Course Outline

- Plant Selection – Right plant, right place
- Selecting quality nursery plants, shrubs & trees
  - Trunk, stem, leaf and rootball examination
- Soil percolation testing, dealing with hardpans
  - Planting hole
  - Amendments, tree wells and surface mulch
- Planting steps
- Proper tree staking
  - Anchor protection, support
  - Appropriate materials and techniques

Why do plants fail?

- Poor production
- Poor selection
- Poor timing
- Poor planting
- Poor irrigation
- Poor maintenance
- Diseases, pests, abiotic stresses

Plant Selection and Selecting Plants

- Majority of maintenance and plant problems stem from either selecting the wrong kind of plant for a location or planting an inferior or defective specimen of the selected plant type.
- **Plant Selection** – What species of tree or plant are you going to buy? RIGHT PLANT – RIGHT PLACE
- **Selecting Plants** – Once the species is chosen, which specimen out of many available at the nursery will you choose?

See UoA Publication az1153-2015 in ACLP Resources: Plant Selection and Selecting Your Plants
**Site Challenges**

- **Soil**
  - Depth (can root to depth of 36”)
  - Texture (sand, silt, clay)
  - Compaction/drainage
  - pH (alkalinity/acidity)
  - Salinity
  - Fertility/toxicity

- **Plant Function**
  - Plant size and shape
  - Shading
  - Screening

**Tree Characteristics**

- Mature size
- Deciduous or evergreen
- Grows quickly or slowly
- High litter or low litter
- Desert acclimated or non-native
- Shade creator or will light spill through

**Shapes to Consider**

- Round
- Spreading
- Pyramidal
- Oval
- Conical
- Vase
- Columnar
- Open
- Weeping
- Irregular
Right Tree Right Place

- Poor plant selection choices lead to problems and expense years after installation (maintenance/removal/replacement)
- Poorly pruned trees to “fit” the location
- Select for establishment and natural growth and development
- Design with mature plant development in mind
- Remember root development, not just branches
- Below ground not just above ground
Trees for Small Spaces (~15’ X 15’)

- Vitex or chaste tree (*Vitex agnus – castus*)
- Little leaf ash (*Fraxinus greggii*)
- Cascalote (*Caesalpinia cocalaco*)
- Texas mountain laurel (*Sophora secundiflora*)
- Texas olive (*Cordia boissieri*)
- Bonita ash (*Fraxinus velutina ‘Bonita’*)
- Mastic tree (*Pistacia lentiscus*)

Trees for Medium Spaces (~25’ X 25’)

- Palo verde varieties (*Parkinsonia floridum, P. microphyllum, P. praecox*, etc.)
- Feather tree (*Lysiloma microphylla*)
- Desert willow (*Chilopsis linearis*)
- Palo blanco (*Mariosousa willardiana*)
- Twisted acacia (*Acacia schaffneri*)
- Mulga tree (*Acacia aneura*)

Trees for Large Spaces (>25’ h X >25’ w)

- Arizona ash (*Fraxinus velutina*)
- Ironwood (*Olneya tesota*)
- Evergreen elm (*Ulmus parvifolia*)
- Mesquite (*Prosopis juliflora, P. velutina, P. glandulosa*)
- Blue palo verde (*Parkinsonia floridum*)
- Arizona sycamore (*Platanus wrightii*) – needs lots of water
- Eucalyptus varieties (*Eucalyptus spathulata*)
- Fruitless olive (*Olea europaea*)
- Pecan tree (*Carya illinoinensis*)
- Texas ebony (*Ebenopsis ebano*)
- Southern live oak (*Quercus virginiana*)
- Pistache (*Pistacia chinensis*)

Selecting Plants at the Nursery

**Selecting Plants – Above ground**

- Vigorous and healthy shoots
- Size per ANA Standards
- Avoid closely staked trees
- Good taper of trunk
- Central leader or multi-stemmed
- No evidence of insects or disease
- No physical damage

**ANA Tree Standards**

*Standards established for container-grown trees in Arizona*
*Helps determine if a tree is too big or too small for container size*
*Caliper determination - measured at 6” above soil line*
What is Taper?

