

# USING COFFEE GROUNDS IN GARDENS AND LANDSCAPES



## Introduction

Americans consume an average of three cups of coffee per day (World Population Review 2021); at our 2021 population level, that works out to over 980 million cups of coffee a day. Producing this volume of coffee means we generate a lot of coffee grounds in the process. Putting coffee grounds to use in the garden makes both economic and environmental sense (Figure 1). Many gardeners already use coffee grounds as an essential part of their compost mixture, but an increasing number of people are using them directly as mulch, based on the thousands of websites that discuss this topic.

Speculation abounds that coffee grounds repel cats, kill slugs, prevent weeds, aerate and acidify the soil, provide nitrogen, and attract earthworms. This publication examines the science behind the use of coffee grounds in gardens and landscapes and provides recommendations for home gardeners to use coffee grounds appropriately.



Figure 1. Many coffee shops provide used grounds for their customers. Photo: L. Chalker-Scott.

## Chemical Composition of Coffee Grounds

Not everything contained in a coffee bean makes it into a cup of coffee. Nitrogen-rich proteins needed for seed germination and growth comprise over ten percent by weight of the content in coffee grounds (Table 1) (Tokimoto et al. 2005). Since coffee is extracted in water, most of the hydrophobic compounds, including oils, lipids, triglycerides, and fatty acids, remain in the grounds, as do insoluble carbohydrates like cellulose. Structural lignin, protective phenolics, and the wonderful aroma-producing essential oils also remain in the grounds following the brewing process. Even small amounts of caffeine may remain in the grounds (Bravo et al. 2012).

While many minerals are solubilized and leached during the brewing process, a percentage remain in the used grounds (Table 1). The values are highly variable, but potassium is commonly the largest mineral constituent followed by a combination of phosphorus, magnesium, and calcium.

## Decomposition of Coffee Grounds

Left outdoors over the course of several months, bacteria and fungi break down the various chemical components of coffee grounds. Nitrogen-rich compounds including proteins and caffeine break down quickly, releasing plant-available nitrogen into the soil.

Some larger bioconsumers, including earthworms (Figure 2), use coffee grounds as a food source (Bollen and Lu 1961). The fact that earthworms pull coffee grounds deeper into the soil may account for noted improvements in soil structure such as increased aggregation following the application of coffee grounds (Wakasawa et al. 1998).



Table 1. Comparative chemical composition of spent coffee grounds from commercial coffee (Mussatto et al. 2011) and espresso (Cruz et al. 2012) production.

	Percent Dry Weight									
	Protein	K	P	Mg	Ca	Al	Fe	Mn	Cu	Na
Coffee	13.6	22	9	8	5	2	1	<1	<1	---
Espresso	12.8–16.9	38–64	8–9	12–20	2	---	<1	<1	<1	<1–4

Notes: K = potassium; P = phosphorus; Mg = magnesium; Ca = calcium; Al = aluminum; Fe = iron; Mn = manganese; Cu = copper; Na = sodium.

Carbon-to-nitrogen ratios change during coffee ground degradation, generally starting out high (e.g., 25–26:1) and decreasing over time to about 10:1 (Morikawa and Saigusa 2011, 2008; Ouatmane et al. 2000). The latter is an ideal ratio for plant and soil nutrition.

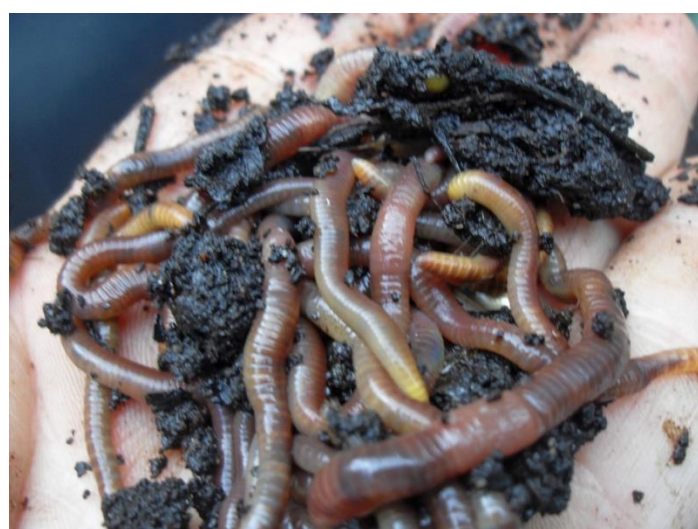


Figure 2. Earthworms are voracious consumers of coffee grounds. Photo: L. Chalker-Scott.

