Evaluating Grain Sorghum Nitrogen Fertilization Recommendations

Final Report for Last Year (2003)

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Objective:

(1) To evaluate grain sorghum yield response to nitrogen fertilizer rates at different plant populations.

Current status/ importance of research:

Farmers often have difficulty obtaining an optimum plant population of grain sorghum because of soil crusting, seedling diseases, or insufficient soil moisture at planting. In grain sorghum fields with thin or "skippy" populations, farmers need to know whether nitrogen fertilizer rates should be adjusted up or down from current soil test recommendations. One of the challenges with grain sorghum fertilization is estimating a realistic yield goal for fields with reduced plant populations. Yield goal is the most important variable in the Missouri soil N recommendation equation for grain sorghum. The recommendations for a 5000 lb/acre grain sorghum yield goal is 110 lb N/acre for silt loam and 120 lb N/acre for clay soils. The equation for calculating N recommendations in Missouri is 60+(yield goal in lb)(0.014)-organic matter adjustment. The organic matter adjustment for soils with less than 2.0% is –20 lb N/acre for silt loam soil and –10 lb N/acre for clay loam soil.

Research activities in 2003:

Two experiments were conducted at the University of Missouri- Delta Research Center at Portageville, Missouri. A randomized complete block design with four replications was used in each test. Grain sorghum was planted on 30-inch rows in each test. In the first plant population test, grain sorghum was planted at a high seeding rate (150,000 seeds per acre). After emergence, plots were evenly thinned by hand to low and high populations (35,000 and 105,000 plants per acre). Five early-season N Treatments were applied at rates of 0, 50, 100, 150, and 200 lb N/acre (ammonium nitrate) when grain sorghum was 4 inches tall. In the second test, plots were intentionally thinned unevenly. A factorial with a 3-feet, 6-feet, or 9-feet long skip applied 1, 2, or 3 times per 50 feet of row was used. Three fertilizer rates were applied to each skip treatment at rates of 45, 90, and 135 lb N/acre.

Results in 2003:

Grain sorghum plants demonstrated a strong capacity to compensate for reduced plant populations by producing larger heads (Figure 1). No significant interactions between plant population and nitrogen rates were found in the evenly thinned or skippy stand experiments. Although thinning plants in rows reduced yields, N yield response in high and low population plots were similar on the silt loam soil. Solving quadratic equations for maximum yield showed the highest values on the silt loam were with 119 lb N/acre in the low population plots and 121 lb N /acre on the high population plots (Figure 2). On the clay soil the highest yields for low and high populations were 152 and 165 lb N/acre, respectively. Average yields for nitrogen rates across plant populations are shown in Table 1.

In "real-life" farm conditions, poor stand in grain sorghum fields are due to long plant skips (long spaces between plants) in rows rather than a uniform low plant population. As expected, we found that a few long skips in rows had a more negative effect on grain sorghum yields than more frequent short skips in rows (Table 2). Grain sorghum in plots with 9-feet skips did not respond to greater that 45 lb N/acre. Grain sorghum with 3-feet skips yielded and responded to N almost the same as the check plots with an optimum stand.

Conclusions:
Whether nitrogen fertilizer rates should be adjusted down in fields with low grain sorghum plant population scenarios depends on whether the plants are evenly spaced or not. In our experiments, grain sorghum plants compensated some for yield by producing larger heads. If the grain sorghum plants are evenly spaced in the rows, a nitrogen fertilizer rate for a normal yield goal in the field should be used. Grain sorghum plots with three 9-feet skips per 50 feet of row were not able to completely compensate regardless of the nitrogen rate. In this situation a farmers should either conserve money by applying less N; or, if it is not too late in the season, replant it in grain sorghum or another crop.

