

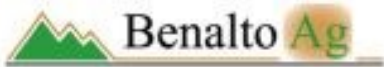


## 2018 Cover Crop Trial Plots

NE-03- 40- 07- W5



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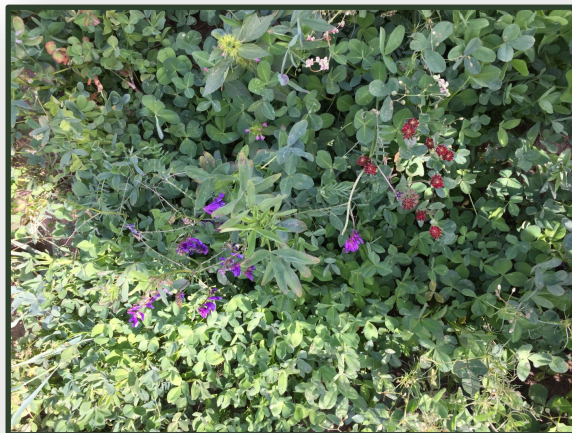


# 2018 COVER CROP TRIAL PLOT REPORT FOR CLEARWATER COUNTY

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## **SUMMARY**

Clearwater County Agricultural Service Board set up thirteen trial plots featuring different varieties of cover crops in order to track their use for soil amendment and extended grazing. Research looked at soil quality changes, as well as nutritional quality and yield of the different crops.

Samples from each plot were taken in September and November. Tests were carried out for yield and feed quality in September and yield and feed quality in November. Soil tests were taken at the start of the trial and following Spring.



## **ACKNOWLEDGEMENTS**

Firstly I would like to thank Greg Paranich from Performance Seed who has been involved from the start with the project and whose input and expertise has been very important to the success of the trial.

I would also like to thank all those who partnered in the project. Thanks to Performance Seed for donating all the seed for the trial plots, to Benalto Ag for donating the fertilizer for the plots as well as their agronomist Devin Knopp. Thanks also goes to Challand Pipeline for donating the use of a billion seeder and Grey Wooded Forage Association who helped design and implement the trial.

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## INTRODUCTION

Producers in Clearwater County are becoming increasingly aware and interested in the use of cover crops both for soil amendment and extended grazing.

There are many different types of farming operations in Clearwater County and not all have livestock to utilize cover crops for grazing. Some producers are looking at adding a cover crop after a silage or greenfeed crop has been harvested, others are looking to seed the cover crop in the Spring with the cereal for silage or greenfed and then allow the regrowth of the cover crop after harvesting. Others are looking to seed cover crops after an exhausted hay crop into sod that has been sprayed out with glyphosate. Some are looking to terminate the cover crop by winter and others to utilize a fall or winter species that will provide early grazing the following Spring.

With so many options for the use and timing of cover crops we decided that it would be impossible to research and replicate every possibility. Therefore, after some discussion we have decided to showcase twelve different cover crops and see how they perform in our soil, climate and growing conditions.



Research exists already about the benefits and uses of cover crops and so the thought behind the 2018 trials were to seed monocrop plots and then producers would be able to adapt the research and use to their own operation.

After discovering which species are successful in the County we can then think about future research like cocktail mixes, seeding timing and rates, agronomic management etc. With this in mind we may be looking at several years of trials to obtain reliable and replicable data.



## CLEARWATER COUNTY GEOGRAPHICAL AREA

Clearwater County is located in west central Alberta. Jasper and Banff National Parks border its western edge. Other bordering municipalities include Yellowhead County, Brazeau County, County of Wetaskiwin, Ponoka County, Lacombe County, Red Deer County, Mountain View County and the Municipal District of Bighorn. ( See Diagram 1). The total land mass of the County is 4,527,101 acres. Only 19% or 846,781 acres are suitable for agricultural use. Of this, more than 75% is used as improved pasture or native range, supporting the livestock industry. Less than 25% is used for the production of perennial forage and annual crops.



The County is challenged by a short growing season of about 85-95 frost free days due to elevations of 1000m above sea level.

