Agroecosystems Research in the Texas High Plains: Graduate Student Studies

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 nearly 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 highlights current graduate student research related to sustainable integrated systems research in the Texas High Plains.

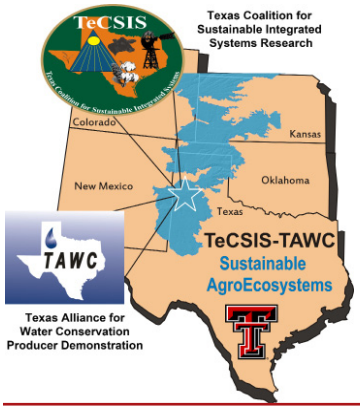


Photo credit: Lisa Baxter, Texas Tech University

Texas Tech University graduate students play an integral role in furthering research of forage-based crop/livestock systems to better manage water, improve production efficiency, and maximize profitability across the Texas High Plains.

Since 1997, over two dozen Master's, PhD, and visiting students have conducted research and published articles related to sustainable integrated systems research in the Texas High Plains.

Southern SARE has funded several Graduate Student Grants, including allelopathic effects of small grain cover crops on cotton plant growth and yields, and optimizing water use for three old world bluestems in the Texas High Plains.

The following are examples of current studies by Texas Tech University graduate students, advised by Chuck West, Thorton Distinguished Chair of Plant and Soil Science.

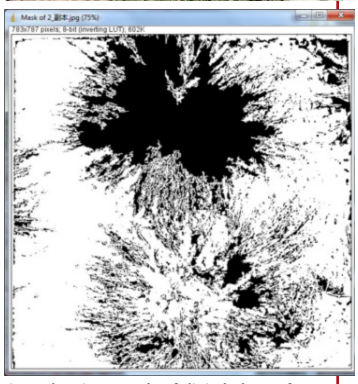
Integrating Legumes with Grass to Improve Forage-Livestock Systems

Lisa Baxter, a PhD student in forage systems, is exploring various grass and legume species – using perennials and annuals – to construct sustainable grazing systems that limit costly inputs while maximizing productivity without jeopardizing environmental resources.

"I am investigating how novel grazing management strategies may promote sustainability and productivity of pasture-based beef stocker systems in the Southern High Plains," said Baxter.

In one trial, Baxter is using digital analyses to manage the coverage of alfalfa when growing with or without old world bluestem. Since alfalfa is a "thirsty" crop, the purpose of the trial is to determine the threshold of alfalfa coverage that minimizes water usage, but provides maximum grazing potential. Small-acreage alfalfa is being tested as a protein bank to supplement the grazing of old world bluestem.

Cattle grazing on an old world bluestem/legume mix. Photo credit: Lisa Baxter, Texas Tech University



(Top photo): Example of digital photo of WW-B.Dahl bluestem in a one square meter area.
(Bottom photo): Digitization of photograph and conversion of green leaf area to precent ground cover using image softward. Photo credits: Victoria Xiong, Texas Tech University

"Growing persistent legumes in pastures with low irrigation input is a potential tool for stretching water supplies while diversifying income sources on the farm," said Baxter. "These results will apply to beef cow-calf, beef stocker, and dairy heifer development."

The imminent depletion of the Ogallala Aquifer demands innovative cropping alternatives to prevent dramatic losses of income when water levels are insufficient for irrigated row-crop production in the Southern High Plains. Integrating winter cover crops with summer crops maximizes land productivity and system profitability by improving water infiltration, stabilizing soils, and increasing potential income channels. Even though the benefits of cover crops for nutrient retention and erosion control are well recognized, adoption has been slow because of concerns that cover crops withdraw soil water to the detriment of the summer crop.

Baxter has received a SSARE graduate student grant to study the effects of irrigation and tillage on soil water depletion and forage productivity. The cereal grains rye and wheat will be compared with burr clover, hairy vetch, and rape-kale on water use by the summer annual teff grass. Winter cover crops can add flexibility to the system, reduce fertilizer inputs and improve forage quality without the inclusion of grains. A small-plot experiment was established in autumn 2015 to test the interacting effects of irrigation and tillage management techniques with five cover-crop species on soil water depletion and productivity of the cover and subsequent summer forage crop. The impact of this project is two-fold: strengthen rural communities by ensuring the persistence of profitable agriculture in the region, and stabilizing the soil surface from excessive wind erosion and desiccation.

Effect of WW-B.Dahl on Cattle Flies and Other Insects in the Pasture

Krishna Bhandari is capturing data on what was, up until now, just casual field observations of the reduction of flies on cattle grazing on old world bluestem.

In this unique Integrated Pest Management (IPM) study, Bhandari is studying the composition of essential oils in old world bluestem that appear to deter flies on cattle and fire ants in the pasture.

"My research is investigating the link between WW-B.Dahl and deterrence of face flies and horn flies on steers, as well as measuring effects on other insects that live on the grass and in the soil. We know that this grass gives

off natural chemicals that volatilize through the air," said Bhandari. "Camphor is an example of a natural compound from this grass that can deter insects."

Preliminary data in the study indicated a significant reduction in the number of flies found on cattle grazing on old world bluestem compared to cattle grazing on alfalfa.

In addition, field trials found fewer insect pests present in old world bluestem fields compared to alfalfa fields. Research has shown reduced numbers of fire ants in WW-B.Dahl compared with bermudgrass and other pastures.

Modeling WW-B.Dahl Forage Growth in Response to Water Supply

Victoria Xiong aims to improve a computer simulation model that calculates forage yield of WW-B.Dahl old world bluestem in response to the supply of water.

"We consider WW-B.Dahl an excellent forage grass for low irrigation management for beef cattle," said Xiong. "The TAWC (Texas Alliance for Water Conservation) online tools for calculating irrigation needs are currently set up for cotton, corn and grain sorghum, but not for WW-B.Dahl bluestem."

Xiong is correlating plant growth to soil water content so that a forage producer can predict forage yield depending on the amount of rain or irrigation applied. This will allow one to plan ahead for forage production and how many cattle to carry in response to the water supply available.

"We are making frequent measurements of forage growth and soil water content in order to calibrate the model for the Southern High Plains," said Xiong.

The graduate student is also comparing grazed WW-B.Dahl to grass being cut for hay so that the TAWC tools can simulate water usage for both types of management.

Persistence of Grazed Alfalfa with Perennial Grasses with Low Water Input

Madhav Dhakal is a new graduate student who will initiate trials on grazing tolerance of alfalfa under water-limited conditions in mixture with native grasses and old world bluestem. Alfalfa has a deep root system which can mine water from depths below where grass roots usually obtain their water. Newer types of alfalfa bred for high quality and yield will be screened for their ability to produce high protein feed for grazing cattle while growing with summer perennial grasses.

An old world bluestem/alfalfa mix. Photo credit: Victoria Xiong, Texas Tech University

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/

USDA-ARS Ogallala Aquifer
http://ogallala.ars.usda.gov/

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: Agroecosystems 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

Grant Projects

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

LS14-261 Long-term Agroecoystems 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

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

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

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