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Peace Region Grass Seed Testing Program

Coordinated by:

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

Annual Report 2016

Compiled by:

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and Talon Gauthier**

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Deutsche Saatveredelung AG

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PureSeed

Limoges Forage Grasses Seed

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Agriculture and Agri-Food Canada

Alberta Agriculture and Rural Development

We thank the following for their partnership and technical assistance:

Calvin Yoder, Alberta Agriculture

Shirley Neighbour, Agriculture and Agri-Food Canada

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Protocol for Peace Region Grass Seed Testing Program (PRGST)

Revised December 2016

1. Research Sponsorship

The research sponsorship of **\$240 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 will administer funds for the Peace Region Grass Seed 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 % of the forage crop seed 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; creeping red, chewings, hard, meadow, sheep or tall fescue; annual or perennial ryegrass
- 200 gm of meadow or smooth brome grass, wheatgrasses
- The germination % of each cultivar

Approved seed entries shall supply seed 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 seed 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 in various annual reports and 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.

Some results in this report have been tested for one or two harvested years. It is advised not to use average yield figures to make cultivar comparisons for these years. Only after a minimum of two harvested years of creeping red fescue or three harvested years of timothy, meadow fescue, tall fescue, meadow brome grass and smooth brome grass as a recommended year for the test, the data should be considered as 90% reliable. 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.

Peace Region Grass Seed Testing (PRGST) Program

2017 Application for Entry

1. Company: _____ Telephone: _____

Contact person: _____ Fax: _____

Mailing address: _____ Email: _____

| Species | | Type Forage or turf | | Cultivar name/code | | % Germ | | Relative maturity early, medium, late |
|---------|--|---------------------|--|--------------------|--|--------|--|--|
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Send application form no later than March 15th, 2017 to:

Nityananda Khanal, Ph.D., P.Ag.

Research Scientist – Integrated Forage Crops Management
 Beaverlodge Research Farm | Ferme de recherche de Beaverlodge
 Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada
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INTRODUCTION

The Peace Region offers tremendous potential to increase the production, productivity and quality of forages and turf grass seed for the domestic and export market. Lack of regionally adapted cultivars and appropriate management options such as registered plant protection materials are major constraints to quality seed production in the region. There are growing concerns for weed competition and insect pest infestations in the forages and other crops in the recent years. In order to address the production constraints and foster the forage seed industry in this internationally reputed region, the Beaverlodge Research Farm of AAFC has been extending collaboration with the Peace River Forage Seed Association (PRFSA) through an initiative known as the Peace Region Forage Seed Testing (PRGST) (originally known as Western Grass Seed Testing Program) and with projects under Agri-Innovation Program for last several years. The primary objective of the PRGST trials is to evaluate the adaptability, productivity and quality of the proprietary species and cultivars of U.S. 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 three perennial growth seasons, except for the creeping red fescue which was evaluated for two perennial growth seasons, in the Peace Region Grass Seed Testing Trials (PRGST) under the Agri-Science Projects Growing Forward 2 Program from 2013 to 2016. A total of 73 entries of different forage and turf grass species from various origins were evaluated in this period. The number of entries included 18 of timothy (*Phleum pratense* L.), 46 of creeping red fescue (*Festuca rubra* L. var. *rubra*), 3 of meadow fescue (*Festuca pratensis* Huds.), 8 of tall fescue (*Festuca arundinacea*) and 8 of crested wheatgrass (*Agropyron cristatum* [L.] Gaertn.). Most of those cultivars were developed outside of Canada and hence must be tested under Canadian conditions for seed yield and adaptability. The seed yield results of the cultivars under the PRGST trials are helpful to establish contacts between seed companies and growers. Assessment of regional adaptability of the cultivars of foreign origin under appropriate agronomic practices such as stand establishment, integrated pest management, plant nutrient management, harvest and post-harvest procedures provide valuable information in terms of consistency, quality and marketability and thereby providing confidence to both producers and seed companies for contractual decisions. Ultimately, the cultivars that perform well undergo seed multiplication and the seeds are destined to domestic and international markets.

MATERIALS AND METHODS

The Peace Region Grass Seed Testing (PRGST) trials were conducted at Beaverlodge Research Farm, AB (lat. 55°12'N) from 2013 to 2016. The results included in this report were derived from trials that were established in 2013, 2014 and 2015. The new cultivars of timothy (*Phleum pratense* L.), creeping red fescue (*Festuca rubra* L. var. *rubra*), meadow fescue (*Festuca pratensis* Huds.) and tall fescue (*Festuca arundinacea*) and crested wheatgrass (*Agropyron cristatum* [L.] Gaertn.) were tested for their agronomic performance and seed production potential in comparison to popular cultivar of respective species in the region (Table 1 and 2). The cultivars in the trials were evaluated according to their agronomic performance that required two harvested years of seed production for fine fescue and three harvested years of seed production of tall fescue, meadow fescue, timothy, crested wheatgrass and brome grass. The forage grass cultivars and the checks included in the trials were obtained from Canadian and international seed companies and their foreign associates. Several seed companies Moore Seed Processors, Imperial Seed, Foster's Seed and Feed LTD and Pure Seed) participated in the Peace Region Grass Seed Testing Program (PRGST). The site at Beaverlodge, AB had been under pea-barley-wheat-canola rotation before seeding. The trials are direct seeded and fertilizers are applied in the fall according to results from the soil testing laboratory. During the trials, weeds were controlled by a combination of trimming, inter-row cultivation, and application of recommended herbicides. Individual experimental plots were comprised of four rows, each 6 m long with row spacing of 30 cm apart. The yield was collected

from the central two rows. The experimental design for each species was a randomized complete block with four replications.

Table 1. List of cultivar trials that completed the required evaluation of perennial growth cycles in 2016

| Forage species | Year of seeding | Seed sources | No. of Entries | Cultivars | Year of evaluation |
|---------------------|-----------------|-----------------------|----------------|---|--------------------|
| Timothy | 2013 | Barenbrug USA | 6 | BAR BOO5, BAR D003, BAR 1006, BAR M002, BAR R001, BAR S004 | 2014, 2015 & 2016 |
| | | Moore Seed Processors | 3 | Teuho, Tuukka, Varis | |
| | | Local check | 1 | Climax | |
| Creeping Red Fescue | 2014 | Moore Seed Processors | 8 | MSB0313, MSK0213, MSP0613, MSP0713, MSP0813, MSP0913, MSR0413, MSU0113 | 2015 & 2016 |
| | | Foster's Seed | 3 | B130421, B130428, B130429 | |
| | | Local check | 1 | Boreal | |
| Meadow Fescue | 2013 | Barenbrug USA | 9 | FP75RO, COSMONAUT, BOR 20613, BOR 20614, 11-FPF12, 11-(09-FPF7), PRADEL, FP75RO1, BARCRYPTO | 2014, 2015 & 2016 |
| | | Local check | 1 | Preval | |
| Tall Fescue | 2013 | Barenbrug USA | 2 | BAR FA 9125, BAR FA 9017 | Failed to mature |
| | | Local check | 1 | Courtenay | |

