GUIDE

Correct Composting – Tips and Tricks

German Environment Agency

Umwelt Bundesamt

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Preface

The Compost Manual by the German Environment Agency (UBA) was published for the first time 25 years ago. With a total circulation of more than three million copies, it is one of UBA's most successful publications. It provides tips and advice for the correct and environmentally friendly composting of organic waste in the home garden and is aimed at home and amateur gardeners, for whom the closed-loop natural cycle is an integral part of garden management.

Today, the closing of material cycle in a resource-efficient and environmentally friendly way – far beyond the organic waste flow – is the environmental challenge of our times. Meanwhile, legislators are not just leaving it all up to the commitment of amateur gardeners to recycle organic waste. The vast majority of organic waste from private households is collected separately in organic waste containers, fermented and/or composted in central plants, and subsequently utilized as digestate and compost for fertilization and soil improvement, especially in agriculture and horticulture. The Circular Economy Act and the Organic Waste Ordinance, as well as the Fertilizer and Fertilization Ordinances, regulate the central treatment and utilization of organic waste. For the use of organic waste in the home garden, however, there are very few mandatory specifications. This compost manual is intended to provide help and answer questions in this regard.

With the new edition, we want to build upon the success of the previous compost manual and, at the same time, provide up-to-date information and recommendations.

This new edition is not only addressed to environmentally-conscious home and amateur gardeners, but also to the municipal policy makers who have to decide on the home composting as an exemption from the obligation of separate collection of organic waste that has been in force since 01 January 2015. In Chapter 03 "What belongs in the compost?" it is clearly showing that even a comprehensive home use of organic waste (i.e. home composting) cannot replace the separate collection since not all organic waste that is produced in the household is suitable for home composting.

The UBA does not regard home composting as an alternative to separate collection, but as a useful supplement to it, provided that the composting is done correctly.

An incorrect operation of home-composting can be seen as ecologically detrimental when compared to the large-scale composting and anaerobic digestion processes, especially in terms of greenhouse gas emissions, soil over-fertilization, and groundwater vulnerability.

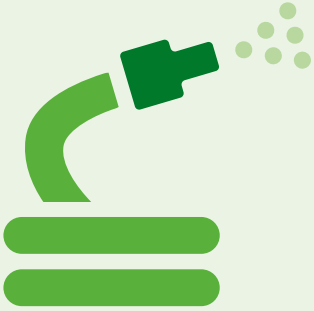
Consequently, the rules of good practice must be followed for environmentally sound self-composting. With this new version of the compost manual, UBA provides these rules of good practice in a lucid style for all environmentally-conscious citizens with (and without) a house garden or a garden plot.

A quick overview of composting – Rules for good compost

1.
Place the compost pile on bare ground in a shaded and wind-protected location. Do not put it on stone, concrete, or asphalt, and never in a pit. The compost pile needs soil base that can be reached by worms and other microorganisms.

2.
Loosen the ground and put down a bottom layer of coarse material about 10 – 20 cm thick. Then add a well-mixed layer of smaller materials, such as leaves, kitchen scraps, etc. Only spread a thin layer of grass clippings or mix them well with other materials; grass clippings should be dry or wilted to avoid putrefaction.

3.
Materials to be composted must be thoroughly chopped up and mixed; the greater the variety of starting materials, the better.



4.
Add a few shovels of normal garden soil or finished compost to the new compost heap to "inoculate" it and, if necessary, add compost worms. Onion skins, coffee grounds, and tea bags/leaves are ideal foods for worms.

5.
Keep the compost moist, as microorganisms need water.

6.
Do not overwater the composting materials because it leads to air deficit and anaerobic conditions. The composting process comes to a standstill and instead anaerobic digestion starts. The compost contents should only be as moist as a wrung-out sponge.

7.
Waste material like meat, bones and cooked food attracts pests and therefore belong in the organic waste containers.

8.
Ensure good aeration for the compost material:

- mix with coarser material,
- provide adequate ventilation openings for compost bins,
- never use containers that are closed on all sides.

9.
Turning the compost heap improves the mixing and the aeration of the decomposing material, thus speeding up the process of maturation. Sift out the finished compost and return the non-decomposed pieces to the heap.

10.
Cover the finished compost with wood, a thick layer of foliage, or similar material to retain moisture and nitrogen!

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If the compost heap is not sufficiently aerated, it starts to smell bad. Under anaerobic conditions (absence of air), bacteria form the odorous gases ammonia and hydrogen sulfide, and the climate-damaging gas methane. Active compost heap, on the other hand, does not stink, but smells like fresh woodland.

Under aerobic conditions, not only is the breakdown process faster, but the risk of forming climate-damaging methane is largely averted.

01
When can organic waste be composted at home? (Legal aspects)

Article 11 (1) of the German Circular Economy Act (KrWG) requires the public waste management authorities to separately collect organic waste as of 01 January 2015 at the latest. According to the definition of organic waste, this requirement affects both garden, park and landscape maintenance waste as well as food and kitchen waste.

What is organic waste which has to be collected separately?

In principle, all garden and kitchen waste generated in private households are to be handed to the public waste management authorities (örE).

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The purpose of the KrWG is to promote the circular economy for the sake of conserving natural resources and to ensure the protection of humans and the environment when generating and managing waste (§ 1 KrWG).

The goal is to achieve a high-quality utilization of unavoidable waste as much as possible.

The exception is waste that garden owners utilise on their own land using do-it-yourself composting. An "exemption" from the separate collection of organic waste can therefore only be granted if the organic waste generated in the household can be utilized in the occupant's own garden.

