The Performance of Cover Crops in Minimally Tilled Forage-based Grazing Systems

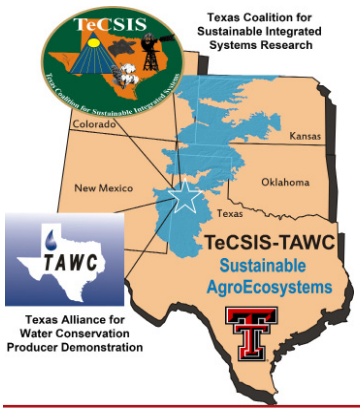
One can't talk about agriculture in the Texas High Plains without including "water" in the same sentence. The Ogallala Aquifer, which has kept ag production humming for nearly a century, is running low. Agriculture in the Texas Panhandle and Southern Plains is adapting to decreased water availability.

For over two decades, researchers and producers across the Texas High Plains have been developing integrated crop/livestock production systems that address the growing need for water conservation, while keeping soils fertile, crop yields profitable, cattle production thriving, and surrounding communities viable.

Funded through nearly $1.5 million in Southern SARE Research & Education, Large Systems, and Graduate Student grants, the results showcase long-term alternative production systems, and how those results are being translated into practical field production practices and sustainable agriculture applications.

This model of sustainable agroecosystems in the Texas High Plains is changing the face of agriculture in the region and helping to conserve water, improve soil health, boost ag profits and keep the High Plains region thriving for generations to come.

This bulletin looks at the performance of cover crops in minimally tilled forage-based grazing systems.



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Texas plays a major role in agriculture, especially in the beef industry. Cattle production is crucial to the Texas High Plains agriculture community, but production systems that jeopardize the sustainability of water use through the continued depletion of the Ogallala Aquifer put the industry and the vitality of rural communities at risk.

Forage-based livestock systems have proven to be economical and resource-efficient methods for High Plains agriculture. Long-term integrated crop/livestock systems help reduce overall water use and preserve soil health while maintaining marketable weight for animals that are proving profitable for farmers.

Integrating winter cover crops with summer forage crops could maximize land productivity and system profitability by improving water infiltration, stabilizing soils, and increasing additional potential income channels. However, adoption of cover crops has been slow because of concerns that cover crops withdraw soil water to the detriment of the summer crop, and they may not generate immediate economic benefits.

In a Southern SARE-funded Graduate Student Grant (GS15-152), "Evaluation of Winter Annual Cover Crops Under Multiple Residue Management: Impacts on land management, soil water depletion, and cash crop productivity," Texas Tech University researchers investigated five cover crops species as potential complements to a warm-season beef-stocker grazing system. The impact of the project was two-fold: Stabilize the soil surface from excessive wind erosion and desiccation; and strengthen rural communities by ensuring the persistence of profitable agriculture in the region.

Research Summary

The use of winter annual cover crops is very promising for the Texas High Plains. The five species selected for the study (rye, burr medic, hairy vetch, rape-kale, and wheat) were developed for or found to be adaptable to the Southern High Plains. The target uses of these cover crops serve the dual roles of stabilization and enhancement of soil plus their use as a grazeable spring forage.

The research investigated the interacting effects of irrigation and tillage with the five cover crops on soil water depletion and productivity of the cover and subsequent forage crop (teff) to identify the most successful cover crop practices in the drought-prone Southern High Plains.

Research Objectives

Researchers compared the persistence and productivity of five winter cover crop species under four water and tillage treatment combinations for the ability to conserve soil water and promote growth of summer forages.

They also compared the residual effects of cover crops and winter management strategies on the productivity and nutrient status of a subsequent no-till, irrigated summer teff hay crop. Such effects could include nitrogen supplied by legumes, allelopathy from wheat and rye, and the depletion of soil water in the rooting zone.

Research Results

The two-year study was conducted at the Texas Tech Research Farm in New Deal, TX. A 50 foot by 180 foot area was allocated to the small plot experiment with three replicate blocks. Two irrigation treatments, dryland and irrigation, were applied across all blocks. Within each block, two tillage treatments (minimal and no-till) were arranged with the cover crop treatments. Treatments compared rye, wheat, burr medic, hairy vetch, rape-kale and an unplanted fallow.

Irrigation and Rainfall:

Rainfall was lower in the first year of the study than in the second year. As a result, there were differences in the way the cover crops performed between years as the crops were irrigated in the drier year to make up for the lack of moisture. Overall, researchers found that ground cover was greater in the first year when rainfall was higher. However, in the year where irrigation was used, winter cover crops did not require more irrigation than the winter fallow within each irrigation and tillage combination.

