Forage Review
Agriculture and Agri-Food Canada
External Panel Review Committee Report

February 6 – 8, 2006

Committee members:

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Introduction

As part of its forage research program review, Agriculture and Agri-Food Canada (AAFC) established an external review panel composed of five members and asked their expert opinion on two questions concerning its forage research programs: "Are things being done right?" and "Are the right things being done?". The five members of the panel met with scientists on February 7, 2006 in Calgary, Alberta. Following this meeting, observations and comments were made and are presented in the following section. On February 8, 2006 the panel met first with the review planning committee and the management directors and after with the management directors alone. Following this review process, recommendations regarding AAFC forage research programs were made and are presented as follows.

General observations, comments and suggestions

The process:

- The whole process was half a day too short. While the external panel would not modify the setting of the presentations on Tuesday February 7th, we would add a formal meeting of the external panel after the presentations as well as a half-day with the group the following morning.
- The full day was appropriate for the panel to get acquainted with the research projects and the researchers. However, the external panel needs a planned meeting after the presentations to gather their thoughts and put in common some ideas to prepare for the following half-day meeting (it was done spontaneously but should have been planned ahead). An added half-day meeting with the researchers would allow the external panel:
    - to understand how the projects are connected together and connected to larger projects outside AAFC forage research (ruminants, GHG, carbon sequestration, etc.
    - to understand where the collaboration is and where it is not, and
    - to get a feeling on how the researchers would react to suggestions from the panel or if the researchers had suggestions of their own.
- The external panel meeting with the management directors could have followed to finish in mid afternoon.

Frequency of reviews:

- While a full review as done with an external panel should not be more frequent than once every 5 years, members of the panel considers that a partial review of the AAFC forage research program should occur more often than every 5 years. Two complementary suggestions are made to solve this apparent contradiction.
- First: While AAFC forage researchers are meeting occasionally for research conferences or administrative work, a formal setting in which a meeting is called to assess how the different research teams are currently meeting their objectives or goals should occur every 2 years. All AAFC forage researchers, their superiors as well as outside AAFC researchers that participate in the research projects should be present.

- Second: With the existence of a continuous or internal review process that includes outside AAFC resources as regular participants, full reviews with an external panel could be further spaced apart and be done every 7 or 8 years.
- For both types of reviews, tools or indicators should be available to evaluate progress towards the program objectives or goals as well as the collaboration within and outside AAFC. Organisations like NSERC have such tools that could be adapted by and for AAFC.

Do we do things right?

- The question of AAFC doing things right was raised. Every member of the external panel received a briefing book and listened to the presentations that took place on February 7th in Calgary.
- Everyone on the panel agreed that, from what we have read and what we have seen, many things are getting done and they are getting done right. Problems are addressed and solutions are sought. The number of publications and other tangible outputs (e.g., germplasm and cultivars) is good and so are the journals in which they are published.

Do we do the right things?

- Many things are done… too many things. In what was presented to the external panel, the scope of what is getting done is too broad. The proportion of research projects associated with short term targets outside well defined mid and long term objectives or goals is too high and there is a lack of general strategic objectives.
- Choices will need to be made on what should be done and on how it should be done.
- One reason that this issue comes up could either be because of a missing “well defined and shared vision” of what should be done or a vision that has not been internalized by the researchers.
- Questions that need to be raised are: “Is it relevant scientific research?” and “Does this problem fall within the AAFC expertise?”.

