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Composting and fertilization trials

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Composting and fertilization trials

- Introduction
- Methodology of exact trials
- Trials to optimize the composting process
- Optimization of utilization of compost

Introduction

- Use of quality composts
  - Improve and maintain soil fertility
  - Supply an optimal nutrition for the plants
  - Increase quantity and quality of vegetable production
  - Improve soil structure and water retention
  - Protect crop against diseases
- To be successful, it's need to
  - Optimize composting process
  - Optimize compost utilization
- Composting and fertilization trials are the way

Introduction

› Aims of compost and fertilization trials: optimize the entire process, from choice of raw materials to utilization of the composts

- Starting mixture (quality and quantity of the different ingredients)
- Composting system (often already defined and only little change possible)
- Composting process management (control of aeration and humidity, turning frequency, etc.)
- Duration of maturation
- Choice of the adapted compost and utilization strategy for the different target uses

Methodology of exact trials

› To obtain useful results, it is important to manage the composting process precisely in order to control the different parameters

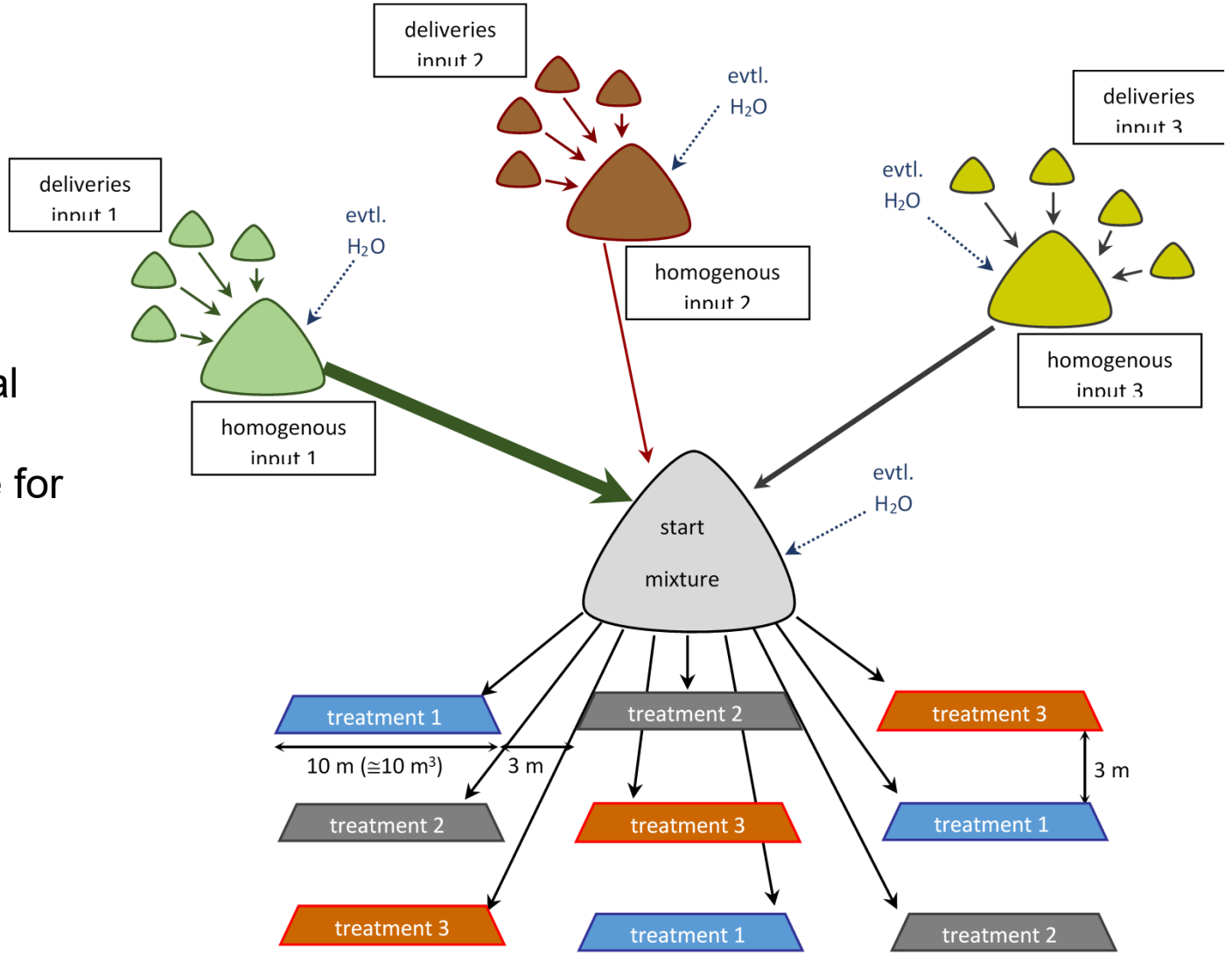
- Technical measures (e.g. covering the material to avoid uncontrolled losses of humidity)
- Dimension of the compost trials (for windrow composting, at least 10 m^3 of starting material is necessary to obtain representative results)
- Per treatment and trial at least three replicates are needed
- The composting process has to be intensively looked after, especially in the first ten weeks of the process

