TEXAS A&M AGRILIFE EXTENSION

SOIL & CROP SCIENCES TEXAS A&M UNIVERSITY

June 17, 2014

2014 Stiles Farm Field Day

The Department of Soil and Crop Sciences Texas A&M AgriLife Research & Extension

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Evaluation of Cotton Yield, Quality, and Plant Growth Response to Soil-Applied Potassium

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ABSTRACT

The frequency and severity of potassium (K) deficiency symptoms on the highly productive clay soils in the Central Blacklands and Gulf Coast regions of Texas have increased in recent years. While continuous dry conditions have undoubtedly contributed to this consistent occurrence of deficient K symptoms, the frequency and widespread geographic nature of the K deficiencies in multiple row crops, specifically cotton, is a major concern to producers and scientists. Two locations in the Central Blacklands and Gulf Coast regions were chosen based on soil sampling for low to medium soil K levels. Five rates of injected liquid K and four rates of dry broadcast K were evaluated. During the season, plant measurements were taken including height, total nodes, and nodes to first fruiting branch. There was some variation in height and total nodes between differing amounts of K applied, but the biggest visual differences between plots were the presence of K deficiency symptoms in the leaves. Plots with higher rates of K, showed fewer signs of K deficiencies. After the growing season, plots were harvested, seed cotton weighed, and then ginned. After ginning, samples were sent to Cotton Inc. for HVI analysis. Plots with higher rates of liquid K showed the greatest yield response, the greatest fiber quality response and the greatest return on investment.

INTRODUCTION

For the past decade, Texas has continued to dominate U.S. cotton production. Much of the state's cotton is produced on clay soils in the Blacklands and Gulf Coast. Although K deficiencies have been reported in these regions in various years over the past 20 years, the frequency of reported K deficiency symptoms seems to be on the rise, and the geographic occurrence seems to be increasing as more K is mined from the soils. Additionally, under deficient K levels, cotton plants are more prone to foliar diseases that can further reduce the yield potential.

Previous research has shown a two bale cotton crop will remove 30 lbs K/acre. While a 2 bale rainfed crop is generally considered strong, increased yield potential in new varieties and better pest management have pushed cotton yields to 3-4 bales, and even exceeded 5 bales on irrigated land. As K demand increases, deep profile soil samples indicate a reduced level of plant available K in some production areas. The objective of the research was to evaluate the effect of K application rates and methods on cotton growth, development, yield, and fiber quality.

MATERIALS AND METHODS

Studies were initiated at two field sites with a previous history of K deficiency, one in Williamson County in the Blacklands region and one in Wharton County in the Upper Gulf Coast region. Based on soil test results, 0 and 60 lbs K_2O/acre were recommended for the Wharton and Williamson sites, respectively, and soil test K (ammonium acetate) levels were 150 and 60 for the sites. Treatments were 0, 20, 40, 80, 120, and 160 lbs K_2O/acre applied using liquid 0-0-15 as KCl, and 40, 80, 120, and 160 lbs of K_2O/acre applied as a granular 0-0-60. The liquid K treatments were injected approximately four inches to the side of the row at a 6 inch depth. The dry treatments were broadcast by hand and incorporated with light tillage. Both K application methods occurred 2 - 3 weeks prior to planting. In early April, cotton cv. DP 0935B2RF was planted into a Lake Charles clay loam at the Wharton site. In mid-April, cv. Phytogen 499WRF was planted into a Burleson clay at the Williamson county site. Phosphorous and nitrogen were applied based on soil test recommendations for 2 bale/acre cotton yield goal.

In-season plant measurements included stand counts, plant height, nodes to first fruiting branch, and total nodes. After harvest, yield was calculated, and samples sent to Cotton Inc. for HVI analysis. For return on investment calculations, a base value of 75 cents/lb of lint was used and then lint values calculated using the 2013 loan calculator provided by Cotton Inc. The return on investment calculations only include fertilizer costs and are presented relative to the untreated check. Fertilizer prices used were $520 per ton of 0-0-60 and $275 per ton of 0-0-15.

RESULTS AND DISCUSSION

Yield and other significant data for the 2013 crop are presented in Figures 1-4. There was below normal rainfall for most of the growing season at both locations, but good yields were obtained due to the timeliness of the rain. Visually, the biggest differences between treatments were the presence and severity of K deficiency symptoms in the leaves. Plots with higher rates of K, especially injected liquid K, showed fewer K deficiency symptoms. Higher rates of K had a small effect on plant height in the Wharton location but seemingly no effect at the Williamson location (Figure 1). Near the end of the season, weather conditions were conducive for some foliar disease, and disease symptoms were observed in the K deficient treatments. Overall, there appears to be a positive correlation with amount of K applied, and the impact on yield and plant health. Treatments with a high rate of liquid K had higher yields compared to a similar rate of dry K at both locations (Figure 2). This could be attributed to placement and mobility of K in the soil. The liquid K was placed in the active root zone while the dry K was less plant available due to dry soil surface conditions.

The highest rates of injected K had a slight positive effect on lint loan price at the Wharton location, while the dry K had no significant effect. At the Williamson location, there were mixed effects on loan price due to high micronaire (Figure 3). When the K rate and price factors are used to calculate the net return on investment, fewer significant differences were observed for both sites (Figure 4). Despite the highest injected rates being considered unrealistic for farmers, a significant return on investment was obtained from the higher injected rates. As with yield, the liquid treatments had a higher return on investment than the dry treatments of a similar rate.

Figure 1: Plant Height

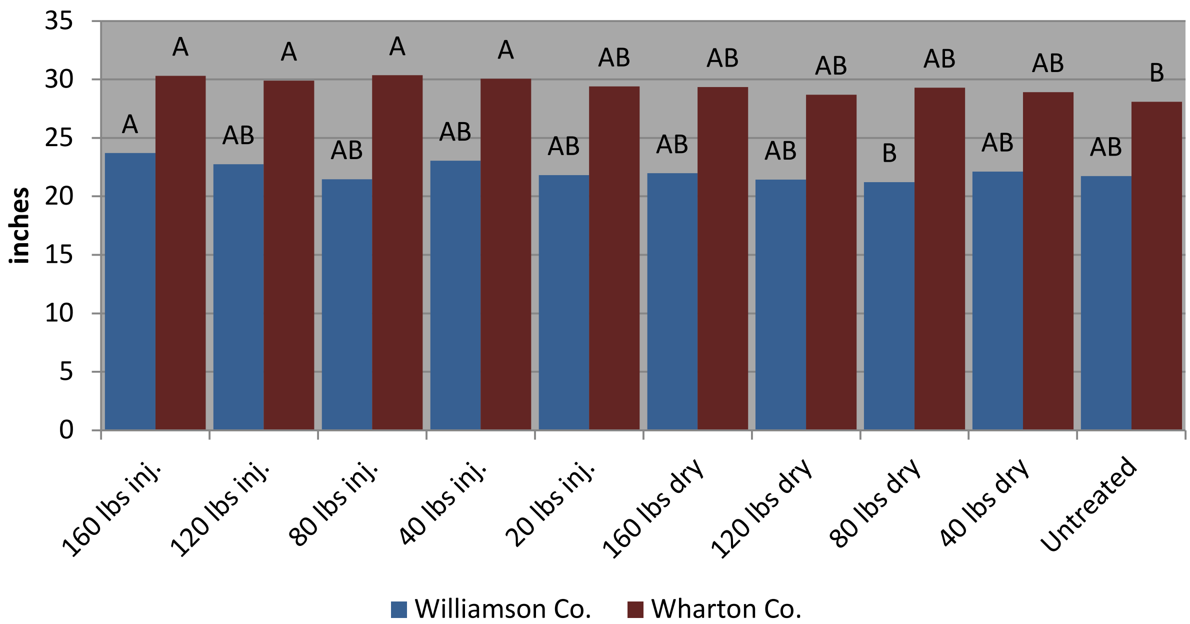


Figure 2: Yield

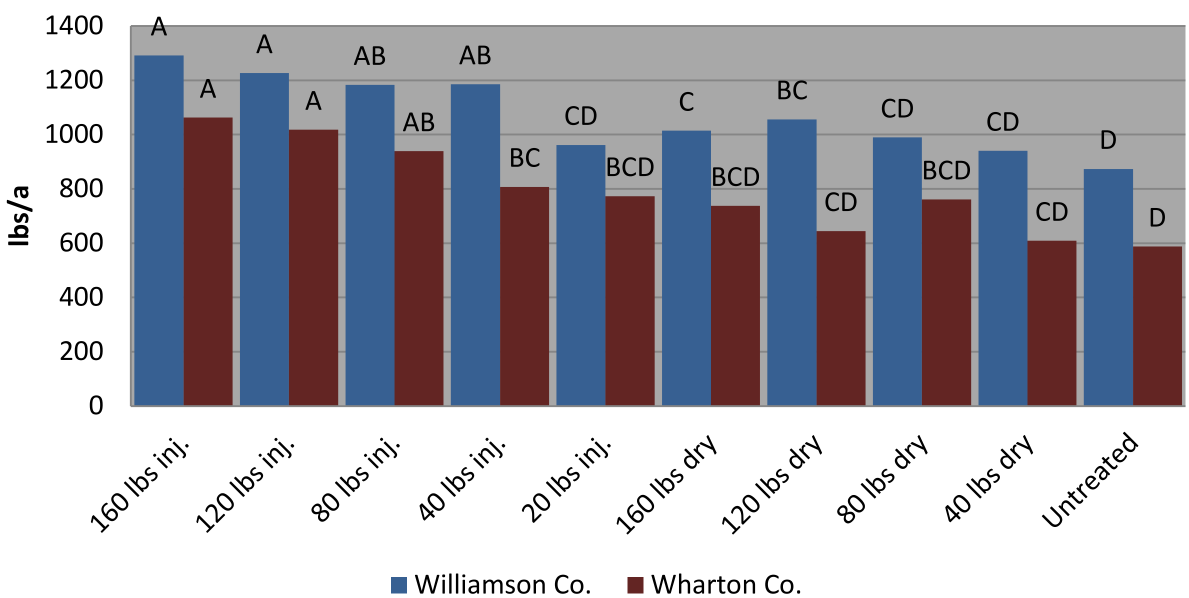


Figure 3: Net Loan Price

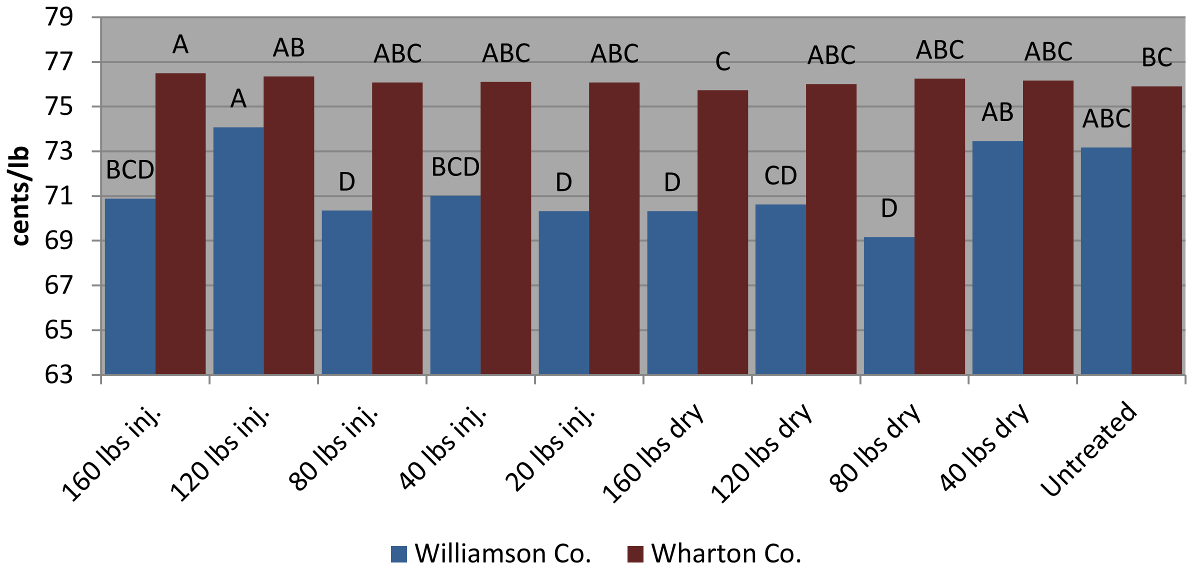
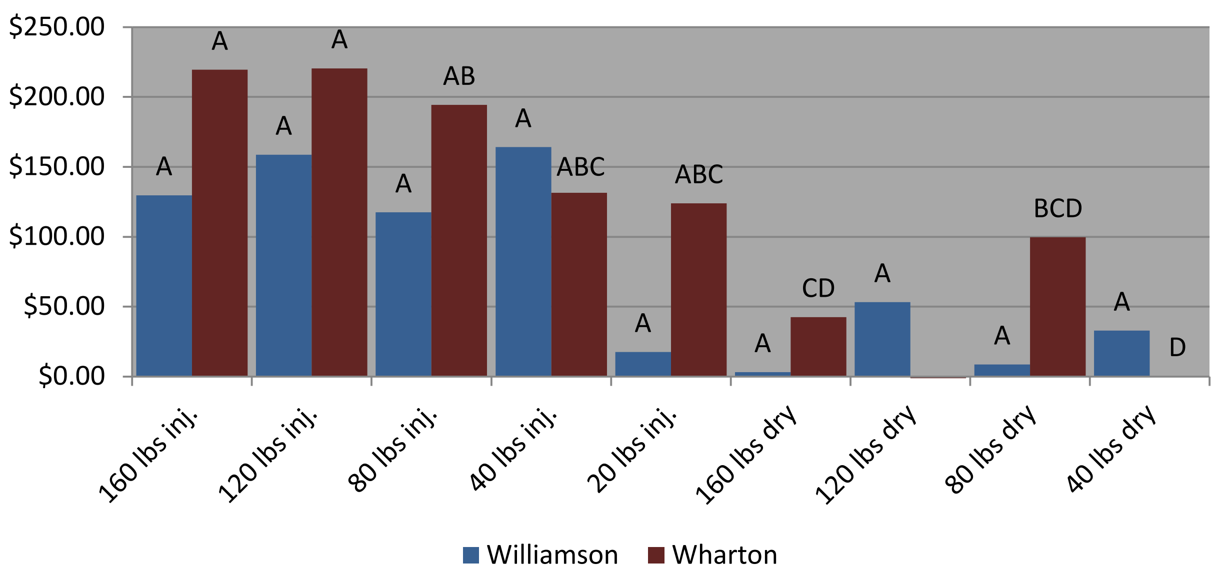


Figure 4: Return on Investment



CONCLUSIONS

Applications of K had a positive effect on yield and fiber quality in soils with 150 ppm of soil K or less. Treatments with injected liquid K showed greater plant response than treatments with dry K and therefore a higher K use efficiency. Return on investment was higher, on average, for the injected treatments versus the dry treatments.

ACKNOWLEDGEMENTS

We would like to thank the Stiles Farm Foundation for the use of their land and equipment, Mr. Glenn Emshoff for the use of his land: Cotton Inc. for providing fiber analysis and financial support: United Agricultural Cooperative, Inc. for donating the fertilizer; IPNI for partial support of this research.

Preparing Your Ranch for the Next Drought

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They say hindsight is 20-20. The question is: What lessons can we learn in hindsight to minimize the negative effects of the next drought? Because there certainly ***will*** be a next drought. Below are several key factors to help prepare for, and survive, the next drought.

Adjust Stocking Rate

Even when the production system is irrigated, drought will be part of the risk associated with forage production, and by extension, livestock production. One immediate and dramatic strategy that can mitigate the negative effects of future drought events is to adjust the stocking rate of the cow herd to 75% of what could be maintained based on long-term precipitation and forage production records. This stocking rate ***should*** be based on several years (more is better) of observing the quantity of forage produced under the typical management strategy. Additionally, cow size has increased over the years. Larger cows require more forage; thus the stocking rate should also be adjusted for a difference in cow size if the ranch used to run 100 cows 25 years ago when average cow size was 900 to 1000 pounds/head.

