



## Long-term effects of manures and fertilizers on chemical fractions of Fe and Mn and their uptake under rice-wheat cropping system in North-west India

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**Abstract :** In India the deficiencies of Fe and Mn are becoming very common as rice-wheat system (one of the predominant cropping systems of the country) is extended on light textured soils to feed the burgeoning population. Farm yard manure (FYM), green manure (GM) and wheat cut straw (WCS) help in release of different fractions of iron (Fe) and manganese (Mn) in the soil, when these are applied in combination with chemical fertilizers. Therefore, the present research study was conducted with a prime objective to investigate the long term effect of chemical fertilizers (NPK) alone and in combination with FYM, GM and WCS on different fractions of Fe and Mn and their interactions with each other. For this, a field experiment was in progress since 1983 with rice-wheat cropping system at Research Farm, Department of Agronomy, Punjab Agricultural University, Ludhiana. In different treatments, 50 per cent recommended dose of N was applied through chemical fertilizers (urea fertilizer with 46.4 per cent N) whereas, the remaining 50 per cent N was substituted through FYM, WCS and GM (*Sesbania aculeata*) and their biomass was added to soil on dry weight basis. Surface soil samples were collected and analyzed for basic soil parameters using standard procedures. These soil samples were also subjected to estimation of different fractions of Fe and Mn using atomic absorption spectrometer (Varian AAS-FS Model). Rice grains samples were analyzed for their Fe and Mn concentrations with Varian AAS-FS Model. The results of present study revealed that these three organic manures lowered the soil pH and EC as well as increased the organic carbon (OC) content and available NPK in soil with the application of FYM, WCS and GM in conjunction with N fertilizers as compared to alone NPK fertilizers. Significant changes were observed in the different fractions of Fe and Mn when FYM, WCS and GM were applied in conjunction with different combinations of chemical fertilizers. The broad view of results revealed that the GM, FYM and WCS applied before transplantation of rice increased the concentrations of water soluble plus exchangeable (WS+EX), amorphous iron oxide (AFeOX), crystalline iron oxide (CFeOX) and organic matter (OM) bound fractions of Fe and Mn whereas, their fractions held on specifically adsorbed (SPAD) on inorganic sites and manganese surfaces (MnOX) decreased with the incorporation of GM, FYM and WCS. Among these manures, GM ( $T_3$ ) reported higher concentrations and uptake of WS+EX, SPAD, MnOX, AFeOX, CFeOX and OM bound fractions of Fe and Mn followed by FYM ( $T_6$ ) whereas, higher concentrations of Fe and Mn in case of total micronutrient (TM) were reported by FYM ( $T_4$ ). The increase in the WS+EX, AFeOX, CFeOX and OM bound fractions were indicative of the enhanced availability of Fe and Mn with the application of GM, FYM and WCS. The micronutrient fractions were activated differentially and the dynamics of their inter conversion from one fraction to other was accelerated due to decomposition of GM, FYM and WCS. The results further concluded that after 27 years of rice-wheat cropping system, the application of FYM, WCS and GM resulted in significantly higher content of the WS+EX- Fe and Mn in the soil with GM followed by FYM and WCS (GM>FYM>WCS) which may be ascribed to the higher supply of Fe and Mn through decomposition of organic manures.

**Key Words :** Chemical fractions, Green manure, Farm yard manure, Wheat cut straw, NPK fertilizers

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