The average temperature for the May to September period is 11.9 C. Hottest months are normally July and August with an average daytime temperature of 20C.

Annual precipitation ranges between 500 and 550mm. The wettest month is typically July which averages around 200mm.

### **Diagram 1. Counties within Alberta**

Soils range from pockets of Black Chernozemics along the east central portion of the County to Dark Grey to Grey Luvisols across the central portions with Brunisols toward the western portions. Therefore although producers on the eastern side of the County may be lucky enough to be farming black soils, typically most of the agricultural land in Clearwater County is Grey Wooded with less than 10% organic matter.

Statistics Canada reported in the 2016 census that the majority (45%) of farms in Clearwater County are beef cattle farms. There are roughly 30,000 cows on 517 farms in Clearwater County.

## **COVER CROPS—AN OVERVIEW**

The use of cover crops has grown exponentially in the last ten years as our understanding of soil science has rapidly gone from strength to strength. Research into soil micro-biology has increased and this has led to a greater realization of what is really going on in the soil, especially in regards to building a healthy topsoil with increased organic matter. The microbes which exist in the soil rely on nutrients in the agroecosystem and cover crops can provide these through either improved organic matter or from the exudates from the roots that feed the fungi, bacteria and nematodes. The grey wooded soils of Clearwater County are notoriously renowned for low organic matter and building this precious resource has become of key concern to many area farmers.

Cover crops are being used as green manure for organic production, as catch crops to prevent nutrient leaching, to improve soil organic matter and nutrient cycling, break up hardpan, protect soils from erosion and to increase the productivity of grazing systems.





## DATES AND RATES

The site chosen for the trial plots was NE-03-40-07-W5 just North of the Town of Rocky Mountain House. The land had been down to hay for several years and for the past two years the trial plot area had been seeded to oats harvested as green feed.

Soil tests were carried out on the area in May 2018 and results showed that N, P and K were deficient and organic matter was low at 3.7%. (see appendix A).

The area was sprayed with 2L /acre glyphosate on June 4th for quack grass, hemp nettle , corn spurry and lambs quarter. The plots were fertilized on June 12th with a blend of 16-13-11-9 at a rate of 181lbs per acre. This provided 30lbs N, 25lbs P, 20K and 16 S. The field was then cultivated.

The area was divided into 13 trial plots and seeded on June 19 and 20. The first plot was seeded to oats. The cover crops that were chosen were divided into three grasses, four legumes and four brassicas. The grasses seeded included Festulolium ( a meadow fescue x ryegrass hybrid) , Annual Rye Grass and Meroa Rye Grass. The legumes were Forage Peas,

Crimson Clover, Frosty Berseem Clover, and Purple Hairy Vetch. The brassicas chosen were Purple Top Turnip, Tillage Radish, Premier Kale and Impact Collards. A cocktail for soil amendment was also seeded, Performa Nitro Max.

The peas and oats were seeded at about 1 1/2" deep with the County's direct seeder, a John Deere 9350 hoe drill, and the remainder were seeded using a Brillion at about 1/2" deep. Seeding occurred in very dry conditions which proceeded well into the season. Only 3 1/2 inches of rain fell before the snows that began on September 7th and continued for the next three weeks.



## **PLANTING INFORMATION**

<b>Species</b>	<b>Planting Date</b>	<b>Performance Recommended seed rate</b>	<b>Actual seedRate (lbs/acre)</b>	<b>Seeding Depth (inches)</b>
<b>Impact Collards</b>	20-Jun	8lbs/acre	9.5lbs/acre	0.5
<b>Premiere Kale</b>	20-Jun	5lbs/acre	6lbs/acre	0.5
<b>Purple Top Turnip</b>	20-Jun	5lbs/acre	5lbs/acre	0.5
<b>Tillage Radish</b>	20-Jun	8-12lbs/acre	13lbs/acre	0.5

