

# Optimisation of growing media for organic greenhouse production

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## Background

In greenhouse vegetable production large amounts of nutrients are needed. It can be difficult to control the fertilisation, such that excess of nutrients are avoided, and in conventional as well as organic productions this can lead to nutrient losses due to leaching or gaseous emissions. To improve organic greenhouse production it is important to optimise the nutrient supply. As nutrients for organic plant production can be limited it is the aim to compose compost based on readily available plant residues, which can be used as growing medium as well as fertiliser. This compost must supply the plants with a sufficient and balanced nutritional input without losing large amounts of nutrients under or after the composting period. In addition, structure and stability of the compost are important parameters when compost is mixed in the soil or used alone as a growing media. Especially when using compost in closed containers as in potted plant production the structure is important as the plants are growing in a limited volume. The availability of water, air and nutrients are therefore determined by this growing medium.

A suitable growing medium for organic production could be produced by composting readily available plant residues focusing both on nutritional quality and physical structure.

## Objective

The overall aims of these studies were:

- To increase the knowledge and understanding of N turnover in plant based compost and investigate how this can be managed.
- To examine how plant anatomy affects decomposition in a compost environment.
- To study how the structure of plant-based compost can be influenced in order to provide suitable physical properties for plant growth.
- To combine and utilise this knowledge in developing a compost-based growing medium for organic greenhouse production providing both structural stability and high nutrient availability.

## Progress – 2004

Examinations of the physical properties of composts based on different plant materials have been conducted. The anatomy of the plant residues is an important parameter determining the physical properties of compost and the fibre rich material of hemp stems was shown to improve water retention of the compost.

However, most of the year has been used for writing the Ph.D. dissertation, which is based on 4 papers and a general review on compost as growing medium. The Ph.D. dissertation is being printed right now and is expected to be handed in to KVL next week.

In general, the studies comprised in the dissertation intended to investigate some basic processes during composting, both regarding nutritional quality and structural changes. From the nutritional studies it was concluded, that:

- Postponing the addition of some of the nutrient rich material affected the mineralisation pattern, resulting in more plant available N after 7½ weeks of composting.
- Total losses of mass, C or N were not affected significantly by the delayed addition of some of the clover-grass hay. However, temperature and pH differed due to the postponed addition.
- There seemed to be a critical N addition below which net mineralisation was not obtained during the composting period.
- After 24 weeks of incubation an effect of postponed addition was shown in the nutrient-poor compost with significant higher content of mineralised nitrogen when addition of part of the clover-grass hay was delayed 3 weeks during the previous composting period.
- The altered mineralisation pattern due to the postponed addition is believed to be a result of changes in the microbial communities.

Structural properties of the materials used for compost based growing media are of immense importance for horticultural purposes. The studies revealed the discrepancies in the decomposition rate and extent between different straw materials. From the structural studies it was concluded, that:

- Compost based solely on wheat straw and clover-grass hay might not be sufficiently stable.
- Decomposition of straw material during composting is not solely dependent on the content of recalcitrant chemical compounds and nutrients but more importantly on the anatomical arrangement of the tissue, as penetration of microorganisms to cells within the straw material is impeded by the anatomy of the straw.
- Differences in anatomical arrangement of lignified tissues in monocots and dicots affect decomposition, and the structural quality of the residues left after decomposition.
- Structure of what is left after decomposition is important when choosing plant material for compost as a growing medium.
- Particle size was shown not to be a good indicator of the physical properties of composted plant residues.
- No differences in particle size distribution was found between composts based on three different straw materials; wheat, hemp and *Mischanthus* straw.
- Hemp based compost had a higher water retention than the other plant based composts and the geometry of the particles were more irregular.
- Compost based on hemp straw is expected to be a realistic alternative to the use of peat.

## Plans - 2005

None

## Publications

Beck-Nielsen, Dorte (2003) [Plantebaseret kompost - en erstatning for sphagnum og husdyrgødning?](#) [Plant based compost - can it replace peat and animal manure?]. In *Forskningsnytt om økologisk landbrug i Norden*, July, Volume 2, page 10-11.\*

Dresbøll, Dorte Bodin and Thorup-Kristensen, Kristian (2004) [Delayed nutrient application affects mineralisation rate during composting of plant residues.](#) [preprint]\*

Dresbøll, Dorte Bodin and Magid, Jakob (2004) [Structural changes of plant residues during decomposition in a compost environment.](#) [preprint]\*

Dresbøll, Dorte Bodin and Thorup-Kristensen, Kristian (2004) [Structural differences in wheat \(\*Triticum aestivum\*\), hemp \(\*Cannabis sativa\*\) and \*Mischanthus\* \(\*Mischanthus ogiformis\*\) affect the quality and stability of compost as growing medium.](#) [preprint]\*

Dresbøll, Dorte Bodin and Magid, Jakob and Thorup-Kristensen, Kristian (2004) [Long-term stability and mineralisation rate of compost is influenced by timing of nutrient application during composting of plant residues.](#) Working Paper.\*

Dresbøll, Dorte Bodin (2004) [Optimisation of growing media for organic greenhouse production.](#) Ph.D. thesis, Department of Horticulture, Danish Institute of Agricultural Sciences.\*