When stocked at 75%, livestock producers usually will not be overstocked during most drought years. This prevents having to purchase expensive feed in an attempt to "feed your way out of a drought". The 75% stocking rate also will reduce the need to sell cows at a time when many others are being sold and prices are deflated. During years of good forage production, stocker calves may be used as flex grazers to utilize excess forage. Calves may come from the producer's herd (keep them longer) or may be purchased or grazed on a gain or head/day basis. Excess forage in good years also may be harvested and stored for drought years or sold as hay.

Forages should never be grazed "to the roots" under any circumstance; removal of most or all green leaves deprives the plant of the ability to convert sunlight into carbohydrates (energy) vital for plant growth. Decreased carbohydrate production results in decreased root production, thus reducing the plant's ability to obtain necessary water and nutrients from the soil. The relationship between leaves and roots is critical at all times, but especially during drought. Besides allowing the plant to carry out optimum photosynthetic activity, adequate green leaf residue also reduces soil moisture evaporation and promotes infiltration of precipitation that is received. When there is little or no forage residue, raindrop impact on bare ground can damage soil structure resulting in surface crusting, reduced rainfall infiltration and much greater water loss as runoff. For bermudagrass, a target residue height should be no less than 4 inches while other species will be different depending on their growth habit. Some of the tall, bunch grasses like little or big bluestem should not be grazed shorter than 10 to 12 inches.

Store Hay and Use Hay Substitutes

If you do not produce your own hay, "drought management hay" should be purchased in non-drought years and properly stored. Properly stored hay will retain its nutritive value for many years. Hay should be stored under a roof on a well-drained or impervious surface. Hay tarps may also be used but the life expectancy is less than a storage barn. Finally, round bale hay may be stored in the field, but the loss due to weathering will be much higher compared to hay stored in a barn or under a tarp. Hay stored outside should be stored in rows oriented north-south on a well-drained slope. Flat ends should be together, but there should be 2-3 feet between the round sides of the rows. More importantly, purchasing hay during a drought can be difficult and costly, and often producers are forced to buy what is available even if it is low quality. To stretch limited hay supplies, use corn or other plant by-products as substitutes for hay. However, forage should generally comprise at least 50% of the diet. One pound of corn will replace about 2.25 pounds of hay, so 450 pounds of corn could substitute for a 1000-pound round bale of hay. Nevertheless, be aware that attempting to "feed your way out of a drought" can be very expensive. Do not be afraid to sell the cattle! Cut your losses!!

Manage Fertilizer Inputs

Fertilizer is never inexpensive, and all fertilizer nutrients have increased in cost dramatically in recent years. Thus, the first inclination of livestock producers is to not fertilize during drought. This is seldom a wise strategy. Nitrogen is essential for photosynthesis, which enables the plant to produce its own food. Phosphorus and potassium are critical for root development, water use efficiency, and overall plant vigor. Soil testing and implementing a well-balanced fertility program can help plants survive drought and recover more rapidly after the drought has ended.

If fertilizer already has been applied, but there has been no significant precipitation, fertilizer will remain in the upper soil profile. Although nitrogen is subject to some volatilization loss as ammonia gas to the atmosphere under certain conditions (wet soil or sod, high soil pH, elevated temperatures), the fertilizer investment in the pasture program will not have been wasted. When precipitation does occur, the plant will re-initiate growth and plant uptake of the fertilizer nutrients will occur.

If fertilizer has not been applied, the tendency of many producers is to take a "wait and see" attitude regarding a break in the prevailing dry weather pattern. This strategy reduces financial risk but may result in missing the first good precipitation event. Pay attention to weather forecasts and if it appears that the pattern may change and offer a higher potential for precipitation, make every attempt to get the fertilizer in the field before that next rain. Fertilizing immediately AFTER a rainfall event is not recommended. Addition of a urease inhibitor to urea-containing fertilizers (urea and liquid 32%) also may be justified to reduce potential nitrogen volatilization losses when chances for rainfall are uncertain.

Summary

The following key points should be remembered regarding preparation for the next, and inevitable, drought event.

- For commercial livestock producers, attempting to feed your way out of a drought is usually not economically viable and should not be attempted.
- The cow herd should be stocked for 75% of what the forage resource can produce based on long-term records.
- Properly fertilized forages tolerate and recover from drought better than poorly fertilized forages.
- It is generally better to have fertilizer in the field waiting on a precipitation event than to fertilize after rain, so that the rainfall can move nutrients into the plant root zone for uptake.
- Do not be afraid to sell cows; protect your forage resources by culling deeply before the drought becomes too severe.

Managing Fertilizers to Protect Groundwater Quality

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Inorganic and/or organic fertilizers are important for the production of most agricultural crops, and also are used by homeowners for the lawn and garden. If you store and/or use fertilizers on your property and if you obtain your drinking water from a well, this publication provides basic knowledge and suggested practices to reduce the potential for fertilizers to contaminate your drinking water.

An inorganic fertilizer is a mineral nutrient source containing less than 5.0% of carbonaceous material. Examples of inorganic fertilizers include products such as ammonium sulfate and urea ammonium nitrate. In reference to fertilizers, the term 'organic' typically means matter from a once-living organism. Accordingly, organic fertilizers are products or materials composed of plant and/or animal residues such as manure, compost, municipal biosolids, seaweed, guano, and processed bone meal.

The State of Texas requires all products sold commercially as fertilizer to be labeled with the product guaranteed analysis. A guaranteed analysis lists the minimum percentages of primary, secondary, and micro plant nutrients contained in the product. This information allows for product comparisons and enables proper rates of application to be determined. While inorganic fertilizers must be labeled, organic products (such as composts) sold as "soil amendments" are not. Many land grant university laboratories and commercial laboratories offer testing services to determine the nutrient content of organic products.

Nitrogen is the most common groundwater contaminant originating from the application of fertilizers and organic soil amendments. Other nutrients have been found in groundwater, but nitrogen concentrations are more likely to exceed health-based criteria.

The nitrate form of nitrogen (NO_3-N) is very soluble and can leach downward, particularly in coarse-textured (sandy) soils. Nitrate is undetectable without testing because it is colorless, odorless, and tasteless. The Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) for nitrate-nitrogen[1] in drinking water is 10 milligrams per liter (mg/L) based on acute health effects, specifically the risk of methemoglobinemia (sometimes referred to as "blue baby syndrome"), in which blood lacks the ability to carry sufficient oxygen to individual body cells. Acute health effects are those that result from ingestion of a contaminant over a short period of time.

[1] Nitrate concentrations in water are reported as 'nitrate-nitrogen (NO_3-N)' or total nitrate (NO_3). Use the following to compare the two reporting systems: 10 mg/L nitrate-nitrogen (NO_3-N) = 44.3 mg/L nitrate (NO_3).

Private well owners are not required to monitor their drinking water quality and information about local groundwater contamination may be difficult, if not impossible to obtain. In areas with significant historic or current inorganic or organic nitrogen application, drinking water from private wells should be tested annually to determine nitrate concentration.

GUIDANCE AND REGULATIONS ON FERTILIZERS IN TEXAS

The Office of the Texas State Chemist [http://otscweb.tamu.edu/] regulates the sale of fertilizers and is tasked with protecting consumers and enhancing agribusiness through its feed and fertilizer regulatory compliance program, surveillance and monitoring of animal-human health and environmental hazards, and preparedness planning. Texas regulations establish specific limits on heavy metal contaminants that may be found within various fertilizers, and testing and labeling requirements.

The Occupational Safety and Health Administration (OSHA) in its hazard communication standard requires employers to include in Material Safety Data Sheets (MSDS) information on any product component present at 1% or greater (0.1% for constituents known to be carcinogens). If hazardous constituents are present in sufficient quantity in fertilizer products, that information can be obtained from the MSDS. The MSDS is available at time of purchase, or can be obtained by searching the product name on the internet.

Organic fertilizers and soil amendments derived from manures and animal mortalities also must be managed to reduce the risk of bacterial contamination of drinking water. Extension publications *Composting Manure and Sludge* (Sweeten and Auvermann, 2008), *Easy Gardening Composting* (Masabni and Lillard, 2011), and Composting Large Animal Carcasses (Auvermann, et al., 2006) are recommended to ensure the production and use of organic materials does not impact groundwater.

Following label instructions coupled with proper training and licensing, and review of the MSDS, will ensure fertilizer use is protective of the environment and reduces the potential for contamination of your water supply.

The following questions are designed to help identify potential risks associated with livestock feeding and holding pens. Many of these situations can lead to contamination of your drinking water if they are not managed properly.

If you answer YES or don't know the answer for any of the following questions, you may have a high-risk situation on your property. Refer to the factsheet section with the same number as that question (under the heading "**What you should know about . . .**") for more information.

YES	NO	
☐	☐	1. Are your fertilizer storage facilities located closer than 100 feet from your water well?
☐	☐	2. Do you mix and load fertilizers on your property?
☐	☐	3. Do you dispose of or burn fertilizer containers on your property?
☐	☐	4. Do you apply fertilizer on your property without first getting a soil test recommendation?

Groundwater is the underground water that replenishes wells and springs. It is the source of drinking water for many Texans. Millions of gallons of groundwater may be located under the typical acreage, farm, or ranch. Fertilizer and pesticide storage areas, fuel tanks, livestock pens, manure and wastewater storage, and septic systems may be situated above the groundwater aquifer and all are potentially major sources of pollution. The management decisions you make on your property can significantly affect the quality of your drinking water and your family's health. These decisions can also affect your potential legal liability and the value of your property.

What you should know about . . . .

1. FERTILIZER STORAGE AND HANDLING PRACTICES

Proper storage and handling of fertilizers may necessitate the construction of a new facility or modification of an existing structure. Factors to consider in the design of a fertilizer storage facility include ventilation, water access, temperature control, and worker safety. Professional assistance should be obtained for the design/installation of a new or modified storage structure. An example plan is shown in Figure 1.

Stored fertilizers can pose a danger to fire-fighters and the environment. Reducing fire risk in the storage area is of primary concern, and the following also should be considered:

- All storage facilities should be at least 100 feet away and downslope from any drinking water well. Distances should be greater in areas of fractured shallow bedrock or sandy soils.
- Road access should be adequate for deliveries and emergency equipment.
- Design your storage facility so that in the event of a fire, contaminated surface water will drain to a confined area. If you store large volumes of fertilizer, the confined area should consist of an impermeable drainage pad with sump for liquid collection.
- The mixing and loading area should be adjacent to the storage facility to minimize the distance chemicals must be transported.
- Liquid and dry products should be stored separately, and bags should be stored on pallets.
- The containment area for large bulk tanks should be large enough to confine 125% of the contents of the largest bulk container, plus the displaced volume of any other storage tanks.

- Post signs and labels identifying contents to give emergency personnel important information during fires or spills.
- Lock the facility to improve security.

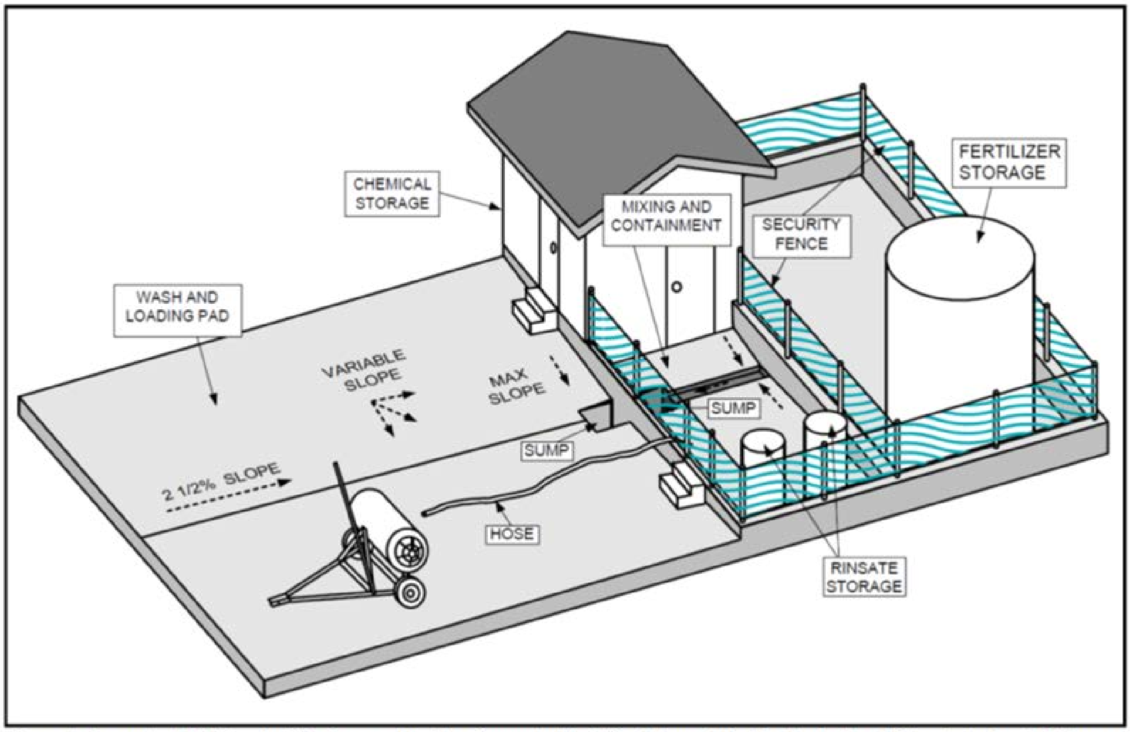

Figure 1. Farm-sized fertilizer facility. Source: Modular Concrete Wash/Containment Pad for Agricultural Chemicals, by. R.T. Noyes and D.W. Kammel, American Society of Agricultural Engineers Paper Number 891613.

2. FERTILIZER MIXING AND LOADING PRACTICES

Soil and groundwater contamination can result from small quantities spilled regularly in the same place. Cleanup of spills should follow the instructions provided by the manufacturer and also outlined on the MSDS. You can minimize spills by following these basic guidelines:

- Use a nurse tank to transport water to the mixing and loading site to avoid working with chemicals near any well.
- Mixing sites should be moved within the field of application each year to avoid build-up of spilled chemicals in the soil.
- Mixing sites should not be on gravel driveways or other surfaces that allow spills to move quickly into the soil.
- Install back siphon prevention devices on plumbing, hoses, or hydrants to prevent reverse flow of liquids into the water supply.
- Never put the water supply hose in the mixing tank; leave a 6-inch air gap between the hose and top of the sprayer tank.

- All personnel should be trained to follow exact procedures in handling fertilizer materials, particularly anhydrous ammonia and ammonium nitrate.
- Closed handling systems transfer chemicals directly from a storage container to the application equipment and may be a good investment.
- Use rinsate for mixing subsequent loads.
- MSDS include descriptions of appropriate storage conditions as well as chemical exposure and spill response actions with emergency contact telephone numbers.

3. CONTAINER DISPOSAL

Fertilizer containers (bags, jugs, etc.) can be a source of pollution if not disposed of properly. Burning fertilizer bags is illegal in Texas. Follow the guidelines below to minimize potential problems:

- Purchase fertilizer materials in bulk to minimize the number of containers.
- Purchase chemicals in returnable containers, when possible.
- Triple rinse containers when feasible and pour rinsate into the applications tanks.
- Product MSDS information will contain instructions for appropriate disposal of containers and excess chemicals, and emergency contact telephone numbers.

4. FERTILIZER USE PRACTICES

The most important factors affecting the potential for nitrate pollution of groundwater from agricultural production are related to rate and timing of fertilizer application. Fertilizer application rates must be based on crop yield potential. In addition, soil testing is essential to measure residual nitrogen levels in the soil which can be credited to reduce supplemental fertilizer application rates. Because nitrate is soluble, nitrogen fertilizer should be applied as close to the time of crop need as possible to ensure maximum uptake by plants. Where possible, cover crops also can be used to recover residual nitrogen and reduce potential leaching losses.

The following practices are protective of groundwater.

- **Soil Test.** Annual soil testing enables land managers to determine the most economical and environmentally appropriate application rate of nitrogen fertilizer by crediting residual nutrients. Furthermore, research has shown that in addition to standard soil samples collected to a depth of 6 inches, deep samples (6 to 18 or 6 to 24 inches) tested for residual nitrogen help optimize application rates. Soil testing services are available through the Texas A&M AgriLife Extension Service Soil, Water and Forage Testing Laboratory at Texas A&M [http://soiltesting.tamu.edu] or various commercial laboratories.
- **Rate of application.** Match the rate of fertilizer application with the expected crop yield to prevent over-application.

