Plant Agriculture

WINTER 2015 SEMINAR SERIES

TITLE: **Agronomics, physiology, and modeling of soybean maximum yield**

SPEAKER: **Dr. Larry C. Purcell**
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University of Arkansas

LOCATION: **Room 1307-Thornbrough Bldg**

TIME: **3:35 pm**

DATE: Wednesday, March 4th

ABSTRACT: Prior to 2006, the highest reported soybean yield was 7923 kg ha^{-1} in 1983 by Dr. Roy Flannery at Rutgers University (Flannery, 1989). In 2006, a farmer in southwest Missouri, Mr. Kip Cullers, won the Missouri Soybean Yield contest with a yield of 9327 kg ha^{-1}. Over the next several years, Mr. Cullers continued to win the Missouri Yield Contest with the highest yield occurring in 2010 (10,791 kg ha^{-1}). These yield levels were met in the scientific community with skepticism as being beyond the theoretical yield potential of soybean. In 2011, my lab began making measurements at Mr. Cullers' farm to document the yield in his contest fields and to provide physiological measurements that underpin the concept of 'theoretical yield potential'. Over the 3 years that we conducted research at Mr. Cullers', the highest yield among several cultivars within a year ranged between 7400 and 7900 kg ha^{-1} (Van Roekel and Purcell, 2014). The highest values of radiation use efficiency (RUE, g MJ^{-1}) and N accumulation rates (NAR, g N m^{-2} d^{-1}) among cultivars

within a year ranged between 1.0 and 1.9 g MJ^{-1} and 0.58 to 1.88 g N m^{-2} d^{-1}, respectively. These values of RUE and NAR are substantially greater than any values previously reported for soybean.

In small plot research at the University of Arkansas, we attempted to create an environment similar to Mr. Cullers' by heavily manuring our field, deep tillage, and eliminating water, nutritional, and biotic factors that would negatively impact yield. Yields, RUE, NAR, and seed growth characteristics were similar to those at Mr. Cullers. We used a crop simulation model (Sinclair et al., 2003) to assess yield potential given our weather data and using the maximum default values for RUE, NAR, and seed growth dynamics. Using these values, predicted yields were under predicted and not well associated with observed yields. When measured values of RUE, NAR, and seed growth characteristics were used as inputs in the model, predicted yields were generally within 15% of the observed values. Although yields approaching 10,000 kg ha^{-1} were not documented in this research, physiological growth characteristics of the crop far exceeded previous reports, which may require reconsidering the theoretical yield potential of soybean.

Flannery, R.L. 1989. The use of maximum yield research technology in soybean production. p. 160-174. In R. Munson (ed.) The physiology, biochemistry, nutrition, and bioengineering of soybeans: Implications for future management, PPI/PPIC, Nocross, GA.

Sinclair, T.R., R. Farias, N. Neumaier, and A.L. Nepomuceno. 2003. Modeling nitrogen accumulation and use by soybean. Field Crops Res. 81:149-158.

Van Roekel, R.J., and L.C. Purcell. Soybean biomass and nitrogen accumulation rates and radiation use efficiency in a maximum yield environment. Crop Sci. 54: 1189 1196.

BIOGRAPHY:

Dr. Larry Purcell is originally from Gainesville, Georgia and received his B.S. (1981) and M.S. (1984) degrees in Agronomy from the University of Georgia. Following his Master's degree, Larry worked for several years as a county extension agent in Floyd County, Georgia and as a technician in the soybean breeding and physiology programs at the University of Georgia. In 1988 he began a PhD program at the University of Florida in Gainesville and completed his degree in Agronomy/Crop Physiology in 1992. Following a one-year postdoctoral position at the University of Missouri in the Biochemistry Department, Larry accepted a position as Assistant Professor at the University of Arkansas in Fayetteville. Larry is currently professor of Crop Physiology at the University of Arkansas, and he holds the Altheimer Chair for Soybean Research. Larry's research interests include optimizing the efficiency with which crops use essential resources of light, water, and nutrients through management and genetic strategies.