# 9.8 Alfalfa phosphorus ramp demonstration

2016 INT 9

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| Project Lead: | Ray Bittner, Livestock Specialist, Manitoba Agriculture |
| MBFI Location (s): | Brookdale Farm |
| Collaborating Partners: | John Heard, Fertility Specialist, Manitoba Agriculture |
| Start Date: | 2016 Status: In progress |

### 9.8.1 Introduction

In Manitoba phosphorus (P) is one of the main limitations to alfalfa production. Producers who manage their alfalfa forage crops with optimum P fertility normally outproduce average area 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 in turn lowers the forage cost per tonne of product.

The concept of a Manitoba-based P ramp demonstration was developed in 2008 when P prices spiked to well over $1,000/tonne for monoamonium phosphate (11-52-0). Alfalfa P ramp demonstrations were set up at seven Interlake farms to profile the benifits of optimum fertility. The basis of the project mirrored work that was done with nitrogen around Manitoba in previous years[1]. The project started in 2008 and was completed in 2012 with very impressive results - demonstrated on soils with low fertility - below 10 ppm Olsen P. The results were profiled at multiple producer meetings, the Manitoba Soil Science Society annual meeting, summer tours and a poster presentation at the Manitoba Agronomists Conference[2].

Phosphorus has become a controversial nutrient with the 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 P applied. Optimal P application rates will improve alfalfa profitability but also limit P loss to the environment and waterways[3].

Alfalfa is one of the most significant protein sources for cattle in Manitoba, however many producers are adopting high 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.

Improved alfalfa production has multiple environmental benefits[4]. Alfalfa in comparison to annual forages has an increased moisture usage over longer periods of time which will reduce spring and summer runoff erosion and nutrient migration. Perennial alfalfa stands can sequester more carbon and increase soil organic matter over annual forage or non-forage cropping alternatives. Healthy alfalfa stands produce more usable energy and protein per acre and accordingly require less land to feed the Manitoba cow herd. Multi-cut alfalfa stand management increases protein and energy availability in rations, which in turn can reduce methane production in ruminants.

The P ramp project will function as a visual aid and provide quantitative yield and quality characteristics of different P application regimes. In the end, optimum P application will protect the environment and reduce the number of acres devoted to forage production while still producing a higher quality feedstuff.

### 9.8.2 Objectives

This project will provide alfalfa yield results. Average alfalfa yields in Manitoba are far from maximized; many operations are below economic optimum. This project will demonstrate the opportunity to harvest more yield by using various application rates that are economical.

This project endeavors to determine how much of the applied P is removed by the harvested biomass.

The demonstration plots will also profile the benefits of using manure application rates on farm, which will provide an ideal usage of cattle manure.

### 9.8.3 Project Design and Methods

The alfalfa P Ramp plot is located on an existing alfalfa field at MBFI's Brookdale Farm, 200 yards south east of the main shop which is easily accessible for producer tours. This alfalfa stand was established in 2015. The demonstration plot has 12 parallel narrow strips of increasing phosphorus application rates: 100, 0, 20, 40, 60, 80, 100 lb/ac of P in the form of mono-ammonium-phosphate, and 15 and 30 tonnes beef manure/ac. The plots were replicated three times in a randomized block layout.

Depending on the growing season, plots will be harvested for yield as many as three times (three cut system). The forage quality and P content of the forage will be analysed to determine P utilization and potential P losses. The plot will continue to be monitored in 2017 and 2018 for yield, forage dietary P, stem counts, and crown counts.

At the completion of this project in 2018, a fertility budget will be calculated, which considers original soil P value, applied P amount, forage removal values, and final P value of soil.

### 9.8.4 Results and Discussion

The alfalfa P ramp project was initiated in the spring of 2016 with the intent of finding out the most economic level of P fertilization. The demonstration plots were cut three times and produced very good yields. The plots were harvested on June 24, August 3 and September 13. The yields were above the average area yields due to abundant moisture during the growing season. The accumulated precipitation at the third cut was 14.6" or 128% of normal.

This project is a three-year project where much of the benifits of fertilizer will be derived in 2017 and 2018. The following observations were made in this inagural year. There was a precieveable difference between the unfertilized and higher fertilized plots. For example, the zero fertility yielded about 7,500 lb/ac, but the well-fertilized plots yielded nearly 9,000 lb/ac of 15% moisture hay per acre. Visually there were differences as the well-fertilized plots had a more robust, darker green colour. The stems appeared thicker and more succulent. Laboratory testing indicated that the well-fertilized plots had forage dietary P levels much higher than the unfertilized plants (Fig. 1). This is significant, as P is a vital livestock nutrient that has a lot of bearing on animal health and reproduction. Plots with higher fertility levels of P also had less alfalfa stems per square foot. While it seems counterintuitive to have less stems in more fertility, we found it to be consistently true in all of the P ramp plots in 2016. In future years of the project, we will continue to look for differences in stem counts. Our long-term expectations for this demonstration is to document the yield differences and the longevity traits that prevail with higher P soils. In 2017, observations of yield will be made at the end of June, late-July and in September if there is enough growth for a third cut.

Higher P fertility resulted in greater forage yield, higher dietary forage P content in the hay, a reduced number of stems per square foot at the second cut, and larger leaves. There wa no measurable crown count variation in 2016.

The beef manure added in the spring of 2016 seemed to have some yield increase in later cuts, but visually it was obvious that an early May application of beef manure caused smothering problems that limited the first year's productivity.

