Seed yield potential of Turf and Forage Cultivars in the Peace River Region of Western Canada

Annual Report 2022

Cultivars Adaptation for Forage and Turf Seed (CAFTS) Program

Coordinated by

Peace Region Forage Seed Association
in collaboration with
Agriculture and Agri-Food Canada
Beaverlodge Research Farm
and
SARDA Ag Research

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Peace Region Forage Seed Association

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Protocol for Cultivars Adaptation for Forage and Turf Seed (CAFTS) program

Updated – May, 2023

1. Research Sponsorship

An annual research sponsorship of **$350 CAN/entry/year/location** is requested, this sponsorship will be paid for the establishment year as well as for the harvest years. Peace Region Forage Cultivar Testing Program funds will be administered by the Peace Region Forage Seed Association (PRFSA). Each seed company will be invoiced annually by the PRFSA General Manager.

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 is not received on time
- if there is a restriction of space in any year at a particular location
- if entries are too few in any year for a particular location
- if the germination percentage of the seed is below 75%

3. Seed Requirements and Deadline for Seed Entry

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

- 50 g of timothy, bentgrass, or Kentucky bluegrass
- 100 g of fescues - creeping red, chewings, hard, meadow, sheep or tall fescue, orchardgrass, annual or perennial ryegrass
- 200 g of bromegrasses – meadow, smooth, hybrid, and wheatgrasses
- 200 g of leguminous species such as alfalfa, birdsfoot trefoil, clovers
- 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 if the submission is **a turf type or forage** for grass cultivars.

Please ship approved seed to*:

Peace Region Forage Seed Association
401 114 Ave
Dawson Creek, BC V1G 2Z7

* *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 receive an annual report. Seed producers will be provided information on cultivars 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, no guarantee can be made that a particular test will be successful. If a test is not successful it can 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 trade names or commercial products are made with the understanding that no discrimination is intended, and no endorsement is implied.

5. Use of Seed

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

Cultivars Adaptation for Forage and Turf Seed (CAFTS)

2024 Application for Cultivar 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, 2023 to:

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Executive Summary

This report covers the results of cultivar evaluation trials established in 2020 and 2021, and status of the trials established in 2022. In 2022, cultivar evaluation trials were established on creeping red fescue (*Festuca rubra* L. var. *rubra*), perennial ryegrass (*Lolium perenne* L.), timothy (*Phleum pratense* L.) and crested wheatgrass (*Agropyron cristatum* [L.] Gaertn.) from the new submissions of cultivars in 2022 and those submitted in 2021 at Beaverlodge Research Farm, AB for evaluating seed productivity in 2023 and possibly following years. In 2021, a total of six cultivar evaluation trials were established in Beaverlodge Research Farm and three trials in at SARDA Ag Research area in Donnelly, AB. Various cultivars of creeping red fescue, perennial ryegrass, timothy, alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.), and alsike clover (*Trifolium hybridum* L.) were evaluated for their seed yield in comparison with popular cultivars of respective species in the region. In 2020, three trials on creeping red fescue, various fine fescues and crested wheatgrass were conducted in the farmers' fields in Donnelly, AB. The test cultivars were received from various Canadian seed companies and their foreign affiliates including Foster's Seed & Feed Ltd, Limoges Forage & Grasses Ltd, BrettYoung, DLF Moore Seed and Northstar Seed.

The growing season in 2020 had generally favourable rainfall distribution for crop growth and development. However, the humid condition favoured pest pressure and crop lodging leading to poor seed set of the crops. In contrast in 2021, dry spell spanning the whole month of June (9 mm total precipitation compared to historical average of 64 mm) with intense heatwave during reproductive stage in the late June caused pollen desiccation. The dry spell continued for early three quarters of July caused premature senescence of crop leading to extremely poor seed yield. In 2022, the freezing nights until 3rd week of May slowed down the spring growth, which was followed by more favourable growth condition, promoting tiller development till the 3rd week of June. Then, a dry spell for about a month from late June to late July again coincided with reproductive phase of the crop. The weather pattern created nonsynchronous tiller growth leading to facultative ripening and lower seed recovery in grasses. The plant stand establishment of 2021 seedings was evaluated in the spring of 2022, and the representative samples were collected at maturity for yield measurements. The seed yield of creeping red fescue, timothy, and perennial rye grass for the first harvest year in 2022 showed a large coefficient of variation, hence re-stablished in 2022 along with the newly submitted crested wheat grass and perennial rye grass cultivars. For the forage legume trials, the test cultivars did not show significant difference in yield compared to control cultivars. Due to extended period of vegetative growth, the alfalfa cultivars did not produce seeds in 2022, the first harvest season. Apparently, it is associated with the soil-climatic conditions of the experimental site.

Introduction

Agricultural systems need to adapt to new challenges and opportunities brought about by global climate change and globalization of market. Innovations in crop breeding provide continuous flux of new crop cultivars that require assessment of their regional adaptability and end use quality. To address this need in forage seed crops in the Peace region, Agriculture and Agri-Food Canada (AAFC) - Beaverlodge Research Farm and Peace Region Forage Seed Association (PRFSA) have established a long-term collaborative program, Cultivars Adaptation for Forage and Turf Seed (CAFTS) an evolution from Western Grass Seed Testing (WGST), Peace Region Grass Seed Testing (PRGST) and Peace Region Forage Cultivar Testing (PRFST) since mid-1990s. Funded by the Government of Canada through Canadian Agriculture Partnership (CAP) with contribution from PRFSA, the primary objective of the program is to evaluate new proprietary and public cultivars to support production and marketing decisions for producers and seed companies. The CAFTS validates adaptability, productivity, and seed quality of public and proprietary forage and turfgrass cultivars and provides the most recent yield data for the farmers and stakeholders in the western Canada.

The crop growing season in the Peace River region of Canada is typified by long day, cool night, and modest soil water deficit. This condition provides relative advantage for seed production of turf and forage crops 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. The forage seed production provides farmers with on-farm diversification options for improved crop rotation, distribution of labour and equipment over the season, and niche market opportunities.

This report covers the results of cultivar evaluation trials established in 2020 and 2021, and status of the trials established in 2022. The crop species included in cultivar testing include creeping red fescue (*Festuca rubra* L. var. *rubra*), perennial ryegrass (*Lolium perenne* L.), timothy (*Phleum pratense* L.), crested wheatgrass (*Agropyron cristatum* [L.] Gaertn.), alfalfa (*Medicago sativa* L.), red clover (*Trifolium pratense* L.), and alsike clover (*Trifolium hybridum* L.). A weather patterns of the corresponding growing seasons are also highlighted.

Materials and Methods

The test cultivars of various species established in 2020, 2021 and 2022 are presented in Table 1, Table 2, and Table 3, respectively. The weather conditions in the corresponding years are presented in Figure 1.

The trials were laid out in randomized complete block design (RCBD). In all trials, the entries were replicated four times. Specific trial management information is provided in the individual trial description in the following sections.

The perennial forage species have predominantly vegetative growth and no seed production in the establishment year. Established in 2020, the hard, slender, and chewing fescues, and crested wheatgrass performances were evaluated for two successive harvest years in 2021 and 2022. Results of single growing season are reported for the trials established in 2021. The plant heights, seed yields, seed dockage percentage and 1000-seed weight data were recorded.

All the measured variables were analyzed following one-way analysis of variance (ANOVA) in RCBD using PROC GLIMMIX of SAS SAS® 9.4 (Statistical Analysis System for Windows™; SAS Institute, Cary, NC). Repeated measure ANOVA was used for the trials established in 2020 as the data collection were performed up to two harvest seasons from the same crop stands. The assumption of normal distributions (Proc Univariate) and homogeneity of variances (Levene's test) were evaluated prior to ANOVA, and no data transformation was required. The denominator degrees of freedom method (ddfm) option used the Kenward-Roger approximation method. Cultivar means were compared using the Tukey's studentized range test at 5% level of significance (P<0.05).

