

# **Evaluation of Annual Legumes as Potential Seed Crops in Alberta**

Alberta Crop Industry Development Fund Ltd. Project #2003C010R

Final Report

Henry Najda<sup>1</sup>, Jane King<sup>2</sup> and Surya Acharya<sup>3</sup>

August 2007

1. Alberta Agriculture and Food – Crop Diversification Centre South, Brooks, AB
2. University of Alberta – Edmonton, AB
3. Agriculture and Agri-Food Canada – Research Centre, Lethbridge, AB

## **ABSTRACT**

Alberta has been the leading producer of grass and legume seed in Canada for over 60 years accounting for at least 50% of the Canadian production. Part of the success of this industry has been the diversification into newer seed crops in the province such as meadow brome grass, tall fescue and Kentucky bluegrass.

This project evaluated six annual legume species – arrowleaf clover, berseem clover, crimson clover, Persian clover, rose clover and woollypod vetch for seed production capability at three irrigated locations in southern Alberta: Bow Island, Brooks and Lethbridge and one rain fed site at Edmonton.

Row spacing and seeding rates were evaluated for their effects on seed production and generally these did not result in significant differences for any of the species tested. Early seeding was imperative to ensure full maturation of the species under our short growing season. Three species, crimson clover, rose clover and woollypod vetch produced seed yields that were consistent enough to be considered for commercial contract production especially under irrigation in southern Alberta.

## **ACKNOWLEDGEMENTS**

Thank you to Alberta Crop Industry Development Fund Ltd. for providing funding for this project. Thank you to Dr. Medhat Nasr, Alberta Agriculture and Food, for providing honeybees for pollination at the University of Alberta test site and to Mr. Weldon Hobbs of MR Pollination Services for providing leafcutter bees for pollination at the Agriculture and AgriFood Research Station site at Lethbridge and the Alberta Agriculture and Food, Crop Diversification Centre South sites at Brooks and Bow Island.

Special thanks to Art Kruger, Doug Friebel and Jennifer Wallace for their technical expertise in seeding, maintaining and harvesting trials and performing the statistical analyses on the data. Thanks to summer staff Roxanne Hansen, Nicole Manderscheid for their assistance in plot maintenance, seed cleaning and seed analysis.

Thanks to Dr. Gerald Evers of the Texas Agricultural Experimental Station, TAMU Agriculture Research and Extension Center, Overton, Texas for his invaluable advice and suggestions concerning the species in this project. Thanks to Dr. Manjula Bandara, Special Crops Scientist, Agriculture and Food, Crop Diversification Centre South for his statistical expertise in developing the experimental protocol.

## **Table of Contents**

	<b>Page</b>
<b>Background.....</b>	<b>1</b>
<b>Project Objectives.....</b>	<b>2</b>
<b>Key Results Expected</b>	
<b>Materials and Methods</b>	
Research Design	
<b>Results and Discussion</b>	
Arrowleaf clover	
Berseem clover	
Crimson clover	
Persian clover	
Rose clover	
Woollypod vetch	
<b>Conclusions</b>	
<b>Implications and Recommendations</b>	
<b>Bibliography</b>	
<b>Tables and Figures</b>	
<b>Appendix</b>	
<b>Biographical Data of Primary Researchers</b>	
<b>List of Publications Arising from the Project</b>	

## List of Tables

<b>Table</b>	<b>Page</b>
Table 1. Seeding dates at trial locations for all species.	
Table 2. Pre-plant application dates of Treflan.	
Table 3. Irrigation amount (cm) applied for southern Alberta trial locations	
Table 4. 10% flowering date for arrowleaf clover at trial locations.	
Table 5. 10% flowering date for berseem clover at trial locations.	
Table 6. 10% flowering date for crimson clover at trial locations.	
Table 7. 10% flowering date for Persian clover at trial locations.	
Table 8. 10% flowering date for rose clover at trial locations.	
Table 9. 10% flowering date for woollypod vetch at trial locations.	
Table 10. Harvest date for arrowleaf clover at trial locations.	
Table 11. Harvest date for berseem clover at trial locations.	
Table 12. Harvest date for crimson clover at trial locations.	
Table 13. Harvest date for Persian clover at trial locations.	
Table 14. Harvest date for rose clover at trial locations.	
Table 15. Harvest date for woollypod vetch at trial locations.	
Table 16. Mean seed yields (kg ha <sup>-1</sup> ) of arrowleaf clover harvested at Bow Island, AB	
Table 17. Mean seed yields (kg ha <sup>-1</sup> ) of arrowleaf clover harvested at Brooks, AB	
Table 18. Mean seed yields (kg ha <sup>-1</sup> ) of berseem clover harvested at Bow Island, AB	
Table 19. Mean seed yields (kg ha <sup>-1</sup> ) of berseem clover harvested at Brooks, AB	
Table 20. Mean seed yields (kg ha <sup>-1</sup> ) of crimson clover harvested at Bow Island, AB	
Table 21. Mean seed yields (kg ha <sup>-1</sup> ) of crimson clover harvested at Brooks, AB	

Table 22. Mean seed yields (kg ha<sup>-1</sup>) of crimson clover harvested at Edmonton, AB

Table 23. Mean seed yields (kg ha<sup>-1</sup>) of crimson clover harvested at Lethbridge, AB

Table 24. Mean seed yields (kg ha<sup>-1</sup>) of Persian clover harvested at Bow Island, AB

Table 25. Mean seed yields (kg ha<sup>-1</sup>) of Persian clover harvested at Brooks, AB

Table 26. Mean seed yields (kg ha<sup>-1</sup>) of rose clover harvested at Bow Island, AB

Table 27. Mean seed yields (kg ha<sup>-1</sup>) of rose clover harvested at Brooks, AB

Table 28. Mean seed yields (kg ha<sup>-1</sup>) of rose clover harvested at Edmonton, AB

Table 29. Mean seed yields (kg ha<sup>-1</sup>) of rose clover harvested at Lethbridge, AB

Table 30. Mean seed yields (kg ha<sup>-1</sup>) of woollypod vetch harvested at Bow Island, AB

Table 31. Mean seed yields (kg ha<sup>-1</sup>) of woollypod vetch harvested at Brooks, AB

Table 32. 1000 kernel weight (g) of arrowleaf clover seed harvested at Bow Island, AB

Table 33. 1000 kernel weight (g) of arrowleaf clover seed harvested at Brooks, AB

Table 34. 1000 kernel weight (g) of berseem clover seed harvested at Bow Island, AB

Table 35. 1000 kernel weight (g) of berseem clover seed harvested at Brooks, AB

Table 36. 1000 kernel weight (g) of crimson clover seed harvested at Bow Island, AB

Table 37. 1000 kernel weight (g) of crimson clover seed harvested at Brooks, AB

Table 38. 1000 kernel weight (g) of crimson clover seed harvested at Edmonton, AB

Table 39. 1000 kernel weight (g) of crimson clover seed harvested at Lethbridge, AB

Table 40. 1000 kernel weight (g) of Persian clover seed harvested at Bow Island, AB

Table 41. 1000 kernel weight (g) of Persian clover seed harvested at Brooks, AB

Table 42. 1000 kernel weight (g) of rose clover seed harvested at Bow Island, AB

Table 43. 1000 kernel weight (g) of rose clover seed harvested at Brooks, AB

- Table 44. 1000 kernel weight (g) of rose clover seed harvested at Edmonton, AB
- Table 45. 1000 kernel weight (g) of rose clover seed harvested at Lethbridge, AB
- Table 46. 1000 kernel weight (g) of woollypod vetch seed harvested at Bow Island, AB
- Table 47. 1000 kernel weight (g) of woollypod vetch seed harvested at Brooks, AB
- Table 48. Mean percent germination of arrowleaf clover seed harvested at Bow Island, AB
- Table 49. Mean percent germination of arrowleaf clover seed harvested at Brooks, AB
- Table 50. Mean percent germination of berseem clover seed harvested at Bow Island, AB
- Table 51. Mean percent germination of berseem clover seed harvested at Brooks, AB
- Table 52. Mean percent germination of crimson clover seed harvested at Bow Island, AB
- Table 53. Mean percent germination of crimson clover seed harvested at Brooks, AB
- Table 54. Mean percent germination of crimson clover seed harvested at Edmonton, AB
- Table 55. Mean percent germination of Persian clover seed harvested at Bow Island, AB
- Table 56. Mean percent germination of Persian clover seed harvested at Brooks, AB
- Table 57. Mean percent germination of rose clover seed harvested at Bow Island, AB
- Table 58. Mean percent germination of rose clover seed harvested at Brooks, AB
- Table 59. Mean percent germination of rose clover seed harvested at Edmonton, AB
- Table 60. Mean percent germination of woollypod vetch seed harvested at Bow Island, AB
- Table 61. Mean percent germination of woollypod vetch seed harvested at Brooks, AB

## **Background**

Alberta has been the leading producer of grass and legume seed in Canada for over 60 years and is responsible for over 50% of the Canadian production. According to Statistics Canada's last census in 2001, Alberta's seed production acreage has increased by over 80% in the last 5 years (1996-2001) and there is a continuing opportunity for expansion as seed companies are looking for new seed production areas for new species. Farm gate value for seed in Alberta in 2002 was estimated at \$65-70 million. Part of the success of this industry has been the diversification into newer seed crops in the province including cicer milkvetch, meadow bromegrass, tall fescue and Kentucky bluegrass supplementing the traditionally grown seed crops of alfalfa, creeping red fescue, crested wheatgrass and timothy

Increased seed production of newer crops will not only lead to diversification in the primary production sector but will provide employment opportunities in the seed processing, marketing, retailing and transportation sectors of Alberta's economy. Seed cleaning plants in southern Alberta have already upgraded equipment to deal with forage seeds they weren't cleaning 15 years ago.

