

# **SEED RELATED EDUCATION IN CANADA**

**for the  
Canadian Seed Trade Association**

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## Table of Contents

<b>SUMMARY</b> .....	<b>3</b>
<b>What can be done about this?</b> .....	<b>3</b>
<b>Recommendations for industry</b> .....	<b>3</b>
<b>INTRODUCTION</b> .....	<b>6</b>
<b>ENVIRONMENTAL SCAN</b> .....	<b>8</b>
<b>Baccalaureate and Postgraduate</b> .....	<b>8</b>
<b>Diploma</b> .....	<b>11</b>
<b>PROGRAM CONTENT</b> .....	<b>11</b>
<b>Baccalaureate Programs</b> .....	<b>11</b>
<b>Diploma Programs</b> .....	<b>13</b>
<b>Postgraduate Programs</b> .....	<b>13</b>
<b>ENROLMENT</b> .....	<b>13</b>
<b>Why are enrollments down despite plentiful job opportunities for graduates?</b> ....	<b>16</b>
<b>What can be done about this?</b> .....	<b>16</b>
<b>What can industry do to assist in increasing enrollments?</b> .....	<b>17</b>

## **SUMMARY**

Enrollments in agriculture programs in Canadian universities and colleges have been trending downwards for over 20 years. This has been most evident in diploma and baccalaureate programs but has also affected Master's and Ph.D. programs as well. Students with an interest in field crops are primarily choosing to specialize in agronomy as opposed to crop or plant science. The significance of this is that these students are not required to take courses in biochemistry and plant breeding and thus are not as well prepared for aspects of the seed industry, which require this knowledge. This obviously has a negative impact on the availability of graduates for employment in the industry. Estimated annual recruiting requirements at a 5% turnover rate in the industry are as follows, postgraduate 30, baccalaureate 200, diploma or certificate 400. Current outputs are insufficient to meet these demands, especially if one considers other, competitive, employers for these graduates.

There are eight Canadian universities with traditional agricultural faculties. In addition several other universities offer agriculture related programs. There are many colleges in Canada, offering diploma and certificate programs in agriculture, but very few offer crop related programs. Of these only a couple offer courses related to seed. Budgetary pressures and reduced enrollments have led to cutbacks in faculties and pressures to focus on Tri-Council funding have resulted in a move away from market oriented research such as plant breeding. Two of the eight Canadian agricultural universities, for example, have no plant breeders on their faculty and another two have only one plant breeder. This phenomenon is not unique to Canadian universities. Similar trends exist in the United States, Australia and Western Europe.

### **What can be done about this?**

There are no easy answers or the universities would have already found them. Industry could employ foreign nationals however this pool is also smaller due to the same trends. Industry can employ graduates from other programs and train them in house. This is feasible for lower skilled jobs but it becomes increasingly onerous as the skill and training level increases. Industry can also employ displaced workers from other sectors and retrain them. This has similar restraints to employing graduates from other programs. Industry can work with universities to increase enrollments, and thus ultimately, the pool of graduates available for employment.

## **Recommendations for industry**

Industry should work with other sectors in food and agriculture to better the image of our chosen field, especially with urbanites and potential students.

Provide information on career opportunities, which is sexy and accessible to students. An obvious vehicle is the electronic media; however, students still rely on written materials in guidance counselors' offices.

We need to provide materials, which not only indicate the exciting opportunities for a career in the seed industry but also lay out the skills and knowledge, which are required by the industry. This material should be available to high school students so that they can make the right choices of courses to gain them admission to the appropriate University programs. It should also be available to University students so that they can select electives, which are appropriate to industry needs.

Assist with recruitment of students. We should particularly target high school guidance counselors, who are very influential in guiding student choices. We should provide written materials and we should make ourselves available to talk to students at career days and similar fora. We should of course be sending our youngest and brightest to do this and not the "old boys and girls."

We should also be willing to provide funding to universities to support their recruiting initiatives.

We need to provide part-time and full-time employment for students, even more so than in the past.

We need to provide experiential learning experiences for students beyond those available on an employment basis.

We must make ourselves available to give guest lectures, including not only crops related classes, but also agricultural business classes as well.

We need to allow our enterprises to provide case study materials for students to work with.

It is important to meet with Deans, face-to-face on at least an annual basis. We need to inform the deans of our needs and our willingness to assist in recruitment and program delivery.

It is important that we be willing to work with faculties to develop special programs, for example; retraining programs, concentrated short courses and course modules, which can be made available to faculties across the country for use in courses at various levels.

In addition to working with deans it is also important to influence senior university administrators and ensure that they are aware of the importance of agriculture programs to Canada's well-being.

It is also important for us to influence Canada's science policy. At the moment it contains little or no agricultural emphasis. Agriculture needs to be one of the pillars of Canada's science and innovation policy, and it is up to us to ensure its presence using political pressure if necessary.

