Second RUFORUM Biennial Meeting 20 - 24 September 2010, Entebbe, Uganda

Research Application Summary

Comparative effects of Minjingu phosphate rock and triple super phosphate on residual P in an Ultisol

Kalala, A.M.[1] & Semoka, J.M.R.[1]
[1]Soil Science Department, P. O. Box 3008, Sokoine University of Agriculture, Tanzania
Corresponding author: asherikalala@yahoo.com

Abstract

A glasshouse experiment was conducted at Sokoine University of Agriculture to compare the effects of Minjingu Phosphate Rock (MPR) and Triple Super Phosphate (TSP) on Residual Phosphorus in an Ultisol. The soil was collected after seven years since 480 kg/ha fertilizer application was stopped. MPR and TSP fresh application increased significantly (P= 0.05) the soil phosphorus, maize dry matter yield (DMY), P concentration and uptake. Both residual P from MPR and TSP treated soil were comparable in Bray I, maize DMY, and P uptake although the values were lower than for fresh application. The values were above the suggested critical concentration.

Key words: Minjingu Phosphate Rock, Morogoro, P fertiliser

Résumé

Une expérience de serre a été entreprise au sein de la faculté d'agronomie de l'université Sokoine pour comparer les effets du Phosphate Naturel de Minjingu (MPR) et du Phosphate Super Triple (TSP) sur le phosphore résiduel dans un Ultisol. Le sol a été rassemblé après sept ans puisque l'application d'engrais de 480 kg/ha a été arrêtée. L'application fraîche de MPR et de TSP a augmenté de manière significative (P= 0.05) le phosphore du sol, le rendement en matière sèche de maïs (DMY), la concentration en P et son absorption. Les phosphores résiduels du sol traité avec MPR et TSP étaient comparables dans le Bray I, le rendement DMY du mais et l'absorption du phosphore P bien que les valeurs aient été plus inférieures que pour l'application fraîche. Les valeurs étaient au-dessus de la concentration critique suggérée.

Mots clés: Phosphate naturel de Minjingu, Morogoro, engrais P

Background

Good quality and optimal production of maize crop which is a staple food, and sometimes a cash crop for the majority of Tanzanian smallholder farmers is influenced by ability of soils to supply nutrients especially Phosphorus (P). An application of inorganic phosphatic fertilizers is a critical agronomic practice

for improvement of maize production in P deficient soils. P fertilizers are known to have residual effects. A green house experiment was carried at Sokoine University of Agriculture to compare effectiveness of residual P in an Ultisol treated with 480 kg/ha of either soluble fertilizer (Triple Super Phosphate) or water insoluble Fertilizer (Minjingu Phosphate Rock).The study examined possibility of reducing costs of fertilizer use by improving the utilization of residual P in soils instead of applying fresh P fertilizers for each subsequent season of maize production

Literature Summary

In Tanzania over 50% of cultivated soils are estimated to be deficient in P (Semoka and Kalumuna, 2000). The use of chemical fertilizers is often considered to be an immediate solution to correct nutrient deficiencies in soils. However, water soluble fertilizers are expensive to resource poor farmers (Kimbi *et al.*, 1996). Farmers could benefit more by using phosphate rock fertilizers which are less expensive. In 2008-09 Tanzania provided about 24,160 tones of MPR were supplied compared to 2,000 tons of water soluble phosphatic fertilizer under subsidy scheme (Habari Leo Newspaper, 2009). Bollard and Gilkes (1990) reported that sometimes soluble and insoluble sources of P have comparable residual P effects. For example, an application of 1411 kg/ha super phosphate for 5 years was adequate to yield 2.7 t/ha of maize compared to the control experiment which yielded 1.8 t/ha. Adequate level for maize production under field conditions was established to be 25 mg P /kg for acidic soils (Singh *et al.*, 1997). Although MPR has now been approved for wide scale use in Tanzania no studies have been done to compare residual effect from this source with water soluble sources.

Study Description

The composite topsoil (to a depth of 15 cm) was collected from the experimental farm located at Sokoine University of Agriculture. The Magadu farm was fertilized with TSP or MPR at 480 kg P/ha and 120 kg P/ha, respectively in each year for four consecutive years from 1998 to 2002. Soil was also collected from control plots from the same site. The collected Composite soil samples were used for laboratory routine analysis and for pot experiment in a green house. Maize (*Zea mays*) variety TMV1 was grown and harvested 35 days after sowing. Soil and plant tissues from the pot experiment were analysed for various parameters including dry matter yield (DMY), P concentration and P uptake. Data were subsequently analyzed using MSTAC computer package and Means

separated using New Duncan Multiple Range Test (NDMRT) at 5% level of significance.

