Evaluating your lateral move irrigator

Lateral move irrigators 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 the application may not be uniform.

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

It is possible to assess how effectively 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 – for marking the distance water is thrown
- 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 lateral is not operating

- Measure the length of each span and the distance from the centre to the end wheel track
- Attach the tees and fittings above the pressure regulator of selected emitters
  - > Measurements should be taken from at least the first sprinkler, the last sprinkler, 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 lateral
  - > Ensure they are in a straight line, are evenly spaced and no more than 5 m apart
  - > Add at least two extra containers on each end to allow for any changes in wind speed or direction
  - > Do not place them in wheel tracks and where possible avoid areas that will receive excessive water (e.g. under towers)
  - > 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
- Measure the time that catch cans are capturing water
- Measure the operating speed
  - > Place a peg or marker next to one wheel
  - > After 10-20 minutes (the longer the time, the more accurate the result), place another peg next to the same wheel
  - > Record the distance and time
- 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.

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.

Converting volume readings (mL) to depth readings (mm)

- For round containers with a diameter of 110-115 mm, it is accurate enough to divide the volume by 10 e.g. if the volume collected is 750 mL, the depth is 75 mm
- For 4 L square ice-cream containers: divide the volume collected by 40 e.g. if the volume collected is 750 mL, the depth is 19 mm
- For other containers, use the conversion chart e.g. if the can diameter is 145 mm divide the volume collected by 21.3; if the volume collected is 750 mL, the depth is 35 mm.

Converting volume readings to depth readings

Diameter of catch can (mm)	Figure to divide the volume collected by
75	4.4
80	5
90	6.4
100	7.9
105	8.7
110	9.5
113	10
115	10.4
120	11.3
125	12.25
145	16.5
165	21.3
200	31.4
220	38

Calculations

When all of the measurements have been taken the following can be calculated:

- Mean application rate
- Distribution uniformity
- Average pressure and pressure variation
- Average flow and flow variation.

Example data

Test results

Control panel readings	Speed setting: Depth applied:
Test distance (to calculate actual speed)	20 m
Time to travel test distance	25 minutes
Catch can diameter	125 mm
Catch can spacing	5 m
Time water was landing in catch cans	Start time: 11.45 am Finish time: 12.01 pm Number of minutes: 16
Wind speed and direction	

Catch can data

Catch can position	Catch can reading mL	Catch can depth mm
1	176	14
2	272	22
3	160	13
4	256	21
5	204	17
6	190	16
7	223	18
8	255	21
9	165	13
10	227	19
11	232	19
12	224	18
13	188	15
14	218	18
15	269	22
16	285	23
Total	**3544**	**289**

Calculate travel speed and compare to machine settings

Divide the test distance by the time taken to travel that distance	Test distance = 20 m
	Time taken to travel = 25 minutes
	Travel speed = 0.8 m/min

Convert volume reading (mL) to depth reading (mm)

Divide the catch can volume by the appropriate factor	See catch can data

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, #1		107	100	8	11.6	0.69	0.7
Span 3, #5		93	100	7	10.3	0.68	0.7
Span 4, #5		101	100	9	12.0	0.75	0.7
Span 7, #10		103	100	10	15.2	0.66	0.7

Calculate the mean application rate (MAR)

This is the average rate (mm/h) at which water is applied to the soil. It can be compared to the average infiltration rate of the soil to determine if run-off or ponding is likely to occur. This is more likely if the irrigator is moving slowly and applying a lot of water.

Calculate the average depth Sum the depths collected in all catch cans and divide by the number of cans used	Sum of catch can depths = 289 mm Number of catch cans = 16 Average depth = 18 mm
Convert the time water was landing in cans from minutes to hours	16 minutes ÷ 60 = 0.27 hours
Calculate mean application rate by dividing the average depth by the time	18 ÷ 0.27 = 67 mm/h

Calculate the distribution uniformity

Distribution uniformity is how evenly water is being applied. 100% is perfect and greater than 90% is desirable.

Divide the number of catch cans by four; if necessary round the number down to the nearest whole number	16 ÷4 = 4
Mark the quarter of catch cans that have the lowest depths; these are the *lowest quarter* readings If you are using a spreadsheet it is possible to sort the can readings from lowest to highest, this makes finding the lowest quarter easy	In this case: Can 3 – 13 mm Can 9 – 13 mm Can 1 – 14 mm Can 13 – 15 mm
Add up the depths of the lowest quarter readings	13 + 13 +14 + 15 = 55 mm
Calculate the *average lowest quarter* depth by dividing the sum of the lowest quarter readings by the number of readings	55 ÷ 4 = 13.75 mm
Calculate distribution uniformity by dividing the average of the lowest quarter of readings by the average of all readings Multiply the answer by 100 to get a percentage	(13.75 ÷18) × 100 = 76%

Calculate pressure variation

If there is a large degree of variation in pressure across the machine it could indicate problems with the valve system or that the system has been poorly designed. For the comparison to be valid all the nozzles must be the same and pressure compensators cannot be fitted. A variation of more than 10% either side of the midpoint indicates a problem.

Calculate the midpoint pressure by adding the maximum and minimum readings and dividing by 2	(107 + 93) ÷ 2 = 100 kPa
Calculate the difference between the maximum and the midpoint by subtracting the midpoint from the maximum	107 – 100 = 7 kPa
Calculate the pressure variation by dividing the difference by the midpoint; multiply the answer by 100 to get a percentage	(7 ÷ 100) × 100 = 7%

Calculate average pressure

The average pressure can be compared to the design pressure of the sprinklers to check that the irrigator is performing as intended.

Average pressure is the sum of all the pressure readings divided by the number of readings	(107 + 93 + 101 + 103) ÷ 4 = 101 kPa

Calculate flow variation

A variation in flow of more than 5% either side of the midpoint is considered unacceptable.

Calculate the midpoint flow by adding the maximum and minimum readings and dividing by 2	(0.75 + 0.66) ÷ 2 = 0.705 L/s
Calculate the difference between the maximum and the midpoint by subtracting the midpoint from the maximum	0.75 – 0.705 = 0.045
Calculate the flow variation by dividing the difference by the midpoint; multiply the answer by 100 to get a percentage	(0.045 ÷ 0.705) × 100 = 6.4%

Calculate average flow

The average flow can be compared to the manufacturer's data to check that the sprinklers are performing as intended.

Average flow is the sum of all the flow readings divided by the number of readings	(0.69 + 0.68 + 0.75 + 0.66) ÷ 4 = 0.695 L/s