

YUKON AGRICULTURE



RESEARCH and DEMONSTRATION 2010 PROGRESS REPORT

EXECUTIVE SUMMARY

In 2010, the Agriculture Branch's research and demonstration program included a forage demonstration of various grasses and legumes, and trials on wheat, oat and pea varieties, soil amendments, and raspberry inputs.

The 2010 growing season temperature was average to above average across Yukon, with an above average season in central Yukon. Precipitation in the Whitehorse area was normal with very little precipitation in May and a total of 176 mm over the growing season.

Wheat, oat and pea trials continued in 2010 to explore different management practices and new varieties. Wheat yields in central Yukon were much greater and of superior quality than the wheat grown in the Whitehorse area. Yields of 4 T/ha are achievable in central Yukon. AC Mustang oats continue to be a strong performer in Yukon. When compared against some newer varieties suitable for the North, yields are similar. Some very high yields were recorded with Murphy seed yields of over 7 T/ha. Pea seed yields and quality were substantially better in central Yukon than in the Whitehorse area. Pea seed yield of over 4 T/ha was recorded under irrigation in central Yukon.

A new trial examining soil amendments, fertilizers, compost and lime incorporated into the Research Farm site. In the first year, the control, with easily available synthetic nitrogen, yielded double the nearest treatment with yields of 800 g/m².

The raspberry orchard assessment continued to evaluate input management and the economics of production. Raspberry production was much improved over 2009 with over 130kg/1,000m² (1/10 ha).

PREFACE

This document is a record of agricultural demonstrations and studies conducted in Yukon. This is a yearly publication of new and accumulated information set out to assist growers and researchers with future endeavors related to northern agriculture.

The target audience for this publication is commercial agriculture producers, growers and those interested in northern agronomic research.

ACKNOWLEDGEMENTS

The Yukon Agriculture Branch would like to thank all of the agricultural producers who participated and contributed with site location, data collection and field monitoring. Recognition is also extended to the Forest Management Branch and the Department of Energy, Mines and Resources. In addition, the Agriculture Branch would like to thank Clair Langlois (BC Grain Producers Association), Krystal Reaume and Alicia Vainio (Agriculture Branch summer students), and all the raspberry pickers.

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TABLE OF CONTENTS

1.0 INTRODUCTION	4
2.0 WHEAT	10
3.0 OAT VARIETY TRIAL	13
4.0 FIELD PEA VARIETY TRIAL	16
5.0 RASPBERRY MANAGEMENT AND PRODUCTION.....	19
6.0 NORTHERN SOIL AMENDMENTS	22
7.0 FORAGE DEMONSTRATION	27

1.0 INTRODUCTION

The Yukon Government, Agriculture Branch began conducting its own research in co-operation with industry in the 1980s. In 1988, the Yukon government established a small research farm at the Gunnar Nilsson and Mickey Lammers Research Forest allowing for additional controlled research. Projects are ongoing in partnership with industry in south and central Yukon. The co-operation with industry takes advantage of on-farm expertise and site variation, providing insight into the diversity and the potential that exist in different Yukon regions.

The research and demonstration reports enhance the knowledge base of agriculture north of 60° and support the development of a sustainable Yukon agriculture industry.

The research and demonstrations reported in this document include:

- Oat, wheat and pea variety trials;
- Soil amendment trial utilizing city compost; and
- Raspberry input management and economics of production trial.

Agriculture Regions

Yukon agriculture has been divided into four defined agricultural regions:

- Whitehorse
- Central Yukon
- Haines Junction
- Watson Lake

These agriculture areas are a result of either climate and/or current and past agriculture activities.

The Whitehorse and surrounding area accounts for a majority of Yukon agricultural activity. This region is composed of the Takhini River valley and Yukon River valley between Marsh Lake and Lake Laberge.

The central Yukon region is the largest area of the agriculture regions and is recognized for having the warmest growing season. The region is also historically one of the first areas in Yukon developed into agriculture because of demand for fresh food from the influx of miners at the turn of the 20th century. The central Yukon agricultural region lies in Yukon, Pelly, Stewart and McQuesten river valleys stretching from Carmacks to Dawson and includes Pelly and Mayo.

The Yukon government research and demonstration projects are located within the Whitehorse and central Yukon regions.

The Haines Junction region has a cool growing season and high incidence of frosts. It has been identified as an agriculture region because historically it was home to an Agriculture Canada Research station from 1944 to 1968 and is considered to have a strong, growing agriculture community with the addition of the Marshall Creek agriculture subdivision.

The Watson Lake region has warm continental temperatures and receives more precipitation than the other regions. The area has been identified to have an enhanced agriculture potential and currently has a stable agriculture industry.

There is currently no field research being conducted by the Agriculture Branch in the Haines Junction and Watson Lake agriculture areas.

Site Descriptions

The bulk of the research and demonstration projects are conducted in the Whitehorse area at the Agriculture Branch Research Farm (identified as site RF). In 2010, the Research Farm supported forage demonstrations, a raspberry orchard production assessment, irrigated and dryland oat and pea variety trials, wheat variety and management trials, and vegetable crops grown under various soil amendments. This site is located in the Gunnar Nilsson and Mickey Lammers Research Forest located at the junction of the Yukon and Takhini River valleys. The research site is two hectares surrounded by Lodgepole pine and embedded in soils that are typical of those encountered at many farms in the southwest region of Yukon. The forest provides shelter from winds, but consequently creates a frost pocket. The soil, landscape and climatic properties of the site are typical of the farms in this region of Yukon. The area was cleared of willow, aspen, spruce, lodgepole pine, soapberry, and bearberry in 1987 and has been worked intensively for a variety of research projects since. The soil texture is silty loam to fine loamy sand and moderately well to well drained; pH is 7.0 with organic matter levels around 2%.

A field location near Whitehorse has been involved in various research trials since 2006 thanks to Steve and Bonnie MacKenzie and their continued support. Site SM at the MacKenzie's Yukon Grain Farm was the location for a second Whitehorse area oat evaluation this year. Site SM is located in the Yukon River valley, near the southern tip of Lake Laberge. This site is located within the warmest summer micro-climate in the Whitehorse area. The field experiments were located on a corner of a large 50 ha field. The soils in the area are a range of medium to coarse loamy sand to sand which is moderately well to rapidly drained; pH is around 7.2 and organic matter is between 2-3%.

Research and demonstration was also conducted in central Yukon at McCabe Creek, site MC. This site is within the central Yukon climatic region and provides research results that are applicable for farms near Dawson and Mayo. Research was conducted at McCabe Creek in the 1990s and in 2009 the Agriculture Branch re-established the site at Cathy and Jerry Kruse's farm. The site was involved in the forage demonstrations, oat, wheat, and pea trials and was split up to evaluate irrigated and non-irrigated trials. The site is located on the east side of the Yukon River, on the north side of a large hay field providing excellent solar radiation and frost drainage. The soils in the area are fine sandy loam to silt loams which are moderately well drained; pH is around 7.5 and organic matter levels are around 2%.

Climate Monitoring

Climate is the major limiting factor for agriculture in Yukon. Yukon has a short growing season, frost can occur at any time and there is less than ideal precipitation. The 2010 growing season was just about average compared to the last 10 years. Table 1.2 shows the 2010 climate summaries and ten year average.

Climate data is collected from meteorological stations operated by Environment Canada (EC) and the Yukon government (YG) and from portable weather stations in the four regions to better understand the diverse weather patterns and the season-to-season variability in growing conditions. The multitude of information from climate monitoring can provide growing season analysis for both producers and research projects.

The climate data from the past growing season is collected and used to calculate agroclimatic capability. The agroclimatic capability is a measure of the degree of limitation imposed by climate on agricultural production and a measure of the amount of heat available to crops during the growing season. The agroclimatic capability is modified to account for local climate patterns, such as killing frost (-2.2°C), daily average temperature and day length. Table 1.1 defines the agroclimatic classes from Class 1 (no restrictions) to Class 6 (severe limitations for cultivated agriculture). The agroclimatic capability is based on Growing Degree Days (GDD), which are calculated using the average daily temperature minus a basic mean temperature of 5°C required for cool season crop growth. For example, if the daily mean temperature is 10°C , the GDD total is 5. Similarly if the daily mean temperature is 16°C , GDD equals 11. However, in the instance that an average temperature is 5°C or lower, GDD would equal 0.

