

# **2003 TAIWAN INTERNATIONAL SCIENCE FAIR**

**CATEGORY : Environmental Science**

**PROJECT TITLE : Biosolids : Bio-transfer Factors of  
Trace Metals**

**AWARD : Second Award**

**SCHOOL : Merritt Secondary**

**FINALISTS : Keri Williams**

**COUNTRY : Canada**

# Biosolids: Bio-transfer Factors of Trace Metals

Keri Williams

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With an increase in the use of biosolids as a soil replacement and as a fertilizer for crop production, consumers continue to question the safety of crops grown in biosolids. Although past research has shown that there are no adverse affects in the nutritional value of plants grown in biosolids, I further researched the safety levels of trace metals in crops fertilized using biosolids.

To complete my research I selected six trace metals that (when not controlled) are deemed such a sufficient risk that there are regulations in place to control the levels in which they are introduced into the environment. I analyzed the level of trace metals in three varied soil environments: non-fertilized soil,

## Trace Metals Analyzed

Cadmium (Cd)	Chromium (Cr)
Lead (Pb)	Copper (Cu)
Nickel (Ni)	Zinc (Zn)

soil amended with chemical fertilizer, and soil amended with Class A biosolids. I also analyzed plant tissue samples from peas, barley and two field crops (barley and rye grass combined). Samples were taken from 24" by 24" plot squares where the variables were well controlled. Seed selection, seed application rates, planting depth and spacing were all controlled. In addition, fertilizer selection and application rates as well as irrigation application rates were well monitored and documented.

I prepared the Soil Material Available sample(s) using the DTPA extraction method and used the Inductive Coupling Argon Plasma (ICAP) machine to analyze and to measure the amount of trace metals found in soil and plant samples.

To evaluate the safety of the crops grown in biosolids, I created a data analysis chart for each plant tissue sample. I included the health standards for the "Daily Optimum Intake" as well as the "Daily Intake for the Onset of Toxicity" for trace metals. I also included the lab data results from my plant tissue samples as well as the "Average Cattle Consumption (hay/day)" data. By taking the "Daily Intake (mg/kg) for the Onset of Toxicity" / trace metal and dividing it by the data for each plant tissue sample, I determined the amount cattle would have to consume/day (of the trace metal) in order for toxicity to occur.

The results clearly supported the safety of using biosolids as a fertilizer. The transfer of trace metals from soil to plants was evident, however the amounts transferred were found to be in quantities that were well within the safe levels identified by both environmental and health standards. I discovered that it would be impossible for cattle to consume the amount of feed that would be required to create toxicity, from trace metals, in field crops. This project's data does support the use of biosolids as a safe, healthy fertilizer.

## Bibliography

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## 評 語

本研究已進行三年，是一項很持續而完整之研究。對於生質堆肥之金屬微量影響有很深入之分析，因此頗具有實用價值。