Table 1. Location, species, cultivars, and their sources for the cultivar testing trials established in 2020.

Location	Species	SN	Cultivar	Source
AAFC, Beaverlodge	Alfalfa	1	Nijagara	Dept. of Forage Crops, Serbia
		2	Banat VS	Dept. of Forage Crops, Serbia
	Red Clover	3	Una	Dept. of Forage Crops, Serbia
	Vetch	4	Novi Beograd	Dept. of Forage Crops, Serbia
SARDA Ag, Donnelly	Creeping Red fescue	5	Boreal	AAFC - Check
		6	BY-2889	BrettYoung
		7	BY-17-8070	BrettYoung
		8	DLF MSP-05-17	DLF Moore Seed
		9	DLF MSP-06-17	DLF Moore Seed
		10	2020-05	Foster's Seed & Feed Ltd
		11	2018-01	Foster's Seed & Feed Ltd
		12	2018-08	Foster's Seed & Feed Ltd
		13	Brynn	Foster's Seed & Feed Ltd
		14	2018-10	Foster's Seed & Feed Ltd
		15	2018-11	Foster's Seed & Feed Ltd
		16	Oracle	AAFC - Check
	Hard, Slender & Chewings Fine Fescues	17	Boreal	AAFC - Check
		18	2020-02	Foster's Seed & Feed Ltd
		19	2020-03	Foster's Seed & Feed Ltd
		20	2020-04	Foster's Seed & Feed Ltd
		21	2020-06	Foster's Seed & Feed Ltd
		22	2018-05	Foster's Seed & Feed Ltd
		23	2018-06	Foster's Seed & Feed Ltd
	Crested Wheatgrass	24	Fairway	Limoges Forage and Grasses Ltd
		25	Kirk	Limoges Forage and Grasses Ltd
		26	AC Newkirk	Limoges Forage and Grasses Ltd

Table 2. Location, species, cultivars, and their sources for the cultivar testing trials established in 2021.

Location	Species	SN	Cultivar	Source
AAFC, Beaverlodge	Timothy	1	NSE20EA	North Star Seed
		2	NSEZ1SW	North Star Seed
		3	NSEZ1AT	North Star Seed
		4	Alma	AAFC/Check
	Perennial Ryegrass	5	21PR50	Fosters Feed & Seed
		6	21PR51	Fosters Feed & Seed
		7	21PR55	Fosters Feed & Seed
		8	21PR53	Fosters Feed & Seed
		9	21PR54	Fosters Feed & Seed
		10	21PR60 (Check)	Fosters Feed & Seed
	Creeping Red Fescue	11	Rufi	North Star Seed
		12	BLMT	Limoges Forage and Grasses Ltd
		13	RCRF	Limoges Forage and Grasses Ltd
		14	Oracle	AAFC/Check
		15	Boreal	AAFC/Check
	Alfalfa	16	Nijagara	Dept. of Forage Crops, Serbia
		17	Banat VS	Dept. of Forage Crops, Serbia
		18	CRS1001BWR	AAFC
		19	Beaver	AAFC/Check
	Alsike Clover	20	Menta	DLF Moore Seed
		21	Aurora	AAFC
		22	CRS 111	AAFC/Burnett Agronomic Resources
		23	Aurora Common	AAFC/Check
	Red Clover	24	Una	Dept. of Forage Crops, Serbia
		25	AC Christie	Quality seed, Ontario
		26	Janico	DLF Moore Seed
		27	CRS32	AAFC/Burnett Agronomic Resources
		28	CRS33	AAFC
		29	Altaswede Common	AAFC/Check
SARDA Ag, Donnelly	Alsike Clover	30	Aurora	Check/Check
		31	Menta	DLF Moore Seed
		32	2020AC1	AAFC
	Red Clover	33	Altaswede	AAFC/Check
		34	Una	Dept. of Forage Crops, Serbia
		35	Janico	DLF Moore Seed
		36	2020 RC3	AAFC
	Perennial Ryegrass	37	20PR1	Fosters Feed & Seed
		38	20PR2	Fosters Feed & Seed
		39	20PR3	Fosters Feed & Seed
		40	20PR4	Fosters Feed & Seed
		41	20PR5	Fosters Feed & Seed
		42	21PR53	Fosters Feed & Seed
		43	Norlea	Fosters Feed & Seed

Table 3. Location, species, cultivars, and their sources for the cultivar testing trials established in 2022.

Location	Species	SN	Cultivar	Source
Beaverlodge Research Farm	Perennial Ryegrass	1	21PR50	Fosters Seeds and Feeds
		2	21PR51	Fosters Seeds and Feeds
		3	21PR52	Fosters Seeds and Feeds
		4	21PR53	Fosters Seeds and Feeds
		5	21PR54	Fosters Seeds and Feeds
		6	21PR60	Fosters Seeds and Feeds
		7	Fost 2201	Fosters Seeds and Feeds
		8	Fost 2202	Fosters Seeds and Feeds
		9	Fost 2203	Fosters Seeds and Feeds
		10	Fost 2204	Fosters Seeds and Feeds
		11	Fost 2205	Fosters Seeds and Feeds
		12	Fost 2207	Fosters Seeds and Feeds
		13	Norlea 60861	Fosters Seeds and Feeds
	Crested Wheatgrass	1	S9615	University of Saskatchewan
		2	Kirk	Limoges Forages & Grasses Ltd.
		3	AC Goliath	Limoges Forages & Grasses Ltd.
		4	AC Newkirk	Limoges Forages & Grasses Ltd.
		5	Fairway	Limoges Forages & Grasses Ltd.
	Timothy	1	Alma*	Common
		2	TM0402	Fosters Seeds and Feeds
		3	TM1001G	Fosters Seeds and Feeds
		4	QYDN	Fosters Seeds and Feeds
		5	NSEZ1AT*	Northstar Seed Ltd.
		6	NSEZ1SW*	Northstar Seed Ltd.
		7	NSE20EA*	Northstar Seed Ltd.
		8	TM0803	Fosters Seeds and Feeds
	Creeping Red Fescue	1	Rufi*	Northstar Seed Ltd.
		2	BLMT*	Limoges Forages & Grasses Ltd.
		3	RCRF*	Limoges Forages & Grasses Ltd.
		4	Oracle*	Common
		5	Boreal*	Common
* Cultivars of 2021 trials re-seeded in 2022				