**Taper** = trunk caliper is thicker at the base of a tree and decreases further up the trunk

**Why is taper important?**

- Stabilizes trunk to hold crown and withstand wind

*Leaving lower temporary lateral branches on trunk and allowing the trunk to move in the wind promotes caliper and taper

Selecting Plants – Roots

- Avoid root bound plants
- Root ball should hold firmly together
- Root ball should be moist
- Container should be full of media and not partially full

Circling roots – cut them, or tear up the edge of the root ball to spread roots out

Selecting Plants

- Natural shape of trees – No heading back or severe pruning
- Plants grown locally or in a climate similar to the one where they will be established often adjust more rapidly and may perform better
Timing of Planting

- Year round planting is possible
- Late fall is ideal
  - Soil temperatures are warm
  - Air temperatures are cooler
  - Roots establish most quickly
  - Be cautious with frost sensitive species
- Spring is also a good time
  - Roots establish more slowly

Root Systems

- Tap roots are usually non-existent in nursery grown stock
- Shallow, wide system – 1.5 to 4 X canopy width
- Distribution is limited by genetics and soil compaction
- A wide hole promotes root establishment

Root Crown Susceptibility

- Trunk bark is more vulnerable to soil related problems and wetness than root bark
- Settling deeper into the soil exposes the trunk to these problems – a leading cause of failure
- Plant in a shallow hole to avoid settling and trunks buried in soil
- Always remove nursery mulch layer to expose root flare and inform proper planting depth

Planting Specifications

- Shallow, wide hole with rough sloping walls
- No organic amendments in back fill
- Remove nursery mulch to expose root flare
- Root ball on undisturbed soil
- Organic mulch
- No unnecessary pruning
- Stake only if necessary
- Plant during late fall or early spring if possible

Severely root bound tree
Root growth of oak one year after planting
Root balls that have grown into the shape of their containers
Soil Interface

- Roots will not easily penetrate dense clay or compacted soils
- The sides of the planting hole should be roughened to facilitate root penetration
- Going from ‘organic’ to clay soils can present problems with establishment

Failure of Bottle Tree

- Planted from 15 gal. container
- Blew down after 5 years
- 24 ft. tall, 4” trunk caliper at 4.5 ft. above the ground

Severely compromised root ball of a FanTex ash tree planted as 24” box approximately 7 years ago.

Choose trees that are within ANA size guidelines for the container size. Ensure that the top of the root flare is exposed.

Trees kept excessively long in a crowded nursery can develop asymmetric growth that is difficult to correct subsequent to installation

Further Example of Asymmetric Growth
Steps for Proper Planting

1) Look up for wires/lights
2) Dig shallow/wide hole
3) Find the top-most root and treat root defects
4) Place tree in hole
5) Position top root 1-2 inches above landscape soil
6) Straighten tree
7) Add backfill soil and firm the root ball
8) Water in
9) Add mulch and irrigation
10) Stake and prune ONLY if needed

Step 1: Look up!

This is your last chance to be sure you have selected the right tree for the right place.

If there is a wire, security light, or building nearby:
- Plant elsewhere or
- Plant a different tree

Step 2: Prepare and Dig a Hole

- Did you call Arizona 811? (formerly Blue Stake)
- Rake aside DG and put a tarp down for the excavated soil
- Measure the distance between the top most root and the bottom of the root ball
- Dig the hole to about 90 to 95% of this depth

Percolation Test

- Pre-fill planting hole with water to test percolation
- Water should drain 1” per hour to verify good drainage
- Bonus: a pre-wet hole will prevent adjacent dry soil from wicking moisture from root ball
Step 3: Find and check the roots

- Make sure that the point where the top-most root emerges from the trunk is at the surface.

Remove excess soil

- Remove excess soil and/or mulch from the top of the root ball

Three inches of soil and media were removed from the top of this ball.

Look for Root Defects

- Remove the nursery mulch layer to expose the trunk/root flare
- Remove any roots growing over the flare

Defects can be inside root ball

- Be sure to look for roots that circle when trees were in a smaller container
- These are difficult to cut because they are hidden in the interior of the ball

Steps 4-6: Planting

4) Place tree in hole
5) Position correctly
6) Straighten

Is this at the right planting depth?!
Step 7: Fill in the Hole

- Use backfill soil
- **No need** to add fancy soil or organic amendments
- Water in for best soil settlement

![Backfill diagram](image)

**Backfill**

University of Arizona study showed that organic amendments were ineffective in backfill:

- Backfill in test plots were amended with 33% organic material or native soil
- Organic amendments did not promote root and shoot growth
- Roots of oak trees planted in amended soils were 15% less in length than those planted in native soil

Step 8: Add mulch at soil surface

(Not as a backfill amendment, NOT against tree trunk)

**Benefits of Organic Mulches**

- Reduces evaporation
- Reduces weed growth
- Insulates soil surface
- Recycles nutrients
- Produces humus
- Promotes root growth
- Promotes trunk growth

![Mulch image](image)

**Finishing Planting**

- Cover root ball with no more than 1" of soil or mulch
- Watering plants in immediately after planting settles soil and prevents root ball from drying out
- Water root ball and native soil immediately surrounding it

![Finishing Planting image](image)

**Tree Protection Options**

- Tree trunk protection

![Tree protection options](image)

*Photo credit: missouribotanicalgarden.org*
Congratulations on Planting a Tree!

Establishment rate is influenced by a variety of factors

<table>
<thead>
<tr>
<th>Encourages growth</th>
<th>Limits growth</th>
<th>Little or no effect</th>
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</thead>
<tbody>
<tr>
<td>Loose soil</td>
<td>Compacted soil</td>
<td>Peat or organic matter added</td>
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<tr>
<td>Proper irrigation</td>
<td>Little or no irrigation</td>
<td>Water absorbing gels</td>
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<tr>
<td>Mulch 8’ around planting hole</td>
<td>Grass and weeds close to trunk</td>
<td>Root stimulant products</td>
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<tr>
<td>Root flare above soil surface</td>
<td>Planting too deeply</td>
<td>Adding spores of mycorrhizae *</td>
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<tr>
<td>Leaving shoots intact</td>
<td>Pruning at planting</td>
<td>Fertilizing at planting</td>
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We planted the tree – aren’t we done?

- Pruning
- Irrigation
- Staking
- Pests & Diseases

Pruning can really make a statement!!

Effects of Pruning

- Reduces new root growth
- Reduces trunk growth and tree stability

Pruning for Young Trees

- Avoid unnecessary pruning
- Prune away dead, damaged or diseased branches
- Allow temporary branches to remain
- Remove crossing or rubbing branches
- Create a strong central leader
- Create well spaced scaffold branches
Irrigation after Planting

- Irrigate the root ball and the planting area immediately, taking care that the root ball remains level with the soil surface even after irrigation.

Irrigation Basics

- Always irrigate the entire depth and width of the plant root zone regardless of the time of year.
- Irrigation frequency is dependent on how quickly the soil dries out.
- Soil texture and plant rooting depth will determine the length of time to irrigate.

Irrigation Basics

- Take care that the root ball (often higher in organic matter than surrounding soil) doesn’t dry out.
- Light, frequent irrigation creates shallow, weak root systems.
- Deep, less frequent irrigation encourages deep strong root systems that can tolerate longer periods of drought.

Irrigation for the long term

- Many native trees may be capped after a few seasons in the ground, helping to reduce excessive growth.
- Timing
  - At night or early morning (3:00am - 8:00am)
  - Reduces water loss from evaporation & wind
- Placement = Emitters need to move as roots grow
  - Roots grow at the water source so you must encourage the root system to expand
Diseases, Pests, and Stress

- A healthy plant can withstand pest problems more readily than a stressed one
- Too much water as well as too little water can be a source of stress
- Pruning is a wounding process and a source of stress

Common Pest Problems

- Weeds
  - Compete with your tree for water and nutrients
  - Eliminate them before they set seed either manually or, if they get out of hand, use chemical control.

Reasons for Staking*

- Anchorage
- Support
- Protection

*Stake only if necessary
Remove stakes after 1 – 2 seasons

Staking for Anchorage

- Keep root ball from moving until new roots grow into surrounding soil
- Full or over grown trees with small root balls
- Wet or loose soils

Staking for Support

- Keeps tree straight in excessive wind or until trunk is strong enough

  - Weak trunks without taper
  - Tall trees without bottom branches
  - Some trees e.g., (Eucalyptus, Prosopis hybrid, Nerium, Acacia)
Staking for Support

If the tree is tall and the stakes do not support the tree, the leader will often bend and become sun burned. A new leader will ultimately develop.

