Right Plant, Right Preparation: the sustainable approach

Why do so many landscapes fail?

- Poor quality roots
- Improper soil management ⇒ Poor Root Establishment
- Inadequate root preparation
- Installed too deeply

Roadmap of seminar

- Plant selection
- Soil preparation
- The bare-root approach
- Woody mulches

1. Plant Selection

Plant inspection

- Choose plants that:
  - have heights appropriate to pot size
  - have good taper
  - have a visible root flare (are not buried too deeply)
  - do not have surface roots
  - do not have suckers
  - are free from damage and disease
  - have not been improperly pruned
  - have a strong central leader (unless multiple leaders are natural for the species)
  - have branches well-distributed along trunk
  - do not have included bark

Plant inspection during installation

- Return or restore plants with roots that:
  - circle, girdle, or kink
  - have uneven growth and distribution
  - are injured or dead

2. Soil Preparation

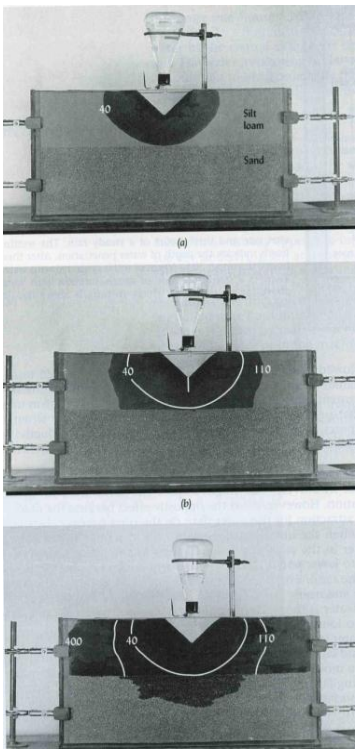
Urban landscape soils…

- …can be heavily compacted and/or have abrupt layers, creating perched water tables
- …do not necessarily resemble "native" soil types
- …need to be tested before selecting plants or adding amendments

Compaction

- Causes: Vehicles, equipment people & animals, water
- Result: reduced water and air movement, impeding root growth
- Treatment: loosening soil by digging and by mulching

Perched water table



Water enters fine-textured soil; vertical and horizontal movement both occur

Water contacts soil interface; vertical movement stops

Water enters coarse-textured soil only when gravitational pressure overcomes barrier

Soil components

- Sand and silt: Low nutrient binding capacity, quick draining
- Clay: High nutrient binding capacity, relatively slow draining
- Organic matter: ideally 5-10%
- Oxygen and water in pore spaces

Any changes you impose on your soils must be sustainable

Unsustainable: Amending soil with organic material before planting
Short-term result: Soil amendment increases drainage and reduces compaction within amended area, but decreases water and air transfer with unamended areas (see perched water table!)
Short term result: many newly installed trees and shrubs die in the first years
Long term result: Highly amended soils will subside and compact as organic matter decomposes and disappears
Long term result: landscape decline and failure over next several years

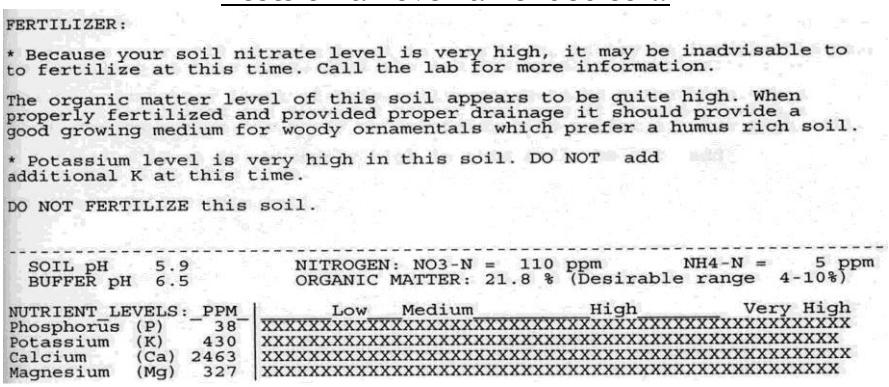
A sustainable soil system has an OM content that can be naturally replenished