Methodology of exact trials

- Preparing raw materials and starting mixture
  - The raw materials have to be of good quality and free from impurities. Attention has to be paid to the collection and the storage of the raw materials.
  - Aim of the preparation of the raw materials: obtain an homogenous starting mixture.
  - If the starting mixture is the same for different treatments, a homogenous mixture has to be prepared in a sufficient quantity for all treatments (+ about 10% as reserve), and then divided between the different treatments.
  - If different mixtures have to be compared, a homogenous mixture has to be prepared for all replicates, and then divided between the different replicates

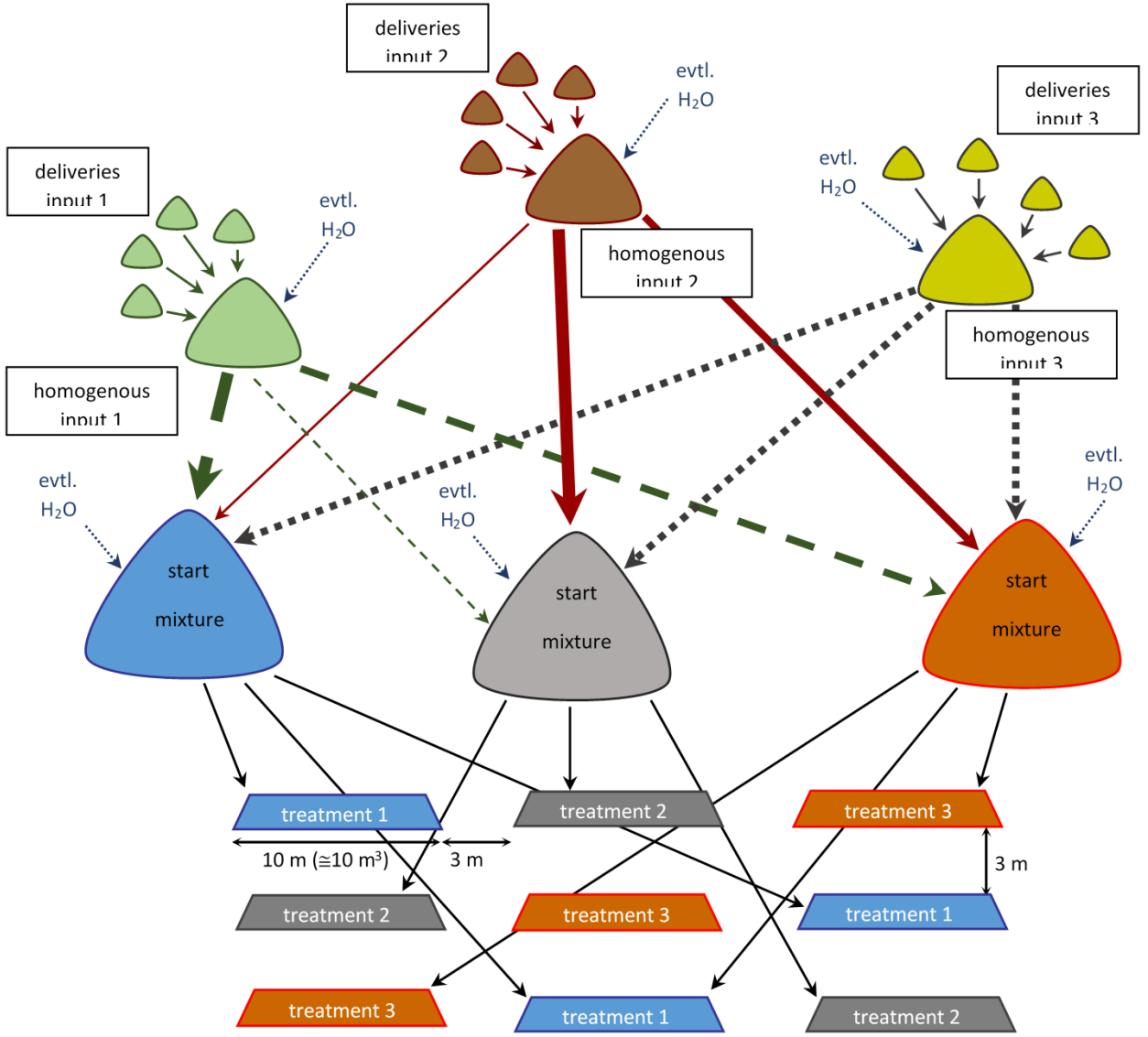
Methodology of exact trials

