

Distribution Uniformity For Sprinkler Irrigation

Distribution Uniformity (DU) is a measure of how evenly water is applied across a field during irrigation. For example, if one inch of water is applied in one part of the field and only half an inch is applied in another part of the field, that is poor DU. DU is expressed as a percentage between 0 and 100%, although it is virtually impossible to attain 100% in practice. DUs of less than 70% are considered poor, DUs of 70 - 90% are good, and DUs greater than 90% are excellent. In short, bad DU means that either too much water is applied, costing unnecessary expense, or too little water is applied, causing stress to crops.

Irrigation Efficiency is different than DU. Irrigation Efficiency refers to how well the irrigator matches water applications to crop water need, and generally answers the question of how much to apply, and how often. This is generally referred to as irrigation scheduling. For instance if a crop needs 24" per year and the irrigator applies close to that amount (less any distribution inefficiencies) then the irrigation efficiency would be high. In contrast, if the irrigator applied 48" per year with a high DU system, and the crop really only needed 24", the irrigation efficiency would be very low, nearly 50%.

Obviously, there must be good DU before there can be good irrigation efficiency, if the crop is to be sufficiently watered. So although good DU alone is no guarantee of good irrigation efficiency, it is a good place to start.

Following are profile views of two adjacent sprinklers in a field and the root zone underneath them. The spray patterns from the adjacent sprinklers must overlap to result in the same amount of water falling in all parts of the field.

In the figures, the horizontal, dashed line depicts the depth of the actual soil water deficit at irrigation. This is the amount of water that the grower applies to soak into the soil to satisfy crop water use requirements. The dark brown area depicts the actual depth of water infiltrated during

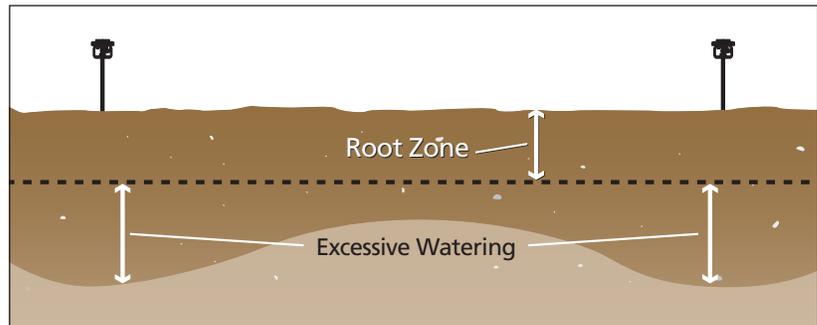


FIGURE 1: Depiction of irrigation resulting in poor DU and excessive watering

the irrigation. Over irrigation is indicated whenever the actual depth of irrigation is below the soil water deficit line (the horizontal, dashed line). Conversely, under-irrigation is indicated whenever the actual depth of irrigation line is above the soil water deficit.

In Figure 1, the farmer has irrigated to sufficiently water the entire field. The poor DU, indicated by the uneven infiltrated water, has resulted in excessive watering in some areas of the field. That is, more water was applied than necessary to satisfy the crop.

also likely that a more even application of water would result in a healthier, more consistent crop with higher yield and quality.

In Figure 2, the farmer has acted to prevent excessive watering by shortening run times, without any other changes. But as a result part of the field now remains under-irrigated. Although under-irrigation prevents waste, it is undesirable because the crop will likely suffer from lack of water. In addition, salts may not be properly leached from the root zone leading to further crop decline.

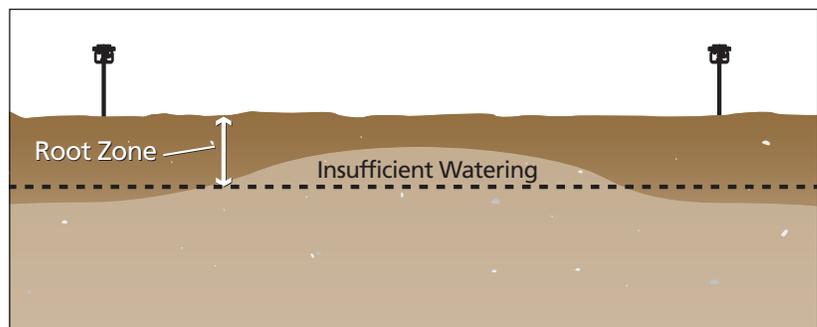


FIGURE 2: Depiction of irrigation resulting in poor DU and insufficient irrigation in parts of the field

