South Dakota 2019 State Report for Midwest Cover Crop Council

Various projects pertaining to cover crops are in place within South Dakota. Projects range from cover crop establishment in corn and soybean rotations, to nutrient cycling for various cash crops, to herbicide carryover and cover crop implementation. Below are brief summaries related to some, but not all, of the projects taking place in South Dakota.

Cover Crop Nutrient Cycling in South Dakota.

Anthony Bly; SDSU Extension

Cover Crop use is steadily becoming a field practice on South Dakota croplands. The many reasons for using a cover crop include forage for livestock, wildlife habitat, capture of inorganic nutrients that might harm the environment, and building of soil health through additions of carbon and formation of beneficial soil structure and aggregates. A popular question from agriculture producers is how do cover crops affect the cycling of soil nutrients and how does this influence the growth and yield of cash crops?

A three-year project evaluating the nutrient cycling in the soil began in the fall of 2017 on 30 farm fields across South Dakota. The On-Farm sites encompass the evaluations of three project objectives that are 1. Determine the influence of cover crop composition on nutrient cycling and availability for subsequent cash crops. 2. How cover crop compositions and rate of nutrient loss effect on following cash crop nutrient uptake and yield as well as soil moisture status in western SD. 3. How cover crop carbon/nitrogen ratio effect corn and sorghum nitrogen requirements.

During 2019, South Dakota experienced extreme precipitation and many of the research project sites had to be abandoned due to saturated soil conditions. A few objective 1 sites were able to continue, three objective 2 sites were successful, and only one out of six objective 3 sites were salvaged. The project was able to put our several sites during the Fall of 2019 and we are hoping the climate becomes drier so we can finish our work in 2020.

MS graduate students, Hunter Bielenberg and Amin Rahal started working with Jason D. Clark during June, 2019.

Funding: USDA/NRCS South Dakota

Principle Investigator: Anthony Bly

Co-Investigators: David Karki, Sara Bauder, Ruth Beck, Chris Graham, Howard Woodard, Peter Sexton, Shannon Osborn, Michael Lehman and Jason Miller

Student Investigators: Justin Brown, Hunter Bielenberg and Amin Rahal.

Expected Completion: December 2020 (project extension anticipated to June 2022)

CURRENT COVER CROP RESEARCH

David Clay, Sharon Clay, Graig Reicks, Deepak Joshi, Janet Miller, Shaina Westhoff

1. Impact of Cover Crops on Greenhouse Gas Emissions
    a. 20 cm diameter pvc pipes on Aurora Research Farm either with or without rye (5 plants/pipe)
    b. Piccaro gas analyzer collected gas emissions from each pipe every 4 hours for 15 min.
    c. Every 20 days, the cover crop was clipped and removed from the system, as biomass needed to be contained in the pipe for best results.
        i. In both years, there were 3 sampling periods, each lasting 20 days
    d. During the first 20 day sampling period, a living cover crop reduced CO_2 emissions
        i. 5x less between May 7-25, 2018
        ii. 2x less between Apr. 26 - May 15, 2019
    e. In both years, the living cover crop effect on reducing CO_2 emissions diminished after the first 20 day sampling period.
    f. Evening sampling (6 and 10 PM) yielded less variable results for the bare soil treatment in both years, showing that time of day matters when sampling gas emissions.

2. Rye Cover Crop Interactions with Corn
    a. Can cover crops remove Spring moisture and make a no-till corn/soybean production system more attractive to farmers in the wetter parts of SD?
    b. Cereal rye drilled in 8" twin rows in Fall 2018 on the Aurora Research Farm (Oct. 4) in east central SD and in a farmer's field in the SE part of the State (Oct. 30)
    c. Cereal rye emerged in Fall 2018 at Aurora Research Farm, but not in SE SD
    d. Corn was planted in the 22" wide gaps between the twin rows of rye on 5/17/19 at Aurora and on 6/4/19 in SE SD
    e. Terminated rye with glyphosate at different timings (week before planting, at planting, V2 corn, V4 corn) to see how cover crops impacted soil moisture, soil N, and corn yields.
    f. Relative to conventional tillage with no cover crop at Aurora in 2019:
        i. Rye (422 lbs biomass ac^{-1}) terminated at V2 corn growth stage on 6/18 didn't affect corn yield
        ii. Rye (655 lbs biomass ac^{-1}) terminated at V4 corn growth stage on 6/28 resulted in a 23% yield loss ($p=0.16$)
    g. SE SD results still being analyzed

