（学位第３号様式）

学　位　論　文　要　旨

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題　目	Effects of P-dipping on NERICA 4 Rice Resilience to Moisture and Phosphorus Stresses at Early Growth Stages (イネ品種 NERICA 4 の生育初期における土壌水分およびリン酸ストレスに対する P-dipping の効果)

Drought stress and phosphorus (P) deficiency are major abiotic factors limiting rice yields in sub-Saharan Africa (SSA). The P deficiency is mainly caused by the highly weathered soils in the tropics, which are low in available P and high in P-sorption capacity owing to their acidity and high content of Fe and Al oxides. Soil water status and the availability of P to rice plants are strongly related. Given that dry spells are becoming more prevalent, the need to optimize water and P use to improve rice production cannot be overemphasized. To improve the available P supply in the highly weathered soils, farmers use several P application methods, one of which is P-dipping, i.e., dipping the root of seedlings into P-enriched slurry before transplanting. However, little is known about the effect of P-dipping on the root distribution of NERICA varieties under soil P and water stress conditions, and in different soil textures at the initial growth stages.

We conducted a split-plot pot research experiment to determine how the effect of localized P application via P-dipping on NERICA 4 rice growth interacts with two water regimes, including waterlogging and moderately dry. Results showed that shoot dry weight and plant length differed significantly under the various P-dipping application levels, with an application of 40 kg P ha^{-1} providing the highest mean values under both water treatments. While the mean leaf area did not statistically differ among the P-dipping treatment levels under the moderately dry condition, all P-dipping treatments had increased leaf area relative to that observed without P-dipping. Mean root length differed significantly between the water treatments, whereas the mean root dry weight was higher with the P-dipping treatments than without P-dipping under both water conditions (36% and 8% mean increases under the waterlogged and moderately dry treatments, respectively). These findings show that P-dipping improves the ability of NERICA 4 rice seedlings to withstand water and nutrient stresses under rainfed lowland at early growth stages.

We also evaluated the combined effect of soil texture (sand, clay loam, and clay) and P treatments P-dipping (Pdip) and two other broadcasted P fertilizer levels (Brod1 and Brod2) on the growth of NERICA 4 rice in the initial growth stages in a factorial experiment. Findings showed that across all soil textures and P treatments, total plant biomass ranged from 1.06 to 4.63 g pot^{-1}. The Pdip treatment significantly increased shoot and root biomass relative to control from 1.27 to 1.98 and 0.23 to 0.38 g pot^{-1}, respectively. Mean photosynthetic rate values under Pdip (20.1 μmol m^{-2} s^{-1}), Brod2 (19.5 μmol m^{-2} s^{-1}), and Brod1 (19.3 μmol m^{-2} s^{-1}) treatments showed significant 42%, 37%, and 36% increases over control, regardless of soil texture. In striking contrast, P-dipping significantly promoted growth of root length under clay soil, but without a commensurate increase in shoot P uptake. The findings of our studies provide new insights into improving P uptake and use efficiency for the widely adapted NERICA 4 rice variety across SSA.