Capturing Opportunities in Pulse Crops: Market Expansion through Crop Diversity

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Farming For the Future
On Farm Demonstration Project

Alberta Pulse Growers Commission - Zone 5

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Alberta Agricultural Research Institute
On-Farm Demonstration Program

Project Number:	**#2002NE04 and**
Project Name:	**"Capturing Opportunities in Pulse Crops: Market Expansion Through Crop Diversity"**
Project Coordinator:	**Mark Olson, Pulse specialist**
Project Cooperator:	**Alberta Pulse Growers Commission Zone 5**
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☐ **Progress Report** ☐ **Interim Report** ☒ **Final Report**

Year _____1_____ of _____3___ _ year project.
(1,2,3) (1^{st}, 2^{nd}, 3^{rd})

I. Key Results and Conclusions

In 2002, Killam was selected as the location for the **"**Capturing Opportunities in Pulse Crops: Market Expansion Through Crop Diversity" project location. The site was seeded on May 14, however, drought conditions appeared soon after crop emergence (early June) and no reliable data was gathered after this point. The Battle River Research Group(BRRG) had intentions of collecting harvest data, however, on August 28th, 240 head of cattle got into the Killam site overnight, and grazed it to the ground.

The agronomic traits, normally, measured are plant emergence, vine length, plant height, standability, maturity, 1000 kwt and yield.

II. Background:

Historically, pulse crops have shown significant industry and revenue growth potential when successfully introduced into Alberta. For instance, from 1986 to 2000, field peas demonstrated a production area increase of over 4000% (622,600 acres in 2000) and the current industry in Alberta is valued in the millions of dollars. While this represents a best case scenario for any crop our team might develop, the impressive potential of any new pulse crop introduced into Alberta must be recognized.

Very preliminary screening of small numbers of cultivars of lupins, soybean and other assorted annual grain legume species has been carried out in various parts of the province by CDC North and CDC South researchers.

Current grain legume research is on-going, but with limited focus on additional market classes. Limited screening of field pea types other than green and yellow cotyledon types has been carried out.

The Alberta Field Pea Breeding Program has now been established and is dedicated to identifying superior cultivars for Alberta conditions.

Over the last 5 years, a strong provincial team dedicated to contributing to growth in the Alberta pulse industry has been established. The team is now able to conduct targeted and concise market research, agronomic research, germplasm selection and breeding research and extension throughout Alberta.

The project outlined in this proposal is part of a provincial effort that provides a framework and process for integrating and expanding all the work described above while also exploiting the inherent

efficiencies that come with integration. Team members are also involved in Pulse Canada Research and coordinating efforts with numerous partner agencies.

III. Objectives:

1) Explore market types, market size and future market opportunities for a wide range of pulse crops not currently grown in Alberta. Using the above information, gather appropriate germplasm from institutions and other partners around the world.

2) Test the adaptability of the introduced germplasm and screen the most promising lines in different agro-climatic zones of the province with an emphasis on product quality and economic feasibility. Based on the data generated from this screening make further selections of appropriate material and conduct research into solving agronomic production problems that become evident during the screening process.

3)Create product awareness in the global industry by showcasing the production potential and product quality that is generated from this process. An integral part of this process will be extension to make growers and processors aware of the progress made.

IV. Project Plan or Method Used

Team members, in consultation with current partners and other industry players, will explore the potential of pulse species or classes not currently commercially produced in Alberta. For any potential new species or market type, team members will document the following where possible: 1) Global market size and location of demand, 2) Current suppliers to these markets, 3) Customer satisfaction with current suppliers, 4) Quality requirements of these markets, 5) Price requirements of these markets, 6) Future growth potential of these markets, 7) Possible alternative products for these markets and their growth potential, 8) Agroclimatic, trade or other barriers to entry to these markets and 9) Potential for Alberta based value-added processing to supply these markets.

