La végétation d'ornement

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Ornamental vegetation

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Synonyms

Landscape plants, residential fuel

Definition

Any vegetation, native of the area, exotic or bred only for horticulture purposes, as well as dead fuel material and organic mulches used for landscaping near structures.

Introduction

The wildland-urban interface (WUI) is a complex fuel environment, consisting of an intermix of both vegetation and housing. The WUI vegetation is a very heterogeneous fuel compared to that of wildland, composed of individuals and clusters of plants spread around housing or of hedges often used to delimit the property.

In WUIs, the fire risk is high and, regularly, numerous wildland fires threaten local communities and their assets. Fire propagation in these areas is a big concern in many countries, e.g. in the USA and Canada (Cohen 2000 ; Syphard et al. 2012, 2013; Johnston & Flannigan 2018) as well as in Europe and Australia (Bradstock & Gill 2001 ; Blanchi et al. 2006 ; Lampin-Maillet et al. 2010). These WUI fires can have devastating effects on human life and local economy because of the significant damage and loss of lives that had already occurred during such events (Blanchi et al. 2010; Cohen 2000; Maranghides & Mell 2011). Numerous studies underline the key role of the ornamental vegetation (and of other fuel elements such as wood pile, wood fences, sheds, etc.) in the fire behavior in WUI (Ramsay et al. 1987; Monroe et al. 2003; Etlinger and Beall 2004; Leonard & Blanchi 2005). Indeed, this vegetation is the main fuel source located between wildland vegetation and housing and, once structures and ornamental vegetation are burning, they have the potential to contribute significantly to continued fire spread through the WUI community.

As there are no 'fireproof' plants, they will burn when exposed to the extreme conditions generated by a wildland fire (Behm et al., 2004). However, it was demonstrated that individual homeowners can reduce the vulnerability of their houses to wildland fire, this include the creation of a defensible space (Bell et al. 2007) and the choice of less flammable species for landscaping. Species differ in their ability to ignite and combust (Randall & Duryea 2011; Ganteaume 2018) as well as to produce firebrands (Manzello et al. 2009) and, consequently, the role of the ornamental vegetation in fire propagation must be well understood for a better fire prevention in these areas.

The different types of ornamental vegetation

Native vs exotic live vegetation

Due to the nature of WUIs, native plant species naturally exist near urban development and around houses. In addition, native species are popular with residents wishing to promote local wildlife and natural surroundings (Behm et al. 2004). In the Mediterranean area, for instance, these species are adapted to drought, thus require less watering. However, exotic species are often favored, for various purposes that encompass esthetic, windbreak or screening purposes.

The structure of the ornamental vegetation around housing varies and can be composed of individual trees and shrubs, scattered clusters of plants, lines of plants forming hedges that can be located at various distances from housing, layers of vegetation such as lawn, etc. These two latter fuel structures create a horizontal fuel continuity that can become deleterious during a fire if they are located too close from housing, along with overhanging trees.

Landscaping mulches

The importance and role of landscaping mulches in wildland urban interface fires is well recognized as they are widely used adjacent to buildings. These mulches encompass shredded hardwood, different sizes of pieces (nuggets) of pine bark, pine straw, cocoa shell, shredded cypress wood, hay, etc. (Fig. 1). They represent a potential threat to the building as a layer of fuel that can propagate fire or ignite during a firebrand shower (Stewart et al. 2003; Manzello et al 2006a, 2006b, 2008, 2017; Quarles & Smith 2004; Rogstad et al. 2007; Long et al. 2006a; Zipperer et al. 2007; Beyler et al 2014, Suzuki et al 2015), as often happened during a WUI fire. Organic mulches being dead surface fuel, their moisture content depends directly on the local climatic conditions (relative humidity and temperature) and their ignition also depends on the number and the size of firebrands which can cause smoldering or flaming ignition.

