# SOIL FACTORS INFLUENCING ROW CROP PRODUCTION AND PHOSPHATE ABSORPTION ON LEVELED LIGNITE MINE SPOIL BANKS

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A three-year field plot study was conducted to determine the feasibility of raising corn ('Texas 28A'), sorghum ('Top Hand'), and two cultivars of soybean ('Hill' and 'Lee') on leveled mine spoil banks. The location of this field study was near the Big Brown Steam Electric Station near Fairfield, Texas. This is a lignite surface mine and power generation operation. Treatments included nine different phosphorus-nitrogen fertilizer combinations per crop per year. The pH and base status of the spoil in the crop area were monitored throughout the course of this study.

Laboratory experiments were conducted to determine the adsorption characteristics of sodium salts of ortho-, pryo-, and tripolyphosphate by two surface spoil samples and an unmined surface soil sample.

A marked response by the crops to both N and P additions was found in 1974. In 1975 and 1976, only N additions yielded significant increases in both grain and total dry matter yields. An inspection of soil pH values from 1974 to 1976 revealed a marked drop in pH from 1974 (pH = 6.6 ± 0.3) to 1975 (pH = 5.3 ± 0.2) with a subsequent stabilization of these values through 1976 (pH = 5.2 ± 0.3). The lack of response of the crops to fertilizer P additions was attributed to the dissolution of native P compounds present in the spoils. This dissolution was caused by the increased acidity resulting from the oxidation of pyrite ($FeS_2$) present in the spoils. Enough P for plant growth was released from this acidulation that no significant response to fertilizer P additions was observed in 1975 and 1976. As this acidity is further increased due to the oxidation of organic sulfide linkages present in lignite particles and the removal of bases, the soluble P becomes increasingly controlled by A1 and Fe phosphorus compounds. This is beneficial since more P is released to the soil solution from A1 and Fe phosphates than from hydroxyapatite or octacalcium phosphate. The stabilization of the pH values was attributed to the disappearance from the top 20 cm of spoil material of readily oxidizable, acid producing pyrite.

Reaction of $NaH_2PO_4$ with two spoil samples and a surface soil sample revealed two energy adsorption stages. Only one energy adsorption stage was found from the reaction of $Na_4P_2O_7$ and $Na_5P_3O_{10}$ with the surface samples. Adsorption energy sequences varied from one soil to another and with one phosphate species to another. More P was adsorbed as pyrophosphate than as tripolyphosphate. The least amount of P adsorbed came from the reaction of $NaH_2PO_4$ with the surface samples. Enthalpies of adsorption were found to decrease with increasing surface coverage by the phosphate species. High initial soluble Ca levels were found in the spoils. It was predicted that soluble phosphate anions would precipitate as Ca salts.

It was concluded that all four row crops tested would grow successfully on leveled mine spoils if proper fertilization and cultural practices were provided. Sorghum, because of its drought tolerance characteristics, was found to be the most promising crop of those tested. Enough native P was made available to plants (caused by pyrite oxidation) that no fertilizer P was needed for plant growth after 1974. This situation is expected to reverse itself as the available native P pool becomes depleted.

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