

**Comparing heavy metal  
content found in spinach  
(*Spinacia oleracea*) grown on  
the roof and ground sites at  
Portland State University**

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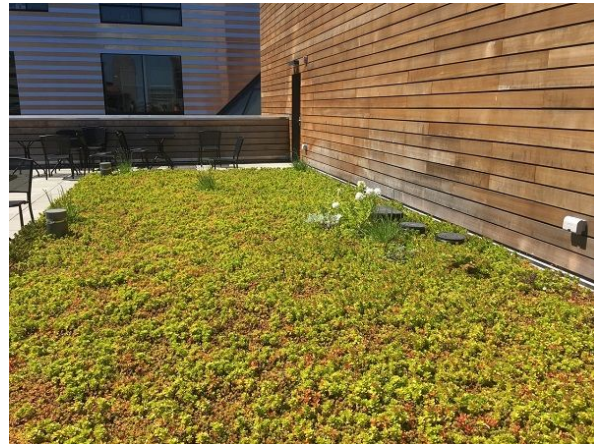
# Introduction

Green roof is as a roof with purposeful living vegetation

- Green roofs benefits
  - Reduces energy costs
  - Mitigates urban heat island effects
  - Improves water storm runoff
  - Reduces noise pollution
  - Increases roof life-span
  - Reduces air pollution
  - Utilize previously unused space



Green roof found on RSTC building on PSU campus



Green roof found on Karl Miller Center building on PSU campus

# Introduction

- Benefits of Produce grown on roofs
  - Eliminate contamination from shipping
  - Eliminate pollution form shipping
  - Lower prices of produce
  - Fresher, cleaner produce
- Concerns of produce on roofs
  - Pollution of leafy greens
  - Heavy
  - Shallow roots



Birds eye view of Karl Miller Center building on PSU campus

The slide features decorative green leaves in the corners. The top-right corner has a cluster of leaves, the bottom-right corner has several leaves with small white spots, and the bottom-left corner has a few leaves. The background is white.

## **Research Question:**

Does growing food on the roof reduce heavy metal contamination?  
How does the roof vs ground compare when it comes to heavy metals contamination?

# Purpose

- Replicate a previously unpublished study
- To analyze air pollutants affect on leafy greens
- Compare different levels of roofs
- Define benefits and disadvantages of growing produce on roofs vs ground
- Explore potential urban agriculture sites
- Offer a direct route to fresh, clean, healthy food



# Design

- Spinach beds
  - Cat trays for base
  - Potting soil
  - 3x7 seed planting pattern
  - Temp sensor
- Watered weekly unless it rains
  - Same water for each limit variables
- Air quality tests weekly
- Weekly monitoring
  - Measuring growth
  - Pictures



# Design

- Spinach bed places at five rooftop locations and five ground locations in close proximity of each other at varying heights



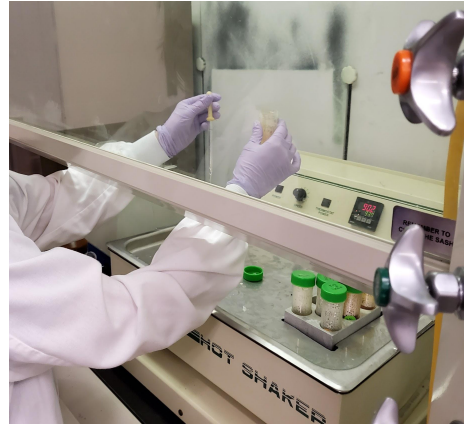
# Methods

- Separate the leaves from the roots
- Dried and weighed
- Extraction
  1. Ground up leaves to powder
  2. Digested the leaves
  3. Filtered the solution
  4. Used ASV and ICP-OES machines to determine the concentration

