

ANNUAL REPORT
September, 2000

PROJECT TITLE: Improving Grain Sorghum Profitability with Ultra-Narrow Row and Conservation Tillage Production Systems.

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PROJECT DESCRIPTION: Corn, grain sorghum, wheat, and cotton are the principle agronomic crops in central and south Texas. Two crop production technologies have shown tremendous potential for increasing yields and reducing production costs in local, state, and national research studies—ultra-narrow row systems (UNR) and conservation tillage (CON-till). Two field studies were established at the Texas A&M Stiles Farm Foundation to examine the application of UNR and CON-till practices on grain sorghum productivity. These studies complement ongoing UNR and CON-till studies on corn and cotton on the Stiles Farm. The project goals are three fold: 1) to demonstrate the application of UNR and Con-till practices on sorghum productivity; 2) to determine if a combined UNR and CON-till practices further enhance crop yield and profitability; and 3) determine the production and profitability risks associated with grain sorghum and corn-based cropping systems.

EXPECTED BENEFITS TO THE GROWER: This project will identify cropping practices and systems that maximize yield and yield stability over years and maximize profit and stability in income over years.

MOST IMPORTANT OUTCOME THIS YEAR: Row spacing and tillage significantly affected crop yield. Reducing row spacing from conventional (38-inches) to UNR (19-inches) had the biggest impact on grain yield- increasing sorghum productivity as much as 20 percent. Switching from CON-till to No-till increased yield another 3 to 4 percent.

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PROJECT TYPE: Regional (Central and South Texas)

OBJECTIVES:

1. Test and compare “conventional” production systems with an improved production package that couples ultra-narrow row and conservation tillage systems.
 - a. Demonstrate the application of UNR and Con-till practices on sorghum productivity.
 - b. Determine if a combined UNR and CON-till practices further enhance crop yield and profitability.
2. Compare productivity and profitability of corn and sorghum based cropping systems.
 - a. Determine the production and profitability risks associated with grain sorghum and corn-based cropping systems.

METHODOLOGY:

Objective 1. Two field experiments were conducted on the Texas A&M Stiles Farm Foundation, Thrall, TX. Production practices examined were row spacing (19, 30 and 38-inches, plant population (50, 75 and 100-thousand plants per acre, hybrid maturity (Gaucho treated Pioneer 84G62: 118 day maturity and Pioneer 87G57: 102 day maturity) and tillage (conventional and no-till). The experiments were planted March 9 on a Burleson clay soil that was previously cropped to cotton. Liquid fertilizer (150 lbs N and 30 lbs P₂O₅) was preplant incorporated in the conventionally tilled fields and was surface applied on the no-tilled cropped areas. Weeds were controlled with a preemerge broadcast application of Bicep (atrazine and metolachlor at 2.0 quarts/acre) immediately after planting. Experiments were planted with John Deere vacuum planters configured on 30 and 38-inch row spacing. A side-shifting 3-point hitch that offset the planter 9.5 inches from center was installed on the 38-inch planter to construct the ultra-narrow (19-inch) rows. The UNR plots were planted in two passes so the tractor wheels could follow the same path minimizing soil compaction.

Experiment I examined the influence of row spacing, plant population, and hybrid maturity on grain sorghum production. The treatments, described above, were arranged in a split-plot, randomized complete block design with 4 replicates. Plots were approximately 15-ft wide by 100 ft in length. Total aboveground dry matter, grain yield, and yield components were collected at grain maturity by hand sampling an area equivalent to 1×10^{-3} acre.

Experiment II was planted adjacent to *Experiment I*. It examined the influence of row spacing (19 and 38-inch), tillage, and plant population on grain sorghum production. Treatments were arranged in a split-plot, randomized complete block design with 4 replicates. Plots were 26 ft. wide by 200 ft in length. Grain yield and yield components were collected at grain maturity by hand sampling an area equivalent to 1×10^{-3} acre.

Objective 2. Productivity and profitability of corn and sorghum-based cropping systems using combination of row spacing, plant populations, variety maturity, tillage practices will be compared using the cropping system simulation model, CroPMan. We will first validate CroPMan with data from the field studies described and with data from companion cotton and corn UNR field investigations underway at the Stiles Farm and with data from conventional field scale tillage/residue management studies also underway at the Stiles Farm Foundation. Once validated, the model will be used to identify the most profitable practices (row spacing, population, and tillage) cropping systems (crop rotation) for major soil types in the northern, central, and southern Blacklands based on historical weather records for each region. Validation and simulation activities will begin at the end of FY01.

RESULTS AND DISCUSSION:

Grain yields were excellent in 2000, averaging 5400 lbs/acre over all treatment combinations. Reducing row spacing and tillage increased yield of grain sorghum (Tables 1 and 2). Reducing row spacing from 38 to 19 inches had the biggest impact on grain yield—increasing yield as much as 20 percent in some cases. Eliminating primary and secondary tillage with no-till production practices increased grain yield three percent. Analyses of data from Experiment 2 comparing row spacing and tillage indicates that the impact of UNR and reduced tillage (no-till) had an additive impact on yield—e.g., grain sorghum yields for the UNR/no-till combination were greater than UNR or no-till alone. Yield of the early hybrid (87G57) was approximately 12 percent lower than the late hybrid (84G62). Overall, grain yields did not increase with plant populations (density) above 50,000 plants per acre, regardless of row spacing, hybrid, or tillage method. In most cases, grain yields were lower when populations exceeded 50,000 plants per acre. In summary, both UNR and no-till production practices increased grain yield of sorghum, but the UNR/no-till production system resulted in the highest grain production. I believe the project is achieving its objectives.

