



University of Nevada
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The Combustibility of Landscape Mulches



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Mulch plays an important role in Western residential landscapes. It can:

- ▶ reduce the water requirements of plants
- ▶ cool soil temperatures
- ▶ reduce the occurrence of weeds
- ▶ control soil erosion and dust
- ▶ prevent soil compaction
- ▶ visually enhance the landscape

Consequently, mulches are often promoted as being environmentally friendly and a desirable landscape practice.

Unfortunately, despite the positive attributes, many mulches are combustible, a major drawback when used in home landscapes located in wildfire-prone areas (Figure 1). A combustible material is defined as one capable of igniting and burning (Berube 1991). In 2008, an evaluation of mulch combustibility was performed in Carson City, Nev., by the Carson City Fire Department, Nevada Tahoe Conservation District, University of California Cooperative Extension and University of Nevada Cooperative Extension. Using the results from this project, recommendations are offered concerning the use of mulches in wildfire hazard areas.

Mulch Types

Mulch is defined as any material used to cover the soil surface for a variety of purposes (Rogstad et al. 2007). Mulch materials are generally classified as organic or inorganic. Organic mulches usually come from plant materials. Examples include pine needles, wheat straw, pine bark nuggets of various sizes, shredded western red cedar and redwood bark,











▲ Figure 1. Embers from an oncoming wildfire ignited the pine bark nugget mulch in this flowerbed. The burning mulch then ignited landscape timbers and scorched the adjacent lawn. Fortunately, the house was separated from the mulch by lawn and a concrete sidewalk.

wood chips from recycled pallets or wildfire fuel reduction projects and cocoa shells. Ground and shredded rubber are also considered organic mulches. Inorganic mulches are usually derived from non-plant materials. They include rock, gravel and brick chips. Organic and inorganic mulches vary considerably in terms of size, shape, texture and parent material, all of which can influence their combustibility.



◀ Figure 2. The eight different mulch treatments were replicated three times and randomly positioned within the plot layout on May 28, 2008. After being exposed to the elements for over 2½ months, they were ignited on Aug. 14, 2008.

Table 1. Description of mulch treatments evaluated during the project.

