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SOYBEAN RESPONSE TO ROW SPACING AND SEEDING RATES IN NORTHEAST KANSAS

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Soybean is a major crop in northeast Kansas and plays an important role in summer row-crop rotations. Since the early 1980's, planting soybeans in narrow rows (10 in or less) has become popular and is used for approximately 50% of the soybeans in the region. Row spacing and seeding recommendations generally are developed from results of field experiments and local experience. Kansas producers typically plant between 130,000 and 180,000 seeds/a with 30-in rows and increase seeding rates by approximately 10 to 25% with narrow rows. Yields vary tremendously depending on soil and environmental conditions, with yield potential being 20 to 25 bu/a in some locations and 50 to 60 bu/a in others. This study was designed to determine the influence of environment on optimum row spacing and seeding rates for soybeans in northeast Kansas.

Procedures

Ten field experiments were conducted over a 3-year period from 1991 to 1993 at various dryland sites in northeast Kansas (Table 1). Rates of 52,272; 104,544; 156,186; 209,088 seeds/a were used every year, and an additional rate of 261,360 seeds/a was included at each location in

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Table 1. Planting dates, soybean cultivar, and total rainfall received during the growing season (May-September) for individual site-years.

Site	Year	Planting Date	Soybean Cultivar	Growing Season Rainfall (in.)
Belleville	1992	May 22	Corsica	22.4
	1993	May 28	Corsica	38.4
Manhattan	1991	May 15	Resnik	12.8
	1992	May 21	Corsica	26.1
	1993	May 27	Corsica	46.0
Powhattan	1991	June 5	Resnik	8.9
	1992	May 15	Corsica	21.9
Rossville	1993	May 21	Corsica	32.5
Topeka	1992	May 22	Corsica	16.6

1992 and 1993. Row spacings were 8 and 30 in. A factorial arrangement of treatments in a randomized complete block design with three or four replications was used. Grain yield and final plant heights were determined at maturity.

Yield Results

Average site-year soybean yields ranged from 21.9 to 62.8 bu/a as the result of a range of planting dates and rainfall amounts. Initially, all data were combined and statistically analyzed. The F-test (not shown) indicated that the site x seeding rate, site x row spacing, and site x seeding rate x row spacing interactions were significant. Each site-year was designated as high-, medium-, or low-yielding based on its average grain yield. The high-yielding group consisted of four site-years with yields of greater than 50 bu/a. The medium-yielding group consisted of three locations with grain yields between 40 and 50 bu/a. The low-yielding group consisted of two locations with yields below 40 bu/a. The data were reanalyzed within each yield group (Table 2).

In high-yielding environments, seeding rates affected soybean yields differently in 8-in rows than in 30-in rows (Figure 1). In 30-in rows, increasing seeding rates from 52,000 to over 250,000 seeds/a had little effect on grain yield, with the maximum yield of 57 bu/a at approximately 110,000 seeds/a. In 8-in. rows, grain yields increased as seeding rates increased, with the maximum yield of 59 bu/a at approximately 203,000 seeds/a. Under low seeding rates, the 30-in rows outyielded the 8-in rows, whereas the 8-in rows were superior when seeding rates exceeded 155,000 seeds/a.

Increasing seeding rates under medium-yielding environments affected soybean yield differently in 8-in rows than in 30-in rows (Figure 2). The responses were similar to those in high-yielding environments. The maximum yield of 46 bu/a in a 30-in rows was at 115,000 seeds/a, whereas the maximum yield of 50 bu/a in 8-in rows was at 225,000 seeds/a.

Table 2. F-test significance for soybean grain yields across site-years with high, medium, and low yields.

	Yield Group		
Variable	High	Medium	Low
Site (S)	***	**	**
Seeding Rate (SR)	***	***	NS†
S x SR	NS	NS	NS
Row Spacing (RS)	NS	NS	**
S x RS	NS	NS	NS
SR x RS	***	***	NS
S x SR x RS	NS	NS	NS
CV, %	9.0	9.6	15.6

, * Significant at the 0.01 and 0.001 probability levels, respectively.
† NS = not significant

Yields from 30-in rows were greater than yields from 8-in rows at low seeding rates, but yields from the 8-in rows were greater when the seeding rate exceeded approximately 155,000 seeds/a.