Composting trial with the same starting mixture for all treatments

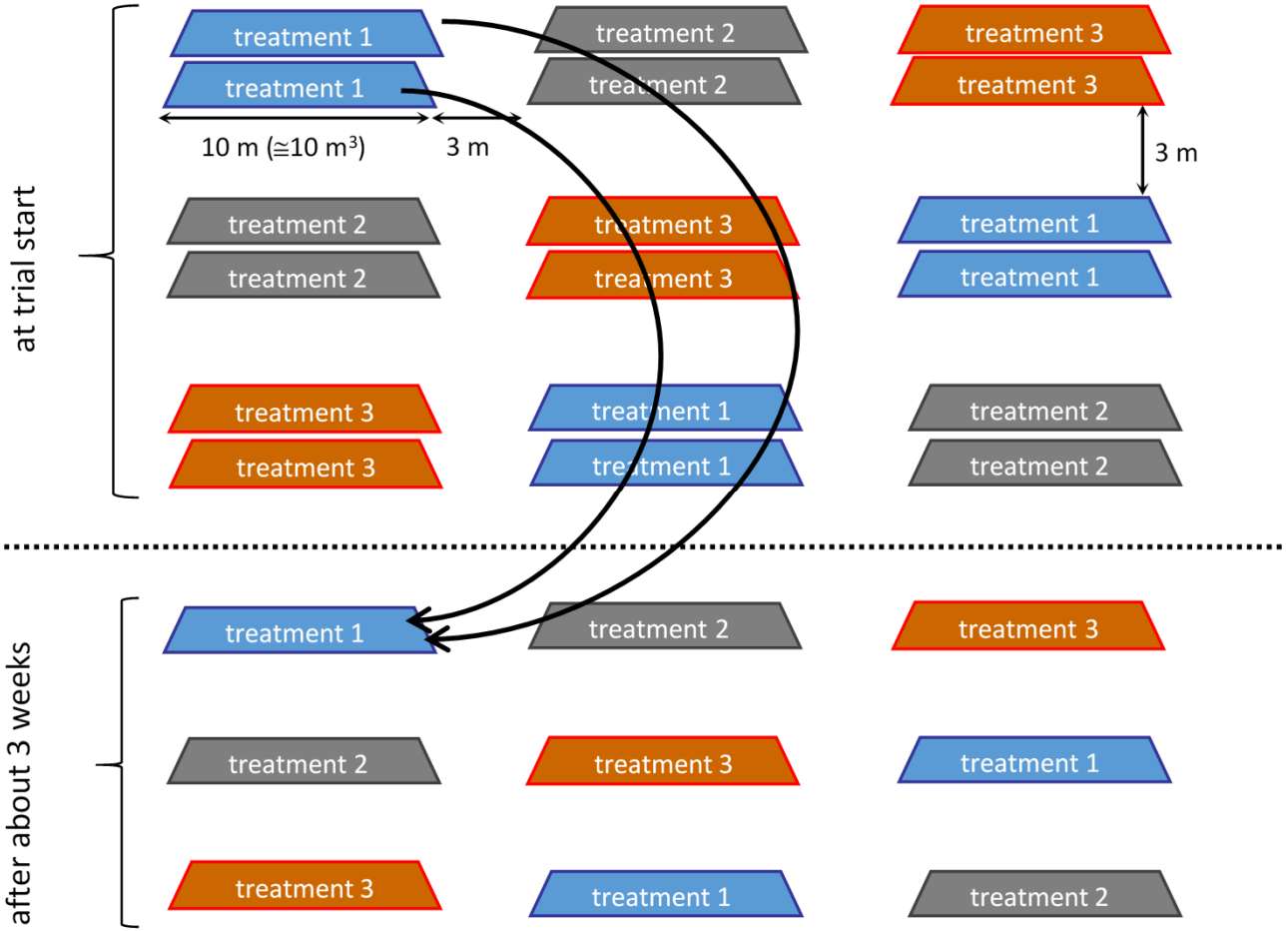


Methodology of exact trials

Composting trial with different starting mixture in the treatments



Methodology of exact trials

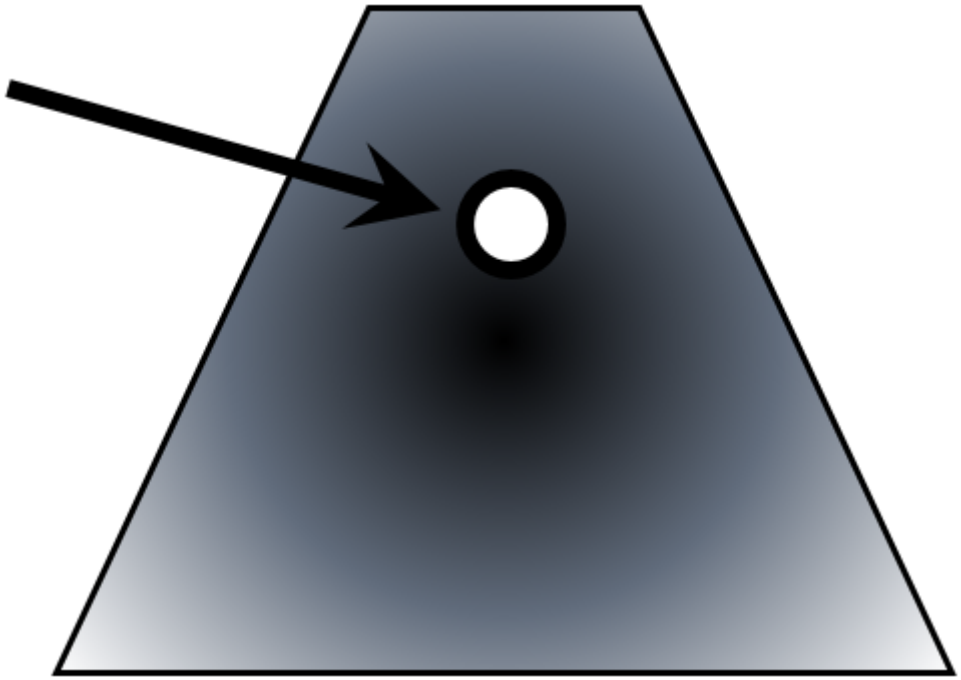


Organization of the composting trial in order to improve the volume of the composting mixture during the curing phase.

Methodology of exact trials

- Trial monitoring
  - Composting is a very active process, and an intensive monitoring is necessary to evaluate the treatments.
    - Weather conditions such as precipitations, temperature and wind direction/force can influence the evolution of the composting process. So they have to be duly logged
    - Temperature at the hot spot of the replicates (at three point along its length)

Methodology of exact trials



Hot spot in compost windrow, where temperature has to be measured

Methodology of exact trials

too·wet¤

OK¤

too·dry·¤

Fist test to control the humidity of compost during the composting process

Methodology of exact trials

- Trial monitoring
  - Composting is a very active process, and an intensive monitoring is necessary to evaluate the treatments.
    - Weather conditions such as precipitations, temperature and wind direction/force can influence the evolution of the composting process. So they have to be duly logged
    - Temperature at the hot spot of the replicates (at three point along its length)
    - Humidity content has to be evaluated

