Raffaelea lauricola **System:** Terrestrial

Kingdom	Phylum	Class	Order	Family
Fungi	Ascomycota	Sordariomycetes	Ophiostomatales	Ophiostomataceae

Common name

Synonym

Similar species *Raffaelea quercivora*

Summary

Raffaelea lauricola, a newly discovered fungus, causes laurel wilt in members of the Lauracae family, most notably redbay trees (*Persea borbonia*). It is vectored by *Xyleborus glabratus* an ambrosia beetle native to Asia. The recent introduction, rapid spread, and high mortality rates caused by *R. lauricola* and *X. glabratus* indicate the complex is a serious threat to the survival of redbay trees in southeastern United States. Furthermore, their invasive potential to the avocado industry in Florida and elsewhere could be devastating and extremely costly.

view this species on IUCN Red List

Species Description

Condiophores of *Raffaelea lauricola* are single to aggregated in sporodochia, hyaline, unbranched or sparingly branched, one-celled to septate, and produce terminal conidia holoblastically. Conidiogenous cells proliferate percurrently or sympodially, leaving denticles, and lack inconspicuous scars or annelations. Conidia are small, hyaline, elliptical to ovoidal to globose, slimy, secession schizolytic, producing yeast-like growth through budding (Harrington *et al*, 2008).

Notes

Indications of trees infested by the ambrosia beetle and laurel wilt include beetle entrance holes, cylinders of frass emanating from the trunk, black discoloration of sapwood that start as streaks and becomes extensive throughout cross sections, wilting of branch tips and leaves, dieback of individual branches, and red and brown-to-purple coloration of dying leaves that persist over a year after its death (Fraedrich *et al*., 2008; Hoddle, 2009).

The association of a wilt-causing fungus with an ambrosia beetle is unprecedented. The only previously documented case of extensive mortality of forest trees caused by an ambrosia beetle and a fungal symbiont appears to be the death of oaks *Quercus crispula* and *Q. serrata* in Japan associated with *Raffaelea quercivora*, a fungal associate of the ambrosia beetle *Platypus quercivorus*. This ambrosia beetle is thought to be indigenous to Asia and the decline of oaks in Japan has been documented since the 1930s. The attacked trees appear to be weakened by drought or other agents, and mass attacks by *P. quercivorus* are necessary for the oak trees to die. R. quercivora is thought to facilitate tree death through localized colonization of the tree in the vicinity of the ambrosia beetle galleries, but the fungus does not colonize the host systemically. In contrast, the *Raffaelea lauricola* that causes laurel wilt is a very aggressive vascular wilt pathogen that is capable of colonizing the entire tree from a single introduction into small branches or stems by egg-laying attacks of *X. glabratus* (Fraedrich *et al*., 2008; Cameron *et al*., 2008).

Lifecycle Stages
A laboratory culture of *Raffaelea lauricola* provided the following evaluation: \"Colony at 10 days cream-buff, smooth, but later mucilaginous in the center, margins of colony uneven, side branches of submerged hyphae at advancing front producing conidia and tight clusters of blastoconidia; 2 week old colonies cottony, honey yellow, and with a yeasty odor. Conidiophores hyaline, usually aseptate and unbranched but sometimes septate at branches, terminal or arising as a side branch from hyphae, variable in length but mostly (8.5)13-60(120) x (1.0)2.0(2.5) .tm wide. Conidia produced holoblastically, at the tip of the conidiogenous cell, but not leaving conspicuous scars or annelations, primary conidia oblong to obovoid,sometimes flattened at the point of attachment, hyaline, thin walled, (3.0)3.5-4.5(8.0) x (1.0)1.5-2.0(3.5) tun; budding new cells, the blastospores forming in a cluster at the tip of the conidiophore and a slimy mass over the central part of the colony\" (Harrington *et al*, 2008).

