WASHINGTON STATE UNIVERSITY EXTENSION

USING COFFEE GROUNDS IN GARDENS AND LANDSCAPES

Home Garden Series

By
Dr. Linda Chalker-Scott, Extension Urban Horticulturist and Associate Professor, Washington State University,

WSU PEER REVIEWED

FS207E

Using Coffee Grounds in Gardens and Landscapes

Americans consume nearly 700 million cups of coffee a day (Zagat 2015), which 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.

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

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 10 percent of the content in coffee grounds (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.

Figure 1. Many coffee shops provide used grounds for their customers. (Photo by Linda Chalker-Scott, WSU.)

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.

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.

Humic substances, which are important chemical and structural soil components, are produced through coffee ground degradation (Ouatmane et al. 2002). Carbon-to-nitrogen ratios change as well, generally starting out high (e.g. 25-26:1) and decreasing over time to about 10:1 (Morikawa and Saigusa 2008; Ouatmane et al. 2000). The latter is an ideal ratio for plant and soil nutrition.

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 increase 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.

Figure 2. Earthworms are voracious consumers of coffee grounds. (Photo by Shanegenziuk, via Wikimedia Commons.)

They 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 (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 used properly, coffee grounds supply nutrients and provide other benefits that increase plant growth (Yamane et al. 2014). In general, only composted coffee grounds should be worked in as a soil amendment, while either fresh or composted grounds can be used in a mulch layer. Fresh grounds are more likely to be phytotoxic (Wakasawa et al. 1998), so keeping them away from direct contact with desirable plant roots is recommended.

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 either as an amendment or a mulch (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 non-pathogenic *Pseudomonas*, *Fusarium*, and *Trichoderma* spp. and pin molds (Mucorales), prevent pathogenic fungi from establishing (Hamanaka et al. 2005; Ros et al. 2005).

Action list for 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.
- 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 non-pathogenic organisms found in decomposing coffee grounds has only been demonstrated under controlled conditions on a handful of crops, including bean (Adams et al. 1968a and b), melon (Ros et al. 2005), spinach (Escuadra et al. 2008), and tomato (Nagai et al. 2002). Their efficacy in gardens and landscapes is unknown.

Figure 3. Coffee grounds can be used as a component of home compost piles. (Photo by Linda Chalker-Scott, WSU.)

Action list for using coffee grounds directly as a mulch

- Apply a thin layer (no more than half an inch) of 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 from compaction (Figure 4).

Figure 4. Arborist wood chip mulches can cover and protect coffee grounds from compaction and erosion. (Photo by Linda Chalker-Scott, WSU.)

- 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.

Adapted from Chalker-Scott, L. 2009. Coffee grounds – will they perk up plants? *MasterGardener Magazine* 3(1):40-41.

Cover photo by BenFrantzDale, via Wikimedia Commons.

References

Adams, P.B., J.A. Lewis and G.C. Papavizas. 1968a. Survival of root-infecting fungi in soil. IX. Mechanism of control of *Fusarium* root rot of bean with spent coffee grounds. *Phytopathology* 58(12):1603-1608.

Adams, P.B., G.C. Papavizas and J.A. Lewis. 1968b. Mechanism of control of *Fusarium* root rot of beans with spent coffee grounds. *Phytopathology* 58:883.

Azouaou, N., Z. Sadaoui, A. Djaafri and H. Mokaddem. 2010. Adsorption of cadmium from aqueous solution onto untreated coffee grounds: equilibrium, kinetics and thermodynamics. *Journal of Hazardous Materials* 184(1/3):126-134.

Ballesteros, L.F., J.A. Teixeira and S. Mussatto. 2014. Chemical, functional, and structural properties of spent coffee grounds and coffee silverskin. *Food and Bioprocess Technology* 7(12):3493-3503.

Bollen W.B. and K.C. Lu. 1961. Microbial decomposition and nitrogen availability of reacted sawdust, bagasse, and coffee grounds. *Journal of Agriculture and Food Chemistry* 9:9-15.

Bouchenafa-Saïb, N., A. Mekarzia, B. Bouzid, O. Mohammedi, A. Khelifa, K. Benrachedi and N. Belhaneche. 2014. Removal of malathion from polluted water by adsorption onto chemically activated carbons produced from coffee grounds. *Desalination and Water Treatment* 52(25/27):4920-4927.

Chalker-Scott, L. 2015. Using arborist wood chips as landscape mulch. *Washington State University Extension* Publication FS160E.