There was also an identical alfalfa P ramp set up at Ashern, Manitoba. This site is intended to be synergistic to the Brookdale site. This doubles the data and increases the exposure of the projects. It will also assure producers that the data is appropriate for more soil types than just the one site at Brookdale. Funding for the Interlake site is provided by the Livestock Stewardship Initiative.

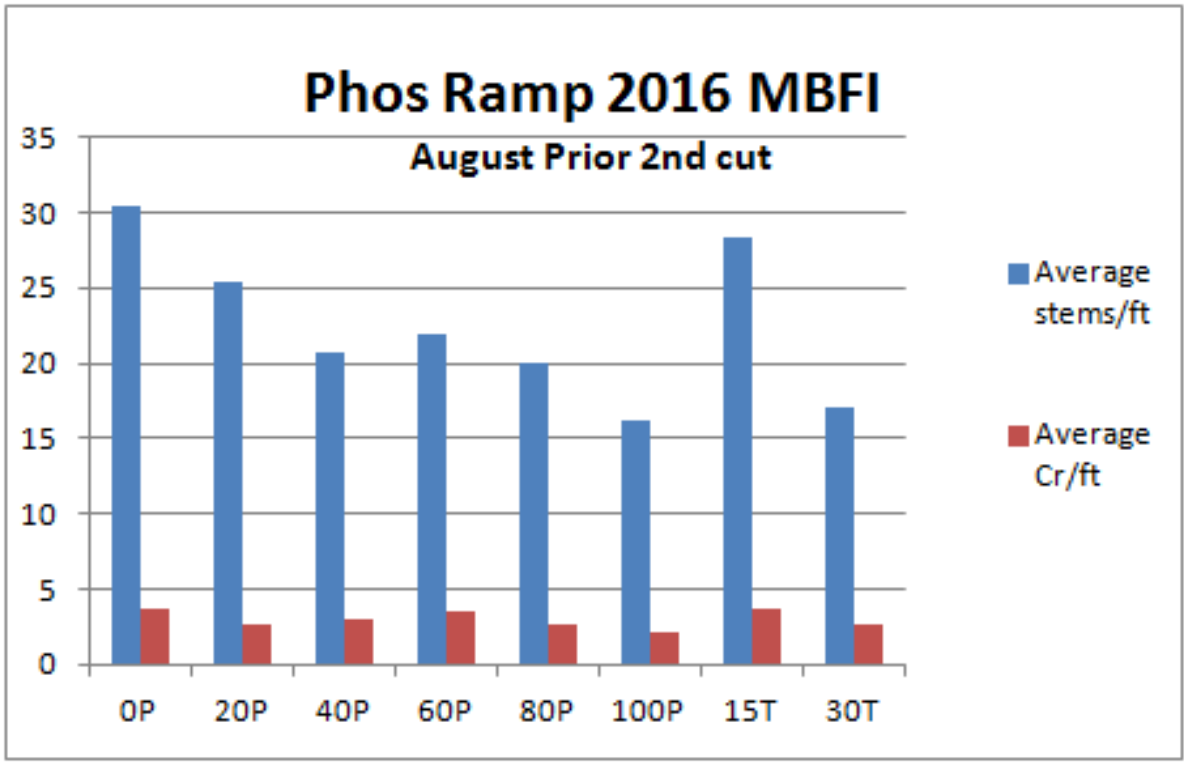


**Fig. 9.8.1** Average number of alfalfa stems and crowns per foot, prior to the second cut (August 2016)

### 9.8.5 Conclusion

Alfalfa production is a good fit for most of Manitoba's agricultural soils. Producers can use alfalfa to improve soil quality, increase soil porosity, tilth and moisture holding abilities. With optimum fertility, alfalfa can provide a competitive economic return in comparison to annual cropping alternatives, and complement annual cropping with soil improvements in nitrogen, tilth and water holding capacity. Phosphorus fertility is required to achieve the optimum yield, and this project helps quantify the economic results over multiple years.

Yield, crown count, and stem counts that were completed in late July 2016 showed marked changes to the plants within the third month after application, and similar analysis will be completed at 15 and 27 months after the May 2016 fertilizer application. By the end of the project in 2018, when the alfalfa plants are four years old, we will have good data on yield, and an indication of stand longevity through plant counts and observation of plant vigor.

### 9.8.6 References

[1]Nitrogen ramp calibration strips in Manitoba [Internet]. Available from www.gov.mb.ca/agriculture/crops/soil-fertility/nitrogen-ramp-calibration-strips-in-manitoba.html

[2]www.umanitoba.ca/faculties/afs/agronomists_conf/media/Ray_Bittner_poster.pdf

[3]Soil fertility guide [Internet]. Available from www.gov.mb.ca/agriculture/crops/soil-fertility/soil-fertility-guide/

[4]Putnam D, Russelle M, Orloff S, Kuhn J, Fitrzhugh L, Godfrey L, Kiess A and Long R. Alfalfa, wildlife and the environment: The importance and benefits of alfalfa in the 21st Century [Internet]. California Alfalfa and Forage Association. 2001. Available from http://agric.ucdavis.edu/files/242006.pdf

**Fig. 9.8.2** Manure rate 15 and 30 tonnes/ac, Brookdale Farm, May 5, 2016; photo by MBFI.


**Fig. 9.8.3** Application rate of zero P, June 23, 2016; photo by MBFI.


**Fig. 9.8.4** Application rate of 40 P, June 23, 2016; photo by MBFI.


**Fig. 9.8.5** Application rate of 100 P, June 23, 2016; photo by MBFI.