

2019 USAFRI Research Project Objectives

Forage Production of Alfalfa Established in Silage Corn vs. Conventional Production Systems USDA-ARS U.S. Dairy Forage Research Center - Grabber

Project Award: \$75,000

Justification:

- Agricultural statistics indicate alfalfa acreage in the United States has declined by over 50% in the last 30 years to around 11.5 million acres in 2018. Among other factors, this decline has occurred because silage corn has become the primary source of forage for dairy cattle and other ruminant livestock. One reason for this shift is the relatively low yield of alfalfa compared to silage corn. First year yields of spring-seeded alfalfa are particularly low, often being one-half that of subsequent full production years. Planting small grain, grass, or legume companion crops can modestly improve forage yields during alfalfa establishment, but overall forage quality is often reduced.

One way to bypass the low-yielding establishment year is to interseed alfalfa into corn to jumpstart full production of alfalfa the following year. During and after establishment, interseeded alfalfa also serves as a cover crop to reduce soil and nutrient loss from cropland. Regrettably, this system has been unworkable because traditional intercropping approaches require producers to either favor high corn yields at the expense of reliable alfalfa establishment (e.g., interseed alfalfa late at the V5 growth stage of corn) or to favor establishment of interseeded alfalfa by sacrificing corn silage yield (e.g., interseed alfalfa into corn planted at low density). Therefore, scientists the USDA-ARS and other institutions have been working to develop reliable methods for establishing alfalfa in high-yielding silage corn.

Ten years of research in Wisconsin has shown that establishment of alfalfa in high-yielding silage corn is more successful by using growth-altering and protective agrichemicals, adapted alfalfa varieties, and adequate alfalfa seeding rates. Work from 2008 to 2014 demonstrated that foliar spray applications of a commercial growth regulator (prohexadione) increased seedling survival of interseeded alfalfa by up to 300% under high-yielding corn grown at populations over 30,000 plants per acre (Grabber, 2016; Osterholz et al., 2018). Low rates of prohexadione shift alfalfa growth from tops to roots, but yields of corn are not affected if applications are made early in the growing season or with spray directed toward the lower half of corn plants. Due to its effectiveness and low toxicity, a product label for on-farm use of prohexadione on interseeded alfalfa is expected for the 2020 growing season (Daniel Kunkel, Associate Director, Interregional Research Project Number 4, personal communication). Several studies also revealed that shifting the alfalfa seeding rate from 8 to 16 lb per acre increased alfalfa plant density by 32 to 50% following corn harvest (Grabber, 2016; Osterholz et al., 2018). Other experiments in 2015 and 2016 with 38 conventional and Roundup Ready alfalfa varieties found substantial and consistent differences in plant survival and several varieties had over a 4-fold greater survival under corn than the poorest performing varieties when treated with prohexadione (Grabber et al., unpublished). To facilitate the use of well-adapted alfalfa varieties for interseeding, various herbicides were tested in 2015 and 2016. Warrant and Buctril were found to be effective for controlling weeds with little or no injury to alfalfa (Renz et al., unpublished). Work conducted in 2017 and 2018 found that fungicide and insecticide applied after prohexadione ensured good survival of interseeded alfalfa under growing conditions that killed untreated alfalfa and severely damaged stands treated only with prohexadione. Studies carried out in 2018 and 2019 will identify the optimal rate and timing for applying prohexadione in combination with fungicide and insecticide to ensure cost-effective establishment of alfalfa in corn. Other USDA-NIFA funded experiments conducted in 2018 and 2019 on research stations and producer fields in Wisconsin, Idaho, Michigan, and Pennsylvania have confirmed the benefits of prohexadione, fungicide and insecticide in high stress environments and highlighted the need for adequate weed

control and good seedbed preparation for good establishment of interseeded alfalfa.

When successfully established, first year yields of interseeded alfalfa in Wisconsin were 60 to 130% greater than conventionally spring-seeded alfalfa. Initial studies in Wisconsin from 2008 to 2013 found alfalfa interseeding reduced silage corn yields by an average of 11% when a moderate rate of nitrogen fertilizer (160 lbs N per acre) was used. Shifting nitrogen fertilizer to the upper-end of recommended rates (200 lbs N per acre) in 2014 to 2018 reduced yield drag on silage corn yield to an average of 5%. Other Wisconsin work in 2017 and 2018 found that corn populations of 32,000 to 35,000 plants per acre provided a good balance between high corn silage yields and reliable establishment of interseeded alfalfa when prohexadione, fungicide and insecticide were applied (Grabber, 2016; Osterholz et al., 2018; Grabber et al., unpublished). Other important aspects requiring further study include refining the proper timing of alfalfa interseeding into corn and the timing of corn silage harvest to promote high corn silage yields while allowing good establishment of alfalfa. The effect of interseeding on corn silage and alfalfa forage quality also must be evaluated. The ultimate goal of this work is to develop reliable and profitable corn-interseeded alfalfa production systems for farms in northern states where alfalfa usually cannot be successfully established in the fall after corn silage harvest.

While many aspects of the corn-interseeded alfalfa production system have or will be worked out in the next several years, one longstanding question remains that will greatly affect the adoption of this practice on farms. What is the long-term forage production of alfalfa established in silage corn vs. conventionally established alfalfa? An experiment designed to answer this question will be the primary goal of this USAFRI project and followup work. The study will be carried out in Wisconsin and Idaho, two major northern alfalfa producing states that would respectively represent the rainfed Eastern region and the Western irrigated intermountain region of the United States. A key aspect of this work will be to evaluate the timing of alfalfa interseeding into corn and the timing of corn silage harvest, because these factors will directly impact corn silage yields and the productivity of interseeded alfalfa. Forage yield and quality of the interseeded alfalfa systems will be compared to several conventional alfalfa establishment and production systems that are currently utilized in Wisconsin and Idaho.

The alfalfa interseeding system holds promise for protecting cropland, reducing nutrient losses, and improving farm profitability. Rain simulator studies indicated alfalfa interseeding reduced runoff of both soil and nutrients by 40 to 80% during and after silage corn production compared to a conventional system where alfalfa was spring seeded after silage corn (Osterholz et al., 2019). Alfalfa is known to be an excellent scavenger of residual nitrate throughout the soil profile and recent work found residual soil nitrate from corn production was reduced much more rapidly by interseeded alfalfa than by spring-seeded alfalfa (Osterholz et al., unpublished). Based on recent estimated costs of production and forage values in southern Wisconsin, economic analyses suggest a reliable alfalfa interseeding system would provide an annual net return of \$123 to \$149 per acre, with a 3-year corn and 3-year alfalfa rotation identified as the most profitable. Conventional rotations with spring seeded alfalfa provided lower annual net returns of \$89 to \$118 per acre, with a 4-year corn and 4-year alfalfa rotation identified as the most profitable conventional rotation (Osterholz et al., unpublished). Recent USDA data indicate alfalfa and silage corn were planted on about 1.7 and 4.5 million acres per year, respectively, in the Northeast through the Northern Mountain regions of the USA. Because alfalfa is often grown in rotation with corn throughout this region, a workable interseeding production system could potentially be adopted on a substantial scale to provide groundcover during silage corn production and to jumpstart alfalfa into full forage production during subsequent growing seasons.

Objectives:

- The objective of this project is to 1) Compare silage corn and alfalfa forage production from conventional seeding practices with alfalfa that was established by interseeding with corn in Wisconsin and Idaho.