# FARM IRRIGATION FACT SHEETS

## SET 3: CATCH CAN TESTS

Measure Application and Evenness for Solid Set, Wheel & Handlines, Reel Guns, Pivots, & Drip Systems

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LIVING LANDS AGROECOLOGY

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# Application & Evenness

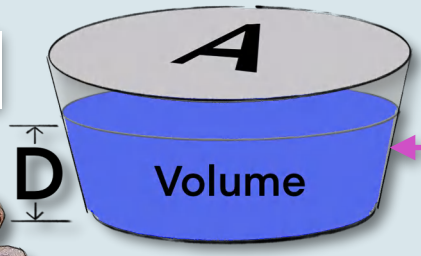
## APPLICATION RATE

### Measure application rate.

Lay out identical catch cans, equally spaced. Record the ***volume or weight (1 gram = 1 ml)*** that each can catches over a set period of time.

1) Calculate the **average volume, V,** of water.
2) Measure the **area, A,** of the can's opening.
3) **Depth of water, D,** is volume divided by area.

$$\text{Depth} = \frac{\text{Volume}}{\text{Area}}$$




Time in ***hours***

4) The ***depth per hour*** is the application rate.

$$\text{Rate} = \frac{\text{Depth}}{\text{Time}}$$

***If the catch can's sides were vertical,*** you *could* measure depth with a ruler. But it's ***faster and more accurate to use volume.***

## EVENNESS

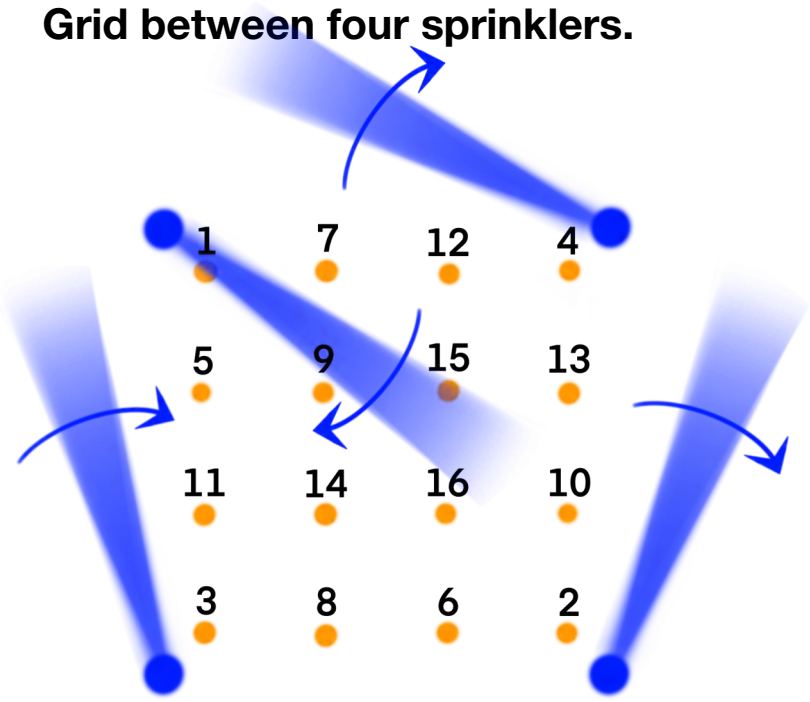
### Compare the "lowest quarter" to the average for all the cans.

List the volume of water caught by each can and identify the ***lowest quarter*** — the 25% of the cans with the least water in them.

If the ***average of the lowest quarter*** is less than 80% of the ***average of all the cups*** in a sprinkler system (or 90% in a drip system), then it's "uneven" and you want to tune it up.

## SPRINKLER CATCH CANS

### Grid between four sprinklers.




## EXAMPLE

### Application Rate

16 cans in a 4x4 grid between 4 sprinklers caught water for ***2 hours***.

The ***average volume*** was ***200 ml*** (which is ***200 cm³***).

Each can's opening had a 16 cm diameter, so ***200 cm² of catchment area***.

