MBFI alfalfa phosphorus ramp project

2018 INT 9

Measuring the fate of soil applied mono-ammonium phosphate to established alfalfa through yield and forage analysis testing

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MBFI Location(s): Brookdale Farm

Collaborating Partners:

Start Date: May 2016 Status: In Progress

Introduction

In Manitoba Phosphurus is the main limitation to Alfalfa production. Producers who manage their alfalfa forage crops with optimum phosphorus fertility normally outproduce area average yields collected by MASC insurance by 30 to 100% With higher yields, fixed inputs like land costs and taxes are amortized over more yield, which inturn, lowers the forage cost per tonne of product.

The concept of a Manitoba based alfalfa phos ramp was hatched in 2008 when phosphorus prices spiked to well over $1000 per tonne of monoamonium phosphate. (11-52-0) An alflafa phosphorus ramp demonstration was setup at 7 interlake farms to profile the benifits of optimum fertility. The basis of the project mirrored work that was done with nitrogen around Manitoba in years previous. The project started in 2008 and completed in 2012 with very impressive results demonstrated on soils with fertility below 10 ppm Olsen Phosphorus. The results were profiled in multiple producer meetings, Manitoba Soil Science Society, annual meeting and summer tour and the Manitoba Agronomist Conference poster section.

Phosphorus has become a controversial nutrient with ongoing focus on water quality and lake health so while greater rates of nutrient application result in improved yields, attention must be given to the the fate of all phosporus applied. This project endevors to determine how much of the applied phosphorus is removed by the harvested biomass. Optimal phosphorus application rates will improve alfalfa profitability but also limit phosphorus loss to the environment and waterways.

In the end, optimum phosphorus application will protect the environment and reduce the number of acres devoted to forage production, while still producing a higher quality protein feedstuff which can be used to balance feed rations in effort to limit methane production in ruminants.

Objectives

This project is intended to improve forage and grassland Productivity through quantitative yield productivity results of various rates of phosphorus fertility of alfalfa. Average alfalfa productivity in Manitoba is far from maximized, and many operations are below economic optimum. This project will display the opportunity to harvest more yield with various economic fertility application rates.

Alfalfa nutrition and feed efficiency is a priority that this project addresses as alfalfa is the most significant protein source for cattle in Manitoba, however many producers are adopting hi input annual forage cropping systems and moving away from alfalfa. We would contend that with ideal alfalfa crop nutrition and management, alfalfa will be a more cost-effective protein and energy source on most soil types.

This project will promote alfalfa as a champion of Environmental Sustainability because alfalfa uses water over a longer period which reduces erosion during periods of runoff which is an issue for annual forages. Alfalfa also sequesters more carbon than annual cropping alternatives. In this project alfalfa is also fertilized with cattle manure which is an excellent demonstration of proper use of manure, and the value of manure.

Project Design and Methods

The alfalfa phos ramp plot is located at an existing alfalfa field at MBFI Brookdale, 200 yards south east of the main shop which is easily accessible for producer tours. The plot has 12 parallel narrow strips of increasing phosphorus application rates. Eg. 100,0,20,40,60,80,100 lbs/acre of phosphorus in the form of Mono Ammonium phosphate, and 15 and 30 tonnes beef manure/acre. The plots were replicated three times in a randomized block layout.

Plots were harvested for yield three times in 2016 (three cut system) Twice in 2017(due to dryness and lack of 3rd cut) and Once in 2018 (due to lack of growth due to dryness) . Forage Quality, and phosphorus content of forage was analysed to determine phosphorus utilization and potential losses. The plot will continue to be monitored in 2019 because we feel that 2017 and 2018 yields were so low due to dry conditions that some applied phosphorus has yet to be used in the soil, and if growing conditions return to nomal there could be significant yield diffences in 2019.