Figure 1: Mulches used in residential landscapes

The role of the ornamental vegetation in fire propagation

Ornamental vegetation can ignite houses and other buildings during a wildland fire in different ways:

At short distance (Fig. 2): (i) through direct contact between flames and combustible wood decks or siding when plants are in contact with the building or growing very close to it, (ii) through radiant heat which is produced by the burning vegetation, even though the flames may not actually touch the structure. In both cases, the primary way to protect buildings is by a proper landscaping and plant selection, removing flammable vegetation and fuel continuity near the structure (maintaining spaces between plant crowns and between plant crowns and buildings). Creating a defensible space surrounding a house allows an easy access for firefighting but also increases the level of self-protection if the firefighters cannot step in.

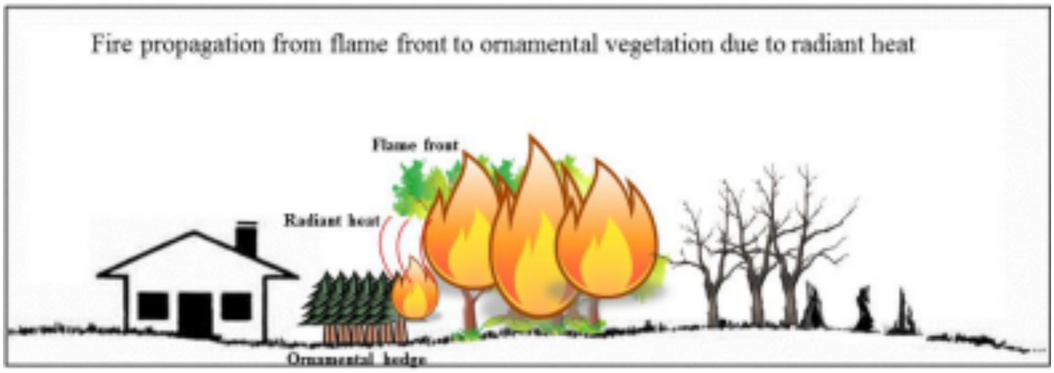

Figure 2: Fire propagation from flame front to ornamental vegetation due to radiant heat.

At long distance: showers of firebrands are produce by trees and buildings burning during WUI fires (Fig. 3). These firebrands are transported ahead the flame front by the winds. There, they can start secondary fires (e.g. “spot fires”) when landing on or under decks, in eaves or gutters, on wood shingles or on other plants/mulches acting as receptor fuel (Manzello et al. 2006a, 2006b, 2007, 2017; Etlinger & Beall 2004; Barrow 1945; Wilson & Ferguson 1986; Abt et al. 1987; Maranghides & Mell 2009; Suzuki et al 2015). The frequency of ignition of houses and other buildings due to such spot fires seems to increase over time (Foote et al. 2011). Depending on their type and on wind speed, firebrands can be transported up to several kilometers ahead the flame front (Manzello et al. 2007; Ganteaume et al. 2011).

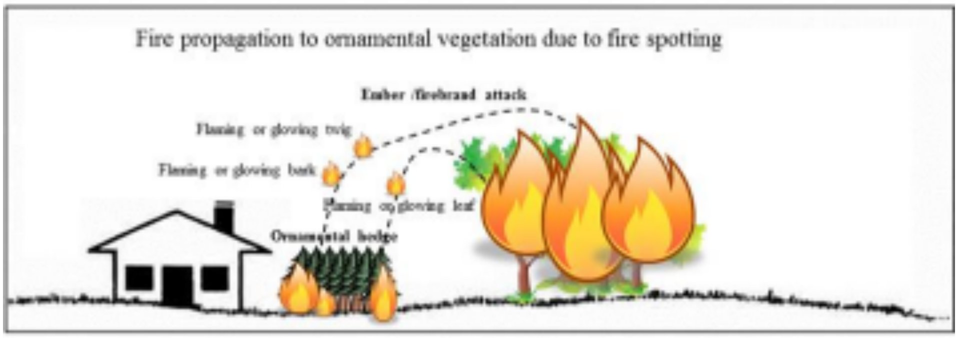

Figure 3: Fire propagation to ornamental vegetation due to fire spotting.

Conversely, before flaming, plants can act as a protective screen against radiant heat, also trapping firebrands in their canopy (Fig. 4). In that case, the barrier effect will depend on plant distribution patterns or on their capacity to resist fire (Leonard 2003; Ramsay & Rudolph 2003; Blanchi et al. 2006).

