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Conducting a Water Application Uniformity Evaluation for an Overhead Sprinkler Irrigation System in the Nursery

Thomas A. Dudek and Dr. R.Tom Fernandez*

Most nurseries in Michigan use some type of overhead irrigation system to irrigate container grown nursery stock and field grown liners, seedlings and to a lesser extent field grown shrubs and trees.

Knowing your irrigation systems application uniformity is critical to make certain that the water you are applying is spread evenly across the growing zone. If your application is uniform then the depth of water you have applied over the entire area should be about the same. With that in mind, a uniform water application is essential for a nursery to maximize their efficiency of water use and to conserve water by avoiding over application.

Many factors can be involved in why an overhead irrigation system in a nursery has poor uniformity they include:

1. Improper selection of the delivery system piping (diameters either too small or too large).
2. Incorrect sprinkler heads and nozzles.
3. Poor overlap by sprinklers.
4. Pumping system not sized correctly for the system.
5. Effects of wind on the sprinkler distribution of water.
6. Wear and age of the system causing changes in volume of water emitted through nozzles.
7. Nozzles become clogged.

Generally speaking, if the Distribution Uniformity (DU) is poor then some plants in a zone will be under watered and others will be overwatered. Improperly watered plants will show poor growth and increased pest problems. Also dry or water logged media or soils will reduce fertilizer uptake by the plants.

Items Needed to Conduct Irrigation Uniformity Checks

1. Catch cans (straight sided) minimum of 16.
2. Ruler to measure depth in catch can.
3. Clock or stop watch to time irrigation application.
4. Pitot tube on pressure gauge to check nozzle pressure.
5. Paper and pencil to record data collected.

Steps to Conduct Distribution Uniformity Check of Your Irrigation System.

1. Choose an area that is representative of the crop and irrigation system you want to check.
2. Check each sprinkler or emitter to be sure they are not plugged.
3. A Pitot tube with gauge **(Figure 1.)** may be used to test the pressure directly at a sprinkler nozzle.

(Figure 1.)

4. Wind speeds over 3 mph will affect the DU so; try to do the test on a calm day.
5. Set out a minimum of 16 straight-sided catch cans in the irrigation zone you wish to check. A square grid pattern is best. Avoid areas along the edge of an irrigation system because they probably do not represent the water distribution one normally finds. Also, avoid affects of plants (interception or shedding) on the catch cans.

(Suggested Catch Can Placement Based on Sprinkler Pattern)
If your sprinklers are full circle with rectangular or triangular spacing then set your catch cans between sprinklers along the lateral lines and in the spacing between the laterals.

If your sprinklers are in a single line of full circle sprinklers in a polyhouse set the catch cans between sprinklers along the line and the width of the house.

Finally, if using partial circle sprinklers along the perimeter of a nursery production area… set your catch cans between sprinklers and in the growing area width.

6. Run the irrigation system to apply at least ½ acre-inch of water. Measure the water depth in each catch can.
7. Distribution Uniformity is calculated by the following equation. DU = (average low quarter depths/overall average depth) x 100%.

The lowest one-fourth or quarter of the measurement is one measurement. The other measurement you need is the overall average depth from your test.

As an example represented in (**Figure 2**). Overall average irrigation depth collected over 45 minutes for the 16 cans is: (0.7 + 0.9 + 0.8 + 0.7 + 0.7 + 0.8 + 0.8 + 0.9 + 0.8 + 0.8 + 0.9 + 0.8 + 0.9 + 0.8 + 0.8)/16 = 0.8 acre-inch.

Thus in our example the average low quarter depth = (0.7 + 0.7 + 0.7 + 0.8) /4=0.7 acre-inch.

DU = (average low quarter depth/overall average depth) x 100

DU = 0.7/0.8 x 100 = 87.5%

● 0.7	● 0.9	● 0.8	● 0.7
● 0.7	● 0.8	● 0.8	● 0.9
● 0.8	● 0.8	● 0.9	● 0.9
● 0.8	● 0.9	● 0.8	● 0.8

(Figure 2.) Example of 16 catch can results

Interpreting Your Results

Distribution Uniformity (DU) has been studied by the irrigation industry and they have put together some guidelines and a rating scale.

Distribution Uniformity Rating

< 77% = Very Poor
77% - 82% = Poor
83% - 90% = Acceptable
> 90% = Excellent

If your evaluation results in a poor or very poor rating, first check the obvious-clogged emitters or heads that are not spinning. If emitters are not functioning properly, you probably need to redesign or make improvements to your existing irrigation system. You may need to add sprinklers, replace worn sprinklers, change spacing, and check pump and line pressure or retest if you suspect the wind was a factor. Pump pressure and line pressure can indicate leaks. If pump pressure is appropriate but line pressure is not then a leak is possible. Check for visible wetting or leaks where pipe is laid and check pressure along the lines if possible from pump to zone in question to help identify breaks that are not visible. Having several in-line pressure gauges along an irrigation system is relatively inexpensive and will help with troubleshooting. Be sure to get removable pressure gauges so you can bring them in over the winter.

When determining DU by this method you also get irrigation system application rate (the overall average / time test run). For the example above, overall average is 0.8 acre-inches for a 0.75 hour (45 minutes) run time so the application rate = 0.8 acre-inches / 0.75 hour = 1.06 acre-inches per hour.

The test can also help with troubleshooting if the location of the catch cans is recorded along with the measurement. A pattern of low or high measurements could indicate a crack or blockage of a line.

References:

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*Senior District Horticulture and Marketing Educator, MSU Extension-Ottawa County, 12220 Fillmore Street, Suite 122, West Olive, MI 49460 dudek@anr.msu.edu (616) 994-4580.

Extension Specialist, Department of Horticulture, A216 Plant & Soil Science Building, Michigan State University, East Lansing, MI 48824-1325 fernan15@msu.edu (517) 355-5191 ext. 1336.