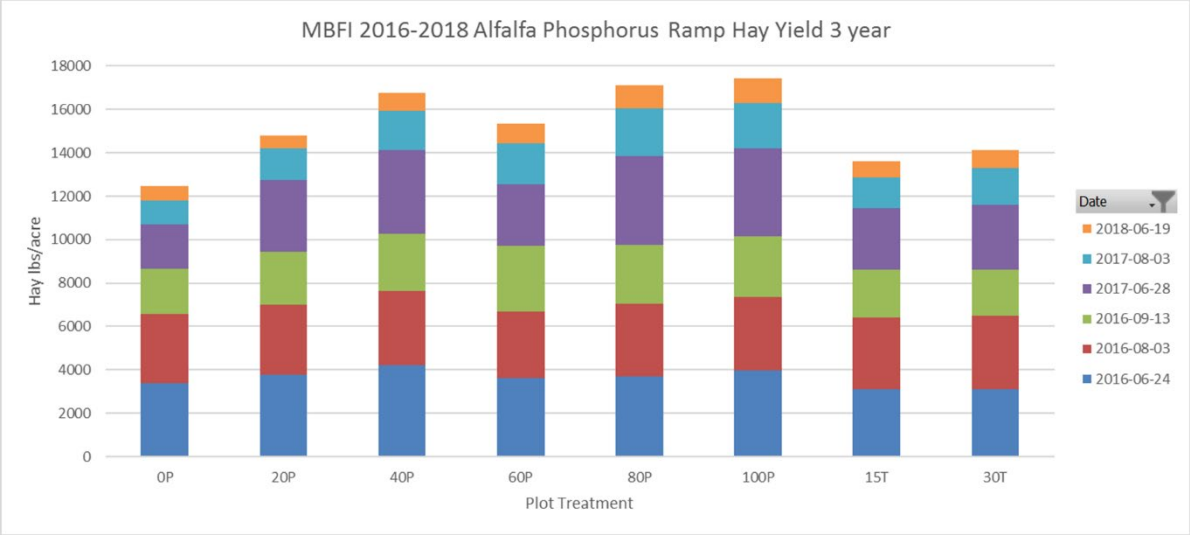
2016-18 Alfalfa Phos Ramp Diagram North Up

MBFI Brookdale Farm INT 9

300 60p Delete	301 20p	302 0p	303 100p	304 15 tonne Beef Manure	305 40p	306 0p	307 30 Tonne beef Manure	308 0p	309 80p	310 100p
200 0p Delete	201 30 Tonne Beef Manure	202 15 Tonne Beef Manure	203 0p	204 100p	205 80p	206 60p	207 40p	208 20p	209 0p	210 100p
100 100p Delete	101 0p	102 20p	103 40p	104 60p	105 80p	106 100p	107 0p	108 15 Tonne Beef Manure	109 30 Tonne Beef Manure	110 0p

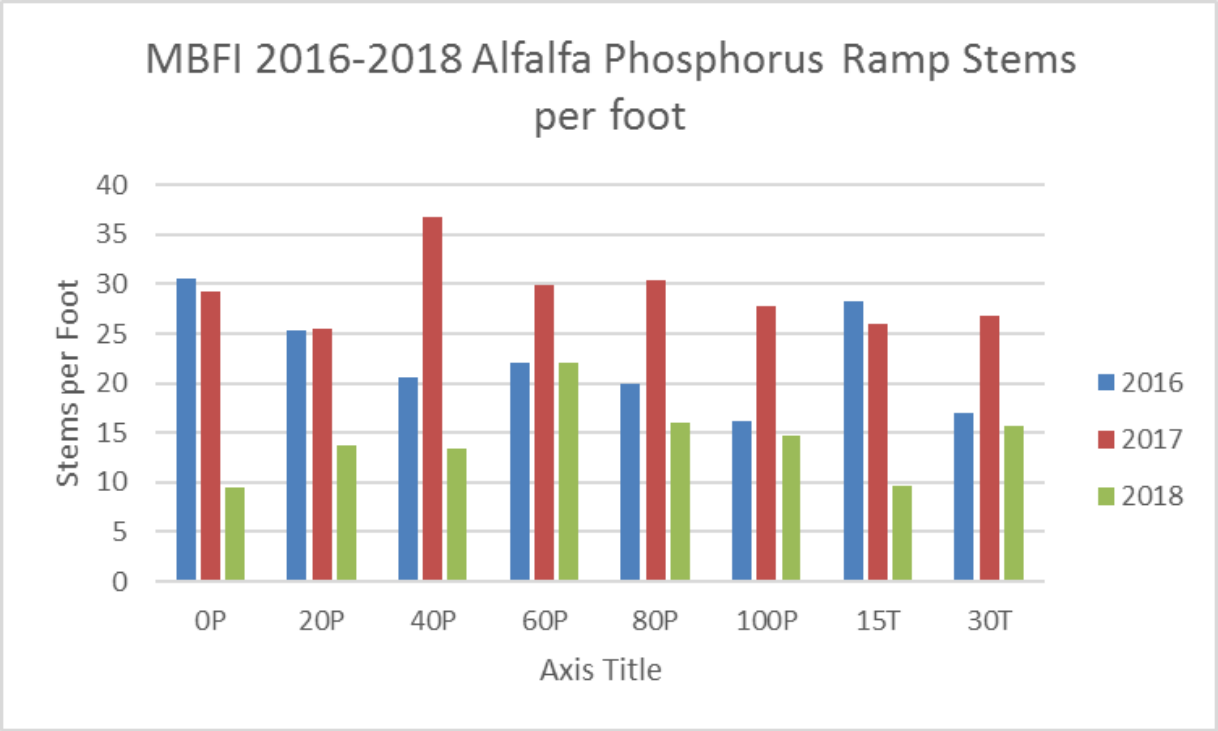
2018 Results and Discussion

The addition of phosphorus to deficient soil increases yield, while this is not unexpected, it is rewarding to see a near-linear relationship between fertilizer application and yield. Due to dryness extending through the 3rd quarter of 2017 to the end of 2018, yields have been very small on all plots and surrounding conventional management alfalfa fields. Subsequent 2019 yield data will be needed to determine if residual and sufficient phosphorus remains to support growth beyond