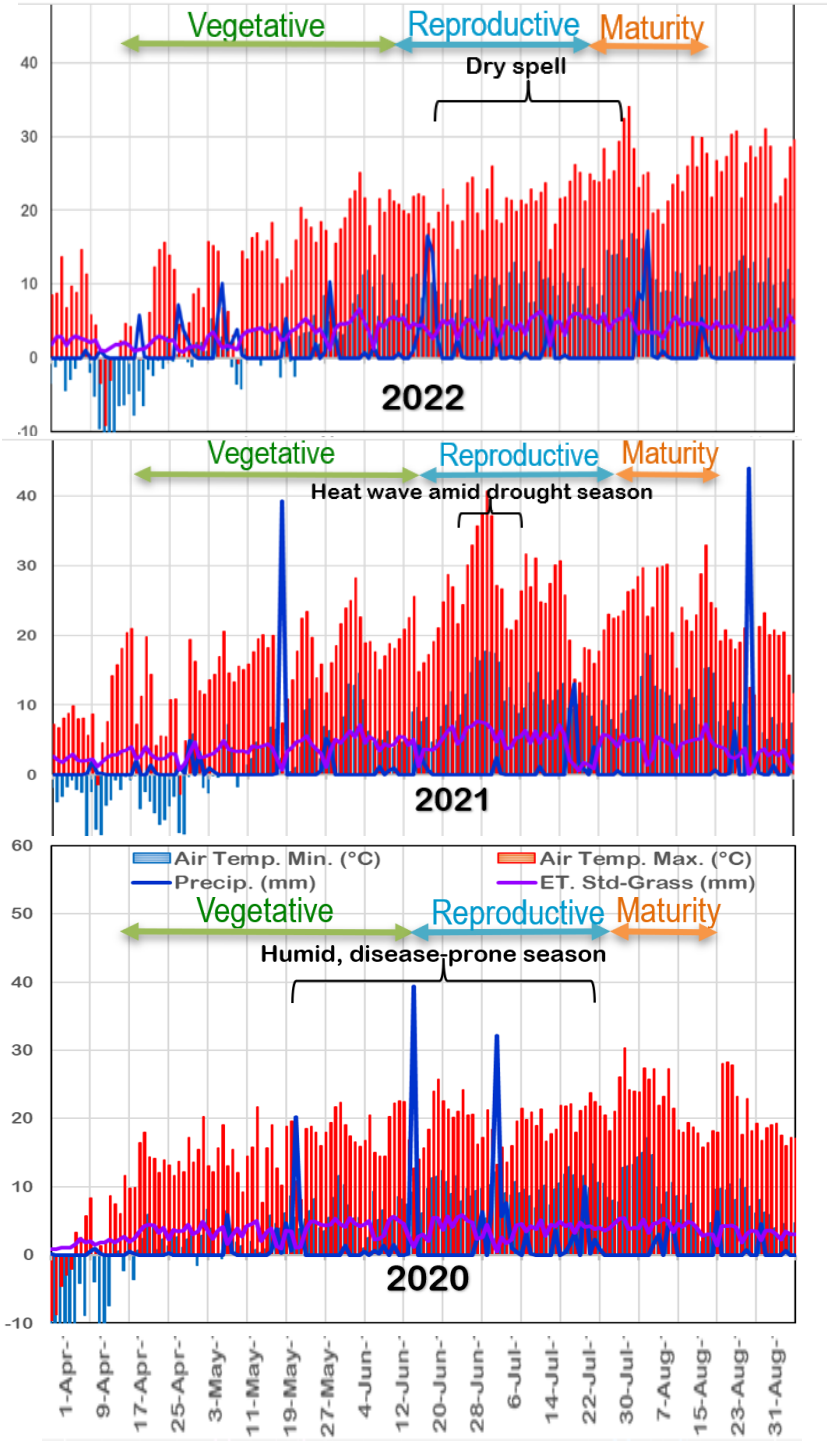

Figure 1. Weather conditions with highlights of crop growth stages in 2020, 2021 and 2022 growing seasons. Note the period of intense heatwave and drought during reproductive stage of the forage seed crops.

The growing season in 2020 had generally favourable rainfall distribution for crop growth and development. However, the humid condition favoured pest pressure and crop lodging leading to poor seed set of the crops. In contrast in 2021, dry spell spanning the whole month of June (9 mm

total precipitation compared to historical average of 64 mm) with intense heatwave during reproductive stage in the late June caused pollen desiccation. The dry spell continued for first three consecutive quarters of July caused premature senescence of crop leading to extremely poor seed yield. In 2022, the freezing nights until 3rd week of May slowed down the spring growth, which was followed by more favourable growth condition, promoting tiller development till the 3rd week of June. Then, a dry spell for about a month from late June to late July again coincided with reproductive phase of the crop. The weather pattern created nonsynchronous tiller growth leading to facultative ripening and lower seed recovery in grasses.

Hard, slender and Chewings fescue cultivar trial - Donnelly, 2020-2022

Objective

To evaluate seed yield potential of hard, slender and Chewings fescue cultivars submitted by various seed companies, compared to locally adapted popular cultivars Boreal.

Materials and methods

In this trial, six proprietary cultivars of hard, slender and Chewings fescues were compared with creeping red fescue cultivar Boreal (Table 1, Fig 5). The trial was laid out in randomized complete block design with four replicates. Trial was conducted on a grower's field, where the previous crop was Invigor canola. The trial was seeded on June 5th, 2020, with the SARDA small plot drill. Seed rate was 3 kg ha^{-1} for each variety. The plot dimensions were 13 m x 1.4 m (18.2 m^2), which accommodated 5 rows of 13 m long with row spacing of 28 cm. About 34 kg ha^{-1} (30 lbs/acre) of nitrogen and the same amount of phosphate was applied at the time of seeding. Weed control measures included application of a pre-emergent herbicide PrePass on June 11, followed by post emergence herbicide Infinity FX applied on June 29 and August 5. The trial area was fertilized on October 21 with 70 lbs/acre of nitrogen in the form of urea.

In 2021, the trial area was sprayed with Stellar to control broad-leaved weeds. Plant heights were measured on June 28. The hard, slender and Chewings fescue cultivars matured about one week earlier than Boreal creeping red fescue. Two of the cultivars were swathed on July 9, four of them were swathed on July 13, and Boreal was swathed on July 19. Individual plots were combined on July 23. The net harvest area was 14 m^2. Samples were dried and cleaned for the determination of clean seed, dockage, and 1000-seed weights.

Results and discussion

The plant heights of the test cultivars ranged from 40 to 50 cm for the first harvest year, while it was 68 to 82 cm for the second harvest year. The cultivar 2020-06 produced shorter plants in both production years, while rest of the cultivars were on par with Boreal for plant height (Fig 5).

