



Agriculture and  
Agri-Food Canada

Agriculture et  
Agroalimentaire Canada



## Canadian Genetic Resources Program, emphasis on plants

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USDA Crop Germplasm Chairs meeting  
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**Canada**

## 2006 AAFC Science priorities – responding to relevance (Ministerial request)

### 7 priority areas

1. Enhancing the quality of food and the safety of the food system
2. Enhancing security and protection of the food supply
3. Enhanced human health and wellness through food and nutrition and innovative products
4. Enhancing economic benefits for all stakeholders
5. Enhancing environmental performance of the agricultural system
6. **Understanding and conserving Canadian bioresources**
  - Science deliverables:
    - \*availability of information on the classification / attributes of Canadian bioresources
    - \*availability of science based tools and knowledge to predict the behavior of biological resources in response to environmental change
7. **Developing new opportunities for agriculture from bioresources**



(developed through national consultations with producers, industry, provinces<sup>2</sup>)

# Current process for research proposals

## Funding through 3 main sources

- **Clusters** (large, multidisciplinary teams, long-term, eg. wheat, dairy)
- **DIAP** (smaller, shorter term, eg. gene resistance identification)
- **A-base** (hypothesis driven research & service type activities)

## Peer review process

- external reviewers & internal reviewers
- includes budgets operating, but not salary dollars
- funding for 1-4 yrs
- anticipate increased reporting / accountability to research objectives

## Collaboration Policy Framework (May 2010)

- **Response to Auditor general report / accountability**
- **Requires AAFC to ensure that collaborations:**
  - **Meet government and departmental priorities**
  - **Align with the Key Results (22) for Research Branch**
  - **Effectively leverage government resources**
  - **Have a high probability of impact for Canadians**
- **Benefits**
  - **Clear directions to scientists and managers**
  - **RB report on agreement commitments**

# Principles for Collaboration

- **Impartiality and Fairness: Built on Trust**
- **Public Interest and Accountability**
- **Commitment and Reliability**
- **Transparency and Openness**
- **Results-based Management and Implementation**



## **Scientist-Initiated Collaborations - Criteria**

- **Responds to Departmental Mandate Priorities**
  - One or more of departmental priorities (7)
- **Aligns with Research Priorities**
  - One or more of the Research Branch 22 Key Expected Results (KER)
- **Builds on Synergies**
  - Generates benefits
- **Appropriate Role of Government**
- **Leverages Federal Investment**
- **Capability of the Team**
- **Dollar value influences level of pre-approval (locally or Ottawa)**

# AAFC Science and Innovation Strategy and Priorities

- **Research Branch developed (summer 2009) in response to Ministerial priorities**
  - **Priority 6: Enhanced understanding of Canadian Bioresources and protecting and conserving their genetic diversity**
- **developing authoritative information on the nature and characterization of Canadian bioresources is a core public good activity**
- **research provides a wealth of information that supports further work to achieve economic, environmental, social and security objectives**
- **assembling, conserving, documenting and using collections of bioresources and investing in the facilities and practices to preserve their genetic diversity for the benefit of Canada and Canadians is a key responsibility of AAFC**

## 3 Key Expected Results

## Expected outcomes 2010-2015

- Physical and biological systems models are used to predict the behaviour of biological resources in response to change (farming practices, climate change, etc).
- Canadian agri-industries are able to identify opportunities to use bio-resources and their constituent parts to enhance their competitive position in domestic and global markets.
- Canadians and Canadian industries have an enhanced understanding of how to protect and conserve the biological diversity in Canada.



