STUDY ON HEAVY METALS IN SOILS OF VIETNAM

Bui Cach Tuyen, Nong Lam University

ABSTRACT

There is an increasing concern about heavy metal contaminants in soils and crops in South-East Asian region that can effect intensive agricultural systems and on human health. This project has been conducted to determine the heavy metal residues in soils in 64 provinces in Vietnam. Three trial sites have been chosen from these to observe heavy metal absorptions of Cu, Zn, and Cd by different plants at different soil types in HoChiMinh city, Tan Thanh and Lam Dong provinces. Heavy metal concentrations in soil and plant were analysed by Atomic Absorption Spectrometer (AAS) lamp and graphite. In addition to accumulation of heavy metals in soil increases with the increasing of added biosolid, level of heavy metal accumulated in each part of plant depend largely on which metal plant absorbs. Peanut can uptake 10 - 40% Cd concentration available in soil and plant absorbs different metals at different levels. The study has provided preliminary data for assessing the impacts of biosolid wastes contaminated with heavy metals and heavy metal residues in soil on plant and human health.

INTRODUCTION

With the rapid development of both agricultural and industrial practises in most parts of Vietnam, there is an increasing level of heavy metal residues on soil and crops that effect intensive agricultural systems and on human health. This study has been carried out to provide preliminary data for the protection of the soil resource in Vietnam from irreversible degradation by heavy metals, to maximise the benefits and minimise the risks from use of wastes and fertilizers in peri-urban agricultural systems.

MATERIALS AND METHODS

Top soils in different locations from Ca Mau to Hue, soils at different depths (0-15, 15 - 30, 30 - 45, 45 - 60, 60 - 90 cm) in three field sites: Nong Lam, Tan Thanh and Lam Dong and four biosolid types: urban waste compost, cow manure, pig manure, and chicken manure (biosolid type based on the use of local farmers) were collected and tested for Cu, Zn, Pb, Cd by Atomic Absorption Spectrometer (AAS) lamp and graphite and measured for these parameters: pH, bulk-density, total & extractable metals, total C & N, bicarb P, SIN*, biomass C*, EC50 from SIN test* (* : Could not be done)

Trials have been carried out by fertilizing three salt types: $CuSO_4$, $ZnSO_4$, $CdCl_2$ at different rates: 0.5, 1, 1.5, 3, and 4.5 times of farmer practice, chemical; and chemical and 1 times of each salt per hectare relatively (rate response design based on multipliers of farmer practice (FP); Cu and Zn rates calculated from EC50 resulted at Bioassay experiment in greenhouse; Cd rates based on divider of Cd maximum sorption capacity of soil). Heavy metal absorption of these metals by peanut and soya bean in Nong Lam field site; cabbage in Lam Dong; Chinese cabbage and spring onion in Tan Thanh field site (crop types depend on site conditions) were examined

RESULTS AND DISCUSSION

Experiment results in greenhouse show that EC50 of Zn (the concentration at which 50% of the individuals treated exhibit growth reduction) of each plant has different value (see figures below)

