2017 USAFRI Research Project Objectives

Evaluating Progress in Alfalfa Forage Quality Improvement
University of Minnesota - Sheaffer

Project Award: $28,576

Justification:

- A new generation of alfalfa varieties with greatly improved forage quality is available for producers. These new varieties developed through conventional breeding and through transgenic transformation (genetic engineering) have potential to provide increased profit and to increase management flexibility for growers. However, there is lack of information for growers on direct comparison of these alfalfa varieties. We propose to answer the question, "How do the large numbers of conventional "high quality" varieties compare with transformed, reduced-lignin types"? We will conduct research to measure the forage quality and forage yield of a diversity of new alfalfa varieties over a range of harvest maturities used by growers.

  Our research will provide decision-making information to producers and will provide the basis of an educational program on criteria to select alfalfa varieties. Direct beneficiaries will include hay producers, livestock farmers feeding alfalfa, and alfalfa and hay marketers. The northern region of the U.S. is a very important alfalfa producing region with states from Minnesota to New York producing nearly 10 million acres of alfalfa for hay and silage with a market value of nearly 4 billion dollars (National Agricultural Statistics Service, 2016). Our results can have huge financial implications for growers in this region.

  There have long been efforts to improve alfalfa forage quality through conventional plant breeding. But until recently, differences in variety forage quality have been inconsistent over locations and greatly influenced by factors such as growth condition and crop maturity (Lamb et al., 2006; Sheaffer et al. 1998). Recently, alfalfa breeding companies have announced development of varieties with reduced lignin content (Holin, 2014). Reduced-lignin alfalfa varieties with high digestibility have been developed through conventional plant breeding. 'Hi-Gest', released by Alforex seeds (http://www.alforexseeds.com/alfalfa-product/hi-gest-360/), contains 7-10% less lignin than standard varieties and in research trials had about 12% greater total tract digestibility (Total Tract NDF digestibility) (Alforex, 2014). 'King Fisher 425HD' from Bryon Seeds (http://www.byronseeds.net/our_products/legumes/legumes.php?section) is described as having reduced lignin content similar to 'Hi-Gest 360'.

  A transgenic, genetically engineered, reduced-lignin alfalfa, named HarvXtra, is marketed by Forage Genetics International (http://www.foragegenetics.com/). In field trials in Minnesota, we found that compared to conventional alfalfa cultivars, '54HVX41' a reduced lignin alfalfa, had an average of 10% less acid detergent lignin (ADL) and 10% greater neutral detergent fiber digestibility (NDFD) compared to non-transgenic reference varieties (Grev et al., 2017). Dairy cow feeding trials with transgenic low-lignin alfalfa forage as a portion of the ration showed increased milk production of 2.6 lb/head/day compared to forage from conventional alfalfa controls (Mertens and McCaslin, 2008; Undersander et al., 2009). Conventional low-lignin 2 varieties or other varieties marketed as high quality have not been directly compared to HarvXtra branded varieties in trials spanning the northern region.

  Use of alfalfa varieties with improved forage quality has potential to be advantageous to growers. At any given maturity stage, high quality alfalfa varieties will have greater feeding value than standard varieties. In addition, improved forage quality provides growers management flexibility to delay harvest to a later stage of maturity. This could allow for a wider optimal harvest window, making it

possible for alfalfa growers to achieve higher yields by delaying alfalfa harvest while still maintaining higher forage nutritive values. For example, in Minnesota we found that, '54HVX41', a reduced lignin alfalfa, harvested on a 35-day harvest interval showed a 21% gain in yield and only a 3% reduction in RFQ while reference varieties had similar gain in yield but greater loss in RFQ (Grev et al., 2017). We do not know if the pattern of quality decline within increased maturity and time observed with the '54HVX41' will be similar for all the new "high quality" varieties and therefore sampling over a range of maturities is important.

Results from this research will also be used for revision of the standard test for characterization of alfalfa varieties for forage nutritive value. Standard tests developed by the North American Alfalfa Improvement Conference are used by plant breeders for development and certification of new alfalfa varieties by The Association of Official Seed Certifying Agencies (AOSCA). Sheaffer et al. (1995) developed a standard test to characterize alfalfa varieties for relative feed value (RFV) (https://www.naaic.org/resource/stdtests.php). They identified check varieties and procedures to characterize RFV and its cell wall components. That test is not current as it does not include RFQ, an estimate of digestible fiber intake, now considered a critical forage quality component (DHIA, 2017; http://stearnsdhialab.com/whatis.html).

Objectives:

- The objectives of this project are to 1) Evaluate the forage quality of new alfalfa varieties over a range of maturities, and 2) Measure forage yield of new alfalfa varieties marketed for improved forage quality.