IDENTIFYING SOLUTIONS TO LIMIT CONTAMINATIONS OF VEGETABLES BY METALLIC TRACE ELEMENTS IN KITCHEN GARDENS

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CONTEXT

During the last two centuries, the important development of heavy industries in the Walloon region has been responsible for atmospheric contaminations of the environment. The Meuse valley (Fig 1a) was especially concerned due to transportation facilities. As a result, soils located around these old industries are contaminated with cadmium, copper, lead, and zinc, among other pollutants.

A transect was realized across the valley according to direction of the dominant winds (NO-SE) and the plough layer of cultivated soils was sampled. Soil cores were taken in 13 locations along the axis (Fig. 1c). Levels of contamination were assessed through determination of pseudo-total (aquae-regia) and available (NH_4-CH_3COOH +EDTA) contents of Cd, Cu, Pb, and Zn.

The distributions of the element contents gives evidences of contaminations from the valley as gradients of contamination extend in both directions (Fig 1b). Similar observations were found for cadmium, copper, lead or zinc.

The main concern of this study is to assess the risks of transfer of contaminants from soils to vegetable in kitchen gardens and to contribute to the identification of solution to limit these risks. Two pot experiments were conducted by vegetable growing on contaminated garden soils.

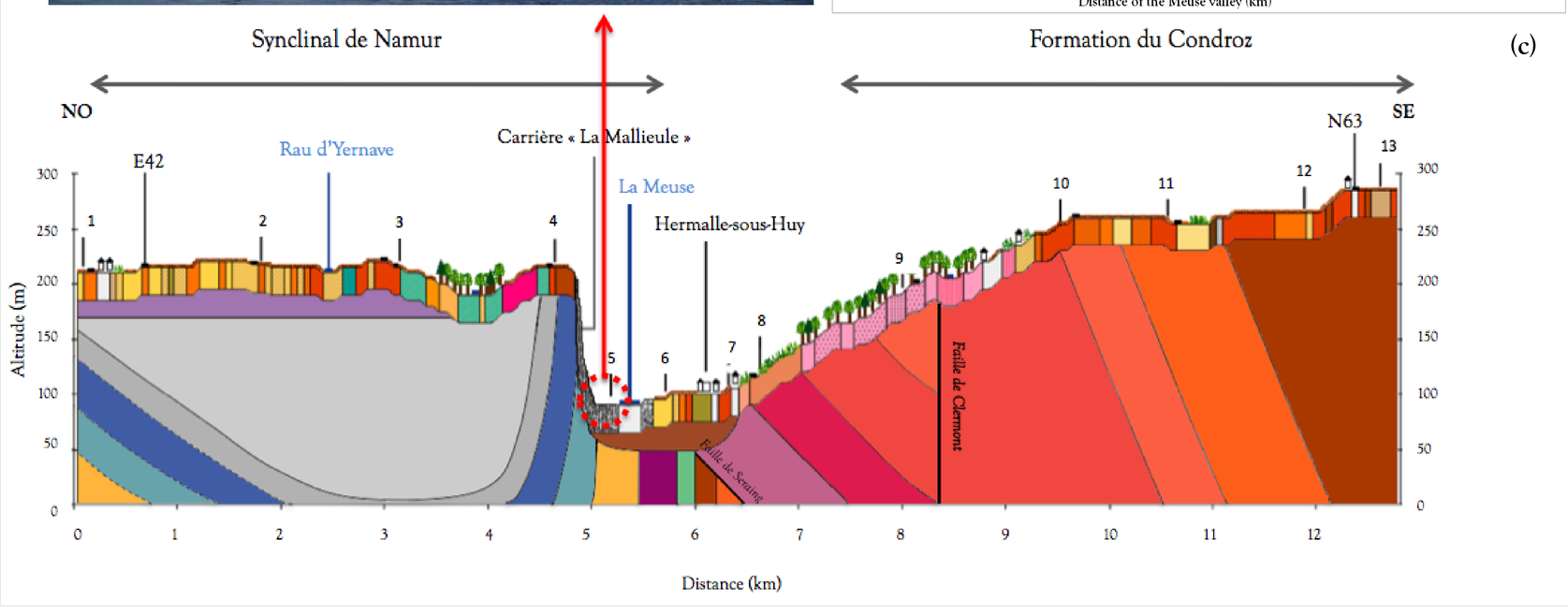

Figure 1: Context description (a) picture of Meuse valley , (b) graphic of zinc distribution and (c) toposequence of Meuse valley with the samples localisation

SOIL-PLANT TRANSFERS STUDIES

COMPARED BEHAVIOUR OF 2 VEGETABLE SPECIES CULTIVATED ON CONTAMINATED SOILS

Figure 2: State of lettuce at harvesting

Lettuce sp. and *Endive sp.* were cultivated on 10 contaminated garden soils and 2 control soils during 2 months (Fig. 2). Contaminated soils had been taken in gardens of Meuse valley between Huy and Liège.
We investigated the effect of plant species (both are "leaf" vegetables) on element uptake when they grow on a range of contamination[2]. This range is representative of levels found in Liège province.

