Peace Region Forage Cultivar Testing (PRFCT) Program

Coordinated by

Peace Region Forage Seed Association
and
Agriculture and Agri-Food Canada
Beaverlodge Research Farm, Alberta

Annual Report 2018

Prepared by

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Acknowledgments

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Barenbrug USA
BrettYoung
Deutsche Saatveredelung AG (Imperial Seeds)
DLF Moore Seed
Foster's Seed & Feed Ltd
Limoges Forage & Grasses Ltd
Northstar Seed

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Protocol for Peace Region Forage Cultivar Testing (PRFCT) Program

Updated - March 11, 2018

1. Research Sponsorship

The research sponsorship of **$350 CAN/entry/year/location** is requested on an annual basis, as years of production will vary with the species being tested and applies to the establishment year as well. The Peace Region Forage Seed Association (PRFSA) will administer funds for the Peace Region Forage Cultivar Testing Program. The PRFSA General Manager will invoice each seed company annually.

2. Eligibility of Entries

Released and experimental lines of all tame and native grass species will be considered if they are of interest to commercial seed companies. We reserve the right not to initiate tests:

- if seed arrives late
- if there is lack of space in any year at a particular location
- if there are too few entries in any year for a particular location
- if the germination percentage of the seed is less than 75%

3. Seed Requirements and Deadline for Seed Entry

The applicant will provide for **EACH TEST LOCATION**:

- 50 gm of bentgrass, Kentucky bluegrass or timothy
- 100 gm of orchardgrass, fescues - creeping red, chewings, hard, meadow, sheep or tall fescue; annual or perennial ryegrass
- 200 gm of bromegrasses – meadow, smooth, hybrid, and wheatgrasses
- The germination percentage of each cultivar

Approved seed entries shall be supplied by **April 1st** of the establishment year and **will include the percent germination and relative maturity** (early, medium or late) of each cultivar. Please indicate whether the submission is **a forage or turf type**.

Please ship approved seed to*:

Peace Region Forage Seed Association
904 102 Ave
Dawson Creek, BC V1G 2B7

*** European companies submitting entries need to ship their seeds to their US or Canadian head office then to the PRFSA. Seed shipped from the US to Canada needs to be accompanied by all phytosanitation paperwork to clear customs.**

4. Publication of Results

Data will undergo appropriate statistical analysis and each applicant will be provided with an annual report. Information on cultivars will be made available to seed producers upon request. Results will be posted by the end of the fiscal year on the research page of the website www.peaceforageseed.ca

All reasonable care will be taken to ensure a successful test; however, a guarantee cannot be made that a particular test will be successful. If required a test will be reseeded.

The cultivars will be tested for two harvest seasons after the establishment. Cultivar performance is reported in terms of biomass and seed yields for each harvest season. In some cases, data may not be reported due to extreme variations that cannot be accounted for in the statistical design.

Disclaimer

Reference to commercial products or trade names is made with the understanding that no discrimination is intended, and no endorsement is implied.

5. Use of Seed

Seed submitted will only be used to establish the agreed upon trials. The seed will **NOT** be used for increase, selection or distribution.

2019 Application for PRFCT Entry

Company: **Telephone:**

Contact person: **Fax:**

Mailing address: **Email:**

Species	Cultivar Name/Code	Type Forage/Turf	Relative Maturity Early/Medium/Late	% Germination

Send application form no later than March 31, 2019 to:

Nityananda Khanal
Beaverlodge Research Farm
Agriculture and Agri-Food Canada
P.O. Box 29, 1 Research Road
Beaverlodge, AB T0H 0C0
Telephone: 780 354 5111
Email: Nityananda.Khanal@canada.ca

Or

Talon Gauthier
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Executive Summary

Agriculture and Agri-Food Canada (AAFC) - Beaverlodge Research Farm and Peace Region Forage Seed Association (PRFSA) have established a long-term collaboration through various industry-led research and development projects, including the on-going Canadian Agricultural Partnership – Agri-Science projects. This report presents the results of various forage and turf grass cultivars that were evaluated for seed yield for 2017 and 2018 crop seasons.

Various cultivars of creeping red fescue (*Festuca rubra* L. var. *rubra*), meadow fescue (*Festuca pratensis* Huds.), tall fescue (*Festuca arundinacea*), crested wheatgrass [*Agropyron cristatum* (L.) Gaertn.], northern wheatgrass [*Agropyron dasystachyum* (Hook.) Scribn.], meadow bromegrass (*Bromus riparius* Rehm.), smooth bromegrass (*Bromus inermis* Leyss), hybrid bromegrass (*Bromus riparius* × *Bromus inermis*), timothy (*Phleum pratense* L.), red clover (*Trifolium pratense* L.), alsike clover (*Trifolium hybridum* L.) and alfalfa (*Medicago sativa* L.) were tested for their seed yield in comparison to popular cultivars of respective species in the region. The forage grass cultivars and the checks included in the trials were received from various Canadian and international seed companies and their foreign affiliates including Foster's Seed & Feed Ltd, Limoges Forage & Grasses Ltd, BrettYoung, DLF Moore Seed, Northstar Seed and Barenbrug USA.

During the reporting, one trial each of creeping red fescue, tall fescue, meadow fescue, bromgrasses and wheatgrasses was concluded, while one trial each of creeping red fescue, tall fescue and timothy underwent the evaluation for first crop year in 2018 and is subjected to further evaluations in the coming season in 2019. Variable weather patterns in different years provided desirable test environment for examining the adaptability of the cultivars in the Peace region. From the concluded trial of creeping red fescue, seed yield is the major trait of economic interest for creeping red fescue, provided the cultivars have similar end use quality – the turf. Based on the seed yield performance of two crop seasons, creeping red fescue cultivars Chanellor and BAR FRR 15134 perform promisingly, standing on par with Boreal. The test cultivars of tall fescue in the 2016-established trial showed less adaptability to Peace region compared to Courtenay for the seed yield. Their seed yield performance lagged far behind the check cultivar Courtenay. The meadow fescue test cultivars BAR FP 32 and Pradel showed adaptability to the Peace region. Their seed and biomass were comparable to the check cultivar Preval. The bromegrass cultivars AC Knowles, S9356M outperformed all test entries including Fleet and Carlton. However, for biomass production Carlton, S9356M and AC Knowles were comparable. Seed yields of all wheatgrass cultivars were poorer compared to other grasses such as fescues and bromegrasses and compared to wheatgrass seed yields in the lower latitudes. Further improvement in wheatgrass populations may be necessary for adapting cresting wheatgrass as viable seed crop in the Peace region.

The end use value in bromegrasses, crested wheatgrasses, meadow fescue, tall fescue, and timothy lie on the forage biomass quantity, nutritive values and stand persistence. Except for the case of wheatgrasses, all species under evaluation showed positive correlations between seed yield, biomass and plant heights. That means high seed producer cultivar also produces higher biomass for livestock feed and other uses.

INTRODUCTION

Endowed with extensive northern agricultural frontier with varied micro-climates, the Peace River region of Canada offers good potential to produce high quality seeds of forages and turf grass for the domestic and export market. About 25,000 metric tons (55 million lbs.) of forage and turf grass seeds are sold annually from this region. Use of regionally adapted cultivars with appropriate management practices conforming to the national and international standards are crucial factors underlying the successful seed industry.

Agriculture and Agri-Food Canada (AAFC) - Beaverlodge Research Farm and Peace Region Forage Seed Association (PRFSA) have been working together through collaborative projects for improving forage seed production systems in the Peace Region. One of the collaborative platforms is Peace Region Forage Cultivar Testing (PRFCT) program (originally known as Western Grass Seed Testing Program) which has been operation through Growing Forward to the Canadian Agricultural Partnership launched by the Government of Canada. The primary objective of the PRFCT program is to evaluate the adaptability, productivity and quality of public and proprietary forage cultivars originated from U.S.-based and European companies for contract seed production in western Canada.

This report presents the results of various forage and turf grass cultivars that were evaluated for seed yield for one and two crop seasons from 2017 to 2018. Various cultivars of creeping red fescue (*Festuca rubra* L. var. *rubra*), meadow fescue (*Festuca pratensis* Huds.), tall fescue (*Festuca arundinacea*), crested wheatgrass [*Agropyron cristatum* (L.) Gaertn.], northern wheatgrass [*Agropyron dasystachyum* (Hook.) Scribn.], meadow bromegrass (*Bromus riparius* Rehm.), smooth bromegrass (*Bromus inermis* Leyss), hybrid bromegrass (*Bromus riparius* × *Bromus inermis*), timothy (*Phleum pratense* L.), red clover (*Trifolium pratense* L.), alsike clover (*Trifolium hybridum* L.) and alfalfa (*Medicago sativa* L.) were tested for their seed yield in comparison to popular cultivars of respective species in the region. Adaptability and performance testing of cultivars of different geographical origin is advantageous for both seed companies and producers for making informed contractual decisions.

