

Centre Pivot Irrigation – Distribution Uniformity

Introduction

Distribution uniformity refers to how even irrigation water is applied across the field. Fields that are irrigated with systems that have poor uniformity will have areas that receive the desired depth of water, but will have areas that are over and under irrigated. This variation in applied depth can lead to variation in yield.

Non-Uniformity Factors

Factors that contribute to non-uniform irrigation include:

- Incorrect emitter spacing, operating pressure and emitter configuration;
- Nozzle size and position along machine;
- Nozzle height, angle and wear;
- Machine movement, step size and consistency;
- Flow rate variation due to discontinuous end-gun operation, and variation in pump duty; and
- Runoff due to application rates exceeding soil infiltration rates.

Variation in sprinkler pressure will affect uniformity for both regulated and non-regulated machines. Variation can occur with groundwater aquifer height change and should be managed so the machine is operating at the correct design pressure.

Measuring Uniformity

The uniformity of water application for centre pivots can be measured by using catch cans and two transects across the travel path. There are standards for testing uniformity of centre pivots (ISO11595 and ASAE S436).

Before testing uniformity, the pivot should be operating at the pivot design pressure, and all

nozzles must be checked and installed as per the nozzle chart.



Coefficient of Uniformity

The coefficient of uniformity is used to describe the “evenness” of applications. For centre pivots the modified Heermann and Hein uniformity coefficient is used which weights the applied depths based on the circular area each catch can represents. The modified Heermann and Hein uniformity coefficient, CU_{HH} :

$$CU_{HH} = 100 \left[1 - \frac{\sum S_s |D_s - \bar{D}|}{\sum D_s S_s} \right]$$

where D_s is the applied water depth for one collector position at a distance S_s from the pivot point. The weighted applied depth, \bar{D} is:

$$\bar{D} = \frac{\sum D_s S_s}{\sum S_s}$$

For centre pivot irrigation, CU_{HH} results greater than 90% are considered the minimal level of acceptability.