Yukon Agriculture Research & Demonstration

2003 Progress Report

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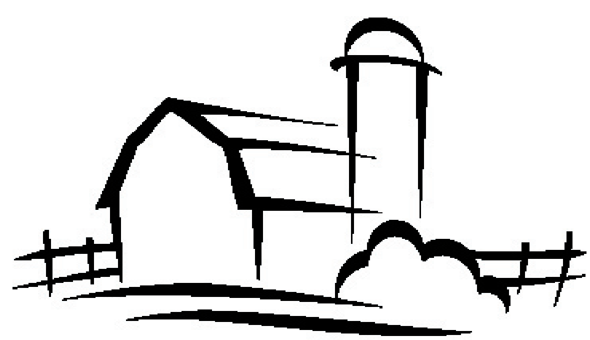
Prepared by

Tony Hill
Agrologist
Agriculture Branch

Matt Ball
Agriculture Research Technician
Agriculture Branch



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Takhini Forestry Farm Demonstration Site

Introduction

The 2003 growing season provided some very useful trial data from two trials initiated at the Takhini agriculture test site the previous summer. This was the first summer that harvest data could be collected from the input management trial and the second year that data was collected on the range improvement trial. Two new forage plots were added to the test site in 2003 to determine nitrogen mobilization in hay crops under irrigated conditions.

A multi-year input management trial was initiated in 2002 to determine optimum irrigation and nutrient inputs for growing perennial berry crops. The purpose of the trial is to examine best management practices combining fertilization, irrigation, row cover and mulching techniques to optimize production of these crops under Yukon conditions. Another aspect of the trial is to examine the usefulness of emerging delivery system technologies that can be used to supply nutrients and irrigation water to the plants.

2003 marked the second year of a range management fertilizer trial located on a southeast facing slope at the Takhini Forestry Farm. A randomized block design was used to compare the grazing capability of unfertilized native range to native rangeland fertilized with varying levels of potassium, phosphate and nitrogen. The study looked at the productivity and nutrient level in plants palatable to livestock and the productivity of unpalatable plants under the various fertilizer treatments.

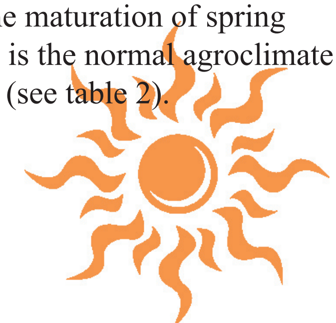
A new fertilizer nitrogen trial will monitor nitrogen movement in soil within a hay field under irrigated conditions. By understanding the movement of soil nitrogen in a hay field under irrgated conditions we will be able to maximize the benefits of applied fertilizer nitrogen. Using fertilizer more effectively will require less fertilizer to be used and reduce the cost to both the commerical operator and the environment. In year one, a pure stand of brome grass was establshed and another of timothy. Nitrogen movement within these plots will begin in the summer of 2004.

~ Table 1 ~
Definitions and operational constraints of land capability classes for cultivated agriculture in the Yukon Territory (Tarnocai et al. 1988)

Class 1 1400-1600 GDD	These lands have no significant limitations that restrict the production of the full range of common Canadian agricultural crops (none in Yukon).
Class 2 1200-1400 GDD	These lands have slight limitations that restrict the range of some crops but still allow the production of grain and warm season vegetables (none in Yukon, based on a 30 year average).
Class 3 1050-1200 GDD	These lands have moderate limitations that restrict the range of crops to small grain cereals and vegetables (in a few localized areas in Yukon).
Class 4 900-1050 GDD	These lands have severe limitations that restrict the range of crops to forage production, marginal grain production and cold-hardy vegetables (valleys of central Yukon).
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 (the most common class of agricultural land in Yukon).
Class 6 <700 GDD	These lands have such severe limitations for cultivated agriculture that cropping is not feasible. These lands may be suitable for native grazing.
Class 7	These lands have no capability for cultivated agriculture or range for domestic animals.

Agrometerology

Climate is the major limiting factor to agriculture in the Yukon because of the short frost free period and lack of heat units during the growing season. Agroclimatic capability ratings are a measure of the degree of limitation imposed by climate on agricultural production. These ratings are derived from 30-year normal data collected by the Meteorological Service of Environment Canada. They represent a measure of the amount of heat available to crops during the growing season. The agroclimatic rating is modified to account for local climate patterns, such as frost occurrences, which affect the length of the growing season. As shown on Table 1, agroclimatic classes range from Class 1 (no restrictions) to Class 7 (unable to be used for any agricultural purpose).The number of growing degree days (GDD) are calculated beginning the fifth consecutive day of the year with mean temperatures above 5°C, and terminated the day of the first killing frost (-2.2°C) which occurs after mid-July. During the 2003 growing season the Takhini Forestry Farm recorded 642 growing degree days. This temperature factor is adjusted upward by 18% to account for the boost plants receive from the long hours of daylight north of 60° latitude. As you head further north the GDD is adjusted incrementally higher (Dawson City is adjusted by 22%). Therefore, the 642 GDD recorded in 2003, becomes 758 effective growing degree days (EGDD) at the Takhini Forestry Farm, just outside of Whitehorse. The first killing frost occurred on August 9. The agroclimatic rating for 2003 was Class 5 (700-900 EGDD), which is fine for growing hay and cold hardy vegetables but one class to low for the maturation of spring seeded cereal grains. This is the normal agroclimate classification for this area (see table 2).



~ Table 2 ~

Agroclimatic data for the 2003 growing season at the Takhini Forestry Farm

Climate Factor	May	June	July	August	Total
Max Temp (°C)	21.4	25.7	29.1	28.2	
Min Temp (°C)	-8.8	-4.2	0.1	-4.1	
Daily Mean (°C)	6.2	12.0	15.4	11.7	
30 Year Normal *	6.9	11.8	14.1	12.5	
Total Precipitation (mm)	2.51	23.83	48.18	14.94	89.46
30 Year Normal *	13.0	29.7	41.4	38.5	122.6
Growing Degree Days	54.9	211.1	323.1	53.6	642.6
Effective Growing Degree Days **	64.8	249.1	381.3	63.3	758.3
Frost Free Period ***		June 27	------------------	Aug 7	40 days
Killing Frost Free Period (-2.2 °C)		June 16	------------------	Aug 9	54 days

* 30 year normals are derived from the Whitehorse Airport weather station 1971-2001.

** The temperature factor is adjusted upward by 18% to account for the boost plants receive from the long hours of daylight north of 60° latitude.

