



**ALBERTA BEEF,  
FORAGE & GRAZING  
CENTRE**

## **2019 Annual Report**



## Executive Summary

The Alberta Beef Forage and Grazing Centre (ABFGC or the Centre) has garnered a large amount of industry support, as well as engagement from key stakeholders including federal and provincial governments, academic institutions and applied research associations. While challenges remain on how best to integrate activities taking place outside of the main hub at the Lacombe Research and Development Centre under the umbrella of the ABFGC, many of these activities are captured through current collaborations by research scientists or funding awarded by the three signatory organizations.

The Centre participates in a number of key research and knowledge translation and transfer (KTT) activities, has an engaged industry advisory board and management committee, and strong commitment from all stakeholders. However, the overarching Agreement supporting the Centre expired in March 2020 and has yet to be renewed. Complicating the Agreement renewal and impacting the activities of the Centre was the loss of several key Alberta Agriculture extension specialists associated with the Centre earlier this year.

The projects led by, or with participation from, the Centre's core personnel group are quite impactful. For example, projects contributing to improved efficiency and reduced environmental impact attracted over \$2.64 million in cash funding, while leveraging over \$5.82 million. In 2019, 63 research and extension projects supported the Strategic Goals of the Centre. The development of new KTT resources under the Centre's branding, in partnership with the Beef Cattle Research Council, has also helped to expand general awareness of the Centre.

Several of the projects outlined in this report confer significant linkages to each other. For example, barley breeding efforts result in new varieties that are utilized in backgrounding or swath grazing trials. Grazing management and agronomy trials will impact the environmental component of feed efficiency as well as the environmental footprint of the cowherd and feeding costs. Improved forage quality reduces cost of gain, while concurrently reducing greenhouse gas emissions. Improved knowledge regarding how management practices and environmental conditions impact genetic potential directly leads to better selection decisions and forage management strategies to ensure cattle are suited to their environment and production system.

It is important that the activities of the Centre reflect the strategic plan and goal development, recognizing the long-term nature of those goals. Granted, it can be difficult to assess progress against goals with a substantial time horizon (in this case 15-20 years), however; the research and KTT activities both in progress and completed demonstrate the commitment of personnel and organizations involved with the Centre towards achieving those long-term goals.

The Centre has six strategic, long-term goals as follows:

1. Reduce winter feeding costs by 50%

- Supported by thirteen research and extension projects, investigations into variety development, variety evaluation, higher energy forages, and grain processing will assist in decreasing winter-feeding costs for producers. Success stories include the evaluation of new feed and forage annual crop varieties in terms of estimated profitable gain for swathgrazing or backgrounding at an earlier point in the breeding process, and the generation of scientific data on the performance of hybrid rye. In addition, several new high-performing varieties of two and six row barley, and triticale were commercialized.
2. Reduce the environmental footprint of the cowherd by 15%
    - Supported by thirteen research and extension projects, determining the factors related to decreased methane production and improving nutrient management practices will help beef producers decrease their environmental footprint. In addition, a better understanding of carbon sequestration, water use efficiency, and biodiversity will also contribute to a reduced environmental footprint. Lifecycle greenhouse gas assessment quantified the reduction in the carbon intensity of beef production from maintaining high hybrid vigour in the cowherd as determined by genomic retained heterozygosity. Total GHG reductions from increasing hybrid vigour was 639 kg/CO<sub>2</sub>e/youthful animal slaughtered, which would be worth \$19, assuming \$30/t CO<sub>2</sub>e.
  3. Improve cow efficiency by 15%
    - Supported by ten research and extension projects, elucidating the factors contributing to differences between animals in feed efficiency, the interactions between feed efficiency and feed stuffs, as well as ways to improve the feed efficiency of the mature cow herd will not only improve producers' bottom lines, but also contribute to reducing the environmental footprint of beef production. Success stories include: an investigation by fourth-year students at UCVM demonstrated that the odds of calves with low hybrid vigour getting sick or dying were 2.45 times higher than calves with high hybrid vigour. In addition, selection indices (Feeder Profit \$ Index and Replacement Heifer \$ index) are being refined and validated to help producers utilize genomic data for herd improvement.
  4. Reduce backgrounding costs by 50%
    - Supported by seventeen research and extension projects, incorporation of new or better adapted forage varieties, higher energy feedstuffs, interaction between feed quality and feeding management, and better grazing management will improve the performance of backgrounded cattle while decreasing costs. Updated economic analyses compared AgriProfit\$, Manitoba Cost of Production, ABFGC benchmarks, and silage trial economic assessments (for modelled silage only and actual silage diets). The actual (with supplement) triticale and barley diets were 15 and 25% lower than the ABFGC benchmarks (after adjusting the benchmark for cost of feed inflation) and the only assessment lower was the 2004 AgriProfit\$ (based on prices in 2004). When these assessments were extended to profit per steer basis, the actual triticale diet was essentially a breakeven, and the actual barley diet was the only one that resulted in a positive return (after labour).
  5. Improve late summer/fall pasture productivity by 30%

- Supported by twelve research and extension projects, developing forage varieties and management practices to mitigate the decline in forage yield and quality in late summer and fall will reduce overall cost of production and help to ensure the nutritional requirements of cows are met year-round. Success stories include the development of alfalfa populations with reduced fall dormancy that are still winter hardy, variety testing work to demonstrate variety adaptation to the various soil zones and eco-regions within Alberta, and quantifying the benefits of introducing bloat free legumes into existing stands - the cost of sod-seeding was recovered after three years at Lanigan when the return was estimated as dry matter yield valued at the three-year average price for standing hay (\$0.046/kg).
6. Build and maintain research and extension capacity
- Supported by all of the activities and projects of the Centre, this key goal underpins all of the other goals. Without adequate research and extension capacity, this entire initiative, the strategic goals, and the progress made to date is lost, and unlikely to be recovered.
  - The expansion of the Rancher Researcher pilot led by the applied research associations has been met with enthusiasm. The larger KTT project has already developed two decision making tools to assist producers in critical analysis of feed test results and to price feed based on quality that are available on [beefresearch.ca](http://beefresearch.ca). The KTT project has also been instrumental in preserving the knowledge that was available on [foragebeef.ca](http://foragebeef.ca). Forage-U Pick was also released on June 8, 2020. The extension efforts of the Centre have contributed to the coordination of extension initiatives within the province among multiple organizations, reducing duplication and maximizing resources while increasing impact and improving audience reach.
  - Key capacity has been lost. Arguably, the Centre had little control or ability to impact these capacity reductions, but it is necessary to recognize that increased funding does not offset capacity losses and can result in a situation where not enough physical capacity exists to undertake activities, even if funding is plentiful.

## Background

The concept for the Alberta Beef, Forage and Grazing Centre arose from concerns expressed to the Alberta Minister of Agriculture and Rural Development by individual beef producers and forage/beef interest groups about a lack of essential applied forage research and extension available to beef producers in Alberta. A research-extension group called the Western Forage Beef Group had operated as a federal-provincial organization out of the Lacombe Research Station, from 1995 to 2005, and had a focused approach to these issues. The concerns and inquiries expressed the necessity for a similar group to address current industry issues. Subsequently, focus groups were organized and carried out by a third party, which confirmed the interest and the need for a renewed research and extension effort in the forage-beef area. This led to the formation of a steering committee in the summer of 2011, with representatives from ARD, AAFC, University of Alberta (U of A), Alberta Beef Producers (ABP), Beef Cattle Research Council (BCRC), Agricultural Research and Extension Council of Alberta (ARECA),

Alberta Forage Industry Network (AFIN) and the Canadian Forage and Grasslands Association (CFGAs). Support for the concept was recognized throughout all levels of industry and government.

In April of 2015, The Alberta Beef, Forage and Grazing Centre became a reality, with a tripartite agreement between Alberta Beef Producers (ABP), Agriculture and Agri-Food Canada (AAFC), and Alberta Agriculture and Forestry (AF). It has the mission of developing and transferring knowledge, innovative processes and tools to improve the forage/beef industry.

The Centre utilizes existing AAFC and AF facilities and staff, with a small cash infusion from ABP to assist with core funding and KTT initiatives.

## General Centre Activities

- Industry Advisory Committee membership currently consists of:
  - Arno Doerksen, Gem, AB (cow/calf; finishing)
  - Sean McGrath, Vermilion, AB (cow/calf)
  - Ron Buchanan, Fort St. John, BC (cow/calf)
  - Matthew Gould, Consort, AB (cow/calf, backgrounding, finishing)
  - Stacey Meunier, Barrhead, AB (cow/calf, custom grazing)
  - Jill Burkhardt, Gwynne, AB (Alberta Beef Producers representative)
  - Christine Fulkerth, Olds, AB (Alberta Forage Industry Network representative)
  - Ken Ziegler, Rocky Mountain House, AB (Agricultural Research and Extension Council of Alberta representative)
- The fourth annual meeting of the Centre was held on February 5, 2020 in Lacombe, with attendance from the Management Committee, the Research and Extension Advisory Committee, the Industry Advisory Committee, Applied Research Association managers and was also open to a general producer audience. Approximately 40 people were in attendance. The agenda was designed to present research and extension highlights for each goal, and presentations were followed by an open discussion to capture producer perspectives on priority research and extension activities that would provide future direction for each goal.

## Extension (KTT) Activities

- **“Advancing knowledge translation and transfer to support sustainable livestock and forage production systems.” (PI: Alberta Beef Producers, supported by Susan Markus, Darren Bruhjell (AAFC), Dianne Westerlund (CARA), Field Crop Development Centre, and others; in progress**
  - Activities to date are broken out by project theme.
  - **Managing grazing under average and extreme conditions:** Work is well underway in collecting, categorizing, and organizing existing information for the main activity under this theme, dubbed “Pasture School 2.0.” Pasture School 2.0 will be a primarily online

resource designed to be an abbreviated version of comprehensive hard copy pasture school binders. Module development is well underway, and this information will be incorporated as part of the BCRC site, [www.beefresearch.ca](http://www.beefresearch.ca)

- Work continues on module development
- **Species Selection for regional adaptation:** We applied for and were successful in obtaining additional funding for this theme from the Beef Cattle Research Council, as well as the BC Ministry of Agriculture. We will be utilizing the tool developed by the Saskatchewan Forage Council about 12 years ago and updating it to reflect all of the soil zones/eco-regions in western Canada. Called Forage U-Pick, this tool is in the final stages of development and was released June 8, 2020. It allows the user to select their province, appropriate soil zone or eco-region, field characteristics and then displays the perennial forages most suitable given the data entered by the user. Each forage is pictured and contains more detailed information that can be accessed by clicking on the species name or picture. A seeding rate calculator is also included, along with information on common weeds and control measures. Forage researchers, specialists and agronomists from across western Canada contributed time and expertise to generate the information contained within Forage U-Pick. Forage U-Pick is hosted on [beefresearch.ca](http://beefresearch.ca) and likely mirrored on the Saskatchewan Forage Council's website as well.
- Forage U-Pick was highlighted at the National Technology Transfer Network meeting in March 2020, in an article in Alberta Farmer Express, and in a March BCRC webinar.
- **Critical elements of animal nutrition and feed quality:** Two tools have been developed and are available at <http://www.beefresearch.ca/research/feed-value-estimator.cfm>.
- One tool looks at buying feed on a cost per nutrient basis, by using crude protein and total digestible nutrient values and comparing them to reference feeds. This comparison allows you to determine whether purchasing feed is a good deal or not in terms of feed quality and how well that particular feed will meet animal nutrient requirements, instead of simply buying feed by the ton, bale, or bushel.
- The other tool uses well established nutritional rules of thumb to “flag” any major nutritional deficiencies in a single feed. Users can choose their class of cattle (backgrounders (with an approximate rate of gain associated with it), heifers or mature cows at early, mid, late gestation or lactating, or mature bulls), enter their own feed test results and the tool uses colour coding to tell approximately how well that feed meets the nutritional requirements of that class of cattle at certain stages of production.
- Since the launch of these tools on May 29, 2019, the feed testing page that hosts the tools has received 5317 total views, 4262 unique views and users spent an average of 4:16 (m:s) on the page.
- **Rancher Researcher Pilot Expansion:** Templates for delivery of the program by the applied research associations were created and circulated. Interviews with producer participants identified by the applied research associations are underway.

