SOYBEANS: NEW CROP FOR THE PEACE REGION

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ABSTRACT
Soybeans are an attractive alternative crop, with established and rising markets, as well as soil benefits. They have not yet been fully adapted to the unique growing conditions of the Peace River Region. The objective of this project was to look at some of the new cold-tolerant lines and establish how the beans reacts under Peace River region growing conditions, with the goal of finding a variety to produce 20 bushels per acre. Unfortunately, this goal was not met, however in the last year of the study, promising techniques were discovered. By planting the soybeans early and shallow, the plant grew well, producing more pods per node with more seeds then previously seen. It must be stated that the data collected in this trial is termed inconclusive due to inconsistent raw data collection and a high Coefficient of Variation; therefore all views discussed are based on trends observed.

INTRODUCTION

Soybeans have become an excellent source of nutrition; humans use the oil content while animals utilize the oil extraction byproduct, the meal. The meal is used largely for poultry and swine nutrition to balance amino acid intakes. The BC Peace Region has two major markets that would initially be focused on: southern BC poultry market, as well as the overseas human consumption market, namely in Japan.

Soybeans, being a legume crop, have proven to benefit proceeding crops as well as offer lower input costs. Legumes are able to satisfy much of their nitrogen requirements through a symbiotic relationship with nitrogen-fixing bacteria, thus reducing the need to fertilize. Therefore, soybeans benefit not only the producer but the land as well.

The traditional soybeans are of an indeterminate type, being night-length sensitive and therefore not suitable for the short nights of the Peace River region. Determinant type soybeans are now available, which are not affected by the night-length making them a possibility for this area. One challenge that will need to be addressed is that soybeans cultivated at high latitudes, such as in the Peace River region, can suffer from above freezing low temperatures. This chilling stress normally retards growth, may cause abortion of the flowers and

immature pods, resulting in a reduced final seed yield (Raper and Kramer, 1987). The limiting factors for soybean growth in the Peace River region are the long day-length and the cool northern temperatures. Therefore the term cold tolerance is an improved description, as further investigation shows that the term determinate does not cover all these factors.

Dr. Elroy Cober of the Eastern Cereal and Oilseed Research Centre (ECORC) has been involved in developing cold tolerant short-season soybean cultivars, adapted to a cooler climate region. It is possible that the same genes and selection process used to develop cultivars for the short-seasoned zones of Eastern Canada may prove helpful for the Peace River region.

The Manitoba Pulse Growers Association enlisted Dr. Cober between 1998-2000 inclusively, to execute a similar search to find a soybean to survive in their climate. Only one line, OT99-08, proved to suit the Manitoba environment out of approximately 25 lines in a COOP test, 20 lines in an early elite test, as well as approximately 50 lines in an oilseed screening test. Their data showed the range of maturity to be from 118 to 138 days, with only a small portion maturing at 120 days. All of which suffered from a lower seed yield then the later maturing lines (MacNair, 2001). It is impossible to extrapolate directly the maturity claims from Manitoba to the Peace River Region. However, it is assumed that due to the more northern latitude of the Peace Region, finding success will be that much more challenging. The Manitoba Pulse Grower Association in December 2001 concluded for its region “It remains a challenge to develop early maturing and high yield varieties” (MacNair, 2001).

For many of the same reasons, the BC Grain Producers also asked for Dr. Cober’s assistance, along with other organizations in Easter Canada working to a similar end, to provide soybean lines to try in the Peace River Region. This project will first establish how the bean reacts to the long day-lengths, cool temperatures and short growing season. The goal is then to find a variety capable of producing at least 20 bushels per acre, the believed amount needed to attain a profit in the Peace River region. If this is successful, an interested

breeder will be asked to assist in furthering the project, to develop a high quality clear hilum short-season bean for the human consumption market.

MATERIALS AND METHODS

Two farm sites are used to collect data: the first is located in the South Peace at Dawson Creek, the other is in the North Peace at Fort St. John. The sites are kept as identical as possible and are treated equally throughout the season. Plots are planted, maintained, analyzed and harvested according to proper research protocol.

All varieties were planted at 50 viable seeds per meter squared according to other short-seasoned regions using a narrow-row seeding schedule. The planting depth was kept less than one inch deep to compensate for slow growth particularly in the spring. Soybean granular inoculant was placed with the seed in appropriate fashion at plant. Planting was delayed until mid-May, except for the 2006 season where planting occurred as early as ground conditions allowed: the same time-frame as that for field peas. Physiological maturity is classified by the percentage of leaves dropped: 80 percent equals maturity.