On a larger scale:

- Canada is a vast country with very different soil and climatic conditions. Research issues in eastern and western Canada are different and should be addressed on this large regional basis as they are linked to different problems (ex.: dairy, cold and winter hardiness of alfalfa in the east, beef cattle, rangeland, and grass/legume productivity in the west). Western Canada should be divided in two regions: the Parkland Region and the Shortgrass Prairie Region. Nevertheless, it should develop a common strategic scientific vision across these two western regions despite their specific problems. What are the common problems?
- While there are 19 researchers involved in AAFC forage research, they are thinly spread all over Canada. With the exception of the forage research group based in Ste. Foy, there is a lack of cohesion between the forage research activities being done. An on-site localisation of forage researchers with expertise from different disciplines appears to be an essential element to favour synergism. However, the panel has no knowledge of the interactions of forage scientists with other programs (mainly animal sciences) and what appeared to us as an isolated researcher could be a significant component of a larger team in a different national program.
- AAFC as an entity, as opposed to an individual researcher basis, does not sufficiently seek outside collaborations.

Major concerns:

- In the near future, a number of researchers are going to retire. While such timing could present opportunities for reorientation of resources, it is obvious to the external panel that the direct replacement of some researchers is an utmost priority.
- Aging of some infrastructure is a concern that will need to be addressed.

Recommendations

A vision:

- **RECOMMENDATION 1.** The first recommendation of the external panel is for AAFC forage research programs to develop a well defined vision of what should be done. This vision should be long term with short, mid and long term objectives or goals.
- This vision needs to take into account
    - the rapidly evolving global world market and policies, as well as the environmental and ecological outputs of grasslands and forages,
    - what is being done in the world and in the U.S.A., in particular,
    - the necessity for the research to be done more specifically or more effectively in Canada,
    - the impact on worldwide science assumed by AAFC as a leader.
- While major orientations should be determined by some competent authorities to insure that they are kept inline with the AAFC mandate and mission, somewhere in the process of determination of research priorities and scientific objectives, researchers need to be involved so they internalize the long term objectives and goals of AAFC forage research.
- Research programs need to be put together in accordance to these objectives and goals. Each research program should be a team effort.

Working towards a vision, an evaluative process:

- While a common vision could be set for the AAFC forage research programs, regular exchanges are needed between the actors to keep in tune their individual actions. An instrument to measure the progress made is needed.

- **RECOMMENDATION 2.** We recommend that forage researchers and administrators formally meet every 2 years as part of an internal review process to evaluate how the set objectives and goals of the AAFC forage research programs are met.
- **RECOMMENDATION 3.** We recommend that AAFC develops or adapts indicators (e.g. NSERC) to evaluate the attainment of its research objectives and goals and that these indicators be used during internal and external reviews.

Breeding:

- While forage plant breeding is a research activity in which AAFC is involved as well as the industry, specific and unique needs related to Canada's soil and climatic conditions as well as the integration of particular traits in well utilised species demand that recurrent selection programs continue, within AAFC, to produce cultivars, as is the current practice. Otherwise, new varieties adapted to the Canadian climate and soil environment or with new traits will not be introduced to producers.
- As forage breeding is kept within AAFC research and since a certain number of cultivars have already been released on the market for utilisation in Canada, "adaptation to the north" cannot be the only driving force or the main focus of forage breeding programs within AAFC. Forage breeding programs within AAFC need to focus either on breeding for a new objective (e.g. cold tolerance in eastern Canada, drought tolerance c.f. Paul Jefferson's work, grazing alfalfa in western Canada…) with the introduction of these traits into new cultivars or on developing novel techniques of plant improvement.
- Forage breeding programs need to be more closely linked to agronomic research teams (physiology, quality, biotechnology) and end users that will participate in the research for new traits and new uses. As we could observe, the best integration of agronomic traits within breeding programs is the one existing in Ste. Foy, where researchers of different expertise are grouped at one site and focused on a common objective.
- As AAFC forage researchers are of limited number and while resources are limited as well, efficient breeding effort would be better served if the breeding work is focussed on a few major forage species used in Canada and on more precise breeding objectives.

- **RECOMMENDATION 4.** The panel recommends a two tiered approach to breeding, in which some major species are continuously being improved with recurrent introduction of superior or novel trait cultivars,

and numerous minor species are selected for only enough time to develop an improved cultivar, or an ecovar.