Necessary requirements for do-it-yourself recycling

In view of the implementation of the comprehensive separate collection of organic waste, the majority of the örE have expanded the existing requirements of compulsory connection and usage for residual waste to include the separate collection of organic waste and specified it in the waste management rules. If an exemption is intended such as for the case of "own usage" in private households, the örE should ask for the proof of a professional and correct own usage. Possible criteria for this have been formulated within the scope of a UBA study, see info box on page 7.

Whether home composting is done professionally and correctly is ultimately the responsibility of the do-it-yourselfer who must be able to manage a proper and environmentally friendly composting process throughout the year.

Organic waste bin goes well with home composting

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Possible criteria to request an exemption from seperate collection of organic waste

The application for exemption, drafted by örE, should include at least the following entries:

- lot owner,
- plot size,
- garden area,
- house type (single/multi-family house),
- number of households and inhabitants,
- proof that the minimum garden area is approx. 50 square meters per inhabitant according to a site plan,
- and photo documentation of the plot, garden area, and type of composting system (e.g. composter) in order to assess the local conditions.

02
Why composting?

Circulation of nutrients and soil quality

In the German classification of soils, garden soil is called hortisol (from Latin hortus for garden and sol for soil). Hortisol is a type of soil used intensively for a long time with a productive and humus-rich soil layer of more than 40 cm in depth. This generally contains more than 4% of organic matter by weight. This humus-rich layer is produced by long-term horticultural

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Soil life benefits from:

- careful soil management,
- favorable air and water ratios,
- favorable pH value (6 – 7.5),
- shade provided by vegetation,
- and organic substances.

use and regular, strong feeding of organic matter (such as compost). Frequent irrigation and a long-lasting shading promote its development. Due to the high content of organic matter, it contains and binds a large amount of important nutrients. These include not only the main nutrients nitrogen, phosphorus, and potassium, but also magnesium, calcium, and so-called micronutrients such as selenium and manganese.

Not to be underestimated are the soil-dwelling organisms like fungi, bacteria, algae, worms, and insects. They ensure the provision of necessary nutrients, the formation of humus by breaking down the organic material and a sufficient aeration. They are abundant in garden soils.

As long as the gardener adheres to the rules of good practice, an important contribution can be made to the preservation of positive soil conditions, and thus to environmental protection. He also promotes the circulation of nutrients and soil quality.

pH value and lime content

An important part of the aforementioned good practice is maintaining the site-specific pH value of the soil through appropriate measures. The pH value indicates whether the soil is alkaline, neutral, or acidic. Lime content correlates with the pH value.

Optimal crop growth requires a certain pH value. The composition of soil life is also strongly pH-dependent. The pH fluctuations caused by lime leaching and environmental influences (acid rain) have a significant impact on the ecological balance in the soil.

One pH test strip is enough to measure the pH value.

If the soil becomes too acidic, nutrients can be dissolved more quickly and absorbed by plants more intensely. Since the plants cannot use an oversupply, some of the nutrients are displaced and possibly discharged into the groundwater. This can affect the environment. As a result, for example, eutrophication can occur.

The use of compost in the soil leads to a better buffering capacity against pH fluctuations. In addition, the alkaline substances present in the compost ensure that there is no acidification of the soil.

Humus, soil life and soil fertility

Composting aims to produce humus, maintain nutrients in the circulation, and improve or maintain soil fertility. The effect of compost in the soil begins with the decomposition of organic material by numerous soil-dwelling organisms. Their activity and thus the rate of decomposition of the organic material depend on

- the temperature in and on the soil,
- the moisture of the organic material,
- the oxygen content,
- and the pH value.

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A rule of thumb:
The more diverse an ecosystem is, the more stable and healthy it is.

If organic matter is introduced into the soil through compost or plant remains, for instance, the easily mineralized substances such as proteins and simple sugars are the first to decompose. Thus the minerals contained in the plant cells as salts or only weakly fixed are released. The intermediate products of decomposition and persistent substances such as tannins and waxes or the cellulose and lignin are processed more slowly. Organic fragments and newly formed intermediate products of decomposition combine to form stable humic substances (the so-called permanent humus), which are very resistant to decomposition and thus provide long-term soil fertility. Also some of the minerals, especially nitrogen and sulfur, are permanently incorporated into the intermediate products. In this intricate process where organic material is converted, the clay-humus-complexes are formed, which provide particularly beneficial physical conditions in the soil (air circulation and soil structure). The breakdown and conversion process slow down if new materials are not constantly applied. However, it does not stop completely: even mature compost decomposes slowly after being spread on the soil and gradually releases its fixed nutrients. With the compost, minerals are added to the soil along with humic matter and nutrients. The mineral admixtures become part of the mineral body of the soil (e.g. sand or silt).

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Humus = a part of the soil that comes from dead organic substances. Microbiological decomposition causes the first breakdown of the organic matter. This produces various gases as well as water, nutrients, minerals, and energy (heat from the compost pile). At the same time, the stable, brown-black humic matter forms, which accumulates under slow and constant heating condition. This reacts with mineral substances (clay minerals) and forms a clay-humus-complex.

Nutrient humus = easily degradable organic matter, which serves as the food source for soil life.

Permanent humus = persistent organic substances. Permanent humus is the finished material in the compost heap at the end of the composting process.

Each year, some of the humus substances are consumed and have to be replaced. As seen with natural soils, this occurs in the natural cycle through falling leaves and herbaceous vegetation that remain on the ground. In cultivated soils, one must actively recycle organic substances, for example by composting, mulching, surface composting, green manuring, and selecting the right crop rotation.

Humus loss is not immediately seen in nutrient loss, but slowly through adverse changes in the soil structure. Optimal growth requires a high proportion of substances that store the moisture necessary for soil from precipitation and keep it available to plants and soil-dwelling organisms. High humus content equals rich soil cultivation.