MATERIALS AND METHODS

The PRFCT trials were conducted at AAFC's Beaverlodge Research Farm, AB (55° 11´ N, 119º 32´ W; dark gray luvisolic soil of BERWYN series) from 2016 to 2018. A total of 68 proprietary and public entries of different forage and turf grass species from various origins were evaluated in this period. The number of grass species entries included 38 of creeping red fescue, three of timothy, two of meadow fescue, five of tall fescue, nine of wheatgrasses and four of bromegrasses, which were tested for seed yield in comparison to popular cultivar of respective species in the Peace region (Table 1). Similarly, legumes cultivar testing included 4 entries of red clover and 2 of alsike clover being compared with a single entry of alfalfa elite line. The forage grass and legume entries included in the trials were originated or received from AAFC, and various Canadian and international seed companies and their foreign affiliates including Barenbrug USA, BrettYoung, Deutsche Saatveredelung AG, DLF Moore Seed, Foster's Seed & Feed Ltd, Limoges Forage & Grasses Ltd, and Northstar Seed.

Table 1. List of forage and turf grass cultivars from various proprietors tested during the reporting period.

Forage species	Year of seeding	Seed sources	No. of Entries	Cultivars	Year of evaluation
Creeping Red Fescue	2016	Barenbrug USA	1	BAR FRR 15134	2017 - 2018
		Foster's Seed & Feed	3	C8-14-4ED4, Chanellor Chewings, C8-14-4BEN	
		Imperial Seed	3	DSV 15-01, DSV 15-02, DSV 15-03	
	2017	BrettYoung	4	BY-676, BY-369-13883, BY-2889, BY17-8070	2018 - 2019
		DLF Mooree Seed	7	MSP-03-17, MSP-06-17, MSP-07-17, MSP-08017, MSP-02-17, MSP-04-17, MSP-05-17	
		Foster's Seed & Feed	3	Fosters FX, Fosters FO	
	2018	BrettYoung	2	BY-2889, BY17-8070	2019 - 2020
		DLF Moore Seed	3	BY17-8070, MSP-05-17, MSP-06-17	
		Foster's Seed & Feed	12	2018-01, 2018-01, 2018-02, 2018-03, 2018-04, 2018-05, 2018-06, 2018-07 2018-08, 2018-09, 2018-10, 2018-11, Foster-FO	
Timothy	2017	Northstar Seed	3	NSE1701, NSE1723, NSE1730	2018 - 2019
Wheatgrass	2016	Limoges Forage & Grasses	4	**Crested:** Kirk, AC New Kirk, Fairway; **Northern**: Elbee	2017 - 2018
		Barenbrug USA	1	**Creeping:** BAR-GRL-CWG	
	2018	Limoges Forage & Grasses Ltd	4	**Crested:** Kirk, AC New Kirk, Fairway**; Northern:** Elbee	2019-2020
Bromegrass	2016	Barenbrug USA	2	**Meadow:** BAR BCF 1FRRL; **Smooth:** BAR BIF 1GRL	2017-2018
	2016	AAFC	2	**Meadow:** S9356M; **Hybrid:** AC Knowels	
Tall Fescue	2016	Barenbrug USA	4	BAR FA 11701, BAR FA 14173-11, BAR FA 14173-15, Bariane	2017 - 2018
	2017	Foster's Seed & Feed	5	Titan Rx, Titan Ultra, Covenant, Rendition RX, Hudson	2018 - 2019
Meadow Fescue	2017	Barenbrug USA	2	BAR FP 32, Pradel	2018 - 2019
Alfalfa	2018	AAFC	1	CRS1001BWR	2019 - 2020
Alsike Clover	2018	DLF Moore Seed	1	Menta	2019 - 2020
		AAFC	1	CRS-111	
Red Clover	2018	DLF Moore Seed	1	Jancio	2019 - 2020
		AAFC	3	A.C Christie, CRS32, CRS33	

As perennial species, the forage seed crops comprised an establishment year followed by two or more seed production years, referred to as crop years. For the PRFCT, all forage cultivars are evaluated for two crop years for seed production. The experimental site at Beaverlodge is maintained under annual crop sequences such as pea-barley-wheat-canola, in the preceding years prior to the establishment of forage cultivar trials. The forage crops are direct-seeded without tillage. Fertilizers are applied in the fall on the basis of soil test results. Weeds are controlled by a combination of mechanical and chemical measures with the application of recommended herbicides. Individual experimental units comprise of four rows of 6 m length, spaced 30 cm apart. The yield samples are collected from the central two rows.

The experiments are laid out in a randomized complete block with four replications. The data are analyzed by using GLIMMIX, CORR and Means Procedures of SAS® 9.4 System. A single year results are analysed using randomized complete block design (RCBD) GLIMMIX and two years data on the same stand are analysed RCBD repeated measure GLIMMIX procedure.

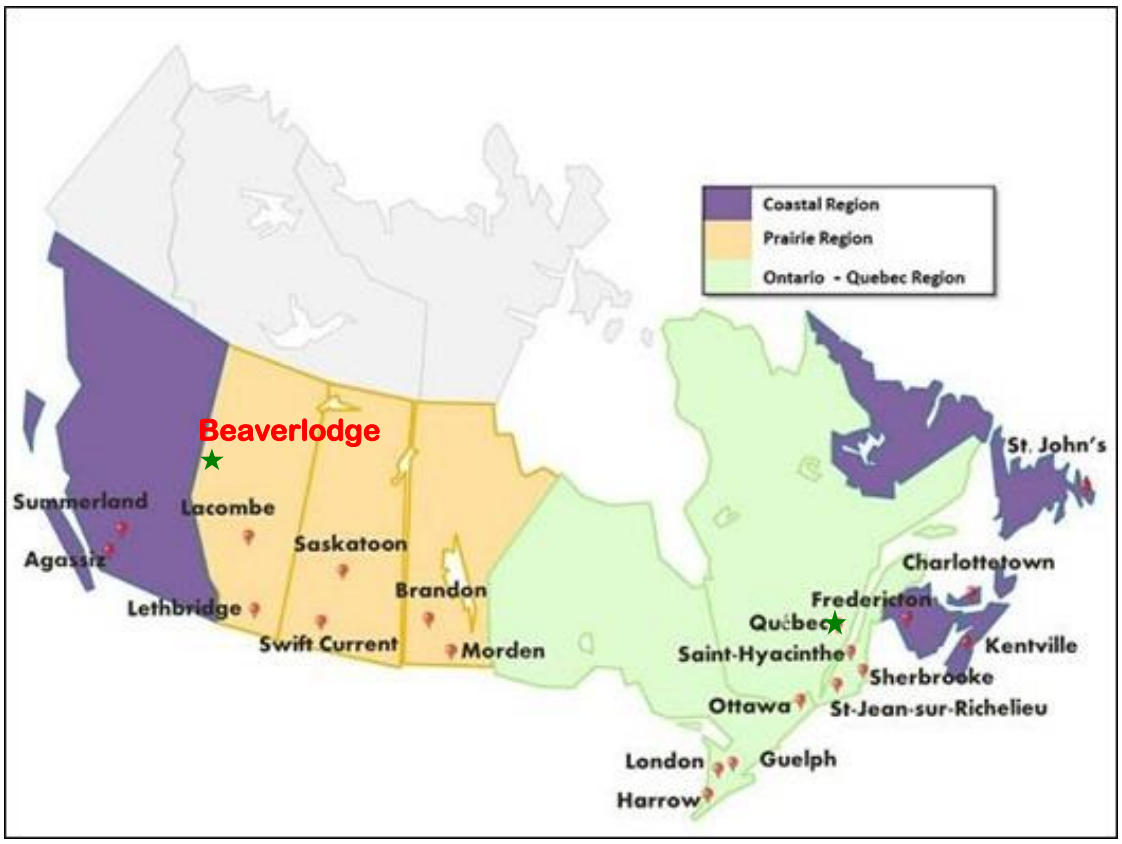

Figure 1. Map of Canada showing the locations of Beaverlodge Research Farm and other AAFC Research and Development Centres.

RESULTS

Weather effects on crops

The results included in this report were derived from trials that were established in 2016 and 2017. Despite some anomalies of the May and October temperatures over the reporting years from 2016 to 2018, the monthly maximum and minimum temperatures in other growing months displayed similar patterns with long-term average for last 30 years (Figure 2). However, the amount and distribution of precipitation showed noticeable monthly variation in growing seasons over the reporting period. In 2016, May and July were moderately dry, while June and August were wet months compared to the long-term average. In contrast, in 2017, May was wetter, and rest of the season was drier than normal. The wetter spring followed by gradual decline in precipitation over the months caused some moisture stress during reproductive stage, while permitting favorable dry harvest conditions in 2017. The 2018 growing season is characterized by much drier May, drier June-July and wetter August, compared to long-term average. The variable weather conditions over years are one of the major factors causing fluctuations in productivity.

