Green Thumb Education Series:

"Diagnosing Environmental Stress"

will start momentarily.

Upcoming Master Gardener Events:

April 8: Garden Walk: Fifth Street Community Garden, 10-11:30

April 13: Garden Design: T*wo Views, Old and New*
Bev Dawson and Marilynn Elliott, Master Gardeners
Location: Clallam County Courthouse Commissioners' Room

April 27: Pollinator Plantings: Perfecting the Process
Nita Wester, Jefferson County Master Gardener
Location: Carver Room, Port Angeles Public Library

WSU EXTENSION
Clallam County

Stressed Out!

How to recognize, treat, and avoid environmental stresses in trees and shrubs

Seminar overview

- Symptoms of water stress
  - Reduced leaf water
  - Salt
  - Hypoxia
- Anthocyanins as a diagnostic tool
- Diagnostic delusions!

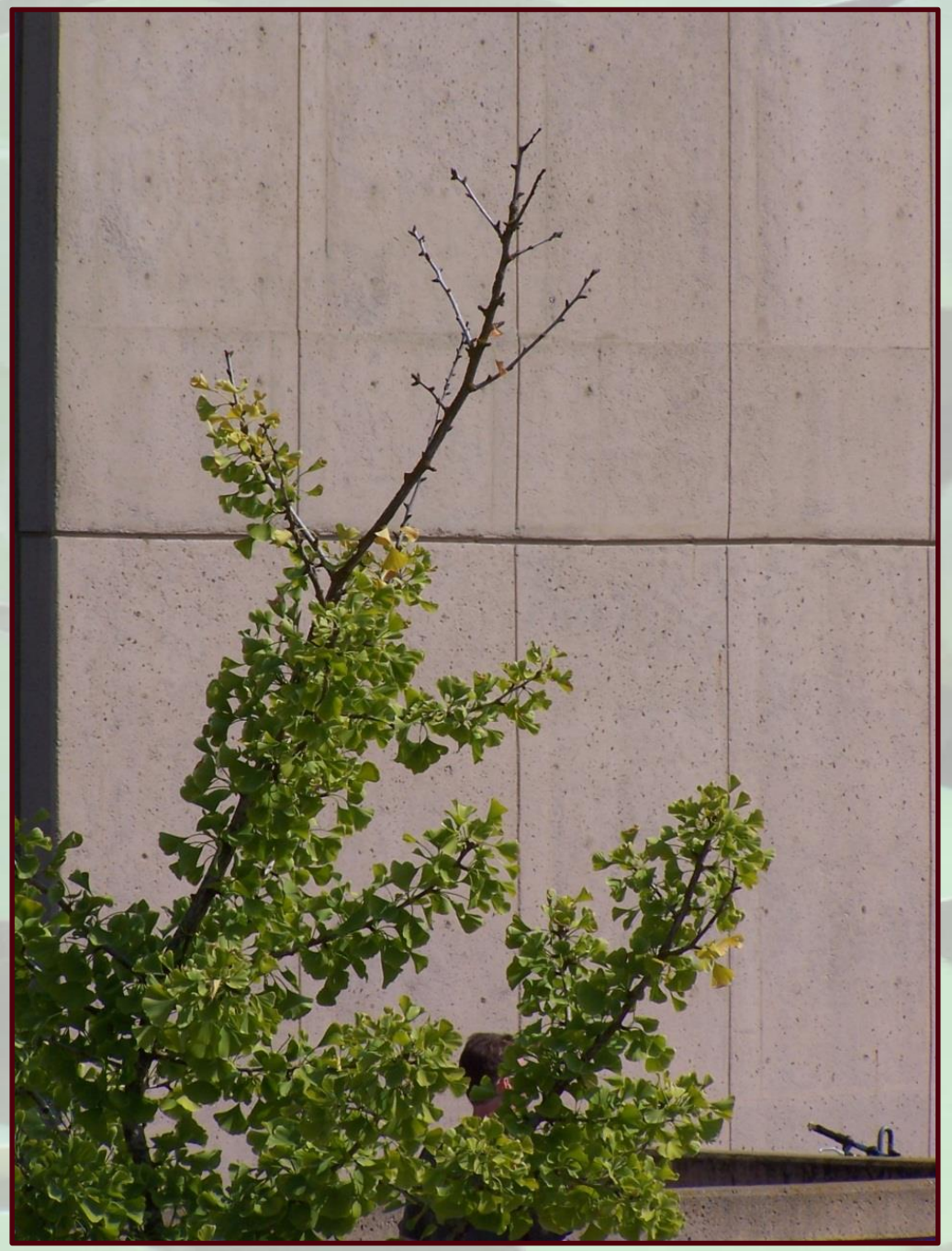
Almost every stress is related to water

Leaf wilt

Tip and marginal reddening

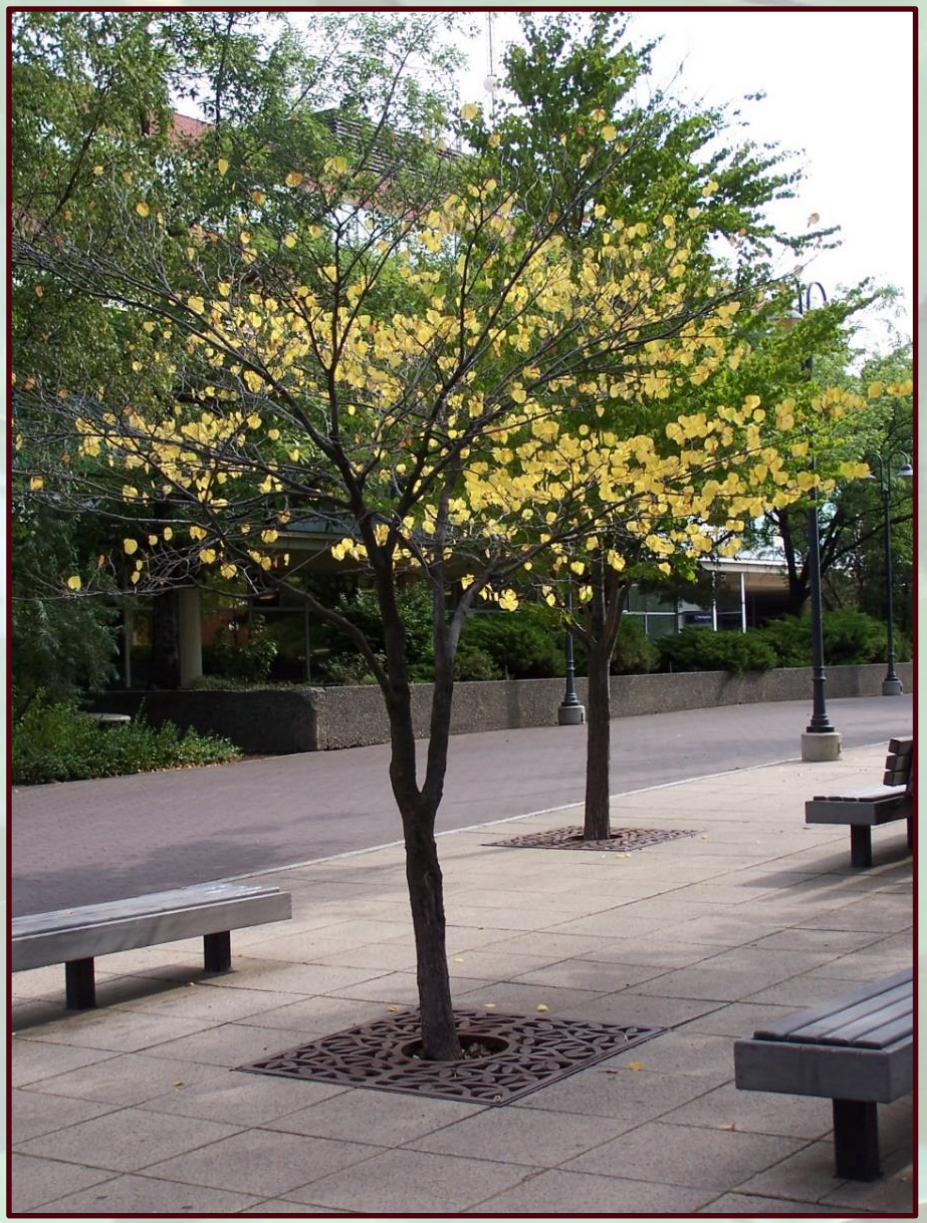
Tip and marginal necrosis

Branch tip dieback from chronic, severe drought



Decreased leaf size

Suckers and water sprouts



Early leaf color change (and drop)