Habitat Description
Very little is known about this newly discovered fungus. *Raffaelea lauricola* is known to inhabit tropical to temperate forests that bear suitable hosts of the Lauraceae family. It appears to only be vectored by *X. glabratus* and dependant on its climate range. One climate matching study estimated the native range climates of *X. glabratus* to possess an extreme minimum temperature range of -26-15°C and a 30-year mean growing season of 61% moisture (Koch & Smith, 2008).

Reproduction
Raffaelea lauricola is an asexual fungus that typically produces small conidiophores in tight clusters (sporodochia) in beetle galleries. The fungus is introduced into its host from the mycangia of its ambrosia beetle vector *Xyleborus glabratus* (Harrington *et al*., 2008).

Nutrition
Raffaelea lauricola derives its nutrition from its host. Suitable hosts include members of the Lauraceae family including redbay (*Persea borbonia*), sassafras (*Sassafras albidum*), camphor (*Cinnamomum camphora*), silkbay (*Persea borbonia humilis*, California bay (*Umbellularia californica*), avocado (*Persea americana*), pondspice (*Litsea aestivalis*), and pondberry (*Lindera melissifolia*) (Cameron *et al*, 2008; Fraedrich *et al*, 2008)

General Impacts
Raffaelea lauricola is a very aggressive vascular wilt pathogen that causes laurel wilt in members of the Lauraceae family, most notably redbay trees (*Persea borbonia*). It is capable of colonizing the entire tree from a single introduction into small branches or stems by egg-laying attacks of the redbay ambrosia beetle (*Xyleborus glabratus*). When the beetle introduces *R. lauricola* into trees the fungus spreads through the vascular system of trees, blocking water transport, and causes the trees to wilt and die within months of initial infection. The wood of dying and recently killed trees serves as host material for *X. glabratus* and other ambrosia beetles, which multiply rapidly, resulting in large numbers of beetles capable of spreading to new locations. The ambrosia beetle has a rapid rate of natural spread that has been estimated at 34 miles/year and may be advanced further by anthropogenic dispersal of infested wood products. Currently *X. glabratus* is the only confirmed vector of *R. lauricola*.
The redbay ambrosia beetle and its accompanying *R. lauricola* have spread the wilt through forests of coastal southeastern United States, killing almost all redbays over 2.5 cm in diameter in its path. A survey of redbays in counties near Savannah, the point of introduction of *X. glabratus* and *R. lauricola* in Georgia, found mortalities of redbays as high as 70% to 90% in the most heavily infested locations. Other known, susceptible hosts include: sassafras (*Sassafras albidum*), silkbay (*Persea borbonia humilis*, California bay (*Umbellularia californica*), avocado (Persea americana), pondspice (*Litsea aestivalis*), which is endangered in Florida and threatened in Georgia, and pondberry (*Lindera melissifolia*), which is federally endangered. Additionally *R. lauricola* has been isolated from camphor (*Cinnamomum camphora*) trees with branch dieback. However the collapsing wilt seen in redbay and other species has not been observed (Smith *et al*., 2009).
Laurel wilt has essentially eliminated mature redbay trees from a large portion of the South Atlantic Coastal Plain and maritime forests. *R. lauricola* and *X. glabratus* may continue to expand throughout coastal plain forests from Virginia to Texas. This invasive complex is considered a “very high risk”. *R. lauricola* and the ambrosia beetle are also a major threat to the avocado industry in south Florida, Mexico, and elsewhere. The invasion of Florida’s avocado groves, valued around $13-30 million annually, by *X. glabratus* and *R. lauricola* could be devastating.
Redbay is important to wildlife as its fruit, seed and or foliage are eaten by several species of songbirds, wild turkeys, quail, deer, and black bear, particularly in winter foraging. Two butterflies, the spicebush swallowtail (*Papilio troilus*) and the Palamedes swallowtail (*P. palamedes*) use Lauraceae species as hosts. Although *P. palamedes* larvae may feed on redbay or sassafras, adult females strongly prefer to oviposit on redbay. Reduction in redbay densities may have significant negative impacts on *P. palamedes* populations in their current range (Mayfield & Thomas, 2006; Koch & Smith, 2008).
R. lauricola and *X. glabratus* are thought capable of spreading throughout the entire range of redbays in the U.S. in less than 40 years. It may eventually become even more widely distributed if it continues to spread in sassafras, which is found in much of the eastern half of the U. S. There are many additional genera and species in the laurel family, concentrated mainly in the tropical and subtropical areas in Central and South America, which may also be susceptible (Cameron *et al*., 2008; Koch & Smith, 2008).