- **Review of Foragebeef.ca:** The content review of foragebeef.ca and integration of relevant material into beefresearch.ca is well underway. New live topic pages incorporating information from foragebeef.ca are as follows:
- Grazing Management (live on February 4, 2019) <http://www.beefresearch.ca/research-topic.cfm/grazing-management-48>. Analytics (April 15, 2019-March 27, 2020): 3737 total hits, 3330 unique hits, 4:52 (m:s) time on page
- Stored Forages (live on April 4, 2019) <http://www.beefresearch.ca/research-topic.cfm/stored-forages-87>. Analytics (April 15, 2019-March 27, 2020): 1306 total hits, 1197 unique hits, 4:01 (m:s) time on page
- Drought Management Strategies (live on May 7, 2019) <http://www.beefresearch.ca/research-topic.cfm/drought-management-strategies-96>. Analytics (April 15, 2019-March 27, 2020): 1054 total hits, 881 unique hits, 4:15 (m:s) time on page
- Rangeland and Riparian Health (live on May 24, 2019) <http://www.beefresearch.ca/research-topic.cfm/rangeland-and-riparian-health-82>. Analytics (April 15, 2019-March 27, 2020): 805 total hits, 664 unique hits, 4:27 (m:s) time on page
- Rejuvenation of Hay and Pasture (live on June 18, 2019) <http://www.beefresearch.ca/research-topic.cfm/rejuvenation-of-hay-and-pasture-98>. Analytics (April 15, 2019-March 27, 2020): 1614 total hits, 1404 unique hits, 4:52 (m:s) time on page
- Extended Grazing (live on August 1, 2019) <http://www.beefresearch.ca/research-topic.cfm/extended-grazing-45>. Analytics (April 15, 2019-March 27, 2020): 2245 total hits, 1960 unique hits, 4:15 (m:s) time on page
- Forage Establishment (live on November 19, 2019) <http://www.beefresearch.ca/research-topic.cfm/forage-establishment-99>. Analytics (April 15, 2019-March 27, 2020): 411 total hits, 354 unique hits, 3:38 (m:s) time on page
- Alternative Feeds (live on January 28, 2020) <http://www.beefresearch.ca/research-topic.cfm/alternative-feeds-100>. Analytics (April 15, 2019-March 27, 2020): 409 total hits, 354 unique hits, 3:54 (m:s) time on page
- Topics under development which will be posted in the coming months include: Water Systems, Forage Species (to coincide with the release of Forage U-Pick), Beef Cattle Nutrition, Weed & Brush Control, Manure & Nutrient Management, and Forest Grazing/Silvopasture.
- The feed testing tools in particular have experienced a lot of attention, with more workshops hosted by applied research associations in the fall/winter of 2019 (~78 attendees), a BCRC webinar (<http://www.beefresearch.ca/resources/webinars/webinar-detail.cfm?id=49>) to 107 live attendees (142 more viewed the recording), and Alberta Agriculture's Cows 'n' Chaos webinar series (63 recorded views), articles in Canadian Cattlemen and Alberta Farmer Express, and featured in a live interview on Global News in both Edmonton and Calgary. Forage U-pick was featured at the 2020 National Tech Transfer meeting on March 26, 2020 (~70 attendees), and a BCRC webinar on March 25,

2020 (<http://www.beefresearch.ca/resources/webinars/webinar-detail.cfm?id=59>) with 62 live attendees and 19 recorded views thus far. The project as a whole was also presented at the ABFGC annual meeting on February 5, 2020 to approximately 35 attendees, in a written update to the Grey Wooded Forage Association newsletter, and the Alberta Forage Industry Network AGM on March 10, 2020 to about 40 attendees.

- **“The Rancher Researcher Pilot.” (PI: Alberta Beef Producers, supported by Susan Markus, Darren Bruhjell (AAFC), Dianne Westerlund (CARA); Kristine Dahl (Consultant)); completed 2019**
  - All innovations have been implemented on farm. Three operations have utilized drone technology to increase efficiency of checking cattle, fencelines and water sources. Three operations utilized parentage testing and/or Envigour HX (hybrid vigour analysis) on their 2018 calf crop. Two operations rejuvenated pastures via reseeding. Three operations implemented software to improve recordkeeping and management. One of these focused on pasture management (Pasture Map), while the other programs (HerdTrax and ITS global) are enterprise based systems. One operation implemented a new Bluetooth enabled scale and chute system to enhance animal processing and recordkeeping efficiency. Water developments have been completed on one operation. Two-stage weaning with nose flaps was utilized during weaning on one operation as well.
  - Soil tests and forage analyses were completed on many of the participating operations, and results are presented below. In addition, six of the eight participants underwent an economic analysis of their operation through AgriProfit\$.
  - Farm performance benchmarks (e.g. GOLD indicators) along with AgriProfit\$ data and soil/forage analyses are presented as addenda to this report on an anonymous basis. Case studies have been prepared for each innovation, and also include an expert analysis of the benefits, or potential reasons why a particular innovation did not provide the expected results. This is especially relevant for one of the pasture rejuvenation innovations which did not return expected results due to inappropriate species selection and poor growing conditions. This highlights the extension need to work carefully with producers when they are adapting innovations for adoption on farm and ensuring that they are aware of all the benefits and pitfalls that may be expected. This need is being addressed through the extension of the pilot, partially funded by IMD Project #2017L054D, which is creating templates for this type of extension model for use by other industry and government organizations to promote the adoption of best management practices and new technologies that have the best return on investment and are the most necessary for a particular operation.
  - Generally speaking, analysis of the GOLD indicators indicated that while the producers in the pilot had longer overall calving season length than what is recommended, they also had an average of 65% of their cows calving in the first two cycles. Despite this, it was noted that areas for improvement include improved calf growth rate in some situations and reducing open rates. This is borne out from wider industry data such as the Western

- Canadian Cow Calf Surveys in 2014 and 2017 (and the AB Cow-Calf Surveys in the '90s) that have demonstrated a relatively flat trend in conception rates in the beef industry.
- The addition of an on-farm private consultation with an expert in farm business management proved to be a popular component of the pilot to explain AgriProfit\$ results. The pilot provided this as a service, but the feedback indicated that most producers would seek this aspect out at their own cost if a service like this was consistently available, as they saw significant benefits from the one on one conversations about their operations. Producers valued a support team to interpret their data in order to assist with decision making. This benefit of a “support structure” for data interpretation was echoed in the report “Ranch Size in Relation to Innovation Adoption” undertaken by Olds College students in 2019. A copy of this report is also included as an attachment with this report. This aspect will be incorporated into subsequent activities as part of the expansion.
  - Case studies (attached) have been created for each of the innovations pursued by producers. Due to the wide variety of innovations undertaken by the pilot producers, the project team felt a “testimonial” or “case study” approach would best communicate quickly the lessons learned from these pilot producers. A series of 10 unique case study slide decks have been created to highlight the different innovations pursued by the pilot participants. These slides will be included on the ABFGC website, used in presentations, made available to ABFGC partners and will be included in multiple communications activities.
  - The innovation case studies were grouped together based on commonalities, with the personal experience of the producer being the main focus. To provide balance to the producer insights, a researcher or industry expert slide was developed for each group of innovations. For example: five ranches chose to have a soil health analysis completed on areas of their operations; therefore, these five are grouped together as one innovation slide deck, where each producer provides comments regarding their experiences with the innovation and the impact they perceive it to have had on their operation. In this example, the expert testimonial was made by a soil scientist who provided some guidance on the technical aspects of proper soil sampling.
  - One of the pilot ranches was featured as part of the ABFGC summer tour in August 2019, with approximately 40 attendees. Industry, researchers, extension personnel and other stakeholders toured the rancher’s water developments and listened to his experience with implementing those innovations on his operation. There was a discussion regarding the value of this type of extension model, with generally positive feedback.
  - A six-part series of beef/forage issues was published in the September 2019 Cattleman’s magazine after the summer tour. Follow-up from experts was requested from three producers who read about pasture rejuvenation the utilization of triticale as part of this series and was facilitated by ABFGC extension and research network. The Olds College report mentioned above summarizes some of the issues we experienced during this project and others that were considered when drafting the subsequent expansion

activities that evolved from this pilot project. A group of three students from the AgriBusiness Research course surveyed cattle producers and completed focus groups to provide insight on innovation adoption on ranches.

- Some abbreviated results were presented at the annual meeting of the Alberta Beef, Forage and Grazing Centre on February 5, 2020 in Lacombe, AB to approximately 35 attendees, and a written update on the project was included as part of the Grey Wooded Forage Association's newsletter. Part of this project was also presented at the Alberta Forage Industry Network AGM on March 10, 2020 to approximately 40 attendees.
- **“Nutrient patterns in swath grazed fields” (PI: Darren Bruhjell); completed**
  - The project supports Goals 2 and 6. The findings in this project supported the nutrient loading/loss estimates given by the Nutrient Loading Calculator.
  - A draft summary report has been completed
  - The work will also lead to improved swath grazing management guidelines that will benefit producers because it will lead to better recommendations on the amount and formula of additional synthetic fertilizer required for the next year's forage crop growth.
- **“Data Interpretation for Sustainable Cow-calf Production” (PI: Susan Markus); in progress**
  - Supports Goal 6
  - Animal agriculture is prone to market and environmental variation which ultimately affects individual farm profitability and competitiveness. Science-based best management practices exist to show acceptable measures of success, but they are not always connected to the four aspects: profitability, productivity, environmental sustainability, and public trust. Too much data and information with too little, meaningful, long term interpretation relevant to the efficiencies and profitability of beef operations is a concern as new technologies promote their benefits in isolation. This project will bundle meaningful indicators from innovations with impact on cow/calf operations' decision-making into a summarized custom report.
  - This project develops a dashboard for reporting concise, meaningful data along with the appropriate interpretations captured through projects such as the Rancher Researcher Pilot and expansion.
- **“Evaluation of AAC Trueman alfalfa on five sites in central and northern Alberta” (PI: Darren Bruhjell); in progress**
  - This project supports Goals 4 and 5.
  - Beef producers in the Northern and Western Prairies require alfalfa varieties with greater winter hardiness and late season yield to extend the grazing season and increase the hay supply.
  - Six sites were established in 2019. An additional site will be established in Manning in 2020.
- **“Carbon Pasture Management Pilot Project” (10 locations across the province); in progress**
  - Supports Goals 2 and 6

- Will involve collection of soils and soil analysis to monitor soil carbon levels under grazing
- **“Perennial Forage Variety Evaluation and Demonstration at Multiple Sites in Alberta”;** **completed and further work in progress**
  - The final report for regional yield and quality trials of 37 grass, legume and grass/legume mixes was submitted in 2018. These trials, carried out by 8 applied research and forage associations, support Goals 1, 4 and 5 of the ABFGC. Regional information assists local producers in selecting high yielding and high-quality perennial crops which will help reduce costs of winter feeds, decrease costs for backgrounding calves and improve summer pasture options.
  - Several of the associations have maintained the trial sites used in the forage evaluations and will monitor longevity of the perennials with support from the Canada Agricultural Partnership (CAP) program. Approval has also been received for the assessment of a new group of perennials beginning in 2020.
- **“Regional Silage Trials”**
  - Several applied research and forage associations have conducted trials evaluating yield and feed quality of a number of varieties of oats, barley, triticale, and cereal pulse mixes. These trials and associated extension by the groups support Goals 1 and 4 of the Centre. Results of these evaluations are presented in the spring version of the Alberta Seed Guide for use by producers across western Canada. CAP funding has been received to expand the trials to include spring/fall cereal mixtures as well as a number of alternative forage options (e.g. millet, sorghum, Sudan grass, forage brassicas, etc.)

## Research Activities

- **“Identification of forage potential using a forage evaluation spreadsheet of current and recently registered cereal varieties selected for other purposes.” (PI Vern Baron and Co-PI Pat Juskiw, 2016-2019); Completed 2019.**
  - The project supports Goals 1 and 4 by evaluating and ranking potential and new barley, oat and triticale varieties compared to older checks. Initial indications are that some varieties sold as forage types, for example CDC Cowboy, are inferior for forage quality attributes compared to cultivars such as Champion. Results from the agronomic trial and spreadsheet are verified in swath-grazing trials at Lacombe where cows swathgrazing a genetically similar cultivar CDC Maverick have consistently lost more weight than the food-type Canmore.
  - Previously we had developed a forage evaluation spreadsheet which yield and quality data from plots and were projected onto animal response and economic data. For swath grazing, parameters included weight gain or loss, body condition score and daily cost. Backgrounding parameters included, rate of gain and cost of gain. Two projects were carried out which ranked small grain forages for backgrounding and swath grazing potential using the Forage Evaluation Spreadsheet. Milk potential was determined using the Milk 2006 spreadsheet.

