Port Colborne Community Action Plan (PCCAP)

Guidance for Growing Ornamental Plants in the Vicinity of the Port Colborne Refinery

Key Guidance

- Nickel, copper, cobalt, and arsenic (Ni, Cu, Co and As) concentrations in soils around Vale Canada's Port Colborne Refinery are elevated due to historical emissions from the refinery. The company accepted responsibility for the contamination and undertook the Port Colborne Community-Based Risk Assessment (CBRA). All CBRA documentation is available at http://vale.com/canada/EN/aboutvale/communities/port-colborne/CBRA/CBRA-documentation/Pages/default.aspx
- The Port Colborne Community Action Plan (PCCAP) was initiated to address certain issues that arose from the CBRA.
- The CBRA addressed agricultural crop plants, but did not specifically address the growing of ornamental plants in the area: the elevated soil Ni, Cu, Co, and As (chemicals of concern or CoCs) in surface soils warrants discussion of this issue.
- Visual symptoms of plant toxicity (phytotoxicity) due to the CoCs is revealed by chlorosis (yellowing and die back of leaves) and/or stunting of plant growth, with Ni being the CoC of greatest importance due to its predominance among the CoCs.
- Phytotoxicity due to the CoCs involves direct toxicity but also includes disruption of pathways for other trace elements, including iron and manganese.
- Addition of clean soil in plant bedding can dilute the metals to prevent phytotoxicity. Amendments such as limestone, manganese, and iron can also reduce uptake of these phytotoxic CoCs.
- The Vale Port Colborne information helpline is available by telephone (289-478-8253) or email (Ontario.questions@vale.com) to have questions answered.

Supporting Information

The Port Colborne Community-Based Risk Assessment (CBRA) studied the effects of the historically emitted elements Ni, Cu, Co, and As (chemicals of concern or CoCs) on agricultural crops in a series of laboratory (greenhouse) and field experiments (Stantec, 2014). Various measurements (endpoints) were studied, such as impairment of germination and growth, but for ornamental plants, for which such measurements are not available, perhaps the most useful indicator of the phytotoxic effects of the CoCs are characteristics such as leaf damage, including the yellowing of leaves (chlorosis), and stunting of plant growth. Therefore, for residential gardeners of ornamental plants, these symptoms will likely be the most practical indicators of phytotoxicity potentially resulting from the CBRA CoCs.

Visual symptoms of CoC toxicity (primarily believed to be due to Ni, the predominant CoC) were seen in corn and oats in the CBRA crop studies. The general signs of Ni phytotoxicity include growth reduction among roots and shoots, deformation of plant parts, including flowers, leaf spotting and chlorosis, and inhibition of germination (CCME, 2015). In oats grown in the CBRA field and greenhouse studies, the visible toxicity symptom is an alternating pattern of chlorotic banding across the width of young leaves, while in corn, interveinal chlorosis and red to reddish-purple discoloration (purpurescence) on leaf margins was observed (Stantec, 2014)[1].

For Port Colborne residents in the historically impacted area (Fig. 1) that have experienced difficulties maintaining ornamental plants and for which symptoms such as those mentioned above have been previously observed, phytotoxicity due to the CBRA CoCs could be a factor.

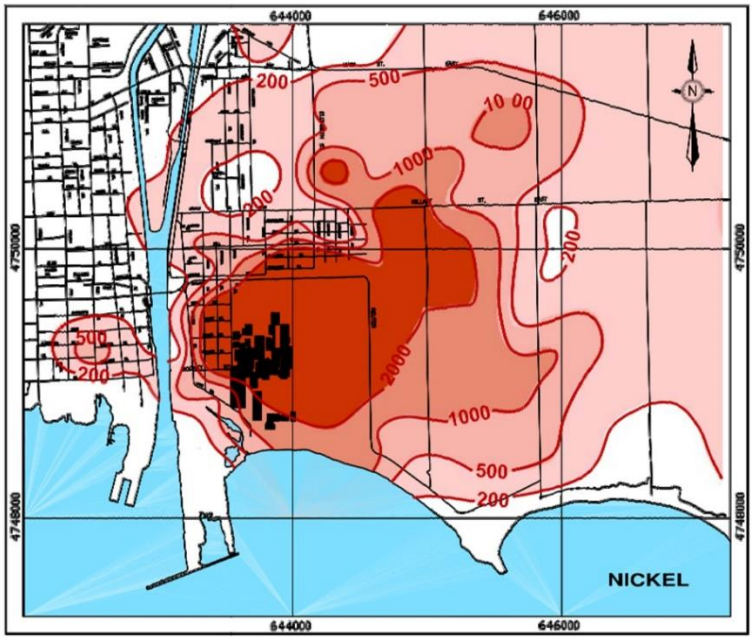

Fig. 1. Soil Ni patterns around the Port Colborne refinery. This was originally part of Fig. 2-1 in Chapter 2 (Appendix 2A) of (Stantec, 2014).

[1] Appendix 1L of Stantec, 2014 (Vol I – Part 3 and Part 4).

The use of clean commercially available soil in the beds prepared for ornamental plant roots will minimize the potential for phytotoxicity in ornamental plants in Port Colborne. Raised beds using such soil would also minimize the potential for metal phytotoxicity. New plantings on previously unused soil in the impacted area would be similar to that in unimpacted areas, particularly at older properties where construction practices might have stripped topsoil, and where topsoil addition is commonly used to increase the success of ornamental plantings. See *The Online Gardener's Handbook* (OMAFRA, 2010) and Penn State (2002).

Bulk elements and trace elements all have characteristic pH-solubility curves (OMAFRA, 2018), so pH can be used to some extent to control uptake of contaminant metals. For Ni (which is considered to be a trace nutrient, but at background levels rather than the elevated level seen in the impacted area), uptake and phytotoxicity can be minimized under alkaline soil conditions. However, care should be exercised by the gardener in manipulating soil pH and nutrients. Follow the guidelines for care of the ornamental plants. For less sophisticated gardeners, the addition of clean top soil should be seen as a first step for dealing with potential CoC phytotoxicity.

Four commercially available soils and compost were analyzed for the CoCs and provided in Table 1. The low levels of CoCs indicate high suitability for reducing potentially elevated CoC levels in soils of the impacted area.

Table 1. Concentrations of CBRA CoCs in commercially available bagged soils.

Soil Brand	[Ni] (ppm)	[Cu] (ppm)	[Co] (ppm)	[As] (ppm)
Pro Mix Premium Organic Vegetable and Herb Mix	<7	9.8	<13	<1.5
Pro Mix Premium potting mix	<6	<3	<12	<1.4
Sta-Green enriched lawn soil	<5.2	<2.7	<10	<1.2
Scotts Select Black Earth	<10	17.6	<28	<2.3

References

CCME, 2015. Scientific Criteria Document for Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health: Nickel. Canadian Council of Ministers of the Environment. 178 pp.

OMAFRA, 2010. The Online Gardener's Handbook 2010 - Chapter 6: Ornamental Plants - Problem Areas on Ornamental Plants (gov.on.ca)

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