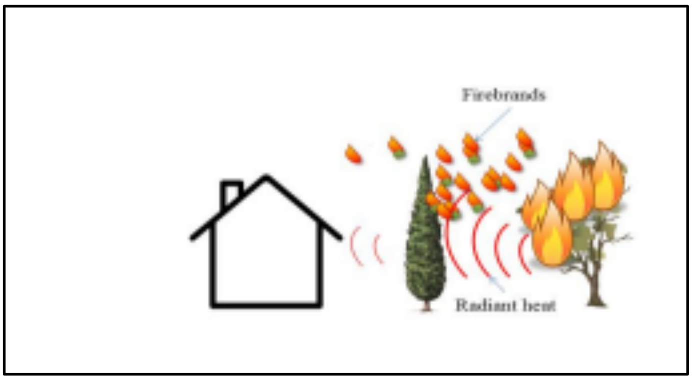

Figure 4: Role of protective screen against radiant heat and firebrand shower.

Selecting and locating the proper ornamental vegetation to mitigate fire propagation

Risk-reduction methods for ornamental fuels are analogous to risk reduction in wildland fuels in that both involve fuel treatments. In these fuels, the goal is to decrease the likelihood of housing ignition by acting on the structure of vegetation, for instance (Mell et al. 2010). Fuels too close from buildings, especially when their maintenance is poor, facilitate the contact with flames and increase radiant heat that leads to higher housing vulnerability.

Although all plants burn, some species are less flammable than others. These less flammable plants must be favored in a landscaping adapted to fire-prone areas and their list available to homeowners. These lists are most helpful when they include local plants adapted to local climate and soils e.g. drought resistant species; however the characteristics of such species can often make them more flammable (mainly because of lower moisture content). Knowledge of how species differ in their flammability is thus needed to develop more reliable lists of plants recommended for landscaping in WUI of a given region. Moreover, people also need information on how to perform a proper maintenance (watering, pruning, thinning, cleaning dead fuel, etc.), especially when this vegetation presents multiple usages that can be conflicting. Indeed, ornamental vegetation planted to create privacy could increase the fire risk at the same time (presence of ladder fuel, fuels too close to buildings, etc.). However, these plant lists are often based on casual information rather than scientific data or may only consider a few characteristics for ignition-resistant plants (White & Zipperer 2010). Although it can be tested under controlled environment in a laboratory, plant flammability can vary during a fire, where the conditions are often unpredictable. Besides plant fuel moisture content (FMC), structural (e.g. leaf size, shape, thickness, etc.) and chemical (e.g. resins, waxes, oils) leaf characteristics can make plants more flammable than others, some being highly ignitable but burning slowly or the opposite. Likewise, dead surface fuel (e.g. litter) can propagate surface fire or act as receptor fuel for spot fires; the litter structure and composition also influences flammability, thus must be taken into account in the choice of species. Several works agreed, for instance, that the ornamental species *Pittosporum tobira* was among the less flammable species (Long et al. 2006b; Ganteaume et al. 2013a, 2013b; Ganteaume 2018). Furthermore, the plant structure (branching pattern, leaf density in the canopy, capacity to retain dead fuel) contributes to the overall flammability. Indeed, some species present high amounts of dead fuel within their canopy (Ganteaume et al. 2013a), due to the shape of the tree (as for the pencil cypress*: Cupressus sempervirens* var. *pyramidalis*) or to frequent trimming of hedges that increases the amount of dead fuel and thus the fire risk. Choosing less flammable species also means selecting those burning with the lowest fire intensity (e.g. plants with the lowest biomass, especially for landscaping close to housing.

In contrast to wildland vegetation whose flammability has been extensively studied, a few scientific works investigated the flammability of ornamental vegetation, providing lists of desirable plants based on their fire related characteristics (Doran et al. 2004; Behm et al. 2004; Hansen et al. 2007; Hermansen-Báez 2011; Moritz & Svihra 1998) and ranking species according to their flammability (Frommer & Weise 1995; White et al. 1996; Irby et al. 2000; Beall 2001; White et al. 2002; Moritz 2003; Etlinger & Beall 2004; Behm et al. 2004; Weise et al. 2005; Long et al. 2006b, White & Zipperer 2010, Bartoli et al. 2011; Ganteaume 2018).