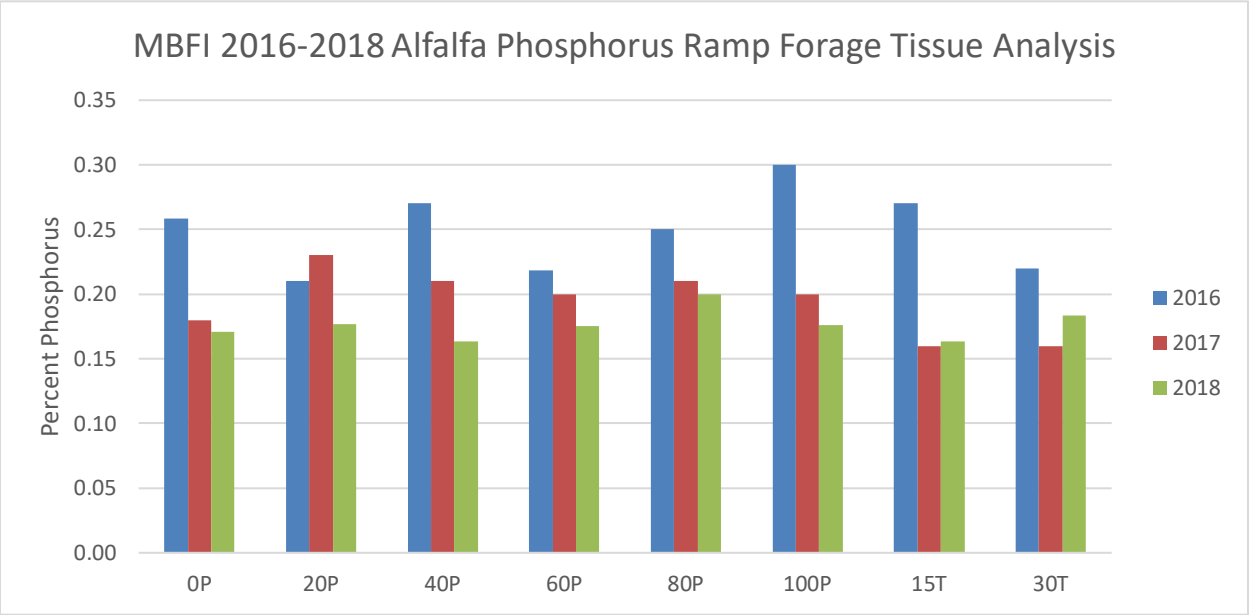
2018 Stems per Square Foot

Stems of alfalfa per square foot is a trait that predicts quality of forage to a large degree, as more stems per square foot indicates finer stems, and less indigestible fiber. The MBFI phos ramp stem count is resulting in very interesting stem counts, as in 2016 increased phosphorus availability and plant tissue concentration actually resulted in lower numbers of stems which is counter intuitive. In 2017 and 2018 stem counts increased with soil phosphorus concentration.



