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TEXAS ALLIANCE FOR WATER CONSERVATION

TEXAS TECH

Davis College

DAVIS COLLEGE OF AGRICULTURAL SCIENCES & NATURAL RESOURCES

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TEXAS WATER DEVELOPMENT BOARD


Cover Photo by Irish Pabuayon
This Photo by Julianna Espindola

TEXAS ALLIANCE FOR WATER CONSERVATION

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In this issue:

The Texas Alliance for Water Conservation strives to conserve water and soil for future generations in collaboration with producers to identify agricultural production practices and technologies that, when integrated across farms and landscapes, will reduce the depletion of ground water while maintaining or improving agricultural production and economic opportunities.

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Texas Produced Water

Article by Samantha Borgstedt
Photos submitted by Texas Pacific Water Resources

Produced water is an issue in Texas. Fresh water is something the state may be short of, but it is generating an abundance of produced water, which is becoming a problem.

The Texas Produced Water Consortium (TXPWC) 2024 report estimates the Permian Basin in Texas is generating produced water at 12 million barrels per day (504 M gal/d, 1,547 Ac-ft/d) with a projection of up to 15 million barrels per day (630 Mgal/d, 1,935 Ac-ft/d) by 2042.

It is important to note that these volumes are estimates since oil and gas producers are not required to report volumes of produced water. The same is true for water used for well completion (hydraulic fracturing) in part because state law exempts oil and gas producers from permitting requirements and from reporting requirements for groundwater use.

However, the TXPWC 2024 report estimates 8.1 million barrels per day (340 Mgal/d, 1,044 Ac-ft/d) current water use for oil and gas exploration and production in the Permian Basin in Texas. Generally, the produced water is collected and stored in storage pits and tanks before being transported by trucks or pipelines to SWDs to be reinjected into zones above or below the oil and gas producing zones.

While most of all produced water is disposed of through re-injection, increasing operational cost, limited disposal capacity, and increased regulation in response to seismic activity associated with these injection wells are pushing oil and gas producers toward alternative approaches.

Irrigated Agriculture within the Permian Basin region accounts for approximately 75% of total water use. Models employed by WestWater predict shortages in the Permian Basin agricultural sector of over 200,000 acre-feet per year (AFY) by the year 2030, and shortages nearing 300,000 AFY by the year 2050. The projected total quantity of water demanded for irrigated agriculture declines by 100,000 AFY between now and 2050, as marginal irrigated acreage is converted to dryland production; however, the long-term shortage could stay closer to 200,000 AFY with technologies that support use of deeper and/or less suitable groundwater resources.

Texas Pacific Water Resources (TPWR) recently conducted studies using cleaned produced water on Alfalfa. It was found that Alfalfa grown with 1000 TDS water was the healthiest, BUT, excess salt & trace metals lead to unhealthy soil conditions in the 1500 TDS samples. Ultimately, it was determined that utilizing treated produced water for crop irrigation is safe, but will likely require supplemental nutrients until further research is done on nutrient availability in the concentrate.

Water quality was analyzed in reference to the Railroad Commission (RRC) Land Application standards, & TCEQ Discharge standards. When blending with RO Concentrate,

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water did not meet specs for various metals present in produced water. While iron, nitrogen, boron, calcium, magnesium and potassium were good for the plants, the other excess metals could be harmful long term. Permitting permits were filed during Phase 1 to continue research outdoors with alfalfa, and to discharge to waters of Texas in Reeves County.

Phase 2 operated under an RRC Land Application Pilot Permit from May - Dec of 2024. Alfalfa was irrigated with 200-300 gallons of water daily. Control was changed to Midland groundwater, a more likely alterative water source. Continued focus was placed on soil health throughout the study as well as more in-depth investigation into water quality.

PHASE 2: FINDINGS - Differences in Biomass

Midland groundwater was better for early growth, but treated produced water allowed more sustained productivity over multiple harvests. Research continues on soil differences, mineral uptake, nutritional comparison, and microbial activity. Alfalfa grown with produced water improved in forage quality throughout the duration of the study, while the groundwater control side declined.