Salinity stress symptoms

- Wilting
- Marginal and tip necrosis
- Premature leaf drop
- White salt crusts

Hypoxic soils

Compaction

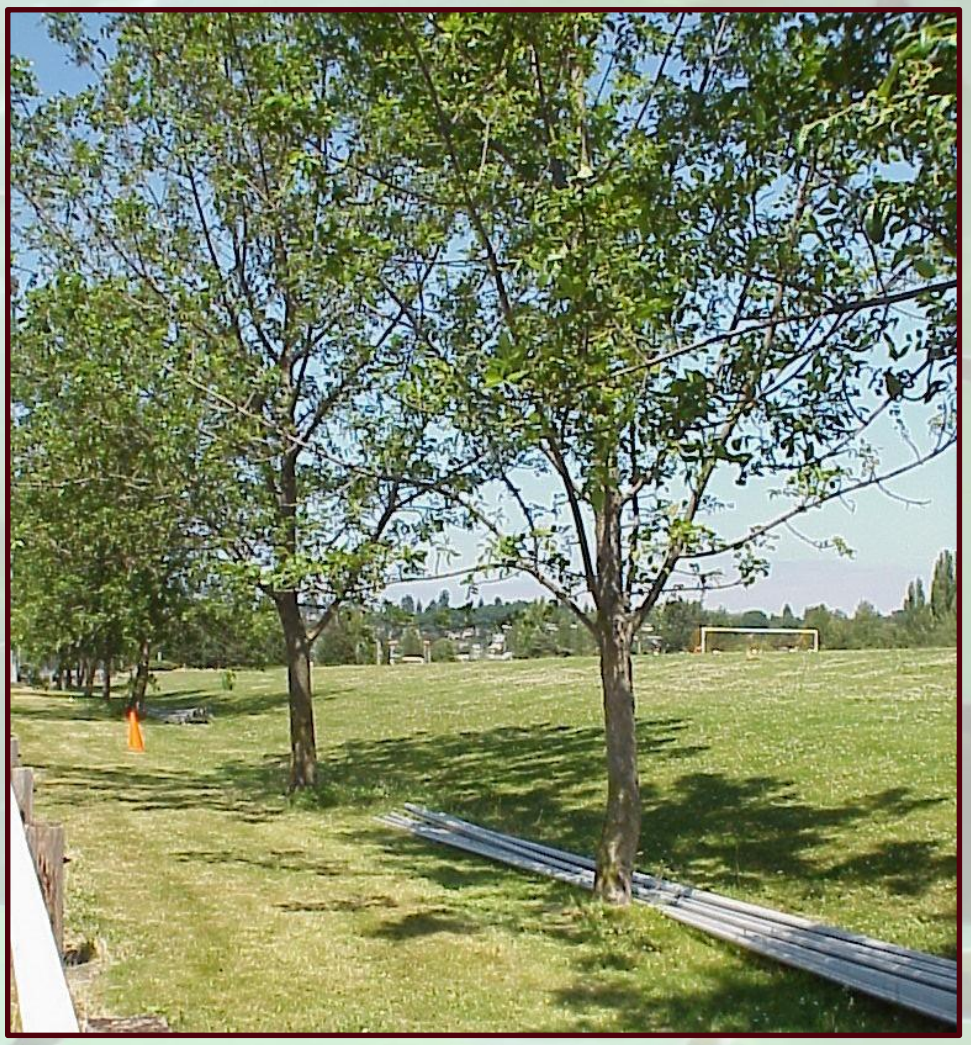
Hypoxic soils

Flooded conditions

Soil hypoxia reduces leaf water

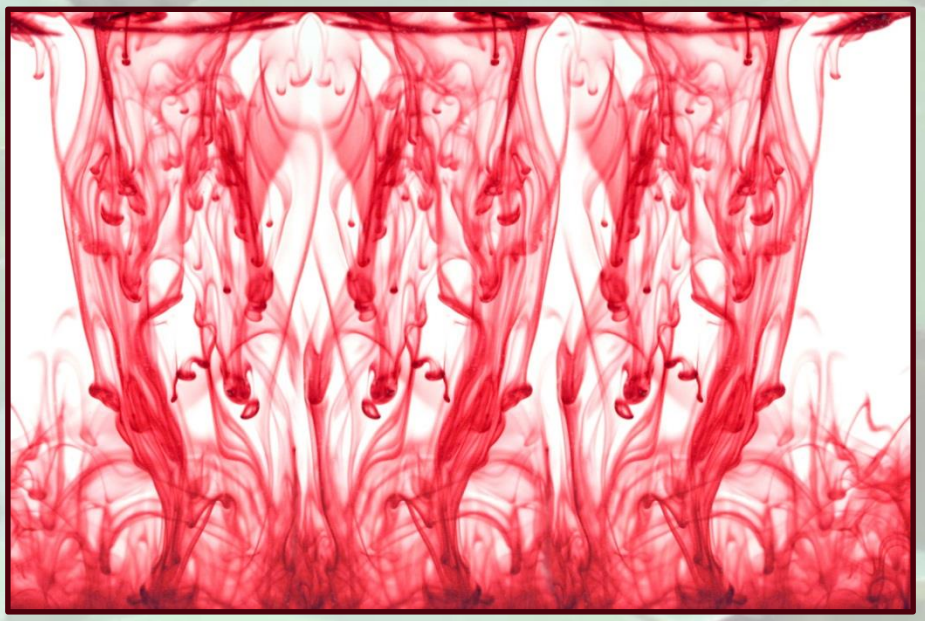
- Pore space restricted by compaction or excess water
- Oxygen reduced by lack of pore space or grade changes
- Root function impaired
- Leaves receive less water

