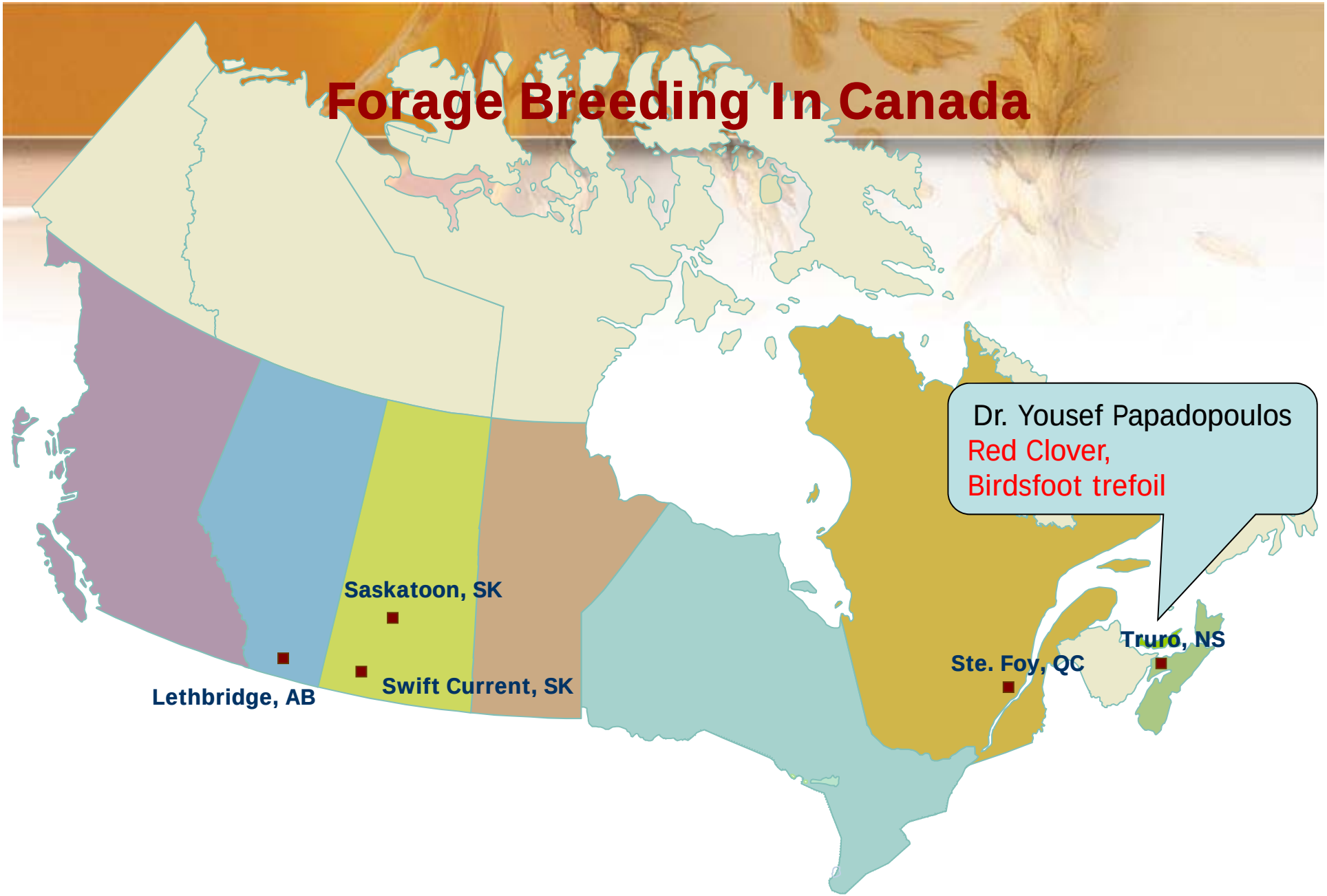
Canada

National FS Objective

Forage Crop Improvement for the Canadian Livestock, Forage, Bio-energy and Conservation Industries.

Forage Breeding In Canada



Red Clover Genetic Adaptation

- NE-1010 Trial (multi-sites).
- Breeding strategies to expand the adaptation of red clover.
- Selection for general adaptation of red clover: Evaluating the theory of general vs regional adaptation in red clover.

Progress In Trefoil Breeding

- Improved Establishment – Seedling Vigour (First Growth Vigour).
- Management – Performance Under Hay and Grazing.

