

# Trends in Crop Breeding Research Capacity in Western Canada

1973 - 2010



Prepared for Ag-West Bio Inc.

By John M. Clarke

June 30, 2011



# Trends in Crop Breeding Research Capacity in Western Canada 1973 – 2010

Prepared for Ag-West Bio Inc. by John M. Clarke

Submitted June 30, 2011

## Contents

Executive Summary .....	2
Background .....	3
Trends in Global and Canadian Investment in Agricultural Research.....	3
Crop Production Trends in Western Canada .....	4
Trends in Crop Development Research in Western Canada.....	7
Wheat.....	8
Barley .....	10
Oat.....	11
Canola .....	12
Pulses .....	13
Rye and Triticale.....	14
Other annual crops.....	14
Forage Crops .....	15
Summary of Trends by Organization .....	17
Research Support Staff .....	18
Research Investment.....	19
Areas of Concern.....	21
References.....	23
Other Sources of Information .....	23
Acknowledgements.....	24

## Executive Summary

This report summarizes trends in crop breeding and supporting disciplines from 1973 to the present. Changes in crop area during that period appear to have influenced allocation of crop improvement resources. For example, there was increased seeded area of canola, peas, and lentils made possible through reduction of Canada Western Red Spring wheat and summer fallow area, the latter because producers have moved to continuous cropping and zero-tillage. The number of research personnel working with wheat and flax remained relatively stable during the review period, but numbers declined slightly in barley and oat. There was a major decline in breeding effort in forage crops. The number of research professionals working with pulse crops and canola increased during the period reviewed.

Looking at number of breeders only, numbers declined by one-third in Agriculture and Agri-Food Canada (AAFC) since 1990. Numbers remained relatively stable at the Universities of Alberta and Manitoba during this period. The number of breeders increased markedly in the private sector (principally in canola breeding), and more modestly in Alberta Agriculture/Alberta Research Council and University of Saskatchewan/Crop Development Centre. These increases more than offset the AAFC losses, so total number of breeders in western Canada has increased in recent years.

Current (2010) private sector breeder numbers are greatest for canola, comprising about 70% of the total. Wheat is the only other crop with significant private sector breeding activity in western Canada, with about 30% of the total breeder numbers. Several multinational companies are rumoured to be interested in establishing wheat breeding programs in western Canada. Producer checkoff funds augment public-sector breeding programs in most crops, totalling about \$10.8 million in 2010, compared to about \$5.8 million in 1995.

Areas of concern for the future of crop breeding capacity on the prairies include the low level of commitment to forage crop and oat breeding, reduced cereal chemistry support for wheat, aging infrastructure, and age demographic of researchers. Both forage crops and oats appear to have less breeding resources relative to other crops based on seeded area. Infrastructure upgrading and replacement is falling behind in AAFC, which together with increased difficulty in management of collaborative research funds, will increase the difficulty of attracting and retaining new scientists. The age demographic within AAFC is such that a large number of scientists are eligible for retirement within the next 5 to 10 years. Unless these are replaced in similar disciplines, there will be a further decline in breeding capacity within AAFC. Given recent announcements of staff reductions in several federal departments, replacement of all retiring staff seems unlikely.

Enhanced coordination of public sector crop development efforts will be key in future as infrastructure deficiencies and funding shortfalls become more severe. Coordination of public sector activities such as genomics research, genomic and marker-assisted selection, breeding, pathology, entomology and adaptation (yield) testing in a broad range of prairie environments will provide public programs with the types of resources already routinely applied within large multi-national breeding companies. This will ensure efficient usage of public and producer checkoff funds in crop improvement.

## Background

Breeding of crop cultivars has been fundamental to the growth and prosperity of the agricultural industry in Western Canada. This is documented for all major field and forage crops grown here, with striking examples in spring wheat, canola and pulse crops. All of these now-viable crops started with attempts to grow cultivars imported from outside the region, and progressed through breeding efforts to improve adaptation, pest resistance and market quality. Market quality is a fundamental requirement for development of export markets, given that the majority of field crop production is exported to discerning markets that demand high standards of purity, sanitation, food safety and processing quality.

Development of new crops and maintenance of existing crops depends upon appropriate levels of research and development in Western Canada. While some of our crops may be considered to be 'mature' industries, continued research and genetic improvement for the development of new high-yield, disease and insect resistant, high-quality cultivars is fundamental for the maintenance of these highly successful value chains. All of this must be accomplished at a time of apparent reduction in public-sector investment in agricultural research (Brinkman 2004; Gray 2008).

## Trends in Global and Canadian Investment in Agricultural Research

Total Canadian research and development investment as a percentage of gross domestic product lags the Organization for Economic Cooperation and Development (OECD) average (Thomsen Corp. 2006; Gray 2008), and is substantially behind individual countries such as Japan and the U.S.

Brinkman (2004) reported a decline of 37% from 1995-2002 in public sector agricultural research professional staff in Canada. The accuracy of this estimate is suspect because it was partly based on ICAR (Inventory of Canadian Agricultural Research) data, which became less accurate after about 2000 (personal observation and Gray 2008). However, Gray (2008) reported a similar decline in that Agriculture and Agri-Food Canada (AAFC) investment in crop research dropped in 2006 dollar terms by about 35% from 1996 to 2004, based on information from AAFC. Much of this reduction occurred since 2000. Statistics Canada data cited in the Thomsen Corp. (2006) report indicates an approximately 40% reduction in number of AAFC scientists from 1996 to 2002. Gray (2008) also noted a reduction in the number of cereal and oilseed breeders and an increase in the number of pulse breeders during the period, but did not provide data or references to support this statement.

A few comparisons have been made of breeding research investment across countries. Thomsen Corp. (2006) reported that Australia invested an average of \$38 million (\$1.10 per tonne of production) on wheat, oat, barley and rye breeding from 2000 to 2004, compared to \$31 million (\$0.70 per tonne) in Canada and \$25 million (\$0.57 per tonne) in the U.S. Total cereals research expenditure (including breeding) was three-fold greater in the U.S. than in Canada. The higher breeding R&D investment in Australia may have contributed to a lower reduction in export market share for cereals such as wheat in Australia than in Canada and the U.S. (Thomsen Corp. 2006).

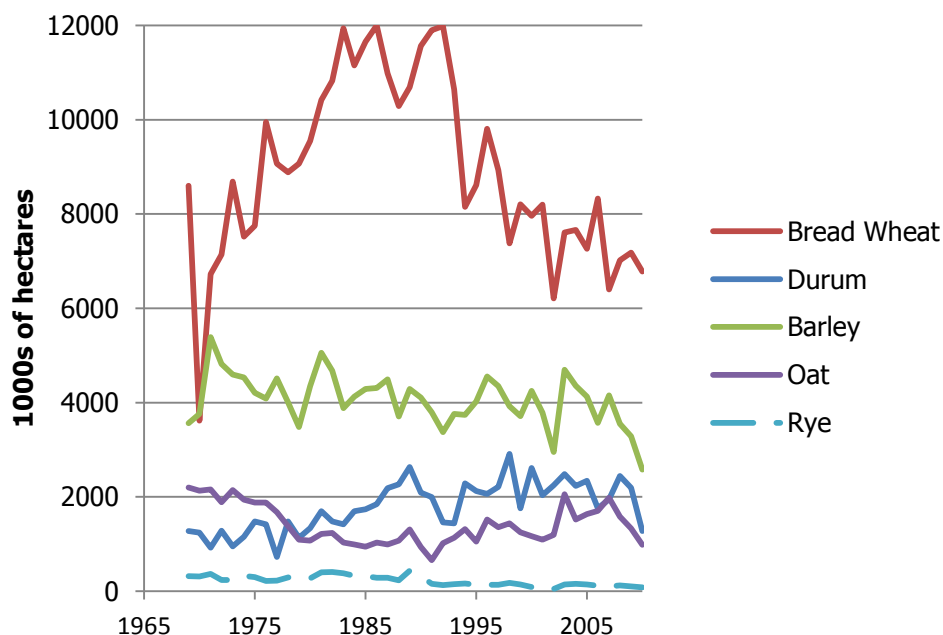
## Crop Production Trends in Western Canada

Changes in seeded area of major field crops reflect the attempts of producers to maximize their income by shifting to crops that provide maximum net return, within limitations required for crop rotation to manage disease risks. Crop acreage in return influences the research and development investments of both the public and private sector entities involved in crop breeding.

