9 How growers can assess compost quality?

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In short

- For the grower it is essential to choose the appropriate compost for the target application.
- A farmer can already acquire useful information about the compost quality using his own senses.
- Chemical analyses and biotests complete the information and allow the grower to evaluate and choose the right compost.
- A good relationship between compost producer and compost user is key to the successful implementation of compost in farming systems.

It is not always easy for a grower to choose the compost he wants to use. He has to select a compost that has been produced correctly and has good qualities for the intended application.
In this chapter, we will present to the grower some simple methods for performing an assessment on the composts.

9.1 Compost sampling

A very important point is that compost assessment should be based on a representative sample. To do this, samples are taken 30-40 cm inside the compost pile at different places and mixed together. An initial evaluation of the homogeneity of the compost can be carried out during this process. Observation of important differences between the subsamples (in regard to moisture content, colour, structure) can indicate whether the management of the composting process and/or the storage of the product was not optimally performed. In this is not the case, caution with the product has to be taken. Observations and analyses have to be performed with fresh samples. If not possible, the samples can be stored for 2 to 3 days at 4°C.

9.2 Assessments with own senses

Observations of compost with own senses (eyes, nose, touch) can provide information about the compost quality. These observations cannot replace chemical analyses or plant tests, but they can complement them.

9.2.1 Colour of the compost

At the beginning of the composting process, the material presents a mosaic of colour deriving from the input materials. During the process, a homogenisation of the colour takes place, and, with the evolution of the humification, the compost becomes brown or blackish. If the compost is too dry during the process, grey moulds can be observed.

Figure 9.1 *View of organic material at the beginning of the composting process (left) and mature compost (right).*

9.2.2 Odours

Compost always smells but the odours can be more or less intensive and more or less agreeable depending on the management process. The odour of a compost depends on its maturity and on the process management. Young composts containing nitrogen-rich materials smell of ammonia, and will be transformed during the maturation processes into a product with the smell of forest soil.
Disagreeable odours such as that of "rotten eggs" or butyric acid are typical for poorly controlled anaerobic processes in the compost pile. Organic acids are formed as a result of oxygen starvation, and they cannot be transformed forward, which causes the emission of intens and disagreeable odours.

9.2.3 Structure of the compost

Mature compost produced by an optimal process has a crumbly structure and no recognizable starting material except for some wooden pieces. The presence of much fibrous material is a sign that the compost is not sufficiently mature. This can happen if the humidity content of the compost pile was too low especially in the hot phase. The ammonium present in the pile would therefore be lost as ammonia, leading to a shortage of N for the microorganisms and insufficient decomposition, even when water is available. When such a fibrous compost is applied, there is risk of nitrogen immobilization in the soil.

Figure 9.2 *Fibrous compost (left) and crumbly compost (right).*

9.2.4 Wood breaking test

The wood breaking test also allows the characterization of the degree of maturity of the compost and the risk of nitrogen immobilization in the field after its use. Degradation of wood starts after the high temperature phase. Hence, we observe only minor degradation of wood in young compost, and clearly attacked wood in mature compost. If relatively raw wood is applied to a field soil, the microorganisms responsible for its degradation will immobilise the available nitrogen in the soil in order to perform the degradation. This nitrogen is therefore temporarily unavailable to the plants which inhibits their growth.

Table 9.1

Evaluation of the wood breaking test.
To test the degradation of wood, little branches with a diameter of about 10 mm are broken between fingers. The point of fracture is then observed.

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

9.3 Interpretation of measurements and analyses

The compost user should obtain information from the compost producer that can be used in combination with personal observations to evaluate the compost.

9.3.1 Composting process protocol

Each compost producer has to follow a protocol about the composting process (see chapter 4). For the compost user, the most important point here is the control of the evolution of the temperature, in order to be sure that the compost is hygienically safe (chapter 4.1.1). This is the case if the compost reaches, after the last input of fresh organic material at least 55°C during three weeks or 65°C during one week, and if the compost pile is turned at least twice during the thermophilic period.

9.3.2 Chemical analyses

The compost producer has to periodically perform chemical analyses of his compost and these data can be requested from him. The first point to check is whether the heavy metals contents respect the legal limits (see chapter 4.2.1.3). To be able to plan the quantity of compost to be used and to calculate the nutrient balance, the nutrient analysis are also needed (see chapter 4.2.1.4). The heavy metals and nutrient contents are relatively stable during the composting process and do not need to be analyzed immediately before compost's use. The pH-value (see chapter 4.2.1.5), the salt content (chapter 4.2.1.6), mineral nitrogen content (see chapter 4.1.4) and the phytotoxicity (see chap. 4.2.1.2) can greatly vary during the composting process and during the storage of the compost. For this reason, we recommend analysis of these characteristics a few days before using the compost. These analyses can be performed with a simple laboratory infrastructure (field labor).

9.3.3 Phytotoxicity tests

Bio-tests (such as phytotoxicity tests) are very useful to complete the evaluation (see chap. 4.2.1.2). In such tests, plants react to the whole of the compost quality and not only to some parameters such as those mentioned above. The tests recommended are the open cress test (not so sensitive) and the closed cress test (highly sensitive).

9.4 How to choose the right compost for the desired application

Different quality requirements are needed depending on the planned utilization of the compost. We can classify the target utilisation into four groups:

- Compost to fertilize the crops
- Compost to improve organic matter in the soil and soil structure
- Compost to feed soil life and to improve its disease suppressiveness
- Compost as component of growing media

To be successful, the compost user has to interact with the compost producer in order to choose the appropriate compost for the planned utilization. Table 9.2 gives some global information to help the grower to choose the right compost. Of course, the different parameters can interact, and different soils and climatic conditions can also influence the reactions of composts following application. It is important to consider these points when performing a global evaluation of compost suitability.