- It was suspected that cereal cultivars marketed as forage types were no better than varieties developed for other purposes such as malting, food or feed grain. The spreadsheets could be used to identify production benefits and risks as a result of variety choice, thus providing a competent variety choice-decision. All of the spreadsheets provided an evaluation that combined attributes of yield and quality, instead of single variables. Seven 2-row, three 6-row barley, three oat and three triticale varieties were grown over the three-year period at two Lacombe locations and Trochu, AB. In each of 2016, 2017 and 2018 various prospective breeding lines of barley that were entered in the Western Canadian forage barley coop were also included.
- **Forage yield and quality.** Canmore, Champion and Gadsby 2-row barley were identified as having superior attributes for animal utilization based on yield and quality compared to Cowboy, a variety marketed as a forage type. The former varieties were superior for starch content and fiber digestibility and lower fiber (ADF and NDF) contents than Cowboy, including lignin, which is indigestible. For triticale, AC Ultima had the best combination of yield and quality over Bunker; Sunray had superior quality but was lower yielding. For oat, Baler had superior forage quality, but not greater yield than Mustang and Haymaker.
- **Swath grazing.** Canmore and Gadsby barley had the best combination of weight gain and daily feeding cost. The lower yield of Champion reduced carrying capacity and increased daily cost, but weight gain was acceptable. A major drawback for CDC Cowboy barley was low weight gain, which would indicate a risk for cows under cold temperatures. Ultima triticale was identified as a good choice for reduced cost, although weight gain was not at the top level. Oat carrying capacity and low daily cost were favorable, but low weight gains due to low forage quality indicated a risk compared to the best 2-row barley cultivars.
- **Backgrounding.** The evaluation spreadsheet calculated rate of gain (ROG) and cost of gain, which was used to indicate varieties with potential. Cost of gain was reduced by high digestible dry matter yield. Generally, backgrounding potential ranked 6-row barley > 2-row barley > triticale > oat. On the basis of individual varieties, Canmore, Champion, Gadsby and AC Ranger barley, and AC Ultima triticale were identified as those with the most potential. The lowest among barley cultivars was CDC Cowboy. ROG of oats was too low. Even though forage yields were high enough to reduce costs, a low ROG was considered risky in volatile price/cost scenarios.
- **Milk production.** For milk potential barley > triticale > oat. Canmore, Champion, AC Ranger and Vivar barley were superior for milk/tonne, while CDC Cowboy was lowest. For milk/ unit area Gadsby could also be included in the group. Canmore and Champion tended to rank highly for backgrounding and milk production. This was primarily due to consistently high starch contents and fiber digestibility and greater than average forage yields.
- **New varieties.** Canmore and Champion emerged as being superior for many aspects of ruminant utilization as forages. With respect to yield and forage quality parameters AB Cattlelac (FB455), FB022, FB472, AB Advantage (FB473) and FB476 were comparable to

- Canmore. AB Advantage, FB472 and FB476 were within range of Canmore for swath grazing potential. For backgrounding, AB Cattlelac, FB 472, AB Advantage and FB476 are projected as having potential. FB472, AB Advantage and FB476 were similar to Canmore and Champion for milk potential. From these lines AB Cattlelac marketing rights are with Alliance Seeds and AB Advantage marketing rights are with SeCan Seed.
- **Outcome.** Seed companies may use the evaluation system outputs to provide marketing information to customers. Alberta Barley has included information about the variety-choice system with copies of the Alberta Seed Guide to all barley and wheat producers in the province of Alberta. Breeders now use the evaluation system in pre-licencing programs such as the Western Co-operative Forage Barley Registration Test.
  - **Publications, presentations, articles and public outreach:**
    - Baron, V.S. and Juskiw, P.E. 2019.** Identification of forage potential using a forage evaluation spreadsheet of current and recently registered cereal varieties selected for other purposes. Final Report for Project 2012C007R. 35 pp. Alberta Livestock and Meat Agency (ALMA), Edmonton, AB
    - Baron, V. and P. Juskiw. 2019.** Identifying superior small grain varieties for forage utilization. 2019 ASA-CSSA-SSSA International Annual Meeting, Nov. 10-13 2019, San Antonio TX. (Poster)
    - Baron, V. and P. Juskiw. 2019.** Superior Small Grain Cereals for Forage Utilization. Prairie Cereals Summit. Banff, AB. Dec. 11-12, 2019. [Alberta Barley and Alberta Wheat] (Poster)
    - Baron, V.S. 2020.** Annual forages and annual forage systems. Lecture to forage class at U of A. March 3, 2020.
    - Baron, V.S. 2019.** How you choose forage varieties is important. 2 Presenter Abstracts. Lacombe Field Day 2019. July 24, 2019. 100 people.
    - Richard Kamchen 2019.** Swath grazing livestock can help cut feed costs. Farm Credit Canada's weekly *Express*. Winnipeg, MB. May 16, 2019.  
<https://www.fcc-fac.ca/en/ag-knowledge/knowledge/swath-grazing-livestock-can-help-cut-feed-costs.html>.
    - Baron, V.S. 2019.** Swath grazing impacts economic, social and environmental characteristics of beef production. Presentation to Deputy General Policy and Program Management Committee. July 25, 2019.
  - **“Integration of Forage Quality for Ruminant Nutrition into Western Canadian Cereal Forage Breeding Programs.” (PI: Vern Baron, Pat Juskiw); in progress**
    - This project supports Goals 1 and 4 by evaluating and ranking promising varieties for quality at an early stage of selection during the breeding process for quality. The project got underway in 2018. The goal is to integrate the forage nutritional spreadsheet (see above project) developed by Dr. Baron et al. into selection practices for forage oat, barley, wheat and triticale. The spreadsheet allows evaluation to meet the nutritional needs of different classes of beef and dairy cattle.
    - We have developed a system of forage evaluation using the Forage Barley Coop

- test. The test has been grown at 7 locations across western Canada. Forage yields and forage quality data are determined. These data are used to derive animal production variables such as carrying capacity on winter pasture for cows, average daily gain for backgrounding calves or weight gain/loss by cows. Then economic variables such as cost per grazing day for cows and cost of gain for calves is calculated using cost of production estimates and the animal variables. All variables are subjected to Analyses of Variance.
- Funding was attained from AAF to conduct forage quality analyses and conduct simulations of swath grazing, backgrounding and milk production.
  - The Western Co-operative Forage Barley Registration Test was grown at Lacombe AAFC and AAF in Alberta, at Kernan and Saskatoon by U of S and Melfort AAFC in SK and at Brandon and Hamiota, AAFC in Manitoba. These were evaluated in the system described above and reports completed and presented.
  - Over of 1000 lines of breeding material were also assessed using the above system. These were:
    - Oats: J. Mitchell-Fetch, Brandon AAFC; Jim Dyck, Oat Advantage, Saskatoon; Brian Rossnagel and Aaron Beattie, CDC
    - Barley: Joseph Nyachiro, Pat Juskiw, Yadeta Kabeta, and Flavio Capettini, Lacombe, FCDC; Brian Rossnagel and Aaron Beattie, CDC
    - Spring triticale: Mazan Aljarrah, Lacombe, FCDC
    - Winter Triticale: Mazen Aljarrah, Lacombe FCDC; Rob Graf, Lethbridge, AAFC.
  - The barley silage data summary has been presented to the Prairie Recommending Committee for barley and oats at their annual meeting (e.g. Winnipeg, Feb 2020). Subsequently in 2020, the Prairie Recommending Committee for Wheat, Rye and Triticale (PRCWRT) passed a resolution to adopt the protocols developed by this project to be used in the evaluation of prospective forage wheat, rye and triticale varieties. The animal and economic data generated are attractive to seed companies to demonstrate the potential economic value of prospective varieties. For the breeder and seed retailer, this provides a technology transfer tool along with the new variety.
  - Additional work by Dr. Juskiw and Dr. Baron demonstrated that heritabilities for yield and forage quality among the entrants to the Barley Forage Coop Trial are moderate to high. Heritability was 0.65 for yield, 0.85 for ADF, 0.72 for NDF, and 0.87 for in vitro true digestibility. Heritabilities for the calculated variables from the forage evaluation spreadsheet were 0.69 for carrying capacity for swath grazing and 0.85 for average daily gain.
  - This work will continue in 2020-21.
  - **Publications, presentations, articles and public outreach:**
    - Juskiw, P. and Baron, V. 2020.** 2019-2020 Forage Barley Coordinators Report. Field Crops Development Centre and Lacombe Research and Development Centre, Lacombe AB.
    - Juskiw, P and Lajeunesse, S. 2020.** 2019 Western Co-operative Forage Barley Registration Test report. Presented Breeding and Agronomy Evaluation Team of the

Prairie Recommending Committee for Oat and Barley (PRCOB), Winnipeg, MB. PRCOB password protected. Feb 26-27, 2020

**Baron, V.S. 2019.** Barley utilization for forage in Alberta. Talk and tour on barley for forage to Frisa Cooperative, Brazil. July 30, 2019, Lacombe, AB. 20 people.

- **“Forage Potential of Hybrid Rye.” (PI: Vern Baron); in progress**
  - Supports Goals 1, 4, and 5.
  - Hybrid rye (HR) is a new winter cereal crop that was introduced in 2015 to western Canada for grain production. In pre-registration trials across Canada the new hybrid types out-yielded the traditional open pollinated rye (OP-R) for grain (approx. 30%) and had equal to or better winter-hardiness. Registration did not require “forage testing.” The fact that HR are the F1 generation conferred advantages over OP-R types such as vigour and uniformity, but they are also genetically different, shorter, have less lodging, and are more stress (heat and drought) tolerant.
  - While the research-evaluation for forage potential is non-existent, “on-farm” yield and quality of silage in southern Alberta in 2015 was impressive as evidenced by Kolk Farms feed analyses (KWS commun.). Hybrid fall rye (HR) bred by KWS has been grown in Germany since the 1970s. Inbred rye lines are developed by selfing and selection and F1 seed is produced using a cytoplasmic male sterility-restorer gene system. At least two heterotic families exist ensuring heterosis is maximized in the F1. Heterosis has allowed HR to achieve greater yield and stress tolerance than OP-R counterparts.
  - Agronomic investigation in public cereal evaluation trials among HR lines relative to grain yield has been much more prevalent than on forage and pasture production. Because of the hybrid seed production, HR seed costs are higher than for OP-R varieties.
  - Funding: collaborative research proposals have been written or are in progress. Funding has been attained from Saskatchewan Cattlemen’s Association, KWS and FP Genetics to carry out field trials at Lacombe to compare HR varieties with other winter and spring cereal species. A proposal entitled “Forage potential of hybrid fall rye (HR) in Alberta and Saskatchewan” was submitted to BCRC to obtain funds to conduct the research at Swift Current, SK, and under irrigation at Lethbridge, AB. The first planting date will occur at these locations in the fall of 2020. Another proposal entitled “Hybrid rye as a forage source for beef cattle” was submitted to the Alberta government in 2019 and was approved. This proposal is led by Dr. Greg Penner and will investigate feeding silage made from hybrid rye.
  - Preliminary results: Forage quality for hybrid rye was very good as indicated by in vitro true digestibility (IVTD) and fibre digestibility (NDFd) values. The hybrid rye varieties Bono and Brassetto may have a small advantage over Progas. The forage quality of Pintail winter wheat is exceptional although silage yield was much lower than HR. We believe these high digestibility levels are repeatable and all information has been passed on to Dr. Penner.
  - Estimates of average daily gain and cost of gain for hybrid rye compared favourably with the other winter species and verified favourable reports from the feedlot industry in southern Alberta.