Successful seed production of these annual legumes would also result in the use of new high quality annual forages in Alberta and play a part in rotations of such high value crops as potatoes, sugar beets and pulses. This would have positive environmental aspects with reduced use of commercial fertilizer, as the legumes would fix nitrogen naturally.

A pollination study in the mid-80's (Richards, 1995) on the alfalfa leafcutter bee as a potential pollinator for some annual forage legumes and a study on the yield potential and forage quality of annual legumes in southern Alberta in the early 90's identified several annual clover species and vetches which have exceptional seed and forage yields under our conditions (Fraser et al., 2004).

The encouraging results from the aforementioned studies was the basis for this proposal to evaluate and identify annual legume species firstly for their potential as seed crops in Alberta and their subsequent use in other aspects of agriculture in the province. The species to be tested have various agricultural and nutritional attributes associated with their utilization including: low bloat potential, green manure, high quality and high-yielding forage, early pasture, extension of fall pasture, soil improvement, stabilization of roadsides, reclamation uses, specialty honey production and alternate crops for pollinators such as leafcutter bees.



## **Project Objectives**

Identification and evaluation of new annual legume crops for seed production in Alberta

Diversification of agriculture in Alberta

- new seed crop species
- new alternative high quality and high yielding annual forages

Introduction of possible new species for amenity and reclamation use.

## **Key Results Expected**

In addition to identifying potential new species for seed production, agronomic aspects of seed production will be investigated such as row spacing and seeding rate. This will ensure basic production information is available for commercial seed producers when they begin contract production of these annual legumes.

Basic agronomic data on potential new annual legume seed and forage crops for Alberta.

Identification of new seed and forage crops that would be used as part of a rotation with other high value special crops to enhance environmental sustainability through reduced use of fertilizer

## **Materials and Methods**

Plots were seeded in the spring of 2004 and 2005 at four test locations (CDCS - Brooks, CDCS - Bow Island, AAFC - Lethbridge, U of A – Edmonton) and in 2006 at three test locations (CDCS - Brooks, CDCS - Bow Island, U of A – Edmonton) (Table 1). A randomized complete block design with 4 replicates was used for all trials.

Seedbeds were treated with a pre-plant application of Treflan (Table 2) and prepared to provide for a uniform seeding depth of 1.25 –1.90 cm. Species-specific inoculants were applied to seed before planting. Plots were sprayed with graminicides for grassy weeds and hand-weeded to remove broad-leaved weeds as required. Irrigation in southern Alberta was provided as required (Table 3).

Treatments included:

Legume Species: Arrowleaf clover, Berseem clover, Crimson clover, Persian clover, Rose clover and Woollypod vetch

Row spacings: two (based on plant characteristics for each species tested)

Seeding rates: three (based on seed size for each species tested).

Measurements to be made each year:

soil tests to determine soil characteristics associated with economic seed production  
canopy height

flowering date  
disease/pest survey  
seed yield (seed counts, germinations, and seed weights)  
environmental data (precipitation, temperature)

Data was analyzed using ANOVA procedures and mean separations with Student-Newman-Keuls test.

## Results and Discussion

**Arrowleaf clover** (*Trifolium vesiculosum* Savi) – This clover (Figures 1 & 2) prefers well-drained sandy or loam soils and a pH range of 5.0-7.5 (Millar & Wells, 1985). It has low bloat potential, is late maturing and has a high hard seed content. Ten percent bloom for this species occurred in the first two weeks of August (Table 4). This late flowering time resulted in late maturity of the species and plots were not harvested until late October or early November (Table 10).

Seed was only harvested at two locations (Tables 16 & 17). In 2004, Bow Island had an average seed yield of 266 kg ha<sup>-1</sup> with no significant differences in treatments but a trend of increasing seed yield with increasing seeding rate at the 20 cm row spacing. The cool damp August impacted bloom and early frosts resulted in poor seed set at Edmonton and Lethbridge and in the case of Brooks, small-shriveled seed.

In 2005, seed yields were not harvested from any of the locations due to a cool wet June and a cool August, which resulted in very poor, or no seed set. In 2006, the highest seed yield for arrowleaf clover at Bow Island was 767 kg ha<sup>-1</sup> at a row spacing of 50 cm and a seeding rate of 50 seeds m<sup>-1</sup>. Seed yields at Brooks were much lower than at Bow Island with yields averaging 462 kg ha<sup>-1</sup> (Table 17). 1000 kernel weight for the different treatments were not significant (Tables 32 & 33) and averaged 1.27 and 1.17 g at Bow Island and Brooks, respectively. Germination averaged 93.5% at Bow Island and 88.7% at Brooks in 2006 (Tables 48 & 49).

The inconsistent seed yields for arrowleaf clover over three years of testing would rule this species out as a candidate for seed production in Alberta pending further agronomic investigation. The species could though serve as a green manure crop or as a low bloat forage.

Figure 1. Arrowleaf clover flowers.

Figure 2. Arrowleaf clover plots at Bow Island, Alberta.

**Berseem Clover** (*Trifolium alexandrinum* L.) – This clover (Figures 3 & 4) tolerates poorly drained soils and prefers clay or loam soils and a pH range of 6.5-8.0. It has a low bloat potential, is late maturing with low hard seed content (Knight, 1985). Flowering was late in this species with the earliest 10% bloom occurring at Bow Island on Aug. 2 (Table 5).

Harvest dates for this species were from mid to late October (Table 11). Seed was only harvested at two locations (Tables 18 & 19). In 2004, Bow Island had a mean seed yield of 416 kg ha<sup>-1</sup> and Brooks 145 kg ha<sup>-1</sup> as the cool damp August impacted bloom and early frosts resulted in poor seed set. In 2005, there were no seed yields from any locations due to a cool wet June and a cool August, which resulted in very poor, or no seed set. In 2006, yields at both locations were substantially higher than in 2004 as mean temperatures during July and August were higher than the previous two years. The highest yield at Bow Island was 1026 kg ha<sup>-1</sup> at the 20 cm spacing and 734 kg ha<sup>-1</sup> at Brooks at the 75 seeds m<sup>-1</sup> seeding rate.

The 1000 kernel weight for seed at Bow Island was not significantly different between treatments with the average being 3.04 g. At Brooks weights averaged 2.72 g however there was a significant difference for seeding rate in 2006 (Tables 34 & 35). There were no significant differences in germination at either Bow Island or Brooks with germination averaging 95.8% and 92.8% respectively (Tables 50 & 51).

As in the case of arrowleaf clover, seed yields were inconsistent over the three years of testing and despite the encouraging results in 2006 this species should not be considered for seed production purposes in Alberta until further agronomic work is conducted to stabilize seed production capabilities. This crop would be valuable as a quick growing non-bloat forage used in rotations.

Figure 3. Berseem clover flowers.

Figure 4. Berseem clover plots at Bow Island, Alberta.

**Crimson Clover** (*Trifolium incarnatum* L.) – This clover (Figures 5 & 6) prefers well-drained sandy, clay or loam soils with a pH range of 6.0-7.0. It is an early maturing clover with moderate bloat potential and low hard seed content (Knight, 1985). This species had 10% bloom around mid-July at most locations (Table 6). The harvest dates ranged from early September to late October depending on location (Table 12).

Generally, yields at the irrigated sites at Bow Island and Brooks had commercial potential (Table 20 & 21). Average seed yields in Bow Island ranged from 982 kg ha<sup>-1</sup> in 2004 to 386 kg ha<sup>-1</sup> in 2006, in Brooks seed yields averaged 1227 kg ha<sup>-1</sup> in 2004 to 554 kg ha<sup>-1</sup> in 2006. There were no consistent trends to spacing and seeding rate treatments and these varied from year to year in seed yield production.