Staking for Protection

- A barrier around the trunk protects the tree from vehicles, humans, animals, equipment and vandals (these barriers are not attached to the tree trunk)
- 3 or 4 short stakes outside of the planted root ball
- Sturdy metal frame around the outside of the trunk

Effects of Staking on Plants

A staked versus un-staked tree will:

- Grow taller
- Grow away from the stake if tightly secured
- Grow less in caliper near the ground
- May produce a decreased or reverse taper
- Is unable to sway in wind
- Has a greater potential for damage from stakes and ties

Effects of Staking on Plants

- Trunk movement is very important to strengthen the stem
- Increases stem taper
- Increases caliper
- The nursery stake should be removed at transplanting

Staking Methods

- Above ground
- Below ground
- Stakes at different heights
- Different tie materials
Above Ground Staking

Single or multiple stakes

Tie Materials

Should be wide, smooth, flexible, possibly biodegradable

Desirable materials
- Elastic webbing
- Polypropylene straps
- Flexible tubing

Undesirable materials
- Cable, duct tape, tie down straps
- Electrical wire, rope

Tie Materials

Two tall stakes, two ties
Support staking for taller trees
Install at lowest height possible on the trunk that keeps the leader upright, while allowing maximum movement of the crown
Stakes too tall for shorter trees

Potential problem: mechanical branch injury from stakes.

Conventional method

Proper Tree Staking
Leave a loop around the trunk large enough for the tree to move with the wind.

A Few More Stakes Needed?

Which is staked – the tree or the nursery stake??

Nice touch!
Is this ideal?

- Stakes parallel to street are not always perpendicular to prevailing winds
- Nursery stake needs to be removed
- Lower branches will promote taper
- Stakes may be too tall

Below Ground Staking

Staking method: Two stakes through root ball
- Two steel rods 36" long with 5/8" diameter were driven at 45° angles through the root ball into the underlying soil to anchor the plant. Works well for trees that require little staking and stand upright on their own.

- Mesquite staked with this method developed greatest taper 6 months after transplanting compared to the other three staking methods.
- Acacias staked with this method are leaning and will require corrective pruning to establish a new leader.

- No above ground structures
- No maintenance
- No removal
- No damage to tree

Staking method: Single tall stake
- Works well for taller trees requiring staking.
- Mesquite and acacias staked with this method developed more taper than conventional double staked trees 6 months after transplanting because trunks have more freedom of movement.

Two Short Stakes

- Works well for shorter trees
- Those requiring minimal staking, such as mesquite
- Acacias staked with this method were not kept upright and will require corrective pruning to establish a new leader

Single stake, leader not well supported
Staking can create hazards without maintenance. Fast growing species such as *Parkinsonia, Rhus, Ulmus, Schinus, Acacia* and *Prosopis* require frequent inspection of stakes during spring and summer.

Minimizing the need for staking

- Purchase plants that were not bound tightly to stakes during production
- Select smaller trees or multiple trunk trees that generally do not require staking
- Select plants with a well proportioned height to crown ratio that often require less staking

Review - Keys to Successful Tree Establishment

**Plant Selection**

- Right plant for right place
- Healthy roots and shoots
- Minimal or no staking
- Locally grown or adapted
- Buy and plant during late fall or early spring

**Planting**

- Planting hole should be no deeper than the root ball, 3-4 times as wide, with rough sides
- No organic amendments in backfill
- Remove nursery stake at planting
- Cover root ball lightly with native soil
- Irrigate immediately during & after planting

Stake only if necessary

- Use correct staking technique and materials
- Inspect stakes and ties routinely
- Remove within two growing seasons

By following the guidelines for selecting, planting, and staking, trees are ready to successfully establish and thrive in the landscape.
MOST TREE PROBLEMS RESULT FROM OUR POOR UNDERSTANDING OF HOW TREES WORK.

BASE YOUR TREE MANAGEMENT DECISIONS ON HOW TREES FUNCTION.

TREES HAVE DIGNITY.

Resources

Books

Websites
- Plant Selection and Selecting your plants: ag.arizona.edu/pubs/garden/az1153.pdf
- Planting Guidelines: Container Trees and Shrubs: ag.arizona.edu/pubs/garden/az1022.pdf
- Arizona Community Tree Council: aztrees.org
- International Society of Arboriculture: isa-arbor.com
- Arizona Master Gardener Manual: ag.arizona.edu/gardening/mgmanual/mgmanual.html

Thank you!!!

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