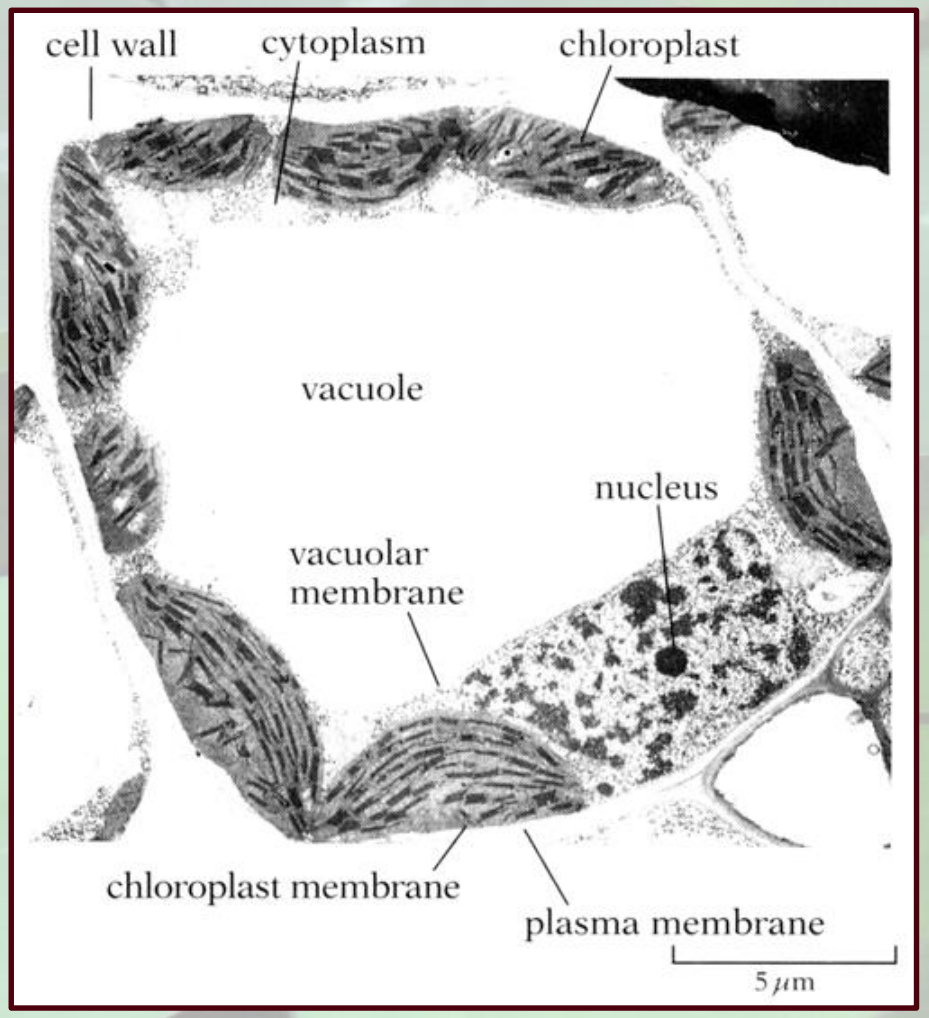
Grade changes over root zone



Anthocyanins in diagnosis

- Water soluble pigment
- Found in vacuoles





Genetics

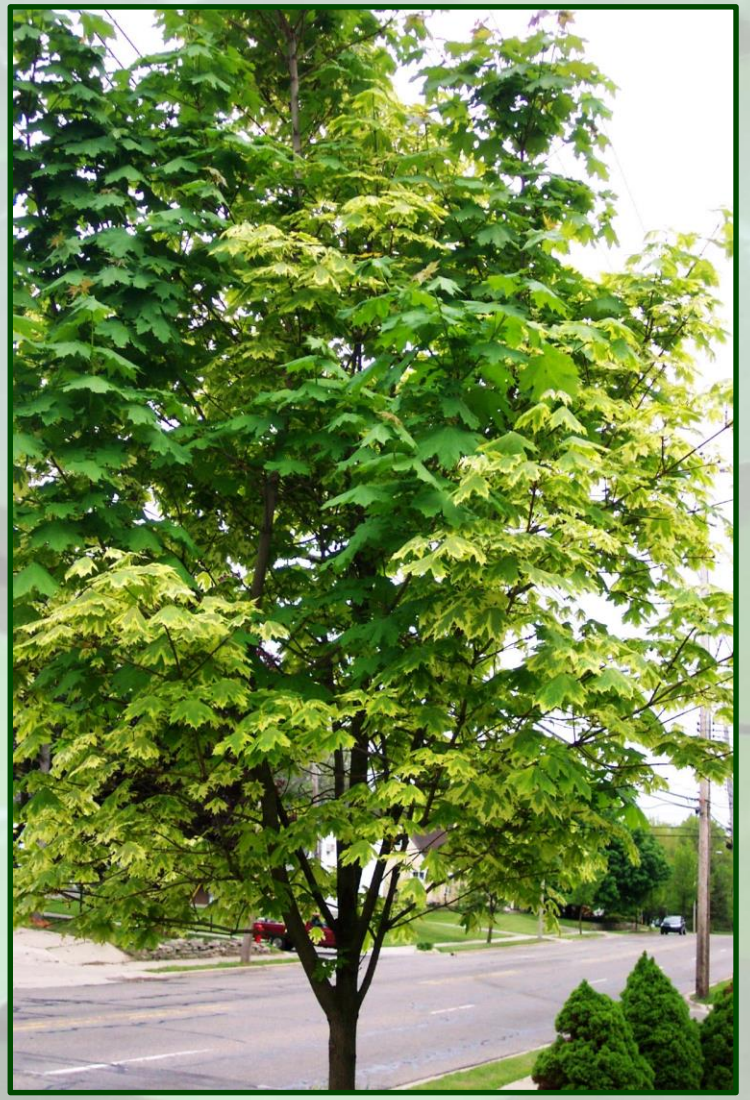
Young tissues

- Lack of cuticle
- Turgor maintenance

Environmental transience

- Stress response
- Normal color returns once stress is relieved (or leaves die)

Diagnostic Delusions:
You can't always believe your eyes



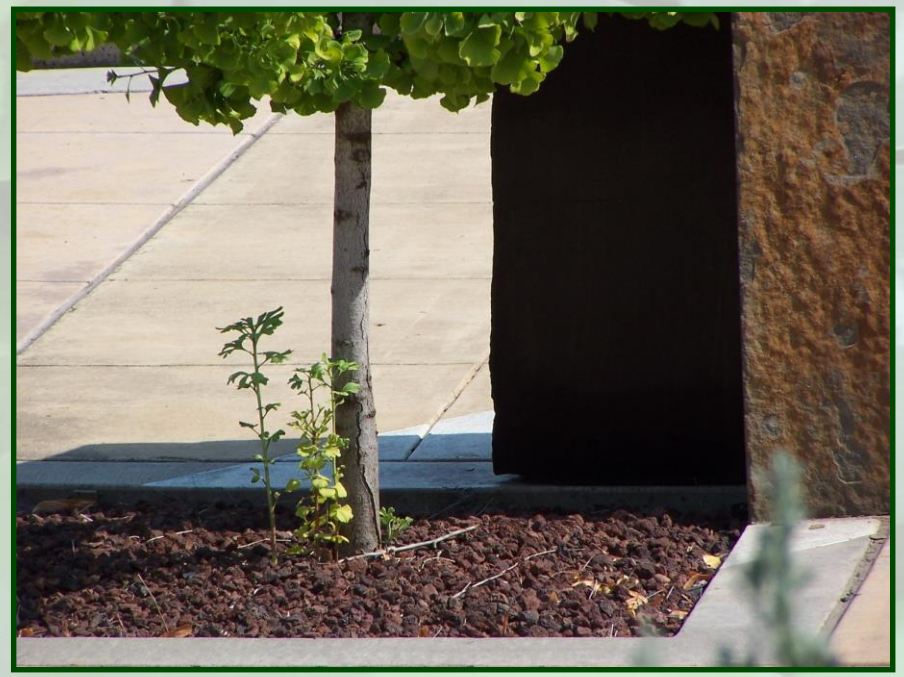
Hereditary Hijinks

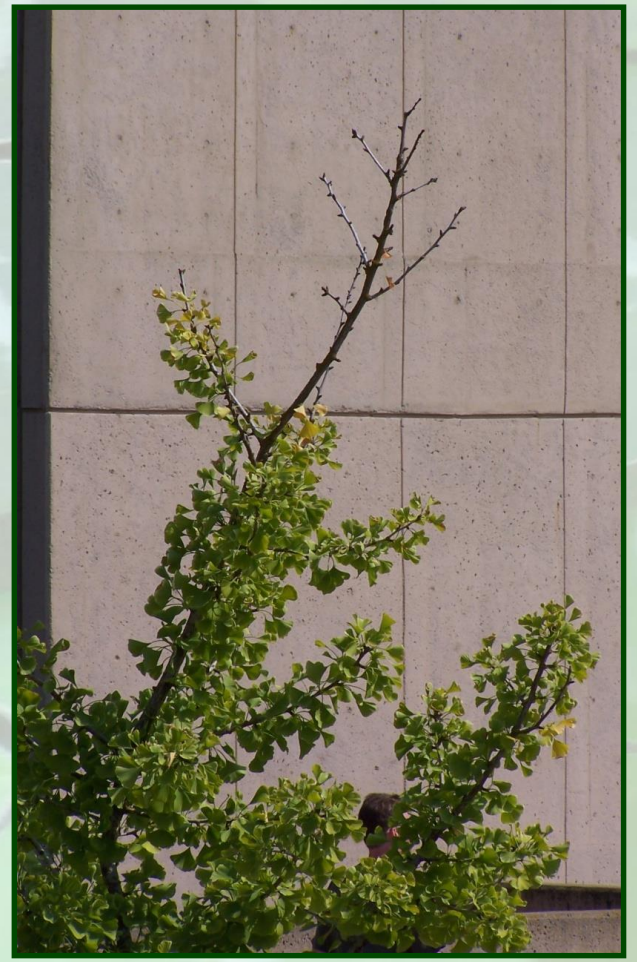
- Cultivated variation in foliage
- Reversion to wild type
- Natural variation in bark
- Morphological mutations

