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Evaluating Irrigation System Uniformity

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Evaluation Goals of Irrigation System Uniformity

Irrigation System Uniformity is the concept that all areas within an irrigated field receive the same amount of water. In simple terms, if the producer's goal is to apply one inch of irrigation water, the system will apply one inch of irrigation water in each area. Areas of the field that receive under or over the goal will receive under or over the goal for all applications, multiplying the error.

Areas that are under or over the average by 40 percent and will receive 0.6 inches (if under) or 1.4 inches (if over) of irrigation water each time the producer intends to apply one inch of water. By the end of the season, areas requiring eight inches of irrigation water will receive 4.8 inches (if under) or 11.2 inches (if over) of irrigation water.

Standards and Methods for Evaluation of Irrigation System Uniformity

Two commonly accepted standards or methods are available as guidelines for performing evaluations of Irrigation System Uniformity.

- ASAE Standards (436.1) — Available at: http://msue.anr.msu.edu/uploads/236/43605/ASAE_S436.1.pdf
- NRCS Handbook — Available at your local Natural Resource Conservation Service office or http://msue.anr.msu.edu/uploads/236/43605/USDA-NRCS-IrrigationGuide-Chapter15.pdf

Pivot Extensions (cornering arm or Z-arm)

Some center pivot irrigation systems are designed to expand the wetted area to allow coverage of corner or odd-shaped fields, often referred to as cornering arms or Z-arm. These systems require two separate evaluations if the extension accounts for 30 percent or more of the irrigated portion of the field. One evaluation will evaluate the system while extended, and a second when the arm is not deployed.

Overview of Evaluation of Irrigation System Uniformity Guidelines (center pivot)

1. Have the producer walk the system length and note any application problems while the system is applying water. All known application problems need to be corrected before doing an evaluation of Irrigation System Uniformity.
2. Have the producer start the system and establish a setting for his normal application (avoid weather extremes).
3. Run the system for 10 minutes or more without changes to water supply system.
    - Place catch cans in a line from the center pivot point past the outer edge of the wetted area.
    - Catch cans should be placed to form a straight line from the pivot point to a point on the outer edge of the wetted area.
    - Space catch cans 20 feet apart for system overhead impact sprinklers, and 10 feet apart for all other center pivot application systems.
    - Place catch cans with opening at a height above the crop, or in a field opening width four times greater than the height difference between the crop and catch can opening.

- A drop of mineral oil may be added to each catch can to minimize evaporation if a reading cannot be taken immediately and conditions favoring evaporation are prevalent.
- If the catch can placement falls into the wheel tracks, it may be moved one to two feet to avoid damage.

4. Record the number of catch cans placed, the producer's intended application, catch can opening diameter and other pertinent information. A sample record sheet to use for data collection follows.
5. Record volume collected from each catch can (ml.).

Evaluation of Data

To simplify evaluation of data, enter data into the spreadsheet available at: http://msue.anr.msu.edu/uploads/236/43605/lyndon/Uniformity_Spreadsheet_6.11.xls or utilize the standards listed above.

Cleaning the Data

1. Catch can data from the first 20 percent of the system length closest to the center pivot point should be ignored. The "average catch can (ml)" data replaces the first catch can data points. The actual "distance from center point" is entered for the first data point (remaining after deletion of other points closer to the center pivot point). Coverage near the center point of the system represents such a small amount of the total system coverage deviation from the average, that it yields little effect on the machine's overall uniformity.
2. Catch can data from the outer edge of the wetted area is deleted from the data set when the volume is less than 70 percent of the average. Removing the data that tails off at the outer edge of the system designates the effective irrigated area, and avoids dilution of the data points representing the actual targeted irrigated area.
3. Up to three percent of the data points should be removed if it is an extreme deviation from the average. This is done after the outer edge data has been removed to define the effective irrigated area and up to 20 percent of the inner area data has been removed. A few catch cans could collect extreme data that is not representative of the system area, like water running from a trust rod or brace rod directly to the cup.