The ***depth*** of water applied, then, was ***1 cm*** (or 0.4").

The ***application rate*** *(depth divided by 2 hours)* *is* ***0.5 cm/hr*** (or 0.2"/hr).

### Evenness

The ***lowest quarter*** — the 4 of 16 cans with the least water — ***averaged 164 ml***, which is ***82% of 200 ml***, the average for all 16 cans.

For sprinklers, ***more than 80% is even enough***.

| # | Volume (ml) |
|---|---|
| 1 | 248 |
| 2 | 236 |
| 3 | 234 |
| 4 | 230 |
| 5 | 216 |
| 6 | 214 |
| 7 | 204 |
| 8 | 200 |
| 9 | 198 |
| 10 | 194 |
| 11 | 190 |
| 12 | 182 |
| 13 | 178 |
| 14 | 166 |
| 15 | 156 |
| 16 | 154 |

Lowest Quarter

| | |
|---|---|
| ***AVERAGE:*** | 200 |
| ***LOW QUART:*** | 164 |
| ***EVENNESS:*** | 82% |

# Wheel & Handlines

## CATCH FROM ONE LINE

### Only one line runs at once, so use a special catch can method.

Put cans in equal numbers and spacing on ***both sides*** of the row, with at least 16 cans per side.

Space the cans to ***span the full width*** from the previous wheelline to the next wheelline positions.

Run the test, time it, and measure each can.

***Add each can on the "left side" (A) to the corresponding can on the "right side" (B).***
E.g. In the diagram, add A1+B1, A2+B2, …

The sum is the water that would have been caught had the wheelline been moved and run again, as in a normal irrigation cycle.

From there, calculate application rate and evenness as for the "solid set" system.

## EXAMPLE

### Application Rate

The table shows the raw data for ***sides A and B***, and for ***A+B***, after the system was run for ***2 hours*** with cans spaced as in the diagram.

On average ***200 ml*** fell in each cup, each with an opening of ***200 cm²***, a depth of ***1 cm*** (0.4"), so the application rate is ***0.5 cm/hr*** (0.2"/hr).

### Evenness

The ***lowest quarter*** are the ***4 of 16 cans (A+B)*** with the least water in them: 148ml, 158ml, 160ml, and 174ml.

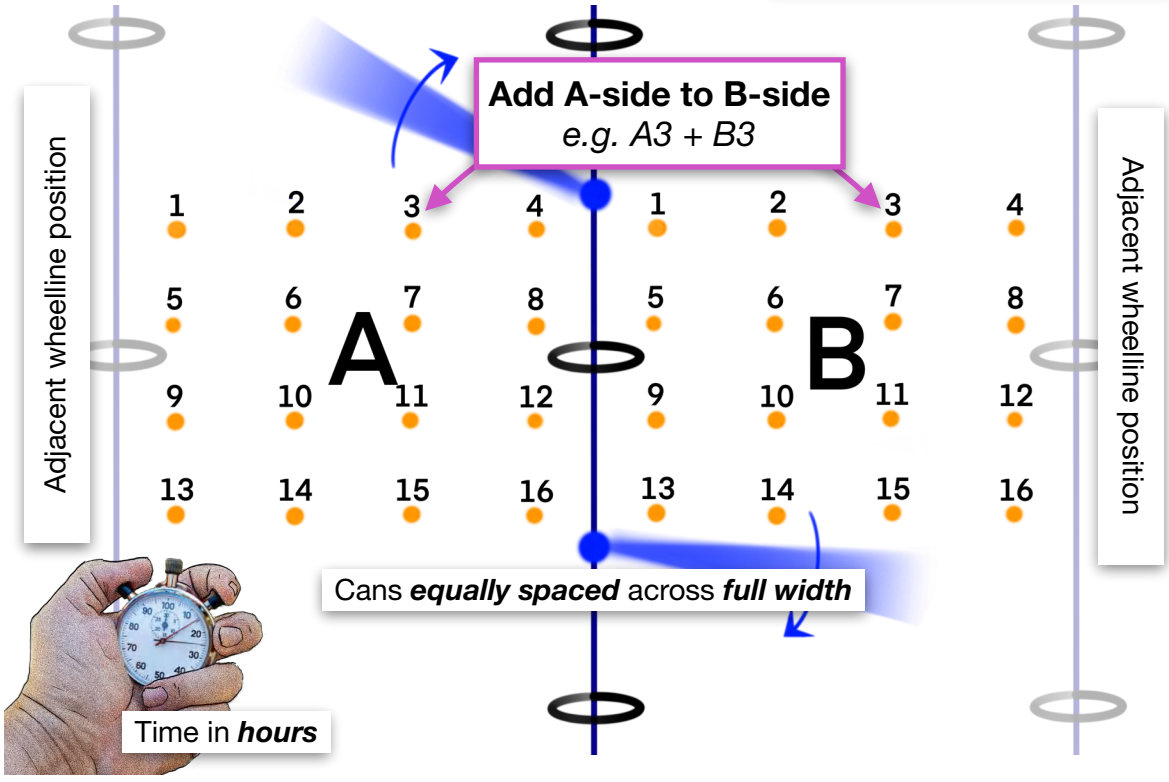
The lowest quarter ***average 160 ml*** is ***80% of the overall average*** of 180 ml… 80% is just barely acceptable!