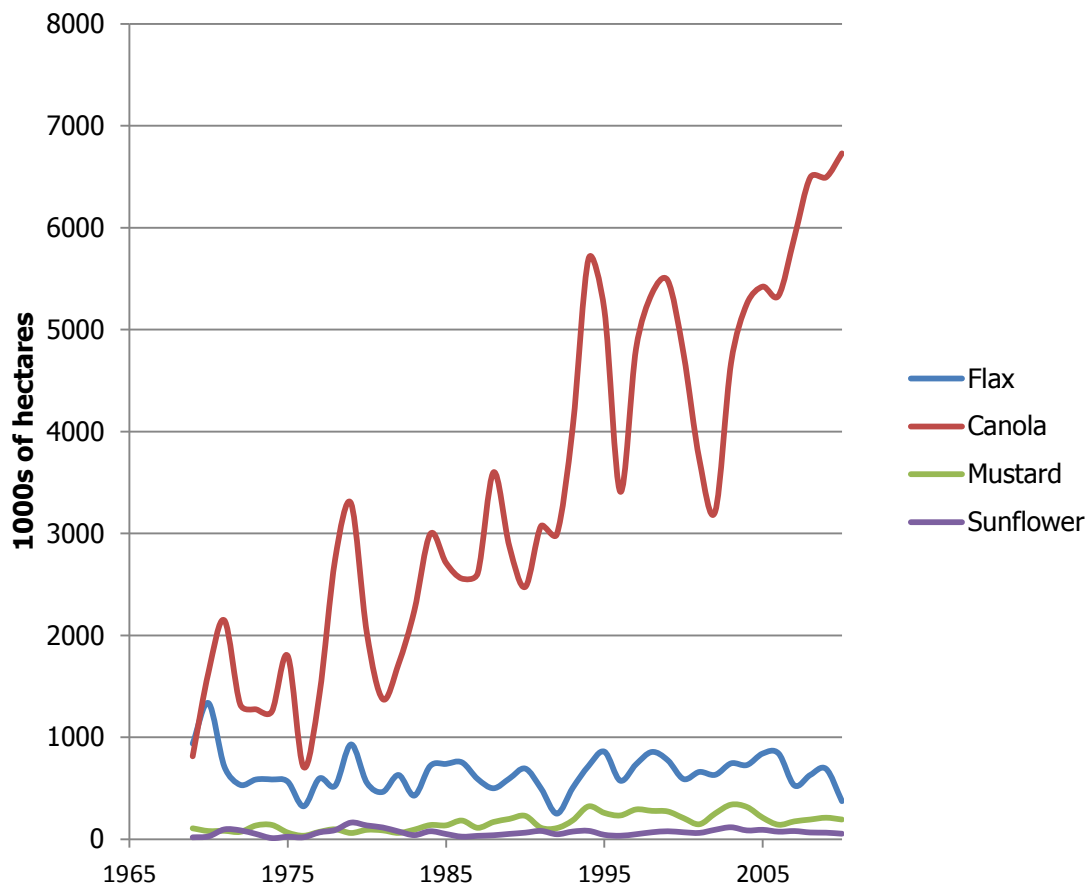
A notable trend in cereal crop production in the past 40 years is the decline in Canada Western Hard Red Spring (CWRS) area since about 1990 (Fig 1). Seeded area dropped from a high of 11 to 12 million hectares in the 1980s to 7 to 9 million hectares currently. Durum area has fluctuated around 2 million hectares since the late 1980s. Barley has remained relative stable, and oats have recently returned to about 2 million hectares after a low period in the 1980s and 1990s.

In the oilseeds, flax and mustard production have remained relatively stable, while canola area has grown dramatically (Fig. 2). Canola now rivals CWRS wheat in acreage share, having passed it in dollar value some time ago. Pea and lentil production have also increased dramatically in the past 20 years (Fig. 3). Soybean area has become significant in Manitoba over the past five years. Tame hay area has grown steadily over the past 40 years, while summer fallow area has dropped since 1980 (Fig 4). The very wet spring of 2010, particularly in east-central Saskatchewan, contributed to a significant upswing in fallow area.

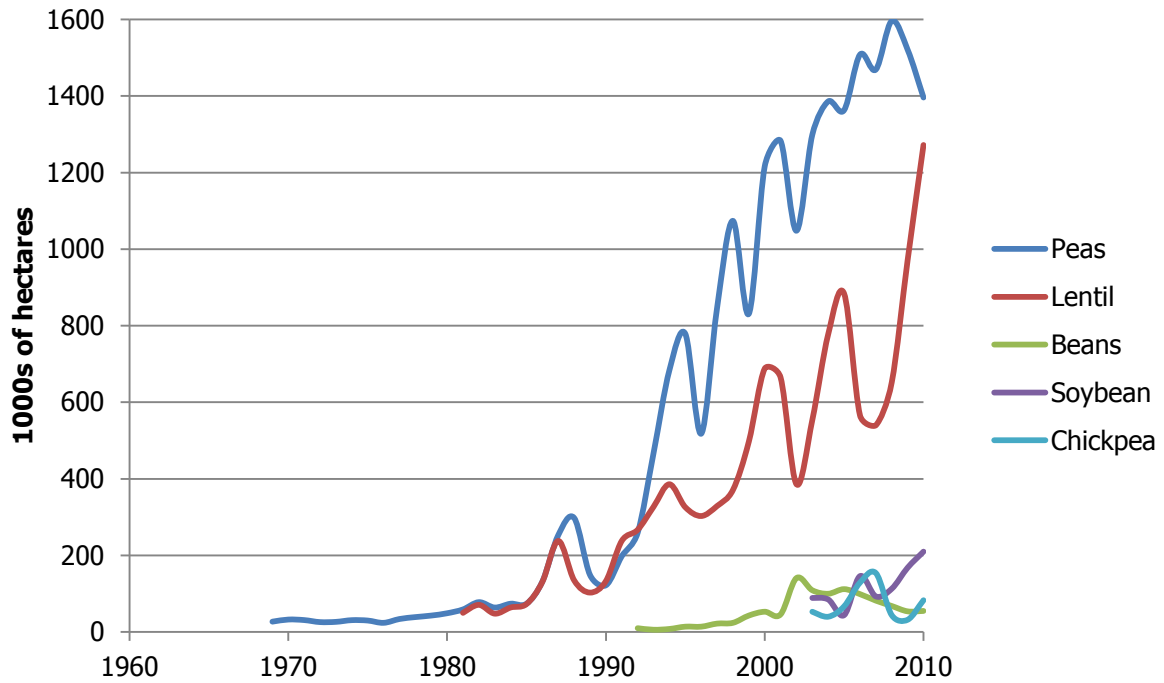
The increased seeded area of canola, peas, lentils and hay has thus been possible through reduction of CWRS area and reduced summer fallow as producers have moved to continuous cropping and zero-tillage.



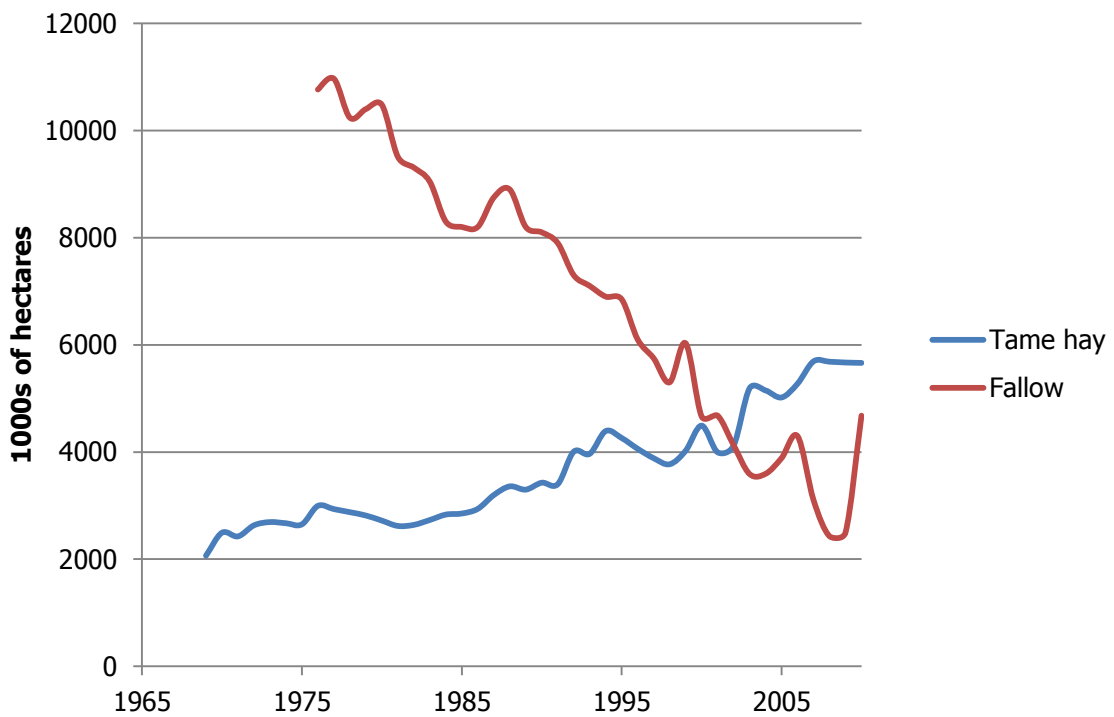
**Figure 1.** Production area of cereal crops in Western Canada 1969-2010.