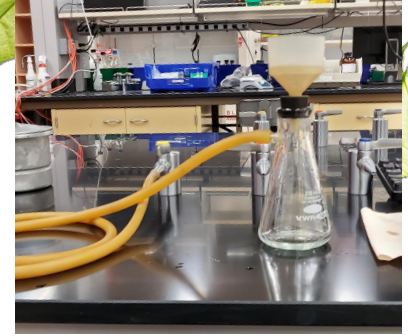
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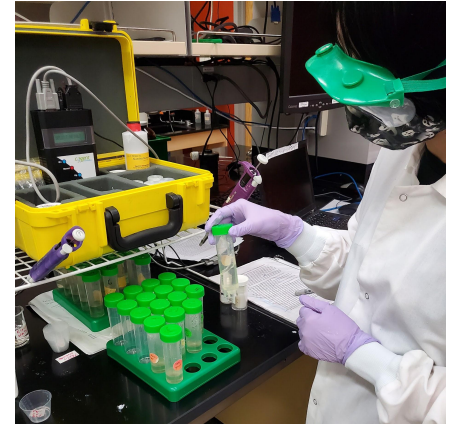
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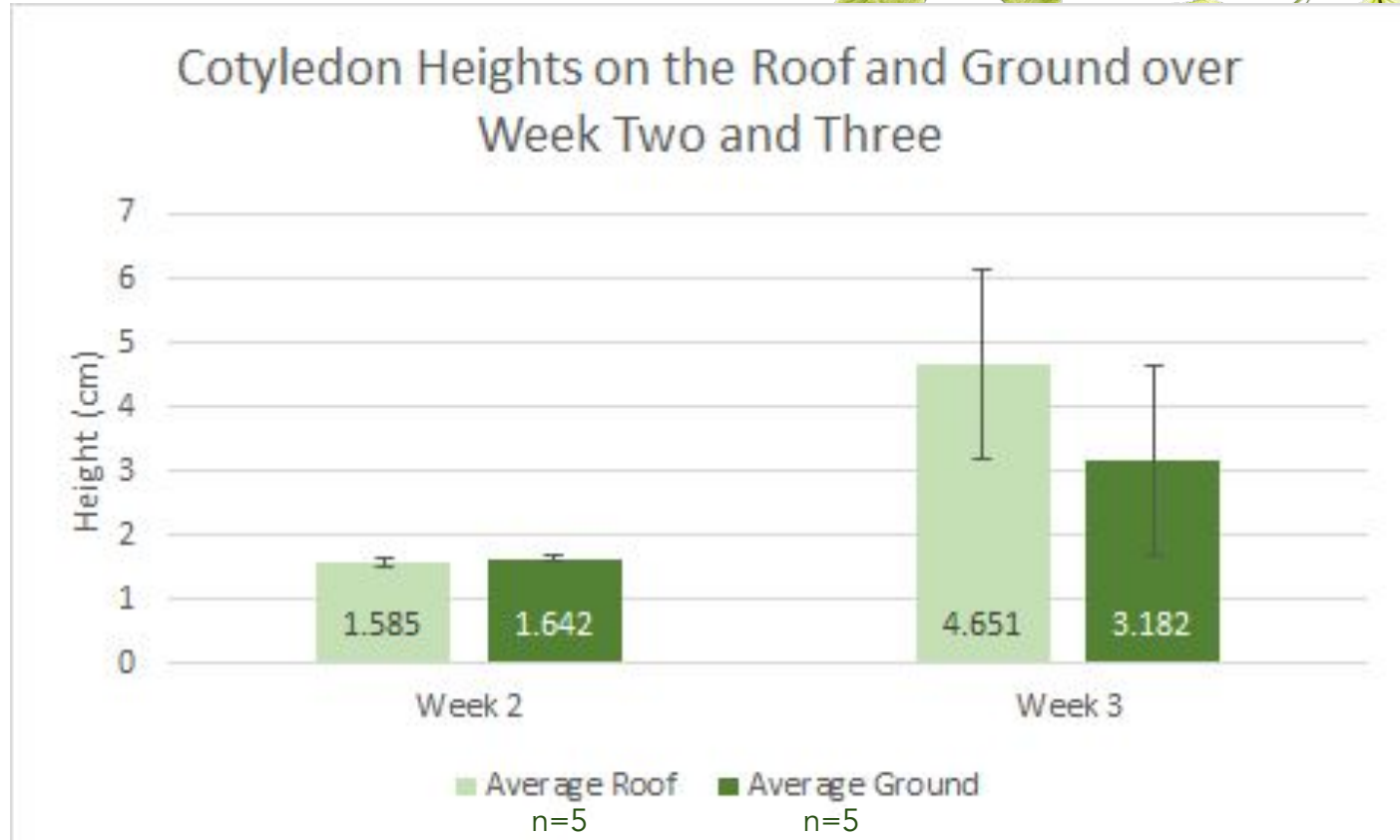
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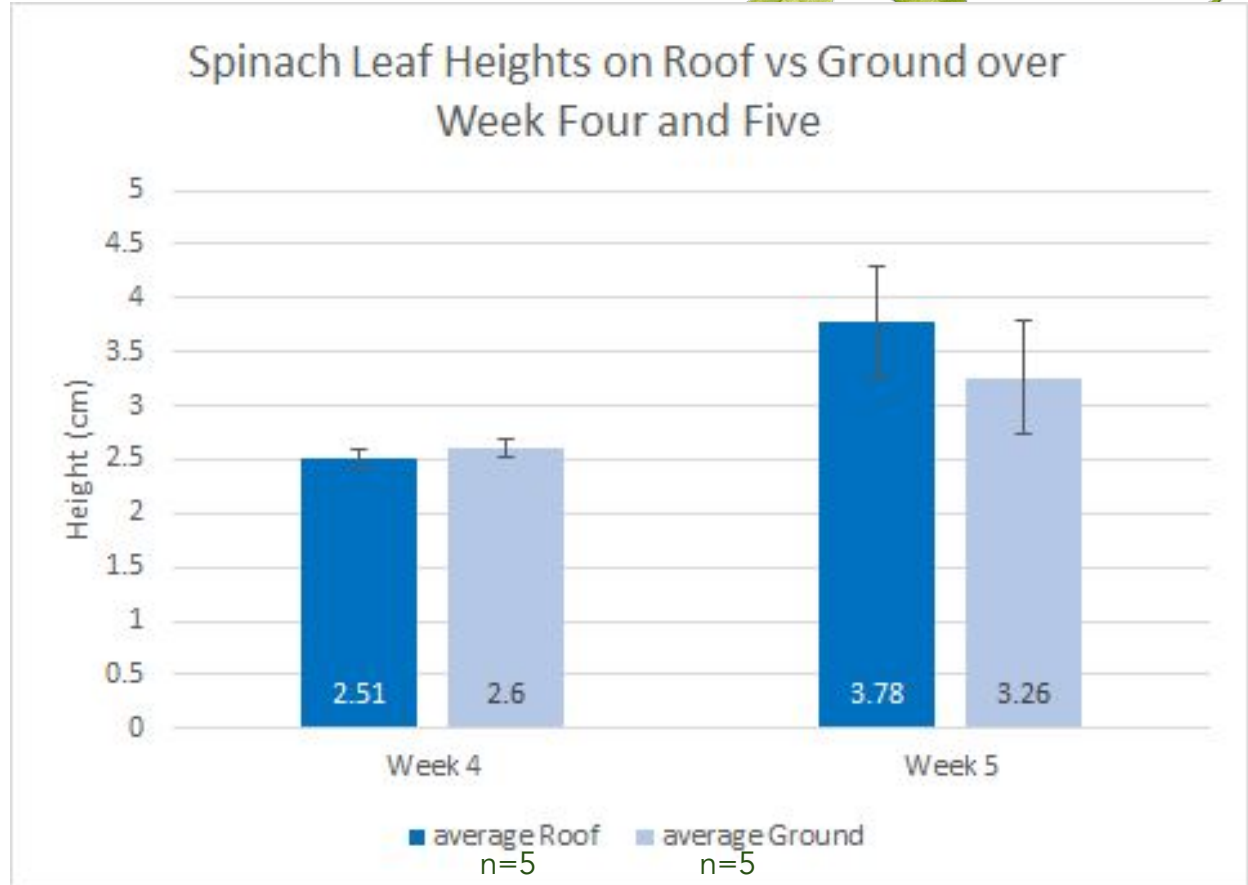
# Growth Results