Management Info
Preventative measures: The Laurel Wilt Working Group public education and outreach campaigns recommended that emphasis be placed on the potential destructive consequences of moving firewood and raw materials infested with *Raffaelea lauricola* and *Xyleborus glabratus* to uninfested, areas and those groups of people most likely to transport infested host material should be targeted (Cameron *et al*., 2008).\r\n
Researchers have proposed that redbays be removed from a 4 to 5 km thick band surrounding the known populations of *X. glabratus*. Such wide areas devoid of redbay hosts may deter the spread of *R. lauricola* by its vector *X. glabratus*. A similar measure has been suggested around avocado production areas in south Florida by the Laurel Wilt Working Group (Cameron *et al*, 2008; Hess, 2007; Hanula *et al*, 2008a).\r\n
Avocado farmers are advised to be extremely vigilant regarding *R. lauricola* and *X. glabratus*. They are encouraged to report signs of wilt and dieback in the United States to the Florida Division of Plant Industry. They are also advised to avoid plant stress on crops as it makes them more vulnerable, and to not move infested crops but burn the individual crops in the grove (Crane, 2009).\r\n
Chemical control: The fungicide propiconazole may be a useful method of preventing infection of redbay trees by *R. lauricola*. Research results found that propiconazole completely inhibited mycelial growth of *Raffaelea* spp. in vitro at concentrations 0.1 parts per million (ppm) or greater and was fungitoxic at 1 ppm or greater. Ten mature redbay trees received root-flare injections of propiconazole and none developed crown wilt symptoms for at least 30 weeks after being inoculated with *Raffaelea* spp., whereas nine of ten untreated control trees wilted in more than one-third of their crowns. Concentrations of propiconazole diminish in trees over time but the fungicide was retained in the stem xylem for at least 7.5 months after injection. Fungicide injections may not be a viable technique for avocado crops because at this time there are no fungicides registered for use on avocado. Control of the redbay ambrosia beetle is complicated by the fact that adult beetles must be in the immediate area of aerial sprays to be controlled. Detection of adult beetles involves monitoring traps and/or scouting groves. Once adult beetles bore into the trees contact insecticides are ineffective. The current recommendation is to periodically apply permethrin to the trunk and major limbs of uninfested, potential host trees up to about 10 ft above the ground beginning in early March. If an infestation is taking place, an application of permethrin is recommended to knock down the population as soon as possible (Mayfield *et al*., 2008a; Crane, 2009).

Pathway
Raffaelea lauricola is readily isolated from the mycangia of the exotic beetle *Xyleborus glabratus* and assumed brought to the United States from Asia with its vector in solid wood packing material (Fraedrich et al. 2008).

Principal source: Cameron, R. Scott; Chip Bates and James Johnson., 2008. Distribution and Spread of Laurel Wilt Disease in Georgia: 2006-08 Survey and Field Observations . Georgia Forestry Commission September 2008 Funded partially by the USDA Forest Service Forest Health Protection Region 8
\r\nFraedrich, S. W; Harrington, T. C; Rabaglia, R. J; Ulyshen, M. D; Mayfield, A. E. III; Hanula, J. L; Eickwort, J. M; Miller, D. R., 2008. A fungal symbiont of the redbay ambrosia beetle causes a lethal wilt in redbay and other Lauraceae in the southeastern United States Plant Disease. 92(2). FEB 2008. 215-224.
Harrington, T.C., Fraedrich, S.W., Aghayeva, D.N. 2008. *Raffaelea lauricola*, a new ambrosia beetle symbiont and pathogen on the Lauraceae. Mycotaxon, Volume 104, pp. 399-404 (April - June 2008).