**Figure 2.** Production area of oil crops in Western Canada 1969-2010.



**Figure 3.** Production area of pulse crops in Western Canada 1969-2010.



**Figure 4.** Area of tame hay and fallow in Western Canada 1969-2010.

## Trends in Crop Development Research in Western Canada

There have been relatively few studies documenting cultivar development research in Western Canada, or analyzing trends in research effort. The book 'Harvest of Gold' (Slinkard and Knott 1995) provided a narrative history of breeding efforts and researchers up to that point. Ulrich (2001) documented numbers of breeders in cereals, pulses and oilseeds, Briggs (2007) looked at public sector cereal breeding programs, and Thomas (2005) reviewed the canola sector. All of these provided only number of researchers current at the time of writing. Coulman (2011) documented the number of forage breeders as of 1975, 1990 and 2008. None of these studies looked at the number of non-breeding researchers contributing to cultivar development and delivery to producers, such as plant pathologists, agronomists, cereal and food quality chemists, and biotechnologists. This study attempts to document those numbers, but excludes scientists doing the necessary up-stream research to develop technologies and genetic information that can be applied at the practical breeding level.

The trend figures presented below do not show changes in the number of establishments within organizations involved in active, independent plant breeding, although some of the information is presented in the narrative and can be found in the supplementary spreadsheets. There has been considerable breeding program 'rationalization' over the past 20 years. This can improve efficiencies of scale within breeding organizations by having fewer breeders but probably more technical support in most cases. The downside is fewer professionals, ie. less total intellectual input into addressing the challenges of each crop. Another potential problem, so far not too acute, is that closing of smaller research centres will lead to reduced coverage of agro-ecological zones and reduced ability to adequately evaluate the adaptation of breeding lines and new cultivars.

The numbers of professionals associated with crop breeding have been estimated from a combination of sources listed at the end of the report. While breeder numbers were relatively easy to document and estimate full-time equivalent (FTE) per crop, it was more difficult to assign FTE of other professionals (agronomists, cereal chemists, entomologists, pathologists, etc.) because in many cases these people work on more than one crop.

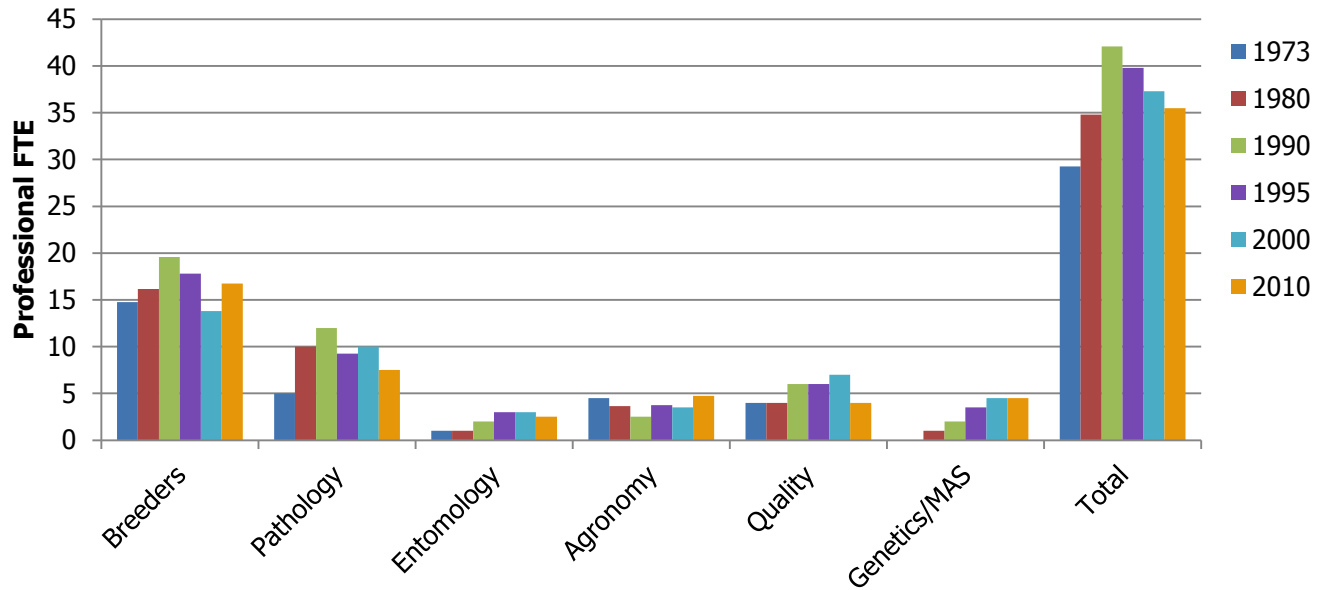
## Wheat

The total number of wheat breeders has been relatively stable since 1973, varying up and down during the period (Fig. 5). There was an upswing in the 1980s as breeder numbers increased at the Crop Development Centre and Saskatchewan Wheat Pool started a program with two breeders. The 1995 breeder number was lower than 1990, reflecting closure of the Saskatchewan Wheat Pool program at that time. The 2010 numbers have increased, mainly reflecting an increased number of private-sector breeders (Syngenta, Western Plant Breeders [Monsanto], World Wide Wheat and the Western Feed Grain Cooperative). There are rumours that other multi-national breeding companies are poised to enter wheat breeding in western Canada.

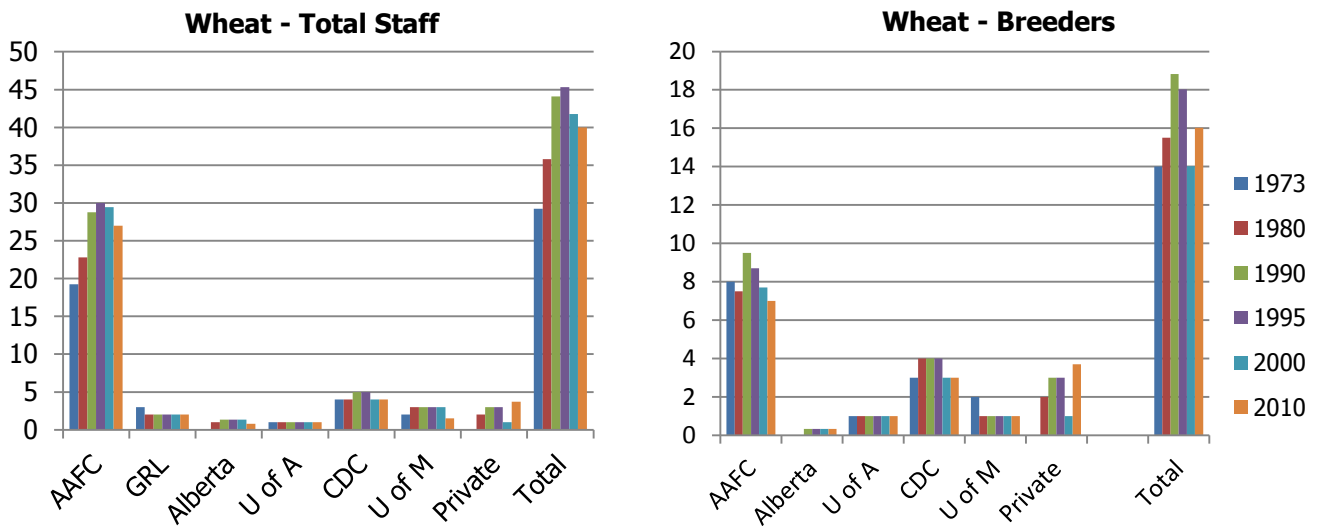
There were more total professionals associated with wheat breeding in the 1980 to 2000 period compared to 1973, principally due to an increase in the number of plant pathologists. The number of pathologists and end-use quality scientists dropped from 2000 to 2010, reflecting a failure to replace retirees. There was also a decline staff working in cereal chemistry and end-use quality from 2000 (7 FTE) to 2010 (4 FTE). There was a loss of two positions at AAFC Winnipeg and one at the University of Manitoba. The number of agronomists has remained relatively stable, while there was a steady increase in the number of scientists involved in marker-assisted selection. Total effort in marker-assisted selection is undoubtedly underestimated because in some cases this work is covered by a breeder or other team-member.

Looking at total wheat professional staff and number of breeders separately by organization, there was a decline from 1990 to 2010 in AAFC (Fig. 6). The drop was principally related to reduced breeder FTE resulting from closure of breeding programs at Lethbridge, Lacombe (CWRS programs in both cases), Beaverlodge (CPS/CWES/CWRS) and Winnipeg (durum). There was some shift in numbers among market classes, such as the addition of effort in soft white spring, hard white spring and Canada Prairie Spring. Other publically-funded organizations maintained essentially the same total FTE during the period. The addition of breeding positions in the private sector during the past decade partially off-set the AAFC reductions.

## Wheat



**Figure 5.** Trends in professional full-time equivalents (FTE) working with wheat cultivar development and delivery in Alberta, Saskatchewan and Manitoba (MAS is marker-assisted selection).