It is important to provide research funding that is targeted to industry needs. Supporting faculty chairs in seed related disciplines would ensure ongoing focus on those areas. This of course is not cheap.

There are no doubt other things that can be done, the key is to become involved and to apply our creative minds to finding solutions to these issues.

## INTRODUCTION

In recent years the Canadian seed industry has experienced difficulty in recruiting staff to fill positions in various aspects of its industry. As a result Canadian Seed Trade Association has commissioned two studies. The first was to quantify and categorize employment within this sector. The second was to investigate the situation in regard to the status of seed related education in Canada. This report presents the results of a review of the latter.

The employment survey, conducted on behalf of the industry revealed that there are approximately 14,000 people employed in the seed industry in Canada, representing over \$400 million per annum in salaries and benefits. The total economic activity of this sector is of course, many times greater than this total. This is a significant contribution to the Canadian economy. It is important therefore that the businesses which make up this industry have access to individuals who have the knowledge and training to staff their human resources needs. The seed industry can be divided roughly into four categories; Plant breeding and research, seed production, seed processing and production support and marketing and distribution. The survey reported the following numbers for these categories. Plant breeding and research 628, made up of 197 plant breeders, 377 scientists supporting breeding activity (agronomists, plant pathologists, seed physiologists and quality control/evaluation scientists) and 54 biotechnology scientists. Research support staff total, 1106 technicians and 1315 seasonal employees. In seed production, 2270 seed producers and 305 seed contractors (many of whom hired additional personnel). Seed processing and production support 5871. Marketing and distribution, 2371. These give a grand total of 12,550 full-time and 1315 seasonal employees. The survey did not collect information on the age profile of these employees and thus it is difficult to predict recruitment requirements in any given year. It is possible however to estimate numbers, if one assumes specific employment turnover rates. If an annual turnover rate of 1% is assumed the requirement would be for 6-7 scientists, 40 baccalaureate graduates and 80 diploma or certificate graduates. With a 5% turnover rate these numbers would be 32, 200 and 400. At 10% they would be 65, 400 and 800. Given retirements, deaths and position changes 5% is not an unrealistic number. There is no reason to expect that the seed sector is any different to the rest of Canada and one could anticipate a large turnover in the next 5+ years as the baby boomers retire from active employment. This could push the turnover considerably higher in the short run obviously exacerbating the situation. One must of course factor in the competition of allied industries for these same graduates.

The business of the seed industry is to create new varieties of crop species, to produce seed of crop varieties, to process condition and package the seed and to market and distribute this seed in Canada and around the world. Thus a broad range of skills are required to service this industry. There is a need for individuals from the full spectrum of education credentials. Research scientists have the highest requirement for education, for the most part requiring Ph.D.'s, or at least a master's degree. The fields include plant breeders, plant pathologists, agronomists, quality evaluation scientists and plant biotechnologists. At the baccalaureate level recruitment needs are primarily in the following areas; plant/crop sciences, agronomy, biotechnology, chemistry, food science and business/economics. At the diploma level, crops,

agronomy, biological technology, chemical technology and farm management are the areas sought.

Traditionally, the industry has looked to the eight Canadian universities which have agricultural faculties, to provide the graduates they need. From West to East these are the University of British Columbia, University of Alberta, University of Saskatchewan, University of Manitoba, University of Guelph, McGill University, Laval University and Nova Scotia agricultural College. In addition, there have been a number of institutions, which offer diploma and certificate programs in agriculture. It will come as no great surprise that many changes have occurred at these institutions over the years. Most have changed names to reflect changes in emphasis and in scope. Some no longer use the word agriculture in the name. Most now offer several degrees where before it was all covered by a B.Sc. Agriculture degree. All Universities across their entire offerings are facing considerable challenges in these times. The financial crisis has negatively impacted direct government grants to educational institutions and has seriously reduced income from endowment funds and investments. Enrollments in agriculture programs have been falling and thus budgetary cutbacks have been greater for these units than for those where enrollments have remained strong.

Canada's national priorities for science and technology do not include agriculture, and thus government funding for research in agriculture is suffering. This is amazing considering the importance of agriculture to Canada's national economy and the importance that Canadians place on food security and food safety. The result is reduced numbers of faculty in agriculture and the view of our students that this is a less desirable area in which to establish a career. It is ironic that internationally, given the food crises of the last several years, and a growing recognition of the need to increase agricultural output to feed a growing global population, there is a rediscovery of the primacy of agriculture in addressing these issues. Thus we see a glimmer of hope in the new strategic directions of IDRC and CIDA. Agriculture is not only back in their vocabulary, but in fact it is front and center. It is no longer hidden in environment and natural resources management programs. Unfortunately, they have very few in-house staff that have experience or training in agriculture and thus implementation of the new strategic directions will be hampered. It is to be hoped that other federal government departments and agencies will also bring agriculture research to the forefront in their priorities. At the same time that federal government funding for applied agricultural research is being reduced, private sector support, especially check-off funding from farmers has increased substantially. University and Agriculture and Agri-food Canada's research has shifted away from applied research such as plant breeding and agronomic practices. This is reflected in hires and the availability of research funding for these areas. Little credit is given in career advancement for variety release or the development of an improved cropping practice. Less credit is also given for outreach activities and thus contacts with farmers and business people are reduced.