Humus loss amounts to the loss of species. High humus content is a kind of health insurance for plants. In soils sufficiently supplied with humus, the rich soil life releases energy and raises the soil temperature. This has a positive effect on plants and soil life. Added nutrients are kept in the root area and are protected from leaching. Humus deficit causes a deterioration in physical soil properties and is the starting point of a series of disastrous consequences for the soil. The soil structure is damaged and crumb formation stops, which hinders the aeration and water supply. Deteriorated soil conditions lead to further loss of humus due to environmental threats like soil erosion by water and wind.

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Chemical and biological effects of compost:

- humus development through added organic matter
- fertilizing effect through nutrients added
- slow release of the nutrients from the compost
- increase in biological activity
- improved nutrient uptake from the soil
- reduction of nutrient leaching

Physical effects of compost:

- improved air and water balance
- improved aggregate stability
- easier workability of the soil
- better warming of the soil in the spring

03
What belongs in the compost?

Anything containing carbon in a biodegradable form can be composted. However, not everything is suitable for composting in a home garden. In the following, suitable and unsuitable materials are listed for home composting.

Suitable materials

Grass clippings

Care should be taken when adding grass clippings to the compost heap. Grasses preferentially take up nitrogen (N) from the soil. That is, when it has been highly fertilized, the content of nitrogen in the grass is also high. Grasses store water in their cells as well, which, in conjunction with nitrogen, causes heat to build up significantly in the cuttings. This resulting heat can even lead to the spontaneous ignition of grass piles. Due to the poor structure and the high nitrogen content, it can start to putrefy and smell bad. Methane, which is a climate-damaging greenhouse gas, can then be formed and released into the atmosphere. To avoid this kind of decomposition process, grass clippings should only be applied to a compost heap after drying and in a thin layer or mixed with other structure-rich materials such as leaves, hedge trimmings, and fresh wood chips.

Leaves

Leaf is one of the most important materials for composting in the garden. Some types of leaves are more difficult to decompose such as the leaves of:

- Oak,
- Chestnut,
- Poplar,
- Birch,
- Plane trees,
- Beech,
- Walnut trees,
- Spruce,
- Acacia.

Since tannic acid, which leads to the acidification of the compost, is released during the breakdown of these types of leaves, especially oak leaves, the addition of lime or clay minerals (bentonite) can be useful. Leaves that are easily compostable:

- Pome and stone fruits,
- Maple,
- Linden,
- Willow,
- Ash,
- Rowan,
- Alder,
- Common hazel.

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TIP:
Shred leaves with the lawn mower before collecting and composting!

Tree and hedge trimmings
This material can be cut up with garden pruners or shredders and added to the compost heap for better aeration.

Kitchen scraps
- Fruit and vegetable waste
- Coffee and tea filters
- Eggshells

Materials to be used in moderation

Peels from tropical fruits
To ensure better durability during transport, tropical fruits are treated with fungicidal substances (fungicides). These chemicals are biodegradable and do not interfere with the decomposing process in small amounts. Smaller quantities are therefore unproblematic for overall composting.

Paper and cardboard
Small amounts of newspaper or kitchen paper used for lining the kitchen waste container can be easily composted.

In principle, paper and cardboard are biodegradable and are also decomposed during the composting process. However, these often contain ingredients and additives that are not suitable for use in the soil. Larger quantities of paper, printed paper like newspaper and cardboard, including egg cartons and fruit and vegetable trays, can be ecologically better recycled by using the waste paper recycling system.

Small animal beddings
For hygienic reasons, only the beddings of small herbivores should be used, provided that they are plant-based (e.g. wood or straw beddings). All commercially available granular beddings are non-compostable. Unless they are particularly described as biodegradable, they belong in the residual waste containers.

Beddings from rabbits, hamsters, birds, etc., can be composted. However, beddings and droppings should be mixed well with other compost material. The droppings of pets can be added to straw and woody compost materials as an additional supply of nitrogen.

Beddings and feces from dogs and cats, as well as from all other carnivorous animals, should not be composted for hygienic reasons.

Wood ash
Ash from the combustion of untreated wood can be added as a mineral component in small quantities during the composting process. The ash should be well mixed. Larger amount of ash is not suitable for do-it-yourself recycling, since the accumulation of heavy metals in the ash can lead to an accumulation of heavy metals in the compost.

Unsuitable Materials

- Diseased plant parts (belong in the organic waste containers)
- Invasive plants, such as ragweed, giant hogweed/cow parsnips (belong in the organic waste containers or even in the residual waste containers); see “Prerequisites for composting (decomposition)”

- Glass, metal, plastic and composites
- Oil and paint residues
- Construction waste and mortar
- Coal ash from furnaces
- Gutter sludge
- Vacuum cleaner bags
- Grass clippings from lawn treated with herbicide (combination products)
- Treated wood and particle board
- Diapers

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Diseased plant parts

Plants infested with pests or disease, whether from the garden or the house, should not be composted in the home garden. Pests such as lice, thrips, European red mite, or maggots only die in the compost at very high temperatures. Similarly, fungi and their spores, such as powdery mildew on cucumbers and pumpkins, downy mildew on lettuce or spinach, rust on geraniums, or black spot on roses, are not sufficiently destroyed during home composting.

Please do not compost:

- cabbages with club root
- tomatoes and potatoes with blight
- dead branches with coral spot
- branches of apple, pear, cotoneaster, as well as red and white hawthorn, mountain ash, etc., with fire blight
- bulbs and tubers with white rot
- plants like asters, strawberries, and tomatoes that died quickly and suddenly of wilt disease during the growing season
- Raspberries with spur blight
- Diseased plants and infected garden waste belong in the organic waste bins or should go directly to composting plants

A note on kitchen waste

Non-vegetable kitchen waste (meat, sausage, fish scrap, bone) are not suitable for do-it-yourself composting because the required temperatures over a certain period necessary for a good compost hygiene(hygienic control of epidemics) are normally not reached. In addition to this, all cooked kitchen waste should be thrown away for hygienic reasons, so as not to attract rodents and vermin.