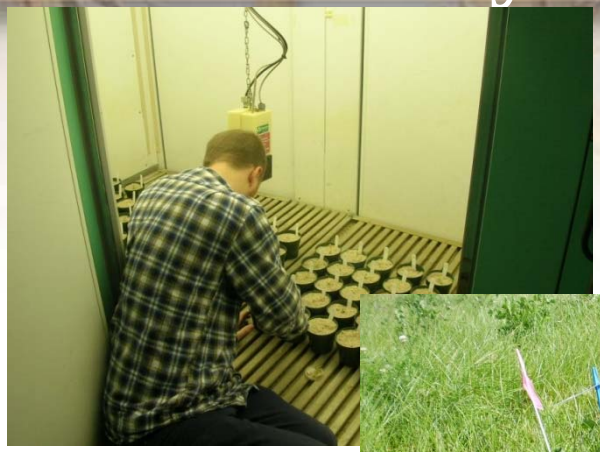
- Seasonal Yield Distribution: Improved – Pasture Regrowth and Seasonal Biomass Distribution.
- Feed Efficiency – Chemical Composition (Phenolic Compounds and Condensed Tannins).

Progress In Alfalfa Breeding

- long-term persistence.
- Evaluation and selection for adaptation to acidic soil conditions.
- Intensive selection under grazing.
- Adaptation to climate change (Flooding Tolerance….).

Forage Mixtures And Nutrient Cycling

- Contribution of forage legumes to soil NO3- when grown in mixture with grasses compared to an unfertilized pure grass stand.



- Genetic variability among red clover and alfalfa cultivars for nitrogen fixation and transfer to companion grasses.

- Performance of forage mixtures under a beef grazing management system

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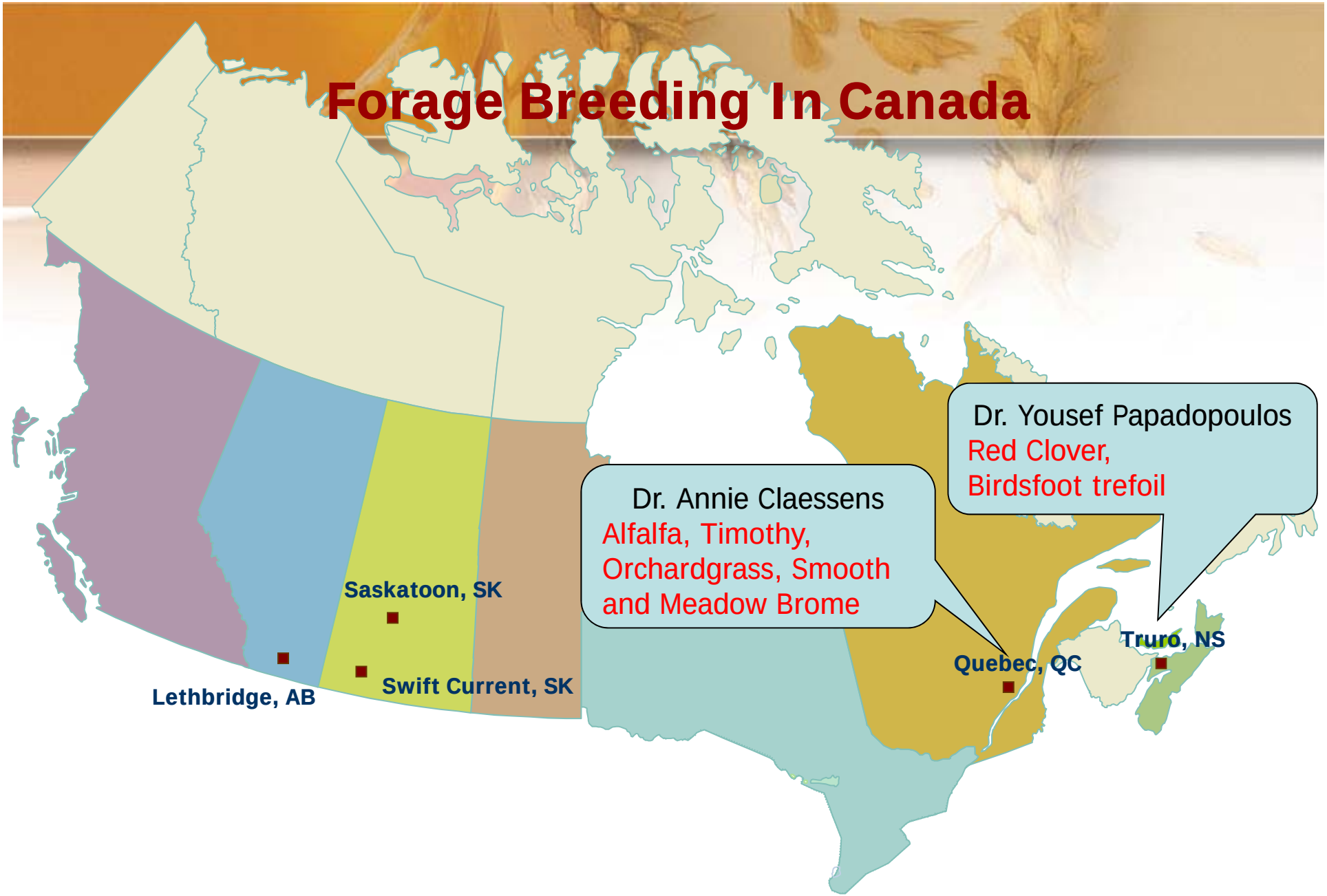


