

2019 USAFRI Research Project Objectives

Developing Practical Phosphorus & Potassium Tissue Test Recommendations & Utilizing Struvite in Modern Alfalfa Systems III Washington State University - Norberg

Project Award: \$50,000

Justification:

- Confusion exists for crop consultants in terms of P and K recommendations since there are inconsistencies among regional and national recommendations. An example is WA is the fertility recommendations for the Pacific Northwest Alfalfa Fertilizer Guide (PNWG) (Koenig et al., 1999), and California whole plant fertility recommendations in the Chapter 6 of the Alfalfa Handbook (CAH), (Meyer et al., 2008). The lowest soil K level without a K recommendation is 80 ppm in CAH, whereas it is 150 ppm in the PNWG. The optimum fertility in our research suggested that CAH was best for K, but the PNWG was best for P. Whole plant tissue testing in the Appendix Table A of CAH in both instances was closer to CAH Appendix A. The PNWG does not provide a recommended value for whole plant P concentration at mid-bud stage at which much of the alfalfa is harvested. This result confirms our concern for the need of more extensive research and possible revision of the PNWG especially for tissue testing.

Most inorganic Phosphorus (P) fertilizers are derived from phosphate rock, where 98% of the reserves are in other countries with the USA only holding 2% (Stewart 2002, USGS 2013). Dairies accumulate P and need appropriate outlets to reach a whole farm P nutrient balance (WA Dept. of Ecology and EPA). In contrast, alfalfa (*Medicago sativa*) producers need to reverse the trend of declining soil test P content to maintain high crop yield and quality. At the same time our first-year research shows us that over application of P or K decreases hay quality and increases nutrient loss in forage sold. Both declining soil test values and nutrient influence on hay quality requires more precision than a soil test can provide and we believe tissue testing will provide more accurate results. To compound the problem just a few years ago the price of commercial P fertilizers soared to record high prices, and will likely to do again as reserves diminish. A viable solution is the adoption of technology to capture P from liquid manure in the form of 'struvite', a slow release form of P based fertilizer. Current Pacific Northwest struvite fertilizer has an analysis of 6, 29, 0, 16 percent nitrogen, phosphorus, potassium, and magnesium, respectively. Struvite has the texture of sand is easy and economical to handle and transport due to its low moisture content.

A USDA -NRCS-CIG grant titled "Mobile System for Nutrient (Phosphorus) Recovery and Cost-Efficient Nutrient Transport" (years 2017 – 2019) has had the dual objectives of capturing excess P from dairies in the form of struvite, and demonstrating the value of the struvite as a P source at commercial alfalfa hay growers. The agronomic response in year 1 (2018) of struvite under commercial alfalfa production indicates that struvite to be a comparable source of P compared to standard sources. A second year (2019) of comparison is underway.

With high P and K costs it is important to apply nutrients only when needed, often using one-foot, calibrated soil tests. With taproots that penetrate deeply into soils, alfalfa plants can remove potassium and other nutrients from much deeper depths creating disproportional inaccuracy in crop response related to a 1 ft soil sample. Tissue testing provides the opportunity to make nutrient application more accurate and determine in-season critical levels that would determine recommendations for applications between cuttings or through fertigation. Alfalfa growers often have higher quality demands than one-tenth bloom, with harvests often scheduled at bud stage, a week or sooner than

the more mature than the PNW recommendations.

Struvite provides a slow release option we believe would work best in combinations with faster release forms such as mono-ammonium phosphate (MAP). This research impacts and has relevance to with USAFRI Research Priorities of "Agronomic Management" and "Fertility, Soil Management, Soil Health, Macro/Micro Nutrients" and has the ability to transfer research findings to alfalfa producers' operations over a wide geographic area. Again, 2017-2018 preliminary research confirms our concern for the need of more extensive research and possible revision of the PNWG especially for tissue testing of whole plants at the mid-bud stage. We propose this project as research is needed before adjustments can be made.

Objectives:

- The objectives of this project are to 1) Develop and calibrate P and K nutrient recommendations for tissue testing at bud stage alfalfa for maximum profit, yield, and direct comparison to current soil testing recommendations; 2) Compare efficacy of MAP and struvite for fertilization of alfalfa; 3) Evaluate quality of hay samples at different P and K rates and tissue concentrations; and 4) Extend this information to a wide audience using a variety of outreach methods.