Besides taking the flammability of plant species used for landscaping into account, a landscaping taking into account plant flammability is important. Allowing wildland vegetation to grow too close to housing or placing flammable plants near a house or other structure increases the probability of building ignition. So, the plant location is just as important as the species itself. Spacing between trees and shrubs is important so that fire cannot jump from a plant to housing, nor from one plant to another and finally to housing. This spacing depends on the species selected and must anticipate the reduction of this distance as the plants grow larger. In general, breaking the fuel continuity (horizontal as well as vertical) is of the upmost importance in order to mitigate fire impacts on housing by decreasing fire propagation and fire intensity in the vicinity of buildings (Fig. 5).

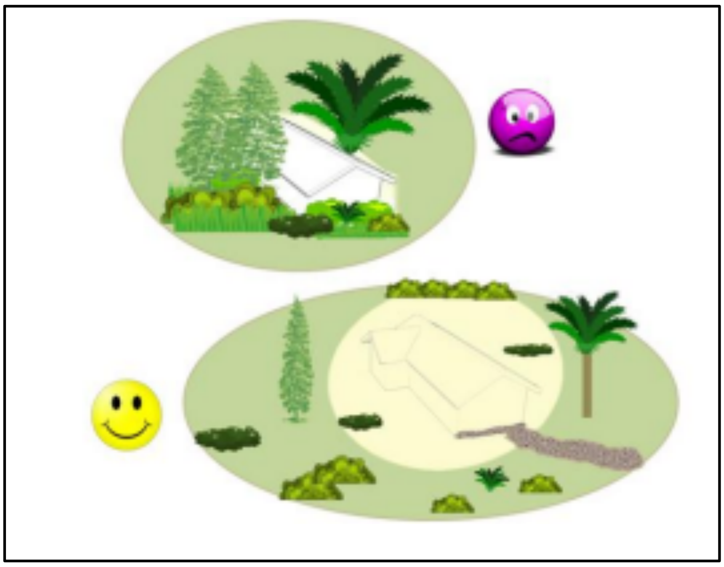

Figure 5: Bad *vs* good landscaping in WUI

Because of the flammability characteristics of the ornamental species and of the heterogeneous structure of this vegetation (differing from those of wildland vegetation), an adapted modelling of fire propagation in WUI is needed. This modelling would help to have a better understanding of the processes involved in the fire propagation in this complex fuel and their impact on housing vulnerability. The safest landscaping scenario (considering both species and spatial patterns) must be chosen to improve fire prevention in these areas.

Maintaining the ornamental vegetation

Even before homeowners consider the proper trees, shrubs and ground covers, other landscape issues should be considered. For example, a dry lawn can burn and carry a fire to housing. Lawns should be watered and dead lawn litter should be raked and either removed from the property or composted. A green lawn will not easily carry a fire and will typically serve as a protective barrier around the house, highlighting the role of watering, especially when the fire risk is high. Conversely, landscaping natural vegetation or a lawn that has become very dry allows a wildland fire to spread and make the house at risk.

In order to prevent the fire to reach the fire to the plant crown, trees have to be pruned and be cleared of their litter. For instance, conifers that have branches growing close to the ground can provide “ladder fuels” for a surface fire to climb into the canopy. Should this happen, the radiant heat given off could set a nearby house or other structure on fire.

Conclusion

The amount of fuel available for a fire and fuel distribution patterns increase burning risk of housing. It is thus important to understand how this ornamental vegetation influences fire behavior when planning a garden. Consequently, adapting fire behavior modelling to the heterogeneous structure of the ornamental vegetation is needed given the impact these fires have in WUI. Furthermore, this vegetation presents numerous exotic (or horticultural) species whose flammability is still unknown. Moreover in WUI fires, the scale at which they spread is smaller than for usual wildland fires. These species’ flammability should be taken into account, especially through its characteristics (leaves, branch, or litter), avoiding near housing species presenting, for instance, high amount of dead fuel within their canopy (such as cypress, palm tree, or Eucalypt with loose bark) that can release a high fire intensity when burning.

