Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Potato Gene Resources

Number 16 – 2009

Taking a Bite out of History

Vanessa Currie
Department of Plant Agriculture
University of Guelph
Guelph, Ontario

In the spring of 2008, I was asked by a television production company to be an "expert" on potato late blight. They were producing a docudrama on the Irish potato famine, and they needed someone to explain the role that potato late blight had played in this history-changing event. It seemed daunting, because pathology is not my specialty, and I'm a bit camera-shy. However, the producers were determined and encouraging and gave me a short list of questions to research. I didn't want to look like a fool, so I gleaned answers and details from all the people who I knew to be the real experts. Lucky for me, they were generous and enthusiastic. I also read two very helpful books, The Great Hunger by Cecil Woodham-Smith and Propitious Esculent by John Reader. I learned about the production of potatoes in the 1800's and that there were three cultivars commonly grown, Apple, Cup and Lumper. Of these three, Apple and Cup were considered quite edible, but the Lumper was most reviled. The Lumper was wretched, unpalatable, unfit for humans, and even beasts would reject them if another variety were available. It seems that their abundance was based solely on economics. The Lumper would out yield the others by as much as 30%. At a time when hungry bellies were plentiful, people filled them with Lumpers. I was fascinated at the idea that 4 million people could be fed on a potato that was considered "scarcely food enough for swine". Wow! How bad could it be, if an entire population was living and thriving almost exclusively on it? I have tested new potato germplasm for over 20 years, and seen thousands of different selections and varieties. Some are worse than others, but I have never tried one that sounded so awful.

While I was considering the Lumper and all its infamy, the TV show fell through, or at least my involvement with it. I was mostly relieved, but the curiosity about the Lumper remained and I needed some answers. My work at the University of Guelph is testing breeding lines and new varieties to determine their suitability for commercial production. Evaluating the Lumper was something I could do, if I could only get my hands on some. I wrote to Jane Percy at the Gene Repository in Fredericton and asked her if she could help me. To my delight, she

would send me some tissue culture plantlets. I could grow them in the greenhouse here and plant the resulting mini-tubers at the research farm in the spring. I was thrilled and put my plan in motion.

Vanessa Currie in Guelph proudly showing Lumper tissue culture plantlets received from the Potato Gene Resources Repository.

In the spring of 2009, I planted 200 mini-tubers in the potato field at the Elora Research Station. They grew impressively, with pretty white flowers and large lush vines. Most potatoes are also attractive plants, so this was not unusual.

Every August, I host a Field Day to showcase our trials and research to the local industry and our benefactors. We usually have a wide range of visitors, from potato growers and chip processors to food writers and retail produce purchasers. I have most of the lunch catered, but I also cook up some of our promising new potato varieties for judgment by the experts. On the advice of food activist, Anita Stewart, who is one of our regular attendees, I decided to go for it. Yes, I would feed my guests potatoes that the historical records suggest are not food fit for humans or even pigs.

The day before the Field Day, I took my trusty potato fork and even more trusty summer students out to the potato field. We turned over 5 plants. The yield was good and it was not hard to see why so many poor families had thrived on them. The vines were large and spreading and still very green. The Lumpers would have a late maturity and I sadly imagined unsuspecting Irish cottiers scattering slimy, spore laden vines all over their crop. The tubers were oval to oblong in shape, with deep eyes and a rough, knobby appearance. The skin was smooth and pale. The flesh was cream coloured, not white, but not yellow. They were quite possibly the ugliest potatoes I have grown.

When the guests arrived the next day, we did our usual field tours of the promising new potato selections and varieties. When we returned to the lunchroom, the students had boiled several dozen of the Lumpers and quartered them. They were arranged attractively on serving plates, with a toothpick in each piece, just like a fancy hors-d'oeuvre. Guests were offered a bite as they descended from the wagon. They were warned, before they accepted, that this was a bite of history and that the reputation of the Lumper was unlike any of the potatoes that they had just seen in the field. They might taste bad. They probably would taste bad. This was the insufferable potato variety that had changed world history and a good many of the guests would not be here, on this soil, if not for the Lumper.

Lumper potato tubers grown at the Elora Research Station for sampling at the Annual Field Day in Guelph.

As the host, I was distracted with the presentations so I didn't get around to looking for my taste until a short while later. I scanned the room, looking for signs of distaste and revulsion. No one was angry with me. No one was grimacing or covertly putting a napkin to their mouth. People were smiling and chatting pleasantly amongst themselves. Now that I had used my guests as unwitting food tasters, I decided to take the plunge myself. I noticed that there was only one bite left from the dozens of samples.