***Volume (ml)***

| # | A | B | A+B |
|---|---|---|---|
| 1 | *23* | *209* | **232** |
| 2 | *73* | *171* | **244** |
| 3 | *164* | *70* | **234** |
| 4 | *142* | *16* | **158** |
| 5 | *22* | *198* | **220** |
| 6 | *59* | *139* | **198** |
| 7 | *146* | *62* | **208** |
| 8 | *180* | *20* | **200** |
| 9 | *25* | *227* | **252** |
| 10 | *57* | *133* | **190** |
| 11 | *112* | *48* | **160** |
| 12 | *133* | *15* | **148** |
| 13 | *17* | *157* | **174** |
| 14 | *55* | *129* | **184** |
| 15 | *126* | *54* | **180** |
| 16 | *196* | *22* | **218** |
| ***AVERAGE:*** | | | **200** |
| ***LOW QUART:*** | | | **160** |
| ***EVENNESS:*** | | | **80%** |

## WHEELLINE CATCH CANS

### Grid on *both sides* of the line.



# Reel Guns (Travellers)

## CATCH FROM ONE PASS

### Set up cans from lane-to-lane and catch a full pass.

After pulling out the cart, but before starting it up, lay out catch cans perpendicular to the lane with equal numbers of cans equally spaced on ***both sides*** of the current lane.

Space the cans to ***span the full width*** from the ***previous lane to the next lane***.

Ensure the cans are deep enough to catch the full irrigation amount. ***The gun will completely pass the catch can line during the test.***

***Add*** each can on the ***"left side" (A)*** to the corresponding can on the ***"right side" (B).*** E.g. In the diagram, add A1+B1, A2+B2, …

The sum is how much would have been caught had the gun been moved over a lane and run again.

## EXAMPLE

### Application Depth (per cycle)

After the ***full lane was irrigated*** with cans spaced as in the diagram, ***sides A and B*** were added (***A+B***) in the table.

An average of ***1000 ml*** was caught by a ***200 cm²*** area. A ***depth of 5 cm*** (2") is irrigated in each cycle through all the lanes.

### Evenness

The ***lowest quarter*** — the 4 of 16 cans with the least water — had an ***average of 693 ml***, or ***69%*** of the 1000 ml overall average.