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[3] UNITED STATES

BIBLIOGRAPHY

37 references found for **Raffaelea lauricola**

Managment information

Brockerhoff, E.G., 2009. Wood Borer and Bark Beetle Risk Analysis. SCION Date: May 2009 Client: Forest Biosecurity Research Council
Summary: Available from: http://www.fbrc.org.nz/pdfs/Wood_borer_bark_beetle_risk_assessment_final_May_2009.pdf [Accessed 23 November 2009]
Cameron, R. Scott; Chip Bates and James Johnson., 2008. Distribution and Spread of Laurel Wilt Disease in Georgia: 2006-08 Survey and Field Observations. Georgia Forestry Commission September 2008 Funded partially by the USDA Forest Service Forest Health Protection Region 8
Summary: Available from: http://fhm.fs.fed.us/em/funded/09/so-em-08-02-report.pdf [Accessed 23 November 2009]
Crane, Jonathan H., 2009. Issues concerning the Control of the Redbay Ambrosia Beetle (*Xyleborus glabratus*) and Spread of the Laurel Wilt Pathogen (*Raffaelea lauricola*). March 12, 2009
Summary: Available from: http://www.avocadosource.com/papers/Research_Articles/CraneJonathan2009.pdf [Accessed 23 November 2009]
European and Meditteranean Plant Protection Organization, (EPPO) 2006. EPPO Reporting Service NO.10 PARIS, 2006-10-01
Summary: Available from: http://archives.eppo.org/EPPOReporting/2006/Rse-0610.pdf [Accessed 23 November 2009]
Florida Department of Agriculture and Consumer Services, Division of Plant Industry., 2009. Pest Alert: The Redbay Ambrosia Beetle, *Xyleborus glabratus* Eichhoff (Scolytinae: Curculionidae). Albert E. Mayfield III & Michael C. Thomas Revised by Dr. Greg Hodges - Division of Plant Industry and Jeff Eickwort - Division of Forestry on July 30, 2009
Summary: Available from: http://www.doacs.state.fl.us/pi/enpp/ento/x.glabratus.html [Accessed 23 November 2009]
Gramling, Joel M., 2009. PS 88-138: Predictions and early observations on the impact of Laurel Wilt Disease on the flora of North America. The 94th ESA Annual Meeting (August 2 -- 7, 2009)
Summary: Available from: http://eco.confex.com/eco/2009/techprogram/P20940.HTM [Accessed 23 November 2009]
Results/Conclusions: Twelve native and three introduced species in the Lauraceae are thought to be at risk of being impacted by Laurel Wilt Disease. At least four of these native species are already viewed as vulnerable to extirpation or extinction. Over 55 native plant communities recorded in the International Vegetation Classification system found in the United States and Canada may be impacted by Laurel Wilt Disease. Initial observations from the monitoring plots have demonstrated that mortality associated with Laurel Wilt Disease is greatest in large-stemmed individuals (DBH > 10cm) initially. Similarly, over time stems < 2.5 cm in diameter were significantly less likely to exhibit the disease. A die-back of the primary stem due to Laurel Wilt Disease was found to correlate with a doubling in the average number of resprouts growing from the base of the stem. Overall initial observations suggest that Laurel Wilt Disease preferentially affects large stems, exhibits a high mortality rate, and spreads through the stem rapidly, but may not invade the root system.
