Introduction

Early soybean production systems have made it easier for farmers to avoid drought and reduce irrigation in the Mid south. Ultra-early cultivars attain yields similar to full-season cultivars, but in order to accumulate enough light, they require substantially higher population densities. We hypothesized that experimental, 5- and 7-leaflet varieties would intercept more light than near-isogenic 3-leaflet varieties at equal population densities. Therefore, ultra-early, 5- and 7-leaflet varieties could yield the same as full-season, 3-leaflet varieties at relatively low population densities. The objectives of this research were the following:

1. Evaluate yield response to CIPAR (Cumulative Intercepted Photosynthetically Active Radiation)
2. Determine population densities required to give full yield potential
3. Use SSR markers to map the gene that confers the 7-leaflet trait

Materials and Methods

- Genetically similar soybean lines (near isolines), differing only in leaflet number, were created by backcrossing 5- and 7-leaflet PI's with MG 00, 0, 1, 1.4, and 1.8 cultivars.
- At Fayetteville, AR in 2005 and 2006, experimental 7- and 3-leaflet, and 5- and 3-leaflet isoinline pairs were drill-seeded at populations ranging from 5 to 80 plants m⁻² in 19-cm rows.
- Sprinkler irrigation was used to maintain favorable soil moisture that was necessary for plant growth.
- Fraction of light intercepted (FLI) by 3-, 5-, and 7-leaflet soybean plants was measured approximately every 3 days from seedling emergence to growth stage R6 using digital imagery.
- The FLI values were used to estimate daily light interception, and these values were cumulated to determine CIPAR.
- Multiple regression analysis was used to predict the response of CIPAR to population density and maturity group (R² = 0.95).
- To establish a putative association between the 7-leaflet trait and a region of the soybean genome, polymorphic SSR markers were run on segregating populations derived from heterozygous BC₁F₂ and BC₁F₃ plants.

Results

- The highest yielding seeding rate-by-leaflet number-by-MG-combination was 348 g m⁻² in 2005 and 398 g m⁻² in 2006.
- Relative yields for 2005 and 2006, expressed as a fraction of 348 g m⁻² and 398 g m⁻² respectively, increased linearly as CIPAR increased (Figure 1).
- This linear response occurred between 200 MJ m⁻² and 500 MJ m⁻² of CIPAR, which was similar to what Edwards et al. (2005) found between 200 and 600 MJ m⁻² of CIPAR (Figure 1).
- Depending on maturity group and population density, 5- and 7-leaflet genotypes accumulated more light than 3-leaflet genotypes in 2005. In 2006, 3-leaflet genotypes consistently had higher CIPAR values than 5- and 7-leaflet genotypes.
- Seven-leaflet plants had more leaf area per leaf than 3-leaflet genotypes, but 3-leaflet plants had more nodes than 7-leaflet plants (Figure 2).
- Consequently, predicted population densities required for optimal yields showed little difference among 3-, 5-, and 7-leaflet varieties.
- An SSR marker from the B1 linkage group was putatively associated with the gene that confers the 7-leaflet trait.

Conclusions

- Short-season varieties have similar yields as a full-season crop, but require similar populations for 3-, 5-, and 7-leaflet genotypes.
- Soybean plants compensate for high leaf area per plant in 7-leaflet genotypes by producing fewer nodes.

References


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