Table 1.1: Definitions and operational constraints of agroclimatic capability classes for cultivated agriculture in Yukon

Class 1	1,400-1,600 GDD	These lands have no significant limitations that restrict the production of the full range of common Canadian agricultural crops.
Class 2	1,200-1,400 GDD	These lands have slight limitations that restrict the range of some crops but still allow the production of grain and warm season vegetables.
Class 3	1,050-1,200 GDD	These lands have moderate limitations that restrict the range of crops to small grain cereals and vegetables.
Class 4	900-1,050 GDD	These lands have severe limitations that restrict the range of crops to forage production, marginal grain production and cold-hardy vegetables.
Class 5	700-900 GDD	These lands have very severe limitations that restrict the range of crops to forages, improved pastures and cold-hardy vegetables.
Class 6	<700 GDD	These lands have such severe limitations for cultivated agriculture that cropping is not feasible.

GDD is calculated beginning the fifth consecutive day of the year with daily mean temperatures above 5°C and terminated the day of the first killing frost occurring after July 15. This killing frost temperature does not need to occur as a daily mean temperature, but rather at any moment of a day. Although the specific killing frost temperature differs between crops, for the purpose of determining the end of the growing season from year to year for Yukon, a temperature of -2.2°C is used as a standard killing frost for cool season crops.

Table 1.2: Comparison of 2010 season to the range & average from the previous 10 years

		Year	2010	Range		10 Year Average
Whitehorse Area	Whitehorse Airport (EC)	EGDD	1135	896	- 1350	1098
		Start of growing season	19-Apr	19-Apr	- 21-May	5-May
		End of growing season	20-Sep	5-Sep	- 30-Sep	20-Sep
		Land capability class	Class 3	Class 5	- Class 2	Class 3
		Number of frosts during growing season	24	5	- 24	13
	RF (YG)	EGDD	1008	681	- 1263	856
		Start of growing season	19-Apr	19-Apr	- 22-May	6-May
		End of growing season	27-Aug	25-Jul	- 2-Sep	15-Aug
		Land capability class	Class 4	Class 5	- Class 2	Class 5
		Number of frosts during growing season	47	12	- 47	29
Central Yukon	Pelly Farms (YG & EC)	Sum EGDD	1416	1122	- 1529	1286
		Start of growing season	21-Apr	21-Apr	- 17-May	1-May
		End of growing season	16-Sep	22-Aug	- 22-Sep	10-Sep
		Land capability class	Class 1	Class 3	- Class 1	Class 2
		Number of frosts during growing season	24	6	- 29	16
	Mayo Airport (EC)	EGDD	1363	1065	- 1470	1302
		Start of growing season	29-Apr	24-Apr	- 17-May	3-May
		End of growing season	13-Sep	31-Aug	- 27-Sep	15-Sep
		Land capability class	Class 2	Class 3	- Class 1	Class 2
		Number of frosts during growing season	11	2	- 18	10
	Dawson Airport (EC)	EGDD	1294	833	- 1348	1131
		Start of growing season	29-Apr	26-Apr	- 17-May	5-May
		End of growing season	13-Sep	21-Jul	- 27-Sep	4-Sep
		Land capability class	Class 2	Class 5	- Class 2	Class 3
		Number of frosts during growing season	15	3	- 24	14
Haines Junction (EC & YG)	Haines Junction (EC & YG)	EGDD	940	626	- 1159	911
		Start of growing season	30-Apr	27-Apr	- 22-May	7-May
		End of growing season	27-Aug	10-Aug	- 17-Sep	31-Aug
		Land capability class	Class 4	Class 5	- Class 3	Class 4
		Number of frosts during growing season	35	12	- 46	25
Southern Yukon	Watson Lake Airport (EC)	EGDD	1293	1057	- 1332	1168
		Start of growing season	29-Apr	23-Apr	- 22-May	8-May
		End of growing season	20-Sep	8-Sep	- 30-Sep	21-Sep
		Land capability class	Class 2	Class 3	- Class 2	Class 3
		Number of frosts during growing season	15	1	- 15	9

The longer day length experienced in Yukon has a positive effect on the crop growth which is not accounted for in a simple GDD calculation. To account for the boost plants receive from the long hours of daylight north of 60° latitude the GDD is adjusted upward and reported as Effective Growing Degree Days (EGDD) as outlined in the calculation of the day length factor in the Land Suitability Rating System for Agriculture Crops.¹ For example, the 978 GDD recorded at Whitehorse Airport, is multiplied by a factor of 1.16 and becomes 1,135 EGDD. The daylight

¹ Agriculture and Agri-Food Canada. Technical Bulletin 1995-6E,
<http://sis.agr.gc.ca/cansis/publications/manuals/lrsr.pdf>

factor changes with latitude, for example in Dawson a factor of 1.18 is used and for Watson a factor of 1.14 is used.

Table 1.3: Whitehorse area agroclimatic data

Year			2010
Yukon River Valley	Yukon Grain Farms	EGDD (from 98-00 research report)	1,054
		Start of growing season	14-May
		End of growing season (first killing frost -2.2°C)	27-Aug
		Land capability class	Class 3
		Number of frosts during growing season	13
	Whitehorse Airport (EC)	EGDD	1,135
		Start of growing season	19-Apr
		End of growing season (first killing frost -2.2°C)	20-Sep
		Land capability class	Class 3
		Number of frosts during growing season	24
Jct of Yukon and Takhini Valleys	RF (YG)	EGDD (from 98-00 research report)	1,008
		Start of growing season	19-Apr
		End of growing season (first killing frost -2.2°C)	27-Aug
		Land capability class	Class 4
		Number of frosts during growing season	47
Takhini Valley	TR	EGDD	974
		Start of growing season	16-May
		End of growing season (first killing frost -2.2°C)	27-Aug
		Land capability class	Class 4
		Number of frosts during growing season	22
	GZ	Sum EGDD:	1,026
		Start of growing season	16-May
		End of growing season (first killing frost -2.2°C)	17-Sep
		Land capability class	Class 4
		Number of frosts during growing season	28
South of Whitehorse	Jakes Corners	EGDD	1,016
		Start of growing season	15-Sep
		End of growing season (first killing frost -2.2°C)	19-Sep
		Land capability class	Class 4
		Number of frosts during growing season	23
	McClintock Valley Farms	EGDD	841
		Start of growing season	24-May
		End of growing season (first killing frost -2.2°C)	21-Aug
		Land capability class	Class 5
		Number of frosts during growing season	11

The EGDD for 2010 was average to above average across Yukon. Central and southern Yukon are the hotspots for growing in Yukon which is highlighted by the Class 2 climate in these areas. Pelly Farm's weather station was the hotspot with a Class 1 climate. The additional heat units experienced at Pelly Farm may be attributed to aspect of the weather station, located on a south facing slope. Aspect and location effects growing conditions as seen by data collected in the Whitehorse area. Table 1.3 summarizes the data for the Whitehorse area. This data shows how

areas in the larger Yukon River valley have either better frost drainage and/or accumulation of heat compared to areas such as the Takhini valley and McClintock valley which tend to be cooler.

Graph 1.1 and table 1.4 show the precipitation for May to September 2010. The total rainfall from May to September ranges from 138 to 201 mm across Yukon. Although some areas saw more rainfall than others, there is nonetheless a moisture deficit across Yukon impeding yields for all common agriculture crops.