Cool damp conditions in Edmonton and the late seeding at Lethbridge impacted seed yields in 2004 (Table 22 & 23). Seed yields tended to be slightly higher at the narrow row spacing in Edmonton although this was only significant in 2006. The highest seed yields in Edmonton were harvested in 2005 with an average of 375 kg ha<sup>-1</sup>. There were no seed yield data from Lethbridge in 2005 as any seed yields were low and heavily contaminated with weed seeds and were discarded.

The 1000 kernel weight at Bow Island (Table 36) was generally not significant for either spacing or seeding rate treatments. 3.70 g was the highest weight for both the 30 cm spacing and the 25 seeds m<sup>-1</sup> seeding rate in 2005. At Brooks (Table 37) average 1000 kernel weight was the lowest in 2006 at 3.24 g and the highest in 2005 at 4.03 g. In Edmonton in 2005, 1000 kernel weight averaged 4.16 g and in Lethbridge the average 1000 kernel weight in 2004 was 3.27 g.

There were no significant differences in germination at Bow Island (Table 52) with an average of 99.5% in 2005 and 98.7% in 2006. At Brooks (Table 53) in 2005 the average germination was 99.6% and in 2006 99.4%, while at Edmonton (Table 54) in 2005 it was 96.6% and 99.2% in 2006

Crimson clover seed yields were commercially acceptable from both the Bow Island and Brooks locations. Consistency varied year to year and could be a limiting factor to contract production in these areas however; these two locations could be considered as possible areas for commercial production.

Figure 5. Crimson clover flowers.

Figure 6. Crimson clover plots at Bow Island, Alberta

**Persian Clover** (*Trifolium resupinatum* L.) – This clover (Figures 7 & 8) prefers a pH range of 6.0-8.0 and clay or loam soils (Knight, 1995). It is a medium maturing clover and has a high bloat potential. Persian clover has a medium hard seed content. Seed yields for this species were only obtained at two locations. 10% bloom occurred near the end of July for the southern sites (Table 7). Harvest dates ranged from mid-October to early November (Table 13).

Seed yields at Bow Island (Table 24) were not significantly different for spacing treatments, but were for seeding rate in 2004 with the highest yield of 379 kg ha<sup>-1</sup> obtained at the 50 seeds m<sup>-1</sup> rate while in 2005 the highest yield of 194 kg ha<sup>-1</sup> resulted from the 100 seeds m<sup>-1</sup> rate. Highest average seed yields at Bow Island occurred in 2006 with yields of 502 kg ha<sup>-1</sup>.

At Brooks, seed yields were not significantly different for spacing treatments but in 2004 they were for seeding rate (Table 25) with 379 kg ha<sup>-1</sup> at the 50 seeds m<sup>-1</sup> rate. Seed yields were not obtained at the Lethbridge site due to the late seeding date and in Edmonton, growth occurred however the growing season was too short for this late maturing species to produce seed.

There were no significant differences for 1000 kernel weight (Tables 40 & 41) at either the Bow Island or Brooks locations. Data was only collected in 2006, with Bow Island having an average weight of 1.62 g compared to the average of 1.20 g at Brooks. The percent germination at Bow Island (Table 55) was not significantly different for spacing treatments; however it was for the seeding rate with the highest germination of 98.5% for

the 100 seeds m<sup>-1</sup> rate. At Brooks (Table 56), there were no significant differences for percent germination and the mean was 97.9%.

The late maturing nature of this species and the relatively low seed yields obtained do make Persian clover a viable crop for seed production in Alberta. It could serve as a useful crop for green manure however its high bloat potential makes it a risky crop for forage use.

Figure 7. Persian clover flowers.

Figure 8. Persian clover plots at Bow Island, Alberta

**Rose Clover** (*Trifolium hirtum* All.) – This clover (Figures 9 & 10) prefers well-drained sandy, clay or loam soils and is adapted to a pH range of 5.5-8.3. It is of medium maturity and has a low bloat potential. Rose clover has a high hard seed content (Love, 1985). 10% bloom occurred during the first half of July at Bow Island and Brooks and two weeks later in Lethbridge due to the later seeding date and about mid-July at Edmonton (Table 8). Harvest dates ranged from early September to late October depending on the year of harvest and location (Table 14).

At Bow Island, seed yields were higher at the narrow row spacing than at the wider row spacing although not significantly (Table 26). The highest seed yields at Bow Island were obtained in 2004 averaging 1263 kg ha<sup>-1</sup>. This was also the case at Brooks in 2004 with average yields of 1158 kg ha<sup>-1</sup>. There were no clear trends for spacing and seeding rate effects at these two irrigated locations. Seed yields from Edmonton were the most consistent year to year (Table 28). Mean seed yields for 2004, 2005 and 2006 were 314, 309 and 319 kg ha<sup>-1</sup>, respectively. There were no significant differences in seed yield with row spacing but generally the narrow row spacing yields were slightly higher. There was a significant difference in seed yields for seeding rate treatments in 2004 and 2005. Seed yields increased with seeding rate increase and this was also the case in 2006 but the effect was not significantly different. There were no yield data from Lethbridge in 2005 and 2006 as any seed yields harvested were low and heavily contaminated with weed seeds and the data were discarded (Table 29).

The 1000 kernel weight of rose clover seed harvested from all four test locations did not have any significant differences for any of the treatments in any of the years (Tables 41-44). Germination of rose clover seed harvested from Bow Island and Brooks (Tables 57 & 58) averaged 96.2% and 91.8% respectively in 2005. However, the germination was drastically reduced in 2006 only averaging 55.7% and 49.7% at the two locations. One explanation could be that seed may have been harvested too early resulting in the lower germination observed. At Edmonton (Table 59) mean germination in 2005 and 2006 was 79.6% and 75.3% respectively.

Seed yields of rose clover from the irrigated sites of Bow Island and Brooks were commercially acceptable and would be worth considering for contract seed production in those areas.

Figure 9. Rose clover flowers.

Figure 10. Rose clover plots at Bow Island, Alberta

**Woollypod Vetch** (*Vicia villosa* ssp. *dasycarpa*) Woollypod vetch (Figure 11) is tolerant of a wide range of soil textures, including sandy soils to heavy clays if they are well drained. It is tolerant of acidity and is adapted to a pH range of 4.5-7.0 (Smith, 2002). It is used for green manure and for extending the grazing season. 10% bloom occurred (Table 9) in the first two weeks of July at both Bow Island and Brooks. Harvest dates (Table 15) ranged from mid-September to late October.

Seed yields from Bow Island averaged 1819, 1382 and 1944 kg ha<sup>-1</sup> in 2004, 2005 and 2006, respectively (Table 30). There were no significant differences in seed yields for row spacing and seeding rate treatments. At Brooks (Table 31) seed yields also did have significant differences to any of the treatments. Yields in 2005 however, were substantially lower than those from 2004 or 2006. The reason for this maybe the late harvest date of October 12. Woollypod vetch seed can easily shatter and this may be one possibility of reduced seed yields obtained in 2005 (Undersander, 1990).

Generally, there were no significant differences among treatments for 1000 kernel weight at either Bow Island or Brooks (Tables 46 & 47). As well, there were no significant differences among treatments for mean percent germination (Tables 60 & 61).

The substantial high seed yields harvested for woollypod vetch make it a potentially commercially viable seed crop for southern Alberta. Seed yields for this trial were comparable to those obtained for common vetch in Saskatchewan (Coulman & Lyons, 2001).

Figure 11. Woollypod vetch.

## CONCLUSIONS

Generally row spacing and seeding rates did not significantly affect seed yield in the six species of annual legumes evaluated for this project. Environmental factors such as temperature and precipitation affected seed yields as indicated by the variation in seed production from year to year. Length of the growing season was also a factor, in Edmonton despite early seeding dates, later maturing species such as arrowleaf, berseem and Persian clover did not mature early enough for adequate seed production to occur. In Lethbridge, late seeding dates resulted in low or no seed yields for the various species indicating that early seeding is imperative to successful seed production of these annual legumes.

Of the six species evaluated, crimson clover, rose clover and woollypod vetch showed the greatest potential as commercially viable seed producing crops. Depending on the contract price offered, seed yields at Bow Island and Brooks were high enough to make seed production of these three species economically worthwhile. Arrowleaf, berseem and Persian clover were inconsistent in their seed production. In some years when environmental conditions were advantageous to allow plants to fully mature seed production was possible, however in those years when conditions were less than ideal seed yields were either very low or non-existent. These would not currently be considered economically feasible for contract seed production. However, in regard to berseem clover it was observed that substantial forage growth was produced making this an ideal crop for annual forage or green manure.