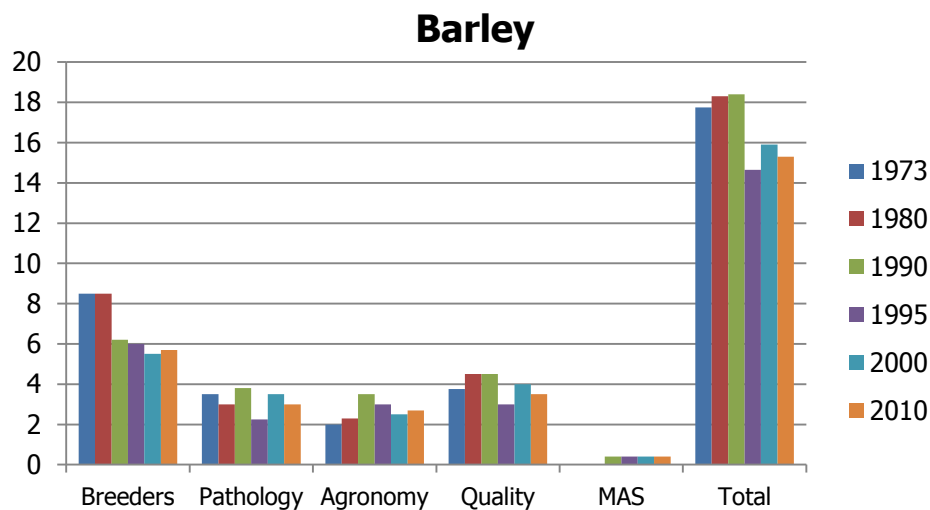


**Figure 6.** Trends in professional full-time equivalents (FTE) working with wheat cultivar development and delivery in Alberta, Saskatchewan and Manitoba 1973-2010 by organization (AAFC – Agriculture and Agri-Food Canada; Alberta – Provincial Funding, U of A – University of Alberta, CDC – Crop Development Centre/Dept. of Plant Sciences, U. of Sask; U of M – University of Manitoba).

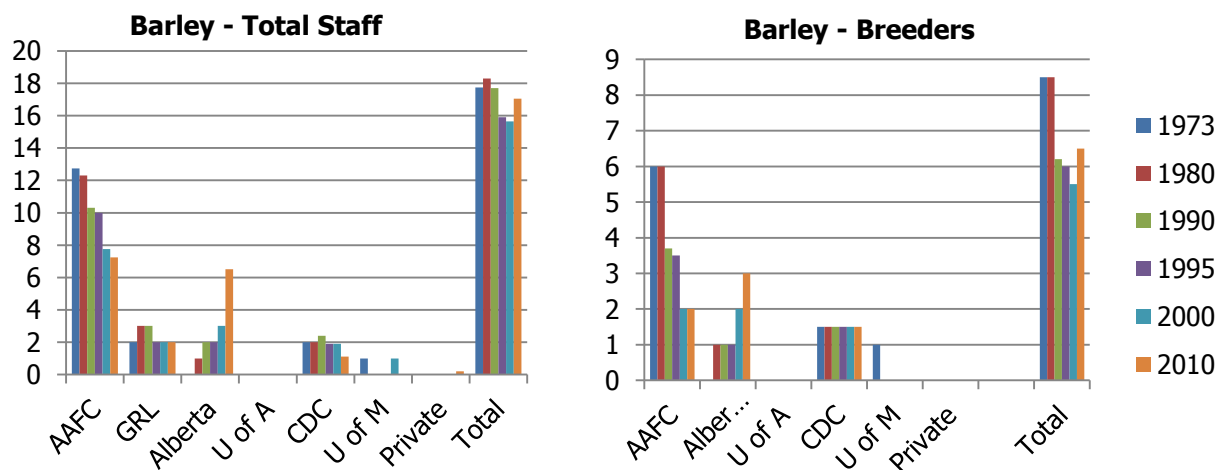
## Barley

The number of barley breeders has been relatively stable since 1990 (Fig. 7). Reduced numbers from 1980 to 1990 reflect discontinuance of AAFC programs at Lethbridge and Winnipeg (Fig. 8). The subsequent discontinuance of the AFFC programs at Lacombe and Beaverlodge were offset by increases at Alberta Agriculture, Lacombe. Currently there are three barley breeding programs – Alberta Agriculture at Lacombe, the Crop Development Centre at Saskatoon, and AAFC at Brandon.

There were no major trends in the supporting disciplines of plant pathology, agronomy, cereal chemistry or applied biotechnology over the review period. The total number of scientists committed to barley breeding and cultivar delivery has thus been fairly stable since 1990.



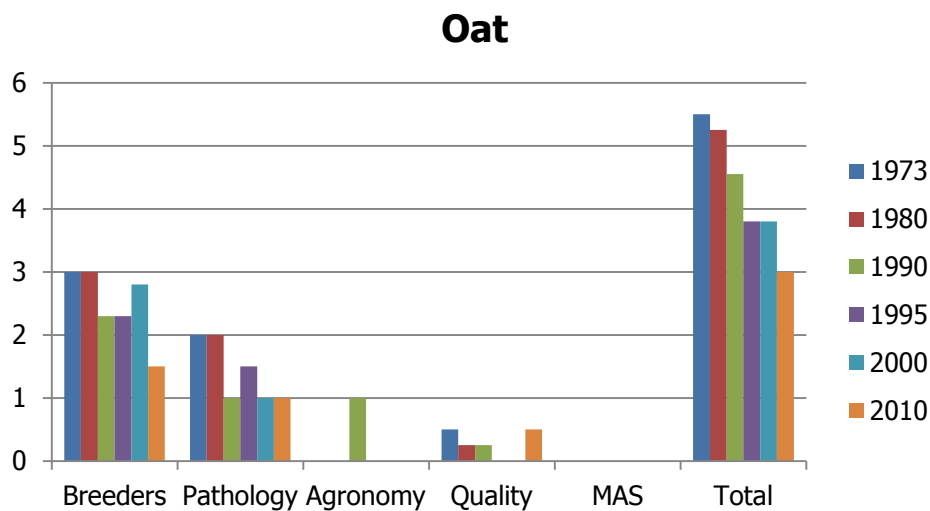
**Figure 7.** Trends in professional full-time equivalents (FTE) working with barley cultivar development and delivery in Alberta, Saskatchewan and Manitoba (MAS is marker-assisted selection).



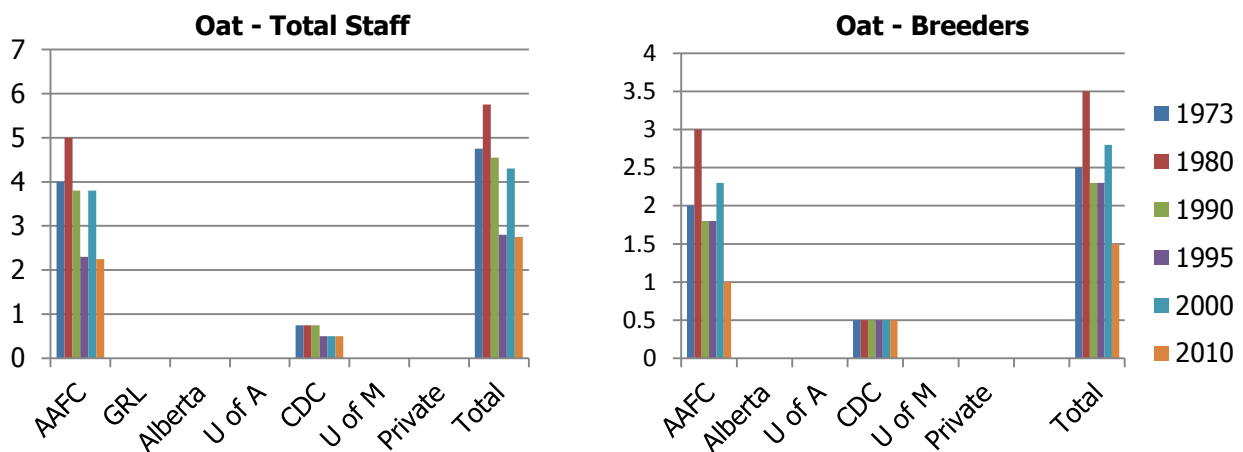
**Figure 8.** Trends in professional full-time equivalents (FTE) working with barley cultivar development and delivery in Alberta, Saskatchewan and Manitoba 1973-2010 by organization.

## Oat

There was a loss of one oat breeder position from 2000 to 2010, reflecting the death of Dr. Solomon Kibite of AAFC Lacombe (Fig. 9, 10). His position was not replaced, and the breeding material was absorbed into the AAFC Winnipeg oat breeding program. There has also been erosion in plant pathology support for oat. It was difficult to pin down commitment to oat agronomy because it has been addressed by various scientists on a short-term project basis rather than as a full program commitment. Cereal chemistry support for oat has been minimal, although some of the work done in this area may also be hidden under the barley umbrella. The total scientist commitment to oat has dropped by 2 FTE from 1980 to the present as a consequence of the loss of one breeder and one pathologist. Current breeding programs are at the CDC and AAFC Winnipeg.



**Figure 9.** Trends in professional full-time equivalents (FTE) working with oat cultivar development and delivery in Alberta, Saskatchewan and Manitoba (MAS is marker-assisted selection).

