

Nachurs Grain Sorghum fertility trial in the Texas Rolling Plains-Year 1

Final Report

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MATERIALS AND METHODS

Nachurs grain sorghum fertility trial was conducted at the Texas A&M AgriLife Research & Extension Center at Chillicothe Research Station (34°19' N, 99°52' W, elev. 1480 ft, Hardeman County) on Grandfield fine sandy loam. Soil sample was taken from the study site prior to planting. The 20 samples at the depth of 8" were randomly collected from the field. The composite soil sample was sent to the Word Laboratories at Kearney, NE (Table 1). 'Dekalb 37-07' sorghum [*Sorghum bicolor* (L.) Moench] was planted at the rate of 2 seeds ft⁻¹ into 4 rows with 40 inch spacing on April 21, 2015. The trial was a large plot trial with the length of 700 ft, resulting in 9310 ft² or 0.214 ac plot⁻¹. Seedbed was prepared by rolling cultivator, and grain sorghum was planted with Monosem vacuum planter. During the growing season, 3 inch of supplemental water was applied using in-furrow flood irrigation. In addition to the supplemental water, the research site received 15.8 inch of rainfall during the growing season from April to August. Harvesting was conducted on August 26, 2015 using a CaseIHG 1620 combine with a drive on platform scale. Data collection included stand count, plant height, stalk diameter, chlorophyll measurements, root mass photos, tissue samples at V5-7, and yield data.

The study design was a completely randomized block design with 3 replications. There were 8 treatments including an untreated control (or a grower standard). List of treatment is summarized in the Table 2. All plots were fertilized at 75 lb ac⁻¹ of N and 40 lb ac⁻¹ of P according to the soil test results with the yield goal of 100 bu ac⁻¹.

Statistical analyses were conducted by analysis of variance (ANOVA) using the mixed procedure of SAS (SAS 9.3 Institute, 2013) to determine the influence of main effect and interaction with date (DAP) on stand count, plant height, chlorophyll measurement, stalk diameter, tissue nutrient concentrations, test weight, moisture, and grain yield. Treatment was considered fixed effect, while the replication was considered random effect. Mean separation was conducted by lsmeans where differences were significant at $P < 0.1$.

RESULTS

Stand count, height, stalk diameter, and chlorophyll

Stand count was influenced by the treatment ($P<0.01$) and DAP ($P<0.05$). The stand count was reduced by 28% with EXP9PBWO during the first 42 days after planting as compared to the other treatments (Figure 1). Chlorophyll concentration was influenced by the treatment ($P<0.01$), while no treatment effect was observed on the height and stalk diameter (Table 3). Mean chlorophyll concentration was high (16.2 cci) on the treatments EXP9PBWO and RhyzoSZn (Rhyzo-Link 9-15-3-1S-.25Zn) (Figure 4). The lowest mean chlorophyll concentration (11.3 cci) was found from on the EXP10WOK and control.

Tissue nutrient concentration

Treatment significantly influenced plant tissue concentration of P, S, Mg, B, and Mo at V5-7 (Table 4). The tissue P concentration was increased with EXP9WOK (4.9 %), RhyzoSZn (4.7 %), Nachurs (4.5 %), and RhyzoFin (4.7 %) as compared to the untreated control (3.9 %) (Table 5). The tissue S and B concentrations were negatively influenced by EXP9PBWO (B: 91 ppm), EXP9WOK (S: 0.37 %, B: 91.3 ppm) and RhyzoSZn (S: 0.36 %, B: 92 ppm) as compared to the untreated control (S: 0.43 %, B: 104 ppm) (Table 5). Tissue concentration of Mg and Mo were higher with the control as compared to other treatments. Treatment had no significant influence on the rest of macro- and micro-nutrients.