This research indicated that commercial production of at least three species is a possibility. To be successful however, there is a definite need for herbicide evaluation to provide producers with the necessary weed control to make such a venture possible. As indicated above, early seeding is required to ensure a full season of growth, however, the possibility of fall seeding should be investigated to determine if this would enhance the successful seed production of the later maturing species. As well, harvest management methods need to be evaluated to determine whether desiccating the plants as is done in alfalfa seed production would improve yields, or whether swathing or straight cutting is the method to be used to harvest. During threshing of seed samples, it was noted that crimson and rose clover are hard to thresh from their hulls and a method needs to be determined to increase the efficiency of separating the seeds from the hull.

Finally, as the highest seed yields were attained under irrigation, management studies on irrigation application (to crimson and rose clover in particular) need to be conducted to determine the means to maximize seed production in our short growing season.

Table 1. Seeding dates at trial locations for all species.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	May 07	May 05	May 05
<b>Brooks</b>	May 04	May 06	May 10
<b>Edmonton</b>	May 12	May 04	-
<b>Lethbridge</b>	June 02	May 16	-

Table 2. Pre-plant application dates of Treflan.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Apr 27	May 02	May 01
<b>Brooks</b>	Apr 30	May 03	Apr 28
<b>Edmonton</b>	-	May 02	-
<b>Lethbridge</b>	Jun 2	-	-

Table 3. Irrigation amount (cm) applied for southern Alberta trial locations

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	15.8	12.5	10.0
<b>Brooks</b>	17.1	7.5	15.0
<b>Lethbridge</b>	12.7	n.a.	-

Table 4. 10% flowering date for arrowleaf clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Aug 08	Aug 16	Aug 04
<b>Brooks</b>	Aug 10	Aug 16	Aug 08
<b>Edmonton</b>	-	-	-
<b>Lethbridge</b>	Aug 16	-	-

Table 5. 10% flowering date for berseem clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Aug 08	Aug 12	Aug 02
<b>Brooks</b>	Aug 10	Aug 16	Aug 04
<b>Edmonton</b>	-	-	-
<b>Lethbridge</b>	Aug 25	-	-

Table 6. 10% flowering date for crimson clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Jul 16	Jul 16	Jul 17
<b>Brooks</b>	Jul 16	Jul 15	Jul 15
<b>Edmonton</b>	Jul 28	-	-
<b>Lethbridge</b>	Jul 16	-	-



Table 7. 10% flowering date for Persian clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Jul 26	Jul 18	Jul 11
<b>Brooks</b>	Jul 26	Jul 18	Jul 14
<b>Edmonton</b>	-	-	-
<b>Lethbridge</b>	Jul 26	-	-

Table 8. 10% flowering date for rose clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Jul 07	Jul 08	Jul 11
<b>Brooks</b>	Jul 05	Jul 11	Jul 12
<b>Edmonton</b>	Jul 22	-	-
<b>Lethbridge</b>	Jul 19	-	-

Table 9. 10% flowering date for woollypod vetch at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Jul 02	Jul 08	Jul 10
<b>Brooks</b>	Jun 30	Jul 11	Jul 10
<b>Edmonton</b>	-	-	-
<b>Lethbridge</b>	-	-	-

Table 10. Harvest date for arrowleaf clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Oct 26	-	Oct 24
<b>Brooks</b>	Nov 02	-	Oct 25
<b>Edmonton</b>	-	-	-
<b>Lethbridge</b>	Oct 27	Oct 24	-

Table 11. Harvest date for berseem clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Oct 26	-	Oct 24
<b>Brooks</b>	Oct 28	-	Oct 13
<b>Edmonton</b>	-	-	-
<b>Lethbridge</b>	Oct 27	Oct 24	-

Table 12. Harvest date for crimson clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Sep 02	Sep 26	Sep 07
<b>Brooks</b>	Sep 08	Oct 07	Sep 08
<b>Edmonton</b>	Oct 14	Oct 25	-
<b>Lethbridge</b>	Oct 27	Oct 24	-

Table 13. Harvest date for Persian clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Oct 26	Oct 13	Oct 24
<b>Brooks</b>	Nov 02	-	Oct 13
<b>Edmonton</b>	-	-	-
<b>Lethbridge</b>	Oct 27	Oct 24	-

Table 14. Harvest date for rose clover at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Sep 02	Sep 26	Sep 19
<b>Brooks</b>	Sep 08	Oct 07	Sep 19
<b>Edmonton</b>	Oct 13	Oct 25	-
<b>Lethbridge</b>	Oct 27	Oct 24	-

Table 15. Harvest date for woollypod vetch at trial locations.

	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Bow Island</b>	Sep 13	Sep 26	Sep 11
<b>Brooks</b>	Sep 17	Oct 12	Sep 11
<b>Edmonton</b>	-	-	-
<b>Lethbridge</b>	-	Oct 24	-

Table 16. Mean seed yields (kg ha<sup>-1</sup>) of arrowleaf clover harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	282	-	670
30	250	-	726
LSD	ns	-	ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	228	-	688
75	272	-	723
100	298	-	683
Mean	266	-	698
LSD	ns	-	ns
<b>Spacing/Seeding Rate</b>			
20/50	254	-	609
20/75	271	-	736
20/100	322	-	666
30/50	203	-	767
30/75	274	-	710
30/100	273	-	700

Table 17. Mean seed yields (kg ha<sup>-1</sup>) of arrowleaf clover harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	25	-	473
30	26	-	452
LSD	ns	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	18	-	379
75	24	-	408
100	35	-	600
Mean	25	-	462
LSD	17	-	198
<b>Spacing/Seeding Rate</b>			
20/50	16	-	332
20/75	26	-	392
20/100	33	-	694
30/50	19	-	426
30/75	20	-	424
30/100	38	-	506

Table 18. Mean seed yields (kg ha<sup>-1</sup>) of berseem clover harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	461	-	1026
30	372	-	948
LSD	69.7	-	ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	319	-	962
50	454	-	1021
75	477	-	979
Mean	416	-	987
LSD	86.5	-	ns
<b>Spacing/Seeding Rate</b>			
20/25	394	-	1018
20/50	486	-	1122
20/75	501	-	940
30/25	244	-	907
30/50	421	-	920
30/75	452	-	1018

Table 19. Mean seed yields (kg ha<sup>-1</sup>) of berseem clover harvested at Brooks, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	166	-	701
30	124	-	700
LSD	ns	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	125	-	686
50	140	-	682
75	170	-	734
Mean	145	-	701
LSD	Ns	-	Ns
<b>Spacing/Seeding Rate</b>			
20/25	163	-	732
20/50	150	-	646
20/75	184	-	725
30/25	87	-	640
30/50	130	-	717
30/75	156	-	744

Table 20. Mean seed yields (kg ha<sup>-1</sup>) of crimson clover harvested at Bow Island, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	1013	878	431
30	951	858	340
LSD	Ns	Ns	60
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	971	902	278
50	1034	841	416
75	942	861	463
Mean	982	868	386
LSD	ns	ns	66
<b>Spacing/Seeding Rate</b>			
20/25	1003	866	324
20/50	1073	891	452
20/75	963	878	518
30/25	938	938	232
30/50	994	792	380
30/75	920	844	408

Table 21. Mean seed yields (kg ha<sup>-1</sup>) of crimson clover harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	1376	963	550
30	1079	862	558
LSD	Ns	99	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	1134	835	512
50	1300	943	563
75	1248	960	588
Mean	1227	912	554
LSD	Ns	60	Ns
<b>Spacing/Seeding Rate</b>			
20/25	1224	868	490
20/50	1458	1003	582
20/75	1446	1018	580
30/25	1044	801	534
30/50	1142	882	544
30/75	1050	901	596

Table 22. Mean seed yields (kg ha<sup>-1</sup>) of crimson clover harvested at Edmonton, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	190	410	362
30	203	339	271
LSD	Ns	Ns	70
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	135	362	288
50	211	400	312
75	243	363	350
Mean	196	375	316
LSD	94	Ns	ns
<b>Spacing/Seeding Rate</b>			
20/25	142	399	336
20/50	155	448	319
20/75	272	382	430
30/25	128	324	239
30/50	266	350	305
30/75	215	344	269