So how did the Lumper taste? Delicious, as a potato should taste. Not better or worse, in fact, nothing out of the ordinary at all. It seems that no matter how fitting the potato's place on the world stage; its power lies in its humble gifts.

Genetic diversity in potato and world collections

Dr. Ken Richards, Manager
Plant Gene Resources of Canada
Agriculture and Agri-Food Canada
Saskatoon, SK

Genetic diversity within a species or population enables that population to adapt to its environment through natural selection. When genetic diversity is low, the possible combination of genes responding against environmental challenges is reduced, decreasing the probability of successful individuals arising in the population. Small populations with low genetic diversity may face larger genetic variability or higher chance of going extinct. Thus a population in nature needs to have adequate genetic diversity to sustain its continued existence.

The same is true in crop improvement programs. As an example, low genetic diversity in potato resulted in the Irish potato famine where close genetic relationships between varieties existed. The Irish farmers were growing varieties genetically uniform and susceptible when a pandemic of the disease, late blight, wiped out the potato crop of Europe and North America. Two factors influence the degree of vulnerability: the relative growing areas devoted to each variety and the degree of uniformity (relatedness) between varieties.

Globally, about 99,000 accessions of potato can be found in world gene banks, 80% of which are maintained in 30 key collections, FAO, 2nd State of the World's Plant Genetic Resources for Food and Agriculture report, 2009. Largest collections are kept in France, INRA-Rennes with 10,461 accessions; Russia, Vavilov Institute with 8,889 accessions; Peru, International Potato Centre with 7,450 accessions; Germany, Leibniz Institute for Plant Genetics and Crop Plant Research with 5,392 accessions and USA, USDA-Sturgeon Bay with 5,277 accessions. Clearly, the Canadian heritage collection of 157 accessions is small in comparison but, nevertheless, an important and useful

heritage collection. Accessions are conserved as botanical seeds or vegetatively as tubers and *in vitro* plantlets.

A recent molecular genetic diversity study by Yong-Bi Fu, PGRC, Saskatoon and others of 114 Canadian and 55 exotic potato accessions, indicated a narrow genetic base of the Canadian potato germplasm. This limited genetic diversity and differentiation among potato groups are not surprising for a few reasons. Only a small number of introduction events formed the basis of modern potato germplasm. The USA cultivar, Katahdin, is responsible for almost a quarter of the germplasm making up prominent North American cultivars. Canadian potato breeding has long been limited to a narrow genetic base with fewer introgressions of new exotic germplasm. Yet recent efforts to incorporate germplasm from Andean cultivated species into Canadian cultivars, yielded an improvement but only in the level of genetic relatedness and not in the magnitude of genetic diversity.

These recent molecular results on genetic association and distinctiveness are helpful for parental selection of diverse plants for potato breeding. The small Canadian collection is important in the selection process as the various clones have already proven to be environmentally adapted to Canadian growing conditions. Knowledge about and locations of world potato collections are useful guides for acquiring and selecting specific germplasm with distinct genetic background for further diversifying the potato breeding program.

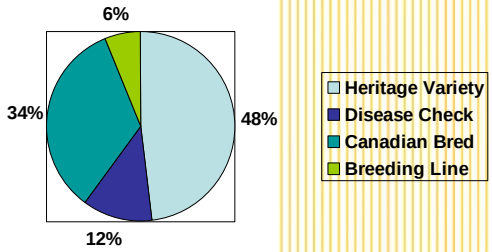
Annual Report 2009

Jane Percy
Potato Gene Resources Repository

The Collection

1. Holdings

• The Potato Gene Resources Repository contains 159 clones. Of this total, 150 are maintained *in vitro* and 9 as tubers. A full listing of accessions may be found on the attached request form. The following chart shows the percentage of clones in each Repository category.



2. Accessions

• Nine *in vitro* clones were added to the Repository in 2009. The new accessions include Columbia Russet, Cow Horn, Red Acadian, Red Dutch, Poorlander, Ratte, Kroop Neber, Heidzel Blue and Stella's Newfoundland. These clones were obtained as part of an agreement with Seeds of Diversity Canada and Plant Gene Resources of Canada.

• Columbia Russet was developed by William Scott, in the Parsons district Columbia Valley, of British Columbia about 1919 and was obtained from the NBDAA, Plant Propagation Centre, Fredericton, NB.