Graph 1.1: Precipitation for May to September for 2010

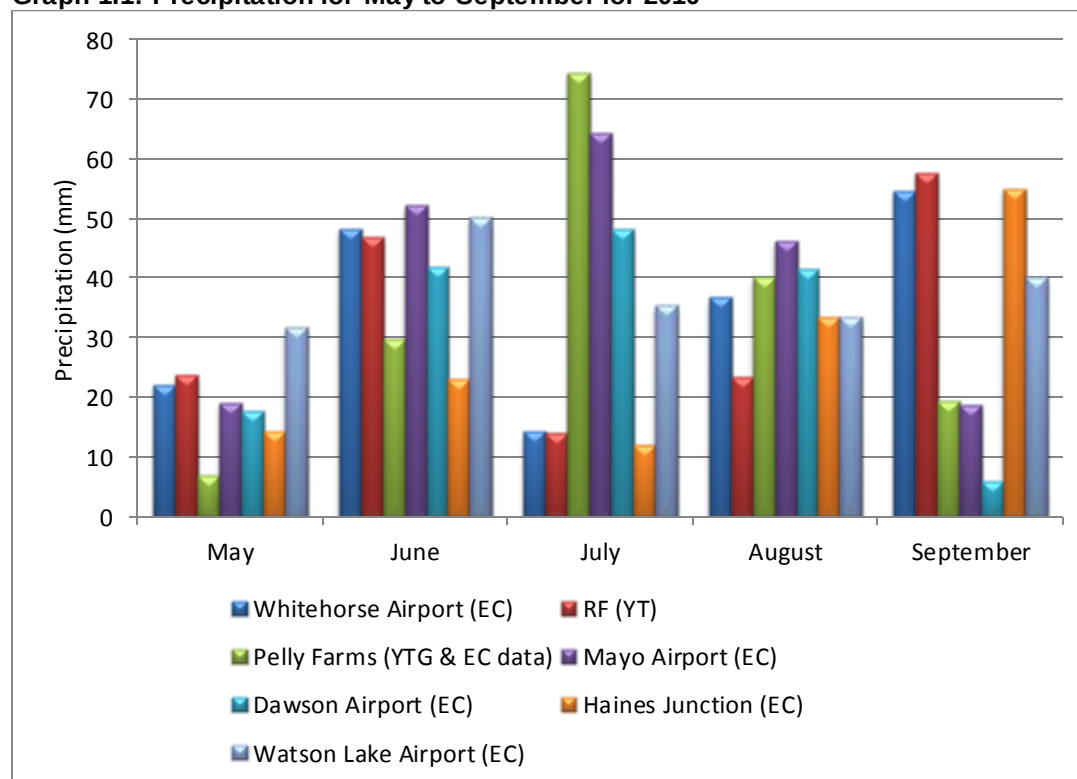


Table 1.4: Precipitation totals for May to September 2010

Month	Whitehorse Airport (EC)	RF (YG)	Pelly Farm (YG)	Mayo Airport (EC)	Dawson Airport (EC)	Haines Junction (EC)	Watson Lake Airport (EC)
May	22.1	23.84	6.83	19	17.8	14.22	31.7
June	48.4	46.93	29.89	52.2	42	23.06	50.3
July	14.2	14.18	74.58	64.4	48.2	12.15	35.6
August	36.8	23.57	40.31	46.4	41.6	33.48	33.6
September	54.6	57.79	19.27	18.8	6.1	55.04	40.1
Total	176.1	166.31	170.88	200.8	155.7	137.95	191.3

2.0 WHEAT

Location: Government of Yukon Research Farm, Whitehorse

Initiated: 2009

Funding: Government of Yukon

Objective: To assess varietal performance in different locations with varied seeding dates.

Introduction

Wheat trials have been conducted throughout Yukon going back to 1917 at Swede Creek just south of Dawson. Wheat was grown as part of the Yukon Crop Development trials and as part of the Yukon government's research work in the 1990s. In most years growing wheat around Whitehorse led to very poor results. In this trial, different management practices with some new varieties were tested to see if quality and yields could be improved.

Materials and Methods

In the Whitehorse area a fall and spring seeding were conducted with three spring wheat varieties at the Government of Yukon Research Farm (RF). The fall seeding was planted just before freeze up with the intent of the seed remaining dormant until spring, and sprouting in early spring (this is not winter seeded wheat, but rather frost seeded). The purpose of evaluating a fall seeding just before freeze up is to have seed in the ground for spring to take advantage of the valuable spring moisture and to get a few extra growing days at the start of the season. Accessing spring moisture can be a real benefit because May tends to be one of the driest months in the year with very little rainfall.

The wheat varieties were also seeded at a location in central Yukon to evaluate the difference between Whitehorse and central Yukon climatic zones. Central Yukon is warmer and offers better growing conditions for wheat. Central Yukon is represented by the McCabe Creek research plots and the wheat was only seeded in the spring.

Table 2.1: Hard red spring wheat selected

Variety	Supplier	Location
ACS Intrepid	Borek Farms	Dawson Creek, BC
Alvena	Spruce Vista Seed Farm	Berwyn, AB
CDC Osler	Supplier Hill Farm Ltd	Fort St John, BC

* Thanks to Clair Langlois, Research Manager of the BC Grain Producers Association, for assistance with varietal selection.

An Allis Chalmers Precision Seeder was used to seed the plots at the Research Farm, the winter seeding was done on October 20, 2009 and spring seeding was done on May 6, 2010 at a rate of 135 kg/h, and seeded into a 2 m x 30 m block. A manual push seeder was used at McCabe Creek, and was seeded May 19, 2010 at a rate of 135 kg/ha into 1 m x 5 m plots.

Irrigation was applied as required equaling approximately 89 mm (3.5") from late May to early August. Fertilizer was applied following soil analysis recommendations in early June.

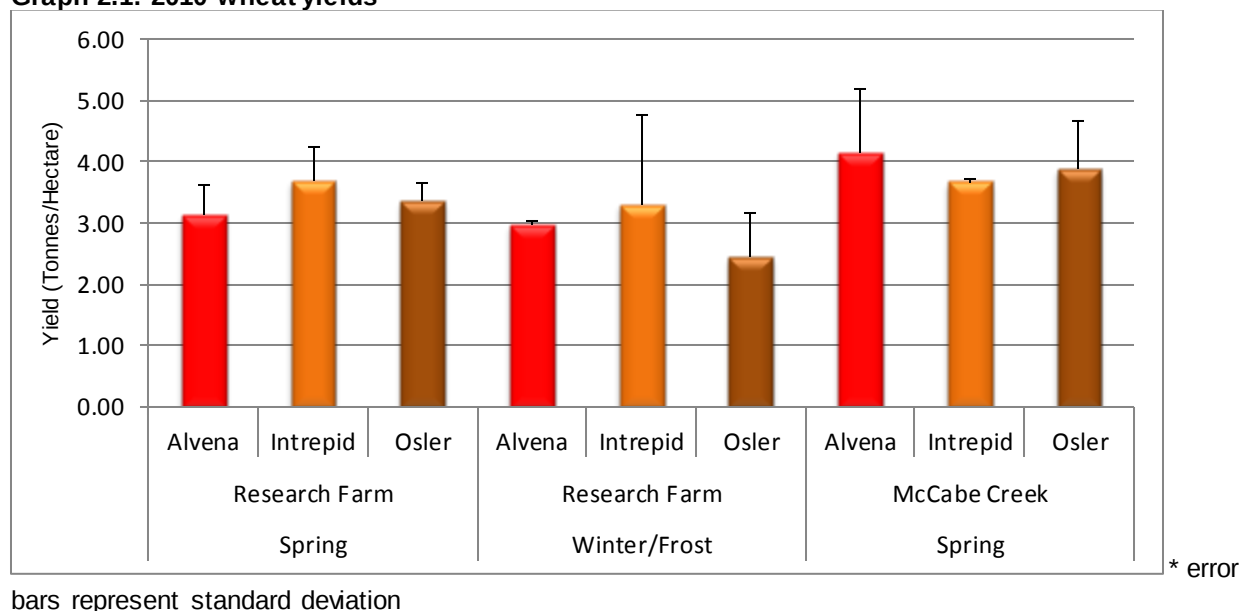
An application of MCPA Amine 500 was used to control shepherd's purse and narrow leaved hawksbeard on June 3.

Multiple samples were harvested in the fall and used to calculate yields after threshing and cleaning of the seed.

