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Irrigation Distribution Uniformity – Why and How?

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Irrigation Uniformity

Irrigation uniformity is a measure of how evenly water is applied to a field (figure 3). It is commonly referred to as distribution uniformity (DU) and expressed as a percentage. When an irrigation system applies water at a high uniformity, it is possible to achieve a high irrigation efficiency. Similarly, when irrigation is uniform, crop production and quality is often higher and boosts revenue potential. Extra water is usually applied to assure that the crop in the areas of the field receiving the least water have enough to grow and produce well which elevates the importance of achieving high irrigation uniformity. Low irrigation uniformity cannot be overcome by management of irrigation frequency or duration.

No irrigation system can apply water perfectly uniform across a field. A DU less than 70 percent is considered poor for pressurized systems. Ideally, the DU of a pressurized system should be maintained at 85 percent and preferably higher.

Uniform Water Applications with Pressurized Systems

The importance of applying water uniformly with pressurized systems and its close association with irrigation efficiency is shown in figure 3.

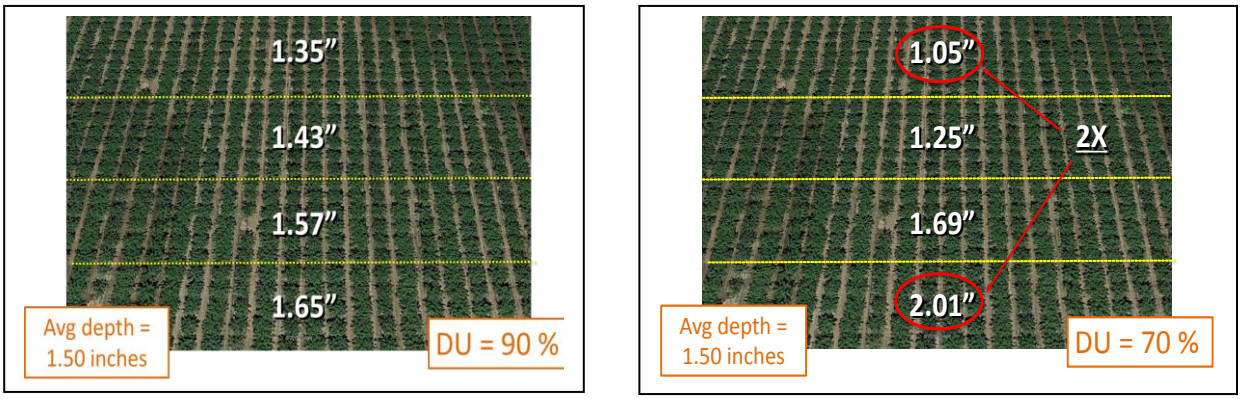

Figure 3. Illustration of how water application distribution uniformity (DU) is important to achieving efficient irrigation and nitrogen management with pressurized irrigation systems.

The picture on the left represents an average depth of applied water of 1.5 inches with a distribution uniformity of 90 percent. The average applied water in the ¼ of the field receiving the

least water was 1.35 inches and the average applied water in the quarter of the field receiving the most water in the field was 1.65 inches. The difference was only 0.15 inches above and below the target of 1.5 inches.

The illustration on the right shows a situation where the average depth of applied water was also 1.5 inches. However, the applied water ranged from a minimum of 1.05 inches in the ¼ receiving the least water and a maximum of 2.01 inches in the ¼ of the field receiving the most water. This represented nearly a 2 fold difference in applied water. If extra water were applied to make sure the low ¼ received 1.5 inches of water, the amount of water applied in the high ¼ would be even greater and at more risk of overwatering the crop and deep percolation. Equally as important, if nitrogen fertilizer were applied through the irrigation system, the rate would not be uniform and at more risk of leaching.

Uniformity of applied water with pressurized irrigation systems is tied to the investment into the initial irrigation design and ongoing commitment to maintain it. Selection of effective filters and pressure regulators, appropriately sized pipelines and tubing, and emission devices are important. Shortcuts in irrigation system designs at the onset to save on costs can be difficult and costly to correct or perhaps infeasible to correct after a crop is established.