### **Legumes**

<b>Species</b>	<b>Planting Date</b>	<b>Performance recommended seed rate</b>	<b>Actual seeding rate</b>	<b>Seeding depth (inches)</b>
<b>Frosty Berseem Clover</b>	19-Jun	8lbs/acre	11lbs/acre	0.5
<b>Purple Bounty Hairy Vetch</b>	19-Jun	15lbs/acre	14lbs/acre	0.5
<b>Kentucky Pride Crimson Clover</b>	19-Jun	8lbs/acre	12lbs/acre	0.5
<b>Forage Pea 4010</b>	19-Jun	55lbs/acre	75lbs/acre	1.5
<b>Performa Nitro Max</b>	19-Jun	8lbs/acre	8lbs/acre	0.5

### **Annual Grasses**

<b>Species</b>	<b>Planting Date</b>	<b>Performance recommended seed rate</b>	<b>Actual seeding rate</b>	<b>seeding depth (inches)</b>
<b>Spring Green Festulolium</b>	20-Jun	15lbs/acre	14lbs/acre	0.5
<b>Meroa Italian Rye Grass</b>	20-Jun	15lbs/acre	16.5lbs/acre	0.5
<b>Annual Rye Grass</b>	20-Jun	15lbs/acre	14.5lbs/acre	0.5



## September 25th Testing

### Method

Collected clippings from  $.25M^2$  quadrants and extrapolated to per acre.

Trial plots were tested for yield and nutrient analysis for the cover crop species only.

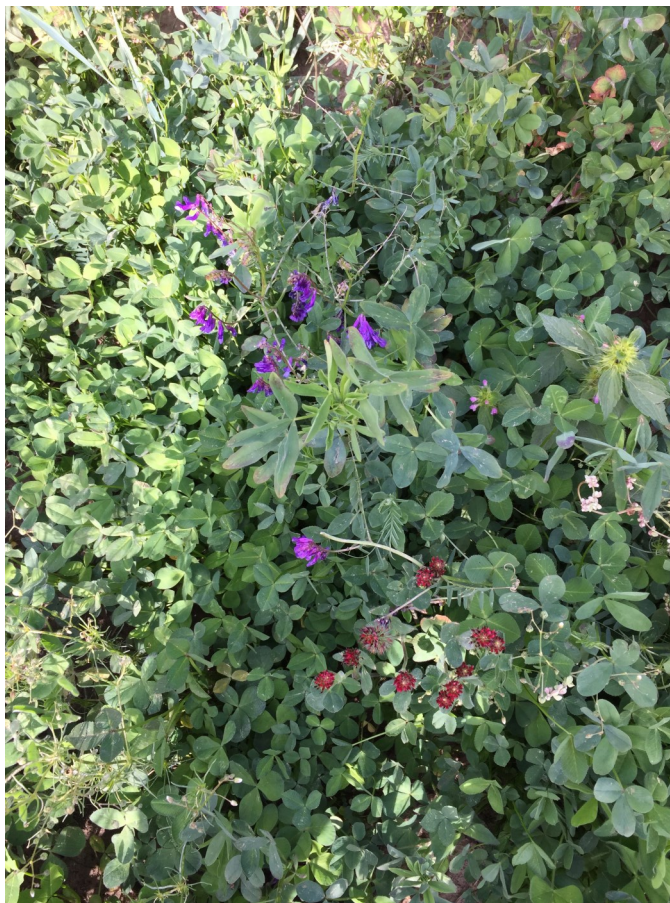
Although there were volunteer oats and weeds within the plots researchers avoided including them in the sample in order to ascertain information pertaining only to each individual species of cover crop.







