Greenhouse and Garden Experiments to Study Soil-Hg Interactions with Plants

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Overview

- Study objectives
- Soil/Site selection criteria
- Soil characterization
- Vegetable selection
- Greenhouse study plan
- Garden study plan
- Vegetable analysis
- Proposed Project Timeline

Study Objectives

- Determine if soil-Hg is taken-up via the roots of vegetable crops in sufficient levels to be a health risk
- Greenhouse Study
  - Well-controlled conditions; water, light, fertilization, temperatures, homogenized soil, control pests
- Garden Study
  - Include larger number of vegetable crops
  - Validate results of greenhouse study

Soil / Site Selection Criteria

- "Representative" Site/Soil
  - Representative range of Hg content
  - Representative soil characteristics
  - Currently supports plant growth
- Four soil-Hg levels
  - "Background", "Low", "Medium", "High"
- Collect from surface to 15-cm depth
- Paired to potential garden site

Soil Characterization

- Mercury content
  - Total, extractable, and available
  - Physical/chemical speciation
- pH
- Texture/Clay content
- Soil Organic Matter Content
- CEC, plant available nutrients
- Water-holding capacity

Vegetable Crops – Top 15 in Economic Value (*Root Crops)*

- Beans (pole, bush)
- *Beets*
- Broccoli
- *Carrots*
- Cucumbers
- Edible pod peas
- Green bunching onions
- Head lettuce
- Onion storage bulbs, shallot
- Peppers
- Summer squash
- Swiss chard
- Tomatoes
- *Turnip* (greens & roots)

D. Relf and A. McDaniel, 1996. Vegetable planting guide and recommended planting dates. Va Cooperative Extension. Pub. 426-331.

Greenhouse Study Plan

- Completely randomized design
  - Min. 4 reps
- Five planting media
  - Greenhouse potting mix – reference soil
  - “Background” Hg soil – control soil
  - “Low” Hg soil
  - “Medium” Hg soil
  - “High” Hg soil
- Remove rocks/debris greater than 7 mm
  - Adjust pH between 6.2 to 6.8
  - Add compost and any required nutrients
  - Mix, pot, plant/transplant; water as needed

Greenhouse Study Plan (cont'd)

- Five vegetables, including 2 root crops
- Harvest, prepare, and analyze edible part(s) at maturity
  - Composite samples from each rep
  - Pots/samples:
    - 4 Reps x 5 Soils x 5 Vegetables = 100
- Re-analyze soils at harvest

Garden Study Plan

- Site(s) characteristics
  - Selected from where soils were collected
  - Level area or south-facing slopes
  - No low spots and windy areas
  - Loose, well-drained
  - Good, accessible water supply
  - Convenient place to work; secure
  - Away from trees, shrubs, and buildings

Garden Study Plan (cont'd)

- At least 6 hours of sun (8 to 10 hours ideal)
- Remove rocks/debris
  - Adjust pH between 6.2 to 6.8
  - Add compost and any required nutrients
  - Rototill, plant or transplant; water as needed
- Plant following VA Cooperative Extension recommendations
  - Planting dates, horticultural practices, vegetable varieties, etc.
- Include vegetables from greenhouse study
- Re-analyze soils at harvest

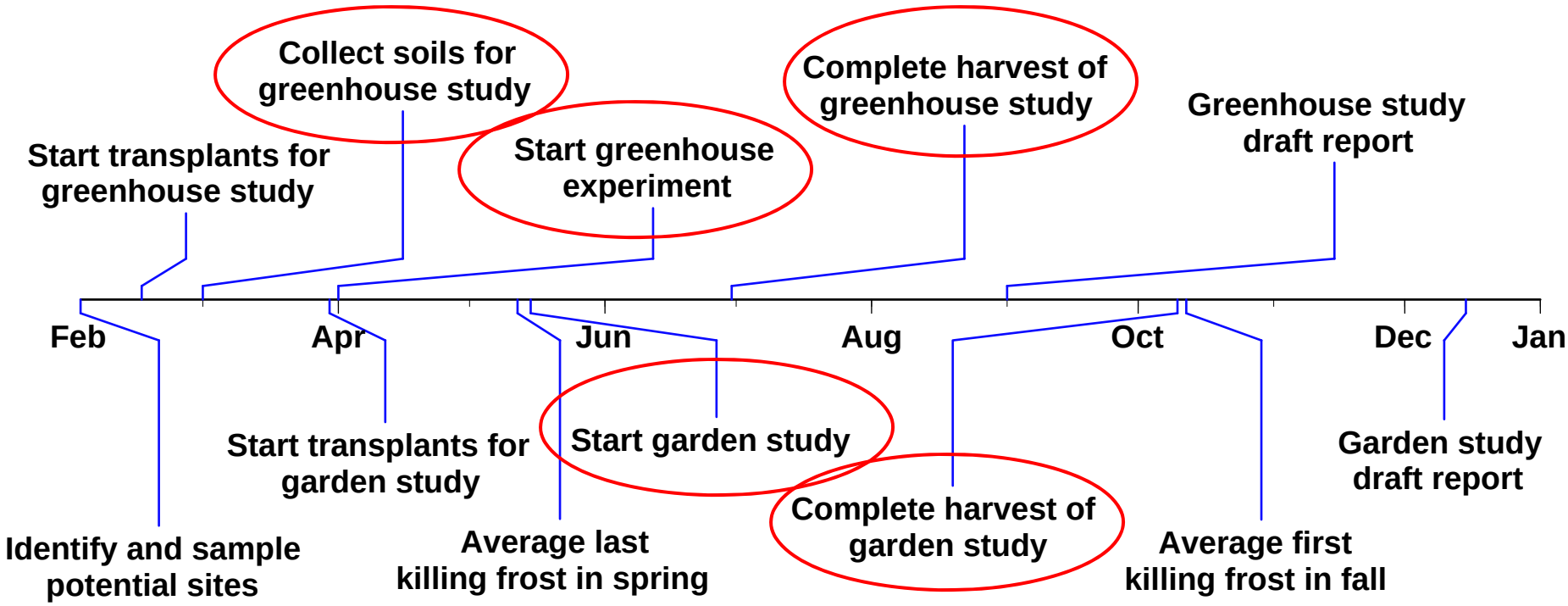
Vegetable Analysis

- Fresh and dry weights
- Preparation for analysis
  - Above-ground
    - Unwashed and washed
  - Root crops
    - Washed; washed and unpeeled; washed and peeled beats, carrots, onions
- Digest and measure total mercury
- Check for soil contamination
  - Determine elements in high amounts in soil but not taken up by plants
    - Titanium and/or Aluminum

Sources of Guidance

- Virginia Cooperative Extension
- Peer-reviewed literature
- US EPA Test Guidelines
  - Seed germination/seedling emergence (850.4100, 850.4200, 850.4225)
  - Early seeding growth (850.4230)
  - Vegetative vigor (850.4150 & 850.4250)
  - Terrestrial plants field test (850.4300)
  - Plant uptake and translocation test (850.4800)

Proposed Project Timeline



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