College of Food, Agricultural, and Environmental Sciences
Department of Horticulture and Crop Science

CFAES

Elucidating how N management practices and excess water conditions affect corn N uptake and grain yield

Wanderson Novais[1], Christine D. Sprunger[2], Laura E. Lindsey[1], Sami Khanal[3], Osler Ortez[1], Meredith Mann[2], and Alex. J. Lindsey[1]. 1. Horticulture and Crop Science Department, The Ohio State University, 2. Department of Food, Agricultural and Biological Engineering, The Ohio State University, 3. W.K. Kellogg Biological Station and The Department of Plant, Soil, and Microbial Sciences, Michigan State University.

Introduction

- Precipitation has been increasing in the Midwest region [1].
- Due to climate change, more flooding and waterlogging events should be expected [1].
- Waterlogging causes yield reduction and environmental N losses [2].
- Corn Nitrogen Rate Calculator does not account for N applications or water excess [3].
- It is critical to understand how N rates and water excess affect corn growth and yield.

Objective

This research aims to quantify how N application practices before and after waterlogging affect corn N uptake and yield.

Material and Methods

- Field experiment started in 2021 in Custar, Ohio.
- A split-plot randomized complete block design were implemented.
- The whole plot factor was waterlogging duration (WD): 0 days, 3 days (Term 1), 3+3 days (Term 2).
- The subplot plot factors were N pre-planting at 0 or 110 kg N ha^{-1} combined with N post-waterlogging applications 0, 67, 134, or 202 kg N ha^{-1} .
- Waterlogging implemented at V4 growth stage.
- Biomass and soil nitrate were measured over time.
- The statistical analysis were performed in SAS mixed effect model for earleaf, stalk nitrate, and yield.
- Pairwise comparison were performed using paired t-test ($p < 0.05$).

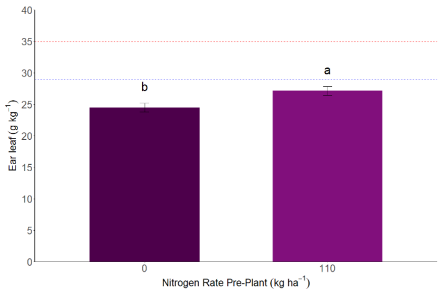

Figure 1: Ear leaf N content of each pre-plant N treatment across WD and post-waterlogging N. Dashed lines represent optimum levels for ear leaf N. Different letters are statistically significant ($p < 0.05$).

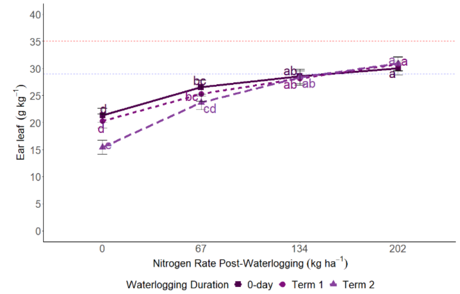

Figure 2: Ear leaf N content of each post-waterlogging N treatment across pre-plant N rate. Dashed lines represent optimum levels for ear leaf N. Different letters are statistically significant ($p < 0.05$).

Corn is still responsive to N after repeated waterlogging. All is not lost!

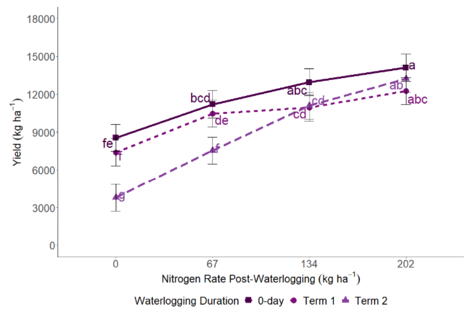

Figure 3: Corn yield in kg ha^{-1} as influenced by WD and post-waterlogging N application across N pre-plant. Different colors denote different WD treatments. Different letters are statistically significant ($p < 0.05$).

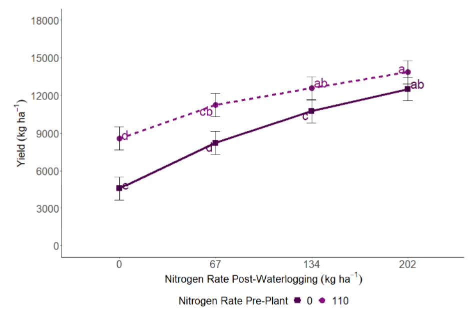

Figure 4: Corn yield in kg ha^{-1} as influenced by pre-plant N and post-waterlogging N applications across WD. Different colors denote different pre-plant N treatments. Different letters are statistically significant ($p < 0.05$).

Discussion and Conclusions

- Repeated waterlogging (3+3-days) delayed plant growth and resulted in a yield penalty.
- Post-waterlogging at 134 and 202 kg N ha^{-1} maintained yield for single and repeated waterlogging.
- Earleaf N concentration was below optimum range.
- For stalk nitrate, no treatments were above the optimum range (data not shown).
- This trial will be repeated in 2022 and 2023 at more Ohio locations to ensure responsible N recommendations to help farmers optimize yield in areas prone to flooding.

Figure 5: Field experiment taken 24 days after waterlogging initiation. Differences in plant color are attributed to waterlogging and N application treatments .

Acknowledgments

- Nasib Koirala, Alayna Call, Katelyn Hartman, Cori Lee, Wesley Fauver, and Isabel Delamater for their help with the study.
- The Sprunger Lab for their collaboration.
- Northwest Agricultural Research Station staff for their help.
- Funding from USDA-NIFA Award 2021-67013-33615.

References

[1] Dai, S., M.D. Shulski, K.G. Hubbard, and E.S. Takle. 2016. A spatiotemporal analysis of Midwest US temperature and precipitation trends during the growing season from 1980 to 2013. International Journal of Climatology 36(1): 517–525. doi: 10.1002/joc.4354.

[2] Kaur, G., Singh, G., Motavalli, P.P., Nelson, K.A., Orlowski, J.M. and Golden, B.R., 2020. Impacts and management strategies for crop production in waterlogged or flooded soils: A review. Agronomy Journal, 112(3), pp.1475-1501.

[3] ISU, I.S.U.A.E. and O. 2020. Corn Nitrogen Calculator. http://cnrc.agron.iastate.edu/nRate.aspx (accessed 3 June 2021).

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

USDA NIFA

hcs.osu.edu
@novaiswander