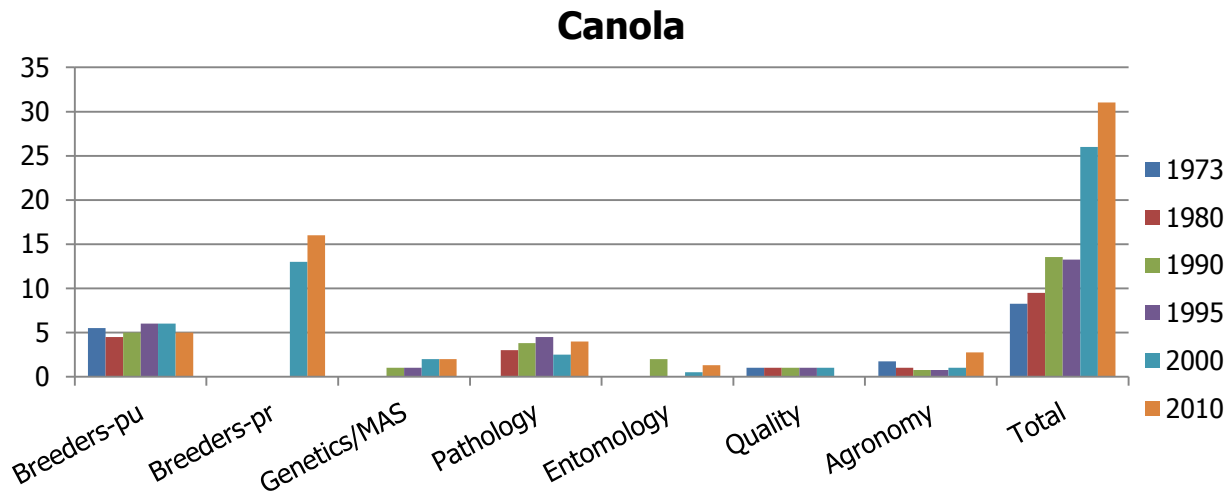


**Figure 10.** Trends in professional full-time equivalents (FTE) working with oat cultivar development and delivery in Alberta, Saskatchewan and Manitoba 1973-2010 by organization.

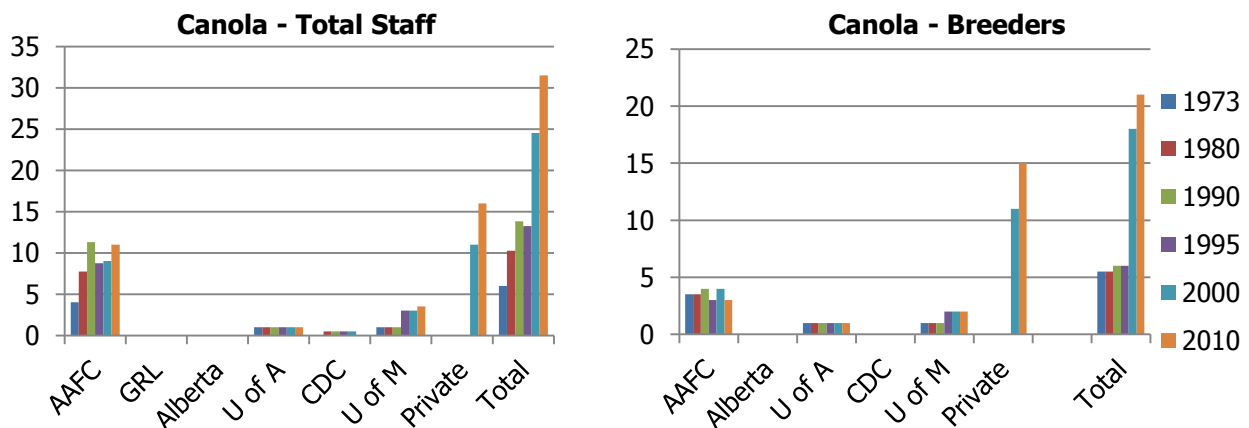
**Canola** (Note: this includes both canola and 'canola-quality' mustard)

The number of public breeders has remained constant over the 1973 to 2010 period (Fig 11). Public breeding programs remain at the Universities of Alberta and Manitoba, and the largest at AAFC Saskatoon (Fig. 12). One small program at AAFC Beaverlodge, Alberta was closed after 2000. Private companies entered canola breeding in the 1990s, with 13 breeders by 2000 (Ulrich 2000) and an estimated 16 currently (none of the canola breeding companies responded to requests for information). It is not known what proportion of these breeders is devoted to Canada vs. company interests elsewhere, and conversely, whether scientists outside the country contribute to the Canadian scene.

Supporting disciplines for canola have remained relatively constant in the public sector. The extent of support scientists is not known for the private breeding programs. Consequently the total number of scientists working with canola is probably considerably greater than shown here.



**Figure 11.** Trends in professional full-time equivalents (FTE) working with canola cultivar development and delivery in Alberta, Saskatchewan and Manitoba (pu: public sector; pr: private sector).

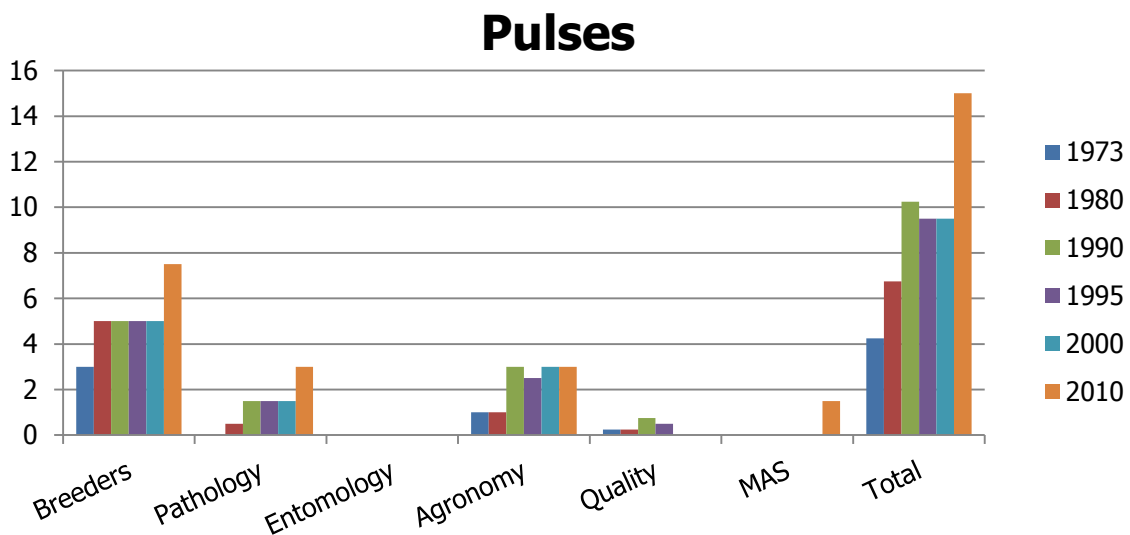


**Figure 12.** Trends in professional full-time equivalents (FTE) working with canola cultivar development and delivery in Alberta, Saskatchewan and Manitoba 1973-2010 by organization.

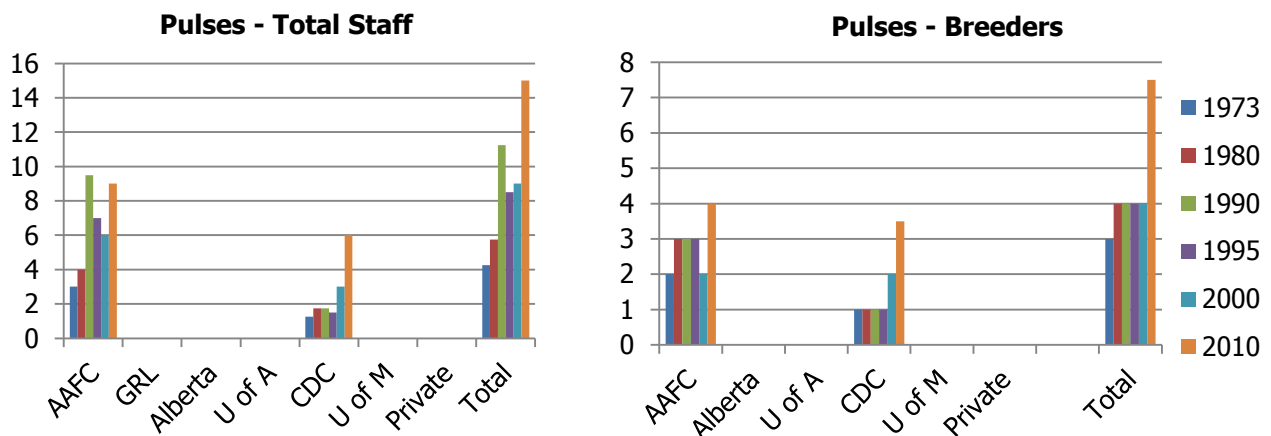
## Pulses

Scientific capacity in pulse crops is the other sector showing substantial growth over the review period (Fig 13). The number of breeders has increased from 3 FTE in 1973 to 7.5 currently. There is a small private sector involvement not counted here, consisting principally of agronomic testing of cultivars developed outside of Canada. AAFC and CDC remain the only organizations with pulse cultivar development programs (Fig. 14).