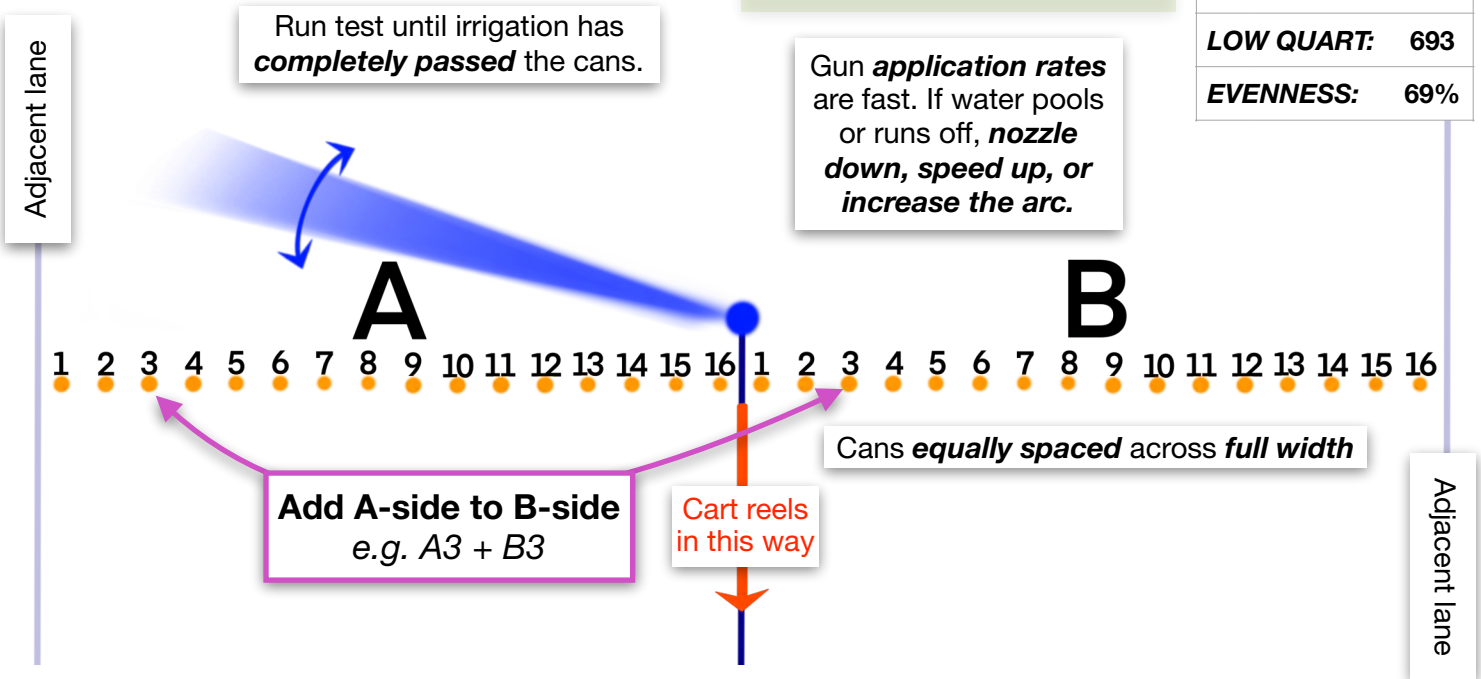
This ***uneven distribution*** may be from pressure problems, lanes too far apart, or a windy day.

***Volume (ml)***

| # | A | B | A+B |
|---|---|---|---|
| 1 | *0* | *1410* | **1410** |
| 2 | *0* | *1210* | **1210** |
| 3 | *0* | *1170* | **1170** |
| 4 | *0* | *1130* | **1130** |
| 5 | *50* | *941* | **990** |
| 6 | *188* | *752* | **940** |
| 7 | *225* | *525* | **750** |
| 8 | *272* | *408* | **680** |
| 9 | *298* | *322* | **620** |
| 10 | *432* | *288* | **720** |
| 11 | *595* | *255* | **850** |
| 12 | *725* | *205* | **930** |
| 13 | *900* | *100* | **1000** |
| 14 | *1120* | *0* | **1120** |
| 15 | *1180* | *0* | **1180** |
| 16 | *1300* | *0* | **1300** |
| ***AVERAGE:*** | | | **1000** |
| ***LOW QUART:*** | | | **693** |
| ***EVENNESS:*** | | | **69%** |

## TRAVELLING GUN CATCH CANS

### A full-width line between lanes.



# Centre Pivots

## CATCH FROM ONE PASS

### Set up cans from the pivot in a "spoke" to the far end.

Lay out cans in a straight line, ***equally spaced***, from the pivot to the furthest reach of the end gun.

