

Sustaining Farming on the Urban Fringe



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Urban Market-Garden Rapid Soil Assessment for Trace Metal Contaminants

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Farmers know that everything begins with soil - its assessment, its productivity, and its management. Accompanying the renaissance in urban market-gardening, i.e., growing some additional food in our cities, is the need to reuse and renew urban soils long ago abandoned for farming uses. New Jersey's urban soils are frequently contaminated with elevated levels of trace heavy metal elements like lead or arsenic from generations of residential and industrial activities.

The time and prohibitive cost of intensive soil sampling to assure safety, constrains the increasing demand for renewed use of urban soils for food production. Unused land *is* available in urban areas, but just because land exists doesn't mean it will be a productive plot, nor can we assume it is free from contamination and safe to use.

How can we rapidly and cost effectively assess soils at potential urban market-gardens sites nestled among old residential areas, on former industrial sites, or at empty abandoned brownfields?

In a conversation with Rutgers alumni and NRCS State Soil Scientist, Rich Shaw, we learned that he had purchased and successfully used a handheld X-ray fluoroscope (XRF) for mapping urban NYC soils when updating the USDA Web Soil Survey.

It occurred to us that the XRF might provide a way to rapidly assess soil at urban market-garden sites easily, quickly, and with precision. A collaboration between Rutgers Extension, NRCS NJ soil scientists (Rich Shaw and Edwin Muñiz), and the Unity Square Partnership of Catholic Charities of Metuchen, was formed.

The Unity Square Partnership has ties to a long-established neighborhood community garden. The previous soil in this urban market-garden had a history of contamination from residential lead-based paint. It was remediated more than a decade ago in a Rutgers-community funded project using landscape fabric, imported soil, and construction of 14 raised beds. Neighborhood gardeners have grown food at the site since. Recent home improvements adjacent to the garden prompted Unity Square Partnership to question, "Has old wood siding construction debris affected our previously remediated market-garden soils?" This was an ideal XRF test for rapid multiple trace metals soil sampling.



In our trial, we collected 77 soil samples, yielding results for 22 important trace heavy metal elements (Pb, As, Cd, Cr) and plant nutrients, sampled at 3 depths, with measuring time of approximately 60 seconds per sample, in about 2 hours work. Testing provided real-time results and revealed contamination in bed 1, with lead levels ranging from 203 to 381 ppm and arsenic levels at 16-24 ppm. We also sampled paint chips found on the soil surface and an adjacent painted brick foundation, finding highly elevated concentrations of lead and arsenic.

Garden Beds 1 and 2		
Lead (Pb) and Arsenic (As) ppm soil concentrations. Where multiple XRF samples were recorded, n=sample size is given and ppm is an average.		
Sample (n=no. samples)	Pb ppm	As ppm
Bed 1 soil surface (n=3)	348	18
Bed 1 soil ~ 5 in. depth (n=2)	362	24
Bed 1 soil ~ 10 in depth (n=2)	228	16
Bed 1 paint chip in soil	7,142	None Detected
Bed 2 soil surface (n=2)	23	None Detected
Bed 2 soil ~ 5 in. depth (n=2)	18	None Detected
Bed 2 soil ~ 10 in depth (n=2)	18	None Detected
Brick foundation -Painted	4,786	167
Brick foundation -No paint visible	8,539	917
EPA/NJDEP residential direct soil contact cleanup standard	400	20

precise, multiple simultaneous hazardous metal element detection, non-destructive sampling, with no sample preparation. You know, in real-time, what you are dealing with.

As urban market-gardening expands its foothold in and around cities, these soil assessments will be critical for supporting safe use, remediation, or abandonment of sites for supplemental food production. XRF is a tremendously useful tool for rapidly assessing the viability of urban sites, but it is not to be used casually. This is an instrument of significant cost requiring calibration and maintenance that should be used only by professionals.

Food production is risky and challenging even on the worlds' most fertile and productive 'prime soils.' Urban market-gardeners wanting to improve their sense of food security, and modestly contribute to food self-sufficiency, are discovering those risks and challenges with the added complication of working potentially contaminated, compacted urban ground.

Resources

Rutgers Fact Sheet FS336, Lead Contaminated Soil: Minimizing Health Risks, discusses metal elements found in soils, like lead, arsenic, and cadmium, and the hazard to human health when elevated levels are present.

The values in bed 1 approach recommendations in NJDEP Residential Direct Contact Soil Cleanup Standard, N.J.A.C. 7:26D, for remediating. Alternatively, the soil should not be used for direct contact activity like food crop gardening, leisure, or children's play. Fortunately, only two other beds had elevated levels, and the remaining 11 beds showed typical, safe background lead and arsenic levels.

Shortly after our visit to the site, the community and Unity Square Partnership held a volunteer cleanup day to remediate the site and the affected beds.

XRF brings the concept of precision agriculture (making site-specific soil recommendations based on sampling) to bear on serious health concerns facing urban market-gardening. XRF offers rapid,