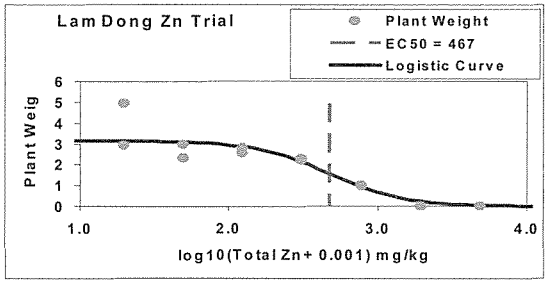


Figure 1. EC50 of cabbage

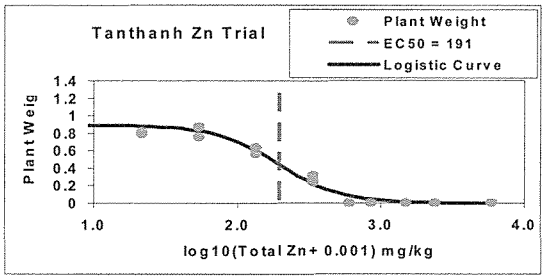


Figure 2. EC50 of Chinese cabbage

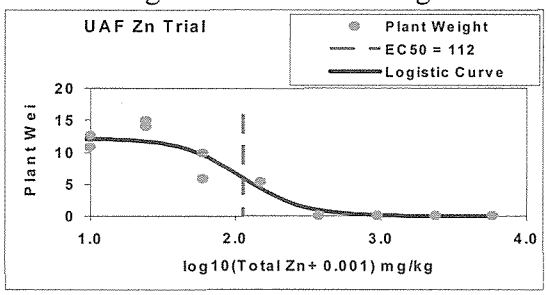


Figure 3. EC50 of peanut

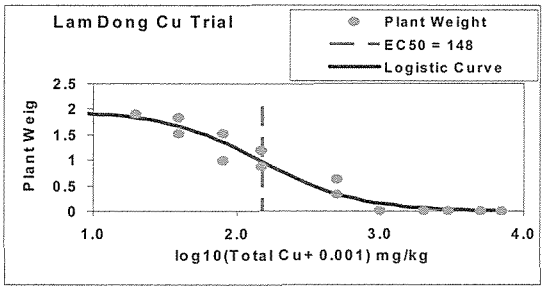


Figure 4. EC50 of cabbage

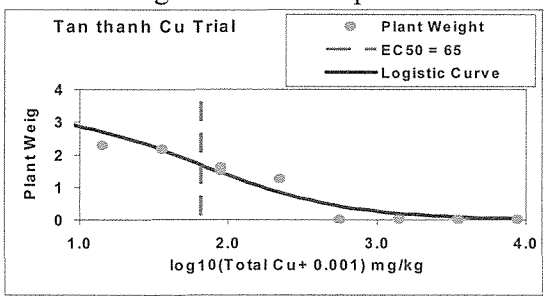


Figure 5. EC50 of Chinese cabbage

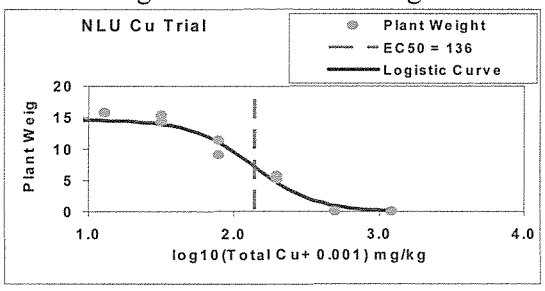


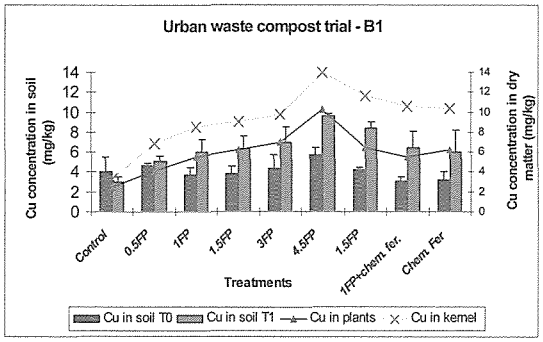
Figure 6. EC50 of peanut

Relatively the EC50 of Cu bioassay is below

The results show that the absorption value of Cu and Zn of cabbage in Lam Dong field site is different; relatively Chinese cabbage and peanut have different absorption values of Cu and Zn. It is seen that plant absorbs different metals at different levels.

Three biosolid types: urban waste compost, cow manure, and pig manure were fertilized at different rates on peanut at Nong Lam field site. Cu concentration in soils: control and experimented were analysed before planting and after harvesting. The result is presented in figures below.

Copper (Cu) in biosolid trials



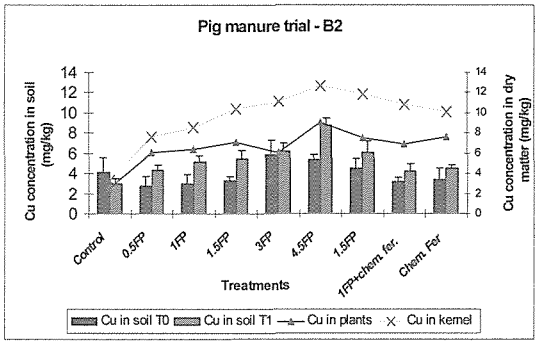


Figure 7. Urban waste compost trial

The results show that:

- Cu in soil increases with the increasing biosolid added to the soil.
- Cu concentration in kernel is higher than that of plant.
- Treatments applied only chemical fertilizer have higher concentration of Cu than control.

The results of Zn bioassay are shown as below

Figure 8. Pig manure trial

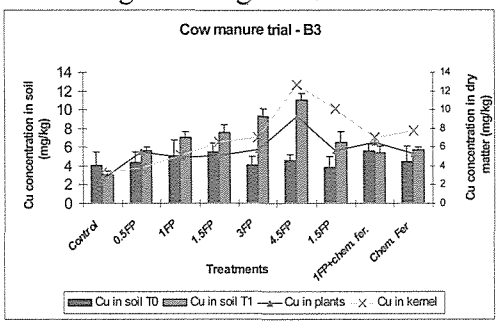


Figure 9. Cow manure trial

Zn in Biosolid trial

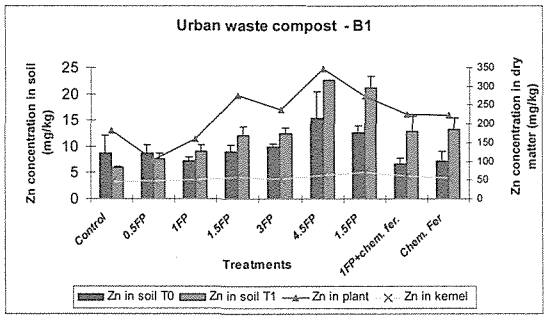


Figure 10. Urban waste compost trial

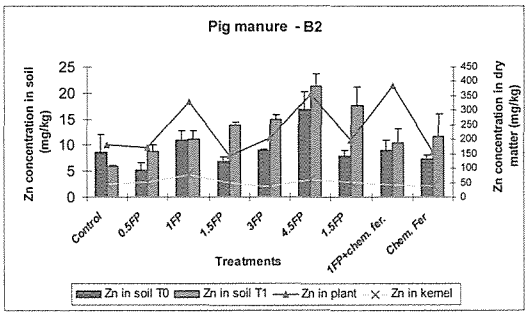


Figure 11. Pig manure trial

There are a significant different in Zn concentration in soil and plant treated with biosolid treatments and control.

