Tree and Grass Water Use Ratios; Tradeoffs in the Urban Landscape

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Abstract

Water demand in the southwestern United States continues to rise, especially in the Las Vegas Valley, where the population now exceeds 2 million people. It is estimated that 60 percent of all the water used in the valley is used in the residential sector, with 70% of that water used outdoors to irrigate urban landscapes. These landscapes are dominated by trees and turf grass and although much is known about the water use of turf grass species, little is known about the water use of landscape trees and therefore little is known about the tradeoffs between grasses and trees in urban landscapes. We are conducting a tree to grass water use ratio study focusing on ten common landscape tree species grown in the valley (mesquite, ash (Modesto and Arizona), desert willow, oak, Palo Verde, vitex, locust, elm and crepe myrtle) and four turf grass species (bermudagrass, bent grass, tall fescue and ryegrass). We are estimating water use by closing hydrologic balances on the trees (basins) and turf grass (lysimeters). We are also estimating transpiration of trees using Granier probes and estimating conductive tissue with a novel dye injection system. We will compare water use of all ten tree species with the four turf grass species and develop models that incorporate reference ET and morphological characteristics such as tree height, canopy volume, basal canopy area, LAI and leaf area. Observations are ongoing.

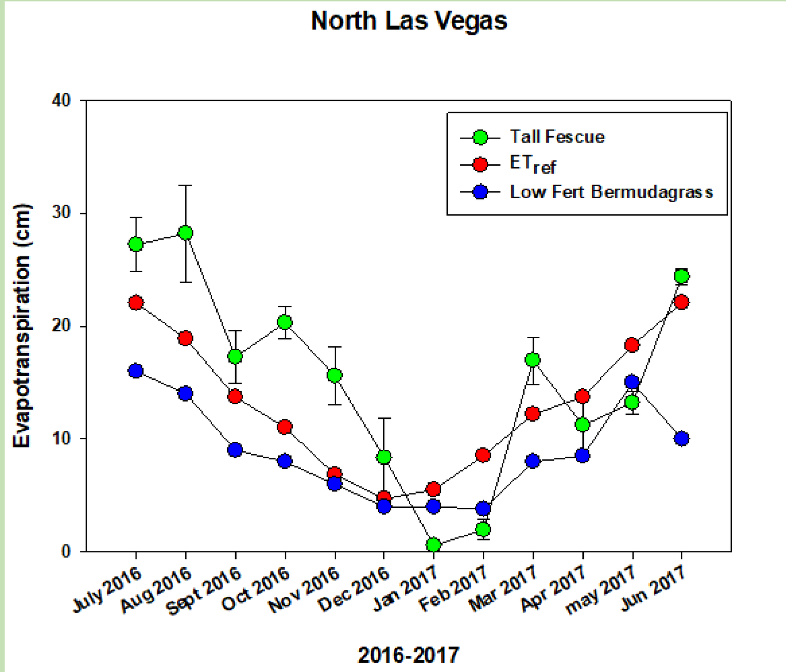


Figure 1. With one standard error

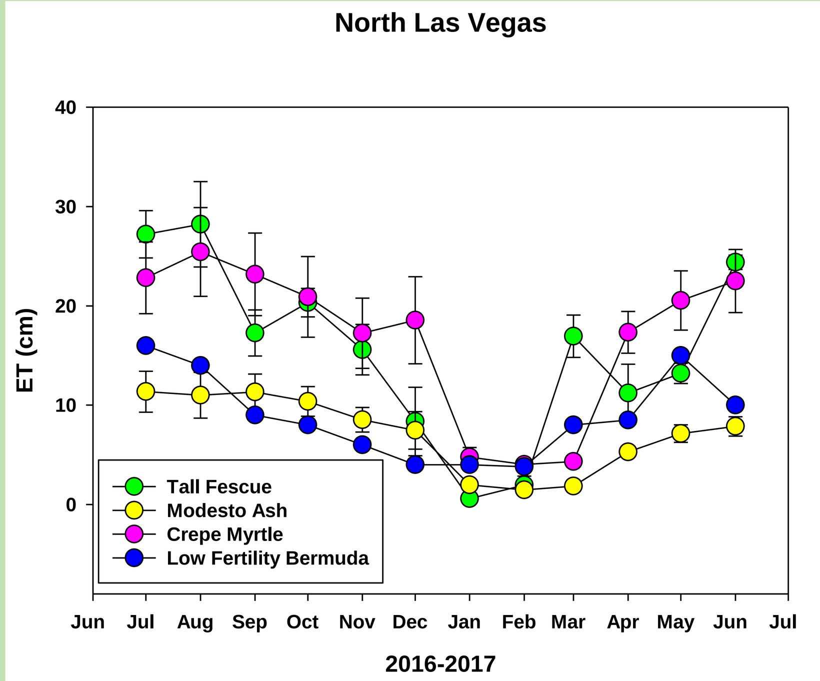
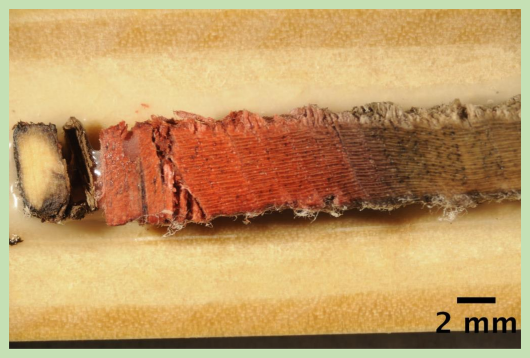