Results

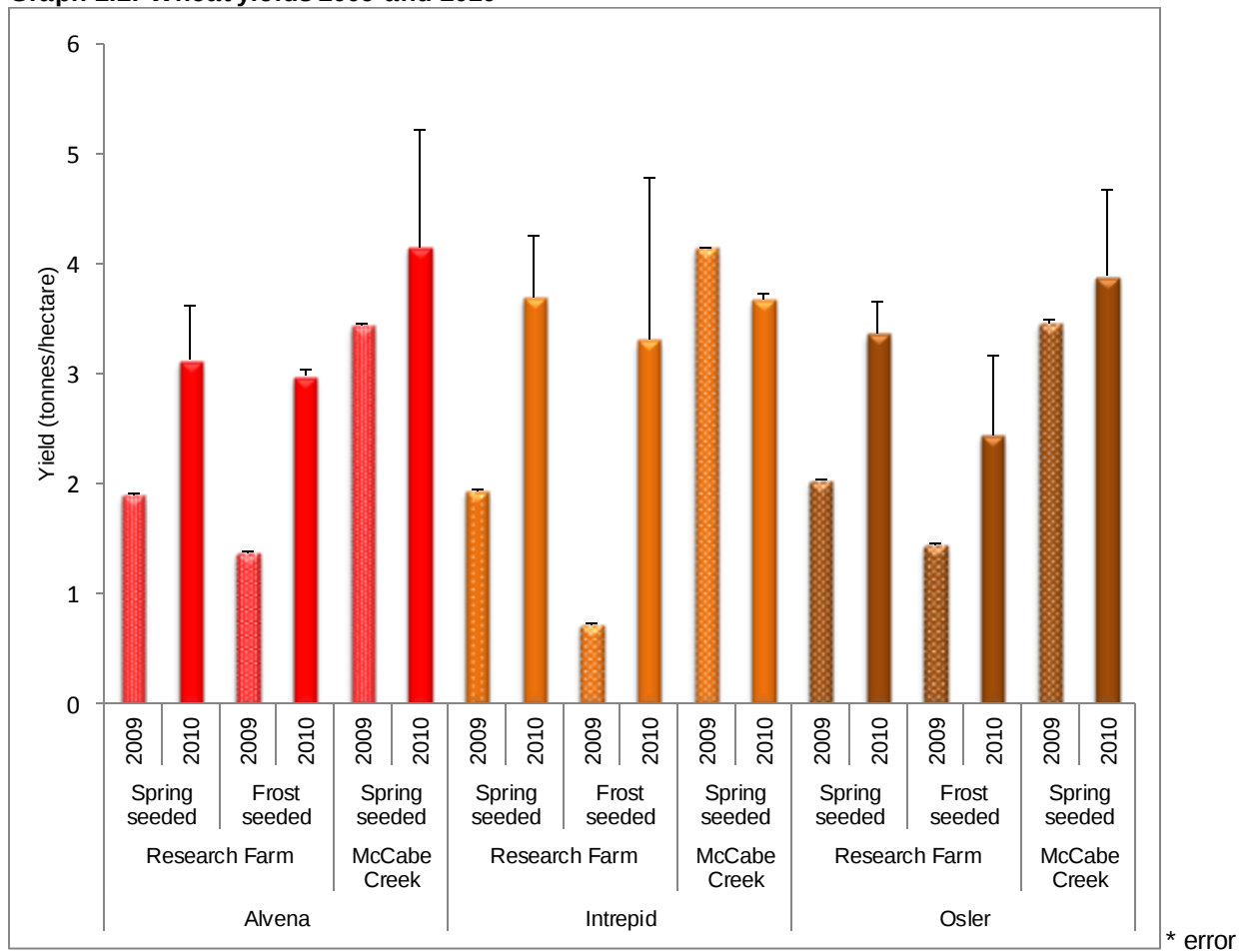
Graph 2.1 summarizes the yield at each of the two locations and the difference between the spring and fall seeding at the Research Farm. The graph highlights slightly higher yields in central Yukon at McCabe Creek but what is not shown was the observed difference in quality. The McCabe Creek samples were of superior quality compared to the Research Farm. Wheat kernels from the Research Farm did not mature before the first frosts and were visible damaged by these frost events. When comparing the Research Farm samples, the quality of the fall seeded wheat was better although the seed was still marginal in quality. The fall seeded wheat resulted in poor yields compared to the spring seeded sample at the same location and can be directly related to poor germination.

Graph 2.1: 2010 wheat yields



As seen in graph 2.2, the 2010 results showed less of a difference between location and seeding strategies compared to that of 2009 which was more variable. Although there is not enough data to distinguish a better yielding variety, as seen in graph 2.2, McCabe Creek has less variability from year to year compared to the Research Farm. We did see a significant increase in yields at the Research Farm in 2010 compared to 2009 which can be correlated directly to a warmer growing season (an increase of over 300 EGDD in 2010). Intrepid looks to be a better producer in cooler years as seen by improved yields in the cooler season of 2009 at McCabe Creek and 2010 at the Research Farm. Alvena and Osler outperformed Intrepid in 2010 at McCabe Creek suggesting that these two will perform better in warmer summers.

Graph 2.2: Wheat yields 2009 and 2010



bars represent standard deviation

Conclusion

The warmer climate of central Yukon allows for growing and maturing selected wheat varieties. Yields in central Yukon are comparable to the Canadian prairies outlook reports, granting irrigation is provided. Yields and quality in the Whitehorse area are marginal depending on the growing season. Fall seeding does provide a longer growing season, but the poor overwinter survival of the seed dropped yields substantially. The Whitehorse area average temperatures during the two years of this trial have not provided enough growing degree days to mature quality wheat.

3.0 OAT VARIETY TRIAL

Locations: Government of Yukon Research Farm, McCabe Creek, and Yukon Grain Farm

Initiated: 2010

Funding: Government of Yukon

Objective: To assess performance of new oat varieties in Yukon.

Introduction

Oats are a major crop in Yukon for green manure, forage and grain. Most producers use AC Mustang as the oat variety of choice. It is known that selection of appropriate varieties can make a dramatic difference in the yields of both forage and grain at the end of a growing season. Although AC Mustang oats has served producers well, the purpose of this trial is to understand if there are any new varieties that may increase yields over the current standard.

Varieties sourced for this trial were done by contacting a number of seed companies in the prairies for their recommendation of varieties that would perform best in Yukon's short, water deficient growing season. This trial was designed to be a low-input crop trial and investigate the crop as a forage and grain.

Materials and Methods

This trial was designed as a demonstration therefore no plot replication was implemented. Three recommended varieties and a control were planted in small plots at each of the sites.

Oat varieties tested:

-
- AC Mustang (control)
 - Triactor
 - Lu
 - Murphy

The sites included two in the Whitehorse area and one in central Yukon. All sites are under some irrigation and each site had differing levels. At the Research Farm a completely dryland trial was also conducted.

Table 3.1: Summary of sites and moisture

Site	Irrigation	Precipitation	Total
Research Farm (Whitehorse area)	76 mm (3")	165 mm (6.5")	241 mm (9.5")
McCabe Creek (central Yukon)	51 mm (2")	152 mm (6.0")	203 mm (8.0")
Yukon Grain Farm * (Whitehorse area)	25 mm (1")	170 mm (6.7")	196 mm (7.7")

* Irrigation was added only to initiate germination after seeding

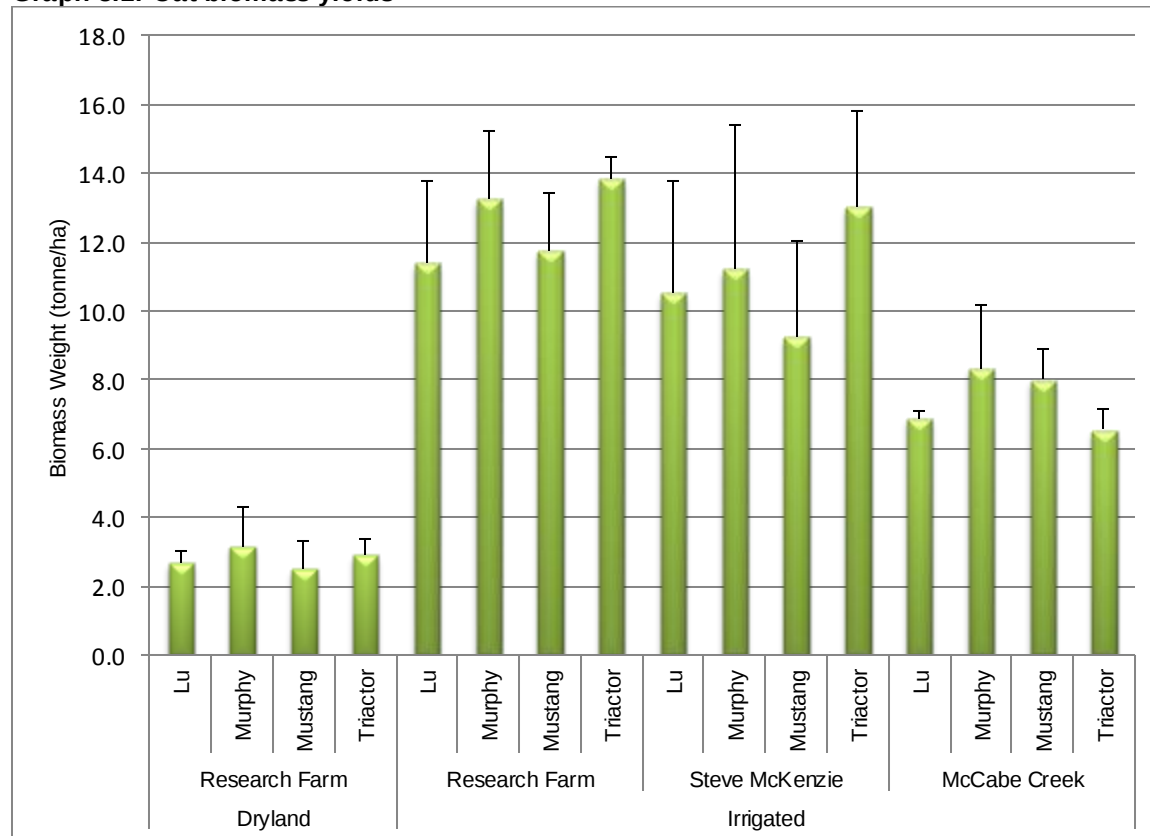
The sites were seeded at a rate of 100 kg/ha between May 20 to June 1. The sites were fertilized in early June based on optimal fertilizer rates of N: 80 kg/ha, P₂O₅: 12 kg/ha, K₂O: 39 kg/ha, and S: 14 kg/ha.