## How Coffee Grounds Affect Soils

Coffee grounds used as mulches or amendments have mostly positive effects on soils (Yamane et al. 2014). Coffee grounds will moderate soil temperature and help retain soil water (Ballesteros et al. 2014) like any other good mulch material. Coffee grounds bind pesticide residues (Bouchenafa-Saïb et al. 2014; Fenoll et al. 2014) and toxic heavy metals such as cadmium (Azouaou et al. 2010; Kim et al. 2014), preventing their movement into the surrounding environment. They can also increase the availability of essential plant nutrients, such as nitrogen, phosphorus, iron, and zinc (Kitou and Okuno 1999; Liu and Price 2011; Morikawa and Saigusa 2011, 2008), especially in more alkaline soils.

## FAQs about Coffee Grounds

**Q:** Will coffee grounds make my compost or soil too acidic?

**A:** Many gardeners assume that coffee grounds are acidic, but this does not hold true experimentally. Studies on coffee ground composting have reported pH levels ranging from mildly acidic (Cruz et al. 2012; Morikawa and Saigusa 2008) to somewhat alkaline (Ros et al. 2005). The pH of decomposing coffee grounds is not stable and one shouldn't assume that it will always, or ever, be acidic. Also keep in mind that pH changes will only be in the immediate vicinity of the coffee grounds, not throughout the entire soil profile.

**Q:** Can coffee grounds help my plants?

**A:** Yes. When they are composted, either alone or as part of a compost pile, coffee grounds provide a rich supply of nutrients once applied to the soil (Yamane et al. 2014). Fresh grounds are demonstrably phytotoxic to a variety of plants (Cervera-Mata et al. 2020; Ciesielczuk et al. 2018; Hardgrove and Livesley 2016; Wakasawa et al. 1998), so their use as an amendment or mulch is not recommended.

Likewise, don't use coffee grounds in areas where you are growing plants from seed. Reduced seed germination and plant growth of many crop and ornamental species has been observed in experiments using coffee grounds (Ciesielczuk et al. 2018; Nagaoka et al. 1996; Wakasawa et al. 1998).

**Q:** Will coffee grounds keep slugs and other animal pests away?

**A:** There is no published evidence that coffee grounds will repel or kill any garden pests. Nor is there any science-based information on their ability to attract either pests or beneficial animals like earthworms.

**Q:** Do coffee grounds help control diseases?

**A:** Research suggests that the bacterial (Nagai et al. 2002; Ros et al. 2005) and fungal species normally found on decomposing coffee grounds, such as nonpathogenic *Pseudomonas*, *Fusarium*,

and *Trichoderma* spp., and pin molds (*Mucorales*), prevent pathogenic fungi from establishing (Hamanaka et al. 2005; Ros et al. 2005) on crops such as beans (Adams et al. 1968a, 1968b), melons (Ros et al. 2005), spinach (Escuadra et al. 2008), and tomatoes (Nagai et al. 2002).

## Action Items for Gardeners Using Coffee Grounds in Compost

- Use no more than 20 percent by volume of coffee grounds in a compost pile (Figure 3). A diverse feedstock will ensure a healthy diversity of microorganisms. Excessive coffee grounds in composts can be phytotoxic (Kopeć et al. 2018).



Figure 3. Coffee grounds can be used as a component of home compost piles. Photo: L. Chalker-Scott.

- Don't assume coffee grounds will make an acidic compost; pH levels will change over time.
- Be sure to allow coffee grounds to cool before adding them to your compost; heat can kill your beneficial microbes.
- Avoid adding coffee grounds to vermicomposting bins; they can injure or kill earthworms in these confined areas (Liu and Price 2011).
- Understand that disease suppression from nonpathogenic organisms found in decomposing coffee grounds has only been demonstrated under controlled conditions on a handful of crops; their efficacy in gardens and landscapes is unknown.
- Refer to *Backyard Composting* (Cogger et al. 2017) for additional information on composting at home.

## Action Items for Gardening Using Coffee Grounds as a Landscape Mulch

- Be sure to have a soil test to determine if your soil requires any additional nutrients or organic material. If you have optimal or excessive nutrients, do not add coffee grounds in any form.
- Organic material, including coffee grounds, should not be worked into the soil, but laid on top as a thin mulch layer for natural incorporation.
- If your soil test indicates that nutrients are low, apply a thin layer (no more than half an inch) of composted coffee grounds. Cover with a thicker layer (four inches) of coarse organic mulch like wood chips (Chalker-Scott 2015). This will protect the coffee grounds, and underlying soil, from compaction (Figure 4).
- Don't apply thick layers of coffee grounds as a stand-alone mulch. Because they are finely textured and easily compacted, coffee grounds can interfere with moisture and air movement in soils (Chalker-Scott 2007).



Figure 4. Arborist wood chip mulches can cover and protect coffee grounds from compaction and erosion. Photo: L. Chalker-Scott.

## Acknowledgements

Adapted from *Coffee Grounds—Will They Perk Up Plants?* (Chalker-Scott 2009).

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