- Cotyledon, pre-leaves, growth is an indication of nutritional value in the early stages of the plant



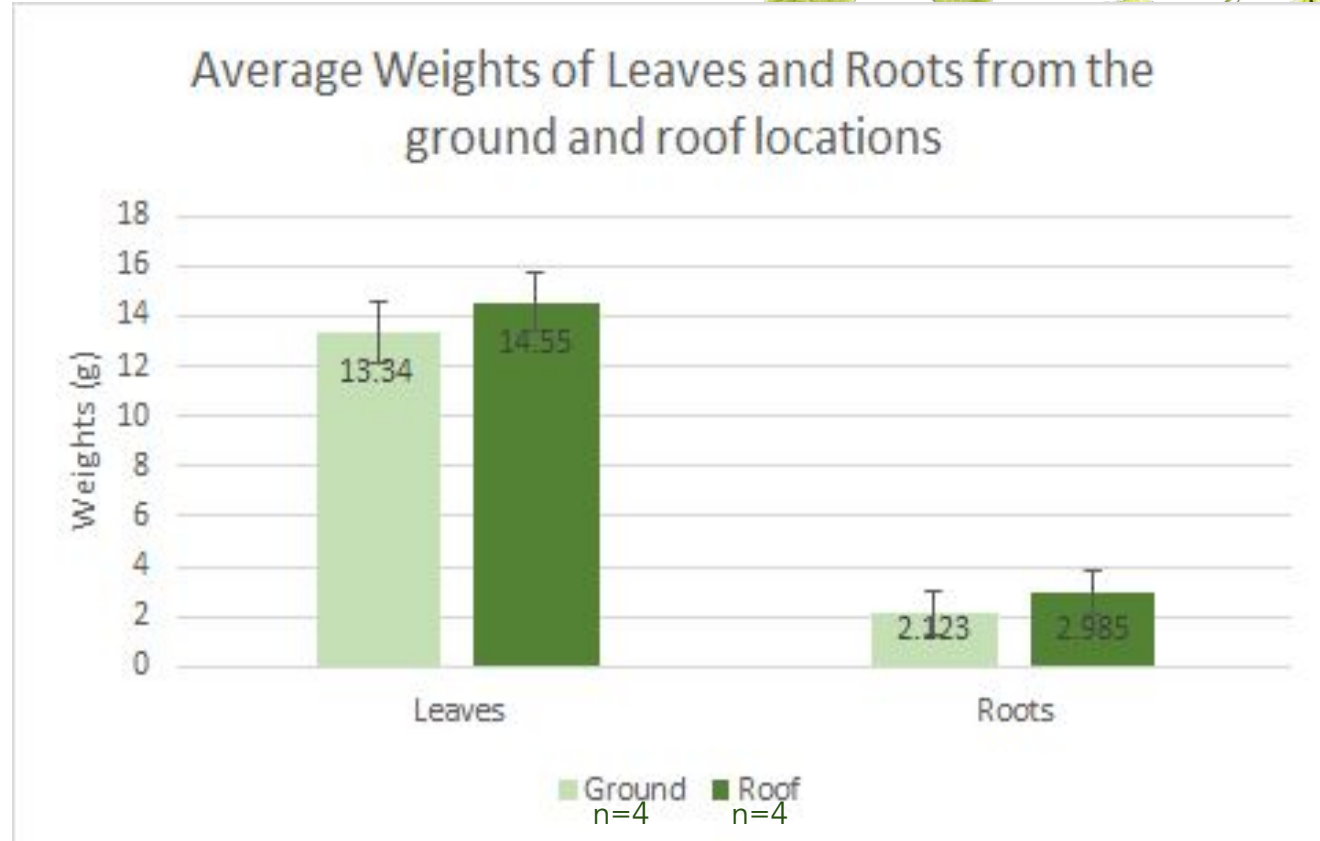
# Growth Results

- More variation in the later weeks
- Week 4 showed spinach was growing taller on the ground locations
- Week 5 showed higher heights on the roof
- Outside influences, animals or humans



# Growth Results

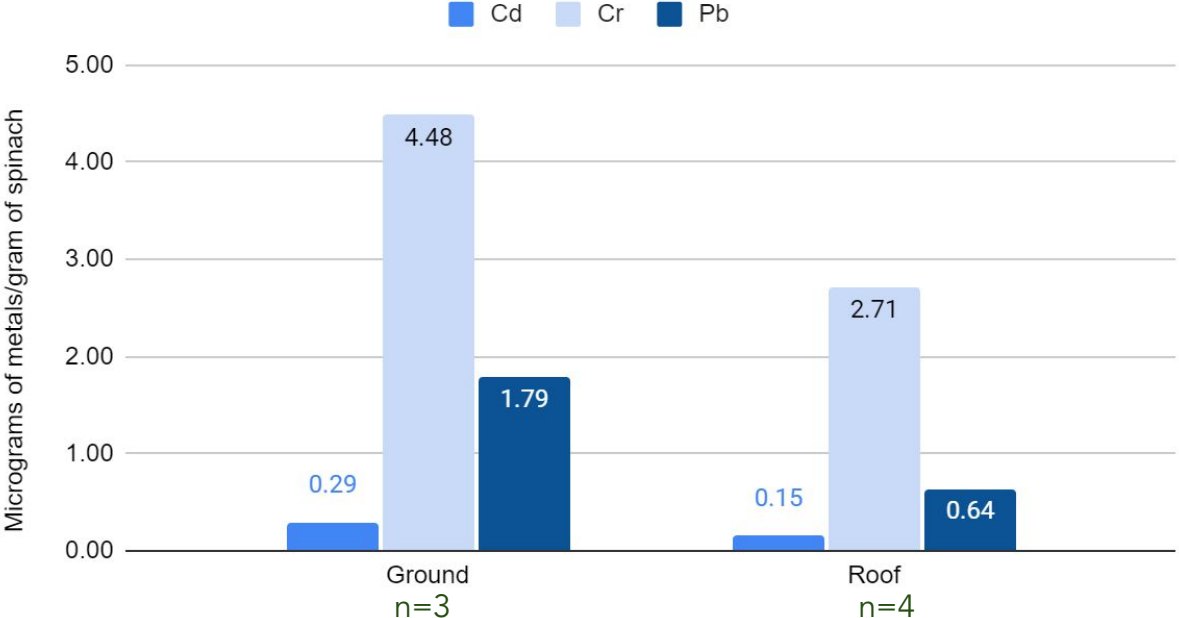
- Only 4 roof and 3 ground locations produced
- The overall weights showed higher yield on the roof locations for both roots and leaves