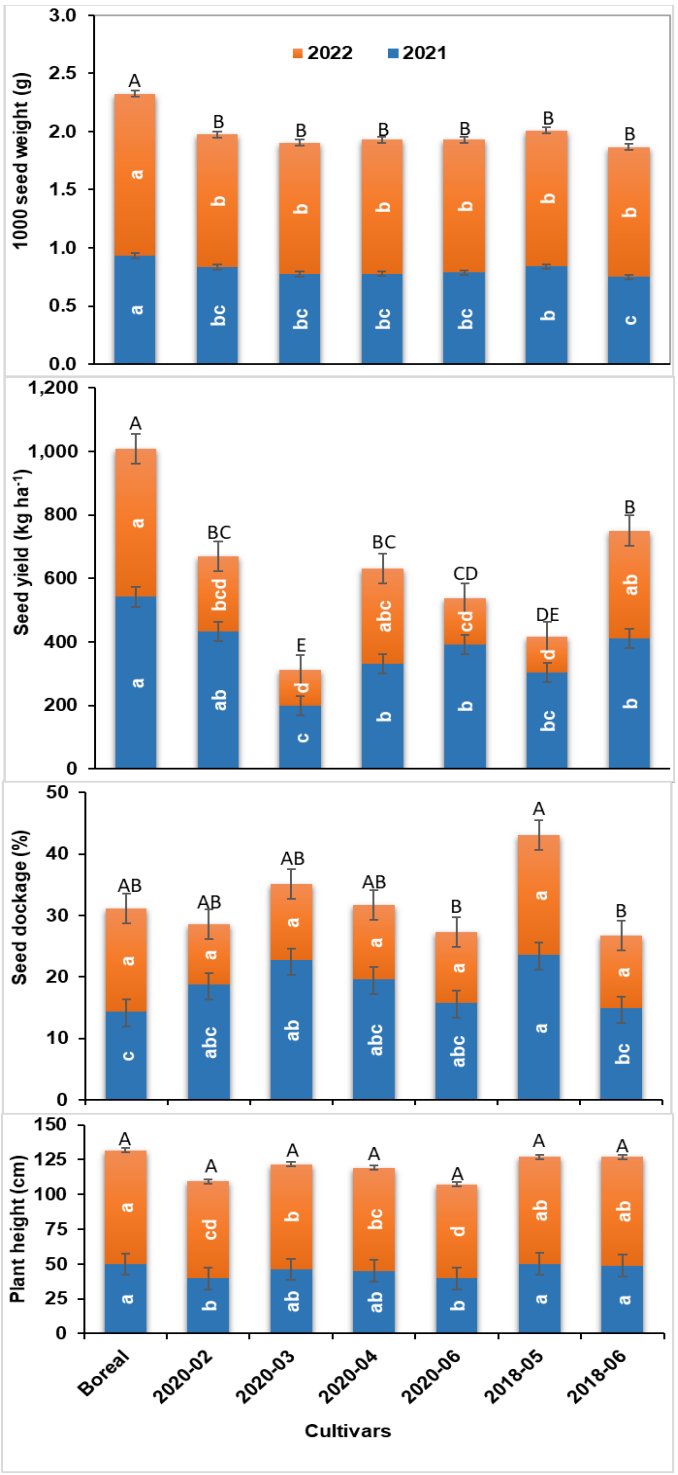

Figure 2. Seed yield, seed dockage, 1000-seed weight, and plant heights of hard, slender and Chewings fescue cultivars, in comparison with Boreal creeping red fescue for the first and second harvest years of 2021 and 2022. The trial was established in 2020 in Donnelly, AB. Means followed by same letter do not differ at 5% level of significance ((P=.05, Tukey's studentized range test). The error bars are standard error of mean (N=4).

Boreal outperformed all the test cultivars for seed yield and 1000-seed weight ($P < 0.01$). All test cultivars had less mean seed yield by 31% to 74% than that of Boreal up to the second harvest years (Table 4). Among rest of the cultivars, 2018-06 had significantly higher mean seed yield than 2020-03, 2020-06 and 2018-05, while remaining on par with 2020-02, and 2020-04. The 1000-seed weight was higher in boreal, differing significantly from other cultivars evaluated in this study.

Table 3. Total seed yield of hard, slender and Chewings fescue cultivars in comparison with Boreal for the 2021 and 2022 growing seasons. The trial was established in 2020 in Donnelly, AB.

Cultivars	Kg ha^{-1}			lb acre^{-1}			% of Boreal
	2021	2022	Total	2021	2022	Total	
Boreal	542	468	1009	482	416	898	100
2020-02	433	237	669	385	211	596	66
2020-03	199	111	311	177	99	276	31
2020-04	331	300	630	294	267	561	62
2020-06	393	144	537	350	128	477	53
2018-05	303	113	416	270	101	370	41
2018-06	411	341	751	365	303	668	74

The mean plant heights showed modest correlation with seed yields ($r = 0.32$), hence failed to explain any variation in seed yield ($R^2 = 0.103$) (Fig 6). The seed yield and dockage percentage had strong negative correlation ($r = -0.83$), and the dockage percentage explained 69% variation ($R^2 = 0.69$) in seed yield (Fig 6). The cultivars which produced higher seed yields had lower dockage, and vice versa. This implies that low yield was mainly due to floret abortion rather than low spikelet numbers.

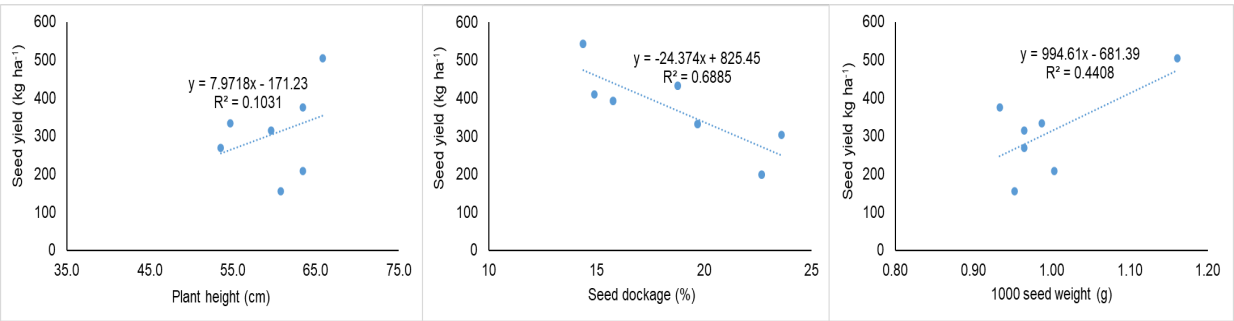

Figure 3. Relationship between seed yield, seed dockage, 1000-seed weight, and plant heights of hard, slender and Chewings fescue cultivars in 2021 growth season. The trial was established in 2020 in Donnelly, AB.

Crested wheatgrass cultivar trial, Donnelly, 2020-2022

Objective

To identify locally adapted, high seed-yielding cultivars of crested wheatgrass.

Materials and methods

The crested wheatgrass trial comprising three cultivars – Fairway, Kirk, and Newkirk, was laid out in randomized complete block design with four replicates. The trial was seeded on a grower's field on June 5, 2020, with the SARDA small plot drill. The previous crop was Invigor canola. Seed rate was 4 kg ha^{-1}. Plot size was 18.2 sq. m. with 5 rows of 13 m length spaced 28 cm apart. About 34 kg ha^{-1} (33 lbs/acre) of nitrogen and phosphate each was applied at the time of seeding. Weed control measures included application a pre-emergent herbicide PrePass on June 11, and two applications of in-crop herbicide Infinity FX on June 29 and August 5, 2020. The crop was fertilized on October 21, 2021, with 93 kg ha^{-1} (83 lbs/acre) of nitrogen.

In 2021, the trial area was sprayed with Stellar to control broad-leaved weeds. Plant heights were measured on June 28 when the crop was in reproductive phase. The entire trial was swathed on August 11 and combined on August 18. Harvest area per entry was 15 sq. m. Samples were dried and cleaned to determine seed yield, dockage, and 1000-seed weights. For the 2022 growing season, the trial was fertilized on October 21, 2021, with 112 kg ha^{-1} (100 lbs/acre) of nitrogen in the form of urea.

Results and discussion

The mean plant heights of crested wheatgrass test cultivars ranged from 80 to 101 cm. Kirk and Newkirk had significantly taller plants in both production years than that of Fairway cultivar (Fig 7). For seed yield, Fairway outperformed both Kirk and Newkirk in the first harvest year ($P = 0.017$) but averaged out with the second harvest year. However, the Kirk and Newkirk produced 15% and 7% lower seed yield, respectively than Fairway (Table 5). The 1000-seed weight of Kirk and Newkirk was significantly higher than that of Fairway in both production years. On contrary, Fairway had significantly less seed dockage than that of Kirk and Newkirk (Fig 7).