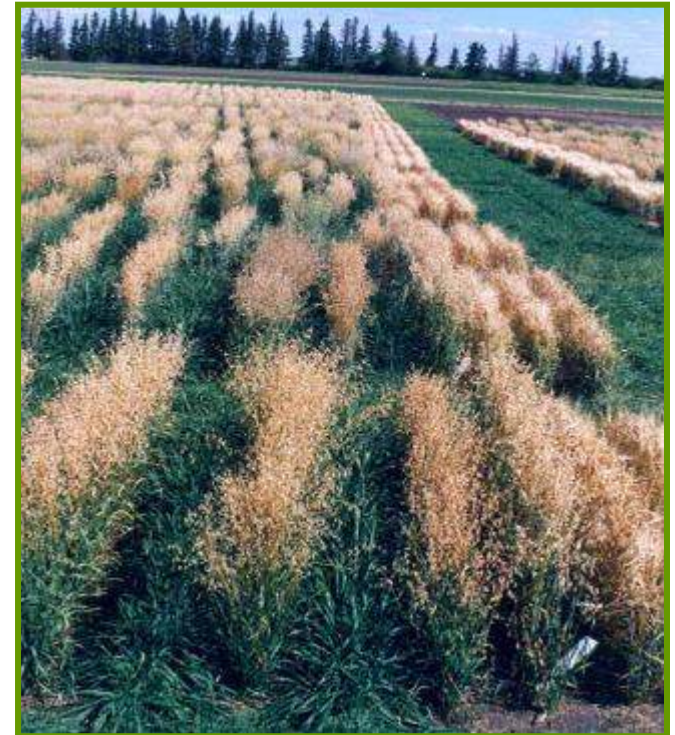
## Expected outcomes 2015-2030

- **Canadians have an appreciation of the benefits of using and conserving the biological resources that exist within their territory.**
- **Canadian expertise in classification, assessment, conservation and preservation of bioresources is sought out globally.**
- **Canadian bioresources are well characterized and information as well as germplasm are readily available for Canadian and international researchers and for immediate applications by regulatory agencies and industry.**



# Key Expected Result 1

**AAFC's preserved collections (invertebrate, plants, fungi), plant germplasm banks, farm animal germplasm collections and microbial (fungi and bacteria) and viral living collections are improved through better conservation, regeneration and acquisitions, taking into account risks and opportunities for the agricultural and agri-food and agri-based products sectors.**



## Key Activities 6.1

- 6.1.1 Acquire plant germplasm, including herbarium specimens, from diverse sources and locations
