Sugar Research Australia

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Booklet

Evaluating your centre pivot irrigator

Centre pivots are generally considered to be an accurate and efficient way to apply irrigation water.

However, if the machine is not operating as designed it may not be applying the correct amount of water, or the total amount may be right but it may not be applying water uniformly.

If the application is not uniform some areas will be overwatered and others will be under-watered.

It is possible to assess how accurately the machine is operating by taking some relatively simple measurements. These measurements will show how much water is being applied and how uniform that application is.

What you need

- Catch cans – these need to be the same size and shape
- Weights to hold the cans down or stakes to lift them above the canopy
- A measuring cylinder marked in millilitres (mL)
- 30 m measuring tape and a ruler
- Pegs or markers
- Pens, calculator and evaluation sheets
- Manufacturer's sprinkler performance charts
- Wind meter
- Container of known volume e.g. 10 L bucket
- Stopwatch
- An accurate pressure gauge
- Tees and fittings to fit the gauge above the pressure regulators, you will need enough fittings to measure a minimum of 3 positions.

Method

Some of these measurements need to be taken while the machine is operating normally. Take great care around moving parts.

Record the wind speed and direction. If the wind speed is greater than 5 m/s the test will not be accurate.

While the pivot is not operating

- Measure the length of each span and the distance from the centre to the outer wheel track
- Measure and record tyre sizes and pressures
- Mark a measured distance e.g. 10 m around the outer wheel track
- Attach the tees and fittings above the pressure regulator of selected emitters
  - > Measurements should be taken from at least one emitter on the first span, one on the end span, and one in between
  - > Record the make, model, and nozzle size or colour of each emitter to be tested
  - > Record its span and position
- Place the catch cans along the length of the pivot
  - > Place them far enough ahead of the boom so they don't get water in them before they are all set up
  - > Ensure they are in a straight line, are evenly spaced and no more than 5 m apart
  - > The cans need to be clear of the crop canopy, for taller crops this may mean raising the catch cans on stakes. All cans must be level and at the same height.

When the irrigator is operating normally

- Record the control panel settings
- Record the time it takes for the end drive unit to move between the two points that were marked around the outer edge; this gives the machine speed
- Record the pressure of the selected emitters
- Measure the flow rate by holding a container of known volume under an emitter and timing how long it takes to fill
  - > Take measurements from at least one emitter per span and record the span and emitter position
- Measure and record the diameter of the wetting pattern near the end drive unit
  - > Place a peg/marker at the limits of the throw and then measure the distance between them after the machine has passed.

When the irrigator has passed over all the cans

- Measure and record the volumes (mL) in each container
  - > It is very important that the volume is written in the correct position on the recording sheet
  - > If there is no can or recording mark it with an X.
  - > For very long pivots it is acceptable to ignore the first one or two spans because the time taken to pass over them is too long and they will have little impact on the overall result. However, the can positions *must* be noted and the volumes marked with an X.

Calculations

To calculate the distribution uniformity on a centre pivot it is necessary to use weighted catch can figures. These calculations are complex and the use of a spreadsheet is recommended. NSW DPI has an online calculator which can be accessed at the following address.

http://www.dpi.nsw.gov.au/agriculture/resources/water/irrigation/sustaining-the-basin/resources/centre-pivot-weighted-catchcan-calculator

The online calculator will determine the mean application and distribution uniformity.

Pressure and flow rates can be compared to the design standard to see if there is variation from that design. Similarly the actual speed and application depth can be compared to the control panel settings.

Example data

Test results

Control panel readings	Speed setting: Depth applied:
Test distance (to calculate actual speed)	10 m
Time to travel test distance	15 minutes, 24 seconds
Catch can diameter	125 mm
Catch can spacing	5 m
Wind speed and direction	

Catch can data

Catch can position	Catch can reading mL
1	176
2	272
3	160
4	256
5	204
6	190
7	223
8	255
9	165
10	227
11	232
12	224
13	188
14	218
15	269
16	285

Pressure and flow readings

Sprinkler position	Nozzle type	Pressure (kPa)	Design Pressure (kPa)	Volume (L)	Time (s)	Flow rate (L/s)	Design flow rate (L/s)
Span 1, #4		204	180	7.8	39	0.2	0.2
Span 2, #4		180	165	7.5	18.75	0.4	0.5
Span 3, #4		142	150	8	16	0.5	0.6

Mean applied depth and distribution uniformity

Use the online calculator to determine the mean depth applied and the distribution uniformity	In this example the mean depth applied was 18.6 mm, the lowest quarter depth was 14.6 mm and the distribution uniformity was 78%
Compare the applied depth to the system setting	

Calculate travel speed and compare to machine settings

Convert time taken to seconds Multiply minutes by 60 and add any seconds	Time: 15 min, 24 sec = (15 × 60) + 24 = 924
Travel speed (m/h) = distance travelled (m) divided by the time taken (s) multiplied by 3600	= 10 ÷ 924 × 3600 = 38.96 m/h
Machine circumference at outer wheel track	$= 2\pi \times \textit{pivot radius}$ $= 2\pi \times 78$ m = 490 m
Time to complete one full revolution = machine circumference divided by travel speed	= 490 ÷ 38.96 = 12.5 hours

Compare actual flow rate to design flow rate

For each sprinkler subtract the design flow rate from the measured flow rate, the answer may be positive or negative	For span 1, sprinkler 4: measured flow rate = 0.2 design flow rate = 0.2 difference = 0
Calculate the variation in flow (%) by dividing the difference by the design flow and multiplying by 100 Ideally the variation should be less than 5%	Difference = 0 Design = 0.2 Variation = 0%

Compare actual pressure to specified pressure

For each sprinkler subtract the specified pressure from the actual pressure	
Calculate the variation by dividing the difference in pressure by the specified pressure and multiplying by 100	