Weather wrongdoings

- Late freezes
- Heat during tissue expansion
- Excessive heat or drought

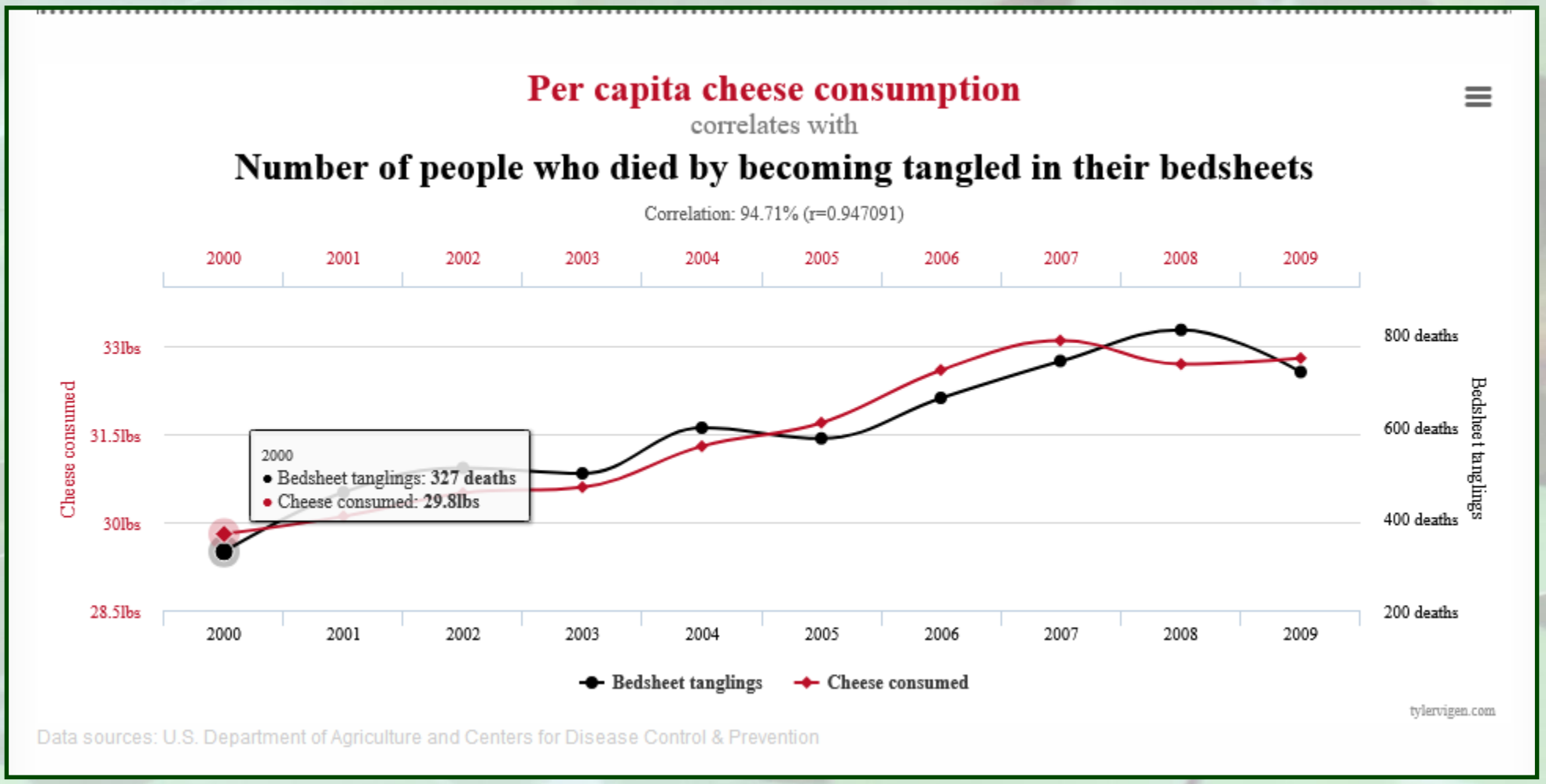
Cultural Crimes and Management Malpractice





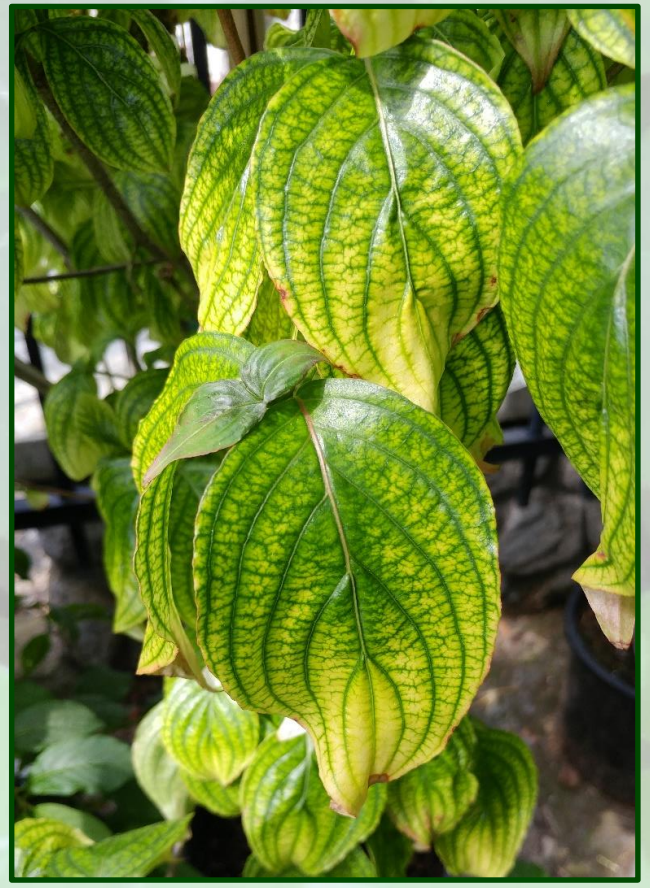
- Poor quality plants
- Poor siting and installation
- Poor irrigation and fertilizer use

Avoid equating correlation with causation!



https://www.tylervigen.com/spurious-correlations

Case Study #1: Nutrient deficiencies



"Leaf chlorosis is a good indicator for adding nutrients"

“Crime” lab analysis

Analysis	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	6.7	
Modified Morgan extractable, ppm		
Macronutrients		
Phosphorus (P)	45.2	4-14
Potassium (K)	436	100-160
Calcium (Ca)	2269	1000-1500
Magnesium (Mg)	391	50-120
Sulfur (S)	21.0	>10
Micronutrients *		
Boron	0.4	0.1-0.5
Manganese (Mn)	5.5	1.1-6.3
Zinc (Zn)	9.8	1.0-7.6
Copper (Cu)	0.2	0.3-0.6
Iron (Fe)	4.2	2.7-9.4
Aluminum (Al)	12	<75
Lead (Pb)	0.7	<22

Analysis	*Value Found*	*Optimum Range*
Cation Exch. Capacity, meq/100g	19.3	
Exch. Acidity, meq/100g	3.7	
Base Saturation, %		
Calcium Base Saturation	59	50-80
Magnesium Base Saturation	17	10-30
Potassium Base Saturation	6	2.0-7.0
Scoop Density, g/cc	1.02	
Optional tests		
Soil Organic Matter (LOI), %	8.7	
Nitrate-N (NO3-N), ppm	4	

- Excess soil nutrients can cause leaf deficiencies
- Many fertilizers are high in P
- Excess P reduces root uptake of Fe, Mn

Let tests guide nutrient additions

Results

Analysis	*Value Found*	*Optimum Range*	*Analysis*	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	6.7		**Cation Exch. Capacity, meq/100g**	19.3	
Modified Morgan extractable, ppm			**Exch. Acidity, meq/100g**	3.7	
Macronutrients			**Base Saturation, %**		
Phosphorus (P)	45.2	4-14	Calcium Base Saturation	59	50-80
Potassium (K)	436	100-160	Magnesium Base Saturation	17	10-30
Calcium (Ca)	2269	1000-1500	Potassium Base Saturation	6	2.0-7.0
Magnesium (Mg)	391	50-120	**Scoop Density, g/cc**	1.02	
Sulfur (S)	21.0	>10	**Optional tests**		
Micronutrients *			Soil Organic Matter (LOI), %	8.7	
Boron	0.4	0.1-0.5	Nitrate-N (NO3-N), ppm	4	
Manganese (Mn)	5.5	1.1-6.3			
Zinc (Zn)	9.8	1.0-7.6			
Copper (Cu)	0.2	0.3-0.6			
Iron (Fe)	4.2	2.7-9.4			
Aluminum (Al)	12	<75			
Lead (Pb)	0.7	<22			

* *Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.*

Soil Test Interpretation

Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				

Phosphorus is excessive!!!

