Trees and Shrubs for Sustainable Built Environments

HORT 306
Fall 2018

TEXAS A&M UNIVERSITY

Intro, Terminology & Definitions
Home pages for HORT 306 & 608 can be found on http://hortsciences.tamu.edu/
HORT 306 TREES AND SHRUBS FOR SUSTAINABLE BUILT ENVIRONMENTS

Instructor: Dr. Michael Aloysius Arnold (http://agec.horticulture.tamu.edu/faculty/arnold.html)
Lectures: [SP 110], Monday and Wednesday, 12:40 PM – 1:50 PM
Laboratory Assistance?

• Lecture
  – Dr. Michael Arnold
  – Office Hours 11:00 am to noon on Monday & Wednesday & by appointment

• Tuesday 10:00 am – Noon lab &
  Tuesday 1:00 pm – 3:00 pm lab
  – Mr. Jonathan Caples

• Tuesday 3:00 pm – 5:00 pm lab &
  Wednesday 3:00 pm – 5:00 pm lab
  – Ms. Amanda Birnbaum
Lecture Examinations (306/608)

- Lecture portion of class = 1200 pts = 50%
  - All materials are cumulative, emphasis on recent
- Lecture midterm 250 pts
  - Wednesday October 10, 2018, in class.
- Lecture quizzes 550 pts (11 at 50 each)
  - Unannounced (pop quizzes/assignments) but mostly on Wednesdays each week beginning third week of lecture
- Lecture final 400 pts
  - Monday, December 10, 2018, 10:30 AM - 12:30 PM.

PLEASE NOTE!!!
- Average lecture grades usually lower than lab grades
  - Lecture exams entail more challenging application of material, while lab identification is more rote memory
  - Thus, timely learning of lab materials is easy way to improve grades
  - And, don’t wait until the last minute to study for lecture exams
Laboratory Examinations (306/608)

- Laboratory examinations = 1200 pts = 50%
  - All laboratory material is cumulative
- Laboratory quizzes  900 pts (first 9 required of 11)
  - Weekly beginning second week of classes
  - 1st is morphology & parts of scientific name
  - Remaining 10 lab quizzes are all plant identification
    - Part cuttings, some whole plants, outdoors & indoors
    - Save make-ups for illness / schedule conflicts
- Laboratory final    300 pts
  - 30 cuttings or potted plants, all indoors, last weeks of labs
Recitation Section (HORT 608)

- Graduate students only on Fridays
- 10:20 am – 11:10 am HSFB 105
- Discuss grading differences from HORT 306 discussed on 1st Friday
  - Weekly paper reading summaries
  - Two field trips (Oct. 5, Oct. 26)
  - Discussion sessions
Textbook

On-line availability
http://www.stipes.com/horticulture.html
http://amazon.com

Local availability:
A&M bookstore (MSC)
Traditions (Rothers)
Texas Aggieland
Miscellaneous

- Attendance is mandatory, need medical excuse to miss.
- NO ELECTRONIC DEVICES in lecture or lab unless approved ahead of time by Dr. Arnold.
  - No texting in lab/lecture, **turn off your cell phones**!
- Labs meet at classroom at HFSB 110 (default location) unless otherwise notified.
- Cheating & Plagiarism
  - Campus-wide emphasis, Aggie-Honor Code
    - http://aggiehonor.tamu.edu/
- Those with special needs, please notify me as soon as possible through requests from student services.
**Bonus / Extra Credit**

- **Good news = bonus point opportunities!**
  - Extra exam questions
  - Low attendance bonus opportunities
  - Plant materials games
  - Bonus plants on lab quizzes
  - TAMU Gardens & Greenways participation!!

- **Bad news = no individualized extra credit!**
  - Bonus points represent approximately a 10% built-in curve
    - So exams and course grades are almost never curved
  - Put your efforts into the assigned work
Average Grade Earned Over Past 14 Yr.

