CAN SOYBEAN GROWERS BENEFIT FROM PRECISION AG DATA?

Ethan R. Smidt and Shawn P. Conley[1/]

Growers are collecting many forms of spatial data for their fields including yield, elevation, and soils data. Highly accurate GPS systems along with advances in variable rate technology (VRT) are allowing growers to create and use variable rate planting prescriptions to optimize yields and seed placement. Finding the key measureable parameters determining soybean seed yield in Wisconsin and using them to create VRT prescriptions are the objectives of this research.

Materials and Methods

This study was conducted on 11 fields scattered across Wisconsin in 2013 and 11 different fields were used in 2014, as shown in Figure 1. Prior to planting, a prescription for each field was created by defining zones roughly perpendicular to the majority of the soil types as shown in Figure 2. Seeding rates were confirmed using the as-planted data collected from the planter as well as multiple plant population counts in each zone. Soil samples were also taken at these georeferenced points.

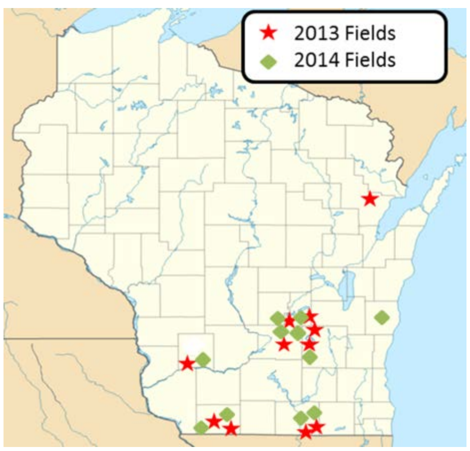

Figure 1: Map of field locations.

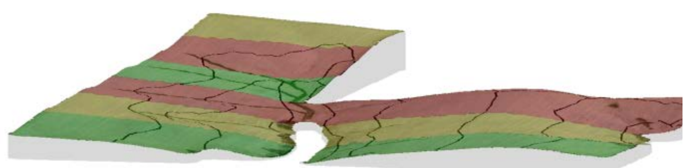

Figure 2: Example of seeding rate by soil type map.

Each field was harvested with combines equipped with GPS receivers and calibrated yield monitors to collect the final seed yield data. This yield data was "cleaned" to discard outliers and incorrect data points as outlined by Wiebold et al. (2003). Inverse distance weighting was used for data interpolation. Elevation data was obtained from differential GPS receivers during planting and harvest. The data were analyzed using the random forest process, then the optimal number of important variables were determined by cross-validation. A decision tree model was then created from those most important parameters to facilitate soybean yield predictions.

Results and Discussion

The random forest process indicated that soil type was the primary variable in determining yield across the 2013 pooled data set. Cross-validation showed the next 5 variables were also important and useful in dividing the data and those were soil phosphorus (ppm), soil organic matter (%), soil water storage capacity from 0-39 inches (in), elevation (ft), and soil pH. Within a given soil type the remaining explanatory variables were used to create a soil type independent decision tree diagram as seen in Figure 3.

[1/] Graduate Research Assistant and Professor, Dept. of Agronomy, Univ. of Wisconsin-Madison, 1575 Linden Drive, Madison, WI 53706.

