Scheduling Nitrogen Applications in Maize with a Simulation Model

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Introduction

- High maize (*Zea Mays* L.) yield requires high nitrogen input levels
- Nitrogen in the soil is difficult to manage due to its dynamic nature
- Models are decision support tools that can assist farmers to manage nitrogen efficiently
- Most models used in the United States were developed for the Midwest. Few are adapted for the southeastern Coastal Plain

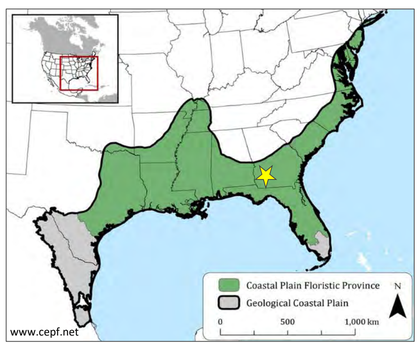

Fig. 1. Location of the experimental site in the U.S. southeastern Coastal Plain

Objectives

- Adapt a maize nitrogen use simulation model to the Southeastern Coastal Plain
- Use the model to predict real-time soil nitrogen availability for maize
- Incorporate the model into the SmartIrrigation Corn App - a tool for scheduling irrigation

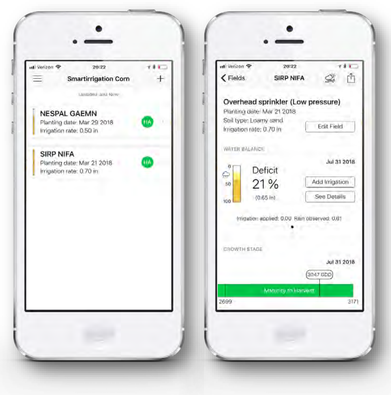

Fig. 2. Screenshots of the SmartIrrigation Corn App

Materials & Methods

Model STICS *(Simulateur mulTIdisciplinaire pour les Cultures Standard)* France, INRA

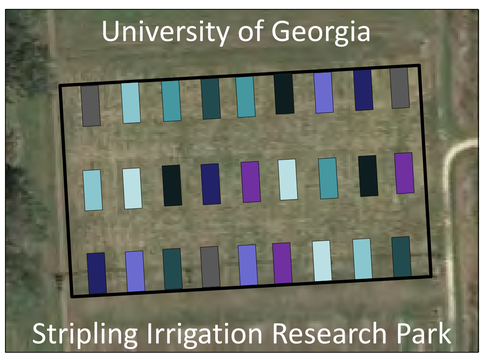

Fig. 3. Field experiment: 27 plots consisting of 9 treatments with 3 replicates each (3 irrigation × 3 fertilisation treatments)

