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Characteristics of Fe-toxic soils in the flooded valleys of the high rainfall zone of Tamil Nadu

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ABSTRACT

The toxicity of Fe occurs mainly in poorly drained inland valleys often with lateral seepage and or upwelling Fe containing water, coastal saline-acid soils, peat soils, acid sulphate soil and other hydromorphic soils and others. Surface soil samples(0 – 20 cm depth) were collected from rice fields in the areas of the soils prone to varying degree of Fe toxicity in the high rainfall zone of Tamil Nadu and analysed for their physico-chemical characteristics. The Aquic Hapludalf recorded 62.5 per cent of the samples with > 40 mg/ kg of water soluble Fe followed by Udic Rhodudalf (52.6%). The upwelling ground water caused the accumulation of Fe and subsequent precipitation resulted in the presence of reduce brown scum of iron oxides and hydroxide on the surface of the soil particularly along the border of the field. Fe accumulation also induced deficiency of P,K, Zn and bases *viz.*, Ca and Mg

Key words : Physico-chemical characteristics, Fe-toxic soils

The continuous water stagnation and accumulation of Fe due to lateral seepage from hills in the valleys of the high rainfall zone of Tamil Nadu (Kanyakumari Dt.) pose nutritional disorders, toxicity of Fe and low yield of rice. Although these soils show varying degree of reddish brown scum and oily looking layer in the flood water, the extent of toxicity is site specific and varies with soil characteristics. No information is available on characterizing Fe toxic soils in the high rainfall zone of Tamil Nadu. An attempt was, therefore, made to characterize these soil and to determine the extent of toxicity of Fe in different dominant soil subgroups.

MATERIALS AND METHODS

Surface soil samples (0 – 20 cm depth) were collected from rice fields in the areas of the soils prone to varying degree of Fe toxicity in the high rainfall zone of Tamil Nadu at 50—55 days after transplanting each, 50 nos. representing the major soil subgroups *viz.*, Aquic Hapludalf, Udie Rhodudalf, Udic Hapludalf and typic Haludalf. The soil samples were air dried and passed through a 2mm sieve. The pH, CEC, organic c, Bray's-p, available K (1 N NH,OAc extractable) exchangeable cations (including H and Al), $CaCl_2$ extractable S, base saturation per cent, DTPA extractable micronutrients water soluble B and Fe fractions were determined by following standard procedures.

RESULTS AND DISCUSSION

The soils (73.4% of the soils analyzed) prone to Fe toxicity were in general low in available (Bray's) P. The possibility of the formation of Fe and Al phosphates leading to reduced P availability in the soil could also be well established by the significant negative correlation observed between available AI (r = -o.389*). Exchangeable H(r = -0.518**) and exchangeable AI (r = -0.460**). Nine per cent of these soils were deficient in available (IN NH_4OAc extractable) K and a significant negative correlation was observed both for water soluble Fe and dilute acid extractable Fe with the exchangeable K (r=-0.490**; r = - 0.399**) and available K (r = -0.515**; r = -0.403*) indicated the possible conversion of these forms of K into sparingly soluble double salt of K_2SO_4 and $FeSO_4$ as stated by Singh *et al*. (1993). Sulphur was marginally deficient in 5.2% of soil samples analysed. The per cent Zn deficiency was 92.0 and 91.5 per cent, respectively for Aquic Hapludlf and Typic Hapludalf, but was cent per cent in the rest of the subgroups. Thus, by and large, Fe – toxic soils were deficient in available P, K, DTPA-Zn and S to a marginal extent.

The undulating topography caused translocation of hydrated compounds of Fe in the runoff and seepage water. The data on the distribution of different Fe fractions in the major subgroups are presented in Table 2. The continuous water stagnation and the upwelling water paved the way for the content of higher exchangeable Fe (226 mg kg^{-1}) in the Aquic Hapludalf than other subgroups besides the influence of comparatively lower pH. Similar to the exchangeable Fe the highest reducible Fe content of 280 mg kg^{-1} was also noted in Aquic Hapludalf than other subgroups besides the influence of comparatively lower pH. Similar to the exchangeable Fe the highest reducible Fe content of 280 mg kg^{-1} was also noted in Aquic Hapludalf. Moreover, at