SHORT COMMUNICATION

Evaluation of suitable extractant for available lead in soils

Summary

Four extractants were used to extract Soil-Pb from alluvial soils and the amounts of Pb extracted was correlated with Pb concentration in wheat crop. Of all the reagents, the Grigg's reagent was found to extract maximum amount of Pb from soils and the \( \text{NH}_4\text{OAc} \) the least. A highly significant correlation \( (r = 0.295) \) was observed between Grigg's reagent extractable Pb and Pb concentration in wheat plants followed by ammonium acetate \( (r = 0.238) \). While 0.02M EDTA did not show any significant correlation, a negative significant correlation was observed with 0.1N HCl.

Introduction

It is well known that lead is toxic for animals and plants. Since the plants are the direct or indirect suppliers of all types of food stuffs, a knowledge regarding the uptake and content of lead in soils and plants is essential. Usually soils contain traces of Pb but in areas where potential hazard of lead exists due to the automobile exhaust, coal, excess use of fertilizers and pesticides, it can increase the lead content in soils and plants alike. Chapman predicted that as little as 4.0 ppm \( \text{NH}_4\text{OAc}\)-extractable Pb can prove toxic to some plants. A number of extractant (\( \text{NH}_4\text{OAc}, \text{CaCl}_2, \text{HCl} \) and organic acids) have been used previously to extract the soil-Pb but there is not evidence of its being significantly correlated with its availability to plants. The present paper deals with the evaluation of a standard extractant for the determination of available lead in alluvial soils of Allahabad, U.P (India) using wheat (Kalyan Sona variety) as a test crop.

Methods

Soils used. Sixteen different places in a circuit of 18 miles of wheat-growing alluvial tracts of Allahabad, Uttar Pradesh were selected for the present study. Seventy bulk samples from these sites were taken, brought to the laboratory, dried, powdered and stored. The samples were analysed for their pH, total \( \text{CaCO}_3 \) and organic carbon contents using standard methods. These soils were all alluvial. The ranges of pH, \( \text{CaCO}_3 \) and organic carbon of the soils were 6.9–7.8 (average 7.2), 0.1–2.1% (average 0.4%) and 0.105–1.35% (average 0.382%) respectively.

Extractants used. Four extractants were used for extracting soil Pb in
order to correlate it with concentration of Pb in wheat plants. The extractants used were: a) 1N NH₄OAc, b) 0.1N HCl, c) 0.02M EDTA and d) Grigg’s reagent which is acid ammonium oxalate buffer (498 g ammonium oxalate and 252.1 g oxalic acid in 20 litres of distilled water) used originally by Grigg for the determination of available Mo in soils. Pb in the extracts was determined colorimetrically by dithizone method.

Concentration of lead in wheat. One kg of each of the soils was filled in small polythene buckets washed previously to remove any impurity adhering to the surface. Three replications were made. Each was given a basal treatment of NPK @ 120, 60 and 60 kg/ha respectively and the soils were irrigated with deionized water. Four seeds of wheat were sown in each pot. The plants were allowed to grow up to 45 days and then harvested. The plant material was washed first with distilled water and then two times with 0.1N HCl solution and finally 4 times with redistilled water. The plant material was then allowed to dry at 70°C in an oven. 2.5 grams of this oven-dried plant material was digested in a triacid mixture using sulphuric, nitric and perchloric acid and Pb was determined colorimetrically. The concentration of lead in plants was calculated in terms of μg/g.

Results and discussion

The range and average values of Pb obtained by four different extractants from soils (all alluvial) and total concentration of Pb in wheat plants are given in Table 1.

The amount of Pb extracted varied with the soils and extractants. Out of four extractants, Grigg’s reagent possesses maximum ability to extract Pb from soils and NH₄OAc the least. The soils with high CaCO₃ content extracted little Pb. The extractability of Pb also varied with soil pH. As the pH increased, the amount of extractable lead decreased. Ammonium acetate-extractable Pb varied from 0.00-0.66 ppm. None of the soils were found to contain toxic level of Pb assuming 4.0 ppm Pb as a critical level. The average values of Pb extracted by different extractants were Grigg’s reagent (2.75 ppm) > 0.1N HCl (1.86 ppm) > 0.02M EDTA (1.28 ppm) > 1N NH₄OAc (0.20 ppm).

A number of investigators have used ammonium acetate-extractable Pb as a measure of available Pb in soils. MackLean et al. used CaCl₂ and Sakhrova HCl for extracting Pb from soils.

The total concentration of Pb in plants varied from 0.64 to 20.64 ppm with an average of 6.38 ppm. It has been reported that Pb contained in the grass grown in filtered air was 2.5 μg/g. Lead content of pasture dry matters normally lies in the range of 1.0-10.0 ppm. Mixed herbage contained 37.4 ppm of lead.

When correlations between Pb extracted from soils and concentration of Pb in plants were calculated (Table 2), it was found that Grigg’s reagent correlated highly (r = 0.295). Ammonium acetate was the next best extractant to correlate significantly (r = 0.238).

EDTA did not give a significant correlation. A negative significant corre-