



# Potassium Fertilization and Its Impact on Yield, Quality, and Winter Hardiness of Alfalfa

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## OBJECTIVES

To determine the effect of potassium (K) fertilization on alfalfa yield, quality, and persistence in alfalfa of different fall dormancy and with variable rate application and harvest stress.

To determine the changes in root carbohydrate reserves in alfalfa with different K rates and application timing.

To determine the interaction between fall dormancy and K fertilization on root storage of protein and starch.

## STUDY DESCRIPTION

There are multiple factors that determine the appropriate rate of potassium (K) fertilization in alfalfa, one of them is soil clay mineralogy. Potassium becomes immobile when the soil smectite-to-illite clay mineralogy ratio is greater than 3.5. The goal of this study was to determine the effect of K rate and application timing, varietal fall dormancy, and harvest stress on forage yield, nutritive value, and winter survival in soils with different clay mineralogy. Experiments were established in Lisbon and Milnor, ND in 2019. Milnor and Lisbon have soils with a smectite-to-illite ratio  $>3.5$  and  $<3.5$ , respectively. The experimental design was a randomized complete design with a split-plot arrangement and four replicates, where the varieties Presteez RR, Stratica RR, and L-450 RR were assigned to the main plots. The subplots were a factorial combination of K rates (0, 150, and 300 lbs  $K_2O$ /acre) and two application timings. Two harvest timings were also included (stressed and non-stressed treatments). Higher K fertilizer rates did not increase alfalfa forage yield. Increase of K application did result in a decrease in nutritive value (TDN). Alfalfa stand counts decreased from fall to spring. Alfalfa harvested on 18 September (stress treatment) had a stand reduction from fall to spring between 47.1 and 51.4% and alfalfa harvested on 16 October (non-stress treatment) had a stand reduction of 16.5 to 26.9%. The differences in soil available K in the fall between locations supports that the higher smectite-to-illite clay ratios soil may have lower

availability of K to plants. Summing soil available K in the fall and K applied as fertilizer, the K accumulated in the plant explains less than 25% and 54% of the K available at the highest fertilization rate at the  $<3.5$ -clay ratio soil and  $>3.5$ -clay ratio soil, respectively. Root protein content was lower when harvested in September.

Figure 1. Alfalfa without K fertilization with clear symptoms of K deficiency.



## RESULTS

**Alfalfa forage yield:** No significant effect of K fertilization or variety was observed on total forage yield in the seeding year.

**Alfalfa forage nutritive value:** Potassium fertilization or variety did not affect crude protein concentration or fiber components (NDF, ADF, ADL). Ash content was higher and total digestible nutrients (TDN) were significantly lower with higher rates of K. TDN was highest in the first cut across all varieties.

**Alfalfa persistence:** stand counts decreased from fall to spring in all treatments. Alfalfa harvested on 18 September (stress treatment) stand reduction ranged between 47.1 and 51.4%. Alfalfa harvested on 16 October (non-stress treatment) had significantly lower plant stand reduction

ranging between 16.5 and 26.9%. Potassium fertilization or varieties did not have an influence on stand reduction.

*Potassium fate:* Potassium fertilizer applied to the soil with smectite-to-illite ratio >3.5 did not increase available K soil level between the spring and fall. Potassium extracted by alfalfa biomass could not explain the fate of K. Potassium unaccounted for in the high smectite-to-illite ratio soil ranged between 100-300 lbs/acre, indicating it is likely the K is being fixed by soil clays.

- Root protein concentration was not influenced by K rate or K application timings.
- Root starch concentration analysis has not been completed at the closing of this report.
- No interaction was observed between fall dormancy and K fertilization on root storage of protein on the seeding year of alfalfa.