Haack, Robert A., 2006. Exotic bark- and wood-boring Coleoptera in the United States: recent establishments and interceptions. Canadian Journal of Forest Research. 36(2). FEB 2006. 269-288.
Hanula, James L; Sullivan, Brian., 2008. Manuka Oil and Phoebe Oil are Attractive Baits for *Xyleborus glabratus* (Coleoptera Scolytinae), the Vector of Laurel Wilt. Environmental Entomology. 37(6). DEC 2008. 1403-1409.
Hodges, Greg & Jeff Eickwort, 2009. Technical Bulletin: The Redbay Ambrosia Beetle Found in Jackson County Forest Health Notes # 23 Issued: 8/2009
Summary: Available from: http://www.mfc.state.ms.us/pdf/Mgt/FH/RBAB/TB23_Redbay_Amrosia_Beetle_Pest_Alert.pdf [23 November 2009]
Hughes, M. A; Smith, J. A; Mayfield, A. E; Ploetz, R; Fraedrich, S. W; Dreaden, T. J., 2008. Population studies of a newly introduced species of *Raffaelea* causing laurel wilt disease in the southeastern United States. Phytopathology [Phytopathology]. Vol. 98, no. 6, suppl., p. S70. Jun 2008.
Kendra, Paul E; Wayne S. Montgomery; Elena Q. Schnell; Jerome Niogret; Nancy D. Epsky; Robert R. Heath; Raymond J. Schnell; Tom�s Ayala-Silva; Alan W. Meerow and Michael Winterstein., 2009. USDA-ARS Strategies to Address the Imminent Threat of Redbay Ambrosia Beetle and Laurel Wilt Disease to Florida Avocados. USDA-ARS, Subtropical Horticulture Research Station and National Germplasm Repository, Miami, Florida USA
Summary: Available from: http://flaentsoc.org/fes-09pk2.pdf [Accessed 23 November 2009]
Mayfield, Albert E. III; Barnard, Edward L; Smith, Jason A; Bernick, Shawn C; Eickwort, Jeffrey M; Dreaden, Tyler J., 2008. Effect of Propiconazole on Laurel Wilt Disease Development in Redbay Trees and on the Pathogen In Vitro. Arboriculture & Urban Forestry. 34(5). SEP 2008. 317-324.
National Agricultural Pest Information System (NAPIS), 2010. Reported Status of Redbay Ambrosia Beetle - *Xyleborus glabratus*
Summary: Available from: http://pest.ceris.purdue.edu/searchmap.php?selectName=INBQRHA [23 November 2009]
North American Plant Protection Organization (NAPPO), 2008. Phytosanitary Alert System. *Raffaelea lauricola* sp. nov. T.C. Harr. Fraedrich & Aghayeva
Summary: Available from: http://www.pestalert.org/viewNewsAlert.cfm?naid=63 [Accessed 23 November 2009]
Rabaglia, Robert., 2008. EXFOR Database: *Xyleborus glabratus*
Summary: Available from: http://spfnic.fs.fed.us/exfor/data/pestreports.cfm?pestidval=148&langdisplay=english [Accessed 23 November 2009]
Rabaglia, Robert J; Dole, Stephanie A; Cognat, Anthony I., 2006. Review of American *Xyleborina* (Coleoptera : Curculionidae : Scolytinae) occurring North of Mexico, with an illustrated key. Annals of the Entomological Society of America. 99(6). NOV 2006. 1034-1056.