Research Team at AAFC - Quebec

Scientists

Annie Claessens	Plant breeding
Annick Bertrand	Plant biochemistry
Yves Castonguay	Molecular physiology
Patrice Audy	Plant pathology

Research assistants

Marie-Claude Pépin	Plant breeding
François Langevin	Germplasm development
Josée Bourassa	Plant biochemistry
Jean Cloutier	Molecular genetics
Réjean Desgagnés	Molecular biology
David Gagné	Bioinformatics
Josée Michaud	Molecular physiology

Breeding Program

Dairy industry

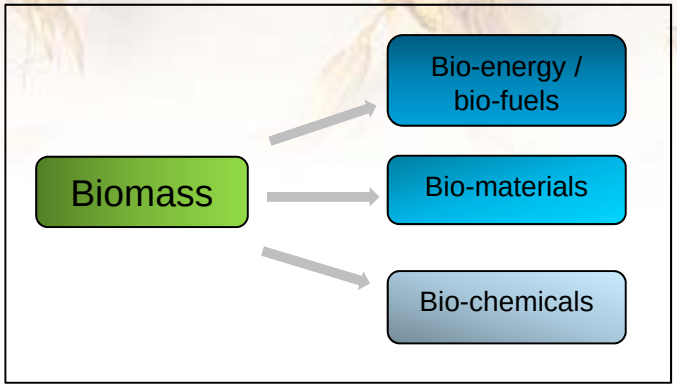
Alfalfa

Timothy

Tall fescue

Improve forage nutritive value for superior animal performance

Bioproduct industry



Switchgrass

Reed canarygrass

Big bluestem

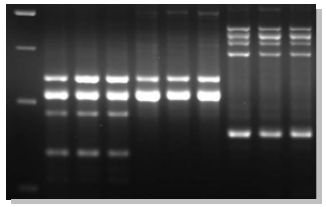
Improve biomass quality to meet bio-industry needs

Development of genetic material adapted to the cold and humid environmental conditions of eastern Canada

Breeding Projects

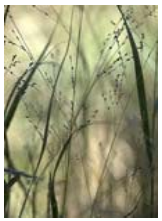
Alfalfa

- Nutritive value
  - Concomitant selection for high stem sugar content and greater fiber digestibility
- Persistence
  - Marker-assisted introgression of cold hardiness into germplasm with low fall dormancy
  - Development of phenotypic assassays and marker-assisted approaches to improve dry matter digestibility and stress tolerance (Phytophthora and Aphanomyces root rot, cold and salt tolerance)



