ABSTRACT

The productivity of acid alluvial and laterite soils of West Bengal, India for wetland rice, is kept at a low level by the reduced availability of sulfur (S) and micronutrients. In an attempt to increase the soil and plant availabilities of S and micronutrients, the biological availability of these nutrients were quantified by the modified Neubauer's technique in 16 alluvial and 14 laterite soils; the most suitable chemical extractants for Cu, Zn, Fe and Mn were identified by relating their soil fractions with the biological availability; the total and available status of S, B, Cu, Zn was characterized in relation to soil properties and availability of Fe, Mn and Al; the effects of prolonged submergence on soil pH and soil and plant availabilities were ascertained; the effects of liming and soil moisture regime on the time changes of soil pH and Eh, soil and plant availabilities of sulfur and micronutrients, transformation behaviour of Cu, Zn, Fe and Mn, were assessed; the influence of liming, soil moisture regime and application of S, B, Cu, Zn on growth and yield responses of rice were evaluated, in incubation and greenhouse experiments. Liming was done @ 2 tons ha^{-1}. The soil moisture regimes included field capacity (30 KPa) (FC) as monitored tensiometrically, 5±1 continuous flooding (F) and alternate flooding (5±1) and drying (30 KPa) (AFD). In greenhouse experiments, rice (IR 36) was grown with N, P, K applied @ 60 mg N, 30 mg P_2O_5 and 30 mg K_2O per kg of soil. S, B, Cu and Zn were applied respectively @ 10 mg, 0.5 mg, 1.5 mg and 5 mg per kg of soil.

The results of the investigation revealed that the native soil available fraction extracted by 0.005M DTPA (pH 7.3) was highly significantly related with the biological availability of Cu, Zn, Fe and Mn to rice. Biological availability of S and B was also significantly related with their soil available concentration as extracted by respectively 0.15 % $CaCl_2$ and hot water. The acid alluvial and laterite soils were deficient in B but had toxic concentration of Fe. Prolonged submergence of the soils increased pH and reduced Eh, which in turn decreased the availability of S, B, Cu and Zn in these acid soils. Liming of these acid soils significantly reduced the availability of S, Cu, Zn, Fe and Mn, but increased that of B irrespective of soil moisture regime. Continuous flooding during rice growing season decreased the plant availability of S, Cu and Zn but increased that of B, Fe and Mn. Alternate flooding and drying was more beneficial to rice than continuous flooding as it significantly increased the plant availability of S, B, Cu, Zn and decreased that of Fe and Mn. Organic complexed and water soluble plus exchangeable were the dominant soil fractions controlling plant availability of Cu, Zn, Fe and Mn particularly in limed and submerged soils. Application of S, B, Cu and Zn respectively, @ 20, 1, 3 and 10 kg ha^{-1} significantly enhanced the growth and yield of rice over control in acid laterite and alluvial soils. The yield response of rice to the application of S, B, Cu, Zn was further improved by liming and maintaining the soil moisture regime of alternate flooding and drying during the growing season.