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Using a bucket and stopwatch to measure flow rates

One of the keys to irrigation management is knowing how much water is being applied. Knowing application amounts allows you to:

- Determine if you are applying more water than the crop needs or the soil can hold
- Work out if you are not applying enough water
- Calculate how much it is costing to irrigate (in conjunction with water and/or energy costs).

Calculating irrigation amounts is simple if you have meters, but what are the options if you don't have a meter? One option is to use an ultrasonic meter. These are instruments that have transducers that are mounted on the outside of the pipe. They bounce a sound wave between the transducers and calculate the flow based on the time it takes for the sound to move between the transducers. Ultrasonic flow meters are quite accurate, but they have some limitations. Firstly there needs to be a sufficiently long section of straight pipe without valves or breathers on which to mount the transducers. Secondly they use the wall thickness and pipe material in the flow calculations. Pipes with iron build-up or that are rusted on the inside change the wall thickness and render the meter inoperable.

The second option for calculating flow, if there isn't a meter, is to take bucket and stopwatch readings. Bucket and stopwatch readings are simple and require minimal equipment – but care and time needs to be taken to ensure an accurate result. They also require 2 people.

Equipment

Bucket – the bucket needs to be large enough to capture several litres of water without having it splash over the sides. It also needs to fit under the cup, be sturdy, and be manageable. At BPS we have found these 12 L plastic buckets to work in most situations. They have a good wide mouth and are made of thick plastic which doesn't bend or twist.

Measuring jug – to accurately measure the water that is caught in the bucket a calibrated jug is needed. A 5 L chemical jug is suitable – just make sure it hasn't been used for measuring chemicals.

Stopwatch – either use a stopwatch or the stopwatch feature on your phone.

Pen and paper to record the results

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Taking the readings

The key with bucket and stopwatch readings is to take enough readings across the set to get an accurate picture of the flow rate onto the block. The number of readings will be influenced by the size of the set. If it's a small set, then taking a measure from each cup or every second one is practical; but for large sets only a selection of cups can be measured. The more cups that are measured, the more accurate the result. Taking multiple readings for each cup will also improve the accuracy. It is also important to take the readings across the whole set, not just at one end or in the middle. For large sets, and depending on the set size, we would aim to measure every 3rd, 4th or 5th cup.

The first person has the bucket, while the second has the stopwatch. Before starting, ensure there is enough room under the cup to get the bucket under and to catch several litres of water.

The person with the bucket then places it under the cup and captures as much water as they can without it splashing out or spilling. The second person times how long it takes to catch the water. It is usually easier if the person with the bucket counts down to the start. Don't worry about trying to capture a specific volume or taking a certain amount of time – just catch as much as possible and time how long it takes.

Measure the volume of water that has been caught by pouring it into the measuring jug.

Record the volume (litres) and the time (seconds).

When all the measurements have been taken, add up the total litres and the total time. Then divide the litres by the time to get an average L/s/cup.

It can also be helpful to calculate individual cup flows to see how consistent the flow is across the set.

Calculate the application amount

To calculate the amount of water being applied:

1. Multiply the average flow by the number of cups to get total litres/second **(L/s)**
2. Multiply **L/s** by 3600 to get litres per hour **(L/hr)**
3. Multiply **L/hr** by the number of hours the irrigation ran for to get total litres **(L)**
4. Divide **L** by 1,000,000 to get megalitres **(ML)**
5. Divide **ML** by the area being watered (in hectares) to get **ML/ha**; to convert from ML/ha to mm, multiply by 100 e.g. 1.5 ML/ha = 150 mm