Crops from the control side showed decline in biomass and nutrient content by the end of the study, likely because Midland groundwater was used from the Edwards Trinity that was about 650 TDS and higher in salt than treated produced water. Treated desalinated water was around 250 TDS. It is believed the decline in quality on the control side was caused by increase in SAR and some other minerals but these hypothesis still need to be validated with more data.

While research is moving forward, there are still hurdles that beneficial reuse as a whole will need to work out to guarantee long term success and implementation in the Permian Basin.

Power is a major issue. Most desalination methods require 5-50kwH/BBL meaning large scale power infrastructure or generation will be required. Brine/Solids management is also an issue. Desalination will produce either concentrated brine or solids. For Example, a 10,000BPD site processing 120,000mg/L PW would hypothetically produce:

- ~4200 BBls of 240,000mg/L brine.
- OR 210 tons of solids daily

Management of high-density brine or solids, either by disposal or resource recovery will be required. Operator partnerships and significant capital investment commitments will be necessary to facilitate near-future, large-scale implementation. However, all industries are working together to resolve produced water issues. This will continue to be an interesting and important topic in Texas, and the results could lead to major changes in water availability.

Late Grown Corn Presents a Less Explored Opportunity to Sustain Yields with Reduced Risk Under Water Scarce Environments

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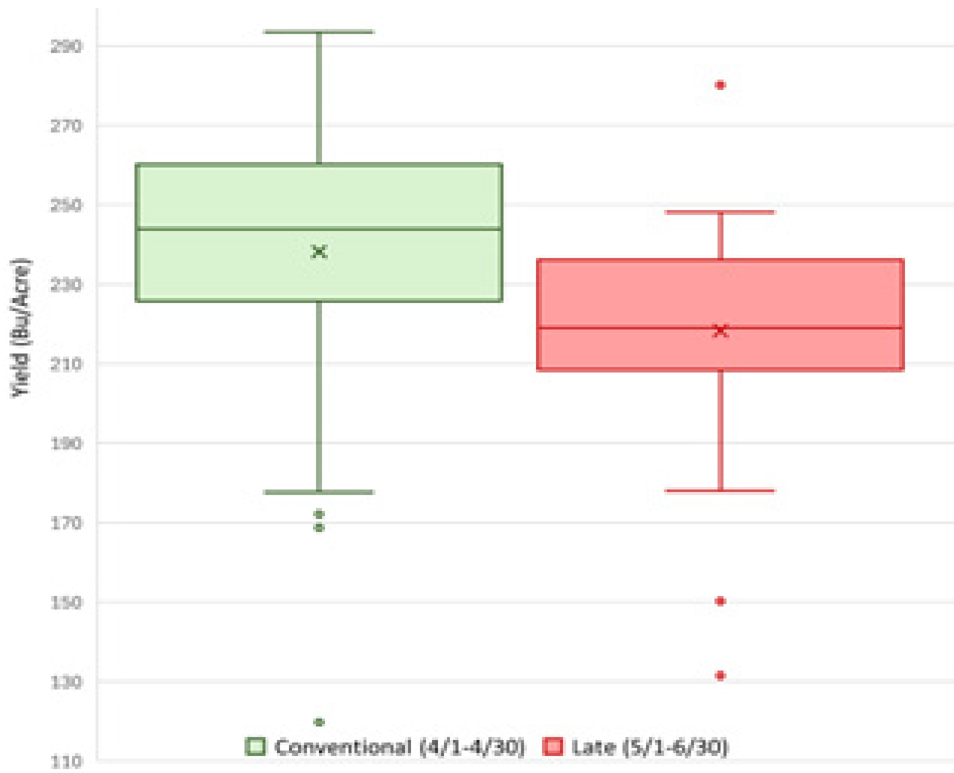

Graph 1: Conventional and Late Planted Corn Boxplot for Various Producer Plots from 2018-2024

Texas corn producers produce on average 285 million bushels of corn annually (Texas Corn Producers) making it the State's second largest commodity crop and a large part of the agricultural economy. Throughout the growing season corn will generally require between 0.15 and 0.20 inches (in) of water per day (Kranz et al., 2008). In water scarce regions, such as the Texas High Plains where most water is sourced from the Ogallala Aquifer this can be hard to accomplish. Some producers in the Texas High Plains have observed corn planted later producing similar yields to a normally planted crop while exhibiting higher water use efficiency (WUE). Using producer provided field data collected from 2018 to 2024 across the Texas High Plains, which included multiple production variables, this paper will investigate how late planted corn production practices compare to conventional planted corn and evaluate the risk associated with this practice. The data was separated between conventional (April planting) and late (May and June planting) planted corn before being analyzed to find the trends. The data provided did not include expenses for all plots. Due to this limitation, plots with expense data were separated into a subset after the initial results were found and analyzed to compare the expenses and profits.

