

## 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<sup>-1</sup> (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 K<sub>2</sub>O 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.