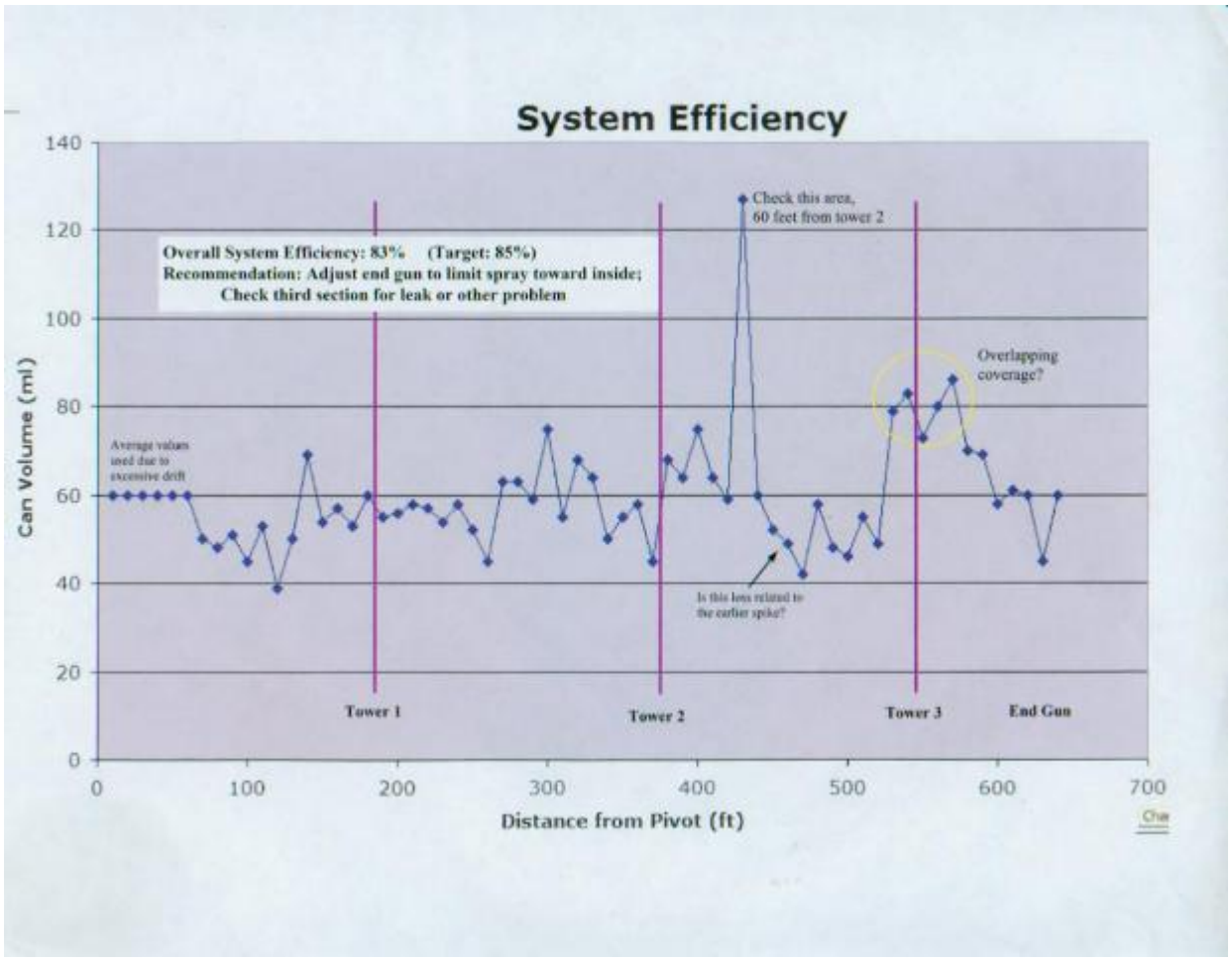
System Uniformity Coefficient

- System Uniformity Coefficient is a numeric judgment of the overall performance of an irrigation system's ability to evenly apply water to the field.
- A System Uniformity Coefficient of 85 percent or greater, is considered not to need major adjustments to the sprinkler package, although individual sections of the irrigator may benefit from corrections (green or black in the spreadsheet).
- System Uniformity Coefficient of 80 to 85 percent may need further analysis of the sprinkler package, and individual sections of the irrigator would benefit from corrections (yellow in the spreadsheet).
- System Uniformity Coefficient of less than 80 percent requires an adjustment to the sprinkler package design and correction of individual sections of the sprinkler package (red in the spreadsheet).

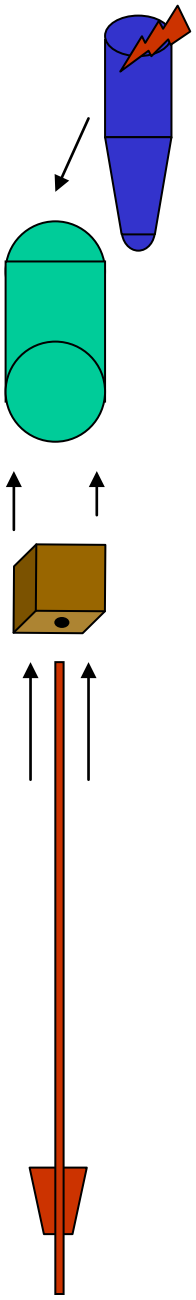
Creating a Take-home Message for the Producer

The System Uniformity Coefficient provides the producer with a report of the overall performance of the system. Almost all systems will benefit from some corrections. Correction of areas of the system with greater than 20 percent deviation from average (red in the spreadsheet) will improve performance. Entering a second data set, replacing the red (high deviation) data with the "average catch can (ml)" data, will create a before/after scenario that will identify the benefits of repairs or corrections to the system.

Tools for implementing irrigation management practices, fact sheet on water-use reporting and other irrigation/water-use related materials, can be found at: http://msue.anr.msu.edu/resources/irrigation



Catch Can Stands
Evaluating Irrigation Uniformity



A simple, inexpensive catch can stand can be built using:

1. 32 oz. disposable soda cup (Taco Bell cup)
2. 3 inch plastic drain pipe cut to 5 inch in length
3. 2 x 3 inch stud, cut to length to wedge into plastic drain pipe
4. Steel (step-in) electric fence post

Assembly directions: The 2 x 3 inch stud chunks wedge into the base of the cut plastic drain pipe sections, and make the transition between the cup and post. Electric fence post should fit snug into the drill hole. The screw may be placed through the side of the plastic drain pipe into the 2 x 3 inch" stud chunks. Electric fence post and cups can be stored and transported in separate stacks.

The total cost per unit is less than one dollar and requires only a saw and a drill. The catch can stand will allow data collection in fields with crops up to 30 inches.