Purple top turnip



Performa Nitro Max



Tillage radish



Meroa Italian Ryegrass





Frosty Berseem Clover



Crimson clover



Festulolium



Purple Hairy Vetch





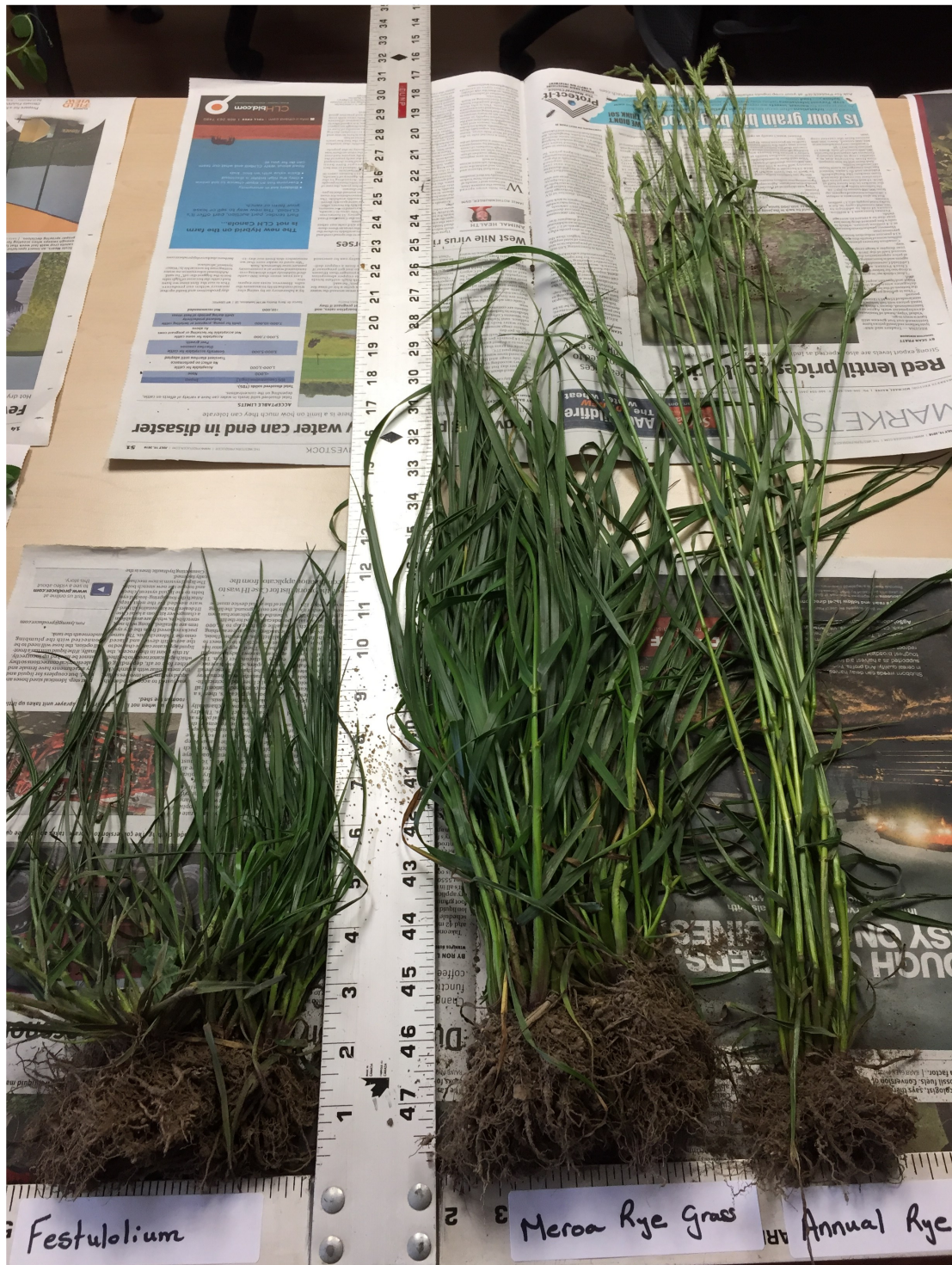
September tillage radish



Turnips of various sizes







September 26th



## November 14th Testing

Conditions had been cold and snowy. There was a brief break in between snowfalls where we took the opportunity to do the second round of testing.







Volunteer oats were showing brown but the ryegrasses were still green under the snow. Especially the Meroa.