Methodology of exact trials

- Collection of samples
  - Normally, compost samples have to be taken two times during the process:
    - at the end of the hot phase (when the temperature clearly begins to decline)
    - when the maturity of the compost is achieved (almost no more increase of temperature in the two days after compost turning)
    - humidity content has to be evaluated during the all process
  - The most efficient way is to take samples immediately after turning the compost:
    - To obtain an homogenous and representative sample, 20 sub-samples of 500 – 1'000 ml are taken at different sites of the compost pile and well mixed together. The needed quantity of compost is then taken from this mixture.

Methodology of exact trials

- Analyses of compost
  - Compost samples should be analysed according to the Swiss directive for quality of composts and digestats 2010:
    - dry matter (DM)
    - organic matter (OM)
    - pH, salt content
    - NH_4-N-, NO_2-N- and NO_3-N-contents
    - phytotoxicity
  - Analyses have to be made on site as soon as possible after sampling. If analyses at the same day is not possible, samples have to be kept at 4 °C until analyses can be done.
  - Usual fertilizer analyses (N, P, K, Mg, Mn, Ca) have to be performed by a recognized laboratory in the country

Methodology of exact trials

- Interpretation of the results
  - Temperature sufficient for hygienization if above 55 °C for at least 3 weeks, or above 65 °C for at least 7 days. In addition the compost has to be turned at least twice during this period.
  - Humidity (fist test): -3 (completely dry) / 0 (optimal) / +3 (completely wet)
  - Structure: material not decomposed – material fibrous - material crumbly
  - Odor intensity: 0: no odor - 3 odor intensive
  - Odor quality: ammoniac – organic acids (bad odors) – odor of forest soil (pleasant odor)

Methodology of exact trials

› Interpretation of the results

Interpretation of the compost quality by comparing the contents of the different mineralized forms of nitrogen			
Relative content of NH_4-N	NO_2-N	NO_3-N	Interpretation
+++	-	-	very young compost, nitrification not yet starting
+++	++	+	young compost, nitrification just starting
+	++	+++	compost almost mature, nitrification soon completed
-	-	+++	compost mature, nitrification completed
-	+++	++	Compost mature, nitrification completed, but oxygen starvation during storage

Methodology of exact trials

- Interpretation of the results: phytotoxicity tests
  - Open cress test: not very sensitive, and only composts of poor quality achieve bad results with this test:
    - growth in compost < 50% of growth in reference substrate: compost with low compatibility with plants.
    - growth in compost > 75% of growth in reference substrate: compost with good compatibility with plants.
  - Closed cress test: is very sensitive (cress seeds also in contact with the gases coming out of this compost. Only composts with high quality obtain good results:
    - growth in compost > 25% of growth in reference substrate: compost with medium compatibility with plants.
    - growth in compost > 75% of growth in reference substrate: compost with high compatibility with plants.

Trials to optimize the composting process

- Optimization of raw material management
  - Can the composting process be improved by optimized raw material management ?
  - Can nitrogen losses be reduced by optimized raw material management ?
  - Can the quality of produced compost be improved by optimized raw material management ?
  - Example of start mixture:
    - T1: Starting mixture: 50% of leaf residues of date palm + 50% of animal manure. No addition of other materials during the rest of the process.
    - T2: 66% of leaf residues of date palm + 34% of animal manure. After 3 weeks, addition of the same quantity of animal manure as at the start.

Trials to optimize the composting process

- Optimization of turning interval
  - What is the optimal turning intensity of the windrows in order to:
    - obtain a compost with high quality,
    - avoid nitrogen losses during the composting process, and
    - avoid unnecessary labour and costs
  - Example of treatment comparison:
    - T1: Windrows with turning interval: 1 week
    - T2: Windrows with turning interval: 2 weeks
    - T3: Windrows with turning interval: 4 weeks

Optimization of utilization of compost

› Before beginning a compost experiment, the specific question to be answered has to be clearly defined as this will influence the design:

- Influence of compost on the soil structure
- Fertilization effect of compost
- Plant disease suppression
- …

