QUANTIFYING AND RANKING THE FLAMMABILITY OF ORNAMENTAL SHRUBS IN THE SOUTHERN UNITED STATES

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INTRODUCTION

Wildfire preparedness programs focus on education and provide assistance with community design, home construction, and landscape design. Wildland-Urban Interface (WUI) residents, nursery employees, and landscape architects often request lists containing species that would be appropriate for placement in firewise landscaping. Existing lists were created from personal experience or based on lists originating in the western United States. These lists, when applied to southern landscape designs, have inconsistencies.

Even with extensive research, there is still no standard method of ranking plant flammability. Although it is possible to measure the individual plant characteristics that influence flammability, it is not known how those individual characteristics affect overall plant flammability (Behm et al. 2004). A recent study found that the flammability of entire plants is most influenced by foliar moisture content and the quantity of foliar biomass (Etlinger and Beall 2004). To compare species, it is important to reduce the impact of environmental variables such as wind and relative humidity; and to accurately and precisely measure the flammability of entire shrubs. These criteria were met by performing all tests using the large-scale calorimetry equipment at the Building and Fire Research Laboratory (BFRL) at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland. The research objective was to rank landscape shrub species from the South by their flammability.

METHODOLOGY

Species selection: Species were selected from a survey sent to WUI fire professionals in the South to identify species in their area that are highly flammable, less flammable, and species with unknown flammability. From these surveys, we selected 34 species from all three categories and based on the following criteria: shrub, non-invasive, and desirable plant characteristics.

Measuring Flammability: The major components of flammability are: ignitability, sustainability, combustibility, and consumability (Martin et al. 1994). Ignitability was quantified based on time to independent ignition. The ignition source was a u-shaped gas burner. Sustainability included the time interval after independent ignition to the end of flaming combustion. Tests were videotaped to validate the measurement of time intervals.

Combustibility was measured in multiple ways. The first measurement was peak heat release rate (Peak HRR). Total energy released was the second measurement. Maximum flame height was also recorded as a measure of combustibility. Consumability, or the amount of the plant that is burned in fire, was measured with a spatial comparison of initial canopy volume to remaining canopy volume after combustion. Plants were placed in front of a placard with a defined grid and the change in cover was estimated by comparing before and after images on the placard. Digital pictures were taken in two directions before and after the fire test.

Plant measurements: Variables that may influence the flammability included height, average width, foliar moisture content, and foliar energy content. Overall height and height to the lowest branch were measured prior to ignition. Crown width at half the plant height was measured in two directions. A sample of leaves was collected from the plant prior to ignition and immediately weighed. Samples were returned to the University of Florida where dried-weights were obtained. Moisture content was reported in % moisture content by dry weight. The dried leaf sample used to test the moisture content of leaves was also used in an energy content analysis. Standard isoperibol oxygen combustion calorimetry (Parr® Model 1261 Calorimeter) was conducted at the University of Florida.

Statistical analysis: Principle component and cluster analysis were utilized to determine comprehensive differences in flammability among the southern shrub species tested. The principle component analysis identified the importance of dependent variables for differentiating among species. The cluster analysis of all dependent variables was used to group species into categories of flammability.

RESULTS AND DISCUSSION

With a cluster analysis utilizing all quantified flammability characteristics (PHRR, total energy, mass loss, plant density loss, time to ignition, maximum flame height, temperatures, and heat fluxes), three clusters or rankings of flammability were identified. Twenty-two species were ranked as low flammability, eight species as moderate flammability, and four species as high flammability- *Ilex glabra*, *Ilex vomitoria*, *Juniperus chinensis*, and *Kalmia latifolia* (Table 1). These four species should not be planted close to structures. Species ranked as moderate flammability could become highly flammable under drought conditions. Similarly, these species should not be planted near structures. The study did identify 22 species that can be used in firewise planning.