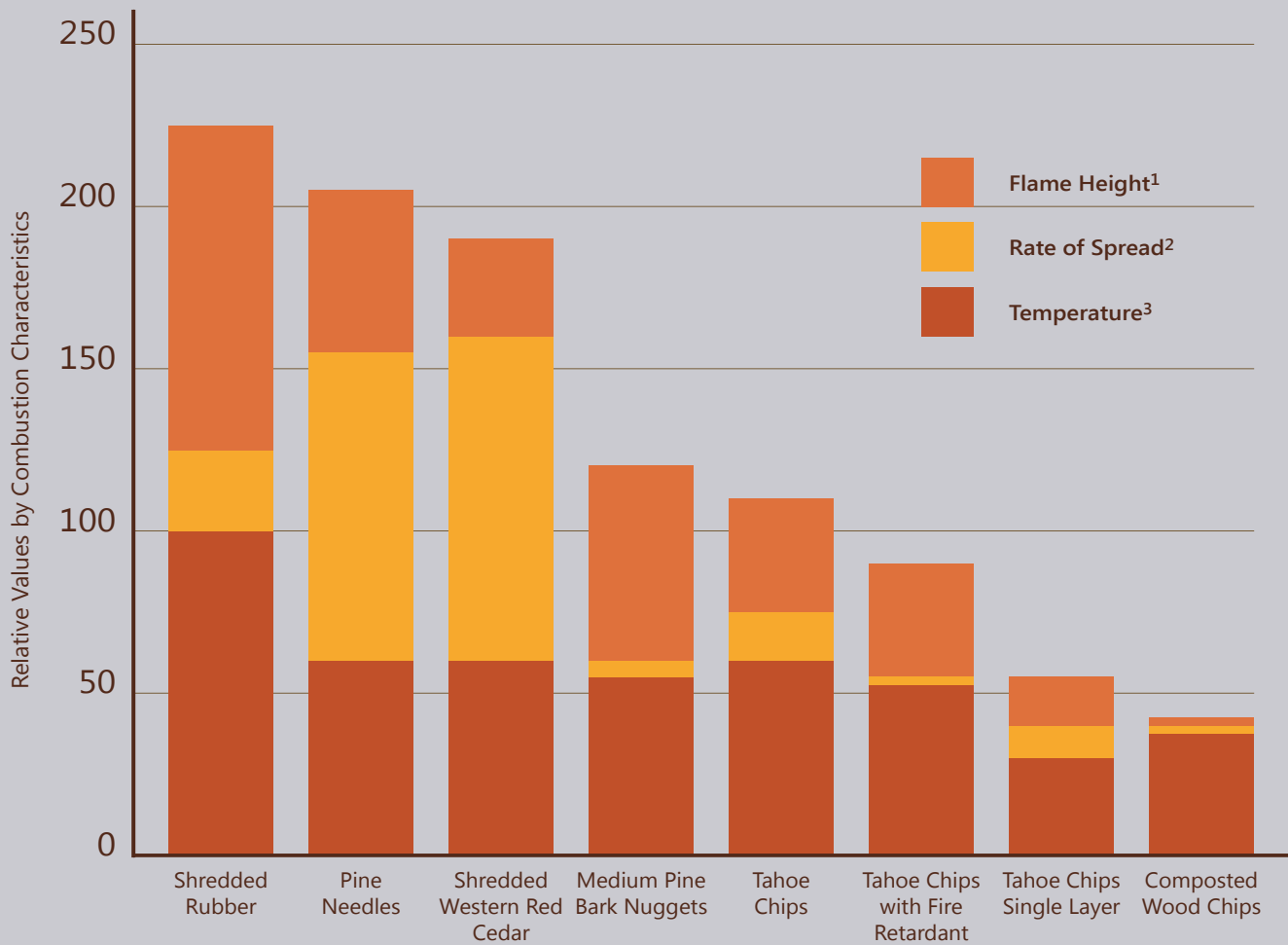
Mulch Treatment	Description	
Composted Wood Chips, 2- to 3-inch depth		Fertile Mulch ¹ , produced by Full Circle Compost, Inc. of Minden, Nev., was used. Wood chips are composted for an eight-week period using a proprietary process.
Medium Pine Bark Nuggets, 2- to 3-inch depth		Garden Bark Western Decorative Bark ¹ medium-sized pine bark acquired from a home improvement store was used. Approximately 75% of the material tested consisted of pine bark pieces about 1 inch in diameter. The balance of the material was wood chips and other unrecognizable materials.
Pine Needles, 2- to 3-inch depth		Approximately 80-90% of this material consisted of four to eight inch long needles shed from native ponderosa and Jeffrey pine trees and 10-20% was comprised of twigs, leaves, wood chips and cone scales. This is a popular naturally occurring mulch in the Sierra Nevada region.
Shredded Rubber, 2- to 3-inch depth		DuPont Signature Premium Rubber Mulch ¹ acquired from a home improvement store was used. This product is made from 100% recycled rubber, dyed and processed to resemble redwood mulch products.
Shredded Western Red Cedar, 2- to 3-inch depth		Mountain Magic Gorilla Hair Mulch ¹ is made from western red cedar that is machine shredded to create a long stringy, fibrous material. Approximately 5% of the material tested consisted of wood chips.
Tahoe Chips, 2- to 3-inch depth		A by-product of Lake Tahoe Basin chipping operations, this product consisted of pine needles, wood chips, bark and other plant biomass. The size, shape and texture of the chips varied and was influenced by the material being chipped.
Tahoe Chips with fire retardant, 2- to 3-inch depth		Same material and application depth as above, but sprayed with an ammonium sulfate-based wood colorant/fire retardant solution manufactured by Fire Chief Coatings, Inc. ¹ The retardant was applied at a rate of 1.25 gallons/50 sq. ft. on July 7, 2008 by the manufacturer's representative.
Tahoe Chips, single layer depth		Same material as above, but applied as a single layer of chips without fire retardant. The single layer of chips provided 80-100% ground cover.