Peanut uptake Zn and accumulate in plant higher than in kernel.

Cow manure content higher concentration of Zn than Pig manure.

The trials were conducted for Cd absorption of peanut kernel and plant; the obtained results are presented as figure 13, 14, and 15

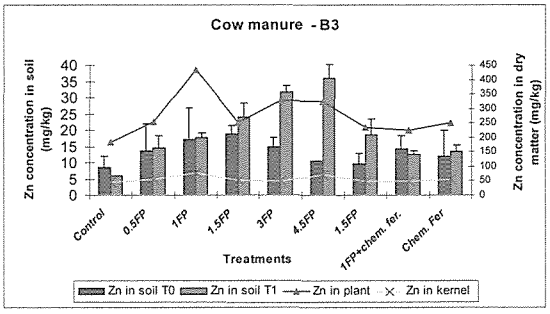


Figure 12. Cow manure trial

Cd in Biosolid trial

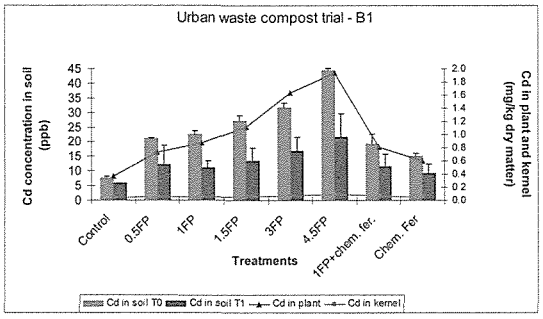


Figure 13. Urban waste compost trial

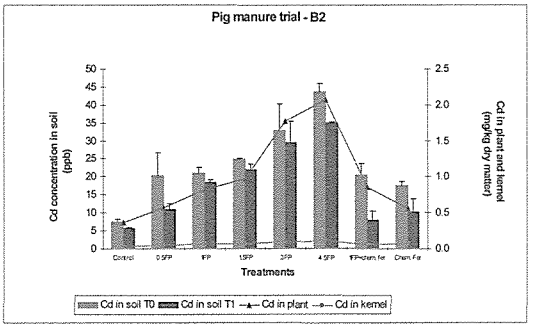


Figure 14. Pig manure trial

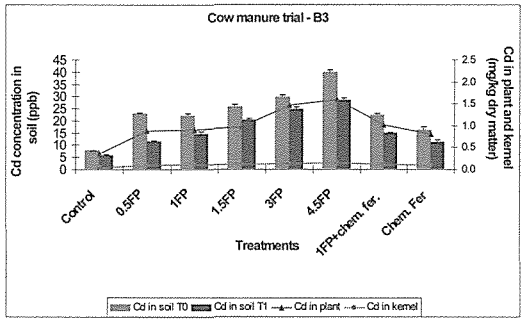


Figure 15. Cow manure trial

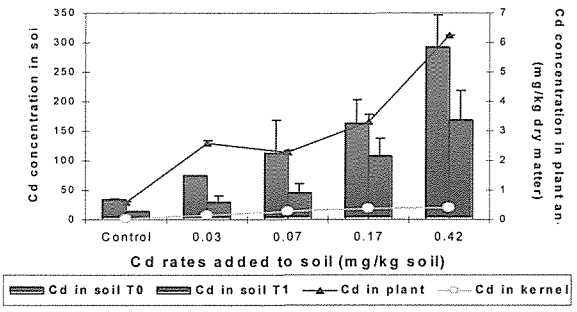


Figure 16. Cadmium trial

Cd concentration in soil rises when the rate of biosolid increases.
Peanut uptakes Cd in soil increases when creasing Cd concentration in soil.
After 1 crop, peanut uptakes 10 to 40% Cd concentration available in soil.
Trial to test for the best Cd level in soil for plant growth was conducted and it is shown that peanut grow well in higher concentration of Cd in soil up to 0.42 mg/ kg and Peanut plant can uptake high concentration of Cd (> 6mg/kg dry matter)

CONCLUSIONS

The study has provided preliminary data for estimating the impacts of heavy metals on plant growth, effects of biosolid wastes contaminated with heavy metals in different soil types and plants. Plants can still grow on those soils contaminated with certain levels of heavy metals and produce crop, however, how these crops with high concentration of heavy metals effect to human health should be investigated. Policy interventions in setting standards and criteria of heavy metals for agricultural soils and fertilizers should be done to obtain sustainable agricultural system.