Escuadra, G.M.E., T. Usami and Y. Amemiya. 2008. Effect of compost amendment on soil microbial community and pathogen causing *Fusarium* wilt disease in spinach. *HortResearch* 62:21-29.

Fenoll, J., N. Vela, G. Navarro, G. Pérez-Lucas and S. Navarro. 2014. Assessment of agro-industrial and composted organic wastes for reducing the potential leaching of triazine herbicide residues through the soil. *Science of the Total Environment* 493:124-132.

Hamanaka, Y., K. Toyota and K. Hayashi-Ikeda. 2005. Screening of fungal strains responsible for strong fungistasis against *Fusarium oxysporum* f. sp. *radicis-lycopersici* in a coffee compost-amended soil. *Japanese Journal of Soil Science and Plant Nutrition* 76(6):817-824.

Kim, M.S., H.G. Min, N.M. Koo, J.S. Park, S.H. Lee, G.I. Bak and J.G. Kim. 2014. The effectiveness of spent coffee grounds and its biochar on the amelioration of heavy metals-contaminated water and soil using chemical and biological assessments. *Journal of Environmental Management* 146:124-130.

Kitou, M. and S. Okuno. 1999. Effect of mulching with coffee residue on the growth of soybeans and growth of following crops fertilized with coffee residue: study on agricultural utilization of coffee residue (part 2). *Japanese Journal of Soil Science and Plant Nutrition* 70(5):495-503.

Liu, K. and G.W. Price. 2011. Evaluation of three composting systems for the management of spent coffee grounds. *Bioresource Technology* 102(17):7966-7974.

Morikawa, C.K. and M. Saigusa. 2008. Recycling coffee and tea wastes to increase plant available Fe in alkaline soils. *Plant and Soil* 304(1/2):249-255.

Morikawa, C.K. and M. Saigusa. 2011. Recycling coffee grounds and tea leaf wastes to improve the yield and mineral content of grains of paddy rice. *Journal of the Science of Food and Agriculture* 91(11):2108-2111.

Nagai, H., M. Matsusaki and M. Ogiso. 2002. Disease suppressing of *Fusarium* crown and root rots of tomato by antagonistic bacteria AP-1. *Research Bulletin of the Aichi-ken Agricultural Research Center* 34:105-110.

Nagaoka, T., K. Umezu, K. Kouno, S. Yoshida, Y. Ishiguro and T. Ando. 1996. Selective inhibitors of germination of legume seeds in activated sludge compost. *Plant Growth Regulation* 20(3):295-302.

Ouatmane, A, V. D'Orazio, M. Hafidi and N. Senesi. 2002. Chemical and physicochemical characterization of humic acid-like materials from composts. *Compost Science and Utilization* 10(1):39-46.

Ouatmane, A., M.R. Provenzano, M. Hafidi and N. Senesi. 2000. Compost maturity assessment using calorimetry, spectroscopy and chemical analysis. *Compost Science and Utilization* 8(2):124-134.

Ros, M., M.T. Hernandez, C. Garcia, A. Bernal and J.A. Pascual. 2005. Biopesticide effect of green compost against fusarium wilt on melon plants. *Journal of Applied Microbiology* 98(4):845-854.

Tokimoto, T., N. Kawasaki, T. Nakamura, J. Akutagawa and S. Tanada. 2005. Removal of lead ions in drinking water by coffee grounds as vegetable biomass. *Journal of Colloid and Interface Science* 281(1):56-61.

Wakasawa, H., K. Takahashi and K. Mochizuki. 1998. Application and composting conditions of coffee grounds. 1. Application of coffee grounds in soil. *Japanese Journal of Soil Science and Plant Nutrition* 69(1):1-6.

Yamane, K., M. Kono, T. Fukunaga, K. Iwai, R. Sekine, Y. Watanabe and M. Iijima. 2014. Field evaluation of coffee grounds application for crop growth enhancement, weed control, and soil improvement. *Plant Production Science* 17(1):93-102.

Zagat. 2015. National Coffee Survey.

Issued by Washington State University Extension and the U.S. Department of Agriculture in furtherance of the Acts of May 8 and June 30, 1914. Extension programs and policies are consistent with federal and state laws and regulations on nondiscrimination regarding race, sex, religion, age, color, creed, and national or ethnic origin; physical, mental, or sensory disability; marital status or sexual orientation; and status as a Vietnam-era or disabled veteran. Evidence of noncompliance may be reported through your local WSU Extension office. Trade names have been used to simplify information; no endorsement is intended. Published April 2016.