Optimization of utilization of compost

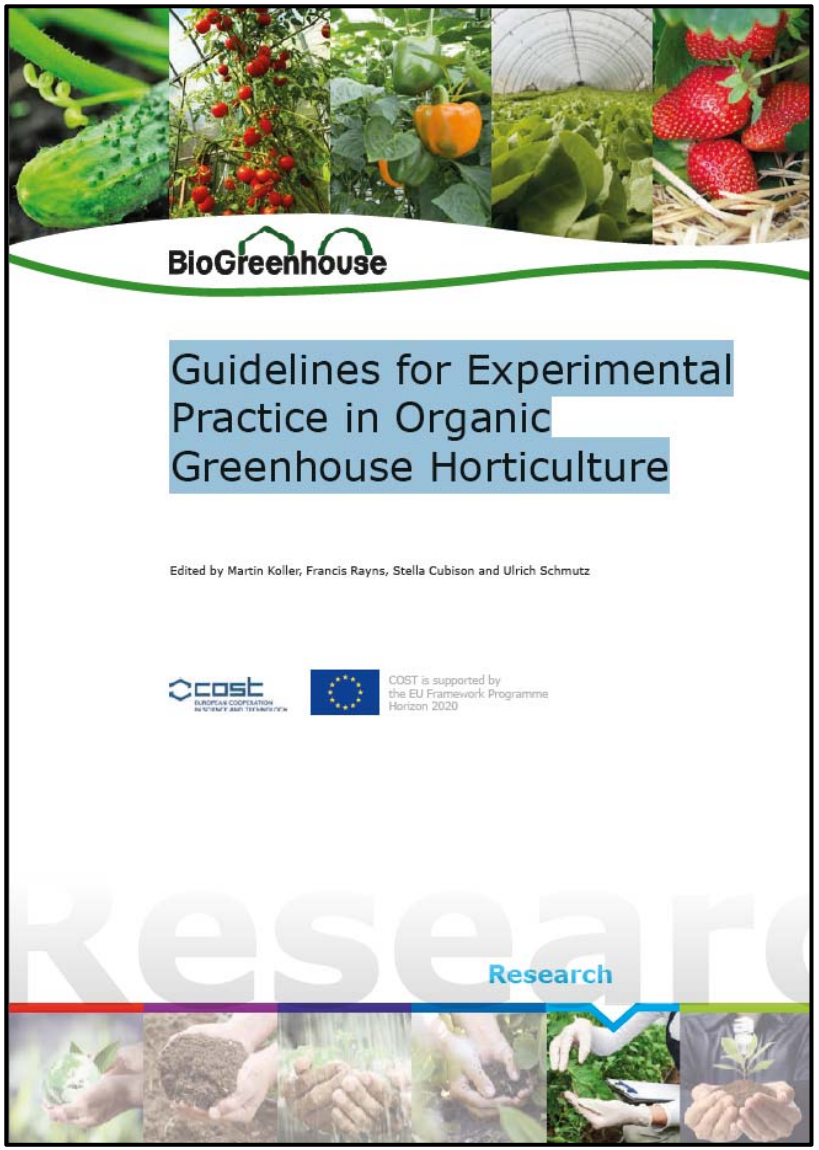
- General requirements for such experiments
  - Site on which the experiment will be done has to be homogenous
  - Choice of the site should be in relation to the question we want to investigate
  - The soil where the experiment is performed also has to be analyzed (type of soil, texture, organic matter content, N, P, K, Mg, Ca etc.)
  - Composts used have to be well characterized in order to compare the results of different experiments (with description of analyze methods)
  - Information on the quantity of compost used (balance of fertilizer)
  - Reference plots: If not only fertilization questions have to be answered, it is important to have, in addition to an untreated reference plot, also a standard treatment (a N, P, K, Mg control)

Optimization of utilization of compost

- Experimental design
  - Experiments with a duration of only one season: standard design with four replications can be used
  - 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 analyzed before the work begins
  - Demonstration experiments: larger plots, without repetition (for example half of field with compost, half of field with reference fertilizer)

Publication on biology, production quality and use of composts (and digestates)

To be downloaded on
www.biophyt.ch



Publication: Guidelines for Experimental Practice in Organic Greenhouse Horticulture

To be downloaded on
www.biophyt.ch

Questions ? Discussion ?

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