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Breaking Soybean Yield Barriers: A Cropping Systems Approach

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Breaking Soybean Yield Barriers: A Cropping Systems Approach

Abstract

Two soybean research trials were conducted at Scandia, KS, in dryland and irrigated environments. The objective of this trial was to study the contribution of different farming systems to developing efficient and high-yielding soybean production systems. Each experiment had five treatments: farmer practices (FP), comprehensive fertilization (CF), production intensity (PI), ecological intensification (CF + PI), and advanced plus (AD). Under dryland, FP and CF treatments yielded 34 bu/a, differing in 27 bu/a compared with PI, EI, and AD scenarios. Under irrigation, FP and CF presented comparable yield levels, differing by close to 36 bu/a compared with crop intensification treatments (CF + PI; AD).

Keywords

soybean, yield barriers, cropping systems

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Summary

Two soybean research trials were conducted at Scandia, KS, in dryland and irrigated environments. The objective of this trial was to study the contribution of different farming systems to developing efficient and high-yielding soybean production systems. Each experiment had five treatments: farmer practices (FP), comprehensive fertilization (CF), production intensity (PI), ecological intensification (CF + PI), and advanced plus (AD). Under dryland, FP and CF treatments yielded 34 bu/a, differing in 27 bu/a compared with PI, EI, and AD scenarios. Under irrigation, FP and CF presented comparable yield levels, differing by close to 36 bu/a compared with crop intensification treatments (CF + PI; AD).

Introduction

Gaps between potential and actual on-farm yields are primarily defined by crop management practices (such as row spacing, planting date, and fungicide and nutrient application) and their interactions with the environment (weather). For example, Kansas producers have shifted soybean planting dates earlier at a rate of about 0.5 days/year since the 1980s. Thus, after considering genetics and the environment, on-farm yield is primarily influenced by farmers' decisions, the main components of which are agronomic practices. Crop management practices are often specific to the environment, hybrid/variety, and/or yield level. Row spacing, plant population, nutrient management, and other agronomic practices can modify yields. Selecting appropriate management practices can help farmers increase yields and close yield gaps. Increasing plant populations and narrowing rows are two common intensification practices in high-yielding soybean systems.

Procedures

Two soybean research trials were conducted at the Scandia Unit of the North Central Kansas Experiment Field, one in dryland and the other under irrigation. Soybean from maturity group 4.0 was planted on May 15. The experiment was designed to follow five production systems: (1) farmer practices (FP), common farming practices (120,000 seeds/a + no-inoculation + no-nutrient application + 30-in. row spacing); (2) comprehensive fertilization (CF), or balancing nutrients (120,000 seeds/a + inoculation + nutrient application + 30-in. row spacing); (3) production intensity (PI), increasing productivity via narrowing rows and increasing plant population (180,000 seeds/a +

inoculation + no-nutrient application + 15-in. row spacing); (4) ecological intensification (CF + PI; 180,000 seeds/a + inoculation + nutrient application + 15-in. row spacing); (5) and advanced plus (AD), or increasing input applications (180,000 seeds/a + inoculation + nutrient application + 15-in. row spacing). Each treatment was replicated five times. The soybean was harvested on October 15.

Results

Weather: 2014 Growing Season

Weather conditions influenced the final yields observed in both dryland and irrigated research studies. The 2014 growing season maximum and minimum temperature variations were similar to documented historical trends (4-year average).

The historical precipitation pattern portrayed a peak during the first two weeks of August (Figure 1). The 2014 growing season precipitation pattern was unlike the historical weather trend because precipitation was more concentrated during the last week of August and first two weeks of September (close to 16 in. during that 3-week period; Figure 1). This amount of precipitation coincides with a later growth stage (R3–R4) for the soybean crop.

Phenological Information

Complete information related to planting date and phenological information is presented in Table 1. Soil characterization before planting can be reviewed in Table 2.

Soybean Dryland Yields

Under dryland, both farmer practice (FP) and comprehensive fertilization (CF) scenarios presented similar soybean yield (averaging 34 bu/a), differing by 27 bu/a compared with the production intensity treatment (PI; 15-in. rows and superior plant population) and with the high level of inputs [ecological intensification (EI), and advanced plus (AD)]. These last three scenarios, (PI, EI, and AD) did not differ in the final yield achieved at the end of the season (averaging 61 bu/a) (Figure 2).

Soybean Irrigated Yields

Farmer practice (FP) and comprehensive fertilization (CF) presented comparable yields, differing by close to 36 bu/a compared with the treatments intensifying crop production. These last three scenarios, production intensity (PI), ecological intensification (EI), and advanced (AD), did not differ in the final yield achieved at the end of the season (averaging 84 bu/a) (Figure 3).

