

Development and dissemination of an efficient fertilizer management practice for lowland rice cultivation in sub-Saharan Africa

Yasuhiro Tsujimoto (Japan International Research Center for Agricultural Sciences, JIRCAS)

tsjmt@affrc.go.jp

Abstract

Phosphorous deficiency restricts crop growth, particularly in the tropics, due to the inherently low P content of soils and the high P-fixing capacity of other minerals such as active Al- and Fe- oxides¹). Large amounts of mineral P fertilizer have been continuously applied to overcome low P-use efficiency and achieve high grain yields. However, given the finite nature of the P fertilizer resource and increasing environmental concerns about the excess use of P in agricultural systems, it is vital to investigate sustainable crop production strategies that facilitate the efficient utilization of applied and available P in soils. Such strategies are also critical for the food security of resource-poor farmers with low fertilizer inputs in developing countries. In order to overcome this problem, we have developed the P-dipping technique for lowland rice cultivation. The P-dipping is a simple manipulation to dip rice seedlings into muddy soils added with a small amount of phosphorus fertilizer (1.8%–2.6% P concentration in the slurry), whereby the seedling roots are coated with the P-enriched slurry and transplanted in the main field. The soluble P hotspot created by the technique nearby the root system facilitates initial P uptake by plants and accelerates the plant growth even under highly P-fixing soils in the tropics²). Repeated on-farm trials in Madagascar demonstrated that rice yields greatly improve with the P-dipping, and besides that the P-dipping has an advantage against low temperature stress at the end of the rainy season by shortening the growth duration and against flash flooding by accelerating the initial growth of rice³). As such, the technique simultaneously addresses phosphorus deficiency and climate-induced stresses with no needs of specific equipment or skills and suited to smallholder farmers having little capacity to purchase mineral fertilizer. Then, the technique is currently being disseminated to a large number of farmers in Madagascar.

1. Nishigaki, T., Tsujimoto, Y.*, Rinasoa, S., Rakotoson, T., Andriamanajara, A., Razafimbelo, T. 2019. Phosphorus uptake of rice plants is affected by phosphorus forms and physicochemical properties of tropical weathered soils. *Plant and Soil* 435, 27-38.
2. Oo, A. Z., Tsujimoto, Y.*, Rakotoarisoa, N. M., Kawamura, K., Nishigaki, T. 2020. P-dipping of rice seedlings increases applied P use efficiency in high P-fixing soils. *Scientific Reports* 10, 11919.
3. Rakotoarisoa, N. M., Tsujimoto, Y.*, Oo, A. Z. 2020. Dipping rice seedlings in P-enriched slurry increases grain yield and shortens days to heading on P-deficient lowlands in the central highlands of Madagascar. *Field Crops Research* 254, 107806.