*** Whitehorse Airport records a 30-year mean frost free period of 87 days. This is longer than the 2003 frost free period and most others recorded at the Forestry Farm. The airport site regularly receives winds which tend to keep the temperature above freezing, while the forest sheltered nature of the Takhini Valley site reduces air movement, and therefore frosts are more common.

~ Table 3 ~
Summary of weather data 1995-2003 for the Takhini Forestry Farm

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003
EGDD	859	595	901	972	957	784	838	729	758
Land Capability Class	Class 5	Class 6	Class 4	Class 4	Class 4	Class 5	Class 5	Class 5	Class 5
Frost Free (days)	44	25	45	35	50	50	51	18	40
Killing FF (days)	67	50	74	81	85	68	77	51	54
Precip (mm)	107	162	125	57	145	179	159	98	89.5
Max Temp (°C)	31.1	29.6	28.7	34.1	33.2	35.0	30.8	27.3	29.1

Soils

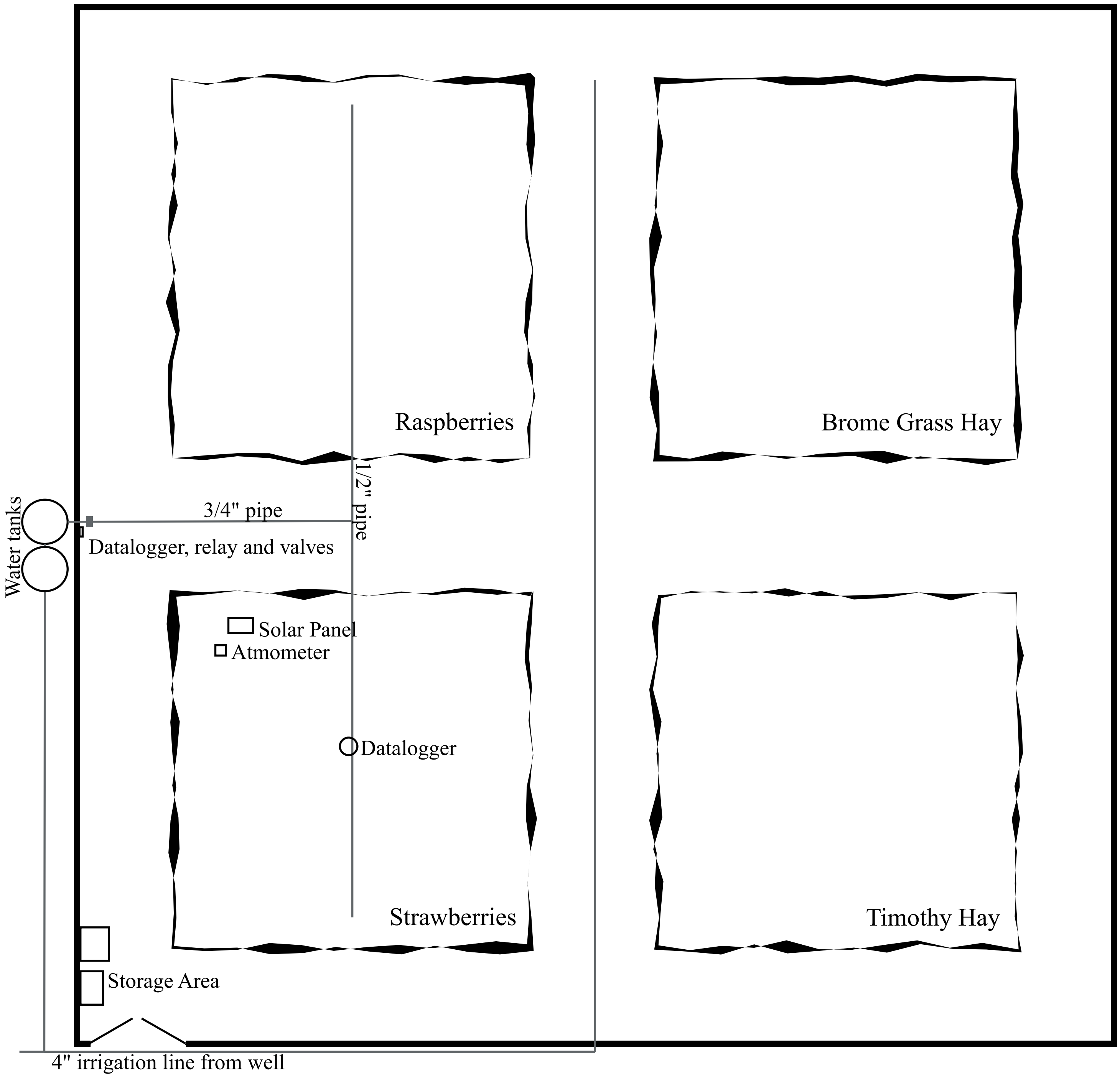
The fine textured soils at the demonstration plot vary from silt loam to sandy loam, and their potential for agricultural production is rated as fair to good. These soils belong to the Lewes soil association and are characterized as loam, with an average particle size breakdown of 42% sand, 47% silt and 11% clay throughout the four fields. The average soil pH in these plots is around 7.0 (neutral) and is trending downwards over the years. Average soil organic matter is 2%, which is low, and somewhat surprising considering the soil building effort that has occurred on this piece of land.

~ Photo 1 ~
Pacific Agri-Food Research Centre Scientists working at the demonstration site

Site Preparation and Plot Design

The agriculture test plots are located at the Gunnar Nilsson and Mickey Lammers Research Forest situated south of the junction of the Klondike Highway and the Takhini Hotsprings Road. The demonstration plots are located on a level, sheltered 0.98 hectare field which is divided into four 40 m x 35 m test plots (Diagram 1). All crops are grown under irrigated conditions. The soil, landscape and climatic properties of the site are typical of those encountered at many farms in the southwest region of the Yukon.

~ Diagram 1 ~
Layout of the Takhini Demonstration Site



Trial on Optimizing Irrigation and Nutrient Inputs to Yukon Crops

In collaboration with Peter Parchomchuk & Denise Neilsen

Introduction

An input management trial was initiated in 2002 with collaboration from the Pacific Agri-Food Research Centre in Summerland, BC. The purpose of the trial is to examine best management practices for fertilizing and irrigating Yukon crops. The idea being to apply only as much water and fertilizer as is needed. This not only conserves water resources, but it reduces the risk of nitrate leaching.

