In-Season Forecasting of Plant Growth, Soil Water-Nitrogen, and Grain Yield in Southeast Iowa

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Introduction

In 2015, a yield forecasting project was initiated with the objective of forecasting in-season soil water-nitrogen dynamics, in-season plant growth, and end-of-season grain yields. This concept was initiated to help farmers and agronomists make in-season management decisions, in addition to the ability to look back on the growing season to see what management practices could have been changed to improve grain yields and net profits, but also reduce nitrogen loss.

Materials and Methods

This project combines the use of the Agricultural Production Systems sIMulator (APSIM) cropping systems model, the Weather Research and Forecast (WRF) model, and in-field data collection. Forecast simulations were based on current year weather up to the date of the simulation, followed by a 10-day weather forecast, and then a 35-year weather file to the end of the season. In-field data were collected from two replications of corn and soybean plots with and without tile drainage conditions. Both the corn and soybeans were planted May 16. The corn hybrid Pioneer 1197AMXT was planted at 35,000 seeds/acre and the soybean variety Pioneer 32T16R was planted at 141,000 seeds/acre. Nitrogen was applied to the soybean stubble at a rate of 170 lb N/acre pre-planting followed by field cultivation. In-field data collection included crop staging, soil temperature and moisture, soil nitrate-nitrogen, crop biomass, and grain yield. The in-field data collection was used to validate the forecast simulation.

Results and Discussion

Corn yields in 2017 were 202 bushels/acre in the tile-drained plots and 217 bushels/acre in the undrained plots (Figure 1). Soybean yields were 63 and 64 bushels/acre in the tile-drained and undrained plots, respectively. Both the corn and soybean plots had yields not statistically different than the modeled long-term average yield.

Corn yield estimation using the APSIM cropping system model did well in predicting both corn and soybean yields as early as the June median prediction (Figure 1). Confidence (narrowing of the best/worst case predictions) occurred by mid-August for corn and early September for soybean. The yield predictions were within five percent of the actual yield.

There were minimal soil moisture differences between the tile-drained and undrained plots for the 1- to 2-ft soil depth (Figure 2). The largest difference occurred from May to June. However, by the end of June, soil moisture was similar between treatments and depletion occurred at approximately the same rate through mid-September.

Acknowledgements

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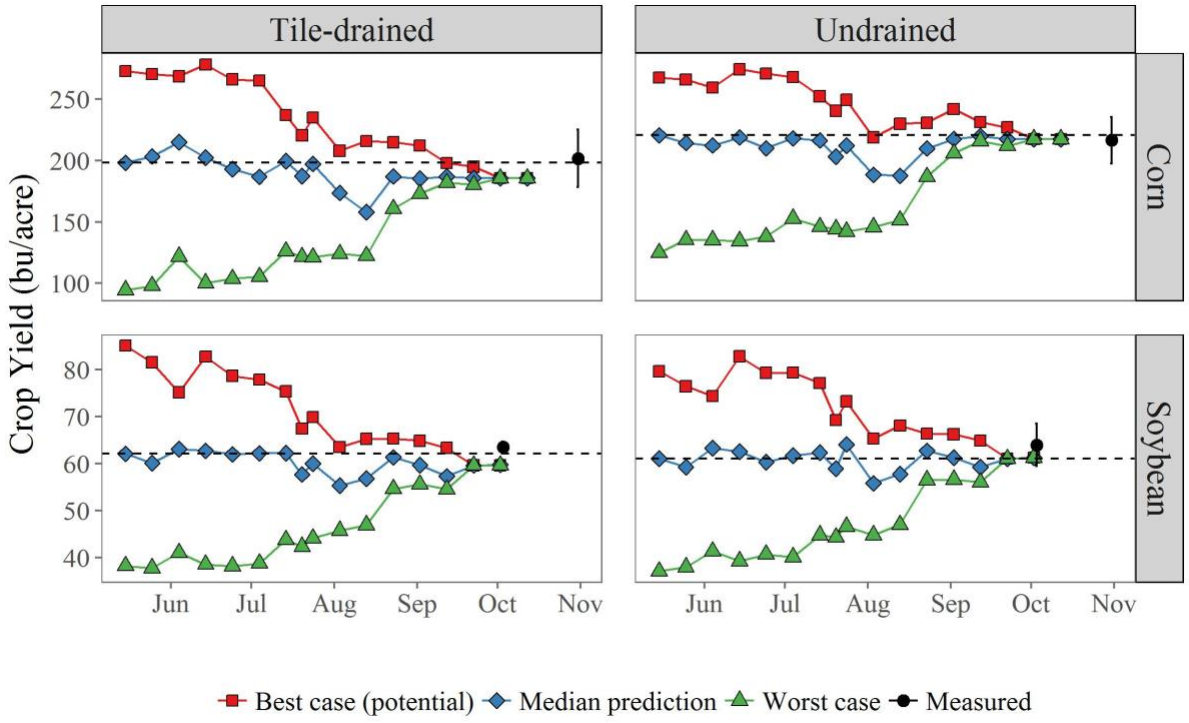

Figure 1. Yield forecasts of corn and soybean over the 2017 growing season. Triangles, diamonds, and squares show the probabilities of yield being above that level, in worst, median, and best cases, respectively. Measured yields (solid circle), harvested with a combine, are shown with error bars. Estimated long-term attainable yields mean are indicated with dashed horizontal lines.

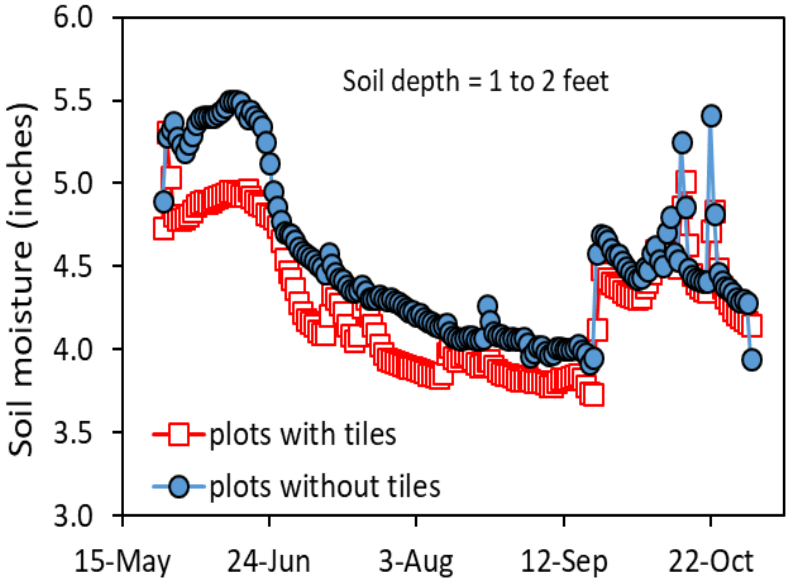

Figure 2. Soil moisture in plots with tile drainage (squares) and plots without tile drainage (circles) in 2017 at Crawfordsville, IA.