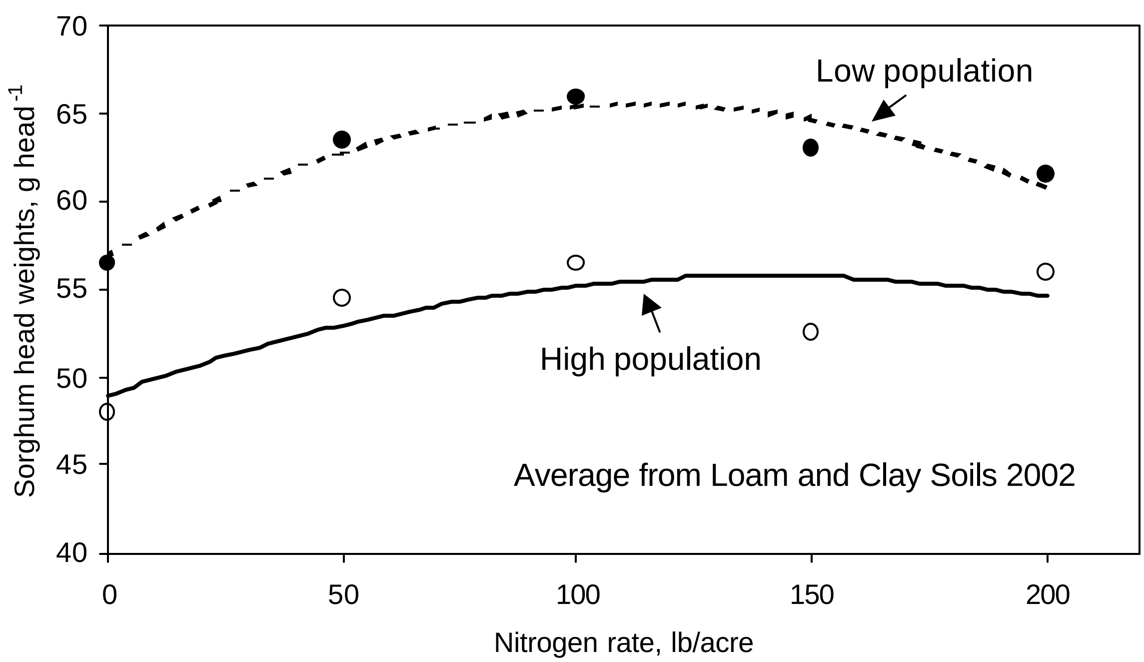

Figure 1. Effect of evenly thinned plant populations and N fertilizer rate on grain sorghum head fresh weight averaged across Tiptonville silt loam and Sharkey clay soils in 2002 at Portageville, Missouri.