Partners to be consulted while this research is proceeding include: Alberta Pulse Growers Commission (APG), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Institute for Tropical Agriculture (IITA), International Board for Plant Genetic Resources (IBPGR), International Soybean Program (INTSOY), Asian Vegetable Research and Development Centre (AVRDC), Australian Centre for International Agricultural Research (ACIAR), United States Department of Agriculture (USDA), Pulse Canada, Crop Development Centre – Saskatoon, and a number of contacts in the domestic and international pulse processing and marketing industry. This process will serve to sort germplasm for trial based on agroclimatic suitability and market opportunity within Alberta.

Screening trials will be conducted in each agroclimatic zone of Alberta to assess the suitability of the material collected using the methodology outlined below. This OFD application is intended to support **one research site within NE Alberta for the next 3 years.**

i)Treatments: The trial had (7) different species with a number of varieties within in each totalling (16) treatments. Lathyrus or grasspea (*Lathyrus sativus L.*), fenugreek ((*Trigonella foenum-graecum*), lupin (*Lupinus angustifolia L.*), soybean (*Glycine max L.),* lentil (*Lens culinaris* Medikus), fababean (*Vicia faba)* and field pea(*Pisum sativum*)(check) were seeded at the site on May 14. Very little weed growth occurred at this site, thus, the plots were hand weeded (June 12 and 27). Blister beetles attacked the fababeans and lupins;an application of Sevin(carbaryl) was made to preserve the plots.

Table. 1 Crops and expected plant populations

Crop	Cultivars/lines	Expected plant population/ m^2	Number of seeds/plot ($7.6m^2$)
Fababean (*Vicia faba* L.)	Earlibird	44	365
	CDC Fathima	44	365
	CDC Blitz	44	365
Fieldpeas (*Pisum sativum* L.)	Swing	90	760
	Performance 4010	100	836
Fenugreek (*Trigonella foenum- graecum* L.)	F 86	120	1000
	F 70	120	1000
Lathyrus – Chickling Vetch (*Lathyrus sativum* L.)	X 850002	100	836
Lentil (*Lens culinaris L.*)	Redwing	110	920
	Crimson	110	920
	CDC Milestone	110	920
Lupin (*Lupin angustifolia* L.)	G 12-1	100	836
	E 2-2	100	836
Soybean (*Glycine max* L. Merr.)	AC Orford	50	418
	Gentleman	50	418

ii) Replications: Each trial was conducted as a three replicate randomized complete block design in order to statistically analyse yield results. Other agronomic characteristics, monitored were plant height, vine length, maturity, 1000 kwt, standability and yield.

The varieties were seeded according to proper agronomic practises including PKS blanket application, granular inoculant, and proper weed control. For those species that did not have commercial inoculant available, soil fertility levels were target at N=150 kg/ha, P2O5=40kg/ha and S=12kg/ha.

iii) Plot Size/# Annual Per Rep: Each sub plot was four rows with a plot length of 7.0 m X 1.08 m (18cm spacing).

iv) Experimental Design: The project was conducted as three replicate randomized complete block.

a) all subplots were 4 rows x 7.0 m length.

V. Data Collected and Analysis

i) Climate Information:

v) Climate Information:

Growing Season Precipitation (mm)**

	May	June	July	August	Total	30 year (aver)
Killam	2.6	6.6	18.0	53.0	59.2	265.2

Growing Degree Days Above 5C**

	May	June	July	August	Total	30 year (aver)
Killam	147.3	359.9	442.4	326.8	1276.4	1203.6

** Unverified data from Environment Canada.

This information does not reflect environmental conditions prior to seeding and post harvest. The fall/winter of 2001/2002 and spring of 2002 was very dry in Alberta and Western Canada. The total growing season precipitation was 22% of the 30 year average for Killam and growing degree days for Killam was 106 % of the 30 year average. The distribution of precipitation and amount of water in the various rainfall events paint a better picture of the 2002 growing season. In May, precipitation and temperatures were well below last year and the 30 year average. June and July were much hotter than usual; pulse crops in general are adversely affected by temperature above 25°C. The rain received in August was too late to have any positive effects on crop growth and final yield.

ii) Seeding: Killam was seeded on May 14th.

