CHROMIUM in Garden Soils

Should I Be Concerned?

What is chromium?

Chromium is a metal that exists naturally in the environment and is also released into the environment as a result of human activities.[1,2] Chromium is used to manufacture paint pigments and in the making of stainless steel.[3] There are many different forms of chromium, but the most common forms are metallic chromium, trivalent chromium (Cr^{+3}), and hexavalent chromium (Cr^{+6}).[4] Trivalent and hexavalent chromium compounds are commonly released into the environment through various industrial processes, such as leather tanning, fabric dyeing, and chrome plating operations.[5,6]

Where does chromium in soil come from?

Chromium may enter soil from multiple sources. Chromium compounds are commonly released into the environment from industrial manufacturing plants, such as chromium electroplating operations.[5] Airborne chromium particles emitted from nearby factories and other pollutant sources may be deposited into soil.[4] Once in soil, Cr^{+6} will be changed to trivalent chromium by microbes. This means that chromium produced from industrial activities that ends up in soil will become less toxic over time as it degrades.[5] Chromium is also found naturally in a type of rock called serpentinite,[7] and in some groundwater aquifers in North Carolina.[8] Based on a U.S. Geological Survey study from 1984, chromium in U.S. soils ranges from 1.0 – 2,000 ppm, with an average of 54 ppm.[9]

Are there regulations for chromium in soil?

The state of North Carolina has adopted the U.S. EPA's residential health-based Preliminary Soil Remediation Goals (PSRG) for soil contaminants in North Carolina. For chromium, the PSRG is 24,000 ppm for Cr^{+3} and 0.3 ppm for Cr^{+6} in soil.[9] By comparison, guidance values of 36 ppm for Cr^{+3} and 22 ppm for Cr^{+6} were set by the New York State Environmental Remediation Program, which considered exposure from gardening.[10] The NC guidance value is based on the assumption that the chromium is present in the soil in its most toxic form (Cr^{+6}), and therefore it is a conservative value that represents an abundance of caution.

How might I be exposed to chromium in the garden?

Most of the chromium found in urban garden soils is Cr^{+3}, the relatively less toxic form of the metal.[7] Chromium is toxic and not essential for plants, so they only take up small amounts from the soil.[7] Chromium that is taken up tends to accumulate in the roots and seeds of most plants.[7,11] Studies show that there is little transfer of soil chromium to above-ground parts of the plant, and this may be a response by the plant to limit the spread of chromium through the plant.[7,12]

Most above-ground, edible parts of vegetables will have only small amounts of chromium, even when chromium levels in soil are relatively high. To minimize risks for exposure to chromium, soils high in chromium should not be used for growing root crops such as onions, carrots, or beets.

Therefore, the major pathway of exposure to chromium from urban gardens is through interacting with the soil.[13] There are three primary ways that you may be exposed to chromium in the soil: inhaling contaminated soil particles, eating contaminated soil particles, or by directly touching contaminated soil, which children sometimes eat.

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How can chromium affect my health?

Chromium can affect our health in very different ways depending on the form. Trivalent chromium (Cr^{+3}) is considered an essential element, which means that it may be beneficial for your health in very small (trace) amounts, like the amounts you can find in a multivitamin.[14] Research suggests that Cr^{+3} may help with normal insulin function in the body, among other benefits.[14,15]

Hexavalent chromium (Cr^{+6}) is toxic to humans in any amount, and elevated levels are associated with many adverse health outcomes. Inhaling hexavalent chromium may cause irritation in the nose and difficulty breathing. Some people become sensitized to hexavalent chromium, which means they develop an allergy to chromium that worsens with repeated exposures.[2] This allergy may result in asthma, cough or wheezing, and shortness of breath. Eating Cr^{+6} in soil may irritate the stomach or intestines and may cause people to develop ulcers on their stomach lining.[2] Hexavalent chromium is also associated with anemia. Long-term exposure to Cr^{+6} may adversely affect the male reproductive system.[2] Hexavalent chromium is a known carcinogen, but there is no evidence that trivalent chromium causes cancer.[16]