The key to minimizing water use is to have a clear understanding of how much moisture is used by the plant, how much is transpired through the leaves and how much is lost through the soil. Using various crop monitoring technologies, information on soil moisture and evapotranspiration (ET) is computed and water is automatically delivered as required. This trial will also help determine the usefulness of new technologies in Yukon applications. Crop management experience was gained during the Small Fruit Variety Trial initiated in 1998 that was incorporated into this new trial. Our hope is that some of these new techniques could be applied to other Yukon field crops such as potatoes, grains and forages.

Site Design

Two 30 X 40 meter plots are used, one for the raspberry and the other for the strawberry trial. Each trial has two guard rows on either side to act as a buffer against environmental extremes. The strawberry varieties were randomly laid out in half row sections and one of two irrigation lines was randomly chosen for each row.

Methods

For this trial two strawberry and three raspberry varieties are used. The two strawberry varieties Cavendish and Kent, were chosen because they performed well in the Small Fruit Variety Trial. The three varieties of raspberries chosen were Kiska, Boyne and Souris. Boyne and Kiska were both brought from the Small Fruit Variety Trial and the Souris was imported from down south. All these varieties have proven viability in the north.

For this trial a variety of automated technologies are being used to apply the fertilizer and water in required amounts. An atmometer (evaporation meter) takes readings throughout the day and sends the data to a CR-10 datalogger. This datalogger computes values for evapotranspiration and sends a signal to a relay that turns on the water pump for a specific amount of time on each seperate line. Fertilizer is applied during every irrigation. Ethanol was added to the water in the atmometer in early August, to avoid freezing the frost sensitive equipment.

Another datalogger is located in the middle of the strawberry plot and compiles data from moisture sensors and temperature sensors beneath the plastic mulch. Examination of this data is for assurance that the system is functioning properly and to help determine plant water uptake. All the data is downloaded onto a laptop computer once a week.

Rows were mounded with an attachment on the rear of the tractor and wavelength selective thermal plastic mulch was used to cover the rows. This mulch provides soil warming, is an effective weed control and provides a clean surface for the berries to mature on.

2003 Strawberry Results

On April 28, the straw mulch that was applied to the strawberry rows the previous October, used as winter protection, was removed from the rows and an assessment was made of the over-wintered plant stock. There was very little difference in the survival rate of plants covered with straw and those plants left uncovered. This came as a bit of surprise considering that the trial site did not receive substantial snow cover until late January.

Transplanting to replace gaps in the rows where plants didn't establish in 2002 took place during the second week of May. A light weight floating row cover (17g/m^2) was applied to half of the rows in the trial to see if this would improve any of the production results. The row cover chosen provided up to 4º F of frost protection, provided protection from the wind and created a micro-climate that increased air temperature and reduced water losses from evaporation.

On June 11th, the row covers were removed when the first flowers were observed on the plants under the row covers. The variety Cavendish was well into flowering displaying three times as many blooms as the Kent variety. In the rows without row covers the first flowers were just beginning to show. The plants under row covers were also noticeably larger than the uncovered plants.

Harvesting began on July 11th. Both the Cavendish and Kent varieties that had been under row covers produced fruit a full week earlier than the rows without covers. Cavendish produced fruit earlier than Kent, by a few days, but also finished producing fruit earlier than Kent, regardless of the row cover treatment.

The other variable used in the trial was two different fertilizer levels. Fertilizer levels were based on recommendations from the British Columbia strawberry production guidelines.

Calcium nitrate was applied at a 30ppm to half the test plots and 60ppm to the other half between the 2nd and 8th week of the season. Between week 9 and 18, during the fruiting period, all varieties received an equal amount of potassium nitrate. All plants received an equal amount of ammonium phosphate fertilizer in the first week following transplanting in May (see table 4).

The different fertilizer levels had a significant effect on the fruit production of the varieties under row covers and a minimal to negative effect on the production of fruit on the varieties without row covers. Under row covers, the Kent variety receiving 30ppm of calcium nitrate (CaNO3) only produced 77% of Kent that received 60ppm; and the Cavendish variety receiving 30 ppm produced 76% of the Cavendish receiving 60ppm CaNO3. Without row covers, the Cavendish that received less fertilizer managed to produce 93% as much fruit as the plants receiving the higher rate and in the Kent there was actually a slight (less than 1%) decrease in production for the plants receiving the higher rate of fertilizer (see table 5 on the next page).

The major difference seen in fruit production in 2003, was between the plants with row covers and those without. Without row covers, Cavendish averaged 65% of the production of the same variety using covers and Kent without row covers averaged 85% of production of Kent with row covers. Overall, Cavendish was not as productive a variety as Kent , averaging 80% of Kent's production with row covers and less than 60% of Kent's production when no row covers were used. Just under 10% of total production was culled due to either insect or bird damage, rot, or poor pollination resulting in small misshaped berries.