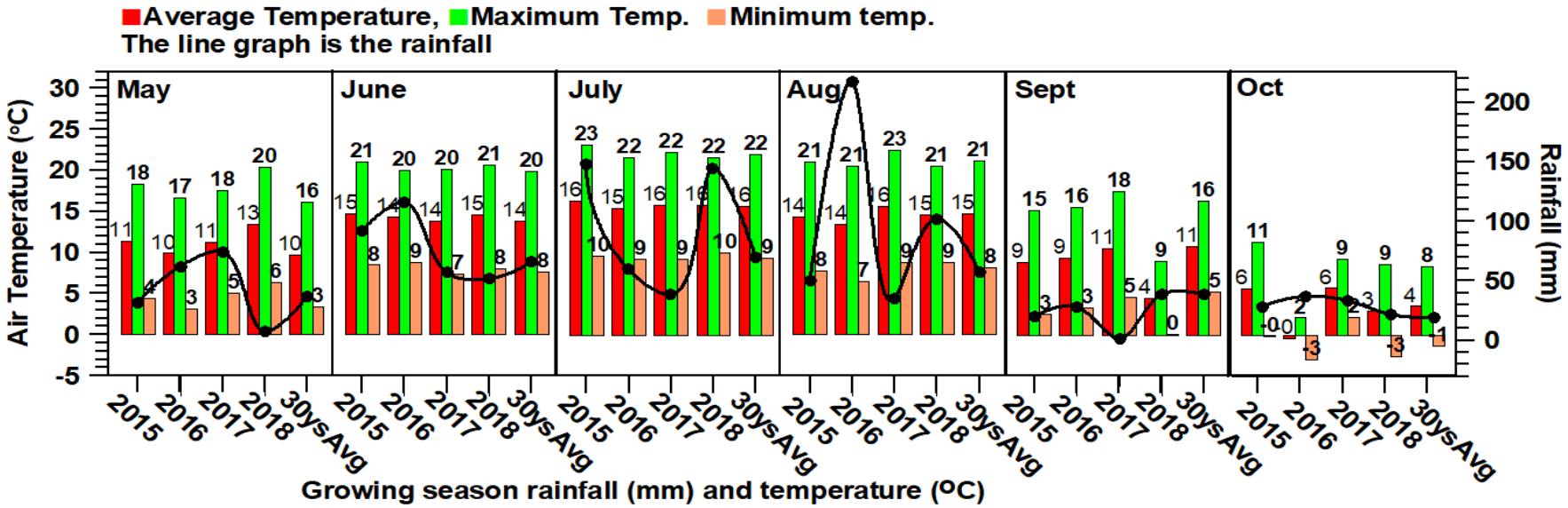

Figure 2. Average monthly maximum and minimum temperature and total monthly rainfall during the growing seasons of 2015 to 2018 compared with 30-years (1989-2018) monthly average at Beaverlodge, AB.

Results of completed trials

Creeping Red Fescue

Seven proprietary cultivars of creeping red fescue received from Foster Seed & Feed, Barenbrug USA and Deutsche Saatveredelung AG were compared with the legendary cultivar Boreal. The seed yields of the cultivars differed significantly (p <.01). Boreal with the highest cumulative mean seed yield was on a par with Chanellor and BAR FRR 15134. Boreal and Chanellor yielded significantly higher than the rest of the five cultivars, while BAR FRR 15134 stood on a par with DSV1503 and DSV1501 (Table 2). Two-year cumulative seed yields of C814-4BEN, C8-14-4EDN and DSV1502 were less than the cumulative experimental mean (896 kg acre^{-1}). A photograph of the first crop year in 2017 is presented in Figure 3.

Table 2. Seed yield, plant height and dry matter yield of creeping red fescue cultivars in 2017 and 2018 crop season from the trial established in 2016 at Beaverlodge, AB. The trial was seeded on May 26, 2016 and harvested on July 24, 2017 and July 26, 2018 for first and second crop year respectively.

Company	**Cultivar**	**Plant height**		**Dry matter yield**		**Seed yield**						
		2017	2018	2017	2018	2017	2018	Mean	2017	2018	2017	2018
		cm		kg ha^{-1}		kg ha^{-1}			lb ac^{-1}		% of check	
Barenbrug USA	BAR FRR 15134	67	43	3068	1248	995bc	176a	585ab	888	157	84	169
Foster Seed & Feed	C814-4BEN	69	43	3223	1068	562f	44e	303e	502	39	47	42
	C8-14-4EDN	64	42	3252	987	776de	90cd	433cd	693	80	65	87
	Chanellor	80	54	4265	1574	1152ab	93bcd	622a	1028	83	97	89
Deutsche Saatveredelung AG	DSV1501	77	56	3861	1476	896c	121b	509bc	800	100	76	116
	DSV1502	75	52	3527	1220	709ef	65ed	387d	633	58	60	63
	DSV1503	79	58	4083	1443	987c	85cd	536b	882	76	83	82
Check	Boreal	81	58	4263	1853	1185a	104bc	644a	1058	92	100	100
	CV%	2.0	4.1	6.0	9.0	8.6	14.6	8.2				
	LSD $_{0.05}$	3.6	4.3	443	309	162.9	29.6	83.3				

Figure 3. Photograph taken in 2017 of creeping red fescue trial established in 2016 at Beaverlodge, AB.

The seed yields of all cultivars in the second crop year in 2018 were very low, accounting for only 9 to 18% of the yield of first crop year ($p < .01$). There was a significant cultivar-by-crop year interaction ($p < .01$), suggesting the differential ranking in seed yield between the crop years (Figure 4). Cultivar BAR FRR 15134 showed better yield stability with the yield with second crop yield being 18% of the first crop year. Average plant heights of the cultivars ranged from 64 to 81 cm in the first crop season and 42 to 58 cm in the second crop season, with all cultivars showing impaired growth in the 2018 harvest season (Table 2). Moisture stress due to exceptionally low precipitation in May 2018 and less than average precipitation in June and July 2018 can explain the results.

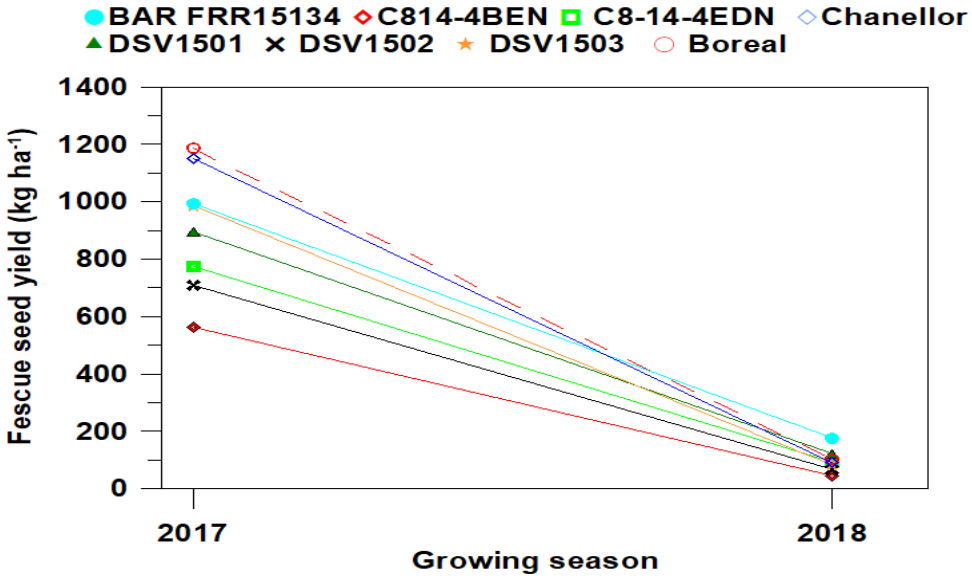

Figure 4. Seed yield trend of creeping red fescue cultivars in two consecutive crop seasons of 2017 and 2018 from the trial established in 2016 at Beaverlodge, AB.

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As in the previous years, the seed yield, dry biomass and plant heights were positively correlated in creeping red fescue. Significant correlations were observed between seed yield and biomass (r = 0.95; p = <.01), between seed yield and plant height (r = 0.88; p = <.01), and between biomass and plant height (r = 0.93; p = <.01) (Figure 5).