Source: https://www.kompost.de/themen/selbst-kompostieren/kompostmaterial/

04
Hygiene

Organic waste and compost heaps are generally harmless to human health, provided that some basic rules are followed: mold allergy sufferers and people with weakened immune systems should be careful, that is, remove the organic waste as quickly as possible from the kitchen and throw it in the organic waste containers instead of having a home compost heap. For healthy people, composting is safe in the home garden.

Scientific studies have shown that the use of compost suppresses soil-borne plant diseases (phytosanitary effect) on one hand, but on the other, human and plant pathogens as well as weed seeds can also be introduced into the soil.

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Microorganisms that infest plants or decompose organic matter are necessary to turn organic waste into valuable humus. They are generally harmless to humans.

It is therefore crucial to ensure the destruction of pathogens and weed seeds during composting process for the sake of human and plant hygiene.

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Hygienisation – Advantages of composting plant versus home composting:

When it comes to large-scale composting, the requirements for epidemic control and plant hygiene are regulated through the Ordinance on the Utilisation of Biowastes on Agricultural,Silvicultural and Horticultural Land (BioAbfV) as well as the occupational health and safety standards: for organic waste composting plants, a temperature of at least 55 °C over a period of 2 weeks is stipulated in order to kill germs and weed seeds. The processes used in the composting plant reach these high temperatures in a short time. The targeted control of aeration and water content allows optimal conditions for decomposition. Corresponding legal requirements and technical possibilities are not available for home composting.

✔ **Home composting = Self-responsibility!**

Monitoring the temperature in the compost system ensures the destruction of pathogens and weed seeds

In particular, the heat generated during composting is crucial for destroying pathogens and weed seeds. Sufficiently high temperatures over a prolonged period, combined with proper moisture contents, cause the death of pathogens and weed seeds.

During home composting, these decomposition temperatures are rarely achieved, nor are they sustained for the required period of time because the comparatively small heaps only heat up inadequately due to their unfavorable surface area to volume ratio. Many pathogens for humans, animals, and plants, as well as seed-bearing weeds and their roots are therefore not effectively killed in the small-scale compost heap.

Corresponding plants and parts of plants should therefore be disposed of by better means: the organic waste collection.

05
How to properly compost

Composting is all about creating the best living conditions for aerobic microorganisms. Only with their help is it possible to have an odorless decomposition of organic waste. It has proven useful to follow certain basic rules, without dictating one given formula.

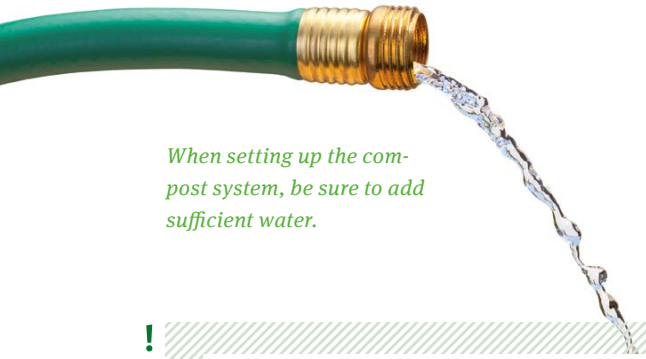
Prerequisites for composting (decomposition)

Composting is a biological process. In order to initiate and accelerate the maturation of the compost, it is necessary to try to promote good living conditions of the microorganisms involved in composting. It is therefore necessary to consider their particular needs. Of particular importance are the following factors:

- water,
- air,
- heat,
- and nutrients (starting materials).

Water is required for all microbiological processes. When there is no water, many micro-organisms enter into a resting period, which slows the decomposition process. The compost material must be therefore adequately watered when setting up the compost pile. If it hasn't rained for an extended period of time, and lots of garden waste still have to be composted, the entire compost material must be moistened well. During the composting process, water evaporates due to the heat generated, so that active compost may have to be re-moistened.

On the other hand, too much water (soaking) hinders the activity of the aerobic organisms. Aeration is jeopardized, the heap cools off, and undesirable anaerobic digestion can occur as a result. The compost heap should therefore be covered in very wet weather, e.g., during rainy days. This is especially important when a compost heap is newly set up, the heap is not yet finished, or the compost container is not full yet.



When setting up the compost system, be sure to add sufficient water.