## **ENVIRONMENTAL SCAN**

## **Baccalaureate and Postgraduate**

**University of British Columbia:** The Faculty of Land and Food Systems is no longer departmentalized and focuses largely on urban agriculture, horticulture, and environment. The University offers one relevant degree for seed education B.Sc. (APBI) with specialties in applied plant and soil sciences and food and environment. The Faculty has no plant breeders and no field crops, production specialists on staff. The focus of the University can be seen from the description of career paths in the applied plant soil sciences program “soil scientist, Bio meteorologist, environmental consultant, natural resources planner, ecologist, conservation officer, academic instructor, and agricultural extension officer”. Similarly the career paths suggested for the food and environment specialization are equally revealing “sustainable agricultural systems, organic farm management and design, agricultural extension, vegetable crop management”. This faculty and does not offer graduate training in plant breeding. Neither does the University offer diploma programs.

**University of Alberta:** Seed related programs are offered at this University in the Faculty of Agriculture, Life and Environmental Sciences. This college offers 12 degrees, including the B.Sc. Agriculture. The relevant specialties in this degree are crop and horticulture science and sustainable agricultural systems. These programs are offered through the Department of Agriculture, Food and Nutritional Sciences. Fourteen of the faculty members in this department have plant related expertise. Of these two are plant breeders, three are agronomist/ production specialists and five are biotechnologists/geneticists. The department offers postgraduate training in plant breeding, biotechnology and crop production. They are not involved in diploma training.

**University of Saskatchewan:** The College of Agriculture and Bioresources offers several degrees including the B.S.A. within which seed related specialties exist. The Plant Sciences Department is the result of the amalgamation of three previous departments, Crop Science, Plant Ecology and Horticulture Sciences and contains the Crop Development Centre as an integral part of the department. Plant Sciences offers specialization in agronomy and in crop science. The majority of students are in the agronomy option, this option is considered to be broader and easier by students. Courses such as biochemistry, genetics, plant breeding, and biotechnology are not required as they are in the crop science option. The difference is typical across most of the Canadian University offerings. The department has 18 academic faculty, of which 4 have agronomy/ production expertise, 2 biotechnology and 4 are breeders. An additional 7 breeders reside in the Crop Development Center, a research unit, which is an integral part of the department. This makes this location the largest concentration of plant breeders in Canada. These scientists contribute to undergraduate teaching, but their primary teaching input is in graduate training. Additional input into the graduate training offered by this department comes from a long term, close association with NRC's Plant Biotechnology Institute

and the Agriculture and Agri-food Canada, Research Station both located on campus. A number of graduate students are co-supervised by scientists from these organizations. A number of crop related industries are located adjacent to the University in Innovation Place or other locations in the city and also contribute. Thus there is an extremely strong cluster at this location which is unequalled in Canada. The department offers M.Sc. and Ph.D. training in plant breeding, genetics, agronomy, plant physiology and biotechnology. The department also offers a diploma in agronomy program.

**University of Manitoba:** This University also offers several degrees through its Faculty of Agricultural and Food Sciences. The B.Sc. Agriculture offers specializations in plant biotechnology and in agronomy. The B.Sc. Agroecology offers specialization in agroecology. The Plant Science department has 16 faculty members, including 4 breeders, 5 biotechnologists and 3 production/agronomy specialists. This department has strengths in seed development and seed physiology. This University also has an AAFC research station located on campus and the Canadian Grain Commission, Grain Research Laboratory is located in the city. The scientists from these organizations contribute to graduate training at this institution. In addition to the baccalaureate programs this University offers M.Sc. and Ph.D. programs in the full range of seed related research. They also offer a diploma program including specialties in crop management, general agriculture and business management.

**University of Guelph:** The Ontario agricultural College is the oldest agricultural College in Canada. It offers a full range of programs at all levels of education. Two baccalaureate degrees offer training that relates the seed sector. Within the B.Sc. the plant science major fits this niche. This degree program has a heavy science orientation and is designed primarily for those wishing to go into a research career. The B.Sc. Agr. degree program has a more applied orientation, and there are two majors, which provide seed related education. These are crops, horticulture and turfgrass sciences (CHATS), and organic agriculture. There are streams within these majors that provide seed related perspective. The Plant Agriculture Department is the major sponsor of all these offerings. This is a large department, which has arisen from the amalgamation of the former Horticulture and Crop Science departments and also the staff from the former OMAF stations and colleges where diploma programs are offered. There are 45 faculty in the department including 7 breeders, 6 biotechnologists and 10 with expertise in production/agronomy. Graduate training is offered at the M.Sc. and Ph.D. levels in the full range of plant science disciplines. In the University of Guelph diploma programs in plant agriculture are offered at several of their locations. OAC is clearly one of the strongest agricultural education facilities in Canada.

