



Cover Crops, Forage Grasses and Legumes

FOR GRAZING, FORAGE, BIOMASS AND DUAL-USE SYSTEMS

Overview

Winter-hardy cover crops, perennial grasses, and legumes are options for diversification of summer-annual cropping systems by providing year-round ground cover. Cover crops provide soil coverage during seasons when a summer annual crop—such as corn and soybean—is not actively growing. Cover crops are useful management tools for enhancing the sustainability of agroecosystems and reducing negative environmental impacts in a summer-annual system, by lengthening the “green phase” of the system by growing in the months between harvesting and planting. Cover crops can decrease soil erosion, improve soil organic matter, and water quality. They support summer annual crop production by suppressing weeds, and disrupting pest and disease cycles. Cover crops can improve soil nitrogen management and water quality by utilizing nutrients in late fall and in early spring when they are typically lost in a field with only summer annual crops. Perennial grasses and legumes provide year-around ground cover and forage for many livestock species, and are key to a rapidly growing organic dairy industry. These crops greatly reduce soil erosion and store significant quantities of carbon belowground; in rotation, these crops can greatly improve soil quality and fertility.

Dual-use systems provide an important pathway for integrating cover crops and perennial grasses into current farming systems. Biomass from cover crops and perennial crops can be marketed for bioproducts and/or animal feed. If complemented with cover crops and perennial grasses, corn-soybean farms can sustainably produce large amounts of corn residue biomass, as well as additional biomass from cover crops and perennial grasses, increasing total production and profit while also improving soil and water quality. Sustainably-produced biomass is increasingly demanded for liquid fuels, high-value animal feeds, and other bioproducts. Another promising dual-use system is grazing of cover crops to enhance sustainable livestock systems.

Research Status and Goals

Investments made in faculty, post-doctoral researchers, graduate students, technicians, undergraduate employees, and site support:

BREEDING, GENETICS, AND AGRONOMICS

Improve the genetic quality of cover crops including hairy vetch and Kura clover, and forage grasses such as perennial ryegrass.

Activities:

1. Hairy vetch breeding to improve winter hardiness and earlier spring maturity.
2. Testing a new method to establish Kura clover by interseeding it into an existing alfalfa stand, allowing development of a kura stand as the alfalfa eventually thins, while continuing to harvest forage.
3. Working with tillage equipment manufacturers to develop new methods for seedbed preparation when planting corn into kura clover living mulch.
4. Perennial ryegrass breeding to improve winter hardiness and introduce a spreading trait into forage-type ryegrass breeding populations.
5. Dual-use system research to improve biomass from corn residue (stover) and other crops, and develop decision-support tools for advanced crop/soil management methods.
6. Cropping systems research to improve legume potential to enhance nutrient cycling and soil health.

Outcomes:

New varieties of cover crops and perennial forage crops will enable profitable seed production, provide adequate and affordable seed stocks for these crops, and enable growers to better achieve benefits from using these crops in cropping systems. Products will include improved varieties, guidelines for production, and scientific reports on varieties and agronomy strategies.

TIMELINE

2020–25 AND BEYOND

- Improved varieties and agronomic systems
- Key pilot and commercialization activities

Pilot Studies

Selection nurseries are variously located at Becker, Rosemount, Roseau and St. Paul. Focal traits include: vetch—emergence and vigor in late fall, winter survival, flowering date, seed production potential and biomass yield in spring and fall; and perennial ryegrass—improved performance under grazing, forage yield, fast regrowth potential, winter survival, and spreading growth habit; Kura clover—increased seed production potential and harvest efficiency.

Pilot studies on dual-use systems are advancing integration of diversified biomass production in corn-soybean systems within several watersheds in south central Minnesota. Key pilot activities will include: on-farm and experiment station research and demonstration work to improve crop and soil management for more sustainable biomass production; multi-level collaborative planning and coordination for extensive diversified biomass production; and providing and improving model-based decision support for diversified biomass production.

Commercialization Plan

Minnesota has a vibrant grass and legume seed production industry centered in Roseau and Lake of the Woods counties in northwestern Minnesota. The University has a long-standing relationship with the seed growers dating back over 60 years when funding to initiate a research program in seed production was received. Our goal is to enable profitable, large-scale production of our improved hairy vetch, Kura clover, and perennial ryegrass varieties by northern Minnesota seed growers. Dual-use system commercialization will leverage the broad appeal of diversified biomass production systems, which can substantially improve production, profit, and conservation, offering a strong value proposition to many commercialization partners. Biomass end users, such as POET LLC, are keen to diversify biomass sources for their biorefineries to manage risks associated with fluctuating supplies of corn biomass. Commercialization will be advanced by collaboration with a wide range of leading firms and organizations working on issues related to production, processing and marketing. These firms, organizations, and agencies include providers of biomass harvest systems (Pacific Ag) and services (FDC Enterprises), sub-field diversification strategies for producers (AgSolver), policy innovation (Delta Institute), and a range of non-profit groups (including the Nature Conservancy, Minnesota Corn Growers), and governmental agencies (Minnesota Region 9 Economic Development). Initially, we will focus on establishing pilot-scale diversified biomass production in a watershed that has provided formative stakeholder input to the commercialization project already near to an existing grain ethanol facility.