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

RFR-A1794

Sotirios Archontoulis, assistant professor
Mark Licht, assistant professor
Raziel Ordóñez, postdoc researcher
Department of Agronomy

Introduction

In 2017, the Yield Forecasting (FACTS) project was replicated to achive 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-season crop field data for model inputs were collected from two corn and two soybean experimental plots.

The main factor in these experiments was two planting date treatments (early and late). Treatments were replicated three times. The crop varieties Pioneer P1555CHR and Pioneer P34T07R2 were used for corn and soybean, respectively. Planting date occured April 13 and May 5 for corn, and April 24 and May 15 for soybean. Both crops were planted using standard seeding rates commonly used in this area, 34,000 seeds/acre for corn and 16,000 seeds/acre for soybean. Crop agronomic practices were implemented, in an effort to mimic those used by farmers in this region. Broadcast nitrogen was applied to the corn stubble at a rate of 150 lb N/acre pre-planting followed by field cultivation. Soybean plots did not have any nitrogen applied. 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

The average corn yield was 197 bushels/acre in the early-planted plots and about 193 bushels/acre in the late-planted plots (Table 1). The higher corn yields at the early planting date were attributed to more kernels per ear and higher kernel weights. The soybean yields were 65 and 66 bushels/acre in the early and late plots, respectively. The lack of yield differences is a result of very similar number of nodes/plant, pods/plant, and plant biomass accumulation (Figure 1b).

Averaging all the data together, early and late planted corn roots were 5 in. deeper than soybean root growth (Figure 1). Biomass accumulation was consistently higher in the early versus late planting for corn, and soybean biomass was almost the same between the early and late plantings during the entire growing season.

Acknowledgements

This project would not have been possible without the funding support from DuPont Pioneer, Iowa Soybean Association, ISU Department of Agronomy, and ISU

Agriculture and Natural Resources Extension. This was a collaborative project involving many faculty, staff, and students. A special thanks to the farm manager, Dallas Maxwell, and ag specialist Daniel Schaben.

Table 1. Corn and soybean grain yields with select yield components for 2017.

Planting	Combine yield (bu/ac)	Kernel/ear (lb)	Kernel (mg/kernel)
Corn			
Early	197.1 ± 2.9	494.1 ± 41.4	332.7 ± 15.0
Late	193.3 ± 15.5	468.2 ± 37.8	317.5 ± 12.0

Planting	Combine yield (bu/ac)	Nodes/plant	Pods/plant
Soybean			
Early	65.2 ± 1.2	18.1 ± 0.5	38.4 ± 4.7
Late	66.2 ± 1.4	18.5 ± 0.2	38.4 ± 4.6

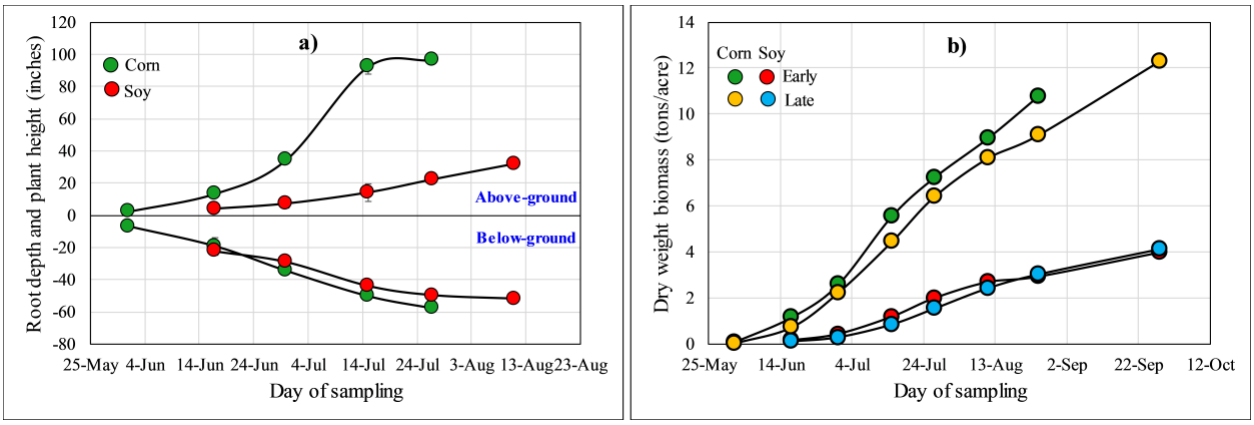

Figure 1. Root depth and plant height (left panel, a), and biomass accumulation (right panel, b) during the 2017 growing season for both corn and soybean for early and late planting dates.