Samples were harvested in mid-September and used to calculate yields of forage and, after threshing and cleaning, yields of grain.

Results and Discussion

Oat forage yields increase with the addition of irrigation. Graph 3.1 shows the dramatic difference between dryland production and irrigated production at the Research farm. There was some varietal difference when it came to forage yields. In the cooler Whitehorse area Triactor showed improved forage yields whereas Murphy performed better at McCabe Creek. AC Murphy had the highest yields in the dryland crop, though there was not much varietal difference to analyze.

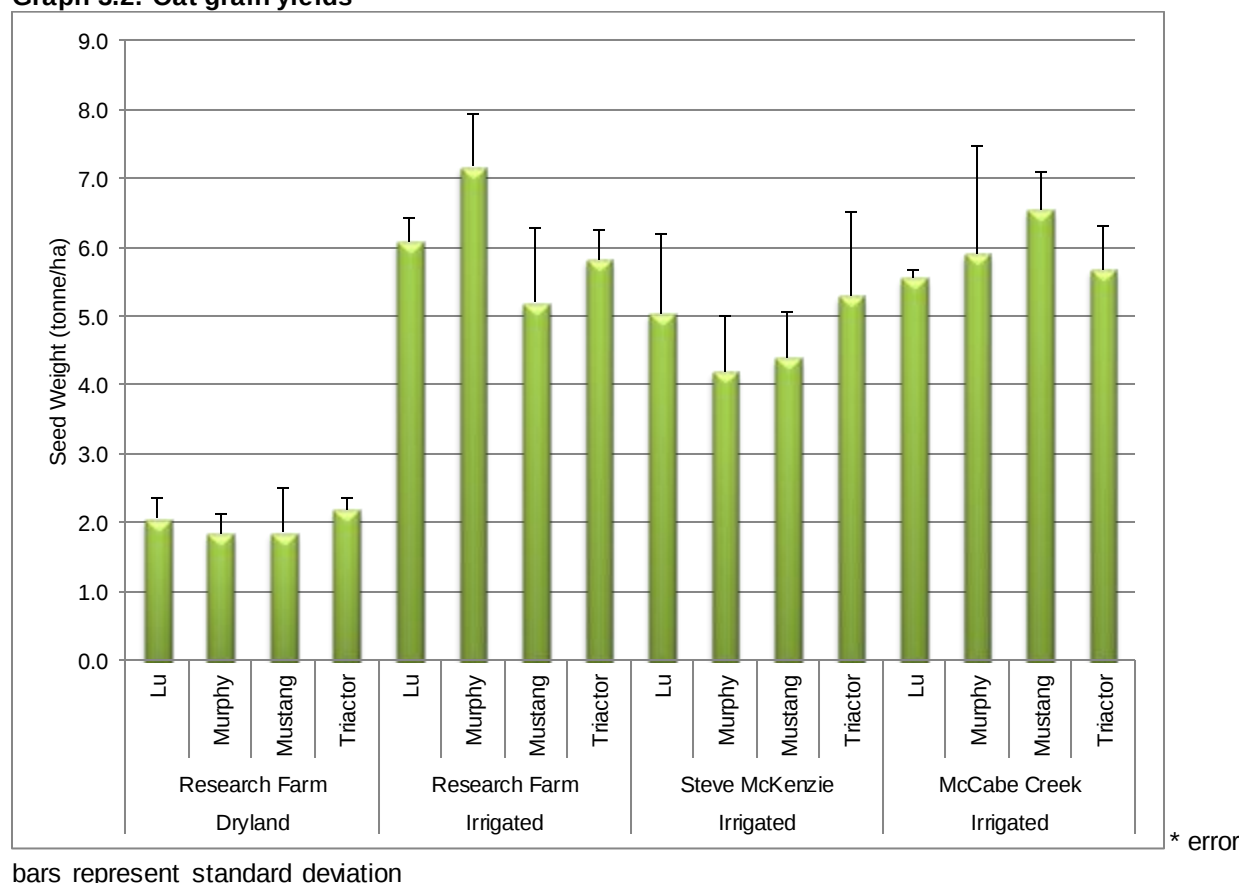
Graph 3.1: Oat biomass yields



* error bars represent standard deviation

Grain yields were low in the dryland production and there was very little difference observed between the varieties, as seen in graph 3.2. This graph shows varietal differences in yield at each site, but each site responded differently. Under irrigation at the Research Farm AC Murphy was the top producer, whereas at site SM Triactor and Lu showed the best yields. The control, AC Mustang, outperformed the new varieties at McCabe Creek.

Graph 3.2: Oat grain yields



bars represent standard deviation

Conclusion

Although there are differences between varieties, the variable response of the varieties from site to site, and whether for biomass or grain indicates that there is not one variety that works best or stands apart from the control. AC Mustang has proven to be a dependable crop based on the widespread use here in Yukon. The newly tested varieties did perform well and may be used as a viable alternative to AC Mustang both for forage and grain, further research is warranted to see if one of these oat varieties is substantially better.

At McCabe Creek, with a significantly warmer summer climate, better performance was expected. McCabe Creek compared equally in seed weight but poorly in biomass against the Whitehorse area results. This further demonstrates the requirement for irrigation to achieve better yields in central Yukon to offset the crop water requirement. Oats are an excellent cool season crop and are very much suited to the Whitehorse area as much as warmer central Yukon.

4.0 FIELD PEA VARIETY TRIAL

Location: Government of Yukon Research Farm and McCabe Creek

Initiated: 2009

Funding: Government of Yukon

Objective: To assess crop viability and varietal performance in Yukon.

Introduction

Research into alternative higher proteins feeds for livestock and poultry, along with an evaluation of cool season crops has resulted in renewed interest in the viability of field peas for Yukon. Peas have been planted in past trials in Yukon with limited success. The availability of new varieties, warmer summers and renewed interest for alternative feeds has warranted new research into field peas.

Research into field peas focused on new, shorter season varieties that are being grown in the northern BC Peace region. The climate in the B.C. Peace region is similar to central Yukon, and varieties grown in this area offer hope of consistent performance in central Yukon and, in warm years, the Whitehorse area. Yields in the Peace region are in line with other pea producing areas in Canada. Although this evaluation will be looking for mature pea yields, the evaluation will also look at biomass yields of field peas to be used as forage/silage for livestock. Typically as a forage/silage for livestock it is more common to mix field peas with a cereal grain. This trial will just look to understand total biomass of the peas as a component of mixed forage/silage crop.

Background ²

Peas can be used for both direct human consumption and animal feed. Feed peas are used in a wide variety of animal feeds with significant on-farm use in hog feeds. Peas are valued for both their protein and energy content and as such are regarded as a multi-purpose feed ingredient. The basic nutrient composition of feed peas is shown in table 4.1.

Table 4.1: Typical composition of feed peas (10% moisture basis)

Component	Average
Moisture	10.0%
Crude Protein (N x6.25)	23.0%
Rumen bypass protein	22.0%
Oil	1.4%
Starch	46.0%
Ash	3.3%
Crude fibre	5.5%
Trypsin Inhibitor Activity	3.5 TIA/mg
Phytic acid	1.2%

For more information on the use of peas as a livestock or poultry feed, refer to the Canadian Feed Peas industry guide available online at www.pulsecanada.com.³

² Canadian Feed Peas Industry Guide, David Hickling, Third Edition, 2003, Published by Pulse Canada

³ Follow the links to Feed Industry, Animal Feed and click on Feed Pea Industry Guide

Materials and Methods

Three varieties of yellow seed field pea were evaluated at two locations with one of the locations looking at dryland and irrigated production. The field peas were planted at a rate of 210 kg/ha. Field pea seed was inoculated with *Rhizobium leguminosarium* bacteria to enhance nitrogen fixing ability at a rate of 4.6 kg/ha.

