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Research Paper :

Effect of lime on the changes in adsorbed and soluble sulphate in Alfisols of Orissa

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ABSTRACT

A laboratory investigation was carried out to study the effect of lime applied with and without gypsum on the changes in adsorbed and soluble SO_4^{2-} at different time intervals in two Alfisols of Orissa. Lime was applied @ 0 and 0.3 LR with three different combinations of sulphur *i.e.* 0, 20 and 40 µg g^{-1} through gypsum. The soils were incubated for a period of 60 days. Soil pH, after liming, increased by 0.3 to 0.6 unit in Dhenkanal soil and 0.4 to 0.9 unit in Jharsuguda soil at different days of the incubation period in different treatments. Soil pH either remained constant or decreased slightly with application of gypsum. There was a significant reduction in exchangeable H^+ and Al^{+++} after liming. Effect of gypsum on the changes in exchangeable H^+ and Al^{+++} was insignificant. Application of lime decreased the adsorbed SO_4^{2-} -S by 20.3 to 58.1 % and 30.9 to 47.5 % and increased the soluble by 14.3 to 99.3% and 21.3 to 125.4% in Dhenkanal and Jharsuguda soils, respectively in different treatments at different days of the incubation period. However, adsorbed, soluble and (adsorbed + soluble) were higher in the lime + gypsum treated soils than in the lime treated soils only. There were irregular changes in adsorbed, soluble and (adsorbed + soluble) with increasing days of the incubation period.

Key words : Alfisol, Lime, Gypsum, Soil pH, Adsorbed SO_4^{2-}-S, Soluble

A dynamic equilibrium exists between the adsorbed and soluble sulphate in soil which controls the sulphate availability to plant. With removal of sulphate from the soil solution due to plant uptake, the adsorbed sulphate is released to the soil solution to maintain the equilibrium and the reverse occurs with addition of sulphate to the soil solution. Sulphate adsorption by soil is highly pH dependent. It decreases with increasing pH since the OH^- is a strong competitor of SO_4^{2-} to occupy the adsorption sites (Huang *et al*., 1998).

More than 70 % of the cultivated area in Orissa is covered by Alfisols. These soils are moderately to strongly acidic with high Fe and Al oxides and are dominated by low active clays (Das, 1985).Soil acidity is the major constraint for crop production in these soils. These soils, therefore, need liming to correct soil acidity for increasing crop production. The effect of lime persists only for a short period due to heavy precipitation causing the loss of Ca from soil. The present recommendation is, therefore, application of lime at a lower rate *i.e.* 0.2 to 0.3 LR to each crop or to alternate crop (depending upon the reduction in pH) before sowing or planting. No information is available on the effect of lime on the changes in adsorbed and soluble SO_4^{2-} in these soils at different time intervals when applied at a lower rate with and without gypsum. The present communication reports the effect of lime applied @ 0.3 LR with and without gypsum on the changes in adsorbed and soluble SO_4^{2-} -S at different time intervals in two Alfisols of Orissa.

MATERIALS AND METHODS

Surface soil samples (0-15 cm) were collected from the upland cultivated areas of two acid soils *viz.*, Dhenkanal and Jharsuguda belonging to Alfisols. The soils were air-dried, ground and passed through 2 mm sieve. Some of the important physical and chemical properties of the soils were determined by standard procedures. Exchangeable H^+ and Al^{+++} were determined in 1 M KCl extract of soil (Black, 1965). Lime requirement of these soils to pH 7.0 was determined by Woodruff's buffer method. Soluble SO_4^{2-} -S was extracted by 0.15 % $CaCl_2.2H_2O$ (Tabatabai, 1982), whereas (adsorbed + soluble) was extracted by $Ca(H_2PO_4)_2$ solution containing 500 ppm P (Ensminger, 1954). Sulphate -S in these extracts were determined turbidimetrically (Hoeft *et al*., 1973).

For the incubation study, 250 g of soils, passed through 2 mm sieve, were taken in 500 mL polythene beakers in duplicate. Required quanties of pure $CaCO_3$ @ 0 and 0.3 LR were added to the soils and mixed thoroughly. Required quantities of pure $CaSO_4.2H_2O$ to supply S @ 0,20 and 40 µg g^{-1} were dissolved in the volume of water needed to maintain the field capacity of soil. The solutions