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Wrap up and Validation of the Yield Forecast Project for 2015

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Abstract
During the 2015 growing season, a group of scientists from the Department of Agronomy ran a pilot project with the objective of forecasting end-of-season yields and in-season water and nitrogen dynamics (crop demand and soil supply). In-season updates were put in past ICM News articles (June 17th, July 31st, and August 14th). Briefly, this project combined the use of a cropping systems model (APSIM), a climate model (WRF), and high-resolution, in-season measurements to create the forecasts. The project focused on eight cropping systems in 2015: two sites (Ames and Sutherland), two crops (corn and soybean), and two planting dates of each crop. More details can be found in a previous ICM News article with plot management details from June 17, 2015. In this article we'll present validation results of our last forecast on September 12.

Keywords
Agronomy

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

ICM News

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During the 2015 growing season, a group of scientists from the Department of Agronomy ran a pilot project with the objective of forecasting end-of-season yields and in-season water and nitrogen dynamics (crop demand and soil supply). In-season updates were put in past ICM News articles (June 17th, July 31st, and August 14th). Briefly, this project combined the use of a cropping systems model (APSIM), a climate model (WRF), and high-resolution, in-season measurements to create the forecasts. The project focused on eight cropping systems in 2015: two sites (Ames and Sutherland), two crops (corn and soybean), and two planting dates of each crop. More details can be found in a previous ICM News article with plot management details from June 17, 2015. In this article we'll present validation results of our last forecast on September 12.

Corn yields at Ames were higher than at Sutherland, while soybean yields were higher at

Sutherland than Ames (Fig. 1; left side). In most cases, combine and hand measured yields were similar. The model predicted yields within ± 10% error in 7 of 8 cropping systems and within ± 5% error in 5 of 8 cropping systems (Fig. 1; right side). These first results are very encouraging and show that use of a well-calibrated process-based cropping system model can be of great value for end-of-season yield predictions.

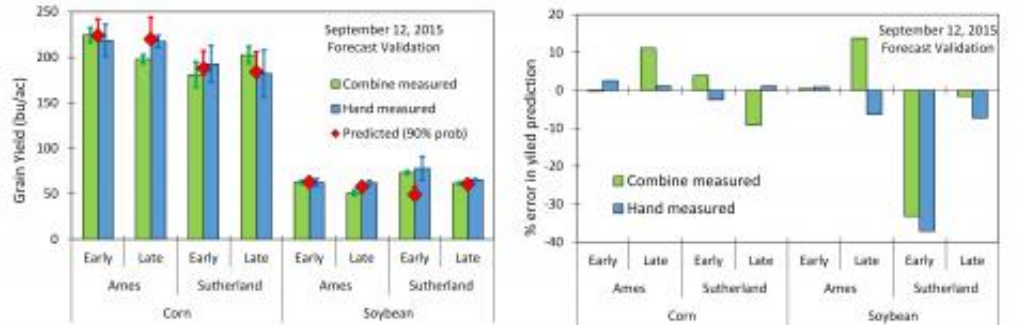

Figure 1. Predicted vs measured corn and soybean yields at the yield forecast plots near Ames and Sutherland, Iowa. Click image for larger view.

The model was also evaluated to determine if it provided the right answer (grain yield) for the right reasons by comparing in-season APSIM model predictions to additional soil and crop measurements. The model simulated reasonably well soil water, depth to groundwater, soil nitrogen dynamics, crop growth and partitioning, and tissue nitrogen concentration for all cropping systems. Figure 2 is an example from the Ames early planted corn system. Similar results were obtained for the other cropping systems (data not shown). These results indicate that the model can be used as an early warning system for crop demand and soil supply of water and nitrogen. Therefore, it can provide information that can be used to adapt in-season management when possible for optimum economic and environmental outcomes.

