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RAIN
RURAL AGRI-INNOVATION NETWORK

2015 Agricultural Research Summary

Compiled by Christine O'Reilly, RAIN Research Technician

This document is a collection of the research notes summarizing results from field projects in 2015.

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Some data analysis was completed by Christine O'Reilly, Research Technician (2016).

Table of Contents

2015 Crop Report: Canola	3
2015 Crop Report: Soybeans	4
Fodder Trees: 2015 Yield and Analysis	5
2015 Sheep Production Report on Fodder Trees Diet	7
2015 Sheep Preferences of Fodder Trees	9
Economic Analysis and Practical Applications of Fodder Trees	11
2015 Keyline Report	13
2015 Pasture Improvement Demonstration and Assessment Report: Spanish River Carbonatite	15
2015 Pasture Improvement Demonstration and Assessment Report: Grazing Management	16

RAIN Research Note 020316

Crop Variety Trials: 2015 Canola Report

Bayer CropScience provided canola seed for testing in Algoma.

Variety InVigour L130 yielded 0.96 tons/acre at 9.4% moisture.

Thanks to Craig and Sandy Holmberg for their hard work in making this trial a success.

RAIN hopes to continue testing a range of crop types and varieties in 2016. Producers interested in assisting with this project are asked to please contact:

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Ten acres of canola were grown in 2015 with a grower co-operator near Echo Bay. Bayer CropScience provided seed for variety InVigor L130.

Previous crop was a long-term hay field. Canola was planted the first week in June and harvested September 24th. No additional nutrients were applied to the crop.

Dry yield (tons/acre)	0.957
Moisture (%)	9.4
Grade	1.0
Unit Price ($/ton)	466.70

The grower reported no economic difference between growing canola and horse hay that year.

Historic Yields

In 2004, nine canola varieties were tested in the Portlock area. Yields on these small plots ranged from 0.44 – 0.95 tons/acre with an average of 0.72 tons/acre. The trial was planted June 8th and harvested in mid-November.

RAIN Research Note 160316

Crop Variety Trials: 2015 Soybean Report

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Three cold-hardy varieties of soybean were grown in 2015 with a grower co-operator near Thessalon. NorthStar Genetics (Winnipeg, MB) provided seed for NSC Moosomin, NSC Gladstone, and NSC Reston.

Soybeans were planted on June 11; Moosomin and Gladstone at a rate of 67 lb/ac and Reston at 87 lb/ac. Harvest was on October 14. The varieties tested were rated for 105 – 112 days to maturity.

Variety	Density (plants/acre)	Height (inches)	Pods/plant	Ht. to lowest pod (inches)	Yield (tons/acre)
NSC Moosomin	178,118	15.75	22	1.63	1.01
NSC Gladstone	191,456	19.92	23	2.29	0.91
NSC Reston	251,689	20.27	13	2.28	1.13

NorthStar Genetics provided three soybean varieties for testing in Algoma.

Yields as follows:

NSC Moosomin: 1.01 tons/acre

NSC Gladstone: 0.91 tons/acre

NSC Reston: 1.13 tons/acre

Thanks to Matt Seabrook for his hard work in making this trial a success.

NorthStar Genetics

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Ontario Northern Ontario Heritage Fund Corporation / Société de gestion du Fonds du patrimoine du Nord de l'Ontario

RAIN Research Note 130416

Fodder Trees: 2015 Yield and Nutrient Analysis

This research note is part of a series detailing results from different facets of the trial. For more information, see:

2015 Sheep Production Report on Fodder Tree Diet

2015 Sheep Preferences of Fodder Trees

Economic Analysis and Practical Applications of Fodder Trees

RAIN has partnered with the Ontario Sheep Marketing Agency to investigate whether fast-growing, coppiced trees can be a nutritionally and economically viable fodder source for sheep. This project is taking place over the 2015 and 2016 growing seasons near Sault Ste Marie.

Thanks to our farmer co-operators Collen Alloi and Brent Atwell for their assistance with this project.