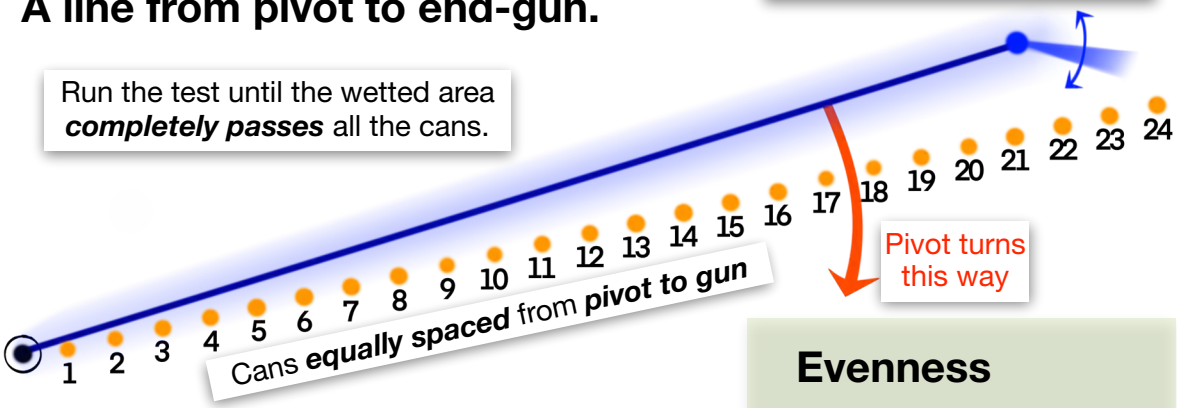
Turn on the pivot from a location before the cans, and ***irrigate completely over all the cans*** before collecting measurements.

The water collected is the amount that is irrigated in ***one pass of the pivot at that particular speed***.

## CENTRE PIVOT CATCH CANS

### A line from pivot to end-gun.

Run the test until the wetted area ***completely passes*** all the cans.




## Application Rates

For travelling guns and pivots, we calculate the application rate based on the ***time an area actually spends getting wet***.

E.g. A ***1000 ft pivot*** rotates once every 24 hours, so the ***farthest sprinkler*** moves at ***4 ft/min***. The sprinklers have a ***40-ft*** diameter, so the wetted time is ***10 minutes***. If 0.2" is applied in 10 minutes, that gives an ***application rate of 1.2"/hr***.

Can the soil absorb this?

A ***sandy loam*** growing grass might handle ***0.5"/hr***, and applications ***under 15 minutes*** can infiltrate ***2.5 times faster***. Because 2.5 x 0.5"/hr ≈ 1.2"/hr, the soil should be okay… but there's ***no substitute for going out to watch!***

## EXAMPLE

### Application Depth (per pass)

After the pivot completely passed all 24 cans, an average of ***90 ml*** fell in each cup (***180 cm²*** area), so a depth of ***0.5 cm (0.2")*** is applied with ***each pass.***

***Application rate*** is fastest at the far end of the pivot. See erosion? ***Speed up the pivot to reduce the rate.***

| # | Volume (ml) |
|---|---|
| 1 | 107 |
| 2 | 95 |
| 3 | 109 |
| 4 | 108 |
| 5 | 105 |
| 6 | 105 |
| 7 | 104 |
| 8 | 111 |
| 9 | 102 |
| 10 | 100 |
| 11 | 99 |
| 12 | 81 |
| 13 | 112 |
| 14 | 98 |
| 15 | 97 |
| 16 | 95 |
| 17 | 93 |
| 18 | 88 |
| 19 | 101 |
| 20 | 119 |
| 21 | 103 |
| 22 | 106 |
| 23 | 89 |
| 24 | 84 |
| ***AVERAGE:*** | 100 |
| ***LOW QUART:*** | 88 |
| ***EVENNESS:*** | 88% |

## Evenness

The ***lowest quarter*** — the 6 of 24 cans with the least water — ***averaged 88 ml***, ***88%*** of the 100 ml overall average. This is ***very even*** for sprinklers.

| Wetted time less than… | Soil can absorb… |
|---|---|
| 15 minutes | 2.5 x faster |
| 30 minutes | 2 x faster |
| 60 minutes | 1.75 x faster |
| 90 minutes | 1.5 x faster |
| 120 minutes | 1.25 x faster |

Soil can absorb water faster in shorter periods of irrigation.