~ Table 4 ~

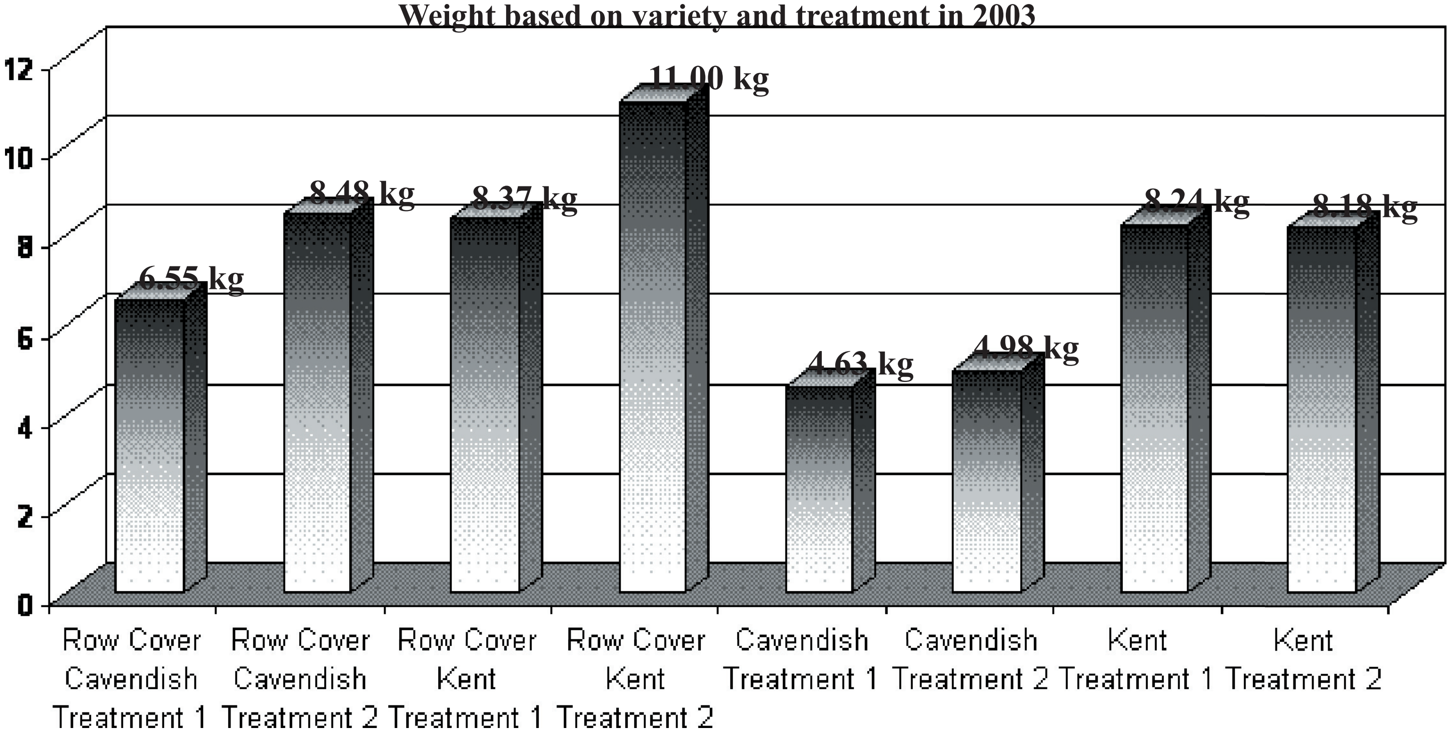
Fertilizer treatment schedule 2003

	Week 1 May 20 - 27	Week 2-8 May 28 - July 16	Week 9-18 July 17 - Sept 18
Fertilizer Treatment 1	4.15kg 10-52-10 / tank	0.97kg 15.5-0-0 / tank	0.393kg 13-0-46 / tank
Fertilizer Treatment 2	4.15kg 10-52-10 / tank	1.94kg 15.5-0-0 / tank	0.393kg 13-0-46 / tank

Tanks are 1100 Imperial Gallons (5000 Litres)

The results listed in graph 1 are from a mix of 1st and 2nd year plants. These results are based on the harvest weight of fruit, the cull weight is not included.

~ Graph 1 ~
Weight based on variety and treatment in 2003



Soil pH in the strawberry rows averaged 6.9 (neutral) and organic matter averaged 2.1% (normal).

2003 Raspberry Results

2003 was still a stock building year that saw excellent primocane development for fruiting in 2004. No fruit was picked in 2003 so there was no assessment done on different fertilizer treatments.

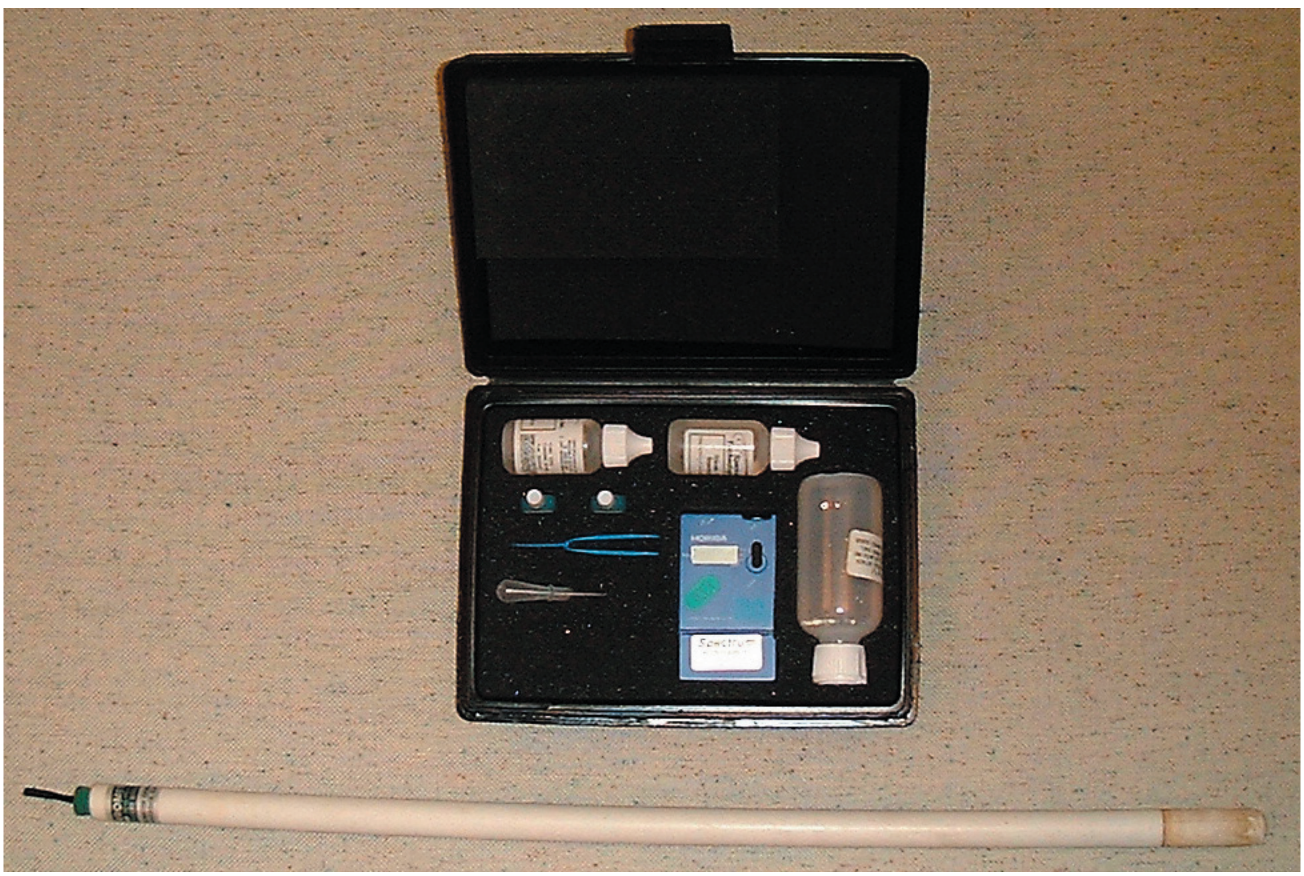
Soil pH in the raspberry rows averaged 6.6 (neutral) and organic matter was 2.1% (normal).