ONTARIO Sheep MARKETING AGENCY

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RAIN RURAL AGRI-INNOVATION NETWORK

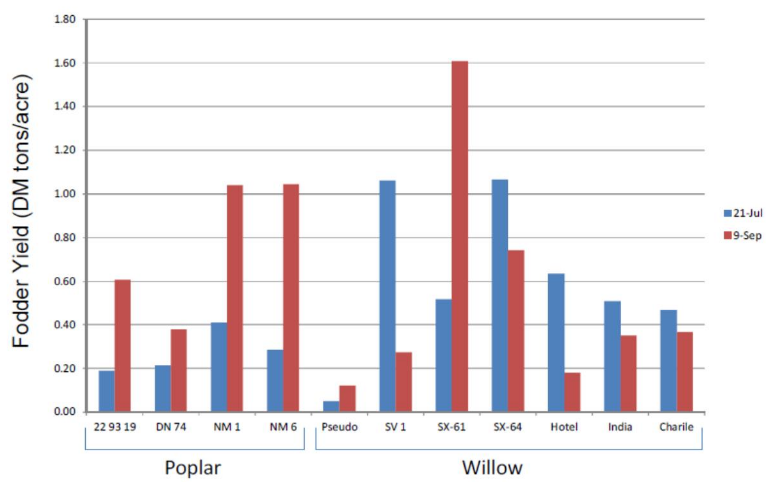
Method

In 2007, a short rotation woody coppice plantation was established by the Canadian Forest Service to assess the potential of fast growing willow and poplar for bioenergy. A section of this plantation was fenced off and split into four 0.75 acre paddocks. Trees were cut to 4" and allowed to regrow to heights of 12-24" before sixty mature, dry, Arcott Outaouais ewes rotationally grazed the new re-growth. Outside the grazed area, three species of native trees (Speckled Alder, Trembling Aspen, and White Birch) were also coppiced for comparison with the domestic varieties. Samples of the new growth were taken to determine dry matter yields and nutrient content of the tree re-growth.

Results

Tree Yield: Dry matter (DM) yield was assessed at two times during the growing season. Yields of tree crops in July ranged from 0.05 tons/acre to 1.07 tons/acre with an average of a 0.49 tons/acre. This sample included the entire succulent stem. In September, DM yields for leaves only ranged from 0.12 tons/acre to 1.61 tons/acre with an average of 0.61tons/acre.

Figure 1. Dry matter yield (tons/acre) in the existing arrangement of fast growing willow and poplar fodder varieties for July and September 2015.



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Ontario Northern Ontario Heritage Fund Corporation / Société de gestion du Fonds du patrimoine du Nord de l'Ontario

Nutritional Content of Trees: Leaf samples were sent to A&L Laboratories Canada for macro- and micro-nutrient analysis. Nutrient levels were reported for nitrogen (N), sulphur (S), phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), sodium (Na), copper (Cu), boron (B), zinc (Zn), manganese (Mn), iron (Fe), aluminum (Al), and molybdenum (Mo).

The data were analyzed to compare different groups of trees as follows:

1) Domestic (ie: artificially selected hybrids of fast-growing willow and poplar) vs native trees
2) All willow (genus *Salix*) vs all poplar (genus *Populus* – includes native Trembling Aspen)
3) Domestic willow (genus *Salix* – all willows were domestic) vs domestic poplar (genus *Populus*)

Figure 2. Sheep grazing coppiced regrowth

There were no statistically significant differences between any of the above tree groups for N (which is closely related to crude protein content), Na, B, Zn, Fe, or Mo.

Domestic tree varieties had significantly higher levels of S and Mg than native trees.

When comparing all willows to all poplars, willows had significantly higher levels of S, Mg, Ca, and Al. Poplars had significantly higher levels of K and Cu.

Some results changed when native Trembling Aspen was removed from the poplar group. When comparisons between willows and poplars were done using only domestic trees, willows had significantly higher levels of P, Mg, Ca, Mn, and Al. Poplars had significantly higher levels of Cu.