Western WA: 5-10% OM Eastern WA: 0.5-5% OM

Don't overload your landscape

- Managed landscape soils are rarely nutrient deficient (except for nitrogen)
- Add only enough amendment to raise OM to normal levels
- Abnormally high levels of nutrients can have negative effects on plant and soil health
- Nutrients not immediately utilized contribute to watershed pollution

Tests on an over-amended soil:



FERTILIZER:

* Because your soil nitrate level is very high, it may be inadvisable to to fertilize at this time. Call the lab for more information.

The organic matter level of this soil appears to be quite high. When properly fertilized and provided proper drainage it should provide a good growing medium for woody ornamentals which prefer a humus rich soil.

* Potassium level is very high in this soil. DO NOT add additional K at this time.

DO NOT FERTILIZE this soil.

SOIL pH 5.9 NITROGEN: NO3-N = 110 ppm NH4-N = 5 ppm
BUFFER pH 6.5 ORGANIC MATTER: 21.8 % (Desirable range 4-10%)

NUTRIENT LEVELS:	PPM	Low Medium High Very High
Phosphorus (P)	38	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Potassium (K)	430	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Calcium (Ca)	2463	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Magnesium (Mg)	327	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Misapplication of agricultural practices to urban landscapes

Annual crop production:

- Vegetation is removed yearly
- Soil is amended on an annual basis
- System adapted to annual disturbance

Permanent landscape:

- Permanent vegetation
- Can't amend soil after installation
- System not adapted to annual disturbance

Proper soil management: bottom line

- Eliminate restrictive soil interfaces
- Sustain a natural rate of decomposition and eliminate subsidence
- Eliminate nutrient overload
- Add organic matter as a mulch, not as an amendment

Things to do before moving on to step 2

- Have the results from your soil test
- Amend soil with organic material only if tests show less than 5% OM
- Don't dig holes!

3. The Bare-root Approach

Unsustainable: Leaving root balls intact during transplanting from containers or B&B
Short term result: No transplant shock, good crown growth for first season or two
Long term result: Crown growth slows or stops as roots fail

Roots fail because

- They have barriers between themselves and the native soil
- They are structurally flawed and left uncorrected
- They are installed too deeply

Removing ALL materials from root balls and correcting root flaws improves root establishment and tree survival

- ◊ Have adequate water and organic mulch on site
- ◊ Keep roots shaded and moist at all times
- ◊ Remove all containers and other foreign materials from the roots
- ◊ Use a hose or a water bath to remove all media from the roots
- ◊ Let root balls soak for several hours if they are too dry to work
- ◊ Prune excessively long and defective roots

Installation

- ◊ Dig a shallow hole only as deep as the root system and at least twice as wide
- ◊ Arrange the roots radially and backfill with unamended native soil
- ◊ Use root washing water in planting hole; it contains nutrients and microbes
- ◊ Add soil as holes develop. This is called "mudding in"
- ◊ Keep it simple and natural: do not crown prune or add expensive, but pointless, transplant supplements
- ◊ If your tree or shrub is in leaf when it is installed, you may lose many of the leaves especially if you have pruned the roots. New leaves will grow once the roots have established

Proper root preparation: bottom line

- ◊ Eliminate multiple barriers to root growth
- ◊ Detect and correct otherwise fatal root flaws
- ◊ Know that you are planting at grade
- ◊ Enhance plant establishment and survival

4. Woody Mulches

Impacts of landscape mulches compared to bare urban soils

	Living	**Synthetic**	**Inorganic**	**Organic**
Soil moisture?	+/0/-	-	+	+
Reduce compaction?	+	+/0	+	+
Moderate temperature?	+	+/0/-	+/0/-	+
Provide nutrients?	+/-	-	0	+/0
Enhance plant growth?	+/0/-	0/-	+	+
Enhance beneficials?	+	-	+	+
Control weeds?	+	-	+/-	+
Control pest insects?	+/0	0/-	+/0	+/0
Control disease?	+/0	0/-	+/0	+/0
Reduce pesticide use?	+	-	+/-	+
Cost?	$	$$ to $$$	$ to $$$	Free to $$
Availability?	N/LC	N/LC, HI	N/LC, HI	N/LC, HI, A/U/TS
Ease of replacement?	Moderate	Difficult	Easy	Easy