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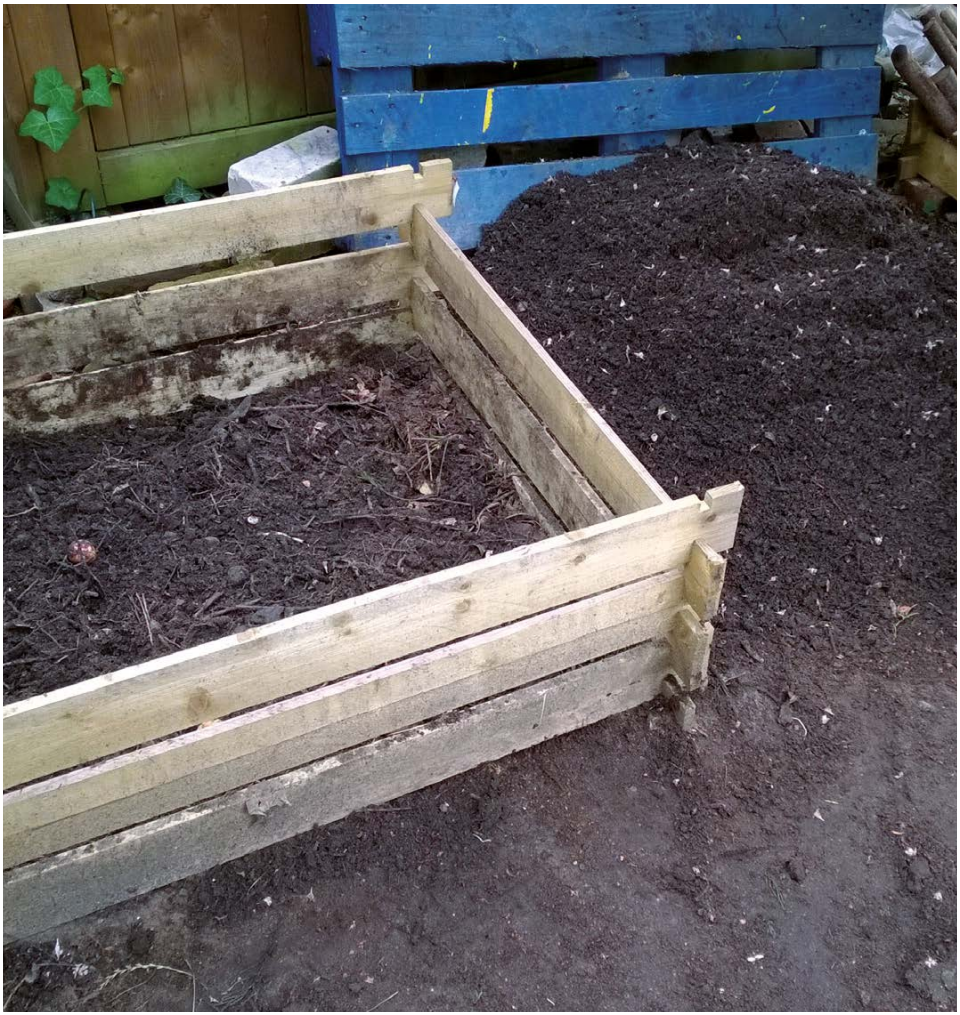
Water is the key requirement for all life.
It is just as important for composting as the air is.



Air contains oxygen (O_2) that is necessary for aerobic microorganisms to breathe. If the compost material is insufficiently aerated, such as in closed containers or concrete waste pits, forming a dense layer, or when there is an accumulation of moisture, anaerobic microorganisms that do not require oxygen proliferate. The result is a cessation of composting and the beginning of the anaerobic digestion with all its harmful and unpleasant side effects, such as odor (hydrogen sulfide (H_2S), ammonia (NH_3)) and the development of climate-damaging gases such as methane (CH_4) and nitrous oxide (N_2O).

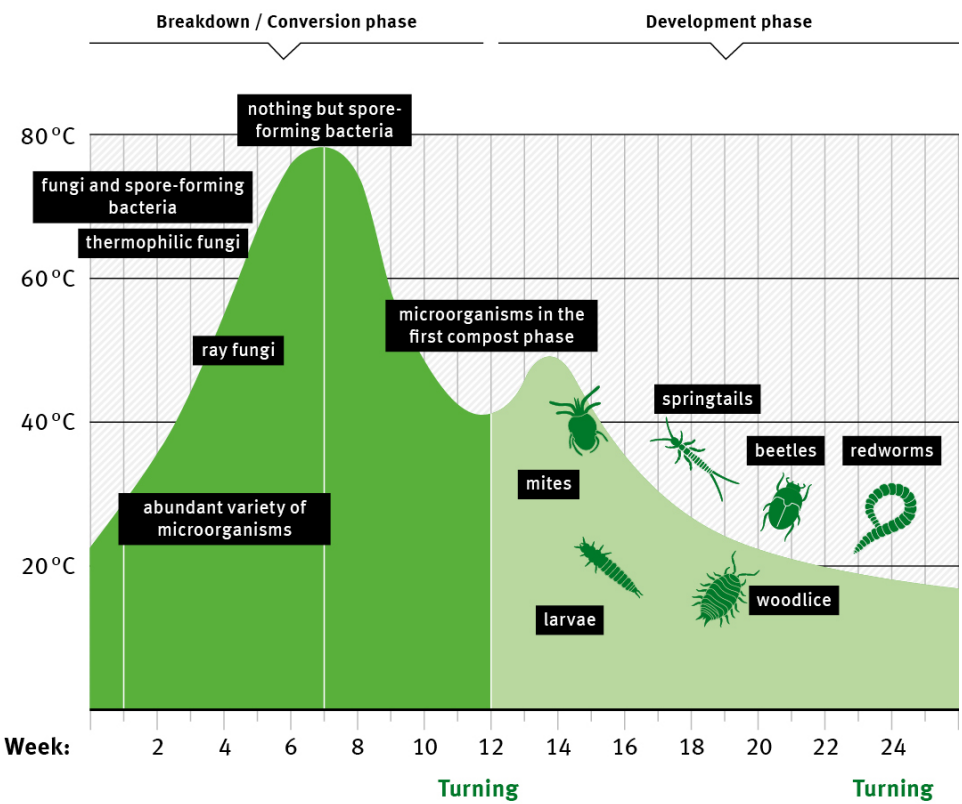
In order to ensure good airflow, sufficiently coarse, well-structured material should be contained in the compost material. In addition, containers with air-permeable walls and sufficient drainage to remove excess water should be used. In order to allow air to enter the compost stack, it should not be wider than 2 m and not higher than 1.5 m.

Turning the compost not only improves aeration, but also contributes to better mixing of the compost material.

