Variation in Water Use of Container-Grown Plants

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INTRODUCTION

The nursery industry is taking steps to reduce its use of irrigation water. Public concerns about water use and pollution prevention and increasing irrigation costs are motivating this change. Kabashima (1993) believes nurseries will reduce water use by recycling water, increasing the water application uniformity, and by improving irrigation scheduling. Water is conserved when irrigation is scheduled to apply only the amount of water used by the plant. Growers have found that certain plants need more water than others, while other plants are easily over-watered. Burger et al. (1987) showed that water use varied greatly between different plant varieties when they reached market size.

The amount of water used by container-grown plants is influenced by the climate, production practices, and crop characteristics (Regan, 1991). Plants use the most water on sunny days that are hot, dry, and windy. Growers can use local daily meteorological data or reports to schedule irrigation. When container-grown plants are moved to a more open spacing their water use increases. Pruning a crop usually results in less water being used until shoot growth begins. Crop coefficients are used to adjust irrigation to specific production practices and crop characteristics (Doorenbos and Pruitt, 1977). Comparison of crop coefficients shows the relative difference in water use between plants or crops.

In 1989, a 5-year project at Oregon State University began to estimate water use of #1-size, container-grown, woody landscape plants. This report of a 1992-1993 study will discuss some of the variation in water use.

MATERIALS AND METHODS

Rooted liners or seedlings of 23 different woody landscape plants were potted on 5 May 1992, in #1 (3.0 liter) plastic nursery containers. The medium consisted of 0.5 inch minus Douglas fir bark (90%) plus sphagnum peat moss (10%) amended with 20 lb per yd^3 North Willamette Container Mix (25% Nitroform, 12.5% gypsum, 12.5% dolomite #10, 5% ammonium nitrate, 5% potassium sulfate, 5% ferrous sulfate, 0.5% F.T.E. 503). Plant containers were placed on gravel and overhead irrigated at the North Willamette Research and Extension Center, Aurora, Oregon. Containers were arranged by variety in plots, seven containers wide by eight containers long. The plants were over-wintered in a polyhouse covered with 4 mm white copoly. The following spring, the plants were fertilized, pruned, and spaced as needed to reach marketable quality.

Crop coefficients (k_c) were calculated as described by Burger, et al. (1987) every 2 to 4 weeks during the irrigation season (May-October 1992, March-June 1993). Ten plants were randomly selected from each plot and weighed 2 h after irrigation (8:00 A.M.) and again in 24 h. The reference crop evapotranspiration was determined using the FAO Blaney-Criddle method (Doorenbos and Pruitt, 1977) on a daily basis (Allen and Brockway, 1983).

RESULTS AND DISCUSSION

This study found that k_c values vary greatly. The range of k_c values was from less than 1.0 to greater than 5.0. The range is greater than other agricultural crops. Doorenbos and Pruitt (1977) reported a range of k_c values for field-grown citrus between 0.45 and 1.0. The high k_c values are artifacts of the calculation method. If the calculation were based on the surface area of the plant spacing (as with field-grown plants), instead of only the container top surface area, container-grown nursery crops would have k_c values similar to other crops. Actual water consumption during the production of dry matter (grams transpired per gram of dry matter produced) is less for trees than field crops (Table 28, Larcher, 1975). Variation in water use existed within the major plant groups (conifer, deciduous, broadleaf evergreen) as well as between the groups. For example, *Hydrangea macrophylla* 'Nikko Blue' used over twice the amount of water compared to *Acer palmatum* f. *atropurpureum*.

The k_c is different for each growth and development stage of a given crop. For this discussion, three crop stages will be used to describe the production of container-grown plants. The first stage begins when the liners are potted until the plants become established. Generally, spring plantings take 6 to 10 weeks under favorable conditions to become established. The second stage is characterized by active shoot growth and development until the onset of dormancy. The third stage begins in spring when the crop resumes active growth and matures to marketable size and quality.

The lowest K_c values occurred during crop establishment, the first stage. The plants were small and shoot growth slowed down or stopped while the roots explored the medium. Containers were arranged can-tight during this stage which contributes to lower k_c values. In addition, k_c values did not change very much during this crop stage. An exception to this was *Cotoneaster apiculatus* that established itself quickly and resumed shoot growth soon after potting.

Water use during crop development, the second stage, was influenced by the type of shoot growth and dormancy. *Chamaecyparis pisifera* 'Boulevard' (syn. *Cupressus pisifera* 'Boulevard') grew continuously (free-growth) and reached a k_c value of 4.0, compared to *Pinus nigra* ($k_c = 2.9$) which had only one growth flush (fixed-growth). Another growth factor that appears to affect water use is growth rate. Slow-growing *Juniperus squamata* 'Blue Star' consistently had low k_c values, even though it grew continuously. Slow-growing plants remained at can-tight spacing longer during this stage than did plants with rapid growth. Water use declined rapidly during October for all plant varieties with the onset of dormancy and winter acclimation.

The highest level of plant water use was observed during crop maturity, the third stage. A sharp increase in k_c occurred during shoot growth following spring bud break. *Hydrangea macrophylla* 'Nikko Blue' showed the greatest increase in k_c. Water use of certain plant varieties, including *Arctostaphylos uva-ursi* 'Massachusetts' and *Viburnum tinus* 'Spring Bouquet', remained relatively low ($k_c < 2.8$). Plants were not pruned during this stage and were grown at an open spacing (16 in. o.c.).

This experiment demonstrates that crop water requirements of container-grown plants can be estimated to help nursery managers improve irrigation practices. To conserve water, plants with similar k_c values should be grouped under the same irrigation zone. This allows irrigation water to be scheduled for both daily evapotranspiration and crop stage.

LITERATURE CITED

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