The growth in the importance of pulse crops is also reflected in an increase in the number of plant pathologists and agronomists working in the area. Work on quality of pulses is no doubt under-reported here, with considerable involvement in various food science laboratories both on the prairies and elsewhere.



**Figure 13.** Trends in professional full-time equivalents (FTE) working with pulse crop cultivar development and delivery in Alberta, Saskatchewan and Manitoba (MAS is marker-assisted selection).



**Figure 14.** Trends in professional full-time equivalents (FTE) working with pulse cultivar development and delivery in Alberta, Saskatchewan and Manitoba 1973-2010 by organization.

## Rye and Triticale

Only breeder numbers were estimated due to the small size of these programs (Fig. 15). Rye breeding declined through the loss of a part-time effort at the University of Manitoba, and a diversion of a partial FTE from the AAFC Swift Current program (Fig 16). Rye breeding seems unlikely to continue beyond the impending retirement of the AAFC breeder.

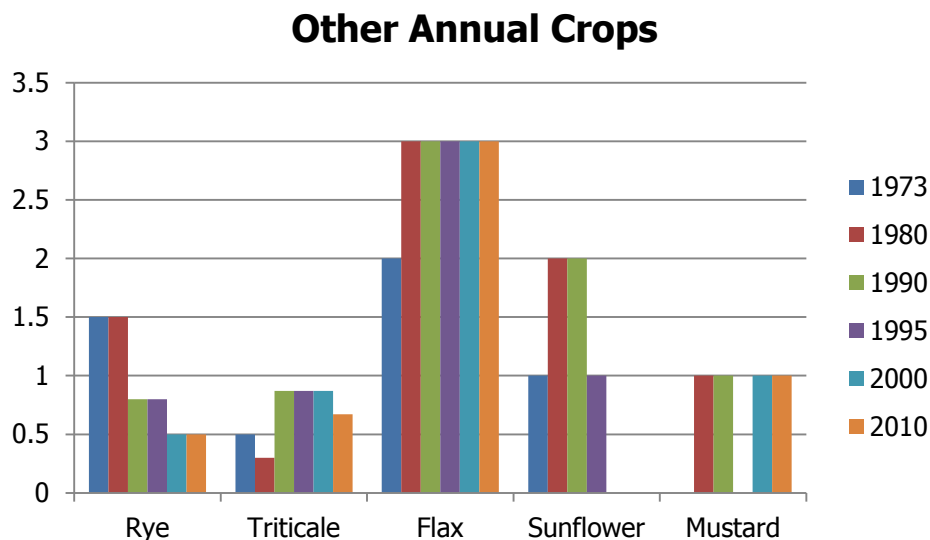
Triticale effort has been relatively constant since 1990. The only foreseeable breeding effort in future will be that of Alberta Agriculture, Lacombe following the replacement of the late Dr. Donald Salmon who committed 67% time to triticale breeding.

## Flax

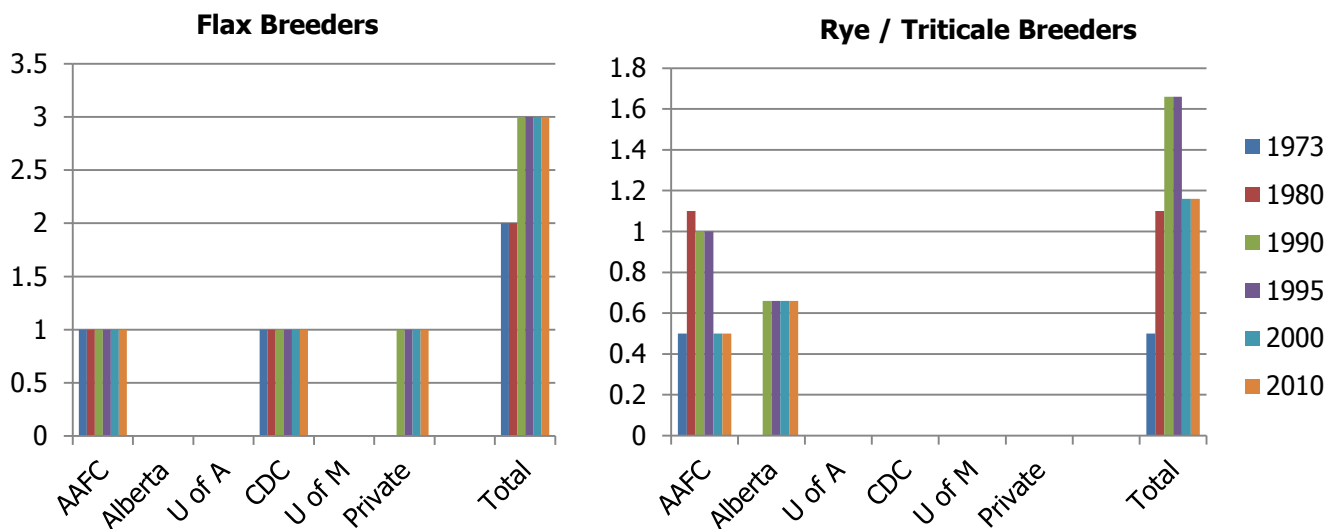
Again only breeders were counted here due to the small size of the breeding effort (Fig 15). Other scientists counted under other crops will have contributed to the agronomy, pathology and quality of flax as a small portion of their activities. The number of breeders has remained constant, with one at CDC, one at AAFC Morden, and one at Viterra (now at Vulcan, Alberta - program initially started by United Grain Growers at Morden) (Fig. 16).

## Other annual crops

There was a small effort in sunflower and safflower breeding within AAFC until about 1995. There was little producer interest in the crops, and the small Manitoba sunflower crop is based on U.S. cultivars. Breeding of condiment mustard has been relatively stable, with 1 breeder FTE at AAFC Saskatoon. (Fig 15)



**Figure 15.** Trends in breeder professional full-time equivalents (FTE) working with rye, triticale, flax, sunflower and mustard cultivar development and delivery in Alberta, Saskatchewan and Manitoba.



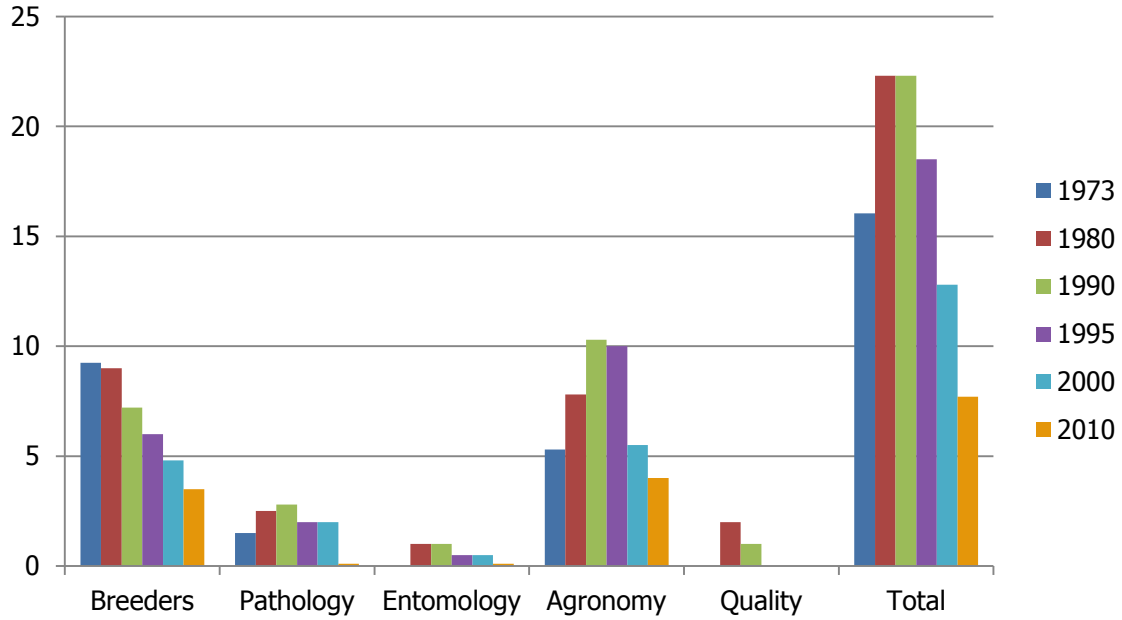
**Figure 16.** Trends in professional full-time equivalents (FTE) working with flax and rye/triticale cultivar development and delivery in Alberta, Saskatchewan and Manitoba 1973-2010 by organization