- Preliminary work has also been conducted at Lacombe on HR and other winter cereals for use as fall and spring pastures.
- **Publications, presentations, articles and public outreach:**
  - Baron, V.S., Aljarrah, M., Block, H., and Juskiw, P.E. 2019.** Triticale as a forage and pasture in Alberta. 10<sup>th</sup> International Triticale Symposium. Pg. 24. Itinerary and Abstracts. July 15-19, 2019, Lethbridge, AB.
  - Baron, V.S. 2019.** AAFC Lacombe Research Centre – Forage-Beef. Talk and tour for Growsafe and Livestock Gentec personnel. July 12, 2019.
  - Baron, V.S. 2019.** Talk and Tour for 10<sup>th</sup> International Triticale Symposium. July 19, 2019. Lacombe, AB.
  - Baron, V.S., 2020.** Research progress in late-season pasture production and implications to future beef production in Alberta. Annual meeting of the Alberta Beef, Forage and Grazing Centre. Feb 6, 2020. Lacombe, AB.
  - Baron, V.S., 2020.** Presentation to KWS and FP Genetics representatives about hybrid rye research at Lacombe. March 10, 2020.
- **“Malt Two-row barley variety development.” (PI: Pat Juskiw); in progress**
  - The project supports Goals 1 and 4 by the development of new varieties of two-row barley that primarily have a higher probability of making malt but may also fit into forage or feed end uses. The objective of this program is to develop varieties of two-row malting barley with good malting quality characteristics, high yield and agronomic adaptation. In addition, good disease resistance and tolerance to abiotic stresses such as low nitrogen, drought, cold and other adverse environmental factors are considered. Core breeding project at FCDC.
  - **Achievements:** AB BrewNet was released and will be marketed by SeedNet. Support for registration of TR17635 passed by the PRCOB in February 2020.
  - Lowe has potential as a replacement variety for ‘CDC Copeland’, with additional malting testing underway. Lowe’s resistance to FHB with low DON accumulation is very important to the industry.
  - TR14617 had extended the support for registration by the PRCOB to March of 2021. It has been identified as a non-glycosidic nitrile producer (non-GN) type. GN is a cyanogenic glycoside precursor of ethyl carbamate, which develops during malting. Ethyl carbamate is an undesirable trace component that remains in spirits or whisky produced from malted grains that contain GN. There are currently no non-GN malting barley varieties commercially available in Canada, while varieties are highly demanded by the industry.
  - Pre-registration Cooperative trials: two lines in second year malting Collaborative testing (TR18635 put forward and supported for registration); no second year Coop/first year Collab; five lines entered into first year Coop with three selected to be advanced to second year Coop and first year Collab in 2020.
  - Crosses: 32 elite crosses of our most advanced lines with new malting varieties from western Canadian programs; 20 top crosses of F<sub>5</sub>s with ‘CDC Copper’, a high yielding

- variety with multiple disease resistance (although it lacks FHB resistance); 10 crosses of mutants (low LOX, LOX-less, high Beta-amylase) with elite malting varieties.
- Yield evaluation trials: 676 entries were tested at 1-10 locations for 1-4 years.
  - The malting program is moving to an exclusively marker assisted selection protocol with the support of the Biotechnology lab. Selection using molecular markers will occur 2 generations earlier than the standard program, reducing the time to complete the breeding cycle. This is possible due to the number of malting quality markers FCDC has. The goal is to use at least one marker for each important disease by 2020-21. As well we will continue to screen parents with genetic markers for the presence of favorable genes before making crosses.
  - **“Feed Barley (six-row and two-row) barley variety development.” (PI: Joseph Nyachiro); in progress**
    - The project aligns with Goals 1 and 4 of developing feed grain and forage barley varieties. The objectives of the program are to develop two- and six-row feed barley. Specific priorities include high grain yield that exceed the current cultivars, better adaptation to the environment, superior agronomic traits (e.g. lodging resistance, early maturity, enhanced grain and forage yields, etc.) A good combination of resistance to multiple diseases such as scale, net blotch (spot- and net-form), spot blotch, smuts (e.g. *Run8* gene), stem and stripe rusts and FHB is important. Moving forward the feed barley program will prioritize two-row varieties, while adjusting the six-row program to market demand. Core breeding project at FCDC.
    - Generally, in barley, there is a high positive correlation between grain yield and biomass. This indicates that high grain yielding barley varieties are also more likely to yield high biomass which translates to more forage.
    - **Achievements:** TR18645 and TR18647 were supported for registration by the PRCOB in Feb. 2020.
    - TR18647 (FB494) is a dual-purpose feed and forage two-row barley. It has grain yields 6% higher CDC Austenson and 5% higher than Champion. Its forage yields are similar to the two-row checks Gadsby, CDC Austenson and CDC Cowboy. This line has high forage protein, fiber digestibility (IVTD and NDF30-NDF) and starch, with low NDF and ADF. These good forage quality traits result in high estimates for empty body weight gain (beef cow gain on swath grazing, minus fetus weight), excellent average daily gain and low cost of gain for beef calf backgrounding, and high milk production per tonne (MPTI) and per land basis (MPHI).
    - **Strengths of TR18647 (FB494):**
      - Grain yield: TR18647 had incredible yields in the drought year of 2018, yielding significantly higher than all of the checks, being 11% higher than CDC Austenson and 8% higher than Champion. TR18647 maintained good yields in 2019 across all soil zones, with 2% higher yields than CDC Austenson and Champion. Overall grain yields were 6% higher than CDC Austenson and 5% higher than Champion.
      - Resistant or moderately resistant to stem rust, surface smut, loose smut, and moderately to intermediately resistant to Fusarium head blight.

- Lodging resistance is similar to the best check CDC Austenson
- Quality: The forage quality of this line is superior giving it very good estimates for empty body weights, average daily gain, and milk production.
- **TR18645** is a two-row hulled barley with potential for feed use. TR18645 has grain yields 4% higher than CDC Austenson and 3% higher than Champion. It is well adapted to all soil zones, with good adaptation to the western Black/Grey soil zone. This line did particularly well in drought areas/years with yields in 2018 being 8% higher than CDC Austenson and 5% higher than Champion. It has a very plump seed and low percent thins. TR18645 has good straw strength with similar lodging to CDC Austenson despite being taller.
- **Strengths of TR18645:**
  - Grain yield: TR18645 had good yields in the drought year of 2018, being 8% higher than CDC Austenson and 5% higher than Champion. TR18645 maintained good yields in 2019 across all soil zones, with 2% higher yields than CDC Austenson and Champion. Overall grain yields were 4% higher than CDC Austenson and 3% higher than Champion. TR18645 did particularly well in the western Black/Grey Soil Zone.
  - Lodging resistance is similar to the better of the checks, CDC Austenson.
  - Quality: high percent plump and low percent thins under drought and non-drought conditions.
  - Disease resistance: TR18645 has good disease resistance, with resistance to stem rust, and moderate resistance to the surface-borne smuts and net-form of net blotch. It also has intermediate resistance to the spot-form of net blotch, spot blotch, scald and FHB.
- **SR19524 (FB492) feed and forage barley**, bred by Dr. Yadeta Kabeta, has superior nitrogen use efficiency to protect yield under limited N conditions. It is a semi-dwarf, smooth-awned variety with high grain and forage yield, as well as good lodging resistance.
- **Strengths of SR18524**
  - Enhanced nitrogen use efficiency, 106% of Vivar and 110% of Amisk and AC Ranger.
  - Grain yield is 103% of Vivar and Amisk and 105% of AC Rancher
  - Forage yield is 103% of six-row, semi-dwarf check, Vivar
  - Resistant to lodging, similar to the best check, Amisk
  - Plumper seed than AC Rancher and Vivar
  - Test weight better than all the checks
  - Short height, similar to the semi-dwarf checks, Amisk and Vivar
  - Smooth-awned
  - Favourable combination of forage quality characteristics. Crude protein, starch, and in vitro true digestibility compared favourably to the higher end of the range of check varieties, with neutral detergent fibre and acid detergent fibre at the lower end of the range, as desired.
  - Good disease resistance package with resistance or moderate resistance to surface-borne smut, stem rust, spot blotch, and the net form of net blotch.

Intermediate resistance to the spot form of net blotch.

- **AB Tofield**, tested as **SR17515 (FB481)**, had the highest grain yield for two consecutive years in the Co-ops. It is a smooth-awned, hulled barley with consistently good agronomic performance, including lodging resistance better than AC Ranger and Vivar. AB Tofield was tested as FB481 in the Forage Barley Co-op where it showed higher forage yield than AC Ranger and equal to CDC Austenson and CDC Cowboy. AB Tofield has cow carrying capacity similar to CDC Austenson but higher than AC Ranger.
- AB Tofield has an acceptable disease package with moderate resistance to the surface-borne smuts, intermediate resistance to stem rust, and net- and spot-forms of net blotch and spot blotch. The high grain and forage yields with good lodging resistance traits make AB Tofield suitable for feed grain and forage production.
- AB Tofield is a six-row, smooth-awned feed and forage barley marketed by SeCan. Its grain yield is 8% higher than present varieties, with a forage yield 3-6% higher. Grain quality is reflected in the high amount of plump seed, test weight, and heavy kernels. It has excellent lodging resistance, higher than the dominant varieties. In addition, it shows multiple disease resistance profiles, including resistance to scald, spot blotch, spot-form net blotch, surface-borne smuts, loose smuts, and stem rust.
- **Strengths of AB Tofield**
  - Grain yield is 108% of AC Ranger and Vivar in the Six-row Co-op, and 107% of CDC Austenson in the Forage Coop.
  - Forage yield is 106% of AC Ranger and 103% of CDC Austenson.
  - Percent plump seed is higher than AC Ranger.
  - Test weight is higher than all the six-row feed checks AC Ranger, Vivar and Amisk.
  - Carrying capacity is higher than AC Ranger, CDC Austenson and Vivar in the Forage Barley Co-op.
  - Lodging resistance is better than all checks in the Six-row Co-op and better than Gadsby in the Forage Co-op.
  - Intermediate disease resistance to the surface-borne smuts, loose smut, stem rust, scald, spot blotch, and spotted net-blotch.
- **AB Wrangler** is a two-row feed and forage barley marketed by Canterra Seeds. It has an overall yield 3% greater than the feed checks and matures one day earlier. In the drought of 2018, it yielded 8% higher than the checks in the black and grey soil zones. It has forage yields similar to the forage checks, but the forage quality is significantly superior to current cultivars, with improved forage digestibility and higher starch. DON levels are 36-46% lower than current feed and forage varieties.
- **Pre-registration Cooperative trials:**
  - Six-row Co-ops: Four of 11 first year six-row lines were advanced to second year. One of the four second year lines was put forward for PRCOB approval for registration in Feb 2020.
  - Two row Co-ops: two lines were advanced to second year with both being put forward and supported for registration by the PRCOB in Feb 2020; three two-row lines were entered into first year Co-op but were not advanced.

- Crosses: 24 two-row and 15 six-row feed/forage crosses were made between advanced and elite two-row varieties.
- Yield evaluation trials: Six-row: 208 superior feed and forage lines were tested in year 1 to year 3 for yield, agronomic and quality characteristics, at 1 to 10 locations.
- Canmore occupied 5% of the insured acres in 2019 making it the fifth most popular non-malting type in western Canada.
- **Publications, presentations, articles and public outreach:**
  - Juskiw, P., L. Oatway, M. Oro, J.M. Nyachiro, Y. Anbessa, K. Xi, T.K. Turkington, S. Lohr, J. Bowness, and F. Capettini. 2019.** Registration of 'Lowe', a Two-Rowed Malting Barley with Enhanced Resistance to Fusarium Head Blight. Journal of Plant Registrations 13:301-310. [doi.org/10.3198/jpr2018.11.0075crc](https://doi.org/10.3198/jpr2018.11.0075crc)
  - Juskiw, P and S. Lajeunesse. 2020.** Western Cooperative Forage Barley Test: 2019 Report. Submitted to the Prairie Recommending Committee for Oats and Barley. February 2020.
  - Kabeta, Y., A. El-Mezawy, J. Nyachiro, P. Juskiw, J. Zantinge, L. Oatway, and F. Capettini. 2019.** Final Report: Improving yield and sustainability of feed and fodder barley through targeted research in nutrient and water use efficiency. Project Report to Alberta Innovates and Alberta Barley.
- **“Forage barley variety development.” (PI: Yadeta Kabeta); in progress**
  - This project supports goals 1 and 4 by developing barley varieties specifically with forage end-use in mind. By focusing on forage yield, quality, smooth awns, etc., this program improves the barley available to be grown strictly for forage. Many two-row barley varieties have rough awns, which can cause mouth ulcers. This program aims to have all forage varieties bearing smooth awns by 2024. Within this line, a “hooded” awn characteristic has also been developed. Improved forage quality is achieved by crossing new germplasm with low lignin levels (orange lemma mutants), to improve fibre digestibility and overall energy value. These new lines seem very promising.
  - **Achievements:** TR18647, as FB494, was supported for registration by the PRCOB in Feb 2020.
  - Pre-registration Cooperative trials: Two two-row lines were tested in 2019 with one line (FB495) advancing to second year Co-op testing; seven two-row lines were entered into first year Co-op testing in 2020.
  - The first set of lines developed from the orange lemma mutant crosses were evaluated for forage yield and quality in 2019. The forage yield for these lines was lower, but these had higher forage quality as compared to the standard cultivars. The best lines were advanced for further evaluation.
  - Dr. Kabeta was appointed coordinator of the Western Cooperative Forage Barley Test by the Barley Agronomic Evaluation Team at the PRCOB meeting in Feb 2020.
  - Twenty-four specific 2-row feed/forage crosses were made.
  - Yield evaluation trials: 188 entries were tested between 1 and 10 locations.
- **“The Development of Improved Spring Triticale Cultivars.” (PI: Mazen Aljarrah); in progress**