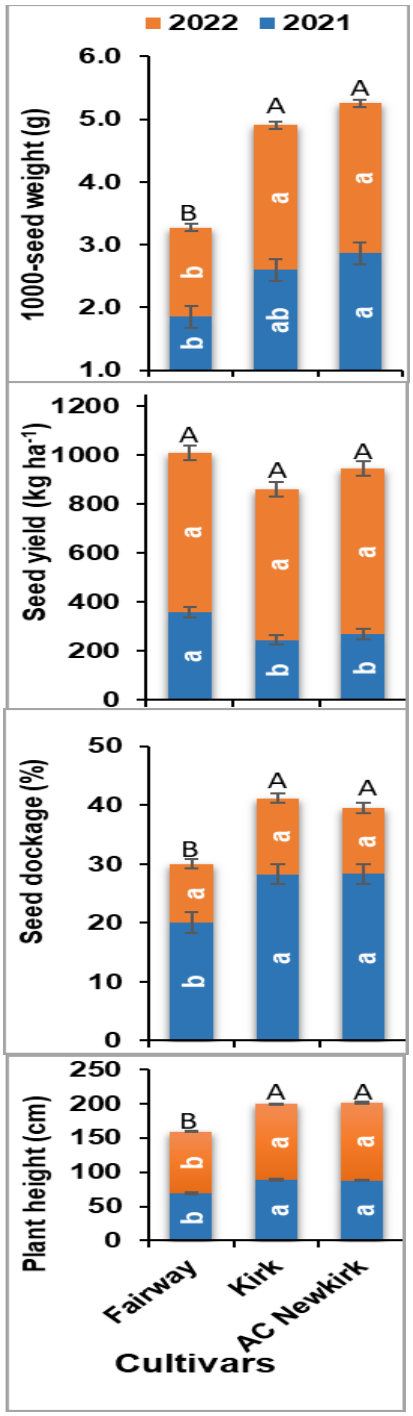

Figure 4. Seed yield, seed dockage and plant heights of crested wheatgrass cultivars for the first and second harvest years of 2021 and 2022. The trial was established in 2020 in Donnelly, AB. Means followed by same letter or symbol do not significantly differ (P=.05, Tukey's studentized range test). The error bars are standard error of mean (N=4).

Table 4. Total seed yield comparison of crested wheatgrass cultivars from 2021 and 2022 growing season. The trial was established in 2020 in Donnelly, AB.

Cultivars	Kg ha^{-1}			lb acre^{-1}			% of Fairway
	2021	2022	Total	2021	2022	Total	
Fairway	360	651	1011	321	579	900	100
Kirk	246	616	862	219	548	767	85
AC Newkirk	270	675	945	241	601	841	93

The mean plant heights and seed yields had negative correlation (r =-0.81), hence the plant height explained 66% variation (R^2 = 0.656) in the seed yield (Fig 7). It is apparent from both Fig 7 and Fig 8 that crested wheatgrass seed yields were not much influenced by plant heights. The seed yield was negatively correlated with 1000-seed weight (r = -0.73) and explained 53% (R^2 = 0.530) variation in seed yield. This suggests that 1000-seed weight did not contribute to seed yield in crested wheatgrass. The dockage percentage also showed strong negative correlation (r = -0.90) with seed yield, explaining 81% variation (R^2 = 0.81) in seed yield (Fig 8). The cultivar which produced higher seed yields had lower dockage, and vice versa. This implies that low seed yield was mainly due to floret abortion rather than low spikelet numbers.

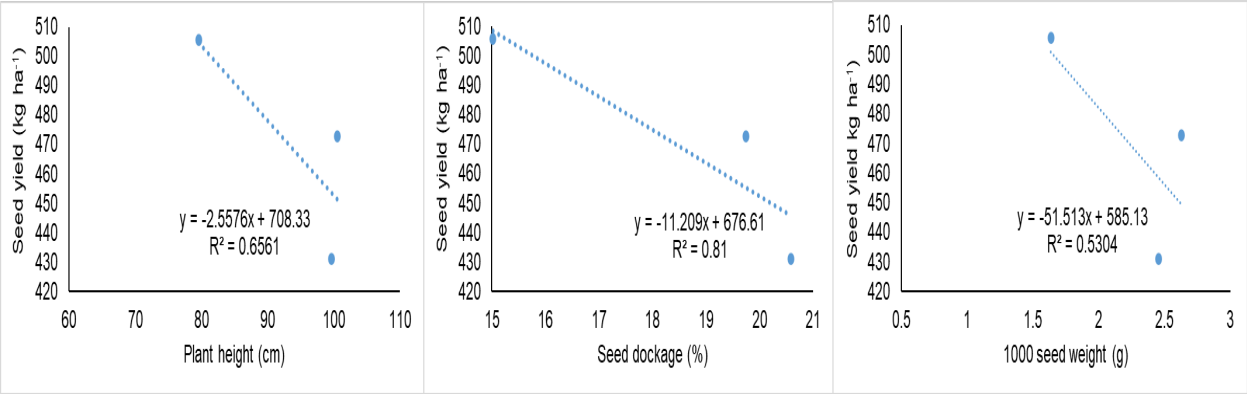

Figure 5. Relationship between seed yield, seed dockage and plant heights of crested wheatgrass cultivars in 2021 growth season. The trial was established in 2020 in Donnelly, AB

Red clover cultivar trial, Donnelly, 2021-2022

Objective

To identify locally adapted, high seed-yielding cultivars of red clover.

Materials and methods

A field trial with four red clover cultivars including Altaswede, Janico, Serbian - Una, and 2020RC3 was established in 2021 at Donnelly, AB. The study was laid out in randomized complete block design with four replicates. Individual plot size was 20 m x 2.8 m (56 m^2), which accommodated 10 rows of 20 m long with the row spacing of 28 cm. The crop was directly seeded on wheat stubbles using the SARDA small plot drill on June 1, 2021. The seeding rate of each cultivar was 5 kg ha^{-1}. The cultivars 2020RC3 and Una were desiccated with Reglone Ion on August 18th, 2022. These cultivars were harvested on August 30th by straight combining down the middle of each plot from an area of 34 m^2. The cultivars Altaswede and Janico were desiccated with Reglone ION on August 3, 2022 and harvested on September 8th. The seeds were dried and cleaned for the measurements of seed yield, dockage, and 1000-seed weights.

Results and discussion

The highest seed yield was recorded from the Janico cultivar, which was 37% higher than the check, Altaswede (Table 6, Fig 9). The 2020RC3 cultivar produced significantly lowest seed yield along with the lowest 1000-seed weight. The Serbia cultivar yielded 8% higher than Altaswede, but it was statistically similar. There was a significantly negative correlation between the seed dockage and seed yields (r = -0.89) which explained 74% variation (R^2 = 0.735). The relationships between 1000-seed weight and seed yield were positive (r=0.35) that can explain only 12% variation (R^2=0.125).