The performance of the microorganisms is at its highest when optimum moisture levels and aeration are maintained. The intense heating up of compost is evidence

Figure 2

The composting process in a composting plant



Source: Author's own presentation following www.kompost.de/themen/selbst-kompostieren/prozess/

of this. Higher temperatures in turn accelerate the decomposition process. To kill pathogens and weed seeds, a temperature of 55 – 60 °C over a longer period is necessary. Compared to composting in a professional composting plant, these temperatures are usually not reached during garden composting or not over the required period of time. Composting in one's own garden is therefore not suitable for treating diseased plant parts or seeds of unwanted plants (such as weeds or invasive plants), see also chapter "Hygiene".

Shredding

For the speedy breakdown of starting materials, it is necessary to shred particularly hard and bulky organic waste. The crushed woody components serve as structural material and improve the aeration of the compost. A mixture of crushed woody material and soft plant parts makes the compost loose and air-permeable. Since branches are not available at all times of the year, one or more sacks of branch material can be collected, chipped, and set aside for times when mainly soft plant parts such as lawn clippings are produced. With woody material, everything that pruning shears can handle should be cut into approximately 5 cm long pieces, if possible in a green state. With the trusty old chopping block and a handy hatchet, you can make light work of it. However, a garden shredder can also be used.

Thicker stems, for example from sunflowers or dahlias, should be chopped up or split to provide microorganisms with better access for decomposition.

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The problem of "invasive species"

Unlike large-scale composting plants, home composting does not ensure that the tissue and seeds of problematic invasive species are destroyed. As such, further spread of these species is possible.

Examples:

- ragweed originating from North America. It is already widespread in large parts of Europe and causes allergies and severe skin rashes
- Giant hogweed originates from Caucasus. It contains substances that are phototoxic when combined with sunlight. It leads to painful welts and blisters on the contacted skin.

invasive species = non-native plant species

It all depends on the mixture

The more diverse the mixture of organic waste is, the better the decomposition process will be, and the more valuable the final compost will be. It doesn't matter whether the compost heap is built up layer by layer or mixed with materials as they become available. The only important thing is to avoid adding one type of material in large quantities all at once to the compost heap, e.g., only foliage or grass clippings.

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Of great importance to the composting process is the ratio of carbon (C) to nitrogen (N) (C / N ratio) in the decomposing material. Carbon is the basic building block of any organic substance. Nitrogen is an essential element for the buildup of plant and animal proteins.

The optimal C / N ratio is between 25 and 35. As a rule, this ratio is achieved when a mixture of fresh green material and shrubby material is composted.

The kind of setup depends ultimately on the more or less continuous waste generation during the year. Almost every biodegradable thing in the garden and household can go on the compost pile. In cases where there are insufficient amounts of different kinds of waste available, the structure of the heap can be improved by mixing in other substances. For example, the coarse materials left after sifting the compost (screen overflow) or other shredded material could be mixed back in.

Peat should not be used. Peat tends to lock in moisture so when the compost heap gets too dry, any remaining moisture is held inside the peat instead of being available for the small organisms in the rest of the heap. In addition, one should bear in mind that the peat mining is a risk to wetlands and, for ecological reasons, the use of peat should be avoided.

Are additives necessary?

If the compost material is a diverse mixture of kitchen and garden waste, no additives are necessary.

Success depends on the variety of materials used, which is a loose mixture of coarse and fine, hard and soft substances.

In order for the optimal breakdown to start within a few days and continue until the compost is mature, a few shovels of finished compost, the screen overflow from sifting or garden soil can be mixed with other compost material. The small and micro-organisms contained in finished compost or in garden soil certainly serve as “inoculants” for the new compost. This makes the purchase of so-called “probiotic” unnecessary.

Commercial compost additives, such as composting starters, accelerators, lime, rock flour, bentonite, and fertilizer, can also be dispensed with when composting is done correctly, namely with a diverse and structurally rich mixture of organic waste. It is because additives generally do not guarantee the success of the compost and do not fix any serious errors that are made along the way.

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When is the compost finished?

- Fresh compost (= immature compost) is finished in approx. 3 – 4 months and can then be used as mulch and for soil improvement. It mostly contains parts that are still coarse, but also some humus and many small organisms that can revitalize depleted garden soil.
- Mature compost (= humus fertilizer) is ready in the warmer half of the year after approx. 4 – 6 months, otherwise after about 6 to 12 months at most, after turning once.
- A uniform crumbly texture and the smell of damp forest soil indicate that the compost is ready for spreading. Depending on how optimally the compost process has taken place, this state is reached after 6 – 12 months.
- Compost should not be stored for more than one year, as the organic substances get decomposed to an excessive extent and do not contribute sufficiently to humus enrichment.

Cress test for the assessment of maturity and plant compatibility:

- Mix a handful of compost with garden soil in a small container and moisten it with water.
- Sow cress seeds on top of this mixture, cover it with cling film, and place the container in a bright location out of direct sunlight for seed germination.
- If the seeds germinate after about a week and the seedlings grow rapidly without brown or yellow discoloration, the compost is mature and compatible with plants.
- If the seedlings hesitate to grow or have discolored leaflets, the compost is still too fresh and should not be used as potting soil, rather just as mulch or for soil improvement.

Setting up a compost heap

Compost pile

Not everywhere in the garden is suitable for composting. If possible, the compost heap should be placed in a shady area in the garden in order to keep it from drying out.

Extreme weather conditions can hinder the composting process. Therefore, the location should be surrounded by hedges, pole beans, or espaliered plants in order to provide protection from strong winds. The area must be easy to reach and provide sufficient space to move when doing work like turning the compost.

