Changes in plant-available soil phosphorus as affected by repeated applications of different organic products for twelve years

Muhammad Akhtar, Christian Morel, Denis Montenach, Frederic Hammel, Malick Ndiaye, Sabine Houot

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Improving P use efficiency and maize yield by phosphoric acid application with farm yard manure and rice straw

Muhammad Yaqub, Muhammad Akhtar and Wasiq Ikram*
Soil Science Division, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad
***Email:** yaqubniab@yahoo.com

Integrated use of organic and inorganic fertilizers can improve crop productivity and sustain soil health and fertility. Green-house experiment was conducted on maize to assess the influence of phosphoric acid (PA) in combination with farm yard manure (FYM) or rice straw (RS). Phosphoric acid was applied alone or after mixing with organic amendment (FYM or RS) in a ratio of 1: 5 and 1: 2.5 on w/w basis. Phosphorus (P) was applied at 37.5 and 75 mg kg^{-1} soil (equivalent to 75 and 150 kg ha^{-1}). The results showed that PA applied with FYM increased the dry matter yield of maize compared to PA applied alone; however, RS combined with PA was effective only at lower level of P application. The beneficial effect of PA application at high rate with FYM were not as significant as was found at low rate. The PA applied with FYM at low rate produced almost two folds dry biomass than that produced by PA applied alone at the same rate; which was similar to the biomass produced by higher rate of PA alone. The effect of FYM was more pronounced than RS. Phosphoric acid applied with RS increased the yield only at lower rate. Similar trend was also observed on plant height, N and P uptake, P agronomic efficiency and apparent P recovery. The increased dry matter yield with combined application of PA and FYM was mainly attributed to increased N and P uptake by plants. The findings of this study suggest that the organic amendments enhanced the availability of phosphorus to plants. The FYM amendment effectively made phosphorus available in bioavailable pool for a longer period presumably due to lesser contact with soil constituent compared with application of PA alone.

Higher phosphorus use efficiency and productivity of wheat and maize by phosphoric acid application in alkaline calcareous soil

Muhammad Akhtar, Muhammad Yaqub, Faqir Hussain, Asif Naeem and Khalid Mahmood*
Soil Science Division, Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad

Low efficiency of existing granular phosphate fertilizers demands to explore better alternative for improving phosphorus utilization and productivity of upland cereals grown in Pakistan under alkaline calcareous soil environment. Field experiments each on wheat and maize were conducted using RCB design with factorial arrangements where phosphoric acid (PA) was evaluated against diammonium phosphate (DAP) applied at different rates i.e. 0, 22, 44, 66, 88 kg P_2O_5 ha^{-1} and different methods of application were compared. Irrespective of methods of application, phosphoric acid application improved P uptake and yields of wheat and maize crop as compared with granular P fertilizer i.e. DAP. While,

the efficiency of fertilizers was also influence by methods of their application. Among treatments, subsurface application of PA produced highest grain yields both of wheat and maize while the lowest performance was observed by broadcast method. Phosphoric acid application at 66 kg P_2O_5 ha^{-1} was found more effective in increasing wheat grain yield over that of control. In wheat, each rate of P as PA usually produced equivalent yield to that produced by the next higher rate as DAP. The use of PA as fertilizer generally saved 50 % P in wheat while 33 % in maize production without affecting crop yields. The trend in grain P uptake was found similar to that observed for grain yield. Maximum P uptake by grain was recorded at the highest P rate and the lowest at zero P. The significant increase in P uptake with P rates was generally related to the increase in yield rather than its concentration in grain. Phosphorus Agronomic Efficiency (PAE) and Phosphorus Recovery Efficiency (PRE) were found higher at lower P rate and decreased with P application. However, PA applied by the either method resulted in higher PAE and PRE compared to DAP. Phosphoric acid is suggested as an efficient alternative to commercial granular P fertilizers for wheat and maize production in alkaline calcareous soils.