Table 23. Mean seed yields (kg ha<sup>-1</sup>) of crimson clover harvested at Lethbridge, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	71	-	-
30	37	-	-
LSD	13.3	-	-
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	34	-	-
50	54	-	-
75	74	-	-
Mean	54	-	-
LSD	12.3	-	-
<b>Spacing/Seeding Rate</b>			
20/25	43	-	-
20/50	68	-	-
20/75	101	-	-
30/25	24	-	-
30/50	40	-	-
30/75	46	-	-

Table 24. Mean seed yields (kg ha<sup>-1</sup>) of Persian clover harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	370	184	523
30	323	172	481
LSD	Ns	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	379	155	478
75	348	184	546
100	312	194	481
Mean	346	178	502
LSD	61.8	34.9	Ns
<b>Spacing/Seeding Rate</b>			
20/50	437	188	487
20/75	362	152	562
20/100	312	210	520
30/50	321	121	470
30/75	335	216	531
30/100	312	178	443

Table 25. Mean seed yields (kg ha<sup>-1</sup>) of Persian clover harvested at Brooks, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	299	-	395
30	325	-	351
LSD	Ns	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	344	-	355
75	318	-	362
100	274	-	401
Mean	312	-	373
LSD	63.6	-	Ns
<b>Spacing/Seeding Rate</b>			
20/50	326	-	335
20/75	298	-	370
20/100	273	-	480
30/50	361	-	376
30/75	338	-	355
30/100	275	-	322

Table 26. Mean seed yields (kg ha<sup>-1</sup>) of rose clover harvested at Bow Island, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	1301	661	520
30	1225	608	509
LSD	Ns	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	1166	554	505
50	1282	689	491
75	1339	660	546
Mean	1263	634	514
LSD	134.7	61.9	Ns
<b>Spacing/Seeding Rate</b>			
20/25	1223	565	543
20/50	1336	717	473
20/75	1325	700	544
30/25	1123	542	467
30/50	1228	662	510
30/75	1358	620	550

Table 27. Mean seed yields (kg ha<sup>-1</sup>) of rose clover harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	1196	538	603
30	1121	580	557
LSD	ns	ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	972	502	546
50	1257	539	548
75	1245	616	645
Mean	1158	558	580
LSD	160.4	89.7	Ns
<b>Spacing/Seeding Rate</b>			
20/25	1007	448	616
20/50	1340	545	542
20/75	1240	600	649
30/25	938	556	475
30/50	1173	531	554
30/75	1251	634	641

Table 28. Mean seed yields (kg ha<sup>-1</sup>) of rose clover harvested at Edmonton, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	313	339	358
30	316	279	280
LSD	ns	ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	254	272	286
50	279	281	337
75	411	374	336
Mean	314	309	319
LSD	66.2	59.9	Ns
<b>Spacing/Seeding Rate</b>			
20/25	213	308	334
20/50	290	299	373
20/75	436	409	368
30/25	295	236	237
30/50	268	264	301
30/75	386	338	303



Table 29. Mean seed yields (kg ha<sup>-1</sup>) of rose clover harvested at Lethbridge, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	34	-	-
30	20	-	-
LSD	Ns	-	-
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	20	-	-
50	25	-	-
75	34	-	-
Mean	27	-	-
LSD	6.6	-	-
<b>Spacing/Seeding Rate</b>			
20/25	28	-	-
20/50	28	-	-
20/75	45	-	-
30/25	13	-	-
30/50	23	-	-
30/75	23	-	-

Table 30. Mean seed yields (kg ha<sup>-1</sup>) of woollypod vetch harvested at Bow Island, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	1761	1480	2001
30	1877	1285	1886
LSD	ns	ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
10	1953	1393	2098
20	1694	1480	1852
30	1809	1274	1880
Mean	1819	1382	1944
LSD	185.5	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/10	1821	1325	1937
20/20	1688	1527	2052
20/30	1773	1586	2014
30/10	2085	1461	2260
30/20	1701	1432	1653
30/30	1845	962	1746

Table 31. Mean seed yields (kg ha<sup>-1</sup>) of woollypod vetch harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	1406	456	1967
30	1259	467	1935
LSD	Ns	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
10	1385	492	1923
20	1255	469	2014
30	1357	423	1917
Mean	1332	461	1951
LSD	Ns	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/10	1595	497	2082
20/20	1063	443	1981
20/30	1558	427	1839
30/10	1174	488	1764
30/20	1447	495	2047
30/30	1155	419	1996

Table 32. 1000 kernel weight (g) of arrowleaf clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	1.28
30	-	-	1.26
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	-	-	1.25
75	-	-	1.27
100	-	-	1.28
Mean	-	-	1.27
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/50	-	-	1.27
20/75	-	-	1.28
20/100	-	-	1.30
30/50	-	-	1.24
30/75	-	-	1.26
30/100	-	-	1.27

Table 33. 1000 kernel weight (g) of arrowleaf clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	1.18
30	-	-	1.16
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	-	-	1.16
75	-	-	1.18
100	-	-	1.17
Mean	-	-	1.17
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/50	-	-	1.18
20/75	-	-	1.17
20/100	-	-	1.19
30/50	-	-	1.14
30/75	-	-	1.20
30/100	-	-	1.14

Table 34. 1000 kernel weight (g) of berseem clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	3.02
30	-	-	3.05
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	-	3.08
50	-	-	3.03
75	-	-	3.01
Mean	-	-	3.04
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/25	-	-	3.04
20/50	-	-	3.02
20/75	-	-	3.01
30/25	-	-	3.11
30/50	-	-	3.04
30/75	-	-	3.01

Table 35. 1000 kernel weight (g) of berseem clover seed harvested at Brooks, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	-	-	2.79
30	-	-	2.64
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	-	2.82
50	-	-	2.65
75	-	-	2.68
Mean	-	-	2.72
LSD	-	-	0.14
<b>Spacing/Seeding Rate</b>			
20/25	-	-	3.02
20/50	-	-	2.65
20/75	-	-	2.71
30/25	-	-	2.61
30/50	-	-	2.66
30/75	-	-	2.64

Table 36. 1000 kernel weight (g) of crimson clover seed harvested at Bow Island, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	3.15	3.62	3.40
30	3.22	3.70	3.42
LSD	0.04	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	3.16	3.70	3.33
50	3.18	3.64	3.44
75	3.20	3.65	3.46
Mean	3.18	3.66	3.41
LSD	Ns	Ns	0.11
<b>Spacing/Seeding Rate</b>			
20/25	3.15	3.74	3.34
20/50	3.15	3.60	3.42
20/75	3.14	3.54	3.44
30/25	3.17	3.66	3.32
30/50	3.21	3.68	3.46
30/75	3.26	3.77	3.48

Table 37. 1000 kernel weight (g) of crimson clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	3.67	4.00	3.15
30	3.69	4.06	3.33
LSD	ns	Ns	0.13
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	3.63	4.01	3.22
50	3.68	4.04	3.24
75	3.73	4.04	3.26
Mean	3.68	4.03	3.24
LSD	Ns	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	3.56	4.04	3.14
20/50	3.71	3.96	3.14
20/75	3.74	4.02	3.17
30/25	3.70	3.98	3.30
30/50	3.54	4.12	3.35
30/75	3.72	4.08	3.35

Table 38. 1000 kernel weight (g) of crimson clover seed harvested at Edmonton, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	3.26	4.15	3.33
30	3.52	4.18	3.31
LSD	Ns	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	3.36	4.24	3.33
50	3.40	4.14	3.32
75	3.41	4.10	3.30
Mean	3.39	4.16	3.32
LSD	Ns	ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	3.24	4.30	3.36
20/50	3.29	4.10	3.33
20/75	3.26	4.05	3.29
30/25	3.48	4.18	3.31
30/50	3.50	4.18	3.31
30/75	3.57	4.16	3.30

Table 39. 1000 kernel weight (g) of crimson clover seed harvested at Lethbridge, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	3.27	-	-
30	3.27	-	-
LSD	Ns	-	-
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	3.17	-	-
50	3.28	-	-
75	3.36	-	-
Mean	3.27	-	-
LSD	0.10	-	-
<b>Spacing/Seeding Rate</b>			
20/25	3.15	-	-
20/50	3.22	-	-
20/75	3.42	-	-
30/25	3.18	-	-
30/50	3.34	-	-
30/75	3.29	-	-

Table 40. 1000 kernel weight (g) of Persian clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	1.61
30	-	-	1.62
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	-	-	1.61
75	-	-	1.64
100	-	-	1.60
Mean	-	-	1.62
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/50	-	-	1.60
20/75	-	-	1.62
20/100	-	-	1.61
30/50	-	-	1.62
30/75	-	-	1.66
30/100	-	-	1.58

