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Title: Improving soybean production through integrated disease management, sustainable agronomic practices, and variety evaluation

Soybean Disease Scouting: Sentinel Plots & Kudzu

Both kudzu (as the primary source of soybean rust inoculum) and soybeans (i.e., soybean sentinel plots) were scouted for signs of soybean diseases in 2017 from January through early August, when this year's commercial soybean crop was deemed mature enough to forego additional scouting.

FL and LA were the first states in the country to report detections of soybean rust (SBR) on overwintering kudzu in January 2017. Results of disease scouting on kudzu and soybeans through the season (beginning in January and ending in August) were reported to the Integrated Pest Management – Pest Information for Extension and Education (PIPE, <http://sbr.ipmpipe.org/cgi-bin/sbr/public.cgi>).

Four sentinel plots were planted earlier than normal commercial soybeans (i.e., Mar-Apr, 2017) with an early-maturing soybean variety (Pioneer P54T94R) to detect early outbreaks of soybean diseases. Sentinel plots were located in a 3-county region in north Florida believed to be important for the early detection of SBR: Jackson, Gadsden, and Leon counties.

The SSPs were sampled monthly May through August for the presence and severity of diseases. FL was first state in the U.S. to report SBR detections on this season's soybean sentinel plots (SSP) on June 16, 2017 in Leon County (and also the first state to report signs of Frogeye leaf spot, in FL State Commentary of July 3, 2017, PIPE). By the end of the season, Florida's sentinel plots were discovered to have soybean

rust at 100% incidence levels in Jackson County (August 7) and Leon County (August 3), and 25% in Gadsden County (August 3). Frogeye Leaf Spot was found on August 3 in Leon County at 25% incidence and in Gadsden at 14% but was not detected in Jackson County. No other diseases were discovered at reportable levels. By the end of 2017, SBR had been observed in MS, AL, GA, TN, LA, SC, AR, and KY (Source: PIPE). Reports of soybean rust were communicated with the public via the Panhandle Ag E-News <http://nwdistrict.ifas.ufl.edu/phag/2017/07/21/soybean-rust-detected-in-jackson-county/>. The Panhandle Ag E-News weekly articles are sent to 4313 subscribers across the Southeast US with an average of 749 views per day. The information is also distributed to 1906 Facebook followers and 857 Twitter followers.



Figure 1. Soybean sentinel plot in Leon County.

2017 Soybean Maturity Group Trial. Determinant vs Indeterminant Varieties

The experiment investigating the productivity of determinant and indeterminant varieties in Florida was planted on May 23, 2017. A randomized complete block design was implemented with 4 varieties in 4 blocks.

Table 1. Four soybean varieties of determinant and indeterminant growth habits and yield:

Variety	Maturity Group	Growth habit
P46T59R	4.6 IV	Indeterminant
P49T97R	4.9 IV	Indeterminant
P52T86R	5.2 V	Determinant
P55T81R	5.5 V	Determinant



Figure 2. Indeterminate vs determinant soybean varieties.

Fertilizer, herbicides, insecticides, and irrigation were applied as needed.

Statistical analysis

Differences among varieties in yield and disease was analyzed using a general linear mixed effects model in JMP 13.2.0 with variety as a fixed effect and block as a random effect. Means were separated using Tukey's Honest Significant Difference test at the 5% probability level.

Yield

Soybean yields differed significantly between varieties with determinant variety P55T81R achieving a significantly higher mean yield (86.08 bu/A) than either of the indeterminant maturity group IV varieties. Variety P52T86R achieved the second highest mean yield (79.93 bu/A) and did not differ significantly from P55T81R or from the indeterminant group IV varieties (Fig. 3).

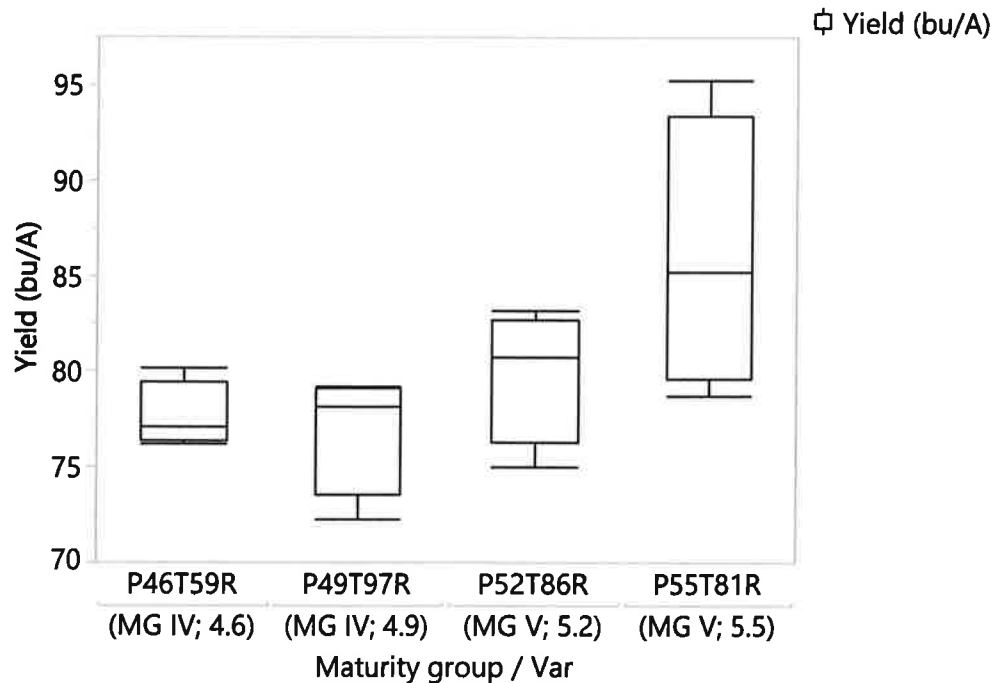


Figure 3. Yields for soybean maturity group trial comparing determinant with indeterminant varieties

