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Improving Potassium Use Efficiency in Rice-Based Cropping Systems on Degraded Soils in the Red River Delta of Viet Nam

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Abstract

Rice (*Oryza sativa* L.) is the staple in the North of Viet Nam and is cultivated in two distinct seasons that differ in climatic yield potential. In this 2-year study, we focused on the rice—rice—maize rotation, which is the most widespread cropping system in the Red River Delta, one of the most intensively cultivated agricultural areas in the world. We investigated opportunities to increase K use efficiency on a low-fertile Acrisol that is characterised by strong K limitations and a low CEC.

In the spring season, lowland rice yields ranged from 4.8 to 5.2 Mg ha⁻¹ irrespective of K fertiliser rates, the K splitting pattern or the application of farmyard manure or crop residues. Despite small K soil reserves, the highest grain yields were obtained when rice solely relied on residual fertiliser K, soil supply and K inputs through the irrigation water. When fertiliser K was applied, we determined very unfavourable K/Mg ratios in the plant tissue during crucial development stages of rice. This may have prevented a further yield increase despite a large increase in total K plant uptake that ranged from about 40 kg ha⁻¹ when K was omitted to 130 kg ha⁻¹ when recommended fertiliser rates were supplemented with farmyard manure.

During the summer season that is characterised by a lower yield potential, the splitting of recommended K fertiliser rates (50 % at 15 days after transplanting, 50 % before panicle initiation) significantly increased the grain yield of lowland rice by 12 % over the basal application and by 18 % over the unamended control. The average yield levels were 3.6 and 3.3 Mg ha⁻¹ with and without the application of farmyard manure, respectively. The incorporation of rice straw that added 40 to 60 kg K ha⁻¹ to the system only increased rice yields without the additional application of fertiliser K. It appeared that the K flush resulting from the quick solubilisation of K in the straw was largely lost by leaching due to the low K requirements during the early growth stages of rice and the poor K retention by the low CEC.

Keywords: Acrisol, K/Mg ratios, leaching, *Oryza sativa*, split application, straw incorporation