# Heavy Metals Results

- ICP-OES machine results

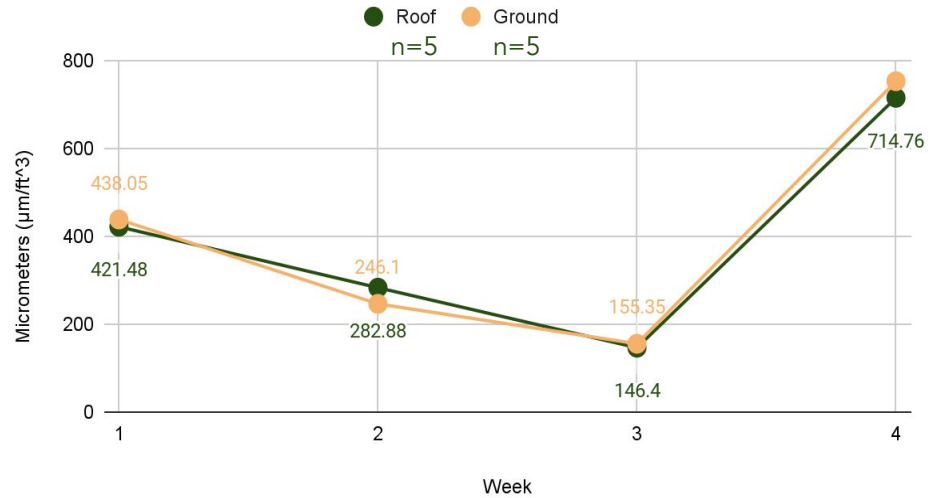
Average amount of As, Cd, Cr and Pb per gram of spinach on roof and ground locations



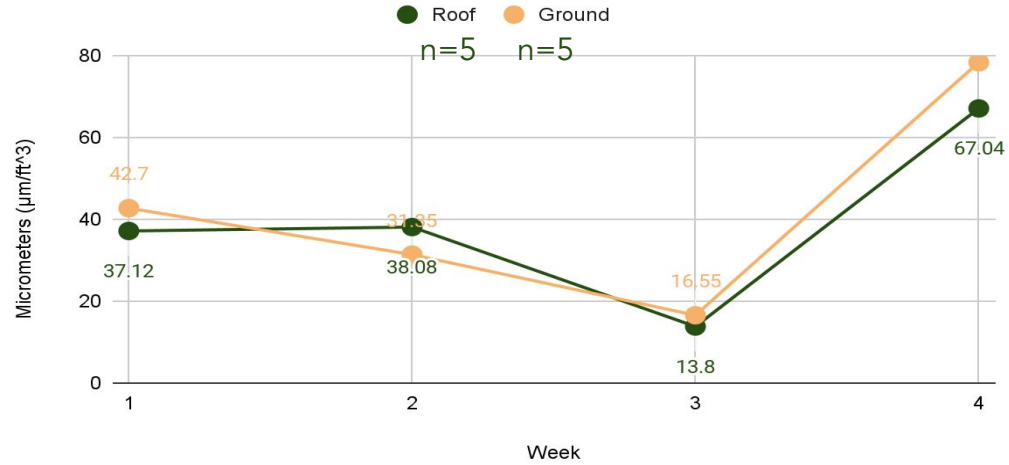
# Air quality Results

- Small particle air quality results

Average small particles on the roof and ground over 4 weeks



Average Large Particles on the roof and ground over 4 weeks



- Large particle air quality results



# In conclusion

- Overall the roof locations grew more spinach and had fewer heavy metals
- Ground locations had issues with outside influence, reflects that ground locations have more potential to be disrupted by people or animals (crows, squirrels, dogs)
- Average large and small particles are less on roof vs ground, may have overlap in the heavy metals in spinach, more research to be done

# Future Direction

- Replication of the study with more ground locations and more barriers in place
- Replication of the study using a different plant that grows better in this area

# Works Cited:

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