Disease assessment

In addition to informal qualitative field inspections, three formal laboratory evaluations of field samples were made between Aug 7 and September 20 revealing the presence of several soybean diseases. Downy mildew, bacterial pustule, frog eye leaf spot (Fig. 4) and soybean rust were all detected. The diseases were all naturally-occurring and, due to the environmental conditions of the season, were present at low and variable disease pressure. Consequently, there were no statistically significant differences between the soybean varieties for either frog eye leaf spot (Fig. 4) or soybean rust (Fig. 5) disease levels. Low severity of both diseases was unlikely to have contributed to yield loss.

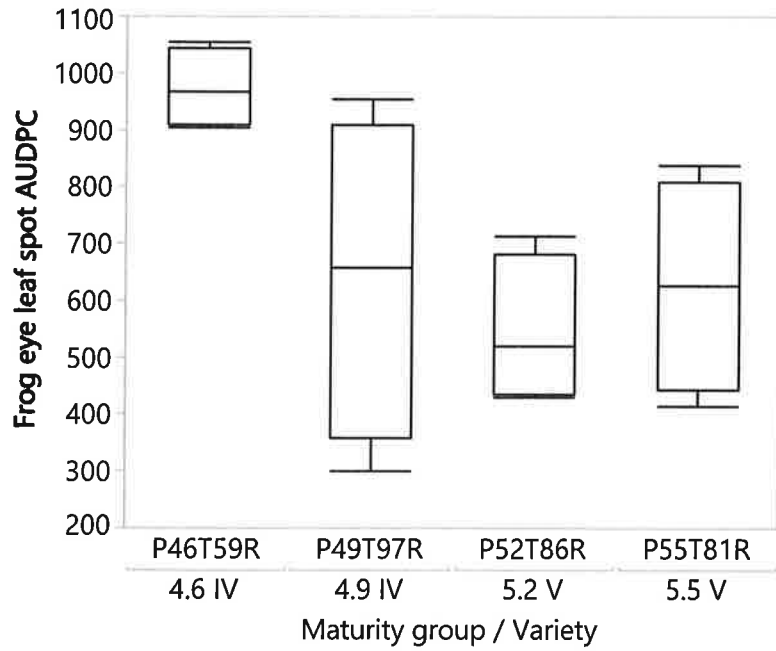


Figure 4. Frog eye leaf spot area under disease (incidence) progress curves (AUDPC) for soybean varieties tested

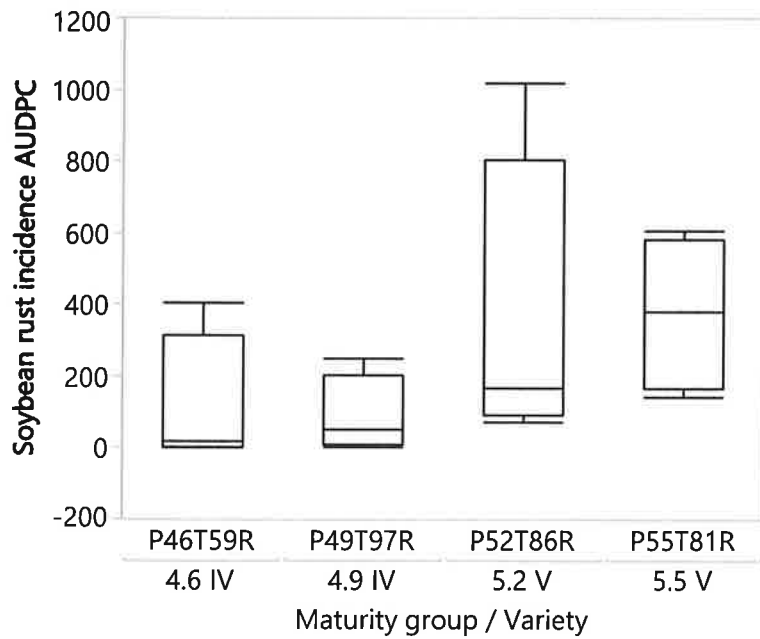


Figure 5. Soybean rust area under disease (incidence) progress curves (AUDPC) for soybean varieties tested

Discussion

Sentinel plot results from this study were disseminated widely to the agricultural community and provided the first report of soybean rust on in-season soybeans. This information provides growers and consultants with an early warning system for production areas in southern states and producers in the mid-south as well as northern states.

High yields were achieved in field studies with both indeterminate maturity group IV and determinant group V varieties under growing conditions in Florida. Although we hypothesized that there might be a potential advantage conferred by the indeterminate nature of the maturity group IV varieties selected for this study we did not observe higher yields for these varieties. It is possible that early planting and harvesting of maturity group IV varieties might confer an advantage, but we followed standard planting dates for this study. In Florida, maturity groups 5 through 7 are recommended and the results of this study support the existing recommendations. Although the acreage of soybeans produced in Florida has declined relative to historic acreages it is apparent from this study that high yields can still be achieved under our local production conditions. In this study we did not observe levels of disease sufficient to result in any yield loss.

In addition to the sentinel plot monitoring and field experiment conducted for this proposal we evaluated transgenic soybean lines developed by a molecular biologist at the University of Florida for resistance to soybean rust. Unfortunately, we did not observe disease resistance in our greenhouse evaluation of the lines.

Outside of this grant we have recently initiated a four-year life cycle analysis (LCA) that will include soybean as one of the crops in our study.