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Balanced Nutrition and Crop Production Practices for Closing Grain Sorghum Yield Gaps

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Abstract

A field experiment was conducted at the North Central Kansas Experiment Field near Scandia, KS, in the summer of 2014 to evaluate diverse cropping systems approaches to closing sorghum yield gaps. Yield gaps can be understood as the difference between maximum and attainable on-farm yields. The approach taken in this project is system wide, rather than focusing on one factor and its interaction. The factors that were tested include narrow row spacing; plant population; balanced nutrition practices, including various timings of nitrogen, phosphorus, and potassium (NPK) and micronutrient applications; crop protection with fungicide and insecticide applications; plant growth regulator effects; and the use of precision ag technology for maximizing yields, including a GreenSeeker meter (Trimble Navigation, Westminster, CO) for more precisely determining fertilizer nitrogen needs of sorghum. Grain sorghum yields ranged from 95 to 125 bu/a in Scandia under dryland conditions. One of the lowest yields was obtained when common practices were implemented (treatment 10), with an average 103 bu/a, whereas maximum yield was registered with the “kitchen sink (all inputs are applied)” treatment (treatment 1), with an average 115 bu/a. Notwithstanding the lack of treatment difference, the grain sorghum yield gap from a common practice to “kitchen sink” was 12 bu/a.

Keywords

sorghum, production practices, nutrients, yield

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Summary

A field experiment was conducted at the North Central Kansas Experiment Field near Scandia, KS, in the summer of 2014 to evaluate diverse cropping systems approaches to closing sorghum yield gaps. Yield gaps can be understood as the difference between maximum and attainable on-farm yields. The approach taken in this project is system wide, rather than focusing on one factor and its interaction. The factors that were tested include narrow row spacing; plant population; balanced nutrition practices, including various timings of nitrogen, phosphorus, and potassium (NPK) and micronutrient applications; crop protection with fungicide and insecticide applications; plant growth regulator effects; and the use of precision ag technology for maximizing yields, including a GreenSeeker meter (Trimble Navigation, Westminster, CO) for more precisely determining fertilizer nitrogen needs of sorghum. Grain sorghum yields ranged from 95 to 125 bu/a in Scandia under dryland conditions. One of the lowest yields was obtained when common practices were implemented (treatment 10), with an average 103 bu/a, whereas maximum yield was registered with the “kitchen sink (all inputs are applied)” treatment (treatment 1), with an average 115 bu/a. Notwithstanding the lack of treatment difference, the grain sorghum yield gap from a common practice to “kitchen sink” was 12 bu/a.

Introduction

Kansas sorghum producers face low attainable yields. Grain sorghum is one of the major crops grown in the state of Kansas, and closing yield gaps will increase short-term productivity. The latter can be achieved via implementation of better genotypes and best management practices. This project quantifies the diverse interactions that can maximize yields by considering several factors in farmers’ decision-making processes.

Procedures

At the location in Scandia, KS, the plots were set up with 5 replications with 11 treatments in each replication. A randomized complete block design was used for the grain sorghum treatments. The plots were 10 ft × 50 ft, or 0.01 acres. Sorghum Partners NK7633 hybrid was used. Measurements for plant characterization were taken at the V5 growth stage, flowering stage, mid-reproductive stage, and at harvest. The measure-

ments taken included: plant population stand counts, leaf area index (LAI) at V5 and flowering, chlorophyll (SPAD) readings at V5 and flowering, canopy temperature at flowering, aboveground biomass and nutrient concentrations at diverse growth stages, and grain yield and its components (grain number/head and seed weight).

Results

Yield information is expressed in bushels per acre at 12.5% moisture content. Yield was collected from the central two rows (30-in. row spacing) or four rows (15-in. row spacing) (5 ft × 50 ft). The treatments evaluated in this location did not present any significant difference for the yield factor (Table 1, Figure 1). One of the lowest grain yields, 103 bu/a, was obtained when common practices were implemented (treatment 10), whereas yield was maximized at 115 bu/a when the “kitchen sink” approach was employed (treatment 1). Although treatment was not statistically significant, the grain sorghum yield gap was 12 bu/a when high (treatment 1) vs. low (treatment 10) input costs were compared.

Table 1. Description of sorghum treatments implemented in this study

Seeding rate	Treatments										
	1	2	3	4	5	6	7	8	9	10	11
Row spacing	Optimum	Normal	Optimum	Optimum	Optimum	Optimum	Optimum	Optimum	Optimum	Normal	Optimum
N program	15 in.	15 in.	30 in.	15 in.	15 in.	15 in.	15 in.	15 in.	15 in.	30 in.	15 in.
Fungicide/insecticide	GS	GS	GS	Standard	GS	GS	GS	GS	GS	Standard	GS
Micronutrients	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
PGR	Fe, Zn	Fe, Zn	Fe, Zn	Fe, Zn	Fe, Zn	None	Fe, Zn	Fe, Zn	Fe, Zn	None	Fe, Zn
Starter fertilizer	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Chloride	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NPKSZn	NP	NPKSZn
GreenSeeker + N	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
	No	No	No	No	No	No	No	No	No	No	Yes

Optimum seeding rate = 80,000 plants/a; Normal = 50,000 plants/a; 15 in. = narrow row spacing; 30 in. = wide row spacing; GS = GreenSeeker meter (Trimble Navigation, Westminster, CO); Standard = conventional N application (without precision ag technology); Fe = Iron; Zn = Zinc; PGR = plant growth regulator; N = nitrogen; P = phosphorus; K = potassium; S = sulfur.

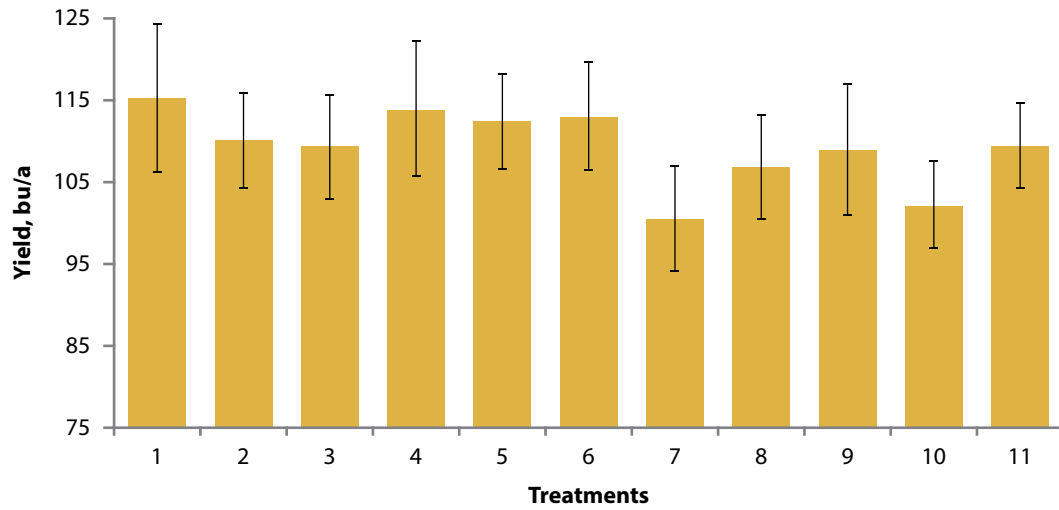


Figure 1. Sorghum grain yield under diverse cropping systems approaches at the Scandia Unit of the North Central Kansas Experiment Field. See Table 1 for treatment details.