Irrigation efficiency is the key to controlling runoff

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The most important step a grower can take to manage water quality is to maximize irrigation efficiency. Nurseries that irrigate efficiently will have less runoff, and therefore less of a problem to manage.

Irrigation efficiency refers to the amount of water consumed by the crop relative to the total amount applied. An irrigator who wants to maximize irrigation efficiency must apply the proper amount of water uniformly over the target plants at the right time. This requires answers to the following three questions.

How much water do the plants need? The main job of an irrigator is to satisfy the thirst of the crop, but few really know how much water is needed to do this. The quantity depends on plant size, environmental conditions, and spacing, so exact requirements will vary. Some typical values are given in Table 1. Note that few plants in 6-inch or gallon containers need more than a cup (8 oz.) of water per day, and most need even less.

Growers can easily refine this information for their own crops and conditions by measuring the change in weight of a pot containing the crop plant between irrigations. The difference in weight, in ounces or grams, represents the amount of water used, in ounces or milliliters, respectively. It is best to weigh several pots distributed throughout the growing area, if possible.

Table 1. Typical daily water use of ornamental crops in California. Actual values will depend on plant size and environmental conditions.

Crop	Water use	
	ml per day	oz. per day
Acorus 'Ogon' (1 gallon, outdoor shade)	140	5
Aucuba japonica (1 gallon, outdoor shade)	100	3.5
Camellia 'Winter's Star' (1 gallon, outdoor shade)	100	3.5
Chrysanthemum (6-inch)	240	8
Dietes vegeta (1 gallon, outdoor)	130	4.5
Holly (1 gallon, outdoor shade)	140	5
Hydrangea (1 gallon, outdoor shade)	340	11.5
Hydrangea (6-inch, greenhouse)	175	6
Impatiens (4-inch, greenhouse)	100	3.5
Juniperus scopulorum 'Moonglow' (1 gallon, outdoor)	140	5
Lantana 'Pink Caprice' (1 gallon, outdoor)	200	7
Lavandula dentata (1 gallon, outdoor)	160	5.5
Magnolia grandiflora (5 gallon, outdoor)	340	11.5
Nandina domestica (1 gallon, outdoor shade)	120	4
Pelargonium (6-inch, greenhouse)	175	6
Penstemon 'Red Rocks' (6-inch, greenhouse)	150	5
Pistacia chinensis (5 gallon, outdoor)	580	20
Platanus racemosa (5 gallon, outdoor)	940	32
Prunus ilicifolia (5 gallon, outdoor)	250	8.5
Quercus agrifolia (5 gallon, outdoor)	260	9
Quercus lobata (5 gallon, outdoor)	335	11
Rhododendron (1 gallon, outdoor shade)	200	7
Rose (mature greenhouse plant for cut flowers)	400	14
Sequoia sempervirens (5 gallon, outdoor)	390	13
Weigela 'Variegata Nana' (1 gallon, outdoor shade)	160	5.5

How much water is needed for leaching? Crops usually grow poorly if soil water is very salty. Problems can develop from high total salts, as indicated by elevated electrical conductivity values, or from specific ions, such as sodium, chloride, or boron. Salts can be removed from irrigation water by reverse osmosis or deionization, but treatment is expensive. A cheaper alternative is to leach salts, but this can increase runoff. Many short-term crops (3 months or less) can tolerate salt accumulation without obvious effects, but most crops require leaching. This is best achieved on ornamental crops by applying

the proper leaching fraction. This is the ratio of the volume of water leached (for example, the water that runs out of the bottom of a pot) to the volume of water applied (for example, the total amount of water applied to a pot). The proper leaching fraction depends on the salinity of the irrigation water (including fertilizer, in a liquid feed program) and the salinity sensitivity of the crop. In general, ornamental crop producers in California should apply leaching fractions between 0.2 and 0.3. In other words, 20 to 30% of the irrigation water is applied just to leach out salts. For the 6-inch mum in Table 1 that requires 8 oz. of water each day, another 2 to 3 oz. would be needed daily to satisfy the leaching requirement.

How uniform is water distribution? In an imperfect irrigation system some sprinklers or emitters put out more water than others, so some plants receive more water than others at each irrigation. Measuring irrigation uniformity—distribution uniformity (DU) for overhead systems, emission uniformity (EU) for drip systems—gives irrigators two important pieces of information. First, it provides a measure of how good the system is. Second, the measured uniformity helps irrigators to decide how long to run the irrigation system.

Simple instructions for measuring DU and EU are widely available. The general concept is to measure the amount of water applied throughout the irrigation system, then divide the output of the places receiving the least water (usually the average of the lowest quarter of all values) by the overall average output. The resulting value tells how much the lowest quarter of plants receive compared to the average ones. In a perfect system, DU = 1.0. If DU = 0.6, then the lowest quarter of the plants get only 60% as much water as the average plants and, to irrigate properly those plants in the lowest quarter, the system must be run longer than is needed to irrigate the average plant. How much longer? Divide the application time needed for the average plant by the DU to get the answer. Figure 1 illustrates how irrigation uniformity affects the application time. A DU of 0.5—not unusual in nurseries—means that the system must run twice as long as a perfect system. There are simple ways to improve irrigation uniformity. For example, using better nozzles (and making sure all are the same type), repairing leaks, and eliminating sources of large pressure drops can eliminate many problems in irrigation systems. Is it worth the effort? Look at Table 2, which compares the irrigation requirements of four hypothetical nurseries that differ in either water quality, distribution uniformity, or both. Even in most good systems, only about 75 to 80% of applied water is used by the crop. Poor water quality knocks that efficiency down a bit more because of the greater leaching requirement, but a low DU sends irrigation efficiency down to 40% or less. That means money down the drain—literally—and a management headache. Take the time to improve irrigation efficiency and your problems will evaporate.

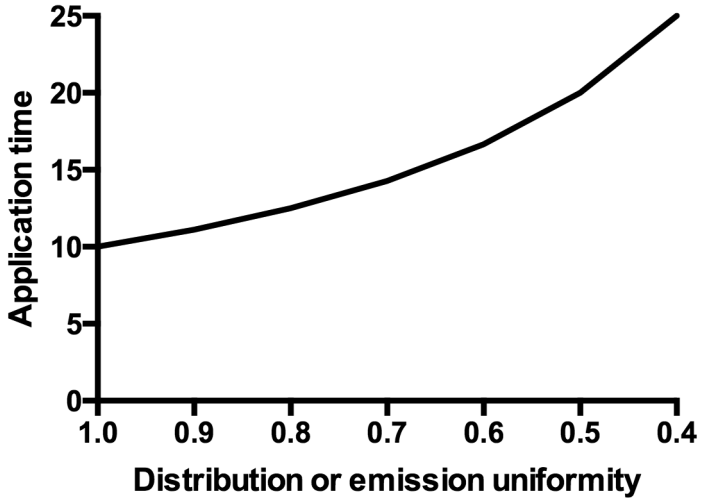

Figure 1. Effect of irrigation uniformity on required application time.

Table 2. Hypothetical irrigation requirements (in ounces) for a 6-inch chrysanthemum plant in four different nurseries varying in water quality and irrigation uniformity. Irrigation efficiency is the percentage of applied water that is actually used by the plant.

	Good system		Poor system	
Water needed for:	Good water	Poor water	Good water	Poor water
Plant	8.0	8.0	8.0	8.0
Leaching	1.4	3.4	1.4	3.4
“Dry” spots	1.0	1.3	9.4	11.4
Total applied	10.4	12.7	18.8	22.8
Irrigation efficiency	77%	63%	42%	35%