The bar chart shows the average grade earned over the past 14 years, from 2004 to 2017. The grades are categorized as A, B, C, D, F, and Q/W. The chart indicates the percentage of students earning each grade for each year.
Study Hints:

• Learn plants as we go
• Review lecture slides for weekly quizzes
• Review lab image review sets / plant picture pages
  – See links on class website, be wary of internet sites
• Review plants from past labs as seasons change
• Make flash cards
• Make lists
• Organize a study group
• Study specimens in timely manner
Getting Off To A Good Start Helps Ensure Success
$y = -2.8571x + 88.257$

$r^2 = 0.6854$
Lecture Plans, First 5 days

- Introduction
- Definitions, taxonomy, nomenclature
- Plant adaptation & hardiness
- Ecological regions of Texas & U.S. regions (out-of-class assignment)
- Genetic variation / provenance
- Key pest and disease concerns
- Implications of cultural practices
- Woody plants as design elements
Lecture Plan, After First 5 Days

- Cover important groups of woody shrub and tree species for use in our regional landscapes by usage groups
- Cover important counterparts used in U.S. and to a lesser extent global landscapes
- Discuss implications of plant selection for sustainable designs in built environments
- Apply critical thinking to design challenges
- More discussion for graduate HORT 608 students on Friday
Laboratory Plans

• Introductory / review lab on morphology & scientific names for lab quizzes
• Introduction to monocots & dicots and short plant list 1 (palms)
• 10 additional plant lists, one each week
  – @ 15 to 20 for ID on each list
  – 11 lab quizzes (10 taxa each)
• Lab final (30 taxa)
Reading Assignments

Pages 1-34

Plus Corresponding Color Plates in

Landscape Plants For Texas And Environs, Third Edition
What Does Sustainable Mean?

Sustainable built environments involve the balancing of social responsibility, environmental and cultural compatibility, economic viability, and effective space utilization to achieve the desired aesthetic impacts and maintenance efficiencies in a dynamic manner that meets current client needs while ensuring continued design integrity and quality of life for future generations.
Are These Designs Sustainable?

Depends upon many factors and sustainable relative to what purpose?

Must know many plant characteristics to integrate them successfully as design elements in sustainable combinations and situations
Trees, Shrubs, and Scientific Names
Woody versus Herbaceous
(somewhat arbitrary)

Woody
• Above ground portions usually do not die to ground each year
• Perennial
• Secondary growth is common, usually from a vascular cambium
• Size variable, but many obtain >20’ heights
• Environment dependent, especially cold

Herbaceous
• Above ground portions often die to ground each year
• Perennial, biennial, or annual
• May or may not have secondary growth
• Seldom exceeds 20’ tall
• Environmental dependent
Trees

• Perennial
• Woody, generally upright growth habit
• Single or multiple trunks
• > 4” to 6” in diameter at breast height (DBH)
• Height variable, few feet to 350’+
• Artificial distinctions, environmental dependent
• For this course:
  – Small Tree = < 20’ to 25’ tall
  – Medium Tree = 25’ to 50’ tall
  – Large Tree = > 50’ tall
Shrubs (≠Bushes)

- Perennial, rarely annual
- Woody, upright or spreading growth habits
- Single or multiple trunks
- < 4” to 6” in DBH
- Height variable, but typically <20’
- Artificial distinctions, environmental dependent

For this course:
- Small Shrub = < 4’ tall
- Medium Shrub = 4’ to 8’ tall
- Large Shrub = > 8’ tall
Scientific Names

Why not just use common names?

– Scientific names convey relatedness
– More than one common name per species
– More than one species per common name
– Common names vary from locale to locale
– Legal consequences in designs
– Professionalism
– Product labeling (Ag. Chemicals, etc.)
– Truth in labeling laws?
**Taxonomy & Nomenclature**

- **Taxonomy** involves the hierarchical ordering of groups of living organisms
  - Various philosophies and systems in use
  - Most aimed at elucidating the underlying genetic relationships and origins of various taxonomic groups
  - Involves professional judgement and interpretation of data
  - Example 3 versus 1 species of *Taxodium*

*Taxodium distichum*
*Taxodium ascendens*
*Taxodium mucronatum*
**Taxonomy & Nomenclature**

- **Nomenclature** is consists of the system of conventions and rules used to assign scientific names to taxa of living organisms
  - Nomenclature changes in an orderly fashion as we alter the taxonomic status of various taxonomic groups
  - Primarily an application of rules with minimal subjective interpretation
  - Example proper name of 3 taxa of *Taxodium* once their taxonomic rank is decided

