Protocol on how to safe water & fertilizers in horticulture

Ornamentals – Annuals

1. Reduction of water input

1.1 By the use of tools

- Which sensors?

Substrate sensors, such as WET-sensor (fast, cheap, user friendly) measure soil or substrate moisture and conductivity. These sensors can be used to monitor the effect of water reduction on the substrate and the plant and can thus significantly reduce the amount of water use. More advanced plant-based tools are also available, e.g. porometer (stomatal conductance), but advice and help of researchers or other external parties is recommended.

- How to use substrate sensors?

- Perform scattered measurements every 1 to 2 weeks in representative pots. If reduction in irrigation started, measure several times a week to follow up the moisture content of the soil/substrate more closely. If you use sensors coupled with a datalogger, the characteristics of the soil are continuously monitored. Make sure that the WET-sensor is set up for the types of substrate you use (coir, peat, soil).
- Short periods of mild/severe drought stress can be tolerated without heavily effecting commercial plant quality.

Guide values for peat-based substrate:

- 40 – 50 vol%: optimal
- ± 30 vol%: mild drought stress
- ± 20 vol%: moderate drought stress

➔ On the Bio4safe-project page (https://bio4safe.eu/sensors), you can find information leaflets about different types of soil sensors and a porometer.

1.2 By combining tools and biostimulants

Soil sensors and the more advanced tools can be used in combination with biostimulants, which can influence plant tolerance against drought stress. You can find the most suitable biostimulant for your case in our online Bio4safe database.

- How to use Bio4safe-database?

- Surf to https://bio4safe.eu/
- Click on the button '**Crop group**' and select '**Annuals**'
- If you want, you can further filter your search result for the desired effect. (E.g. 'Increased drought stress tolerance)
- Click on one of the listed products you are interested in for more detailed information.

2. Reduction of nutrient input

2.1 By the use of tools

- Which sensors?

Non-destructive optical sensors that pick up indicators of nutrient stress such as early decrease in chlorophyll and increase secondary stress metabolites (phenolics, anthocyanins) e.g. Dualex Scientific (fast, cheap and easy to use, but control needed) and PolyPEN RP410 (fast, cheap, easy to use software, control needed) or increase in chlorophyll fluorescence e.g. MiniPAM (more advanced, robust, fast, sensitive and reliable measurements). These sensors can give a good indication of the presence of stress if slight visual color differences become visible (more severe stress). If there is nothing noticeable visually, it is recommended to combine the sensors with isotope analyzes or other destructive laboratory analyzes.

- How to use non-destructive optical sensors?

- Perform scattered measurements on the youngest, fully developed leaf of representative plants at the edge and in the middle every 1 a 2 weeks. Remind yourself that the pigment content doesn't change quickly when a plant experiences stress.
- Compare indices of plant in nutrient stress with plant in optimal conditions to verify whether there is a shift in the pigment composition (less chlorophyll and more secondary metabolites) due to the presence of stress.

➔ On the Bio4safe-project page (https://bio4safe.eu/sensors), you can find information leaflets about different non-destructive optical sensors.

2.2 By combining tools and biostimulants

Non-destructive optical sensors can be used in combination with biostimulants, which can influence the nutrient use efficiency 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 '**Annuals**'
- 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: Surfinia (*Petunia x hybrida* 'Surfinia White'®)

1. *Reduction in irrigation*

A reduction in overhead irrigation (top sprinkling) of **20 % (4 L/m² instead of 5 L/m²; 2000 J)** is possible resulting in a **higher commercial plant quality** (more compact (-19%) & blooming (+12%) plant). The seaweed extract **Kelpak** had an additional effect on the number of **flowers (+36.8 %)** compared to the untreated control grown in the same drought stress conditions.

Even a reduction of **40 %** in overhead irrigation (**1.03 L/m² instead of 1.72 L/m²**) is possible, with a more branched (+9%) and compact (-22%) plant as a result.

2. *Reduction in fertilizers*

A reduction in fertilizer use (slow-release fertilizer) of **20 % (2.2 kg/m³ substrate instead of 3 kg/m³ substrate)** is possible, but commercial plant quality may be negatively affected (less (-18%) and shorter (-9%) branches). The seaweed extract **Kelpak** had an additional positive effect on the branch length (+6.6 %) compared to the untreated control in the same stress conditions.

A further reduction of **40 %** in fertilizer use (**1.8 kg/m³ substrate instead of 3 kg/m³**) is possible, with more compact plants as a result (-18% more compact, no significant effect on branching).