- 6.1.6 Develop regeneration protocols for difficult to increase species or species at risk (e.g. hairy prairie clover, a near relative to agriculturally important crop varieties)
- 6.1.7 Optimize in vitro culture protocols, virus indexing, heat therapy to obtain clones free of viral loads for clonally propagated crops such as raspberries, strawberries, blueberries and apples



# Plant holdings

- 1000 species
- over 112,800 accessions in database and available for use
- over 20,000 cultivated plant accessions in backlog
- over 3500 native Canadian plants acquired including about 900 from the arctic region

## Crops covered by ITPGRFA

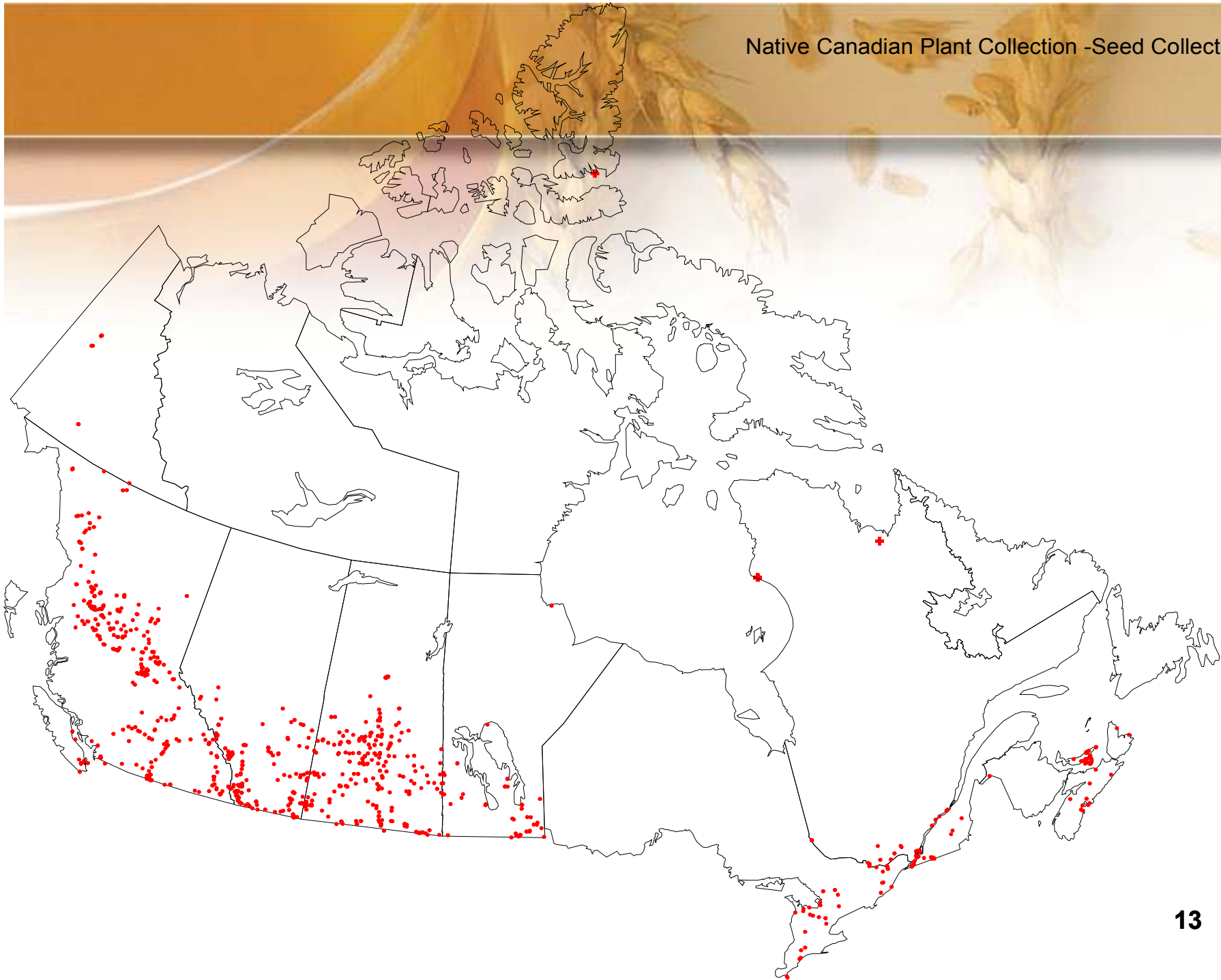
• Barley	39,000
• Oat	28,000
• Wheat	13,000
• Forages	4,000
• Vegetables	3,500
• Millets	3,500
• Crucifers	4,500
• Clonal (apple, strawberry)	3,500
• Potato	139
• Others	13,000