**McGill University:** The Faculty of Agricultural and Environmental Sciences is situated at the Macdonald campus of McGill University, located in Ste. Anne de Bellevue, Quebec. This faculty also offers programs at all levels of education. Two seed related majors exist within the B.Sc.

Agr. program. These are plant science and botanical science. As the names imply the former has a more applied orientation than the latter. The Plant Science Department has a faculty complement of 19, 1 breeder, 4 biotechnologists/geneticists, and 6 agronomy/production specialists. M.Sc. and Ph.D. programs are offered in a range of plant disciplines. With only one breeder on faculty however, they do not have the critical mass to make this an area of strength.

**Laval University:** This University offers Canada's only Francophone agriculture programs at the baccalaureate and postgraduate levels. Seed related programs are offered in the department of Phytology in the Faculty of Agriculture and Food Science. The agronomy specialization in the B.Sc. A. program offers training in the appropriate area. There are 22 faculty members in this department, of which two are geneticists, two are biotechnologists and five are agricultural production specialists. There are no plant breeders per se on the faculty; however, one of the geneticists has relevant training. M.Sc. and Ph.D. degrees are offered in a range of plant related topics.

**Nova Scotia Agricultural College:** This institution is the only one offering agriculture training in the Atlantic provinces. Two relevant undergraduate degree programs are offered B.Sc. Agr. and the B.Tech. The primary specialization in the seed area is plant science. The Environmental Science and the Bio-environmental Systems Management specialties also offer training of some relevance to the seed industry. In the B. Tech. program the applied science, specialty also offers some training of relevance to the seed industry. The Animal and Plant Science Department, also contributes to training programs at the diploma and M.Sc. levels. There are 12 plant oriented faculty members in the department, three biotechnologists/geneticists, one breeder and three production oriented scientists. This institution has recently engaged in a 2+2 program with a Chinese university in which students complete their first two years in China and then the last two at NSAC. This of course has the effect of significantly raising their enrolment and graduating student numbers. Some of these students are staying in Canada and thus contributing to the employment pool.

In addition to these traditional agricultural colleges several other universities offer relevant training. The University of Lethbridge offers a B.Sc. agricultural studies. However, the enrollment in this program is low and its viability is in question. The University of Western Ontario offers a plant science program, which has some seed related content. Simon Fraser University offers a program in plant protection, which is relevant to that aspect of crop production.

## **Diploma**

The website for the Canadian Association of Diploma in Agriculture Programs, lists 15 institutions, across Canada which offer diplomas in agriculture.

From west to east these are:

- in British Columbia, Kwantlen University and the University of Fraser Valley, both of these institutions offer diplomas in horticulture, but not in crops;
- in Alberta, Lakeland College offers a diploma in crop technology and one in general agriculture with a crop concentration, Lethbridge community college offers a diploma in agricultural technology with a plant and soil major, Olds college offers a diploma in agronomy, they no longer offer the diploma in seed technology;
- in Saskatchewan, the University of Saskatchewan offers a diploma in agronomy;
- in Manitoba, Assiniboine community college offers a diploma in agricultural studies with a general agriculture concentration, the University of Manitoba offers diplomas in crop management and general agriculture;
- in Ontario, Kemptville college offers an associate diploma in agriculture, College Alfred offers a diploma in Technologie Agricole, instruction in this program is in French, Ridgetown college offers a diploma in crop production(this was the only program that I could find that listed a course entitled 'Grain grading and seed production');
- in Québec, Macdonald college offers a diploma in farm management and technology, this is a three-year program, Institut de Technologie Agroalimentaire at St Hyacinthe and at La Pocatier offer professional diploma programs in horticulture, but not in field crops;
- in Atlantic Canada, Nova Scotia Agricultural College offers a diploma in plant science.

There are a number of institutions, which do not belong to this organization but which do offer diploma programs in agriculture. From a plant perspective the majority of these programs are horticulture related. A number of these institutions offer certificate programs in specialized areas such as a pesticide applicator certificate or a greenhouse manager certificate.

## **PROGRAM CONTENT**

### **Baccalaureate Programs**

The Agricultural Institute of Canada accreditation program lists the following required outcomes for baccalaureate programs agrology.

- knowledge of natural and social sciences
- knowledge of agricultural sciences
- an understanding of the business of agriculture
- sufficient depth in the area of specialization
- computer literacy
- ability to communicate orally and in writing

- ability to solve problems in a team context
- an appreciation of the arts and humanities
- knowledge of ethical professional behavior.