Effect of sulfur on nitrogen use efficiency and yield of maize crop

Rafiq Ahmad[1*] Khadim Muhammad Dawar[1], Dost Muhammad[1] and Maria Mussarat[2]

[1]Department of Soil and Environmental Sciences, The University of Agriculture, Peshawar

[2]Department of Soil and Environmental Sciences, Amir Muhammad Khan Campus, Mardan, The University of Agriculture, Peshawar

The influence of sulfur on N use efficiency and grain yield of maize was conducted at farmers' field at Dargai, Malakand Agency, Khyber Pakhtunkhwa during 2015. Sulfur at rate of 0, 20, 30 and 40 kg ha^{-1} in the form of NH_4-SO_4 was applied with adjusted levels of 0, 120 and 150 kg N ha^{-1} from urea fertilizer. The treatments were arranged in two factorial RCB design with plot size of 2 m x 3 m^2 and were grown with maize cv Azam with row to row space of 75 cm and plant to plant distance of 20 cm. The given all S levels and half of N with 90 kg P_2O_5 ha^{-1} and 60 kg K_2O ha^{-1} were applied at time of sowing while the remaining half N was applied 35 days after sowing. The result showed that grain yield, plant height, total N in soil, and S concentration in soil were significantly affected by sulfur and N applications. Higher grain yield (3098 kg ha^{-1}), Plant height (209 cm), total N in soil (0.12 %) and S concentration in soil (24.93 mg kg^{-1}) were recorded at 30 kg S ha^{-1}, while higher total N in leaves (1.11 %) was recorded at 40 kg S ha^{-1}. Each increment of S application increased N use efficiency at both levels with more effect at higher than lower N levels. These observations indicated limited/restricted supply of S in the given soil and climatic conditions to meet the crop requirements at expected higher and faster yields associated with higher N levels. It is concluded that application of S fertilizers should be given due attention in hilly areas of the Khyber pakhtunkhwa for optimum maize and oil seed crops.

Changes in plant-available soil phosphorus as affected by repeated applications of different organic products for twelve years

Muhammad Akhtar[*1], Christian Morel[2,3], Denis Montenach[4], Frédéric Hammel[4], Malick Ndiaye[5], Sabine Houot[6]*

[1]Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, Pakistan;
[2]INRA, UMR 1391 ISPA, F-33140 Villenave d'Ornon, France
[3]Sciences Agro, UMR 1391 ISPA, F-33170 Gradignan, France
[4]INRA, SEAV 0871 Plateforme expérimentale F-68021 Colmar, France
[5]Université Cheikh Anta DIOP, Département de Biologie végétale, LBC, Dakar, Sénégal
[6]INRA, UMR 1402 ECOSYS, F-78850 Thiverval-Grignon, France
***Email:** akhtarniab@gmail.com

Organic waste products could serve as a possible source of phosphorus (P) for crop production. A field experiment was conducted on a French Calcaric Cambisol to study the long term (12 years) impact of repeated application of different organic products such as dehydrated urban sewage sludge (USS), sewage sludge composted with green waste (GSW), biodegradable household waste (BIO), cattle manure (FYM), composted cattle manure (FYMC). A control (CTR) treatment (no P applied) was also maintained. Organic materials were applied on the basis of supplying constant N (170 kg ha^{-1}). The study aimed to examine changes in the plant-available soil P using a process-based approach which describes gross amount (Pr) of diffusive phosphate ions (Pi) at solid-to-solution interface as a function of Pi concentration in soil solution (Cp) and time (t). This technique couples both sorption-desorption of Pi for 40 h followed by immediate dilution kinetic of labelled Pi with ^{32}P radioisotope for about 6 hours. Total P stock in all soils changed proportionally corresponding to cumulated P budget, i.e. the difference between P applied and annual P export by grain during 12 years. Major portion (92%) of P applied as organic products was found in the plough layer (0-28 cm) while a little (8%) in the deeper layer (28-35 cm). After 12 years, cumulated P budget ranged from -156 kg P ha^{-1} in CTR to +358 kg P ha^{-1} in USS treatment whereas the corresponding Cp values ranged from 0.24 to 0.65 mg P L^{-1}, respectively. Experimental Pr values were accurately described by the Freundlich kinetic equation for all soils. These dynamics were significantly modified by application of organic products in comparison with CTR. The parameters of Freundlich kinetic equation which addresses both rapid and slow reactions were affected most likely because of modification in some soil properties especially organic matter content and cation exchange capacity. This happened either because of addition of different quantities of organic materials or their different elemental compositions. The initial rapid reaction decreased up to -30% in soils amended with FYM whereas slow reactions increased up to +25% in soils amended with USS, GWS, FYM and FYMC. The combined effects of cumulated P budget, P released from organic products and soil properties on the diffusive Pi for one year were dominant in the soil amended with USS: +167% relative to CTR. The information seems beneficial for depicting existing scenario of Pi dynamics in crop cultivated soils and thus facilitates in decision making for precise fertilizer management to sustain agro-ecosystem.