Using a moisture sensor, weekly in row moisture test were taken in the raspberry plots to check the automated water delivery. In row moisture averaged 22±1% over 140 samples. The permanent wilting point for the Lewes soils is between 10-16% and the feild capacity is anywhere from 21-35%, therefore the irrigation system

Soil Nitrogen Movement in Hay Crops Under Irrigated Conditions

Two 30 x 40 meter forage plots were seeded at the Takhini test site on July 31, 2003. One of the plots was seeded with “Carlton” smooth bromegrass, the most common forage species grown in the Yukon and the other was seeded with “Climax” timothy, a species grown in the Watson Lake and Dawson City regions where the soils are more acidic and rainfall is more common than around Whitehorse.

The initial purpose of the trial will be to record the movement of fertilizer nitrogen in the soil under irrigated field conditions. Irrometers (porous ceramic tubes) will be placed at different depths throughout the plots to capture fertilizer nitrogen in solution at different times throughout the growing season.. This solution is then analyzed for nitrate nitrogen (NO_3) content using a Cardy Nitrate Sensor. This information, combined with irrigation records and local climate data, will help determine how nitrogen moves in Takhini Valley soils and how it should be applied to achieve the best forage result. Rooting depth and variety response will also be monitored to determine best fertilizer management practices for timothy and smooth bromegrass under Takhini Valley soil and climate conditions.



~ Photo 2 ~
Cardy nitrate sensor and irrometer

Range Improvement Trial

In collaboration with Patricia Smith

Introduction

During the growing seasons of 2002 and 2003, a study was conducted on the effects of fertilizer on Yukon rangeland. The fertilizer trial compared the grazing capability of unfertilized native Yukon range to rangeland fertilized with varying levels of potassium, phosphate and nitrogen. The study looked at the productivity and nutrient level in plants palatable to livestock and the productivity of unpalatable plants under the various fertilizer treatments.

Study Site & Design

The study site, which is located at the Gunnar Nilsson and Mickey Lammers Research Forest near the Takhini River, is on a slope with a southeast aspect. The vegetation consisted of native grasses, forbs and a few shrubs. This type of plant community is commonly found in Yukon grazing agreements.

Three fairly homogeneous blocks each of 6.5 m x 6.5 m area were selected for the study. Each block was divided into 1 m x 1 m plots with a .5 m buffer zone separating each plot. The plots were hand fertilized in a randomized block design with varying levels of ammonium nitrate, phosphate and potassium in the following manner:

~ Diagram 2 ~
Fertilizer trail design

No Fertilizer		N 50lbs/ac		N 75lbs/ac		N 100lbs/ac
-- 1 meter --	0.5 m					
P 40lbs/ac		N 50lbs/ac P 40lbs/ac		N 75 lbs/ac P 40lbs/ac		N 100lbs/ac P 40lbs/ac
P 80lbs/ac		N 50lbs/ac P 80lbs/ac		N 75lbs/ac P 80lbs/ac		N 100lbs/ac P 80lbs/ac
P 60lbs/ac		N 50lbs/ac K 60lbs/ac		N 75lbs/ac K 60lbs/ac		N 100lbs/ac K 60lbs/ac

Before starting the study in 2002, soil samples were taken from each block and analyzed for levels of nitrogen, potassium, phosphorus and sulphur.

Before any fertilizer was added in 2003, soil samples were taken from three plots that had been treated with different fertilizer regimes the previous year.

In 2002, the plots were fertilized on May 28, and in 2003, the plots were fertilized on June 3. The blocks were monitored over the course of both growing seasons and harvested on August 26 in 2002 and on August 27 in 2003. Harvesting for each plot involved identifying each plant present, categorizing plants as desirable or undesirable for grazing and removing them at the level that grazing livestock would.

The productivity (g/m) of each plot for both categories of plant was determined by drying and weighing plants. Desirable plants from plots of similar treatment from the three blocks were

~ Table 5 ~
2002 and 2003 soil nutrient levels before application of fertilizer
(Sample taken from 0 – 6 inches and extrapolated to total lbs/ac)

	Nitrogen lbs/ac	Phosphorus lbs/ac	Potassium lbs/ac	Sulphur lbs/ac
Range of values from soil sampled in 2002 before study	< 2	20-26	369-532	7-9
2003- soil from plot treated in 2002 with 50 lbs/ac N & 80 lbs/ac P	< 2	120	534	74
2003-soil from plot treated in 2002 with 75 lbs/ac N & 60 lbs/ac K	< 2	64	351	29
2003-soil from plot treated in 2002 with 100 lbs/ac N & 60 lbs/ac K	3	49	387	29

pooled and analyzed for protein and mineral levels. An average value was determined for each fertilizer treatment. Plants from plots fertilized with the highest nitrogen level were analyzed for nitrate level. Precipitation values for the area for the time of the study were obtained from the federal weather station located at the Research Forest.

Results

Soil was deficient in nitrogen on all soil tests done in 2002 and 2003. In 2002, soil was deficient in phosphorus, but in 2003 all soil samples had marginal to optimal levels of phosphorus. In both years, all soil samples had optimal levels of potassium.

Precipitation

The amount of precipitation from May to August in both 2002 and 2003 was slightly less than the thirty year normal for this time. According to the thirty year normal values, little precipitation falls in May, and precipitation is fairly evenly distributed over June, July and August. In 2002, very little rain fell in June. Almost 50% of the growing season precipitation fell in July. In 2003, July also received almost 50% of the growing season precipitation, but in contrast to 2002, August of 2003 received very little precipitation while June received almost normal amounts.

Observations

During June 2002, there was very little rain in the study area, and plant growth was less than most years. During an inspection on July 5, 2002, fertilizer pellets were still present on top of the ground. However, following rainfall in mid July, the fertilizer was absorbed by the soil. Considerable plant growth was obvious on an inspection in mid August. When the study site was harvested on August 26, plants from areas treated with fertilizer were deeper green than plants in unfertilized areas outside the study blocks.

In 2003, more rain fell in June than in the previous year so the fertilizer pellets were absorbed by the soil earlier in the season than in 2002, and plant growth also occurred earlier in the season. By mid July, there was considerable plant growth in all three test blocks. Areas treated with fertilizer were obviously more productive than untreated areas. By the time of harvest at the end of August, plants in areas treated with fertilizer were deeper green than plants in untreated areas.