Table 41. 1000 kernel weight (g) of Persian clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	1.23
30	-	-	1.18
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	-	-	1.21
75	-	-	1.18
100	-	-	1.22
Mean	-	-	1.20
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/50	-	-	1.21
20/75	-	-	1.24
20/100	-	-	1.25
30/50	-	-	1.20
30/75	-	-	1.13
30/100	-	-	1.19

Table 42. 1000 kernel weight (g) of rose clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	3.53	3.65	3.82
30	3.53	3.68	3.82
LSD	Ns	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	3.50	3.66	3.81
50	3.53	3.64	3.82
75	3.57	3.68	3.81
Mean	3.53	3.66	3.82
LSD	Ns	Ns	ns
<b>Spacing/Seeding Rate</b>			
20/25	3.52	3.66	3.84
20/50	3.52	3.63	3.83
20/75	3.55	3.66	3.78
30/25	3.47	3.66	3.79
30/50	3.55	3.66	3.81
30/75	3.58	3.72	3.85

Table 43. 1000 kernel weight (g) of rose clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	3.71	3.67	4.04
30	3.73	3.73	4.00
LSD	Ns	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	3.66	3.72	3.97
50	3.75	3.69	4.00
75	3.76	3.68	4.07
Mean	3.72	3.70	4.02
LSD	Ns	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	3.62	3.70	3.93
20/50	3.71	3.66	4.05
20/75	3.80	3.66	4.13
30/25	3.69	3.74	4.02
30/50	3.80	3.72	3.95
30/75	3.71	3.71	4.02

Table 44. 1000 kernel weight (g) of rose clover seed harvested at Edmonton, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	3.12	4.08	3.92
30	3.14	4.09	3.84
LSD	Ns	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	3.13	4.08	3.82
50	3.12	4.07	3.90
75	3.15	4.11	3.93
Mean	3.13	4.08	3.89
LSD	Ns	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	3.13	4.10	3.93
20/50	3.10	4.04	3.82
20/75	3.14	4.11	4.02
30/25	3.14	4.06	3.71
30/50	3.14	4.10	3.97
30/75	3.16	4.12	3.84



Table 45. 1000 kernel weight (g) of rose clover seed harvested at Lethbridge, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	2.86	-	-
30	2.57	-	-
LSD	Ns	-	-
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	2.69	-	-
50	2.67	-	-
75	2.78	-	-
Mean	2.71	-	-
LSD	Ns	-	-
<b>Spacing/Seeding Rate</b>			
20/25	2.82	-	-
20/50	2.74	-	-
20/75	3.00	-	-
30/25	2.56	-	-
30/50	2.59	-	-
30/75	2.55	-	-

Table 46. 1000 kernel weight (g) of woollypod vetch seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	44.72	37.10	50.47
30	44.11	34.52	50.62
LSD	Ns	1.28	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
10	44.38	35.30	50.00
20	44.06	36.71	50.30
30	44.80	35.41	51.33
Mean	44.41	35.81	50.54
LSD	Ns	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/10	44.50	36.61	47.80
20/20	44.32	38.13	51.73
20/30	45.33	36.55	51.87
30/10	44.25	33.99	52.20
30/20	43.80	35.29	48.87
30/30	44.28	34.27	50.80

Table 47. 1000 kernel weight (g) of woollypod vetch seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	43.80	29.17	50.47
30	41.87	29.94	50.12
LSD	Ns	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
10	42.86	28.46	49.55
20	42.23	30.33	50.75
30	43.42	29.87	50.58
Mean	42.83	29.55	50.29
LSD	Ns	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/10	44.46	28.62	49.40
20/20	42.03	28.90	51.25
20/30	44.91	29.99	50.75
30/10	41.26	28.30	49.70
30/20	42.43	31.76	50.25
30/30	41.92	29.75	50.40

Table 48. Mean percent germination of arrowleaf clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	93.8
30	-	-	93.2
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	-	-	91.8
75	-	-	93.0
100	-	-	95.8
Mean	-	-	93.5
LSD	-	-	2.4
<b>Spacing/Seeding Rate</b>			
20/50	-	-	93.8
20/75	-	-	92.5
20/100	-	-	95.2
30/50	-	-	89.8
30/75	-	-	93.5
30/100	-	-	96.2

Table 49. Mean percent germination of arrowleaf clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	87.2
30	-	-	90.2
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	-	-	88.0
75	-	-	89.6
100	-	-	88.5
Mean	-	-	88.7
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/50	-	-	88.0
20/75	-	-	88.5
20/100	-	-	85.0
30/50	-	-	88.0
30/75	-	-	90.8
30/100	-	-	92.0

Table 50. Mean percent germination of berseem clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	97.4
30	-	-	94.2
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	-	95.5
50	-	-	95.5
75	-	-	96.5
Mean	-	-	95.8
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/25	-	-	97.2
20/50	-	-	96.2
20/75	-	-	98.8
30/25	-	-	93.8
30/50	-	-	94.8
30/75	-	-	94.2

Table 51. Mean percent germination of berseem clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	92.1
30	-	-	93.5
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	-	93.0
50	-	-	92.0
75	-	-	93.4
Mean	-	-	92.8
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/25	-	-	94.8
20/50	-	-	90.2
20/75	-	-	91.2
30/25	-	-	91.2
30/50	-	-	93.4
30/75	-	-	95.5

Table 52. Mean percent germination of crimson clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	99.3	98.9
30	-	99.8	98.4
LSD	-	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	99.0	98.4
50	-	99.9	98.6
75	-	99.6	99.0
Mean	-	99.5	98.7
LSD	-	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	-	98.3	98.0
20/50	-	99.8	99.8
20/75	-	99.8	99.0
30/25	-	99.8	98.8
30/50	-	100.0	97.5
30/75	-	99.5	99.0

Table 53. Mean percent germination of crimson clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	99.3	99.3
30	-	99.9	99.6
LSD	-	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	99.6	99.5
50	-	100.0	99.4
75	-	99.1	99.5
Mean	-	99.6	99.4
LSD	-	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	-	99.3	99.2
20/50	-	100.0	99.5
20/75	-	98.5	99.2
30/25	-	100.0	99.8
30/50	-	100.0	99.2
30/75	-	99.8	99.8

Table 54. Mean percent germination of crimson clover seed harvested at Edmonton, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	97.2	99.1
30	-	96.0	99.2
LSD	-	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	97.1	99.4
50	-	96.1	98.8
75	-	96.6	99.4
Mean	-	96.6	99.2
LSD	-	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	-	96.2	99.2
20/50	-	98.0	98.5
20/75	-	97.5	99.5
30/25	-	98.0	99.5
30/50	-	94.2	99.0
30/75	-	95.8	99.2

Table 55. Mean percent germination of Persian clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	96.7
30	-	-	97.7
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	-	-	96.9
75	-	-	96.1
100	-	-	98.5
Mean	-	-	97.2
LSD	-	-	2.2
<b>Spacing/Seeding Rate</b>			
20/50	-	-	96.2
20/75	-	-	96.0
20/100	-	-	97.8
30/50	-	-	97.5
30/75	-	-	96.2
30/100	-	-	99.2

Table 56. Mean percent germination of Persian clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	-	97.2
30	-	-	98.6
LSD	-	-	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
50	-	-	98.5
75	-	-	97.5
100	-	-	97.8
Mean	-	-	97.9
LSD	-	-	Ns
<b>Spacing/Seeding Rate</b>			
20/50	-	-	97.8
20/75	-	-	96.8
20/100	-	-	97.2
30/50	-	-	99.2
30/75	-	-	98.2
30/100	-	-	98.2

Table 57. Mean percent germination of rose clover seed harvested at Bow Island, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	96.6	54.7
30	-	95.9	56.8
LSD	-	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	96.9	55.5
50	-	95.9	50.6
75	-	96.0	61.0
Mean	-	96.2	55.7
LSD	-	Ns	8.0
<b>Spacing/Seeding Rate</b>			
20/25	-	98.5	49.5
20/50	-	95.8	47.2
20/75	-	95.5	67.2
30/25	-	95.2	61.5
30/50	-	96.0	54.0
30/75	-	96.5	54.8

Table 58. Mean percent germination of rose clover seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	93.4	50.5
30	-	90.2	48.8
LSD	-	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	91.0	48.8
50	-	91.1	49.4
75	-	93.4	50.9
Mean	-	91.8	49.7
LSD	-	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	-	91.0	47.2
20/50	-	92.8	53.0
20/75	-	96.5	51.2
30/25	-	91.0	50.2
30/50	-	89.5	45.8
30/75	-	90.2	50.5

