Defensible Space Landscaping: Mulches

Mulch can play an important role in your landscaping. In addition to aesthetics, proper mulch application provides benefits to water retention, soil temperature, weed inhibition, and soil erosion. Improving water retention and reducing weed growth can help reduce fuel risk in fire-prone areas, but unfortunately, when mulch is composed of wood-based, plant-based, or petroleum products, using mulch also introduces a new combustible material into your landscape. For this reason, it is important to consider the **type**, **location**, and **quantity** of mulch used to best achieve your goals and help protect your property and home from fire.

What Is Mulch?

Mulch is any material used to cover the soil surface for a variety of purposes.[1] There are three types of mulch materials – organic, inorganic, and synthetic. Each type can vary considerably in terms of size, shape, texture and parent material, all of which can influence their combustibility.

- **Organic mulches** – derived from living plant materials such as wood chips, shredded bark, hay and straw, compost, tree trimmings (e.g., arborist wood chips), grass clippings and leaves, and pine needles.
- **Inorganic mulches** – derived from naturally occurring, non-living materials such as rock, gravel, paving stones, and brick chips.
- **Synthetic mulches** – derived from manufactured materials such as shredded rubber and landscape fabrics made of polypropylene and polyester.

Combustion Characteristics of Mulch

Although inorganic mulches are not combustible, organic and synthetic mulches are combustible. Organic and synthetic mulches can ignite from embers, radiant heat, or direct flame contact. Not all combustible mulch materials will have the same combustion characteristics. **It is important to understand how different materials and their structures affect the flammability of mulch**. This section will summarize the combustion characteristics of a variety of mulch types (Table 1). Please note that depending on where you live, products may go by different names.

Mulch that is more resistant to ember ignition may reduce the chance of a home landscape catching fire.[2] Generally, mulches consisting of smaller diameter particles (e.g., fibrous redwood or cedar bark, straw) tend to quickly dry out and can easily ignite. Coarse mulch materials (> 1 inch) are more likely to trap embers and are more prone to ignition than compacted mulch.[3,4] Compacted mulch will have less air space and lower oxygen content than coarse mulch particles and therefore will be less ignitable and flammable.[5,6] Greater moisture content may decrease mulch ignition, particularly if frequent irrigation is directly applied to the mulched material.[7,8]

Combustion Characteristics of Mulch

Although inorganic mulches are not combustible, organic and synthetic mulches are combustible. Not all combustible mulch materials will have the same combustion characteristics. **It is important to understand how different materials and their structures affect the flammability of mulch**. This table summarizes the combustion characteristics of a variety of mulch types commonly used in near-home landscaping. Be aware that depending on where you live, products may go by different names. Please note that anticipated fire behavior does not include information on anticipated behavior under extreme fire and weather conditions.

Mulch Type	Description	Anticipated Fire Behavior	Defensible Space Considerations
Organic Materials			
Bark Nuggets and Non-Composted Wood Chips 	• Materials 1-3 inches in diameter. • **Combustible**: YES.	• Fire can spread through this material, but not as rapidly as other mulch types. • This material can produce lower temperatures. • This material produces relatively low flame lengths. • Particles > 1 inch can be more prone to ember ignition due to larger crevices between particles.[3,4]	• Limit their use and depth (< 3 inches) across your landscape. • Rake mulch away from the base of larger trees and shrubs.
Composted Wood Chips 	• Materials less than 0.5-inch diameter and may have soil incorporated. • **Combustible**: YES.	• Fire can spread through this material, but not as rapidly. • This material can produce lower temperatures. • This material produces relatively low flame lengths. • This material may smolder (a form of combustion that can transition to flaming when enough heat and wind are applied).	• Smoldering may transmit fire across an area or to a structure if left unattended. • Limit their use and depth (< 3 inches) across your landscape. • Rake mulch away from the base of larger trees and shrubs.
Pine Needles and Straw 	**Combustible**: YES, has the most hazardous combustion characteristics.	• Fire can spread faster through this material. • This material can produce higher temperatures. • This material produces relatively longer flame lengths and can serve as a new source of embers.	• Recommended for use only in areas > 30 feet from structures. • Limit their use and depth (< 3 inches) across your landscape. • Rake mulch away from the base of larger trees and shrubs.

