2018 USAFRI Research Project Objectives

Potassium Fertilization and Its Impact on Yield, Quality, and Winter Hardiness of Alfalfa
North Dakota State University - Berti

Project Award: $37,270

Justification:

- Alfalfa is a high user of potassium (K) which has an important role in alfalfa physiology, including winter hardiness. Potassium is an expensive fertilizer so many growers under-fertilize alfalfa with the consequent of reduced yield, quality, and persistence. The application of K should be related to soil test value, clay chemistry, and alfalfa tonnage removed the previous season. The initial soil test K value, measured with 0-6 inch depth soil cores, should guide pre-seeding K application. The soil cation exchange capacity (CEC) may also be useful to determine the initial K application rate that the soil would support if lower than 10 meq 100g-1 (Franzen and Berti, 2018). Recent research in North Dakota found that the critical level of soil test K required was related to the ratio of smectite-chemistry clay to illite-chemistry clay. North Dakota has been mapped very recently for the smectite-to illite ratio in major soil groups in each county. Soils with a smectite-to-illite ratio greater than 3.5 draw some soil solution K back into the clay interlayers when the soil is dry and prevent its release, rendering it unavailable to crops until the soil becomes moist. Soils with a smectite-to-illite ratio less than 3.5 provide K to crops whether the soil is moist or dry. Using this information, the critical K soil test level for alfalfa in soils with a smectite-to-illite ratio greater than 3.5 would be 200 ppm. For soils in North Dakota with a smectite-to illite ratio less than 3.5, a critical level of 150 ppm should be used. If the soil test K levels are above the critical K level, K fertilizer need not be applied (Franzen, Berti, 2017).

  If the soil test K level is at or below the critical level, then supplemental K application will be important to maintain stand and high yield for a given environment. Early spring K release from soil minerals will sustain the alfalfa crop through the first harvest, but after the first harvest, K application based on removal from the previous year's yields will be essential to maintaining stand and productivity.

  Alfalfa removes about 50 lbs of K2O per ton of dry matter. For example, the recommended rate of potash fertilizer (0-0-60) after the first cutting in a year preceded by removal of 4 tons per acre alfalfa would be 4 tons x 80 pounds per acre of 0-0-60/ton, or 320 pounds per acre of 0-0-60 fertilizer. Alfalfa takes up surface application of K very efficiently. Although these are the recommended levels of fertilization, in North Dakota it is rare for a grower to use these potassium fertilization, even in soils below the soil critical level (Franzen and Berti, 2017). Low forage yield and winter-kill in alfalfa are common in the state due to inadequate attention to K.

  Previous studies have shown that plants with low concentration of K in aboveground tissue also had low concentration of K in the root. Plants with K deficiency had poor persistence and plant death was associated to lower concentrations of starch, soluble protein, and amino-N in taproots when compared with well-fertilized plants (Berg et al., 2018).

Objectives:

- The objectives of this research are to 1) Determine the effect of K fertilization on alfalfa yield, quality, and persistence in alfalfa of different fall dormancy and with variable rate application and harvest stress; 2) Determine the changes in root carbohydrate reserves in alfalfa with different K rates and application timing; and 3) Determine the interaction between fall dormancy and K fertilization on root carbohydrate storage.