Table 2. List of cultivar trials that ongoing for their required evaluation of perennial growth cycles

| Forage species | Year of seeding | Seed sources | No. of Entries | Cultivars | Year of evaluation |
|---------------------|-----------------|------------------------|----------------|---|--------------------|
| Timothy | 2014 | Moore Seed Processors | 1 | MST0513 | 2015 & 2016 |
| | | Barenbrug USA | 8 | PHL1R99, Bor 01033, Bor 2005, Bor 01025, Bor 88060, Bor 01037, Barpenta, Barleo | |
| Creeping Red Fescue | 2015 | Imperial Seed | 4 | Reverent, DSV 15-01, DSV 15-02, DSV 15-03, | 2016 |
| | | PureSeed | 7 | 4SHR, 4BEN, 4RUE-14, 4SP14, 4ED4, 4DR4, 4GRY | |
| | | Moore Seed Processors | 8 | MSPO114, MSPO214, MSPO314, MSPO414, MSPO514, MSPO614, MSG0412, MSR0612 | |
| | | Barenbrug USA | 2 | Bridgeport II, BAR VV-VP3-CT | |
| | | Foster's Seed | 2 | 4CRD-8, ASC295 | |
| Creeping Red Fescue | 2016 | Barenbrug USA | 1 | BAR FRR 15134 | - |
| | | Foster's Seed | 3 | C8-14-4ED4, Chanellor Chewings, C8-14-4BEN, | |
| | | Imperial Seed | 3 | DSV 15-01, DSV 15-02, DSV 15-03 | |
| Meadow Fescue | 2016 | Barenbrug USA | 2 | BAR FP 32, Prade | - |
| Tall Fescue | 2016 | Barenbrug USA | 4 | BAR FA 11701, Bariane, BAR FA 14173-11, BAR FA 14173-15 | - |
| Crested Wheat-grass | 2016 | Limoges Forage Grasses | 4 | Kirk, AC New Kirk, Fairway, Elbee | - |
| | | Barenbrug USA | 1 | BAR GRL CWG | |

RESULTS

Weather and its effects on crops

While the monthly mean temperatures displayed similar patterns with long-term average for last 30 years (Figure 1 & 2), the amount and distribution of precipitation showed noticeable monthly variation in growing seasons over the reporting period of 2013 to 2016 (Figure 3). In general, the growing season in 2013, 2015 and 2016 received higher amount of precipitation, with seasonally wettest months being September, July and August respectively. On the other hand, 2014 growing season remained much drier than the long-term average of 30 years (Figure 3). This condition results in variation in soils moisture regimes in growing season in different years and hence fluctuations in productivity. Negligible precipitation in August of 2014, when most of the species undergo reproductive processes, could have negative effect on seed development. The 2015 growing season showed typical modal pattern of monthly precipitation (Figure 3) favouring the moisture demand of the plants. The precipitation pattern in 2016 was also favourable, except for a high terminal rainfall in August of 2016 (Figure 3) that caused some lodging and some impairment in the harvesting process. In general, both 2015 and 2016 seasons were favourable for plant growth, biomass and seed yield of grass species evaluated in the trials. The data for seed yield for tall fescue trial at Beaverlodge were not reported due to delayed maturity of the new tall fescue cultivars included in 2015 and 2016.

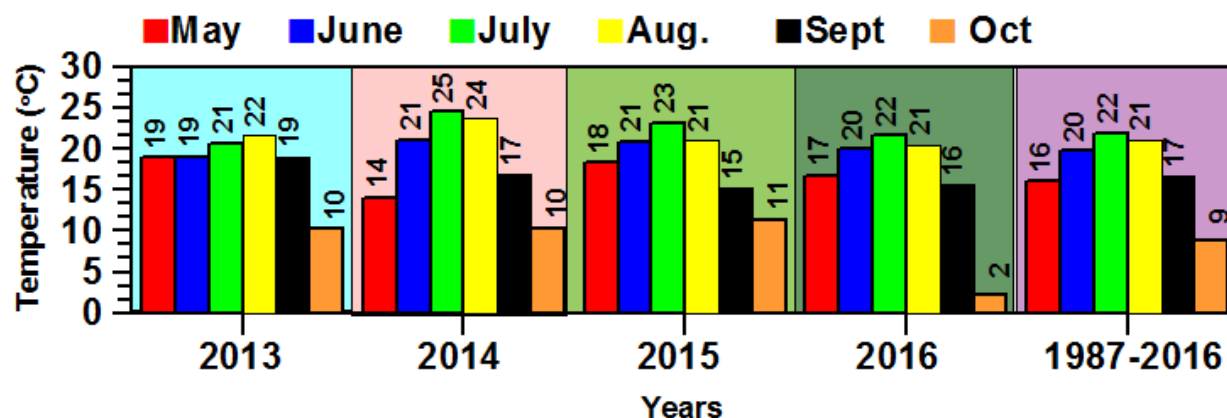


Figure 1. Average monthly maximum temperature during the growing seasons of 2013 to 2016 compared with 30-years' monthly average at Beaverlodge, AB.

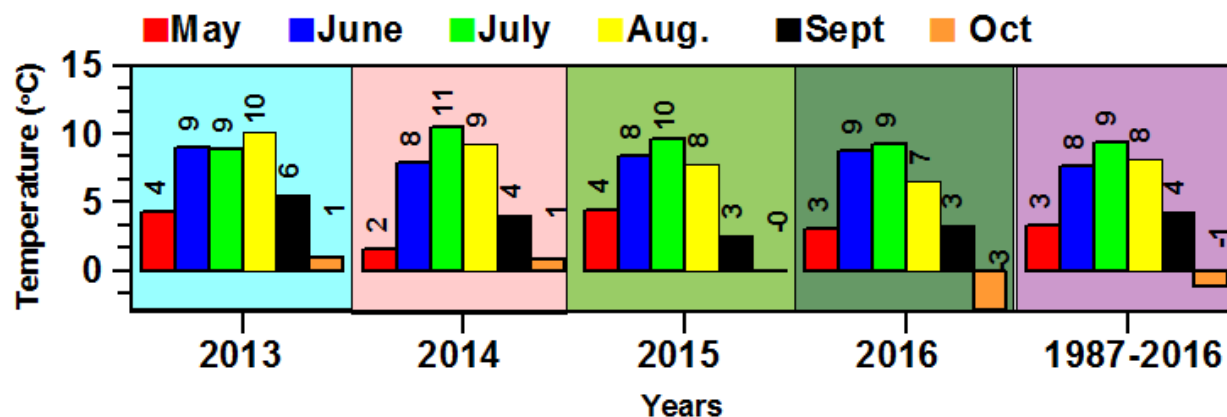


Figure 2. Average monthly minimum temperature during the growing seasons of 2013 to 2016 compared with 30-years' monthly average at Beaverlodge, AB.

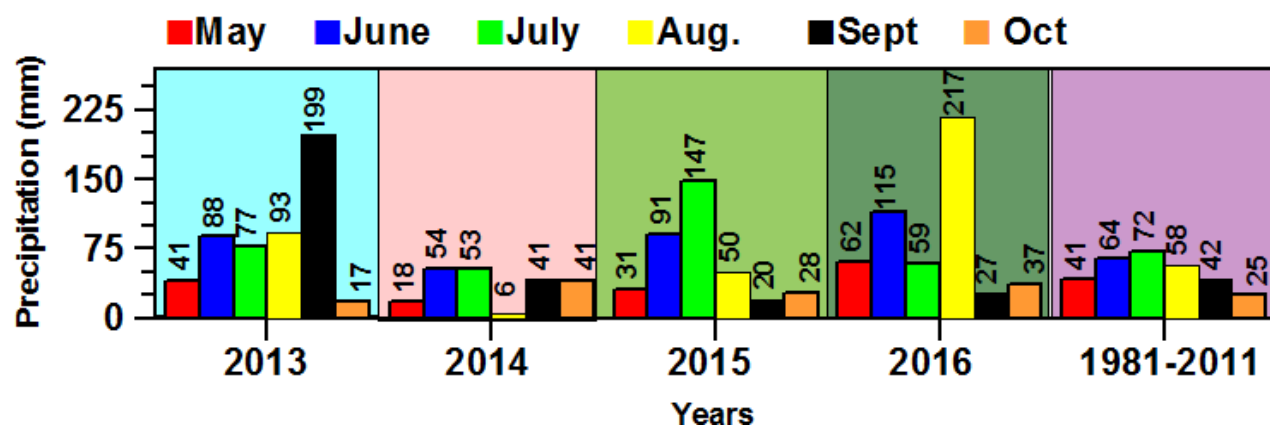


Figure 3. Total monthly rainfall during the growing seasons of 2013 to 2016 compared with 30-years' monthly average at Beaverlodge, AB.

