

Protocol on how to save water & fertilizers in horticulture

Berries & small fruit

1. Reduction of fertigation (water and nutrient input)

1.1 By the use of tools

A. Substrate sensors

Manual sensors, such as WET-sensor and water sensors, can significantly reduce the amount of water and fertilizer use. The WET-sensor determines the volumetric water content and the electric conductivity (EC) of the soil or substrate. Water sensors measure the fertigation input and runoff volumes. They are easy to use, low cost but their implementation requires some experiences to measure, assess and adjust the irrigation timing and irrigation volumes according to the daily needs of the crop.

- How to use soil sensors?

○ WET-sensor:

Measure at least representative grow bags or pots e.g. measure a few bags/pots in the middle and also at each end of each row in the tunnel several times a week. Make sure that the WET sensor is set up for the type of substrate you use (coir, peat, soil).

Guide values:

- Substrate moisture (% volumetric moisture content) should generally be maintained between 45% and 55%. Could be up to 60% in cases when large canopy is supported by small root volume such as raspberry in pots.
- The electric conductivity (EC) is the indication of how much fertilizer is in the substrate and should generally be maintained between 160-180 mS/m.

○ Water meters:

Various meters and methods could be used with similar efficacy. A simple measuring cylinders can be used to capture the fertigation input volume from the drippers and run-off from the gutters installed below grow bags or pots. More advanced water meters/counters and run-off gauges can be installed in line with fertigation to log the input and run-off.

Guide values:

- Run-off % (run off per unit area/ input per unit area) can in most cases be kept between 10 and 20% without decreasing the yields and quality.

Precision irrigation systems such as Precision Irrigation, Senmatic Intelligent Irrigation Program and others can combine real time data from the sensors in the field (temperature, light intensity, wind, substrate moisture, fertigation input, run-off,...) to automatically and reliably use exactly the amount of fertigation required in a given circumstances with minimal or no labour. These systems can save significant amount of water and fertiliser, reduce fluctuations such as under and over watering and thus increase yields/quality and reduce disease risks. They are more expensive and will normally be

Installed by trained professionals who then train the farm personnel on their use and support them with day to day operation.

B. Non-destructive plant health sensors

Can be very useful to determine the minimum amount of fertigation required in your cropping system. These sensors can pick up indicators of plant stress before visible symptoms appear on the plants. They can detect early decrease in chlorophyll and increase in secondary stress metabolites (Dualox sensor), increase in chlorophyll fluorescence (MiniPAM sensor) or decrease in photosynthesis efficiency (LiCOR sensor). Ideally a small section of the crop would be used to measure the effects of decreased fertigation on the crop and then apply the output on the larger scale. These sensors can also give a good indication of the presence of abiotic stresses, such as drought stress or nutrient deficiency.

- How to use non-destructive plant health sensors?
 - Measure representative plants in at least weekly. Take care to measure plants at the edges and at the middle of the plots, rows, tunnels.
 - Compare indices of plant stress with plant in optimal conditions to verify whether there is a stress present.
- ➔ On the Bio4safe-project page (<https://bio4safe.eu/sensors>), you can find information leaflets about different soil sensors, LiCOR, MiniPAM, Dualox, sapflow sensors, dendrometers and non-destructive optical sensors.

1.2 By combining tools and biostimulants

Substrate sensors and non-destructive plant health sensors can be used in combination with biostimulants, which can influence the nutrient use efficiency and drought stress tolerance of plants. You can find the most suitable biostimulant for your situation in our online Bio4safe database.

- How to use Bio4safe-database?
 - Surf to <https://bio4safe.eu/>
 - Click on the button '**Crop group**' and select '**Berries and small fruit**'
 - If you want, you can further filter your search result for the desired effect. (E.g. 'Increased nitrogen 'N' use efficiency; 'Increased phosphorous 'P' use efficiency;...)
 - Click on one of the listed products you are interested in.



Case study 1: Strawberry (*Fragaria x ananassa* cv. Malling centenary)

A reduction of inputs (fertigation fluid) between **20-50%** in comparison to standard commercial practice can be achieved using precision Irrigation in table-top June bearing strawberry grown in coir bags **without decreasing yields or quality**. With the coir moisture kept around 50% and run off around 10-15%, the June bearer strawberries can be grown with fertigation input as low as 13-15 L per plant per season while maintaining commercially comparable yields (350+ g of class 1 yield per plant) and quality. Furthermore, **short 24 h irrigation failure events did not affect the yield or quality** of strawberry grown at the reduced fertigation regime. On the contrary, when overwatering occurred (coir moisture above 60% and run off above 40%) we observed decrease in quality (BRIX), decrease in firmness, and increase of unmarketable fruit.



Case study 2: Raspberry (*Rubus idaeus*)

A reduction of fertigation in coir grow raspberry production is also possible with precision irrigation. When 2-3 raspberry canes are grown in a single 10 L pot the substrate moisture should be kept between around 50% and run-off should be around 10-15%. Due to the small root volume, large canopy and fruit load the **yield starts decreasing when the run-off is decreased to below 10 % and can be reduced as much by as 30-40% when plants are grown with no run-off**. Comparing commercial practice with 30-40% run-off to **precision irrigation with 15% run-off as much as 30% of fertigation liquid can be saved** and the total run-off volume by as much as 75%. The ware use in reduced irrigation was around 48L per season per raspberry cane with each cane yielding around 1.25 kg of marketable berries per season.