¹Information herein is offered with no discrimination. Listing a commercial product does not imply an endorsement by the authors, University of Nevada Cooperative Extension, University of California Cooperative Extension or its personnel.

Evaluation of Mulch Combustibility

Evaluation measurements and plot design for this project were similar to mulch combustibility studies conducted by Zipperer et al. (2007). Eight landscape mulch treatments (Table 1) were evaluated in terms of three combustion characteristics: flame height, rate of fire spread and temperature measured at four inches and 16 inches above the mulch bed. Twenty-four, 8-foot diameter plots containing the mulch treatments were established at the Jacobsen Regional Training Facility in Carson City on May 28, 2008 (Figure 2). Each mulch treatment was replicated three times. The mulches were allowed to settle for 79 days and weather similar to mulches in the home landscape. The plots were ignited on a hot (about 100° F), dry (about 13 percent relative

humidity) afternoon on Aug. 14, 2008, which is typically the height of fire season in northern Nevada. The National Fire Danger Rating System value for that day was extreme. To simulate the windy conditions common to Nevada fire seasons, fans were used to generate a mid-plot air flow of about 10 to 15 miles per hour. After the plots were ignited by a drip torch, the fans were turned on, and the plots were monitored for 20 minutes. The treatments were evaluated by comparing the three measured combustion characteristics. The results are expressed as relative values between the eight mulch treatments. For each combustion characteristic, the measured value for a mulch treatment is expressed as a percentage of the mulch treatment with the greatest value.



▲ Figure 3. Relative values of three combustion characteristics between eight mulch treatments. ¹Average maximum flame height. ²Average rate of fire spread. ³Average maximum temperature measured at four inches above the bed.

Key Findings

Figure 3 presents the evaluation results and the key findings are described below.

- ▶ All of the mulches evaluated were combustible under the test conditions of dry, hot and windy weather and more than 2½ months of outdoor exposure.
- ▶ The mulch treatments varied considerably in terms of flame height, speed at which fire spread and temperature measured above the mulch bed.
- ▶ With the exception of the composted wood chips, all of the mulch treatments demonstrated active flaming combustion. Composted wood chips produced only incidental flaming with smoldering as the primary form of combustion. It is not known if the performance of the composted wood chips is specific to the Fertile Mulch product produced by Full Circle Compost, Inc. and evaluated in this project or if composted wood chips from other sources would perform in a similar manner.
- ▶ Based on cumulative values for the three combustion characteristics, shredded rubber, pine needles and shredded western red cedar demonstrated the most hazardous fire behavior.
- ▶ Composted wood chips and Tahoe chips, single layer demonstrated the least hazardous fire behavior based on the factors measured in this evaluation.
- ▶ Shredded rubber mulch burned at the hottest average maximum temperature (in excess of 630° F measured at four inches above the mulch bed) and produced the greatest flame heights which averaged over 3 feet. It ignited easily and burned intensely for a prolonged period (Figure 4).
- ▶ Pine needles were second only to shredded rubber mulch in terms of the cumulative value of combustion characteristics.

- ▶ The most rapid rate of fire spread came from shredded western red cedar (Figure 5), traveling at an average rate of 47.9 feet per minute. Moderate temperatures averaging 380° F were measured at four inches above the mulch bed and it produced a relatively low average flame height of 11.4 inches. This mulch treatment also produced embers which moved beyond the plot perimeter and ignited adjacent mulch plots.
 - ▶ Medium pine bark nuggets produced relatively moderate flame height and temperature values and also exhibited a low rate of flame spread.
 - ▶ Flame height and temperature values for Tahoe chips, 2- to 3-inch depth and Tahoe chips with fire retardant, 2- to 3-inch depth were similar. The fire spread values, however, for the chips treated with fire retardant were lower than those for the untreated chips. The retardant delayed fire spread for approximately five to 10 minutes, after which the rate of spread was similar to the untreated chips.
 - ▶ The lowest temperature values were produced by the Tahoe chips, single layer treatment. They also produced relatively low flame heights and rates of fire spread.
 - ▶ Composted wood chips demonstrated the slowest fire spread rate of the eight mulch treatments evaluated, less than 0.3 feet per minute (Figure 6). Since the progress of smoldering combustion was, at times, obscured by a non-burning surface layer of chips, fire rate of spread values are an approximation. They also produced the shortest average maximum flame height (note: flaming combustion was rare). The average temperature was the second lowest recorded and was comparable to the Tahoe chips, single layer treatment.
- ▼ *Figure 5. Shredded western red cedar bark, as shown in this photograph, ignited easily and produced the fastest rate of spread of the eight mulch treatments evaluated.*



