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Grain Sorghum Response to Band Applied Zinc Fertilizer

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Grain Sorghum Response to Band Applied Zinc Fertilizer

Abstract
Zinc (Zn) is one of the micronutrients found to be deficient in Kansas. The objective of this study was to evaluate the response of grain sorghum to Zn fertilization using strip trials. The experiment was set up in Manhattan, KS, in 2015. The experimental design consisted of two strips, one with Zn fertilizer and the other without, with five replications. Zn fertilizer was applied as starter in combination with ammonium polyphosphate at the rate of 0.5 lb Zn/a. Plant tissue samples were collected to determine Zn content. Grain yield was recorded by combine equipped with yield monitor. No significant differences were found for sorghum grain yield. Grain Zn content increased with Zn fertilization. Zn fertilization may be considered for future studies in food biofortification.

Keywords
grain sorghum, zinc, strip trial, yield

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Summary

Zinc (Zn) is one of the micronutrients found to be deficient in Kansas. The objective of this study was to evaluate the response of grain sorghum to Zn fertilization using strip trials. The experiment was set up in Manhattan, KS, in 2015. The experimental design consisted of two strips, one with Zn fertilizer and the other without, with five replications. Zn fertilizer was applied as starter in combination with ammonium polyphosphate at the rate of 0.5 lb Zn/a. Plant tissue samples were collected to determine Zn content. Grain yield was recorded by combine equipped with yield monitor. No significant differences were found for sorghum grain yield. Grain Zn content increased with Zn fertilization. Zn fertilization may be considered for future studies in food biofortification.

Introduction

Kansas consistently produces more grain sorghum than any other state in the U.S., representing approximately 46% of the country's total production with an average yield of 74 bu/a (USDA, 2014). Fertility issues can be a limiting factor for high yields. Producers question the effectiveness of micronutrient fertilization and the ability to impact significant grain yields. Zinc (Zn) is one of the micronutrients found to be deficient in Kansas. Involved in the chlorophyll synthesis, Zn is also essential for the synthesis of proteins needed for the production of auxins, a growth hormone (Havlin, 2014). Zn availability to plants is affected mainly by its total content in the soil, soil pH and organic matter (Hawkesford and Barraclough, 2011). According to the Kansas Fertilizer Recommendation, the critical soil level for Zn is 1 ppm; anything below this value is likely to have a response to Zn fertilizer (Leikam, 2003). Band applications of 0.5 to 1 lb/a would correct crop deficiency for the season but the soil deficiency will likely remain. Although sorghum is an important crop in Kansas, there is very little data on sorghum response to Zn fertilizer. The objective of this study was to evaluate the response of grain sorghum to starter zinc fertilization using strip trials at a farm level.

Procedures

A strip trial study was established in the Agronomy North Farm in Manhattan, KS. Grain sorghum (DKS53-67) was planted on June 22, 2015 at 70,000 seeds/a. Strips were 15 ft wide (6 rows planted at 30 in spacing) and 1,070 ft length on average. The experimental design consisted of two strips, no Zn fertilization and with Zn fertilizer, replicated five times. Fertilizer was applied as starter 2 × 2 (2 in below and 2 in to the side of the seed) at 27.4 lb/a of P_2O_5 as ammonium polyphosphate (10-34-0) and 0.5

lb/a of Source Zinc 10 (microSource, East Peoria, IL), a citric acid chelated zinc solution. Nitrogen application was side-dressed at 94 lb/a of N as urea ammonium nitrate (28-0-0). All strips received the same rate of N and P. Thirty above-ground plant samples were collected at V6 stage (six leaf collar), oven dried at 65° C and analyzed for Zn content. Yields were recorded by the combine's yield monitor using AgLeader Technology. Two sections of each strip were selected to analyze using SMS software. Sections were selected based on a straight pass of the combine, one in the west side of the field and another in the east. Statistical analyses were conducted with a paired t-test to determine if there was a difference between yield of strips that received Zn and strips without Zn fertilization.

Results

Zinc fertilization response was expected since the soil test results showed levels of Zn below the critical level in the field (Table 1). However, Zn tissue concentration analyses were 46 ppm on average which is within the sufficiency range for grain sorghum (15-70 ppm) (Walsh and Beaton, 1977). No significant differences were found among treatments in grain sorghum yields (Table 2). This suggests that the current soil test, Zn critical level of 1 ppm, may be too high for sorghum. These results also agree with Gordon and Pierzynski, (1997) and B. G. Hopkins et al., (1992), who didn't find any difference in yields when Zn was applied in studies in Kansas. Zn grain concentration increased 3 ppm when Zn fertilizer was added, statistically higher than strips without Zn (Table 2). The results show that Zn fertilizer application was effective in increasing Zn uptake by sorghum and allocation of Zn to the grain. Future studies with Zn fertilization can contribute in food biofortification helping to solve zinc deficiency in human diets.

References

B. G. Hopkins, D. A. Whitney, Lamond R.E. (1992) Zinc Fertilization of Grain Sorghum. Kansas Fertilizer Research. Report of Progress 670. Kansas State University, Manhattan.

Gordon W.B., Pierzynski G.M. (1997) Responses of Corn and Grain Sorghum Hybrids to Starter Fertilizer Combinations. Kansas Fertilizer Research. Report of Progress 800. Kansas State University, Manhattan.

Havlin J.L., Tisdale, S.L., Nelson, W.L. and J.D., Beaton (2014) Soil Fertility and Fertilizers: An Introduction to Nutrient Management. Pearson Education.

Hawkesford M.J., Barraclough P. (2011) The molecular and physiological basis of nutrient use efficiency in crops. Wiley-Blackwell.

Leikam D.F., Lamond, R.E. and Mengel, D.B. (2003) Soil test interpretation and fertilizer recommendation. MF 2586. Kansas State Univ. Ext., Manhattan.

USDA. (2014) Crop Production 2014 Summary. United States Department of Agriculture (USDA), National Agricultural Statistics Service.

Walsh L.M., Beaton J.D. (1977) Soil Testing and Plant Analysis. Soil Science Society of America, Madison, Wisconsin.

Table 1. Soil test values[1]

pH	Buffer pH	OM	STP	Zn
		%	---------- ppm ----------	
5.5	6.2	3.1	15.6	0.65

[1]pH and Zn values from strips, other data from field average soil samples.
Abbreviations: OM, organic matter; STP, soil test phosphorus; and Zn, zinc.

Table 2. Effects of band applied zinc in grain yield and sorghum grain concentration

	Grain yield			Grain zinc concentration		
Parameters	+ Zn	- Zn	Difference	+ Zn	- Zn	Difference
	---------- bu/a ----------			---------- ppm ----------		
Mean	95	91	4	20.9	17.9	3.0
Standard deviation	11.9	6.8	13.6	1.5	0.80	1.9
Standard error	3.8	2.2	4.3	0.65	0.36	0.86
P-value from t-test			0.392			0.025