Simulation and Optimization of Maize Phyllotaxy and Planting Pattern to Intercept More Radiation

Zhaocheng Xiang[1] and Yufeng Ge[1]

[1]Affiliation not available

October 18, 2023

Abstract

Maximizing crop yield while conserving resources is a pressing challenge in modern agriculture. Maize (*Zea mays L.*), a staple crop worldwide, relies heavily on photosynthesis, making radiation interception a pivotal factor in crop growth and yield. This study presents a novel approach to improve maize crop productivity by harnessing the principles of phyllotaxy and optimizing planting patterns to efficiently intercept solar radiation. Through the enhanced 3D maize model generation algorithm, the simulation incorporates critical factors such as curved surface leaf area, leaf arrangement, plant spacing, and solar angles, allowing us to quantify the radiation intercepted by the maize canopy. We investigate the most efficient phyllotaxy for individual plants and evaluate a range of planting patterns and their impact on radiation interception at various growth stages. Simulation results reveal that optimizing planting patterns based on phyllotactic principles can substantially enhance radiation capture compared to traditional planting methods. In conclusion, our research signifies a significant step towards harnessing the power of plant arrangement and optimizing planting strategies, including the use of an enhanced 3D maize model, to maximize radiation interception in maize crops. The optimal phyllotaxis and planting patterns establish a distinct phenological target for breeders. These findings hold promise for the development of more resilient and productive agricultural systems in an era of growing global food demand and resource constraints.

Zhaocheng Xiang[1], *Yufeng Ge[1]*

[1]Biological Systems Engineering Department, University of Nebraska–Lincoln, Chase Hall, East Campus, Lincoln, NE 68503, USA

ORCiD: 0000-0001-5572-088X

Keywords: Maize Canopy, Phyllotaxis, Light Interception, Planting Pattern, Simulation, Crop Modelling