LITERATURE CITED

Behm, A. L., M. L. Duryea, A. J. Long, and W. C. Zipperer. 2004. Flammability of native understory species in pine flatwood and hardwood hammock ecosystems and implications for the wildland-urban interface. International Journal of Wildland Fire **13**:355-365.

Etlinger, M. G., and F. C. Beall. 2004. Development of a laboratory protocol for fire performance of landscape plants. International Journal of Wildland Fires **13**:479-488.

Martin, R. E., D. A. Gordon, M. I. Gutterrez, D. S. Lee, D. M. Molina, R. A. Schroeder, D. B. Sapsis, S. L. Stephens, and M. Chambers. 1994. Assessing the flammability of domestic and wildland vegetation. Pages 130-137 *in* Proceedings of the 12th Conference on Fire and Forest Meteorology. Society of American Foresters.

Table 1. Flammability ranking for 34 commonly used horticultural plants in the South by their flammability ranking—high, moderate, and low—tested under controlled environmental conditions.

Common Name	Scientific Name	Cultivar Name	Flammability Rank
Glossy abelia	*Abelia* x *grandiflora* (André) Rehd.		Moderate
Pipestem	*Agarista populifolia* (Lam.) Judd		Moderate
Azalea	*Azalea obtusum* (Lindl.) Planch.	'Hershey red'	Moderate
Butterfly bush	*Buddleia davidii* (Franch.)	'Royal red'	Low
Boxwood	*Buxus microphylla* Siebold & Zucc. var. *koreana* Nakai	'Wintergreen'	Moderate
Beautyberry	*Callicarpa dichotoma* (Lour.) C. Koch	'Profusion'	Low
Camellia	*Camellia japonica* L.		Low
Summer-sweet; sweet pepperbush	*Clethra alnifolia* L.		Low
Leyland cypress	x *Cupressocyparis leylandii* (A. B. Jacks. & Dallim.)		Moderate
Klein's forsythia	*Forsythia* x *intermedia* Zab.		Low
Cape jasmine	*Gardenia jasminoides* Ellis	'August beauty'	Low
Bigleaf hydrangea; French hydrangea	*Hydrangea macrophylla* (Thunb.) Ser.	'Nikko'	Low
Oakleaf Hydrangea	*Hydrangea quercifolia* Bartr.		Low
Foster holly	*Ilex* x *attenuata* Ashe	'Fosteri'	Low
Gallberry	*Ilex glabra* L.	'Compacta'	High
Blue holly	*Ilex* x *meservea* S. Y. Hu	'Mesdob'	Moderate
Winterberry	*Ilex verticillata* (L.) A. Gray	'Berry nice'	Low
Dwarf yaupon	*Ilex vomitoria* Ait.	'Schellings dwarf'	High
Anisetree	*Illicium floridanum* Ellis		Low
Ashe juniper; Ozark white cedar	*Juniperus ashei* Buchh.		Moderate
Chinese juniper	*Juniperus chinensis* L.	'Pfitzerana'	High
Mountain laurel; calico bush	*Kalmia latifolia* L.	'Olympic fire'	High
Bayberry; candleberry	*Myrica pennsylvanica* Loisel.		Low
Oleander	*Nerium oleander* L.	'Calypso'	Low
Pittosporum	*Pittosporum tobira* (Thunb.) Ait.	'Compacta'	Low
Potentilla; shrubby cinquefoil; golden hardhack	*Potentilla fruiticosa* L.	'Gold star'	Low
Scarlet firethorn	*Pyracantha coccinea* M. J. Roem.	'Mohave'	Low
Rhododendron	*Rhododendron* L. x *chionoides*	'Chionoides'	Moderate
Rosebay; great laurel	*Rhododendron maximum* L.		Low
Arrowwood	*Viburnum dentatum* L.	'Chicago luster'	Low
Walter's viburnum	*Viburnum obovatum* Walt.		Low
Weigela	*Weigela florida* (Bunge) A. DC.	'Wine and roses'	Low
Adam's needle	*Yucca filamentosa* L.		Low
Coontie	*Zamia pumila* L.		Low

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