# Don't Let the Well Run Dry: Water Conservation Practices for Container Nurseries

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## INTRODUCTION

Plant nurseries are looking for ways to help conserve water and solve environmental concerns regarding water quality and runoff. In addition, water costs are increasing and water use regulations are more restrictive. Managers must determine which irrigation systems and production methods best fit their nursery. First, consider the basic practices that have been shown to conserve water and reduce runoff (Kabashima, 1993). These practices are based on improved irrigation systems, irrigation scheduling, and using tail-water return systems. Secondary consideration should be given to plant water use, water application, and the plant environment. Usually, these methods are effective in conserving water only after implementing the previous practices.

## IRRIGATION SYSTEMS

Selecting the best irrigation system to help conserve water is a difficult but essential task. Overhead irrigation is commonly used to produce container-grown plants and its popularity is based on practicality and economics. Sprinkler systems with low application rates tend to create less runoff. A major objective of sprinkler system design is to apply water uniformly. While drip systems have the potential to substantially reduce the amount of water applied and runoff, if improperly designed and/or managed, poor efficiency and poor plant growth will result. When several diverse species are located within the same irrigation zone, extra water must be applied to satisfy the needs of the high-water-use plant.

Sprinkler systems apply water in the form of a spray and can be used to modify the environment (cooling or frost protection). Impact sprinklers apply water to large areas at a wide range of rates. With fixed-head sprinklers, the diameter of coverage is smaller, thus their application rate is higher. Application rates of spinners are kept low by using a small nozzle size, a factor which can cause the nozzle to become plugged. The traveling boom system used in greenhouses are controlled electronically and the application rate ranges from very low (mist) to moderate.

Water distribution pattern efficiency is a measure of how uniformly water is applied to all the containers within an irrigated area. It can be estimated either on site using a can test or by computer software. Low distribution pattern efficiency means that a greater number of containers will be drier than the rest. To compensate for the dry ones, more water must be applied which causes other containers to be over-watered resulting in poor root systems, excessive nutrient leaching, and increased runoff. Distribution pattern efficiency is influenced by: (1) sprinkler spacing and type, (2) system hydraulics (pressure, friction loss), (3) wind speed and duration, and (4) plant canopy density and configuration.

Drip or trickle irrigation refers to the frequent application of water at very low rates. Larger container sizes are best suited for this type of irrigation system. It is so different from sprinkler irrigation that changes in weed management, fertilization, as well as irrigation are required. When compared to overhead sprinkler irrigation, drip irrigation can lower operating costs, reduce the potential for foliar disease, and allow fertilizer to be injected and applied as needed. Numerous types of microsprinklers are available which distribute water more uniformly over the surface of the container media. Recent developments include: improved pressure compensation, reliable flow control valves, and less tendency to clog.

Some of the overall operational problems with drip systems include: lead tubes becoming displaced, lateral lines interfering with cultural operations, and emitters plugging. The maintenance of drip systems is essential for success. Emitters should be checked and measured for correct flow and water pressure must be monitored. Water used for drip irrigation should at least be as clean as drinking water, preferably even cleaner. Several stages of filtration are often required depending on the types of contaminants in the irrigation water. If a filter does not back-flush effectively, its filtering ability is reduced.

## IRRIGATION SCHEDULING

Irrigation scheduling can result in a 25% savings in water. The ideal way to schedule irrigations is to determine how much water the plants are using and then replenish it. This works best when only one plant cultivar is grown under a single irrigation zone. Frequent irrigations (pulse or daily) that minimizes medium water depletion is considered best for plant growth and irrigation efficiency (Beeson, 1994; Karam et al., 1993). Nursery managers are likely to use container weight measurement to determine percent water depletion. They lift the container and judge the amount of water left in the container by its weight. Moisture measuring technology has not advanced far enough to reliably assist container nurseries. Containers that are allowed to dry down below 40% medium water depletion are very difficult to wet resulting in plant stress. In dry containers, irrigation water tends to move along the sides of container with less chance of it being stored in the medium.