Results

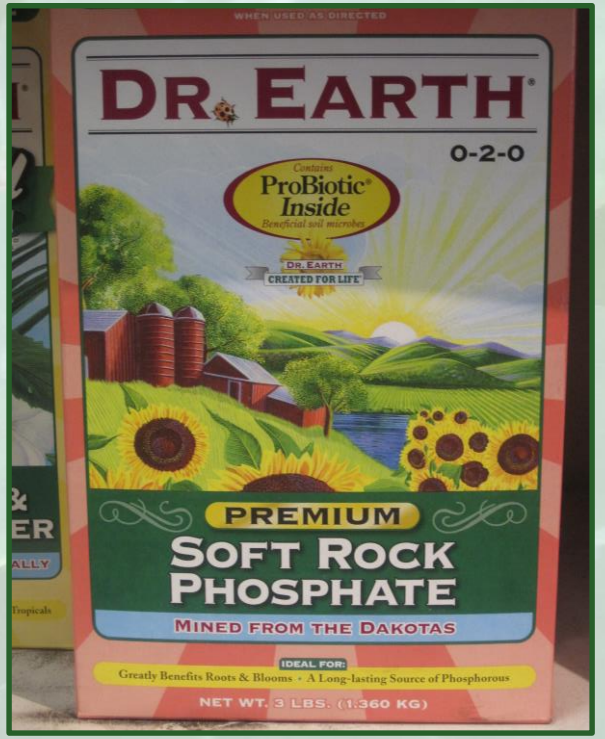
Analysis	*Value Found*	*Optimum Range*	*Analysis*	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	4.9		**Cation Exch. Capacity, meq/100g**	20.4	
Modified Morgan extractable, ppm			**Exch. Acidity, meq/100g**	12.6	
Macronutrients			**Base Saturation, %**		
Phosphorus (P)	3.4	4-14	Calcium Base Saturation	32	50-80
Potassium (K)	146	100-160	Magnesium Base Saturation	4	10-30
Calcium (Ca)	1291	1000-1500	Potassium Base Saturation	2	2.0-7.0
Magnesium (Mg)	109	50-120	**Scoop Density, g/cc**	1.03	
Sulfur (S)	20.8	>10	**Optional tests**		
Micronutrients *			Soil Organic Matter (LOI), %	12.8	
Boron (B)	0.3	0.1-0.5			
Manganese (Mn)	4.3	1.1-6.3			
Zinc (Zn)	8.9	1.0-7.6			
Copper (Cu)	0.4	0.3-0.6			
Iron (Fe)	6.5	2.7-9.4			
Aluminum (Al)	323	<75			
Lead (Pb)	2.5	<22			

* *Micronutrient deficiencies rarely occur in New England soils; therefore, an Optimum Range has never been defined. Values provided represent the normal range found in soils and are for reference only.*

Soil Test Interpretation

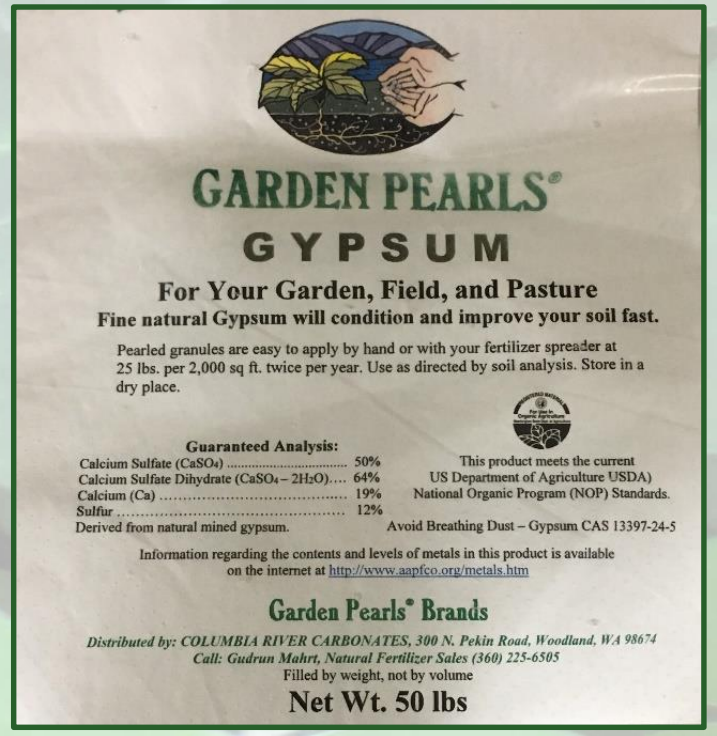
Nutrient	Very Low	Low	Optimum	Above Optimum
Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				

Commonly excessive nutrients



Phosphate

Magnesium



Calcium

Peer-reviewed information

Iron Deficiency in *Rhododendron* is Due to Excess Soil Phosphorus

Linda Chalker-Scott and Scott S. Olmsted

Commercial "transplant" fertilizers are generally phosphate-rich, potentially resulting in nutrient overload in nonagricultural urban soils. It is hypothesized that such fertilizers can result in reduced plant health because of nutrient imbalances. In this experiment, rhododendrons—a common landscape species—were grown under increasing levels of phosphate fertilizer in a greenhouse. Soil concentrations of available phosphate were elevated as a result of using high-phosphate fertilizers, inducing both root and foliar damage. While inappropriate use of high-phosphate fertilizers in urban landscapes will contribute to watershed pollution, this experiment demonstrates their harm on the root-soil environment as well.

Over the past two decades, there has been an increase in the amount of research examining chlorosis in ornamental plants in nursery production as well as in urban landscapes (Pataky 1996; Rose 1997; Krawczyk 2008). With over 250 species of plants susceptible to chlorosis, the causes of the disorder need continued research (Pataky 1996).

Rhododendron are ericaceous species that prefer moist, well-drained acidic soils (pH 5.0-6.5) with moderate to high amounts of organic matter. These common landscape ornamentals have high economic and aesthetic value for their striking floral displays. *Rhododendron*, with their shallow, fibrous root systems, are particularly sensitive to mineral imbalances, (Mason 2001) commonly exemplified by interveinal chlorosis of new leaves (Figure 1). Not only does this detract from the aesthetics of the plants, but it can also make them more susceptible to pests and diseases (Pataky 1996).

Figure 1. Chlorotic rhododendron.

Iron Deficiency

The only nutrient deficiencies directly associated with interveinal chlorosis of new leaves are those of iron (Fe) and manganese (Mn); both are involved in the manufacture of chlorophyll. While Mn deficiency symptoms are somewhat similar to those of Fe, chlorosis caused by the latter occurs throughout the space between the veins (Figure 2). Furthermore, Mn deficiency symptoms are usually first

WASHINGTON STATE UNIVERSITY EXTENSION

Photo Credit: Peter Corbett

EPSOM SALT USE IN HOME GARDENS AND LANDSCAPES

Linda Chalker-Scott, Associate Professor and Extension Horticulturist, WSU Puyallup Research and Extension Center, Washington State University; and **Rich Guggenheim**, Horticulture Extension Educator, Canyon County Extension, University of Idaho

WSU PEER REVIEWED

FS308E

WASHINGTON STATE UNIVERSITY EXTENSION

Photo Credit: James St. John

GYPSUM USE IN HOME GARDENS AND LANDSCAPES

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WSU PEER REVIEWED

FS307E

Low does not equal deficient

Results

Analysis	*Value Found*	*Optimum Range*
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Modified Morgan extractable, ppm		
Macronutrients		
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Optional tests		
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Soil Test Interpretation

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Phosphorus (P):				
Potassium (K):				
Calcium (Ca):				
Magnesium (Mg):				

Ground-truthing

- Evidence of deficiencies?
  - Plant symptoms?
  - Nutrient toxicities?

Results

Analysis	*Value Found*	*Optimum Range*
Soil pH (1:1, H2O)	6.7	
Modified Morgan extractable, ppm		
Macronutrients		
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Case Study #2: Volcano mulching

"Deep layers of wood chips will kill trees"

Are you sure that volcano is just mulch?