Grain moisture, test weight, and grain yield

Treatment effect was observed in the grain moisture ($P<0.05$), while no treatment effect was observed on the test weight and grain yield at $P>0.1$ (or not significant) (Table 4). Grain moisture was increased with Nachurs (16.0) and EXP10WOK (16.1) as compared to the untreated control (15.0). Mean test weight was 60.5, while the mean grain yield was 4494 lb/ac (Table 6).

Orthogonal contrasts in the Table 6 showed that there were no synergistic effects of BioK and PGPR on the Rhyzo-Link 9-15-3 based on the various comparisons among treatment 1, 2, and 3 (contrasts 1 vs 2, 1 and 3 vs 2, 1 vs 3, and 2 vs 3) (Table 6). Influence of Rhyzo-Link 9-15-31S-.25Zn on the yield was same regardless of with or without 2 gallons K13 based on the contrast 4 vs 7. The grain yield with Nachurs 10-18-4 was significantly higher ($P<0.08$) than Nachurs 10-18-4 without Bio-K based on the contrast 5 vs 6. Grain yield was higher under control (trt 8) as compared to the all Rhyzo-Link treatments (trt 1, 2, 3, 4, and 7) by 30 lb ac⁻¹ at $P<0.03$. Grain yield with Nachurs 10-18-4 treatments (Trt 5 and 6 combined) was 160 lb ac⁻¹ greater as compared to the control (trt 8) at $P<0.09$.

CONCLUSION

Although no treatment effects were observed on the grain yield, EXP9PBWO negatively influenced the stand count, which is a critical factor on the stand establishment. Grain yield was numerically higher ($P>0.1$ or not significant) with the RhyzoSZn (Rhyzo-Link 9-15-3-1S-.25Zn) and Nachurs (Nachurs 10-18-4) as compared to the other treatments. Bio-K included in the Nachurs may have enhanced the grain yield as the grain yield was lower in EXP10WOK (Nachurs 10-18-4 without Bio-K). As a conclusion, RhyzoSZn (Rhyzo-Link 9-15-3-1S-.25Zn) and Nachurs (Nachurs 10-18-4) showed slightly better performance among all treatments; however, the study needs to be repeated to verify the result.



Photos of sorghum at DAP 42 (June 1, 2015) for RhyzoSZn (Left), Nachurs (center), and control (right).

DAP 28 root mass photos are found [HERE](#).

DAP 42 photos are found [HERE](#).

Miscellaneous photos are found [HERE](#)

TABLES AND FIGURES

Table 1. Soil test results

Parameters	Values
Soil pH	8.1
Organic Matter	1.3 %
N	6.5 ppm
P	10.0 ppm
K	197 ppm
Ca	3504 ppm
Mg	272 ppm
Na	115 ppm
S	7.0 ppm
Zn	0.27 ppm
Fe	10.0 ppm
Mn	3.8 ppm
Cu	0.53 ppm
Sum of Cations	20.8 ppm

Table 2. Treatment list

Treatments (Abbreviation)	Rates	In-furrow	V5-V8	Boot
1. EXP9WO	5 gal/ac	5 gallons	-	-
2. EXP9PBWO	5 gal/ac	5 gallons	-	-
3. EXP9WOK	5 gal/ac	5 gallons	-	-
4. Rhyzo-Link 9-15-3-1S-.25Zn (RhyzoSZn)	5 gal/ac	5 gallons	-	-
5. Nachurs 10-18-4 (Nachurs)	5 gal/ac	5 gallons	-	-
6. EXP10WOK	5 gal/ac	5 gallons	-	-
7. Rhyzo-Link 9-15-3-1S-.25Zn + Finish Line + K13(RhyzoFin)	5 gal/ac	5 gallons Rhyzo-Link 9-15-3-1S-.25Zn	1qt Finish Line*	2 gallons K13
8. Grower standard (Control)	-	-	-	-

