Managing Multi-Species Cover Crops in the Southeastern USA

Executive Summary of NRCS Conservation Innovation Grant #69-3A75-14-233

Cover crops are a conservation tool that have a key role to play in sustaining agriculture in the Southeast US. Year-round living roots and abundant biomass of high quality are needed to build soil organic matter and enhance soil fertility. There are a variety of cover crops that can be utilized, so producers can pick and choose to suit their local conditions.

Goal

Demonstrate and quantify the impacts of multi-species cover crops in different production systems common to the Southeast.

Approach

Work with a group of farmers from a dozen conservation districts in North Carolina in a team consisting non-profit project coordinator, conservation district specialists, resource specialists from USDA-Natural Resources Conservation Service, and scientists from NC State University and USDA-Agricultural Research Service. The initiative demonstrated to producers that a diverse mixture of cover crop species could be planted in a timely manner, allowed to grow and accumulate biomass and nitrogen, and then be terminated without using tillage to maximize soil health benefits. Quantifiable impacts of multi-species cover crops were determined to promote rapid information transfer from county level demonstrations to producers throughout the mountains, piedmont, and coastal plain areas of North Carolina.

Demonstrations intended to broaden adoption of appropriate multi-species cover cropping and build soil health for a more robust sustainable agriculture in the Southeast. Over 1000 producers were exposed to the value of multi-species cover crops and approaches to assess soil health.

Conservation district specialists have firsthand knowledge of how multi-species cover crops work in their counties; they are better equipped to promote cover crop adoption by leveraging lessons learned and communication tools developed. Project partners are committed to continuing demonstration plots, especially at the same locations to measure longer term impacts, pending availability of funding to support activities.

Overall, participating producers were pleased with the project and the process.

Phillip Whitaker, Henderson County Producer, said “One positive I have noticed is that even without a pre-emergent pesticide, the no-till planting has very few weeds.”

Frank Lee, Stanly County Producer, said “Cover crops are beneficial if they are properly managed.”

Plant and soil properties were characterized, and included the following:

Biomass – Sufficient cover crop biomass is critical for controlling erosion, preserving soil water during the summer growing season, and improving surface-soil properties. Relatively low biomass was recorded for many of the 2015/16 demonstrations. In the 2016/17 demonstrations, three of eight sites achieved a biomass rate greater than a minimum target of 3000 lb/A. In only one of seven demonstrations did multi-species cover crop biomass produce less than a single-species cover crop, but in two cases multi-species cover crop produced more than a single-species cover crop. In all cases, biomass production was greater in demonstration sites with either cover crop type compared to no cover crop (i.e. winter weeds).

Nitrogen (N) – Soil fertility can be enhanced with cycling of N from cover crop biomass to cash crops through slow decomposition of residues throughout the year. Cover crop biomass was enriched in N compared with no cover crop (i.e. winter annual weeds). There was no difference in N content between single and multi-species cover crops in the 2015/16 demonstrations. We set a minimum target of 50 lb N/A in cover crop biomass to enhance long-term soil fertility, but this was attained at only one site in 2015/16. Although data are not yet available, we project that at least three of the eight sites in 2016/17 will have achieved this minimum N content in cover crop biomass.

Carbon (C) – Storage of C in soil as organic matter is a key to enhancing soil fertility in the long-term. Transfer of C from cover crop biomass to soil organic matter is a slow process with only a small fraction of cover crop C eventually retained as soil organic C. Only one demonstration in 2015/16 had enough biomass C to potentially enhance soil organic C, provide a thick enough layer to benefit surface-soil moisture retention, and act as a biological source for microbial activity. No changes in total organic C were recorded; we didn't expect it to, as changes require several years before differences are detectable.

Surface residue – Like cover crop biomass, surface residues (i.e. combination of cover crop biomass and previous crop residues) are critical for controlling erosion, preserving soil water during the summer growing season, and improving surface-soil properties. When measured in 2015/16 demonstrations, surface residue mass was greater with single or multi-species cover crops compared with no cover crop in two of three direct comparisons.

Soil bulk density – Compaction is a concern in some soil types when no-tillage management is utilized. Bulk density was not impacted by cover crop treatment at any of the demonstrations in 2015/16. When measured in spring of 2016/17 near cover crop termination, soil bulk density was significantly greater with multi-species cover crops at three sites as compared with single-species or no cover crops. We will want to monitor this assessment over a number of years and pair it with in-field observations of water runoff or infiltration.

Soil biological activity – Energy embedded in soil organic matter and cover crop inputs drives soil biological activity. Trillions of bacteria, fungi, and actinomycetes in soil perform a variety of functions vital to soil health, e.g. decomposing plant litter, cycling nutrients, creating stable aggregates in soil, enhancing and stabilizing rooting channels, and competing with pathogenic organisms. One measure of soil biological activity is the potential of soil to mineralize N, i.e. the conversion of organic N that is unavailable to plants to inorganic N that is available to plants. In 2015/16, one of eight demonstration sites with multi-species cover cropping had greater N mineralization potential than adjacent plots without cover crops. Another measure of soil biological activity is the flush of CO_2 following rewetting of a dried soil. When averaged across eight demonstration sites in 2016/17, the flush of CO_2 in soil from multi-species cover crops was significantly greater as compared to either no cover crop or single-species cover crops. Even though the cover crop demonstrations were short in duration, we observed an increase in soil biological activity – suggesting it was a sensitive measure of soil health.

Lessons learned

- A variety of multi-species cover crop mixes were developed and proven successful based on producer interests, district knowledge, and recommendations from other sources.
- Establishing multi-species cover crops was feasible at each location. Broadcasting seed was possible, but establishment success was dependent on timely rainfall. Drilling may be more successful in many instances.
- Matching cropping sequences with the right cover crop mixture can be a challenge. Adaptive management may be necessary.
- Producer concerns for late planting of cash crop after cover crops are substantial, but could be overcome with continued demonstration of soil and economic attributes of a functioning system.
- Engaging producers fully into seed selection and planting of cover crops is essential to make demonstrations viable.
- Field days enhanced local interest in cover crops and structuring events with a focus on producers talking to producers was a key element.
- Successful demonstration activities were possible only with the broad teamwork and skills offered by project partners. We found that an effective network involved a nonprofit serving as project coordinator, conservation districts, resource specialists from USDA-NRCS, and scientists from NC State University and USDA-ARS.
- Funding is secured for further demonstrations in Fall 2017 with eight current and four new Conservation Districts. Partners are mobilizing equipment to measure soil moisture and heat stress in three demonstrations. Project partners will seek ways to share lessons learned throughout 2017 and 2018.

Partners

NC FOUNDATION for SOIL&WATER CONSERVATION

NC STATE UNIVERSITY Crop & Soil Sciences

North Carolina ADFP Trust Fund

USDA United States Department of Agriculture
Natural Resources Conservation Service
Agricultural Research Service

Cotton Incorporated