• Cow Horn, Red Acadian and Red Dutch were donated by Shannon Houle of High Prairie, Alberta.

• Heidzel Blue, Kroop Neber, Poorlander and Stella's Newfoundland were donated by Will Bonsall, Curator of the Scatterseed Project, in Farmington, Maine.

• Ratte was obtained from the Maine Seed Potato Board.

• Evaluations of and descriptions for the new accessions will begin in 2010.

• Urgenta placed *in vitro* in 2009, by Trudy Dalton, was added to the Repository.

In Vitro potato plants

• No accessions were lost from the inventory in 2009.

3. Evaluations

• Twenty varieties were grown in an evaluation trial at the Potato Research Centre. Two replications of fifteen hills of the following varieties All Red, Beauty of Hebron, Black Mignion, Bliss Triumph, Candy Cane, Cherokee, Chieftain, Columbia Russet, Crotte d'Ours, Dorita, Earlaine, Houma, Libertas, Lenape, Mouraska, Red Warba, Superior, Up-to-Date, Urgenta and White Rose were grown. Superior and Chieftain were grown as checks. The tubers and tuber light sprouts were photographed by Cynthia Murray. Samples were also taken for Total Glycoalkaloid Analysis (TGA).

Beauty of Hebron

• Twenty-six clones were grown in 20-hill plots at the Benton Ridge Potato Breeding Substation, Benton, NB, to provide material for demonstration and cooking quality throughout the winter and spring.

Siberian tubers

4. Management

• Passport data for all PGR accessions has been added to the Genetic Resources Information Network – Canadian Version (GRIN-CA). GRIN-CA may be accessed through the Plant Gene Resources of Canada web site http://pgrc3.agr.ca/.

• Disease testing of new *in vitro* accessions and clones which have been maintained *in vitro* for five years was completed. Forty-three clones were grown in the greenhouse and tested twice in 2009. All clones were negative for PVA, PLRV, PotLV, PVS, PVX and PVY. Results for PSTV and BRR are pending. Extra minitubers from the greenhouse growout will be offered to PGR clients in the spring of 2010.

• *In vitro* clones were screened for bacterial and fungal contamination using Potato Dextrose Broth and Richardson's Broth, twice during 2009. All clones currently in the Repository were negative for these contaminants.

• A total of 2931 microtubers were produced from PGR clones in 2009. They were harvested and sent to Saskatoon in July, to be stored at Plant Gene Resources of Canada, AAFC. The viability of the Repository is protected by this remote location, long-term storage arrangement. Dallas Kessler of Plant Gene Resources Canada, Saskatoon, SK, continues to monitor and evaluate the microtubers.

Harvested microtubers

5. Requests to the Repository

• Fifty-seven requests for 655 clones were received in 2009. Of this number, 203 clones were distributed *in vitro*, 304 clones as field grown tubers, 7 clones as greenhouse grown minitubers, and 141 as microtubers. The intended use of potato clones distributed in 2009 is tabulated below.

Purpose of request	Request	Clones	*In vitro*	Tubers	Mini-tubers	Micro-tubers
Breeding	-	-	-	-	-	-
Research	8	77	20	55	2	-
Demonstration	17	169	83	86	-	-
Evaluation	27	214	71	138	5	-
Preservation	4	194	28	25	-	141
Certification	1	1	1	-	-	-
Total	57	655	203	304	7	141

Five-year compilation of clone distribution for Potato Gene Resources 2005-2009

Year	Total	Breeding, research or certifi-cation requests	Heritage evaluation, demo or preserva-tion requests	Total clones distributed	Clones distributed as minitubers & tubers	Clones distributed *in vitro*	Micro-tubers distributed
2005	54	18	36	654	364	183	107
2006	45	12	33	511	297	214	0
2007	49	15	34	552	220	210	122
2008	48	9	39	555	345	210	0
2009	57	9	48	655	311	203	141
5-year total	253	63	190	2927	1537	1020	370

• Angelina Mahoney's Blue and Congo were the most requested clones in 2009.

Number of requests by destination

Destination	Number of requests
Newfoundland and Labrador	1
Prince Edward Island	2
Nova Scotia	4
New Brunswick	17
Quebec	10
Ontario	10
Alberta	4
Saskatchewan	3
British Columbia	1
Yukon	1
USA	4
Total	57

Repository Items of Interest

Communication

• Thirty-one requests for information about the Repository, the availability of clones, clone descriptions and pedigrees, and techniques for handling *in vitro* material were received throughout the year.

