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Combined Phosphorus and Water Management Options Towards Sustainable Intensification of Rice Production in P-Deficient Lowlands of Sub-Saharan Africa

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Abstract

In large parts of sub-Saharan Africa (SSA), rice (*Oryza* spp.) serves as an important staple crop. Population growth and urbanisation drastically increase rice consumption. Rice production should concomitantly increase to reduce dependence on rice imports, which endangers food security in many African countries.

Drought and low phosphorus (P) availability are two major abiotic constraints for lowland rice production in SSA. With increasing prevalence of water scarcity and the decline of phosphate reserves, it is urgent to develop sustainable solutions countering these limitations. Therefore, research towards the optimisation of management practices in P and/or drought prone lowland systems is needed to identify opportunities for improvement of resource use efficiencies and rice production.

Both water and P availability can influence root development in several ways. Understanding root plasticity under specific combinations of P and water management is important in efforts towards enhancing resilience to both stresses. There is an urgent need to investigate under which moisture conditions several P fertilisation techniques are applicable and it is important to understand the effects of management combinations on shoot and root development, before recommending them as sustainable intensification strategies.

In this study, several combinations of water saving technologies (i.e. alternate wetting and drying and permanent aerobic rice) and specific P fertilisation techniques (i.e. micro-dose placements and broadcasting) were tested in P deficient lowlands. Plant establishment, root development, yields, and fertiliser and water use efficiency were examined in order to identify best bet management options towards sustainable intensification of drought-prone and P-deficient rice growing lowlands.

Promising effects of P micro-dosing were observed under each water management scenario, but attention should be paid to counteract further P mining of the depleted soils. Root development was predominantly affected by water management. Rooting depth and lateral thickness increased under the water saving technologies, demonstrating that reduced water application can additionally enhance resilience and alleviate stress during drought periods. Reduced water application not only increases water productivity but also enhances the production when P is limiting. It is concluded that strategic combinations of P and water management can contribute to the intensification of rice production in P deficient lowlands.

Keywords: Lowland rice, phosphorus (P) fertilisation, P deficiency, water saving technologies

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