Table 1. Nutrient analysis of tree leaves

Genus	Variety	N (%)	S (%)	P (%)	K(%)	Mg (%)	Ca (%)	Na (%)	B (ppm)	Zn (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)	Al (ppm)	Mo (ppm)
Populus	2239-19	2.04	0.56	0.13	0.72	0.34	0.96	0.01	17	167	153	133	12	55	0.01
Populus	DN	1.89	0.41	0.11	1.32	0.25	0.51	0.01	8	124	119	166	9	31	0.01
Populus	NM-1	1.72	0.55	0.13	1.06	0.34	1.03	0.01	26	196	155	195	11	48	0.01
Populus	NM-6	2.12	0.27	0.12	1.22	0.23	0.79	0.02	17	224	256	308	11	50	0.01
Salix	Charlie	1.68	0.75	0.17	0.7	0.69	1.97	0.01	26	100	189	170	6	99	0.01
Salix	Hotel	2.17	0.72	0.18	0.76	0.53	2.19	0.01	29	164	315	86	8	58	0.01
Salix	India	1.69	0.78	0.16	0.54	0.71	2.08	0.01	14	218	963	240	7	89	0.01
Salix	Pseudo	1.66	0.38	0.16	0.67	0.48	1.77	0.01	18	69	125	164	5	103	0.01
Salix	SV-1	2.2	0.71	0.33	0.6	0.44	2.18	0.01	19	196	480	207	7	68	0.116
Salix	SX-61	1.74	0.59	0.16	0.78	0.35	2.87	0.01	0.18	247	481	136	6	67	0.01
Salix	SX-64	1.69	0.58	0.16	0.99	0.31	2.21	0.01	14	233	527	238	7	87	0.348
Native Trees															
Alnus	Speckled Alder	2.22	0.15	0.12	0.45	0.24	0.56	0.02	4	37	206	145	8	67	0.01
Betula	White Birch	2.03	0.12	0.48	0.99	0.18	0.98	0.01	19	194	113	212	5	74	0.01
Populus	Trembling Aspen	2.74	0.25	0.22	0.93	0.23	1.94	0.02	9	325	295	130	12	53	0.01

RAIN Research Note 270416

2015 Sheep Production Report on Fodder Tree Diet

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Thanks to our farmer co-operators for their assistance with this project.

ONTARIO Sheep MARKETING AGENCY

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Method

In 2007, a short rotation woody coppice plantation was established by the Canadian Forest Service to assess the potential of fast growing willow and poplar for bioenergy. A section of this plantation was fenced off and split into four 0.75 acre paddocks. Trees were cut to 4" and allowed to regrow to heights of 12-24" before sixty mature, dry, Arcott Outaouais ewes rotationally grazed the new re-growth. Outside the grazed area, three species of native trees (Speckled Alder, Trembling Aspen, and White Birch) were also coppiced for comparison with the domestic varieties. Samples of the new growth were taken to determine dry matter yields and nutrient content of the tree re-growth.

Results

Sheep Weight and Body Condition Score:

Animal performance declined generally and could be attributed to numerous factors besides diet, such as stress due to change in environment (ewes were used to barn), absence of grain in their diet, and being older ewes. Sheep lost on average 3.9 lbs. over the four week period. Body condition scores were the same before and after grazing. This indicates that trees alone do not provide enough energy for ewes to maintain their weight, and a complimentary feed source would be required to meet sheep energy demands in a fodder tree system.

Figure 3. Arcott Outaouais ewes rotationally grazing coppiced trees

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Nutritional Value of Trees:

Leaf samples were sent to A&L Laboratories Canada for macro- and micro-nutrient analysis. Nutrient levels were reported for nitrogen (N), sulphur (S), phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), sodium (Na), copper (Cu), boron (B), zinc (Zn), manganese (Mn), iron (Fe), aluminum (Al), and molybdenum (Mo).

The Nation Research Council (NRC) provides nutritional guidelines and recommendations for livestock. Based on the NRC guidelines for ewe maintenance requirements (ie: not growing, breeding, pregnant, or lactating), the trees in this study provided adequate levels of crude protein, calcium, magnesium, potassium, and sulphur. Some trees provided adequate phosphorus, but none of the trees contained enough sodium to meet ewe requirements.

For micronutrients (trace minerals), no tree exceeded the maximum tolerable level (MTL) for the sheep; iron, copper, manganese and zinc were all provided at adequate levels. Only molybdenum was deficient across all tree sources.