The varieties of yellow seed field pea used were:

- Agassiz
- CDC Meadow
- Polstead

Test plots were set up at the Research Farm which represents the Whitehorse growing conditions and McCabe Creek which represents central Yukon.

At the Research Farm each variety was planted on May 27 in two different plots on the farm. This was done to evaluate the field peas under dryland and irrigated management practices. Planting was conducted with an Allis Chalmers Precision Seeder, into 2 m x 30 m irrigated plots and 2 m x 50 m dryland plots.

At the McCabe Creek research site, all three varieties were planted May 19 into smaller 1 m x 5 m plots under irrigation only. It should be noted the inoculant at the McCabe Creek site was top dressed on June 7.

Irrigation was added as required for the irrigated plots, with about 76mm (3") applied at the Research Farm.

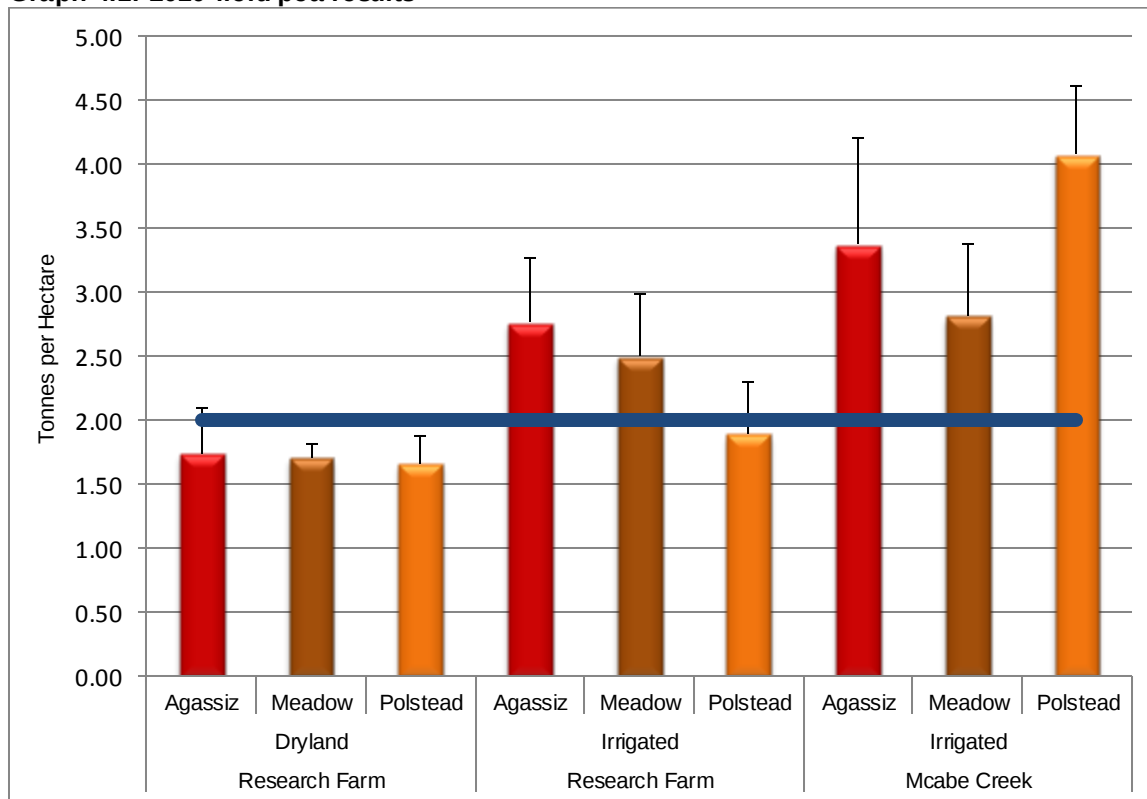
Results

The 2010 growing season provided enough heat to mature field peas. Yields are inline with the expected yields in western Canada. Graph 4.1 shows the result for each variety, site and management. The blue line in the graph is the 1998 to 2004 average yields reported for western Canada.

The highlight for 2010 was the ability to mature and harvest dryland field peas in the Whitehorse area. The dryland production was higher than expected and the variety comparison did not show any significant yield difference. The dryland production ranged between 1.66 to 1.74 tonnes per hectare.

Central Yukon continues to show the benefits of a warmer climate as shown by the increased yields achieved at this site. Yields in central Yukon ranged between 2.81 to 4.08 T/ha compared to the 1.89 to 2.75 T/ha in the cooler Whitehorse area. It should be noted that the central Yukon site was irrigated.

Graph 4.1: 2010 field pea results



* error bars represent standard deviation

Further interpretation of the data indicates that Meadow responded well to increased irrigation and not so well with additional heat; whereas, Polstead responded well to increased heat and very little to no irrigation. Agassiz saw increased yields with the addition of irrigation and again with additional heat.

During the growing season the field peas provided an excellent canopy and would work well as part of the grain/field pea mix. Biomass samples taken at the end of the season at the Research Farm averaged 4.39 T/ha of biomass (data not displayed).

Conclusion

As the livestock and poultry sectors develop in Yukon, field peas may become a valuable protein source for feed and a good rotational crop. Field peas are showing good viability as a crop in Yukon because of consistent maturity and yields. The results to date have shown the ability to mature peas in the Whitehorse area, but there is concern that this area is on the cusp of consistent maturity and in a cooler season may not produce a harvestable crop. More work is required to understand the capability of the Whitehorse area for field pea production, and it will be interesting to see how production responds to a season with below normal temperatures. Central Yukon remains the preferred area to grow field peas as a cooler season in central Yukon will have less impact on production. Dryland field peas were productive and warrant further research to determine the year-to-year variability of field peas under dryland management.

5.0 RASPBERRY INPUT MANAGEMENT AND PRODUCTION TRIALS

Location: Government of Yukon Research Farm, Whitehorse

Initiated: 2002

Funding: Government of Yukon

Objective: To employ best management practices around orchard production and determine the economics of raspberry production in the south-central Yukon.

Introduction

This trial is a continuation of work initiated in 2002 in collaboration with the Pacific Agri-Food Research Centre in Summerland, B.C. A raspberry orchard was developed at the Research Farm to evaluate different varieties of raspberries, economics of raspberry production, and best management practices for irrigation and fertilizing.

Materials and Methods

The raspberry orchard was planted in 2002 and took three years to produce a commercial harvest. The orchard is 1,000m², divided into 10 rows with four sections per row, which allows for the orchard to be divided into 40 individual sections. An automatic drip irrigation system is used to evaluate water and fertilizer management. The irrigation system is controlled by a CR-10 computer system which uses data from soil moisture and evapotranspiration (ET) sensors to determine the optimum water requirements for the orchard. The irrigation system uses two tanks and two different lines to deliver water and fertilizer to the orchard. Soluble fertilizers are added to each of the irrigation tanks that in turn are added to the orchard through the automated system. Different levels of fertilizer were evaluated to determine the effects of fertilizer treatments on raspberry production. Fertilizer treatments were applied at a full rate based on a B.C. Ministry of Agriculture berry factsheet and at half of this rate.⁴

Each section of the orchard was planted with Kiska, Souris or Boyne raspberries. The Kiska is an Alaskan developed variety with a medium size fruit and very tall canes. The Souris and Boyne are common raspberry varieties and have been grouped together in this evaluation. The Souris/Boyne produces a larger, firmer berry more in line with a tabletop or eating berry. In 2010, only six rows or 24 sections were managed in order to prepare the orchard to be moved in the fall. Of the 24 sections under management, the orchard has been assessed with six sections of Kiska, 17 sections of Souris/Boyne and the remaining plot was a mix of the varieties.

During harvest, pickers collected and weighed the berries from each section. The data was then tabulated and used to determine the effect of the fertilizer treatment and variety on raspberry yields. The yield data is used to further estimate the economics of production. The economics are based on a combination of market price and expenses based on operational setup (i.e. u-pick or pick and package operations).

The market price used for the economics of production is divided into three categories:

- \$3.30/kg (\$1.50/lb) represents an estimated B.C. wholesale price.
- \$6.60/kg (\$3.00/lb) represents a B.C. roadside price and/or a Yukon u-pick price.
- \$9.90/kg (\$4.50/lb) represents a Yukon grown, fresh market price.