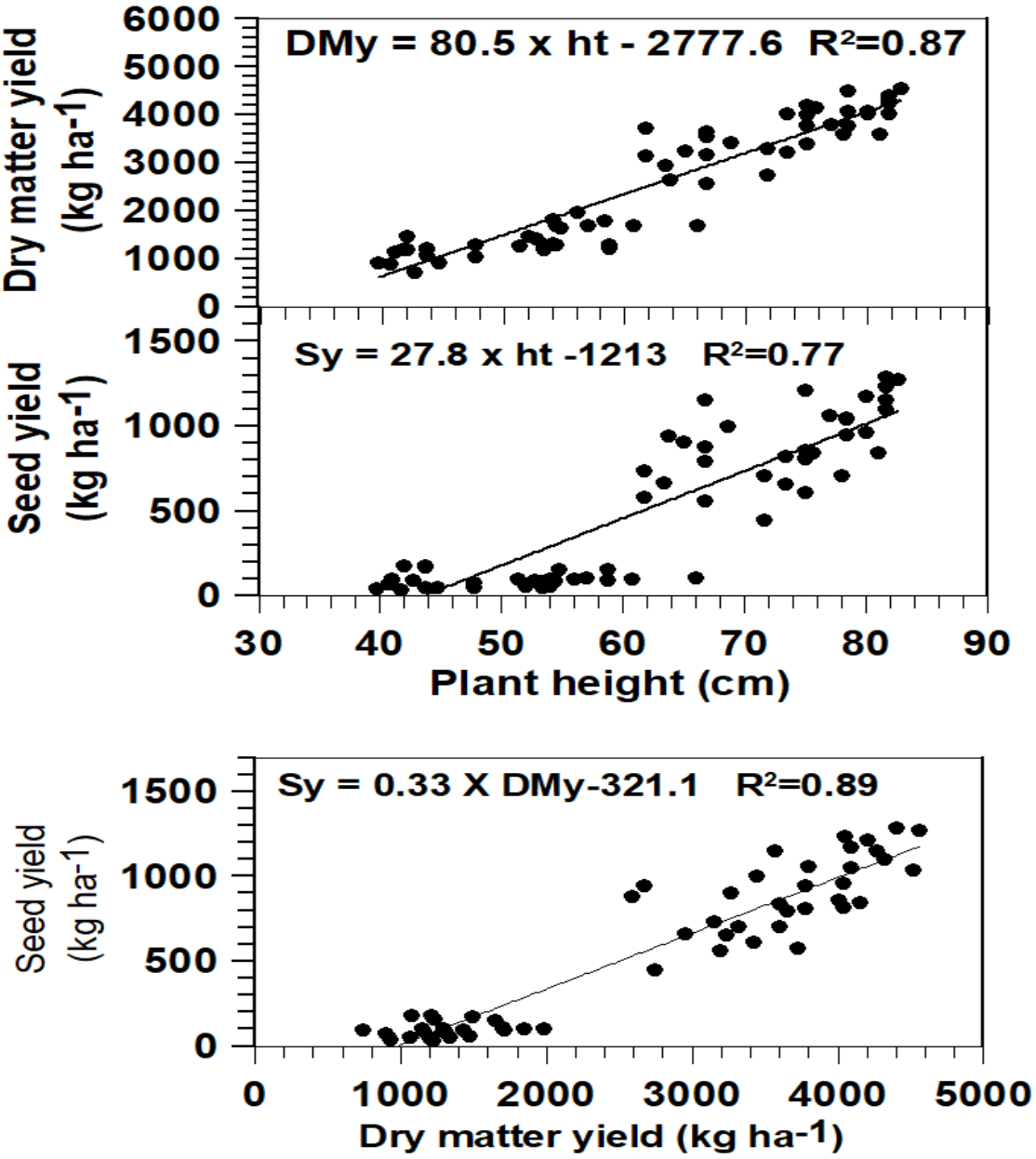

Figure 5. Correlations between plant height (ht), dry matter (DMy) and seed yield (Sy) of creeping red fescue in 2017 and 2018 crop season from the cultivar trial established in 2016 at Beaverlodge, AB. Abbreviations: DMy = Dry matter yield; Sy = Seed yield; ht = plant height.

Tall fescue

The tall fescue trial established in 2016 included four cultivars from Barenbrug USA being compared with the check – Courtenay. With the evaluation in two consecutive seasons in 2017 and 2018, this report concludes the results of this trial. Figure 6 is a snapshot of the trial in 2017.

The tall fescue test cultivars showed less adaptability to Peace region compared to Courtenay for the seed yield (Table 3). Courtenay had significantly higher ($p < 0.01$) cumulative seed yield for two consecutive crop seasons followed distantly by BAR FA 11701 and Bariane with 38% and 40% less yield than that of Courtenay. Other two cultivars BAR FA 14173-11 and BAR FA 14173-15 remained far remote in competition with 77% less cumulative seed yield in 2017 and 2018 season. BAR FA 14173-11 suffered more severe winter injury over 2017-2018 but exhibited satisfactory growth recovery in the spring producing a quarter the amount of Courtenay.

Table 3. Seed yield, plant height and dry matter yield of tall fescue cultivars in 2017 and 2018 crop season from the trial established in 2016 at Beaverlodge, AB. The trial was seeded on May 26, 2016, harvested on July 27, 2017 and July 27, 2018 for first and second crop year respectively.

Company	Cultivar	Plant height		Dry matter yield		Seed yield					
		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
		cm		kg ha^{-1}		kg ha^{-1}		lb ac^{-1}		% of check	
Barenbrug USA	BAR FA 11701	101	90	5530	1602	824b	204b	736	182	68	45
	BAR FA 14173-11	75	78	1697	1431	317c	63b	283	56	26	14
	BAR FA 14173-15	73	82	1685	1343	330c	47b	294	42	27	10
	Bariane	106	95	5123	1740	815b	173b	728	154	67	38
Check	Courtenay	116	111	6110	3058	1217a	449a	1086	401	100	100
	CV%	2..8	2.6	6	12	8	50				
	LSD $_{0.05}$	7.2	5.3	619	463	142	205				

Figure 6. Photograph taken in 2017 of the tall fescue trial established in 2016 at Beaverlodge, AB.

All tall fescue cultivars showed rapid decline in seed yield from first to second harvest season. Courtenay showed better seed yield stability (Figure 7) producing 63% less seed yield in second harvest season, while BAR FA 11701, Bariane, BAR FA 14173-11 and BAR FA 14173-15 produced 75%, 79%, 80% and 86% less seed yield than their first harvest season, respectively.

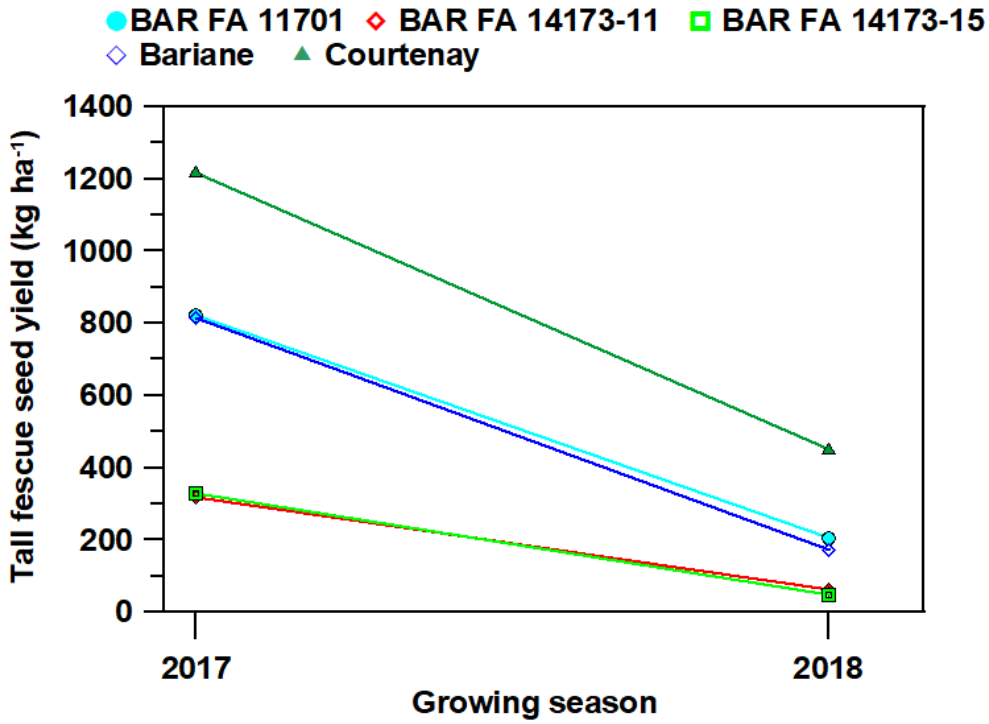

Figure 7. Seed yield trend of tall fescue cultivars in two consecutive crop seasons of 2017 and 2018 from the trial established in 2016 at Beaverlodge, AB.

The seed yield, biomass and plant heights are positively correlated in tall fescue (Figure 8). That means high seed producer cultivar also produces higher biomass for livestock feed and other uses.

