Agronomic Maximization of Soybean Yield and Quality: Population x Management Interactions

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Introduction
Currently, many commercial products advertised to improve yield are available to soybean [Glycine max L. (Merr.)] growers. The majority of these products have been tested individually; however, their interactions with various management practices including soybean plant population, have not been validated. Our objective was to determine the potential yield gain associated with the interaction of population, management regime, and the target population x management regime interaction.

Materials and Methods

Locations: Research was conducted at two locations in Wisconsin, Iowa, Michigan, Illinois, Indiana, Kentucky, Arkansas, three locations in Kansas, and four locations in Minnesota in 2012 (Fig. 1). Treatments: Two management regimes were employed, an untreated (UTC) and a high input system termed SOYA (Systematic Optimization of Yield-enhancing Applications) on six different target plant populations (123,500; 197,600; 271,700; 345,800; 419,900; and 494,000 seeds ha⁻¹). A detailed description of each treatment is given in Table 1. All other soybean management strategies followed University best management practices.

Cultivars: Cultivars were selected regionally to be adapted for maturity and with appropriate defensive traits. All cultivars were obtained from Asgrow® (Monsanto Company, 2013) and were expected to be modern high-yielding cultivars. The experiment was replicated by environment, defined as location within year.

Data Collection: Stand counts were taken at emergence and harvest to confirm emergence and attrition rates. Growth stage was assessed weekly to ensure proper treatment application timing. Disease and insect pressure was monitored weekly during the growing season. Grain yield was determined by machine harvest and subsamples were taken for grain quality and seed mass determination.

Statistical Analysis: Variables were subjected to a non-linear regression analysis using the PROC NLIN procedure in SAS Version 9.3 (SAS Institute Inc., Cary, NC). Variables were regressed over target population, management regime, and the target population x management regime interaction. Significant interactions were found for growing region and analysis was therefore separated by population in both treatments 

Significant interactions were found for growing region and analysis was therefore separated by growing region. Population data were fit using the following equation: \( y = \alpha (1 - e^{-bP}) \) where \( \alpha \) is the predicted asymptotic maximum and \( b \) represents the responsiveness of \( y \) as population increases. This equation has been used and described by Edwards and Purcell (2005).

Yield Results

North (MN, MI, WI)

UTC Yield = 3800(1-exp(-0.000024x))
\( R^2=0.99 \)

SOYA Yield = 4100(1-exp(-0.000022x))
\( R^2=0.99 \)

Fig. 2 North Grain Yield

Central (IA, IL, IN)

UTC Yield = 4000(1-exp(-0.000018x))
\( R^2=0.99 \)

SOYA Yield = 4180(1-exp(-0.000025x))
\( R^2=0.99 \)

Fig. 3 Central Grain Yield

South (KS, AR, KY)

UTC Yield = 3850(1-exp(-0.000018x))
\( R^2=0.99 \)

SOYA Yield = 4110(1-exp(-0.000025x))
\( R^2=0.99 \)

Fig. 4 South Grain Yield

Conclusions

• Maximum yield was obtained at populations lower (~40K to 65K) than previous reports (Edwards and Purcell, 2005) and may be a consequence of the widespread drought through most of the growing season in the Southern Plains and Southeast, and in the latter part of the season in the Northern Plains.

• SOYA treatments increased soybean yield 170 to 300 kg ha⁻¹ however; the economics of the SOYA management approach must be considered and has yet to be analyzed.

• The absence of a significant interaction between population and management indicates there are no greater benefits to the SOYA treatments at higher populations in comparison to lower populations.

Literature Cited


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