Knowledge of natural and social sciences, computer literacy, depth in an area of specialization, communication skills and appreciation of the arts and humanities are common to a broad range of natural and social science degree programs. The strengths of the agrology programs are that they, not only include these aspects, but also knowledge of agricultural sciences, in depth specialization in an agricultural science and an understanding of the business of agriculture. These programs also place a great deal of emphasis on problem solving in teams and communication skills appropriate to a range of audiences and an understanding of the requirements of ethical professional behavior. While these strengths can be acquired in other ways it is most efficient to do so during the student's undergraduate training programs. Accreditation reviews of all eight Canadian agriculture faculty programs indicate that high quality graduates are being produced by all. There is a high level of satisfaction with these graduates on the part of employers. Thus the problem is not one of quality; rather it is one of quantity. It is recognized, of course, that no undergraduate degree programs turn out completely job ready graduates. On-the-job training is always required.

In general terms, the program content of B.Sc. Agr. programs, includes basic sciences, agricultural sciences, specialty courses, communications, arts and humanities. Classes in these programs are usually grouped in one of four categories; required core, required specialization core, restricted electives and open electives.

A typical plant program typically looks something like the following:

- required core- chemistry, biology, economics, a social science, mathematics, statistics, introductory agricultural sciences, communications and computers;
- required specialization core- plant morphology, crop production, genetics, plant physiology, cropping systems, research methods and thesis;
- restricted electives- weed science, plant pathology, economic entomology, plant breeding, plant biotechnology, cell biology, biochemistry, crop quality, field crop production, forage crop production, horticultural crop production, advanced botany courses, crop preservation and handling, and courses in the arts and humanities;(It should be noted that plant breeding, biotechnology and biochemistry are optional, especially in agronomy majors as compared to plant science majors. Very few students choose these classes as their electives and thus a double whammy in terms of numbers of students with familiarity with this discipline which is highly relevant to the seed industry.)
- open electives- any course available to the student.

Given the level of options available to students it would be wise to scrutinize the transcripts of job candidates to ensure that the desired skills are in fact present. It would also seem to be

useful to make it known to undergraduate students what knowledge and skills are important the seed industry so that they can select the appropriate electives.

## **Diploma Programs**

These programs of course, tend to be more generic and technical in their focus. Most of them are two years in duration, as compared to four for a B.Sc. Agr. program. In addition to core courses in the sciences, communication and computer skills, typical crop related courses in a diploma program would include; introductory soils and crops, cereal and oilseed production, insect management, weed management, plant disease management, forage and pasture management, special crops and organic crop production.

## **Postgraduate Programs**

While other programs are available comment will only be made on research M.Sc. and Ph.D. programs. Typically M.Sc. programs involve three to five advanced courses beyond the bachelor's level and a significant research project. Depending on the research project this degree takes 18 months to three years to complete unless the student has entered with significant subject matter deficiencies, which have to be made up during the course of the program. Ph.D. programs typically require three to five additional courses beyond the M.Sc. level and a major research project. These programs usually take four to five years to complete although, strictly speaking, the residency requirement for either a M.Sc. or Ph.D. is usually only one year. That means that any coursework requirements can be completed in the residency year and then the research project can be carried out at a site other than the University.

## **ENROLMENT**

Hard data are difficult to obtain. The deans of agriculture and veterinary medicine kept a log of the enrollment data until 2005 but have not done so since. That data provided information on total enrollments in their faculties and needs to be viewed with some caution, because most of them offer degrees in addition to the B.Sc. Agr. and include students in these other degrees in the totals. Statscan is not a useful source of data, because they combine agriculture, natural resources and conservation and there is no way to segregate agriculture from the combined data. Data from the deans shows a drop in overall agriculture graduates from 1400 in the 1990s to just over 900 in 2005. A drop of over 30%. Over two thirds of the students are now female and thus there would appear to be an opportunity to focus on increasing male participation. A number of the students in agriculture are pre-vets and since the majority do not gain entrance to that college they tend to end up as animal science majors. This poses the interesting question as to whether it is better to take an Animal Science major who has good

knowledge of agriculture but no in-depth knowledge of crops or a Botany major from a Science college who has in depth knowledge of plants but no exposure to agriculture? M.Sc. graduates have decreased from approximately 400 to just under 300. Ph.D. graduates have decreased from 150 to less than a hundred. Fifty percent or less of the postgraduate students took their undergraduate degree at a Canadian institution. Most of the foreign students return to their home countries, on completion of their studies. Thus they are not available to the employment pool. Less than 10% of the students have specialized in plant breeding and this number continues to decrease. Recent information indicates that undergraduate enrollments have plateaued and have even begun to increase. These increases however, are not in seed related programs.