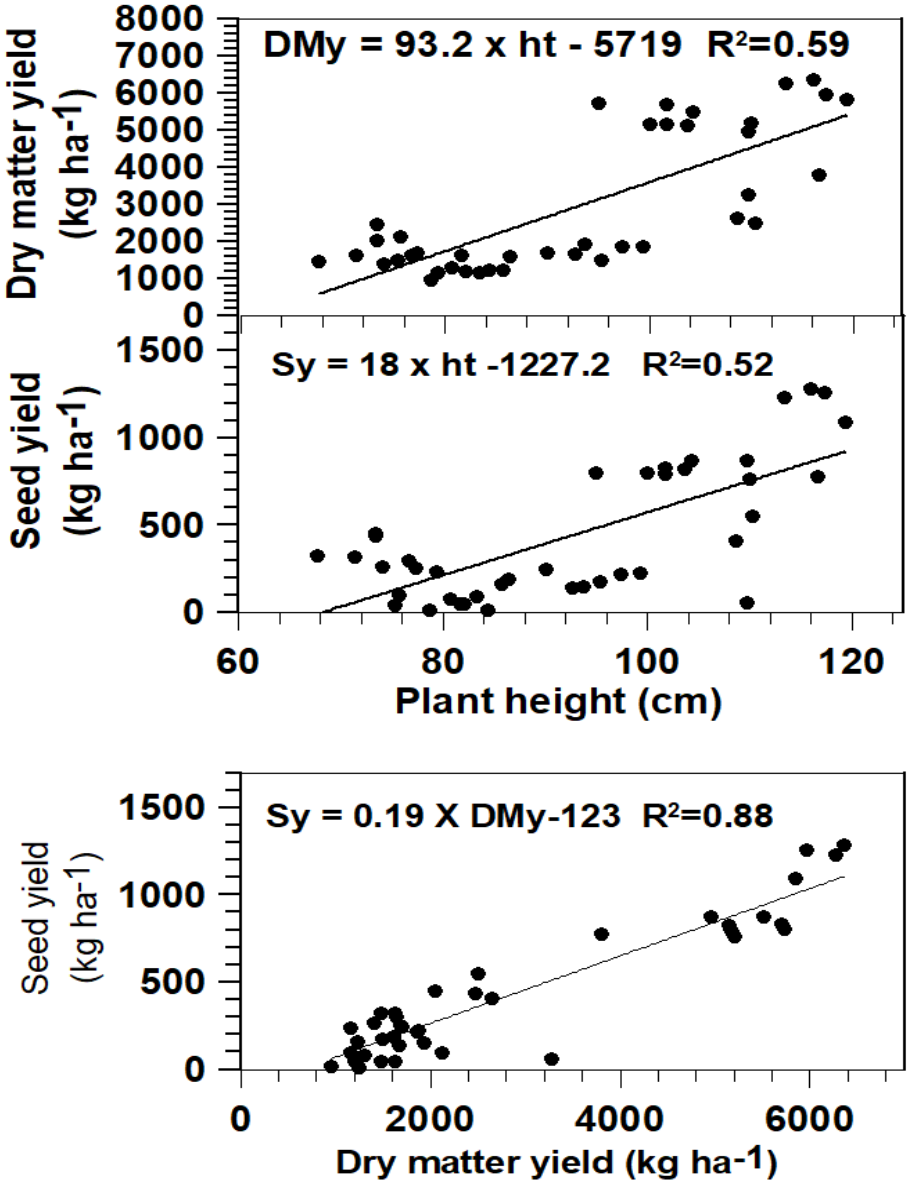

Figure 8. Correlations between plant height (ht), dry matter (DMy) and seed yield (Sy) of tall fescue in 2017 and 2018 crop season from the cultivar trial established in 2016 at Beaverlodge, AB. Abbreviations: DMy = Dry matter yield; Sy = Seed yield; ht = plant height

Meadow fescue

A meadow fescue trial established in 2016 included two new cultivars originated from Barenbrug USA and a check cultivar Preval (Table 4). The new cultivars produced statistically comparable cumulative seed yield to Preval in 2017 and 2018 crop season and matured earlier than creeping red fescue. Two-year cumulative seed yield of BAR FP 32 and Pradel were about 94% of Preval. Meadow fescues have much taller and stable height in both cropping seasons than that of creeping red fescue, with heights ranging from 97 to 102 cm in the first crop season in 2017 and from 81 to 85 cm in second crop season in 2018. The trial is concluded with the evaluation in two consecutive crop seasons.

Table 4. Seed yield, plant height and dry matter yield of meadow fescue cultivars in 2017 and 2018 crop seasons from the trial established in 2016 at Beaverlodge, AB. The trial was seeded on May 26, 2016 and harvested on July 20, 2017 and July 18, 2018 for first and second crop year respectively.

Company	Cultivar	Plant height		Dry matter yield		Seed yield					
		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
		cm		kg ha^{-1}		kg ha^{-1}		lb ac^{-1}		% of check	
Barenbrug USA	**BAR FP 32**	97	84	5190	1828	991a	256b	885	229	94	96
	Pradel	98	81	5031	1333	1046a	195b	934	174	99	73
Check	**Preval**	102	85	5229	1713	1056a	267a	943	238	100	100
	CV%	3.6	2.9	4.5	7.3	3.9	9.5				
	LSD $_{0.05}$	8.7	5.9	564.1	289	98.5	55.9				

Figure 9. Photograph taken in 2017 of the meadow fescue trial established in 2016 at Beaverlodge, AB.

As in other perennial turf and forage grasses, meadow fescue also showed rapid decline in seed yield in the successive harvest season. All three cultivars showed similar yield-plummeting trend from first to second harvest season (Figure 10). The cultivars showed 75 to 80% less yield in second harvest season.

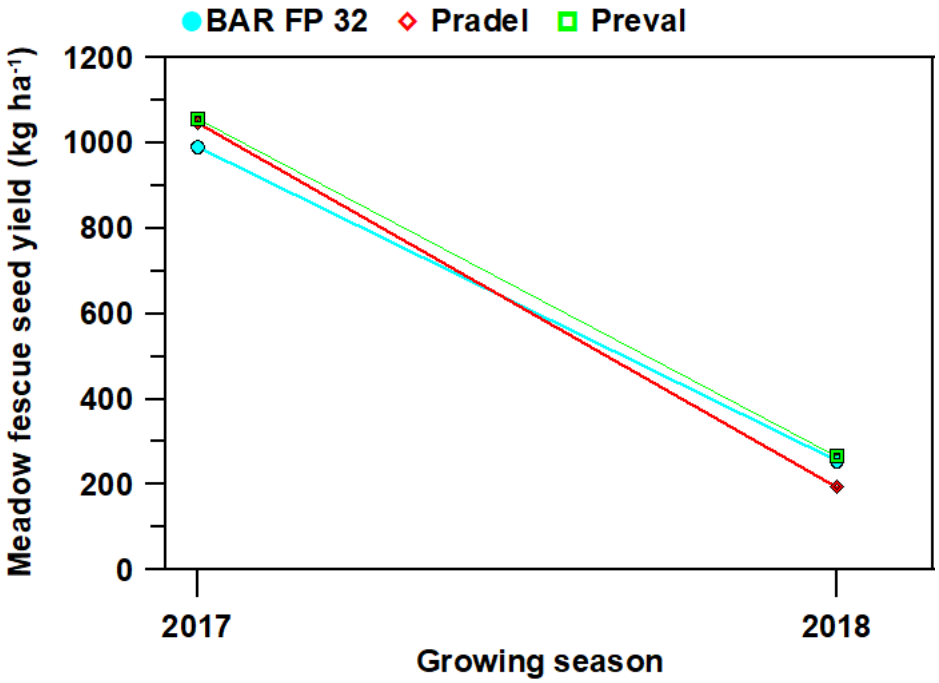

Figure 10. Seed yield trend of meadow fescue cultivars in two consecutive crop seasons of 2017 and 2018 from the trial established in 2016 at Beaverlodge, AB.

Akin to other fescues, the meadow fescue also had positive correlations between seed yield, biomass and plant heights (Figure 11). That means high seed producer cultivar also produces higher biomass for livestock feed and other uses.

