BioGreenhouse

Guidelines for Experimental Practice in Organic Greenhouse Horticulture

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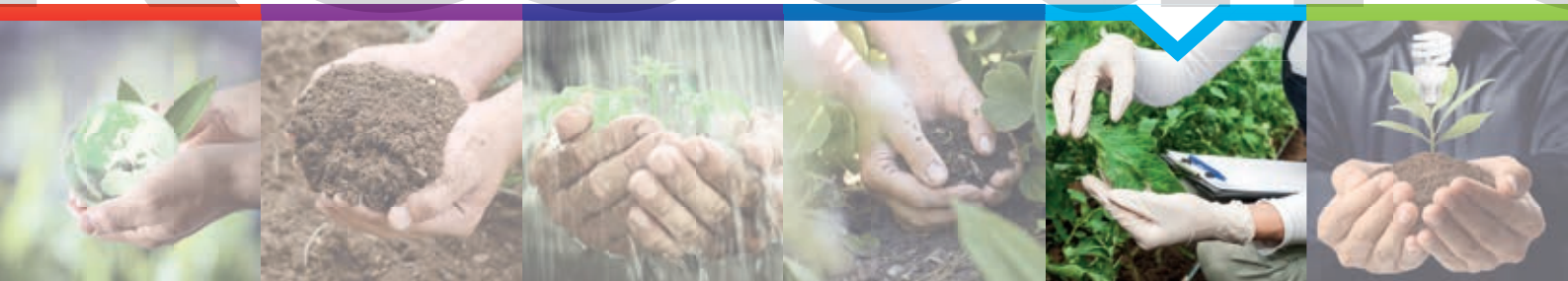

The Editorial Board *This picture was taken at the final meeting to discuss these guidelines, held in Tori, Estonia in September 2015. A commercial organic greenhouse with a tomato crop is shown in the background. Left to Right: Pedro Gomez, Stella Cubison, Wolfgang Palme, Justine Dewitte, Martin Koller, 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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3.2.3 Experiments with compost

By Jacques Fuchs

Aims of compost experiments

Depending on the situation there can be various aims of compost experiments. For example to study the influence of compost on soil structure, on water holding capacity, on plant nutrition, on plant health, to compare of the effect of different compost types (different inputs, different maturity etc.), or to compare different strategies of compost use (e.g. distribution over the whole field or only in the crop rows, rates and timing of compost application etc.).

Before beginning a compost experiment, the specific question to be answered has to be clearly defined as this will influence the design. For example, if the primary aim is to study/demonstrate the influence of the compost on the soil structure, the experiment has to have a minimum duration of five years but if the aim of the experiment is to investigate the effect of compost against diseases then a duration of only one or two crops may be sufficient.

General requirements

The site on which the experiment will be done has to be homogenous. The choice of the site should be in relation to the question we want to investigate (e.g. using land with, or at risk of, soil structural problems if we want to investigate the influence of compost on soil structure).

The composts used have to be well characterized in order to compare the results of different experiments. When analysis results are stated it is important to be clear about the methods used and if the results are expressed relative to compost volume or compost weight (fresh or dried). Different countries each have normally accepted methods (that may be related to compost quality standards e.g. BundesgütegemeinschaftKompost, VKS-ASIC 2010). The concentration of some elements is often expressed in terms of their oxides (e.g. P_2O_5 rather than P). This may be a legal requirement for the declaration of fertiliser composition but it can easily lead to confusion. The information needed includes:

Information about the composting process:

- Quantitative and qualitative characterisation of input materials (in percentage terms).
- Composting system (e.g. open windrow or in vessel).
- Profile of temperature and moisture content during process.
- Information on the intensity and method of compost turning.
- Duration of the process.
- Storage conditions.

Physical and chemical and biological analysis of the compost:

- Sieving size (in mm).
- Bulk density of fresh compost (weight per volume).
- Dry matter (in as a percentage by weight of fresh compost).
- Organic matter (usually as a percentage of dry matter).
- Ph (in water or in a specific salt solution).
- Electrical conductivity and salt content.
- Total element content of major nutrients (including nitrogen, phosphorus, potassium magnesium, calcium).
- Available or extractable nutrient content (e.g. NH_4-N, NO_2-N and NO_3-N).
- C/N ratio.
- Total potentially toxic elements (e.G. Mercury, cadmium and zinc).
- Contamination with inert materials (stones, glass, metal and plastic).
- Occurrence of viable weed seeds.
- Occurrence of human pathogens.

Depending of the aim of the experiment, knowledge of other characteristics of the compost can also be important (Fuchs *et al.* 2008). For example suppressivity potential against Pythium and Rhizoctonia or phytotoxicity effects.

The soil where the experiment is performed also has to be analysed (type of soil, texture, organic matter content, N, P, K, Mg, Ca etc.). It is very important to describe exactly the methods used for the determination of the compost and soil parameters (especially the extraction medium used) as a number of techniques are available that may give quite different results.

Quantity of compost used

The maximum quantity of compost used is determined by the balance of fertiliser. The nitrogen is usually in a very unavailable form and so in some countries (e.g. Switzerland) only 10% of the total amount is considered in the balance. However there may be other limits of application (e.g. in Switzerland a maximum of 25 tonnes dry matter per ha can be applied in any three year period). As the compost cannot offer to the plant all the nutrients in sufficient quantity additional inputs may also be needed (e.g. of nitrogen).

Reference plots

If not only fertilisation questions have to be answered by the experiment, it is important to have, in addition to an untreated reference plot, also a standard treatment (a N, P, K, Mg control). The quantity of fertiliser in this plot has to represent the fertiliser content in the compost, and the availability of the fertilisers also has to be similar. For K and Mg, 'Patentkali' can be recommended – this is a mixture of potassium sulphate and magnesium sulphate. P can be added as rock phosphate. For nitrogen, it is recommended to add horn shavings to balance the soil N_{min} content as a result of compost addition.

Experimental design

For experiments with a duration of only one season, a standard design with four replications can be used. The plots have to be of a sufficient size to avoid border effects in the evaluation of the results (e.g. plots with a minimum width of 4 crop rows and length of 10 meters; the middle two rows are evaluated between meters 2 and 8). For experiments with a duration of several years (e.g. to evaluate the effect of compost on soil structure) the plots have to be larger in order to avoid the mixing of soil from the various treatments. The buffer zones, in which no measurements are done, are more important than in the short time experiments. For experiments running for several years, soil samples from all the plots should be collected and analysed before the work begins in order to establish base line values.

References and further information

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3.2.4 Experiments with green manures

By Francis Rayns

Background

Green manures are crops grown for the benefit of the soil rather than for harvest and sale. They can have a number of effects in protected cropping that include:

- Adding nitrogen to the soil by nitrogen fixation (legumes only).
- Modifying the availability of other plant nutrients.
- Adding organic matter to the soil.
- Stimulating biological activity.
- Contributing to the control of weeds, pests and diseases.