- The project supports Goals 1 and 4 by developing new varieties of forage spring triticale. The objectives of the program are to develop spring triticale with reduced awns, higher digestibility, improved sprouting resistance, lodging resistance, disease resistance, early maturity and seed development via a conventional modified bulk breeding system; with high silage yields; and with high grain yields. Core breeding project at FCDC.
- **2019-20 Success:** The spring triticale breeding program had one new line supported by the Prairie Recommending Committee for Wheat, Rye and Triticale (PRCWRT) for registration in February 2020. The supported lines are T272.
- **T272** has a good package of agronomic characteristics, disease resistance and forage quality. The line is resistant to three rusts, common bunt, and has intermediate resistance to FHB
- **Strengths of T272**
  - Grain yield is 106% of AC Ultima, and 101% of Pronghorn.
  - Kernel and test weight are higher than the checks.
  - Lower ADF and NDF than all triticale checks, compliment with high fibre digestibility.
  - Strong straw, better lodging resistance than Pronghorn and AC Ultima.
  - Resistant to common bunt and leaf, stem and stripe rust.
  - Intermediate to moderate resistance to FHB.
- **“The Development of Improved Cultivars of Winter Triticale (PI: Mazen Aljarrah); in progress.”**
  - The project supports Goals 1, 4 and 5 by development of new varieties of forage winter triticale for fall pasture and silage. The objectives of the program are to develop cultivars with winter hardiness similar to Norstar; disease resistance genes (snow mold, powdery mildew and leaf diseases); short stature; enhanced sprouting resistance; reduced-awn trait; early maturity; and high forage yield. Core breeding project at FCDC.
  - **2019-20 Success:** The winter triticale breeding program had one new winter line supported by the PRCWRT for registration in February 2020.
  - **WT0006** is a reduced awned winter triticale suitable for feed and forage uses, and is well adapted to the dry, cold and milder winter areas of western Canada
  - **Strengths of WT0006**
    - Grain yield is 117% of Bobcat and 106% of Metzger.
    - Winter survival is higher than all other check varieties.
    - Maturity is earlier than all checks, three days earlier than Luoma.
    - Ergot resistance is higher than Metzger and Bobcat.
    - Better forage digestibility than Metzger, Bobcat and Luoma.
  - **Publications, presentations, articles and public outreach:**
  - **Aljarrah, M., F. Capettini, S. Lohr and L. Oatway. 2019.** Breeding Triticale for Grain and Forage Yield and Quality: Challenges and Future Prospects. Presented at: 10th International Triticale Symposium. Lethbridge, AB. July 15-18, 2019.
  - **Aljarrah, M., F. Capettini, S. Lohr and L. Oatway. 2019.** Triticale Production and Utilization in Western Canada. Poster session presented at: 10th International Triticale Symposium. Lethbridge, AB. July 15-18, 2019.

- **Baerg, M. 2019.** Triticale is holding its own thanks to Alberta Agriculture and Forestry plant breeder, Mazen Aljarrah. Alberta Seed Guide, Fall 2019. Input from Mazen Aljarrah <https://www.seed.ab.ca/triticale-is-holding-its-own-thanks-to-alberta-agriculture-and-forestry-plant-breeder-mazen-aljarrah/>
- **“Germplasm and variety development of barley and triticale for animal feed with a focus on feed quality, yield and disease resistance of both grain and annual forage production.” (PI: Flavio Capettini); Completed March 2018**
  - Although this project completed in 2018, the outcomes of the project will continue to influence future breeding and development of the feed and forage barley varieties in western Canada. For variety development of barley (grain and forage) and triticale (forage), FCDC targets improved nutritional quality, yields, yield stability, disease resistance, resource use efficiency, and expanding the germplasm available to ensure that future varietal development continues into the future. Out of this project a Research Project Report was submitted, and a Research Fact Sheet was developed. The Fact Sheet is found at: <https://www.beefresearch.ca/fact-sheets/improving-barley-and-triticale-feed.pdf>. A final report was prepared and submitted to Alberta Beef Producers.
  - **Publications, presentations, articles and public outreach:**
  - **Juskiw, P.E., L. Oatway, M. Oro, J. M. Nyachiro, Kequan Xi, T. K. Turkington, S. Lohr, J. Bowness and F. Capettini. 2019.** Registration of ‘Lowe’ a Two-rowed Malting Barley with Enhanced Resistance to Fusarium Head Blight. J. Plant Registration. 13: (accepted Jan 28, 2019).
  - **Juskiw, P. 2019.** Forage Breeding: Annual Cereal Crops. Guest Lecture University of Alberta, Plant Science 354 Forage Crops. Edmonton, Alberta. Jan. 17, 2019
  - **Xi, K., T.K. Turkington, P. Juskiw, J. Nyachiro, and F. Capettini. 2019.** Field screening is effective for identifying genetic resistance to scald of barley. Crop Sci. (accepted Mar 27, 2019).
  - **Zantinge, J., S. Xue, M. Holtz, K. Xi, and P. Juskiw. 2019.** The identification of multiple SNP markers for scald resistance in spring barley through restriction-site associated sequencing. Euphytica 215: 8 (accepted Nov. 20, 2018, online Jan 2, 2019 <https://doi.org/10.1007/s10681-018-2317-x>)
- **“Development of a rapid screening method to assess grain processing responses of barley as a trait for the selection of feed varieties for cattle.” (PI: Joseph Nyachiro/Tim McAllister, 2017-2020); in progress**
  - The project supports Goals 1,2, and 4. By incorporating grain processing responses of barley into the selection of feed varieties, there is an opportunity to reduce costs and environmental impacts through improved efficiency. This project complements the recently completed Beef Cluster project led by Flavio Capettini that was focusing on germplasm and variety development of barley and triticale with improved feed quality, yield and disease resistance for both forage and grain production.
- **“Determining the critical traits associated with lodging in a set of elite breeding lines and Canadian barley varieties.” (PI: Joseph Nyachiro/Ludovic Capo-chichi, 2018-2021); in progress**

- The project supports Goals 1 and 4. Higher yielding varieties with good lodging resistance can maintain high grain and forage quality while remaining easy to harvest. Lodging results in crop losses, decreasing yield and is a primary concern for barley producers.
- **“gGreenBeefCow: Identifying and evaluating genomic and fecal microbiome markers for low methane emissions in beef cattle.” (2016R033R; PI=Carolyn Fitzsimmons and John Basarab; April 2016 to March 2019); Completed 2019.**
  - The research supports Goals 2 and 3. The overall objective is to evaluate genomic and microbiome markers for animals which produce lower methane emission (g/d) and/or methane yield (g methane/ kg DMI). As of April 2018, a total of 26987 animal/day observations for methane have been collected from 893 unique animals.
  - Validated a non-invasive, remote sensing wireless system (GreenFeed Emissions Monitoring System) for measuring methane and carbon dioxide from beef cattle under grazing and drylot conditions in temperate environments. We also developed and validated an open path laser system for measuring methane from groups of cattle under grazing conditions.
  - **Publications, presentations, articles and public outreach:**
    - Manafiazar, G. 2019.** Genomic Prediction of Methane Production in Beef Cattle. International Plant and Animal Genome XXVII conference (PAG), Jan 12-16, 2019, San Diego, CA, poster.
    - Manafiazar, G., Baron, V.S., McKeown, L., Block, H., Ominski, K., Plastow, G., and Basarab, J.A. 2019.** Methane and carbon dioxide emissions from yearling beef heifers and mature cows classified for residual feed intake under drylot conditions. Can. J. Anim. Sci., <https://doi.org/10.1139/CJAS-2019-0032>.
    - Manafiazar, G., Fleisch, T.K., Baron, V.S., McKeown, L., Byron, B., Block, H., Ominski, K., Plastow, G., and Basarab, J.A. 2019.** Methane and carbon dioxide emissions and grazed forage intake from pregnant beef heifers previously classified for residual feed intake under drylot conditions. Can. J. Anim. Sci., under review.
- **“Measuring and assessing Canadian rangeland and other agricultural best management practices with the enhanced whole-farm model Holos (Whole-farm BMP evaluation using Holos).” (Roland Kroebel, PI); in progress**
  - This project supports Goal 2. Several modeling methods using Tier 2 IPCC methods are used to estimate greenhouse gas emission on a systems basis. Data from grazing systems is supplied from Swift Current and Lacombe. An LCA conducted by Dr. Baron showed swath grazing reduced the amount of energy used in the winter-feeding process by 50% and reduced the greenhouse gas emission per kg of feed fed compared to a traditional feeding system. The carbon footprint for wintering beef cows was reduced by 18.3 kg C per cow grazed for 100 days.
  - The Center is also supporting HOLOS by testing the latest versions.
- **“Development and deployment of MBVs/gEPDs for feed efficiency and carcass traits that perform in commercial beef cattle.” (PI= John Basarab, co-PI= Donagh Berry and John Crowley; October 2015 to March 2020); in progress**

- The project supports Goal 3. It aims to develop and deploy genomic tools to commercial cow-calf producers and has three major deliverables/Activities: 1) 30 million variants screened for functional impact on traits of interest; 2) gEPDs for 10 traits with > 35% accuracy in crossbred cattle; and 3) two multi-trait value indices for commercial producers.
- Released the first “made in Canada” genomic tool for Canadian crossbred cattle producers: This provides parentage, breed composition, and a Vigour-Score that measures hybrid vigour an important trait for optimizing performance of beef production (EnVigour HX™). This test is now licenced to Neogen Canada (royalty of \$2.50/sample returned to Delta Genomics), who plan to market it in Canada, USA, Scotland, Australia, Brazil and China. The benefits associated with maintaining high hybrid vigour in the cowherd are about \$160/cow/year in the first five parities, as well as improved calf health and resilience and a reduced carbon footprint. Deployed sire assignment, genomic breed composition and genomic hybrid Vigor Scores on progeny, sires and dams to 14 commercial beef farms through the Herdtrax software program.
- A list of 450 SNPs representing genomic variants for feed efficiency was generated and a small panel of 216 SNPs developed and tested on 768 animals previously measured for feed efficiency traits. The cost of this panel was \$30 per sample but is expected to be lower after refinement to the validated SNPs and with higher volumes. About 10-20% of the markers were positively associated with the different traits tested and up to 18, 18, 13, 12, 9% of the genetic variance in average daily gain (ADG), dry matter intake (DMI), midpoint metabolic weight (MMWT), residual feed intake (RFI), and residual feed intake adjusted for back fat (RFIf), respectively, were explained by the panel. Although this was below target, the hypothesis was supported in that a relatively large proportion of the SNPs showed significant associations in new cattle populations and their crossbreds. Indeed, if these SNPs perform in this way in all populations then they may represent an opportunity to improve efficiency in commercial animals. These SNPs could be used to generate useful molecular breeding values for ADG, DMI, MMWT and RFI. Patent number: PCT/CA2018/051326.
- Developed genomic or molecular breeding values (MBVs) for crossbred cattle with >35% accuracy for 14 traits and >30% accuracy for four additional traits. Further analyses of imputed sequence data for SNPs and structural variants will improve the accuracy of these MBVs. These MBVs are used in the development of multi-trait selection indices.
- Developed two multi-trait selection indices for crossbred cattle: 1) Feeder Profit \$ Index [FP\$I]; 2) Replacement Heifer \$ Index to assist with adoption of the technology. Each 100 units change in the sire’s FP\$I equaled \$29 per feeder in net income. These indices are presently being refined and validated with industry partners and at Olds College.
- **Publications, presentations, articles and public outreach:**  
**Abo-Isomail, M.K. 2019.** Genome-wide association studies for feed efficiency in beef cattle. International Plant and Animal Genome XXVII conference (PAG), Jan 12-16, 2019, San Diego, CA, poster