⁴ BC Berry Factsheets available through: <http://www.agf.gov.bc.ca/berries/factsheets.htm>

Table 5.1 is a summary of the expenses tallied from the accumulated time spent managing the research orchard using a \$15.00 per hour labour cost. Expenses only account for human hours and does not include fertilizer, materials, equipment, packaging and other overhead expenses. A u-pick operation would not include harvesting expenses. These expenses are based on human hours for the Research Farm orchard and it is important to use costs that are reflective of your farm operation.

Table 5.1: Expenses based on research orchard tabulated hours

	Expenses Cost @ \$15.00/hr Time per hectare	
Pruning & Trellising	40	\$600
Weeding	6	\$90
Harvesting	40	\$600
Total expenses		\$1,290.00

Results and Discussion

The raspberry production in 2010 was much improved over 2009 as seen in table 5.2. The total harvest for 2010 was 78 kg for the 24 section orchard, and based on this data a 1,000 m² orchard would yield approximately 130 kg, which is the highest yield to date for the orchard.

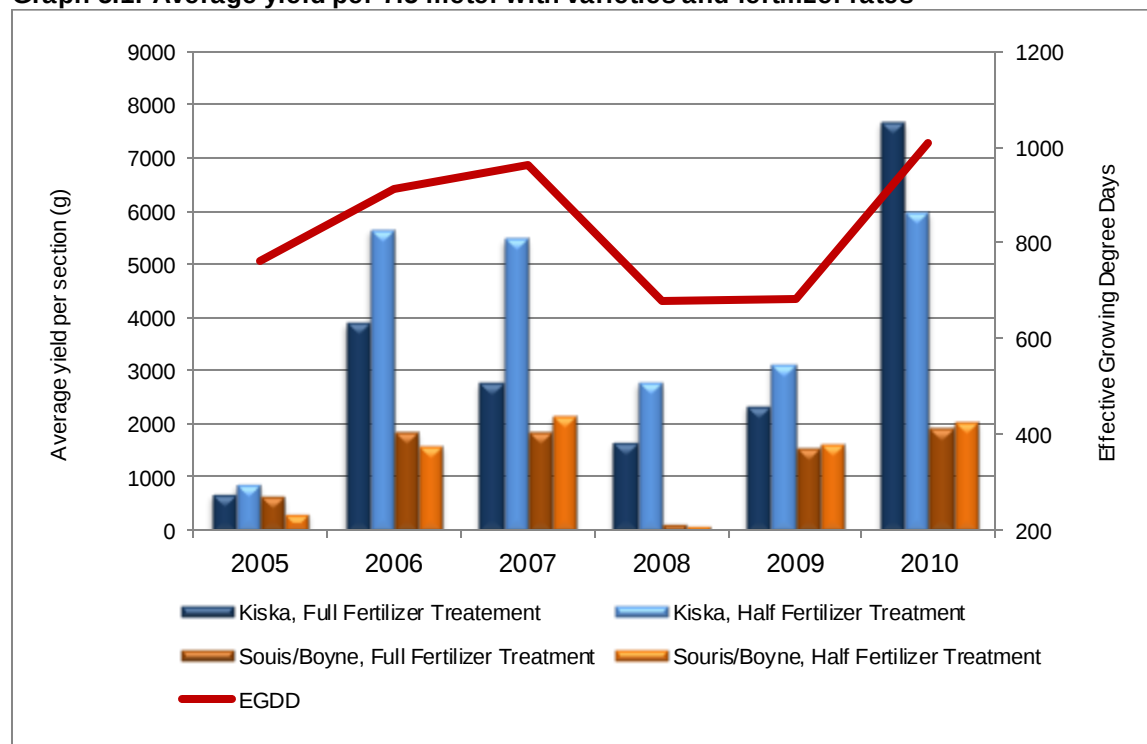
Table 5.2: Summary of total raspberry yields from the orchard 2005-2010

Year	Weight (kg)
2005	21.5
2006	99.3
2007	107.1
2008	27.4
2009	78.6
2010	130.0

There has been a significant difference between the varieties over the year and less of a difference between fertilizer inputs (illustrated in graph 5.1). Since 2006, Kiska raspberries have out produced the Souris/Boyne highlighted by the dramatic difference in yield in 2010, where the Kiska raspberry yielded between 7.7 to 6.0 kg/section compared to 2.1 to 1.9 kg/section for the Souris/Boyne.

The red line in graph 5.1 demonstrates the total EGDD experienced at the orchard over the years. Yields correlate closely with the EGDD data: years with higher EGDD (higher total temperature) show increased yields.

Graph 5.1: Average yield per 7.5 meter with varieties and fertilizer rates



It is difficult to pull out data with regards to the effects of fertilizer on production. Fertilizer was applied at a full and half rate from B.C. recommendations. Kiska in most years produced better with lower amounts of fertilizer with the exception of 2010 where the full fertilizer treatment resulted in higher yields. In 2010 the additional heat units allowed for better utilization of the fertilizer, in turn resulting in better production.

The effects of fertilizer on the production of the Souris/Boyne canes over the years does not show any significant difference in production. In general yields of the Souris/Boyne have been poor, likely due to untimely fall frosts and insufficient heat rather than soil fertility.

Economics

Using the raspberry yield data, a range of selling prices, calculated hourly expense rates for a pick and packaged product and a u-pick operation, a hypothetical economics of production can be reported for the 1,000 m² orchard. Table 5.3 and 5.4 summarizes the economics based on the 2010 variety performance and the last five year average production for each of the varieties. The tables are separated into a picked and packaged economics of production (table 5.3) and a u-pick operation (table 5.4).

Table 5.3: Picked and packaged economics of production

	Yields (kg/1000 m ²)	Projected expenses	Net income @ \$1.50/lb	Net income @ \$3.00/lb.	Net income @ \$4.50/lb
2010 Average Kiska Yields	308	\$1,290.00	-\$271.92	\$746.17	\$1,764.25
2010 Average Kiska Yields	240	\$1,290.00	-\$497.75	\$294.49	\$1,086.74
Average 5 year production Kiska	148	\$1,290.00	-\$801.84	-\$313.69	\$174.47
Average 5 year production Kiska	185	\$1,290.00	-\$679.13	-\$68.26	\$542.60
2010 average Souris/Boyne	82	\$1,290.00	-\$1,018.73	-\$747.46	-\$476.19
2010 average Souris/Boyne	77	\$1,290.00	-\$1,033.78	-\$777.56	-\$521.34
Average 5 year Souris/Boyne	60	\$1,290.00	-\$1,090.19	-\$890.38	-\$690.57
Average 5 year Souris/Boyne	59	\$1,290.00	-\$1,094.83	-\$899.66	-\$704.49

Table 5.4: U-pick economics of production

	Yields (kg/1,000 m ²)	Projected expenses	Net income @ \$1.50/lb	Net income @ \$3.00/lb.	Net income @ \$4.50/lb
2010 Average Kiska Yields	308	\$690.00	\$328.08	\$1,346.17	\$2,364.25
2010 Average Kiska Yields	240	\$690.00	\$102.25	\$894.49	\$1,686.74
Average 5 year production Kiska	148	\$690.00	-\$201.84	\$286.31	\$774.47
Average 5 year production Kiska	185	\$690.00	-\$79.13	\$531.74	\$1,142.60
2010 average Souris/Boyne	82	\$690.00	-\$418.73	-\$147.46	\$123.81
2010 average Souris/Boyne	77	\$690.00	-\$433.78	-\$177.56	\$78.66
Average 5 year Souris/Boyne	60	\$690.00	-\$490.19	-\$290.38	-\$90.57
Average 5 year Souris/Boyne	59	\$690.00	-\$494.83	-\$299.66	-\$104.49

The average production from the last five years for the 1,000 m² research orchard would not generate a profit planted to Souris/Boyne or selling to the wholesale market. On the other hand, a small orchard growing Kiska could generate a small profit. The five year average shows that a 100% Kiska orchard would generate a small profit selling raspberries at a premium \$4.50/lb for a picked berry sold directly to the customer, or a u-pick operation selling berries at \$3.00/lb.

Conclusion

The economics of production is very interesting in that it is a starting point to determine the profitability of an operation. The market prices used are only estimates of Yukon prices that the market may pay but it should be noted that these prices have not been tested. Using these market prices a small 1,000 m² operation would generate only small amounts of income which may not warrant the producer's investment in establishing an orchard. With very little profit margins a raspberry operation would want to start slowly and determine the market demands before scaling their operation up in size. Another opportunity may be to investigate the added value markets in jams, preserves or even alcohol.