Timothy

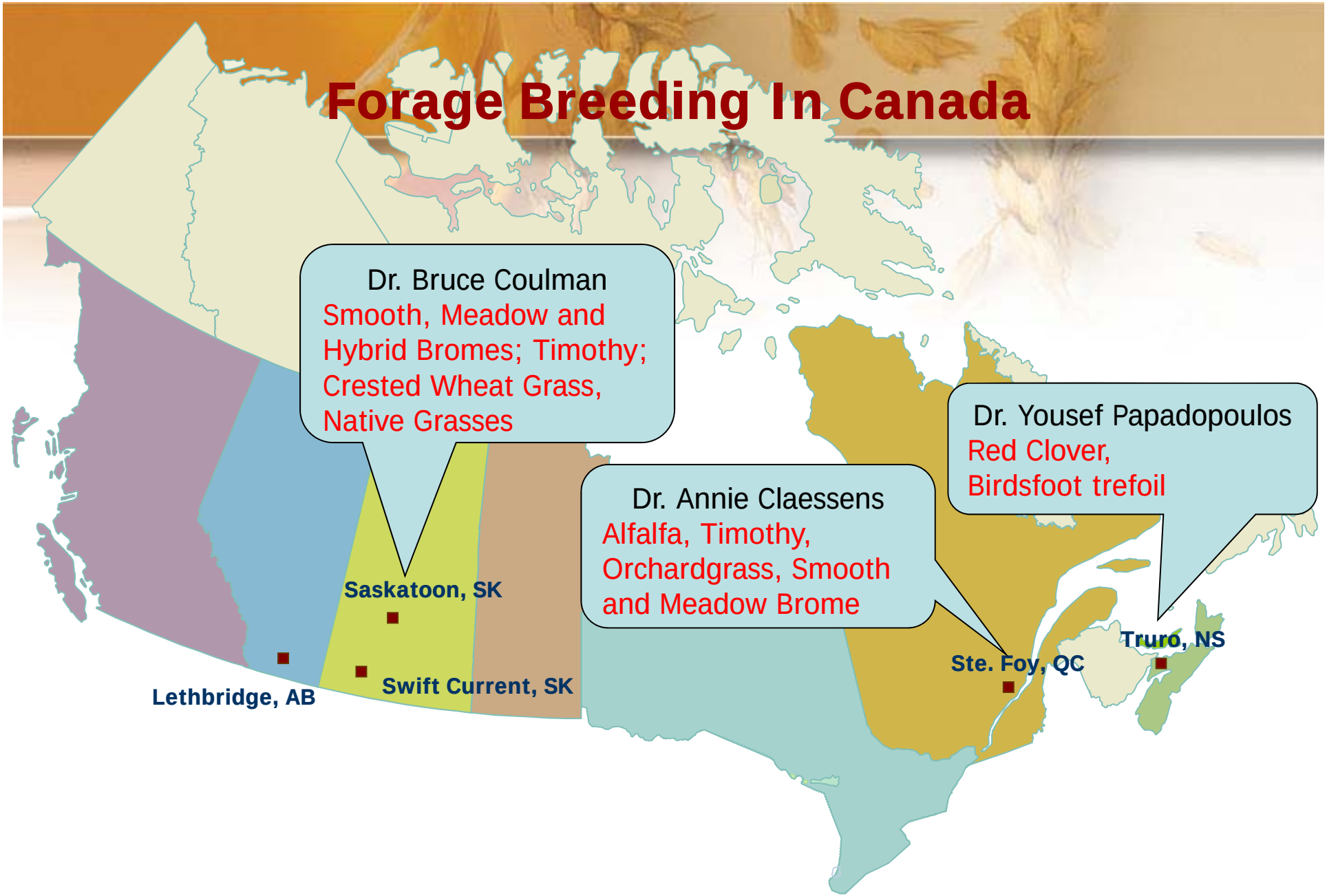
- Yield
  - Increase timothy regrowth capacity



Switchgrass

- Persistence
  - Increase switchgrass cold tolerance
- Bio-fuels
  - Increase switchgrass dry matter degradability

Forage Breeding In Canada



Meadow bromegrass breeding at the University of Saskatchewan/AAFC

B. riparius

- Recent new varieties
  - Armada (2008)
    - Improved seed and forage yield
  - Admiral (2009)
    - Improved vigor and greenness in fall
- Present program
  - Expand genetic base
    - Evaluate new accessions from world genebanks
  - Further improvement in forage yield
  - Evaluation of NAAIC lines selected at four locations