- **RECOMMENDATION 5.** We recommend that in the east, alfalfa, timothy, and red clover be the species with priority breeding programs. However, birdsfoot trefoil should be seriously considered rather than red clover as a forage of interest in eastern Canada. In the west, the panel did not have all the necessary background to make the decisions, although meadow bromegrass, crested wheatgrass, and alfalfa could be the targets.

- **RECOMMENDATION 6.** We recommend that for minor species (including native species), opportunities should be worked on but the length of time should be definite and short term, so not on a continuous basis as for major species. Ecovars should be treated as minor species and following development by AAFC, ecovars should be released to the industry or an organisation. AAFC should not be involved passed a definite and short term period.

- **RECOMMENDATION 7.** The retirement of Réal Michaud is a concern as it is the key position in the breeding program at Ste. Foy, which needs to continue. Therefore, the panel recommends that this breeding position be refilled, rather before than after his retirement.

Agronomy/Rangeland:

- As presented to the panel, agronomy is a vast field with numerous projects. The agronomic/rangeland scientists are addressing six major issues: stress, nutritive value, environment, biodiversity, new uses and seed production. The last two issues are treated in independent sections below: Seed production and new uses for forages. The other four issues are included here.
- With a stated 11 researchers out of a total of 19 in AAFC forage research programs, a large diversity of projects could have been expected and there was.
- As rangeland concerns could be associated with the same four issues addressed by the agronomy research projects with a stronger emphasis on biodiversity, the recommendations of the present section should be considered valid for rangeland as well.
- As an AAFC forage research vision with stated objectives and goals is defined, research projects will need to be evaluated and choices will need to be made. The question of research outputs needs to be raised and addressed.

- **RECOMMENDATION 8.** Depending on the research programs, we recommend consideration of one or more of three major output areas (important as vision, objectives and goals are adopted by AAFC, other major areas are possible):

    - Involvement with a breeding program; as such, the agronomic research projects are oriented towards the introduction of new traits within major species. Included in this orientation are projects mainly involved with stress like cold tolerance of alfalfa, disease resistance, grazing and with nutritive value like digestibility, protein or energy content. Therefore, the interaction of plant breeding with eco-physiology, plant physiology and agronomy within multidisciplinary approaches has to be supported and developed. More focused interactions with animal sciences should be promoted as well;
    - Agronomic recommendations associated with agricultural production; as such, the outputs will need to reach the right target and this should be done in partnership (see the section: AAFC needs to reach out and be more cooperative *with extension persons or organisations)*. Projects included here are involved with issues of stress like drought tolerance; of nutritive value like grazing/feeding strategies, management for forage quality; and of environment like mineral nutrient efficiency and fertilization management. Here also, interactions with animal sciences are needed;
    - Advancement of forages as a public good; with outputs of interest for the society. Projects are concerned with the issues of environment like carbon sequestration, greenhouse gas emission, Kyoto, efficiency and benefits of pasture in rangeland and of biodiversity like native grass productivity, restoration, conservation and the evolution of biodiversity with usage. More

collaborative programs with ecology, soil sciences and environmental sciences should be encouraged.

- **RECOMMENDATION 9.** Considering the numerous research projects in agronomy and considering that resources are limited, we recommend that choices be made on the continuation or not of research projects based on their expected output as they correspond to the vision, objectives and goals of AAFC forage research programs.

Seed production:

- Challenges associated with seed production as they have been met by AAFC in the last few years are more of agronomic and technical concerns than of scientific research intent. As the actual work being done is closer to extension, provincial involvement with this commodity is more important than with the other concerns linked to forage. As well, the industry is currently collecting a check-off that they could use to finance projects linked to their specific needs for knowledge.
- In parallel to these concerns, the major part of the forage seed produced in Canada is of common seeds. While the interest for common seed production is great for the industry, the involvement of AAFC should be limited to provide pedigreed seeds.
- While forage seed production requires specific and adapted production techniques, certain techniques from Europe or the U.S.A. which are major players in forage seed production, could be tested to answer specific problems.
- A good integration of an AAFC seed resource within an agronomical research team could help target and answer temporary research needs without the necessity of this resource being a full time researcher.

