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Drainage, dolomite, and natural phosphate utilisation as tools to mitigate iron toxicity in Burkina Faso

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Abstract

Iron and sulfide toxicities are major edaphic constraints for irrigated rice productivity in Burkina Faso. This study aims to control these constraints through drainage, fertilisation, and tolerant rice varieties. Two field experiments were conducted in dry and rainy seasons in iron-toxic conditions in the irrigated rice scheme of the Vallée du Kou. Four formulas of mineral fertilisers including control plot without any fertiliser (F1), NPK+urea (F2), NPK+Urea+Dolomite+Zn (F3), NPK+Urea+natural phosphate (F4) were applied without (SFO) and with organic manure (FO) according to two drainage modes (flooded and 14-days drainage). FRK76 (sensitive) and FKR62 (iron toxicity tolerant) rice varieties were tested. Soil samples were collected during the study to evaluate the number of Iron-Reducing Bacteria (IRB), and the Fe²⁺ content. Rice agronomic parameters and paddy yields were also determined.

The results showed the presence and activities of IRB in the soil. The Fe²⁺ concentration was higher than the critical limits known. In addition, the soil organic manure amendment increased the sulfide content. Furthermore, the soil iron ($p < 0.001$) content and all the rice varieties yields ($p = 0.002$) were significantly higher in the rainy season than in the dry season. The drainage had a significant impact on yield and the number of panicles of the iron-tolerant rice variety (FRK62N). FOF3 and FOF4 treatments improved significantly the yield ($p = 0.02$) plant tiller ($p < 0.001$) and panicle ($p = 0.002$) numbers across both rice varieties.

Indeed, selecting tolerant rice varieties, combined with periodic drainage and mineral fertilisation (NPK+urea combined with dolomite or Natural phosphate) can significantly improve the rice plant growth and yield in iron-toxic soil in all cultural seasons.

Keywords: Drainage, fertilisation, iron, rice, toxicity, variety