Hybrid bromegrass breeding at the University of Saskatchewan/AAFC

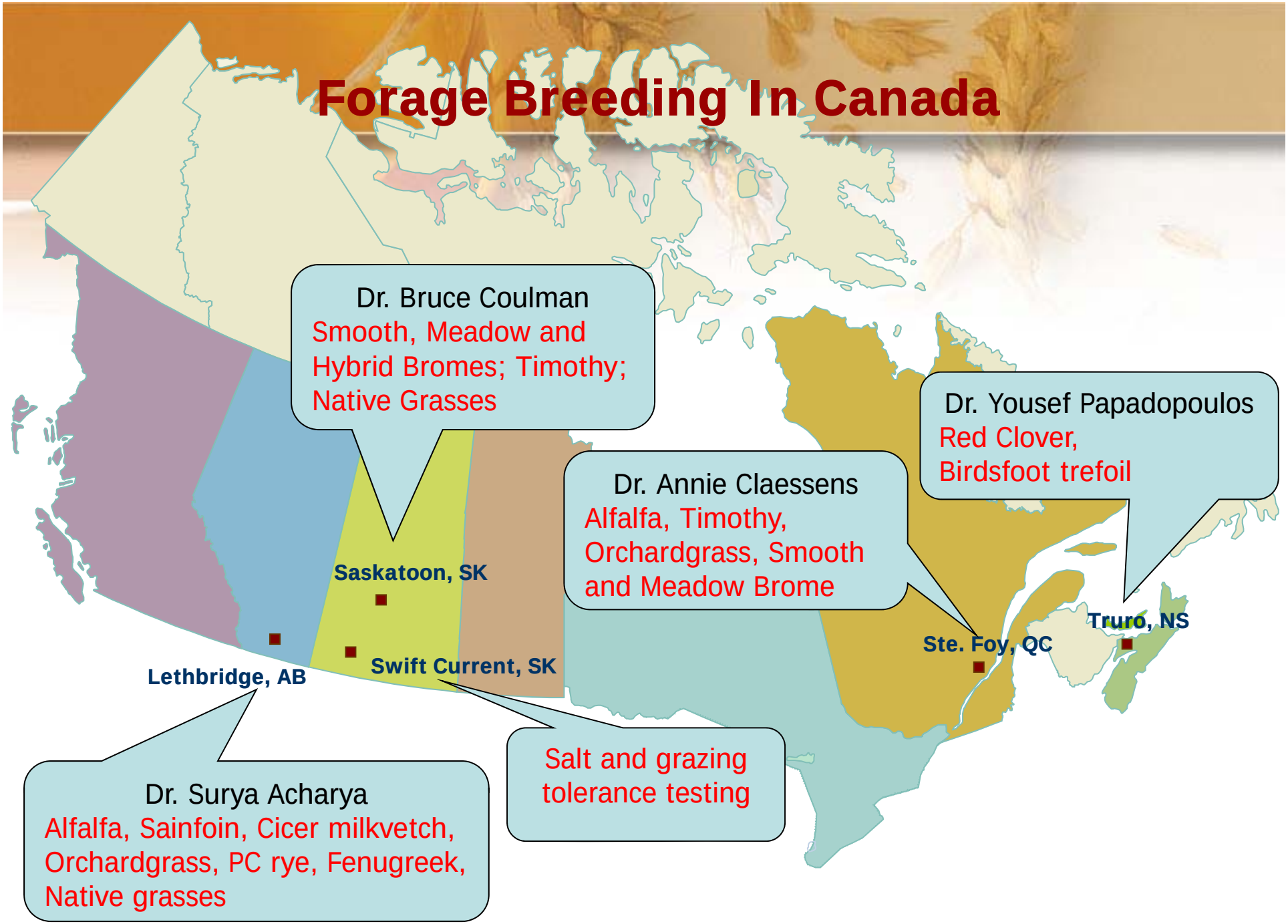
- Meadow X smooth bromegrass hybrid populations
- Two cultivars released in early 2000s – have been widely used
- Continue selection in existing populations
- Expand adaptation to more humid regions
  - New population (S9478) from crosses using “southern” type smooth brome parents