*Finish Line was not applied due to the weather condition

Plot map

	Rep1								Rep2								Rep3							
Plot ID	101	102	103	104	105	106	107	108	201	202	203	204	205	206	207	208	301	302	303	304	305	306	307	308
trt ID	3	5	1	8	6	2	4	7	1	3	7	5	8	6	4	2	1	5	4	3	6	2	8	7

Table 3. Analysis of variance for treatment (trt), Days after planting (DAP), and the interaction of trt and DAP

	DAP 14, 28, and 42	DAP 14 and 42	DAP42 and 86	DAP42 and 86
	Count	Height	Diameter	Chl
trt	**†	ns	ns	**
DAP	*	****	****	****
trt × DAP	ns	ns	ns	ns

†*, **, ***, and **** are significant at $P < 0.05$, 0.01, 0.001, and 0.0001, respectively.
ns, not significant.

Table 4. Analysis of variance for the treatment on plant tissue sample at V5-7 stage and yield data

% N	% P	% K	% S	% Ca	% Mg
ns	*	ns	*	ns	+
ppm Zn	ppm Fe	ppm Mn	ppm Cu	ppm B	ppm Mo
ns	ns	ns	ns	**	+
moisture	test weight	Yield (lb/ac)			
*	ns	ns			

†+, *, and ** are significant at $P < 0.1$, 0.05 and 0.01, respectively.
ns, not significant.

Table 5. Nutrient concentration under five fertility treatments on grain sorghum at V5-7 growth stage

	N	P	K	S	Ca	Mg	Zn	Fe	Mn	Cu	B	Mo
	-----%						-----ppm-----					
1. EXP9WO	24.8	4.5ab [†]	4.0	0.39abc	4.49	0.23ab	0.50	0.31	24.3	169	97.0bcd	11.7ab
2. EXP9PBWO	18.8	4.5ab	4.0	0.42a	4.64	0.24a	0.51	0.34	19.7	180	90.7d	11.1b
3. EXP9WOK	26.8	4.9a	3.9	0.37bc	4.34	0.22b	0.48	0.30	19.0	153	91.3d	11.0b
4. RhyzoSZn	26.0	4.7a	3.8	0.36c	4.53	0.22b	0.51	0.34	43.7	161	92.0cd	10.7b
5. Nachurs	23.8	4.5a	4.1	0.41abc	4.46	0.23ab	0.50	0.36	17.3	172	101.7abc	12.2a
6. EXP10WOK	25.2	3.9b	4.3	0.41ab	4.47	0.23ab	0.48	0.36	16.7	201	110.7a	12.5a
7. RhyzoFin	25.0	4.6a	4.0	0.40abc	4.45	0.23ab	0.50	0.31	20.0	174	94.0bcd	11.6ab
8. Control	27.7	3.9b	4.0	0.43a	4.56	0.24a	0.52	0.35	18.7	169	103.7ab	11.7ab
Mean	24.8	4.4	4.0	0.40	4.49	0.23	0.50	0.33	22.4	172.5	97.6	11.6

[†]Values followed by the same letter within a nutrient are not significantly different at $P<0.05$.

Table 6. Moisture, test weight, and grain yield of grain sorghum under five fertility treatments

	Moisture	Test weight	Grain yield (lb/ac)
1. EXP9WO	15.1b [†]	60.5	4330
2. EXP9PBWO	15.0b	60.7	4299
3. EXP9WOK	14.7b	60.5	4252
4. RhyzoSZn	15.3ab	60.5	4876
5. Nachurs	16.0a	60.1	4720
6. EXP10WOK	16.1a	60.3	4548
7. RhyzoFin	14.7b	60.5	4455
8. Control	15.0b	60.8	4470
Mean	15.2	60.5	4494
Contrasts			
	1 vs 2		ns
	1, 3 vs 2		ns
	1 vs 3		ns
	2 vs 3		ns
	4 vs 7		ns
	5 vs 6		+
	1, 2, 3, 4, 7 vs 8		*
	5, 6 vs 8		+

[†]Values followed by the same letter within a nutrient are not significantly different at $P < 0.1$.
+ and * are significant at $P < 0.1$ and 0.05 , respectively.
ns, not significant.