Herbicides used included bentazon plus surfactant for broadleaf control and sethoxydim plus surfactant for grass control; applied separately at appropriate growth stages. Weed control was a constant challenge with the slow growth of the bean and the vigorous growth of adapted weed species that often did not correspond to the desired application windows suggested by product label. Therefore, hand weeding often followed pesticide applications for the larger weeds, which escaped. Other herbicides were not considered due to: the known crop delay potentials, not easily accessible for local producers and soil residue concerns potentially affecting succeeding locally popular crops.

RESULTS AND DISCUSSION

Seedlings took longer than normal to break through the soil surface and produce expanded cotyledon leaves; this is in large part due to the heavy clay soils and cooler soil temperatures in the Peace. Once the first set of monocot leaves were established, the plants seemed to develop good and steady growth habits. The exception of this occurred during extreme drought conditions occurring at this stage, as witnessed at the Dawson Creek site in 2006. Planting shallow proved to keep this slow emergence issue at a minimum.

Planting was deliberately delayed until mid-May, as it was believed that the bean would suffer severely from common light late-spring frosts. 2005 voluntary soybeans emerged and were at the first trifoliate stage when the 2005 crop was being planted. An early snowfall in the fall of 2004 prevented the harvest of the beans, then a light cultivation in the spring of 2005 provided shallow planting for these voluntary beans. Light spring frosts, post-emergence are actually handled quite well: the plants droop their leaves, protecting the stem surface from frozen droplets. It is assumed that a heavy frost would kill the seedling, there is less risk replanting a crop than losing one during harvest. In the spring of 2006, soybeans were planted as soon as the soil conditions allowed and grew well all season long.

The flowering period is another issue soybeans in the Peace River region must overcome. Dr. Cober stated that the cool single-digit night temperatures that often occur in the Peace in late July and early August cause the soybean plants to abort their flowers or early seed development in a young pod. In the early years of this study, it was noted that instead of the expected three or four pods developing per node only one or two would develop. These pods were also only producing one or two seeds rather then three or four. In 2006 however, both sites had two to three pods per node develop, with two to four seeds per pod as seen in Figure 1 below. This is believed to be the direct result of earlier crop development.

Figure 1. Fort St. John 2006 Soybean Performance Test

Note some pruning by ungulates already present.

Table 1. 2002 - 2006 Soybean Yield Results

		Fort St. John, 2006	Dawson Creek, 2005		Dawson Creek, 2004		Fort St. John, 2003		Dawson Creek, 2002	
Entry		Yield Rating	Dry Yield	Dry Yield	Dry Yield	Dry Yield	Dry Yield	Dry Yield	Dry Yield	Dry Yield
Name	No.	1-3 scale, 1=good 2=fair, 3=poor	kg/ha	bu/ac	kg/ha	bu/ac	kg/ha	bu/ac	kg/ha	bu/ac
OAC Vision	1	1c	369.8cd	5.5cd	317.7bc	4.7bc	--	--	--	--
Apollo RR	2	1c	526.4b	7.8b	566.5a	8.4a	--	--	--	--
Klaxon	3	1.67bc	263.4def	3.9def	318.3bc	4.7bc	--	--	--	--
Aquilon	4	1.67bc	164.4fg	2.4fg	111.0d	1.7d	--	--	--	--
Gentleman	5	1c	221.6ef	3.3ef	295.6bc	4.4bc	--	--	--	--
Medallion	6	1c	274def	4.1def	210.2cd	3.1cd	467.96b	6.96b	140.19c	2.08c
Gailard	7	1.33bc	630a	9.4a	550.9a	8.2a	--	--	--	--
Altesse	8	1c	303.7de	4.5de	436.2ab	6.5ab	--	--	--	--
90A01	9	2.33ab	446.2bc	6.6bc	525.5a	7.8a	--	--	--	--
OT94-43	10	2.83a	329.1cde	4.9cde	339.8bc	5.1bc	--	--	--	--
Alta	11	1c	304.6de	4.5de	430.5ab	6.4ab	578.44ab	8.6ab	306.09ab	4.55ab
Maple Presto	12	2abc	452.8bc	6.7bc	284.8bc	4.2bc	479.31b	7.13b	312.56a	4.65a
Maple Ridge	13	2.33ab	350cde	5.2cde	456.5ab	6.8ab	583.2ab	8.67ab	348.14a	5.18a
Costaud	14	--	27.5h	0.4h	158.9cd	2.4cd	--	--	--	--
OT98-19	15	--	238.6def	3.5def	341.6bc	5.1bc	--	--	--	--
PR46806	16	--	75.5gh	1.1gh	452.3ab	6.7ab	--	--	--	--
OTR00-15	17	2.33ab	--	--	287.0bc	4.3bc	679.65a	10.11a	345.09a	5.13a
OT98-17	18	2.33ab	--	--	182.1cd	2.7cd	--	--		
Maple Presto VE	19	--	--	--	--	--	558.9ab	8.31ab	355.29a	5.28a
Maple Presto VRgrey	20	--	--	--	--	--	606.67a	9.02a		
Har-e?e3e4dt1	21	--	--	--	--	--	474.4b	7.1b	250.05b	3.72b
Accord	22	--	--	--	--	--	--	--	0d	0d
Maple Presto VRt	23	--	--	--	--	--	--	--	329.81a	4.9a
OT99-8	24	--	--	--	--	--	--	--	185.15c	2.75c
OAC Klondike	25	--	--	--	--	--	--	--	57.01d	0.85d
OAC Prudence	26	--	--	--	--	--	--	--	0d	0d
Terr-Natto	27	--	--	--	--	--	--	--	0d	0d
GG-469	28	--	--	--	--	--	--	--	0d	0d
Chernyatka	29	--	--	--	--	--	--	--	0d	0d
LSD (P=.05)		0.684	90.77	1.35	118.33	1.76	126.912	1.887	59.616	0.886
Standard Deviation		0.409	63.52	0.94	83.67	1.24	86.289	1.283	41.717	0.62
CV		24.72	20.42	20.42	24.04	24.04	15.59	15.59	23.8	23.8
Treatment Prob(F)		0.0001	0.0001	0.0001	0.0001	0.0001	0.0233	0.0233	0.0001	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