## Crops covered by CBD

- Flax - 3500 accessions
- Soybean – 900 accessions
- Native Canadian plants - 3500

Use IT SMTA  
for all

Native Canadian Plant Collection -Seed Collection Sites



# Crucifer genetic resources - regeneration



## Key Activities 6.1

- **6.1.8 Monitor viability of seed and microbe collections and regenerate germplasm as required**
- **6.1.10 Establish storage protocols, regeneration via live hosts for microbes and viruses that cause crop diseases**
- **6.1.11 Implement a process for safe and secure back-up of seed and microbe collections (international network under the authority of the International Treaty on Plant Genetic Resources and Biological Resource Centres of OECD)**



# Svalbard Global Crop Diversity Seed Vault

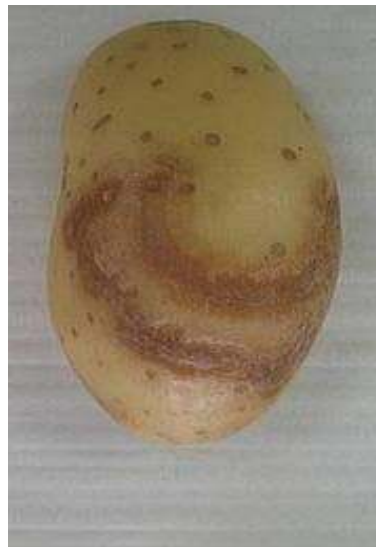


- Seed samples: 491,058      Plant species: 3,487
- Country of origin: 224      Depositing institutes: 27

## Key Expected Result – 6.2

- Preserved and living biological collections are characterized and evaluated to identify attributes that will have significant economic and environmental impact for Canada.

pea lentil  
seed colour



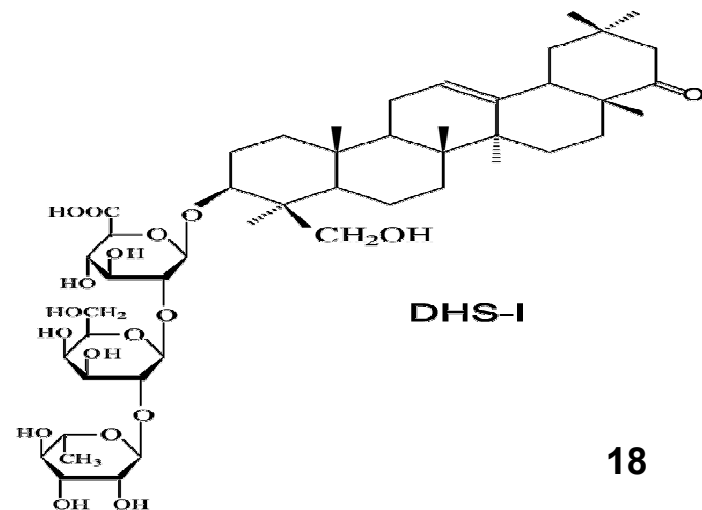
potato clones  
tested for LRV,  
PotLV, PVS, PVX  
and PVY

## Key Activities 6.2

- 6.2.2 Using the national collections, accelerate and facilitate the discovery and characterization of bioresources that can be used by other priorities for new products or contribute to strategies for improved crops, pollinators, biocontrol agents, nutraceuticals, biofertilizers, and various other bio-products.
- 6.2.4 Monitor genetic diversity and genetic erosion in plants and animals leading to development of effective strategies to capture genetic diversity and maintain biodiversity.

