Designing for trees for drought
Trees are a solar powered, temperature and water regulating, erosion controlling, pollutant filtrating, self sustaining AC system that traps carbon.

And provides food and shelter....
Landscape designer are key to urban trees! You will be busy!
Designing with trees and drought in mind. But first, some facts....
What we will talk about today:

• Drought stress: water and soil factors
• Young tree establishment
• Mature trees
• Species
• Design considerations: soil quality-run off and percolation trough water wise design
Drought stress

• 1st Symptoms: Wilting

• Absence of water = absence of chemistry.

• No chemistry, no nutrients: diet (stored carbohydrates come into play)

• Photosynthesis shuts down at 90 degrees while chlorophyll breaks down at 100! No nitrogen production during dormancy.

• Starvation: damage to feeding roots membranes, immune system not functioning due to lack of tannins, alkaloids..., 

• Door open to Insects and pathogen attacks: borers and root rots.
Water: how much?

- 1 sqft requires 1.2 gal to saturate 12” depth and is 1” of rainfall.
- A 20” tree → 1440 sqft CRZ → 1728 gal. → 2160 cuft soil

With a 3/4” hose, at 9gal/min, that is 3h 10 min!

Spray irrigation soaks about 2-3 inches depth en encourages shallow tree roots. Trees become dependant on the turf schedule.
Water: how often?

• Too many Variables.   Good ole finger test and rain gauge.
Moisture monitoring

<table>
<thead>
<tr>
<th>Texture</th>
<th>FC (v%)</th>
<th>PWP (v%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Loamy sand</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>Sandy clay loam</td>
<td>27</td>
<td>17</td>
</tr>
<tr>
<td>Loam</td>
<td>28</td>
<td>14</td>
</tr>
<tr>
<td>Sandy clay</td>
<td>36</td>
<td>25</td>
</tr>
<tr>
<td>Silt loam</td>
<td>31</td>
<td>11</td>
</tr>
<tr>
<td>Silt</td>
<td>30</td>
<td>6</td>
</tr>
<tr>
<td>Clay loam</td>
<td>36</td>
<td>22</td>
</tr>
<tr>
<td>Silty clay loam</td>
<td>38</td>
<td>22</td>
</tr>
<tr>
<td>Silty clay</td>
<td>41</td>
<td>27</td>
</tr>
<tr>
<td>Clay</td>
<td>42</td>
<td>30</td>
</tr>
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</table>
How often?

- Most of our local soils will keep deep moisture after a soaking rain for **2 weeks** easily.
- Deep soaking with a frequency that allows for the top inches to dry up encourages deep roots but discourages needy groundcovers like jasmin, turf, english ivy, even berkeley sedge.
- Our rainfall’s pattern is one of sudden large quantities, the opposite of what we see in temperate climates like in portland, even though our annual rainfall averages same quantities.
- Clay keeps moisture a long time and is an essential component of our local soils
- Local species are adapted to our local rain patterns
Water movement: percolation, Run off

Dig hole 18 inches deep and fill with water

Good  Fair  Poor

Drainage after one hour
Newsflash

- Water does not stand still, it is impacted by gravity
- Trees do not depend on rain only, they also obtain large amounts of water from run off
- More available water = more plants
- Alterations in grade and channeling changes drainage and average annual available water on site

Conclusion:
Retain some of the storm water by all means necessary, including soil quality and quantity
Up By Roots
Healthy Soils and Trees in the Built Environment

James Urban
Root location !!!
¼ crz root mapping
Soil properties:

- Texture: particle sizes. Clay-silt-sand-Gravel
- Structure: bonding of particles. Clay peds are strong. Sandy peds are weak.
- Density: degree to which particles are packed together. Bulk density is the measure of compaction of a soil.
- Water movement: speed at which water moves in response to capillarity and gravity.
- Nutrient holding capacity: clay holds better than sand.
- Temperature: 75F is ideal. Nitrification slows above 85 and roots are damaged at 95 and above.
- Organic activity: rhyzosphere, the last frontier.
Soils in south Austin. Soil is the container for water and nutrients.
The building process
Compaction:
the process of killing soil and loosing water.
Conclusion

Soil: Dig it!
Young tree establishment.
From the nursery to the landscape.


Start with a clean root stock: trees with girdling roots will get worse over time and channel less and less water. Florida’s nursery standards and grades.

• From the nursery to the landscape:
• Nursery: ideal soil and moisture, tight spacing that shades the rootball and the stems
• Travel: trees dry from transports.
• Establishment: urban soils, exposed to sun and winds, irregular watering,...
Seedling in natural forest floor
Young trees are “nursed by shading and sheltering older trees, rolling water catching ground, “fluffy” humus layer, surrounded by live soil.”
Soil first: Put a 5$ tree in a $50 panting hole

Water beyond the root ball to bait roots.

More than 1 bubbler for a 2” tree!!
Mature trees

- Remember CRZ and soil volume
- Mulch can shed water....
- Mulch needs to be “fluffy”
Root flare? Telephone pole syndrome will reduce available water
Raised beds....choking roots and water shedding
Thinking outside the pipe!
Species: water requirements?
Aquatic vs riparian vs upland
<table>
<thead>
<tr>
<th>Upland</th>
<th>Riparian or understory low land</th>
<th>Aquatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Live oak</td>
<td>Burr oak</td>
<td>Bald cypress</td>
</tr>
<tr>
<td>Cedar Elm</td>
<td>Chinquapin oak</td>
<td>Willow</td>
</tr>
<tr>
<td>Lacey oak</td>
<td>Pecan</td>
<td>Live oak</td>
</tr>
<tr>
<td>Eve's necklace</td>
<td>Arizona black walnut</td>
<td>Box Elder</td>
</tr>
<tr>
<td>Ash</td>
<td>Shumard oak</td>
<td>Chinese Tallow</td>
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<tr>
<td>Juniper</td>
<td>Live oak</td>
<td></td>
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<tr>
<td>Mexican White oak</td>
<td>Red Bud</td>
<td></td>
</tr>
<tr>
<td>oak</td>
<td>Buckeye</td>
<td></td>
</tr>
<tr>
<td>Little walnut</td>
<td>Hackberry</td>
<td></td>
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<tr>
<td>Texas red oak</td>
<td>Soapberry</td>
<td></td>
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<tr>
<td>Post oak</td>
<td>Magnolia</td>
<td></td>
</tr>
<tr>
<td>Blackjack oak</td>
<td></td>
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</tr>
</tbody>
</table>
Layers of an ecosystem:

Shade trees
Ornamental trees and shrubs
Perennials
Annuals

Legumes
Edibles (for us and for wildlife)
Ganoderma basal rot, from drought stress
GANODERMA
basal rot:
Infection from
drought stress
Phytophthora: cambium rot disease
Magnolia in the middle of a desert design.
Design and Install consideration

There is no magic bullet!
Instant Soil Rejuvenation in Root Zones
Blue hole park in Wimberley: grow zones and functional space allow for sustainable design.
“Earthworks”: earth is not flat...
From water shedding to water collecting earthworks
Water wise design: 100% of 2” rainfall controlled on site.
Roof run off control
Earth and rock works for waterwise design
Check dams and cedar mulch trail
Edging as mini checkdams
Perennial woodland Garden
Herb and bulb Garden check dam
Infiltration trench
Infiltration trench pathway: river rock and gravel
Vegetated filter strip before the spillway
Spillway
Vegetated filter strip
Rain Garden
Rain Garden
share it for awareness