• The annual Potato Gene Resources newsletter has a distribution of 375.

• The newsletter and several back issues may be accessed on the Weekly Checklist of Government of Canada Publications. Browse for the newsletter by title at http://publications.gc.ca/control/weeklychecklistmain?searchaction=4&searchaction=13&productid=1.

• Dr. Ken Richards, Dr. Richard Tarn and Jane Percy contributed to an article entitled "Preserving Our Genetic Resources", in the AAFC AgriCulture 2009 Special Edition: Environment AAFC10353B.

• Dr. Ken Richards and Jane Percy contributed to an article in the magazine Top Crop Manager, February 2009, entitled "Safeguarding Canadian Potatoes. Use of Microtubers Helpful for Preserving Genetic Stock."

• (L-R) Jacques Millette, Jane Percy, John Richards, The Honourable Keith Ashfield, MP, Minister of State (ACOA), Stephanie Ratelle, Trevor Goff and Yill Sung Park attending the Federal announcement made by Minister Ashfield in which the Federal Government will provide $1.8 million over two years to modernize three important laboratories in New Brunswick. John Richards and Yill Sung Park represented the Atlantic Forestry Centre; Stephanie Ratelle and Trevor Goff represented the Mactaquac Biodiversity Centre; and Jacques Millette and Jane Percy represented the Potato Gene Resources Repository located at the AAFC Potato Research Centre.

• Jane Percy contributed an article about the Repository to the April 2009 issue of SeedBytes, the NBDAA online Newsletter http://www.gnb.ca/0029/0029index-e.asp.

• An article by Andrew Vowles, University of Guelph, Communications Office, highlighted the heritage variety Lumpers which was obtained from the Repository in 2008 by Vanessa Currie, University of Guelph. Lumpers was grown as part of the annual potato trial at Guelph and will be used in culinary evaluations in the fall of 2009.

Displays

• An AAFC exhibit in the Canadian Pavilion at the Festival of Lights in Charlottetown during the Canada Day weekend, showcased potato research. The Potato Research Center's work on the health benefits of colored potatoes, including some varieties already in the marketplace and some numbered varieties that were released to industry by the Centre for further testing, were displayed. Heritage potato varieties and the work of the Potato Gene Repository to preserve potato genetic diversity were also highlighted.

• Potato clones from the Repository and the National Potato Breeding Program were featured at the following events in 2009: Grower's Days, Woodstock, NB; Moncton Home Show; Benton Open House; Atlantic Farm Mechanization Show; Halifax Spring Home Show; Charlottetown Farm Day in the City; Maritime Fall Fair, Halifax, NS; Fred FM Radio Station and Science East.

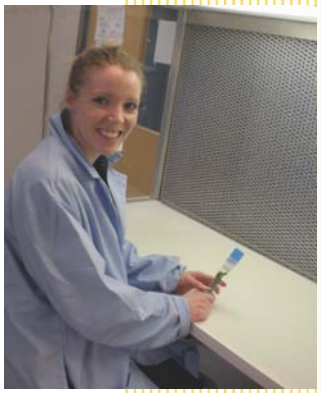
Visitors

• Visitors to the Repository in 2009 included Jane Noseworthy, CFIA, St. John's, Newfoundland and Labrador; the Chilean Ambassador to Canada, Eugenio Ortega Riquelme and members of the Potato Association of America attending the annual meeting in Fredericton in August 2009.

New Technician at the Potato Gene Resources Repository

Dr. Benoît Bizimungu
Research Scientist
Potato Breeder and Germplasm Curator
Potato Research Centre, AAFC
Fredericton, NB

We welcome Ms. Deborah Smith as the new Potato Gene Resources Repository Technician, in replacement of Ms. Jane Percy on leave until October 26, 2010. Ms. Smith has recently moved from Ottawa, where she was working on her Master of Science at the University of Ottawa. She has previously worked as a summer student at Agriculture Agri-food Canada, Eastern Cereal and Oilseed Research Centre in Ottawa where she worked in the soybean genetics and breeding program. Ms. Deborah Smith will be handling requests and shipments of potato clones for 2010. She can be reached at the address below:



Deborah Smith

Ms. Deborah Smith
Potato Gene Resources Technician,
Potato Research Centre
Agriculture and Agri-Food Canada
Fredericton, NB E3B 4Z7
deborah.smith@agr.gc.ca
Telephone: 506-452-3160
Facsimile: 506-452-3316

The Potato Gene Resources Repository
Soon to get a new/home-lab facility

Dr. Benoît Bizimungu
Research Scientist
Potato Breeder and Germplasm Curator
Potato Research Centre, AAFC
Fredericton, NB

Last year (2009), funds were approved for the renovation and development of a new laboratory space to house the Potato Gene Resources Repository at the Potato Research Centre. At present, most of the activities including plant tissue research and the maintenance of the repository collection are conducted in shared laboratories or common use areas.