When comparing yields, conventional corn produced more on average, with a wider range of potential yield levels (Graph 1). Comparing the two planting windows, the coefficient of variation for yield (how much the yield is likely to diverge from the average, either low or high) is 14.58% for conventional and 12.38% for late planted corn. Meaning, while similar, the late planted corn is more consistent with its yield numbers when compared to conventional supporting the results from Graph 1 which infers late planted corn is less risky.

Shown in Table 1, conventionally planted corn produced 19.91 bu/ac more than late planted with similar yields per in of irrigation applied with the conventional corn averaging only 0.45 bu/ac-in more than the late planted. Overall conventional corn used 0.83 in more irrigation and had a better total WUE by 0.62 bu/ac-in. Within this dataset conventionally planted corn made $144.75 more per acre than the late planted corn. The average revenue per irrigation was similar in both with conventional being higher by $4.28 per ac-in applied (Table 1).

A standard t-test and a median test were done for both yield and irrigation for the corn planting categorization and showed similar results with irrigation only having statistical significance when using the t-test with a p-value of 0.05 for a 99% confidence interval and yield having statistical significance with a 99.9% confidence interval. For yield the t-test had a p-value of

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7.92E-04 and the median test had a p-value of 1.30E-05, both less than 0.001 indicating a high statistical significance.

For the subset of the data with expense information, the coefficient of variation for yields was found to be 14.19% for conventional and 7.73% for late meaning late planted corn is almost half as risky than conventional. This is further supported in Graph 2 which shows late planted corn yields had a smaller standard deviation than conventional. Shown in Table 2, late planted corn out produced conventional by 1.53 bu/ac using 1.57 in more irrigation than conventional corn and had higher WUE by 0.53 bu/ac-in. Although late planted had a higher expense of $128.08, it also had higher revenue by $167.60 and overall profit by $39.52 per acre compared to conventional. The difference in profitability observed in this subset of the data could largely be due to late planted corn receiving a $0.75/bu higher price since the planting category did not have statistical significance with yield or irrigation.

Based on this analysis, when corn is planted is statistically significant to yields and following a conventional timeframe for planting (between April and May in the Texas High Plains region) is generally better in terms of yield, revenue, and WUE when compared to late (June planting). Conventional planting has a wider spread in potential yield and exhibits more risk than late planted corn shown by having a higher coefficient of variation. When only looking at the subset of producer data containing expense information, late planted corn performed better in terms of yield, revenue, and profit, but did have a higher price, more expenses, and was less water use efficient than conventionally planted corn. In this subset of the data, neither yield nor irrigation were statistically

Table 1: Data Analysis for Various Producer Plots of Corn from 2018-2024	**Conventional** (4/1-4/30)	**Late** (5/1-6/30)	**Difference** (Conventional - Late)
Count	77	43	34
Acres Sum	13,805.50	6,040.00	7,765.50
Yield Analysis (bu/ac)			
Average	238.19	218.29	19.91
Minimum	97.32	131.53	-34.21
Maximum	293.48	280.4	13.08
Standard Deviation	34.72	26.97	7.75
Water Analysis			
Average Irrigation (in)	24.32	23.49	0.83
Average Precipitation (in)	14.24	15.82	-1.58
Average Total Water (in)	38.56	39.31	-0.75
Average Yield per Irrigation (bu/ac-in)	10.42	9.97	0.45
Average Yield per Total Water (bu/ac-in)	6.31	5.63	0.68
Irrigation Water Use Efficiency (bu/ac-in)	9.79	9.29	0.5
Total Water Use Efficiency (bu/ac-in)	6.18	5.55	0.62
Economic Analysis			
Average Price ($)	$5.42	$5.27	$0.15
Average Revenue ($/ac)	$1,290.73	$1,145.98	$144.75
Minimum Revenue ($/ac)	$375.31	$671.17	($295.86)
Maximum Revenue ($/ac)	$2,313.44	$1,850.63	$462.81
Standard Deviation of Revenue ($/ac)	$354.48	$264.49	$89.99
Revenue per Irrigation ($/ac-in)			
Average	$53.06	$48.79	$4.28
Minimum	$28.65	$117.75	($89.10)
Maximum	$37.45	$57.71	($20.25)
Note: Negative number in difference column indicates late planted corn performed better.			

