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Plants and Microbes Respond Differently to Fertilization and Environmental Factors in a Kenyan Rice Field

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Aim:

In sub-Saharan Africa, rice is an important food crop and its demand is rising. Yields are, however, well below the average in other countries. Intensification is necessary to secure domestic production, but negative environmental impacts must be minimized.

Method:

At the KALRO station in Mwea, Kenya, an agronomic trial was conducted in a paddy rice field, where manure and NPK fertilization were compared. Yield, soil properties and microbial communities were investigated. Different groups of microbes were quantified by ddPCR and their community composition was determined by high-throughput amplicon sequencing of appropriate phylogenetic markers.

Results:

NPK fertilization gave rise to significantly higher grain and straw yield. SOC and TN decreased with soil depth, but no fertilizer effect was obvious. Similarly, no fertilizer effects were observed on concentrations of Nmin. For all investigated microbial groups, a significant decrease in abundance was observed with soil depth at the reproductive plant stage. Microbial community compositions responded in different ways to the environmental factors soil depth, plant stage or fertilization. Additionally, an unintended spatial effect was observed which could have potentially masked more subtle influences on microbial community composition.

Conclusions:

Increased NPK fertilization can substantially booster rice production in SSA, but costs are often too high for local farmers. No negative environmental impacts of NPK fertilization at the applied dose could be observed on soil properties, microbial abundances and belowground biodiversity. Manure is of low quality and cannot provide the nutrients necessary for good yields, but a combination of both could be promising option for rice yield increase at an affordable price.