VI. Discussion of Results:

The site was seeded on May 14, however, drought conditions appeared soon after crop emergence (early June) and no reliable data was gathered after this point. The Battle River Research Group(BRRG) had intentions of collecting harvest data, however, on August 28th, 240 head of cattle got into the Killam site overnight, and grazed it to the ground. The following is a brief description of the crop species tested in 2002.

i)Description of Crop Species Tested

Lentil

The primary market classes of lentil are the Chilean (large seed size, 60-70 grams or higher per 1000 seeds) and the Persian(small seed size, 30-40 grams per 1000 seeds). Other niche markets include red split lentil, zero tannin lentil, Spanish green, and small black (Indian Head) used primarily for green manure plowdown. Seed coat colors range from clear to green, brown, grey, blotched purple or black. Lentil is self pollinating. Early maturing varieties flowers at the 11^{th} or 12^{th} node and later maturing varieties at the 13^{th} or 14^{th}. Flowers appear in clusters of two or three at the base of the upper leaves, and flowering will be delayed in high moisture and high fertility conditions. The lentil plant usually has two or more secondary branches rising from the main stem. The majority of the crop yields comes from branches from the uppermost nodes of the main stem, below the first flower node. Seed pods are less than an inch in length and contain one to two seeds. Seeds are lens-shaped with a range of cotyledon colors-yellow, red or green (Park et al. 1999.pp 105-106).

Fababean

Fababean are traditional crop in Europe, Africa, the Middle East and Asia. Recent trends have been towards a large seeded fababean. Varieties with seed sizes in the range of 500-700 grams per 1000 seeds are preferred types for the human edible market. For livestock feed, fababean is used as a protein supplement as the seed has a crude protein content of approximately 28 per cent. The recent development of zero tannin varieties, shows promise the feeding of monogastric species such as swine. In addition, to be in low in tannins(tannins have anti-nutritional properties for monogastrics), the zero tannin varieties have 15 per cent more useable energy. Fababean is a cool season crop, which prefers cool moist growing conditions. It is best adapted to the irrigated area of southern Alberta and portions of the black soil zone with longer frost-free periods. Fababean is an annual plant with coarse, upright unbranched stems, 1 to 2 metres tall with one or more hollow stems coming from the base. Fababean is the highest nitrogen fixer of all the legumes (Park et al. 1999.pp 123-124).

Fenugreek

Fenugreek is native to an area extending from Iran to northern India, but is now widely cultivated elsewhere, including China, North and East Africa, Ukraine and Greece. The principle use of fenugreek is for curry powder. Some seed is used in pharmaceuticals, particularly as a source of steroids. Egypt uses fenugreek seeds for medicinal purpose, roasts the seed for coffee and consumes the sprouted seed and fresh leaves. Derivatives are used to flavor imitation maple a syrup, vanilla compositions, rum and butterscotch. It is also being researched for its' forage value and ability to fix nitrogen. Fenugreek is annual herb of the legume family. Fenugreek leaves are alternate and consist of three ovate leaflets. White flowers appear in early summer and develop into long slender green pods-60cm(2ft.)stalks almost ide the pea shaped flowers. Mature brown pods contain up to 20 small yellow seeds (Park et al. 1999.pp 144-145).

Lupins

Lupin has been used in agriculture for thousands of years. Prior to the 1920's usefulness of these types was limited by the high alkaloid content of the grain. Between 1928 and 1943, German plant breeding efforts produced low alkaloid lines. To date, the main use for lupin is in livestock rations. The lupin grain contains approximately 28 per cent crude protein. Lupin is an erect, self supporting, herbaceous to woody annual ranging in height from 20 to 150 cm tall when mature. Lupin leaves are compound, comprising between five and eleven leaflets. Lupin typically develops a robust tap root, from which numerous (relatively thick) lateral roots arise). Pods vary in length from 35 to 150 mm, depending on the species. Lupin is a long day plant, and many genotypes are responsive to cold-induced dormancy.