Standard Genetic Distance  $DSG = -\ln \frac{J_{xy}}{\sqrt{J_x J_y}}$

Heterozygosity:  $H = 1 - \sum p_i^2$



# Frequencies for classes of seed colour (n=3500)

light brown  
0.1%

medium brown  
93.0%

dark brown  
0.2%

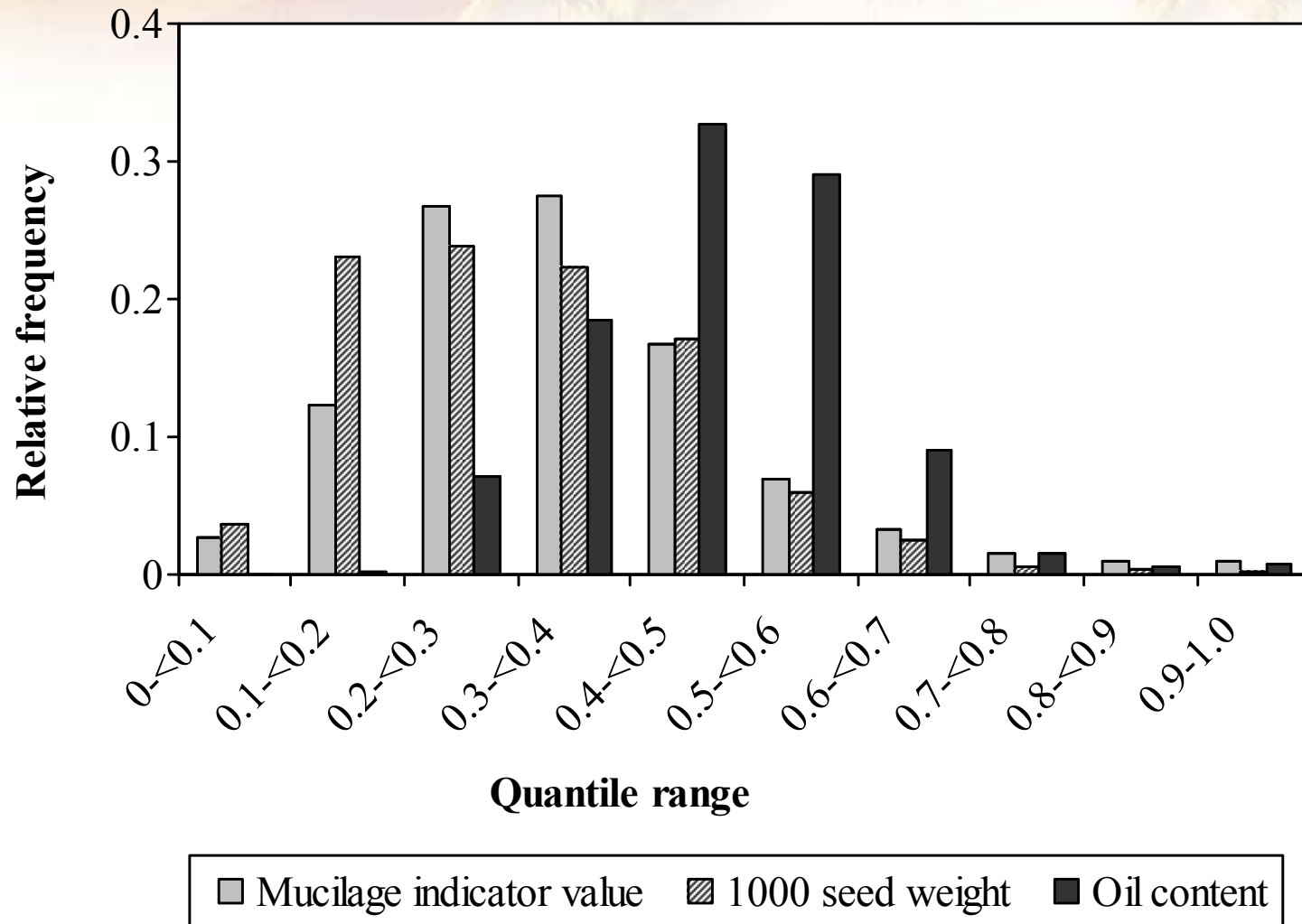
yellow  
4.3%



olive  
0.7%

mottled (last three examples)  
0.4%

# Distribution of mucilage indicator value, 1000 seed weight and oil content of flax accessions at PGRC A Diederichsen



# Genetic diversity in *Sinapis alba* R Gugel

## Agronomic and seed quality traits for 135 *Sinapis alba* accessions

Trait	Mean $\pm$ SD	Min	Max
Days to flower	39 $\pm$ 1.8	33	43
Days to mature	79 $\pm$ 4.0	72	88
Plant height (cm)	136 $\pm$ 11.2	85	166
1000 seed weight (g)	5.6 $\pm$ 0.6	4.8	8.5
% seed oil (dry weight basis)	27.2 $\pm$ 1.8	19.8	35.3
% meal protein (dry weight basis)	49.0 $\pm$ 1.5	45.1	54.3
Major fatty acids (% of total by mass):			
C16:0 - palmitic	2.6 $\pm$ 0.1	2.3	3.2
C18:1 - oleic	25.4 $\pm$ 2.9	20.3	41.1
C18:2 - linoleic	9.5 $\pm$ 0.6	7.7	11.6
C18:3 - linolenic	8.3 $\pm$ 0.7	6.1	10.9