- Case, J.E., 2019.** Association of Genomic Retained Heterozygosity with Health Outcomes of Beef Calves from Parturition to Weaning. University of Calgary, UCVN, Western Canadian Association of Bovine Practitioners, Saskatoon, SK, 2019-01-18.
- Basarab, J.A. 2019.** Beef Project Gets to Meat of the Issue. Genome Alberta, Sept 4, 2019, <http://genomealberta.ca/livestock/beef-project-gets-to-meat-of-the-issue.aspx>
- Miller, M. 2019.** Genome Alberta MLA Reception. Genome Alberta, Oct 28, 2019, Michelle Miller, director of Neogen Canada, told the story of how EnVigour HX™ was developed and commercialized.
- Valente, T. 2020.** Technical description of replacement heifer selection index development. University of Alberta, Mar 11, 2020.
- Li, C., Wang, Y., Zhang, F., Mukiibi, R., Chen, L., Vinsky, M., Plastow, G., Basarab, J.A., and Stothard, P. 2019.** Genetic architecture of quantitative traits in beef cattle revealed by a genome wide association study of imputed whole genome sequence variants: II: carcass merit traits. BMC Genomics GICS-D-19-01045
- Zhang, F., Wang, Y., Mukiibi, R., Chen, L., Vinsky, M., Plastow, G., Basarab, J.A., Stothard, P., and Li, C. 2019.** Genetic architecture of quantitative traits in beef cattle revealed by genome wide association studies of imputed whole genome sequence variants: I: feed efficiency and component traits. BMC Genomics GICS-D-19-01044R5
- Genho, J. 2019. The Next Generation of Genetic Tools. Proceeding, presentation and audio, Beef Improvement Federation, Brooking, SD.**  
<http://www.bifconference.com/bif2019/newsroom.html>
- Abo-Ismael, M.K. 2019.** Genome-wide association studies for female fertility and lifetime productivity in beef cattle. International Plant and Animal Genome XXVII conference (PAG), Jan 12-16, 2019, San Diego, CA, poster.
- Basarab, J.A. 2019.** Validating genomics tools used to select commercial replacement heifers. HerdTrax & CCHMS Producer Seminar, Dec 17, 2019, Invited presentation, Calgary, Alberta.
- Olson, C.A., Li, C., Block, H., McKeown, I., and Basarab, J.A. 2020.** Phenotypic and genetic correlations between feeding behaviours and feed efficiency in crossbred beef replacement females. Can. J. Anim. Sci., accepted.
- **“Evaluating a new tool (GGP-F250) for improving accuracy of gEPDs for production efficiency in commercial beef cattle.” (2017R034R; PI: Graham Plastow and John Basarab; April 2017 to March 2019); Completed 2019**
    - The project supports Goal 3. The project will run approximately 1200 genotypes of genetically diverse cattle using the GGP-F250K and impute approximately 4000 crossbreds genotyped with GGP-LD (~30K SNPs). The results will provide important information on utility and cost of different genotyping strategies to help increase adoption of genomic tools in commercial cattle.
    - Reported that combining mutations from the Gentec 200SNP panel (200 SNPs) with the top 10 significant mutations from GGP F-250 panel (250,000 SNPs) explained 40 and 57% of the genetic variance of feed efficiency (as residual feed intake) and daily dry matter intake, respectively. These results create an opportunity for improving the

- accuracy of genomic selection in commercial cattle, and to further develop accurate, low-cost genomic testing to apply the technology on-farm.
- **“Optimize heterozygosity in composite multi-breed and cross breed beef populations using genetic and genomic tools.” (2017F103R; PI: Graham Plastow and John Basarab; March 2017 to December 2019); Completed 2019.**
    - The project supports Goal 3. This project proposes to 1) determine how many SNPs are required for determining the optimum panel (cost/information content) to accurately predict genome-wide retained heterozygosity (gRHET); 2) test the relationship between gRHET and cow reproductive (e.g., fertility, lifetime productivity) performance; 3) evaluate DNA pooling to determine breed composition and retained heterozygosity and; 4) develop a strategy to monitor, maintain, and optimize RH in herds for improved performance and increased profitability.
    - Important phenotype/genotype data bases and reference populations were developed and supplemented with additional data: a) 50K SNPs, feed efficiency and carcass data on additional 6086 animals were compiled and consolidated with historical data, bringing the total number of animals with 50K SNPs, and feed efficiency traits to 11389, and total number of animals with carcass traits to 8455; b) 50K SNPs of above animals were successfully imputed to whole genome sequence variants of 57,665,943 with an average imputation accuracy >97% and; c) pure breed reference SNP panel for breed composition prediction has been expanded and refined to include 14 major Canadian beef breeds (Black Angus, Red Angus, Charolais, Simmental, Hereford, Limousin, Gelbvieh, Salers, Maine Anjou, Shorthorn, Holstein, Brown Swiss, Jersey, and Galloway). These are valuable intellectual properties.
    - 43 million genomic variants (insertions/deletions and SNPs) screened for functional impact on traits of interest, and results incorporated into global initiatives to improve prediction of phenotype from genotype.
    - Developed a large comprehensive collection of cattle Copy Number Variants (CNVs) and presented them in a novel interactive visual database to assist use by researchers.
    - Demonstrated that “DNA pooling” can be used as a cost effective (\$5-8/sample) and accurate approach for quantifying average breed composition and retained heterozygosity, and contribution of a sire to progeny groups. This technology is presently under review for patent protection.
    - **Publications, presentations, articles and public outreach:**  
**Kommadath, A., J.R. Grant, K. Krivushin, A.M. Butty, C.F. Baes, T.R. Carthy, D.P. Berry, and P. Stothard. 2019.** A large interactive visual database of copy number variants discovered in taurine cattle. *GigaScience*, 8(6): 1-12.  
<https://doi.org/10.1093/gigascience/giz073>
  - **“Genetic analyses of feed intake, feed efficiency, female fertility, and cow lifetime productivity in beef cattle raised under two environments.” (PI: John Basarab and Changxi Li, April 2018 –March 2023); in progress**
    - The project supports Goal 3. Objectives are to: i) Estimate genetic and phenotypic correlations of dry matter intake (DMI as a heifer) and feed efficiency with heifer

- fertility, longevity and lifetime productivity (LTP) of cows reared under two winter feeding systems (higher vs. lower inputs); ii) Determine relationships of mature cow DMI per weight of calf weaned over 3 and 6 calvings with heifer performance; iii) Predict heifer fertility and cow LTP using additive, non-additive and environmental effects; iv) Quantify the economic value differences among heifers using feed intake, fertility, LTP and longevity; v) Phenotype 2000 commercial heifers for feed intake and efficiency using Growsafe's marketing approach and create value indices for these heifers.
- Fertility data bases developed and maintained: a) Lacombe Research and Development cow fertility data base 2005-2019 (> 3500 mating opportunities); b) Roy Berg Kinsella Research Station cow fertility data base 2012-2019 (>4000 mating opportunities); c) Fertility haplotypes - This database contains whole genome sequences (20x coverage; Genome Quebec) from 11 bulls and 9 cows that showed high infertility rate (15+% open rate). Analyses (e.g., scan for infertility haplotypes) will provide more direct information on potential causative mutations in the population or associated infertility haplotypes and improve the accuracy of imputation and identifying polymorphisms for our female fertility prediction index that includes both additive and non-additive genetic effects.
  - **“Development of functional genomic prediction platform for industry application.” (PI: John Basarab and Changxi Li, April 2019-March 2021); in progress**
    - Supports Goals 2 and 3.
    - Constant genetic improvement on beef production efficiency and quality is a key strategy to enhance national and international competitiveness and thus the sustainability of beef production. However, genetic improvement rate via traditional phenotype and/or pedigree based genetic evaluation and selection has been slow for certain important beef performance traits that are difficult/expensive to record such as feed efficiency, methane emission, and fertility. Over the past years, researchers at Livestock Gentec (UA, AAFC, AAF) developed a number of genomic prediction tools including genomic prediction of genetic merit or EPD for feed efficiency and carcass traits (Chen et al. 2013; Chen et al. 2015, Lu et al. 2016), genomic prediction of breed composition and retained heterosis (Akanno et al. 2017; Basarab et al. 2018), multiple trait selection indexes based on genomic EPDs (Ekine-Dzivenu et al. 2018). These genomic tools provide an enabling solution to improving beef cattle performance for the above traits, in particular for many commercial producers who don't have access to information from a breed association and want to select replacements from their own herd. To promote a wider application of the genomic tools in the industry, the proposed project aim to develop a user-friendly platform to deploy the genomic technologies through service providers such as Delta Genomics, Cow-Calf Health Management Services, and GrowSafe Systems Ltd. with the outcome of improving sustainability, competitiveness, and profitability of the Canadian Livestock Industry.
    - The platform will be a window-based portal with modules that include intake of animal data submitted by the industry, database management of reference populations for various genomic prediction purposes, consolidated pipelines for analyzing data for target genomic prediction (i.e. EPD prediction, breed composition and heterosis

prediction, multiple trait selection index calculation), standardized format for release of genomic prediction results to users, and summary tools of feedback from users. The proposed project will use 1000 industry beef cattle as examples to demonstrate and train staff from service providers so the participants can uptake and apply the genomic service via the platform. The expected deliverables include: (1). Standard operation procedures (SOP) for uptake and management of genomic data; (2). Pipelines for genomic data quality control; (3). Optimized reference populations for various genomic predictions based on target candidates; (4). Improved functional genomic tools via leveraging existing “omics” data; (5). Consolidated pipelines or statistical methods for genomic prediction (i.e. EPDs for feed efficiency, carcass and other performance traits, breed composition, retain hybrid vigor; multiple trait selection index); (6). A user-friendly window-based platform that integrates all components from data uptake, data analyses, to result reporting via a demonstration of using 1000 industry beef cattle.

- The proposed project capitalizes genomic tools developed by researchers and will significantly promote the application of genomic approaches to address challenges and opportunities of importance to the beef industry through partnership with service providers. The proposed project is aligned well with the Program Guidelines as the developed genomic platform would allow more beef producers to access the genomic tools to select genetic superior beef cattle to increase production efficiency and quality, and to reduce the environmental footprint (GHG) of livestock production systems.
- **Publications, presentations, articles and public outreach:**  
**Chen, L. 2020.** Technical note: Imputing genotypes to whole-genome sequence for Canadian cattle. University of Alberta, Feb 25, 2020.
- **General publications, presentations, articles and public outreach:**  
**Basarab, J.A. 2019.** Sustainable Beef. Alberta Beef, Forage and Grazing Centre Annual meeting. Feb 6, 2019.  
**Basarab, J.A. 2019.** Student Genome Research in a Class by Itself. Genome Alberta, Mar 1, 2019, <http://genomealberta.ca/livestock/student-genome-research-in-a-class-by-itself.aspx>  
**Basarab, J.A. 2019.** Feed efficiency and methane emissions. University of Alberta, Mar 29, 2019, Guest lecture to Animal Science 474/574 students  
**Basarab, J.A. 2019.** Future of genomics in the Canadian Beef Industry. Alberta Beef Producers, Jun 11, 2019, Invited presentation to Alberta Beef Producers AGM.  
**McAllister, T. 2019.** Strategies to improve the efficiency of beef cattle production, 2019 ASAS-CSAS Annual Meeting and Trade Show, Jul 11, 2019, Presentation at the 2019 ASAS-CSAS Annual Meeting and Trade, July 8-11, Austin, Texas, USA.  
**Basarab, J.A. 2019.** Future of Genomics in the Canadian commercial cattle sector. National Canadian Beef Industry Conference, CBBC, Aug 13, 2019. Invited presentation to CBBC Technical Forum, Canadian Beef Industry Conference.  
**Basarab, J.A. 2019.** Genome Alberta MLA Reception. Genome Alberta, Oct 28, 2019, David Bailey, CEO of Genome Alberta, introduced the Minister of Agriculture and

Forestry, the honorable Devin Dreeshen, and recognized the accomplishments of the gEPD Sustainable Beef Team (J.A. Basarab, G. Plastow, M. Miller).

**Basarab, J.A. 2019.** Sustainable Beef. Growsafe Systems Ltd., Dec 19, 2019, Invited presentation at Growsafe Systems employee seminar.

**Terry, S.A., Basarab, J.A., Guan, L., and McAllister, T.A. 2020.** Invited Review: Strategies to improve the efficiency of beef cattle production. Can. J. Anim. Sci., under review.

- **“Increasing the productivity in winter hardy alfalfa by selecting for reduced fall dormancy.” (PI: Vern Baron); in progress**
  - This project supports Goals 4 and 5
  - Alfalfa with reduced fall dormancy can grow later into the season, so it has higher yields. Alfalfa with higher winter hardiness survives the winter better. Winter hardy alfalfa usually has higher fall dormancy but these traits are genetically independent, so one should be able to select for winter hardy alfalfa with low fall dormancy.
  - Recurrent selection: The team will select Peace and Yellowhead alfalfa varieties for reduced fall dormancy, and test for freezing tolerance, researchers will then look for genes that respond to these selections. They will grow individual plants at long daylengths and warm temperatures, cut them, shorten the daylength and reduce the temperature, grow them again, and find the tallest plants. After three rounds of this, the tallest plants are crossed, and the cycle starts again.
  - Impact of recurrent selection: The resulting seed will be planted to evaluate grazing or cutting tolerance. These populations will also be tested for freezing tolerance by slowly freezing them at 4°C per hour to -22 through -36°C, thawing in the dark at -20°C, regrowing them for 3 weeks, and determining which varieties survive.
  - Genomic validation: Plots established in Normandin, Quebec City, Swift Current and Lacombe will be evaluated for yields, fall dormancy and winter hardiness and their stability in the different locations. Gene markers for freezing tolerance and fall dormancy that have previously been identified in Quebec will be validated in these western populations.
  - The new, improved varieties and others will be exposed to intense continuous grazing in Lacombe to see how they tolerate grazing, and tolerance to cutting frequency will be evaluated in Swift Current.
  - Freezing tolerance results: Freezing tests were conducted in January 2020 in Quebec. Results show that up to three cycles of recurrent selection for reduced dormancy did not affect the freezing tolerance within the cultivar Peace. However, freezing tolerance was reduced in response to a fourth cycle of selection PD4 as compared to PD0 and PD1. The response of cultivar Yellowhead differed: after the first cycle of selection Yellowhead’s freezing tolerance was reduced and remained at a similar level after subsequent selection cycles.
  - After three weeks of regrowth following the freezing test, the biomass was harvested, dried and weighed as an indicator of the vigour of the regrowth, and indirectly, of the dormancy of each population. These results showed that the regrowth of initial cultivar Yellowhead (YD0) was significantly lower than the regrowth of recurrently selected

populations (YD1, YD2, YD3, and YD4), indicating that the high freezing tolerance of population YD0 was linked with a high dormancy level. After the first cycle of selection, the yield and dormancy were improved. The spring regrowth of all populations will be assessed under natural spring conditions in early May 2020 at AAFC Quebec.