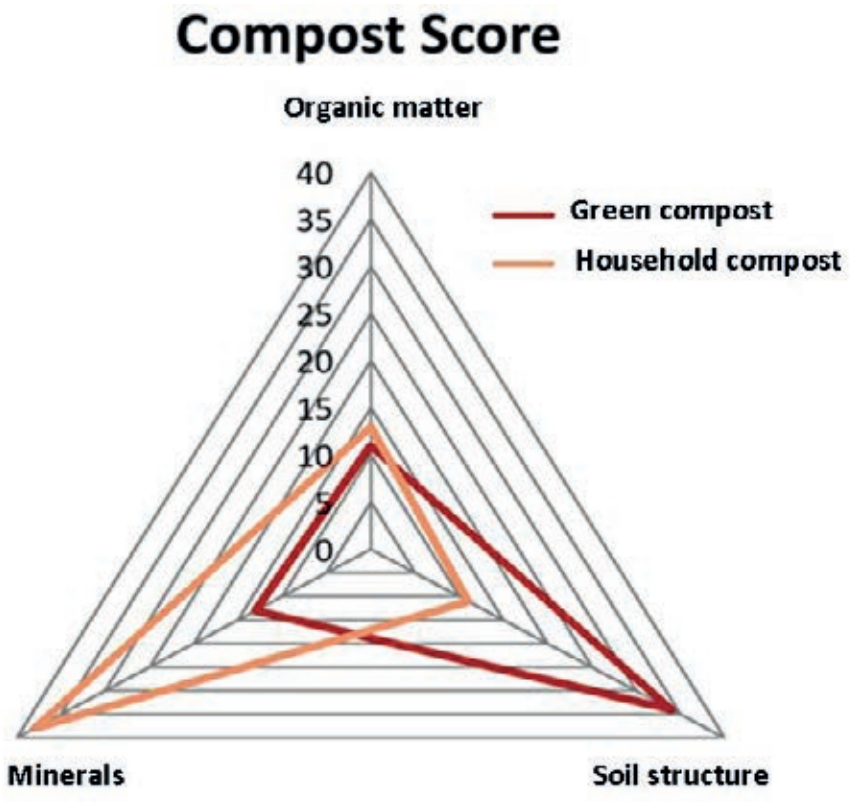

Figure 9.3 *The compost score: the interplay among organic matter, soil structure and minerals. Green compost is indicated in red and household compost in orange. Green compost has a stronger effect on soil structure, while household compost contains more minerals for fertilization purpose.*

The long term effect of compost on organic matter (OM) in the soil depends on the carbon/nitrogen (C/N) ratio and on the origin of the carbon. More woody compost has more effect on the organic matter.

Table 9.2

Evaluation of the suitability of a compost for different use target.

Parameter	Compost to fertilize the crops	Compost to improve organic matter in the soil and soil structure	Compost to feed soil life and to improve its disease suppressiveness	Compost as a component of growing media
Color of the compost				
mosaic of colors	--	-	--	--
homogeneous color, brown to blackish	++	++	++	++
Odours				
ammonia	+	-	0	--
bad (e.g. rotten eggs)	--	--	--	--
forest soil	+	++	+	++
Structure of the compost				
very fibrous	--	0	0	--
crumbly	++	++	+	++
Wood breaking test				
wood still hard, white to light-colored, no degradation signs	--	-	0	--
	--	0	+	--
wood is slightly tender, darkening at the margins and a little bit greasy	++	+	++	++
wood piece tender, the surface of the fracture is dark and the margins black				
Process temperature				
< 55°C during 3 weeks or 65°C during 1 week, and/or the compost pile has not be turned	-	-	--	--
	+	+	++	++
> 55°C during 3 weeks or 65°C during 1 week, and the compost pile has to be turned 2-3x				
Heavy metals content				
does not respect legal limits	--	--	--	--
respect legal limits	++	++	++	++
pH value				
($CaCl_2$ 0.01M 1:10 w:w extract)	0	0	0	--
>7.8	0	0	0	-
7.5 - 7.8	0	0	0	++
<7.5				
salt content				
(H_2O 1:10 w:w extract)	0	0	0	--
>20 gKleq/kg TS	0	0	0	-
10 - 20 gKleq/kg TS	0	0	0	++
<10 gKleq/kg TS				
N_{min}				
($CaCl_2$ 0.01M 1:10 w:w extract)	--	0	-	--
<100 mg N_{min}/kg TS	-	0	0	0
100 - 160 mg N_{min}/kg TS	++	+	+	++
> 160 mg N_{min}/kg TS				
NO_3-N / N_{min}				
< 0.4	--	0	0	--
0.4 – 0.8	0	0	0	0
> 0.8	++	0	+	++

Parameter	Compost to fertilize the crops	Compost to improve organic matter in the soil and soil structure	Compost to feed soil life and to improve its disease suppressiveness	Compost as a component of growing media
Phytotoxicity: open cress test				
< 50% from control media	0	0	--	--
50 - 75% from control media	0	0	0	--
> 75% from control media	0	0	++	++
Phytotoxicity: closed cress test				
< 25% from control media	0	0	0	--
25 - 50% from control media	0	0	+	0
> 50% from control media	0	0	++	++

--: not appropriate for this use; 0: not relevant; ++: appropriate for this use