- **Application timing.** Apply nitrogen fertilizer as close to the time of plant demand as possible.
- **Test organic amendments.** Organic soil amendments that do not have a fertilizer label should be used sparingly or tested to determine the appropriate rate of application.
- **Avoid fall nitrogen applications on coarse-textured soils.** Coarse-textured soils with low water holding capacity have a greater potential to allow nitrate leaching.

Remember:

The following management practices help reduce the risk of groundwater contamination:

- Avoid storing fertilizers by buying appropriate amounts and sharing leftovers with others.
- Store and load fertilizers at least 100 feet from the well, and downslope if possible.
- Make sure all bags and containers are clearly labeled.
- Secure fertilizers from livestock, pets, and children. Put up a fence if necessary.
- Use a separate tank to provide water for mixing fertilizers instead of using a hose directly from the well.
- When filling a tank, maintain an air gap of at least six inches between the end of the hose and the liquid level in the tank to prevent backflow.
- Install anti-backflow devices on your faucets.
- Dispose of all rinsate on the field being fertilized, or save as mixing water for later loads.
- Do not pour rinsate down a drain or on a gravel surface.

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Acknowledgement

Partial funding for this project was provided by the Texas State Soil and Water Conservation Board through a CWA 319(h) grant from the U.S. Environmental Protection Agency.

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Enhancing Sorghum Nitrogen Use Efficiency Through Fertilizer Management

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Background

Grain sorghum is a major crop in Texas and the second most important crop grown for feed and bio-fuel feedstock in the United States. Managing input costs, particularly fertilizer in light of recent substantial increases in material costs, is critical to maintain the economic viability of sorghum production. Nitrogen (N) is an essential plant nutrient and the one applied in the greatest amounts for crop growth. However, N also is the most dynamic of all the essential nutrients, being subject to loss by leaching, runoff, and denitrification (volatilization). Enhancing N use efficiency through the use of slow release nitrogen sources or by addition of compounds which stabilize N in the soil environment could help optimize fertilizer application rates, increase profits, and reduce potential environmental impacts.

Slow release N sources have been marketed extensively in the horticultural sector as a means for limiting N losses and enhancing plant recovery. ESN (Agrium) is a granular, plastic coated urea product designed to retard release of N to the environment for 4 to 6 weeks. Urease inhibitors, such as Agrotain (Agrotain International), are designed to stop the hydrolysis of urea to ammonia for 10 to 14 days under normal field conditions and thereby reduce ammonia volatilization. SuperU (Agrotain International) is a granular N source with a urease inhibitor and a nitrification inhibitor to potentially reduce ammonia volatilization and denitrification or leaching.

Materials and Methods

Background soil samples were collected from multiple locations to identify sites with low residual N levels. It is important to note that the majority of the fields tested had elevated residual N levels that precluded their use. However, three locations had sufficiently low residual soil N levels (< 36 lbs N/acre in the upper 24 inches) and were selected for the project.

All study locations were in dryland production. Additional soil sampling was subsequently conducted at each location and results of the nutrient analyses used to determine treatment strategies. Urea ammonium nitrate (UAN, 32-0-0) and granular urea (46-0-0) were used as standard N sources. UAN was applied alone at rates of 0, 30, 60, 90, and 120 lb N/A to verify the yield response to supplemental N. UAN also was applied at three rates (30, 60, and 90 lb N/A) with addition of the urease/ nitrification inhibitor Agrotain Plus. Urea was hand applied at three rates (30, 60, and 90 lb N/A) and used as a standard N source for comparison with the slow-release nitrogen products SuperU and ESN. Specific treatments used at each location and field site information are presented below.

Monthly rainfall accumulation during February and March ranged from average to 500 percent of long-term average across study sites. However, percent of average monthly rainfall for April, May, and June, respectively, was 88, 30, and 47 for Hill County, 54, 50, and 23 for Hunt County, and 6, 75, and 5 for Williamson County.

Central Blacklands

The study site was a Burleson clay soil under strip-tillage management in Williamson County at the Stiles Farm near Thrall, Texas. Soil samples collected in January 2012 had residual soil test NO_3-N levels of 8, 8, and 20 lb/A for depths of 0 to 6, 6 to 12, and 12 to 24 inches, respectively. In late January, 200 lb of 2-6-12 liquid fertilizer was subsurface banded in the seed row. On April 2, grain sorghum hybrid DK 3707 was planted at a density of 65,000 seed per acre.

Experimental plots were 60 feet in length and four rows wide, with 38-inch spacing between rows. Treatments were replicated five times and arranged in a randomized complete block design. Rates of N, P, and Zn fertilizer were based on soil test results utilizing a crop yield goal of 5,000 lb per acre. Phosphorus was applied at 12 lb P_2O_5/A as ammonium polyphosphate (10-34-0) and Zn at 5 lb/A as TraFix ZnXL (Helena Chemical Co.) across all treatments in the study. Fertilizer treatments were side-dress banded at planting on April 2 and 3. Except where indicated, UAN was the sole source of N fertilizer applied. Agrotain was added at a rate of 1.5 quarts/ton of UAN based on label recommendations. Treatments are shown in Table 1.

In-season measurements included uppermost leaf chlorophyll (SPAD 502, Minolta) and total N at peak flower based on eight subsamples per experimental unit. Whole-plant biomass samples were collected at the soft dough stage from five feet on each of two yield rows and processed separately as stover and grain for determination of total N. Ten feet from each of two center rows of each plot was harvested by hand on August 3. Plant population counts were made from the harvested area. Harvested grain was threshed with a portable Amalco thresher, plot weights measured, and test weight and grain moisture determined using a stationary Dickey Jon meter.

Mid-Northern Blacklands:

The study site was a Houston Black clay soil located in Hill County on a producer field near Hillsboro, Texas. Soil samples collected March 1 had residual soil test NO_3-N levels of 2, 4, and 10 lb/A for depths of 0 to 6, 6 to 12, and 12 to 24 inches, respectively. Grain sorghum hybrid

DKS 44-20 was planted on March 28 at a density of 70,000 seed/A. At planting, liquid fertilizer containing 6-20-0 with 0.77% Zn was applied in-furrow at a rate of 33 lb/A.

Table 1. Fertility treatments, application method, and timing of treatment installation for the study site at Stiles Farm Foundation, Williamson County, Texas.

Treatment	**Application Method**	**Timing**
1. 0 lb N	Coulter	At planting
2. 30 lb N as UAN	Coulter	At planting
3. 60 lb N as UAN	Coulter	At planting
4. 90 lb N as UAN	Coulter	At planting
5. 120 lb N as UAN	Coulter	At planting
6. 30 lb N as UAN	Surface dribble	At planting
7. 60 lb N as UAN	Surface dribble	At planting
8. 90 lb N as UAN	Surface dribble	At planting
9. 30 lb N as UAN with Agrotain Plus	Surface dribble	At planting
10. 60 lb N as UAN with Agrotain Plus	Surface dribble	At planting
11. 90 lb N as UAN with Agrotain Plus	Surface dribble	At planting
12. 30 lb N as urea	Surface dribble	At planting
13. 60 lb N as urea	Surface dribble	At planting
14. 90 lb N as urea	Surface dribble	At planting
15. 30 lb N as SuperU	Surface dribble	At planting
16. 60 lb N as SuperU	Surface dribble	At planting
17. 90 lb N as SuperU	Surface dribble	At planting
18. 30 lb N as ESN	Surface dribble	At planting
19. 60 lb N as ESN	Surface dribble	At planting
20. 90 lb N as ESN	Surface dribble	At planting

Plots were 65 feet in length and four rows wide, with 30-inch spacing between rows. Treatments were replicated five times and arranged in a randomized complete block design. Rates of N and P fertilizer were based on soil test results with a yield goal of 5,000 lb/A. Phosphorus was applied at 35 lb P_2O_5/A as 10-34-0 and Zn at 5 lb/A as TraFix ZnXL across all treatments in the study. Conventional tillage used at the site included planting on a flat surface. Thus, all fertilizer treatments were side-dress banded after crop emergence, stage 2 on April 18. Except where indicated, UAN was the sole source of N fertilizer applied. Agrotain was added at a rate of 1.5 quarts/ton of UAN based on label recommendations. Treatments included in the study near Hillsboro are shown in Table 2.

Table 2. Fertility treatments, application method, and timing of treatment installation for the study site in Hill County, Texas.

Treatment	Application Method	Timing
1. 0 lb N	Coulter	Post plant
2. 30 lb N as UAN	Coulter	Post plant
3. 60 lb N as UAN	Coulter	Post plant
4. 90 lb N as UAN	Coulter	Post plant
5. 120 lb N as UAN	Coulter	Post plant
6. 30 lb N as UAN	Surface dribble	Post plant
7. 60 lb N as UAN	Surface dribble	Post plant
8. 90 lb N as UAN	Surface dribble	Post plant
9. 30 lb N as UAN with Agrotain Plus	Surface dribble	Post plant
10. 60 lb N as UAN with Agrotain Plus	Surface dribble	Post plant
11. 90 lb N as UAN with Agrotain Plus	Surface dribble	Post plant
12. 30 lb N as urea	Surface dribble	Post plant
13. 60 lb N as urea	Surface dribble	Post plant
14. 90 lb N as urea	Surface dribble	Post plant
15. 30 lb N as SuperU	Surface dribble	Post plant
16. 60 lb N as SuperU	Surface dribble	Post plant
17. 90 lb N as SuperU	Surface dribble	Post plant
18. 30 lb N as ESN	Surface dribble	Post plant
19. 60 lb N as ESN	Surface dribble	Post plant
20. 90 lb N as ESN	Surface dribble	Post plant

In-season measurements included uppermost leaf chlorophyll (SPAD 502, Minolta) and total N at peak flower. Measurements were based on subsampling eight leaves per experimental unit. Ten feet from each of two center rows of each plot was harvested by hand on July 23. Plant population counts were made from the harvested area. Heads of harvested grain were later threshed with a portable Amalco thresher, plot weights measured, and test weight and grain moisture determined using a stationary Dickey Jon meter.

Northern Blacklands:

The study site was a Houston Black clay soil located in far western Hunt County on a producer field near Floyd, Texas. Soil samples collected March 2 had residual soil test NO_3-N levels of 1, 9, and 18 lb/A for depths of 0 to 6, 6 to 12, and 12 to 24 inches, respectively. Grain sorghum hybrid Pioneer 84G62 was planted on April 4 at a density of 70,000 seed/A. Plots were 65 feet in length and four rows wide, with 30-inch spacing between rows. Treatments were replicated five times and arranged in a randomized complete block design. Rates of N and P fertilizer were based on soil test results with a yield goal of 5,000 lb/A. Phosphorus was applied at 35 lb P_2O_5/A as 10-34-0 and Zn at 5 lb/A as TraFix ZnXL across all treatments. All fertilizer treatments were side-dress banded after crop emergence, stage 2 on April 25. Except where indicated, UAN was the sole source of N fertilizer applied. Agrotain was added at a rate of 1.5 quarts/ton of UAN based on label recommendations. Treatments are shown in Table 3.

Table 3. Fertility treatments, application method, and timing of treatment installation for the study site in Hunt County, Texas. .

Treatment	Application Method	Timing
1. 0 lb N	Coulter	Post plant
2. 30 lb N as UAN	Coulter	Post plant
3. 60 lb N as UAN	Coulter	Post plant
4. 90 lb N as UAN	Coulter	Post plant
5. 120 lb N as UAN	Coulter	Post plant
6. 30 lb N as UAN	Surface dribble	Post plant
7. 60 lb N as UAN	Surface dribble	Post plant
8. 90 lb N as UAN	Surface dribble	Post plant
9. 30 lb N as UAN with Agrotain Plus	Surface dribble	Post plant
10. 60 lb N as UAN with Agrotain Plus	Surface dribble	Post plant
11. 90 lb N as UAN with Agrotain Plus	Surface dribble	Post plant
12. 30 lb N as urea	Surface dribble	Post plant
13. 60 lb N as urea	Surface dribble	Post plant
14. 90 lb N as urea	Surface dribble	Post plant
15. 30 lb N as SuperU	Surface dribble	Post plant
16. 60 lb N as SuperU	Surface dribble	Post plant
17. 90 lb N as SuperU	Surface dribble	Post plant
18. 30 lb N as ESN	Surface dribble	Post plant
19. 60 lb N as ESN	Surface dribble	Post plant
20. 90 lb N as ESN	Surface dribble	Post plant

In-season measurements included uppermost leaf chlorophyll (SPAD 502, Minolta) and total N at peak flower. Measurements were based on subsampling eight leaves per experimental unit. Whole-plant biomass samples were collected at the soft dough stage from five feet of each of two yield rows and processed separately as stover and grain for determination of total N. The two center rows from each plot were harvested on August 24 with a JD 3300 combine equipped with a Harvestmaster Grain Gauge that measured plot weight, test weight, and grain moisture.

Plant population counts were made from the harvested area. For all harvested sites, data were analyzed by analysis of variance and means separated using Fisher's Least Significant Difference (LSD) at the five percent level ($P \leq 0.05$), where appropriate.

Results and Discussion

Yields of grain sorghum increased with increasing rate of applied N as UAN up to 60 lb/A in Hill and Hunt Counties. In contrast, there was no response to N rate in Williamson County (Table 5) due largely to limited rainfall in the weeks prior to planting and continuing through flowering. No fertilizer rate by source interactions were observed for grain yield. In addition, no significant differences in grain yield were observed between conventional N fertilizer sources and granular slow-release N sources or conventional liquid N (32%) with the N stabilizer additive within rates of N application at the three study locations (Tables 6-8). Below average rainfall early in the season may have limited the potential for a response to the products. However, yields in Hill and Hunt Counties were at or above average ranging from 4765 to 6177 lbs/acre.

Table 5. Effects of N (UAN) rate on grain sorghum yield at study sites in Hill, Hunt, and Williamson Counties, Texas.

Treatments		Grain Yield†		
Source	N Rate	Hill County	Hunt County	Williamson County
	(lb/A)	----------------------------(lb/A)------------------------		
None	0	4828 c‡	4400 b	2633§
UAN	30	5459 b	4446 b	3006
UAN	60	6103 a	5522 a	2714
UAN	90	6038 a	5746 a	3424
UAN	120	6297 a	6009 a	2911
LSD		366	493	
P>(F)		0.0001	0.0001	0.2548
CV		4.7	7	19.3

†Grain yield corrected to 14% moisture.
‡Means within a column followed by the same letter are not different according to LSD ($P \leq 0.05$).
§Means within a column were not different ($P \leq 0.05$).

Table 6. Effects of N rate and source on grain sorghum yield in Hill County, Texas.

	Grain Yield†		
N Source	30 lb N/A	60 lb N/A	90 lb N/A
	----------------------------	(lb/A)	------------------------
UAN	5663‡	6177	5911
UAN + Agrotain Plus	5658	5982	5719
Urea	5674	5682	6138
SuperU	5665	5974	5980
ESN	6032	5789	6100
P>(F)	0.5948	0.3929	0.7871
CV	7.5	6.9	9.5

†Grain yield corrected to 14% moisture.
‡Means within a column were not different (P≤0.05).

Table 7. Effects of N rate and source on grain sorghum yield in Hunt County, Texas.

	Grain Yield†		
N Source	30 lb N/A	60 lb N/A	90 lb N/A
	----------------------------	(lb/A)	------------------------
UAN	4784‡	5155	5605
UAN + Agrotain Plus	4817	5254	5673
Urea	4960	5290	5732
SuperU	4765	5455	5783
ESN	5081	5588	5779
P>(F)	0.4076	0.1598	0.8625
CV	6	5.2	5.2

†Grain yield corrected to 14% moisture.
‡Means within a column were not different (P≤0.05).

Table 8. Effects of N rate and source on grain sorghum yield in Williamson County, Texas.

N Source	Grain Yield†		
	30 lb N/A	60 lb N/A	90 lb N/A
	---------------------------(lb/A)-----------------------		
UAN	3108‡	3214	3068
UAN + Agrotain Plus	2875	3097	3175
Urea	3046	2729	2779
SuperU	2685	3161	3355
ESN	2961	2758	2567
P>(F)	0.9361	0.6045	0.4227
CV	28.3	20.6	23.2

†Grain yield corrected to 14% moisture.
‡Means within a column were not different (P≤0.05).