## Forage Crops

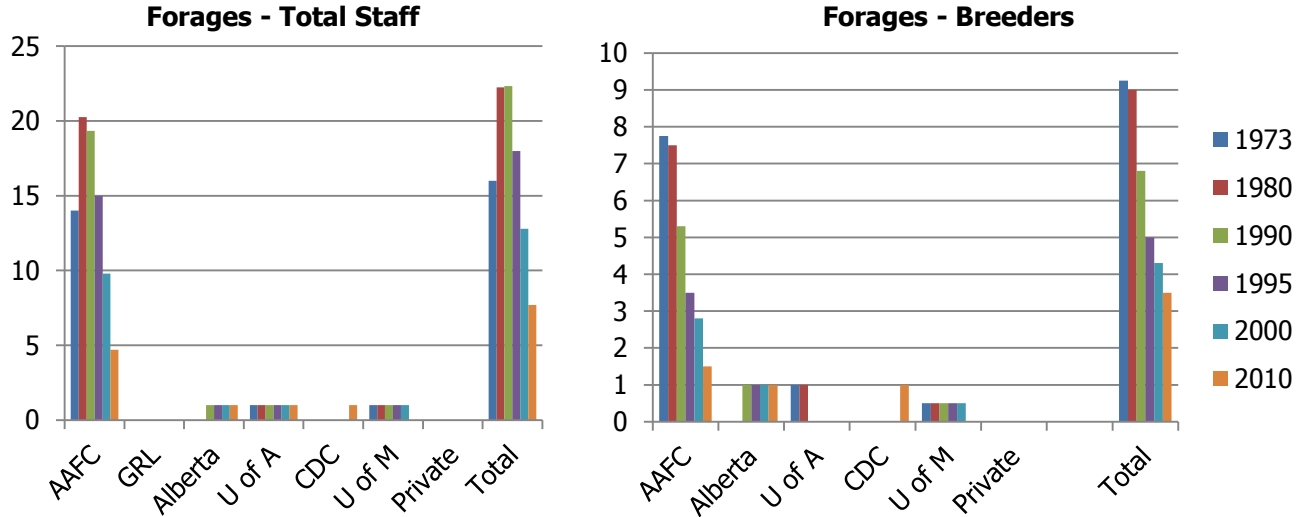
Forage crop breeding has shown the greatest decline among the crops reported herein. The number of breeders has fallen from nearly 10 FTE in 1973 to 3.5 at present (Fig 17). This number is likely to decline further in the near future unless three of the breeders nearing retirement (2.5 FTE) are replaced. There have been commensurate declines in pathology, agronomy and quality scientists, with approximately one third as many professional FTE in 2010 compared to the peak period 1980-1990. The major part of the reduction has been at the AAFC programs at Saskatoon/Melfort and Swift Current, Saskatchewan and at Beaverlodge, Alberta (Fig. 18). These programs formerly had integrated efforts encompassing breeding of grasses and legumes together with strong forage and seed production management research.

The outcome of this decline in forage research will be that any new cultivars will originate in the U.S. or elsewhere, and may receive some adaptation testing here prior to release. The reduction in forage capacity has occurred despite nearly 6 million ha of tame hay (Fig. 4), and an upward trend in area during the review period. The capacity reduction is a result of a perceived lack of industry (ie cattle producer) political or financial support for forage research. There is no producer checkoff system in place as there is for most of the major annual field crops. Public organization science managers have long fought this perception and tried to maintain financial support for the research, but they are obviously losing the battle. The growing realization by the 'green' movement that grass-fed beef is ecologically sustainable will perhaps help stop, if not reverse, the slide in forage research effort.

## Forage Crops



**Figure 17.** Trends in professional full-time equivalents (FTE) working with forage crop cultivar development and delivery in Alberta, Saskatchewan and Manitoba.



**Figure 18.** Trends in professional full-time equivalents (FTE) working with forage cultivar development and delivery in Alberta, Saskatchewan and Manitoba 1973-2010 by organization.

## Summary of Trends by Organization

The number of breeders in Agriculture and Agri-Food Canada in Alberta, Saskatchewan and Manitoba has declined steadily since 1990, dropping from approximately 30 FTE to 20 FTE (Fig. 19). This percentage decline was similar to the 35% drop in research expenditure by AAFC reported by Gray (2008), and to the total professional staff reductions cited in other studies (Brinkman, 2004; Thomsen Corp., 2006). The majority of the Agriculture and Agri-Food Canada decline was in forage crop breeding, followed by barley and oat (see above). The drop in numbers started before the 1995 'program review' within the federal government which sought to reduce the size of the public service. Breeder numbers remained relatively stable at the Universities of Alberta and Manitoba during this period. Numbers increased markedly in the private sector, principally in canola breeding, and more modestly in Alberta Agriculture/Alberta Research Council and University of Saskatchewan/CDC. These increases more than offset the Agriculture and Agri-Food Canada losses.

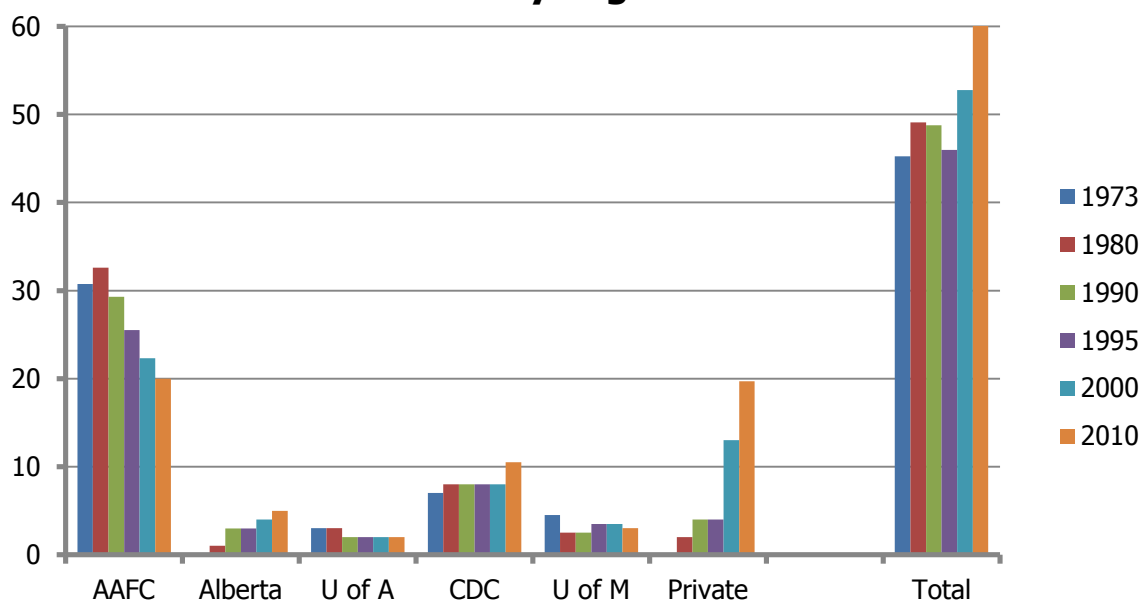
Current (2010) private sector breeder numbers are greatest for canola, comprising about 70% of the total (Table 1). Wheat is the only other crop with significant private sector breeding activity in western Canada, with about 30% of the total breeder numbers. Several multinational companies are rumoured to be interested in establishing wheat breeding programs in western Canada. This, together with the end of the Canadian Wheat Board monopoly in 2012, will change the wheat improvement landscape in Western Canada over the next decade.

**Table 1.** Number of breeders in the public and private sectors by crop, 2010.

	Public	Private
Wheat	10.3	3.7
Barley	5.5	0.5
Oats	1.5	0
Rye	0.5	0
Canola/mustard	6	16
Flax	2	1
Pulse crops	7.5	0
Forage	3.5	?

Note: The private sector numbers are estimates because all but one company declined to provide information

## Breeders by Organization



**Figure 19.** Trends in professional full-time equivalent (FTE) breeders by organization for all major field crops in Alberta, Saskatchewan and Manitoba, 1973 – 2010. [AAFC: Agriculture and Agri-Food Canada; Alberta: Agriculture and Rural Development, Field Crop Development Centre and Alberta Research Council; U of A: University of Alberta; CDC: Crop Development Centre and University of Saskatchewan; U of M: University of Manitoba]

## Research Support Staff

There was not time to pursue this aspect of the study. Also, as with budgets, such information would not be obtainable from the private sector companies. In the case of public sector organizations, it would be very difficult to obtain historical information on support staff without searching through archived hard-copy files within each organization.

As a general observation, research funding provided to public-sector institutions by producer checkoff organizations was mainly used for increased support staff (technicians, labourers and summer students). This made a major contribution to the efficiency of the public-sector breeding programs which had woefully inadequate labour support prior to receiving checkoff funding. These programs had the necessary breeders, but they operated at much below capacity. Producers have in turn benefited from more and better cultivars.

Recently, however, AAFC restricts hiring of technical and other support staff on 'soft' money. This leaves AAFC scientists with outside funding only two staffing options – post-doctoral fellows and summer students, neither ideal for supporting crop development programs. There also seems to be a slow erosion of these soft money and other technical support positions through failure to replace vacant positions by re-staffing from outside AAFC.

## Research Investment

Time did not permit assembly of detailed information on research investment by public and private organizations. Indeed, all private companies considered such information, along with staff numbers, to be protected business information. Through the cooperation of the producer organizations collecting and managing research checkoff funds I was able to assemble figures for trends in their investment in cultivar development (Table 2).

