

Effect of Pb and FYM application on spinach yield, Pb uptake and different fractions of Pb in sewage irrigated *Fluventic ustochrepts* soils of peri urban area of Vadodara

K.C. PATEL, K.P. PATEL, V.P. RAMANI AND J.C. PATEL

Accepted : September, 2008

ABSTRACT

A pot house study was conducted on sewage irrigated *Fluventic Ustochrepts* soils of peri urban area of Vadodara to study the effect of Pb and FYM on spinach yield, Pb uptake and different forms of Pb after spinach (*Spinacia oleracea* L.). The soils were treated with six levels of Pb (0, 5, 10, 20, 40 and 80 mg Pb kg⁻¹) and two levels of FYM (0, 1 %). The results revealed that the significant reduction in yield of spinach was noticed at 80 mg Pb kg⁻¹ soil application. The uptake of nutrients viz., P, K, Fe and Zn decreased at higher Pb level. Amongst the different forms of Pb after spinach, the per cent reduction in Fe-Mn oxide bound Pb and increase in other forms was noticed in sewage irrigated soil. On the other hand, when the spinach was grown on sewage irrigated soil with the application of FYM, percentage of total Pb increased except that of residual Pb. The percentage of exchangeable Pb of total Pb decreased due to Pb addition; and the decrease was comparatively higher in the presence of FYM. The relative abundance of various fractions of Pb after spinach in sewage irrigated soils was in the order: Residual Pb > Fe-Mn oxides bound Pb > Organically bound Pb > Carbonate bound Pb > Exchangeable Pb. The spinach leaf yield negatively correlated with enrichment of carbonated bound Pb ($r = -0.763^{**}$), organically bound Pb ($r = -0.588^{**}$) and Fe-Mn oxide bound Pb ($r = -0.425^{**}$) in the soil. The results indicate that the FYM addition modified the distribution of various Pb fractions leading to reduction in the availability of Pb. Therefore, FYM application could show beneficial effect to mitigate the adverse effect of Pb in the high Pb containing sewage irrigated soil.

See end of the article for authors' affiliations

Correspondence to :

K.C. PATEL

Department of
Agricultural Chemistry
and Soil Science, Anand
Agricultural University,
ANAND (GUJARAT)
INDIA

Key words : Sewage, FYM, Pb fractions, Exchangeable, Fe-Mn oxides.

Fractionation of Pb in contaminated soil could be used to identify sub-fraction of total metal content of soil and correlated with plant uptake. Xian (1989) observed that sum of exchangeable and carbonate bound forms were strongly correlated with Pb and Cd uptake in cabbage and kidney bean plants. The soils of peri urban area of Vadodara in Gujarat have been found contaminated with different heavy metals due to use of sewage water for irrigation by the farmers. Amongst the heavy metals, the level of Pb was of the concern in view of its uptake by plant leading to its entry in to food chain. Therefore, the studies on transformation of various forms of Pb in presence of amendments like FYM are necessary to understand the behaviour of externally added Pb in such contaminated soils in order to manage the possible toxicity of Pb on plant. In view of this, the investigation was taken up.

MATERIALS AND METHODS

A pot house study was carried out using sewage irrigated (SW) bulk soils collected from peri urban area of Vadodara in Gujarat. The soil of the experimental field was *Fluventic Ustochrepts*, loamy sand in texture and

had pH (1:2.5)– 7.73, EC_{2.5}– 0.43 dS m⁻¹, organic carbon– 3.8 g kg⁻¹, available P₂O₅– 33.0 kg ha⁻¹, available K₂O– 415 kg ha⁻¹, DTPA extractable Fe– 10.8 mg kg⁻¹, Mn– 12.0 mg kg⁻¹, Zn– 2.4 mg kg⁻¹ and Cu– 2.1 mg kg⁻¹ and heavy metals like Pb– 2.1 mg kg⁻¹, Ni– 0.71 mg kg⁻¹, Cd– 0.8 mg kg⁻¹, Co– 0.23 mg kg⁻¹.

The spinach (*Spinacia oleracea* L.) was grown under loading of different levels of Pb as 0, 5, 10, 20, 40 and 80 mg Pb kg⁻¹ soil using lead nitrate with (F1) and without FYM (F0). The crop was grown up to 60 days and harvested to record green leaf and dry matter yield. The plant samples were taken for determination of total contents of trace and heavy metals. The oven dried plant samples were finely ground in stainless steel Wiley mill and were digested in di-acid mixture of HNO₃: HClO₄ (4:1) as per the procedure outlined by Jackson (1973). The soil samples were collected for analysis of DTPA extractable Pb (Lindsay and Norvell, 1978) and different Pb fractions after spinach to see its distribution among different fractions. The changes in different fractions of Pb in soil viz., exchangeable, organically bound, carbonate bound, Fe-Mn oxides bound, residual and total Pb were determined using the standard procedure outlined by