



# Compost quality assessment, condition for safe compost use

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# **Compost quality assessment, condition for safe compost use**

- › **Introduction: compost is not compost**
- › **Process management**
- › **Quality control**
- › **Choice of compost in relation to its target use**
- › **Conclusions**

# Introduction: compost is not compost



# Introduction: compost is not compost

## › **Compost:**

- › **Source of organic matter**
- › **Source of nutrients (macro- and micronutrients)**
- › **Source of microorganisms**

## › **Compost:**

### › **Influences soil chemical characteristics**

- › Nutrients (quantity and availability)
- › pH
- › Salinity

### › **Influences soil physical characteristics**

- › Humus quantity and quality
- › Soil structure (aggregates, porosity, stability)
- › Water holding capacity
- › Resistance to erosion

### › **Influences soil biological characteristics**

- › Biological activity
- › Plant disease development

# Introduction: compost is not compost

- › But compost characteristics can greatly vary
  - › Depending on feedstocks

*Variability in chemical characteristics of composts in Switzerland (median, minimum and maximum).  
All feedstocks are source-separated<sup>16</sup>*

Chemical characteristic	Compost for agricultural use	Compost for horticultural use	Compost for greenhouse cultivation and gardening
DM	50.8 (28.2-73.4)	56.7 (40.8-71.1)	56.3 (32.2-64.5)
OM	47.7 (17.0-80.1)	38.1 (23.9-54.7)	30.6 (20.9-52.8)
salt content	862 (361-1580)	787 (173-2657)	660 (328-1539)
pH	8.2 (7.5-8.7)	8.1 (7.6-8.7)	7.9 (7.2-8.5)
N	16.6 (8.7-26.0)	14.6 (9.2-27.6)	15.1 (8.6-25.2)
P	3.0 (1.7-6.1)	3.0 (1.3-12.7)	3.3 (2.1-8.8)
K	12.0 (5.7-25.2)	11.6 (2.2-20.7)	10.7 (5.5-27.8)
Mg	4.8 (3.6-10.3)	6.5 (4.4-10.7)	6.5 (4.4-13.3)
Ca	53.1 (24.0-83.7)	64.0 (35.0-91.5)	44.5 (29.5-69.4)
Fe	8.8 (2.9-16.7)	10.1 (5.4-14.7)	12.0 (6.1-15.8)

DM (dry matter) is given in % of fresh material, OM (organic matter) in % of DM, macronutrients in g/kg DM, micronutrients (Fe) in mg/kg DM, salt contents in mg KCl/100 g fresh manure, pH is determined in 1:2 water extract.

# Introduction: compost is not compost

- › But compost characteristics can greatly vary
  - › Depending on feedstocks
  - › Depending on process management
  - › Depending on maturity

*Relative importance of feedstocks, process management and maturity on specific compost characteristics.*

Compost characteristics	Feedstocks	Process management	Maturity
Total nutrient content	+++	+	-
Available nitrogen	++	+++	+++
Salinity	+++	(+)	+
pH	++	+	+++
Humus content / water extract colour	++	+	+++
Stable humin content	++	+	+++
Phytotoxicity	+	++	+++
Disease suppressive potential	++	+++	++

- almost no influence; + little influence; ++ moderate influence; +++ strong influence

# Introduction: compost is not compost

## › Conditions to a successful compost use:

- › Production of quality products
- › Choice of the correct product for the target use
- › Choice of the optimal strategy of utilization

## › What it means:

- › Management of the composting process
- › Evaluation of the compost quality
- › Evaluation of the needs for the specific target use
- › Elaboration of utilization strategy

# Process management



# Process management and compost quality

- › **Compost: result of the aerobic decomposition of organic residues**
- › **Numerous microorganisms are involved in this process**
- › **Roles of the composting process management**
  - › Creates the conditions that are favorable for the inactivation of the harmful microorganisms and promotes the development of the beneficial ones
  - › Avoid the losses of fertilizer (nitrogen)
  - › Avoid emission of gases damaging for the environment (such as greenhouse gases, odors, ...)
  - › Production of high quality composts appropriate to the target utilization

# Process management and compost quality

- › **Process management: From the collection of green waste up to the use of the final product**
  - › Concept of feedstocks collection
  - › Composting system
  - › Mixture of raw materials
  - › Composting process management
  - › Storage of end-material

# Process management and compost quality

## › Concept of feedstocks collection

- › Influence of quality of feedstock (e.g. quantity of undesirable inputs)
- › Organization and management of the quantity of different feedstock to obtain an adequate starting mixture
- › Planning over the year

# Process management and compost quality

## › Composting system

- › With a lot of systems it is possible to produce high quality compost, but it is also possible with all systems to produce poor quality compost
- › Each composting system has its own specifications
- › The system has to be adapted to the feedstocks and to the target products
- › The different management operations have to be adapted to the system
  - › Mixture composition
  - › Coarseness of the starting mixture
  - › Aeration and humidity management
  - › ...