All CV values for yield data, whether it be "Visual Yield Rating" as in 2006 or as bu/ac dry yield, are above normal acceptable levels for yield dataset, (greater than 15%) but data is presented here in order to give disclosure of data found for this project.

Trials effected by either wildlife damage or weather-related conditions, such as early snowfall, are not included in this dataset.

Some seed sources were not available every year for testing or were dropped after an initial evaluation, usually as no seed was produced.

As noted in the Table 1 above, the yields have proven to be low. It is believed that due to the early planting technique used in 2006, the yields would have been close to reaching the stated goal of 20 bushels per acre. This is based upon field data collected prior to harvest that took into account the number of pods per node and the seed set per pod at the time of assessment. The assessment was recorded using a scale from these visual criteria and was the first to represent data from an early planting. Unfortunately, ungulates damaged the trials beyond use by harvest and so grain samples were not possible to back up visual data. A regrettable setback as this was the last year of testing for this particular project. The highest yields from 2002-2005 were between seven and ten bushels per acre. This is only half of the stated goal and therefore, not an attractive alternative crop choice for the Peace River region. However, the early planting regime seen in 2006 did indicate good yield potential, thus further research using the early planting technique is likely needed.

Maturity has proven to be well over 120 days; any crop that takes this long to mature in the Peace region is at high risk of being lost. See Table 2. Regrettably data from Dawson Creek 2003 and Fort St. John 2002, 2004 and 2006 was not obtained due to the arrival of the first killing frost, early snowfall or damage from ungulates. As soybeans are late maturing, this first frost comes early and is therefore detrimental. Maturities in 2006 were considerably earlier, even with the lack of moisture.

Table 2. 2002 - 2006 Soybean Maturity Results

		Fort St. John, 2006	Fort St. John, 2003
Entry		Maturity	Maturity
Name	No.	days to	days to
OAC Vision	1	122.3b	--
Apollo RR	2	128.7b	--
Klaxon	3	147a	--
Aquilon	4	126.3b	--
Gentleman	5	127.3b	--
Medallion	6	129.7b	129a
Gaillard	7	124.3b	--
Altesse	8	128.3b	--
90A01	9	123b	--
OT94-43	10	122.3b	--
Alta	11	124b	127.5a
Maple Presto	12	123.3b	121.5bc
Maple Ridge	13	123b	122.25bc
Costaud	14	--	--
OT98-19	15	--	--
PR46806	16	--	--
OTR00-15	17	124b	120.75cd
OT98-17	18	103.7c	--
Maple Presto VE	19	--	117e
Maple Presto VRgrey	20	--	118.5de
Har-e?e3e4dt1	21	--	123.75b
Accord	22	--	--
Maple Presto VRt	23	--	--
OT99-8	24	--	--
OAC Klondike	25	--	--
OAC Prudence	26	--	--
Terr-Natto	27	--	--
GG-469	28	--	--
Chernyatka	29	--	--
LSD (P=.05)		4.47	2.53
Standard Deviation		2.68	1.72
CV		2.14	1.4
Bartlett's X2		28.871	
P(Bartlett's X2)		0.007	
Replicate F		0.431	0.348
Replicate Prob(F)		0.6539	0.7907
Treatment F		30.518	23.009
Treatment Prob(F)		0.0001	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)
Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.
Trials effected by either wildlife damage or weather-related conditions, such as early snowfall or an early killing frost in autumn that inhibited collection of maturity data, are not included in this dataset.
Some seed sources were not available every year for testing or were dropped after an initial evaluation, usually as no seed was produced.