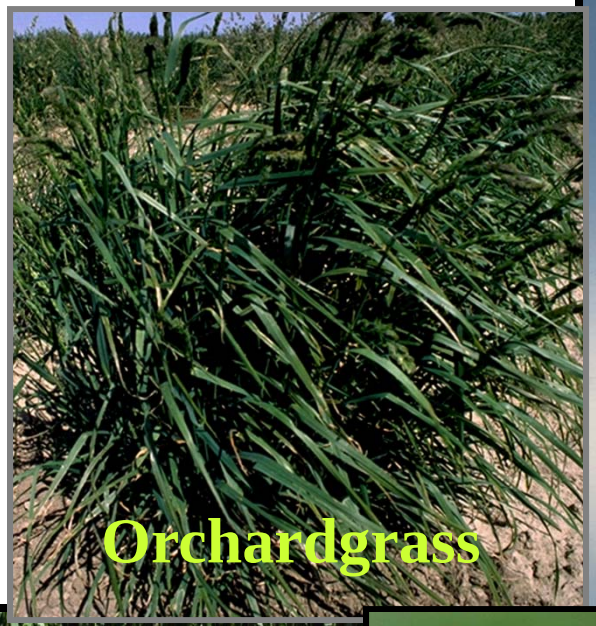
B. riparius

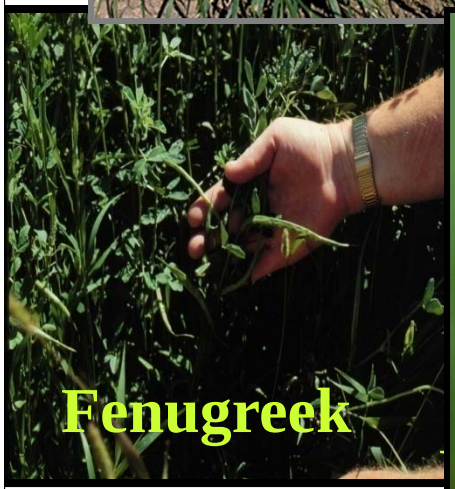
Hybrid
B. riparius X B. inermis

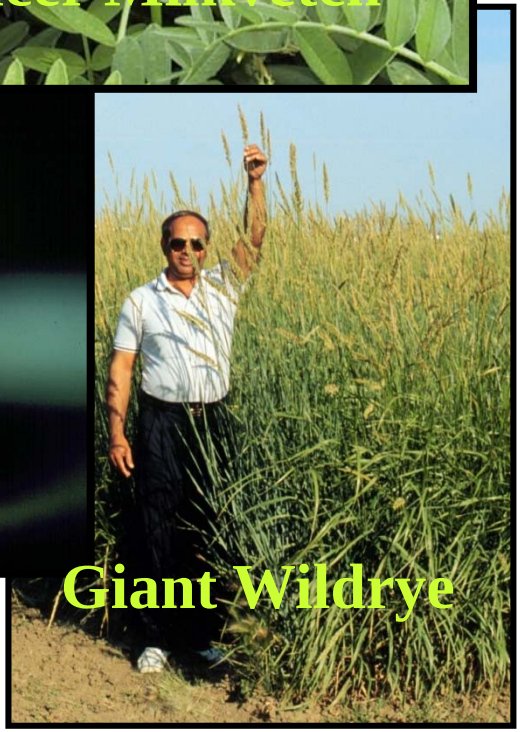
B. inermis

Forage Breeding In Canada









LRC Forage Program deals with seven forage crops

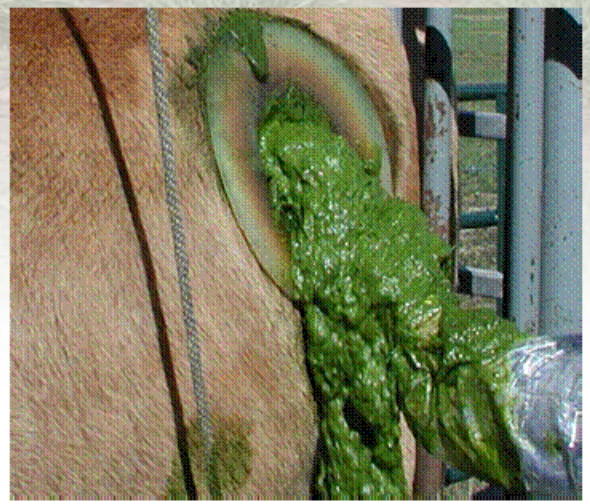
LRC breeding program has produced winter hardy, high yielding and disease resistant alfalfa cultivars.

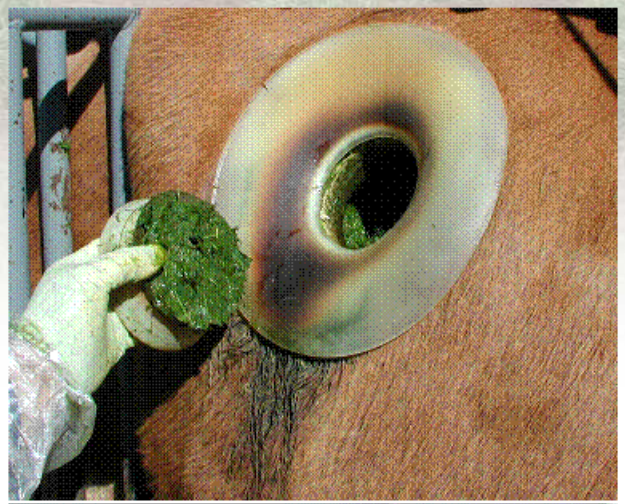
We have also produced an acid tolerant and a saline tolerant alfalfa cultivar in recent years.