The peas were brown and wilted under the snow but tested surprisingly well.







The performance by the vetch was disappointing. Plant population was very low but the few plants we found in November were still green.







Tillage radish plants were brown and slimy. Due to it being planted earlier than recommended the plants had matured, gone to seed and died. Previous trials show that if planted late in the season and not allowed to go to seed that tillage radish will stay green well into the minus double digits. Kale and Collards on the other hand remained green and lush. See below: Collards left and Kale right.





### YIELD DATA SEPTEMBER AND NOVEMBER

<b>Plots</b>	<b>Species</b>	<b>September DM Tonnes/acre</b>	<b>November DM Tonnes /acre</b>
<b>1</b>	<b>Purple Vetch</b>	0.40	0.11
<b>2</b>	<b>Crimson Clover</b>	1.05	0.6
<b>3</b>	<b>Berseem Clover</b>	1.09	0.94
<b>4</b>	<b>Tillage Radish</b>	2.87	2.1
<b>5</b>	<b>Impact Collards</b>	1.66	1.33
<b>6</b>	<b>Kale</b>	1.78	1.33
<b>7</b>	<b>Purple Top Turnip</b>	1.46	0.91
<b>8</b>	<b>Annual Rye Grass</b>	1.82	1.13
<b>9</b>	<b>Meroa Rye Grass</b>	1.50	0.76
<b>10</b>	<b>Festulolium</b>	1.09	0.95
<b>11</b>	<b>Performa Nitro Max</b>	1.13	0.6
<b>12</b>	<b>Peas</b>	3.20	2.29
<b>13</b>	<b>Oats</b>	3.08	2.13

Comparison of Nutrient Results between Species and between September and November Testing

SPECIES	Protein Sept %	Protein Nov %	TDN Sept %	TDN Nov %	NDF Sept %	NDF Nov %	Nitrates % Sept	Nitrates % Nov
Purple Top Turnip	18.6	16.6	76.1	67.7	22.2	27.3	0.04	0.0
Kale	22.9	17.4	78.5	74.8	18.6	22.7	0.1	0.0
Impact Collards	26.5	22.1	78.0	75.7	18.0	23.8	0.8	0.0
Tillage Radish	13.8	13.5	59.2	66.2	46.0	37.9	0.01	0.0
Crimson Clover	17.8	18	71.2	70.9	28.9	43.9		
Vetch	23.6	25.9	61.6	61.6	41.8	36.6		
Berseem Frosty	19.5	18.2	67.0	57.9	37.3	53.1		
Nitro max	20.3	18.6	65.4	59.3	37.6	47.2		
Peas	16.0	15.2	64.4	56.6	41.6	54.1		
Meroa Italian ryegrass	19.2	20.1	76.0	70.5	25.8	41.8		
Festulolium	19.5	20.4	74.6	68.8	29.4	46.5		
Annual ryegrass	15.5	18.1	66.2	64.1	45.1	59.1		
Oats	11.9	9.6	64.8	63.8	61.1	57.4	0.11	0.0
Turnip Roots	15.5	17.6	76.2	76.8				
Tillage Radish Roots	12.5		64.9					



