

Solubility and leaching of boron from borax and colemanite in flooded acidic soils

ABSTRACT

Boron (B) is a micronutrient essential for adequate plant growth. Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) and colemanite ($\text{Ca}_2\text{B}_6\text{O}_{11} \cdot 5\text{H}_2\text{O}$) are common B fertilizer materials, the former being widely used worldwide. Boron is completely water soluble and subjected to leaching. In this study, the dissolution kinetics of both borax and colemanite in deionized water and at pH 3.8, 5.2, 6.5, and 8.2 were determined. Soils incubated with minerals for 40 days and 80 pore volumes of leachates from repacked soil column treated with either surface-applied borax or colemanite (powdered and granular) were collected and analyzed for B contents. Two different soils, Chempaka (Typic paleudult) and Tepus (Typic Kandiaquult) series, taken from paddy-growing areas were used in leaching and incubation studies. Dissolution rate of borax was greater than that of colemanite, and complete dissolution was observed after 100 min, whereas complete dissolution of colemanite was not reached even after 300 min. There was no effect of pH on dissolution rate of borax and colemanite. Boron released from borax was hasty, and after 5 weeks no more B was released. In the case of colemanite, B released was steadily increased until the end of the incubation study. At the end of the study, there was no significant difference in B levels of both borax- and colemanite-applied soils. Particle size had a significant effect on the solubility and dissolution rate of colemanite. Boron dissolution rate and solubility from colemanite powder were significantly greater than those from granular colemanite. Leaching losses from borax were much greater than from colemanite as indicated by the breakthrough curves, which were earlier for borax than colemanite. After 60 pore volumes, no more B was leached out from borax, and in the leachates of colemanite some concentration was detected even after 80 pore volumes. Boron content in soil of columns after the completion of the experiment was greater in case of colemanite. Borax and colemanite fertilizers showed the same trend of leaching and B releasing in both Tepus and Chempaka soil series.

Keyword: Borax; Boron leaching; Boron solubility; Colemanite