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

RFR-A1744

Sotirios Archontoulis, assistant professor
Mark Licht, cropping systems agronomist
Raziel Antonio Ordonez, post-doc
Emily Wright, research associate
Department of Agronomy

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 and a 35-year weather history. In-field data were collected from corn under irrigated conditions with fertigation at two different nitrogen rates. The corn hybrid Pioneer P1197AMXT was planted April 28, 2017, at 35,600 seeds/acre. Nitrogen was applied pre-planting at a rate of 120 lb N/acre with an additional 15 lb N/acre applied through fertigation to both the traditional nitrogen rate and reduced nitrogen rate

treatments. Fertigation also resulted in approximately 9 in. of water over 15 events from June 6 to August 18. With sandy soils, an additional 80 lb N/acre was side-dressed on the traditional nitrogen rate treatment. 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
The average yield for the traditional N rate treatment was 40 bushels/acre more than the reduced N treatment, which received 63 percent less nitrogen (Table 1). The increased yield was a result of more kernels/ear and heavier kernel weights.

The results illustrate the simulated predictions for soil nitrate concentrations follow the measured nitrate concentrations (Figure 1). These results indicate the opportunity for widespread applicability of a well-trained model in assisting with nitrogen and water management decisions.

Table 1. 2017 Corn yield and yield components for the traditional nitrogen plots and the reduced nitrogen plots at the Muscatine Island Research and Demonstration Farm.

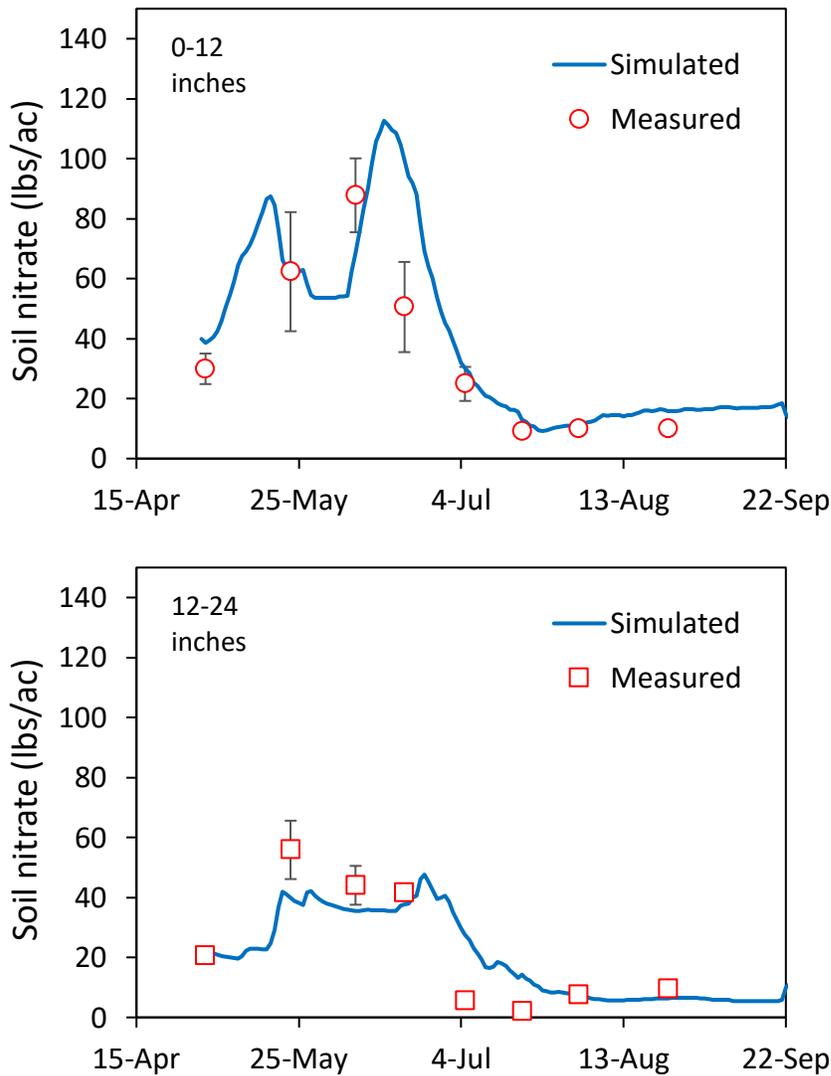|	Yield (bu/ac)	No. kernels/ear	1,000 kernel weight (g)
Traditional N plots	263.3	527	473
Reduced N plots	218.5	495	294

Figure 1. Yield forecast soil nitrate predictions of soil nitrate concentrations over the 2017 growing season for the traditional nitrogen rate plots (120 lb N/ac pre-planting, 80 lb N/ac side-dressed, and 15 lb N/ac through fertigation). Lines are the predicted soil nitrate levels and the boxes/circles are the actual measured soil nitrate levels.