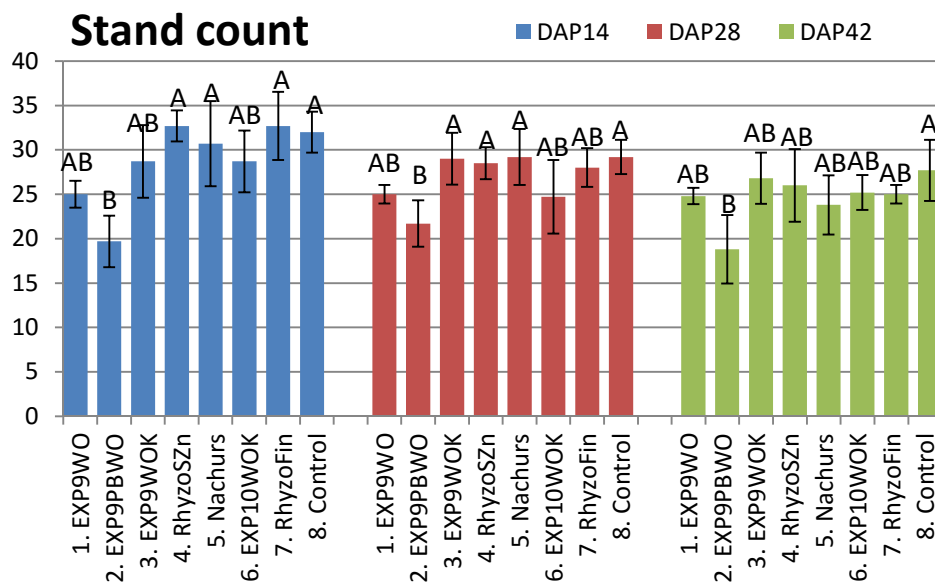


Figure 1. Treatment effects on the stand count on DAP 14, 28, and 42. Column within a DAP followed by the same letter are not significantly different at $P < 0.1$. Bars represent standard errors.

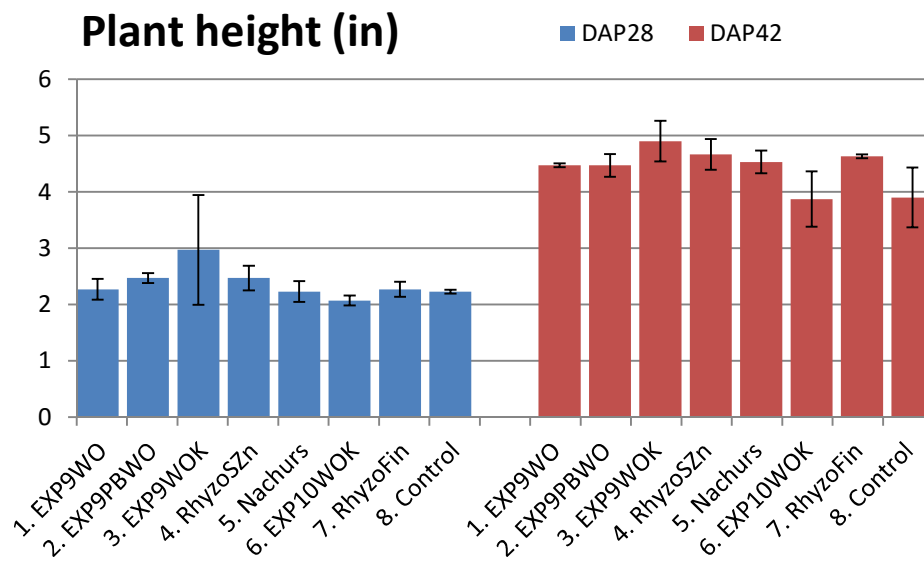


Figure 2. Treatment effects on the plant height on DAP 28 and 42. Bars represent standard errors. No statistical differences were observed.