UAN alone at all rates significantly increased leaf chlorophyll at flowering compared to the zero N control (Fig. 1). However, there were no differences in leaf chlorophyll readings due to N source for any of three rates applied (Fig. 2a-c). UAN alone at rates of 60, 90, and 120 lbs N/acre significantly increased N concentration in mature leaves at flowering in Hunt County compared to the check (0 N) and 30 lbs N/acre; however, the same response was not observed at the other study sites (Table 9). There were no differences in mature leaf N concentration between conventional and slow-release N fertilizer sources or the N stabilizer additive across rates of N fertilizer at any of the three study sites in the Central Texas Blacklands (Tables 10-12).

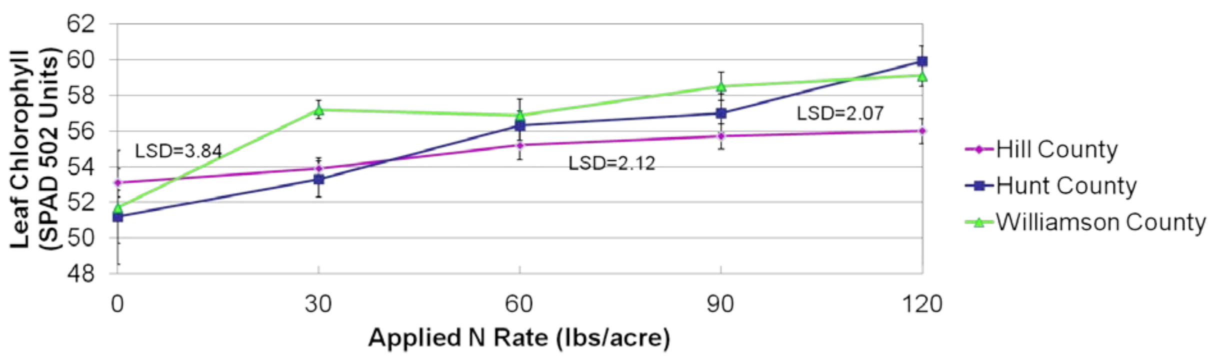
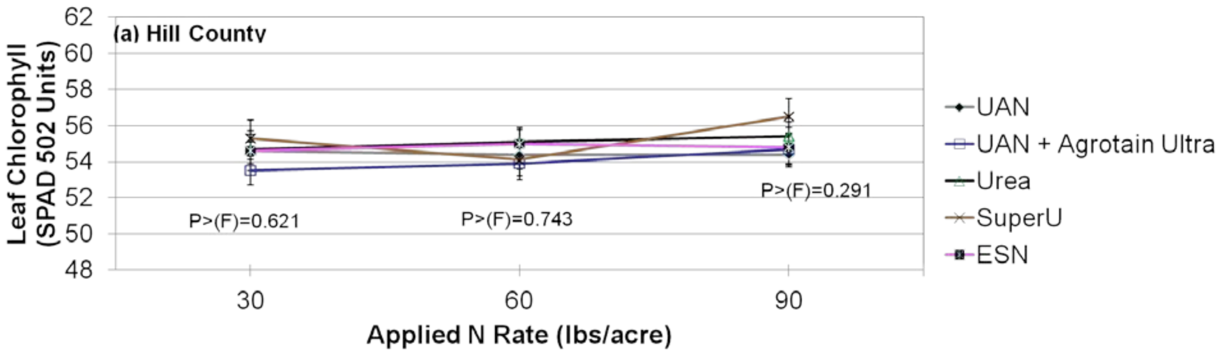
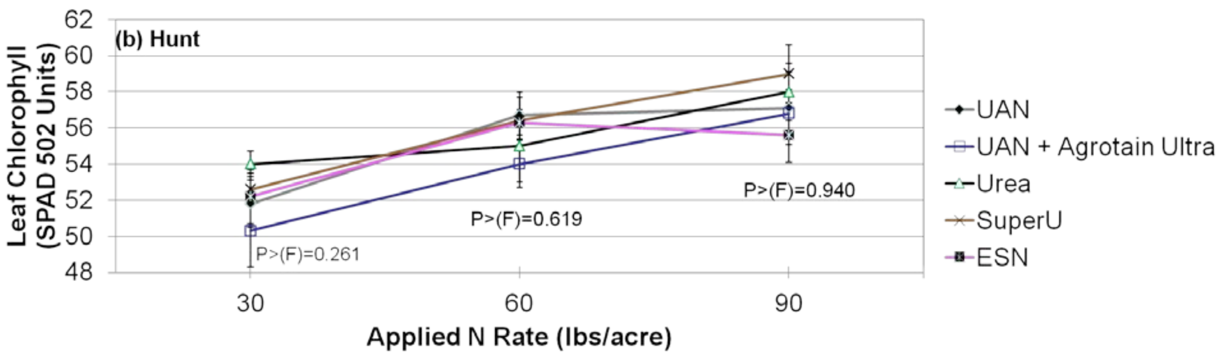


Fig. 1. Effects of N (UAN) rate on leaf chlorophyll at flowering at three locations in the Central Texas Blacklands. Means within a county were significantly different at increased rates of N according to LSD (P≤0.05). Standard error bars represent treatment means.

2a)



2b)



2c)

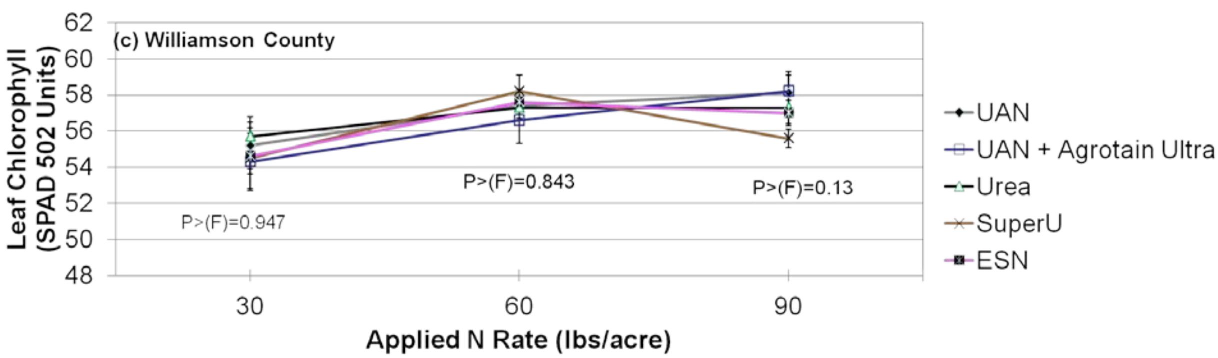


Fig. 2a-c. Effects of N rate and source on leaf chlorophyll at flowering at three locations in the Central Texas Blacklands. Means within a rate of N were not significantly different ($P \leq 0.05$). Standard error bars represent treatment means.

Table 9. Effects of N (UAN) fertilizer rate on leaf N concentration at flowering at three study sites in the Central Texas Blacklands.

Treatments		Leaf N Concentration†		
Source	N Rate	Hill County	Hunt County	Williamson County
	(lb/A)	---------------------------(%)-------------------------		
None	0	2.63‡	2.34 c§	3.19
UAN	30	2.58	2.28 c	3.40
UAN	60	2.61	2.69 b	3.53
UAN	90	2.52	2.78 ab	3.53
UAN	120	2.68	2.89 a	3.61
LSD			0.194	
P>(F)		0.7726	0.0001	0.0682
CV		7.5	5.6	6.3

†Second leaf below the flag leaf.

‡Means within a column were not different (P≤0.05).

§Means within a column followed by the same letter are not different according to LSD (P≤0.05).

Table 10. Effects of N fertilizer treatment at three rates of application on grain sorghum leaf N concentration at flowering, Hill County, Texas.

	Leaf N Concentration†		
N Source	30 lb N/A	60 lb N/A	90 lb N/A
	---------------------------(%)------------------------		
UAN	2.56‡	2.61	2.77
UAN + Agrotain Plus	2.56	2.54	2.73
Urea	2.63	2.59	2.67
SuperU	2.58	2.61	2.63
ESN	2.62	2.62	2.67
P>(F)	0.9624	0.9473	0.6231
CV	7.5	6.7	5.7

†Second leaf below the flag leaf.

‡Means within a column were not different (P≤0.05).

Table 11. Effects of N fertilizer treatment at three rates of application on grain sorghum leaf N concentration at flowering, Hunt County, Texas.

	Leaf N Concentration†		
N Source	30 lb N/A	60 lb N/A	90 lb N/A
	----------------------------(%)------------------------		
UAN	2.37‡	2.71	2.62
UAN + Agrotain Plus	2.33	2.45	2.76
Urea	2.52	2.56	2.77
SuperU	2.48	2.60	2.84
ESN	2.43	2.66	2.69
P>(F)	0.3775	0.2253	0.0605
CV	6.7	6.8	4.1

†Second leaf below the flag leaf.
‡Means within a column were not different ($P \leq 0.05$).

Table 12. Effects of N fertilizer treatment at three rates of application on grain sorghum leaf N concentration at flowering, Williamson County, Texas.

	Leaf N Concentration†		
N Source	30 lb N/A	60 lb N/A	90 lb N/A
	----------------------------(%)------------------------		
UAN	3.32‡	3.5	3.54
UAN + Agrotain Plus	3.35	3.5	3.51
Urea	3.46	3.41	3.53
SuperU	3.36	3.53	3.49
ESN	3.34	3.46	3.52
P>(F)	0.4222	0.5852	0.9772
CV	3.6	3.3	3.7

†Second leaf below the flag leaf.
‡Means within a column were not different ($P \leq 0.05$).

When UAN was applied alone, grain and total N contents of sorghum biomass at the Hunt County site increased at rates of 60 lb N/A and above (Table 13). In contrast, stover, grain, and total N content of harvested sorghum biomass were not affected by N rate in Williamson County (Table 14).

There were no differences in stover, grain, or total N content of plant biomass due to N source at the study site in Hunt County (Table 15). In contrast, plots in Williamson County receiving UAN at 60 lbs N/acre with Agrotain had greater stover N content compared to other treatments (Table 16). In addition, Williamson County plots receiving SuperU at 90 lbs N/acre had higher grain N content compared to other treatments (Table 16). However, similar results were not observed for total N content at lower or higher N rates with these products.

Table 13. Effects of N (UAN) rate on N content in biomass of mature grain sorghum, Hunt County, Texas.

Treatments		N Content of Biomass		
Source	N Rate	Stover	Grain	Total
	(lb/A)	------------------------------(lb/A)-------------------------		
None	0	21.4†	31.1 b‡	52.5 b
UAN	30	22.0	35.2 b	57.3 b
UAN	60	29.4	59.6 a	89.0 a
UAN	90	27.3	62.5 a	89.8 a
UAN	120	27.0	65.2 a	92.3 a
LSD			13.0	17.2
P>(F)		0.2499	0.0006	0.0012
CV		18.5	13.6	12.0

† Means within a column were not different (P≤0.05).

‡Means within a column followed by the same letter are not different according to LSD (P≤0.05).

Table 14. Effects of N (UAN) rate on N content in biomass of mature grain sorghum, Williamson County, Texas.

Treatments		N Content of Biomass		
Source	N Rate	Stover	Grain	Total
	(lb/A)	------------------------------(lb/A)-------------------------		
None	0	17.8†	28.2	46.0§
UAN	30	22.6	43.0	65.6
UAN	60	24.9	45.0	70.0
UAN	90	23.4	46.9	70.4
UAN	120	30.0	49.3	79.3
P>(F)		0.4645	0.0662	0.1578
CV		32.2	18.4	21.7

†Means within a column were not different (P≤0.05).

Table 15. Effects of N source and rate on N content of mature sorghum biomass, Hunt County, Texas.

	N Content of Biomass								
N Source	30 lb N/A			60 lb N/A			90 lb N/A		
	Stover	Grain	Total	Stover	Grain	Total	Stover	Grain	Total
	---------------------------------------(lb/A)------------------------------------								
UAN	22.7†	34.9	57.6	30.8	56.1	86.9	25.8	60.1	85.9
UAN + Ag‡	17.8	33.1	50.9	26.9	50.6	77.6	22.7	62.2	84.9
Urea	20.5	41.2	61.7	26.2	62.6	88.8	25.8	62.8	88.6
SuperU	20.9	43.5	64.4	24.4	51.5	75.9	27.7	66.1	93.8
ESN	23.8	49.7	73.4	21.3	52.3	73.5	27.5	61.3	88.8
P>(F)	0.4261	0.0655	0.1007	0.0861	0.5774	0.4239	0.7716	0.9556	0.9338
CV	18	15.5	14	13.4	17.9	14.1	20	15.9	15.3

†Means within a column were not different (P≤0.05).
‡UAN + Agrotain Plus

Table 16. Effects of N source and rate on N content of mature sorghum biomass, Williamson County, Texas.

N Source	N Content of Biomass								
	30 lb N/A			60 lb N/A			90 lb N/A		
	Stover	Grain	Total	Stover	Grain	Total	Stover	Grain	Total
	(lb/A)								
UAN	17.7[†]	38.1	55.9	22.6	49.4 ab[‡]	72.1	17.1 b	44.2	61.3
UAN + Ag[§]	20.0	39.7	59.7	25.8	61.7 a	87.5	15.0 b	41.8	56.8
Urea	17.1	45.6	62.7	23.4	42.9 b	66.4	21.9 b	41.9	63.8
SuperU	13.8	35.0	48.7	20.9	45.1 b	65.9	39.6 a	50.1	80.1
ESN	18.7	34.5	53.2	17.6	39.5 b	57.2	18.5 b	36.3	54.8
LSD					12.7		7.1		
P>(F)	0.5747	0.7528	0.804	0.6918	0.0276	0.1273	0.0005	0.4363	0.4135
CV	26.3	29.1	26.6	31.6	14.1	17.6	16.4	19.5	25.8

†Means within a column were not different (P≤0.05).
‡Means within a column followed by the same letter are not different according to LSD (P≤0.05).
§UAN + Agrotain Plus

Summary

Yield of grain sorghum and uppermost leaf chlorophyll responded to increased rates of applied N as UAN in two of three locations where seasonal rainfall was more comparable to long-term averages. However, neither UAN applied in combination with a urease-nitrification inhibitor (Agrotain) or slow-release granular N sources (ESN and SuperU) increased grain yield, leaf chlorophyll, or total leaf N when compared to conventional UAN or urea alone. At one location, grain and stover N content were affected by N treatment, but results were not consistent across rates or locations. Overall, results of the project showed that the selected N slow-release and stabilizer products did not offer yield advantages for grain sorghum production compared to conventional N sources under the conditions experienced during these studies.

An important related finding of this work was that elevated residual N levels measured in 75% of the fields evaluated as potential study sites limited site selection. These results further substantiate over 10 years of previous research in cotton and limited recent work in corn and grain sorghum indicating high levels of residual soil N in production regions across the state.

This research has shown that residual soil N to depths of 24 inches are effectively recovered by these crops and can be credited at 100% to reduce supplemental fertilizer needs. Certainly, crop failures and yield reductions due to periodic, and more recently, persistent drought conditions have played a role in nutrient build-up in some areas. However, given the widespread occurrence of the phenomenon additional research is needed to better define field soil sampling protocols that can enable targeted deep (upper 18 to 24 inches) sampling to measure and credit residual soil N. Combinations of yield mapping, veris technology, and other tools may provide new opportunities to do so. Efficient utilization of this highly mobile nutrient not only can improve production economics, but also will enhance the potential for grain sorghum producers to practice and be recognized for employing sound environmental management.

Acknowledgements

Funding support for this project was provided by the United Sorghum Checkoff Program. Thanks also to Koch Agronomic Services, Crop Production Services (Agrium), and Simplot for donations of fertilizer and related products.

Central Texas Blacklands Tillage Trails
Stiles Farm Foundation

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Background:

The Stiles Farm Foundation has as one of its objectives to evaluate tillage practices and tillage methods and to provide educational information to growers in the region.

The summary that follows is a compilation of 8 years of data from 2003-2010 comparing no till, conventional tillage and strip tillage in five rotations: corn09/corn10 etc., cotton 09/corn10 etc., sorghum09/cotton10 etc., corn09/cotton10 etc., and cotton09/sorghum10 etc.

