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Introduction

Negative soil test results that indicate some level of soil contamination can impact the way we view urban/community gardening. Instead of being discouraged, there are ways to continue gardening and be confident that the food produced is safe to eat and/or to sell. Below is a list of options to consider in mitigating soil contamination issues and is based on minimum soil contamination.

General Gardening & Land Use

- Incorporate or top dress the garden area with clean materials such as uncontaminated soil, compost, manure, or peat moss.
- Adjust soil pH to near neutral. Most metals are more bioavailable in more acid soils and can harm plants or animals when pH is too low. Most plants will thrive at pH 7; however, some may require an adjusted level ranging from pH 6.2 – 6.7.
- Mulch walkways and other areas to reduce dust and soil splash back onto crops, or maintain healthy grass or other ground cover.
- Don't grow edible produce directly adjacent to buildings, where lead levels are likely highest.
- Build raised beds with clean soil to grow food crops in more contaminated areas. Regardless of its source, even soil in raised beds should be tested to determine toxicity and nutrient levels. Once this is done, a layer of landscape fabric will prevent plant roots from entering the contaminated soil below the bed.
- For raised beds and other garden projects, don't use certain types of treated lumber that may have chemicals that will further contaminate the soil. In the past, some commercially-available treated lumber contained copper, chromium, and arsenic.
- In more contaminated areas, first consider whether the practices outlined here can sufficiently reduce the amount of contaminants in contact with crops. This can be verified by testing the soil or plant tissue.
- If it is not possible to protect crops from contamination, consider growing crops that are less likely to be contaminated.
- Because of the many benefits of eating fresh fruits and vegetables, growing ornamental plants instead of food crops should only be considered as a last resort.

How Do Plants Get Contaminated?

There are three main ways that heavy metals, such as lead, could contaminate garden crops. This information is important to help select the best crops for particular situations.

1. ***Deposition from the air****:* In the recent past, this was a major source of lead contamination in urban areas until leaded gasoline was phased out completely in the 1980s. Some lead deposition still occurs due to windblown dust from contaminated soils and streets. Other airborne contaminants can also end up on plants. This is a particular problem for leafy crops, which have a high surface area in contact with airborne particles. In particular,

some ester (and amine) herbicides can spontaneously volatize and travel great distances unbeknownst to the individual or group who initially applied it.

2. ***Uptake into plant roots***: In most situations, unless soil is acidic (low pH) or very low in organic matter, not much lead is transferred from contaminated soils to garden crops through plant roots. However, roots are likely to have a higher concentration of lead than leaves and stems, and fruits or seeds are likely to be lowest in lead of all plant parts. Cadmium and some other heavy metals of concern are more readily taken up from contaminated soils into roots and plant tops.

3. ***Direct contamination by garden soil***: Root and tuber crops are more likely to be contaminated than other types of crops because they are in direct contact with soil. Leafy vegetables (lettuce, spinach, collard greens) are also easily contaminated by soil splash and dust. Washing leafy crops can remove up to 80 percent of lead contamination, and much of the lead can be removed from vegetables such as carrots and potatoes by peeling. However, in situations where lead contamination is moderate-to-severe, growing these types of crops directly in the contaminated soil is not recommended.

Fortunately, there are several natural barriers that limit heavy metal transfer into crops.

- ***Soil-Root Barrier***: Some toxic metals (such as lead) have low solubility in most soils, and do not readily enter the plant through roots.
- ***Root-Shoot Barrier***: Most toxic metals bind relatively strongly in roots, and movement to other plant parts is limited.
- ***Shoot-Fruit Barrier***: Most toxic metals are largely excluded from entering the reproductive parts (fruits, seeds) of the crop, remaining instead in the vegetative parts.

Which Garden Crops Are Suitable to Grow in Contaminated Soils?

Some garden crops can take advantage of these natural barriers. However, the physical contamination of crops by soil dust, splash or aerial deposition can often bypass the natural barriers of protection. Practices to reduce the physical contamination of garden food crops and to reduce human exposure therefore become important.

In addition to what is known about contamination pathways, the results of past research also provide some information about the potential for heavy metal transfer into garden crops. All of this information allows for recommendations for garden crops that are most and least suitable for growing directly in contaminated soils.

Most Suitable

Vegetable Fruits and Seeds: tomatoes, eggplant, peppers, okra (seed pods only), squash (summer and winter), corn, cucumber, melons, peas and beans (shelled), onions (bulb only)
Tree Fruits: apples, pears

Least Suitable*

Green Leafy Vegetables: lettuce, spinach, Swiss chard, beet leaves, cabbage, kale, collards
Other Vegetables: broccoli, cauliflower, green beans, snow peas
Root Crops: carrots, potatoes, turnips

Given the many health benefits of consuming fresh fruits and vegetables, every attempt should be made to use the steps outlined on the previous pages to create healthy garden conditions to grow a variety of desirable crops. However, eating fruits and vegetables grown in contaminated soils may have risks.

Planting the Garden

Care must be given to ensure that potentially contaminated soil does not move off site due to garden practices. Aside from the safe gardening guidelines mentioned earlier, vegetable planting strategies can be implemented to maximize garden space and minimize erosion. Listed below are some suggested plans.

- **Intensive Gardening:** Intensive gardens employ space-saving techniques such as wide-row planting, raised beds, intercropping, succession planting, vertical training and planting in stair-step arrangements. Extending the growing season using plant protectors is another technique of intensive gardening. Lettuce, radishes and other cool-season crops can be grown early in the spring or late in the fall with such protection. Early and late planting ensures crops in the ground nearly all year long for consumption. Use cover crops when possible.

- **Raised Beds:** Raised beds increase production by conditioning the soil for excellent root development. This option ensures minimum soil loss from erosion and a controlled growing environment. More information is available by contacting UK Jefferson County Cooperative Extension Service or the University of Louisville Center for Environmental Policy and Management.

- **Intercropping:** Intercropping involves planting different vegetables side by side to take advantage of the different times of maturity, heights, spreads or rooting depths. A classic example of intercropping involves corn, beans and squash. A few weeks after sowing corn seeds, you plant pole beans close to the corn rows to use the corn stalks for support.

- **Succession Planting:** In succession planting, another seed or transplant immediately takes the place of a harvested plant. For example, when you harvest a lettuce plant in early summer, a Swiss chard or New Zealand spinach transplant can replace it. After harvesting an early crop of sweet corn, you might follow with a fall crop of broccoli, spinach or snow peas.

- **Vertical Training:** Vertical training involves growing plants upright rather than horizontally. You can vertically grow vine crops, tomatoes, peas and beans on wood, wire or string trellises, or in cages. Besides having more plants per square foot, you will also have cleaner fruit that will be easier to harvest.

- **Stair step:** The stair step arrangement is a form of vertical planting that lends itself especially well to small plants, such as lettuce, spinach and onions. Basically, stair steps change a two-dimensional space into a three-dimensional one, usually with wooden bins in pyramid shapes.

Information in this document is to be used as a guide to ensure safe gardening while working in soil that may have some level of contamination. The goal is to minimize soil runoff by using proper planting techniques by keeping some type of plant cover, vegetables or cover crop, year around.

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CENTER FOR ENVIRONMENTAL POLICY & MANAGEMENT

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