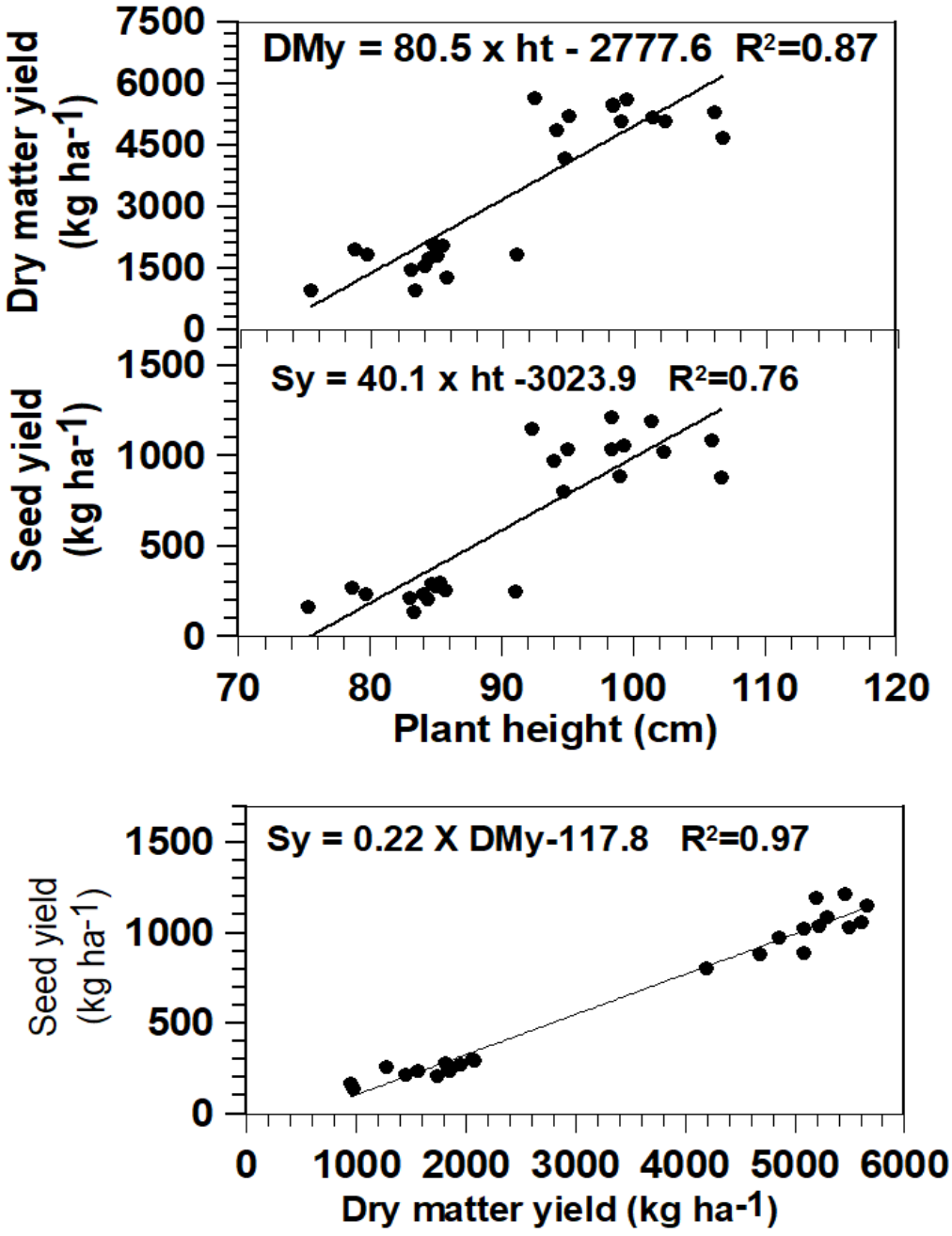

Figure 11. Correlations between plant height (ht), dry matter (DMy) and seed yield (Sy) of meadow fescue in 2017 and 2018 from the cultivar trial established in 2016 at Beaverlodge, AB. Abbreviations: DMy = Dry matter yield; Sy = Seed yield; ht = plant height.

Bromegrasses

The bromegrass trial established in 2016 comprised four proprietary entries that included one cultivar of meadow bromegrass and one of smooth bromegrass and two cultivars of hybrid bromegrass, where Fleet and Carlton were used as the meadow bromegrass and smooth bromegrass checks respectively. Figure 12 is a photograph of the crop year 2017 of the bromegrass trial established in 2016. The trial is concluded with the evaluation for two crop seasons.

In the first crop year 2017, the meadow bromegrass BAR BCF 1FRRL and the hybrid bromegrass AC Knowles produced higher seed yields than Fleet by 11 and 3% respectively, and than Carlton by 204 and 190% respectively. However, the yield differences between BAR BCF 1FRRL, AC Knowles, S9356M and Fleet were not statistically significant in the first harvest year (Table 5). Contrarily in the second crop year, hybrid bromegrass cultivars AC Knowles, S9356M outperformed the rest of the entries for seed yield. In terms of cumulative seed yield for two crop years, AC Knowles, S9356M produced 31% and 22% higher seed yields than the check cultivar Fleet. Both smooth bromegrass cultivars produced significantly lower seed yields than meadow and hybrid bromegrass cultivars

Table 5. Seed yield, plant height and dry matter yield of bromegrasses in 2017 and 2018 from the trial established in 2016 at Beaverlodge, AB. The trial was seeded on May 26, 2016 and harvested on August 2, 2017 and August 7, 2018 for the first and second crop season respectively. Abbreviations: HBG = hybrid bromegrass, MBG = meadow bromegrass; SMG = smooth bromegrass.

Company	Crop species	Cultivar	Plant height		Dry matter		Seed yield							
			2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
			cm		kg ha^{-1}		kg ha^{-1}		lb ac^{-1}		% of Fleet		% of Carlton	
AAFC	HBG	S9356M	122	117	5624	4207	523ab	273a	467	244	88	455	162	258
		AC Knowles	119	111	5291	4616	612a	245a	546	219	103	408	190	231
Barenbrug USA	MBG	BAR BCF 1FRRL	120	106	4689	3312	658a	126b	588	113	111	210	204	119
	MBG	Fleet -Check 1	118	102	4581	2023	593a	60b	529	54	100	100	184	57
Barenbrug USA	SBG	BAR BIF 1GRL	117	106	5192	3831	155c	93b	139	83	26	155	48	88
	SBG	Carlton–Check 2	113	102	6276	5138	322bc	106b	287	95	54	177	100	100
		CV%	2.2	3.9	8.8	13.9	21.6	36						
		LSD $_{0.05}$	5.6	8.97	993.6	1308	219.5	116						

Figure 12. Photograph taken in 2017 of the bromegrass trial established in 2016 at Beaverlodge, AB.

All bromegrass cultivars showed rapid decline in seed yield from first to second crop year. However, both hybrid bromegrass cultivars showed better yield stability than rest of the cultivar. BAR BCF 1FRRL and Fleet showed lowest seed yield stability over the seasons (Figure 13).

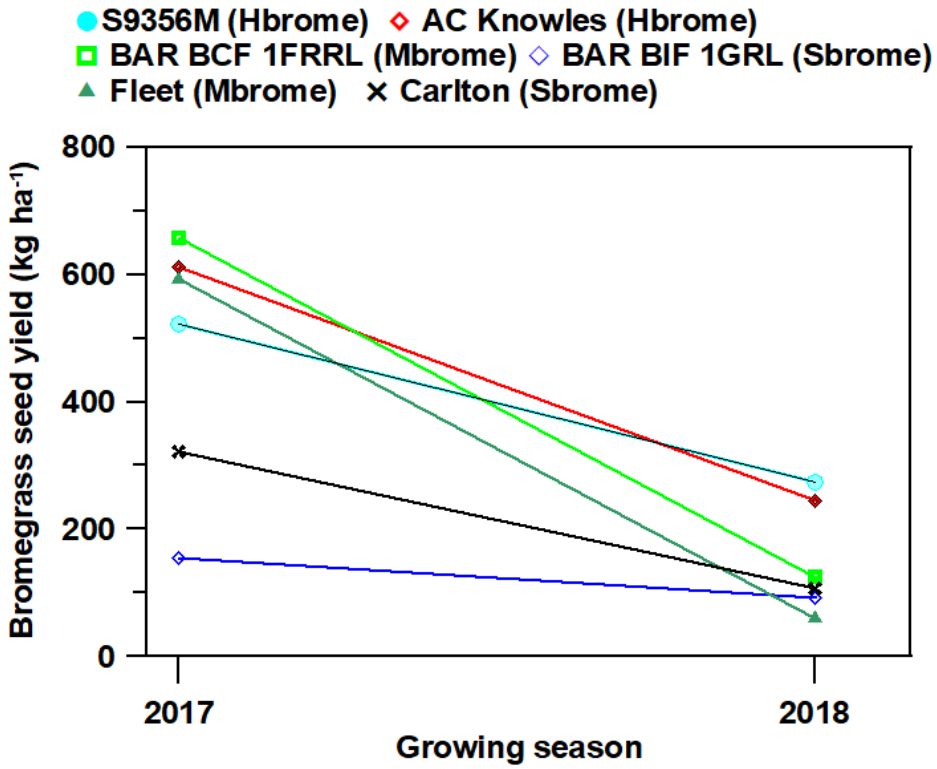

Figure 13. Seed yield trend of bromegrass cultivars in two consecutive crop seasons of 2017 and 2018 from the trial established in 2016 at Beaverlodge, AB. Where Hbrome= Hybrid bromegrass, Sbrome = smooth bromegrass and Mbrome = meadow bromegrass

Both hybrid bromegrasses showed taller heights followed closely by BAR BCF 1FRRL. Positive correlations between seed yield, biomass and plant height means that the high seed yielder will also yield greater biomass (Figure 14).

Bromegrasses are one of the most popular forages for pasture and hay production for livestock. Therefore, end-use value of bromegrasses lies in the biomass quantity, nutritive value and stand persistence. For biomass production Carlton, S9356M and AC Knowles remained on par with significantly higher biomass yield than that of Fleet and other test entries (Table 5).