Table 2. Summary of NRC nutrient requirements for ewes (maintenance) and amounts of nutrient provided by different tree leaves

		Ewe maintenance requirement in a diet that is 100% forages, based on DM content											
		CP (%)	**Ca (%)**	**P (%)**	**Na (%)**	**Mg (%)**	**K (%)**	**S (%)**	**Fe (ppm)**	**Cu (ppm)**	**Mo (ppm)**	**Mn (ppm)**	**Zn (ppm)**
		9.4	0.2 - 0.82	0.16 - 0.38	0.09 - 0.18	0.12 - 0.18	0.5 - 0.8	0.14 - 0.26	30 - 50	7 - 11	0.5	20 - 40	20 - 33
								MTL:	500	25	10	1000	750
Species	**Variety**	**CP (%)***	**Ca (%)**	**P (%)**	**Na (%)**	**Mg (%)**	**K (%)**	**S (%)**	**Fe (ppm)**	**Cu (ppm)**	**Mo (ppm)**	**Mn (ppm)**	**Zn (ppm)**
Poplar	2239-19	12.75	0.96	0.13	0.01	0.34	0.72	0.56	133	12	0.01	153	167
Poplar	DN	11.81	0.51	0.11	0.01	0.25	1.32	0.41	166	9	0.01	119	124
Poplar	NM-1	10.75	1.03	0.13	0.01	0.34	1.06	0.55	195	11	0.01	155	196
Poplar	NM-6	13.25	0.79	0.12	0.02	0.23	1.22	0.27	308	11	0.01	256	224
Willow	Charlie	10.50	1.97	0.17	0.01	0.69	0.7	0.75	170	6	0.01	189	100
Willow	Hotel	13.56	2.19	0.18	0.01	0.53	0.76	0.72	86	8	0.01	315	164
Willow	India	10.56	2.08	0.16	0.01	0.71	0.54	0.78	240	7	0.01	963	218
Willow	Pseudo	10.38	1.77	0.16	0.01	0.48	0.67	0.38	164	5	0.01	125	69
Willow	SV-1	13.75	2.18	0.33	0.01	0.44	0.6	0.71	207	7	0.116	480	196
Willow	SX-61	10.88	2.87	0.16	0.01	0.35	0.78	0.59	136	6	0.01	481	247
Willow	SX-64	10.56	2.21	0.16	0.01	0.31	0.99	0.58	238	7	0.348	527	233
Native Trees													
Speckled Alder		13.88	0.56	0.12	0.02	0.24	0.45	0.15	145	8	0.01	206	37
White Birch		12.69	0.98	0.48	0.01	0.18	0.99	0.12	212	5	0.01	113	194
Trembling Aspen		17.13	1.94	0.22	0.02	0.23	0.93	0.25	130	12	0.01	295	325

*Crude protein content was calculated as 6.25 times the nitrogen content
MTL is maximum tolerable level

These results suggest that, while not a complete feed, the young regrowth of some coppiced trees can be a valuable source of nutrients for sheep. By working with a veterinarian and nutritionist, shepherds may be able to incorporate fodder trees into their management system to provide an alternative source of nutrition for their livestock during the growing season.

RAIN Research Note 110516

2015 Sheep Preferences of Fodder Trees

This research note is part of a series detailing results from different facets of the trial. For more information, see:

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Method

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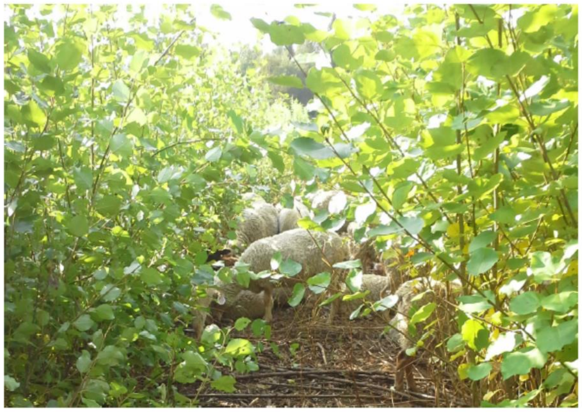

Results

Sheep Preferences

Specific variety preferences were clear; the first species consumed were willow varieties SX-61 and SX-64, sharing similar genetics, qualities and yield. Secondly, sheep preferred to eat willow variety SV-1, then variety Charlie and Pseudo (these last two are tree-type willow varieties rather than shrub-type). Willow variety India was partially consumed and variety Hotel was completely avoided. Hybrid poplar varieties were also avoided, but sheep were witnessed consuming leaves on occasion. Utilization of preferred tree species was 100%.