Table 59. Mean percent germination of rose clover seed harvested at Edmonton, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	-	81.1	75.4
30	-	78.3	75.2
LSD	-	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
25	-	78.2	74.9
50	-	81.9	81.2
75	-	78.7	69.8
Mean	-	79.6	75.3
LSD	-	ns	Ns
<b>Spacing/Seeding Rate</b>			
20/25	-	80.5	72.2
20/50	-	82.8	80.8
20/75	-	79.7	73.2
30/25	-	76.0	77.5
30/50	-	81.0	81.8
30/75	-	78.0	66.2

Table 60. Mean percent germination of woollypod vetch seed harvested at Bow Island, AB

Year	2004	2005	2006
<b>Spacing (cm)</b>			
20	-	90.8	69.7
30	-	87.5	69.0
LSD	-	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
10	-	90.0	68.0
20	-	87.8	72.0
30	-	89.6	68.0
Mean	-	89.1	69.3
LSD	-	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/10	-	91.0	72.0
20/20	-	89.8	74.0
20/30	-	91.5	63.0
30/10	-	89.0	64.0
30/20	-	85.8	70.0
30/30	-	87.8	73.0



Table 61. Mean percent germination of woollypod vetch seed harvested at Brooks, AB

<b>Year</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>Spacing (cm)</b>			
20	-	80.9	74.75
30	-	84.2	68.67
LSD	-	Ns	Ns
<b>Seeding Rate (seeds m<sup>-1</sup>)</b>			
10	-	79.0	70.00
20	-	81.4	74.88
30	-	87.2	70.25
Mean	-	82.5	71.71
LSD	-	Ns	Ns
<b>Spacing/Seeding Rate</b>			
20/10	-	75.2	75.25
20/20	-	81.2	76.00
20/30	-	86.2	73.00
30/10	-	82.8	64.75
30/20	-	81.5	73.75
30/30	-	88.2	67.50

## APPENDIX 1. BROOKS AND BOW ISLAND WEATHER DATA – 2004-2006

		Brooks						Bow Island					
		Temperature Degree C					Precipitation mm	Temperature Degree C					Precipitation mm
		Extreme		Mean		Extreme		Mean					
Year	Month	Maximum	Minimum	Maximum	Minimum	Mean		Maximum	Minimum	Maximum	Minimum	Mean	
2004	April	26.2	-6.4	15.2	-1.5	6.9	14.0	25.3	-5.2	15.2	-0.4	7.4	11.9
	May	25.2	-4.9	16.3	2.6	9.5	36.4	24.3	-2.6	15.8	3.4	9.6	41.7
	June	29.8	1.2	21.2	7.3	14.2	64.8	29.4	2.1	20.8	7.4	14.1	36.1
	July	35.6	7.6	26.0	11.1	18.6	37.6	32.8	5.5	26.0	11.3	18.6	26.2
	August	31.2	4.3	23.4	9.9	16.6	67.0	31.1	5.4	23.7	10.4	17.0	60.6
	September	24.6	-5.9	18.4	3.7	11.0	8.6	27.1	-3.1	18.8	4.8	11.8	12.6
	October	25.3	-9.2	12.2	-2.6	4.7	5.4	25.7	-7.2	12.9	-1.3	5.8	9.6
	November	20.6	-15.5	8.2	-6.9	0.7	0.6	18.5	-12.7	8.1	-5.2	1.4	3.8
2005	April	25.5	-0.9	14.2	-1.6	6.3	14.6	25.6	-7.7	14.4	-0.4	7.0	15.0
	May	26.3	-9.8	19.1	3.3	11.2	22.2	26.2	-9.1	19.1	3.5	11.3	8.1
	June	30.4	4.3	19.8	9.0	14.4	227.8	32.7	5.6	20.7	9.3	15.0	151.1
	July	34.3	5.7	25.6	10.9	18.2	42.0	34.2	6.8	27.3	11.0	19.1	0.3
	August	33.9	0.8	23.0	8.2	15.6	87.2	33.7	2.7	24.5	9.1	16.8	48.8
	September	28.0	-1.7	18.5	4.3	11.4	97.0	29.7	-2.2	19.2	5.5	12.3	62.2
	October	22.8	-5.7	14.1	-0.1	6.7	30.6	23.6	-3.5	14.9	1.4	8.2	23.4
	November	21.1	-16.8	6.8	-5.8	0.6	8.4	19.8	-21.7	8.3	-4.2	2.0	0.0
2006	April	26.1	-5.2	15.7	0.4	8.1	33.0	26.1	-4.6	15.5	1.7	8.6	20.3
	May	31.2	-5.0	20.0	5.7	12.9	50.2	32.6	-3.5	20.5	6.4	13.5	35.8
	June	33.9	5.3	24.0	10.2	17.1	90.8	33.4	7.4	23.6	10.8	17.2	73.4
	July	36.0	7.3	29.8	12.1	21.0	5.4	34.3	9.1	29.5	12.8	21.2	6.4
	August	33.6	4.3	27.1	8.9	18.0	22.2	34.6	5.2	27.4	9.7	18.5	32.8
	September	33.2	-1.2	22.8	5.0	14.0	19.0	32.1	-1.6	21.1	5.7	13.4	11.7
	October	24.8	-13.0	9.9	-2.9	3.5	17.0	24.5	-15.7	10.7	-1.6	4.6	15.5
	November	14.2	-28.1	0.9	-10.5	-4.9	9.4	16.2	-27.9	3.3	-9.4	-3.0	2.3



## BIBLIOGRAPHY

- Coulman, B. and G. Lyons. 2001. Potential of common vetch as a seed crop in Western Canada. Agriculture and AgriFood Canada. Newfield Seeds. 1 p.
- Fraser, J., D. McCartney, H. Najda and Z. Mir. 2004. Yield potential and forage quality of annual forage legumes in southern Alberta and northeast Saskatchewan. *Can. J. Plant Sci.* 84: 143-155.
- Knight, W.E.1985. Crimson clover. p. 491-502. *In* N. L. Taylor (ed.) *Clover Science and Technology*. ASA-CSSA-SSSA, Inc. Publishers. Madison, Wisconsin.
- Knight, W.E.1985. Miscellaneous annual clovers. p. 547-553. *In* N. L. Taylor (ed.) *Clover Science and Technology*. ASA-CSSA-SSSA, Inc. Publishers. Madison, Wisconsin.
- Love, R.M.1985. Rose Clover. p. 535-546. *In* N. L. Taylor (ed.) *Clover Science and Technology*. ASA-CSSA-SSSA, Inc. Publishers. Madison, Wisconsin.
- Miller, J. D. and H. D. Wells.1985. Arrowleaf clover. p. 503-514. *In* N. L. Taylor (ed.) *Clover Science and Technology*. ASA-CSSA-SSSA, Inc. Publishers. Madison, Wisconsin.
- Richards, K. 1995. The alfalfa leafcutter bee, *Megachile rotundata*: a potential pollinator for some annual forage legumes. *J. Apic. Res.* 34:115-121.
- Smith, J. and H. Valenzuela. 2002. Woollypod vetch. Cooperative Extension Service. University of Hawaii. 3 p.
- Undersander, D.J., N. J. Ehlke, A. R. Kaminiski, J.D. Doll and K.A. Kelling. 1990. Hairy vetch. *Alternative Crops Manual*. Minnesota Extension Service. 3 p.

## BIOGRAPHICAL DATA OF PRIMARY RESEARCHERS

<b>Name:</b>	
Dr/Mr/Ms/Mrs.	Last Najda First Henry
<b>Position / Organization / Dept.:</b>	
Grass Seed & Forage Scientist/Crop Diversification Centre South/Agriculture and Food	
<b>Address:</b>	
Street /Box # 301 Horticultural Station Road East	City Brooks Prov. AB Postal Code T1R 1E6
<b>E-mail:</b> <a href="mailto:henry.najda@gov.ab.ca">henry.najda@gov.ab.ca</a>	
<b>Phone:</b> (403) 362-1346	<b>Fax:</b> (403) 362-1306
<b>Past experience relevant to project:</b> (Point form, concise.)	
Agronomic studies on grass seed production (Kentucky bluegrass, tall fescue, perennial ryegrass, orchardgrass, fine fescues) – 1987- present	
Yield potential and forage quality of annual forage legumes in Southern Alberta - 1993-1995	
<b>Degrees / Certificates / Diplomas:</b> B.A.	<b>Institution:</b> University of Lethbridge
MPM	Simon Fraser University
<b>Publications and Patents:</b>	
# of Refereed papers: 13	Conference proceedings: 13
Relevant Patents obtained:	Other relevant citations: 116

