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"Competing pathways for equitable food systems transformation: Trade-offs and synergies"

Alternate wetting and severe drying: A sustainable irrigation strategy for rice production in Burkina Faso?

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Abstract

In the context of water scarcity and increasing fertiliser prices, reducing water input, while maintaining yield and nutrient use efficiency are of critical importance for sustainable production of irrigated rice. Alternate wetting and moderate drying irrigation (AWD15) (i.e., re-irrigation when the water level reaches 15 cm below the soil surface) proved to be an efficient water-saving technology in semi-arid zones of sub-Saharan Africa (SSA) as it allows for the reduction of water input without yield penalty. Alternate wetting and severe drying (AWD30) (i.e., re-irrigation when the water level reaches 30 cm below the soil surface) could further reduce the water input in comparison with farmers' irrigation practices (FP). However, the acute drying phases during its implementation may cause NO_3^-N losses through nitrification and denitrification and reduce the bio-availability of some key nutrients. What are the main potentials and risks of this technology for smallholder rice farmers in semi-arid zones of SSA? To answer this question, from 2019 to 2020, we conducted 33 on-farm field trials in Kou Valley, Burkina Faso, over three seasons and assessed yield, water productivity, nutrients use efficiency, and uptake under two different water management practices: AWD30 and FP. Compared with FP, AWD30 reduced irrigation water input by 37 % with no significant effects on grain yields (mean of 4.8 Mg ha^{-1}), thus increasing water productivity by 45 %. FP and AWD30 were comparable in terms of agronomic N, P, and K use efficiency and apparent N recovery, N, K uptakes, and Mn, Fe, and Zn tissue concentration. However, N content in straw, P and K contents in grain, and total P uptake were 11–16 % lower in AWD30 than in FP plots. In conclusion, AWD30 appears to be an effective strategy to save irrigation water without significant yield and N, P, and K use efficiency reduction. Therefore, AWD30 could be promoted as a substitute for farmers' irrigation practices in semi-arid zones of SSA. However, the observed P and K content reduction in grain points towards possible negative hidden impacts on grain quality and yield under certain conditions. Further studies could unravel the suitable domains for the implementation of AWD30.

Keywords: Agronomic use efficiency, drought, *Oryza* spp., water saving technology, West Africa, yield

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