AHDB

Calibrating a water-powered proportional dilutor

Figure 1. Proportional dilutors are essential items of nursery equipment permitting the delivery of soluble fertilisers, entomopathogenic nematodes, plant protection products and other liquid concentrates

Action points

- **Calibrate water-powered proportional dilutors every six months, or least on an annual basis, record the results obtained and any actions undertaken as a consequence, such as adjusting the dilution settings on the unit**
- **Ensure any conductivity meter used in the calibration procedure is temperature compensated and calibrated**
- **As part of the calibration process take the opportunity to carry out other checks and inspect the basket filter in the unit head (as appropriate) and the filter in the end of the concentrate extraction pipe to make sure they are clean and undamaged, and also the 'o' ring washers on the valve seats in the unit head to ensure they are still in place**
- **Do not leave any fertiliser solution in the dilutor over the winter period or during long periods of non-use, wash the unit out with clean water prior to storage**

A number of different types of dilutor, of varying levels of sophistication and available dilution ratios, are used on nurseries and farms to apply a range of soluble fertilisers, entomopathogenic nematodes and plant protection products to crops, disinfectants onto hard surface areas, or inject various acids and water treatment additives into stored water sources. This factsheet focuses on the calibration of the water-powered proportional dilutor or dosing pump, traditionally used to apply soluble fertilisers to crops, (Figure 1) and should be used in conjunction with the AHDB video entitled 'Calibrating a water-powered proportional dilutor'.

Introduction

A range of in-line or mobile dilutors are used on nurseries and farms to primarily deliver soluble fertilisers to crops, however depending upon their relative accuracy and flexibility, other materials which need to be applied as high volume drenches to crops, hard surface areas or injected as concentrates into larger volumes of water can also be delivered through them. A water-powered proportional dilutor injects a set amount of concentrate into the water passing through it, the concentrate then mixes with the water before the water pressure pushes the solution out of the unit and into the irrigation network. The dose of the concentrate injected by the unit is proportional to the volume of water entering it. It is important to calibrate such units at least annually to ensure they are still performing within the stated tolerance, wear and tear and damage to key parts can impair their performance.

Equipment needed to undertake the calibration procedure

The following items listed below, and shown in Figure 2, are required to undertake the procedure:

- Scales reading in one gram intervals to 2,000g (2kg), with a zeroed reading facility
- A small measuring cylinder capable of measuring up to 20ml in 5ml intervals
- A range of bottles or beakers with capacities of 500mls
- An electrical conductivity meter which has temperature compensation built into it

It is important to have calibration solutions for the electrical conductivity meter and to calibrate the meter at least every four to six months. Generally electrical conductivity meters are far more reliable and robust than pH meters.

Figure 2. Essential items of equipment that are required to undertake the calibration procedure

Calibration procedure

First of all make up a fertiliser stock solution using any commonly available water soluble fertiliser, or use a readily available fertiliser stock solution which would normally be applied to the crops grown. For example, take a compound water soluble fertiliser such as 20-10-20 (N:P:K) and make up a stock solution containing 100g/l. Dissolving the crystalline fertiliser in the water will reduce the temperature of the solution, therefore it should be left for a short while to reach ambient temperature. If possible when making up the stock solution use warm water (say 15–20°C) to help dissolve the crystals and stir the solution continuously to ensure the fertiliser is fully dissolved.

When measuring out small amounts of liquid it is often easier and more accurate to use scales rather than go by the graduation marks on the container. As one millimetre of water equates to one gram in weight this makes the process straightforward. Zero the scales with the container on them and weigh out the corresponding amount of solution.

Weigh out 10g of the water soluble fertiliser stock solution into a small container using the small measuring cylinder. (The type of plastic measuring thimble supplied with cough medicines is accurate enough for this). Pour the measured amount of stock solution into a clean, dry beaker or bottle capable of holding 500mls plus of solution, already placed on a set of scales which have been zeroed, so that the recorded weight is 10g. Now pour in water from the nursery/farm supply until the reading on the scales is 500g. At this point the beaker contains a diluted solution of 1 in 50 (2%). Measure the electrical conductivity (EC) of the diluted stock solution just created. This will be the highest value recorded and will probably be around 2,100μS/cm^2 (microsiemens) or 2.1mS/cm^2 (millisiemens), depending upon the EC of the water used during the calibration procedure. Record the value obtained.

Take a fresh bottle or beaker and place it on the scales and again zero the reading. Weigh into this bottle 50ml of the previously diluted (2%) solution. This should read 50g on the balance. Add to this a further 50mls of the nursery/farm water supply such that the balance now reads 100g. The solution created has now been diluted to 1 in 100 (1%). Measure the EC of this solution, the value will probably be around 1,400–1,500μS/cm^2 or 1.4–1.5mS/cm^2, and record the value.

Finally, in a clean bottle or beaker, again zeroed on the scales, weigh out 50g of the previously diluted solution (1%) and add to it a further 50mls of the nursery/farm water supply. This solution will now be a dilution of 1 in 200 (0.5%). Measure the EC of this solution, which will be in a range of 700–900μS/cm^2 or 0.7–0.9mS/cm^2, and record the value.