When rainfall during the growing season limited soybean yields, increased seeding rates affected yield more in 8-in rows than in the 30-in rows (Figure 3). Under these conditions, yields in the 30-in rows declined slightly as seeding rate increased initially, but then remained unchanged as rates increased to over 200,000 seeds/a. In the 8-in rows, grain yields increased as seeding rates increased, reaching a maximum at approximately 140,000 seeds/a but then declining as seeding rates increased more. Yields from the 30-in rows exceeded those from the 8-in rows at all seeding rates.

These data indicate that when growing season rainfall was plentiful, soybeans planted in 8-in rows produced higher yields than soybeans planted in 30-in rows. As the water supply began to decline, the 8-in rows lost this advantage. When soil moisture was limited during the reproductive

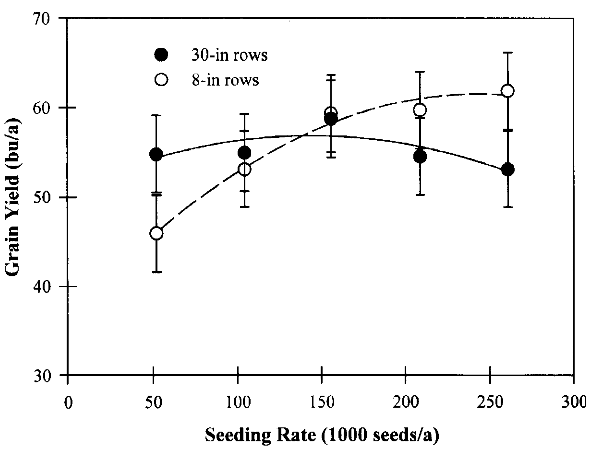

Figure 1. Soybean yield at two row spacings and five seeding rates combined over site-years with high yields. Vertical bars represent LSD (0.05).

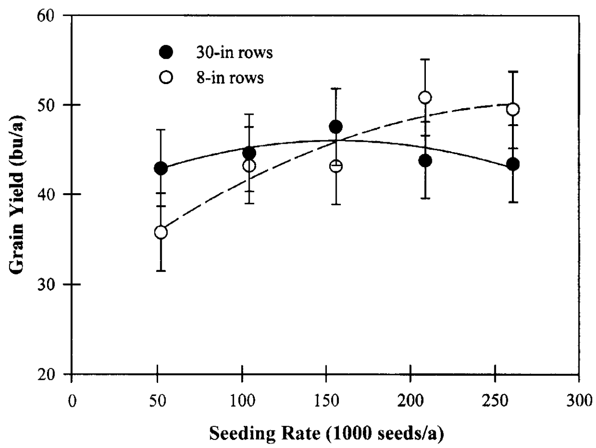

Figure 2. Soybean yield at two row spacings and five seeding rates combined over site-years with medium yields. Vertical bars represent LSD (0.05).

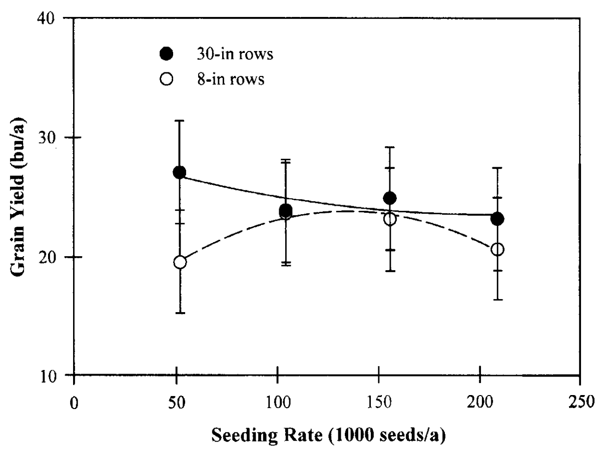

Figure 3. Soybean yield at two row spacings and five seeding rates combined over site-years with low yields. Vertical bars represent LSD (0.05).