Funding: South Dakota Corn and USDA-NRCS

HERBICIDE RESIDUAL EFFECTS ON COVER CROPS AFTER CORN SILAGE AND WHEAT

Gared Shaffer; SDSU Extension Service

Interest in cover crops among South Dakota crop growers has increased in recent years. Producers have realized the need for scientific information on residual effects of commonly used herbicides on cover crops for proper incorporation of these species into their cropping systems. Therefore, it is imperative that information about herbicide residuals effects on cover crops is investigated in South Dakota. Surrounding states that include Minnesota, Iowa, Nebraska and Wisconsin have researched this topic to give their producers educational opportunities in learning how to integrate cover crops into their operations (Bosak 2014; Hartzler, B. and others 2015; Stahl 2016; Jhala and others 2016). This research will assist producers and consultants to continue making wise and informed decisions in common South Dakota cropping systems.

Seven research sites have been established for the 2018 growing season and five research sites established in 2019. There were wheat and corn silage plots established each year. More research plots will be established in 2020. The plots were sprayed with Pre and Post residual herbicides and drilled with cover crops after the cash crop was harvested. Data collection has been accomplished each year to determine herbicide influence on each cover crop species. Final data will be published at the end of the project. The primary goal of this portion of the project is to increase grower knowledge of herbicide residuals from common herbicide programs used in silage corn and wheat. This will help growers fine-tune their herbicide program. The research plots may be utilized for late season grower and professional agronomist tours and training events.

Funding
South Dakota National Research Conservation Service (NRCS)

Principle Investigator
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Co-Investigators
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Student Investigator
Sarah Potthoff

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IMPACT OF INTEGRATED CROP-LIVESTOCK SYSTEM ON SOIL HEALTH, GREENHOUSE GAS EMISSION, AND WATER QUALITY

Dr. Sandeep Kumar; SDSU Department of Agronomy, Horticulture, and Plant Science

Integrated crop-livestock systems (ICLS) enhances ecological interactions among land use systems that improve the efficiency of agricultural ecosystems in nutrient cycling, preserving natural resources, reducing greenhouse gas emission, improving water quality and enhancing soil health. Our USDA-CAP project focuses on assessing the impacts of ICLS on soils and water quality. Livestock and cover crops (CC), when introduced into cropping systems, manure from livestock improve nutrient cycling and crop residues from CC provide feed to livestock and capture nutrients from the livestock waste. We investigated the impacts of ICLS on soil biochemical properties, microbial community structure, greenhouse gas emission and water quality. The results showed that ICLS treatments had a higher soil biochemical properties and microbial community structure (phospholipid fatty acid, PLFA). The dehydrogenase, fluorescein diacetate, urease, β-glucosidase, and arylsulfatase enzyme activities were significantly higher with the ICL system than the CNT treatment. The total PLFA, total bacterial, actinomycetes, Gram-positive bacterial, total fungi,

arbuscular mycorrhizal fungi, and saprophytes biomass PLFAs significantly increased at a greater rate under ICL and CC treatments than control (CNT). Data on greenhouse gas emissions showed that cumulative CO_2 and N_2O fluxes were lower for grass dominated cover crops (CC) with grazing (GdC+G) (4042 kg C ha^{-1} for CO_2 and 1499 g N ha^{-1} for N_2O) than for legume dominated cover crops with grazing (LdC+G) (4819 kg C ha^{-1} for CO_2 and 2017 g N ha^{-1} for N_2O), indicating the superiority of GdC+G over the LdC+G in reducing the GHG fluxes. Similar trend was observed in N_2O fluxes. An on-farm study was conducted near Salem, SD with the specific objective to quantify X-ray computed tomography (CT)-measured soil pore properties. Results showed that the CT-measured macroporosity was significantly higher in ICL system and native grazed pasture (NGP) compared to the CNT. Higher connected porosity, connection probability and macroporosity in ICL system and NGP significantly enhanced saturated hydraulic conductivity compared to CNT. This study provides a clear link between cover crops, grazing, soil microbial communities, soil health, greenhouse gas emission, and water quality. This research found a clear link between ICL systems, CC, microbial communities, and soil health. Furthermore, influences of ICL systems and CC on soil health provide a viable option for achieving and restoring the natural ecosystem and achieving food security.