- **RECOMMENDATION 10.** Considering the needs of the industry and the importance of the sector, the involvement of provincial resources and the industry check-off on seed sales and considering that most problems are of agronomical or technical concerns instead of a scientific research level, we recommend that the research position be replaced by an agronomist or a biologist position, most likely at the M.Sc. level of education, and that this person could rely on the help of forage or cereal grain researchers when specific targeted research needs are brought forth.

Saline soils:

- While we understand that crop production on saline soils is a concern, the adaptation of crop plants to salt is very complex. While light soil salinity could be observed in some areas of western Canada, increasing levels of soil salinity are observed mainly in irrigated fields and these irrigated surfaces are limited in total area. The challenge facing water utilisation, such as urbanisation versus irrigation, could further limit the expansion of irrigated areas.
- To be efficient and have an impact, research teams have to be maintained and large amounts of resources need to be invested on a long term basis because research on this topic is very competitive at worldwide level. Australia has taken that path and plays a leading role in developing crops and understanding how crop plants react to saline soils. Southern states of the U.S.A. have research teams working on saline soils as they relate to irrigation.

- **RECOMMENDATION 11.** Considering the resources that would need to be invested in this research area to have an impact on crop production in Canada or on scientific knowledge worldwide, we recommend that AAFC should phase out its involvement in forage research on saline soils.

New possibilities:

- While resources are few and mid and long term goals need to be well defined, individual researchers or research teams need to have the opportunity of participating or initiating new or promising research projects.
- These projects could be a reply to concerns from the industry, other government agencies or socio-economical urgencies; they could be for a temporary inclusion in university or agency research projects; they could be based on new scientific discovery.

- As such, these research projects would have a definite life span, three or at the most five years, after which they will be ceased or they would have to be integrated into existing programs.
- Such promising research projects should be few at any given time and not constitute the majority of the work that is being done if not by a researcher at least by a research team.

- **RECOMMENDATION 12.** Considering the importance of free minded research in science discovery, and that a researcher needs to have sufficient freedom to practice curiosity driven research, we recommend that new possibilities should be practical oriented to be undertaken by AAFC researchers, but, some guidelines need to be set.

New uses for forages, e.g. bio-fuels:

- New uses should be treated as new possibilities, with openness but with definite time frames and set deadlines.
- Green engineering is probably an important scope for the future, but research on this topic necessitates a specific program with well identified goals. Even if some forage species are identified as promising targets for industrial development, it does not imply that an AAFC forage research program is in the best position to develop this research.
- Because new uses require more often than not the adaptation, modification or creation of technologies that forage researchers do not control, early on the economics as well as the timetable for competent partnership involvement should be required. The impact on farmland areas should also be stated.
- Specifically on bio-fuel forage work, the technical, industrial and economical challenges of producing fuel from forages are, in any foreseen future, far greater than the production of forage biomass for such an industry. Furthermore when forages will be needed, agronomical questions or problems will precede any research development. The economics as related to any research work involved with forage for bio-fuel needs to be determined before the work is started.
- Specifically on the production of forages for medicinal purposes, the extraction and purification of medical molecules, as well as the medical trials that would be eventually needed before approval by the market are major burdens that cannot be supported by AAFC forage researchers. While one should question the farmland areas required to produce what is needed (often a very small acreage), the timeframe for the involvement of extraction and pharmaceutical companies should be set at the beginning of any projects and their financial involvement should begin within a set limit of time (five years) with a major share of the financial burden soon thereafter.

- **RECOMMENDATION 13.** Considering that new uses could be defined as new possibilities with constraints of including outside AAFC expertise before a forage product could be utilised, we recommend that research projects involving new uses be possible as long as they meet the new possibilities guidelines and that the economics and a timetable for competent partnership involvement criteria are met.