- Altogether, these results confirm that the method of selection for reduced dormancy is efficient and that higher yield could be expected, as was previously shown in the field. Furthermore, the level of freezing tolerance was not reduced even after three cycles of selection in Peace alfalfa. In Yellowhead alfalfa, the reduction of freezing tolerance resulting from recurrent selection was largely offset by a larger biomass yield.
- Performance of reduced dormancy in the field: Selection for freezing tolerance within existing high-performance cultivars appears to be an excellent avenue to improve yields in colder regions. Caribou TF3 with high regrowth and total dry matter yield was highly successful and Normandin and Lacombe, locations with generally moderate rainfall. At Normandin, Caribou TF3 had the highest plant survival to 2019; at Lacombe survival was slightly lower, but still comparable to Anik and Yellowhead. At Swift Current, Caribou TF3 had fewer live plants than either Anik or Yellowhead.
- Selection for lower dormancy in Yellowhead was successful for increasing regrowth yield and maintaining winter hardiness in all locations. Yellowhead D1 had increased regrowth yield and total yield over Yellowhead D0 at all locations, ranking as the best variety in Swift Current, a region where falcata types of alfalfa traditionally thrive.
- Selection for low dormancy within Peace alfalfa was not as successful. Perhaps dormancy in Peace was not low enough to observe large difference in yield between Peace D0 and Peace D1. Peace D1 appeared to be taller and more erect than Peace D0.
- Among the farmer field selections, all varieties had good winter hardiness. However, only Rhizoma and MV Blend were competitive with Yellowhead D1 and Caribou TF3 for regrowth yield and total yield. Among all cultivars and populations, Rhizoma was second best to Caribou TF3 at Lacombe.
- Demonstration trial carried out at Skeels' farm near Caroline, AB (Bruhjell and Baron): Alfalfa populations known to survive in Northern Alberta were collected and established as pure stands on Grey Wooded soil at Caroline, Alberta in 2013. Of the populations collected, only Yellowhead is registered as an alfalfa variety. MV Brand was sourced from Seaborn Seeds, Rocky Mountain House, AB, the others were sourced from seed producers in the Peace River region of Alberta. These are: Rhizoma (Allen Batt, Fort Vermillion, AB), Anik (Dave Bartlett, Fairview), Taproot Lundgard and Falcata Lundgard (Lundgard Seeds, Grimshaw, AB). Beginning in 2014, the plots were split in half, forming two blocks originally intended as management treatments. Both blocks were cut and harvested as hay in July of each year, and then one block grazed hard and intensively in September and the other block not grazed. These populations were genotyped and included in agronomy dormancy trials at all locations. The agronomic trials indicated that all of these populations had a Fall Dormancy (FD) < 2, ranging from 0.9 (very dormant) for Anik, Yellowhead and Falcata Lundgard to 1.7 for MV Brand. In general, these dormancy ratings correlated to fall yield potential. By 2016, encroachment into

the pure alfalfa stands by quackgrass and Kentucky bluegrass was substantial. Taproot Lundgard and Rhizoma survived better in competition with grass, occupying greater than 60% of the sward content after 4 years, whereas the highly dormant Yellowhead and Anik were almost totally out competed and winterkilled. Rhizoma and Yellowhead produced 2300 and 3400 kg ha<sup>-1</sup> of grass and alfalfa forage in a second cut or graze with 66 and 68% alfalfa, respectively after four years of growth, whereas only 17% of the Yellowhead plants remained in the stand by September. These populations offer local and regional solutions to poor alfalfa winter hardiness and fall production for the northern Prairies.

- This site continues to be analyzed to determine the impact of haying and livestock grazing on survival and persistence of the six alfalfa varieties.
- Funded by the Beef Industry Science Cluster
- **Publications, presentations, articles and public outreach:**
  - Bertrand, A., Claessens, A., Bourassa, J., Rocher, S, and Baron, V. 2019.** A whole-plant screening test to select freezing-tolerant and low-dormant genotypes. 7 pp in Hinch, Dirk K., Zuther, Ellen (Eds.) Plant cold acclimation. Methods in molecular biology series 2<sup>nd</sup> edition. Springer
  - Baron, Vern 2019.** Improving Late Season Alfalfa Yield. Pg. 2-3 Lacombe Research and development Centre Coffee Room News. May 2019.
  - Annick Bertrand, Annie Claessens, Solen Rocher, Vern Baron, Mike Schellenberg, 2019.** Luzerne: faut-il vraiment choisir entre survie à l’hiver et rendement? Chroniques du CQPF (Quebec Council of Forage Crops)
  - Bertrand, A., Claessens, A., Rocher, S., Lajeunesse, J. et Schellenberg, M. 2019.** Luzerne: faut-il vraiment choisir entre survie a l’hiver et rendement? Journee d’information scientifique – Boivins laitiers et plantes fourragères. 3 pp. Drummondville, Quebec. (Invited Presentation 265 people)
  - Baron, V.S. 2020.** Research progress in late-season pasture production and implications to future beef production in Alberta. Annual meeting of the Alberta Beef Forage and Grazing centre. Lacombe Research and Development Centre. Feb. 6 2020. 40 people.
  - Bruhjell, D. 2020.** Forages and soil health. BC Cattle producers meetings. Smithers, Feb. 7, Vanderhoof, Feb. 8 and Prince George, BC, Feb. 9, 2020. Role of legume regrowth and alfalfa projects discussed in the presentations with producers. 40 to 60 produces at each location.
  - McCartney, D. 2020.** Creating cold tolerant alfalfa. Canadian Cattlemen April 6, 2020 edition, Glacier Farm Media. Winnipeg, MB. 3 pp.
- **“Evaluating the potential interaction between efficiency types for backgrounding weaned cattle and silage varieties differing in feed quality.” (PI: Hushton Block); Completed 2019.**
  - This project focuses on supporting Goals 3 and 4 but builds off activities for Goals 1 and 3 and contributes to Goal 2.
  - In each of two years 128 steers were genotyped and ranked into quartiles by genomic predicted molecular breeding values for residual feed intake. Within each quartile, steers were randomized into 4 pens with 2 pens per quartile randomized to one of two

silage-based backgrounding diets. Silages used in backgrounding diets were selected using a forage evaluation spreadsheet. Supplements to address nutrient imbalances in silages were formulated on a least cost of gain basis and fed to steers for 112 d.

- Performance data collected from the feeding trial was used to evaluate accuracy of genomic predictions, compare silages for use in backgrounding and test for potential interaction between cattle efficiency type and diet quality, including an economic evaluation of treatments.
- Results indicate genomic prediction of RFI was imprecise with no relationship between genomic predicted molecular breeding value for RFI and observed pen average RFI. Use of observed pen average RFI found there was no interaction between observed cattle efficiency type and diet quality. There was a 33% (triticale silage) to 44% (barley silage) improvement in feed conversion (vs. the ABFGC benchmark of 11:1 for a forage-based diet) through silage variety selection and least cost of gain optimized diet formulation.
- Evaluation of trial results with nutritional requirement evaluation software (NASEM 2016) indicate that 3% of the improvement in feed conversion with the triticale silage-based diet vs ABFGC baseline was due to silage, and 97% was due to diet formulation. For the barley silage-based diet, 60% of the improvement in feed conversion was due to the silage and 40% was due to feed formulation. Improvement in feed conversion was estimated to result in a 29% (triticale silage) to 40% (barley silage) reduction in methane emissions intensity and a 19% (triticale silage) to 28% (barley silage) reduction in the total cost of gain during the backgrounding period. This is good progress against the ABFGC goal to reduce backgrounding costs by 50%.
- Updated economic analyses compared AgriProfit\$, Manitoba Cost of Production, ABFGC benchmarks, and silage trial economic assessments (for modelled silage only and actual silage diets). The actual (with supplement) triticale and barley diets were 15 and 25% lower than the ABFGC benchmarks (after adjusting the benchmark for cost of feed inflation) and the only assessment lower was the 2004 AgriProfit\$ (based on prices in 2004). When these assessments were extended to profit per steer basis, the actual triticale diet was essentially a breakeven, and the actual barley diet was the only one that resulted in a positive return (after labour). This suggests a need to rethink backgrounding in terms of what is being achieved and why it is being done as negative returns over enough different types of backgrounding systems and over a relatively long time frame indicates that either the way backgrounding is done needs a fundamental change, or the amount of backgrounding done should be minimized to reduce losses.
- Project funding (AAFC) ended in March 2019. Study results inspired two additional project concepts: “Evaluation of silage varieties and sorting methods for backgrounding steer calves”, and “Individually targeted cow-calf nutrition and management on pasture in support of a net zero carbon beef target.
- **Publications, presentations, articles and public outreach:**  
**Block, H. 2020.** Beef production research at the Alberta Beef, Forage and Grazing Centre. 2020 Beef and Forage Forum. February 24, 2020. Saskatoon, SK.

**Block, H., Baron, V., Basarab, J., Colyn, J., Khakbazan, M., and Li, C. 2019.** A comparison of barley and triticale silage-based diets for backgrounding steers. Presentation to International Triticale Symposium – Lacombe Tour. 19 July 2019. Lacombe, AB.

- **“Evaluation of silage varieties and sorting methods for backgrounding steer calves.” (PI: Hushton Block); in progress**
  - This project focuses on Goal 4 and contributes to Goal 2.
  - In response to favourable results from silage variety selection in “Evaluating the potential interaction between efficiency types for backgrounding weaned cattle and silage varieties differing in feed quality” an anticipatory backgrounding study was conducted to expand the silage variety consideration to include a corn silage variety selected on the basis of low CHU requirements, and to look and genetic (breed composition) vs phenomic (appearance and weight) based sorting of backgrounding cattle to reduce within pen variation in cattle performance.
  - Consideration of additional silage varieties has the potential to improve upon previous study progress towards ABFGC goals through improved crop production and cattle performance. Sorting strategies that reduce within pen cattle variation should allow more targeted nutrition and management contributing to both improved cattle production efficiency and beef quality.
  - A total of 118 steers were randomized two groups based on breed composition. In one group, steers were randomized to pens based on breed composition and weight. In the other group, steers were randomized to pens based on phenotype (colour, breed composition was ignored) and weight. There were 3 pairs of pens per sort treatment (12 pens total) and one of each pair was randomized to a barley silage or corn silage-based diet. Steers were backgrounded for 56 d with data collection on diet composition, feed intake, steer weight, and steer ultrasound backfat.
  - Very preliminary data analyses indicate an effect of sorting method on within pen variability. Effect of backgrounding diet has not yet been assessed.
- **“Individually targeted cow-calf nutrition and management on pasture in support of a net zero carbon beef target”. (PI: Hushton Block); in progress**
  - This project focuses on Goals 2 and 3.
  - Recent cattle management survey results (Sheppard et al. 2015) indicate very low use of supplemental feed, other than minerals, for cow-calf pairs on pasture. The cow-calf segment is the major source of methane related to beef production greenhouse gas emissions intensity (Beauchemin et al. 2010). Substantial improvement in feed conversion and reduction in modeled methane emissions were observed from the “Evaluating the potential interaction between efficiency types for backgrounding weaned cattle and silage varieties differing in feed quality” trial in response to providing a supplement to balance cattle nutrition. This creates incentive to address the challenge of providing targeted supplementation and improving management of cattle on pasture.
  - In each of 2 years, cow-calf pairs managed on a common pasture will be subject to either an un-supplemented (mineral only) or a more intensive supplemented (mineral, nutrition to compliment pasture, ionophores, anti-methanogen products via SmartFeed

