4.4 Gypsum

Another useful agromineral is gypsum, the most commonly applied soil amendment for the reclamation of sodium affected soils (Shainberg *et al.* 1989). 'Black alkaline soils' are soils with excessive quantities of sodium adsorbed to clay minerals. They are characterized by surface crusting and formation of physically impermeable, hard-setting soils. The processes of hard setting and crusting can be overcome by spreading gypsum over the surface. Gypsum improves black alkali soils by providing soluble calcium, which replaces the sodium adsorbed on the clay minerals. Results from field experiments in many parts of the world showed that gypsum applied at several tonnes per hectare decreases the sodium adsorption ratio, physically improves the infiltration rate and significantly increases yields. Naturally occurring gypsum can be used for this purpose but an industrial by-product from the phosphate fertilizer industry, phospho-gypsum, is also very effective in improving the soils' physical properties.

Gypsum, applied at the surface or subsoil, is reported to reduce phytotoxicity in acid soils (Alva and Sumner 1989; Sumner 1995). The mechanism for this reduction is the downward movement of soluble calcium and the subsequent exchange with aluminum in the subsoil (McRay and Sumner 1990; Sumner 1995).

High-analysis fertilizers like urea, di-ammonium phosphate (DAP), or Triple superphosphate (TSP) have economic advantages because of savings in transport, storage and handling but they have a major set-back as they do not include sulphur. This vital soil nutrient is needed in many soils of Africa, including soils in West Africa (Friesen 1991) and Malawi (Weil and Mughogo 2000). Field trials at many sites in semi-arid and sub-humid West Africa have shown the agronomic effectiveness of elemental sulphur or sulphates, such as gypsum or phosphogypsum. Friesen (1991) demonstrated that the S deficiencies in the region could be corrected at relatively low cost.

Studies in Brazil, South Africa and the United States have found that gypsum significantly increases yields when applied at rates between 1 and 10 tonnes per hectare. In most cases the yield responses were related to Ca and S nutrition. Groundnuts (*Arachis hypogaea*) have high requirements for Ca (McNeil 1987; Alva *et al.* 1989; Caires and Rosolem 1991) but also for other elements, such as S and P, B and other trace elements. Without sufficient Ca, pod development will be curtailed leading to empty pods or poorly formed seeds. Calcium is most critical for pod development between 15 and 35 days after the pegs reach the soil. Gypsum is used in groundnut production schemes as it provides both Ca and S (Walker 1975).

The main gypsum deposits in sub-Saharan Africa are associated with Mesozoic to Recent sediments and evaporative crusts. They are found in many coastal basins and in various localities in continental basins in West-Central Africa and the Rift valleys. Gypsum as by-product from the phosphate industry (phospho-gypsum) is found in large amounts in Senegal and Zimbabwe.