**Maize yield response as affected by sulfur, phosphorus and nitrogen as banded applications on a volcanic ash derived tropical soil**

Abstract

Phosphorus and sulfur deficiencies have been observed on many of the volcanic ash derived soils in Central America. One exploratory experiment was initiated in 1987 to examine maize *(Zea mays* L.) grain yield response to phosphorus, sulfur and nitrogen applied together on a volcanic ash derived soil in the Pacific coastal plain of Guatemala. Four cycles of yield data were collected in 2 rainy and 2 dry seasons. Treatments consisted of rate combinations of N (0, 100 kg ha‐1 as urea), P (0, 22 kg ha‐1 as triple superphosphate) and S (0, 57 and 114 kg ha‐1 as CaSO4.2H2O) applied together in continuous bands in a randomized complete block design. Residual P and S response was measured during the last two cycles, whereby only urea was applied at a constant rate to all plots. The combined analysis of the first two cycles demonstrated a linear response of yield to applied S when no P was applied (4.95, 5.75 and 5.95 Mg ha‐1 at 0, 57 and 114 kg S ha‐1 respectively), while yield response was quadratic when S as CaSO42H2O and P as triple superphosphate were applied together in a continuous band at 100 kg N ha‐1 (5.38, 6.38 and 5.48 Mg ha‐1 at the same S rates respectively). Response of yield to S was linear without and with P for the combined residual analysis of the last two cycles at the same N rate (4.65, 4.94, 5.26 and 4.68, 5.53, 5.56 Mg ha‐1 respectively). Grain yields were maximized over the four cycle period using a joint N, P, S band (100 kg of N as urea, 22 kg P as triple superphosphate, and 57 kg S as CaSO4.2H2O ha‐1). It is hypothesized that precipitation of dicalcium phosphate dihydrate (DCPD) and dicalcium phosphate (DCP) took place within the joint N‐P‐S band subsequently reducing the amount of P fixed as Fe or Al hydroxides and/or amounts of P complexed with amorphous allophane. The precipitation and subsequent dissolution of DCPD and DCP within the band could have increased P availability with time. Alternatively, SO4 = blocking of adsorption sites could have increased P availability by reducing the amount of P fixed by the soil. It is possible that both of the previously mentioned mechanisms played a role in first cycle yield responses since increases were noted at the low S rate (57 kg S ha‐1), while reductions were found when the S rate was doubled (114 kg S ha‐1). Significant residual response for the last two cycles was observed for the joint triple superphosphate, CaSO4.2H2O, urea band, especially at the high S rate. This suggests that excess precipitation of DCP and DCPD could have occurred and that this provided delayed dissolution of the precipitated P reaction products. Chemical characterization of precipitated reaction products within the band is needed as well as further verification on similar soils in order to validate the observed response.

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