Cross-references

Spotting/spot fire, fire propagation, surface to crown transition, wildland-urban interface, residential fuel treatments

References

Abt R, Kelly D, KuypersM (1987) The Florida palm coast fire: an analysis of fire incidence and residence. Fire Technology 23, 230–252. doi:10.1007/BF01036938

Barrow GJ, 1945. Survey of houses affected in the Beaumaris fire, January 14, 1944. Journal of the Council for Scientific and Industrial Research, 18 (1), 11p.

Bartoli P, Simeoni A, Biteau H, Torero JL, Santoni PA, 2011. Determination of the main parameters influencing forest fuel combustion dynamics. Fire Safety Journal 46, 27–33. doi:10.1016/J.FIRESAF. 2010.05.002

Beall FC, 2001. Fire-safe vegetation. In 'Introduction to the I-Zone'. pp. 14-1–14-10. (UC Forest Products Laboratory: Richmond, CA)

Behm AL, Long AJ, Monroe MC, Randall CK, Zipperer WC, Hermansen-Báez LA, 2004. Fire in the Wildland-Urban Interface: Preparing a Firewise Plant List for WUI Residents. UF/IFAS Extension Service, University of Florida, 8p.

Bell CE, Gonzales JG, Mellano VJ, Nakamura M, Quarles SL, Salmon TP, Shaw DA, 2007. Wildfire Preparedness and Recovery in San Diego County: A Review and Analysis White Paper of Data and Research Studies Relevant to Wildfire. Farm and Home Advisor's Office, University of California Cooperative Extension, County of San Diego. San Diego, CA. 65p.

Beyler C, Dinaburg J, Mealy C, 2014. Development of Test Methods for Assessing the Fire Hazards of Landscaping Mulch. Fire Technology, 50, 39–60.

Blanchi R, Lucas C, Leonard J, Finkele K, 2010. Meteorological conditions and wildfire-related house loss in Australia. International Journal of Wildland Fire 19: 914-926.

Blanchi R, Leonard J, Leicester RH, 2006. Lessons learnt from post bushfire surveys at the urban interface in Australia. V International Conference on Forest Fire Research, D. X. Viegas, Figueira da Foz.

Bradstock RA, Gill AM, 2001. Living with fire and biodiversity at the urban edge: in search of asustainable solution to the human protection problem in southern Australia. J. Mediterr. Ecol. 2: 179.

Cohen JD (2000) Home ignitability in the wildland–urban interface. Journal of Forestry 98, 15–21.

Doran JD, Randall CK, Long AJ (2004) Fire in the wildland–urban interface: selecting and maintaining fire-wise plants for landscaping. University of Florida, Institute of Food and Agricultural Services, Florida Cooperative Extension Service Circular 1445. (Gainesville, FL)

Etlinger MG, Beall FC (2004) Development of a laboratory protocol for fire performance of landscape plants. International Journal of Wildland Fire 13, 479-488. doi:10.1071/WF04039

Frommer SL, Weise DR, 1995. The quest for all-purpose plants. In: Weise, David R.; Martin, Robert E., tech. coords. The Biswell Symposium: fire issues and solutions in urban interface and wildland ecosystems. Gen. Tech. Rep. PSW-GTR-158. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 155-156

Ganteaume A, 2018. Does plant flammability differ between leaf and litter bed scale? Role of fuel characteristics and consequences for flammability assessment. – Int. J. Wildland Fire. In press. DOI: 10.1071/WF17001.

Ganteaume A, Jappiot M, Lampin-Maillet C, 2013a. Assessing the flammability of surface fuels beneath ornamental vegetation in wildland–urban interface, in Provence (south-eastern France). International Journal of Wildland Fire 22, 333-342.

Ganteaume A, Jappiot M, Lampin C, Guijarro M, Hernando C, 2013b. Flammability of Some Ornamental Species in Wildland–Urban Interface in Southeastern France: Laboratory Assessment at Particle Level. Environmental Management 52, 467-480.