Table 1. Phenological data for the 2014 growing season for soybean

Scandia phenological data	Soybean
Variety	MG 4.0
Planting date	May 14
Emergence date (VE)	May 24
Silking date (R1)	August 4
Maturity	October 9
Harvest	October 15

Table 2. Soil characterization before planting time

Scandia experiments	Organic matter, %	Nitrate, ppm	pH	Buffer pH	Phosphorus, ppm
Soybean, dryland	3.1	22.5	6.3	6.6	18.2
Soybean, irrigated	2.7	12.9	4.9	5.9	68.5

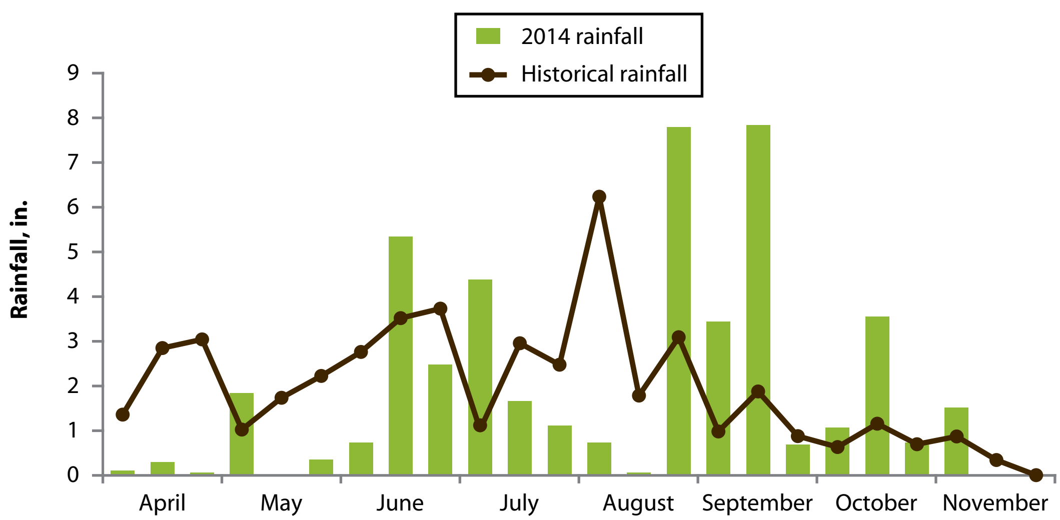

Figure 1. Historical (4-year average) and 2014 precipitation record, Scandia, KS.

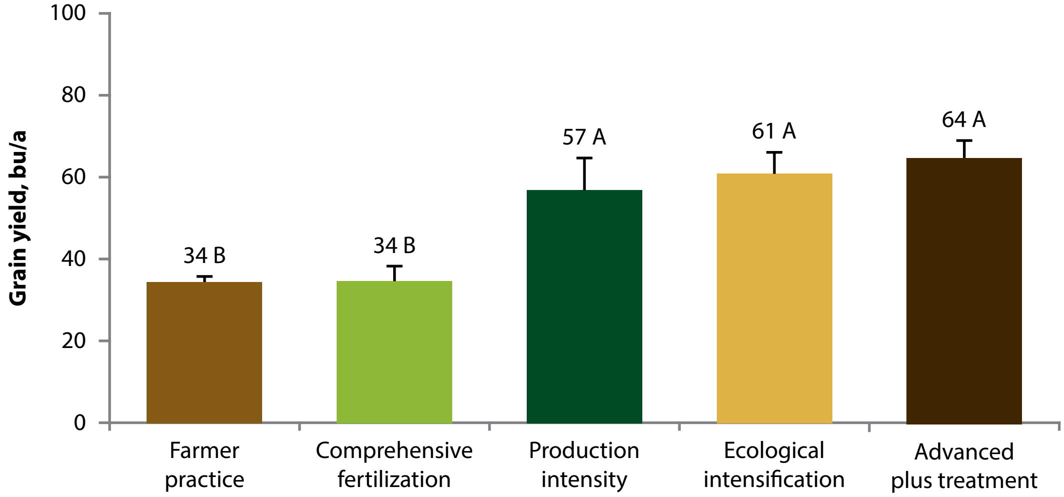

Figure 2. Dryland soybean grain yield (13% moisture), expressed in bu/a, for diverse farming scenarios.

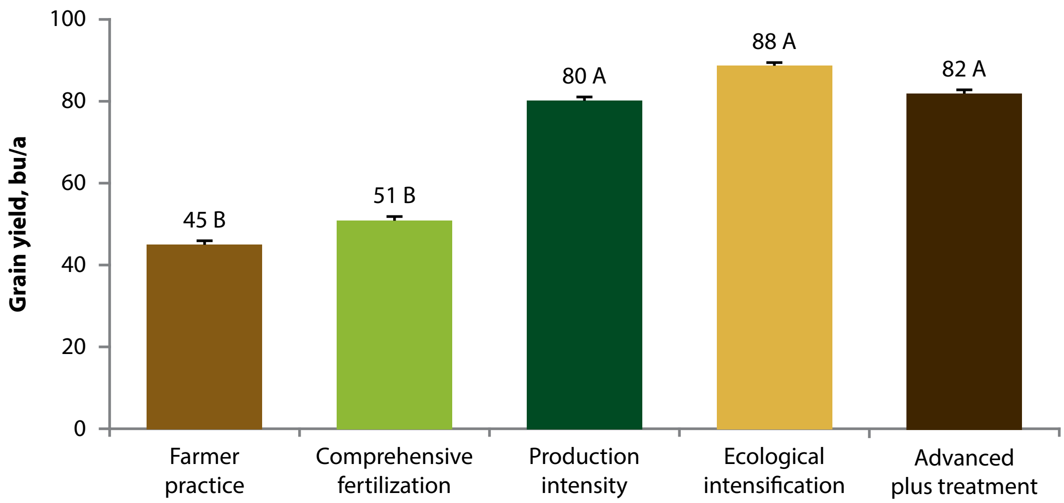

Figure 3. Irrigated soybean grain yield (13% moisture), expressed in bu/a, for diverse farming scenarios.