How much water to apply should be adjusted daily. A standard run time that delivers a specified amount of water is budgeted for the weather conditions (temperature, wind, relative humidity, and sunshine) the previous day. This standard irrigation is based on crop water use for the average evapotranspiration at that time of year. This can be done by a controller operated by a trained irrigation manager or by a computer. For example, if the standard amount of water to be applied is 0.4 inches, and yesterday was much cooler than normal, the irrigation budget for today might be 75% of the standard (0.3 inches). It is very important to evaluate how completely the available water is replenished following an irrigation.

## TAIL-WATER RETURN

An important water conservation practice for container nurseries is tail-water collection. Water is reused by collecting runoff in a reservoir and pumping it back into the water supply. Tail-water return systems are expensive to install especially with existing nurseries. Usually, the return system does not disrupt regular production practices if it has been carefully engineered. Expect a water savings between 30% and 60%. Fertilizers, pesticides, and plant pathogens are dynamic factors which influence water quality and should be monitored frequently. Very little is known about effective treatment (filtration, aeration, chlorination, etc.) of nursery tail-water.

## PLANT WATER USE

Grouping plants with similar water use under the same irrigation zone is a very difficult task for a production nursery. It might be more practical to avoid placing a new planting next to mature crops and only separate out plants with very high or very low water use rates. Water use of plants is strongly influenced by the climate and by production practices and crop characteristics (Regan, 1991). Daily weather conditions affect the amount of water a plant will use. Most temperate zone plants use more water on hot, dry, and windy days. Using crop water requirements to schedule irrigation for container-grown plants is not practical (Schuch and Burger, 1997).

Variation in plant water use exists within the major plant groups (conifer, deciduous, broadleaf evergreen) as well as between the groups (Burger et al., 1987). Generally, as plants get larger they require more water (Knox, 1989). During crop establishment water use is low and rather constant, but frequent irrigation may be necessary due to limited root expansion and soil water evaporation. As the crop develops it is influenced by the type of shoot growth and dormancy. Plants that grow continuously (free growth) tend to use more water than plants which have only one growth flush (fixed growth). Plant growth rate is another factor that affects water use with fast-growing species using more water (Roberts and Schnipke, 1987). Plant water use declines rapidly with the onset of dormancy and winter.

## WATER APPLICATION

Most of the irrigation water applied through sprinklers is not stored in the container medium. Water application efficiency is the amount of water stored in the container medium after an irrigation compared to the total amount of water applied. Application efficiency is very low due to water falling outside of the containers and decreases further when the amount (depth) of water applied exceeds the medium storage capacity (leaching). Application efficiency in ornamental nurseries ranges between 15 to 25% (Beeson, 1991) and about 40% for traveling boom irrigated forest seedlings (Dumrose et al., 1991). The application efficiency is best when the plants are small and spaced can-tight and decreases dramatically when the spacing between containers increases. Water shedding and water holding by dense plant canopies can further reduce application efficiency. While it is not always practical, application efficiency can be improved by using larger containers and keeping them can-tight for as long as possible.

## PLANT ENVIRONMENT

Modifying the growing environment is seldom used to help conserve irrigation water due in part to the expenses involved. The main objective is to lower the air temperatures of the growing area by using an overhead shade structure. Some nursery managers believe that crop water use can be reduced by as much as 40%. This could result in significant savings if irrigation was scheduled accordingly. One disadvantage to growing plants under shade, especially in the northern regions, is that reduced sunlight could limit plant growth and quality. Nursery managers interested in trying this conservation practice should consider using retractable or removable shade. A dense plant canopy cover will also help reduce the container medium temperatures, but this type of canopy could also decrease water application efficiency. In very windy areas, wind breaks could help reduce plant water use up to 10%.

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