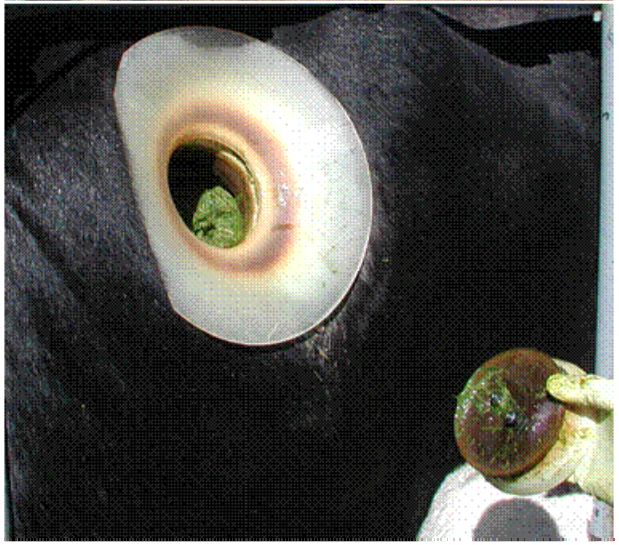
Work on biotic and abiotic stress tolerance in alfalfa continues with emphasis on mixed cropping and grazing tolerance.

Bloat

No bloat

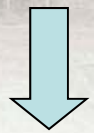




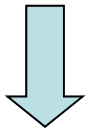


Pasture Bloat

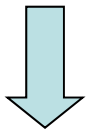
Fast release of soluble proteins into rumen fluid upon eating, thickening of rumen fluid



Fermentation gases get trapped in thickened rumen fluid making it foamy



Trapped gas can not be expelled, keep accumulating causing animal to bloat, and in extreme cases death occurs



Condensed tannin containing forage legumes e.g. sainfoin do not cause ruminant bloat


➲ Excellent quality and palatability.
➲ Easy to establish.
➲ A low proportion of sainfoin in alfalfa pasture can prevent bloat in grazing cattle.
Why is it not used for bloat prevention in alfalfa pasture?
Sainfoin

Available sainfoin cultivars do not

- survive in mixed alfalfa stands
- regrow at the same rate as alfalfa after grazing and so cannot be used for bloat prevention all summer
- have tolerance for frequent cutting or grazing
- produce as much biomass as alfalfa although easy to establish

The challenge was to prove that bloat can be prevented in mixed alfalfa pastures using these new populations.

We have developed several new sainfoin populations with ability to survive in mixed alfalfa stands, tolerate frequent cutting and produce high biomass yield.

Pasture bloat observed in alfalfa / sainfoin mixed stands at Lethbridge in 2010 and 2011.

Bloat incidence and severity in sainfoin/alfalfa mixed pastures observed in 2010 and 2011 at Lethbridge, AB

Experiment (Year)	No. of animals	% sainfoin	Bloat incidence	No. of multiple distension / day	Highest bloat score
1 (2010)	10	5 25	43[a] 5[b]	5 0	3 1
2 (2011)	10	5 25	47[a] 1[b]	8 0	3 1

5% Sainfoin: Nova/AC Blue J mixed stand
25% sainfoin: LRC3519/AC Blue J mixed stand

Under direct grazing a newly developed sainfoin population prevented bloat as it survived in mixed stands with AC Blue J alfalfa in higher proportions than Nova for 3-4 years.

Major Conclusions

New sainfoin populations can stay in alfalfa pasture in higher proportions than Nova for 3-4 years under simulated or direct grazing.

Higher proportion of new sainfoin populations in mixed alfalfa pasture significantly reduced bloat incidence and severity under rotational grazing.

Major Conclusions

In mixed alfalfa stands ne… populations produced … ADGs as Nova without c… at in grazing cattle…