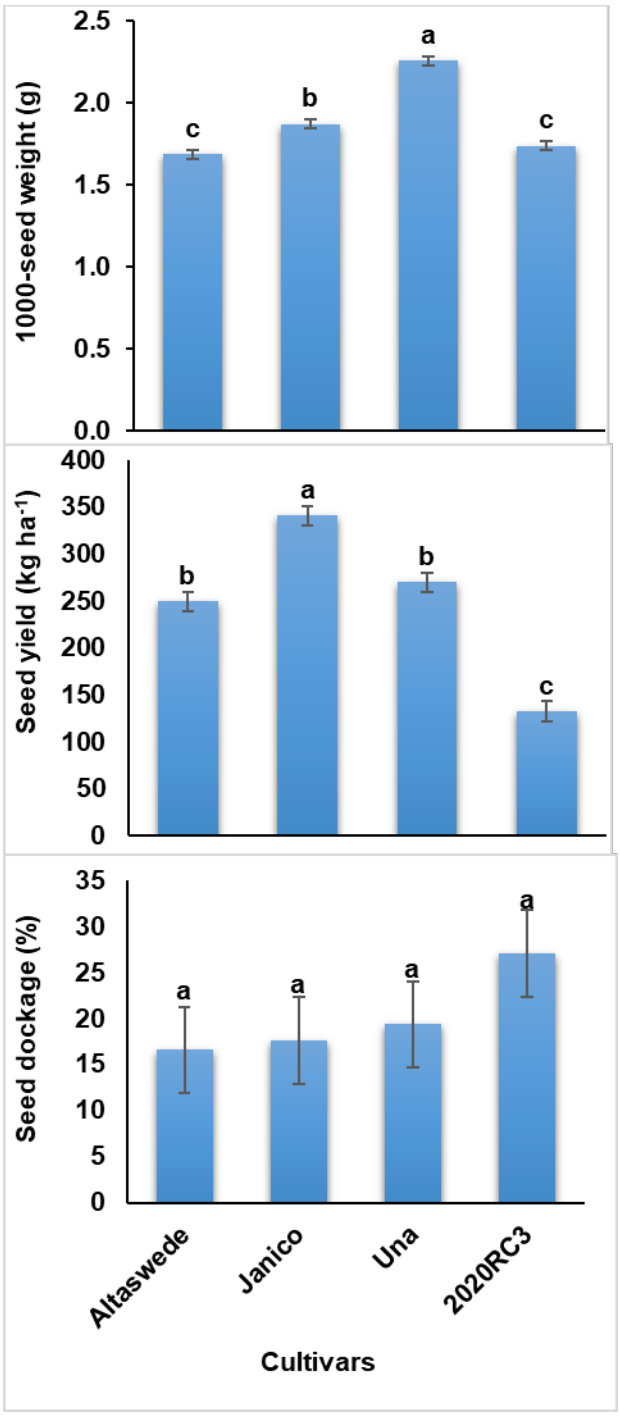

Figure 6. Seed yield, seed dockage and 1000-seed weight of red clover cultivars in the first harvest year of 2022. The trial was established in 2021 at Donnelly, AB. Means followed by same letter do not differ at 5% level of significance (P=.05, Tukey's studentized range test). The error bars are standard error of mean (N=4).

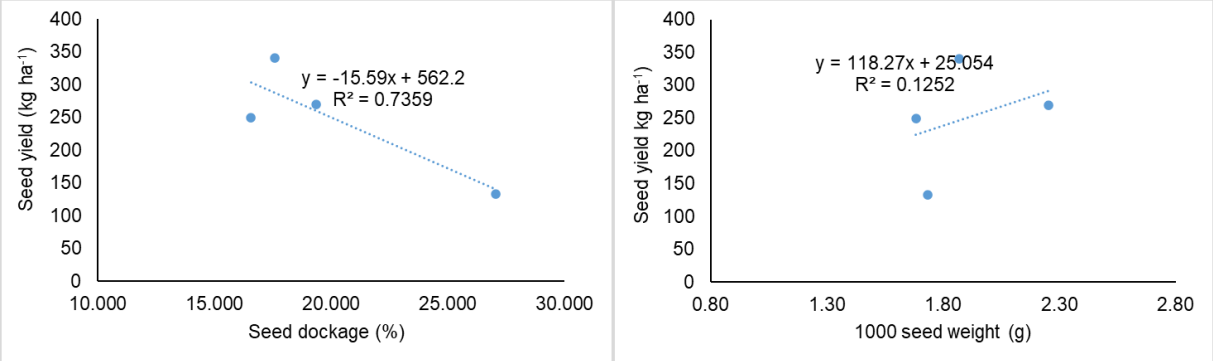

Figure 7. Relationship between seed yield, seed dockage, and 1000-seed weight of red clover cultivars in 2022 growth season. The trial was established in 2021 in Donnelly, AB.

Table 5. Seed yield comparison of red clover cultivars in 2022 growing season. The trial was established in 2021 in Donnelly, AB.

Cultivars	**Seed Yield**		
	kg ha^{-1}	**lb acre^{-1}**	**% of Altaswede**
Altaswede	249	222	100
Janico	341	304	137
Una	270	241	108
2020RC3	133	118	53

Alsike clover cultivar trial, Donnelly, 2021-2022

Objective

To evaluate the seed yield potential of alsike clover cultivars.

Materials and methods

The study was established in 2021 with three alsike clover cultivars such as Aurora, Menta and 202AC1 in a field site of Donnelly, AB. The previous crop grown in the field site was wheat. Experimental layout followed a randomized complete block design with four replicates. The cultivars were seeded in small plots of 20 m x 2.8 m (56 m^2 area) to accommodate 10 rows with 28 cm row spacing. A small plot drill was used to seed directly on wheat stubbles at the 3 kg ha^{-1} seeding rate of each cultivar. The trial area was desiccated with Reglone ION on August 18th, 2022. The crop was harvested on August 30, 2022, from the middle of the plots by straight combining down an area of 34 m^2. Collected seed samples were processed by drying and cleaning prior to measurements of seed yield, dockage, and 1000-seed weights.

Results and discussion

There was a significant difference among the tested cultivars for seed yield (P = 0.005) and 1000-seed weights (P = 0.013). The highest seed yield was recorded from the cultivar 2020AC1, although the 1000-seed weight was the lowest (Fig. 11). Therefore, a very strong negative correlations (r=-0.99) existed between 1000-seed wight and seed yields (Fig. 12). The correlation between seed dockage and seed yield was also negative (r=-0.54) and explained 30% variations (R^2=0.296). The Menta cultivar produced 5% higher seed yield than the check cultivar Aurora, but it statistically similar. The yield increment of 2020AC1 was 39% higher than the check cultivar.

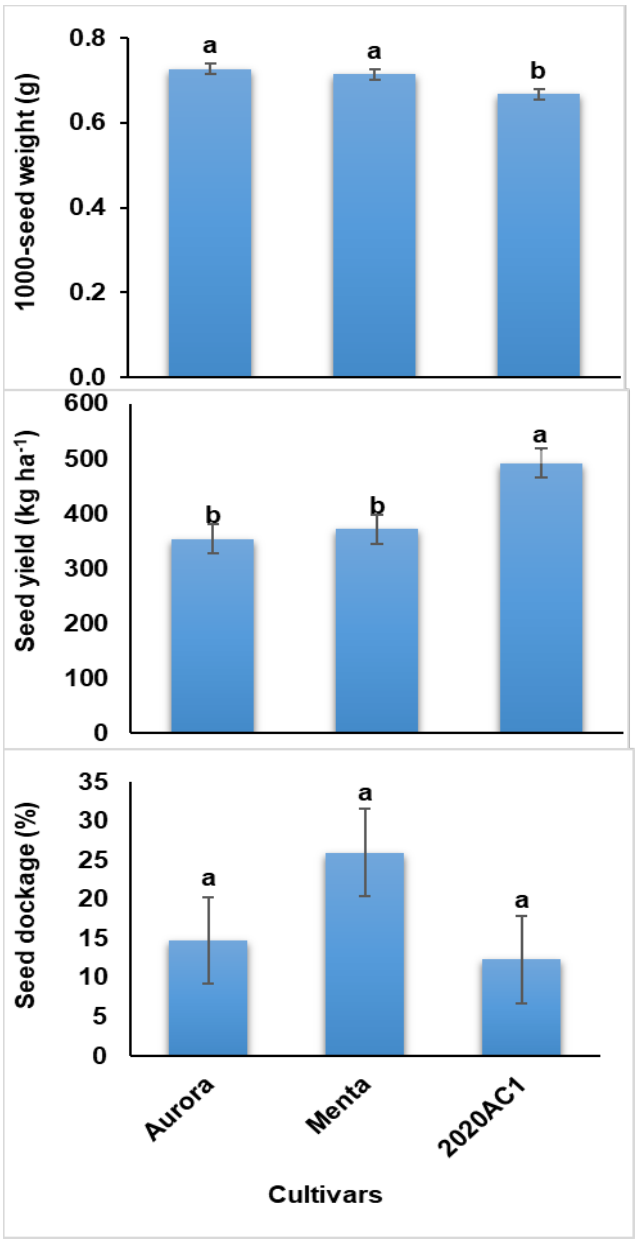

Figure 8. Seed yield, seed dockage and 1000-seed weight of alsike clover cultivars for the first harvest year of 2022. The trial was established in 2021 at Donnelly, AB. Means followed by same letter do not differ at 5% level of significance (P=.05, Tukey's studentized range test). The error bars are standard error of mean (N=4).