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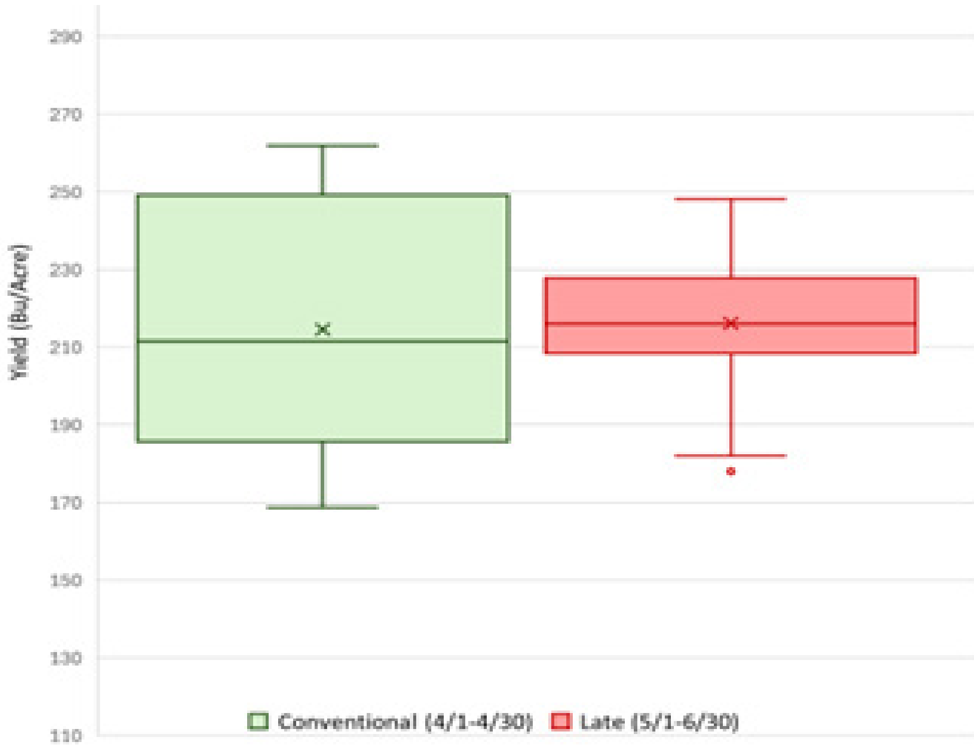

Graph 2: Conventional and Late Planted Corn Boxplot for Various Producer Plots with Expense Information from 2018-2024

significant in their relationship with the planting categorization. Later planted corn was shown to be less risky with a coefficient of variation in yield almost half as large as the conventional planting. In general, conventionally planted corn is better on a widespread basis, but for some plots June planting produces better results. Conventional planting is riskier than late with higher levels of variation in crop yields observed in both datasets, while the risk overall is similar between different planting timeframes. Further research should be done to understand why only some plots keep similar yields to conventional with less risk and higher WUE when planting late before this practice can be recommended for widespread use.

Table 2: Data Analysis for Subset of Various Producer Plots of Corn with Expense Information from 2018-2024	Conventional (4/1-4/30)	Late (5/1-6/30)	Difference (Conventional - Late)
Count	11	24	-13
Acres Sum	1,248.50	2,838.60	-1,590.10
Average Yield (bu/ac)	214.55	216.08	-1.53
Average Irrigation (in)	23.03	24.59	-1.57
Average Yield per Irrigation (bu/ac-in)	9.5	9.05	0.45
Irrigation Water Use Efficiency (bu/ac-in)	9.32	8.79	0.53
Economic Analysis			
Average Price ($)	$4.80	$5.55	($0.75)
Average Revenue ($/ac)	$1,027.42	$1,195.02	($167.60)
Average Expenses ($/ac)	$386.57	$514.66	($128.08)
Average Profit ($/ac)	$640.85	$680.37	($39.52)
Profit per Irrigation ($/ac-in)			
Average[1]	$27.83	$27.66	$0.17
Minimum	$19.86	$17.38	$2.48
Maximum	$29.81	$43.90	($14.09)
Note: Negative number in difference column indicates late planted maize performed better.			