Compost worms – useful helpers in the compost pile

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Measures and effects of a proper composting

- **Variety of organic waste** – Improved nutrients for microorganisms through various substrates.
- **Disposal of waste in higher quantities** – Favors self-heating and improved hygienisation.
- **Shredding of shrub and tree cuttings** – Shorter breakdown time through an increased contact surface area available to microorganisms.
- **Regular loosening and turning** – Mixing improves aeration and reduces oxygen-deficient areas.
- **Green waste as structure material** – coarse material creates void spaces and improves aeration.
- **Covering the composter** – prevents excessive moisture from rainwater and reduces the risk of soil over-fertilization under the composter.

The compost pile should not be set on a ground that is impermeable to water. A ground surface of stones and concrete would block the way into the pile for worms and other beneficial organisms. Water would accumulate at the bottom and lead to putrefaction. A wire mesh on the ground can prevent the invasion of rodents.

The compost pile should not exceed a height of about 1.5 m and a width of about 2 m at its base. The length of the pile depends on the available space and materials to be composted.

First, coarse material is loosely piled up to a height of approx. 20 cm. Shredded tree and hedge trimmings, branches, and stems of perennial plants s and flowers are suitable for this purpose. This provides drainage, which allows excess water to move away from the pile and ensures air circulation. Second, the organic waste from the garden and kitchen is applied. Some old compost or soil is distributed here and there so that the predominant material is thinly covered. The material should be lightly watered from time to time, so that the pile does not dry out too much.

The layering continues in the manner described up to a height of 1.5 m. The top of the compost pile does not form a peak, but rather lies flat.

The compost pile should be covered with a protective layer of grass clippings, reed mats, foliage, or straw. In order to accelerate the decomposition process, the pile can be turned after about 3 months. If the pile gets too wet, it should be turned earlier.

!

When using thermal compost bins, it is important to note that compost worms escape when the temperature reaches above 25 °C.

Compost bin

In small gardens, it is sometimes difficult to find a suitable place to set up a compost pile. The simplest solution is to drive wooden posts into the ground and to attach boards to the sides. It is important to keep in mind that, depending on the width of the planks, 1 – 3 cm of space is left in between in order to ensure adequate air supply.

A good and inexpensive solution is a composter made of wooden boards, which is offered in every hardware store. Here you should pick up two or three of them for:

- better mixing,
- single batch or coarse material storage
- better turning (moving from one container to another).

Lath frames with oversized spaces and containers made of wire mesh tend to dry out the composting material too much and are not recommended.

An alternative to lath or slat composters are plastic ones. These are vessels which are closed upwards and to the sides, and open like other composters to the ground.

Composting is done here by the same rules as for the open piles. A little more care must be taken to regulate the moisture

content and the air supply, since the largely closed design provides the conditions for putrefaction. To counteract this, coarser material should be mixed in during loading.

A further alternative is a thermal composter or "fast" composter. These have thermal insulation as well as precise aeration depending on the type of construction. The insulation is intended to prevent the heat generated by decomposition from being released into the outer area too quickly. The achievable higher composting temperature and the sustained decomposition process even in the winter should speed up the composting process. Nevertheless, a clear influence of the type of composter used on the acceleration of the compost processing time has not been proven so far.

Surface composting and mulching

One special way of utilizing organic waste is surface composting and mulching. It is carried out on the spot where the dead parts of the plant are produced and these are distributed directly onto the ground without being transported to the composting heap. This is particularly labor-saving when it comes to larger areas, since the re-application of the finished compost is not needed. While the material used for surface composting gets tilled under, material used for mulch remains on the surface. Compared to surface composting, mulch is easier to apply in densely cultivated hobby gardens, whereas surface composting is recommended before planting the new garden.

Many types of organic waste can be used, such as leaves, shredded cuttings of perennial plants, grass clippings, vegetable residues, wild herbs without seed, and straw. The more varied the material, the more nutrient-rich the compost layer becomes. Woody perennial cuttings should only be applied if it is finely shredded because a layer of 3 – 5 cm in height does not heat up in the same way as a compost pile does, and therefore decomposition slows down.

In the layer of mulch, microorganisms and worms thrive which are necessary for the conversion of plant material into humus and which make the soil fertile with their castings. The more microorganisms in the

soil, the faster the layer of mulch decomposes and supplies the plants with minerals.

The soil is protected by this permanent ground cover, similar to a mixed coniferous forest,from wind, leaching in heavy rain, and dehydration in the sun. Under this cover, the soil remains moist and crumbly.

Leaf composting

If you have broadleaf trees in the garden and have enough space, you should do leaf composting in autumn:

About 6 m^3 of fallen leaves are laid in the form of a triangular heap, which is 4 – 5 m long by 2 m wide at base. The heap is piled up in layers, each 20 cm high, and has a central ridge being up to 1.5 m high. The microbes need nitrogen for propagation, that is, for the formation of unique protein, and foliage contains very little nitrogen.

Therefore, each layer of leaves is covered with nitrogen-containing additives, e.g. with fresh lawn clippings (as a thin sprinkling) or horn shavings (a small amount, the foliage should still be visible). Garden soil is thrown on the sides of the pile ("made black") so that the wind does not-blow the foliage away. After 4 – 5 days the heat generation in the pile reaches the peak of about 50 °C. In the following weeks, the temperature drops to 25 °C. The pile shrinks because the mass of the carbon (C) has escaped into the air as carbon dioxide (CO_2) or is involved in the decomposition process with the water that forms. At this point the remaining pile should be protected from frost: one half of the pile is put onto the other. The temperature again rises to about 35 °C and then remains at about 15 °C until March. The bacterial decomposition in the pile goes undisturbed further until the compost is finished.

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Mulching serves another important purpose other than fertilizing and revitalizing the soil: it protects the uppermost layer of the soil.