Discussion:

The tillage plots are designed as large scale plots that are machine harvested by custom harvesters. The plots are 16 rows each on 38 inch row spacing with each tillage treatment replicated three times in each rotation. Depending on the field row length, each 16 row tillage treatment encompasses from 2 to 4 acres. All of the plots are dryland and receive no supplemental irrigation. The plots are grown on a Burleson Clay vertisol soil. Over the range of these years, growing conditions have ranged from very dry years to very optimal moisture years.

Conventional tillage consists of either chiseling with sweeps or heavy discing followed by multiple passes with a field cultivator. Strip tillage in 2003 was achieved using a DMI 5310 strip till unit. The 2004-2006 strip till plots were done with a Yetter Maverick 8 row strip till unit. The 2007-2010 plots were treated with the Orthman 1-tRIPr strip till tool.

The 2003-2010 tillage trials results listed show the rotation, yield and net income. Net income includes the value of the individual crop at harvest time with expense deductions that includes tillage trips, spraying, planting and harvesting as well as any other treatments at custom rates for the region. Other expenditures were actual costs as incurred during the season.

Summary:

There are benefits to some tillage in high clay content soils in the thermic regions prevalent in the Central Texas Blacklands. It may not be necessary to do whole acre tillage each year however. An annual check of compaction will be a good guide to determine if tillage is necessary as many factors are involved in compacted soils. Growers may not need to till the entire field depending on the crop to be planted and the previous crop but may want to consider some type of zone tillage such as strip tillage. Strip tillage allows for a narrow band of “clean soil” in the row with residue in the middles for moisture conservation. The soil band left after strip tillage will generally warm sooner in cool springs. In addition, strip till enables application of fall or winter fertilizer placed strategically where the crop can use it more efficiently. Soil quality makes marked improvements by increasing the water holding capacity of the soil.

Including RTK guidance systems as a part of the strip till program further increases efficiency and results in cost savings with better fertilizer placement and a uniform crop stand.

2003-2010 Tillage Trials: Stiles Farm Foundation

ROTATION	YIELD	NET PROFIT
CORN/CORN		
No Till	84.4 bu/ac	$72.73
Strip Till	88.0 bu/ac	$72.19
Conventional Till	90.5 bu/ac	$57.40
COTTON/CORN		
No Till	76.4 bu/ac	$37.17
Strip Till	82.3 bu/ac	$45.32
Conventional Till	78.0 bu/ac	$01.55
COTTON/SORGHUM*		
No Till	4414 lb/ac	$85.85
Strip Till	4683 lb/ac	$93.76
Conventional Till	4806 lb/ac	$87.26
CORN/COTTON		
No Till	536 lb/ac	$04.92
Strip Till	593 lb/ac	$30.99
Conventional Till	620 lb/ac	$07.73
SORGHUM/COTTON		
No Till	590 lb/ac	$51.69
Strip Till	651 lb/ac	$69.87
Conventional Till	686 lb/ac	$66.23

*Represents 7 years data due to sorghum wind damage in 2005.

Effect of Timing of Atoxigenic Strain Application on Aflatoxin Contamination of Corn In Texas - 2013

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The objective of this study was to evaluate the reduction of aflatoxin contamination of corn with different timings of application of a commercial atoxigenic strain of Aspergillus flavus. The rationale was that if an application during the early vegetative stage was as effective as the currently-labeled timing (late vegetative to tasseling), then growers would have greater flexibility in applying the material with a ground rig.

Experimental design and methods: The study was done in three locations in Texas: (1) A commercial field near Palacios, TX in Jackson county. The soil type is a Laewest clay, (2) The Stiles Foundation Farm (Texas AgriLIFE Extension Service) near Thrall, TX in Williamson county. The soil type is a Burleson clay, and (3) A commercial field near Dacosta, TX in Victoria county. The soil type is a Laewest clay.
For all three locations, each treatment was replicated four times in a latin square design and each replicate consisted of 8, 100-ft rows. Replicates were separated by a distance of 100 ft. There were four treatments: not treated (control) and Afla-Guard applied at three timings, by hand, to the tops of rows at a rate of 10 lb./A. The timings for the Jackson county field: V5-V6 (April 23, 2013), VT-R1 (May 13, 2013), and a late R1 (silks brown but moist) (May 21, 2013). The timings for the Williamson county field: V6 (May 12, 2013), V8 to V9 (May 24, 2013), and R1 (May 30, 2013). The timings for the Victoria county field: V6 to V8 (April 23, 2013), VT to R1 (May 14, 2013), and R1 to R2 (May 21, 2013).

Forty ears from the middle two rows of plots were hand harvested (Jackson county, July 5; Williamson county, July 6; Victoria county, July 5) and assessed for the incidence of visible *Aspergillus flavus* ear rot (Figure 1b). To determine toxigenicity of these ear colonies, conidia from ear rots were transferred to half-strength PDA slants (5 ml) using a sterile cotton swab and incubated 10 days. Aflatoxin was extracted from slants with 15 ml 80% methanol and further purified and analyzed using the Vicam Aflatest USDA FGIS procedure. To determine aflatoxin content of the bulk corn samples, ears were shelled and the 7 to 8 lb. samples from each plot were ground using a Romer mill (Romer Labs, Union, MO). Aflatoxin was quantified from 50-g subsamples using the Vicam Aflatest USDA FGIS procedure. Using a sub-sample of intact kernels, internal colonization by *A. flavus* was determined as follows. Kernels were surface-disinfested in 10% bleach for two min, rinsed twice with sterile water and incubated 4 days on moist, sterile paper towels in 8 in.× 8 in. aluminum trays sealed in Zip-loc plastic bags (Figure 1a). One hundred kernels were evaluated for each replicate.

Figure 1. A. Sporulation of *Aspergillus flavus* on surface-disinfested corn kernels. B. Visible ear rot caused by *A. flavus*.

Whole plots were harvested with the grower's combine (Jackson county, July 25; Williamson county, July 25; Victoria county, July 10). Samples for analysis were obtained by holding a bucket over the auger that moves the corn from the concave to the combine's grain bin. To reduce the possibility of cross-contamination, incoming grain was not collected for the first 30 seconds. Thereafter, only a portion of the harvest was continuously collected, allowing for sampling of the whole replicate (i.e. stream sampling). The amount of corn collected per plot ranged from 8-12 lb. Total aflatoxin was quantified and *A. flavus* colonization of intact kernels was done as previously described. Additionally, fumonisin was quantified using the Veratox fumonisin procedure (Neogen, Lansing, MI) for the Jackson county samples.Ear rot incidence was transformed before analysis of variance (square root of [incidence + 0.5]).

Results:
There was hot, dry weather during and after flowering at all three locations. Aflatoxin levels were very low at all locations; the highest value at any location was 26 ppb. Aflatoxin in combine-harvested samples are shown in Tables 1, 3, and 5 for Jackson, Williamson and Victoria county fields, respectively. Aflatoxin in hand-harvested samples are shown in Tables 2, 4, and 6 for Jackson, Williamson, and Victoria county fields, respectively. Fumonisin levels at the Jackson county farm were 2 ppm or lower (Table 1).

At all three locations, the incidence of *A. flavus* ear rot was significantly (*P*=0.05) greater in one or more of the atoxigenic treatments and always in the earliest treatment, as compared with the control. The incidences of atoxigenic *A. flavus* isolated from ear rots are shown in Table 7.

Table 1. Jackson county: combine-harvested plot samples.

Treatment (10 lb./A)	Aflatoxin (ppb)*		*A. flavus* in Kernels, %*		Fumonisin (ppm)*	
	Mean	Range	Mean	Range	Mean	Range
Control	4.6	0.9-9.2	5.7	4-8	1.9	0.8-3
V5-V6	0.1	0-0.3	11	5-20	1.5	0.4-3.4
VT to R1	0.3	0-1.1	5.7	0-11	2.3	0.6-4.5
R1 (late)	2.2	0-3.5	11.5	8-14	2.0	1.3-2.4

*Values are the means of four replicates.

Table 2. Jackson county: 40 hand-harvested ear samples.

Treatment (10 lb./A)	Aflatoxin (ppb)*		Ear rot %**		*A. flavus* in Kernels, %	
	Mean	Range	Mean	Range	Mean	Range
Control	4.5	0-11	15 b	2.3-35	1	0-2
V5-V6	0.8	0-2.9	45 a	24-58	8.2	6-12
VT to R1	0.3	0-0.7	44 a	29-51	6.5	1-19
R1 (late)	5.2	0-17	19 b	17-23	4.7	1-15

*Values are the means of four replicates. **Means followed by different letters are significantly different (P=0.05) using an analysis of variance of transformed data. Non-transformed means shown.

Table 3. Williamson county: combine harvested plot samples

Treatment (10 lb./A)	Aflatoxin (ppb)*		*A. flavus* in Kernels, %	
	Mean	Range	Mean	Range
Control	3.9	0-14	3.7	1-6
V6	0	0	4.2	1-9
V8 to V9	6.9	0-26	5.5	1-9
R1	1	0-4	3.7	2-6

*Values are the means of four replicates.

Table 4. Williamson county: 40 hand-harvested ears.

Treatment (10 lb./A)	Aflatoxin (ppb)*		Ear rot %**		*A. flavus* in Kernels, %	
	Mean	Range	Mean	Range	Mean	Range
Control	4.8	0-18	1.3 b	0-5	2	0-3
V6	6.6	0-26	11 a	3-22	12	10-15
V8 to V9	4.3	0.4-15	12 a	5-15	6.7	0-12
R1	5.8	0-14	8.4 a	3-17	5.5	1-10

*Values are the means of four replicates. **Means followed by different letters are significantly different (P=0.05) using an analysis of variance of transformed data. Non-transformed means shown.

Table 5. Victoria county: combine-harvested plot samples.

Treatment (10 lb./A)	Aflatoxin (ppb)*		*A. flavus* in Kernels, %	
	Mean	Range	Mean	Range
Control	3.7	0-11	6.7	2-14
V6 to V8	1	0-3.7	13.2	8-23
VT to R1	0.1	0-0.2	8.2	2-15
R1 to R2	2	0-8	5.5	0-10

*Values are the means of four replicates.

Table 6. Victoria county: 40 hand-harvested ears.

Treatment (10 lb./A)	Aflatoxin (ppb)*		Ear rot, %**		*A. flavus* in Kernels, %	
	Mean	Range	Mean	Range	Mean	Range
Control	0.1	0-0.2	3 b	0-4.9	3.5	1-8
V6 to V8	0.3	0-1	22 a	13-38	12.5	3-21
VT to R1	0.2	0-0.7	3.7 b	0-7.5	6.2	1-9
R1 to R2	2.5	0-9.2	2.4 b	0-4.7	4	2-9

*Values are the means of four replicates. **Means followed by different letters are significantly different (*P*=0.05) using an analysis of variance of transformed data. Non-transformed means shown.

Table 7. Proportion of atoxigenic isolates from hand-harvested ears.

Treatment	Jackson		Williamson		Victoria	
	%	Total # isolates	%	Total # isolates	%	Total # isolates
Control	91.6	24	50	2	100	5
All 3 atoxigenic	96.4	28	93.7	32	91.6	24

Discussion:
At all three locations, the levels of aflatoxin in the controls were below regulatory thresholds and at these locations, application of an atoxigenic strain would have been unnecessary. However, the study showed that at all three locations, the atoxigenic strain did colonize ears, as seen by the higher levels of *Aspergillus flavus* rot at the tips of ears with the earliest application timings V5 to V8. The higher level of colonization with the earliest application could be a function of more time to sporulate and more favorable conditions for sporulation (more rain events or dew periods), or both. The lack of toxigenicity of all the Victoria *A. flavus* isolates and most of the Jackson *A. flavus* isolates from the controls (Table 7) suggests that there was some cross-contamination from plots treated with the atoxigenic strain. Movement of spores from the atoxigenic treatments to the controls need to be monitored in future experiments to ensure correct interpretation of the results. Such movement could underestimate the effectiveness of an atoxigenic treatment.

Acknowledgements:
We appreciate Steve Stuhrenberg and Duane Kainer for providing the corn fields for the experiments and for assistance with harvesting.

2013 Trial of Topguard Formulations for Control of Phymatotrichopsis Root Rot of Cotton

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The objective of this study was to compare different formulations of flutriafol and different methods of application for control of cotton root rot.

Experimental Design and Methods: The experiment was done at the Texas AgriLife Extension (Stiles) Farm**,** Williamson County, TX (N 30º 36.244' W 97º 17.271'). The soil is a Burleson clay (Fine, montmorillonitic thermic Udic Pellusterts). The row spacing was 38 in. and the field was dryland.

The field was planted April 26, 2013 with 'Phytogen 375' at a population of 43,000/A. Seed was planted into moisture at 2.25 in. deep and a soil temperature of 72ºF. There were four replicates per treatment arranged in a complete randomized block design. Each replicate was 4 rows × 60 ft, with 10-ft alleys along rows. The two middle rows of each replicate were treated.

For the in-furrow application, which was made during planting, a Schaffert Rebounder Seed Cover with a Y splitter was used. The fungicide was applied using CO^2 pressurization at 20 psi and a #45 orifice in the line to give an output volume of 11 gpa. The T-band application was made using a Teejet XR8003VS nozzle, spraying a 4-in-wide band, with a pressure of 22 psi and a volume of 7.3 gpa. The over-spray was made on June 4. A Teejet XR80015VS nozzle was used to apply a 4-in band on the center of the row at 30 psi and a volume of 4 gpa.

A Watermark Soil Moisture Sensor (range:0-200 centibars), buried 2 in., was used to monitor soil moisture during the experiment. The soil was saturated, or nearly so, as a result of rain on these dates: May 9-11, May 16, May 24-26, June 2, July 15-17, July 20-22, July 27, and Aug. 14.

Plots were evaluated for disease symptoms on Aug. 7 and Aug. 20. The plots were harvested Sept. 11 with a stripper.

Results and Discussion:
There was no apparent phytotoxicity noted in any of the treatments. The first significant rain was about two weeks after planting, when many, but not all plants had emerged. There were three additional rain showers in May and June, prior to the over-spray. The next rain was 41 days following the over-spray. A low incidence of disease was first noted June 15. Plants were flowering June 29 and there was more root rot symptoms, but plants were also showing water stress.

There was no significant (*P*=0.05) reduction in disease incidence with any of the flutriafol treatments, nor was there an effect on yield (Table 1). The disease pressure was too low to allow any substantial comparison of treatments.

Table 1. Effect of flutriafol formulations (Topguard 1.04 & Topguard Terra 4.17) applied at different rates and with different methods, at different timings, on Phymatotrichopsis root rot (% incidence) and cotton yield [1].

Formulation (lb. a.i./gal), Rate (pt/A), Method, and Timing[2]	% Disease - 103 DAP[2,3]	% Disease - 126 DAP[2,3]	Lint Yield (bales/A)	Seed Yield (lb./A)
None (control)	31	49	1.47	845
1.04, 1, T-band, at planting	19	37	1.40	814
1.04, 2, T-band, at planting	19	36	1.31	758
1.04, 1, in-furrow, at planting	7	11	1.45	820
1.04, 2, in-furrow, at planting	18	40	1.28	762
4.17, 0.25, T-band, at planting	18	38	1.32	775
4.17, 0.5, T-band, at planting	16	29	1.30	710
4.17, 0.25, in-furrow, at planting	20	34	1.20	680
4.17, 0.5, in-furrow, at planting	13	30	1.19	689
1.04, 2,over-spray, 39 DAP	27	47	1.20	725
1.04, 1, over-spray, 39 DAP	23	49	1.27	721
4.17,0.5, over-spray, 39 DAP	25	39	1.15	677
4.17, 0.25,over-spray, 39 DAP	21	35	1.43	833

[1]Mean of four replicates. Treatment means were not significantly different from the control at *P*=0.05
[2]DAP=days after planting.
[3]The analysis of variance was done using the number of disease plants per plot; % disease incidence is shown.