Checkoff investments have played a significant role in funding of wheat, barley, pulse and public-sector canola breeding. Smaller crops such as flax and oat have provided supplementary funds to breeding programs, but not on the scale or proportion of that done in the major crops. Forage breeding programs struggle to obtain industry funding. There are a few examples of private sector investment such as the Ducks Unlimited funding of improvement of native grasses ('ecovars'), but there has been no long-term funding as seen in the major annual crops.

Overall, research investment of producer checkoff funds has increased substantially from 1995 to 2010. However, note that some organizations were not able to produce spending records for 1995, so the increase is not as large as shown in Table 2. Checkoff funds undoubtedly did much to offset the reductions in research expenditure by AAFC. There is some doubt whether AAFC will continue to accept checkoff funding in future, given the changes in financial management rules noted above.

**Table 2.** Research investment of checkoff funds by various producer organizations in 1995 vs 2009-2010.

<b>Organization</b>	<b>Checkoff rate</b>	<b>Research area</b>	<b>Recipient</b>	<b>1995</b>	<b>2010</b>
Sask. Canola Development Commission	0.75/t	Breeding Agronomy		na	\$216,000 \$300,000
Alberta Canola Producer's Commission	1.00/t	Breeding Agronomy		\$70,000 \$148,000	\$540,000
Sask. Flax Development Commission	1.18/t seed 0.50/t straw	Breeding  Agronomy	CDC AAFC Viterra	\$180,000 \$40,000	\$65,000  \$4,000
Alberta Pulse Growers	1%	na		na	na
Manitoba Pulse Growers Association	0.50%	Breeding & Agronomy	AAFC	\$81,000	\$271,000
Saskatchewan Pulse Growers	1%	Breeding  Agronomy	CDC AAFC NRC-PBI  CDC AAFC Other	\$1,200,000	\$4,487,000 \$68,000 \$317,000  \$300,000 \$127,000 \$96,000
Wheat Producer Checkoff (WGRF)	0.30/t	Breeding	AAFC CDC U. of A Alta. Ag. U. of M	\$3,026,000	\$3,010,000
Barley Producer Checkoff (WGRF)	0.50/t	Breeding	AAFC CDC	\$631,000	\$450,000
Alberta Barley Commission	0.40/t	Breeding agronomy		\$240,000 \$91,000	\$300,000 \$216,000
Prairie Oat Growers Association	0.50/t			na	na
				\$5,806,000	\$10,767,000

## Areas of Concern

Overall, if one looks at current (2010) total FTE per crop as a proportion of the area sown, forage crops and oat show a lower ratio than the other crops, suggesting that research capacity for these crops is less than it should be. However, it should be noted that comparisons of crops on this basis should be approached with caution because of the differences in complexity of cultivar development among crops. Three of the forage breeders (Acharya, Coulman, McLeod) are approaching retirement age; failure to replace them will mean forage breeding on the prairies will become unsustainable.

Loss of cereal chemistry research/screening support in wheat leaves just four positions currently, two at AAFC (one near retirement) and two at the Canadian Grain Commission. The loss of the Canadian Wheat Board monopoly could have ramifications for the Canadian Grain Commission and the Canadian International Grains Institute (CIGI). The Grains Research Laboratory of the Canadian Grain Commission currently plays a large role in the setting of quality targets for wheat and barley, and screens the cooperative test entries for wheat and barley to determine suitability for registration. The funding for CIGI currently comes from AAFC and the Canadian Wheat Board; if CWB revenue drops, at least part of the funding for CIGI may be in jeopardy. Other supplementary funding may be required. In the U.S., U.S Wheat Associates plays a role similar to CIGI – market support for customers, demonstration of wheat processing, etc., and obtains its funding from producer check-offs and the U.S. Department of Agriculture. CIGI may have to move to a similar funding model.

The trend figures reported here do not address other issues that will influence crop breeding capacity in the next 5 to 10 years. The age demographic of researchers, particularly within AAFC, is such that many are eligible for retirement within that period. Whether all current positions will be replaced is unknown at this point, but fiscal restraint and changing government priorities are issues of concern. The current proposal to return to a balanced federal budget by 2014 is likely to mean fiscal restraints such reduction in size of the public service, as well as reduced operating budgets and capital expenditures. Indeed, given recent announcements of staff reductions in several federal departments, replacement of all retiring staff seems unlikely. Failure to replace key research staff would mean that AAFC crop development research capacity will continue to slide as it has steadily for the past 15 years (Fig. 19).

Aging infrastructure is a further concern, examples being the AAFC centres at Winnipeg and Swift Current. Present capital plans offer no hope of addressing these issues in the near future. The consequences are inefficiencies in research programs as well as ability to attract and retain professional research staff.

Small breeding programs have limited access to biotechnology support for marker-assisted selection, which will become more of a concern as high-throughput marker technologies bring genomic selection to practical usage. One bright spot in this regard is the National Research Council 'Flagship' programs being developed to engage in up-stream genomics research in wheat, canola and pulses to develop practical tools for breeding. This will possibly include service laboratories for marker screening.

Federal science spending is increasingly outside the federal public service, which is already pinching budgets at AAFC research centres. This is likely to lead to a reduction in both in-house breeding capacity and the field-testing capability that is currently the backbone of pre-registration ('cooperative test') trials for all crops other than canola. Canola testing is done on a fee basis which is viable for the largely private canola breeding system; such a system would be an added financial strain for other crops where the majority of the effort is in publicly-funded programs. Changes in federal financial management policies are also making it more difficult for AAFC scientists to manage research funds from external sources. This makes it very challenging for breeding teams to manage checkoff and other competitive research grant funds, particularly for staff and travel. This has serious implications for all public organizations involved in breeding on the prairies because, for example, AAFC pathology research and testing of cooperative test lines touches most crops.

Enhanced coordination of public sector crop development efforts will be key in future as infrastructure deficiencies and funding shortfalls become more severe. Partnerships and funding from producer checkoffs should still be able to leverage support from the federal and provincial governments to maintain breeding of crops not of interest to private companies. Coordination of public sector activities such as genomics research, genomic and marker-assisted selection, breeding, pathology, entomology and adaptation (yield) testing in a broad range of prairie environments will provide public programs with the types of resources already routinely applied within large multi-national breeding companies. This will ensure efficient usage of public and producer checkoff funds in crop improvement.

## References

- Briggs, K.G. 2007. Improving the competitiveness of Western Canadian Cereal Crops. Subproject: Review of Western Canadian public sector crop breeding programs and priorities, with an emphasis on bioenergy market requirements. ACIDF/AARI. <http://www.acidf.ca/files/focus/keith.pdf>
- Brinkman, G.L. 2004. Strategic policy issues for agricultural research in Canada. Current Issues in Agriculture, Food and Resource Issues 5:131-147.
- Coulman, B. 2011. Personal communication; information generated for Canadian Seed Trade Association.
- Gray, R. 2008. Agricultural research at a crossroads. Can. J. Agric. Econ. 56:1-11.
- Slinkard, A.E. and Knott, D.R. (eds.) 1995. Harvest of Gold- The History of Field Crop Breeding in Canada. University Extension Press, University of Saskatchewan.
- The Thomsen Corporation 2006. Initiatives for Enhanced Profitability: Plant Breeding Infrastructure in the Cereal Grains Sector. Agriculture and Agri-Food Canada Project # 01B68-5-0126
- Thomas, P. 2005. Review of the University of Alberta canola program. Alberta Crop Industry Development Fund. <http://www.acidf.ca/files/focus/canola.pdf>
- Ulrich, A. Grain breeding activities in Western Canada, 2000. Report submitted to ADF, January 2001.

## Other Sources of Information

Expert Committee/Prairie Registration Recommending Committee/Prairie Grain Development Committee minutes

AAFC Research Centre reports

Inventory of Canadian Agricultural Research (ICAR)

Websites of breeding organizations

Personal communication with research managers and scientists

**Note:** Every effort has been made to make this report as accurate as possible. There are undoubtedly minor errors in the partitioning of FTE by crop and discipline due to inaccuracies in the historical documentation available to me. There are also likely to be differences of opinion regarding the disciplines and people that should or should not be included as directly related to crop breeding on the prairies. For that reason, I provided the spreadsheet of scientist names and time assignments that I used so that others may correct, update or adapt the information for other purposes.

## Acknowledgements

A special thanks to Dr. Brian Rossnagel (Crop Development Centre, University of Saskatchewan), Dr. Bruce Coulman (Department of Plant Sciences, University of Saskatchewan) and Dr. Kevin Falk (Agriculture and Agri-Food Canada, Saskatoon Research Centre) for reviewing and adding to my list of researchers. I also thank Alvin Ulrich (Biolin Resources) for providing a copy of his 2000 report on grain breeding in Western Canada. A big thanks to Dr. Brian Freeze (AAFC Lethbridge) for arranging access to the archived ICAR database. Discussions with Dr. A. Jalil of Saskatchewan Ministry of Agriculture and Dr. W. Keller of AWB did much to improve this report.

I also gratefully acknowledge the time taken by the producer organizations (Table 2) to provide information on producer checkoff investments in crop development.