- Pro, and implants for steer calves) treatment. Cattle weights and ultrasound backfat data will be collected and cows will be measured for methane emissions (GreenFeed). Cattle supplement (measured) and pasture (estimated from cattle performance and pasture quality) intake will be determined and used to assess improvement in cattle production efficiency and reduction in methane emissions intensity.
- Parallel to the grazing trial will be an effort to use automation and artificial intelligence to predict pasture quality, cattle requirements, and supplement formulation to allow application by producers without requiring intensive sampling or direct exposure to nutrition evaluation complexity.
  - Although the first year of the study encountered challenges in getting cows to use the SmartFeed Pro system for supplementation, there was good opportunity to collect forage quality, cow and calf weight and condition data to inform nutrient requirement evaluation. Calf performance data in particular revealed deficiencies in existing nutrient requirement models in regard to pre-weaning calf growth and nutrient requirements. However, the existing models may be reconfigured to address some of these deficiencies. Methane emissions data were collected, and preliminary results indicate faster relative growth rates for steer calves on the more intensive treatment.
  - This study was funded (AAFC) from April 2019 through March 2022. However, the response to COVID-19 has resulted in the second year of the study being deferred.
  - **General publications, presentations, articles and public outreach:**
    - Baron, V., and Block, H. 2019.** AAFC - Alberta Beef, Forage and Grazing Centre research. Presentation to DG (J. Boyd). 27 August 2019. Lacombe, AB.
    - Baron, V., and Block, H. 2019.** AAFC - Alberta Beef, Forage and Grazing Centre research. Presentation to ADM (G. Saindon). 12 September 2019. Lacombe, AB.
    - Block, H. 2019.** BCRC fertility – DMI project meeting. BCRC Project Meeting. 30 May 2019. Lacombe, AB.
    - Block, H. 2019.** Beef production systems research program. AAFC-AAC Lacombe/Beaverlodge Coffee Room News. July 2019. Science Updates. Pages 3-4.
    - Block, H. 2020.** Beef production research at the Alberta Beef, Forage and Grazing Centre. GrowSafe Systems Tour. 12 July 2019. Lacombe, AB.
    - Block, H. 2020.** Objective 2: Mature cow DMI vs. DMI, RFI and growth as a heifer. BCRC Project Meeting. Edmonton, AB. 18 February 2020.
    - McCartney, D. 2019.** Wintering the herd. Canadian Cattlemen. September 2019. Pages 18-21. Contribution to producer magazine article.
  - **“Improving lipid content in vegetative tissue to increase the nutritive value of herbaceous legume forages.” (PI: Surya Acharya); in progress**
    - This continuation of a previous project supports Goals 1, 4 and 5 and intends to 1) determine the stability of increased lipid content and altered fatty acid composition in subsequent generations of mutagenized forage crops; and 2) examine the potential of applying CRISPR/Cas9 on lipid metabolism.
    - The expected project deliverables will be to: 1) identify stable alfalfa and sainfoin populations with increased lipid content (about 5% on dry weight basis) in shoot tissues

- to increase nutritive value and energy content of forages without losing biomass productivity or other agronomic and nutritive constitution for which these crops are favoured; and 2) improve our knowledge base regarding the regulation of lipid metabolism in herbaceous perennial legumes
- Funded by ABP and SCA
  - **“Long-Term Agricultural Experiments Directory Project at Onefour, Kinsella and Stavely” (PI: Darren Bruhjell); in progress**
    - Supports Goals 2 and 5
    - A component of the Soil Health Institute North American, “Long-Term Agricultural Experiments Directory” Project.
    - Once compiled, this database will be made publicly accessible for building teams and planning agricultural research requiring inter-institutional collaboration on a large scale, including soil health. Analysis is currently ongoing.
    - Forage productivity data at Onefour continues to be collected. This data has been collected since the 1920s and has been published twice.
    - Historical Onefour permanent plot plant species and cover information collected from the 1920s to the 1940s has been digitized. These plots will be remeasured and compared to climactic data to asses change in the dry mixed grass prairie. Data will be shared with other institutions and entered into a network of long-term North American monitoring sites.
    - Soil health analysis comparing different prescribed fire intervals in Kinsella were conducted in 2019. Limited data suggests that increased fire frequency may increase carbon capture in some Aspen Parkland soils.
  - **“Development of native and tame forage varieties and mixtures for improved forage and environmental productivity and resilience” (PI: Mike Schellenberg); in progress**
    - Supports Goals 2 and 5
    - The project will develop new tame forage varieties and native plant germplasm and evaluate additional tame grass species.
    - The main focus will be on improved grazing characteristics such as regrowth and persistence across 4-5 different sites. The project will also evaluate forage traits such as forage yield and forage quality.
  - **“Improving grazing capacity through introduction of bloat free legumes in existing pasture stands” (PI: Bart Lardner); completed**
    - Supports Goals 2, 3, 4 and 5
    - Funded by ABP and ADF.
    - Drought conditions affected both study sites in multiple years, which certainly impacts results. The specific sainfoin or cicer milkvetch variety did not affect yield, quality, intake or animal performance at either location.
    - The pastures sod-seeded with sainfoin decreased over the three-year study from 10% to 2% of stand composition, while cicer milkvetch increased from 11% to 14% at Lanigan. At Lethbridge, the pastures sod-seeded with sainfoin decreased over the three-year

- study from 47% to 16% of stand composition, and cicer milkvetch also decreased from 45% to 8%.
- Dry matter yield increased by about 14% when incorporating sainfoin or cicer milkvetch into the existing stands. The inclusion of legumes also increased protein content by just over 2%, and decreased neutral detergent fibre by about 7%, though total digestible nutrients did not differ. The steers at the Lanigan location gained 0.44 lbs/day more than the steers on the control pastures, but at Lethbridge, gains were similar. Inorganic nitrogen levels were 55% greater in sod-seeded sainfoin and cicer milkvetch pastures compared to the control pastures, but after three years of grazing, inorganic nitrogen levels were similar between control and sod-seeded pastures.
  - Differences in rumen fermentation characteristics were discovered between types of forages. Acetate to propionate ratio was lower for cicer milkvetch than for sainfoin and control and total propionate concentration was also increased for cicer milkvetch. Methane production decreased from 33.25 L/kg dry matter intake (sainfoin) and 36.59 L/kg dry matter intake (control) to 28.16 L/kg dry matter intake for cicer milkvetch.
  - The cost of sod-seeding was recovered after three years at Lanigan when the return was estimated as dry matter yield valued at the three-year average price for standing hay (\$0.046/kg).
  - **“Effects of annual and perennial forage systems on plant and soil parameters, grazing animal performance and system economics” (PI: Bart Lardner); in progress**
    - Supports Goals 2, 4 and 5
    - Funded by ABP, SCA and ADF.
    - In 2018, two perennial treatments were established, the PERENNIAL FORAGE SYSTEMS included: (1) AC Success hybrid bromegrass- + PS3006 alfalfa mixture [7+3 kg/ha seed rate]; and (2) AC Armada meadow bromegrass + AC Glenview sainfoin mixture [7+16 kg/ha seed rate]. PERENNIAL Mixtures were established in 2018. All mixtures then managed for weed pressure, persistence and biomass in 2019, 2020, 2021 and 2022.
    - In spring 2019, two annual systems were seeded, the ANNUAL FORAGE SYSTEMS will include 45 acres (18 ha) each of either; (3) AC Hazlet fall rye + Frosty Berseem clover mixture [7+1 kg/ha seed rate]; and (4) Winfred (kale/turnip) + Gorilla forage brassica + Performance 4010 forage pea mixture [2+2+6 kg/ha seed rate] + Austenson barley. ANNUAL mixtures will be established each yr and managed for weed pressure, persistence and biomass.
    - Soil samples were collected prior to spring planting and again in the following spring. Samples were taken at six different locations in each paddock; three in upper slope positions and three in lower slope position
    - Forage DM biomass, botanical composition was evaluated in each replicate paddock by clipping 40, 0.25 m<sup>2</sup> quadrats. All samples were dried, ground and will be submitted for lab analysis including CP, ADF, NDF, NEm, NEg, TDN, OMD, Ca and P.
    - In 2019 (yr 1), 108 stockers (~400 kg) (n=9/replicate group) grazed for 40 d to determine ADG and body weight (BW) per hectare. Cattle were weighed over 2 d at start + end of study period, and every 14 d throughout grazing period. Average daily gain (ADG) was

determined using start/end steer BW/replicate paddock (Table 2).  $BW \text{ gain/ha} = ADG \times AGD$ , where  $AGD = [\Sigma (\text{animal unit equivalent} \times d \text{ on pasture})] / \text{pasture area}$  will also be determined. Dry matter intake will be estimated using a well-published pre + post-graze herbage biomass technique (Jasmer and Holechek 1984; Volesky et al. 2002) to determine kg per day consumed forage.

- Enteric GHG emissions (CH<sub>4</sub>, CO<sub>2</sub>) from grazing animals was measured using 2 methods (i) SF<sub>6</sub> tracer gas technique (CH<sub>4</sub>); (ii) C-Lock Greenfeed Emission Monitoring (GEM) (CH<sub>4</sub>, CO<sub>2</sub>, O<sub>2</sub>) system, during year one grazing period.
- Economic analysis will include calculating the cost of each forage system including establishment and returns per ha.

## Proposals Written

- Agricultural Development Fund, Saskatchewan government. Hybrid Rye as a new forage source for beef cattle. Collaborator with Dr. Greg, Penner. Assisted writing of proposal through LOI and full proposal. Awarded \$298,000.
- Genome Canada; The omics of grazing: A path forward to cattle productivity, ecosystem goods and services and long term sustainability. Assisted in writing LOI and participated in workshops for full proposal Edmonton, May 10, 2019.
- SMART grazing: Integrating new forage species into year-around grazing with automated cow performance assessment. Lead LOI proposal to BCRC, ABFGC Collaborator: Hushton Block, but project not funded.
- Forage potential of hybrid rye in Alberta and Saskatchewan. Lead LOI and full proposal to BCRC and received funding \$88,000 from BCRC and \$20,000 from FP genetics and KWS.
- Nutritional Evaluation of Wheat Forage Varieties for Silage. Collaborator for LOI and full proposal. Led by Y. Wang, Lethbridge. Other collaborators: McAllister, AAFC, Hucl and Biligetu, U. of SK.
- Sea Beef: Evaluation of Mazzaella Japonica as a Ruminant Feed Additive. Project Lead: Edgar Smith (Beaver Meadow Farm), External collaborator: Hushton Block. Resubmitted by Thompson Rivers University (below).
- Purchase & Pilot of Greenfeed Emissions Detector for TRU & the BC Beef Industry. Project lead: John Church (Thompson Rivers University), External collaborator: Hushton Block. Resubmission of proposal initially lead by Edgar Smith with change in project lead. Awarded.
- Beef feeding strategies for carbon neutrality during backgrounding while enhancing overall performance, beef quality and healthfulness. Collaborator. Project Lead: Mike Dugan, Collaborator: Hushton Block
- FDE.04.19 Targeted pre-/post-weaning nutrition for efficient growth of beef calves. Project Lead: Hushton Block.
- FRG. 20.19. The e(nvironmental) proteome: connecting plant and microbial metaproteomes in cattle under different production systems. Project Lead: Leluo Guan, Collaborator: Hushton Block

## General Extension Activities

- A tour was hosted by the Centre on August 7, 2019. We toured Mastin Seeds where we discussed connecting variety development to producer priorities. Over lunch, Kristine Dahl presented an update on the Rancher Researcher Pilot Project, and Jessica Grenke from the U of A updated the group on the Adaptive Multi Paddock Grazing project. Then we viewed Morrie and Debbie Goetjen’s water improvements made through the Rancher Researcher Pilot – a true example of adapting innovations at the farm level. Afterwards feedback was solicited from participants about how the role of the Industry Advisory Committee could be improved, if the Centre goals are still relevant, and how the Centre provides value.
- Forage extension events hosted by the BC Forage Council occurred in Smithers, Vanderhoof, and Prince George. Topics included grazing and haying principles, soil health, soil testing and cow-calf economics.
- An initiative entitled “Cows and Chaos” resulted in the delivery of over 15 webinars by AAF and applied research association staff. The webinar format was well received by producers across the province. The topics addressed supported all the Centre goals, including topics like options for managing pastures during drought, grazing alternatives, feed testing, and fall/winter feeding strategies.

## Communications

- Updates were provided to the AFIN and ARECA annual meetings, as well as a written update to the Grey Wooded Forage Association. Regular updates are provided to ABP’s research committee. Extension tools are promoted through all of the communication channels available to Centre stakeholders
- The ABFGC twitter account has 174 followers: <https://twitter.com/ABForageBeef>, but currently lacks an administrator after the departure of Karin Lindquist
- The ABFGC website is finally up and running at [abfgc.albertabeef.org](http://abfgc.albertabeef.org)