# Process management and compost quality

## › Mixture of raw materials

- › C:N-ratio („available“)
- › Structure, moisture
- › “Ideal mixture”:
  - › 1/3 rough wood  
(shredded wood, sieved rest material from compost, snipped bark)
  - › 1/3 medium-fine, fibrous material  
(shredded branches, wood fibers, straw, foliage, switch grass , reed, peat from consumed potting compost)
  - › 1/3 material, nearly without structure  
(dung, grass, rumen contents, vegetables manure)
  - › Evtl. utilization of additives  
(powdered clay, earth, enzymes, microorganisms, fertilizer, etc.)

# Process management and compost quality

## › Composting process management

### › Moisture

- › Enough humidity is necessary to allow microorganism activities
- › A very high humidity prevents a good aeration of the composting material and hence the good process development
- › At the beginning of the process, an important quantity of water is needed
- › During the maturation phase, the addition of water is to be performed very carefully
- › Water is one of the most important factors to control the temperature of the process
- › Humidity management is one of the most difficult role of the compost manager!

# Process management and compost quality

## › Composting process management

### › Moisture



too wet



optimal



too dry

# Process management and compost quality

## › Composting process management

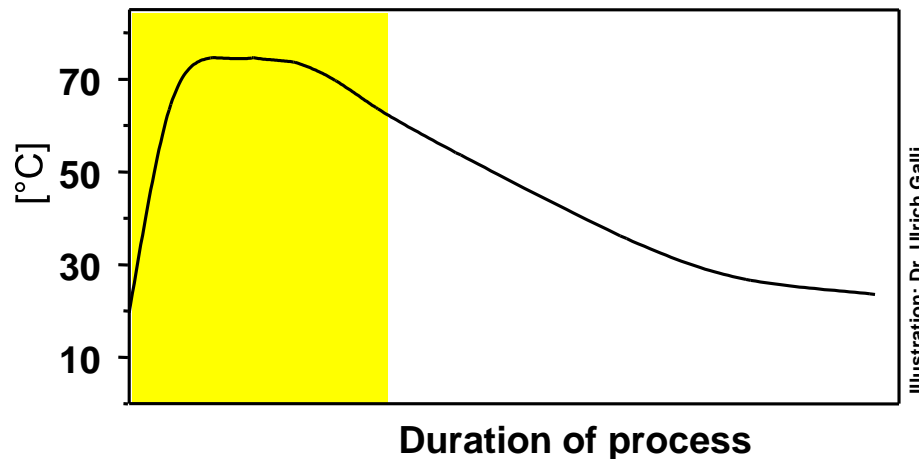
### › Oxygen content

- › Fungi need oxygen to be active.
- › Bacteria can be active without free oxygen. They take then oxygen from other molecules, what can cause the production of toxic compounds (e.g. nitrite from nitrate)
- › The aeration of the compost during the maturation phase is very important. The quality of the products will decrease if no enough oxygen is available then
- › To have an optimal composting process, the oxygen content in the atmosphere of the compost pile has to be at least 3 to 5 %
- › Too much aeration at the beginning of the process (during the hot period) can lead to important nitrogen losses ( $\text{NH}_3$ ) and prevent an optimal microbiological activity

# Process management and compost quality

## › Composting process management

### › Temperature regulation



- › Temperature of a compost pile can increase up to 90°C. But this is not desirable!
- › Optimal temperature for the degradation of organic substrates lies around 55°C
- › The temperature has to be high enough so that weeds and pathogens can be eliminated
- › Good compromise: temperature between 60 and 70 °C in the compost pile during the thermophilic phase

# Process management and compost quality

## › Composting process management

### › Compost turning

- › Compost turning is important to assure an sufficient oxygenation of the compost during the process (effect on structure of pile)
- › Compost turning is important to become an homogenous product
- › Compost turning activate also activate the biological activity of the process

# Process management and compost quality

- › **Composting process management**
  - › Storage of end-material
    - › Compost is an living product. If he didn't be come oxygen, he will died !



# Process management and compost quality

## › Composting process management

### › Storage of end-material

- › Compost is a living product. Without oxygen, he will died !
- › Mature compost doesn't need a lot of oxygen. However, a minimum has to be insured. Different factors are important:
  - › Dimensions of the storage pile
  - › Maturity stage of the products
  - › Humidity
  - › Use of additives
  - › ...