The values can be recorded in a table as outlined in Table 1, noting the EC level recorded against each of the sequential dilution ratios.

Table 1. EC values obtained from the calibration procedure

Dilution ratio or equivalent percentage solution	1:50 2%	1:100 1%	1:200 0.5%
Electrical conductivity value obtained (µS/cm²)	2,100	1,450	825

A graph of the data can then be plotted and used as a calibration curve (Figure 3) as follows:

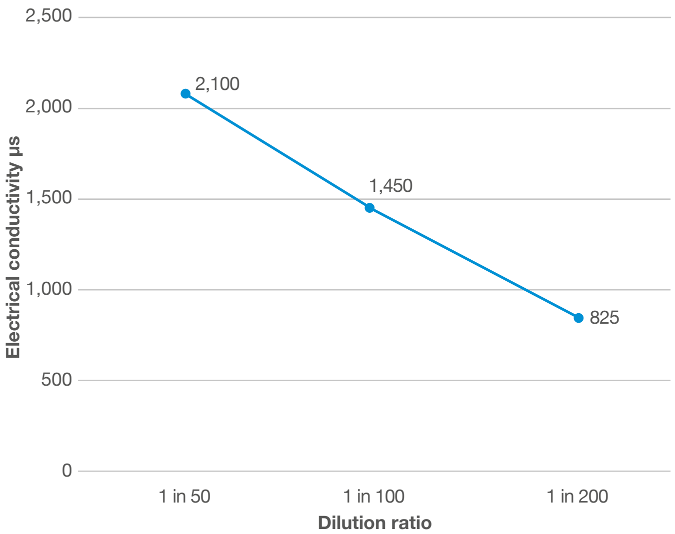

Figure 3. Example calibration curve which can be used to assess the performance of on-site proportional dilutors via the predicted EC levels

The calibration curve created can then be used to test the output of the dilutor at a specific dilution setting. Take the stock solution used to produce the calibration curve and run it through the proportional dilutor to be assessed. Collect the output solution and measure the EC of the solution and compare it to the calibration curve.

For example, at a setting of 1 in 100 (1%) on the proportional dilutor, an EC reading of 1,300µS/cm² may be obtained, where the calibration curve predicted a value of 1,450 µS/cm². To compensate for this, the dilution setting on the dilutor can be adjusted, possibly to 1 in 80 (1.25%). To check this, take a second sample and measure the EC to see if the reading is nearer to the value required. In this way the setting on the dilutor is used as an indicator and the actual accuracy is measured by the use of the EC value. Experience has shown this task to be essential, a regular check is required to verify the correct levels of soluble fertilisers (and other substances) are being applied to crops through the unit.

Note that all the values obtained include the EC of the nursery/farm irrigation water from the source used. Water in the U.K. can have EC values varying between 50µS/cm² and 1,200µS/cm², depending upon source and geographic location. The water used in the calibration procedure described had an EC of 100µS/cm², so all the values shown in Table 1 can only be used for another water source if they were first reduced by 100 and then had the new irrigation water EC value added onto them.

Simple unit maintenance

While undertaking the calibration procedure, it is useful to consider a number of important points regarding unit maintenance:

- Where appropriate check the basket filter in the unit head (Figure 4) to make sure it is clean. It can become clogged with debris in the water source, or concentrate fertiliser crystals can develop on it during periods of low or no use. Ideally when a dilutor is not being used it should be washed out with plain water, via the concentrate feed intake tube, to remove any potential residual fertiliser solution
- Many dilutors contain small 'o' ring washers on the valve seats which close the flow when injecting the concentrate. These 'o' rings can be 'blown off' the valves if the initial water pressure exceeds the unit tolerance levels. These should be checked to make sure they are in place and not damaged. Ideally, upon commencing use of the dilutor, the flow rate of the irrigation water should be gradually increased to working pressure. When in use, the dilutor (if of the piston type) should make a steady audible 'click, click click', as the piston is driven up and down within the unit

Figure 4. Basket filter removed from the unit head of the proportional dilutor ready for cleaning

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Glossary

Electrical conductance (EC): a measure of the ease by which an electrical current passes through a solution or substance; one millisiemen (mS) equates to one thousand microsiemens (µS).

Further information

AHDB Horticulture factsheets and other information

Factsheet 10/16: 'Sampling methodologies and analysis interpretation for growers of hardy nursery stock'.

Factsheet 06/07: 'Principles of strawberry nutrition in soil-less substrates'.

Factsheet 05/05: 'Nutrition of container-grown hardy nursery stock'.

Wallchart 'Strawberry analysis chart – optimum ranges'.

Transfer of INNOvative techniques for sustainable WAter use in FERtigated crops (EU funded Fertinnowa project), website address – **www.fertinnowa.com**

Acknowledgements

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Watch our 'how to' video for an easy step-by-step visual guide to calibrating a water-powered proportional dilutor. Available from: **bit.ly/ProportionalDilutor**

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