

## Effect of green manure, submergence and soil applied manganese on Yield and uptake of manganese under rice-wheat system

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### ABSTRACT

Screen house studies were conducted to investigate the residual effect of green manure (*Sesbania aculeate*) @ 10 g kg<sup>-1</sup> soil) applied to rice on manganese transformations and its availability to wheat in a rice-wheat system. Soil and foliar applications of manganese sulphate were made to compare the residual effect of green manuring. Green manure applied to rice, soil (20 µg g<sup>-1</sup>) and foliar application of manganese sulphate (0.5%) to wheat significantly increased the wheat grain and straw yield, manganese concentration and uptake. Increase in grain yield of wheat due to residual effect of green manure applied to rice was equal to the two foliar sprays of manganese sulphate. Foliar application of manganese sulphate was significantly more effective in increasing the dry matter yield and manganese concentration as compared to soil applied manganese. Maximum grain yield was obtained with four foliar sprays of manganese sulphate.

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The cultivation of rice in the Punjab state is considered more profitable as compared to other crops of the same season. Therefore, the farmers have started growing rice on relatively coarse textured soils, which are otherwise not suitable for its cultivation. The deficiencies of micronutrients have been increasingly felt in many soils and crops (Nayyar *et al.*, 1990). Also the shift of cropping system from cotton-wheat, maize-wheat and groundnut-wheat to rice-wheat has further aggravated the problems of iron deficiency in rice and manganese deficiency in the subsequent wheat or berseem crops (Takkar and Nayyar, 1981; Bansal *et al.*, 1991).

Manganese availability in soils depends upon various factors like pH, CaCO<sub>3</sub>, organic matter and oxidation-reduction conditions. The soil conditions, which help to increase the reducing environments, increase its availability in soil (Zhu *et al.*, 2002). Submergence brings a number of physical, chemical and biological changes in soils, which are normally beneficial for the growth and nutrition of rice. Under submerged conditions higher valent forms of manganese like MnO<sub>2</sub>, Mn<sub>2</sub>O<sub>3</sub> and Mn<sub>3</sub>O<sub>4</sub> get converted to Mn<sup>2+</sup> (reduced) form which is available to plants (Ponnamperuma, 1972). Submergence also increases the availability of the native and applied soil manganese. Singh *et al.* (1998) observed increase in grain and straw yield of maize due to burying of cowpeas as green manure along with 50 kg N ha<sup>-1</sup> through urea fertilizer. Soni *et al.* (2000) observed increase in grain

and straw yield of rice on addition of *Gliricidia aculata* as green manure and manganese sulphate in sandy loam soil. Tiwari *et al.* (1980) also reported 40 per cent increase in rice yield due to the addition of *dhaincha* green manure in a coarse textured alluvial soil.

Higher availability of iron, manganese and zinc was also maintained throughout the growth period of rice in a sandy loam soil. Soil solution manganese concentration increased with the addition of gliricidia leaves (20 t ha<sup>-1</sup>) and rice straw (5 t ha<sup>-1</sup>) over control in red and black soils (Katyal, 1995). Similar increase in manganese concentration in the soil solution by addition of rice straw followed by sesbania and azolla was reported by Nagarajah *et al.* (1989). Singh (1975) revealed that addition of farmyard manure at the rate of 50 t ha<sup>-1</sup> and 100 t ha<sup>-1</sup> enhanced the potato plant growth. Addition of farmyard manure and rice husk increased the yield and micronutrient uptake by rice (Swarup, 1987). Sharma and Yadav (1986) found that gypsum alone or in combination with farmyard manure in sodic soil increased the manganese uptake in rice plant. Formoli *et al.* (1977) reported a significant increase in rice grain yield with farmyard manure and P application to a sandy clay loam soil. Swarup (1984) observed marked improvement in micro nutrient content of rice with the application of farmyard manure (30 t ha<sup>-1</sup>) and rice husk (30 t ha<sup>-1</sup>) to a sandy loam soil. Sood (1987) reported a significant increase in manganese uptake by rice in green manured plots, as compared to peas where only nitrogenous, phosphatic and potassic fertilizers were applied. Gunasena and Ahmed (1977) compared the relative performance