# NUTRIENT TEST RESULT COMPARISON DATA CONTINUED

Species	Calcium Sept %	Calcium Nov %	Phos (P) Sept %	Phos (P) Nov %	Pot (K) Sept %	Pot (K) Nov %	Mag (Mg) Sept %	Mag (Mg) Nov %	Sodium (Na) Sept %	Sodium (Na) Nov %
Purple Top Turnip	3.85	4.27	0.40	0.34	1.75	2.08	0.59	0.51	0.28	0.30
Kale	2.30	2.22	0.37	0.33	2.44	2.22	0.36	0.30	0.38	0.30
Impact Collards	2.29	1.90	0.46	0.42	2.44	3.17	0.44	0.37	0.36	0.23
Tillage Radish	2.11	2.24	0.36	0.41	2.85	2.44	0.31	0.30	0.47	0.28
Crimson Clover	1.53	1.47	0.21	0.22	1.40	1.13	0.48	0.45	0.43	0.30
Berseem Frosty	2.28	1.95	0.22	0.21	1.51	0.95	0.37	0.33	0.45	0.25
Vetch	1.75	1.38	0.28	0.32	1.87	1.70	0.46	0.38	0.09	0.05
Nitro max	1.87	1.56	0.25	0.26	1.47	1.28	0.48	0.37	0.49	0.26
Peas	1.61	1.67	0.31	0.23	1.12	0.61	0.36	0.34	0.10	0.04
Meroa Italian ryegrass	0.78	0.81	0.21	0.24	1.85	1.89	0.28	0.29	0.47	0.35
Festulolium	0.70	0.80	0.20	0.24	1.92	1.94	0.33	0.33	0.46	0.37
Annual ryegrass	0.72	0.79	0.19	0.25	1.56	1.52	0.24	0.25	0.35	0.41
Oats	0.49	0.35	0.23	0.21	0.66	0.76	0.27	0.17	0.28	0.26
Turnip Roots	1.46	0.92	0.48	0.35	2.70	2.24	0.37	0.21	0.38	0.28
Tillage Radish Roots	0.89		0.37		2.81		0.44		0.63	

# NUTRIENT TEST RESULT COMPARISON DATA CONTINUED

SPECIES	Iron Sept ppm	Iron Nov ppm	Mn Sept ppm	Mn Nov ppm	Zinc Sept ppm	Zinc Nov ppm	Copper Sept ppm	Cu Nov ppm
Purple Top Turnip	571	775	291	231	65	56	8	6
Kale	401	704	221	185	44	33	7	6
Impact Collards	525	554	419	184	55	40	10	7
Tillage Radish	362	296	137	89	34	30	6	5
Crimson Clover	1271	3299	220	295	49	56	14	15
Berseem Frosty	438	1885	216	289	54	54	13	14
Vetch	1444	2643	230	233	98	107	17	15
Nitro max	1518	2179	269	386	60	66	14	11
Peas	628	1071	118	123	51	36	10	9
Meroa Italian ryegrass	318	1115	244	316	37	41	7	9
Festulolium	676	1244	259	310	46	47	9	9
Annual ryegrass	342	651	236	258	45	49	8	8
Oats	300	295	83	101	38	32	7	7
Turnip Roots	2204	729	191	78	50	50	11	8
Tillage Radish Roots	2150		136		42		10	

## **OBSERVATIONS**

### **Yield analysis by dry matter**

1. The highest yielding legume was peas . Performa Max cocktail out yielded the other legumes (clover and vetch)
2. Berseem Clover marginally out yielded Crimson Clover.
3. The highest yielding brassica was tillage radish.
4. Collards and Kale were very similar. Purple top turnip showed the lowest yield for top growth
5. The highest yielding grass was Annual Ryegrass, followed by Meroa and then Festulolium
6. The highest yielder overall was peas followed by oats.
7. The lowest yielder overall was vetch

### **Nutrient Analysis by Dry matter**

1. The highest protein for the legumes was Purple Hairy Vetch (23.6)
2. The highest protein for brassicas was Collards (26.5)
3. The highest protein for grasses was Festulolium (19.5) with a slight margin over Meroa (19.2)
4. The largest decline in protein from Sept to Nov was Kale but most crops pretty consistent
5. The highest energy for legumes was Crimson Clover (71.2 % TDN)
6. The highest energy for brassicas was Kale (78.5% TDN)
7. The highest energy for grasses was Meroa (76% TDN)
8. The largest decline in energy from Sept. to Nov. was Berseem Frosty Clover
9. The lowest NDF for legumes was Crimson Clover
10. The lowest NDF for brassicas was Collards
11. The lowest NDF for grasses was Meroa
12. The largest increase in NDF from September to November was Festulolium
13. Overall Collards and Kale performed very similarly.
14. Nitrates declined to zero in all crops in November testing that showed nitrates in September.