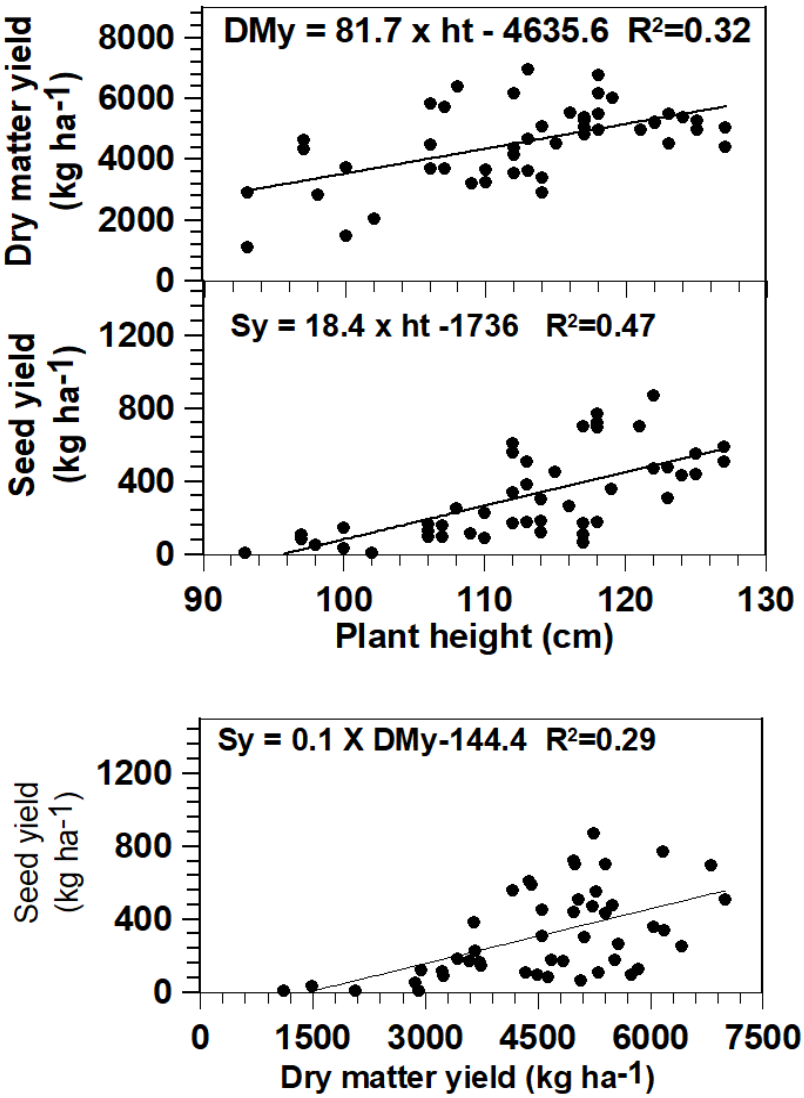

Figure 14. Correlations between plant height (ht), dry matter (DMy) and seed yield (Sy) of hybrid bromegrass in 2017 and 2018 crops seasons from the cultivar trial established in 2016 at Beaverlodge, AB. Abbreviations: DMy = Dry matter yield; Sy = Seed yield; ht = plant height.

Wheatgrasses

The wheatgrasses trial established in 2016 comprised four test entries that included four cultivars of crested wheatgrass and one cultivar of northern wheatgrass being compared with crested wheatgrass Fairway as a check. Seed yields of all wheatgrass cultivars were poorer compared to other grasses, such as fescues and bromegrasses, and compared to wheatgrass seed yields in the lower latitudes. Further improvement in wheatgrass populations may be necessary for adapting cresting wheatgrass as viable seed crop in the Peace region. The cultivar Kirk produced statistically comparable seed yield to the Check – Fairway. Rest of the test cultivars yielded significantly ($p<0.01$) lower than Kirk and Fairway. With tallest plants, BAR-GRL-CWG had significantly higher biomass yield, while northern wheatgrass cultivar Elbee had the lowest biomass yield (Table 6). The trial will continue for two more crop years. Figure 15 is a photograph of the trial in the crop year 2017.

Table 6. Seed yield, plant height and dry matter yield of wheatgrass cultivars in 2017 and 2018 from the trial established in 2016 at Beaverlodge, AB. The trial was seeded on May 26, 2016 and harvest on July 27 (Elbee) and August 3 (rest of the entries) in 2017 and August 14 in 2018 crop season. Abbreviations of crop species used: CWG = crested wheatgrass, CrWG = creeping wheatgrass, NWG = northern wheatgrass.

Company	Crop	Cultivar	Plant height		Dry matter yield		Seed yield					
			2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
			cm		(kg ha^{-1})		kg ha^{-1}		lb ac^{-1}		% of check	
Limoges Forage & Grasses Ltd	CWG	Kirk	85	76	3095	3352	204a	190a	182	170	98	101
	CWG	AC New Kirk	89	81	3230	3753	138c	170a	123	152	66	91
	CWG	Fairway	69	60	2604	3181	209a	187a	186	167	100	100
Barenbrug USA	CrWG	BAR-GRL-CWG	99	101	4069	4479	167b	70b	149	62	80	37
Limoges Forage & Grasses Ltd	NWG	Elbee	74	67	1087	1056	163bc	21c	145	19	78	11
		CV%	3.9		6.4	9.9	7.0	14.8				
		LSD $_{0.05}$	7.0		393	670.9	28.0	41.1				

Figure 15. Photograph taken in 2017 of the crested wheatgrass trial established in 2016 at Beaverlodge, AB.

The test cultivars showed contrasting yield trends. Kirk and Fairway showed stable yield over two years, while AC New Kirk had higher seed yield in second crop year than in the first crop year. Elbee and BAR-GRL-CWG showed rapid decline in yield with the stand age (Figure 16).

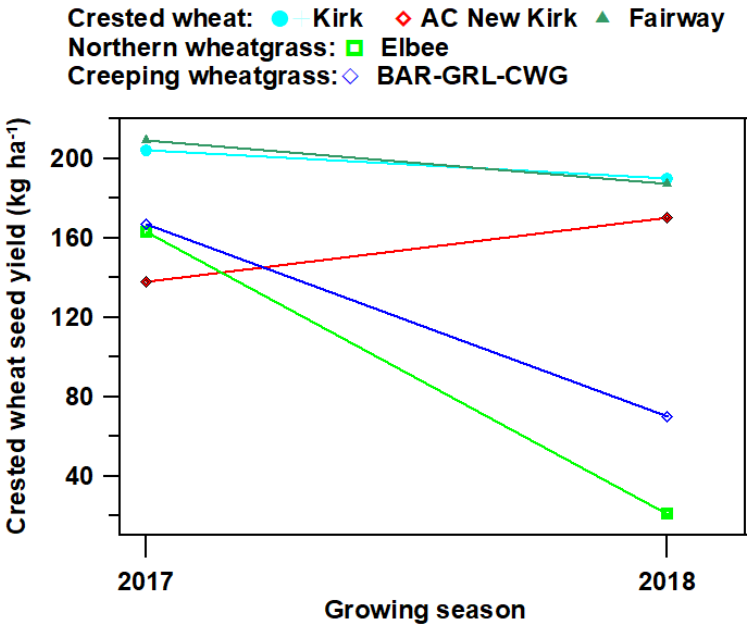

Figure 16. Seed yield trend of crested wheatgrass, creeping wheatgrass and northern wheatgrass cultivars in two consecutive crop seasons of 2017 and 2018 from the trial established in 2016 at Beaverlodge, AB.

Unlike other grass species, wheatgrasses seed yield did not exhibit correlations with biomass production (Figure 17). BAR-GRL-CWG with significantly higher biomass productivity (Table 6) has prospect of introduction in the Peace region for livestock feed and other uses.