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SEEDS OF RESILIENCE

Doctoral student Alondra Cruz is trying to help struggling ag producers.

Article and Photos by Justin Rex

It's a warm September morning, and Alondra Cruz is gathering her tools: shears, gloves, sun hat, paper bags, clipboard, tissue puncher, Sharpie and an ice chest for samples. She is about to hand-harvest sample plots of sorghum.

Alondra is a doctoral student in Texas Tech University's Department of Plant & Soil Science. She is studying sorghum as a potential alternative forage for cattle. Traditional forages in the cattle industry use more water-intensive crops like corn. The sorghum she is researching, though, requires little – if any – water input, allowing growers to be more judicious with limited resources.

Alondra enrolled in a master's program at Zamorano University in Honduras – where she first encountered sorghum. Specifically, she saw it being used as feed for cattle. To Alondra, who was studying integrated crop and livestock systems, it seemed like an easy way to help her work connect to those who needed it.

"In Honduras, sorghum is very popular among livestock producers," she notes. "So, it made sense to use it in my research since it would make my topic more applicable for producers in the region."

Originally an African grain crop, sorghum is used by ranchers in Honduras because of its hardiness, especially during drier seasons, and its flexibility; it is easily preserved as silage for winter feed. This made the plant ideal for ranchers in areas with minimal water and hard-to-predict weather patterns.

Alondra's master's degree

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required an internship, so she applied through the Texas Coalition for Sustainable Integrated Systems Research Program and the Texas Alliance for Water Conservation. It was her experience with sorghum that piqued the interest of Krishna Jagadish, the Coalition's director as well as a TAWC coordinator and professor in Texas Tech's Davis College of Agricultural Sciences & Natural Resources.

"When I was interviewed by Dr. Jagadish, he was really interested in the fact that I had experience working with sorghum," Alondra recalls. "He had an opportunity to continue working with forage sorghum here at Texas Tech, and that made me really happy because it is a crop I was familiar with."

That internship grew into Alondra's enrollment in a doctoral program at Texas Tech. Now, working with Jagadish, she's researching sorghum for use in the livestock industry as a drought-tolerant forage.

Alondra is trying to understand how nutrient-dense sorghum is and if it is safe for cattle. She acknowledges the current lack of research around sorghum for use in the cattle industry. She sees the potential in it, though, for a variety of ranchers, and she hopes this research is a step toward increasing its use.

"Where I come from, there are the same concerns of producing with limited water and nutrient resources, but the reality of agricultural and livestock production in Central America is very different to that of the U.S.," she says. "There are not many policies and insurances currently in place that can help producers if their crop or livestock production fails. For many producers, their production is not even for selling to others; it's more subsistence agriculture – growing and producing food for themselves, and then, if there is leftover, they might sell to get a small profit. So, this is an even more delicate topic because it potentially means not even having food for themselves."

Thus, at its heart, her research is really about helping feed the world.

"I think at the end of the day, that's why we're studying agriculture," she said. "We're studying this because we need to realize that we need to adapt to our changing climate and the different things that are going on. We're not going to be able to feed the world if we keep producing the same way."

Hub City GARDEN TOUR 2025

SATURDAY, JUNE 21
9 AM – 1 PM

Make plans to attend the Lubbock Master Gardener Association (LMGA) garden tour on Saturday, June 21, 2025.

The Hub City Garden Tour is a self-guided collection of gardens in Lubbock. This year's tour features exciting new additions to the LMGA Demonstration Garden, including a new Greenhouse and the newly established Cermin Memorial Butterfly Garden. In addition, you'll explore stunning residential gardens. They range from newly designed spaces to mature landscapes. These are filled with creative planting and design ideas you can apply in your own backyard.