*Taxodium distichum* var. *distichum* (species type)

*Taxodium distichum* var. *imbricarium*

*Taxodium distichum* var. *mexicanum*
Taxonomy has evolved from morphology based to molecular genetics / systematics

- **Phylogeny or phylogenetic systematics**
  - Look at proportion of genes / DNA in common and ancestral relationships

- **Cladistics** → classify based on evolutionary ancestry
  - Can help with evolutionary studies / ancestor species determination
  - Look at derived traits
    - **Monophyletic** – clade – ancestral species & all descendants
    - **Paraphyletic** – common ancestor & part of descendants
    - **Polyphyletic** – contains taxa which appear to have similar traits but are not derived from a common ancestor
Scientific Names

• Latin Names, Binomial system, or Linneaeen system
  – Started by Carl von Linne, known as Linneaus
    • Species Plantarum, 1753
    • Previously named descriptively, very cumbersome
  – System extended to families by A.L. de Jussieu
    • Genera Plantarum, 1789
  – Rules for naming plant taxa standardized
    • International Code of Nomenclature for Algae, Fungi, and Plants (2011 ... periodic updates)
      – Formerly The International Code of Botanical Nomenclature
    • International Code for Nomenclature of Cultivated Plants (2016, ... periodic updates)
Scientific Names

• Not perfect system
  – Rules can create frustration in gardening public when they dictate the revision of commonly accepted names
  • Changes becoming more common with advent of molecular genetics and DNA sequencing
  – Constant revision of genera, species, and particularly within species classifications
  – Latin is dead language, so debatable pronunciation of names
To Key Or Not To Key?

Botanical Keys =

published systems of dichotomous (yes, no) decisions based on various morphological characteristics (flowers, fruit, roots, stems, buds, leaves, or plant habit) and / or geographic distribution used to determine the identification of unknown taxa
Vegetative Key to Common Palms (*Palmae* / *Arecaceae*) in Central Texas

1a. Fronds pinnately divided, feather-like form
   
   2a. Segments attached with basal fold convex side up (reduplicate) = *Butia capitata* (Jelly Palm)
   2b. Segments attached with basal fold concave side up (induplicate) = *Phoenix canariensis* (Canary Island Date Palm)

1b. Fronds fan-like or costapalmate (fan-like, but with remnant midrib)

   3a. Fronds fan-like and less than 2 ft in diameter/length (minus petiole)
      
      4a. Petiole sharply spiny = *Chamaerops humilis* (Mediterranean Fan Palm)
      4b. Petiole undulate to dully serrate, not spiny = *Trachycarpus fortunei* (Windmill Palm)

   3b. Fronds costapalmate and typically greater than 2 ft in length (minus petiole)

      5a. Petiole entire, smooth edge
         
         6a. Developing a trunk
            
            7a. Dominant trunk thick and stout, maturing at ≤ 50 ft tall = *Sabal mexicana* (Texas Sabal)
            7b. Dominant trunk thinner, maturing at 60 to 80 ft tall = *Sabal palmetto* (Palmetto Palm)
         6b. Trunk lacking, leaves originating from base, maturing at 3’ – 6’ = *Sabal minor* (Dwarf Palmetto)

      5b. Petiole armed with large curved spines

         8a. Trunk with swollen base, maturing at 50 to 100 ft tall, segments slightly to moderately filiferous
             = *Washingtonia robusta* (Mexican Fan Palm)
         8b. Trunk tapering uniformly, maturing at 40 to 50, rarely 80 ft tall, segments moderately to strongly filiferous = *Washingtonia filifera* (California Fan Palm)
**Why Not Just Use Keys?**

- **No key exists for all species**
  - Example, Queen Palm (*Syagrus romanzoffiana*) and Date Palm (*Phoenix dactylifera*) not on the preceding key

- **One wrong decision & you are hopelessly lost**
  - Example, trunk development of young *Sabal* spp.