Results of completed trials

Creeping red fescue

The 12 cultivars of creeping red fescue established in 2014 exhibited differences in seed yield, aerial dry biomass and plant height. Figure 4 shows a pre-harvest snapshot of the trial in 2016. The seed yield varied as much as three-fold between the cultivars within the same harvest season. All cultivars showed 53% to 79% decline in yield in the successive harvest season from 2015 to 2016 (Table 3; Figure 5). Average yield ranged from 639 to 1721 kg ha⁻¹ (571 to 1537 lbs acre⁻¹) in the first harvest season of 2015, and the total seed yield over two harvest seasons of 2015 and 2016 ranged from 876 to 2105 kg ha⁻¹ (782 to 1880 lbs acre⁻¹). The check cultivar Boreal out-yielded all new entries in total yield (Table 3), although the seed yield ranks were not consistent for most of the cultivars in two successive growing seasons (Figure 5). Two cultivars MSB0313 and MSU0113 from Moore Seed Processors and one cultivar B130421 from Foster's Seed had relatively consistent performance with 97%, 92% and 94% of the cumulative yield of the check cultivar Boreal (Table 4).



Figure 4. Photograph taken in 2016 of the creeping red fescue trial established in 2014 at Beaverlodge, AB.

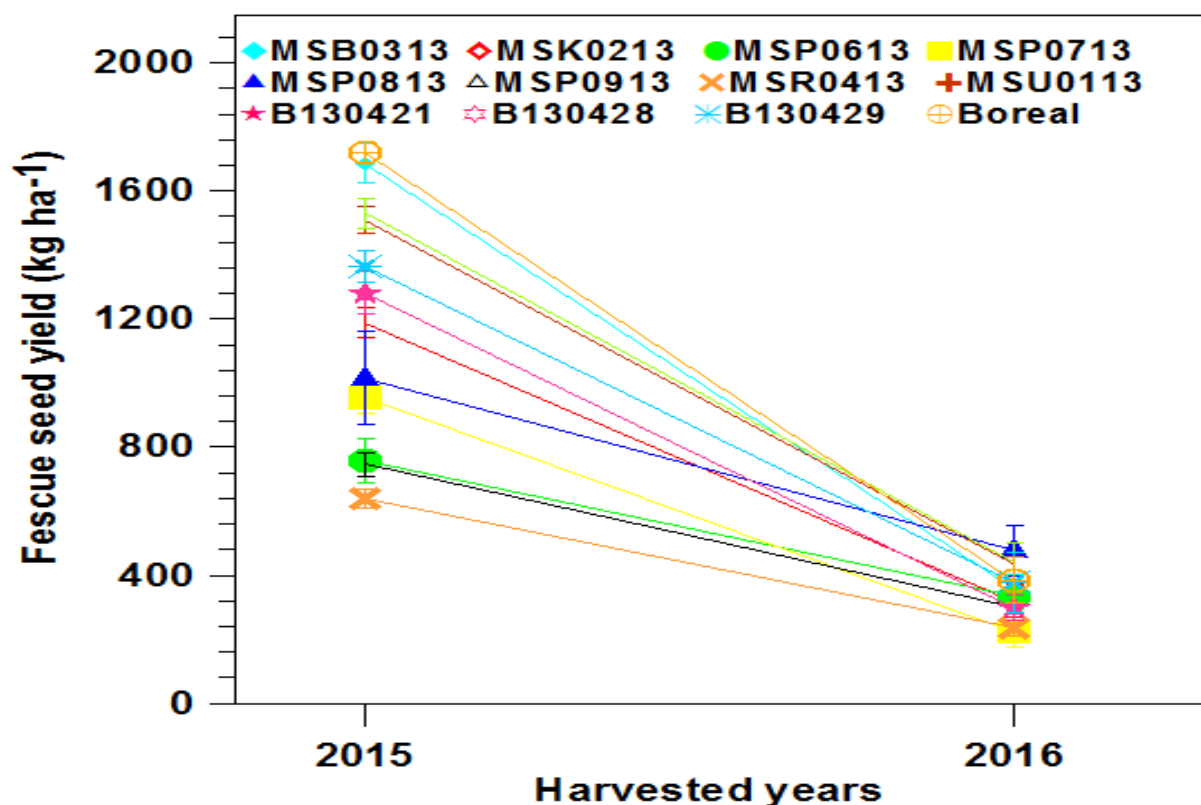


Figure 5. Seed yield of creeping red fescue cultivars in 2015 and 2016 from the trial established in 2014 at Beaverlodge, AB.

Table 3. Seed yield of creeping red fescue cultivars in 2015 and 2016 from the trial established in 2014 at Beaverlodge, AB.

| Company | Cultivar | Seed yield (kg ha ⁻¹) | | | Seed yield (lb ac ⁻¹) | | | Seed yield % of check | | |
|-----------------------|----------|-----------------------------------|------|-------|-----------------------------------|------|-------|-----------------------|------|-------|
| | | 2015 | 2016 | Total | 2015 | 2016 | Total | 2015 | 2016 | Total |
| Moore Seed Processors | MSB0313 | 1687 | 359 | 2045 | 1505 | 320 | 1825 | 98 | 93 | 97 |
| | MSK0213 | 1188 | 321 | 1509 | 1060 | 286 | 1346 | 72 | 83 | 72 |
| | MSP0613 | 756 | 332 | 1088 | 675 | 296 | 971 | 46 | 86 | 52 |
| | MSP0713 | 953 | 227 | 1180 | 850 | 203 | 1053 | 58 | 59 | 56 |
| | MSP0813 | 1016 | 475 | 1491 | 907 | 424 | 1330 | 64 | 123 | 71 |
| | MSP0913 | 747 | 297 | 1044 | 667 | 265 | 931 | 45 | 77 | 50 |
| | MSR0413 | 639 | 236 | 876 | 570 | 211 | 782 | 39 | 61 | 42 |
| | MSU0113 | 1509 | 436 | 1945 | 1346 | 389 | 1735 | 92 | 113 | 92 |
| Foster's Seed | B130421 | 1530 | 440 | 1970 | 1365 | 393 | 1758 | 93 | 114 | 94 |
| | B130428 | 1282 | 301 | 1583 | 1144 | 269 | 1412 | 78 | 78 | 75 |
| | B130429 | 1364 | 378 | 1742 | 1217 | 337 | 1554 | 83 | 98 | 83 |
| Check | Boreal | 1721 | 385 | 2105 | 1535 | 343 | 1878 | 100 | 100 | 100 |
| CV% | | 8 | 22 | 8 | | | | | | |
| LSD _{0.05} | | 195 | 158 | 266 | | | | | | |

Seeding date was 13 May 2014 and harvesting dates were 15 July in 2015 and 29 July in 2016.

Average plant heights of creeping red fescue cultivars ranged from 62 to 82 cm with most of the cultivars showing lower values in the successive harvest season (Table 4). Akin to the seed yield trend, all cultivars had 22% to 54% lower aerial dry biomass in the second successive harvest season (Table 4). Seed yield was found to be moderately correlated with aerial dry biomass ($R^2 = 0.41$) and plant height ($R^2 = 0.17$) (Figure 6).