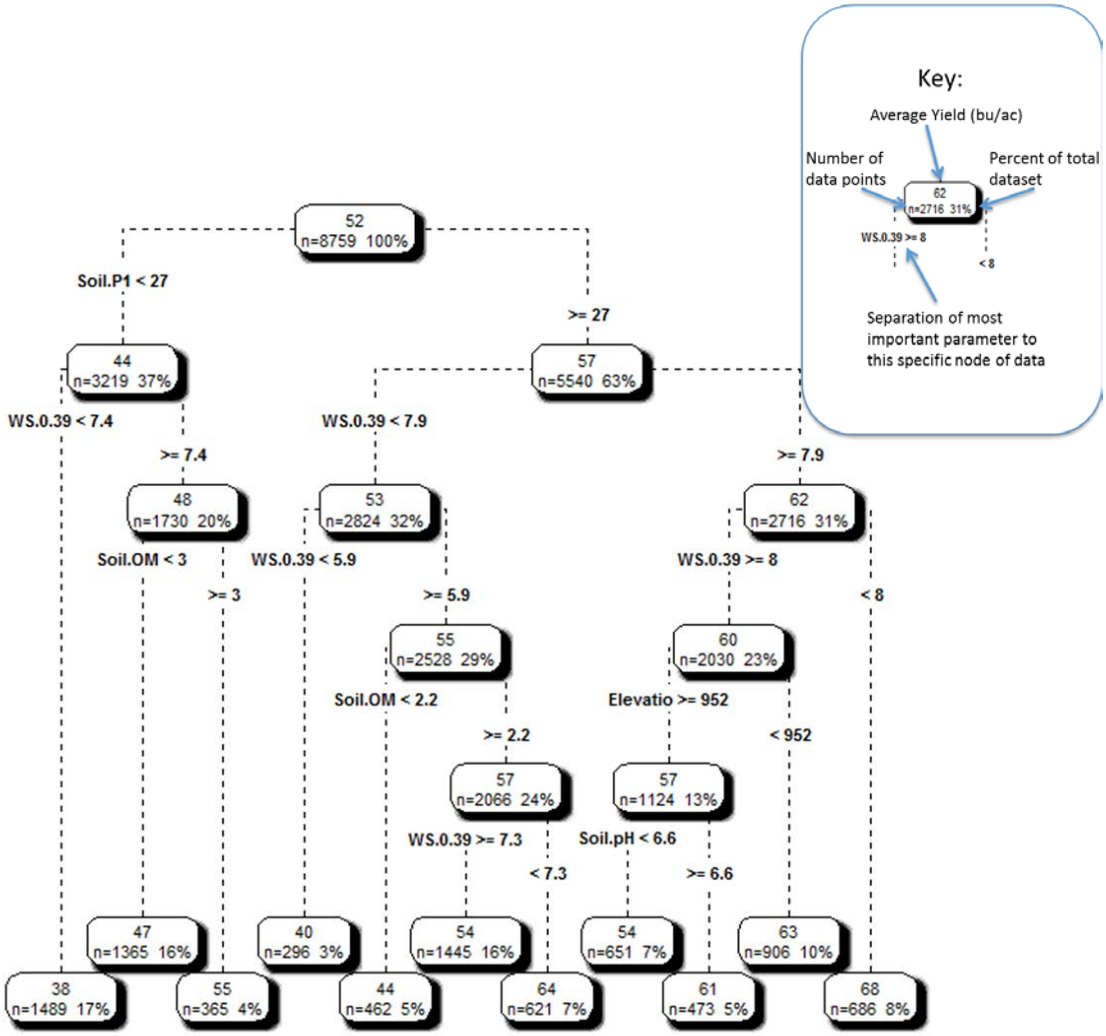

Figure 3: Soil type independent decision tree.

Both the random forest and decision tree models found soil type as the leading factor determining soybean yield in 2013. Maximum predicted yields are attained in soil types Brr, Brp, Bls, Joy, LRy, Mrk, Mnd, Mrm, Pln, Stn, and Tdd and have soil potassium levels >= 155 ppm. Soil type independent maximum yields are attained when soil phosphorus is >= 27 ppm and water storage capacity in the top 39 inches = 8in. Seeding rate was not found to be an important factor in determining 2013 soybean yield in Wisconsin. The 2014 data are currently being analyzed.

Acknowledgments: The authors would like to thank DuPont Pioneer for providing the graduate assistantship for this research project.

References

Wiebold, W., H. Palm, K. Sudduth, N. Kitchen, B. Batchelor, K. Thelen, D. Clay, D. Bullock, G. Bollero, and R. Schuler. 2003. The basics of cleaning yield monitor data. Produced as part of a project jointly funded by the North Central Soybean Research Program and the United Soybean Board, posted 2003. Cited at: http://www.planthealth.info/pdf_docs/yield_data_guide.pdf.