

# Protocol on how to safe water & fertilizers in horticulture

## *Leafy vegetables*

### 1. Reduction of water input

#### *1.1 By the use of tools*

##### - Which sensors?

**Soil sensors**, such as tensiometers (real-time measurements, cheap, easy to use) measure the relative water content of soil/substrate. Absolute values of the water content depend on the soil type. These sensors can be used to monitor the effect of water reduction on the soil/substrate and the plant and can thus significantly reduce the amount of water use. More advanced plant-based tools are also available, e.g. leaf clips (measurement of leaf thickness variation), but advice and help of researchers or other external parties is recommended.

##### - How to use soil sensors?

- Place sensors scattered in the greenhouse, tunnel or field at different depths, at the edges and in the middle of the area. Tensiometers are coupled with a datalogger, which continuously monitors the characteristics of the soil.
- Follow the evolution of the relative water content at the different depths and increase irrigation when soil water content decreased between 2 consecutive descending depths (e.g. between -30 cm and -40 cm) or reduce irrigation when soil water content increases at these depths.

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

#### *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 specific case in our online Bio4safe database.

##### - How to use Bio4safe-database?

- Surf to <https://bio4safe.eu/>
- Click on the button '**Crop group**' and select '**Leafy vegetable**'
- 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 measure indicators of nutrient stress such as early decrease in chlorophyll and increase in secondary metabolites e.g. Dualex Scientific (fast, cheap and easy to use, but control needed and possible damage of leaf clip to the lettuce leaf) and Greenseeker (fast, cheap and easy to use) or increase in chlorophyll fluorescence e.g. Pocket PEA (fast, easy to use software, cheap). 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 leaves of representative plants (e.g. Dualex Scientific, Pocket PEA) or on a constant distance above the crop (e.g. Greenseeker) every 1 a 2 weeks. Remind yourself that the pigment content doesn't change quickly when a plant experiences stress.
- Compare indices of plants in nutrient stress with plants 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 '**Leafy vegetable**'
- 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: Lettuce (*Lactuca sativa L. var. capitata*)

### 1. Grown in field under tunnel – reduction in irrigation

After **20 % reduction in irrigation** given by top sprinkling (**41 mm instead of 52 mm along lettuce cycle**; 8 applications in total during 2 months) and without the application of biostimulants, no significant reduction in lettuce quantity or quality was observed.

### 2. Grown in open field – reduction in fertilizers

When large amounts of nutrients are present in the soil, fertilizer application can be reduced. A good and structured sampling with analysis of the soil is therefore very important to keep a finger on the pulse.

In our trial the mineral soil nitrogen, measured at the beginning of plantation, was 40 kg N/ha. Lettuce needs 120 kg N/ha. Taking into account possible soil mineralization, different nitrogen doses were applied. After 50 % reduction in **fertilization (25 units N instead of 50 units N in the control situation)** and without application of biostimulants, no significant reduction in lettuce quantity or quality was observed.