Table 4. Plant height and aerial dry matter yield at maturity of creeping red fescue cultivars in 2015 and 2016 from the trial established in 2014 at Beaverlodge, AB.

| Company | Cultivar | Plant height (cm) | | Dry matter yield (kg ha ⁻¹) | | |
|-----------------------|----------|-------------------|------|---|------|-------|
| | | 2015 | 2016 | 2015 | 2016 | Total |
| Moore Seed Processors | MSB0313 | 80 | 71 | 9481 | 5440 | 14921 |
| | MSK0213 | 67 | 69 | 9319 | 5512 | 14831 |
| | MSP0613 | 61 | 64 | 7626 | 5849 | 13475 |
| | MSP0713 | 70 | 65 | 7360 | 4426 | 11786 |
| | MSP0813 | 62 | 64 | 6964 | 5462 | 12426 |
| | MSP0913 | 65 | 64 | 7604 | 5259 | 12863 |
| | MSR0413 | 75 | 76 | 7135 | 5076 | 12211 |
| | MSU0113 | 82 | 74 | 9187 | 5814 | 15001 |
| Foster's Seed | B130421 | 71 | 71 | 8098 | 5255 | 13353 |
| | B130428 | 72 | 68 | 11602 | 5324 | 16926 |
| | B130429 | 73 | 70 | 10698 | 5906 | 16604 |
| Check | Boreal | 80 | 71 | 9119 | 5414 | 14533 |
| CV% | | 5 | 6 | 24 | 17 | 17 |
| LSD _{0.05} | | 8 | 9 | 4202 | 1920 | 4900 |

Seeding date was 13 May 2014 and harvesting dates were 15 July in 2015 and 29 July in 2016.

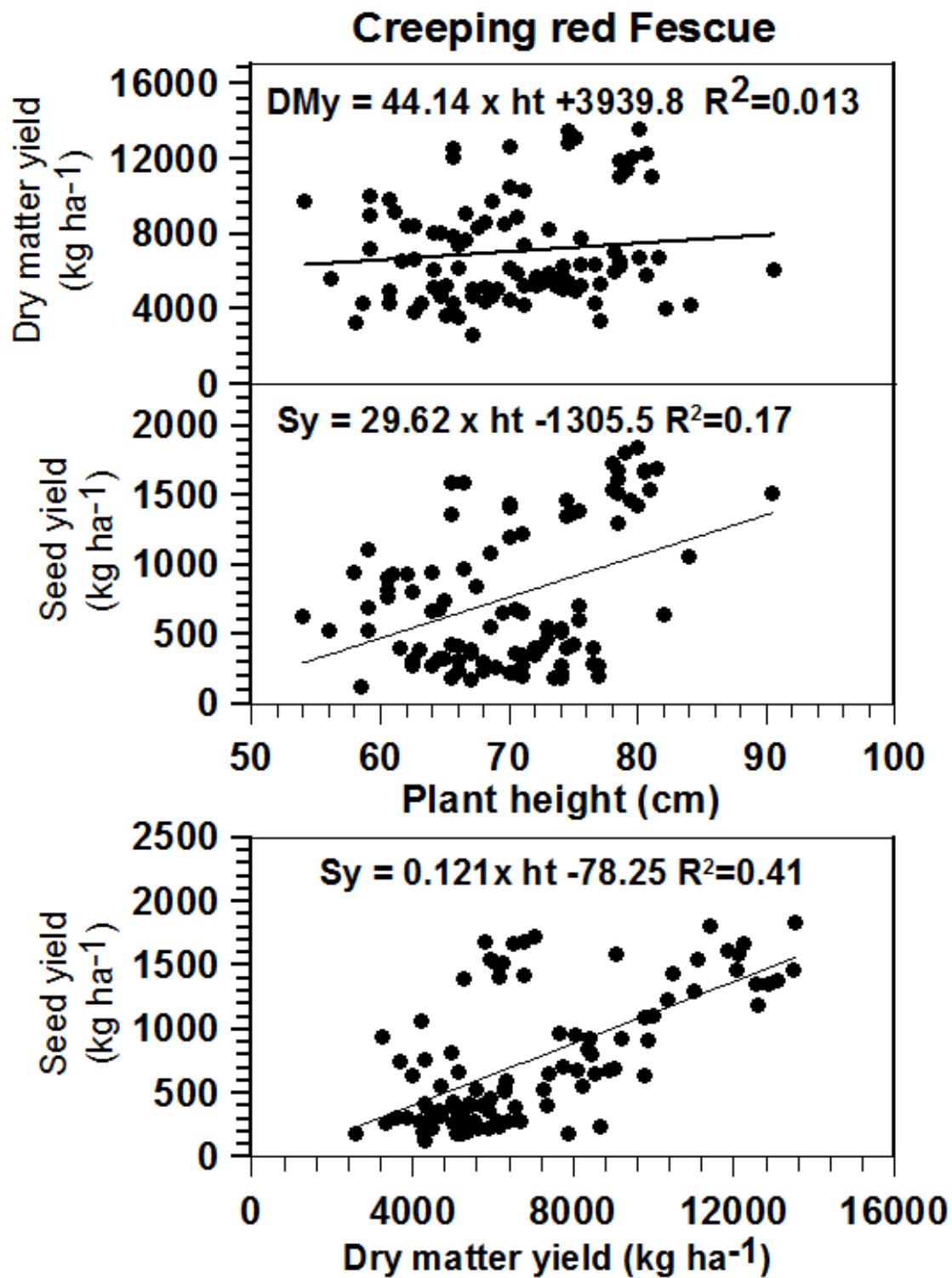


Figure 6. Correlations between plant height (ht), dry matter (DMy) and seed yield (Sy) in 2015 and 2016 of creeping red fescue established in 2014 at Beaverlodge, AB.

Meadow fescue

A meadow fescue trial established in 2013 included nine new cultivars originated from Barenbrug, USA and a check cultivar Preval (Table 5). Unlike in creeping red fescue, the yield variation in a season in meadow fescue cultivars was much lower and seed yield showed characteristic parabolic pattern in that seed yield plummeted in the second harvest year and then bounced back in the third year to the level of the first harvest year's yield (Figure 7). The yield variation was most pronounced in the second harvest year, that is 2015, which ranged from 399 to 808 kg ha⁻¹ (356 to 722 lbs acre⁻¹). Cultivar 11-FPF12 showed most consistent yield trend over three consecutive harvest years resulting in about 15% cumulative yield advantage for three harvest seasons over the check cultivar. On the other hand, cultivar Pradel yielded consistently the lowest yielder. Rest of the cultivars exhibited inconsistent yield ranking over the three successive harvest years from 2014 to 2016 (Table 5, Figure 7). All new cultivars of meadow fescue matured earlier than the creeping red fescue.