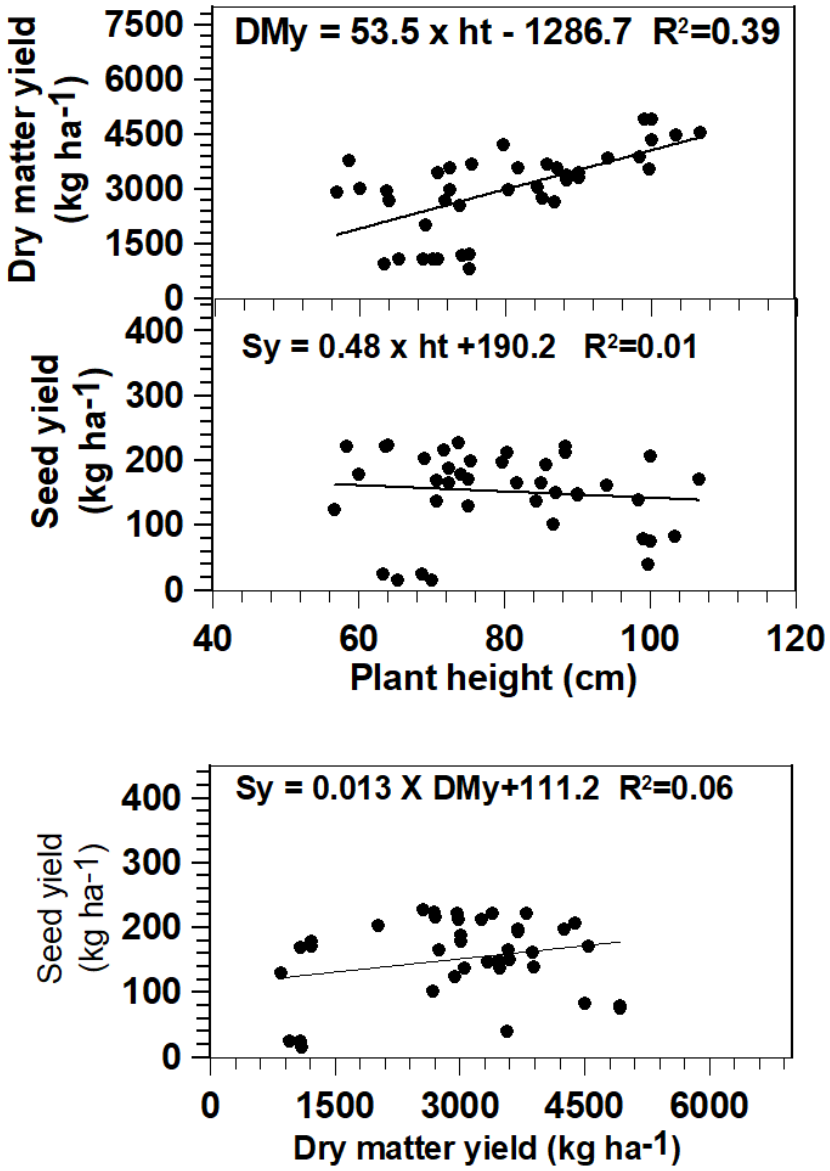

Figure 17. Correlations between plant height (ht), dry matter (DMy) and seed yield (Sy) of crested wheatgrass, creeping wheatgrass and northern wheatgrass in 2017 and 2018 from the cultivar trial established in 2016 at Beaverlodge, AB. Abbreviations: DMy = Dry matter yield; Sy = Seed yield; ht = plant height.

Conclusions of completed trials

Seed yield is the major trait of economic interest for creeping red fescue, provided the cultivars have similar end use quality – the turf. Based on the seed yield performance of two crop seasons, creeping red fescue cultivars Chanellor and BAR FRR 15134 perform promisingly, standing on par with Boreal. The differential yield stability of the creeping red fescue cultivars implicates that producers will have options to choose cultivars for a single or more harvest years, and that there is opportunity to improve this attribute through population improvement.

The test cultivars of tall fescue in the 2016-established trial showed less adaptability to Peace region compared to Courtenay for the seed yield. Their seed yield performance lagged far behind the check cultivar Courtenay.

The meadow fescue test cultivars BAR FP 32 and Pradel showed adaptability to the Peace region. Their seed and biomass were comparable to the check cultivar Preval.

The bromegrass cultivars AC Knowles, S9356M outperformed all test entries including Fleet and Carlton. However, for biomass production Carlton, S9356M and AC Knowles were comparable.

Seed yields of all wheatgrass cultivars were poorer compared to other grasses such as fescues and bromegrasses and compared to wheatgrass seed yields in the lower latitudes. Further improvement in wheatgrass populations may be necessary for adapting cresting wheatgrass as viable seed crop in the Peace region.

The end use value in bromegrasses, crested wheatgrasses, meadow fescue, tall fescue, and timothy lie on the forage biomass quantity, nutritive values and stand persistence. Except for the case of wheatgrasses, all species under evaluation showed positive correlations between seed yield, biomass and plant heights. That means high seed producer cultivar also produces higher biomass for livestock feed and other uses.

Results of on-going trials

Creeping red fescue

A creeping red fescue cultivar trial with 13 proprietary cultivars and Boreal as a standard check was established in 2017. Because of uneven seed drilling, some cultivars did not establish to a uniform stand. The cultivars which had unsatisfactory plant stand in two or more replicates have been re-seeded in 2018. Cultivars with single replicate data are not included for statistical analysis.

The cultivars differed significantly (p <0.01) for seed yield, biomass and plant height (Table 7). The cultivar Fosters FO produced significantly higher yield followed Boreal in the second place, and BY-676 and BY-2889 in the third and fourth place respectively. Rest of the cultivars had significantly less seed yields. Fosters FO produced 17% higher seed yield than Boreal, while BY-676 and BY-2889 yielded 23% and 30% less than that of Boreal. The cultivars will be evaluated for second crop season in 2019. Figure 18 presents a photograph of the first harvest season in 2018.

Table 7. Seed yield, plant height and dry matter yield of creeping red fescue cultivars in 2018 from the trial established in 2017 at Beaverlodge, AB. The trial was seeded on June 2, 2017 and harvested on July 18, 2018. Note on missing data: [1]mean of 3 replicates (1 replicate missing), [2]mean of two replicates (2 replicates missing) and [3]summary of only 1 replicate (3 replicates missing, hence not included in the analysis).

Company	Cultivar	Plant height	Dry matter yield	Seed yield		
		cm	(kg ha^{-1})	kg ha^{-1}	lb ac^{-1}	% of check
BrettYoung	[1]BY-676	61.30	3220	839**c**	749	77
	BY-369-13883	57.50	2742	522**de**	466	48
	[2]BY-2889	57.37	2517	760**c**	679	70
	[3]BY178070	59	2491	426	379	39
DLF Mooree Seed	MSP-03-17	59.25	2328	451**ef**	403	42
	[2]MSP-06-17	47.66	1768	217**g**	194	20
	MSP-07-17	54.75	2450	362**f**	323	33
	MSP-08017	58.50	2618	403**f**	360	37
	MSP-02-17	51.50	2203	436**ef**	389	40
	MSP-04-17	61.50	2610	585**d**	522	54
	[1]MSP-05-17	64.29	2483	521**de**	465	48
Foster's Seed	[1]Fosters FX	55.62	2441	471**ef**	421	43
	[1]Fosters FO	65.47	3593	1263**a**	1128	117
Check	[1]Boreal	71.61	3616	1083**b**	967	100
	CV%	4.4	10.1	9.5		
	LSD $_{0.05}$	5.3	548.6	119.1		

Figure 18. Photograph taken in 2018 of the creeping red fescue trial established in 2017 at Beaverlodge, AB.

Tall Fescue

A tall fescue cultivar trial was established in 2017 with five proprietary entries compared with Courtenay as the check cultivar, and first seed crop was harvested in 2018 season. In this test, all the proprietary cultivars outperformed Courtenay ($p < 0.01$) (Table 8). Cultivar Hudson produced significantly higher seed yield than the rest of the cultivars, while remaining on par with Titan Ultra. Other proprietary cultivars also stood on par with Titan Ultra. Figure 19 presents a photograph of the first harvest season in 2018.

Table 8. Seed yield, plant height and dry matter yield of tall fescue cultivars in 2018 from the trial established in 2017 at Beaverlodge, AB. The trial was seeded on June 2, 2017 and harvested on July 24, 2018.

Company	**Cultivar**	**Plant height**	**Dry matter yield**	**Seed yield**		
		cm	(kg ha^{-1})	kg ha^{-1}	lb ac^{-1}	% of check
Foster's Seed & Feed	Titan Rx	79	2735	877**b**	783	132
	Titan Ultra	84	3057	971 **ab**	867	146
	Covenant	76	2605	937**b**	837	141
	Rendition RX	81	2754	926**b**	827	139
	Hudson	75	2847	1077**a**	962	162
Check	Courtenay	109	3501	666**c**	595	100
	CV%	2.9	8.5	5.4		
	LSD $_{0.05}$	5.1	527.5	104.8		

Figure 19. Photograph taken in 2018 of the tall fescue trial established in 2017 at Beaverlodge, AB.

Timothy

The timothy cultivar trial established in 2017 contained three proprietary cultivars received from Northstar Seed, which were compared with locally adapted popular cultivar Alma. Alma outperformed all three proprietary cultivars both in seed yield and biomass in the first crop year of 2018. The proprietary cultivars were slightly shorter than Alma in plant height. Further evaluation will be carried out in the coming cropping season in 2019. Figure 20 presents a photograph of the first harvest season in 2018.

Table 9. Seed yield, plant height and dry matter yield of Timothy cultivars in 2018 from the trial established in 2017 at Beaverlodge, AB. The trial was seeded on June 2, 2017 and harvested on Aug 8, 2018.

Company	Cultivar	Plant height	Dry matter yield	Seed yield		
		cm	(kg ha^{-1})	kg ha^{-1}	lb ac^{-1}	% of check
Northstar Seed	NSE1701	88	5461	581	519	62
	NSE1723	90	5726	699	624	75
	NSE1730	91	5289	475	424	51
Check	Alma	92	6119	930	831	100
	CV%	2.2	36.6	6.9		
	LSD $_{0.05}$	4.5	468.5	105.1		

Figure 20. Photograph taken in 2018 of the timothy trial established in 2017 at Beaverlodge, AB.

OVERALL CONCLUSIONS

During the reporting One trial each of on creeping red fescue, tall fescue, meadow fescue, bromegrasses and wheatgrasses was concluded, while one trial each of creeping red fescue, tall fescue and timothy underwent the evaluation for first crop year in 2018 and is subjected to further evaluations in the coming season in 2019. Variable weather patterns in different years provided desirable test environment for examining the adaptability of the cultivars in the peace region. Creeping red fescue being an amenity grass, seed yield is the major performance indicator in the PGRST. However, for other forage species, biomass yield will also be duly considered in the evaluation. Forage nutritive value is also an important consideration to be pursued in the future studies.