6.0 NORTHERN SOIL AMENDMENTS

Location: Government of Yukon Research Farm, Whitehorse

Initiated: 2010

Funding: Yukon Government and City of Whitehorse

Objective: Deciding which amendments to use in Yukon can be a challenge given the distance to transport products and the availability of local sources. This long term project was initiated at the Research Farm to provide comparisons of various soil amendments, specifically examining city compost, organic fertilizers, and synthetic fertilizers.

Materials and Methods

The trial was set up as single plot for each variable with multiple samples per plot. Crop rotation will be implemented on this site with a single crop planted per year. Considering the homogeneous nature of the soil and the challenge of soil additions on small replicated plots the decision was to approach this research with one larger single plot for each amendment and take multiple samples (5 samples) within each plot, allowing for some comparisons on variability.

Figure 6.1: Northern soil amendment layout

Expansion 2011 – biochar and NPK
NPK
Organic Fertilizer
Compost and lime
Compost
Expansion 2011 – biochar and compost

*Each plot is 30 m x 5 m (150 m²)

For 2010, the decision was made to measure crop growth using beets, a low nitrogen requirement crop. Seed was ordered from William Dam Seeds Ltd. and was Canada Grade No. 1 variety Detroit Supreme in lot #20532 with 98% germination. Beets were seeded at 1" spacing with thinning to 3" after 2nd leaf with 8" spacing between rows.

Irrigation of approximately 140 mm (5.5") was applied through the low pressure center pivot system.

Table 6.1: Summary of sites and moisture

Site	Irrigation	Precipitation	Total
Research Farm (Whitehorse area)	140 mm (5.5")	165 mm (6.5")	305 mm (12")

Fertilizer was applied based on soil analysis. Nitrogen was applied at 75 kg/ha actual nitrogen.

1. Synthetic NPK

- 1.20 kg urea (46%N)
- 0.70 kg K_2SO_4
- 0.30 kg treble super phosphate

2. Organic NPK

- 4.50 kg bloodmeal (12%N)
- 0.70 kg K_2SO_4
- 0.30 kg treble super phosphate

3. Compost

- City compost was applied at a rate of 45 tonnes/hectare or 670 kg/plot

4. Compost plus lime

- Compost was applied as in #3, with the addition of Garden Green Lawn and Garden Lime, a pulverized limestone with a minimum 38% Ca and 97% $CaCO_3$. Lime added at 6.7 tonnes/hectare or 100 kg/plot

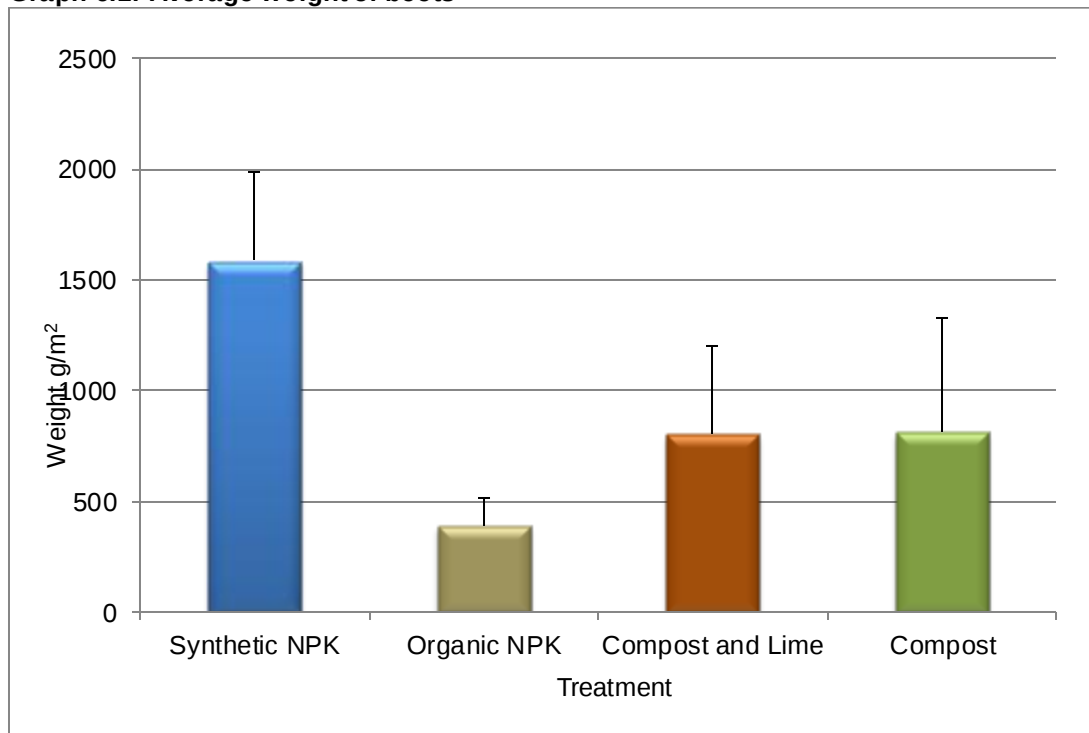


Applying compost (right) and compost and lime (left), June 9, 2010

Results and Discussion

In this first year the results matched expectations with a greater yield from the synthetic fertilizer than from any of the other plots as the artificial nitrogen becomes available much more quickly for plant growth. As the plots mature the anticipated biological activity and rollover effect of the nutrients in the other plots is expected to bring yields up to a level that is comparable. It is anticipated this will take three years.

Graph 6.1: Average weight of beets



* error bars represent standard deviation

In year one, the average yields for the synthetic NPK treatment were double the nearest yield from another treatment. Both of the compost treatments have similar results but with a tremendous amount of variability in the samples. This was anticipated as the compost is more of a heterogeneous mix and application was more challenging, meaning that some spots received higher nutrient rates than others. We also see quite a bit of variability in the synthetic NPK results, which should be more consistent. The compost plots yielded 800 g/m² and the organic NPK yielded only 400 g/m².



Beautiful beets from the synthetic fertilizer plot

Although bloodmeal is a relatively fast acting organic source of nitrogen, graph 6.1 demonstrates clearly that the conversion of bloodmeal to plant available nitrogen is slower than in the other treatments resulting in lower yields.

On a side note, there was no incidence of disease noted in the crop.

Economics

As with many root crops, beets are a good crop option for Yukon producers. Below is an estimated economic model for beet production using the synthetic NPK yields.

The average yield for 2010 is 1,600 g/m² or 16,000 kg/ha. Sales would be either bunched or bagged roots. Direct to consumer sales of bunches could yield prices in around \$8/kg and bagged roots in excess of \$6/kg. Based on analysis from the Multi-Year Development Plan (Government of Yukon, 2007) production from one hectare would feed the entire Yukon population, therefore it would be critical to seek other avenues for sales with the average price estimated at \$2/kg for this model.

Potential gross income at \$2/kg = \$32,000/ha

A more realistic production area would be 1/10 of a hectare for an income of \$3,200, although one may have a higher per kilogram value.

Table 6.2: Estimated expenses to grow beets per hectare

Ground Preparation*	\$ 50.00
Seed (8 kg/ha)	\$ 160.00
Seeding*	\$ 60.00
Fertilizer (300 kg/ha @ \$1100/T)	\$ 330.00
Fertilizing*	\$ 40.00
Weeding*	\$ 500.00**
Irrigation*	\$ 250.00
Harvesting*	\$ 50.00
Total***	\$ 1,440.00

* Custom rates estimated from the Yukon cost of development guidelines and the 2009 Alberta Custom Rates Survey Summary

** Weeding cost will vary dramatically depending on cleanliness of the field and methods

*** Does not include the cost of processing, handling, interest, depreciation of equipment or storage

7.0 FORAGE DEMONSTRATION

Location: Government of Yukon Research Farm, Whitehorse

Initiated: 2005

Funding: Government of Yukon

Objective: To assess the yield and hardiness of various forage species under different harvest management regimes.

Introduction and Discussion

A series of 24 forage demonstration plots were initially set up in 2005. The primary purpose of the trial was to demonstrate the behavior of various grasses in south-central Yukon under different harvest management regimes with irrigation.

In 2010 we adjusted the site to incorporate more plots and include dryland management. Sampling will recommence in 2011.

The forage plots were established on the south side of the two hectare research farm, slightly shaded by the adjacent forest and on a flat to slightly north facing aspect.

An interesting observation over the past two years is that most of the grasses under an intensive two cut system have reduced populations over time. The grasses most affected were timothy and slender wheatgrass, but all grasses had depressed growth in the two cut system. Some leaf hopper damage was noted on the alfalfa.

Sampling and analysis will be available for next year.