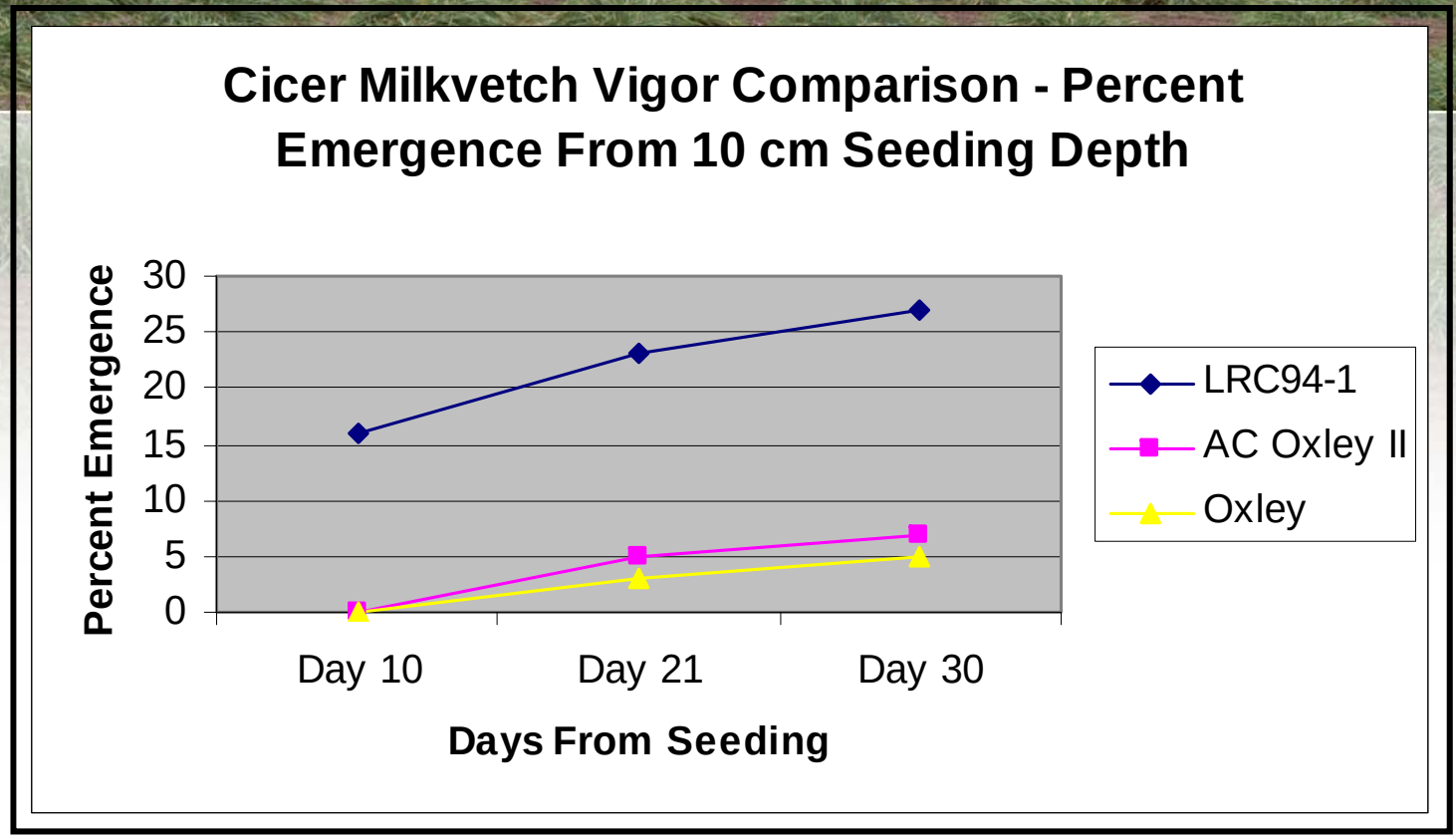
Some ne… ped sainfoin popu… duced significantly higher h… eld than Nova, some produced si… or higher yield than high yielding alfalfa cultivars under simulated grazing.

Please stay tuned for further improvement in sainfoin populations.

Cicer milkvetch breeding goals

Develop cultivars with improved

Forage yield and seedling vigor.



Two quick establishing and high yielding cicer milkvetch cultivars were released from LRC program. These cultivars yield about 20% better than old cultivar Oxley.

Orchardgrass breeding goals

Develop cultivars with improved

Forage yield, seed yield, winterhardiness, digestibility and disease resistance.


Progress to date
New synthetics with improved:
- wh & forage yield (AC Kayak)
- wh & digestibility
- wh & fy & dmd (2014??)


Perennial cereal rye breeding goals
Develop cultivars with improved
Forage yield, seed yield and winterhardiness.

Developed and released first North American PC rye cultivar “ACE-1”.

ACE-1 produces high biomass yield but does not produce as much seed as some fall rye cultivars

Presently focusing on nutritional quality and seed yield improvement of PC rye without sacrificing forage yield


Fenugreek breeding goals
Develop cultivars with improved
Forage yield, seed yield and nutraceutical properties.

Developed and released “Tristar”, the first NA forage fenugreek cultivar.

Tristar produces high yield and high quality forage in western Canada. High qua tion in this area is not consistent due e growth habit of Tristar.

Health food or nutraceutical

Presently focusing on improvement in seed yield and seed quality without sacrificing forage yield

Basin wild rye or giant wild rye

Leymus cinereus

My thoughts

- Development of adapted forage cultivars and appropriate agronomic packages for optimizing forage and seed production for distinct eco-climatic regions need to be given high priority.
- Increased funding for forage crop research is essential for maintaining sustainability of our forage industry which, I believe, has a major impact on Canadian agriculture industry.

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