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Optimizing Sweet Potatoes Yield: An Advanced Modelling using SORDs Constructed using Trigonometric Functions

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Sweet potato (\textit{Ipomoea batatas}) is a vital food crop with the potential to enhance global food security. However, its yield optimization remains a challenge due to soil fertility variations, climatic factors, and inefficient agronomic practices. Traditional experimental designs often fail to capture complex interactions between variables, necessitating advanced optimization techniques. This study employs second-order rotatable designs (SORD) constructed using trigonometric functions to model and optimize sweet potato yield under different organic fertilizer applications. The objective is to determine the most effective combination and application rate of poultry, goat, and rabbit manure for maximizing yield. A SORD with 23 design points was implemented to ensure uniform precision across the factor space. Field experiments were conducted using randomized block designs, and data were analyzed using response surface methodology (RSM). The results indicate that poultry manure significantly enhances sweet potato yield compared to goat and rabbit manure. However, a combination of poultry and goat manure in a 3:2 ratio provided the highest yield increase. The trigonometric-based SORD approach effectively captured interactions and quadratic effects, leading to precise yield optimization. The study concludes that SORD constructed with trigonometric functions offers an efficient framework for optimizing crop yield under varying soil fertility conditions. It is recommended that farmers adopt a mixed manure approach to improve sweet potato productivity sustainably. Further research should explore the integration of additional soil amendments, long-term soil health effects, and the impact of climate variability on sweet potato yield using advanced modeling techniques.

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