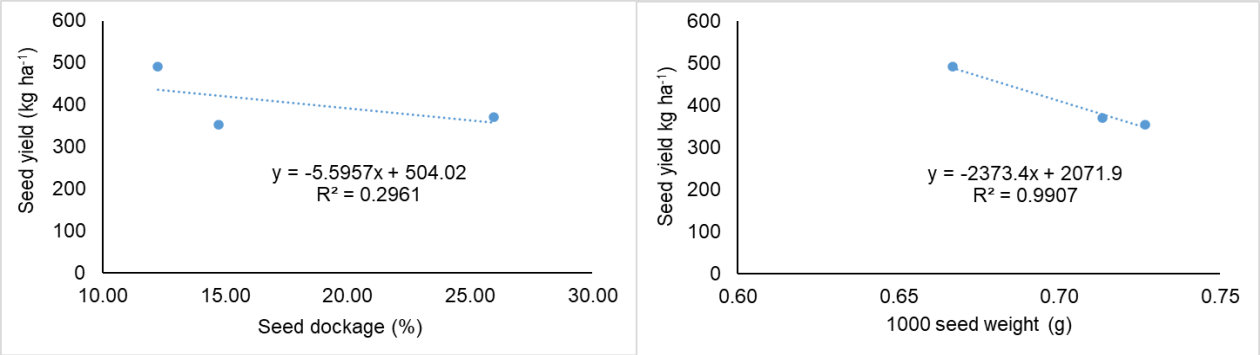

Figure 9. Relationship between seed yield, seed dockage, and 1000-seed weight of alsike clover cultivars for the harvest year of 2022. The trial was established in 2021 in Donnelly, AB.

Table 6. Seed yield comparison of alsike clover cultivars in 2022 growing season. The trial was established in 2021 in Donnelly, AB.

Cultivars	**Seed Yield**		
	kg ha^{-1}	**lb acre^{-1}**	**% of Aurora**
Aurora	353	315	100
Menta	371	331	105
2020AC1	491	438	139

Turf-grass, forage grass and legume cultivar testing trials, Beaverlodge, 2021

Objective

To evaluate seed yield and adaptive performance of turf-grass, forage grass and legume cultivars submitted by various companies, compared to those originated from AAFC breeding programs.

Materials and methods

Altogether six cultivar testing trials, three each of forage grasses and legumes were established at two different fields at 55°20'05.21"N, -119.38'59.43"W and 55°20'16.19"N, -119°39'25.48"W respectively in the Beaverlodge Research Farm. In the spring of 2021, four cultivars of timothy, three cultivars of creeping red fescue and six cultivars of perennial rye grass were seeded along with the widely cultivated and common varieties for relative comparison of productivity. The legume trial included four cultivars each of alfalfa and alsike clover, and six cultivars of red clover. The cultivar and relevant companies' information are summarized in Table 2. The experimental set up was randomized complete block design (RCBD) with four replicates (Fig. 9). Individual plot dimensions were 2 m by 8 m. The grass cultivars were seeded with 30 cm row spacing and legume cultivars with 60 cm row spacing under no tillage condition using a Hege seed driller. Recommended seed rates of Alberta Agriculture and Forestry were used for respective species planting (https://www.agric.gov.ab.ca/app19/calc/forageseed/seedingtable.html). Both grass and legume cultivars were seeded on June 3, 2021, except for the perennial ryegrasses that were seeded on July 23, 2021. Both pre-emergence and post-emergence herbicides were applied for weed control. Manual weeding was done on August 30, 2021, prior to fall fertilization. The trials were broadcast-fertilized on September 15, 2021. The trials were fertilized with commercial fertilizer blend N-P-K-S of 26-14-6-6 at the rate of 80:43:18:18 kg ha^{-1} for grass trial, while the legume trial received 30:16:7:7 kg ha^{-1}.

Based on our experience with forage legumes trials on rhizobium inoculation, chitosan application, grass+legume mixtures, and cultivar trials at Beaverlodge, 30 cm row spacing proved difficult in extracting precise samples from rows because of overlap of plants between rows. Additionally, because of differential maturity, and Beaverlodge being refuge of flocks of deer, grazing by deer confounded true evaluation of adaptability for seed yield. So, we decided to adopt wider spacing of 60 cm and deer-deterring measures for legumes cultivar evaluation and plant selection nurseries. Closer spacing is better for weed suppression, but wider spacing allows us more precise sampling for cultivar comparison. Other measures could be to have whole-plot harvest (swathing+combine) for seed yield, plus use of weigh-wagon to measure fresh biomass and sub-sampling for dry biomass yield. Currently, we do not have appropriate machinery for the whole-plot harvest option for proper comparison between treatments. So wider row spacing is a reasonable solution for precision sampling for forage legumes cultivar trials.

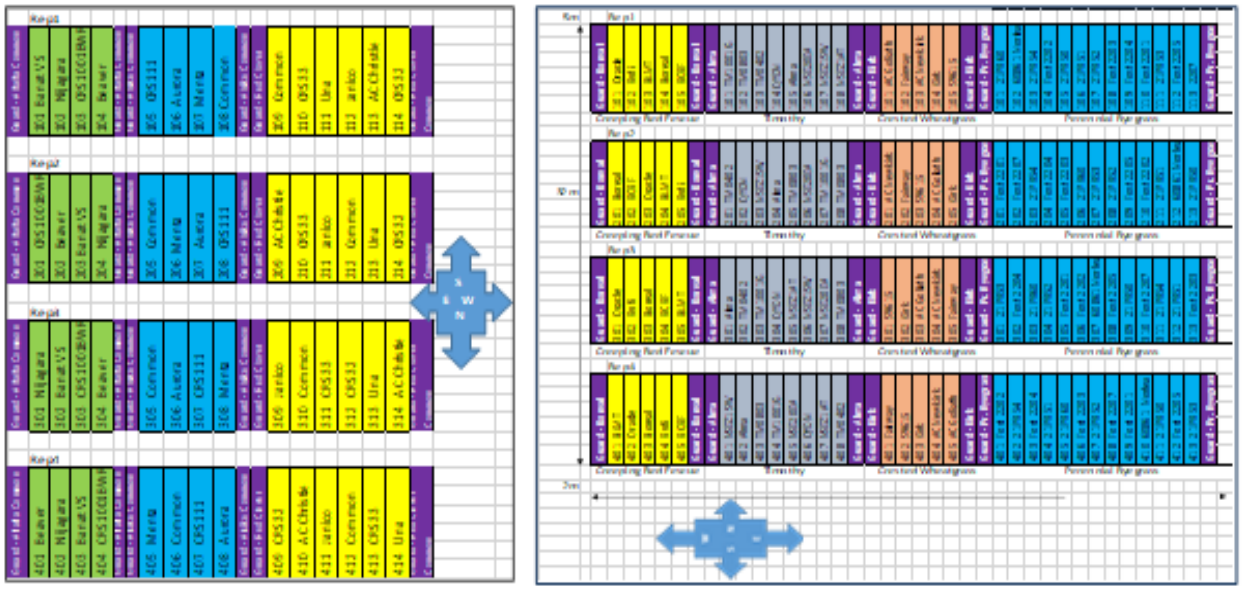

Figure 10. Experimental layout of forage legumes established in 2021 (left panel), and turf and forage grasses established in 2022 (right panel) at Beaverlodge Research Farm, AB.