Figure 1 Graduates in BSA and Diploma Programs at the University of Saskatchewan 1973-2007

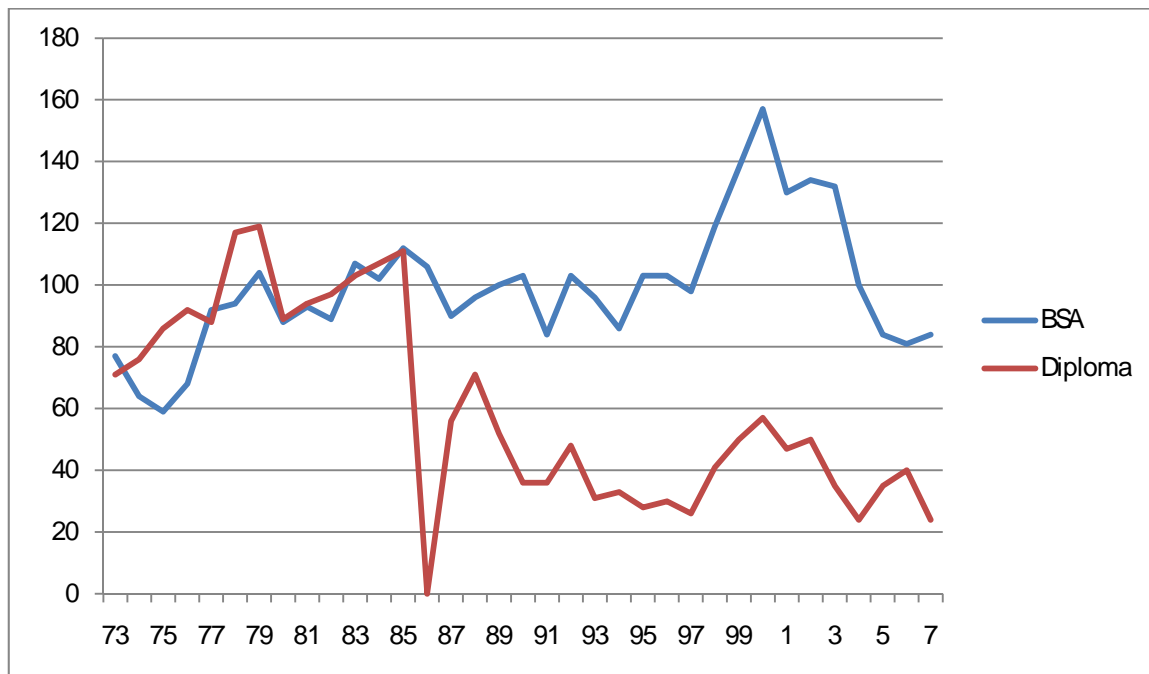


Figure 2 Graduates from Canadian Agriculture Universities. 1998-2005

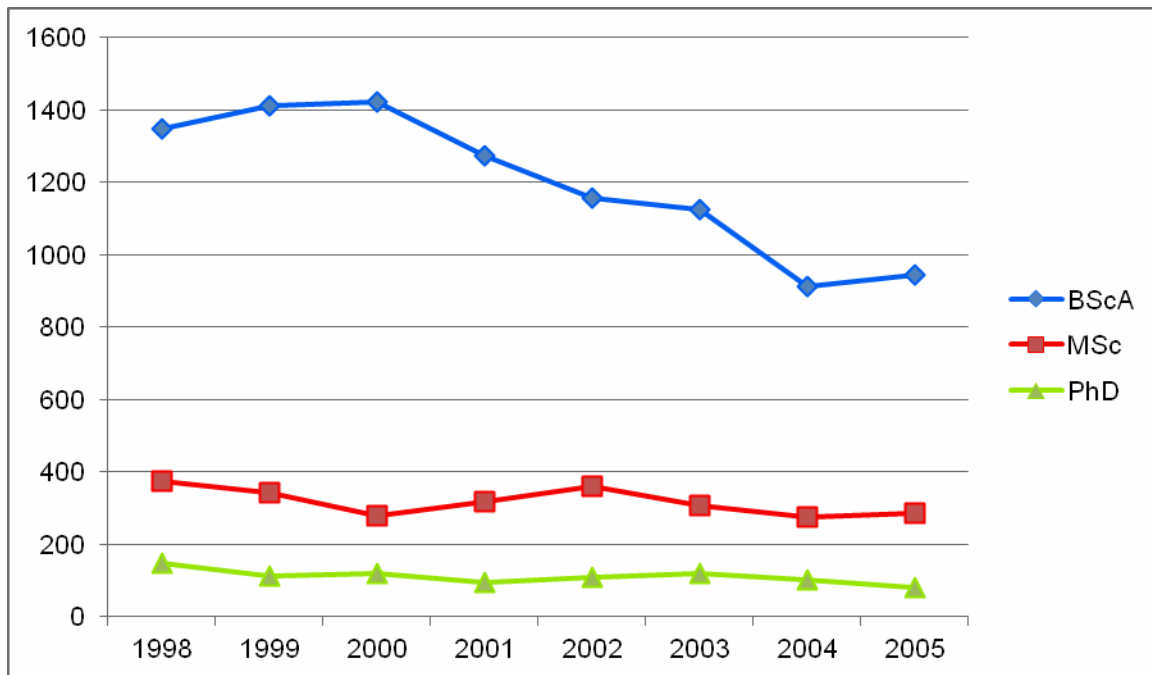
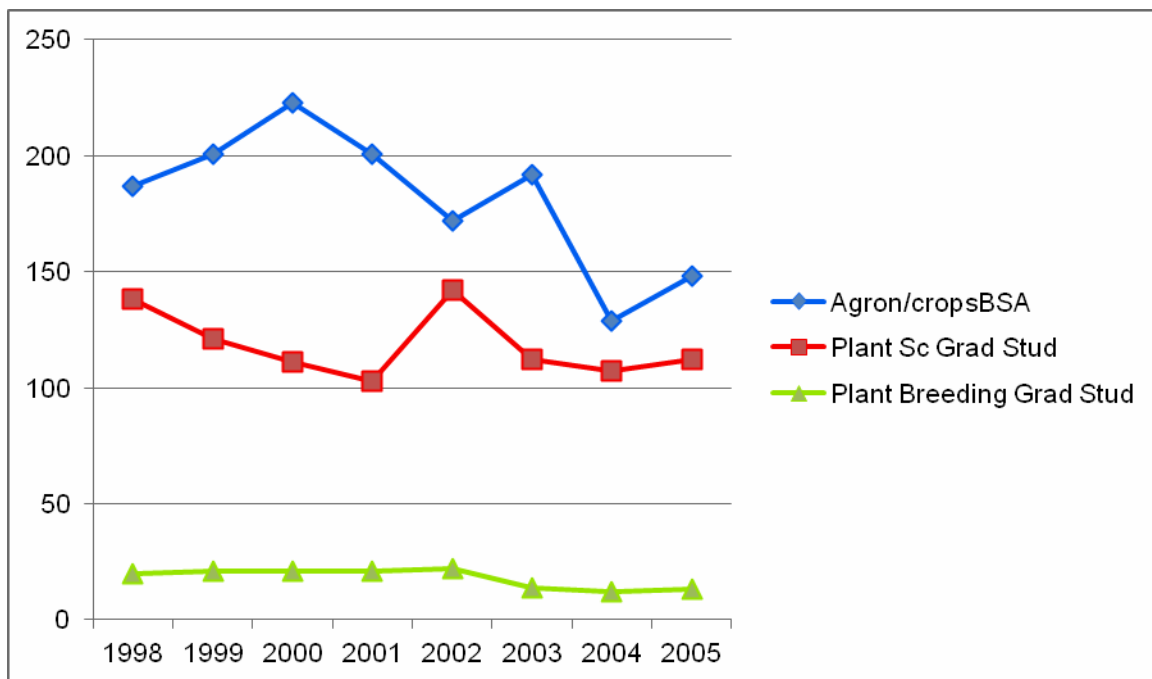


Figure 3 Agronomy and Plant Science Graduates (BScAg, MSc,PhD) 1998-2005



## **Why are enrollments down despite plentiful job opportunities for graduates?**

This is not just a trend which is being seen in Canada since similar trends are evident throughout the developed world. Agriculture continues to suffer from the long standing misconceptions about what is involved in modern agri-food systems. The perception is still there that this just involves on farm production. Farm and rural populations are greatly reduced from the past, due to increased farm sizes and urban migration. In addition, the service sector is now more centralized and tends to operate out of larger more urban centers. These are the traditional recruiting grounds for agriculture programs and thus fewer people on the farm and in small communities mean fewer people of university age, who are likely to be interested in agricultural careers. This is compounded by the aging demographics of the farm population. Many farms these days, especially those who are in startup mode, require off farm income. Many of these individuals find employment in mining, with the oil patch or similar lucrative jobs. These people tend to be reluctant to enter advanced education programs or cannot afford to do so.

Food is taken for granted in today's society; the proportion of income spent on food is the lowest in the history of humankind. Most of the population is urban, and they have little understanding of agriculture or the food production system. Most of what they hear in the press relates to food recalls, environmental harm, negative impacts of pesticides and GMO's, animal abuse and the evils of factory farms and multinational corporations. It is not surprising therefore that agriculture is not seen as an exciting career opportunity for university age students.