▲ *Figure 4. Rubber mulch produced the greatest flame height and temperature of the mulch treatments evaluated in this study.*

- ▶ *Figure 6. The composted wood chip product, Fertile Mulch, primarily burned through smoldering combustion as indicated by the darker areas and smoke. It produced very little flame and had the slowest rate of fire spread of the mulch treatments evaluated.*



Recommendations

Within five feet of the house and other structures

- ▶ Maintaining a noncombustible, ignition-resistant area immediately adjacent to the house and other structures is particularly important (Mercker 2010, Florida Department of Community Affairs and Florida Department of Agriculture and Consumer Services 2004, Deneke 2002 and Glendale Fire Prevention Bureau undated). During a wildfire, embers may accumulate in this area, providing an ample source of ignition for combustible materials. Since all of the mulch treatments tested are combustible, they are not recommended for use within five feet of the house and other structures.
- ▶ Within five feet of the home, use noncombustible rock, gravel, concrete and pavers. Ignition-resistant plant materials, such as irrigated, well-maintained lawn and flowers could also be used.

From five to 30 feet of the

- ▶ Medium pine bark nuggets, Tahoe chips with and without fire retardant and composted wood chips possessed the least hazardous combustion characteristics and are better choices for use within five to 30 feet of the house. Since they are combustible materials and can transmit fire across this area, do not use them in a widespread or continuous manner. Separate areas mulched with these materials with noncombustible and ignition-resistant materials such as concrete, gravel, rock and lawn.
- ▶ Composted wood chips demonstrated the least hazardous fire behavior overall of the eight mulch treatments tested and would be the best choice for use in residential landscapes. However, they are still considered a combustible material and could ignite wood siding, plant debris and other combustible materials in contact with or immediately adjacent to the mulch bed. Also, the smoldering combustion produced by this mulch treatment may not be readily noticeable during a wildfire event and may go undetected by firefighters.



house and other structures

- ▶ The spray-on fire retardant suppressed fire spread for five to 10 minutes in the Tahoe chips mulch. After that, fire behavior of the retardant-treated Tahoe chips was no different than that of the untreated Tahoe chips. Also, the fire retardant-treated Tahoe chips were not exposed to precipitation or irrigation during the evaluation period. Precipitation and irrigation could have reduced the fire retardant's effectiveness by leaching water-soluble components from the formulation. While the fire retardant provided some utility, the treated Tahoe chips mulch was still combustible.
- ▶ Irrigating wood and bark mulches, as in a flowerbed, may reduce the ease with which they ignite and burn. Since water supply and pressure may be limited or not available during a wildfire, wetting mulches should not be relied upon to lessen the fire hazard. Also, the dry, hot and windy weather typical during wildfires could dry out the mulch bed between irrigation cycles and make it susceptible to ignition. It should be noted that drip irrigation used in flowerbeds typically does not wet the entire area. Consequently, dry areas of wood and bark mulches could exist in flowerbeds under irrigation.

More than 30 feet from the house and other structures

- ▶ Shredded rubber, pine needle and shredded western red cedar mulches demonstrated the most hazardous combustion characteristics and are recommended for use in areas more than 30 feet from the house.



Mulches Used in Residential Landscapes



Shredded Western
Red Cedar



Composted Wood Chips



Shredded Rubber



Pine Needles



Medium Pine Bark
Nuggets



Tahoe Chips

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