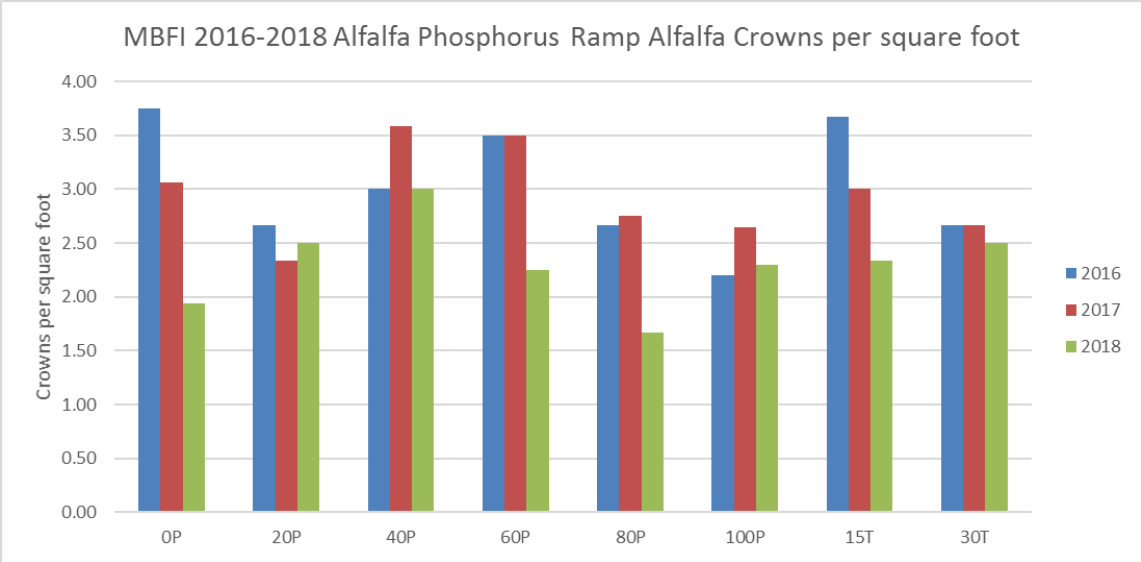
2018 Forage Tissue Phosphorus

The addition of soil applied phosphorus in 2016 resulted in elevated levels of Forage Tissue Phosphorus in the first, year, but has consistently dropped in the two succeeding years. The 2018 data indicates that there is still some effect from the 2016 application. Tissue phosphorus is extremely important to animal health and rationing purposes. Forages with abundant phosphorus are healthier for the animals which consume them with benefits to livestock growth, bone strength and increased reproductive efficiency.



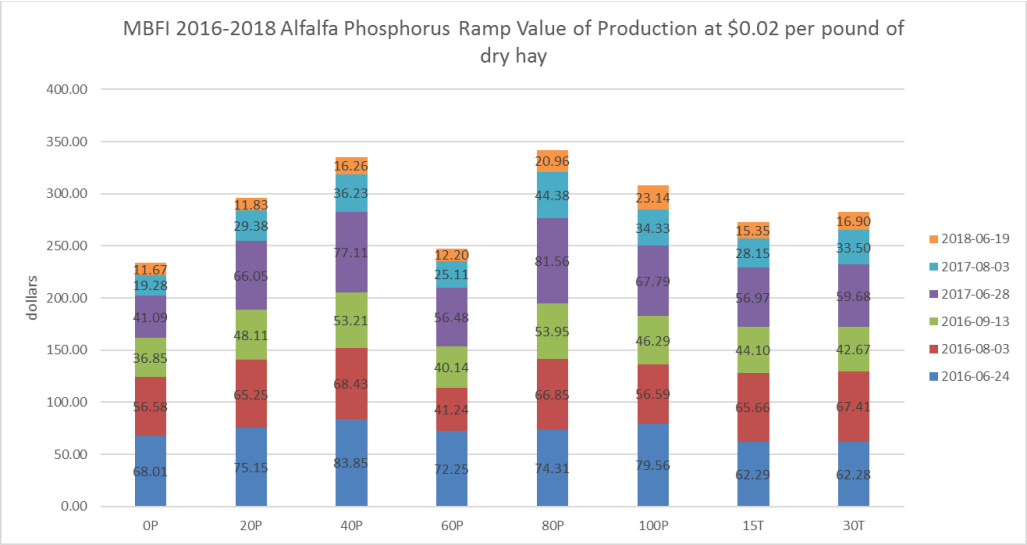
2018 Alfalfa Crowns per Foot

Crowns per foot is a valued indicator to many producers who want to continue harvesting with less frequent rotations. The 2018 data was quite variable with no clear trends evident. We look forward to 2019 to help identify the perils of the crowns on the variable fertility rates but the significant impact of drought on the alfalfa stand.



2018 Economics

Cost benefit of phosphorus fertilizer has multiple components. Normally yield will be a prime driver of economic return, but in years where soil moisture is limited, no amount of fertility can overcome a lack of rain. As the second half of 2017 and all of 2018 were limited rainfall years, the phosphorus ramp has not yielded very well. As such we will need to consider yield in a subsequent year to determine the economic value of phosphorus fertilzer. In a final economic analysis, including crowns per foot will need to be considered which is a driver of economic return due to less need for renovation of stand.



2018 Summary

The use of phosphorus to increase yield is well known, but the interaction of phosphorus fertility and alfalfa quality and longevity need continued study. Phosphorus is clearly being taken up and the plants are using it for yield, root reserve and tissue phosphorus perils.

Unfortunatly drought has hampered yield and normal behavior of the alfalfa plants. Even first cut yield in 2018 was minimal, and second cut barely grew to the height where field hay equipment could cut the crop. As such we chose to leave the minor cutable second cut, and not harvest it.

We are hoping that 2019 will have better moisture regime, and allow for normall cutting and harvest yields. It is only at the point where the crop has sufficient moisture that the crop can use the fertility invested in the field.