## **What can be done about this?**

There are obviously no easy answers to this question, or the universities would have already found them. There is clearly an image problem, which we all have a responsibility in alleviating. Even when we are successful in turning this trend around there is a lag phase and at least a short-term problem due to the expected spike in retirements as the baby boom generation moves out of the active workforce. Short-term solutions include employment of foreign nationals who have the appropriate training. There is however no great excess of such people in the global pool and often we are taking them from employment in underdeveloped countries where they are desperately needed. Additional downsides to this approach include the needs for cultural and language adjustment to the Canadian situation. This can and has been successfully done however. We can employ graduates from other programs and provide them with additional training either in-house or at educational institutions. There are costs associated with this approach. We can also employ displaced workers from other sectors and retrain them. Again, there are costs associated with the retraining required for such an approach. In the long term the best approach is to work with high schools and universities to increase enrollments and thus the graduates from the programs which are of interest to us in the seed industry.

## **What can industry do to assist in increasing enrollments?**

The following are suggestions that the industry may wish to consider. It is recognized that some of these things are already being done.

Industry should work with other sectors in food and agriculture to better the image of our chosen field, especially with urbanites and potential students. This goes beyond just the seed sector and the job to be done is large. Thus all of the players including both public and private sectors should be engaged. This does not happen however unless somebody is willing to take the lead and champion the cause. We have an excellent case to sell; we now have the most secure supply of safe and nutritious food available in the history of humankind. This food is available for the smallest proportion of our disposable income in history despite the fact that a significant proportion of our food is now processed to be “ready to eat” and a large number of meals are eaten in restaurants. This healthy food supply is a significant contributor to the record longevity we experience in our societies today.

It is also important for us to influence Canada's science policy. At the moment it contains little or no agricultural emphasis. Agriculture needs to be one of the pillars of Canada's science and innovation policy, and it is up to us to ensure its presence using political pressure if necessary. This is amazing in a country like ours. Other major countries have not made the same mistake. We need to lobby the appropriate ministers to correct this stupidity. Again this is an industry wide issue that is best done by coordinated effort.

We must provide information on career opportunities, which is sexy and accessible to students. An obvious vehicle is the electronic media; however, students still rely on written materials in guidance counselors' offices. We need to provide materials, which not only indicate the exciting opportunities for a career in the seed industry but also lay out the skills and knowledge, which are required by the industry. This material should be available to high school students so that they can make the right choices of courses to gain them admission to the appropriate University programs. It should also be available to University students so that they can select electives, which are appropriate to industry needs.

Industry can play a more active role in assisting with recruitment of students. We should particularly target high school guidance counselors, who are very influential in guiding student choices. All too many of these people are ignorant of the career opportunities we offer or worse are biased against it. We need to educate them. We should not only provide written materials but we should make ourselves available to talk to students at career days and similar fora. We should of course be sending our youngest and brightest men and women to do this and not the “old boys and girls” despite the brilliance and charm of the latter!!!

In addition to providing information and participation in recruitment opportunities we should also be willing to provide funding to universities to support their recruiting initiatives. Agriculture colleges are aware of the problem and all of them have developed strategies to intensify their recruitment efforts. These cost money to do them properly and thus deserve our support.

We need to provide part-time and full-time employment for students, even more so than in the past. To the extent possible this should be an enriching experience which will attract people to our industry not turn them off. Competitive wages will of course assist the students to carry the considerable costs of their education.

Given that a lot of students these days come from urban backgrounds education programs stress experiential learning. We can assist this by providing experiential learning experiences for students beyond those available on an employment basis.

We must make ourselves available to give guest lectures, not only in crops related classes, but also agricultural business classes as well. This not only gives the chance to make our pitch but also provides us with the opportunity to make contact with students directly and to gain insight as their aspirations and concerns.

We need to allow our enterprises to provide case study materials for students to work with. This provides obvious benefits to students and in doing so provides exposure for our industry. It can also provide benefits to us if we give them problems which young minds can sometime give us novel solutions to.

It is important to meet with Deans and key department heads, face-to-face on at least an annual basis. We need to inform them of our needs and our willingness to assist in recruitment and program delivery. In addition to working with deans it is also important to influence senior university administrators and ensure that they are aware of the importance of agriculture programs to Canada's well-being. This is best done by face to face meetings.

It is important that we be willing to work with faculties to develop special programs for example retraining programs, concentrated short courses and course modules, which can be made available to faculties across the country for use in courses at various levels. The modules produced by Dr. Claude Caldwell and his colleagues are excellent examples of this.

It is important to provide research funding that is targeted to industry needs. This will ensure that faculty scientists are engaged in the area and train graduate students in these same areas. Supporting faculty chairs in seed related disciplines would ensure ongoing focus on those areas. This of course is not cheap.

Targeted scholarships can be an effective tool in achieving objectives. Awards of several thousand dollars for the top three students in a plant breeding course, for example, could be enough to influence a student's choice of electives. In the same vein prizes for competitions can be effective. A prize for the best undergraduate thesis on a seed related topic for example. Prizes for debating clubs when issues relate to issues of interest to the industry are debated.

There are no doubt other things that can be done, the key is to become involved and to apply our creative minds to finding solutions to these issues. If the seed industry does not deal with its own needs nobody is going to do it for us.