Crop Water Requirements of Container-Grown Plants

Richard P. Regan
North Willamette Research and Extension Center, Oregon State University, 15210 N E Miley Road, Aurora, Oregon 97002

Irrigation is a necessary practice for producing container-grown woody landscape plants. Overhead sprinkler irrigation is the most common and practical system used. With overhead irrigation large quantities of water are required to compensate for low water-application efficiency (Beeson and Knox, 1991). Water-application efficiency is the amount of water stored in the root zone compared to the total amount of water used for irrigation (Israelsen, 1962)

When to irrigate and how much water to apply is best determined by the crop water requirements, the capacity of the root-zone medium to store water, the water application uniformity, the leaching requirements, and the availability of irrigation water. The most common methods used to determine when to irrigate container plants are the visual crop appearance and the relative weight loss judged by lifting the container. Plants with similar crop water requirements should be grouped together, and irrigation scheduled accordingly.

Crop water requirements (ET_{crop}) are the amount (depth) of water needed to replace water lost from evapotranspiration of a healthy crop achieving full production potential under a given growing environment (Doorenbos and Pruitt, 1977). Evapotranspiration (ET) is the sum of water loss in vapor form to the atmosphere by transpiration from leaves, plus evaporation from soil (medium) and leaf surfaces. Evaporation of water from the medium surface is greatest for newly planted crops due to increased exposure to sunlight. As the crop develops, the foliage canopy shades the medium surface reducing water evaporation. Transpiration water loss increases as the plants grow larger and root systems fill the container.

Crop water requirements are affected by: 1) climate, 2) crop characteristics, and 3) production practices This report will briefly discuss these factors and how they relate to container-grown plants.

CLIMATE

Climate has a major influence on crop water requirements. Daily temperature, wind, relative humidity, amount of sunshine, and day length are contributing factors Crop water requirements are greatest on sunny, dry, windy days compared to days that are cloudy, humid, and calm To show this relationship between climate and crop water requirements the evapotranspiration of a standard reference crop (ET_0) is used The reference crop is defined as a clipped expanse of green grass and the amount of evapotranspiration expressed in mm (millimeters) or inches of water per day.

Local meteorological data are used to calculate reference crop evapotranspiration Several procedures are available and all are beyond the scope of this report to describe. In Florida, the Thornthwaite procedure is often used to study crop water requirements. Potential evapotranspiration calculated by the Thornthwaite procedure closely predicted the actual transpiration water requirements of container-grown ornamentals (Fitzpatrick, 1983; Roberts and Schnipke, 1987). However, the Thornthwaite procedure works best in humid regions and is not reliable in more arid regions (Cuenca, 1990). The FAO Blaney-Criddle method is very satisfactory for calculating reference crop evapotranspiration in the western United States (Allen and Brockway, 1983). At the North Willamette Research and Extension Center, Aurora, Oregon, crop water requirements for container-grown plants are estimated using the FAO Blaney-Criddle method modified for a 24-hour period

CROP CHARACTERISTICS

There is great variation in the crop water requirements of plants produced outdoors in containers (Burger et al , 1987). Woody landscape plants can be grouped into three major categories 1) high (*Potentilla fruticosa* 'Mount Everest'), 2) moderate (*Juniperus sabina* 'Tamariscifolia'), 3) low (*Tsuga canadensis*). These differences are primarily caused by crop characteristics.

Crop characteristics that affect crop water requirements are plant species or cultivars, stage of development, and planting date. Crop coefficients (k_c) are used as an index to show the difference between crops and the changes that occur during the production rotation ($ET_{crop} = k_c \times ET_o$) Crop coefficients have not been determined for most woody landscape plants.

The rate of crop growth and development is an important crop characteristic Transpiration water requirements of container-grown *Acer* species were found to be significantly less for slower growing trees (*A. saccharum*, *A. platanoides*) when compared to faster growing trees (*A. rubrum*, *A saccharinum*, *A. negundo* (Roberts and Schnipke, 1987) Growth rate is not always a good indicator of crop water requirements. Fitzpatrick (1983) found that certain slow, moderate, or fast growing plants had similar transpiration water requirements.

PRODUCTION PRACTICES

Several production practices will change the crop coefficient of container-grown plants These practices include. 1) container spacing, 2) pruning, 3) container and bed surface color, 4) size of beds, 5) and irrigation frequency. Although these factors are studied extensively for food and fiber crops, few have been investigated for container-grown woody plants.

Wide container spacing is a major factor that affects crop coefficients. Burger (1987) found that crop coefficients for plants spaced at container-width were as much as 50 percent greater compared to crop coefficients for the same plants at container-tight spacing At wide spacings more sunlight can penetrate the foliage canopy increasing the energy load of the plant and medium resulting in higher evapotranspiration. Preventing excessively high container medium temperatures during the summer should help reduce crop water requirements. Medium temperatures are reduced by irrigating a few hours (2 to 4) before maximum air temperature occurs or by using reflective container colors (white) and/or dark bed surfaces (Keever and Cobb, 1985; Keever and Cobb, 1984). Narrow beds have more outside row containers exposed to sunlight and higher temperatures

Overhead irrigation water is held by dense canopy foliage reducing the amount of water that is captured in the root zone (Beeson, 1991). Water on the foliage will evaporate and transpiration is reduced accordingly (Israelsen, 1962). Therefore, with frequent overhead irrigation, water held by plant foliage is a part of the crop water requirements.

Plants with damaged or weak root systems have lower crop water requirements than plants with healthy root systems According to Welsh (1991), over-watering container-grown *Photinia* x *fraseri* decreased medium aeration resulting in poor root development, reducing transpiration water requirements. Winter injury to roots of container-grown plants can also result in reduced crop water requirements the following spring.

Pruning reduces the plant's leaf area and allows more sunlight to penetrate the foliage canopy. Summer pruning is likely to cause a change in a crop's water requirements and requires further investigation. After extensive topiary pruning *Juniperus* species will decline in vigor and/or die if irrigation is not reduced. Dormant shoot pruning of hybrid crape myrtle (*Lagerstroemia* 'Tuscarora')[1] before planting in containers did not affect transpiration water requirements or change the leaf area (Zajicek et al , 1991)

Nursery crop producers have an obligation to use irrigation water efficiently Competition for available water and emphasis on beneficial use will continue to escalate in North America Irrigation management based on a crop's water requirements will conserve water, reduce leaching, and improve product quality.

([1]Bot Ed Note—The cv Tuscarora is a selection from hybridization utilizing *Lagerstroemia fauriei* and *L. indica*)

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