Table 5. Seed yield of meadow fescue cultivars in 2014, 2015 and 2016 from the trial established in 2013 at Beaverlodge, AB.

| Company | Cultivar | Seed yield (kg ha ⁻¹) | | | | Seed yield (lb ac ⁻¹) | | | | % of Check | | | |
|---------------------|--------------|-----------------------------------|------|------|-------|-----------------------------------|------|------|-------|------------|------|------|-------|
| | | 2014 | 2015 | 2016 | Total | 2014 | 2015 | 2016 | Total | 2014 | 2015 | 2016 | Total |
| Barenbrug USA | FP75RO | 946 | 529 | 888 | 2362 | 844 | 472 | 792 | 2107 | 104 | 113 | 98 | 104 |
| | COSMONAUT | 865 | 590 | 832 | 2287 | 772 | 526 | 742 | 2040 | 95 | 126 | 92 | 100 |
| | BOR 20613 | 799 | 464 | 893 | 2155 | 713 | 414 | 797 | 1923 | 88 | 99 | 99 | 94 |
| | BOR 20614 | 804 | 459 | 958 | 2221 | 717 | 410 | 855 | 1982 | 88 | 98 | 106 | 97 |
| | 11-FPF12 | 823 | 808 | 995 | 2626 | 734 | 721 | 888 | 2343 | 91 | 173 | 110 | 115 |
| | 11-(09-FPF7) | 908 | 461 | 915 | 2283 | 810 | 411 | 816 | 2037 | 100 | 99 | 101 | 100 |
| | PRADEL | 768 | 399 | 765 | 1932 | 685 | 356 | 683 | 1724 | 84 | 85 | 84 | 85 |
| | FP75RO1 | 884 | 500 | 916 | 2299 | 789 | 446 | 817 | 2051 | 97 | 107 | 101 | 101 |
| | BARCRYPTO | 834 | 516 | 834 | 2184 | 744 | 460 | 744 | 1949 | 92 | 111 | 92 | 96 |
| Check | Preval | 909 | 467 | 906 | 2282 | 811 | 417 | 808 | 2036 | 100 | 100 | 100 | 100 |
| CV% | | 8 | 8 | 16 | 8 | | | | | | | | |
| LSD _{0.05} | | 148 | 82 | 306 | 370 | | | | | | | | |

Seeding date was 15 May 2013 and harvesting dates were 17 July 2014, 13 July 2015 and 26 July 2016.

Meadow fescues have much taller growth form than the creeping red fescue. Average plant heights of meadow fescue cultivars ranged from 94 to 124 cm with all the cultivars showing taller growth in 2016 harvest season than the 2015 season (Table 6). Similarly, the aerial dry biomass showed an increasing trend in the successive growing seasons with about 3-fold increase in aerial dry matter yield from 2015 to 2016 harvest season (Table 6). These results implicate that meadow fescues respond well to the growing season rainfall for its growth strategy. The plant heights showed strong correlations with seed yield ($R^2 = 0.54$) and dry matter yield ($R^2 = 0.66$) (Figure 8).

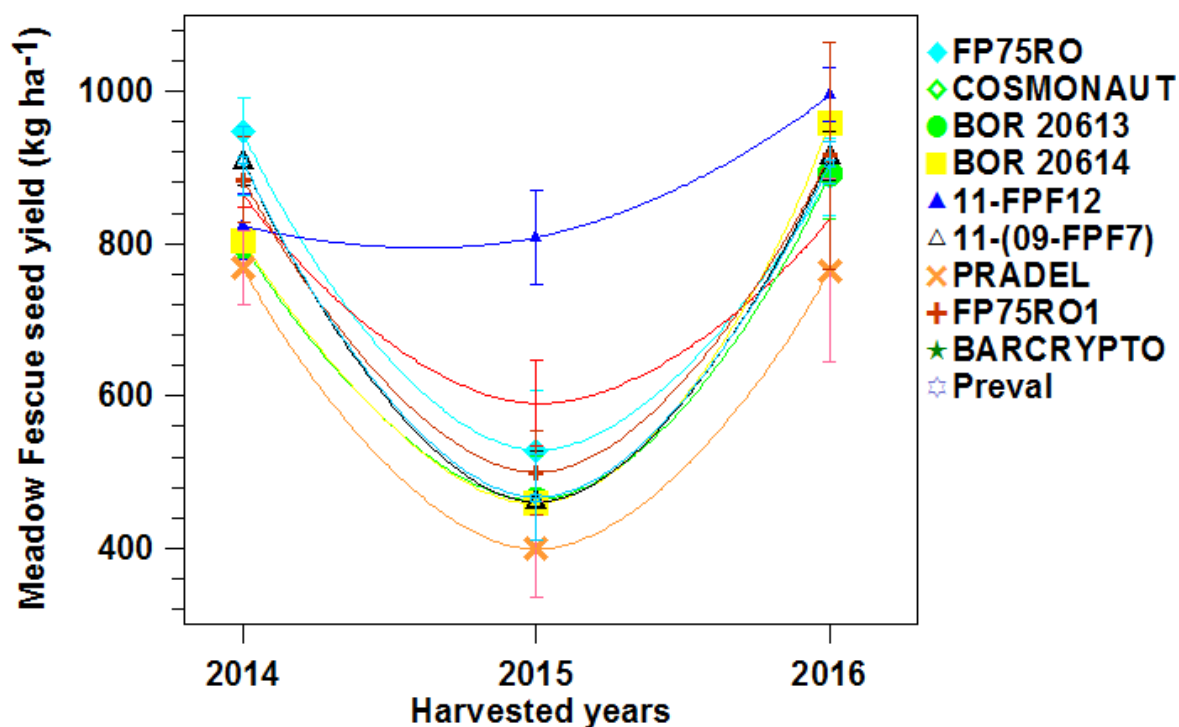


Figure 7. Seed yield of meadow fescue cultivars in 2014, 2015 and 2016 from the trial established in 2013 at Beaverlodge, AB.

Table 6. Plant height and aerial dry matter yield at maturity of meadow fescue cultivars in 2014, 2015 and 2016 from the trial established in 2013 at Beaverlodge, AB.

| Company | Cultivar | Plant height (cm) | | | Dry matter yield (kg ha ⁻¹) | | | |
|---------------------|--------------|-------------------|------|------|---|------|-------|-------|
| | | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | Total |
| Barenbrug USA | FP75RO | | 94 | 116 | 3811 | 4437 | 12064 | 20312 |
| | COSMONAUT | | 98 | 117 | 3510 | 4271 | 12362 | 20144 |
| | BOR 20613 | | 97 | 117 | 3785 | 4258 | 11399 | 19442 |
| | BOR 20614 | | 92 | 119 | 3814 | 4264 | 12097 | 20175 |
| | 11-FPF12 | | 99 | 116 | 3239 | 4122 | 11922 | 19283 |
| | 11-(09-FPF7) | | 103 | 116 | 3745 | 3740 | 11446 | 18932 |
| | PRADEL | | 99 | 117 | 3329 | 4011 | 12777 | 20117 |
| | FP75RO1 | | 99 | 116 | 3248 | 3875 | 12591 | 19715 |
| | BARCRYPTO | | 98 | 117 | 3611 | 4345 | 12291 | 20247 |
| Check | Preval | | 99 | 124 | 3466 | 3978 | 11386 | 18830 |
| CV% | | | 4 | 7 | 10 | 6 | 9 | 5 |
| LSD _{0.05} | | | 4 | 18 | 702 | 530 | 2201 | 762 |

Seeding date was 15 May 2013 and harvesting dates were 17 July 2014, 13 July 2015 and 26 July 2016