**Other evidence of productivity during past 6 years: (Point form, concise)**

- Baron, V.S., **Najda, H.G.** and Stevenson, F.C. 2006. Influence of population density, row spacing and hybrid on forage corn yield and nutritive value in a cool-season environment. *Can J. Plant Sci.* 86:1131-1138
- Fraser, J., **Najda, H.**, McCartney, D. and Zir, M. 2004. Yield potential and forage quality of annual legumes in southern Alberta and northeast Saskatchewan. *Can. J. Plant Sci.* 84:143-155.
- Hwang, S.F., Gaudet, D.A., Turnbull, G.D., Chang, K.F., Howard, R.J. and **Najda, H.** 2002. Effect of plant age and cottony snow mold on winter survival of forage grasses. *Can. J. Plant. Sci.* 82: 701-708.
- Gossen, B.D., Soroka, J.J. and **Najda, H.G.** 2002. Residue management increases seed yield of three turfgrass species on the Canadian prairies. *Can. J. Plant Sci.* 82: 687-692.
- Baron, V.S., **Najda, H.G.**, McCartney, D.H., Bjorge, M. and Lastiwka, G.W. 2002. Winter weathering effects on corn grown for grazing in a short-season area. *Can. J. Plant Sci.* 83 :( in press).
- Najda, H.G.** and R.C. McKenzie. 1996. The agronomy and management of grass seed production under irrigation. Farming for the Future Project 92-0049F. 56 pp.
- Gossen, B.D., Soroka, J.J. and **Najda, H.G.** 1997. Narrow rows and residue management increase seed yield of three turf grasses. *In Proceedings XVIII International Grassland Congress.* Winnipeg and Saskatoon, Canada. June.
- Acharya, S.N., Kozub, G.C., **Najda, H.** and Aasen, A. 1997. Study of genotypic x environment interaction in alfalfa forage yield. *In Proceedings XVIII International Grasslands Congress.* Winnipeg and Saskatoon, Canada. June.

Branch Head, Food Crops – CDC South, AF, 2005 - present

Assistant Director – CDC South, AAFRD 1999-2001

Program leader of the Western Grass Seed Testing program.

21 scientific bulletins, industry and research reports written.

2 new factsheets written and 8 factsheets revised

Responsible for maintaining current grass & legume seed production information on Ropin' the Web

6 farm magazine articles published

4 radio and newspaper interviews given

Reviewer for the Canadian Journal of Plant Science

Participant on several department, producer and professional committees and organizations

<b>Name:</b>	
Dr/Mr/Ms/Mrs.	Last Acharya First Surya
<b>Position / Organization / Dept.:</b> Research Scientist/Agriculture & AgriFood Canada/Research Branch	
<b>Address:</b> Street /Box # Box 3000	City Lethbridge Prov. AB Postal Code T1J 4B1
<b>E-mail:</b> acharya@agr.gc.ca	
<b>Phone:</b> (403) 317-2277	<b>Fax:</b> (403) 382-3156
<b>Past experience relevant to project:</b> (Point form, concise.)	
Development of non-traditional high quality forage crops (including annual legume fenugreek) with distinct advantages for livestock production. (1995 - present)	
Alfalfa breeding: develop cultivars with superior Verticillium wilt and bacterial wilt resistance along with other quality and agronomic traits for hay, pasture and seed production in western Canada. (1989 – present)	
Orchardgrass breeding: develop cultivars with improved winter hardiness, nutritional quality and biomass production in western Canada. (1989 - present)	
Cicer milkvetch breeding: develop cultivars of this bloat free legume with improved seedling vigour, ability to tolerate grazing and yield in western Canada. (1989 - present)	
<b>Degrees / Certificates / Diplomas:</b> PhD.	<b>Institution:</b> University of Saskatchewan
<b>Publications and Patents:</b>	
# of Refereed papers: 68	Conference proceedings: 95
Relevant Patents obtained: 1	Other relevant citations: 118
<b>Other evidence of productivity during past 6 years:</b> (Point form, concise)	
Obtained research funds from AARI and CABIDF in Alberta.	
Obtained research funds from private companies and MII matching grants.	
Offered a course ABiology 5850, Plant Breeding@ through U of L	
Offered guest lecture in U of L and U of A courses.	
Advised graduate students and served in Graduate Student Advisory Committee	
Served as reviewer for funding agencies in Canada and Internationally	
Presented invited papers and seminars in Canadian and International Conferences	
<b>Acharya, S. N.</b> and Taylor, W. G. 2000. Enhancement of medicinal value of fenugreek: a review. Proceedings of the 8 <sup>th</sup> World Congress on Clinical Nutrition, Pitsanulok, Thailand. Dec. 17-20, 2000. (Invited paper)	
<b>Acharya, S. N.</b> 2001. Perennial cereal rye: a profile of traditional research in developing a new crop. Biodiversity. 2(4): 13-19. (Invited review)	
<b>Acharya, S. N.</b> 2002. A multi-disciplinary effort to improve medicinal value of fenugreek ( <i>Trigonella feonum-graecum</i> ). Proceedings of the 9 <sup>th</sup> World Congress on Clinical Nutrition, London, England, June 24-26, 2002. Invited Presentation	

<b>Signature:</b>	<b>Date:</b>
-------------------	--------------

The personal information being collected is subject to the provisions of the Freedom of Information and Protection of Privacy Act.

<b>Name:</b> Dr/Mr/Ms/Mrs.                      Last    King    First    Jane
--

<b>Position / Organization / Dept.:</b> Associate Professor/University of Alberta/Agricultural, Food and Nutritional Science
---

<b>Address:</b> Street /Box # 4-10 Agriculture Forestry Ctr University of Alberta	City Edmonton    Prov.    AB Postal Code T6G 2P5
---	---

<b>E-mail:</b> jane.king@ualberta.ca
--------------------------------------

<b>Phone:</b> (780) 492 4750	<b>Fax:</b> (780) 492 4265
------------------------------	----------------------------

<b>Past experience relevant to project:</b> (Point form, concise.)
--

Forage agronomy/physiology researcher teacher 16 years. 13 students have completed M.Sc. / PhD's under my supervision.

Previous grants have included Kura clover seed production and weed control 2002-2006 ACDIF/AARI, Kura clover for pastures 1999-2002 AARI, Berseem clover in mixtures with cereals for silage 1999-2002 AARI, Grass legume mixtures. 1997-2000 AARI, Annual clovers 1995-1998 AARI, Alfalfa for de-hy 1995-1998 AARI

<b>Degrees / Certificates / Diplomas:</b> B.Sc. Life Sciences <b>Institution:</b> University of Liverpool, England  B.Sc. Botany PhD Botany/Plant breeding
---

<b>Publications and Patents:</b> # of Refereed papers: 19 Relevant Patents obtained:	Conference proceedings: 13 Other relevant citations: 72
--	--



**Other evidence of productivity during past 6 years:** (Point form, concise)

- SM. Ross, **J.R. King**, J.T. O'Donovan and R.C. Izaurralde Interaction between clover and oats on a black soil in Alberta. **submitted** to Can J Plant Sci. August 2002
- D.R. Clements, D.E. Cole, S. Darbyshire, **J.R. King**, and A. McClay. The biology of Canadian weeds. 1 *Leucanthemum vulgare* Lam. **submitted** to the Biology of Canadian weeds. June 2002
- M.Sc. Thesis J.A. Walker 2002 The potential of Kura clover (*Trifolium ambiguum*) as a pasture legume for central Alberta. p.114
- Ross S.M., **J.R. King**, R.C. Izaurralde & J.T. O'Donovan (2001) Weed suppression by seven clover species. Agronomy J. 93 (4) 820-827
- D-H Min, **J.R. King**, D.A. Kim and H.W. Lee (2000) Stand density effects on herbage yield and forage quality of alfalfa. Asian-Australian Journal of Animal Science 13:7, 929-934
- D-H Min, **J.R. King** and D.A. Kim (1999) Effects of variety and stand density on plant morphology, winter survival, and cold hardiness of alfalfa. Journal of the Korean Society of Grassland Science 19:2 167-176.
- Baron V.S., A.C. Dick and **J.R. King** (1999) Leaf and stem mass characteristics of cool-season grasses grown in the Canadian Parkland. Agronomy J. 92:54-63
- King J.R.**, M.J. Hill and W.D. Willms (1998) Temperature effects on regrowth of three rough fescue species. Journal of Range Management 51:463-468.
- Willms W.D., **J.R. King** and J.F. Dormaar (1998) Weathering losses of forage species on the fescue grassland in southwestern Alberta. Can. J. Plant Sci. 78: 265-272
- King, J.R.**, Hill, M.J. and Willms W.D. (1995) Growth response of *Festuca altaica*, *Festuca hallii*, and *Festuca campestris* to temperature. Can. J. Bot. 73:1074-1080