06
Using the compost

Compost can be applied on almost all beds and green areas of the garden. It is not suitable for acid-loving bog plants like Rhododendron because of its lime content. It should not be only excessively applied to the vegetable beds, as is often the case, but should also be used at appropriate amounts on perennial plants, summer flowers, fruit trees, and ornamental plants as well as lawns. If the entire garden area is included in the compost application, overdosing and thus nutrient accumulation (over-fertilization) in the garden soil by excessive compost application can largely be avoided. If the lawn area, which is generally significant, is excluded from compost application, it follows that there is a greater danger of overdosing in other areas.

Compost should only be applied during the growing season which is in the spring and summer. During this main growth period, the plants can absorb relatively high quantities of nutrient and thus make considerable use of the available compost. It is not advisable to apply it during other seasons, as the plants hardly absorb nutrients outside the growing season. Instead, leaching and transfer of nutrients into the groundwater may occur.

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Nutrients in compost

Compost contains lower levels of nutrients than commercial fertilizers, but a regular use of compost can lead to a comparable nutrient supply in vegetable and ornamental gardens. The main nutrients nitrogen (N), phosphorus (P), and potassium (K) are generally found in compost in a closer ratio compared to conventional complex fertilizers. The ratio of N:P:K is more likely to be 1.5:1:1, whereas complex fertilizers for vegetable gardens have higher nitrogen and potassium content relative to phosphorus (e.g., mineral-based complex fertilizer 3:1:4).

This means that it is possible by applying compost to supply substantial nutrients to gardens, but additional supplementation of nitrogen and potassium fertilizer may be necessary for a full supply. For this reason, nutrient content is the limiting factor when determining how much compost should be applied to gardens annually.

Table: Recommendations for Compost Amount on Selected Crops

Table 1

Recommendations for Compost Amount on Selected Cultures

Crop		Amount of Compost
Vegetables (per crop)	with high nutrient requirements	approx. 3 l/m²
	with medium nutrient requirements	approx. 2 l/m²
	with low nutrient requirements	approx. 1 l/m²
Woody plants (per year)		approx. 1 l/m²
Perennials (per year)	strong growth	approx. 2 l/m²
	slow growth	approx. 1 l/m²
Grass		approx. 2 l/m²

Source: Bodenpflege, Düngung, Kompostierung aid-Heft 1375/2002

Compost should only be applied to the soil on the surface. There is enough oxygen in the uppermost soil layer for further aerobic breakdown and conversion of the organic matter contained in the compost. The oxygen content decreases markedly in deeper soil layers. Compost that is applied there possibly decomposes anaerobically (without oxygen), producing substances that are harmful to plants.

In addition to fertilizing with compost, it can be useful to add additional fertilizer for the nutrient supply of plants, but using differentiated approaches. While the need for phosphorus is covered by compost for most plants, supplementary nitrogen or potassium fertilization may be recommended.

The need for sifting of compost before spreading depends on the application. While this is not necessary when being used to improve soil with coarse structure, sifting is recommended to have materials smaller than 10 – 15 mm for sprinkling on lawns or flower beds.

Glossary

Organic waste

Food, kitchen, and garden waste from private households, as well as park and landscape maintenance waste from municipal services.

Definition according to KrWG:
According to KrWG § 3 para. 7, organic waste is biodegradable plant-, animal-, or fungus-materials containing in:

1. garden and park wastes,
2. landscape maintenance waste,
3. food and kitchen scraps from households, catering services and restaurants, retail businesses, and comparable waste from food processing companies, and
4. waste from other sources of origin comparable to the waste referred to in points 1 to 3 by type, quality, or material characteristics.

Degrees of decomposition

The degree of decomposition is a measure of the maturity of compost. The degree of maturity is determined by the self-heating capability under defined conditions in the laboratory.

Degree of maturity I:
raw compost (temperature > 60 °C)

Degree of maturity II:
fresh compost (temperature 50 – 60 °C)

Degree of maturity III:
fresh compost (temperature 40 – 50 °C)

Degree of maturity IV:
finished compost (temperature 30 – 40 °C)

Degree of maturity V:
finished compost (temperature < 30 °C)

Source: http://www.backhus.com/7-0-Glossar-Kompostierung.html?slice_ id=334 &search=

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Public waste management authority (öffentlich-rechtlicher Entsorgungsträger), usually owned by the municipality, is either a private waste management company contracted by the municipality or a merger of several municipalities into a special-purpose association.

Spreadable material

The organic soil matter can be divided into

- biomass (of living organisms) and
- humus as the dead organic matter.

The humus itself can be divided into

- spreading material (=non-humic substances), where the tissue structures are still macroscopically recognizable and
- the humic substances, in which the tissue structures are no longer recognizable microscopically.

The humic substances can be subdivided again into

- fulvic acids
- humic acids and
- insoluble humic substances.

Source: https://de.wikipedia.org/wiki/Organische_Bodensubstanz

C / N ratio

Weight or mass ratio of carbon (C) and nitrogen (N) in the soil. Both elements are organically fixed in humus and are mineralized by micro-organisms (mineralization), that is, converted into inorganic compounds; N becomes available to plants. Soils with a narrow C / N ratio (high N content) are nutrient-rich and fertile (C / N is about 10:1 in black-coloured soil containing a high percentage of humus; chernozem); a high C / N ratio (in the case of raised bogs, approx. 50:1) is characterized by low biological activity and vegetation with nitrogen-poor species. Arable soils should have a narrower C / N ratio than 25:1, otherwise the soil-dwelling organisms will limit their mineralization activity or identify the nitrogen as a part of their own cells. Fertilization with cereal straw (C / N approx. 50–100:1) temporarily reduces the availability of N, while decomposed manure (C / N approx. 15–20:1) favorably influences the soil's productive capacity (soil fertility).

Source: http://www.spektrum.de/lexikon/biologie/c-n-verhaeltnis/14591

Selected further reading

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