

ECONOMICALLY OPTIMAL PLANT POPULATION DENSITY IN MIDSOUTH SOYBEAN PRODUCTION

N.M. Thompson

J.A. Larson

R.K. Roberts

The University of Tennessee

Knoxville, TN

Alemu Mengistu

USDA – ARS Crop Genetic Research Unit

Jackson, TN

Eric Walker

University of Tennessee Martin

Martin, TN

Abstract

Soybeans are an important crop on many cotton farms in the Midsouth. The cost of soybean production is increasing with rising input costs. In particular seed has become one of soybean farmers' most expensive inputs. In response to rising costs, farmers are looking to established production techniques such as plant spacing, specifically narrower row spacing (RS) and higher plant population densities (PPD), as well as the adoption of new practices such as early soybean production systems (ESPS) to help better utilize increasingly expensive inputs. The objective of this research was to estimate economically optimal plant population densities (EOPPD) considering seeding rate, maturity group (MG), RS, and input-output prices.

Data for this study were collected from field experiments during 2005, 2006, and 2007 at the University of Tennessee Research and Education Center at Milan, Tennessee. Experiments were arranged in a randomized complete block, split-plot design with four replications. In each year of the study MG III, IV, and V cultivars were planted in 38 and 76 cm rows at seeding rates ranging from 60,000 to 593,000 seeds ha^{-1} .

Yield response functions were estimated as a function of PPD for each MG, RS and year combination. Several functional forms were fitted to determine which one best fit the data. Due to a wide range of weather conditions during the three years of the experiment, including a severe drought in 2007, the original yield response equations were weighted by year using an Ångström weather index. The weighting procedure allowed for the estimation of a model representative of a wide range of weather conditions. A net returns equation was then set up using a partial budgeting technique to estimate farmers' returns looking only at revenues and costs that vary with changes in PPD. This information was then used to establish biologically optimal plant population densities (BOPPD), EOPPD, and the resulting net returns under each MG, RS combination.

The key findings from this research are as follows. First, EOPPD were lower than BOPPD for each of the six MG, RS combinations evaluated. In addition, statistical testing indicated that four of the six EOPPDs estimated were statistically different from their respective BOPPDs. These findings are consistent with the idea that the knowledge of EOPPDs is of increasing value to farmers with higher input costs. Second, soybeans planted in 38 cm rows were found to produce higher yields as well give higher net returns when compared to soybeans planted in 76 cm rows for all three MGs evaluated in this research. Lastly, holding RS constant at 38 cm, evaluation of the three MGs reveals that MG IV cultivars produced the highest net returns. Again statistical tests revealed that the net returns for MG IV cultivars planted in 38 cm rows were higher than and statistically different from the net returns of MG III and V cultivars. Results of this research indicate that MG IV cultivars planted in narrow rows at seeding rates appropriate to achieve target PPD of 114,000 plants ha^{-1} maximize net returns in the Midsouth.