# Drip or Spray

## SAMPLE EMITTERS

### Catch water from single emitters throughout one zone.

After the system is ***running and fully charged*** with water, collect the flow from ***single emitters*** chosen at random from widely spread out areas ***throughout a single zone***.

Do separate catch can tests for different zones.

If there are ***elevation changes***, you should capture samples from high, low and average elevations.

Sample ***laterals that are both close to, and far from, the zone valve*** that tees into the mainline. Within each lateral, capture samples from the ***beginning, middle, and end of the line***.

Finally, be sure to collect for the ***same amount of time*** for each emitter. Two minutes is usually plenty.

## EXAMPLE

### Application Rate

Drips were collected for ***2 minutes*** from single emitters in 20 places throughout one zone.

On average ***133 ml*** was caught, which equates to ***4 L/h*** (litres per hour), or just over ***1 gph*** (US gallons per hour).

### Evenness

The ***lowest quarter*** — the 5 of 20 cans with the least water — ***averaged 125 ml***, or ***94%*** of the 133 ml overall average.

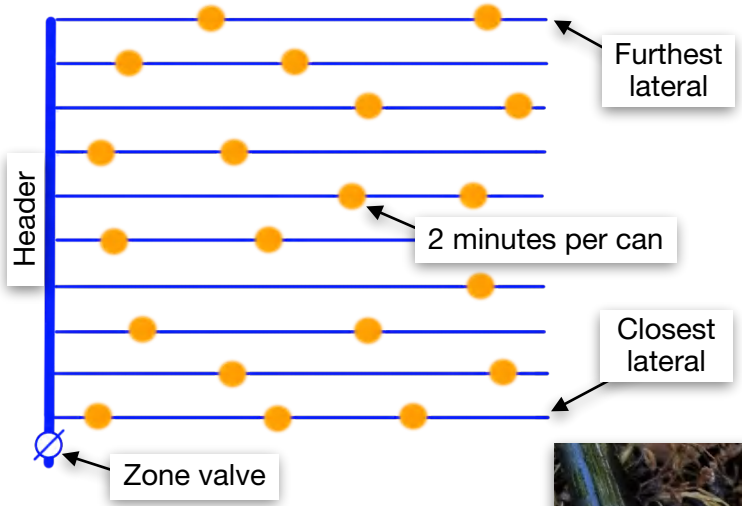
This is very even and it's in good shape.

Try to keep drip systems ***above 90% evenness***, especially if individual plants must rely on only one emitter.

| # | Volume (ml) |
|---|---|
| 1 | 144 |
| 2 | 142 |
| 3 | 133 |
| 4 | 140 |
| 5 | 126 |
| 6 | 130 |
| 7 | 137 |
| 8 | 125 |
| 9 | 136 |
| 10 | 132 |
| 11 | 129 |
| 12 | 128 |
| 13 | 142 |
| 14 | 124 |
| 15 | 140 |
| 16 | 122 |
| 17 | 126 |
| 18 | 140 |
| 19 | 134 |
| 20 | 130 |
| ***AVERAGE:*** | **133** |
| ***LOW QUART:*** | **125** |
| ***EVENNESS:*** | **94%** |

## DRIP CATCH CANS

### Random emitters across a zone.




***Other ideas…***

Sample a row of adjacent emitters at the same pressure to roughly measure the impact of "manufacturing variation".

For drip tape, or systems with many emitters per plant, catch the flow from a set length of trough or rain gutter.

Small changes in pressure have big impacts on flow rates. Use a ***pitot tube and gauge*** to measure pressure.