Mulch can hide a variety of sins…

…like bad planting…

…and bad roots…

…and mulch gets the blame

Removing materials from root ball allows

barrier removal

root correction

planting at grade

Hand in glove stabilizes roots; ball in socket does not

Coarse wood chips and bark wounds

- Coarse wood chips caused faster wound sealing
- No trees in volcanos developed disease or died

Arborist wood chips (AWC)

Coarse

Fine

- Deep layers of coarse chips will suppress weeds and enhance tree roots and mycorrhizae
- Fine mulches restrict air movement

Peer-reviewed publication

Soil & Tillage Research 194 (2019) 104335

Contents lists available at ScienceDirect

Soil & Tillage Research

journal homepage: www.elsevier.com/locate/still

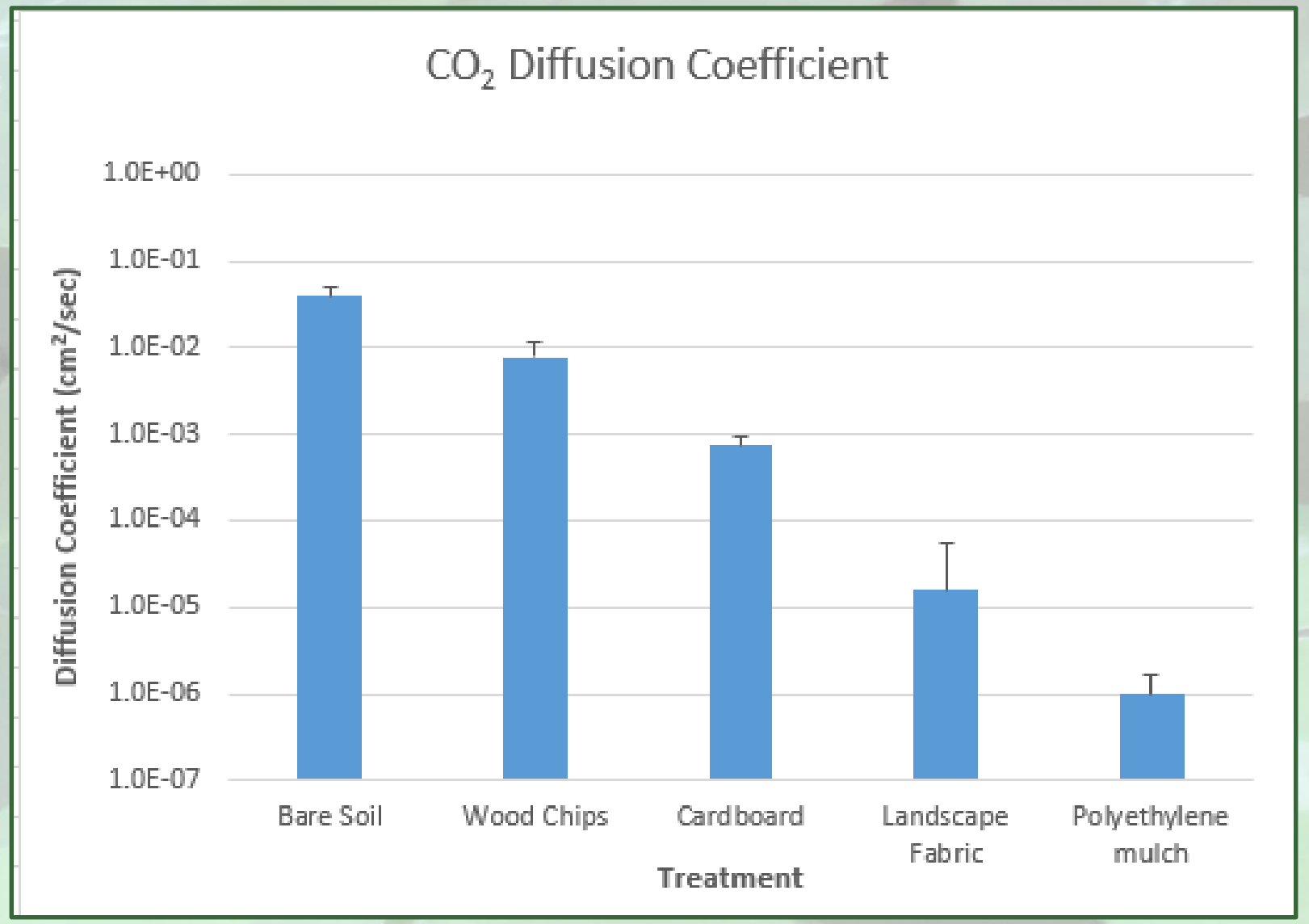
Carbon dioxide and oxygen exchange at the soil-atmosphere boundary as affected by various mulch materials

Khurram Shahzad[a,b,c], Andy I. Bary[a,b], Douglas P. Collins[a,b], Linda Chalker-Scott[b,d], Muhammad Abid[c], Henry Y. Sintim[a,b], Markus Flury[a,b,*]

[a] Department of Crop & Soil Sciences, Washington State University, Pullman, WA 99164, USA
[b] Puyallup Research & Extension Center, Washington State University, Puyallup, WA 98371, USA
[c] Department of Soil Science, Faculty of Agricultural Sciences and Technology, Bahauddin Zakariya University, Multan, Pakistan
[d] Department of Horticulture, Washington State University, Puyallup, WA 98371, USA

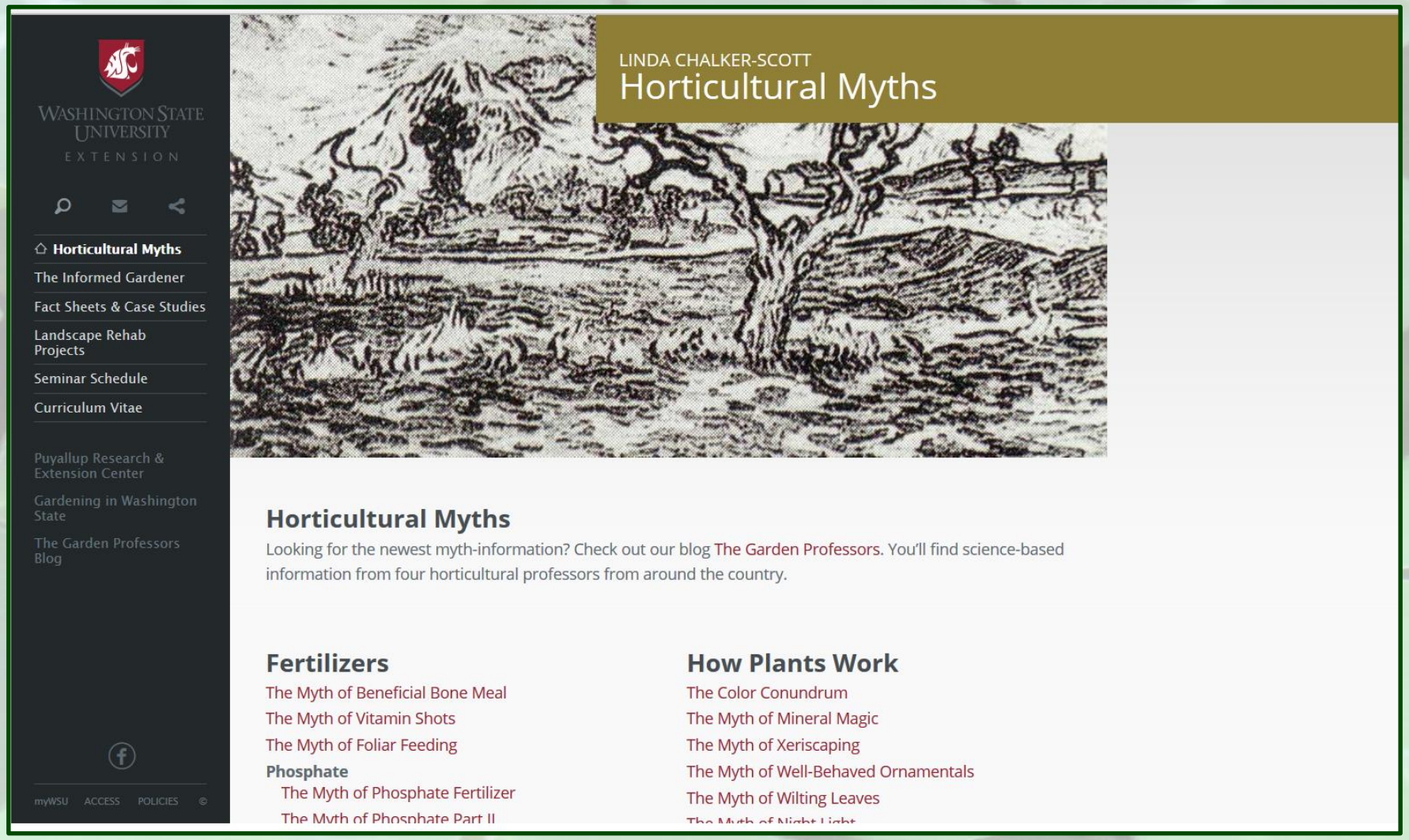
"Among the mulches tested, wood chips are a preferred method of mulching in terms of providing best gas permeability, particularly in landscape conditions."

