BioGreenhouse

Guidelines for Experimental Practice in Organic Greenhouse Horticulture

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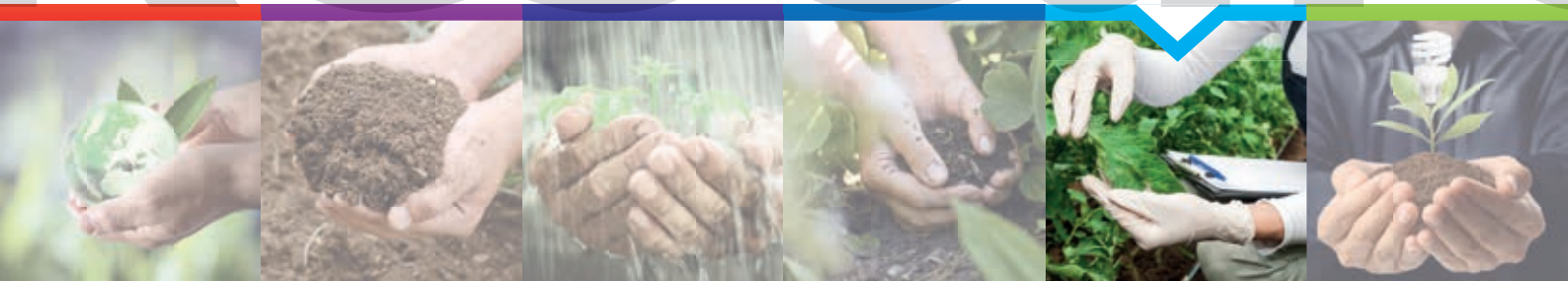

The Editorial Board *This picture was taken at the final meeting to discuss these guidelines, held in Tori, Estonia in September 2015. A commercial organic greenhouse with a tomato crop is shown in the background. Left to Right: Pedro Gomez, Stella Cubison, Wolfgang Palme, Justine Dewitte, Martin Koller, Yüksel Tüzel, Francis Rayns, Ingrid Bender and Ulrich Schmutz.*

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Pictures
All pictures are by members of the Biogreenhouse COST Action FA1105. Contributors to the pictures (in alphabetical order) are: Ingrid Bender, Stella Cubison, Justine Dewitte, Pedro Gomez, Martin Koller, Carolyn Mitchell, Jérôme Lambion, Wolfgang Palme, Virginia Pinillos, Ulrich Schmutz, Yüksel Tüzel and Anja Vieweger.

Disclaimer
The information in these guidelines is based on the expert opinions of the various authors. Neither they, nor their employers, can accept any responsibility for loss or damage occurring as a result of following the information contained in these guidelines.

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References and further information

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3.2.2 Experiments with liquid fertilisers

By Martin Koller

General requirements

The plots must have been fertilized equally in the previous years. If this is not the case the crop and soil management should have be the same at least within each experimental block. If there is any doubt about the homogeneity of the trial site a nitrogen demanding green manure could be established prior to the experiment (e.g. oil radish). The biomass of this green manure has to be removed before the experiment begins.

An appropriate buffer around each core plot has to be established. In most cases 1 m along the row and one row between the plots is sufficient to separate different fertigation treatments (liquid fertilisers mixed in the irrigation water). However the minimum distance between core plots depend on the irrigation system. With drip irrigation systems, at least the length of 3 drip holes between the core plot and the border of the plot should be reserved as a buffer. With sprinkler irrigation systems the border around the core plot has to be at least 1.5 times the irrigation radius of the sprinkler.

Fertilisers

All the fertilisers to be tested have to be characterized carefully. In most cases it is best to determine the nitrogen (and carbon) content of each batch to be used before the experiment begins. For liquid organic fertilisers the density and the viscosity has to be measured (in the case of viscosity this can most easily be described by comparing it to well known fertilisers).

Fertilisers should be applied according to their total nitrogen content. If it is suspected that their rates of nitrogen availability are very different a preliminary incubation experiment should be carried out to determine availability ratio of each one. This enables them to be applied according to "available nitrogen " instead of total nitrogen.

Fertiliser application

For experimental use it is possible to mix the fertiliser with water and to spread it with watering cans. However this is very unlike true farm practice so it is therefore advisable to use drip irrigation hose for each treatment separately and mix the fertilisers and the irrigation water with proportional dosing pumps (e.g. Dosatron).
If dosing pumps are used, it is important to confirm that they work properly, e.g. by measuring the nitrogen content of the fertigation solution. Especially with very viscous fertilisers dosing pumps do not always run properly. In such cases some water should first be added to the fertiliser (20-50% of the volume of the fertiliser is usually sufficient) and the dosing pump then adjusted accordingly. Alternatively the fertilisers can be mixed manually. Some fertilisers will cause clogging. They should, therefore first be tested on a small scale and after every fertigation run the system should be rinsed with clean water.

Figure 3.3 *Equipment used for fertigation of greenhouse crops, mixing nutrients into the irrigation water.*

Soil and plant samples

Before the start of the experiment soil samples should be collected from all plots. For fruiting vegetables samples should be taken down to 60 cm depth; in lettuce and other more shallow rooting crops 30 cm might be sufficient. During the cropping period additional soil sampling could be conducted although mineral nitrogen analysis will not show if plants have already taken up the available nitrogen or if the fertiliser is not yet completely mineralized; interpretation or the results is not straightforward.

A more direct approach is to measure nutrients in plant sap (e.g. using portable ion meters such as LAQUAtwin, www.horiba.com) or to measure the colour of the leaves (e.g. using Minolta SPAD 502 chlorophyll meter).

Soil samples should also be collected at the end of experiment. Measurements should also be made of the vegetative plant material, harvested fruits (at a representative number of harvests) and any leaves or side shoots that are removed. The nutrients in these components should be determined and the data can be used to calculate a nutrient budget for the crop.

In the following example, for nitrogen, the apparent effectiveness of an organic fertiliser could be calculated according to:

N_{tot} = Sum of nitrogen in plants
N_{min} = Mineralised nitrogen in the soil at the end of experiment

Evaluation

In most cases a comparison of the yield is sufficient to compare the effectiveness of different fertilisers. Yield determination has to be carried out according to the recommendation for the different vegetables (see Chapter 4). In fruit crops such as tomatoes, some quality parameters such as total soluble solids, titratable acidity and firmness on at least at three harvest dates could complete the assessment. With leafy vegetables, produce should be sampled for nitrate, at least if grown during winter time, because of concerns of its effects on human health.