Results and discussion

Figure 11. Examining the establishment success of trials established in 2021 and 2022 at Beaverlodge Research Farm, AB. Photographs were taken at early growing season of 2022.

Because of the intense heatwave and prolonged drought conditions causing high evapotranspiration and moisture stress, there was a delayed and staggered emergence in grasses. The summarized results showed a higher coefficient of variation; hence, the data are not presented in this report. However, the grass cultivars were reseeded in 2022 for further evaluation. Legumes also underwent delayed emergence, but the plots attained satisfactory plant population after few weeks of seeding. Furthermore, the alfalfa cultivars did not produce mature seeds due to extended period of vegetative growth as influenced by the regional soil-climatic conditions.

Total biomass and seed yield of red clover cultivars

There was a significant variation in tested cultivars for total biomass and seed yield (Fig. 15). The highest biomass and seed yield was recorded from Janico cultivar, and it was statistically similar to check (common) cultivar. However, it produced 21% higher seed yield than that of common (Table 8).

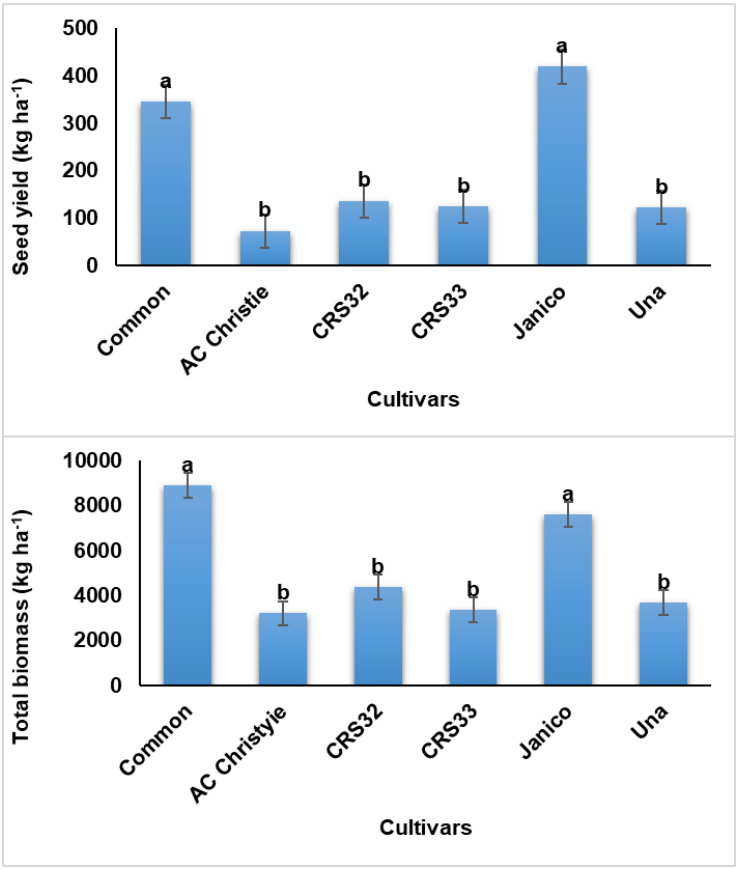

Figure 12. Total biomass and seed yield of red clover cultivars in the first production year of 2022. The trial was established in 2021 at Beaverlodge, AB. Means followed by same letter do not differ at 5% level of significance (P=.05, Tukey's studentized range test). The error bars are standard error of mean (N=4).

Table 7. Seed yield comparison of red clover cultivars in 2022 growing season. The trial was established in 2021 at Beaverlodge, AB.

Cultivars	Seed Yield		
	kg ha^{-1}	lb acre^{-1}	% of Common
Common	345	307	100
AC Christie	74	66	21
CRS32	137	122	40
CRS33	125	112	36
Janico	419	373	121
Una	122	109	35

Total biomass and seed yield of alsike clover cultivars

The total biomass and seed yield of tested alsike clover cultivars were statistically similar for the first harvest year of 2022. The menta cultivar produced 24% higher sed yield than that of common (Table 9), but no significant variation was observed.

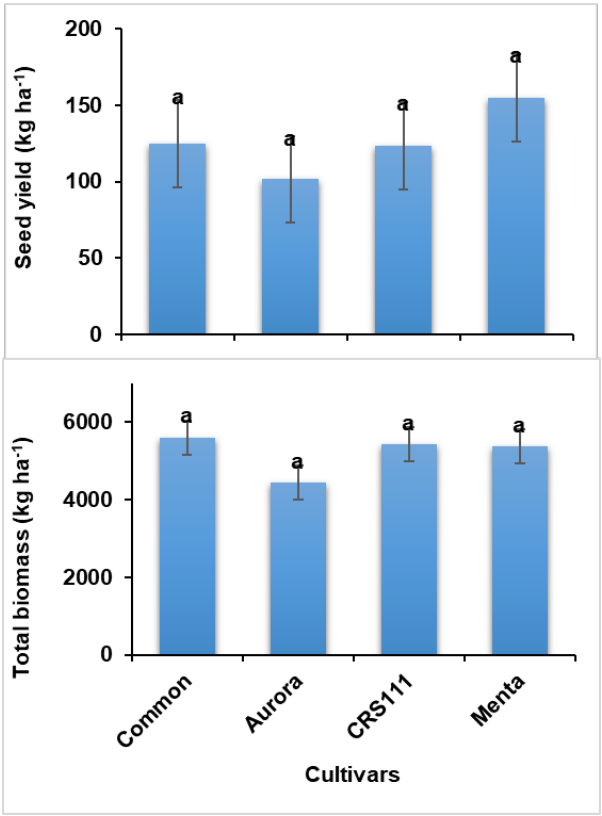

Figure 13. Total biomass and seed yield of alsike clover cultivars in the first harvest year of 2022. The trial was established in 2021 at Beaverlodge, AB. Means followed by same letter do not differ at 5% level of significance (P=.05, Tukey's studentized range test). The error bars are standard error of mean (N=4).

Table 8. Seed yield comparison of alsike clover cultivars in 2022 growing season. The trial was established in 2021 at Beaverlodge, AB.

Cultivars	Seed Yield		
	kg ha^{-1}	lb acre^{-1}	% of Common
Common	125	112	100
Aurora	102	91	81
CRS111	123	110	99
Menta	155	138	124

Conclusion

A series of field experiments were conducted to identify how well the proprietary cultivars adapts to soil and climate conditions of Peace Region. The primary objective was to select varieties that exhibit high adaptability and yield performance, which are essential to determine its suitability for the local agro-ecological conditions. Overall testing process includes examining the establishment success, and measuring the yield components such as biomass, 1000-seed weight, and seed yield of introduced cultivars in comparison to the well adapted check cultivars. The seed germination and crop establishments were critically affected by unusual seasonal weather of 2021 as characterized by intense heatwave and drought stress. It resulted in staggered and uneven emergence, pollen desiccation, poor fertilization, impaired seed development in grass trials. The grass trials were reseeded in 2022 at Beaverlodge site to validate those study results. The first harvest year results of legume cultivar testing trials have identified high yielding red clover and alsike clover cultivars.