C20:1 - eicosenoic	10.8 $\pm$ 0.6	8.6	12.4
C22:1 - erucic	36.0 $\pm$ 4.0	19.4	43.6
Other	7.4 $\pm$ 0.9	5.7	9.8
Major glucosinolates ( $\mu$ moles/g whole seed):			
Total	187.1	139.1	222.7
4-hydroxybenzyl	183.6	134.6	218.7
Other	3.5	–	–

# Genetic diversity in *Sinapis alba* R Gugel

## AFLP variations for 127 *Sinapis alba* accessions

Group	Group size <sup>a</sup>	Mean PFL <sup>b</sup>	Mean DIS <sup>c</sup>	WG variation <sup>d</sup>
<b><i>Region</i></b>				
North America	9	0.269	0.252	29.5
Asia	10	0.287	0.279	35.2
East Europe	35	0.297	0.268	35.0
West Europe	53	0.334	0.285	39.3
Unknown	20	0.314	0.268	34.2
<b><i>Seed colour</i></b>				
Yellow	95	0.295	0.256	31.0
Brown	32	0.364	0.329	44.5
<b><i>Type</i></b>				
Cultivar	59	0.286	0.254	29.9
Landrace	68	0.335	0.293	40.6

<sup>a</sup> Group size = number of accessions within a group.

<sup>b</sup> Mean PFL = mean proportion of fixed recessive AFLP loci for all accessions within a group.

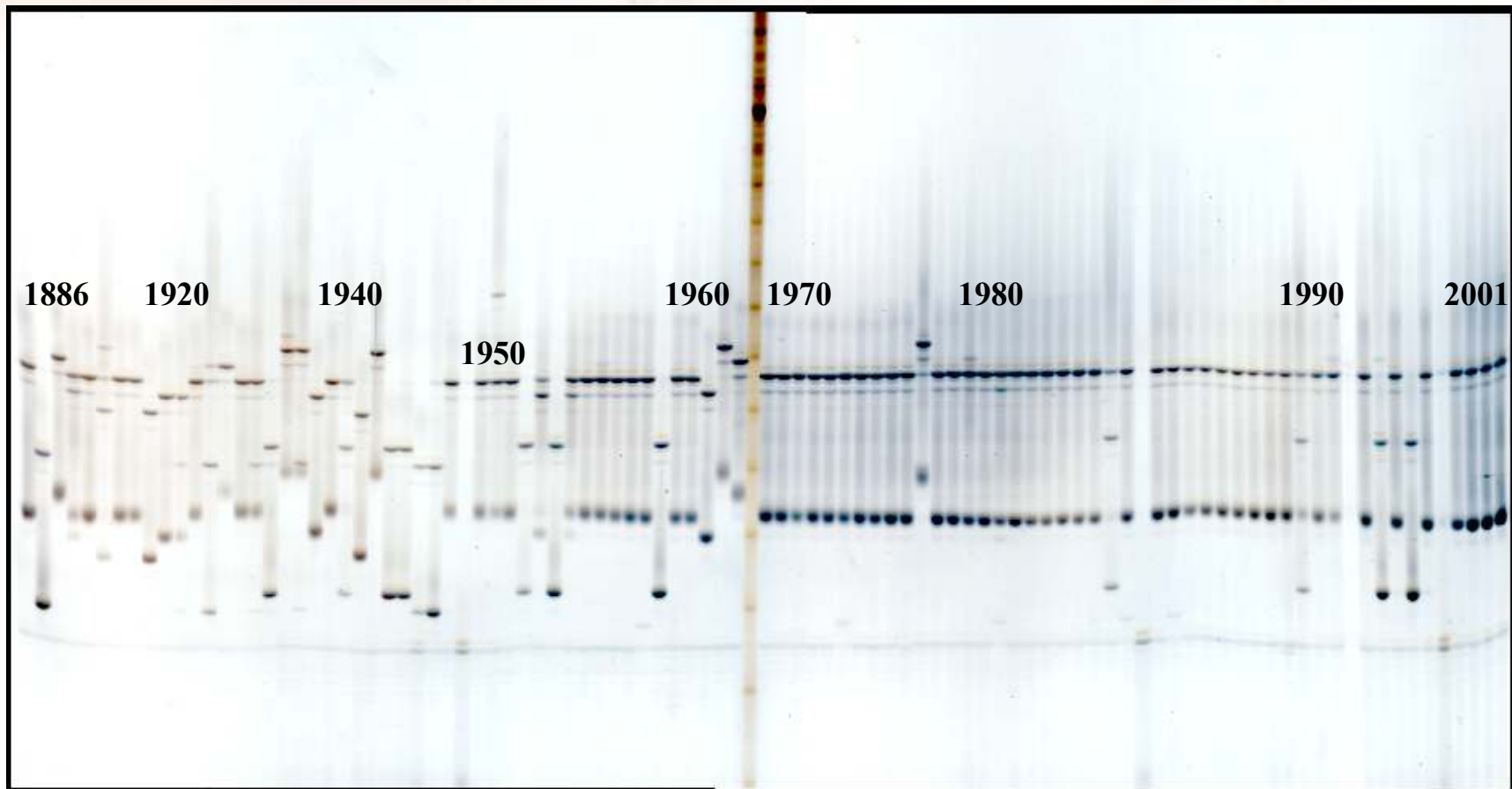
<sup>c</sup> Mean DIS = mean of the average dissimilarities for all accessions within a group.

