

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

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Introduction

In 2018, the Forecasting and Assessment of Cropping systems (FACTS) project was replicated to achieve 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, historical, current and Climate Forecast System (CFS) forecasted weather data, and in-field data collection. Forecasts were initiated at planting and were updated every 10 days.

In-field data were collected from both corn and soybean planted under high- and low-management regimes. Treatments were replicated three times. The crop cultivars Pioneer P1555CHR and Pioneer P36A18X were used for corn and soybean, respectively. Both levels of corn management received a spring application of 150 lb nitrogen (N)/acre as urea. Additionally, the high corn management received an additional 150 lb N/acre in the form of 32 percent UAN at V6. The corn plots were planted at a seeding rate

of 45,000 seeds/acre and 33,000 seeds/acre for the high- and low-management plots, respectively. The soybean high-management plots were planted at a seeding rate of 160,000 seeds/acre and 150 lb N/acre was applied at R1 and R3. The low-management plots were planted at 130,000 seeds/acre with no N applied. Additionally, the high-management plots received a pre-planting application of 100 lb P/acre, 100 lb K/acre, and 30 lb S/acre for both the corn and soybeans. Soybean high-management plots were irrigated from July 26 to August 13 for a total amount of two inches. Weather and crop data collection included crop staging, soil temperature and moisture, soil nitrate-nitrogen, root depth, crop biomass, and grain yield. The in-field data collection was used to validate the forecast simulations.

Results and Discussion

In 2018, soybean yields were 59.4 bushels/acre (± 2.4) and 66.8 bushels/acre (± 1.7) in the low- and high-management plots, respectively. It is believed the yield benefit in the high-input management was due to supplemental irrigation occurring during July, a period with dry conditions (Figure 1, panel A). Higher-than-normal temperatures in May and June accelerated crop development, thus soil water and nitrogen uptake was greater than the 35-year average according to model forecasts (Figure 2). Significant rain in late August and September made harvest challenging.

There was a significant windstorm in the area at the end of June, which resulted in green-snap damage throughout the corn plots (Figure 1, panel B). As a result, only combine yields were taken on these plots, which averaged around 75 bushels/acre.

Acknowledgements

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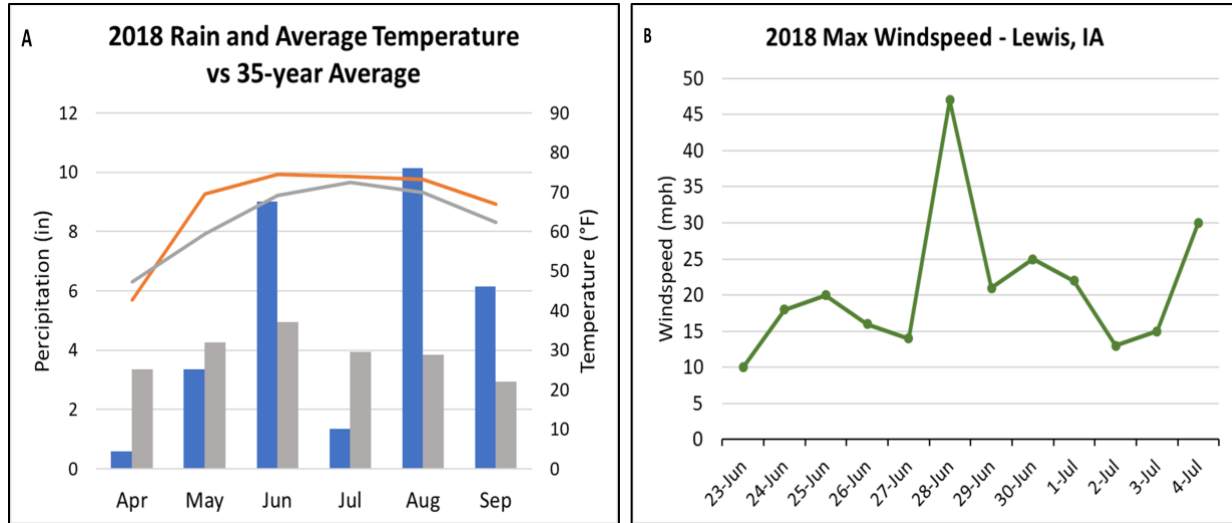


Figure 1. Panel A: Monthly average rain (blue bars) and temperature (orange line) during the 2018 growing season versus the 35-yr average for rain (gray bars) and temperature (gray line). Panel B: Maximum windspeed during a 12-day period surrounding the greensnap event in the corn plots.

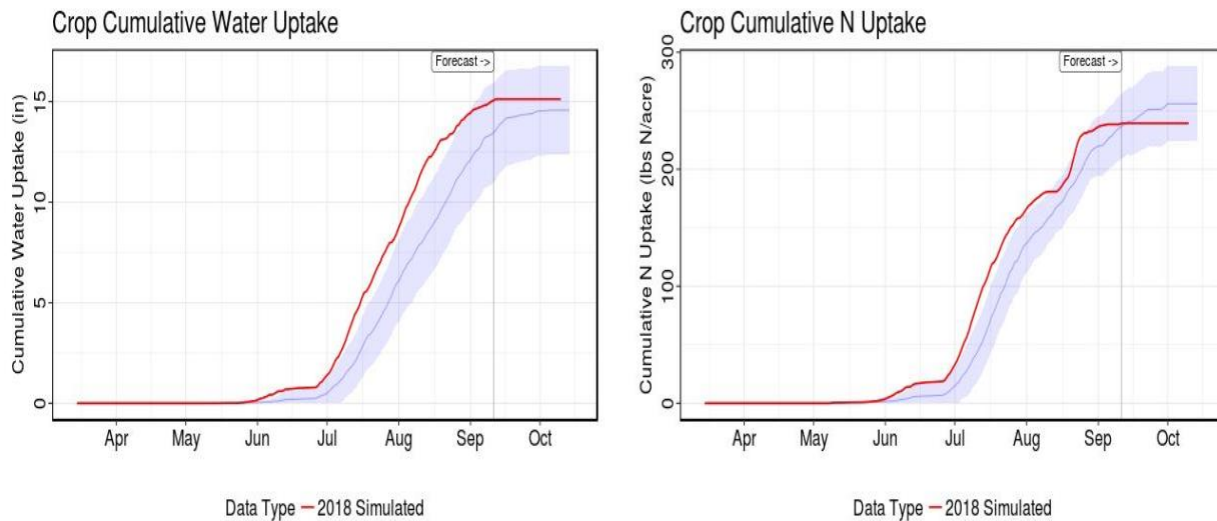


Figure 2. Forecasted water and nitrogen uptake for low-management soybean plots during 2018. Figure taken from Iowa State University’s FACTS website (<https://crops.extension.iastate.edu/facts/>).