### November 14<sup>th</sup> Observations notes

- Purple top turnips - large roots. Doubled in size from September and consistently large. Leaves were still dark green and purple. Turgid and healthy.
- Annual Rye grass – Tall, all headed out. Grass turning brown but mixed with leafy green
- Meroa Rye grass – Many deer tracks in this plot reflecting the excellent palatability. There were signs of lots of ungulate damage (chewing and trampling) therefore the yield may not be accurate due to the extra consumption. Overall it was looking very green and leafy.
- Crimson Clover – Large green leaves. Still looking very healthy.
- Frosty Berseem – Surprisingly the Frosty did not look as good as the other clovers. Purple/brown colour with evidence of very few green plants.
- Tillage radish – Leaves yellow slimy and decayed. Roots already decaying. This is a species that needs to be seeded late (August) in order to capitalize on late fall growth and large roots.
- Collards – Dark leafy green , fleshy no sign of deterioration
- Kale – Not quite as dark green as collards. Some leaves yellowing. But overall green and leafy.
- Oats – Ripe and dead. Straw and grain. Not too much shelling out.
- Peas Ripe, brown and decaying – no peas found in pods
- Nitro Max— Crimson -green, frosty- brown, vetch hard to find. All tangled in snow and down and frozen to ground. Hard to bring up samples.
- Festulolium – Still showing lush and green with many tillers
- Vetch – Individual plants were very hard to find.

### **Nutrient Analysis by dry matter –chart 2 and 3**

1. Brassicas showed highest calcium, followed by clovers and then grasses. Oats were last.
2. Most brassicas showed an increase in Ca and very little change in P and K between Sept and Nov.
3. Brassicas also highest for P and K. Clovers typically highest in Mg.
4. Mg amounts stayed pretty consistent between Sept and November for all crops.
5. Legumes showed highest amounts of iron. Iron levels increased significantly in all crops between sept and nov.
6. Legumes showed highest levels of copper.



## **SOIL TESTING AND OBSERVATIONS**

Soil testing was first carried out on May 20th 2018 over the entire area to be seeded for trial plots. Soil would be tested again for each crop the following Spring to see how the soil had been amended (if at all) in preparation for the following year's crop.

In May 2018 the soil was showing to be slightly deficient in Nitrogen at 66 lbs/acre, Phosphorous at 28lbs per acre and Potassium at 139lbs per acre. Sulphur, calcium Magnesium, Zinc, Manganese, and iron were all optimum. Copper and Boron were showing slightly deficient.

Due to the management of this field with regular fertilization and care the soil test result were already looking pretty good. The pH was 6.4 but organic matter only 3.7%

The following April 23rd 2019 soil tests on each individual plot were taken again.

The only crop that showed an increase in Nitrogen was Crimson Clover. Most cover crop plots showed an increase in Manganese and a reduction in pH from 6.3 to around 5.8.

This makes us question the accuracy of the initial soil test result.

All cover crop plots apart from oats increased the soil organic matter. The highest change came from the Purple Top Turnip which saw the organic matter change from 3.7% to 5%. A close second was Kale with an increase to 4.9%.

All plots that were seeded to brassicas showed a reduction in Sulphur in most cases by half the original amount. This is to be expected as brassicas are known to be strong Sulphur scavengers.

The most prominent observation for the soil tests was the consistent increase in organic matter .

## **Conclusion**

The cover crop trial plots gave us a good indication of which species perform well in Clearwater County.

All cover crops increased soil organic matter but there was little improvement seen in soil quality concerning the nutrients. The biggest changes were seen in the increase in Manganese in most plots and the decrease in Sulphur in the brassica plots. A factor that may have affected the soil nutrients was the hot dry year of 2018.

Nutritionally the cover crops performed well. They all out performed the oat check strip and held their value well from September to November. Results showed that cover crops can be a high nutrient extended grazing option for livestock well into November.

The highest yielders and highest performance nutritionally will be selected for use in cocktails in the 2019 trials.