<sup>d</sup> WG variation = within-group variation (average pairwise difference among all accessions within a group).

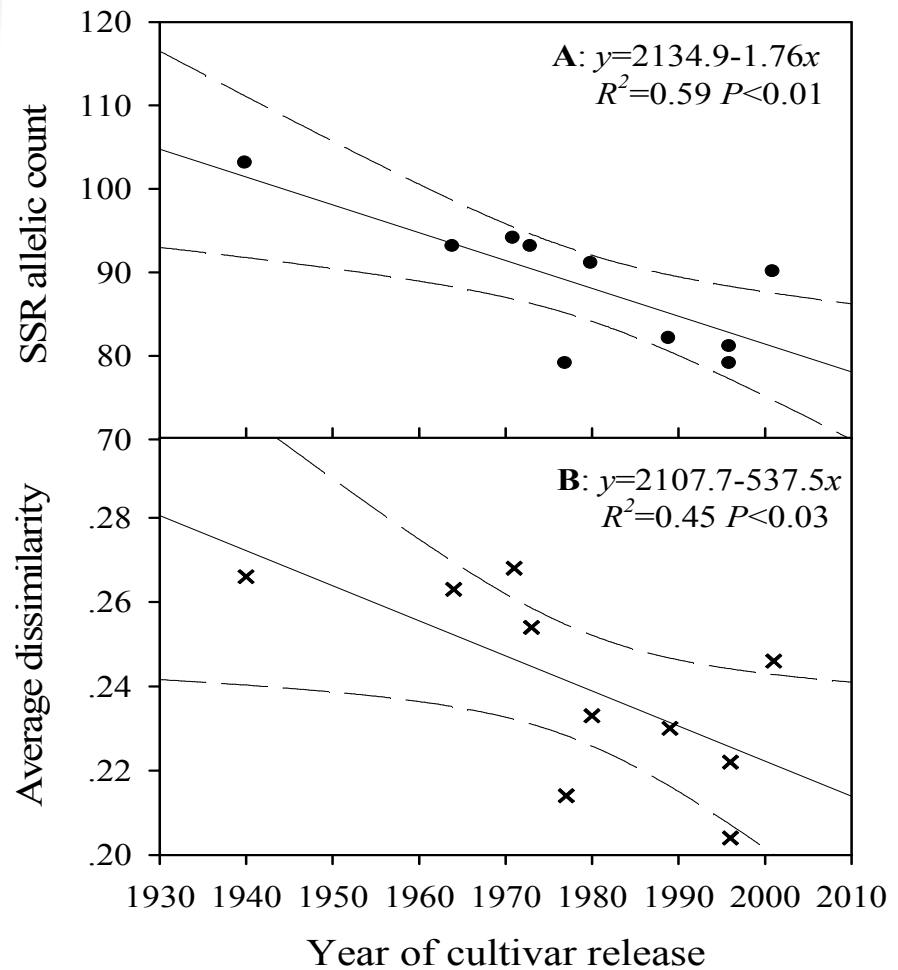
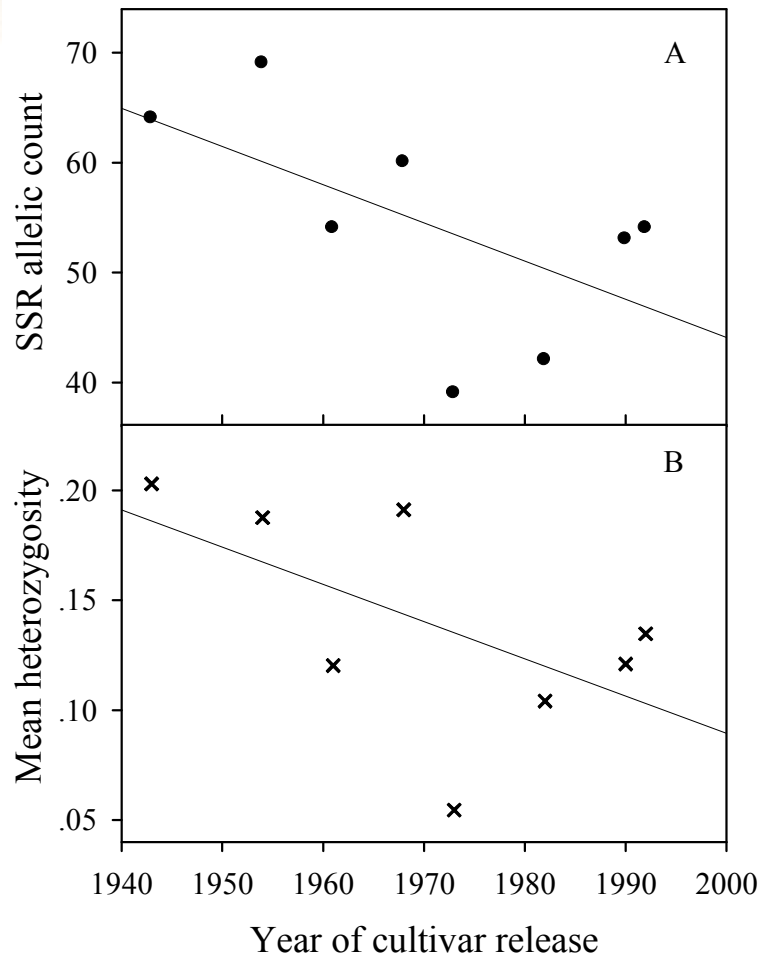
## **Key Activities - 6.2**