Wheat and Oat Variety Performance in Central Texas

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INTRODUCTION

The Texas A&M AgriLife Extension Service has overseen the wheat and oat variety trial in Williamson County for four consecutive years and is part of the statewide network of uniform variety trials. Local variety trials are important in testing adaptation of new variety releases and comparing them to already established lines used by producers. Data collection for multiple years and multiple sites is critical for appropriate variety selection. Environmental conditions vary each year and certain characteristics may be advantageous under certain conditions, but are not representative of the site on average. New varieties can offer better yield and more disease and insect resistance options for producers as well. Many producers use this information to decide which varieties to plant each season. Variety selection not only influences yield potential, but also other management practices such as grazing, fertility, and insecticide and fungicide applications.

METHODS & MATERIALS

In 2014, this trial included 20 hard red winter wheat (HRWW) and eight oat varieties. Wheat and oats were planted on November 20 and harvested on June 3, 2014. Grain yield, seed moisture, and test weight data were collected and analyzed as a four replicate, randomized complete block design in ARM 9 using ANOVA and LSD for mean separation.

RESULTS

Summarized data for the HRWW and oat varieties are presented in Tables 1 and 2, respectively. Tables include recorded yields in 2011, 2012, 2013, and the 3-year average along with test weights. 2014 data will be summarized and included in time for the presentation. Moderate stripe rust levels in 2014 may have a noticeable impact on variety yield performance. Yield was considerably lower in 2011 due to severe drought conditions that year. TAM 304, Duster, Billings, Gallagher, Shocker, Fannin, Armour, and Ruby Lee were statistically all top yielding varieties in 2013; however, Billings ranks the highest on the 3-year average. The only significant difference in test weights for 2013 was a very low weight recorded for Garrison, which was the lowest yielding variety as well. TAMO 411 is a new oat variety release that has performed well at this location the past two years. Statistically, TAMO 411 along with a new entry Harrison, yielded the same in 2013 as Horizon 201, which was the highest yielding oat over the 3-year average.

DISCUSSION

This information is important in highlighting yield-stability of varieties over years. When developing small grains management practices, selection of multiple varieties is a recommended practice in order to spread out risk due to inherent environmental variability. For more information on variety performance across the state, please visit our website at http://varietytesting.tamu.edu/wheat.

ACKNOWLEDGEMENTS

The authors would like to thank Archie Abrameit and others at the Stiles Farm Foundation for their participation in land preparation and cooperation in making this a successful trial.

Table 1: Hard Red Winter Wheat variety yields for 2011, 2012, 2013 and the 3-year yield average at the Stiles Farm.

Variety†	2013 Yield (bu/a)‡		2012 Yield (bu/a)‡		2011 Yield (bu/a)‡		3-Year Average (bu/a)	2013 Test Weight (lbs/bu)	
Billings	54.5	a	70.7	a	21.8	c-g	49.0	60.0	a
TAM 304	55.1	a	57.5	ab	24.7	bc	45.8	57.7	a
Fannin	51.6	ab	55.5	abc	22.2	c-g	43.1	59.5	a
TAM 203	39.4	c-f	63.7	a	25.9	ab	43.0	57.6	a
Duster	54.9	a	43.8	bcd	24.0	bcd	40.9	60.0	a
Greer	36.6	ef	58.7	ab	24.8	abc	40.0	56.4	a
TAM 401	35.3	efg	61.6	ab	19.8	e-h	38.9	56.2	a
Coronado	20.4	h	53.4	abc	24.5	bc	32.8	60.7	a
Fuller	-		64.1	a	23.1	b-e	-	-	
Gallagher	53.8	a	-		-		-	59.8	a
Shocker	53.0	a	-		-		-	58.9	a
Armour	48.2	abc	-		-		-	57.2	a
Ruby Lee	47.3	abc	-		-		-	59.4	a
Cedar	46.7	a-d	-		-		-	59.2	a
TAM 305	42.9	b-e	-		-		-	60.0	a
WB-4458	37.5	def	-		-		-	58.0	a
Santa Fe	33.3	fg	-		-		-	58.6	a
Doans	32.0	fg	-		-		-	58.7	a
Iba	31.6	fg	-		-		-	56.0	a
Jackpot	26.2	gh	-		-		-	58.7	a
Garrison	10.6	i						43.9	b
LSD (P = .05)	9.3		18.4		3.5		-	9.9	
Std Dev.	6.6		12.8		2.4		-	7.0	
CV	16.2		23.5		11.2		-	12.1	
Grand Mean	40.5		54.7		21.9		-	57.8	

†Ranked according to 3-year average.

‡Letters denote significant differences in yield.

Table 2: Oat variety yields for 2011, 2012, 2013 and the 3-year yield average at the Stiles Farm.

Variety[†]	2013 Yield (bu/a)[‡]		2012 Yield (bu/a)[‡]		2011 Yield (bu/a)[‡]		3-Year Average (bu/a)	2012 Test Weight (lbs/bu)
Horizon 201	56.6	a	84.7	a	37.1	ab	59.5	33.1
Horizon 270	38.8	b	85.6	a	44.7	a	56.4	35.0
RAM 99016	37.5	b	71.8	ab	31.5	bc	46.9	36.0
TAMO 406	41.0	b	58.9	bc	28.6	c	42.8	35.8
TAMO 606	37.2	b	43.3	d	35.6	bc	38.7	31.5
Bob	36.8	b	46.1	cd	28.7	c	37.2	32.9
TAMO 411	50.2	a	85.5	a	-		-	36.6
Harrison	49.8	a	-		-		-	-
LSD (P = .05)	7.4		15.6		8.3		-	1.4
Std Dev.	5.0		11.0		5.5		-	1.0
CV	11.6		22.4		16.1		-	1.9
Grand Mean	43.5		49.1		34.4		-	34.4

[†]Ranked according to 3-year average.

[‡]Letters denote significant differences in yield.

Malt Barley Variety Performance in Central Texas

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INTRODUCTION

At one point in time, barley was grown on nearly 600,000 acres in Texas, but acres have steadily decreased since then to under 20,000 acres by 1999 (final year reported by NASS). As acres decreased in the state, so did active barley research, breeding and new varietal development in Texas. The last variety released by Texas A&M AgriLife was 'TAMbar 501' in 2004. Recent interest by producers and consumers in locally grown ingredients has revealed a need for the continuation of barley research in Texas. Until now, Texas has not been considered a malting barley region, but the development of a local malting facility and interest by in-state breweries for local ingredients provides a possible market for locally grown malting barley. Therefore, variety testing of new barley cultivars under Texas environments is needed to identify adapted varieties.

METHODS & MATERIALS

In 2012, a multi-location malting barley trial was conducted at Castroville, McGregor, and Thrall (Stiles Farm), TX to evaluate commercial malting barley varieties. Both spring and winter 2-row and 6-row varieties were evaluated for yield, test weight, and protein. Both spring and winter barley types were planted simultaneously in November. Due to same planting dates, spring types matured quicker than winter types in the spring and had reached maturity at the time of harvest. Because barley harvest occurred when wheat was harvested, most winter lines were too late and green to harvest. In fall 2013, winter lines were planted October 24 and 25 in Thrall and Reisel, TX, respectively to achieve quicker maturation in the spring. Spring lines were planted December 5 in Thrall and Riesel, while Castroville was planted December 17. In spring 2014, Castroville, Thrall, and Riesel locations were harvested May 20, June 3, and June 4, respectively. 2014 results will be included at time of presentation.

RESULTS

CDC Copeland, CDC Kindersley and Pinnacle were all statistically in the top yielding group at both Thrall and Castroville for spring 2-row barleys (Table 1). Endeavor was an early maturing winter barley that consistently yielded well at both Thrall and McGregor (Table 2). VA09B-34, VA10B-43, and Thoroughbred yielded comparatively well to Endeavor, but were only planted in McGregor. Coefficient of variation was relatively high for winter barleys at both locations and thus results are inconclusive.

At McGregor and Castroville locations, all varieties except Pinnacle had protein levels above optimal levels (10.5-13.0%) for malting. CDC Kindersley, Pinnacle, and Endeavor all had lower than desirable protein content, while Maja was slightly above the 13% threshold at Thrall. Protein content can be controlled to some degree by fertility, which explains consistently high protein levels at McGregor and Castroville, however varietal differences were significant among spring barleys. Out of the spring barleys, Pinnacle contained the lowest protein levels at both McGregor and Castroville, which would allow producers to apply more nitrogen fertilizer to maximize yields. Other varieties may sacrifice yield by lowering fertility in order to maintain acceptable protein levels.

Overall, test weights were low for all 2-row varieties except Conlon at Castroville (48.7 lb/bu). Conlon also had the highest test weight at McGregor (47.3 lb/bu), but did not meet the U.S. malt barley grade for 2-row barley (48.0 lb/bu). All three Virginia experimental lines and Thoroughbred were the only 6-row barleys tested that were harvested and met the U.S. No 3 malting grade (43.0 lb/bu).

Bird-cherry oat aphids were the primary pest observed in barley plots. In addition to physical plant injury from aphid feeding, these insects can vector barley yellow, which can significantly reduce yields, particularly if early fall infestations occur. Early season scouting and control of these pests is advised. Fungal diseases such as barley leaf, stripe, and stem rust were largely absent from trials, but have been known to reach economic thresholds in Texas.

DISCUSSION

For producers seriously considering malting barley, irrigation may be needed to maintain consistent high quality standards required by the malting industry. This project is on-going and additional years of data will shed light on the most consistent barley varieties for this region. Successful malting barley varieties could diversify cropping systems and meet a niche market that could provide economic benefits for producers, malters, and brewers in the state of Texas.

ACKNOWLEDGEMENTS

The authors would like to thank Archie Abrameit and others at the Stiles Farm Foundation for their participation in land preparation and cooperation in making this a successful trial. Funding was provided by Blacklands Malt.

Table 1. Spring (2-row) malt barley variety trial results from Thrall and Castroville, TX in 2013.

	Thrall			Castroville†		
Variety	Yield (bu/a)	Test Wt. (lb/bu)	Protein (%)	Yield (bu/a)	Test Wt. (lb/bu)	Protein (%)
CDC Meredith	62.8	44.6	12.1	16.0	40.9	15.5
CDC Copeland	62.0	45.8	11.3	25.9	44.7	14.0
CDC Kindersley	54.3	45.7	9.9	29.2	44.7	14.5
Pinnacle	51.4	44.8	9.7	21.1	42.9	12.0
AC Metcalfe	49.7	45.6	11.4	17.9	42.6	15.7
Conlon	43.1	47.3	12.3	19.7	48.7	13.4
LSD (P=.01)	18.6	1.9	1.2	9.1	3.9	0.9
CV†	15.3	1.9	7.3	18.7	3.9	4.1
Grand Mean	53.9	45.7	11.1	21.6	44.1	14.2

† Castroville received hail prior to harvest, which resulted in lower yields and possibly skewed results.

Table 2. Winter (6-row) malt barley variety trial results from Thrall and McGregor, TX in 2013.

	Thrall†			McGregor†		
Variety	Yield (bu/a)	Test Wt. (lb/bu)	Protein (%)	Yield (bu/a)	Test Wt. (lb/bu)	Protein (%)
Endeavor*	54.3	46.8	9.4	68.2	46.6	14.4
TAMbar 501	34.6	---	11.4	37.1	---	13.5
Maja	29.0	37.6	13.1	---	---	---
Charles*	27.2	41.4	11.9	27.6	---	---
VA09B-34	---	---	---	72.2	47.5	13.8
VA10B-43	---	---	---	68.9	44.7	15.1
Thoroughbred	---	---	---	68.8	44.7	14.1
VA09B-29	---	---	---	57.8	44.0	14.1
Saturn	---	---	---	48.0	41.7	15.5
LSD (P=.05)	---	---	---	---	---	---
CV	---	---	---	---	---	---
Mean	---	---	---	---	---	---

† Locations were harvested at wheat harvest, which favored early maturing winter barleys. Additional varieties were planted, but were too green for harvest.
* Winter 2-row barley variety.

Optimizing Grain Sorghum Seeding Rates in the Texas Blacklands

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Background

Optimum seeding rates have been investigated and discussed extensively in the High Plains and Gulf Coast of Texas. Yet, many producers in the central and northern Blacklands of Texas are using plant populations above optimum levels. This can exacerbate soil moisture limitations and result in lower yields, stalk rot diseases and lodging. Selection of optimum seeding rates is further complicated by spatial and temporal variability of pre-season soil moisture and in-season precipitation. We initiated a study, using large, replicated strips in collaboration with multiple growers throughout the Texas Blacklands to evaluate grain sorghum seeding rates

The first goal of this project is to optimize and develop decision aids for selecting seeding rates for the central and northern Blacklands of Texas. Variation in depth of topsoil, stored soil moisture and in-season precipitation creates challenges for managing seeding rates for grain crops within the region. Similar challenges exist in other production regions of Texas. While growers recognize grain sorghums ability to withstand heat and drought stress compared to other crops, improper seeding rates often results in poor grain yield due to insufficient soil moisture, disease and lodging issues. Current AgriLife recommendations for grain sorghum seeding rates in the Blacklands are from 70,000 to 80,000 seeds per acre. However, this could be too high for certain soil and weather conditions. Growers are advised to reduce seeding rates when poor soil moisture conditions are present or when below average rainfall is expected during the current growing season. Yet, decisions about seeding rates based on current soil moisture levels and projected weather patterns are largely subjective. By monitoring soil moisture and weather conditions before and during the crop season will provide key information for interpreting the results of plant population trials. Supplemental soil moisture and weather data will be an important component of models used to describe grain sorghum yield response to increasing seeding rates. Using advanced models to develop decision-making tools for growers to select seeding rates will be useful for producers in the Blacklands as well as other regions affected by variability in soil and weather conditions.

Goals and Objectives

1. Measure grain sorghum yield in response to increasing seeding rates and soil moisture conditions in the central and northern Blacklands of Texas.

Methods and Activities

Grain sorghum seeding rate trials were imposed at multiple field sites in collaboration with local growers in five areas of the central and northern Blacklands (Stile's Farm - Thrall, Buckholts, Hillsboro (2), and Farmersville). At each field, treatments were arranged in a randomized complete block design with three replications of five treatments. Treatments comprised five seeding rates (35,284, 51,455, 65,340, 81,675 and 94,090 seeds per acre) at all locations on 30" centers and five seeding rates (35,061, 51,584, 64,480, 80,140 and 93,496 seeds per acre) at Thrall (38" centers). Plots were four rows wide and extended the entire length of row for each selected field (near 1,000 ft). Prior to planting, deep soil samples (12, 24, 36, 48 inch depth) were collected from each block to quantify soil moisture at planting and will be collected again following harvest. Soil moisture sensors and tipping rainfall buckets wree connected to a data logger and installed at each site. Temperature and other meteorological data will be obtained from the nearest weather station. Following planting, plots were maintained according to AgriLife recommendations for the duration of the project. Plots will be harvested, weighed, and then moisture and test weight will be measured.

Results

All five locations were planted beginning March 14 in Thrall and was completed by April 11 (Farmersville). Planting moisture was good at all locations except Buckholts. Plant emergence at Thrall averaged 90% of the target seeding rate (Figure 1). Similar results were observed at other locations. Total and plant available moisture within the soil profile at planting did differ among locations. The Buckholts location had 2.15 inches of plant available water in the 0-12 inch soil depth compared to 2.69 inches at the Farmersville location. Soil profile moisture was generally greater for northern locations compared to southern locations, reflecting rainfall patterns during the winter and early spring. In-season precipitation will be monitored and soil moisture at harvest measured. Harvest is expected to begin late July.

Acknowledgment

This work is supported by the Texas Grain Sorghum Producers Board, Texas A&M AgriLife Research and Texas A&M AgriLife Extension.