Figure 2 With one standard error

Tree Species	Height m±SD	Trunk Diameter cm±SD	Basal Area Cm^2±SD	Canopy Volume cm^2±SD
Modesto Ash	4.18± 0.21	41.12± 2.51	16.61± 2.69	27.43± 3.11
Crepe Myrtle	3.73± 0.45	27.94± 2.54	5.69± 0.64	3.14± 2.44
Elm	5.57± 0.12	49.53± 2.54	22.85± 4.77	60.42± 15.25
Locust	4.62± 0.83	48.63± 4.08	17.72± 6.69	33.70± 18.55
Mesquite	5.30± 0.110	67.20± 2.43	22.16± 2.27	52.71± 28.43
Oak	7.10± 0.27	69.85± 6.35	20.49± 6.57	74.53± 29.32
Palo Verde	5.77± 0.38	56.09± 5.09	29.62± 4.70	93.10± 18.49
Vitex	3.37± 0.38	38.10± 5.08	19.67± 4.95	27.30± 13.84
Willow	5.97± 0.32	33.02± 15.86	24.75± 6.52	54.86± 15.51
Arizona Ash	6.95± 0.35	55.25± 11.67	19.05± 0.97	59.11± 4.83

Materials and Methods

- One hundred trees were planted 20 years ago, consisting of ten of each ten species. Only a subset of 30 trees were chosen for the experiment, three of each of the ten species.
- Bermuda grass “Tifway”, Tall Fescue “Monarch”, Ryegrass “Palmer Prelude”, and Bent grass “TI Creeping” were planted in lysimeters. All grasses received nitrogen at 0.5 pounds of N per 1000 square feet per month, with the exception of no N on bermudagrass lysimeters during the months of November through March.
- An Access tube (Dynamax Inc.) was installed in each grass lysimeter and each of the 30 trees basins used in the experiment. The access tubes allowed the Theta Probe PR2/6 (Dynamax Inc.) to estimate soil moisture at six depths.
- To determine Evapotranspiration (ET) we used a hydrological balance approach, using the equation; Evapotranspiration = Input-Output-Change in Storage.
- Trees received water using a metered hose and grass was hand irrigated using a graduated cylinder.
- Reference ET (Penman Monteith) was estimated using meterological data collected from a nearby weather station.
- Thermal Dissipation Probes (ten millimeters long TDP10, Dynamax Inc.), were inserted in the trees in May 2016, to monitor sap flow in the conductive tissue of the main trunk of each tree (one probe per tree). The probes were connected to a data logger (CR1000 ,Campbell Scientific)
- Dye was injected into the trees to assess the amount of conductive tissue. Cores were taken and Photoshop (Adobe) was used to assess the stained area.