Plant Identification:
Plants identified in 2002 and 2003 were:

Plants desirable for grazing:	**Plants undesirable for grazing:**
Calamagrostis purpurascens	*Arctostaphylos uva-ursi*
Festusca saximontana	*Artemisia frigida*
	Solidago decumbens
	Achillea millefolium
	Rosa acicularis
	Oxytropis splendens
	Fragaria virginiana

	Populus tremuloides

<u>Productivity</u>:

Grasses:

• In 2002 and 2003, the average productivity for all plots that were treated with nitrogen was greater than that of plots that were untreated. The increase in productivity of grasses with added nitrogen ranged from 1.7 to 2.4 times.

• In 2002, treating the soil with 50 lbs/ac of nitrogen increased productivity the same amount as treating the soil with 100 lbs/ac of nitrogen, but in 2003 the increase in productivity of grasses was proportional to the amount of nitrogen added.

• In 2002 and 2003, treating the soil with 60 lbs/ac of potassium did not increase productivity compared to untreated soil.

• In 2002, treating the soil with 40 lbs/ac of phosphate increased productivity of grasses by 50%, however treating the soil with 80 lbs/ac of phosphate did not increase productivity compared to untreated soil. In 2003, untreated soil and soil treated with phosphorus had similar levels of grass productivity.

Weeds:

• In 2002 and 2003, the average productivity of weeds for all plots that were treated with nitrogen was higher than the productivity of untreated plots.

• In 2002 and 2003, the increase in productivity of weeds was proportional to the amount of nitrogen added.

• In 2002 and 2003, adding 50 lbs/ac of nitrogen increased productivity from 2.2-2.5 times that of plots that were untreated; adding 75 lbs/ac of nitrogen increased productivity from 2.9-3.3 times that of untreated plots and adding 100 lbs/ac of nitrogen increased productivity from 3.7-5.2 times that of untreated plots.

• In 2002 and 2003, treating soil with 40 lbs/ac or 80 lbs/ac of phosphate had no effect on weed productivity compared to untreated areas.

• In 2002 and 2003, treating soil with 60 lbs/ac of potassium did not change productivity compared to untreated areas.

<u>Feed Analysis</u>:

Crude Protein (see Table 6):

• In 2002, the average crude protein level from grass harvested from untreated plots was 9.2%, and in 2003 it was 10.8%.

• In 2002 and 2003, the average crude protein level from grass grown in plots that were treated with nitrogen was higher than the average crude protein level of grass from untreated plots.

• In both years, the increase in crude protein levels in grass was proportional to the amount of nitrogen added to the soil.

• In 2002, grass harvested from soil treated with 100 lbs/ac had average crude protein levels of 15.5%. In 2003, grass from plots treated with 100 lbs/ac of nitrogen had average crude protein levels of 15.8%.

• In 2002, adding phosphate to the soil did not increase the crude protein level of the grass grown, however in 2003, plants grown on soil treated with 40 lbs/ac of phosphate had higher crude protein levels than plants grown on untreated plots.

• In 2002, adding potassium to the soil did not increase the crude protein level of the grass grown. However in 2003, plants grown on soil treated with 60 lbs/ac of potassium had higher crude protein levels than plants grown on untreated plots.

Minerals:

• In 2002 and 2003, the level of phosphorus in plants did not vary significantly among plants grown on untreated soil and soil treated with nitrogen, phosphorus or potassium.

• In 2002 and 2003, the level of potassium was slightly higher in plants grown on soil with added potassium and nitrogen than in plants grown on untreated soil and soil treated with phosphorus.

• In 2002, the level of nitrates in plants grown on soil with 100 lbs/ac of added nitrogen was .02%. In 2003, soil with the highest amount of added nitrogen had nitrates levels of <0.01%.

Discussion

The Agriculture Branch administers the Yukon Government Grazing program where public land is leased to livestock owners for the purpose of grazing. Currently, the Grazing Policy permits

~ Table 6 ~
Average Crude Protein levels in grass with various fertilizer treatments

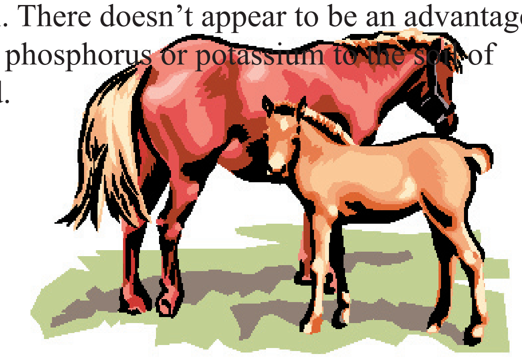
	Nothing added	Phosphate 40 lbs/ac	Phosphate 80 lbs/ac	Potassium 60 lbs/ac	Nitrogen 50 lbs/ac	Nitrogen 75 lbs/ac	Nitrogen 100 lbs/ac
2002	9.2%	9.0%	9.3%	8.4%	13.1%	14.7%	15.5%
2003	10.8%	12.5%		12.1%	13.9%	15.0%	15.8%

grazing lease holders to undertake minimal range improvement. The Agriculture Branch is attempting to broaden the options available for range improvement on Yukon grazing leases. The purpose of this trial was to study the effects of adding fertilizer to Yukon rangeland, and to try to determine if this is a feasible method of range improvement on grazing leases.

During both years of this trial, adding phosphate and potassium to the soil did not significantly increase productivity of grasses or weeds, but adding nitrogen to the soil increased the productivity of both grasses and weeds. The increase in productivity was proportional to the amount of nitrogen added to the soil, however the productivity of weeds increased much more than the productivity of grass. Soil fertilized with nitrogen produced up to 2.4 times as much grass as unfertilized soil and up to 5.2 times as many weeds. This indicates that the limiting factor for plant growth in the study area was the soil level of nitrogen. This was not surprising as soil analysis done before the trial started showed that soil in the study area had very low levels of nitrogen, was deficient to marginal in phosphate and had optimal levels of potassium.

Grass grown on soil fertilized with nitrogen had significantly higher levels of crude protein than grass grown on unfertilized soil. This is expected as plants require nitrogen to produce protein. Adding potassium to the soil did not increase the crude protein level of grass in either year of the trial, however in 2003, grass grown on soil treated with phosphorus had higher levels of protein than grass grown on untreated soil. The reason for this is not known, but one possibility is that the added phosphorus allowed the plants to grow more vigorously thereby increasing their overall protein level.