- **6.2.5 Develop and apply effective biotechnologies to assess population dynamics and genetic diversity of domesticated plants and animal varieties important to agriculture (eg. wheat) as well as important agro ecosystem components (eg. nitrifying bacteria)**
- **6.2.8 Characterize major Canadian crops (wheat, barley, oat, crucifers) and some minor crops; characterize adaptive genes of importance to plant breeding, explore new sources of disease and stress resistance, determine nutritional quality and bioactive compounds in selected crops, native plants and microbes.**
- **6.2.9 Identify diversity in abiotic stress resistance (eg. barley and oat)**

# Microsatellite variation of 96 Canadian oat (*Avena sativa* L.) cultivars developed over the last century YB FU

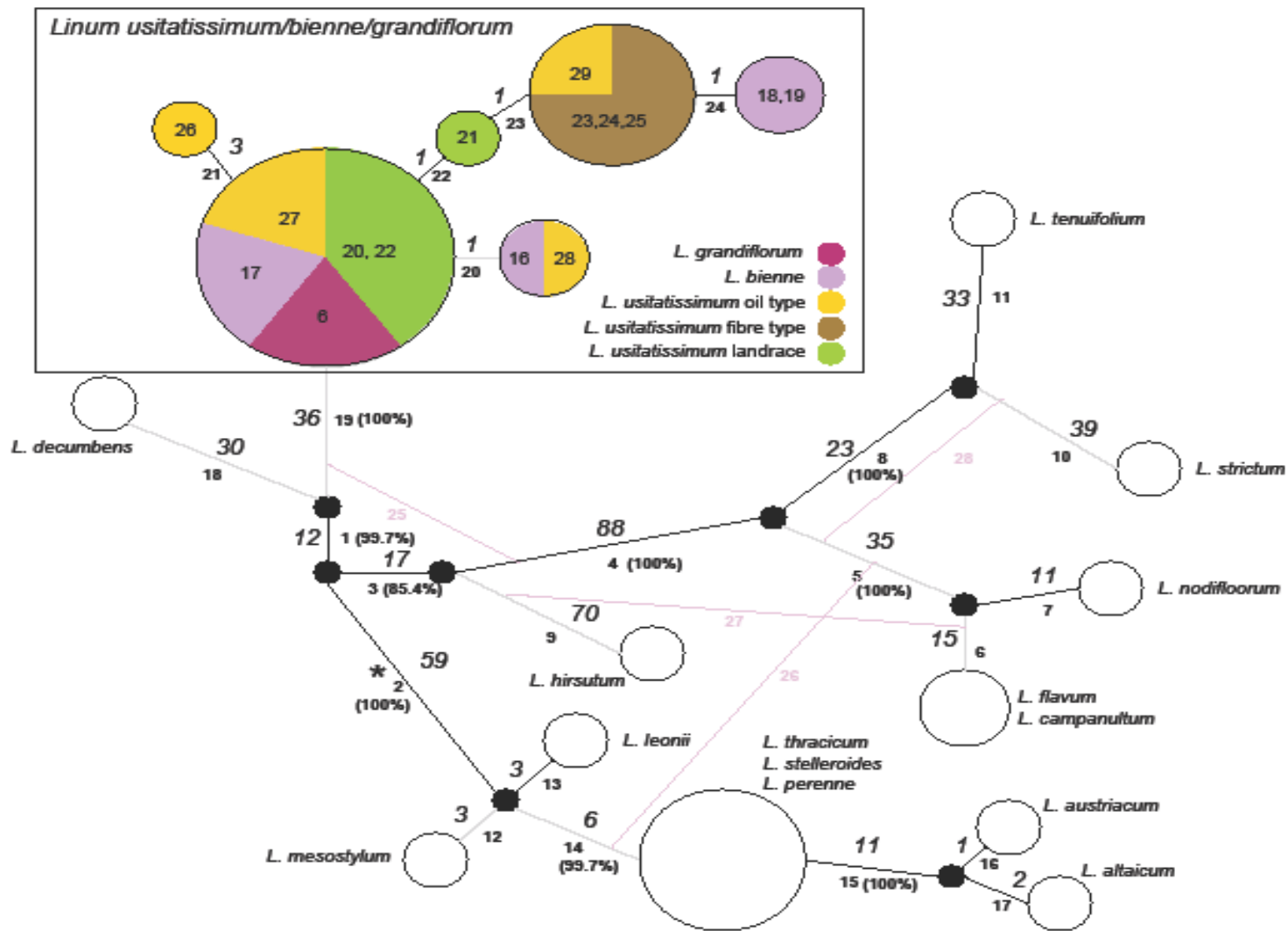


# Genetic diversity (based on SSR allelic counts) in Canadian elite cultivars of *Brassica napus* (L) and *Brassica rapa* (R) YB Fu



# Network of 16 *Linum* species YB Fu

(based on chloroplast DNA sequences)



## Key Expected Result – 3

- **Access to AAFC's preserved and living collections is improved because more is known about the bio resources, and availability of this knowledge for users is greatly improved. Development and maintenance of information systems to deliver a better understanding of the bioresources is key for increased utilization of collections.**

**GRIN-CA  
GRIN  
EURISCO  
SINGER**



**MySQL  
Oracle  
Perl  
NetTerm**

## Key Activity 6.3

- **6.3.2 Design website to integrate GRIN-CA, all plant, animal, microbe and virus resource collections.**
- **6.3.5 Improve linkages to international databases (e.g. GRIN-Global, EURISCO, SINGER, ITPGR-GIS, GBRCN, BOLD)**
- **6.3.7 Improve the plant and other bioresources databases through inclusion of molecular data**
- **6.3.10 Enhance descriptive methods for assessing and documenting genetic diversity for economically important crops (eg. pulse crops) and domestic farm animal breeds and populations.**



# **GRIN-CA indicators**

since May 21, 2001 to May 18, 2010

- **Successful requests: 40,161, 385**
- **Avg. successful requests / day: 12,238**
- **Avg. successful requests for pages / day: 9,471**
- **Distinct files requested: 1,641, 611**
- **Distinct hosts served: 312,352 (155 countries)**
- **Data transferred: 634.18 gigabytes (6.02 gigabytes – last 7 days)**
- **Avg. data transferred / day: 178.58 megabytes**
- **Busiest month: Apr 2009, second March 2010**
- **Busiest day of week: Friday**
- **Busiest hr of day (requests): 2200**

## Conclusions

- **All national programs must be aligned with Ministerial priorities, RB's Key Expected Results, Collaborative Agreements**
- **Response to Auditor General's report; increased transparency and accountability**
- **Genetic Resources National Program encompasses plant, animal, microbe, virus GR to contribute to the security, protection and safety of the Canadian food supply**
- **Basic functions continue: service vs hypothesis driven research will be impacted by resources available**
- **Canada's response to international commitments**
- **International Year of Biodiversity**



Canada