As a simple example, let's say the field in Figure 1 requires 400 acre-feet of water and that the cost of water is \$10/acre-foot. Currently, the farmer is applying 500 acre-feet of water to ensure that the center of the field is adequately watered. If the farmer's system had a better DU, he could reduce his water output by 100 acre-feet. His water expense would decrease from \$5000 to \$4000 giving him a savings of \$1000. It is

Using the same example as above, the farmer has cut back his run time and is now applying 400 acre-feet to his field, but because his system lacks a high DU, the center of the field is now being under watered. Before he cut back his run-time, the farmer's field generated \$50,000 of revenue. Now that crop stress exists, the field is only generating \$40,000 worth of revenue. So although the farmer is saving

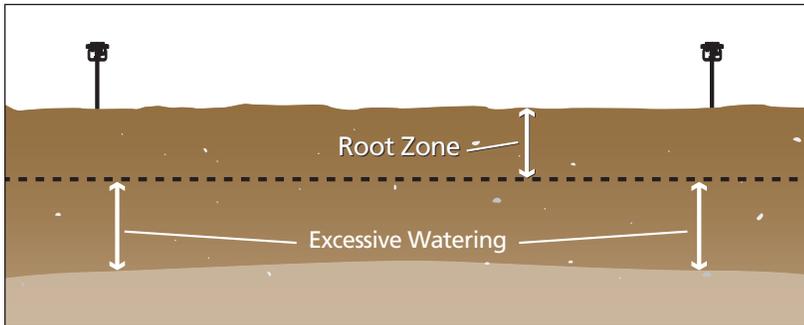


FIGURE 3: Depiction of irrigation resulting in good DU but poor irrigation efficiency

\$1,000 in water expenses, he is losing \$10,000 of revenue for a total loss of \$9,000.

Figures 3 and 4 show that good DU allows for more even applications of water, but in the case of Figure 3, irrigation efficiency is poor because more water was applied than was needed.

water evenly throughout his field, allowing for healthy crops and even better yields. However, because the farmer is running the system twice as long as necessary, the potential is not realized. He is now applying 800 acre-feet of water, doubling his water expense to \$8,000 and putting his crops at risk.

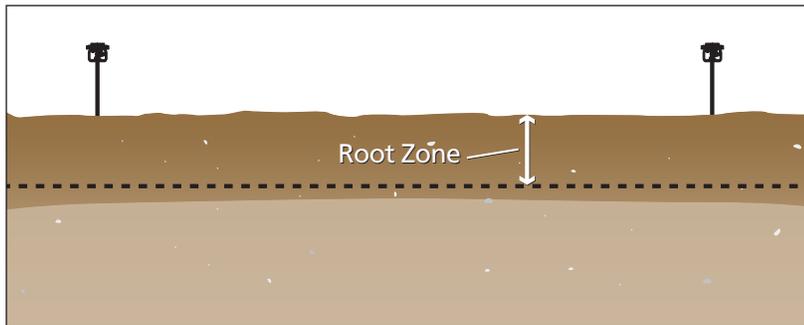


FIGURE 4: Depiction of irrigation sufficiently watering the entire field with good DU and irrigation efficiency

Again, using our example field, the farmer is now using a well-designed and maintained sprinkler system that provides good DU and the potential for high irrigation efficiency. He should be able to apply 400 acre-feet of

Figure 4 depicts good irrigation. Both the DU is high (even application) and the depth is right (irrigation efficiency). The field has been slightly over irrigated but this is probably necessary to leach salts from the

soil profile. In this case, the farmer has applied the right amount of water and has not been forced to waste money to over irrigate, nor has he been forced to sacrifice revenue by under irrigating and producing a substandard crop.

DU may be determined theoretically by using sprinkler uniformity software, or it can be determined by taking actual irrigation application measurements in the field.

In either case, The Center for Irrigation Technology (CIT) has software and guidelines to help farmers and designers achieve the best DU possible. More information can be found on CIT's website

<http://cati.csufresno.edu/cit>

as well as

<http://www.rainbird.com/pdf/ag/SprCU.pdf>

and

<http://www.rainbird.com/pdf/ag/SPACE.pdf>

Remember: better DU means more profits through cost savings, healthier crops and better yields. Measure your DU now and see which category you fall into: below 70%: bad, 70-90%: good, or above 90%: excellent.

Much of this information was provided by The Center for Irrigation Technology and supplemented by Rain Bird Corporation.

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