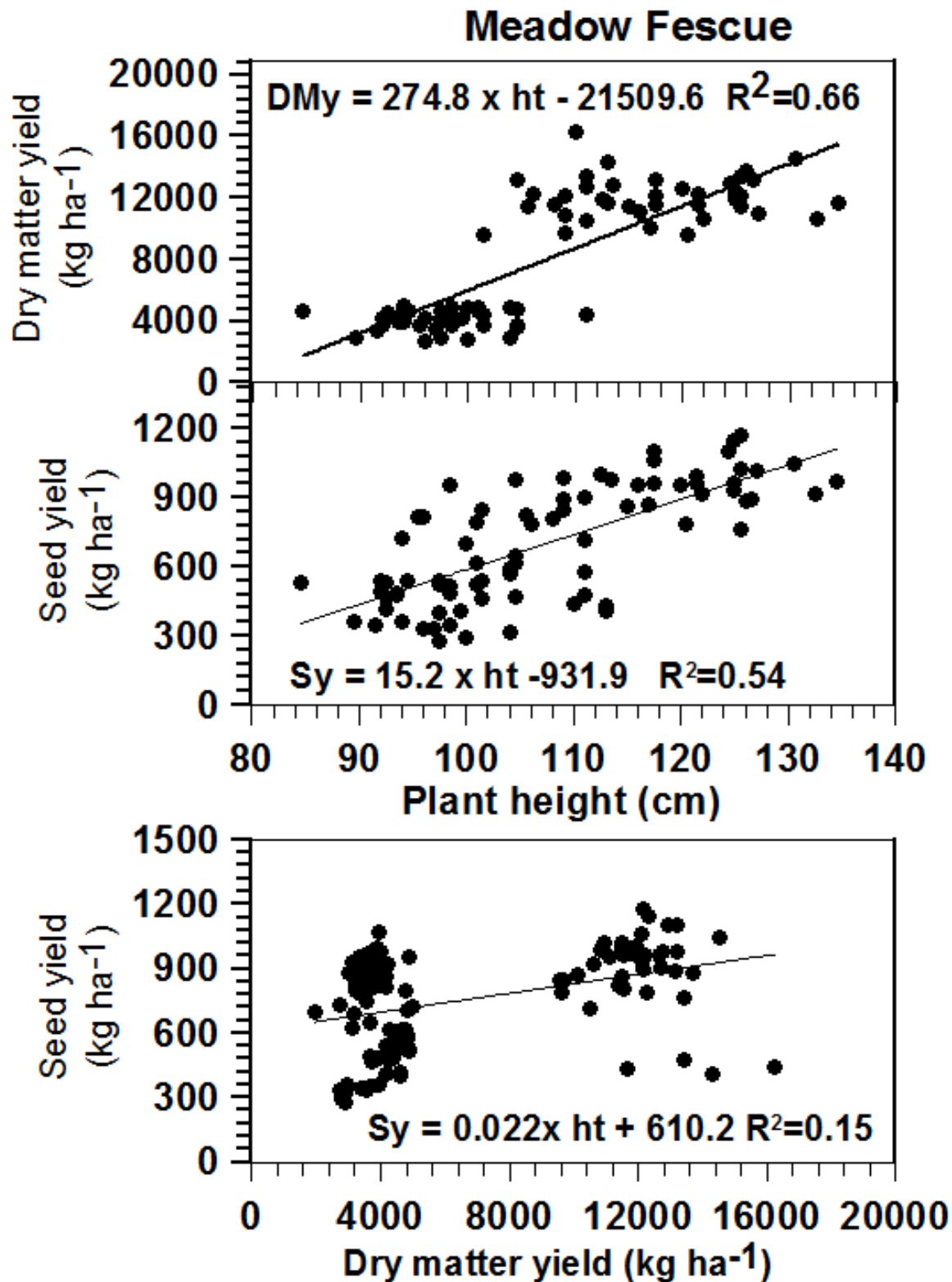


Figure 8. Correlations between plant height (ht), dry matter (DM_y) and seed yield (S_y) in 2014, 2015 and 2016 of the meadow fescues established in 2013 at Beaverlodge, AB.

Timothy

The timothy trial established in 2013 comprised 10 cultivars of which 6 cultivars were from Barenbrug, 3 from Moore Seed Processors and a check cultivar Climax (Table 7). In the contrasting seasonal rainfall amount and distribution pattern from 2014 to 2016, two cultivars Teuho and Tuukka from Moore Seed Processors out-yielded the check cultivar Climax, with cumulative yield advantage of 15% and 14% respectively over the Climax. All test cultivars yielded higher than Climax in 2015 while displaying inconsistent yields in 2014 (atypically dry year) and 2016 (atypically wet summer) (Table 7). Although most of the cultivars showed interactions with the weather patterns in their relative seed yields, the higher yielding cultivars showed declining trends in seed yield over the successive seasons (Figure 9). However, there was an increasing trend in plant heights in the successive harvest seasons and significant increase in biomass yield in the 2nd and 3rd harvest season from the level of 1st harvest season (Table 8). While there was strong correlation between plant height and dry matter yield of Timothy, seed yield did not show any correlations with plant heights and dry matter yield (Figure 10).

Table 7. Seed yield of Timothy in 2014, 2015 and 2016 from the trial established in 2013 at Beaverlodge, AB.

| Company | Cultivar | Seed yield (kg ha ⁻¹) | | | | Seed yield (lb ac ⁻¹) | | | | % of Climax | | | |
|-----------------------|----------|-----------------------------------|------|------|-------|-----------------------------------|------|------|-------|-------------|------|------|-------|
| | | 2014 | 2015 | 2016 | Total | 2014 | 2015 | 2016 | Total | 2014 | 2015 | 2016 | Total |
| Barenbrug USA | BAR BOO5 | 437 | 374 | 351 | 1161 | 390 | 334 | 313 | 1036 | 99 | 109 | 100 | 102 |
| | BAR D003 | 465 | 438 | 334 | 1237 | 415 | 391 | 298 | 1104 | 105 | 127 | 95 | 109 |
| | BAR 1006 | 360 | 373 | 247 | 980 | 321 | 333 | 220 | 874 | 81 | 109 | 70 | 86 |
| | BAR M002 | 417 | 360 | 301 | 1078 | 372 | 321 | 269 | 962 | 94 | 105 | 86 | 95 |
| | BAR R001 | 497 | 408 | 304 | 1209 | 443 | 363 | 271 | 1079 | 113 | 118 | 87 | 106 |
| | BAR S004 | 486 | 402 | 314 | 1202 | 434 | 359 | 280 | 1072 | 110 | 117 | 89 | 106 |
| Moore Seed Processors | Teuho | 525 | 411 | 369 | 1304 | 468 | 367 | 329 | 1163 | 119 | 120 | 105 | 115 |
| | Tuukka | 510 | 428 | 358 | 1296 | 455 | 381 | 319 | 1156 | 115 | 124 | 102 | 114 |
| | Varis | 410 | 379 | 309 | 1097 | 366 | 338 | 276 | 979 | 93 | 110 | 88 | 96 |
| Check | Climax | 442 | 344 | 351 | 1137 | 394 | 307 | 313 | 1014 | 100 | 100 | 100 | 100 |
| CV% | | 13 | 18 | 13 | 11 | | | | | | | | |
| LSD _{0.05} | | 123 | 145 | 86 | 317 | | | | | | | | |

Seeding date was 15 May 2013 and harvesting dates were 12 August 2014, 30 July 2015 and 10 August 2016.