- **Most useful for differentiating among closely related taxa**
  - Example, problems such as Sago Palm (*Cycas revoluta*) which is not really a palm, but a Cycad (Cycadaceae)

- **Often regionally specific**
  - This key is useless in Florida, lower Rio Grande Valley

- **Critical morphology feature may be missing**
  - Wrong season for fruit/flower or sexually immature plants
Tools to learn plant identification:

• More knowledgeable plants-person
• Basic taxonomic vocabulary
• Good texts and web references
• Lots of time, effort, patience, and persistence
**Taxonomic Classifications:**

<table>
<thead>
<tr>
<th>Taxonomic category</th>
<th>Scientific name of the taxa</th>
<th>Common name of the taxa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom</td>
<td>Plantae</td>
<td>Plant kingdom</td>
</tr>
<tr>
<td>Phylum (Division)</td>
<td>Angiospermophyta (Magnoliophyta)</td>
<td>Fruit bearing plants</td>
</tr>
<tr>
<td>Class</td>
<td>Angiospermae (Magnoliopsida)</td>
<td>Flowering plants</td>
</tr>
<tr>
<td>Subclass</td>
<td>Dicotyledoneae</td>
<td>Dicotyledonous plants</td>
</tr>
<tr>
<td>Superorder</td>
<td>Rosidae</td>
<td>Rose superorder</td>
</tr>
<tr>
<td>Order</td>
<td>Fabeles</td>
<td>Legume order</td>
</tr>
<tr>
<td>Family</td>
<td>Fabaceae (Leguminosae)</td>
<td>Legume family</td>
</tr>
<tr>
<td>Subfamily</td>
<td>Mimosoideae</td>
<td>Mimosa subfamily</td>
</tr>
<tr>
<td>Genus</td>
<td>Acacia</td>
<td>Acacia genus</td>
</tr>
<tr>
<td>Species</td>
<td>Acacia farnesiana</td>
<td>Sweet Acacia</td>
</tr>
</tbody>
</table>

We deal with mostly Family or lower in the hierarchy.
Taxonomy

- **Taxa** = divisions or groupings of plants
  - Singular is *taxon*
- **Species** = “a kind of plant or animal distinct from other kinds in marked or essential features that has good characters of identification, and may be assumed to represent a continuing succession of individuals from generation to generation”
  
  L.H. Bailey
Comments on Species

- Bell-shaped curve for characteristics
- Plants do not read books or google websites!!!
  - Do not always adhere to published descriptions
- Morphologically speaking fruit and flower structures are best ID features, but often not available
- Non-visible characteristics can be key features
  - Physiological / biochemical traits and molecular genetic evidence
- Trying to estimate underlying genetic relationships
- Species name consists of two words;
  Species name = genus and specific epithet
  - Should be italicized or underlined in print
- Species type system → type specimen
Botanist’s vs. Horticulturist Perspective

• Usefulness of taxonomic groups
  – *Aceraceae* versus *Sapindaceae* debate
  – Lumpers versus splitters

• Geography may play a larger role
  – Old world *Cassia* versus new world *Senna*
Superspecific Taxa

- **Genus** = more or less closely related and definable group of plants containing one or more species

  Genera = plural

  Examples of plants in the genus *Quercus*  
  - *Q. acutissima*  
  - *Q. havardii*  
  - *Q. macrocarpa*  
  - *Q. virginiana*

- **Family** = more or less closely related and definable group of plants containing one or more genera

  Families = plural

  Examples of plants in the family *Fagaceae*  
  - *Quercus*  
  - *Fagus*  
  - *Castanea*
**Infraspecific Taxa**

**Subspecies** = a distinctive subdivision of individuals with characteristics different than the species type, but insufficiently different to warrant species status

Nearly always geographically related

- Often represents incomplete speciation
- Abbreviated “subsp.”
  - *Chilopsis linearis* subsp. *arcuata*
  - *Acer tataricum* subsp. *ginnala*
  - Similar to variety, easy prey for over zealous taxonomists
Infraspecific Taxa

*Varietas* or *Variety* = a distinctive subdivision of individuals with characteristics distinct from the species type, but not to the extent that they warrant subspecies or species designation.