Cover Crop Yield:

Greater cumulative yields were observed in the first year compared to the second year. In the first year, the greatest yields were observed in rape-kale and irrigated rye (irrigated and dryland) and irrigated rape-kale, followed by dryland rape-kale. In the second year, the greatest cumulative yields were produced by irrigated rye,

A bee on a rape flower. Photo credit: Texas Tech University

followed by irrigated hairy vetch and dryland rye, then wheat (both irriga-

Cover crop trial plots. Photo credit: Texas Tech University

tion regimes) and dryland hairy vetch. Cover crops not listed within each year produced negligible yields.

Cover Crop Crude Protein:

There were no differences in crude protein among the cover crops in the first year. Hairy vetch had the greatest crude protein concentration in the second year.

Nodulation:

Tillage on the legume species studied (hairy vetch and burr medic) reduced the nodulation of the plant roots, thereby diminishing the amount of nitrogen that could be supplied to the cash crop.

Teff Yield:

In the first year, competition from rape-kale decreased teff cumulative yields compared to the other winter cover crops. Winter tillage reduced teff yields in the second year, regardless of winter irrigation or cover crop grown.

Soil Water Content:

The use of a winter cover crop did not significantly reduce the soil volumetric water content at any depth relative to the winter fallow. Tillage reduced the volumetric water content in the top two feet of soil in the tilled plots.

Final Outcomes

A winter cover crop did not decrease soil water reserves more than a winter fallow. Switching to no-till reduced soil water loss and increased cumulative teff yields.

The results should help minimize producer concerns about water use by winter cover crops and the impact on the subsequent cash crop. For producers interested in growing a winter cover crop, the researchers recommend planting rye. Results showed that dryland rye produced a modest yield, even in a dry year. However, light irrigation is needed if producers intend to graze the crop during the winter.

For a more detailed analyses of the research results, visit the national SARE projects database and search by project number GS15-152.

High Plains Water Conservation Resources

General Information

Texas Coalition for Sustainable Integrated Systems (TeCSIS)
http://www.orgs.ttu.edu/forageresearch/

Texas Alliance for Water Conservation
http://www.depts.ttu.edu/tawc/

TAWC Solutions
http://www.tawcsolutions.org/

Texas Water Development Board
http://www.twdb.texas.gov/groundwater/aquifer/majors/ogallala.asp

Texas High Plains Water District
http://www.hpwd.org/

Ogallala Aquifer Program
http://ogallala.tamu.edu

Ogallala Water Coordinated Agriculture Project (USDA-NIFA)
http://www.ogallalawater.org

Publications

High Plains Water Conservation Bulletin No. 1: Water Conservation in the Texas High Plains

High Plains Water Conservation Bulletin No. 2 : Sustainable Crop/Livestock Systems in the Texas High Plains Phase I

High Plains Water Conservation Bulletin No. 3: Sustainable Crop/Livestock Systems in the Texas High Plains Phase II

High Plains Water Conservation Bulletin No. 4: Sustainable Crop/Livestock Systems in the Texas High Plains Phase III

High Plains Water Conservation Bulletin No. 5: Diversifying in the Texas High Plains

High Plains Water Conservation Bulletin No. 6: Agroecoystems Economics in the Texas High Plains

High Plains Water Conservation Bulletin No. 7: Soil Quality of Integrated Crop/Livestock Systems

High Plains Water Conservation Bulletin No. 8: Texas Alliance for Water Conservation

High Plains Water Conservation Bulletin No. 9: Water Use of Old World Bluestems in the Texas High Plains

High Plains Water Conservation Bulletin No. 10: Cover Crops and Cotton in the Texas High Plains

High Plains Water Conservation Bulletin No. 11: Agroecosystems Research in the Texas High Plains: Graduate Student Studies

Grant Projects

LS17-286 Long-term Agroecosystems Research and Adoption in the Texas Southern High Plains: Phase III

LS14-261 Long-term Agroecosystems Research and Adoption in the Texas Southern High Plains: Phase II

LS11-238 Long-term Agroecosystems Research and Adoption in the Texas Southern High Plains: Phase I

LS10-229 Integrated Crop and Livestock Systems for Enhanced Soil Carbon Sequestration and Microbial Diversity in the Semiarid Texas High Plains

LS08-202 Crop-livestock Systems for Sustainable High Plains Agriculture

LS02-131 Forage and Livestock Systems for Sustainable High Plains Agriculture

LS97-082 Sustainable Crop/Livestock Systems in the Texas High Plains

GS18-196 Effects of Cumulative Cattle Trampling on Soil Bulk Density and Infiltration of Rain Water on an Annual Forage Crop Pasture

GS15-152 Evaluation of Winter Annual Cover Crops Under Multiple Residue Managements: Impacts on Land Management, Soil Water Depletion, and Cash Crop Productivity

GS07-056 Allelopathic effects of small grain cover crops on cotton plant growth and yields

GS02-012 Optimizing Water Use for Three Old World Bluestems in the Texas High Plains

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