Graphic comparisons



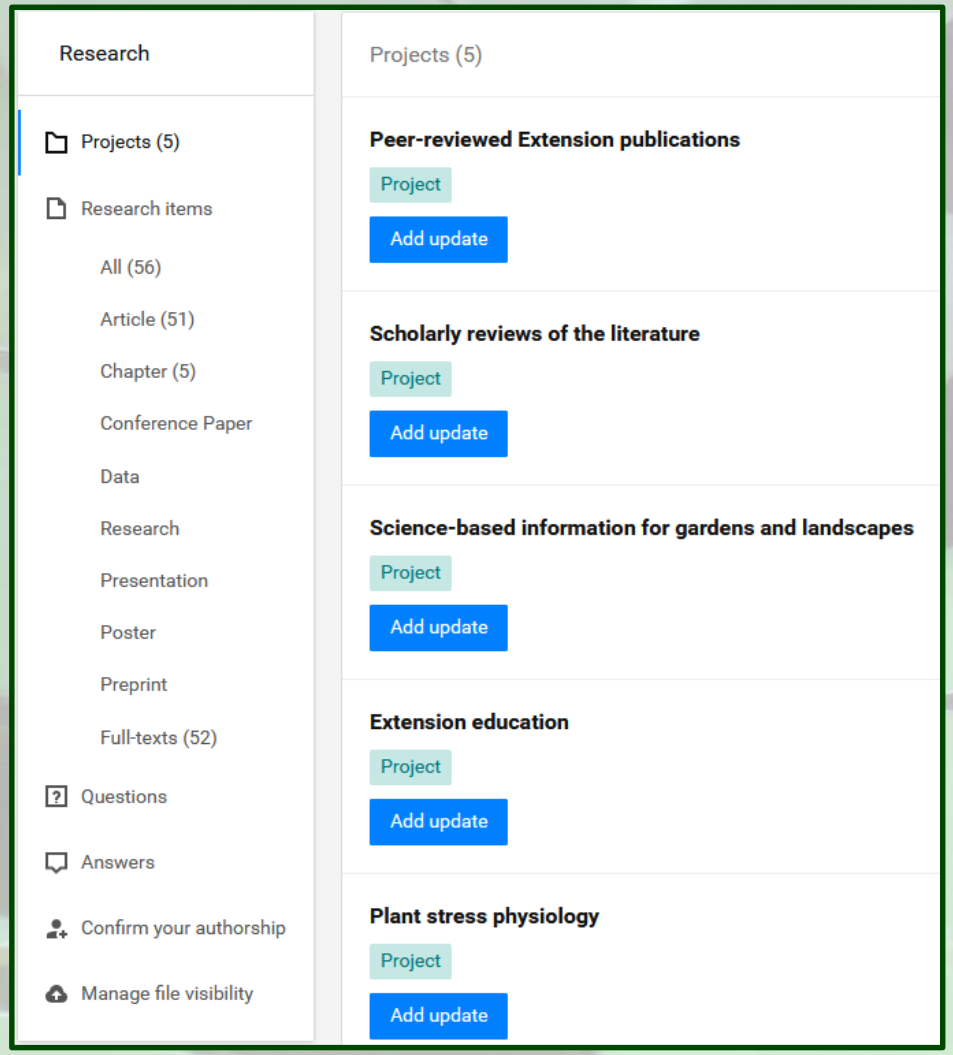
Science-based resources

Horticultural Myths

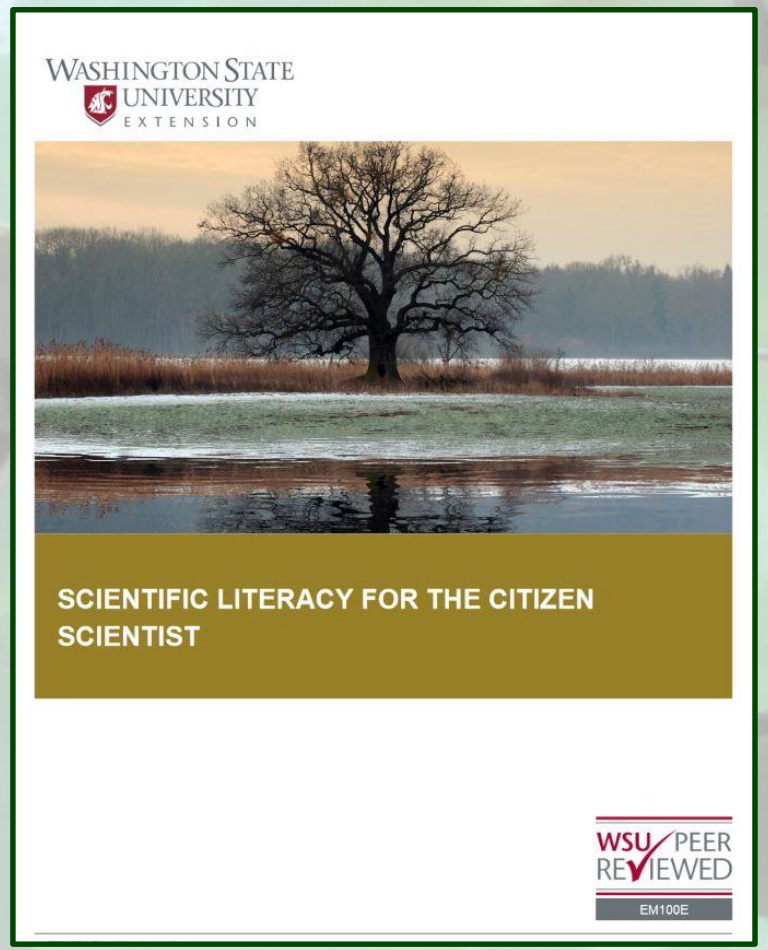


ResearchGate library

Self-managed collection of all available articles



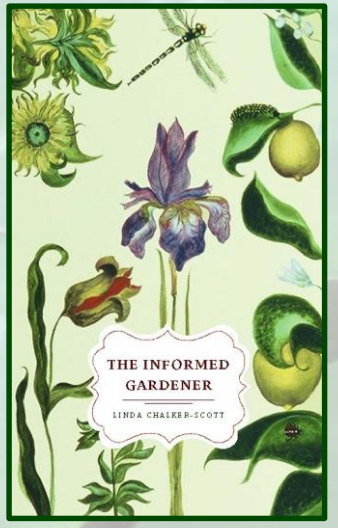
Scientific literacy manual

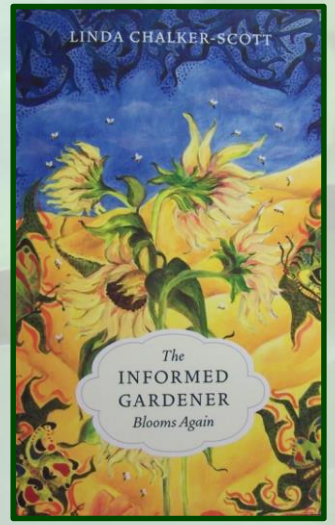


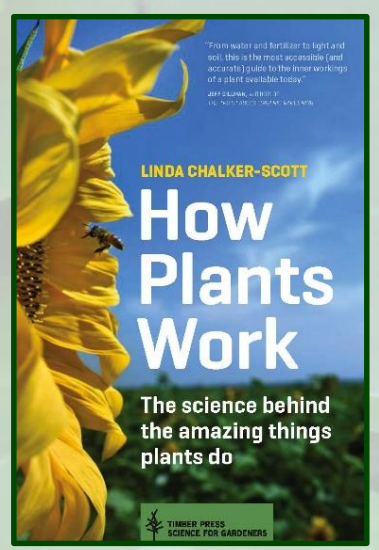
Free, downloadable, peer-reviewed guide