Pressurized systems have several components that will wear and tear over time and require checking and repairing on a regular basis. To prevent this involves decisions to select durable irrigation designs and components. It requires committing enough labor and time to routinely check systems, repair broken components as needed, and flush systems regularly. It will require investing in chemical injection equipment and developing skills with chemigation to manage mineral and biological plugging of emission devices or to hire custom services.

Measuring Distribution Uniformity (DU)

There are several protocols for measuring DU and some public agencies and private businesses perform irrigation system evaluations upon request. A web search for “mobile irrigation labs” is one way to identify where these services are available in California. At the time of this writing, public entities were operating mobile irrigation labs in Kern, San Luis Obispo, Ventura, Napa, and Tehama Counties.

If professional evaluations are not readily available, it is also possible for farm staff to evaluate irrigation distribution uniformity at a preliminary level to help identify potential opportunities to improve irrigation efficiency.

With pressurized systems, a graduated measuring container and a stop watch is used to measure the rate of water discharged from several different drip emitters or micro sprinklers. Measurements are taken from several emission devices in areas near the source of the irrigation water, at a midway point from the water source, and farthest away from the source of the water. Alternatively, a pressure gauge and pitot tube could be used at the same points in a field to measure uniformity of system pressures and determine if they meet the requirement of the emission device (figure 5). The assumption is that uniform pressures equate to uniform water

discharge flows. This is usually a reasonable assumption but not always if the drip emitters or sprinkler have wear and tear.

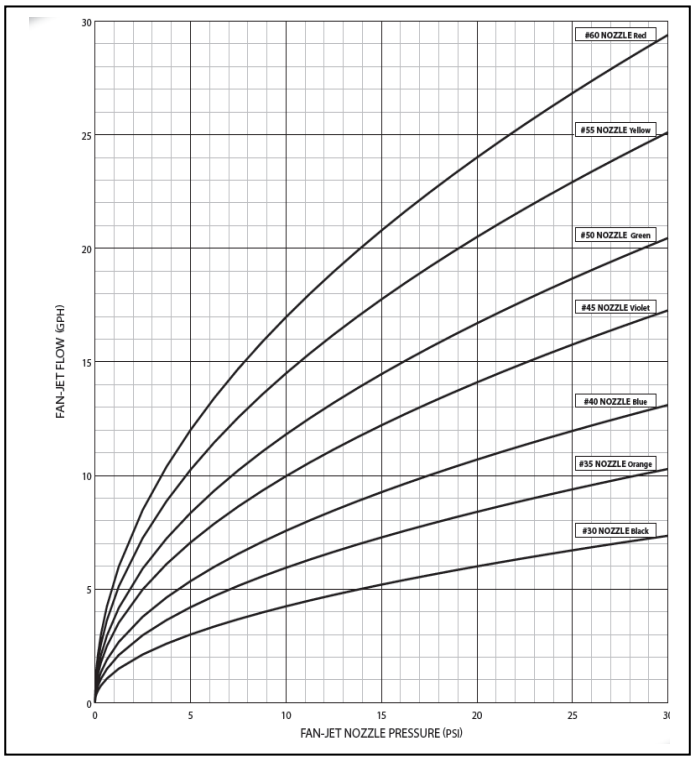

Figure 5. Photo on left shows a 60 psi, liquid filled pressure gauge connected to a brass pitot tube. It can be used to measure pressures inside drip or hose lines and at nozzles of micro sprinklers and sprinklers. The pressure measurements can be compared to technical information for specific emission devices (an example on right) to determine how much the pressure variation may be affecting water discharge rates and irrigation uniformity across a field.

After the field data are gathered, the water volume or pressure are ranked from lowest to highest. The average volume or pressure for the lowest 25 percentile of measurements is calculated and the average for all of the measurements is also calculated. Distribution uniformity (DU) is calculated using equation 1:

Equation 1. Calculating percent distribution uniformity (DU).

$$DU\ (\%) = \frac{\text{Average volume or pressure of lowest 25 percentile}}{\text{Average volume or pressure of all measurements}} \times 100$$