Domestic tree varieties were ranked 1-5 based on the information above, with 1 being the most preferred. When this data was correlated with the data on nutrients that showed statistically significant differences between domestic tree types, it suggests that sheep were selecting for varieties with higher calcium, and were selecting against varieties with higher copper content.

Ewes requiring a maintenance diet (i.e.: not breeding, in later stages of pregnancy, or lactating) need calcium at 0.2% of their total diet in order to maintain their skeletal system. All leaf samples exceeded this requirement, so it is unlikely that their selection preferences were motivated by calcium content.

Figure 4. Sheep consumption of their two favourite varieties of willow.

Sheep are more likely than any other domestic animal to develop chronic copper poisoning (CCP). Normal plant levels of copper are between 10 and 20 ppm (the tree leaves in this trial were between 5 - 12 ppm). Molybdenum plays a critical role in limiting copper uptake in sheep and preventing toxicity; sheep require at least 0.5 ppm molybdenum in their diet. None of the trees contained more than 0.35 ppm molybdenum. Soil sulphur levels influence molybdenum availability; high levels of sulphur tie up molybdenum and prevent it from regulating copper absorption. The soils on this site had very high sulphur levels, at 19 ppm. Because there may be a nutritional motive for sheep to select against copper content, the Rural Agri-Innovation Network (RAIN) is consulting a sheep nutritionist to determine if there is any evidence that sheep express copper avoidance.

Table 1. Sheep preference ranking and nutrient contents – calcium (Ca) and copper (Cu) - with statistically significant correlations

			Ca (%)	Cu (ppm)
			0.2 - 0.82	7 - 11
			MTL:	25
Species	**Variety**	**Preference Ranking**	**Ca (%)**	**Cu (ppm)**
Poplar	2239-19	5	0.96	12
Poplar	DN	5	0.51	9
Poplar	NM-1	5	1.03	11
Poplar	NM-6	5	0.79	11
Willow	Charlie	3	1.97	6
Willow	Hotel	5	2.19	8
Willow	India	4	2.08	7
Willow	Pseudo	3	1.77	5
Willow	SV-1	2	2.18	7
Willow	SX-61	1	2.87	6
Willow	SX-64	1	2.21	7

RAIN Research Note 250516

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Results

Applicable arrangements and projected yields

Using the information gathered from the first year of this project, we can assess practical arrangements that can be used by sheep producers in a pasture setting. Two arrangements were selected; 1) Full Planting (FP) for windbreaks and fence lines, and 2) Silvopastural planting (SP).

A FP would have a similar density to that on the study site, but would be planted linearly rather than in a full block. This arrangement is appropriate for establishing windbreaks along roadsides or fence lines or in other windy areas on the farm. The full planting stem density with 0.6m (~2ft) spacing between trees creates a population density of 11,242 trees/acre. To use this system as a wind break, trees must be allowed to grow to their full height for the entire growing season and animals introduced prior to leaf fall. Projected yield under this system, using the most productive and preferred willow varieties could be in the range of 1000 – 2500 lbs DM/acre per year **(Figure 1)**.

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The second arrangement, SP, fits with typical rotational grazing systems used by pastured livestock farms. This system aims to keep plants in a vegetative state, which provides increased plant growth and nutritional value. A typical arrangement may include evenly spaced rows 30 – 50 ft. apart within the pasture. At 34 ft. spacing, this works out to 1,210 trees/acre and if grazed three times in the growing season could yield in the range of 250 – 750 lbs DM/acre per year **(Figure 1)**.

