

## 2020 USAFRI Research Project Objectives

### Closing the Alfalfa Yield Gap While Improving Soil Fertility and Health Michael Fields Agricultural Institute - Tautges

Project Award: \$98,002

#### Justification:

- Alfalfa crop improvement research has made significant gains in variety development and pest and harvest management, which have significantly increased the yield potential of alfalfa. Yields of alfalfa varieties at experimental stations over time have increased due to breeding and improved management, while yield stability and resilience have not (Picasso et al. 2019). However, alfalfa yields on the average alfalfa-producing farm remain 30 to 50% below the yield potential identified by research trials and “top-tier” alfalfa farms (Russelle 2013), highlighting the persistent yield gap experienced by many farmers. However, identification of this yield gap presents an opportunity to identify and communicate management factors that could lead to substantial near-term yield improvements across alfalfa production operations, reversing recent declining trends of alfalfa production and reinvigorating the perception of alfalfa as a highly productive and efficient crop. This project aims to build on a Midwest Forage Association-funded management survey that identified farms with high alfalfa yields and the production practices they used, by 1) adding a soil fertility and health assessment to on-farm data collection activities, 2) compiling a database that combines alfalfa production, management practices, and soil parameters, 3) identifying critical relationships between alfalfa yields, management practices, and soil fertility and health, and 4) communicate best management practices to close the alfalfa yield gap via workshops, conference presentations, and web-based instructional materials. Alfalfa farmers in the US will potentially benefit from the results of this project and it has the potential to significantly increase alfalfa yields nationally.

The decline in alfalfa’s dominance as a forage crop may be due to a number of factors, including less public research support compared to corn and soy, the need for repeated harvesting practices throughout the year, less innovation in forage harvesting equipment, and relatively lower support and outreach around best soil fertility and management practices, perhaps because alfalfa is perceived to be a “low-input” crop. In truth, achieving sufficient levels of important alfalfa nutrients like phosphorus and potassium are major yield determinants (Berg et al. 2005), as are harvest management practices, including timing and frequency (Russelle 2013). An alfalfa crop advisor in the upper Midwest estimated that up to 30% of the alfalfa yield gap could be attributed to a lack of proper soil fertility management (R. Welch, personal communication). Other soil quality factors, including compaction and poor structure management, can lead to poor drainage and water-logging of soils in the spring, and to poor rain infiltration and water-holding capacity in dryer summer months, limiting yields at throughout the growing season. However thus far, despite the explosive attention to soil health research and improvement from scientists, growers, citizens, and policymakers over the past several years, alfalfa is a crop that has largely been left out of soil health and quality research and discussions. A Google search engine query for “soil health corn” returned more than 10 times the number of results, compared to searching for “soil health alfalfa.” Seemingly, alfalfa growers are being excluded from discussions and outreach around soil management that could be beneficial for both alfalfa productivity and environmental quality on their farms.

Moreover, there is growing evidence that alfalfa in crop rotations can contribute significantly to improving soil health. Alfalfa has been observed in some studies to increase soil biological activity, promote soil particle aggregation, and prevent soil erosion (Fernandez et al. 2019). Despite this

potential, many alfalfa soils suffer from compaction from repeated harvests with heavy machinery using non-controlled traffic, limited nutrient cycling from cationic nutrient depletion, and buildup of soil pathogens. Knowledge of what alfalfa management practices contribute to soil health and consequent productivity gains remains unclear and under-researched. This project will identify management practices that contribute directly to alfalfa productivity gains on real farms, as well as which practices contribute indirectly to yield gains via soil fertility and health improvement.

#### Objectives:

- The objectives of this project are to 1) identify management practices on-farm which increase yields in alfalfa based on farmers survey across Wisconsin over two years; 2) conduct a soil fertility and health survey on-farm, in fields identified by collaborating growers, and work with growers to gather forage yield and quality data from surveyed fields; 3) construct statistical models to identify relationships between soil fertility and health indicators, management practices, and alfalfa productivity indicators; and 4) communicate results describing how soil fertility and health indicators and management practices impact alfalfa forage yields and quality, and how better soil management can close alfalfa yield gaps, through a) soil health reports issued to collaborating growers, with descriptions tailored to their farms, b) presentation of results at grower and industry conferences, and c) Extension materials, including fact sheets, blog posts, newsletters, and articles.