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Different chemical pools of manganese as influenced by submergence, green manure and soil applied manganese under rice-wheat system

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ABSTRACT

A green house experiment was conducted on a sandy loam soil (*Typic Ustochrept*) to study the effect of green manure (*Sesbania aculeata*) applied @ 10 g kg^{-1} soils, on oven dry weight basis and soil applied Mn on different chemical pools of manganese (Mn) under rice-wheat system. Rice was grown under submerged and nonsumberged conditions, with and without the application of green manure and it was followed by wheat.The results revealed that the green manure and soil applied Mn applied to rice increased the concentrations of DTPA-extractable, water soluble plus exchangeable and specifically adsorbed Mn on inorganic sites, whereas, Mn held on organic sites and oxide surfaces decreased with the incorporation of green manure and soil applied Mn. The effect of submergence was largely non-significant on different chemical pools of Mn. Similar was the trend of different forms of Mn after the harvest of wheat due to residual effect of green manure. Hence, the increase in the concentration of DTPA-extractable, water soluble plus exchangeable and inorganic Mn was indicative of the enhanced availability of Mn with the application of green manure. Soil application of manganese sulphate had no significant effect on different factions of Mn.

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In Punjab farmers have started growing rice on relatively coarse textured soil which are otherwise not suitable for its cultivation. The shift of cropping pattern from cotton-wheat, maize-wheat and groundnut-wheat to rice-wheat has further aggravated the nutritional problems of iron deficiency in rice and Mn deficiency in the subsequent wheat (Nayyar *et al.*, 1990; Zhu *et al.*, 2002). Manganese availability in soils depends upon various factors like, pH, $CaCO_3$, organic matter content and oxidation- reduction conditions, etc. The conditions, which help to increase the reducing environments, increase the availability of Mn in soils (Nagarajah *et al.*, 1989). Submergence as well as green manure applied to rice has been reported to increase the Mn availability in the soil. Reduction of oxides of Mn is more when green manure was combined with submergence (Sadana and Bajwa, 1986). Besides this, submergence and green manure also effect the different extractions of Mn from different pools (Chatterjee *et al.*, 1999). Green manuring is an other way to increase the manganese availability in soils. This is due to the fact that organic matter during its decomposition liberates a number organic acids, lowers the soil pH and increase the reduction intensity in the soils. Reduction of oxides of manganese is more when green manuring was combined with submergence. Katyal (2000) reported that the DTPA – extractable manganese increased by several folds over the initial values during 4 to 8 weeks of incubation of a calcareous sandy loam soil and the increase was two –folds in the submerged soil as compared to a soil at field capacity. Green manuring with *Sesbania aculeata* decreased the soil solution pH and increased the manganese in soil solution (Swarup, 1987) which increased further with the application of gypsum (Sadana and Bajwa, 1986). Katyal (2000) found that the applicaton of Gliricidia leaves (20 t ha^{-1}) and rice straw 5 t ha^{-1}), doubled the Mn^{2+} values in soil solution of a red soil and a black clay soil, unlike the laterite soil, where the increase was normal.

Very little information is available on the effect of green manure on different chemical fractions of Mn like DTPA-extractable, water-soluble plus exchangeable K, inorganic, organic and oxide bound Mn and the extent to which the residual effect of green manure can help in enhancing the Mn availability to wheat. Therefore, the present investigation was undertaken to study the effect of green manure and soil applied Mn on different chemical fractions of Mn in soil under submerged and nonsubmerged conditions in rice-wheat system.

MATERIALS AND METHODS

To study the effect of green manure on different chemical pools of Mn, a bulk loamy sand soil sample (*Typic Ustochrept)* deficient in available Mn (DTPA- extractable