Research Application

The application of both MPR and TSP increased significantly (P= 0.05) the soil phosphorus levels, maize DM yield, P concentration and P uptakes (Table 1). Dry matter yield increased significantly (P<0.05) with the P application, being highest where fresh TSP was added. Also significant difference was observed in maize DMY for the residual P from MPR treated soil and residual P from TSP treated soil. These two treatments had higher DMY than the P control. Bray I-P level was high in residual MPR added with the same amount fresh MPR (65.29 mg/kg) followed by residual TSP added with the same fresh TSP to recommended P rate (60.0 mg/kg).Both residual P from MPR (28.46 mg /kg) and TSP (30.23 mg/kg)

Table 1. Comparison of different P rates and residual P effects on dry matter yield, P levels in soil, plant tissues and uptakes.

Treatments	DMY (gm/pot)	P Bray I (mg/kg)	Plant P conc. (%)	P uptake (mg/pot)
Absolute Control	4.3d	6.289g	0.280e	11.50c
P treatment control	6.7d	6.287g	0.293e	19.43c
Residual P from MPR treated soil	36.8bc	28.46f	0.337d	123.2b
Residual P from TSP treated soil	34.8c	30.23f	0.363c	123.1b
Residual MPR added with the same amount Fresh MPR	45.9a	65.29a	0.367c	166.8a
Residual TSP added with the same amount Fresh TSP	40.7abc	40.65de	0.400b	162.26a
Residual MPR added with the same MPR to recommended rate	44.0ab	53.41bc	0.400b	175.9a
Residual TSP added with the same fresh TSP to recommended P rate	44.9a	60.40ab	0.413ab	186.2a
Recommended P rate from MPR	41.3abc	36.37ef	0.430a	177.3a
Recommended P rate of TSP	45.3a	47.59cd	0.413ab	180.0a

Means in the same column followed by the same letter(s) are not significantly (P=0.05) different according to the Duncan New Multiple Range Test (DNMRT).

treated soil were not significantly different in Bray I levels but were relatively higher than in the P treatment control and the absolute control.

Recommendation

Both MPR and TSP had comparable levels of residual Phosphorus. Therefore residual TSP and MPR can be utilized for optimal maize production. But higher performances was obtained by either adding the same amount of fresh MPR to the residual P in the soil or addition of the same fresh TSP to the residual P found into the soil to the recommended P rate. Since Minjingu Phosphate rock is cheap it can replace TSP fertilizer.These findings will be tested in the field for clarification

of how many years/ seasons residual P can supply enough P for maize plants at field conditions.

Acknowledgement

We thank SADC-ICART project for sponsoring this research. Special thanks go to Sokoine University of Agriculture and RUFORUM for facilitating various training programmes for the research team especially students.

References

Bollard, M. and Gilkes, R.J. 1990. The poor performance of phosphate fertilizers in Western Australia. Part 1. The crop and pasture response. *Agricultural Science* 3(1):43-48.

Habari leo News paper, (05, May, 2009). ISSN 1821-570X. Issue no. 00867. In (www.habarileo.co.tz) site visited on 5/5/2009.

Kimbi, G.G., Mnkeni, P.N.S. and Singh, B.R. 1996. Effectiveness of partially acidulated and beneficiated Minjingu Rock phosphate as source of phosphorus for maize and sorghum in three acid soils of Tanzania. *Norwegian Science Journal* 10:301-308.

Semoka,J.M.R. and Kalumuna, M.2000. Potential and constraints of using rock phosphate for crop production in Tanzania. Tanzania Soil Fertility. In: Initiative Background paper. Ministry of Agriculture and Cooperatives, Dar es salaam /FAO Rome, Italy.

Singh, B.R., Uriyo, A.P., Mnkeni, P.N.S. and Msaky, J.J.1997. Evaluation of indices of N and P availability for soils of Mororgoro, Tanzania. In: Proceedings of the conference on classification of tropical soils. Kuala Lumpar, Malaysisa. pp. 273-278.