Mulch Type	Description	Anticipated Fire Behavior	Defensible Space Considerations
Shredded Bark 	• Different particle sizes and can compact over time when exposed to irrigation and rain. **Combustible**: YES, has the most hazardous combustion characteristics.	• Fire can spread faster through this material. • This material can produce higher temperatures. This material produces relatively longer flame lengths and can serve as a new source of embers.	• Recommended for use only in areas > 30 feet from structures. • Limit their use and depth (< 3 inches) across your landscape. • Rake mulch away from the base of larger trees and shrubs. • If using, it is best to apply shredded mulch in the fall or winter so that it has time to compact before warmer, drier conditions occur.[9]
Inorganic Materials			
Gravel, Rock Mulches, and Paving Stones 	• Come in variety of sizes, colors, textures. • **Combustible**: NO. • Can create appealing aesthetics when used with noncombustible landscape edging (e.g., Corten, steel).	• If no combustible materials or vegetation is present on top of mulch, no combustion is anticipated.	• Use within 5 feet of homes and additional structures. • Use along pathways and to segment patches of combustible materials and vegetation into islands. • Apply a weed barrier under rock mulch to reduce unwanted vegetation growth 0-5 feet from structures. Synthetic weed barriers are acceptable. Use of weed barrier fabric in planted areas outside of Zone Zero is not recommended because they can reduce water infiltration to the soil. • These mulches can absorb and retain heat, which some plants may not tolerate.
Synthetic Materials			
Shredded or Ground Rubber 	• **Combustible**: YES, has the most hazardous combustion characteristics.	• Fire can spread faster through this material. • This material can produce higher temperatures. • This material produces relatively longer flame lengths and can serve as a new source of embers.	• Recommended for use only in areas > 30 feet from structures. • Limit their use and depth (< 3 inches) across your landscape. • Shredded rubber is a petroleum product that produces toxic smoke. • Rake mulch away from the base of larger trees and shrubs.

Table 1: Anticipated fire behavior characteristics and defensible space considerations for commonly used organic, inorganic, and synthetic mulch types.[11]

Integrating Mulch into Defensible Space Landscaping Strategies

When applying mulch to a landscape, it is important to consider defensible space and the risk associated with having combustible materials near the house and other structures. **Reducing the continuity and amount of combustible materials near structures increases the likelihood that those structures will survive a wildfire event**. Defensible Space Zone guidelines help mitigate the intensity and spread of wildfires by increasing the horizontal and vertical spacing between vegetation and combustible materials near structures. Consider the purpose of each defensible space zone when determining which mulch to apply to your landscape (Figure 1):

Zone Zero (0-5 ft) reduces the potential for direct flame contact and ember ignition to the structure by removing all vegetation and combustible materials. Maintaining noncombustible, ignition-resistant areas immediately adjacent to the house, other structures, fences, or wood retaining walls is particularly important for defensible space and structure protection. During a wildfire, wind-distributed embers accumulate in these areas, providing an ignition source for combustible materials that can result in flames directly touching the structure. Due to this, **combustible mulches are not recommended for use within five feet of the house and other structures**.

- **Recommended materials**: concrete, gravel, noncombustible rock mulches, and pavers.

Figure 1: Examples of how different types of mulch can be integrated into a near-home defensible space strategy.[11]

Zone One (5-30 ft) can slow the spread of wildfire to aid firefighters in structure defense. Zone One can reduce the potential for crown fire by creating additional spacing between vegetation and combustible materials. **Combustible mulches should not be applied in a widespread or continuous matter and their depth should be limited to three inches.**[12] Areas covered with combustible mulch should be broken up with noncombustible materials, such as walkways or short concrete or stone walls. Create separation between areas of combustible mulch to prevent the mulch, if ignited, from spreading fire across the entire area.

- **Recommended materials**: composted wood chips, concrete, gravel, medium-sized bark chips (1-3 inches in diameter), noncombustible rock mulches, and pavers. It is recommended to limit the use of inorganic mulches around the base of trees due to their ability to retain heat and damage the roots. This is particularly true for California native oaks.

Zone Two (30-100+ ft) can moderate the behavior of an approaching wildfire. Under moderate conditions, a fire in the canopy of dominant vegetation in Zone Two may drop to the ground and burn with less extreme fire behavior. **Limit the depth of combustible mulches to four inches.**[12] Overall, limiting the depth of

combustible mulches across the landscape can lead to less hazardous combustion characteristics[13,10] and is recommended, especially in areas close to the house and other structures.

- **Recommended materials**: composted wood chips, concrete, gravel, medium-sized bark chips (1-3 inches in diameter), noncombustible rock mulches, pavers, pine needles, shredded cedar or redwood bark, and shredded rubber.

Additional Considerations

Burning mulch, whether flaming or smoldering, reaches temperatures above 140°F at the soil surface—hot enough to kill plant roots exposed to it[15,16]. However, tree roots located below the soil surface are protected from this heat[15]. While mulch is beneficial for tree health when placed beneath a tree's canopy, it should be kept several inches away from the base of larger shrubs, trees, and any exposed roots. This spacing reduces the risk of mulch fires causing heat damage to vulnerable surface roots, which could ultimately kill the tree.

Fire-retardant-treated mulches are not recommended near the house. These products have a limited service life and fire behavior of retardant-treated mulch has been shown to be no different than that of untreated mulch.[10] A best practice is to limit all combustible materials around the first 5 feet of any structure, regardless of how they are marketed to behave. Although irrigating wood and bark mulches may reduce intitial suspectibility to fire, **you should not rely on watering combustible mulches to reduce wildfire risk near structures**, as water supply and pressure may be limited or unavailable during a wildfire and these fuels can dry out quickly. Note also that some types of irrigation, such as drip irrigation, do not wet the entire area, which could result in unseen dry areas of wood and bark mulches. Additionally, the dry, hot, and windy weather during some wildfires can dry out the mulch bed well in advance of the flaming front, rendering the irrigation's defense useless.