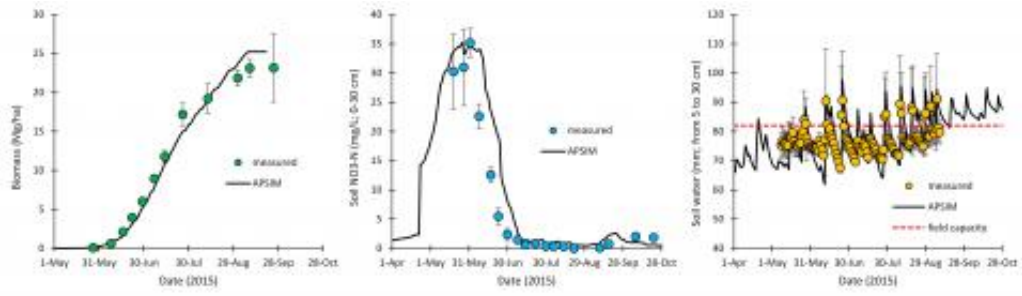

Figure 2. Measured (colored points) vs predicted (black line) crop biomass accumulation (left), soil nitrate (center), and soil water (right) for the Ames early planting corn system. The corn was planted on April 23, 2015 at 32,300 seeds/acre and received 150 lbs N/acre at planting. A 111-day Pioneer hybrid was used. The previous crop was soybean. Click image for larger view.

Actual and historical weather data of high quality, including accurate weather forecasts, are very important for forecasting soil nitrogen, water dynamics, crop growth, and development. This is because the weather variables are the main drivers of soil-crop-atmosphere dynamics. Cropping system predictions are only as good as the inputs. In 2015, the weather files were generated by using the actual weather up to the date of the forecast, the 10-day forecast from the Weather Research and Forecast model, and the 35-year historical weather to the end of the growing season. In general, the forecasted weather was good but improvements are needed. To shed light into this aspect, Figure 3 shows how the yield forecast varied over the growing season. The results illustrate that the simulated median yield (50% probability) at crop emergence is a good proxy of the final simulated yield, but there is a lot of uncertainty (10% and 90% probability). Near the time of pollination the uncertainty of the yield prediction for corn significantly decreases. For soybeans (data not shown), the simulated median yield at crop emergence was also a good proxy for the final yield, but the uncertainty in soybean yield prediction decreased during at the grain filling period, rather than at flowering. More research and sites are needed to explore these scientific questions in more detail, along with customize cropping and climate forecasts to provide accurate predictions of yields as early as possible.

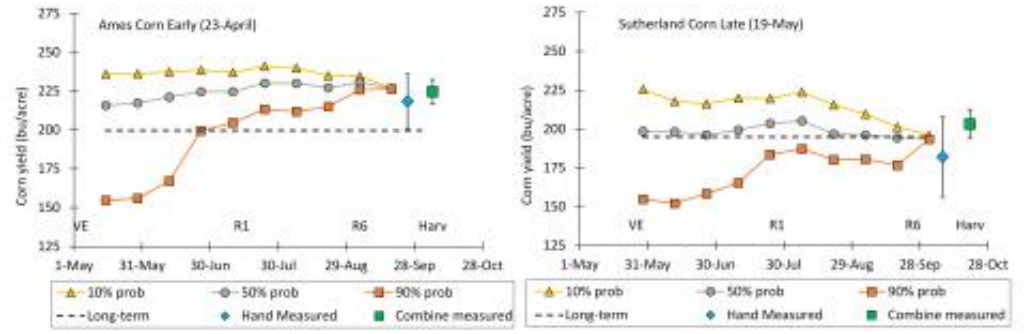

Figure 3. Yield Forecast yield predictions of corn grain yield over the 2015 growing season. Yellow triangles, grey circles, and orange squares show the probabilities of yield being above that level. Hand measured (blue diamond) and combine measured (green square) yields are also shown. Click image for larger view.

Category: Crop Production

Crops:
Corn
Soybean

Tags: yield forecast | cropping systems | crop modeling | corn yield prediction

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Dr. Sotirios Archontoulis is an assistant professor of integrated cropping systems at the Department of Agronomy. His main research interests involve understanding complex Genotype by Management by Environment interactions and modeling various components of the soil-plant-atmosphere continuum. Dr...

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