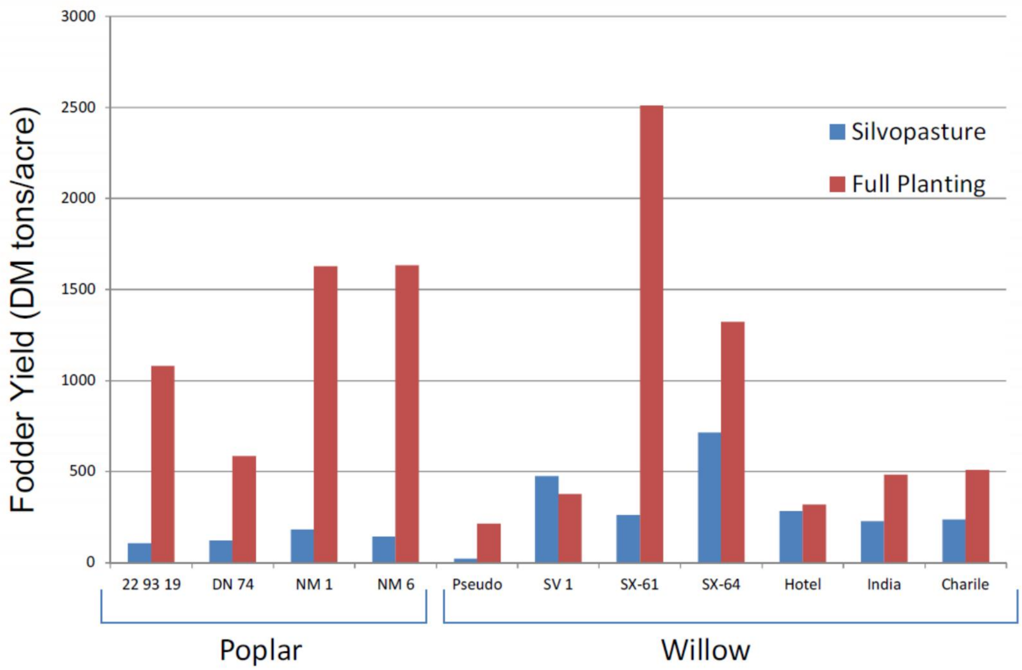

Figure 5. Projected Dry matter yield (tons/acre) for a Full Planting (FP) and Silvopasture (SP) scenarios.

Economic consideration between systems

Whether your farm application is FP or SP, costs can be considerably different. FP for windbreaks provides additional value outside of fodder, but costs are much higher per unit area to establish. Site preparation and weed control costs will be similar for both FP and SP, but tree material and planting costs vary greatly for an acre. For the FP system, at an installation cost of $0.4/tree the total cost is for one acre is $4,497 where one acre of SP will cost $484. To take this and additional step further, we looked at cost per pound of dry matter. For the FP system with a yield of 1500 lbs DM/acre/yr over a five year period the cost is $0.6/lb of DM. For the SP system with a yield of 500 lbs DM/acre/year over a five year period costs $0.2/lb DM. Although the FP system offers a valuable dual purpose as windbreak and shelter, the cost per pound of DM over the first five years is triple. All forage production after five years is essentially free.

Economic analysis completed by Saul Fraleigh.

RAIN Research Note 080616

2015 Results from the Keyline Plowing Trial

This project is examining the impact of keyline pattern subsoiling on forage productivity, water use efficiency, and soil health.

Results indicate that keyline pattern subsoiling helps retain soil moisture. Keyline subsoiling had no effect on soil organic matter, P, K, or S.

Topography in this field (sampling high and low areas separately for comparison) also had no effect on soil organic matter, P, K, or S.

Thanks go to our farmer co-operator Peter Lambert for his assistance with this project.

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RURAL AGRI-INNOVATION NETWORK

Method

Keyline plowing was developed in Australia in the 1940s and '50s. The technique uses a chisel subsoiler plow to break up soil compaction with minimal surface disturbance. "Keyline" describes the drive pattern, which is mapped out to work with the topography of a field to help redistribute water more effectively. This project is examining the impact of keyline pattern subsoiling on forage productivity, water use efficiency, and soil health.