General information

Fraedrich, Stephen W; Thomas C. Harrington and Robert J. Rabaglia., 2007. Laurel Wilt: A New and Devastating Disease of Redbay Caused by a Fungal Symbiont of the Exotic Redbay Ambrosia Beetle. April 2007 Newsletter of the Michigan Entomological Soceity V52(1&2)
Summary: Available from: http://www.public.iastate.edu/~tcharrin/NewsMich.pdf [Accessed 23 November 2009]
Fraedrich, S. W; Harrington, T. C; Rabaglia, R. J; Ulyshen, M. D; Mayfield, A. E. III; Hanula, J. L; Eickwort, J. M; Miller, D. R., 2008. A fungal symbiont of the redbay ambrosia beetle causes a lethal wilt in redbay and other Lauraceae in the southeastern United States. Plant Disease. 92(2). FEB 2008. 215-224.

Fraedrich, S. W.� 2008. California Laurel Is Susceptible to Laurel Wilt Caused by *Raffaelea lauricola*. The American Phytopathological Society, October 2008, Volume 92, Number 10, Page 1469
Summary: Extensive mortality of redbay (Persea borbonia (L.) Spreng.) has been observed in the southeastern United States since 2003. The mortality is due to laurel wilt caused by Raffaelea lauricola T. C. Harr., Fraedrich & Aghayeva, a fungal symbiont of the recently introduced redbay ambrosia beetle (RAB), Xyleborus glabratus Eichhoff (1,2). The wilt is known to affect other members of the Lauraceae including sassafras (Sassafras albidum (Nuttall) Nees) and avocado (Persea americana Mill.) (1,3). Two inoculation experiments were conducted to evaluate the susceptibility of California laurel (Umbellularia californica (Hook. & Arn.) Nutt.) to R. lauricola. Seedlings, averaging 73 cm high and 13 mm in diameter, were wounded with a drill bit (2.8 mm) to a depth of one-half the diameter of the stems. In each experiment, 10 seedlings were inoculated with one of two isolates of R. lauricola (five seedlings per isolate) obtained as previously described (1) from wilted redbays on Hilton Head Island, South Carolina and Fort George Island, Florida. In the first experiment, seedlings were inoculated with spore suspensions (0.1 ml) ranging from 1.9 to 2.3 � 106 spores/ml and produced as previously described (1). In the second experiment, seedlings were inoculated with mycelial plugs obtained from the edge of 10-day-old cultures growing on malt extract agar (MEA). Five seedlings in each experiment served as controls and were inoculated with sterile deionized water or plugs of sterile MEA. Inoculation points were wrapped with Parafilm M (Pechiney Plastic Packaging, Menasha, WI). Seedlings were grown in growth chambers (daytime temperature 26�C, nighttime 24�C, and a 15-h photoperiod) for 13 to 15 weeks. At the end of the first experiment, 7 of 10 seedlings inoculated with R. lauricola exhibited wilt that appeared as a dieback of a few to the majority of branches. Nine of the ten seedlings exhibited sapwood discoloration and the fungus was isolated from eight of these seedlings. At the end of the second experiment, 8 of 10 seedlings exhibited wilt that again appeared as a dieback of a few branches to most branches. All seedlings with wilt exhibited sapwood discoloration and the fungus was recovered from these seedlings. Two seedlings inoculated with R. lauricola exhibited no symptoms of disease and the fungus was not recovered. Control seedlings remained healthy in both experiments with no evidence of wilt or sapwood discoloration and R. lauricola was not isolated. These results indicate that California laurel is susceptible to laurel wilt caused by R. lauricola. Furthermore, the disease on California laurel may appear as a branch dieback affecting individual branches one at a time rather than a rapid wilt of the entire crown as is often observed in redbay (1). Currently, the RAB is not known to occur on the West Coast and it is also not known if this beetle is capable of attacking and producing brood on California laurel. Nonetheless, if the RAB and R. lauricola become established on the West Coast, laurel wilt could pose a serious threat to natural ecosystems as well as the avocado industry in California.
Global Biodiversity Information Facility (GBIF), 2010. Genus: *Raffaelea*
