

# Importance of deposition measurements in Canadian Prairie agro-ecosystems

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**INTRODUCTION.** Western Canada is known for production of animal and plant foods in an area largely free of industrial and other anthropogenic sources of pollution. Incidents of higher-than-desired levels of heavy metals in agricultural crops have occurred.

**RESEARCH PROBLEM.** To this day, sources of these heavy metals have not been identified and thus have remained unknown.

**QUESTION.** Might our global atmospheric pollution contribute to such crop contamination? If so, to which extent and which elements are most significant? As heavy metals tend to bioaccumulate, have some of these elements meanwhile entered our food chain?

**STUDY SITE AND METHODS.** In the 1950s, an area of 600 m<sup>2</sup> of agricultural land in southwest Saskatchewan (N50°15'35.6", W107°44'05.9") was protected from atmospheric input with the construction of a covered shed (Figure 1). This particular area is located at 825 m elevation within the semiarid climate of the brown soil zone of the Palliser Triangle—an agriculturally intensive area. In 2007, soil samples at two depths (i.e., 0-15 and 15-30 cm) were collected from both within the covered area and outside. Differences in heavy metal and metalloid concentrations in the soil (using ICP-MS) as well as soil characteristics were investigated.



Figure 1. Covered shed erected in the 1950s at the South Farm of SPARC in Swift Current, SK.

**BOX 1.**  
Some anthropogenic processes that may increase soil heavy metal concentrations, through wet and dry atmospheric deposition or through direct application:

- the burning of fossil fuels;
- industry emissions and coal ashes;
- animal manure, inorganic fertilizers, pesticides, and sewage sludge;
- urban refuse, municipal sewage, organic waste;
- discarded manufactured products;
- heavy metal mining, smelting, refining, manufacturing, uses, recycling, disposal, and waste incineration, ...

Source: Nriagu and Pacyna 1988, Quinton and Catt 2007

## RESULTS.

- 1) At 0-15 cm, Co (p=0.030) and U (0.050) significantly decreased and at 15-30cm, Cr (0.023), Sr (0.019), and V (0.032) significantly increased in the soil taken from the unprotected area, compared with the soil derived from within the covered area (see Figure 2). Difference in all other heavy metals and metalloids (Al, As, Ba, Be, Bo, Cd, Cu, Fe, Pb, Mn, Hg, Mo, Ni, Se, Ag, Th, Sn Ti, Zn) remained insignificant between these two locations.
- 2) In this study, absolute values of Al ( $12400 \pm 160 \mu\text{g}\cdot\text{g}^{-1}$ ; mean  $\pm$  SEM), Mn ( $542 \pm 11 \mu\text{g}\cdot\text{g}^{-1}$ ), and Hg ( $0.049 \pm 0.001 \mu\text{g}\cdot\text{g}^{-1}$ ) soil concentrations have been found to be above suggested baseline or tolerable thresholds, as suggested in the current scientific literature.
- 3) Soil alkalinity (<0.001) and conductivity (0.009) increased at 0-15cm outside *versus* inside the shed, while these measurements remained statistically insignificant at 15-30 cm. Soil grain size below 75 $\mu$  was decreased by 25% at 0-15cm and by 50% at 15-30cm in the uncovered soil sample, compared to the covered soil sample.

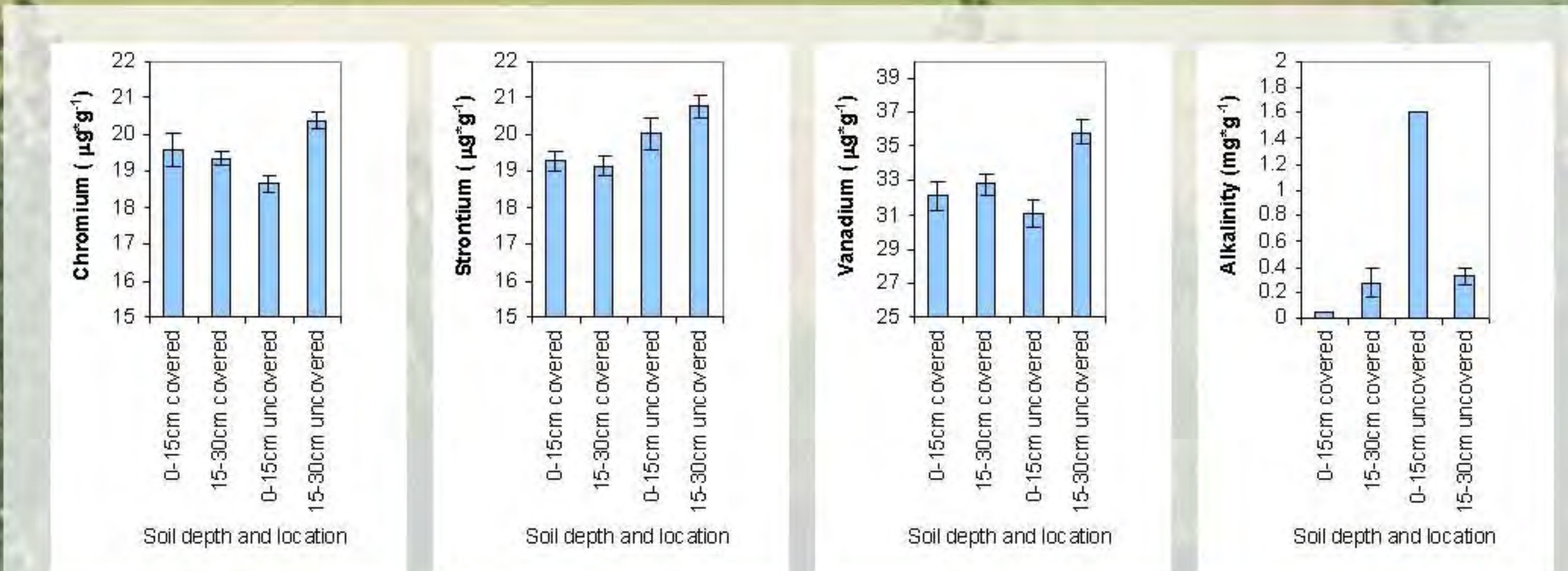


Figure 2. Soil heavy metal concentrations and soil alkalinity depending on soil depth and coverage vs. non-coverage for 55 years. From left to right: Chromium, Strontium, Vanadium, and alkalinity (as CaCO<sub>3</sub>). Sample size n = 3. Bars indicate means  $\pm$  SEM.

**DISCUSSION.** Soils possess an inherent buffer capacity—an ecosystem service that is offered with the assistance and collaboration of soil flora and fauna as well as plant roots. None of these contributing organisms have been investigated in this study. We anticipate that soil flora and fauna as well as plants contribute greatly to our results due to their transformation and uptake capacities. A current research project at the AAFC's SPARC in Swift Current, SK addresses the plant and crop side of this issue, more specifically investigating heavy metal loads of food and feed crops across Saskatchewan. Albeit the importance of agro-ecosystems in producing our daily food, these areas are generally not well monitored regarding atmospheric pollutant deposition. We do not know the immediate atmospheric deposition of heavy metals or the potential transfer of deposited pollutants into crops in such important areas. We thus anticipate the installation of heavy metal collectors across the Canadian Prairies in 2008 for monitoring purposes.

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## LITERATURE

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