In 2003, the protein level of grass grown on untreated soil was 1.6% higher than the protein level of grass grown on untreated soil in 2003. This indicates that the protein level of grass grown on the same untreated soil varies from year to year. This is possibly due to precipitation differences. Although the years 2002 and 2003 received a similar amount of total rainfall from May to August, it was distributed differently over the growing season.
Normally, plants convert nitrates to protein. Sometimes with stress or high nitrate soil levels, nitrates accumulate in the plants. This can be toxic to livestock. Nitrate levels under 0.5% are considered safe. Plants that were grown on soil fertilized with 100 lbs/ac of nitrogen in both years of the trial had nitrate levels below this toxic level indicating this would not be a problem on fertilized rangeland.
The results of this trial suggest that applying fertilizer is not an economically feasible method of rangeland improvement because applying fertilizer to rangeland causes weeds to significantly outgrow grasses. Since adding nitrogen to soil does increase the growth of grasses as well as the crude protein level, adding nitrogen to stands of native grass where there is little weed growth might be beneficial. There doesn't appear to be an advantage to adding phosphorus or potassium to the soil of rangeland.



Small Fruit Variety Trial

In collaboration with Gary Zgeb

Summary

This trial has been succeeded by the input management trial at the Takhini Forestry Farm. Valuable information was gained over the 5 years of this trial that was instrumental in the design of the input management trial. Gary Zgeb, the cooperator in the variety trial, has shifted his focus to suppling spring sales of raspberry canes and strawberry plants and selling fruit at the local farmer's market. Frost patterns in this area make berry production very difficult. There are routinely frosts throughout the growing season, this season the frost free period was limited to 11 days in mid July (see table 8). With such a frosty area it is no surprise that the land capability classification for 2003 is just barely in class 5. Even with soil amendments and row covers, commercial berry production is always going to be a challenge on this farm. This location is not a suitable indicator of the commercial viability of berry production in the southern Yukon. The input management trial will provide further data for commercial operators to analyze. We will continue to monitor temperatures at Gary Zgeb's and will work with him on techniques to minimize frost damage.

~ Table 7 ~
Agroclimatic data for the 2003 growing season at the Zgeb Berry Farm

Climate Factor	May	June	July	August	Total
Max Temp (°C)	21.7	29.9	31.9	30.7	
Min Temp (°C)	-10.6	-4.8	-1.5	-5.3	
Daily Mean (°C)					
Growing Degree Days	46.8	198.1	304.5	51.8	601.2
Effective Growing Degree Days *	55.2	233.8	359.3	61.1	709.4
Frost Free Period			July 6 - 17		11 days
Killing Frost Free Period (-2.2 °C)		June 16	------------------	Aug 8	54 days

* The temperature factor is adjusted upward by 18% to account for the boost plants receive from the long hours of daylight north of 60° latitude.

~ Photo 3 ~
Cavendish strawberries

Little Salmon Carmacks First Nations Gardening Project

In collaboration with Dawn Charlie

Summary

In February 2000, representatives from the Little Salmon Carmacks First Nation (LSCFN) met with agriculture branch staff to ask for technical advice assisting in the development of a community gardening project. The agriculture branch has provided soil test analysis and recommendations, on site weather data and technical information on cold storage and greenhouse design.

The site chosen for the LSCFN garden is along the banks of the Yukon River with easy access to water. The only drawback of the location is that it is only accessible by canoe or along an ATV road. This past summer the site had an above average agroclimatic rating with at least 107 day killing frost free period and 1124 EGDD. This is a class 3 climate, one class above the 30-year normal classification for this area. As shown by the table 9 below, mean temperatures were only slightly above normal throughout the growing season.

The project is growing and we will continue to provide agroclimatic information to LSCFN and assist with technical advice.

~ Table 8 ~

Agroclimatic data for the 2003 growing season at the Little Salmon Carmacks First Nations Farm

Climate Factor	May	June	July	August	September*	Total
Max Temp (°C)	21.0	24.8	30.0	30.7	21.3	
Min Temp (°C)	-6.3	0.7	3.7	-2.0	-9.5	
Daily Mean (°C)	8.0	13.0	17.0	12.7	8.9	
30 Year Normal Mean**	8.0	13.4	15.5	12.7	6.5	
30 Year Normal Precipitation (mm)**	24.7	38.2	55.2	39.5	27.8	185.4
Growing Degree Days	76.1	239.3	371.4	238.5	27.2	952.4
Effective Growing Degree Days***	89.8	282.4	438.3	281.4	32.1	1123.9
Frost Free Period***	May 22	---------------	---------------	Aug 8		79 days
Killing Frost Free Period (-2.2 °C)	May 22	---------------	---------------	---------------	Sept 5	107 days

* Minimum, maximum and mean temperatures only recorded until September 21st
** 30 year normals are derived from the Pelly Farm weather station 1971-2000
*** The temperature factor is adjusted upward by 18% to account for the boost plants receive from the long hours of daylight north of 60° latitude

~ Table 9 ~
Summary of weather data 1995-2003 for the Carmacks area

Year	1995 *	1997 *	2000	2001	2002	2003
EGDD	957.0	1275.6	1024.4	1075.8	@1039.6	1123.9
Land Capability Class	Class 4	Class 2	Class 4	Class 3	Class 4	Class 3
Frost Free (days)			100 days	98 days	93 days	79 days
Killing FF (days)		116 days	111 days	105 days	@112 days	107 days
Max Temp (°C)	21.9	31.7	35.1	33.2	30.0	30.7

@ = approximate
* Data from the McCabe Creek trial 50 kms North of Carmacks
The 30-year normal EGDD for Carmacks is 1002.0

~ Photo 4 ~
Carmacks gardening project

References

Hill, T., and Ball, M. 2002. Yukon Agricultural Research and Demonstration 2002 Progress Report. Yukon Energy, Mines & Resources, Agriculture Branch.

Hill, T., and Sproule, B. 1996. Yukon Agriculture Research and Demonstration Report No.2 1996 Field Season. Yukon Renewable Resources, Agriculture Branch.

Tarnocai, C., Smith, C.A.S., and Beckman, D. 1988. Agriculture potential and climate change in Yukon. *In* Proceedings of the Third Meeting on Northern Climate, September 7-8, 1988, Whitehorse, Yukon. Atmospheric Environment Service, Environment Canada, Downsview, Ontario, pp. 181-196.

