The root of the rotation effect: does diversification change maize roots?

A Data Management Plan created using DMPTool

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Template: U.S. Department of Agriculture (USDA)

Project abstract:

The Iowan landscape is largely dominated by a simple rotation of rainfed maize (Zea mays) and soybean (Glycine max). This rotation of continuous summer annuals leaves the soil vulnerable to erosion and nutrient leaching, negatively impacting both soil health and the environment. Research has shown diversifying these systems can ameliorate these side effects, while also supporting higher and more stable maize yields. The higher yield stabilities may help convince farmers of the production value of diversification, in addition to its environmental benefits. However, although decreased yield variability is likely associated with changes in nutrient and water acquisition, the exact mechanisms for yield stabilization remain unclear. Preliminary data has suggested differences in maize root profiles in 2- and 4-year rotations, but a comprehensive systems-based approach would shed light into how yields are being stabilized. The aim of this project is to utilize long-term research plots with 2- and 4-year maize rotations to quantify (i) the root front velocity across the season, (ii) the seasonal soil water dynamics at 15 and 45 cm depths, (ii) the maize root biomass and length across the 0-2m profile at physiological maturity, coupled with above-ground biomass, and (iii) yield components of the maize (kernel number and weight). This study is unique in that it will link behavior of the plants below-ground (where water and nutrients are acquired), and above-ground (where the cumulative effects of this access are expressed). This study will provide much needed insight into yield-stabilizing mechanisms of crop diversification.

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Expected Data Type

Describe the type of data (e.g. digital, non-digital), how it will be generated, and whether the data are primary or metadata. Research examples include: lab work, field work and surveys; Education examples include: number of students enrolled/participated, degrees granted, curriculum, and training products; Extension examples include: outreach materials, number of stakeholders reached, number of activities, and assessment questionnaires.

A long-term crop rotation site will host data collection for this study. The site includes 3 cropping system treatments: a 2-year rotation of maize-soybean, a 3-year rotation of maize-soybean-oats/red clover, and a 4-year rotation of maize-soybean-oats/alfalfa-alfalfa. Every phase of every cropping system is present each year with 4 replicates arranged in a randomized complete block design. For this study, we will look at the maize phase of the 2- and 4-year rotations over the period of two years (2018-2019).

Soil moisture will be collected every 2 hours using in-situ sensors (Decagon 5 TM connected to an EMXXX Data Logger) installed at 15 and 45 cm depths in the center of each plot at corn planting. Data will be downloaded every two weeks and saved to a cloud account, a hard-drive, and an external hard-drive. Sensors will be removed at maize harvest.

Root front velocities and above-ground maize biomass will be collected by hand every 2 weeks as weather allows, with data recorded manually into data templates. Raw data sheets will be scanned and saved. They will be entered into an electronic csv template within 24 hours of collection. The csv files will be saved to a cloud account, a hard-drive, and an external hard-drive.

End-of-season root biomass and above-ground biomass will likewise be recorded by hand and transferred to electronic form as the data becomes available.

Site management details will be recorded by the lab technician in electronic form on a cloud account. Final season management details will be saved as a separate file (one for 2018, one for 2019) on a cloud account, a hard-drive, and an external hard-drive.

Data Format

For scientific data to be readily accessible and usable it is critical to use an appropriate community-recognized standard and machine readable formats when they exist. If the data will be managed in domain-specific workspaces or submitted to public databases, indicate that their required formats will be followed. Regardless of the format used, the data set must contain enough information to allow independent use (understand, validate and use) of the data.

All data will be stored as csv files. All data processing will be done with R.

Data Storage and Preservation

Data must be stored in a safe environment with adequate measures taken for its long-term preservation. Applicants must describe plans for storing and preserving their data during and after the project and specify the data repositories, if they exist. Databases or data repositories for long-term preservation may be the same that are used to provide Data Sharing and Public Access. Estimate how much data will be preserved and state the planned retention period. Include any strategies, tools, and contingency plans that will be used to avoid data loss, degradation, or damage.

The csv files and R code will be saved to a shared cloud account, a hard-drive, and an external hard-drive. Any data and code specific to a published manuscript will be posted to a public github account.

Data Sharing and Public Access

Describe your data access and sharing procedures during and after the grant. Name specific repositories and catalogs as appropriate. include a statement, when applicable, of plans to protect confidentiality, personal privacy, proprietary interests, business confidential information, and intellectual property rights. Outline any restrictions such as copyright, confidentiality, patent, appropriate credit, disclaimers, or conditions for use of the data by other parties.

All data and code will be posted to my personal public github repository. Data and code will also be stored in the cloud-based sharing tool Cybox in folders accessible to major professors Dr. Sotiris Archontoulis and Dr. Matt Liebman, and any collaborators or co-authors on journal manuscripts resulting from this work.

Roles and Responsibilities

Who will ensure DMP implementation? This is particularly important for multi-investigator and multi-institutional projects. Provide a contingency plan in case key personnel leave the project. Also, what resources will be needed for the DMP? If funds are needed, have they been added to the budget request and budget narrative? Projects must budget sufficient resources to develop and implement the proposed DMP.

As the graduate student in charge of managing the collection and reporting of the data, I will ensure the implementation of the DMP. I will require no additional funding.

Monitoring and Reporting

Successful projects should monitor the implementation of the DMP throughout the life of the project and after, as appropriate. Implementation of the DMP must be a component of annual and final reports to NIFA (REEport) and include progress in data sharing (publications, database, software, curriculum, outreach materials, etc.). The final report should also describe the data that was produced during the award period and the components that will be stored and preserved (including the expected duration) after the award ends. The DMP should be compliant with the Research Terms and Conditions that govern NIFA-funded project. The DMP is not intended to be a replacement for other grant reporting requirements.

Monitoring will be done during the month of March, after the completion of data collection from the previous field season. At that time, all collected data will be appropriately arranged and archived according to this DMP.