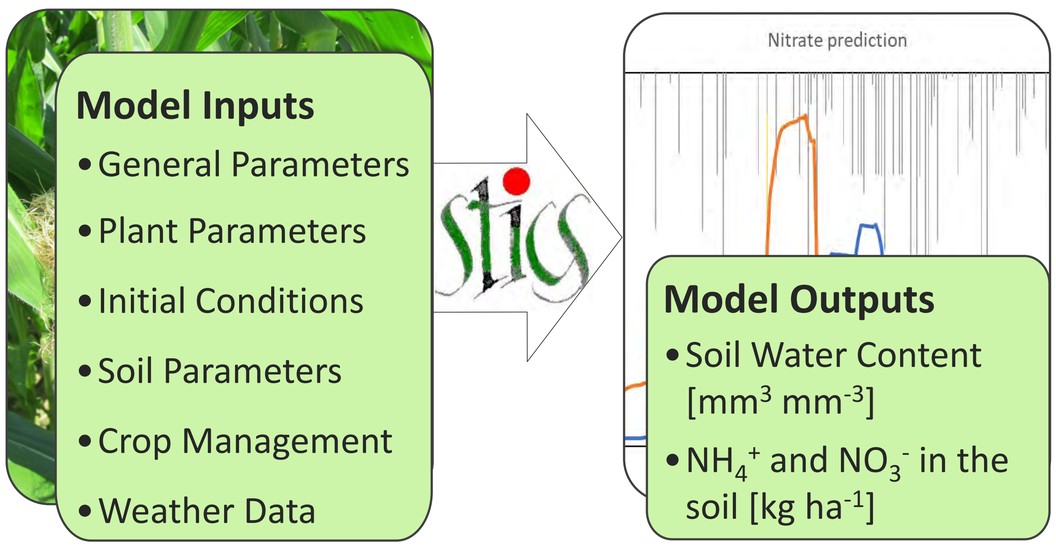

Fig. 4. Lateral used for irrigation and fertigation

Fig. 5. UGA SSA soil water tension sensor

Calibration

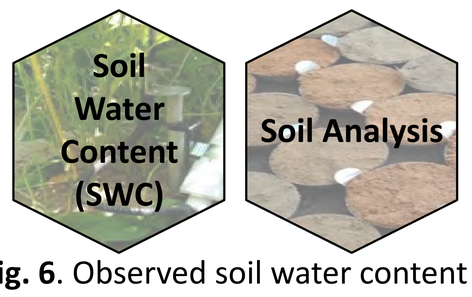

Fig. 6. Observed soil water content ($mm^3\ mm^{-3}$) and soil N content from soil analysis ($kg\ ha^{-1}$) data used for calibration

Validation

- Eight treatments from 2018
- Real-time scheduling during 2019 growing season

Results

Calibration and Validation with 2018 Data

Treatment = 336 kg ha^{-1} N applied as preplant, at planting, and one side-dress × irrigation scheduling using calendar method

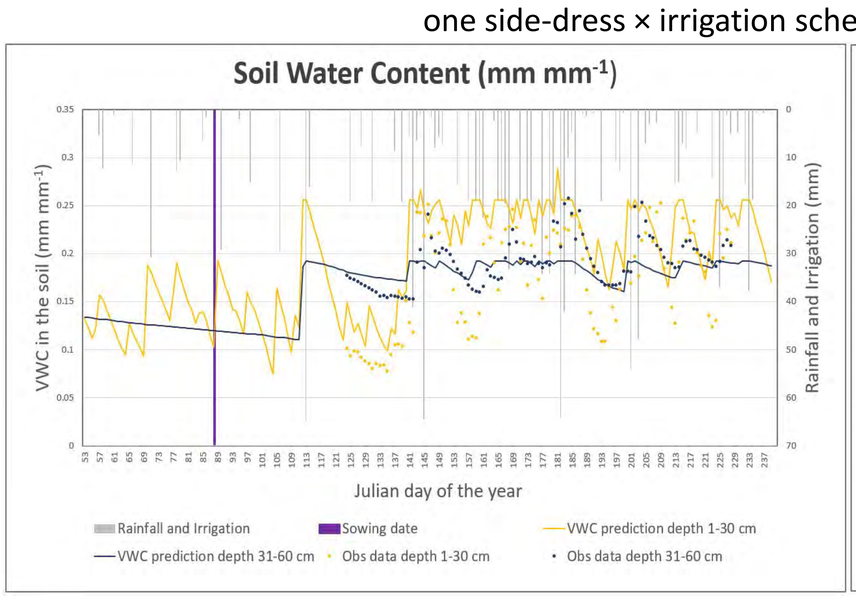

Fig. 7. STICS calibration of soil water content (VWC) at depths 1-30 cm and 31-60 cm [$mm^3\ mm^{-3}$] of treatment (2018)

