Calculating Irrigation Resources and Application Efficiency

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Surface water held in retention structures is the primary source of irrigation at many container nurseries. Wells are often used to recharge (dilute / freshen) and re-supply water in irrigation retention basins. Although nurseries have captured and recycled irrigation run-off to have adequate irrigation supplies, as environmental concern about run-off has increased; capture and recycling has increased. Growers reduce potential problems caused by nutrients, pesticide residues and disease organisms in recycled water by allowing return water to filter through grass strips, and other vegetated areas such as secondary impoundments or constructed wetlands before allowing the water to re-enter primary irrigation supplies. Aerators also help oxygenate surface waters and enhance microflora breakdown of impurities. Many nurseries use water treatment procedures such as chlorination and extensive filtration before reapplying water.

Most nursery crops grown in 1 to 5 gallon containers are irrigated by overhead impact sprinkler irrigation. Sprinkler nozzles may require up to 12 gallons per minute each for proper performance. Professionals who design irrigation systems for container nurseries suggest that no less than one acre inch (27,154 gallons) of irrigation storage per acre of nursery stock per day be used in planning water supplies. Another recommendation used for planning water supply is 5 to 10 acre feet of irrigation water per acre of nursery stock per year. If container stock were irrigated 163 days in a year at the rate of 1 acre inch approximately 4.5 million gallons per acre would be required. This is equivalent to 13 acre feet of water per acre of nursery stock.

Rough calculations of the water supply available from an irrigation structure can be made by estimating the average width, length, and depth (in feet), and multiplying these 3 values to determine the approximate volume in cubic feet. Then multiply the total cubic feet by 7.5 (7.5 gallons / cu. ft.) to determine the approximate storage capacity of the structure. If the nurseryman applies 1/2 inch of water per acre of nursery stock daily; divide the storage capacity by 13,500 gallons to determine the number days of irrigation available from the storage structure. This calculation disregards evaporation and any loss of water other than irrigation but is useful for planning irrigation supply.

Irrigation efficiency can be determined by removing plants from containers and the degree of uniform wetness in the container observed. If the irrigation was adequate, there will be no dry spots in the container root zone and water will have obviously moved through the entire depth of the container profile. If irrigation continues after water has begun draining from containers, fertilizers are being washed from containers and runoff will have elevated levels of nutrients.

If water is applied uniformly, less irrigation will be required. Increasing irrigation efficiency is the best water conservation practice that growers facing a water shortage or who want to reduce water run-off can adopt. Correcting water distribution problems is an important step in water conservation. The uniformity of distribution is very important, since most growers irrigate until the driest plants are watered adequately.

In reality, most growers apply water to an area of containers for a specific time, such as 1 hour. The actual volume of water applied to an area is highly variable depending on design and compatibility of nozzles used, percent of overlap between nozzles, volume and pressure drop over the length of irrigation lines and nozzles, nozzle orifice wear, plus evaporative and environmental conditions such as wind. Various authors suggest that 1 gallon containers (7.5 inch top diameter) must receive 1 pint of water (0.125 gallons) with each irrigation. If 27,000 gallons of water (~ 1 acre inch) is applied over an acre of 1 gallon container nursery stock, 0.19 gallons will enter the pot (plant canopy interference not considered). Actual volumes of irrigation applied can be determined if the nurseryman installs a water meter in the main irrigation line after the pump. Measuring the water applied is the best method of determining uniformity of irrigation over a growing area. Placing rain gauges, cans or cups throughout a block before an irrigation cycle, then measuring after the cycle is over can provide useful observations on uniformity of irrigation distribution. An even better method of evaluating irrigation practices is to measure Leaching Fractions (LF). To determine irrigation leaching fractions, put plant containers into tight fitting buckets or place bags in empty containers and the set container plants in the lined containers. Place an empty lined container next to the plant containers throughout a nursery irrigation zone. Irrigation caught in the empty container represents water application rate based on the area of the container. Likewise, water captured in the bucket or bag under the plant container during an irrigation event represents the volume of leaching fraction applied . Divide the volume of water collected under the plant by the volume collected in the empty container. Ideally the leaching fraction calculated should be 0.1 to 0.2 (10% to 20%) or less. Using several containers, this procedure can be used to determine how uniform water application is over a growing bed or how much different the amount of water captured by various nursery crops varies in the same growing bed. Differences can be as much as 250%. If differences between crops is that great, one of the crops needs to be moved to another irrigation zone where water application will be more compatible to the needs of the crop.