Ganteaume A, Guijarro M, Jappiot M, Hernando C, Lampin-Maillet C, Perez-Gorostiaga P, Vega JA, 2011. Laboratory characterization of firebrands involved in spot fires. Annals of Forest Science 68, 531-541. Doi 10.1007/s13595-011-0056-4

Hansen MF, Fernandez RT, Penskar MR, 2007. Wildfire series, Extension Bulletin • E2948. Michigan state university, p12.

Hermansen-Báez A, 2011. Quick guide to firewise shrubs. U.S. Forest Service, Southern Research Station. http://www.interfacesouth.org/ products/pdf/Shrub_Flammability.pdf.

Irby R, Beall FC, Barrette B, Frago M, 2000. Wildland Fire Hazard Assessment. Final Report FEMA 1005-47. UC Forest Products Laboratory.

Johnston LM, Flannigan MD, 2018. Mapping Canadian wildland fire interface areas International Journal of Wildland Fire 2018, 27, 1–14

Lampin-Maillet C, Jappiot M, Long-Fournel M, Morge D, Ferrier JP, 2010. Mapping wildland-urban interfaces at large scales integrating housing density and vegetation aggregation for fire prevention in the South of France. Journal of Environmental Management 91(3),732-741.

Leonard JE, 2003. People and property – a researcher's perspective. In: Cary, G., Lindenmayer, D., Dovers, S. (Eds.), Australian Burning: Fire Ecology, Policy and Management Issues. CSIRO Publishing, Melbourne, Vic.

Leonard JE, Blanchi R. 2005. Investigation of Bushfire Attack Mechanisms Resulting in House Loss in the ACT Bushfire 2003. A CRC Bushfire Report. Bushfire CRC Report CMIT Technical Report - 2005-478.

Long AJ, Hinton B, Zipperer W, Hermansen-Baez A, Maranghides A, Mell W, 2006a. Fire spread and structural ignitions from horticultural plantings in the wildland-urban interface. In: In "Fire Ecology and Management Congress Proceedings", 13–17 November 2006, San

Diego, CA. (DVD) (The Association for Fire Ecology and Washington State University Extension: San Diego, CA).

Long AJ, Behm A, Zipperer WC, Hermansen A, Maranghides A, Mell W, 2006b. Quantifying and ranking the flammability of ornamental shrubs in the southern United States. In "2006 Fire Ecology and Management Congress Proceedings" 13–17 November 2006, San Diego, CA. (DVD) (The Association for Fire Ecology and Washington State University Extension: San Diego, CA).

Manzello SL, Cleary TG, Shields JR, Yang JC, 2006a. Ignition of mulch and grasses by firebrands in wildland–urban interface fires. International Journal of Wildland Fire 15, 427–431.

Manzello SL, Cleary TG, Shields JR, Yan JC, 2006b. On the ignition of fuel beds by firebrands. Fire Materials 30:77–87.

Manzello, S.L. & Foote, E.I.D., 2014. Characterizing Firebrand Exposure from Wildland–Urban Interface (WUI) Fires: Results from the 2007 Angora Fire. Fire Technology 50, 105-124. https://doi.org/10.1007/s10694-012-0295-4

Manzello SL, Maranghides A, Mell WE, 2007. Firebrand generation from burning vegetation. International Journal of Wildland Fire 16, 458–462. doi:10.1071/WF06079

Manzello SL, Cleary TG, Shields JR, Maranghides A, Mell W, Yang J, 2008. Experimental investigation of firebrands: Generation and ignition of fuel beds. Fire Saf. J. 43(3), 226–233.

Manzello SL, Park SH, Cleary TG, 2009. Investigation on the ability of glowing firebrands deposited within crevices to ignite common building materials. Fire Safety Journal 44, 894–900. doi:10.1016/ J.FIRESAF.2009.05.001Manzello SL, Suzuki S, Nii D, 2017. Full-Scale Experimental Investigation to Quantify Building Component Ignition Vulnerability from Mulch Beds Attacked by Firebrand Showers. Fire Technology 53(2), 535-551.