Table 8. Plant height and aerial dry matter yield at maturity of Timothy cultivars in 2014, 2015 and 2016 in the trial established in 2013 at Beaverlodge, AB.

| Company | Cultivar | Plant height (cm) | | | Dry matter yield (kg ha ⁻¹) | | | |
|-----------------------|----------|-------------------|------|------|---|------|------|-------|
| | | 2014 | 2015 | 2016 | 2014 | 2015 | 2016 | Total |
| Barenbrug USA | BAR BOO5 | 93 | 102 | 108 | 4009 | 5644 | 5256 | 14908 |
| | BAR D003 | 96 | 110 | 112 | 4937 | 6048 | 5806 | 16791 |
| | BAR 1006 | 89 | 99 | 101 | 3784 | 5079 | 5402 | 14264 |
| | BAR M002 | 91 | 97 | 103 | 3830 | 5092 | 5361 | 14282 |
| | BAR R001 | 91 | 106 | 104 | 3883 | 5347 | 5278 | 14508 |
| | BAR S004 | 95 | 98 | 103 | 4219 | 5418 | 5598 | 15235 |
| Moore Seed Processors | Teuho | 93 | 106 | 107 | 4249 | 5397 | 5385 | 15031 |
| | Tuukka | 94 | 104 | 106 | 4276 | 5845 | 5606 | 15727 |
| | Varis | 89 | 106 | 106 | 3879 | 5179 | 5220 | 14277 |
| Check | Climax | 95 | 110 | 107 | 4569 | 5846 | 5949 | 16364 |
| CV% | | 4 | 5 | 4 | 10 | 7 | 7 | 7 |
| LSD _{0.05} | | 8 | 9 | 9 | 823 | 833 | 771 | 2074 |

Seeding date was 15 May 2013 and harvesting dates were 12 August 2014, 30 July 2015 and 10 August 2016.

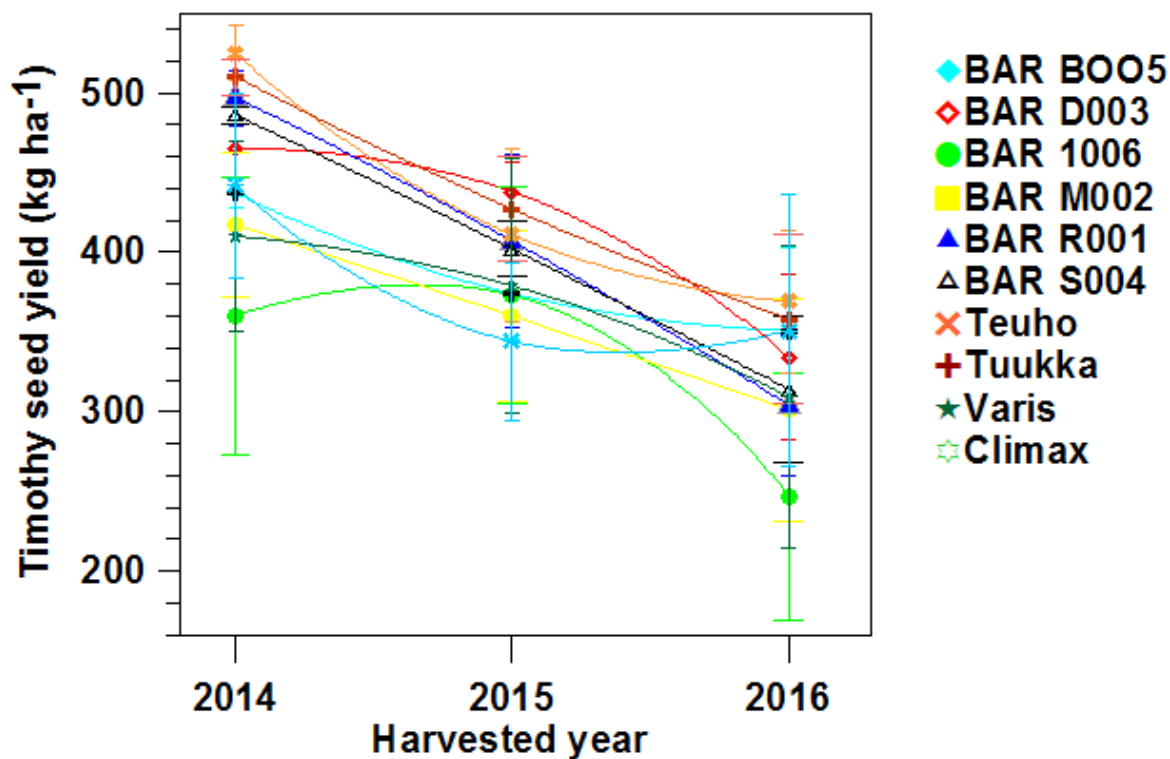


Figure 9. Seed yield of Timothy cultivars in 2014, 2015 and 2016 from the trial established in 2013 at Beaverlodge, AB.

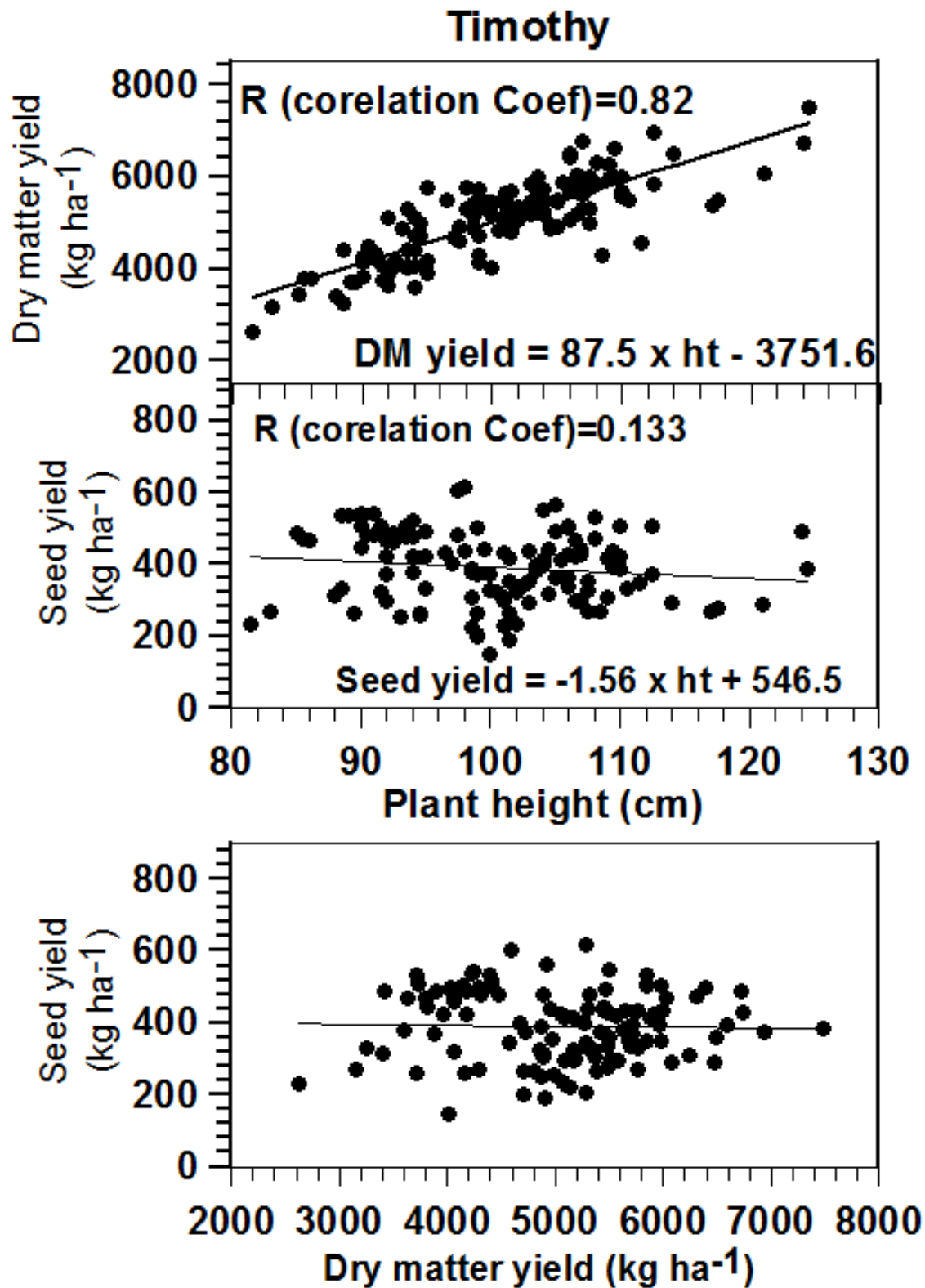


Figure 10. Correlations between plant height (ht), dry matter (DMy) and seed yield (Sy) of Timothy in 2015 and 2016 from the cultivar trial established in 2013 at Beaverlodge, AB.