Stained Vitex core

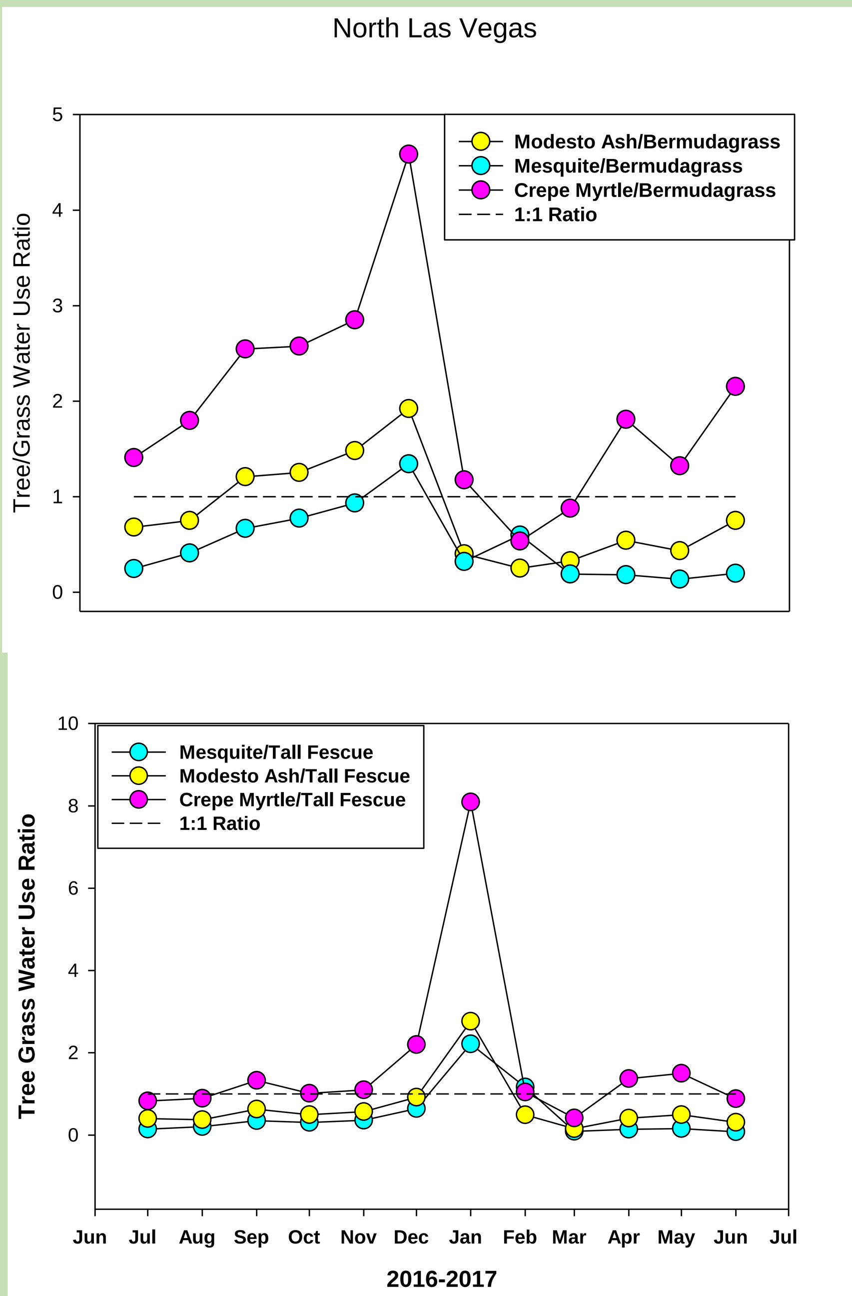


Figure 3

Results

- Reference ET 12 month total = 156.6cm
  Tall Fescue ET 12 month total=185.3 cm
  Low fertility Bermuda grass ET 12 month total=106cm (literature, Devitt et al.1992)
  Refer to Figure 1.
- ET on a basal canopy area basis typically peaked during summer months and declined in fall and winter months with distinct separation on species basis. Refer to Figure 2.
- When comparing tree and Bermuda grass ratios generated for Mesquite, Modesto Ash, and Crepe Myrtle ratios above one occurred for all species but the highest values were primarily confined to the fall and winter period Figure 3.
- When similar ratios were generated for tall fescue fewer months had ratios above 1.0 with the highest ratio during January and February.
- With the exception of the Crepe Myrtle, tree grass water use ratios on a yearly basis always reflected lower water use for trees compared to grasses. This response Indicated that smaller areas of turf grass would need to be removed to be equivalent to tree water use on a basal canopy area basis.
- Research is ongoing including the analysis of the Thermal Dissipation Probe data and core dye analysis. Because of high mortality with bent grass and ryegrass during summer months, tree grass ratios will be confined to fall, winter, and spring periods.

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