$ = low
$$ = moderate
$$$ = high

N/LC = nursery/landscape center
HI = home improvement store
A/U/TS = arborist/utilities/tree service

Organic mulches will

- Provide a slow release of macro- and micronutrients
- Improve soil structure by reducing compaction and allowing aggregates to form
- Enhance establishment of trees and shrubs in low-maintenance landscapes
- Enhance beneficial microbes, which can outcompete pathogens if soils are healthy
- Enhance soil macrofauna biodiversity

Effectiveness of organic mulches – numerous studies

- Weed control improves with mulch depth
- Permeability increases with mulch coarseness
- Greatest benefits and fewest drawbacks with deep, coarse mulches

Problems with cardboard & newspaper sheet mulches

- Can induce anaerobic conditions if used on wet, poorly drained soils
- Will become hydrophobic if allowed to dry out
- Can become pest havens for termites and rodents

Problems with fine-textured mulches

- Includes sawdust and some composts
- Deep applications will lead to anaerobic soil conditions
- Often become compacted into impervious layers
- Generally ineffective for weed control

Problems with coarse woody mulches

Bark mulches

- Bark mulch can be contaminated with salt or weed seeds
- Bark naturally contains waxes that prevent absorption and release of water in landscapes
- Softwood bark mulches are often not "gardener friendly" due to the presence of tiny, sharp fibers

Arborist wood chips

- Concerns about high carbon:nitrogen ratio – will this cause a nitrogen deficiency?
- Will diseased wood transfer pathogens if it is used for chips?

Nitrogen availability

- Wood chip mulches have a high C:N ratio, leading to a localized nitrogen deficiency at the mulch-soil interface
- Wood chip mulches do not cause nitrogen deficiency in established plants
- High C:N ratio in wood chips probably prevents germination of some weed seeds

Fungal pathogens and wood chips

- *Armillaria, Cytospora, Thyronectria* and *Verticillium* can all survive on large wood segments for months
- Survival is enhanced if wood chips are incorporated into soil
- No evidence that pathogens in mulch can infect roots below the soil surface

Fungal communities in wood chips

- Fungal species in wood chips are generally decomposers, not pathogens
- Under healthy (aerobic) soil conditions, beneficial and harmless fungi probably out-compete pathogenic fungi
- Healthy plants are not susceptible to opportunistic fungal pathogens such as *Armillaria* and *Phytophthora*

Weed suppression by wood chips

- Inhibit weeds through allelopathic chemicals
- Decrease nitrogen levels at soil interface
- Reduce light needed by photodormant seeds
- Reduce light availability to buried leaves

Invasive weed control case studies

- Union Bay Natural Area, UW, Seattle, WA
- Frink Park, Seattle WA
- Heron's Glen Wetland Buffer Enhancement, Pierce Co. WA

Mulch strategies using coarse organic materials

- Let wood chips age before using them if there are concerns about disease
- Before installing wood chips, create a thin underlying layer of a more nutrient-rich mulch (like compost) if there are concerns about nutrient deficiencies
- Begin mulch application before annual weeds are established (spring or fall).
- Remove perennial weeds in early spring when root resources are lowest
- Prune or mow perennial weeds at root crown; pulling destroys soil structure
- Remove all noxious weed materials from site to prevent rerooting
- Thick layers (4-6" for ornamental sites, 8-12" for restoration sites and blackberry/ivy control) of coarse materials are best for weed control and water conservation
- Keep mulch away from trunks of trees and shrubs
- Pull any resprouting plants; the mulch layer prevents erosion and facilitates pulling
- Replace mulch as needed to maintain appropriate depth

Good quality roots + Root preparation + Proper soil management =
Successful Establishment →↓ Management $$$

Visualize forests – not fields – when managing permanent landscape soils

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