Develop and calibrate phosphorus (P\(_{2}\)O\(_{5}\)) & potassium (K\(_{2}\)O) nutrient recommendations for bud stage alfalfa using tissue testing for maximum profit, yield and direct comparison to current soil testing recommendations.

Compare efficacy of combinations of monoammonium phosphate (MAP) and struvite (magnesium ammonium phosphate, MgNH\(_4\)PO\(_4\) · 6 H\(_2\)O) for fertilization of alfalfa.

Evaluate quality of hay samples at different P\(_{2}\)O\(_{5}\) and K\(_{2}\)O rates and tissue concentrations.

**OBJECTIVES**

**STUDY DESCRIPTION**

**Plot Layout:**
Three alfalfa research studies (P Study, K Study, and Struvite Study) were grown near Prosser, WA in South Central WA, in a low P & K testing soil.

**P Study:**
Differing rates of P\(_{2}\)O\(_{5}\) using MAP; including: 0, 30, 60, 120, 240 lbs/acre.

**K Study:**
Differing rates of K\(_{2}\)O using K sulfate: 0, 40, 80, 160, 240, 320 lbs K\(_{2}\)O/acre.

**Struvite Study:**
Application of 144 lbs of P\(_{2}\)O\(_{5}\)/acre in differing ratios of MAP:Struvite in alfalfa including: 100:0, 75:25, 50:50, 37.5:62.5, 25:75, 12.5:87.5, 0:100 and an unfertilized check.

**Analysis:**
Results were analyzed for yield, P or K content (ICP method), hay quality (NIRS method), maturity at harvest.

**RESULTS – P STUDY**

**Figure 1a.** First cut yield and P content (%) in hay at harvest as influenced by P\(_{2}\)O\(_{5}\) rate.

**Figure 1b.** First year yield and gross income minus fertilizer cost as influenced by P\(_{2}\)O\(_{5}\) rate.

**Figure 1c.** Field view of control and high rate of P\(_{2}\)O\(_{5}\) in summer 2018.
• Optimum alfalfa tissue P concentration was 0.24-0.25 for first cut, 0.28 - 0.29 for second cut, and 0.26-0.27 for third cut for alfalfa hay priced at $150 and $200/ton respectively.
• Applications of P₂O₅ decreased hay quality so accurate rates are important to maximize profit.

RESULTS – K STUDY

• The experiment started with a 101, 73, and 79 ppm K₂O in the soil (ammonium acetate method) at depths of 0-12, 12-24, and 24-36 inch depths respectively, which we did not see a yield response, yet 240 lb K₂O treatment pulled 308 lb K from the soil as opposed to no application which pulled 198 lb K from the soil. Current soil testing recommendation would have been 100 lbs/acre. K₂O treatment 240 lb/acre decreased RFV and RFQ and increased lignin. Further research is needed.

RESULTS – STRUVITE STUDY

• Source of P₂O₅ had no effect on first cut or first year yield or P₂O₅ content.
• Phosphorus was needed in this trial both in first cut and first season yield and P₂O₅ content.

MANAGEMENT RECOMMENDATIONS/CONCLUSIONS

• Optimum P alfalfa tissue P₂O₅ content based on first year of the experiment should be between 0.24-0.28 and 0.25-0.29 when the alfalfa hay price of $150 and $200/ton, respectively.
• First year data show that struvite can be used alone or in combination with monoammonium phosphate (MAP) when put on prior to planting and incorporated without a yield loss even on a soil averaging 8.1 ppm (Olson Method).
• Excessive P₂O₅ of K₂O has a negative affect on hay quality and can affect aNDF, lignin, RFV, RFQ₄ and nutrient value of hay ($/ton).