TECHNOLOGY TRANSFER AND EDUCATION ACTIVITY:

1. Technology developed and available for producers.
 - a. CroPMan—Crop Production and Management Simulation Model and Farm Decision Aid Workshop. October 25-26, 2000. Texas A&M Blackland Research Center, Temple TX.
2. Publications:
 - a. The influence of row spacing and plant density on corn productivity. Agron. J. (in preparation).
 - b. The influence of row spacing and plant density on canopy light interception of cotton. Crop Science (in preparation).

3. Presentations:
 - a. Improving sorghum profitability: the Sorghum Profit Program. 37th Annual Stiles Farm Foundation Field Day. 20 June 2000. Thrall, TX
 - b. Improving the crop water supply: A key to increasing dryland cotton yields. National Conservation Tillage Cotton and Rice Conference. 30-31 January, 2001.
 - c. Improving the water supply and productivity of dryland grain sorghum. 22nd Biennial Grain Sorghum Research and Utilization Conference. Feb. 18-21, 2001, Nashville, TN.
4. Student education:
 - a. Jeff Kleypas, Summer Intern. Classification: Senior. Major: Agronomy, Texas Tech University.

Table 1. The influence of hybrid, row spacing and plant density on yield and yield components of grain sorghum grown at the Stiles Farm Foundation in 2000.

Variety	Row spacing	Plant density	Plant height	Tillers	Grain yield	Seed wt.	Harvest index	Bushel test	Seed per plant
	inches	X1000	inches	%	lbs/acre	g/100 seeds	%	lbs/bu	
84G62	19	50	47.2	11.4	5880.5	2.5	45.6	60.4	1781
84G62	19	75	47.2	16.9	6013.5	2.6	44.9	60.1	1597
84G62	19	100	46.4	14.5	5725.3	2.5	44.5	59.8	1487
Mean	19		46.9	14.3	5873.1	2.5	45.0	60.1	1621
84G62	30	50	47.2	11.2	5708.0	2.7	46.1	57.0	1724
84G62	30	75	47.2	11.8	5749.0	2.4	46.0	59.7	1913
84G62	30	100	46.9	13.3	5285.0	2.3	43.9	60.0	1667
Mean	30		47.1	12.1	5580.7	2.5	45.3	58.9	1767.7
84G62	38	50	46.8	17.7	5520.5	2.5	45.2	59.8	1726
84G62	38	75	45.9	18.4	5151.5	2.4	44.4	58.9	1635
84G62	38	100	48.4	16.0	5071.8	2.4	45.9	60.1	1770
Mean	38		47.0	17.4	5247.9	2.4	45.2	59.6	1710.1
87G57	19	50	42.5	13.0	5584.3	2.1	47.7	57.7	1500
87G57	19	75	40.6	21.7	5531.3	2.0	47.8	57.2	1564
87G57	19	100	41.3	11.2	5144.8	1.9	47.0	58.1	1464
Mean	19		41.5	15.3	5420.1	2.0	47.5	57.6	1509.5
87G57	30	50	44.5	7.8	5615.0	2.5	41.3	59.8	1691
87G57	38	50	42.9	8.8	4561.0	2.2	46.6	55.5	1573
87G57	38	75	43.7	12.3	4721.8	2.2	46.8	58.2	1614
87G57	38	100	42.5	17.5	4369.5	2.2	46.2	57.5	1435
Mean	38		43.0	12.9	4550.8	2.2	46.5	57.1	1540.4
		C.V. (%)	3.0	51.5	10.8	8.3	5.6	2.2	13
		Lsd 0.2	0.45	2.50	194.96	0.06	0.86	0.44	73.73

Table 2. The influence of tillage method, row spacing and plant density on yield and yield components of grain sorghum grown at the Stiles Farm Foundation in 2000.

Tillage method	Variety	Row spacing inches	Plant density X1000	Plant height inches	Tillers %	Grain yield lbs/acre	Seed wt. g/100 seeds	Bushel test wt. lbs/bu	Seed per plant
Conventional	84G62	19	50	47.1	15.7	5919.8	2.7	60.0	1865
Conventional	84G62	19	75	44.1	11.7	5229.0	2.5	60.7	1905
Conventional	84G62	19	100	47.8	11.1	5307.9	2.5	60.5	1649
Conventional	84G62	19		46.3	12.8	5485.6	2.6	60.4	1806
Conventional	84G62	38	50	48.9	14.2	5221.2	3.0	61.3	1597
Conventional	84G62	38	75	49.6	12.2	5094.1	2.5	60.9	1935
Conventional	84G62	38	100	47.8	17.7	5622.3	2.6	60.8	1449
Conventional	84G62	38		48.8	14.7	5312.5	2.7	61.0	1660.4
No-Till	84G62	19	50	47.3	12.3	6129.4	2.8	60.0	1998
No-Till	84G62	19	75	49.1	11.8	5920.1	2.4	60.5	1966
No-Till	84G62	19	100	49.1	13.6	5522.8	2.4	60.7	1771
No-Till	84G62	19		48.5	12.5	5857.4	2.5	60.4	1911.6
No-Till	84G62	38	50	48.9	10.8	5061.6	2.8	61.4	1765
No-Till	84G62	38	75	50.3	11.4	5438.5	2.6	60.5	1822
No-Till	84G62	38	100	47.6	15.6	5367.1	2.7	61.4	1707
No-Till	84G62	38		48.9	12.6	5289.1	2.7	61.1	1765.0
			C.V. (%)	1.3	48.9	9.7	11.0	1.8	13
			<i>Between population Lsd 0.2</i>	0.23	2.63	191.11	0.10	0.38	79.19
			<i>Between tillage methods Lsd 0.2</i>	0.18	2.11	152.89	0.08	0.31	63.35