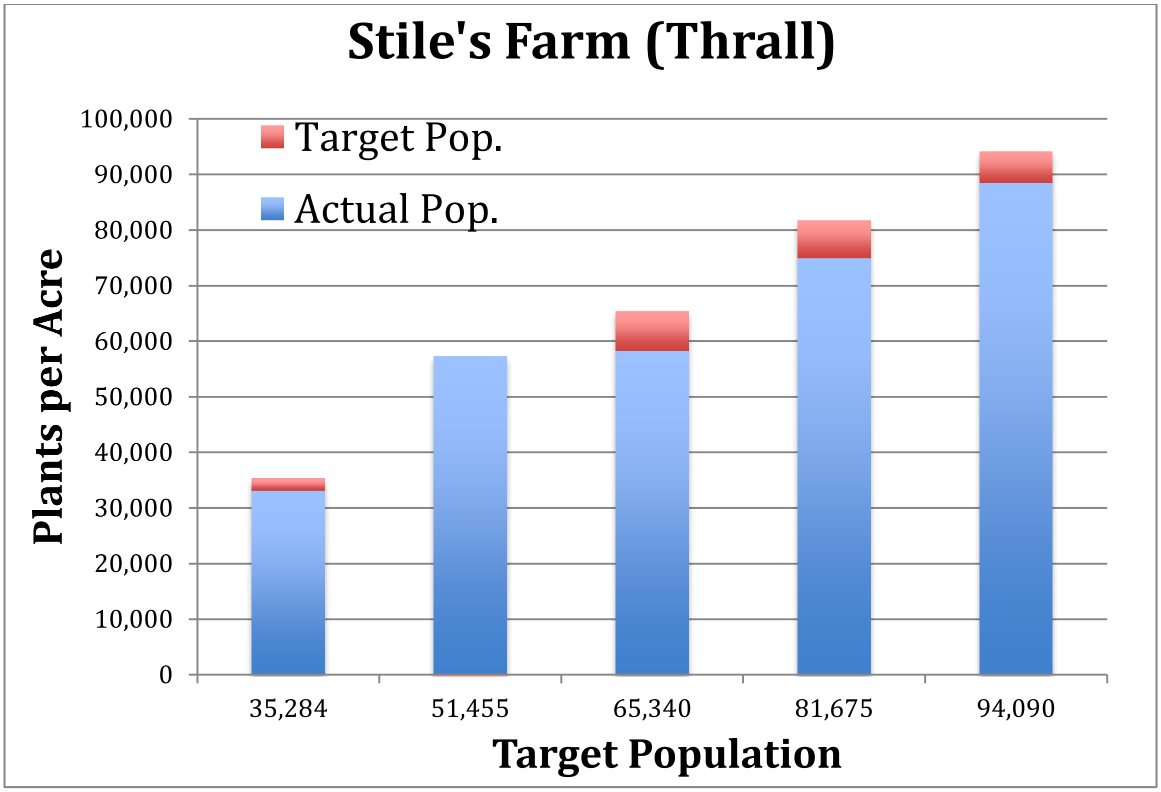

Figure 1. Target seeding rates and resulting plant populations at Stiles Farm near Thrall.

Managing Potassium Fertility for Corn Production

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Introduction

Adequate potassium (K) nutrition is integral to water relations, physiological function of chlorophyll, as well as vegetative and reproductive growth in corn. The second-year studies below were conducted to confirm that current Extension Laboratory recommendations based on soil test results are indicative of crop requirements assuming a representative yield goal and favorable growing conditions. Results showed that the addition of K fertilizer where none was recommended by current Extension guidelines did not improve yield.

Objective

Assess corn response to increasing rate of liquid K subsurface, band applied or granular K surface broadcast applied and shallow incorporated.

Materials & Methods

Two granular K studies were established in fields approximately 0.5 miles apart in Hill County. The liquid K study was located in the southernmost of the two fields. Prior to planting, composite soil samples were collected to a six-inch depth from across each of the three study areas and analyzed by the Texas A&M AgriLife Extension Service Soil, Water & Forage Testing Laboratory. In late December 2012, the producer applied and incorporated 14 lbs./A of nitrogen, 31 lbs./A of phosphate and 6 lbs./A sulfur across both fields. After crop emergence, 106 lbs./A of nitrogen was sidedress applied across all study areas by the grower. The total amounts of nitrogen and phosphorus applied were adequate for corn grain production based on soil test recommendations.

Wheat was the previous crop grown at all thee study locations. All studies were planted to corn variety DKC 64-69 by the producer on February 27 with a row spacing of 30 inches. Experimental design of each study was a randomized complete block. Treated plots were four rows wide by 65 feet long in the liquid K study and four rows wide by 20 feet long in the granular K studies. In all studies, four treatments were replicated four times, for a total of 16 plots.

Treatments in the granular K studies were applied by hand and incorporated on December 14, 2012, whereas, liquid K was subsurface, knife injected at the second leaf stage (March 22). Tillage, herbicide, and other cultural inputs were conducted according to standard practices used by the grower. Corn ears were harvested from ten feet of the middle two rows of plots in all three studies on July 26. Samples were shelled, grain weighed, and grain test weight and moisture determined.

Results and Discussion

Soil samples collected from the 'northern' and 'southern' fields showed residual potassium levels of 239 and 183 ppm, which are greater than the laboratory critical level of 125 ppm. Thus, K fertilizer would not be recommended. Consistent with that recommendation, there were no statistically significant differences between treatments for grain yield, test weight, or grain moisture for any of the three studies (Tables 1-3).

Table 1. Grain yield, test weight, and moisture response of corn to applied rate of liquid potash on the Schronk Farm, Hill County, TX, 2013.

Treatments		Measurements at Final Harvest		
Source	K_2O Rate	Grain Yield†	Test Weight	Moisture
	(lb/A)	(bu/A)	(lb/bu)	(%)
None	0	145§	57.1	12.3
0-0-15	30	144	56.7	12.4
0-0-15	60	149	57.4	12
0-0-15	90	146	56.9	12.4
P>(F)		0.7419	0.0561	0.341
CV		4.31	0.55	2.39

†Grain yield corrected to 15.5% moisture.
§Means within a column were not different according to ANOVA F Test (P≤0.05).

Table 2. Grain yield, test weight, and moisture response of corn to applied rate of granular potash at the southern site, Shronk Farm, Hill County, TX, 2013.

Treatments		Measurements at Final Harvest		
Source‡	K_2O Rate	Grain Yield†	Test Weight	Moisture
	(lb/A)	(bu/A)	(lb/bu)	(%)
None	0	122§	54.4	11.7
0-0-60	30	120	53.9	11.6
0-0-22-11-22	30	115	54.1	11.3
0-0-60	60	127	54.9	11.6
P>(F)		0.5566	0.1352	0.2499
CV		9.36	1.07	2.16

†Grain yield corrected to 15.5% moisture.
‡Broadcast incorporated granular sources to a one-inch depth.
§Means within a column were not different according to ANOVA F Test (P≤0.05).

Table 3. Grain yield, test weight, and moisture response of corn to applied rate of granular potash at the northern site, Shronk Farm, Hill County, TX, 2013.

Treatments		Measurements at Final Harvest		
Source‡	K_2O Rate	Grain Yield†	Test Weight	Moisture
	(lb/A)	(bu/A)	(lb/bu)	(%)
None	0	108§	55.8	11.7
0-0-60	30	120	55.9	11.5
0-0-22-11-22	30	113	56	11.1
0-0-60	60	119	56.2	11.2
P>(F)		0.2784	0.8481	0.0959
CV		8	1.03	2.44

†Grain yield corrected to 15.5% moisture.
‡Broadcast incorporated granular sources to a one-inch depth.
§Means within a column were not different according to ANOVA F Test ($P \leq 0.05$).

These results indicate current K fertilizer recommendations provided by the Extension Soil Testing Laboratory are appropriate for rain-fed corn production. However, due to seasonal variation in climatic/growing conditions and declining amounts of K present within the upper soil profile in some areas, additional studies are needed to assess soil test levels near the current critical level of 125 ppm K.

Acknowledgements

The authors would like to extend their appreciation to Mr. Rodney Schronk for donating land, equipment and time in order that these studies could be conducted. The United Agricultural Cooperative based in El Campo, TX is recognized for their donation of liquid potash fertilizer.

2013 Stiles Farm Corn, Sorghum, and Cotton Herbicide Demonstrations

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As the Extension Weed Science Program has done for most of the past 24 years, demonstrations were conducted in corn, sorghum and cotton to portray the performance of both traditional and new herbicide products. The primary and alarming issue facing Central Texas Blacklands farmers is the onset of glyphosate resistant common waterhemp pigweed (carelessweed). Two factors are in play, one being the shift in some areas of the Blacklands to common waterhemp pigweed that has displaced what was primarly Palmer amaranth pigweed infestations common in most field crops. The second factor is that we have documented and proved common waterhemp resistance to glyphosate herbicide in several areas of southeast and central Texas. This corroborates reports from farmers who have failed to control common waterhemp with glyphosate applications for the past 4-5 years. Armed with these facts, Texas A&M AgriLife Extension has been aggressive in promoting the use of soil-applied herbicides and postemergence herbicides in conjunction with the use of glyphosate. By introducing preplant and preemergence soil applied herbicides with different sites of action than glyphosate, farmers can help themselves prevent the onset of glyphosate resistance or manage it if it has already occurred on their farms. At the same time, they can prevent much of the harmful effects of early-season weed competition with juvenile crops.

In the corn herbicide demonstration (Table 1) several application timings were employed. What is important to note in this demonstration was that all treatments provided 95-100% pigweed control at the end of the season. Some differences in browntop panicum were noted between treatments. In the sorghum herbicide demonstration (Table 2), only one evaluation was performed on pigweed control provided by the new products, Warrant, Huskie, and Cadet. All provided 100% control at the July 18 rating date. In the cotton demonstration (Table 3), several preemergence and postemergence programs were evaluated, with pre applications showing 90-100% control of red sprangletop and 65-100% control of Palmer amaranth pigweed. Early post (EPOST) and later mid post (MPOST) applications varied between treatments.

Please remember to always read product labels as these labels are often updated with important information regarding their use. Some of the herbicides in this report were experimental at the time of this testing. Please consult the authors if you have any questions regarding these studies.

Table 1. Corn Herbicide Demonstration Study

Experiment #:	PB13-03	**Crop:**	Corn
Location:	Stiles Farm	**Crop variety:**	P2088YHR
Experimental design:	Randomized Complete Block	**Sand/Silt/Clay Percent:**	17/38/45
Plot size:	12.67' x 30'	**Planting Date:**	3-27-13
Number of reps:	3	**Fertility:**	Good
Row width:	38"	**pH:**	7.2
Soil type:	Branyon Clay	**% OM:**	1.75

Application Code	**A**	**B**	**C**
Timing	PRE	EPOST	PDIR
Date applied:	3-27-13	4-30-13	5-14-13
Time:	6:15 PM	1:00 PM	10:30 AM
Air Temp. [°F]:	68°F	78°F	78°F
Soil 4" Temp[°F]:	64°F	72°F	72°F
R. Humidity [%]:	34%	56%	46%
Wind [mph]:	S @ 7 mph	S @ 5.5 mph	S @ 8 mph
Cloud Cover:	75%	100%	100%
Dew Presence:	No	No	No
Soil Surface:	Dry	Dry	Dry
Soil Moisture:	Excellent	Good	Good
Sprayer Type:	Backpack CO_2	Backpack CO_2	Backpack CO_2
Nozzle Size/Type:	11003 DG	11003 DG	9504EVS/drop nozzles
Boom Height:	19"	19"	15"
Nozzle Spacing:	19"	19"	15"
GPA/PSI:	15/32	15/38	15/30
Speed [MPH]:	3.0	3.0	3.0

Weed/Crop	**A (Size/Density)**	**B (Size/Density)**	**C (Size/Density)**
Corn (ZEAMX)		V5	V6-V7
Browntop Panicum (PANFA)		2-3"/ 1-3/ft^2	2-5"/ 1-3/ft^2

Corn Herbicide Demonstration

Trt No.	Treatment Name	Form Conc	Form Type	Rate	Rate Unit	Growth Stage	Appl Code	1	2	3	4
Pest Type								W Weed	W Weed	W Weed	W Weed
Pest Code								PANFA	AMAPA	PANFA	AMAPA
Pest Name								Browntop pa>	Palmer amar>	Browntop pa>	Palmer amar>
Rating Date								**4/30/13**	**4/30/13**	**5/14/13**	**5/14/13**
Rating Data Type								Control	Control	Control	Control
Rating Unit								Percent	Percent	Percent	Percent
1	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	EPOST	B	.	.	99.0	100.0
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	EPOST	B				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	EPOST	B				
	Abundit S	4	SL	32	fl oz/a	EPOST	B				
	Ammonium Sulfate (AMS)	100	GR	2	lb/a	EPOST	B				
2	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	EPOST	B	.	.	95.0	100.0
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	EPOST	B				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	EPOST	B				
	Abundit S	4	SL	32	fl oz/a	EPOST	B				
	Atrazine 90 DF	90	WG	16	oz ai/a	EPOST	B				
	AMS	100	GR	2	lb/a	EPOST	B				
3	Cinch ATZ	5.5	SC	0.75	qt/a	PRE	A	65.0	100.0	60.0	90.0
	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	EPOST	B				
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	PDIR	C				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	PDIR	C				
	Crop Oil (COC)	100	EC	1	% v/v	PDIR	C				
	AMS	100	GR	2	lb ai/a	PDIR	C				
4	Cinch ATZ	5.5	SC	0.75	qt/a	PRE	A	65.0	100.0	60.0	100.0
	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	PDIR	C				
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	PDIR	C				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	PDIR	C				
	Abundit S	4	SL	32	fl oz/a	PDIR	C				
	Ammonium Sulfate (AMS)	100	GR	2	lb/a	PDIR	C				
5	Rimsulfuron (Realm Q 4 oz)	25	WG	1.0	oz wt/a	PRE	A	80.0	100.0	75.0	100.0
	Mesotrione (Realm Q 4 oz)	50	WG	4.5	oz wt/a	PRE	A				
	Atrazine	4	SC	1	qt/a	PRE	A				
	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	PDIR	C				
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	PDIR	C				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	PDIR	C				
	Abundit S	4	SL	32	fl oz/a	PDIR	C				
	Ammonium Sulfate (AMS)	100	GR	2	lb/a	PDIR	C				
6	Atrazine	4	SC	1	qt/a	PRE	A	70.0	100.0	95.0	100.0
	Laudis	5.25	SC	3	oz/a	EPOST	B				
	Roundup PowerMax	5.5	SL	32	oz/a	EPOST	B				
	MSO	100	EC	1	% v/v	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
7	Balance FLEXX	4	SC	4	fl oz/a	PRE	A	80.0	100.0	90.0	100.0
	Atrazine	4	SC	1	qt/a	PRE	A				
	Laudis	5.25	SC	3	fl oz/a	EPOST	B				
	Roundup PowerMax	5.5	SL	32	fl oz/a	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
8	Balance FLEXX	4	SC	4	fl oz/a	PRE	A	85.0	100.0	95.0	100.0
	Atrazine	4	SC	1	qt/a	PRE	A				
	Laudis	5.25	SC	3	fl oz/a	EPOST	B				
	Liberty	2.34	SL	22	fl oz/a	EPOST	B				
	AMS	100	GR	3	lb/a	EPOST	B				
9	Zidua	85	WG	3	oz wt/a	PRE	A	82.0	100.0	100.0	100.0
	Armezon	2.8	SC	0.75	fl oz/a	EPOST	B				
	Aatrex	4	SC	1	pt/a	EPOST	B				
	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B				
	MSO	100	EC	1	% v/v	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				

Pest Type							W Weed	W Weed	W Weed	W Weed
Pest Code							PANFA	AMAPA	PANFA	AMAPA
Pest Name							Browntop pa>	Palmer amar>	Browntop pa>	Palmer amar>
Rating Date							**4/30/13**	**4/30/13**	**5/14/13**	**5/14/13**
Rating Data Type							Control	Control	Control	Control
Rating Unit							Percent	Percent	Percent	Percent
Trt No.	Treatment Name	Form Conc	Form Type	Rate	Rate Unit	Growth Stage	Appl Code	1	2	3	4
10	Verdict	5.57	SC	18	fl oz/a	PRE	A	90.0	100.0	100.0	100.0
	Status	56	WG	5	oz wt/a	EPOST	B				
	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B				
	NIS	100	EC	0.25	% v/v	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
11	Untreated							0.0	0.0	0.0	0.0
12	Anthem	2.15	SE	9	fl oz/a	PRE	A	90.0	100.0	95.0	100.0
	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
13	Anthem ATZ	4.5	SE	36	fl oz/a	PRE	A	80.0	100.0	95.0	100.0
	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
14	Atrazine	4	SC	1	qt/a	EPOST	B	.	.	98.0	100.0
	Warrant	3	CS	4	pt/a	EPOST	B				
	Roundup PowerMax	5.5	SL	32	fl oz/a	EPOST	B				
15	Warrant	3	CS	4	pt/a	PRE	A	90.0	100.0	95.0	100.0
	Atrazine	4	SC	1	qt/a	PRE	A				
	Roundup PowerMax	5.5	SL	32	fl oz/a	EPOST	B				
16	Bicep II Magnum	5.5	SC	2.1	qt/a	PRE	A	90.0	100.0	75.0	100.0
17	Lexar	3.7	CS	3.0	qt/a	PRE	A	95.0	100.0	85.0	100.0
18	Bicep II Magnum	5.5	SC	1.3	qt/a	PRE	A	90.0	100.0	98.0	100.0
	Halex GT	4.38	CS	3.6	pt/a	EPOST	B				
	Aatrex	4	SC	1.0	qt/a	EPOST	B				
	NIS	100	EC	0.25	% v/v	EPOST	B				
19	Lexar	3.7	CS	1.5	qt/a	PRE	A	90.0	100.0	98.0	100.0
	Halex GT	4.38	CS	3.6	pt/a	EPOST	B				
	Aatrex	4	SC	1.0	qt/a	EPOST	B				
20	Bicep II Magnum	5.5	SC	2.1	qt/a	PRE	A	90.0	100.0	95.0	100.0
	Touchdown Total	4.17	SL	24	fl oz/a	EPOST	B				
	N-Pak (AMS)	100	SL	1	% v/v	EPOST	B				
21	Lexar	3.7	CS	3.0	qt/a	PRE	A	95.0	100.0	95.0	100.0
	Touchdown Total	4.17	SL	24	fl oz/a	EPOST	B				
	N-Pak (AMS)	100	SL	1	% v/v	EPOST	B				
22	Untreated							0.0	0.0	0.0	0.0
LSD (P=.05)								.	.	.	.
Standard Deviation								.	.	.	.
CV								.	.	.	.
Bartlett's X2								.	.	.	.
P(Bartlett's X2)								.	.	.	.