Table 3. 2002 - 2006 Soybean Height Results

		Fort St. John 2006	Dawson Creek 2004	Fort St. John 2003	Dawson Creek 2002
Entry		Height	Height	Height	Height
Name	No.	cm	cm	cm	cm
OAC Vision	1	38.3bc	65a	--	--
Apollo RR	2	36.7bc	57.5bc	--	--
Klaxon	3	33.3b-e	52.5b-e	--	--
Aquilon	4	46.7a	56.3bcd	--	--
Gentleman	5	38.3bc	55b-e	--	--
Medallion	6	40b	52.5b-e	45.0c	48.8cd
Gaillard	7	35bcd	55b-e	--	--
Altesse	8	40b	60b	--	--
90A01	9	28e	48.8def	--	--
OT94-43	10	27.3e	45f	--	--
Alta	11	36.7bc	66.3a	62.5a	53.8bc
Maple Presto	12	35bcd	57.5bc	55.0ab	48.8cd
Maple Ridge	13	33.3b-e	53.8b-e	50.0bc	45.0def
Costaud	14	--	55b-e	--	--
OT98-19	15	--	50c-f	--	--
PR46806	16	--	51.3c-f	--	--
OTR00-15	17	29de	47.5ef	47.5bc	40.0fg
OT98-17	18	31.7cde	48.8def	--	--
Maple Presto VE	19	--	--	50.0bc	43.8def
Maple Presto VRgrey	20	--	--	50.0bc	--
Har-e?e3e4dt1	21	--	--	52.5bc	37.5g
Accord	22	--	--	--	63.8a
Maple Presto VRt	23	--	--	--	47.5d
OT99-8	24	--	--	--	46.3de
OAC Klondike	25	--	--	--	45.0def
OAC Prudence	26	--	--	--	56.3b
Terr-Natto	27	--	--	--	41.3efg
GG-469	28	--	--	--	46.3de
Chernyatka	29	--	--	--	56.3b
LSD (P=.05)		4.39	4.61	9.415	5.016
Standard Deviation		2.63	3.26	3.981	3.51
CV		7.45	6	7.72	7.31
Bartlett's X2		2.984	8.709		
P(Bartlett's X2)		0.991	0.925		
Replicate F		1.066	12.423	4.831	1.894
Replicate Prob(F)		0.3581	0.0001	0.0639	0.1453
Treatment F		11.581	12.062	3.592	15.783
Treatment Prob(F)		0.0001	0.0001	0.0567	0.0001

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL

Trials effected by either wildlife damage or weather-related conditions, such as early snowfall, are not included in this dataset.

Some seed sources were not available every year for testing or were dropped after an initial evaluation, usually as no seed was produced.

The varieties deemed most promising as assessed from all field notes, height data (see Table 3), maturity data, and yield would include: OAC Vision, Apollo RR, Altesse and Gaillard. There were other lines that showed potential in one or more areas however they were not as consistent in all the characteristics as the ones listed above.

Apollo RR is of particular interest as it is a glyphosate-tolerant cold tolerant variety. This would be beneficial for growers, but may hinder the availability of the overseas market.

An unexpected challenge was discovered during this study; soybeans seem to be a preferred food source by ungulates in high wildlife density areas. This issue may prove to be more of a demise for this alternative crop than that of the cool temperatures. In order for a high value crop, such as the soybeans, to be a viable option for Peace River region producers, wildlife numbers will have to be lowered.

Field notes taken in August 2006, suggested the following lines to be the most promising: OAC Vision, Apollo RR, Altesse, Gentleman, Medallion, Alta and Gaillard. From the previous years, the following lines appear to be consistently higher yielding: Gaillard, OAC Vision, Apollo RR, 90A01, Alta and Altesse. There were definite lines, which did not take to the early planting, likely due to the cooler soil conditions. However, data collection under this early planting regime is limited to one year and cannot be backed by actual dry yield data**.**

CONCLUSION

The data collected for this trial is termed inconclusive due to the lack of consistent raw data obtained as well as a high Coefficient of Variation for yield. The inconsistency of data is due to: killing frosts, early snowfall and ungulate damage. Therefore, the discussions and conclusions made in this report are based on trends witnessed in the results.

It seems that the ideal situation for the Peace River region is to gain as much crop development as early as possible. According to the results seen in 2006, this can be achieved through planting the seeds shallow and as soon as soil

conditions allow: when the weather is warm and the nights are shorter. Further studies would be required to obtain conclusive results and hopefully meet the goal of producing 20 bushels per acre.

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