Range of contamination:
Cd: 0,9 – 22 ppm
Cu: 20 – 250 ppm
Pb: 55 – 1120 ppm
Zn: 240 – 5840 ppm

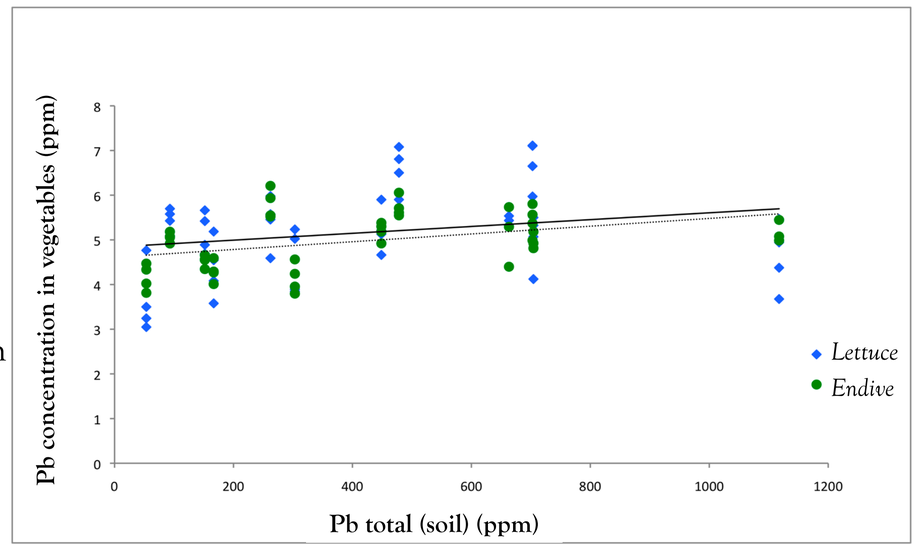

Figure 3: Relationship between plant and soil total Pb content

Statistically, both species accumulate the same amounts of cadmium, copper, lead and zinc (Fig. 3). Positive significant relationships were found between plant and soil content for studied MTE[1]. The risks for people linked to MTE ingestion seem therefore significant and do not depend on the species studied.

IMMOBILIZATION OF MTE AFTER ADDITION OF ORGANIC AMENDMENTS TO THE SOIL

Figure 4: State of spinacia at harvesting

Spinacia oleracea was cultivated during 2 months (Fig. 4) on 3 contaminated garden soils which had been amended by organic products. Three organic amendments (cow manure, cow-chiken-horse manure & compost, all 3 being commonly found in gardening stores) were tested at 4 different concentrations (10, 20, 30 & 40 g carbon * kg^{-1} soil).

Contamination references were measured on the plants of *S. oleracea* that grew on soils without organic amendment . The efficiency of contamination decrease was then assessed on the base of the soil-specific references.

The addition of organic amendments did **decrease** the trace element **uptake** by *S. oleracea* **in every cases**.

The treatment "**cow manure – 30 g C*kg^{-1}**"[1] gave **the best decrease uptake** for the 3 soils. The cadmium, cupper, lead and zinc uptake decreased respectively up to 70%, 20%, 50% and 60% than controls.
Moreover, this **treatment answers to the maximal values set by European directive** (1881/2006/CE, setting maximum levels for certain contaminants in foodstuffs), cadmium (2ppm) – lead (3ppm).

This solution which only reduces risks linked to contamination costs 25€/m^2., which is not affordable for most garden owners. In the future, other (cheaper) solutions should be investigated as well as their durability.

[1] Liénard A. (2009). Contribution à la maîtrise des contaminations des plantes potagères par les éléments traces métalliques. Gembloux Agro Bio Tech

[2] Grognard M. (2008). Etude des jardins potagers contaminés en éléments traces métalliques et des transferts dans les plantes cultivées en Région wallonne. Gembloux Agro Bio Tech