Results

Soil Organic Matter:

Organic matter, also called humic material or humus, is the fraction of soil made up of decomposing plant, animal, and microbial material. It is important for creating soil structure, as well as holding water and nutrients. In 2015, keyline plowing had no effect on soil organic matter content. This is not surprising, as it takes many years to build up organic matter.

Field topography also had no statistically significant effect on soil organic matter content; there was no difference between high and low sampling points.

Soil Nutrients:

Soil nutrients come from the mineral fraction of the soil and from manure applications and fertilizers; they are important for plant growth and production. Keyline subsoiling had no effect on phosphorus, potassium or sulphur when compared to the control. Topography also had no impact on soil nutrients

Soil Moisture:

Weather and soil moisture monitoring began in July. The results from the 2015 field season indicate that the subsoiled plots held more moisture than the control.

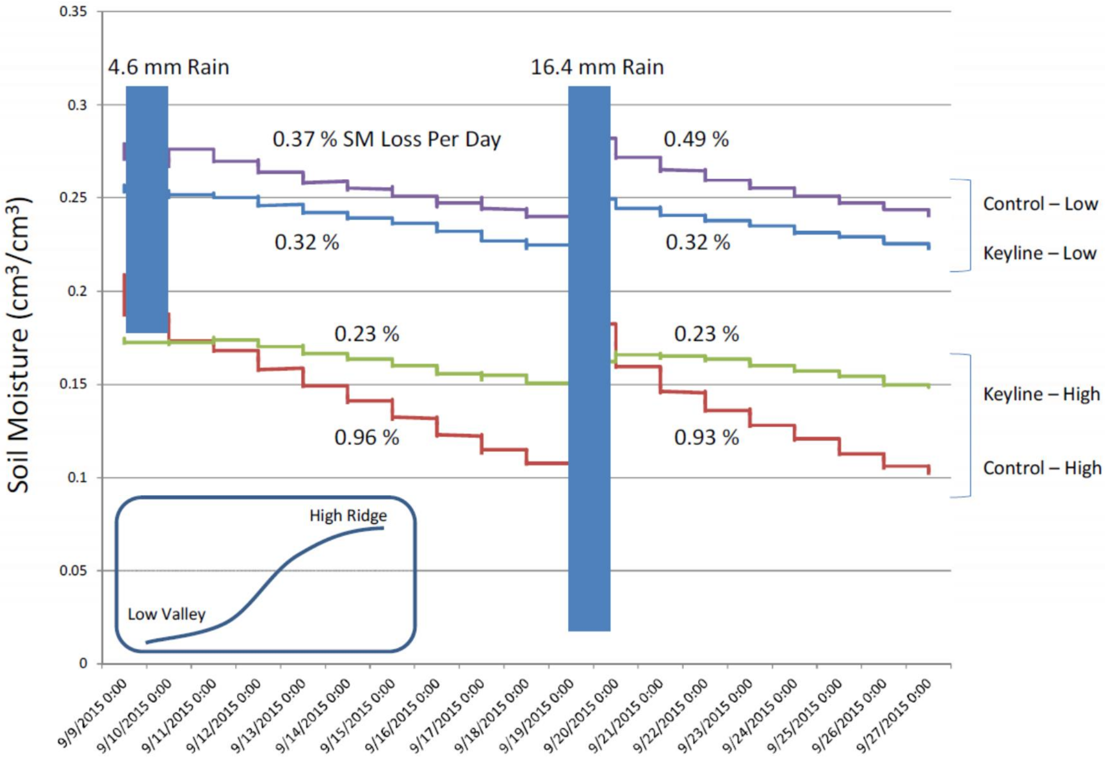

Figure 1. Soil moisture summary of two rain events in September 2015. Soil moisture rate of change (average daily percent soil moisture loss) for keyline and control ridges and valleys.

The increased water-holding capacity of the soil is most likely due to the action of the subsoiler. Soil compaction is a common problem, where soil is compressed to such an extent that water cannot infiltrate and percolate through the soil easily. However, it is not possible to separate the effects of the subsoiler from the effects of the keyline pattern in this trial.

In 2016, more samples will be taken to assess the impact of keyline plowing in the second growing season after the operation.

RAIN Research Note 220616

2015 Pasture Improvement Results: Spanish River Carbonatite

Spanish River Carbonatite (SRC) is mined from a mineral deposit and is used as a soil amendment.