Useful Internet Resources

Agriculture and Agri-Food Canada
http://www.agr.ca

Alberta Agriculture
http://www.agric.gov.ab.ca

BC Agriculture
http://www.gov.bc.ca/agf/

University of Alaska Fairbanks
http://www.lter.uaf.edu

Western Producer
http://www.producer.com

Yukon Agricultural Association
http://www.yukonaa.com/

Yukon Agriculture Branch
http://www.emr.gov.yk.ca/Agriculture/default.htm

Appendix 1

Raspberry Variety Descriptions

Boyne – Developed at the Agriculture Canada Research Station at Morden, Manitoba and introduced in 1960, it is a combination of Chief and Indian Summer. It is the hardiest and most consistently productive cultivar for the Prairies; and the main cultivar for commercial production in all colder regions of Canada and the United States. Canes are medium in height, thick, erect and stocky, with many lateral branches. Fruit is medium sized, dark red, firm, juicy, aromatic and tart.

Double Delight – Developed by Agriculture Canada Research Station, Morden Manitoba, it is a combination of Fall Red, native primocane fruiting type, Cheyenne, Wyoming, Fall Red, and Boyne. Double Delight canes are stout with sparse, short spines and grow to a height of 5 feet. The medium red berries are sweet, tart and excellent.

Honey Queen – Introduced by Robert Erskine from Alberta's Rocky Mountain House in the mid-sixties. It is the hardiest of the yellow raspberries. It has good-sized, aromatic berries that have a mild but entirely different flavour than the red berries. The berries are considered soft, and poorly suited to freezing and processing, but are excellent fresh.

Kiska – Developed by Dr. Arvo Kallio at the Agricultural and Forestry Experiment Station, Fairbanks Alaska. Kiska raspberries have thin, willowy canes. Under optimum fertility and moisture, canes may easily reach 6-8 feet in height. These canes tend to bend outward and downward making harvesting difficult.

Red River – Selected in 1978 at the Agriculture Canada Research Station, Morden Manitoba, it is a combination of Fall Red, native primocane fruiting type, Cheyenne, Wyoming, Fall Red, and Boyne. Red River fruits earlier than other selections tested. It has medium red berries that are sweet, tart and good. Canes are relatively short and stout with sparse short spines, and grow to a height of 3.5 feet.

Souris – Developed by Agriculture Canada Research Station, Morden Manitoba. An improved selection of Boyne because it is better tasting, a heavier producer of fruit and it has 15% better spider mite resistance.

SK Red Mammoth – Developed by the Department of Plant Science at the University of Saskatchewan, it is a variant of Muskoka. It is a large-fruited, red raspberry with yields similar to Boyne, but with longer shelf life.

SK Red Bounty – Developed by the Department of Plant Science at the University of Saskatchewan, it is a combination of Trent and Fraser. It is superior to Boyne in both yeild and winter hardiness. The berries show good resistance to skin injury.

Appendix 2

Strawberry Variety Descriptions

Bounty – Developed in 1972 by Agriculture Canada, it is a cross between Jerseybelle and Senga Sengana. Produces medium to high yields of dark red berries which have a very good flavour when fully ripe. King berries are large but size drops quickly for later fruit. Berries are medium firm and hull easily. Plants are susceptible to red stele (caused by the fungus *Phytophthora fragariae*) and green petal. Makes a jam with excellent flavour. Suited to Pick Your Own (PYO).

Cavendish – Developed by Agriculture Canada in 1990, it is a cross between Glooscap and Annapolis. This variety produces high yields of very large, medium firm to firm fruit. Flavour is good but berries are prone to excessive darkening when overripe and colour can be variable with white blotches evident under some conditions. Plants show low to medium vigour so planting densities should be increased. Resistant to red stele (A-6) but susceptible to powdery mildew and green petal. Suited to PYO or limited shipping.

Glooscap – Developed by Agriculture Canada in 1983, it is a cross between Micmac and Bounty. Produces high yields of medium to large, dark red fruit. Berries are medium firm with good flavour. Plants are vigorous and winter hardy. Susceptible to red stele (A-6) and green petal. Suited to PYO. Symptoms resembling June Yellows have been observed.

Honeyoye – Developed in 1972 by the New York State Agricultural Experiment Station, it is a cross between Vibrant and Holiday. Produces high yields of medium to large, attractive, medium firm berries which are prone to excessive darkening when overripe. Green tip may be observed, particularly on king berries. Honeoye produces ample pollen and has some tolerance to tarnished plant bugs and thereby consistently develops well formed fruit. Fruit flavour is variable and can be quite acid on some sites. Plants are vigorous and they runner well.

Kent – Developed by Agriculture Canada it is a cross between Redgauntlet, Tioga and Raritan. Produces very high yields of large, bright red fruit. Berry flesh is firm but skin may be weak in hot weather. Flavour is fair to good. Has shown some tolerance to red stele (A-6) in some fields. Suited to PYO and limited shipping. Kent is the most widely grown strawberry variety in eastern Canada.

Toklat – Developed in the 1960s by Arvo Kallio at the University of Alaska Experimental Station. It is a recommended perennial "June bearing" strawberry plant which are July-bearing in Fairbanks, Alaska for about two weeks. The strawberry will die if the temperature dips below –6.5^{o}C, but a covering of snow will usually help insulate the plant. Other virtues of the perennial Toklat are its large size, firmness and pleasingly red hue. Toklats produce a lot of runners, which unless controlled will limit fruit production.

Appendix 3

Hay Variety Descriptions

Carlton - Registered in 1961 by Agriculture and Agri-Food Canada in Saskatchewan. A grass suited to the north with high forage and seed yeilding characteristics.

Climax - Registered in 1947 by Agriculture Canada in Ontario. A grass suited for pastures with cool moist peat soils. This timothy is a winter hardy, medium late maturing perennial bunch grass that lives for 4 to 8 years. Withstands spring flooding and acidic soils.

Glossary

Atmometer - An instrument used for measuring evaporation.

CR-10 - Campbell Scientific datalogger.

Irrometer - Soil water sampling device.

Evapotranspiration - The combined water loss due to evaporation from the soil surface and transpiration of plant leaves.

EGDD - Effective Growing Degree Days are an upward adjustment made to the GDD value to account for the boost plants receive for the long daylight hours as you head north.

GDD - Growing Degree Days can be calculated in a number of ways, we calculate them by beginning the fifth consecutive day with mean temperatures above 5^{o}C, and terminated the day of the first killing frost (-2.2^{o}C) which occurs after mid-July.