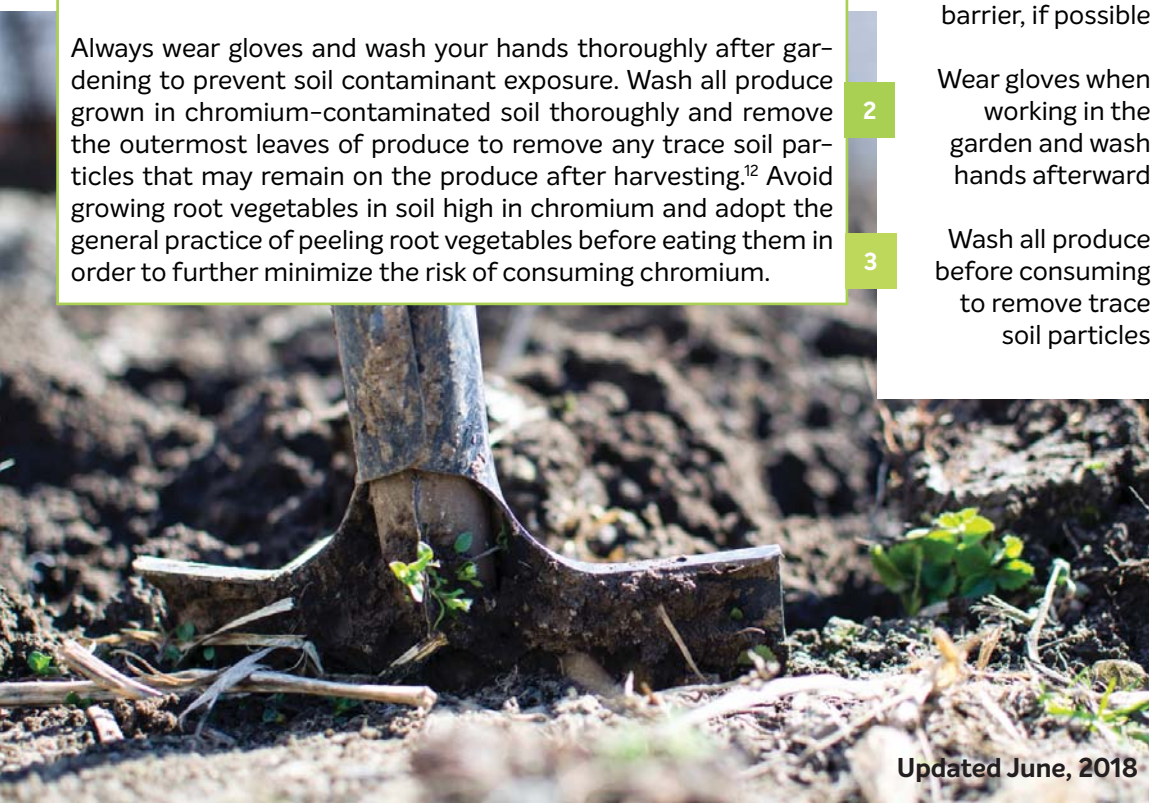
It is unknown whether pregnant women and children are particularly susceptible to health-related impacts of chromium exposure.[2] However, given the sensitive developmental stage of children and their increased hand-to-mouth behavior that can lead to more soil intake, children are more likely to have higher exposures than adults. You can reduce children's risks by taking extra precautions with your children in the garden to prevent exposure, as described in the section below.

What can I do to reduce chromium exposure?

There are several steps you can take to reduce chromium exposure if you are concerned that it may be an issue at your garden. Adding organic matter, such as mulch or compost, may help with converting the Cr^{+6} to non-harmful Cr^{+3} in the soil because it increases microbe activity.[7] Regularly adding compost or soil may also dilute the chromium concentration within the garden soil.

Always wear gloves and wash your hands thoroughly after gardening to prevent soil contaminant exposure. Wash all produce grown in chromium-contaminated soil thoroughly and remove the outermost leaves of produce to remove any trace soil particles that may remain on the produce after harvesting.[12] Avoid growing root vegetables in soil high in chromium and adopt the general practice of peeling root vegetables before eating them in order to further minimize the risk of consuming chromium.

1. Build raised bed gardens using a landscape fabric barrier, if possible
2. Wear gloves when working in the garden and wash hands afterward
3. Wash all produce before consuming to remove trace soil particles



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