

Direct application of Burkina Faso phosphate rock is highly effective on lowland rice cultivation

Phosphorus (P) is a critical nutrient for crop production all over the world. In Sub-Saharan Africa (SSA), deficit of soil P is one of the most serious constraints on crop production. This shortfall has resulted from the high P fixation capacities of highly weathered acidic soils. The lack of soil P impacts on a range of agricultural lands, including paddy soils for rice cultivation. However, few farmers in SSA can use commercial water-soluble P fertilizers to cope with this P deficiency. Resource-poor farmers can especially find it difficult to apply these chemical fertilizers because of very limited accessibility and affordability.

Phosphate rock (PR) is considered as the resource that can be a cheaper alternative to water-soluble P fertilizers such as triple super phosphate (TSP). And it was verified that PR deposits are existing in SSA. So it is imperative to propose a proper PR application method with use of local PRs. But generally, PR produced in SSA was considered to have lower effect because of its low solubility, especially on upland crop production.

However, in the direct application on paddy field, it seemed that PR solubility will be affected by its unique soil conditions. So it cannot be denied that PR direct application will show the positive effect on lowland rice production. Elucidation of the effect of PR direct application will be fundamental information for PR utilization in SSA.

This study examined the impact of direct application of fine ground sedimentary PRs produced in Kodjari, Burkina Faso (BPR) on rice production under two agro-ecological conditions of the Guinea Savanna and Equatorial Forest zones of Ghana, with several application levels as shown in Table 1. Effects of BPR direct application on rice grain yield were observed to be comparable to TSP in both agro-ecological zones (Figure 1). In BPR direct application plots, rice grain yield has increased with increase of BPR application rate. These results suggest that BPR direct application is effective on lowland rice production in Ghana. And positive correlation between plant P uptake and rice grain yield has been indicated (Figure 2). It means that applied P has increased rice grain yield effectively. Moreover BPR direct application shows high residual effect on lowland rice production (unpublished data).

Results shown in this study will have great impact on lowland rice cultivation in SSA, because BPR reserve is estimated that 100 million ton (as P_2O_5) are existing in Burkina Faso, and 600 million tons are estimated in the deposit around Burkina Faso. Moreover, BPR are sold at the 1/4 price against TSP in the market in Burkina Faso.

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Table 1. Summary of fertilizer application rate in each treatment of PR direct application experiment

Treatment	P source	Savanna zone			Equatorial forest zone		
		P_2O_5	N	K_2O	P_2O_5	N	K_2O
Zero†	None	0	0	0	-	-	-
Control	None	0	60	30	0	90	60
PR-L	BPR*	67	60	30	67	90	60
PR-M	BPR*	135	60	30	135	90	60
PR-H	BPR*	270	60	30	270	90	60
TSP	TSP**	270	60	30	270	90	60
TSP-rec†	TSP**	-	-	-	60	90	60

†In Savanna zone, absolute zero application (Zero) plot was settled, and in Equatorial Forest zone, TSP in recommended rate ($60 \text{ kg } P_2O_5 \text{ ha}^{-1}$) was set-upped (TSP-rec), respectively.

*BPR: Burkina Faso phosphate rock (P_2O_5 26%, Ca 32%, Si 6%)

**TSP: Triple Super Phosphate

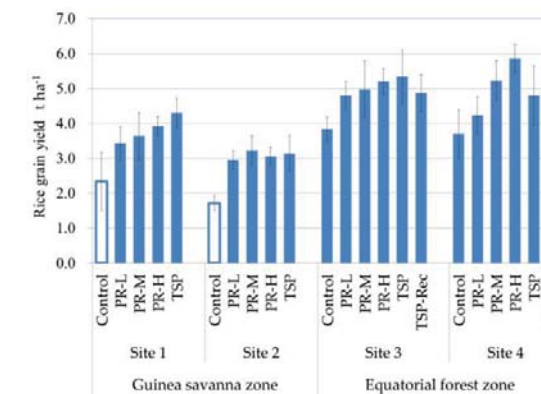


Figure 1. Effect of BPR direct application on lowland rice yield in Ghana

Error bars indicate standard error (n=3). Soil pH in each site were as follows, Site1; 5.60, Site 2; 5.83, Site 3; 4.53, Site 4; 5.70.

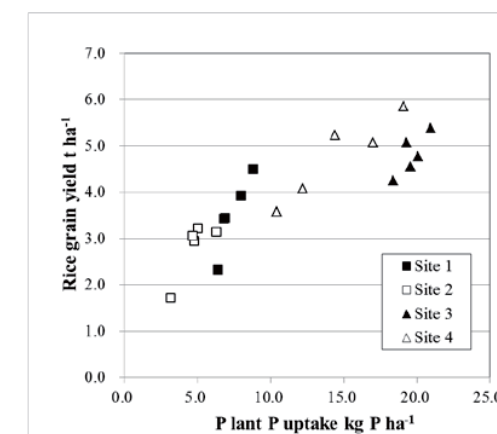


Figure 2. Relationship between plant P uptake and rice grain yield under BPR direct application.

Plant P uptake was calculated as multiplication of P concentration in flag leaf determined by dry combustion method and above ground biomass.