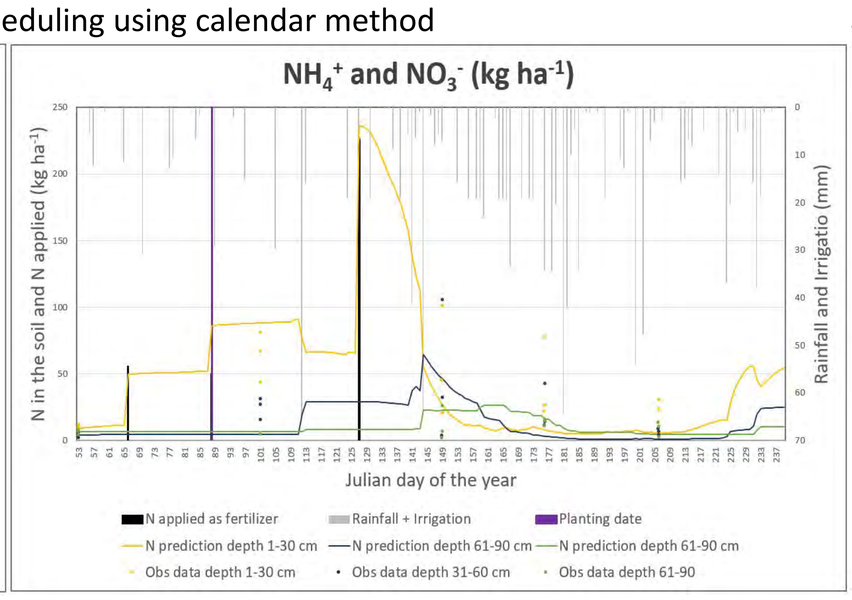

Fig. 8. STICS calibration of NH_4^+ and NO_3^- in the soil at depths 1-30 cm, 31-60 cm and 61-90 cm [$kg\ ha^{-1}$] of treatment (2018)

Real-Time Prediction in 2019

Treatment = 280 kg ha^{-1} N applied as preplant, at planting, and 5 side-dress fertigation × Corn App irrigation scheduling

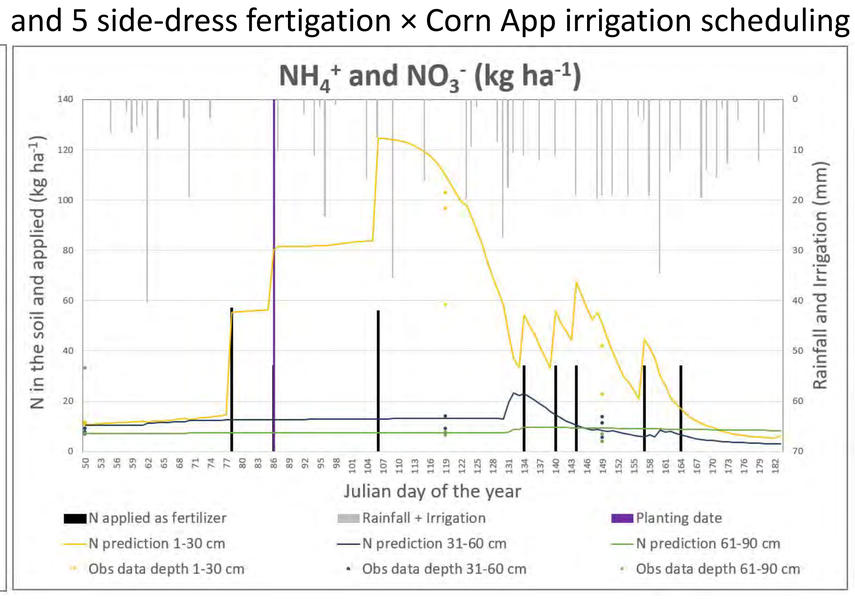

Fig. 9. Simulation of NH_4^+ and NO_3^- in the soil at depths 1-30 cm, 31-60 cm and 61-90 cm [$kg\ ha^{-1}$] of fertigation treatment in which STICS is used to schedule N applications (2019)

Ongoing Work and Conclusions

- Model calibration and validation showed promising results
- Evaluation of the model in real-time during the 2019 growing season
- Model is used to predict the timing of 5 fertigation applications as shown in Fig. 9
- Model is continuously validated with soil and tissue samples
- Model will be incorporated into the SmartIrrigation Corn App to allow farmers to schedule both irrigation and fertigation

Potential Impact

- SmartIrrigation Corn App has resulted in 40% increase in irrigation water use efficiency when compared to traditional methods
- Goal is for the nitrogen component of the SmartIrrigation Corn App to allow corn growers to increase nitrogen use efficiency by more than 20%

Acknowledgements

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