Results of on-going trials

Creeping red fescue

In the creeping red fescue trial established in 2015 (Figure 11), only one cultivar MSPO314 from Moore Seed Processors exceeded check cultivar Boreal in seed yield in the first harvest season in 2016. Other three cultivars MSPO114, MSPO214 and MSR0612 from the same Company produced comparable yield to Boreal. Rest of the 21 cultivars are unlikely to compete Boreal, based on 2016 yield performance (Table 9).

Table 9. Seed yield of creeping red fescue cultivars in 2016 from the trial established in 2015 at Beaverlodge, AB.

| Company | Cultivar | Plant height (cm) | Dry matter yield (kg ha ⁻¹) | Seed yield | | |
|-----------------------|------------|-------------------|---|---------------------|---------------------|------------|
| | | | | kg ha ⁻¹ | lb ac ⁻¹ | % of check |
| PureSeed | 4BEN | 59 | 2914 | 420 | 375 | 47 |
| | 4DR4 | 54 | 2604 | 382 | 341 | 43 |
| | 4ED4 | 55 | 2532 | 523 | 467 | 59 |
| | 4GRY | 60 | 2521 | 326 | 291 | 37 |
| | 4PUE14 | 55 | 3258 | 457 | 408 | 51 |
| | 4SHR | 58 | 1968 | 255 | 228 | 29 |
| | 4SP14 | 55 | 2018 | 273 | 244 | 31 |
| Imperial Seed | Reverent | 77 | 3503 | 768 | 685 | 86 |
| | DSV1501 | 74 | 3252 | 776 | 692 | 87 |
| | DSV1502 | 74 | 2728 | 640 | 571 | 72 |
| | DSV1503 | 73 | 2690 | 609 | 543 | 68 |
| Moore Seed Processors | MSG0412 | 69 | 3139 | 680 | 607 | 76 |
| | MSPO114 | 73 | 3350 | 886 | 790 | 99 |
| | MSPO214 | 76 | 3419 | 852 | 760 | 95 |
| | MSPO314 | 74 | 3188 | 1083 | 966 | 121 |
| | MSPO414 | 66 | 2817 | 586 | 523 | 66 |
| | MSPO514 | 68 | 2138 | 119 | 106 | 13 |
| | MSPO614 | 54 | 2323 | 628 | 560 | 70 |
| | MSR0612 | 63 | 3233 | 864 | 771 | 97 |
| Barenbrug USA | BARVVVP3CT | 59 | 2314 | 221 | 197 | 25 |
| | Bridgeport | 71 | 2796 | 294 | 262 | 33 |
| Foster's Seed | 4CRD8 | 57 | 2535 | 416 | 371 | 47 |
| | ASC295 | 75 | 3071 | 505 | 451 | 57 |
| Check | Boreal | 70 | 3169 | 893 | 797 | 100 |
| CV% | | 5 | 14 | 18 | | |
| LSD _{0.05} | | 7 | 642 | 204 | | |

Seeding date was 13 May 2015 and harvesting date was 27 July 2016.



Figure 11. Photograph taken in 2016 of the creeping red fescue trial established in 2015 at Beaverlodge, AB.

Timothy

In the timothy trial that established in 2014 (Figure 12), all new cultivars from Barenbrug except to Barpenta produced significantly higher total seed yield than Climax as a check cultivar over the two harvested years of 2015, 2016 (Table 10). However, Climax had the tallest plants with highest dry biomass yield of all cultivars (Table 11).

Table 10. Seed yield of Timothy cultivars in 2015 and 2016 from the trial established in 2014 at Beaverlodge, AB.

| Company | Cultivar | Seed yield (kg ha ⁻¹) | | | Seed yield (lb ac ⁻¹) | | | % of Climax | | |
|-----------------------|----------|-----------------------------------|------|-------|-----------------------------------|------|-------|-------------|------|-------|
| | | 2015 | 2016 | Total | 2015 | 2016 | Total | 2015 | 2016 | Total |
| Barenbrug USA | Barfleo | 1145 | 1251 | 2396 | 1022 | 1116 | 2138 | 123 | 115 | 119 |
| | Barpenta | 824 | 444 | 1268 | 735 | 396 | 1131 | 88 | 41 | 63 |
| | Bor01025 | 1287 | 1242 | 2529 | 1148 | 1108 | 2256 | 138 | 115 | 125 |
| | Bor01033 | 1235 | 1113 | 2348 | 1102 | 993 | 2095 | 132 | 103 | 116 |
| | Bor01037 | 1147 | 1117 | 2264 | 1023 | 997 | 2020 | 123 | 103 | 112 |
| | Bor2005 | 1223 | 1129 | 2352 | 1091 | 1007 | 2098 | 131 | 104 | 117 |
| | Bor88060 | 1229 | 1249 | 2478 | 1096 | 1114 | 2211 | 132 | 115 | 123 |
| | PHLR99 | 1231 | 1263 | 2494 | 1098 | 1127 | 2225 | 132 | 117 | 124 |
| Moore Seed Processors | MST0513 | 903 | 1039 | 1942 | 806 | 927 | 1733 | 97 | 96 | 96 |
| Check | Climax | 933 | 1084 | 2017 | 832 | 967 | 1800 | 100 | 100 | 100 |
| CV% | | 10 | 8 | 14 | | | | | | |
| LSD _{0.05} | | 230 | 186 | 641 | | | | | | |

Seeding date was 16 May 2014 and harvesting dates were 10 August 2015 and 12 August 2016.

Table 11. Plant height and aerial dry matter yield at maturity of timothy cultivars in 2015 from the trial established in 2014 at Beaverlodge, AB.

| Company | Cultivar | Plant height (cm) | | Dry matter yield (kg ha ⁻¹) | | |
|-----------------------|----------|-------------------|------|---|-------|-------|
| | | 2015 | 2016 | 2015 | 2016 | Total |
| Barenbrug USA | Barfleo | 117 | 124 | 10011 | 14126 | 24137 |
| | Barpenta | 109 | 112 | 7296 | 14001 | 21297 |
| | Bor01025 | 111 | 117 | 9211 | 15554 | 24764 |
| | Bor01033 | 114 | 119 | 8675 | 14289 | 22964 |
| | Bor01037 | 112 | 114 | 8039 | 14190 | 22229 |
| | Bor2005 | 114 | 115 | 8737 | 14212 | 22949 |
| | Bor88060 | 120 | 123 | 9605 | 15599 | 25204 |
| | PHLR99 | 110 | 116 | 10156 | 14689 | 24845 |
| Moore Seed Processors | MST0513 | 108 | 113 | 8685 | 12234 | 20918 |
| Check | Climax | 126 | 127 | 11733 | 16546 | 28278 |
| CV% | | 5 | 6 | 8 | 7 | 6 |
| LSD _{0.05} | | 12 | 14 | 1502 | 2093 | 3123 |

Seeding date was 16 May 2014 and harvesting dates were 10 August 2015 and 12 August 2016.



Figure 12. Photograph taken in 2016 of the Timothy trial established in 2014 at Beaverlodge, AB.