Forage research as an entity:

- While forages have traditionally been produced and fed to ruminants, their uses for environmental purposes are rapidly increasing worldwide as well as in Canada. As such, forage researchers as a whole in AAFC, as compared to on an individual or even a team basis, will have to consider a range of environmental as well as nutritional impacts.

- **RECOMMENDATION 14.** As animal production would be the main target of a finalised project, we recommend that ruminant (beef, dairy, sheep…) researchers be involved earlier in the orientation of AAFC forage research projects.

- **RECOMMENDATION 15.** As the environmental aspects (GHG, carbon sequestration, ecology…) of forage utilisation could be the general target of a project, we recommend that researchers in this area be involved early in the orientation of the AAFC forage research projects.

- **RECOMMENDATION 16.** As grasslands and forage could play an important role in maintaining or enhancing biodiversity and wildlife in some large territories, we recommend that researchers in ecology play a role in setting the orientations of grassland and forage research projects.

Groups/Teams:

- As far as groups are concerned, the eastern AAFC forage research team of Ste. Foy has demonstrated the strength of having researchers grouped at one site to produce better science by developing multidisciplinary interactions. Such groups do not exist in western Canada as researchers are located at many different sites. Research projects are not as interdisciplinary in the west as they are in the east.
- Research problems are very different between eastern and western Canada and they merit their specific solutions. While this does not rule out collaborative work across Canada on a disciplinary basis, it should not overshadow AAFC long term vision.
- While the forage primary problems are similar across eastern Canada, the challenge associated with forages in western Canada seems be focused on two different regions: the Parkland and Shortgrass Prairie.
- Research on rangeland will benefit from the creation of a closer knit team, as some focus is needed to determine the research aspects to be examined. A priority would be to get ecologists from other agencies or universities on board.

- **RECOMMENDATION 17.** Considering that there are three largely defined forage research zones in Canada, two in the west and one in the east and considering the synergy of larger forage researcher groups with complementary expertise, we recommend to regroup as much as possible forage researchers around three sites: the existing one in Ste. Foy, one in the Parkland region and one in the Shortgrass Prairie region.

Who is missing or needed?

- While there is a significant amount of knowledge regarding the agronomical aspects of forage production, e.g. its quality and persistence, and that this information is linked to a defined research output, i.e., namely the breeding program in Ste. Foy, there is a need for a better integration of the available knowledge.
- Considering the needs for integration based on a farm system that includes soil, plant and animal knowledge, a researcher is needed to put to good use the knowledge that already exists, to analyze the situation and determine what new information is needed, and to actively and continuously participate in the orientation and the experimentation of the projects done by a forage research team.

- **RECOMMENDATION 18.** We recommend that AAFC hire a researcher who can integrate the knowledge, as it relates to forages, analyse the existing data, orient and participate in the experimentations. A scientist with some modelling expertise of complex systems could fill such a position as long as this research is oriented towards system evaluation and problem solving on an agronomical level. Such a researcher needs to be in continuous contact with a forage research team. As such a team presently exists in Ste. Foy, we suggest that this individual be stationed in Ste. Foy. Collaboration could be established with the Department of Animal and Poultry Science at the University of Guelph who is developing an expertise in modelling on farm animals.

AAFC needs to reach out and be more cooperative:

- According to the vision developed and the scientific programs established, AAFC needs to develop or institutionalize a collaborative strategy in Canada and internationally. As such AAFC should work in association with similar agencies in the U.S.A., other ministries in Canada and Canadian universities. Common or complementary projects could be developed. Scientist exchanges or laboratory training to learn new techniques could be organized.

With the U.S.A.