You'll gain plant and design ideas to steal, and many techniques for conquering the challenges of gardening in West Texas High Plains. Beginner or veteran gardener -- or someone who just loves nature's beauty -- there is something for everyone. It offers inspiration for gardeners of all levels.

Hub City Garden Tour is a great opportunity to share the beauty and peace of area gardens with family and friends.

Tickets can be found https://lmga.ticketspice.com/2025-hub-city-garden-tour

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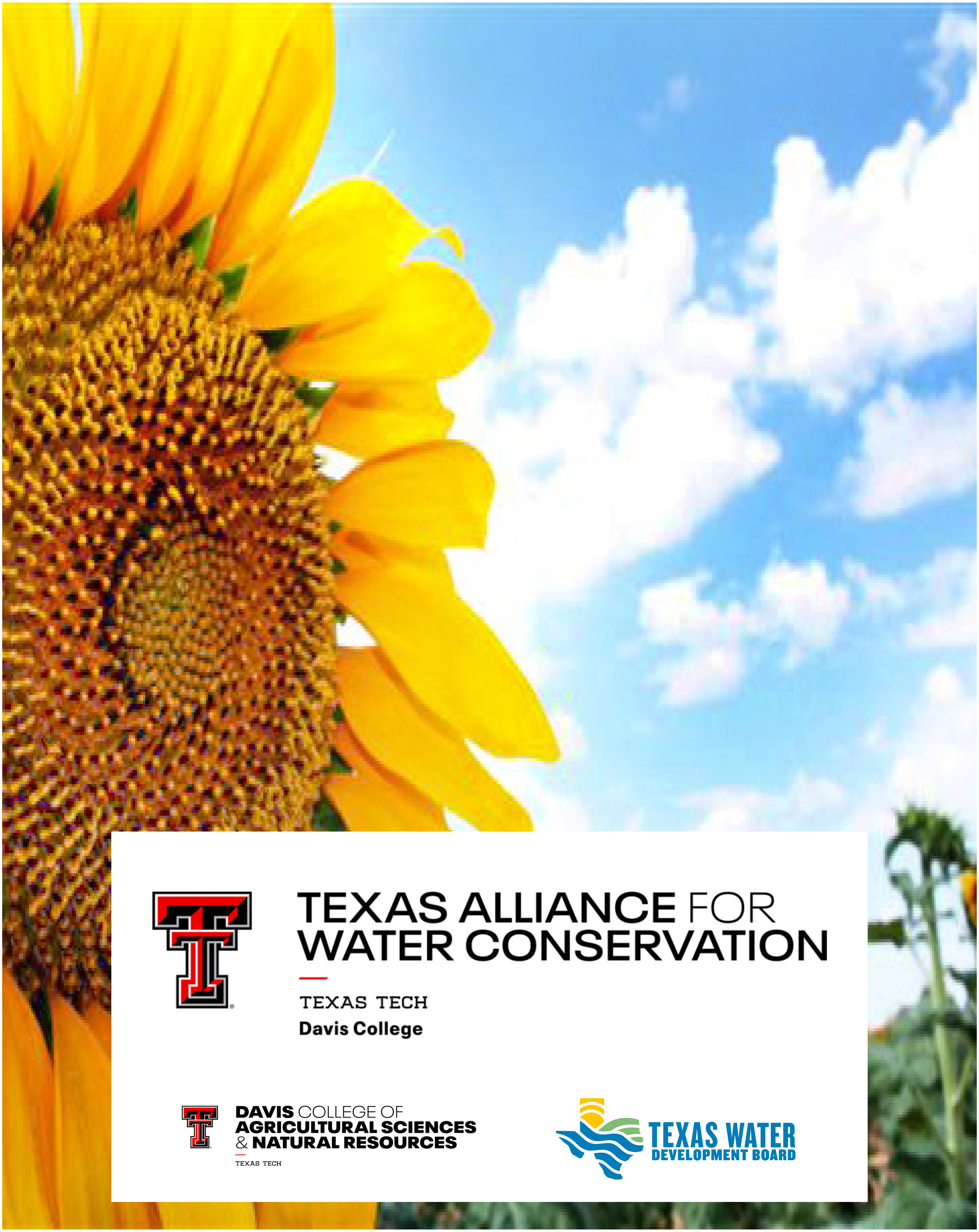

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