Table 3. F-test significance for soybean mature plant height across site-years with high, medium, and low yields.

	Yield Group		
Variable	High	Medium	Low
Site (S)	***	**	NS†
Seeding Rate (SR)	***	***	NS
S x SR	NS	NS	NS
Row Spacing (RS)	NS	NS	NS
S x RS	NS	NS	NS
SR x RS	***	NS	NS
S x SR x RS	NS	NS	NS
CV, %	9.0	9.6	10.5

, * Significant at the 0.01 and 0.001 probability levels, respectively

† NS = not significant

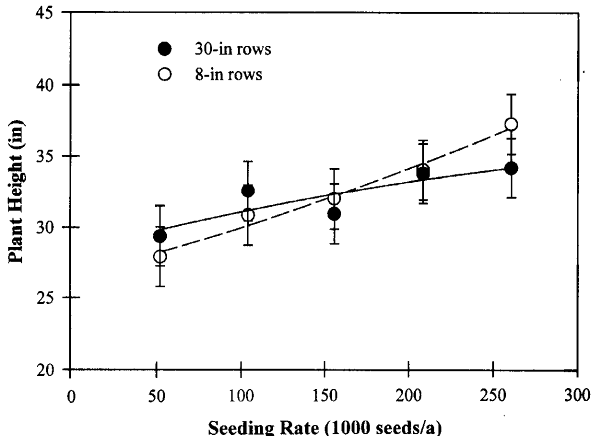

Figure 4. Soybean mature plant height at two row spacings and five seeding rates combined over site-years with high yields. Vertical bars represent LSD (0.05).

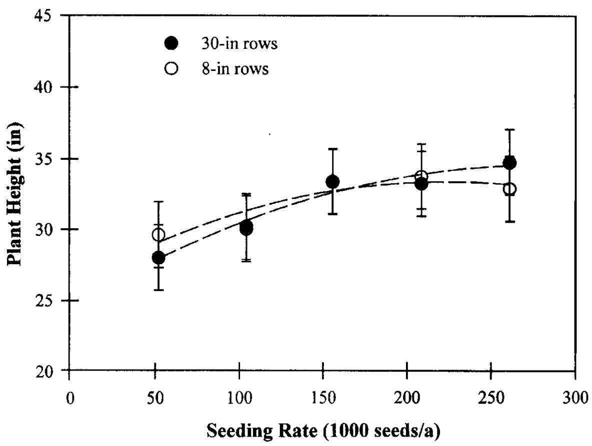

Figure 5. Soybean mature plant height at five seeding rates combined over site-years with medium yields. Vertical bars represent LSD (0.05).

stage, soybeans planted in 30-in rows had greater yields than those in 8-in rows. These results agree with the results of other research indicating that soybeans in 8-in rows used water less efficiently than soybeans in wider rows under severe moisture stress.

Plant Height Results

Plant height at maturity was analyzed in the same manner as grain yield. The seeding rate x row spacing interaction was significant for the high-yielding environments, whereas only seeding rates affected plant height in the medium-yielding environment (Table 3).

Plant height at maturity increased as seeding rates increased in the high- and medium-yielding environments. In the high-yielding environments, mature plant heights were greater in 30-in rows than 8-in rows, when seeding rates were less than 150,000 seeds/a. When the seeding rate was greater than that, mature plant heights were greater in the 8-in rows (Figure 4). In the medium-yielding environment, plant heights increased as seeding rates increased across both row spacings (Figure 5). When soil moisture was limiting, mature plant heights were not affected by row spacing or seeding rate.

Summary

The results of this study indicate that environmental conditions affect soybean response to seeding rates and row spacings. Mature plant heights increased as seeding rates increased when growing-season soil moisture was adequate but were not affected by row spacing or seeding rate in moisture-limiting environments. Differences in yield indicated that recommendations for soybean rows spacings and seeding rates must be adjusted based on expected yield goals. Under high- and medium-yielding environments where adequate soil moisture exists, narrow rows should be recommended over wide rows. When narrow rows are used, producers should increase seeding rates to approximately 210,000 seeds/a. In environments where soil moisture is limiting, wide rows should be used to increase yield stability.

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