- Because eco-zones stretch from within Canada to the U.S.A., some problems and issues concerning forage research and production are similar and a more formal collaboration would be beneficial to both countries.
- While there is individual researcher collaboration between AAFC and the USDA, there is no formal exchange between the two organisations. Similarly, U.S.A. researchers meet annually within their commodity and expertise area, for example NE1010 for forage breeding, and AAFC forage researchers should be encouraged to actively participate in these meetings.
- While such participation could encourage collaborative research work between the U.S.A. and Canada, it should be viewed as an inexpensive opportunity for AAFC to share knowledge with the much larger U.S. scientific community.

- **RECOMMENDATION 19.** We recommend that AAFC formalize its collaboration with the USDA most likely in all areas of interest for AAFC but at the minimum as far as forage research is concerned. Also a regular participation from AAFC forage researchers to recognize groups such as the NE1010 should be encouraged.

With other Canadian agencies, ministries, universities

- While the number of forage researchers in AAFC is limited, research projects are becoming more and more complex with the needs for different yet complementary expertise.

- **RECOMMENDATION 20.** It should not be expected from AAFC to have, in-house, all the expertise it needs to realize its research projects. We recommend that the involvement of researchers such as ecologists, economists and sociologists, be sought for some projects. Origins of these researchers could vary from other ministries, government agencies and universities.

With forage researchers in universities

- For many different reasons, AAFC has been and will stay the backbone of forage research in Canada. Forage researchers are few outside AAFC and even fewer in Canadian universities. Participation of university forage professors in the AAFC structure could be encouraged uniformly across Canada.
- While summer students can fit within a category in the AAFC system, the integration of specific graduate students (and maybe postdoctoral candidates as well) stays problematic.

- **RECOMMENDATION 21.** As AAFC will need to hire forage researchers in a foreseeable future and as the formation of graduate students is a significant research output for society, we recommend that AAFC find a way to better integrate graduate students in its structure as well as facilitate the participation of university forage professors in its forage research projects. (As AAFC researchers become affiliated professors in universities, shouldn't we have professors that become affiliated AAFC researchers?)

With extension persons or organisations

- While it is not the mandate of AAFC to do extension work in agriculture, AAFC needs to make sure that its research results get out and that it gets the credit for the work. In today's society, it is even more essential.

- **RECOMMENDATION 22.** We recommend that AAFC establishes formal links and work in collaboration with organisations like the Canadian Cattlemen's Association, Dairy Farmers of Canada or their corresponding provincial groups to promote its research results to Canadian producers.

- **RECOMMENDATION 23.** We also recommend that AAFC develop metrics to be able to measure its progress in disseminating information and in having that information (or its products) be used on farm, in the industry or by the consumer.

Conclusion

The recommendations and this report are submitted to AAFC management directors. As they would see fit, this report could be made available to the researchers that participated in the review. As a final note, some global concerns associated with forages are addressed in the announced context of the preparation of a business plan by AAFC research branch.

While forages occupy a vast agricultural land area in Canada, forage is not an agricultural commodity like corn, soybean or cereal grains. With the exception of a small proportion of the forage produced in Canada directed towards the dehydration industry or the double compressed hay for export, forages are essentially used on farm for meat and milk production. As such, there is no major forage commercial partner or voice (federation, association, commission) that could represent the industry and get financially involved in forage research and development. At the same time, forages are rapidly becoming a public good. Forages and grasslands offer environmental and ecological outputs that are of increasing interest for the society.

As AAFC research programs exist to support the Canadian agricultural industry, AAFC public appraisal will increasingly be through an improved capacity to answer the people's expectations in terms of environmental issues. As the AAFC research branch is planning to put together a business plan, the status of forages as a commodity put it at odds with other commodities: no commercial voice proportional to its weight in Canadian agricultural production (more than 50% of beef cattle and dairy feed, the largest crop areas in the country) and an undetermined value for its environmental services. While many agricultural producers in Canada may ask to be granted a special status in regards to the proposed AAFC research branch business plan, oddly enough forage, as a commodity, has to rely on the AAFC research branch for its promotion since there is no other voice, commercial or public. One of the challenges of forage research remains its dependency on policies that reward research that attracts grant money.

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