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Pest Type								W Weed	W Weed	W Weed	W Weed
Pest Code								PANFA	AMAPA	PANFA	AMAPA
Pest Name								Browntop pa>	Palmer amar>	Browntop pa>	Palmer amar>
Rating Date								**5/28/13**	**5/28/13**	**7/18/13**	**7/18/13**
Rating Data Type								Control	Control	Control	Control
Rating Unit								Percent	Percent	Percent	Percent
Trt No.	Treatment Name	Form Conc	Form Type	Rate	Rate Unit	Growth Stage	Appl Code	5	6	7	8
1	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	EPOST	B	90.0	97.0	80.0	95.0
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	EPOST	B				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	EPOST	B				
	Abundit S	4	SL	32	fl oz/a	EPOST	B				
	Ammonium Sulfate (AMS)	100	GR	2	lb/a	EPOST	B				
2	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	EPOST	B	90.0	100.0	80.0	100.0
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	EPOST	B				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	EPOST	B				
	Abundit S	4	SL	32	fl oz/a	EPOST	B				
	Atrazine 90 DF	90	WG	16	oz ai/a	EPOST	B				
	AMS	100	GR	2	lb/a	EPOST	B				
3	Cinch ATZ	5.5	SC	0.75	qt/a	PRE	A	68.0	95.0	65.0	100.0
	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	EPOST	B				
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	PDIR	C				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	PDIR	C				
	Crop Oil (COC)	100	EC	1	% v/v	PDIR	C				
	AMS	100	GR	2	lb ai/a	PDIR	C				
4	Cinch ATZ	5.5	SC	0.75	qt/a	PRE	A	95.0	98.0	85.0	100.0
	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	PDIR	C				
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	PDIR	C				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	PDIR	C				
	Abundit S	4	SL	32	fl oz/a	PDIR	C				
	Ammonium Sulfate (AMS)	100	GR	2	lb/a	PDIR	C				
5	Rimsulfuron (Realm Q 4 oz)	25	WG	1.0	oz wt/a	PRE	A	98.0	99.0	90.0	100.0
	Mesotrione (Realm Q 4 oz)	50	WG	4.5	oz wt/a	PRE	A				
	Atrazine	4	SC	1	qt/a	PRE	A				
	Rimsulfuron (Realm Q 4 oz)	25	WG	1.2	oz wt/a	PDIR	C				
	Isoxadifen-ethyl (Realm Q 4 oz	50	WG	0.30	oz wt/a	PDIR	C				
	Mesotrione (Realm Q 4 oz)	50	WG	2.5	oz wt/a	PDIR	C				
	Abundit S	4	SL	32	fl oz/a	PDIR	C				
	Ammonium Sulfate (AMS)	100	GR	2	lb/a	PDIR	C				
6	Atrazine	4	SC	1	qt/a	PRE	A	95.0	100.0	75.0	100.0
	Laudis	5.25	SC	3	oz/a	EPOST	B				
	Roundup PowerMax	5.5	SL	32	oz/a	EPOST	B				
	MSO	100	EC	1	% v/v	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
7	Balance FLEXX	4	SC	4	fl oz/a	PRE	A	95.0	100.0	90.0	100.0
	Atrazine	4	SC	1	qt/a	PRE	A				
	Laudis	5.25	SC	3	fl oz/a	EPOST	B				
	Roundup PowerMax	5.5	SL	32	fl oz/a	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
8	Balance FLEXX	4	SC	4	fl oz/a	PRE	A	97.0	100.0	92.0	100.0
	Atrazine	4	SC	1	qt/a	PRE	A				
	Laudis	5.25	SC	3	fl oz/a	EPOST	B				
	Liberty	2.34	SL	22	fl oz/a	EPOST	B				
	AMS	100	GR	3	lb/a	EPOST	B				
9	Zidua	85	WG	3	oz wt/a	PRE	A	98.0	100.0	95.0	100.0
	Armezon	2.8	SC	0.75	fl oz/a	EPOST	B				
	Aatrex	4	SC	1	pt/a	EPOST	B				
	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B				
	MSO	100	EC	1	% v/v	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				

10	Verdict	5.57	SC	18	fl oz/a	PRE	A	97.0	100.0	90.0	98.0
	Status	56	WG	5	oz wt/a	EPOST	B				
	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B				
	NIS	100	EC	0.25	% v/v	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
11	Untreated							0.0	0.0	0.0	0.0
12	Anthem	2.15	SE	9	fl oz/a	PRE	A	95.0	100.0	95.0	100.0
	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
13	Anthem ATZ	4.5	SE	36	fl oz/a	PRE	A	97.0	100.0	90.0	100.0
	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B				
	AMS	100	GR	8.5	lb/100 gal	EPOST	B				
14	Atrazine	4	SC	1	qt/a	EPOST	B	95.0	100.0	95.0	100.0
	Warrant	3	CS	4	pt/a	EPOST	B				
	Roundup PowerMax	5.5	SL	32	fl oz/a	EPOST	B				
15	Warrant	3	CS	4	pt/a	PRE	A	97.0	100.0	98.0	100.0
	Atrazine	4	SC	1	qt/a	PRE	A				
	Roundup PowerMax	5.5	SL	32	fl oz/a	EPOST	B				
16	Bicep II Magnum	5.5	SC	2.1	qt/a	PRE	A	82.0	100.0	75.0	100.0
17	Lexar	3.7	CS	3.0	qt/a	PRE	A	80.0	100.0	85.0	100.0
18	Bicep II Magnum	5.5	SC	1.3	qt/a	PRE	A	97.0	100.0	90.0	100.0
	Halex GT	4.38	CS	3.6	pt/a	EPOST	B				
	Aatrex	4	SC	1.0	qt/a	EPOST	B				
	NIS	100	EC	0.25	% v/v	EPOST	B				
19	Lexar	3.7	CS	1.5	qt/a	PRE	A	98.0	100.0	82.0	100.0
	Halex GT	4.38	CS	3.6	pt/a	EPOST	B				
	Aatrex	4	SC	1.0	qt/a	EPOST	B				
20	Bicep II Magnum	5.5	SC	2.1	qt/a	PRE	A	95.0	100.0	85.0	100.0
	Touchdown Total	4.17	SL	24	fl oz/a	EPOST	B				
	N-Pak (AMS)	100	SL	1	% v/v	EPOST	B				
21	Lexar	3.7	CS	3.0	qt/a	PRE	A	97.0	100.0	90.0	100.0
	Touchdown Total	4.17	SL	24	fl oz/a	EPOST	B				
	N-Pak (AMS)	100	SL	1	% v/v	EPOST	B				
22	Untreated							0.0	0.0	0.0	0.0
LSD (P=.05)								.	.	.	.
Standard Deviation								.	.	.	.
CV								.	.	.	.
Bartlett's X2								.	.	.	.
P(Bartlett's X2)								.	.	.	.

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Table 2. Sorghum Herbicide Demonstration

Experiment #:	PB13-05	**Crop:**	Corn
Location:	Stiles	**Crop variety:**	DKS-5367
Experimental design:	Randomized Complete Block	**Sand/Silt/Clay Percent:**	17/38/45
Plot size:	12.67' x 100'	**Planting Date:**	3-27-13
Number of reps:	3	**Fertility:**	Good
Row width:	38"	**pH:**	7.2
Soil type:	Branyon Clay	**% OM:**	1.75

Application Code	**A**	**B**
Timing	PRE	POST
Date applied:	3-27-13	5-24-13
Time:	6:15 PM	3:00 PM
Air Temp. [°F]:	68°F	78°F
Soil 4" Temp[°F]:	64°F	72°F
R. Humidity [%]:	34%	56%
Wind [mph]:	S @ 7 mph	S @ 5.5 mph
Cloud Cover:	75%	100%
Dew Presence:	No	No
Soil Surface:	Dry	Dry
Soil Moisture:	Excellent	Good
Sprayer Type:	Backpack CO_2	Backpack CO_2
Nozzle Size/Type:	11003 DG	11003 DG
Boom Height:	19"	19"
Nozzle Spacing:	19"	19"
GPA/PSI:	15/32	15/38
Speed [MPH]:	3.0	3.0

Weed/Crop	**A (Size/Density)**	**B (Size/Density)**
Palmer Amaranth (AMAPA)		3-5"/ 1/ft^2

Texas A&M AgriLife Extension Service

Sorghum Herbicide Demonstration

Trial ID: PB13-05 Protocol ID: PB13-05
Location: Stiles Farm Study Director:
Investigator: Dr. Paul A. Baumann

Pest Type								W Weed
Pest Code								AMAPA
Pest Name								Palmer amar>
Rating Date								7/18/13
Rating Data Type								Control
Rating Unit								Percent
Trt No.	Treatment Name	Form Conc	Form Type	Rate	Rate Unit	Growth Stage	Appl Code	1
1	Warrant	3	CS	4	pt/a	PRE	A	100.0
	Huskie	2.06	SL	16	fl oz/a	POST	B	
	AMS	21	SG	1	lb/a	POST	B	
2	Atrazine	4	SC	1	qt/a	PRE	A	100.0
	Warrant	3	CS	4	pt/a	POST	B	
	Huskie	2.06	SL	16	fl oz/a	POST	B	
	AMS	21	SG	1	lb/a	POST	B	
3	Dual Magnum	7.62	EC	1	pt/a	PRE	A	100.0
	Cadet	2	EC	0.90	fl oz/a	POST	B	
	NIS	100	EC	0.25	% v/v	POST	B	
4	Dual Magnum	7.62	EC	1.33	pt/a	PRE	A	100.0
	Aim	2	EC	0.50	fl oz/a	POST	B	
	NIS	100	EC	0.25	% v/v	POST	B	
5	Dual Magnum	7.62	EC	1.67	pt/a	PRE	A	100.0
	Huskie	2.06	SL	16	fl oz/a	POST	B	
	AMS	21	SG	1	lb/a	POST	B	
6	Dual Magnum	7.62	EC	1.33	pt/a	PRE	A	100.0
7	Cinch ATZ	5.5	EC	1.6	pt/a	PRE	A	100.0
8	Untreated							0.0
LSD (P=.05)								.
Standard Deviation								.
CV								.
Bartlett's X2								.
P(Bartlett's X2)								.

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

Table 3. Cotton Herbicide Demonstration

Experiment #:	PB13-21	**Crop:**	Cotton
Location:	Stiles Farm	**Crop variety:**	FM1944 GLB2RF
Experimental design:	Randomized Complete Block	**Sand/Silt/Clay Percent:**	17/38/45
Plot size:	12.67’ x 100’	**Planting Date:**	7-31-12
Number of reps:	1	**Fertility:**	Good
Row width:	38”	**pH:**	7.2
Soil type:	Branyon Clay	**% OM:**	1.75

Application Code	**A**	**B**	**C**
Timing	PRE	EPOST	MPOST
Date applied:	4-29-13	5-24-13	6-04-13
Time:	3:00 PM	3:00 PM	4:00 PM
Air Temp. [°F]:	83°F	84°F	93°F
Soil 4” Temp[°F]:	78°F	86°F	85°F
R. Humidity [%]:	46%	54%	38%
Wind [mph]:	SE @ 5 mph	W @ 6 mph	SE @ 3 mph
Cloud Cover:	20%	90%	Clear
Dew Presence:	No	No	No
Soil Surface:	Dry	Dry	Dry
Soil Moisture:	Good	Good	Excellent
Sprayer Type:	CO_2 Backpack	CO_2 Backpack	CO_2 Backpack
Nozzle Size/Type:	11003 DG	11003 DG	11003 DG
Boom Height:	19”	19”	19”
Nozzle Spacing:	19”	19”	19”
GPA/PSI:	15/38	15/38	15/38
Speed [MPH]:	3.0	3.0	3.0

Weed/Crop	**A (Size/Density)**	**B (Size/Density)**	**C (Size/Density)**
Cotton (GOSHI)		4 leaf	4-6 leaf
Palmer Amaranth (AMAPA)		2-3”/ 3-5/ft^2	4-24”(avg 15”)/1-5/ft^2
Red Sprangletop (LEFFI)			4-8”

Texas A&M AgriLife Extension Service

Cotton Herbicide Demonstration

Trial ID: PB13-21 Protocol ID: PB13-21
Location: Stiles Farm Study Director:
Investigator: Dr. Paul A. Baumann

Pest Type							W Weed	W Weed
Pest Code							AMAPA	LEFFI
Pest Name							Palmer amar>	Red sprangl>
Rating Date							7/18/13	7/18/13
Rating Data Type							Control	Control
Rating Unit							Percent	Percent
Trt No.	Treatment Name	Form Conc	Form Type	Rate	Rate Unit	Growth Stage	Appl Code	1	2
1	Caparol	4	SC	1	pt/a	PRE	A	99.0	100.0
2	Dual Magnum	7.62	EC	1	pt/a	PRE	A	100.0	100.0
	Reflex	2	SL	1	pt/a	PRE	A		
3	Caparol	4	SC	1	pt/a	PRE	A	100.0	90.0
	Reflex	2	SL	1	pt/a	PRE	A		
4	Prefix	5.29	EC	2	pt/a	PRE	A	100.0	100.0
5	Staple LX	3.2	LX	1.7	fl oz/a	PRE	A	65.0	90.0
6	Dual Magnum	7.62	EC	1.33	pt/a	PRE	A	96.0	100.0
7	Untreated							0.0	0.0
8	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B	85.0	90.0
	Prowl H2O	3.8	CS	2	pt/a	EPOST	B		
	Roundup PowerMax	5.5	SL	22	fl oz/a	MPOST	C		
9	Liberty	2.34	SL	29	fl oz/a	EPOST	B	75.0	80.0
	Prowl H2O	3.8	CS	2	pt/a	EPOST	B		
10	Roundup PowerMax	5.5	SL	22	fl oz/a	EPOST	B	70.0	0.0
11	Liberty	2.34	SL	29	fl oz/a	EPOST	B	65.0	60.0
12	Traxion	4.17	SL	35	fl oz/a	MPOST	C	75.0	75.0
13	Traxion	4.17	SL	24	fl oz/a	MPOST	C	95.0	85.0
14	Roundup PowerMax	5.5	SL	22	fl oz/a	MPOST	C	100.0	90.0
15	Roundup PowerMax	5.5	SL	32	fl oz/a	MPOST	C	88.0	80.0
16	Untreated							0.0	0.0
LSD (P=.05)								.	.
Standard Deviation								.	.
CV								.	.
Bartlett's X2								.	.
P(Bartlett's X2)								.	.

Means followed by same letter do not significantly differ (P=.05, Duncan's New MRT)

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

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