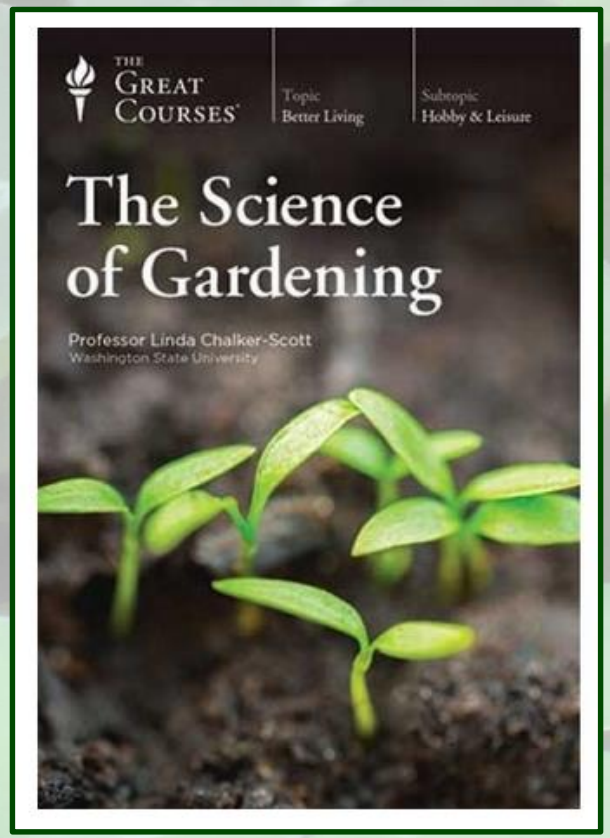
NACAA Journal series

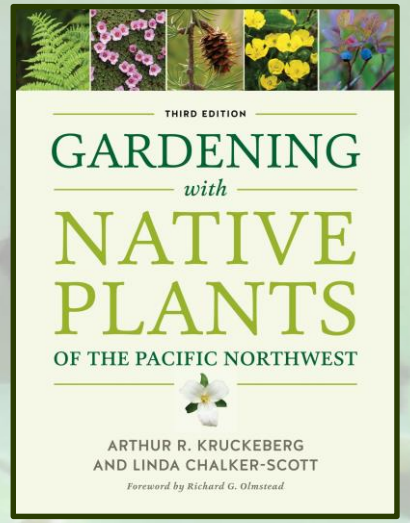
Science-based books and videos





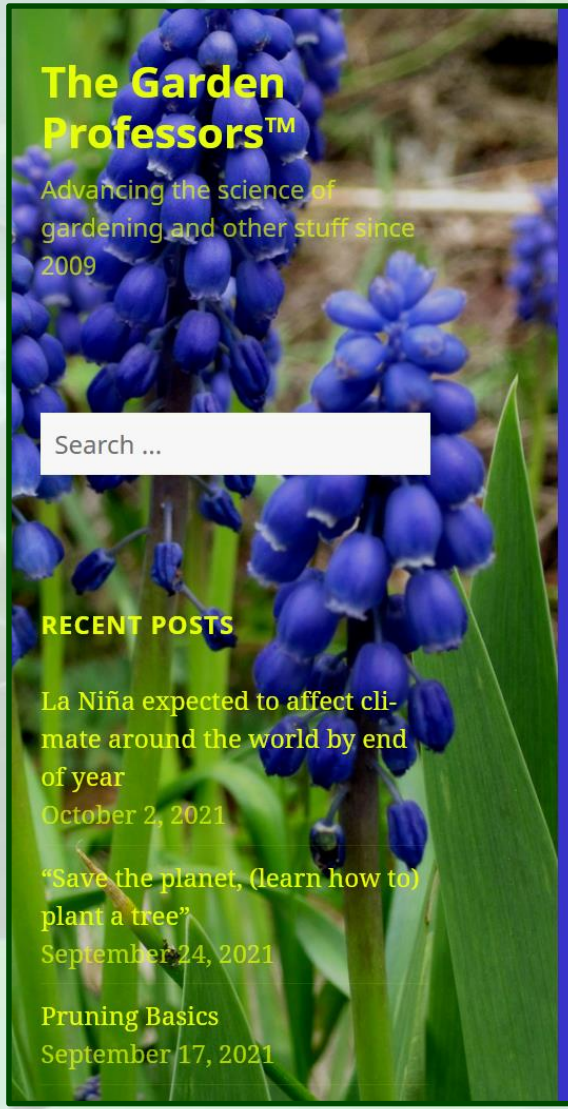






The Great Courses

The Garden Professors blog



Garden Logic – understanding correlation and causation in our gardens and landscapes

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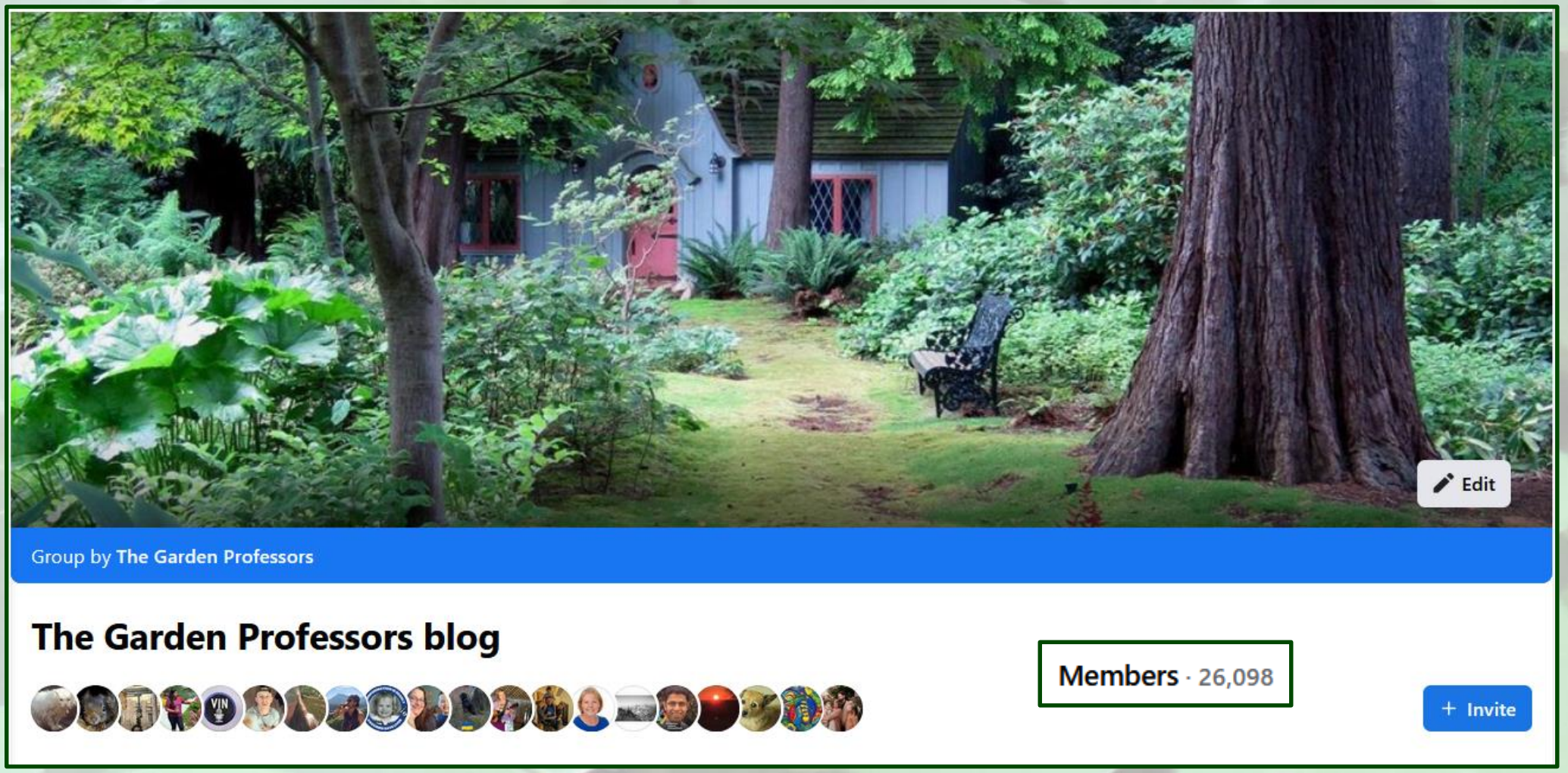
Join the GP blog group




Questions?