The construction that is scheduled to start in early 2010 will allow the repository to meet international standards by providing the required space and a laboratory infrastructure to support the work in a more efficient and secure manner. The number of accessions and requests are expected to increase over the following years, therefore, increasing the need to improve the efficiency and the security of the Repository. The collection includes modern Canadian-bred potato cultivars, heritage cultivars, selected breeding parents and many clones used in research. With access to a complete collection of genetic resources, researchers will be able to respond to the changing needs of the potato industry, the society and the environment.

Potato Gene Resources Newsletter

The Potato Gene Resources Newsletter is an annual publication of the Potato Gene Resources Repository, Potato Research Centre, Agriculture and Agri-Food Canada.

The Newsletter provides information on potato germplasm in the Repository and on issues related to the genetic diversity in the potato. The opinions expressed by authors may not necessarily represent the views of Agriculture and Agri-Food Canada.

The Repository and the Seed Potato System

The Potato Gene Resources Repository provides *in vitro* plantlets and greenhouse or field tubers for breeding, research and heritage preservation. While extensively tested for freedom from disease, the plantlets and tubers distributed by the Potato Gene Resources Repository are produced outside the Canadian Seed Certification System and are not eligible for Certification.

The Canadian Seed Potato Certification System operates under the Seed Act and its Regulations. Certification begins with tested plantlets established *in vitro* in a facility accredited for this task by the Canadian Food Inspection Agency. The plantlets are used to produce greenhouse tubers which then go to the field in a limited generation system, at each step meeting strict standards specified in the Regulations. The Potato Gene Resources Repository is not accredited for seed production by the CFIA.

Potato Research Centre Website

http://www.agr.gc.ca/researchcentre/fredericton
offers an overview of the mandate, resources and achievements of the Centre. The research studies being conducted at the Centre as well as the staff associated with those studies are highlighted. Links to the Potato Research Network and to other agriculture and potato related websites are also available.

Plant Gene Resources of Canada

Canada's Plant Germplasm System is a network of Centres and people dedicated to preserving the genetic diversity of crop plants, their wild relatives and plants present and unique in the Canadian biodiversity. The system plays a significant part of Agriculture and Agri-Food Canada's commitment to the Canadian Biodiversity Strategy in response to the Convention on Biological Diversity.

The Plant Gene Resources of Canada (PGRC) website located at http://pgrc3.agr.ca/ includes information on PCRC and the multi-nodal system of germplasm conservation in Canada as well as opportunities to search for germplasm on the Genetic Resources Information Network-Canadian version (GRIN-CA). Dr. Ken Richards, Research Manager, Plant Gene Resources of Canada, may be contacted at Ken.Richards@agr.gc.ca.

Personnel of the Potato Gene Resources Repository
Potato Research Centre

Benoît Bizimungu – Potato Breeder and Germplasm Curator
Agnes Murphy – Plant Pathologist
Jane Percy – Potato Gene Resources Technician
Trudy Dalton – Potato Breeding Technician
Deborah Smith – Potato Gene Resources Technician
Donna Wilson – Plant Pathology Technician
Cynthia Murray – Potato Breeding Technician
Esther Tremblay-Deveau – Potato Breeding Technician
Stephen Allaby – Potato Breeding Technician
Denise LeBlanc – Potato Breeding Technician
Andrew Gardner – Supervisor – Greenhouse
Danny Burnett – Greenhouse Person
John MacDonald – Greenhouse Person
Sylvia Holder – Greenhouse Person

TO RECEIVE THE NEWSLETTER, PLEASE CONTACT:

Jane Percy
Editor, Potato Gene Resources Newsletter, Potato Research Centre
Agriculture and Agri-Food Canada
P.O. Box 20280, Fredericton, N.B. Canada E3B 4Z7
Tel: 506-452-3160, Fax: 506-452-3316
Email: Jane.Percy@agr.gc.ca

Le Bulletin est également disponible en français sous le titre :
Pommes de terre – Banque de gènes

AAFC No. 11192E

ISSN 1496-497X