References

[5] Beyler, C., Dinaburg, J., and Mealy, C. (2014). Development of test methods for assessing the fire hazards of landscaping mulch. Fire Technology *50*, 39-60.

[13] Butler, K.M., E.L. Johnsson, A. Maranghides, S. Nazare, M. Fernandez, M. Zarzecki, W. Tang, E. Auth, R. McIntyre, M. Pryor, W. Saar, and C. McLaughlin. (2022). Wind-driven fire spread to a structure from fences and mulch. National Institute of Standards and Technology Technical Note 2228-upd1. https://doi.org/10.6028/NIST.TN.2228-upd1

[9] Duryea, M.L., English, R.J., and Hermansen, L.A. (1999). A comparison of landscape mulches: chemical, allelopathic, and decomposition properties. Journal of Arboriculture *25*, 88-97.

[15] Kreye, J.K., Kobziar, L.N., and Zipperer, W.C. (2012). Effects of fuel load and moisture content on fire behaviour and heating in masticated litter-dominated fuels. International Journal of Wildland Fire *22*, 440-445.

[12] Legislative Council Bureau, State of California. (2024). *Public Resources Code, Section 4291*. California Legislative Information. https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?sectionNum=4291.&highlight=true&lawCode=PRC&keyword=mulch

[3] Lin, S., C. Li, M. Conkling, X. Huang, S. Quarles, and M.J. Gollner. (2024). Smoldering ignition and transition to flaming in wooden mulch beds exposed to firebrands under wind. *Fire Safety Journal, 148 (104226).* https://doi.org/10.1016/j.firesaf.2024.104226

[4] Lin, S., Cui, W., Wang, S., Qin, Y., Chen, Y., Zhang, Y., Huang, X., Quarles, S.L., and Gollner, M.J. (2025). Susceptibility to ignition of landscaping mulches exposed to firebrand piles or radiation. Fire Safety Journal *154*, 104388.

[7] Manzello, S.L., Cleary, T.G., Shields, J.R., Maranghides, A., Mell, W., and Yang, J.C. (2008). Experimental investigation of firebrands: generation and ignition of fuel beds. Fire Safety Journal *43*, 226-233.

[2] Nazare, S., Nazare, S., Leventon, I., and Davis, R. (2021). Ignitibility of structural wood products exposed to embers during wildland fires: a review of literature (US Department of Commerce, National Institute of Standards and Technology).

[10] Quarles, S., and E. Smith. (2011). The combustibility of landscape mulches. Reno: University of Nevada Cooperative Extension. https://naes.agnt.unr.edu/PMS/Pubs/1510_2011_95.pdf?utm_source=publications&utm_medium=pub-download&utm_campaign=pub-link-clicks&utm_content=2982

[1] Rogstad, A., T. DeGomez, C. Hayes, J. Schalau, and J. Kelly. (2007).Comparing the ignitability of mulch materials for a firewise landscape. Tuscon: University of Arizona, College of Agriculture and Life Sciences Cooperative Extension Publication 85721. https://extension.arizona.edu/sites/extension.arizona.edu/files/pubs/az1440-2014.pdf

[14] Satomi, R., K. Low, B.J.L. Pitton, I. Zahra. (2024). Fire-smart landscaping in the Sierra Foothills. University of California Agriculture and Natural Resources. https://ucanr.edu/sites/default/files/2025-02/407444.pdf

[16] Sikkink, P.G., Jain, T.B., Reardon, J., Heinsch, F.A., Keane, R.E., Butler, B., and Baggett, L.S. (2017). Effect of particle aging on chemical characteristics, smoldering, and fire behavior in mixed-conifer masticated fuel. Forest Ecology and Management *405*, 150-165.

[8] Suzuki, S., Manzello, S.L., Kagiya, K., Suzuki, J., and Hayashi, Y. (2015). Ignition of mulch beds exposed to continuous wind-driven firebrand showers. Fire Technology *51*, 905-922.

[11] Valachovic, Y., S. Quarles, and S. Swain. (2021). Reducing the vulnerability of buildings to wildfire. Davis: UC Agriculture and Natural Resources Publication 8695. https://anrcatalog.ucanr.edu/pdf/8695.pdf

[6] Zipperer, W., Long, A., Hinton, B., Maranghides, A., and Mell, W. (2007). Mulch flammability. In: Proceedings of Emerging Issues Along Urban-Rural Interfaces II: Linking Land-Use Science and Society: 192-195, 192-195.

Authored by **Isabella Zahra**, UC ANR Fire Network Staff Research Associate Updated 5/4/2026

Bruno Pitton, UC Cooperative Extension Environmental Horticulture Advisor

Katie Low, UC ANR Fire Network Coordinator

With additional feedback from:

Ellie Andrews (UCCE), **Mimi Enright** (UCCE), **Tori Norville** (UCCE), and **Yana Valachovic** (UCCE)

Learn more about the UC ANR Fire Network by visiting our webpage at https://ucanr.edu/sites/fire/