# Quality control



# Quality control

## › Composting process management

- › Control of process parameters
  - › Temperature
  - › Moisture
  - › Oxygen
- › Evaluation of product quality
  - › With own senses
  - › With simple analyses and biotests

# Quality control

- › Evaluation of product quality with own senses
  - › Color and structure of the compost



material at the beginning of  
the composting process



mature compost

# Quality control

- › Evaluation of product quality with own senses
  - › Color and structure of the compost



fibrous compost



crumbly compost

# Quality control

## › Evaluation of product quality with own senses

### › Wood breaking test

Compost	Observation of wood fracture	Risk of nitrogen immobilization in soil
Young compost, in the heat phase	Wood still hard, white to light-colored, and no degradation signs are observed	Medium risk of nitrogen immobilization over a relatively long period
Young compost at the beginning of the maturation phase	Wood is slightly tender, darkening at the margins and a little bit greasy	High risk of nitrogen immobilization over a relatively short period
Mature compost	Wood is tender, the surface of the fracture is dark and the margins black, and water can be easily extruded by pressing the piece of wood	Low risk of nitrogen immobilization

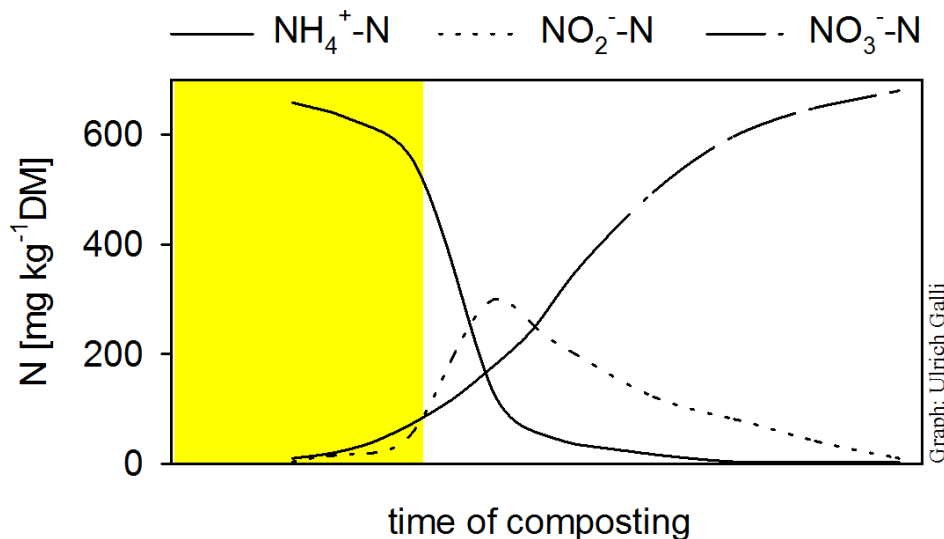
### › Odours

- › Odour of a compost depends on its maturity and on the process management
  - › young compost: smell of ammonia
  - › anaerobic processes in the compost pile: smell of “rotten eggs” or butyric acid
  - › mature compost: smell of forest soil

# Quality control

## › Evaluation of quality with simple analyses / biotests

- › Nutrients contents
- › pH, salt content
- › Mineral nitrogen



- › NO<sub>3</sub>-N/N<sub>min</sub>-ratio:
  - › < 0.2: young compost, with risk of nitrogen immobilization in the field if its carbon content is important (e.g. lignin rich compost).
  - › between 0.2 and 0.8: compost is in curing phase. Can be used in field culture
  - › > 0.8: mature compost. Can be used in substrates and planting holes.

# Choice of compost in relation to its target use



# Choice of compost in relation to its target use

- › **Characteristics and properties of composts can greatly varied**
  - › Nutrient contents
  - › Nitrogen availability
  - › Stability of organic matter
  - › Capacity to suppress diseases
  
- › **The characteristics and properties of composts can be influenced by the process management**
  - › Input materials
  - › Moisture / oxygen management
  - › Process duration

# Choice of compost in relation to its target use

- › **Define the target use and target effect**
  - › Culture, culture system
  - › Main target: fertilization / soil structure improvement / disease suppressivity
  - › Short time / long time effect
  
- › **Choice of the appropriate products and utilization strategy**
  - › Broad application to the whole surface or concentrate on the plant rows
  - › One application or split
  - › Period of application

# Conclusions



# Conclusions

- › **Compost quality can greatly vary from compost to compost**
- › **Quality management starts with the collection of feedstocks and finishes with the use of compost**
- › **The three pillars for safe compost use:**
  - › **Control of the composting process**
  - › **Evaluation of product quality**
  - › **Choice of the correct product for the target use and of its strategy of use**

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Compost benefits, jf, 12.04.2016