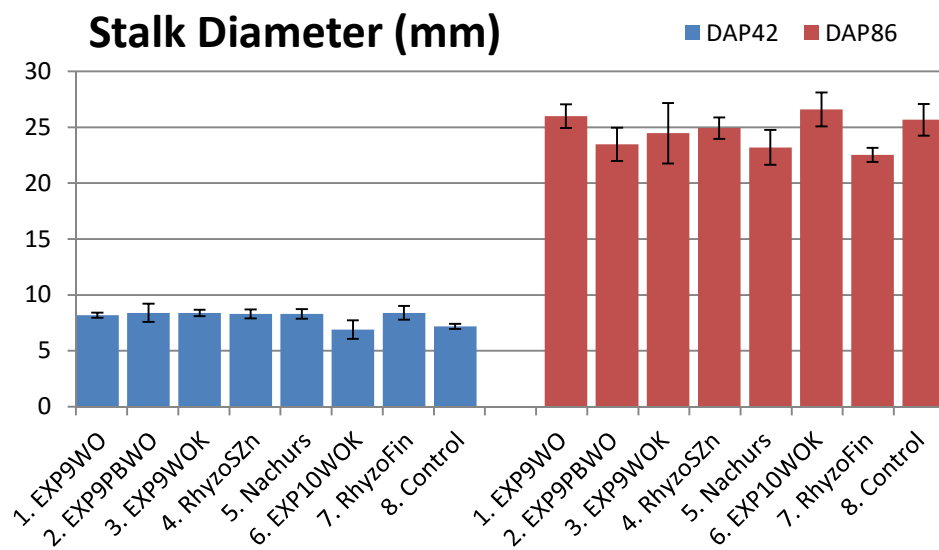


Figure 3. Treatment effects on the stalk diameter on DAP 42 and 86. Bars represent standard errors. No statistical differences were observed.

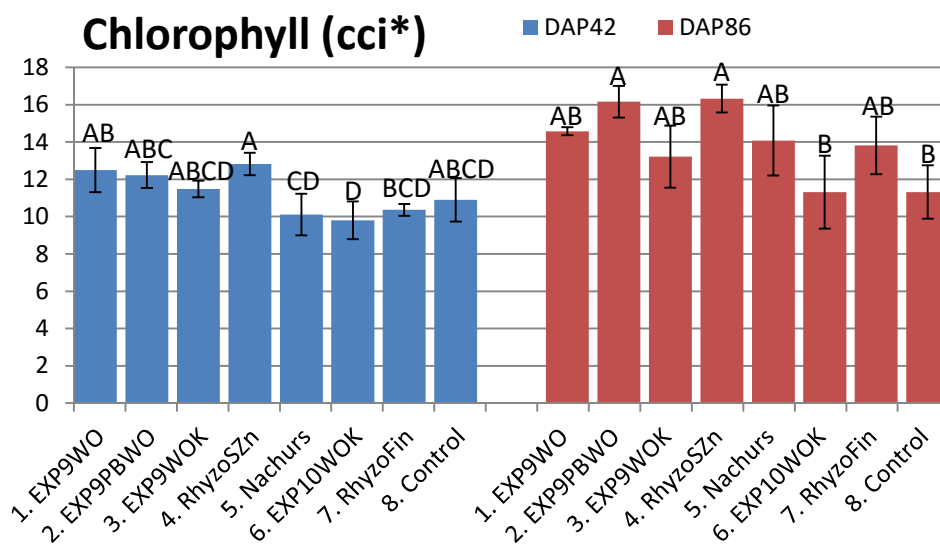


Figure 4. Treatment effects on the chlorophyll measurement on DAP 42 and 86. Bars represent standard errors. Column within a DAP followed by the same letter are not significantly different at $P < 0.1$. *Chlorophyll Content Index unit