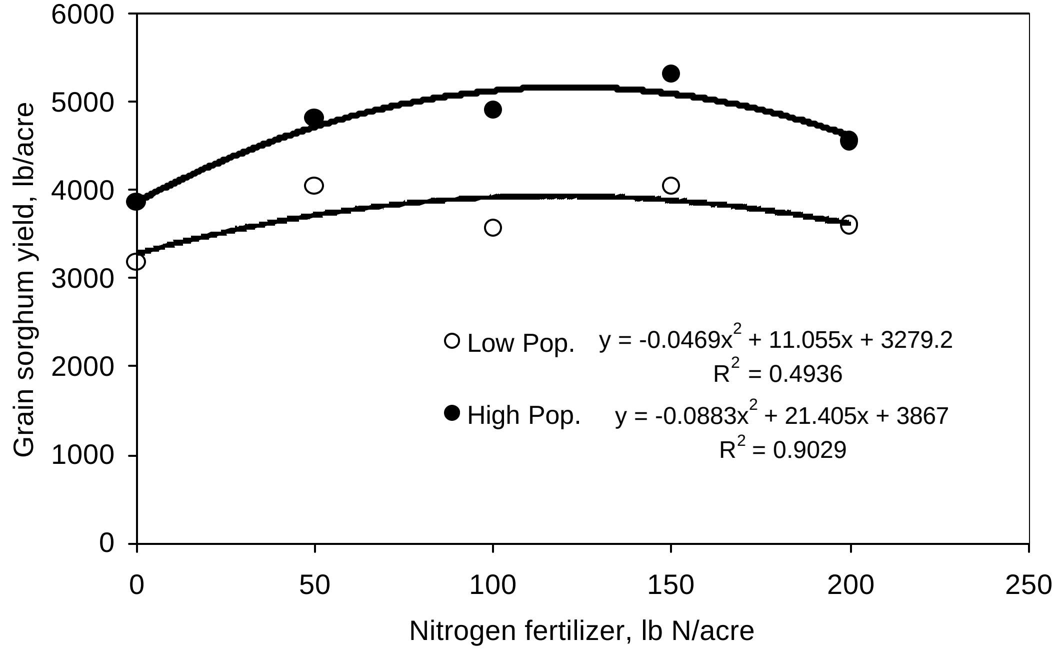

Figure 2. Effect of nitrogen fertilizer rates on low and high plant populations on Tiptonville silt loam soil averaged across 2001-2003.

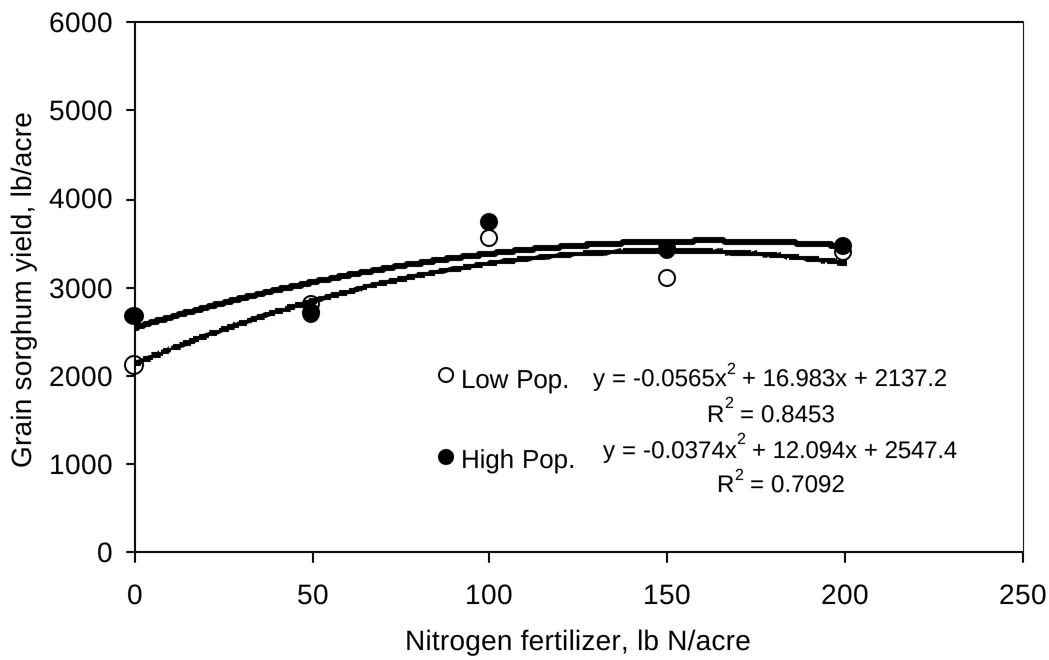

Figure 3. Effect of nitrogen fertilizer rates on low and high plant populations on Sharkey clay soil averaged across 2001-2002.

Table 1. Effect of nitrogen rate on grain sorghum yields averaged across populations on a Sharkey clay and Tiptonville silt loam soil.

Year	Soil	Nitrogen rate	Yield	Letter group †
		lb N/acre	lb/acre	
2001	Sharkey clay	0	2237	B
		50	2089	B
		100	2783	AB
		150	2437	B
		200	2912	A
2002		0	2598	C
		50	3451	BC
		100	4540	A
		150	4129	AB
		200	3988	AB
2001	Tiptonville silt loam	0	3129	BC
		50	3695	B
		100	4203	AB
		150	4787	A
		200	4348	AB
2002		0	3148	B
		50	3824	AB
		100	2830	B
		150	4017	A
		200	3044	B
2003		0	4274	BC
		50	5755	A
		100	5644	A
		150	5207	AB
		200	4828	BC

† Within year and soil type, grain sorghum yields followed by the same letter were not significantly different at the 0.05 probability level.