Summary: Available from: http://www.gbif.net/species/13219596/ [Accessed 15 June 2010]
Goldberg, Nisse, Heine, John. 2009. A comparison of arborescent vegetation pre- (1983) and post- (2008) outbreak of the invasive species the Asian ambrosia beetle *Xyleborus glabratus* in a Florida maritime hammock. Plant Ecology & Diversity. 2(1). 2009. 77-83.
Hanula, J.L., Mayfield III, A.E., Fraedrich, S.W., Rabaglia, R.J. 2008. Biology and host associations of redbay ambrosia beetle (Coleoptera: Curculionidae: Scolytinae), exotic vector of laurel wilt killing redbay trees in the southeastern United States. Journal of Economic Entomology 101 (4), pp. 1276-1286.
Harrington, T.C., Aghayeva, D.N. & Fraedrich, S.W. 2010. New combinations in *Raffaelea*, *Ambrosiella*, and *Hyalorhinocladiella*, and four new species from the redbay ambrosia beetle, *Xyleborus glabratus*. Mycotaxon, 111: 337-361.
Harrington, T.C., Fraedrich, S.W., Aghayeva, D.N. 2008. *Raffaelea lauricola*, a new ambrosia beetle symbiont and pathogen on the Lauraceae. Mycotaxon, Volume 104, pp. 399-404 (April - June 2008).
Summary: Available from: http://www.fs.fed.us/r8/foresthealth/laurelwilt/resources/pubs/399harrington8-53.pdf [Accessed 23 November 2009]
Hess, Matthew. 2007. Effect of an Introduced Ambrosia Beetle (*Xyleborus glabratus*) on Red Bay (*Persea borbonia*) Mortality in Maritime Forest Communities of St. Catherine s Island, GA. Department of Biology, The University of the South.
Koch, F. H; Smith, W. D., 2008. Spatio-temporal analysis of *Xyleborus glabratus* (Coleoptera : Circulionidae : Scolytinae) invasion in eastern US forests. Environmental Entomology. 37(2). APR 2008. 442-452.
Mayfield, A. E. III; Pena, J. E; Crane, J. H; Smith, J. A; Branch, C. L; Ottoson, E. D; Hughes, M., 2008. Ability of the redbay ambrosia beetle (Coleoptera : Curculionidae : Scolytinae) to bore into young avocado (Lauraceae) plants and transmit the laurel wilt pathogen (*Raffaelea* sp.). Florida Entomologist. 91(3). SEP 2008. 485-487.
Mayfield, Albert E. and Thomas, Michael C. 2006. The Redbay Ambrosia Beetle, *Xyleborus glabratus* Eichhoff (Scolytinae: Curculionidae). Florida Department of Agriculture & Consumer Services, U.S.A.
Pena, J.E; Capinera, J.L; Stelinski, L.L; Kendra, P.E; Mayfield, A.E; Hanula, J.L. 2009. The redbay ambrosia beetle, *Xyleborus glabratus*: A threat to avocado. Florida Entomological Society Annual Meeting.
PHYSorg.com. 30 Jun 2008. Tree-killing fungus officially named by scientists.
Summary: Available from: http://www.physorg.com/news134054863.html [Accessed 18 February 2010]
Rabaglia, R. and Fraedrich, S. Undated. The Association of *Xyleborus glabratus* and an *Ophiostoma* species with Mortality of red Bay and Sassafras in the Southeastern U.S. USDA Forest Service, Proceedings�Interagency Research Forum on Gypsy Moth and other Invasive Species.
Rabaglia, R., Duerr, D., Acciavatti, R., Ragenovich, I. 2008. Early detection and rapid response for Non-native bark and Ambrosia beetles. United states Department of Agriculture, Forest Service. U.S.A.
Smith, J. A; A. E. Mayfield, III; C. A. Bates; W. A. Lamborn; and S. W. Fraedrich., 2009. Disease Notes: First Report of Laurel Wilt Disease Caused by *Raffaelea lauricola* on Camphor in Florida and Georgia. February 2009, Volume 93, Number 2 Page 198
Smith, J.A., Mount, L., Mayfield III, A.E., Bates, C.A., Lamborn, W.A. & Fraedrich, S.W. 2009. First report of laurel wilt disease caused by *Raffaelea lauricola* on camphor in Florida and Georgia. Plant Disease, 93(2): 198.
Smith, J. A; T. J. Dreaden; A. E. Mayfield, III; A. Boone and C. Bates., 2009. Disease Notes: First Report of Laurel Wilt Disease Caused *by Raffaelea lauricola* on Sassafras in Florida and South Carolina. October 2009, Volume 93, Number 10 Page 1079
UniProt Taxonomy, 2010. Species *Raffaelea lauricola*
Summary: Available from: http://www.uniprot.org/taxonomy/483707 [Accessed 18 February 2010]
USDA, National Invasive Species Information Center, Species profiles: Laurel Wilt
Summary: Available from: http://www.invasivespeciesinfo.gov/microbes/laurelwilt.shtml [Accessed 18 February 2010]