Lupin has a growing season requirement of between 120 and 150 days, which severely limits production in traditional cool season pulse production areas of the province (Park et al. 1999.pp 147,148). In 2002, lupin types were brought in from Denmark and preliminary evaluation of these types look promising.

Lathyrus

Lathyrus (also called grasspea) originated in southwest and central Asia. It is a high protein grain legume and is an important food crop in Asia and the Middle East where the whole seed is used in soups and ground to make unleavened bread. In Canada uses would be for high protein livestock feed and as a green manure crop or cover crop.Lathyrus has the ability to fix nitrogen under very dry conditions. AC Greenfix is a registered lathyrus variety in Canada. Grasspea is very drought tolerant and the plant likes temperatures of 10 to 25C. It ripens over a four to six months period.The main drawback for lathyrus is it contains neurotoxins that affect the nervous system and causes a disease called lathyrism – it usually shows up if it makes up 30% or more of the diet for three or four months. (Park et al. 1999.pp 145-146).

Soybean

Soybean is not a true pulse crop, as the cultivated form has never been found in the wild However, the sub genus has been found in China, and adjacent areas of the old Soviet Union. Europeans became aware of the crop around the late 17th century and it moved into the US around the mid 1800s Soybean dominates world oilseed production. A large variety of foods are derived from fermented and non fermented soybean. Fermented products are; soy sauce, sufu (soybean cheese), tempeh(soybean cake originating in Indonesia) and natto(Japanese food made from whole fermented soybean). Non fermented are tofu (soya milk curd used in Japan and China). Soybean is also used in margarines, shortening, salad oil, paints, varnishes, printing ink, and soap. Virtually all soybean is grown south of 36 degree N. Germination occurs when air temperature of 25 to 30C occurs over 3-4 days. Highest yields are obtained when the entire growth cycle occurs above 18C. This crop does need high moisture and it's highest potential is probably under irrigation but would competing with dry beans in Alberta. (Park et al. 1999.pp 148-149).

ii) Research results

a) Emergence

The desired plant population is; for lentil10/ft^2(108/m^2), fababean 4/ft^2 (40/m^2), fenugreek 5.5 /ft^2 (58/m^2), lupin 9 ft^2 (100/m^2), lathyrus 9 ft^2 (100/m^2), and field pea 8(90/ m^2).The emergence and plant populations at all locations in 2002 were more than adequate in Killam.

b) Maturity

Maturity is part of the agronomic equation for farmers evaluating new crops for diversification potential. Lentil, fenugreek, fababean, lupin, and soybean all have long season growing requirements in comparison to many traditionally grown crops such as field pea.

The Alberta provincial database indicates a range in days to maturity for each of the crops as follows; Chilean lentil (111days), Persian lentil (104 days), fababean (115-120 days), fenugreek(115 days) lupin (N/A), lathyrus(N/A) and field pea(96 days).

VII. Conclusions

The drought of 2002 devastated the plots at Killam. No meaningful information was obtained in 2002.

VIII. Extension Activities

A field day at Killam was attended by approximately two dozen growers on July 30/2002.

IX. Recommendations/Acknowledgments

No recommendations from the 2002 trial can be made. A further three years of research is required before any definitive statements, on pulse crop diversification should be made.

The directors of APGC Zone 5 and the project coordinator (Mark Olson took over the reigns for Terry Buss) would like to thank the On Farm Demonstration Committee NorthEast Region for their support of pulse projects.

Last, a special thanks to our farmer cooperator; Darrel Holmstrom. His assistance and donation of their land for research purpose is greatly appreciated.

X. References:

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