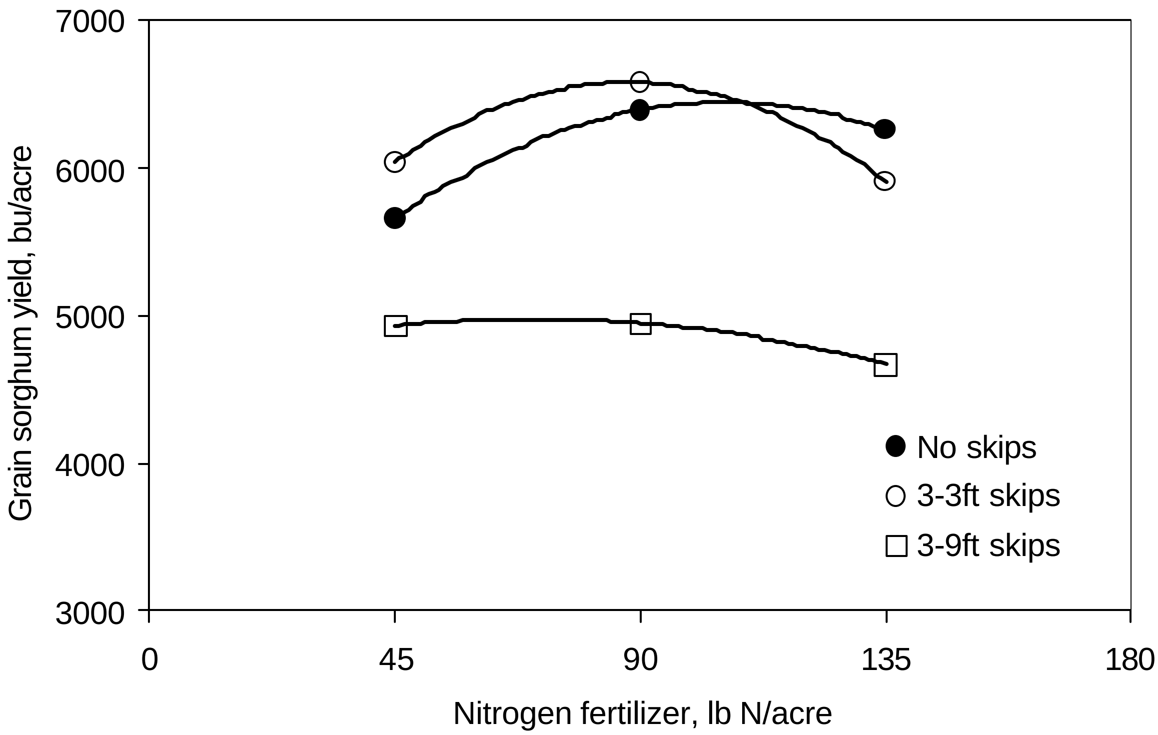

Figure 4. Effect of three 3-feet and 9-feet skips in 50 feet of plot row on grain sorghum yield response to N fertilizer on Tiptonville silt loam soil averaged across 2002 and 2003.

Table 2. Effects of length row skips and total area of skips in grain sorghum averaged across years and nitrogen rates on a Tiptonville silt loam soil in 2002 and 2003.

Row skip length	Total skips	Percentage of total area in skips	Yield	Letter group†
ft	skips/acre	%	lb/acre	
0	0	0	6101	A
3	342	6.5	6011	AB
3	684	13	6192	A
3	1026	19.5	6173	A
6	342	13	6054	AB
6	684	23	5787	ABCD
6	1026	39	5342	CDE
9	342	19.5	5828	ABC
9	684	39	5265	DE
9	1026	58.5	4848	E

† Grain sorghum yields followed by the same letter were not significantly different at the 0.05 probability level.