Differ from the species in several important characteristics

- Usually in response to some environmental gradient, but it is often not as strongly discontinuous as with a subspecies.
- Note: public confuses variety and cultivar!
Variety (continued)

- Abbreviated as “var.”
  - Placed between specific epithet and variety
  - Italicize or underline variety name, but not “var.”
  - *Cercis canadensis* var. *mexicana*

- Current trend is to use subspecies for former subspecies and variety categories and to use variety for what was once a forma designation

- Not the same thing as a cultivar or cultivated variety, varieties must be naturally occurring
Varieties of *Cercis canadensis*

- *C. canadensis* var. *texensis*
- *C. canadensis* var. *mexicana*
- *C. canadensis* var. *canadensis* (species type)
- *C. canadensis* var. *canadensis* and species type hybrid swarm
Infraspecific Taxa

Forma or Form = a subdivision of plants within a species that differs in one or a few characteristics from the species type

- Often not geographical or environmentally related
- Less frequently used today
  • Many groups previously designated as forma are today being designated as varieties
- Abbreviated as “f.”
- *Ilex verticillata* f. *aurantiaca*
- *Ilex verticillata* f. *verticillata*
Infraspecific Taxa

**Cultivar** or **Cultivated Variety** = subgroup within a species that is a cultivated clone or highly inbred line
- Key is that it is propagated and continued by cultivation & does not typically reproduce itself “true-to-type” unaided by man

Designated by enclosing the cultivar name in single quotes, or by placing the abbreviation cv. after the specific epithet, subspecies, variety or forma name
- Not italicized, capitalize first letter of each word
- Typically a vegetatively propagated clone
  - *Chilopsis linearis* ‘White Storm’
  - *Chilopsis linearis* cv. White Storm
- Sometimes a highly inbreed seed line
  - *Zea mays* var. *rugosa* ‘Golden Bantam’
  - Can have a cultivar from the species or from a naturally occurring subspecies, variety, or forma
Trademark Versus Cultivar Names

- Cultivar names are not protected (i.e. in public domain)
- Plant patents are limited, 17-20 yr. duration
  - Generally cannot be found “wild plants”
- Trademarks can be protected indefinitely
  - ™ versus ® designation
  - Also allows branding, example Texas Superstar ®
  - Protect “found plants”
- Promotion of plants by trademarked names allows companies to control marketing of their cultivars
  - Creates major confusion in the trade
  - Sometimes substitute different genotypes under same trademarked name (common in bedding plants)
**Infraspecific versus interspecific Taxa**

*Hybrid* = progeny of 2 genetically different organisms

- Technically progeny from any two individuals that are not the same clone
- Typically assumed to be between two species (intergeneric or intrageneric interspecific hybrids) or two distinct inbred lines (example intraspecific hybrid corn or F₁ bedding plants)

- *Intrageneric hybrid* = progeny of a cross between different species within the same genus
  - Common occurrence in plant kingdom
  - Designate with lower case “x” or multiplication symbol between genus and specific epithet
  - *Acer x freemani* = *Acer rubrum* x *Acer saccharinum*
**Interspecific Taxa**

*Intergeneric Hybrid* = progeny from different species each within different genera

- Relatively rare occurrences
  - Perhaps questions the validity of genera differences
- Designated with capital “X” or large multiplication symbol placed in front of the genus name

\[ X \text{ Chitalpa tashkentensis} = \text{Catalpa bignonioides X Chilopsis linearis} \]

\[ X \text{ Cupressocyparis leylandii} = \text{Cupressus macrocarpa X Chamaecyparis nootkatensis} \]
Scientific Authorities
(or as students ask what numbskull came up with this idea?)

• The honor of naming a newly described plant taxon is accorded to the person who first publishes a valid description

• Hence the initials and / or letters following various taxa in a formal written context indicate the scientific authority(s) that named the taxon

– Acer rubrum L.
– Brassica oleracea L. var. acephala A.P. de Candolle
– Ziziphus obtusifolia (W. Hooker ex J. Torrey & A. Gray) A. Gray
Clarifying Some Design Terms

• **Use Your Glossary!**
  - Many other terms used or referenced during lecture, labs and in your assigned readings are defined in the expanded glossary at the back of your text.
  - If you still do not understand them or cannot find them:
    • Write them down to ask in class.
Questions / Comments?

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