Maranghides A, Mell W, 2011. A Case Study of a Community Affected by the Witch and Guejiton Wildland Fires. Fire Technology 47(2), 379-420.

Maranghides A, Mell WE, 2009. A case study of a community affectedby the Witch and Guejito fires. National Institute of Standardsand Technology, Technical Note 1635. (Gaithersburg, MD).

Mell WE, Manzello SL, Maranghides A, Butry D, Rehm RG, 2010. The wildland–urban interface fire problem – current approaches and research needs. International Journal of Wildland Fire, 19 (2), 238-251

Monroe MC, Long AJ, Marynowski S, 2003. Wildland fire in the Southeast: Negotiating guidelines for defensible space. Journal of Forestry 10, 14-19.

Moritz MA, 2003. Spatiotemporal analysis of controls on shrubland fire regimes: age dependency and fire hazard. Ecology 84, 351-361.

Moritz R, Svihra P, 1998. Pyrophytic vs. fire resistant plants. University of California Cooperative Extension. 8p.

Quarles S, Smith E, 2008. The Combustibility of Landscape Mulches. University of Nevada Cooperative Extension.

Ramsay C, Rudolph L, 2003. Landscape and building design for bushfire areas. Collingwood, VIC, Australia: CSIRO.

Ramsay GC, McArthur NA, Dowling VP, 1987. Results from an examination of house survival in the 16 February 1983 bushfires in Australia. Fire and Materials 11, 49-51.

Randall CK, Duryea M, 2011. Fire in the wildland-urban interface: understanding fire behavior. University of Florida IFAS Extension. 1432.

Rogstad A, DeGomez T, Hayes C, Schalau J, Kelly J, 2007. Comparing the ignitability of mulch materials for a firewise landscape. University of Arizona, College of Agriculture and Life Sciences Bulletin, AZ1440. 5p.

Steward LG, Sydnor TD, Bishop B, 2003. The ease of ignition of 13 landscape mulches. J Arboric 29(6), 317–321.

Syphard AD, Keeley JE, Massada AB, Brennan TJ, Radeloff VC, 2012. Housing arrangement and location determine the likelihood of housing loss due to wildfire. PLoS ONE 7, e33954. doi:10.1371/JOURNAL. PONE.0033954

Syphard AD, Bar Massada A, Butsic V, Keeley JE, 2013. Land use planning and wildfire: development policies influence future probability of housing loss. PLoS ONE 8, e71708. doi:10.1371/JOURNAL.PONE. 0071708SuzukiS, Manzello SL, Kagiya K, Suzuki J, HayashiY, 2015. Ignition of Mulch Beds Exposed to Continuous Wind-Driven Firebrand Showers. Fire Technology(51, 905-922.

Weise DR, White RH, Beall FC, Etlinger M, 2005. Use of the cone calorimeter to detect seasonal differences in selected combustion characteristics of ornamental vegetation. International Journal of Wildland Fire 14, 321-338. doi:10.1071/WF04035

White RH, Zipperer WC, 2010. Testing and classification of individual plants for fire behaviour: plant selection for the wildland–urban interface. International Journal of Wildland Fire 19, 213-227.

White RH, Weise DR, Mackes K, Dibble AC, 2002. Cone calorimeter testing of vegetation: an update. In 'Proceedings of the 35th international Conference on Fire Safety', 22–24 July 2002, Columbus, OH. (Ed. CJ Hilado) pp. 1–12. (Products Safety Corporation: Sissonville, WV)

White RH, Weise DR, Frommer S, 1996. Preliminary evaluation of the flammability of native and ornamental plants with the cone calorimeter. In 'Proceedingsof the 21st International Conference on Fire Safety', Milbrae, CA.

Wilson AAG, Ferguson IS, 1986. Predicting the probability of house survival during bushfires. Journal of Environmental Management 23, 259-270.

Zipperer W, Long A, Hinton B, Maranghides A, Mell W, 2007. Mulch flammability. In: Proceedings emerging issues along urban-rural interfaces ii: linking land-use science and society, pp 192–195.