When applied at 1100 kg/ha, SRC did not affect soil pH or nutrient content. It had no impact on forage yields, and cattle did not favour or avoid areas treated with SRC. It also did not affect the mineral content of forages grown in treated fields.

Thanks go to our farmer co-operators Alex & Helen McRae, and Jim & Bette Withers for their assistance with this project.

For more information on this project, please contact:

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Boreal Agrominerals Inc. owns the Spanish River Carbonatite (SRC) deposit. SRC is marketed as a soil amendment. It contains 50% calcium carbonite, 25% biotite, 12% apatite, and 13% trace minerals. It is also used as a liming agent.

SRC contains following amounts of trace elements:

Manganese (Mn)	1 200 ppm
Zinc (Zn)	60 ppm
Copper (Cu)	10 ppm
Cobalt (Co)	10 ppm
Molybdenum (Mo)	12 ppm
Boron (B)	40 ppm

Two farm sites were used in this trial. Treatments were SRC applied at a rate of 1100 kg/ha and a control, where no fertilizers or soil amendments were applied. There were 5 replicates per farm. Soil and forage samples were taken during the growing season for analysis. Cobalt was not part of the standard analysis packages and therefore was not included. Molybdenum was not a part of the soil analysis package.

Results

The soil tests indicated liming requirements between 3 and 10 t/ha; it is unsurprising that 1.1 t/ha did not affect soil pH. At the rate applied, SRC had no statistically significant effect on soil phosphorus, potassium, sulphur, Mn, Zn, Cu, or B. It did not affect forage yields at any pre-grazing sampling time or when sampling times were pooled. It did not influence cattle grazing patterns; post-grazing residuals in all paddocks were not significantly different. It also had no effect on the trace mineral levels of the forage grown in areas treated with SRC.

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RAIN Research Note 060716

2015 Pasture Improvement Results: Grazing Management

Rotationally grazed paddocks had significantly higher dry matter yields than continuously grazed paddocks.

Grazing management had no effect on soil nutrient status or forage mineral content, except for soil P content.

Thanks go to our farmer co-operators Alex & Helen McRae, and Jim & Bette Withers for their assistance with this project.

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Method

Two farms were set up with five paddocks each: one paddock per farm was continuously grazed; the other four were managed under rotational grazing. Forage samples were taken for nutrient analysis from the cattle farm on June 18 and the mixed livestock farm on October 5. Yield measurements at the cattle farm were done on June 18 and August 14 before cattle were turned out into the rotationally grazed paddocks. Those paddocks were sampled again when the cattle came out.

Results

Overall, rotationally grazed paddocks had significantly higher dry matter yields than continuously grazed paddocks (Figure 1).

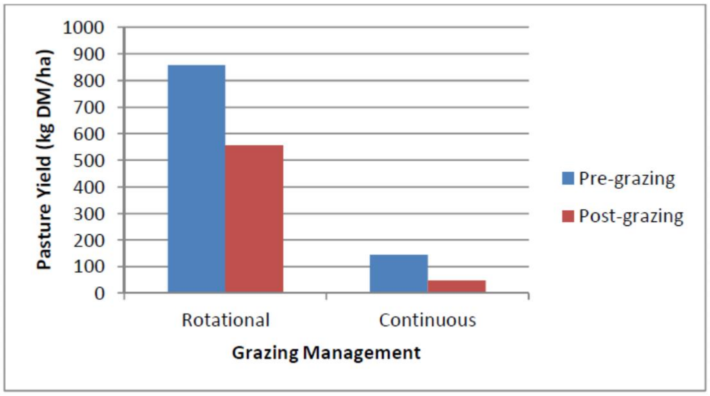

Figure 1. Mean pasture yields under different management systems before and after grazing events

Grazing management (either rotational or continuous) had no effect on soil organic matter, potassium, or sulphur. The analysis indicated that rotationally grazed paddocks had significantly higher phosphorus than continuously grazed paddocks. The reason for this is unknown and could be due to normal variability in a limited number of samples.

Grazing management system also had no effect on forage phosphorus, potassium, and sulphur contents.