Leveraging phenotyping to inform development of process-based plant models

Sajad Jamshidi[1], Sujata Bogati[1], Sam Schafer[1], To-Chia Ting[1], Luis Vargas[1], and Diane Wang[1]

[1]Affiliation not available

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Abstract

Phenotyping plays a crucial role in parameterizing, calibrating, and evaluating process-based plant models, which can be used to understand and predict crop behavior under various conditions. This, in turn, allows for more informed decision-making in agriculture and provides insights into how crops may respond to changing environmental factors. Nevertheless, several potential disparities between current plant models and phenotyping methods exist, which have the potential to undermine the precision and applicability of these models. These discrepancies encompass differences in data resolution and scale (both spatial and temporal) between what is feasibly gathered during phenotyping efforts and what is required by the models. Additionally, issues related to compatibility between the traits measured during phenotyping campaigns and the parameters required for models are prevalent. Furthermore, the representation of genetic and environmental variability in both models and phenotyping data is often limited, resulting in a gap between these two components.

To address these discrepancies, we are developing a new "minimum" plant model. This model has been designed with strong consideration of what data can be measured in phenotyping campaigns across multiple genotypes. While the core model remains straightforward, it has the capability to simulate essential processes to represent fundamental plant physiology. Moreover, it has the potential to be integrated into larger, more comprehensive models or parameterized to suit specific genotypes. This approach aims to bridge the gap between phenotyping and crop models, thus enhancing their effectiveness in addressing the challenges that emerge by utilizing them in broader agricultural applications.

***Sajad Jamshidi*[1]**, *Sujata Bogati[1], Sam Schafer[1], To-Chia Ting[1], Luis Vargas[1], Diane Wang[1]*

[1]Purdue University, West Lafayette, United States

ORCiD: 0000-0001-7211-3109

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