

# Emergence of *Ralstonia solanacearum* as the primary cause of death and decline of *Casuarina equisetifolia* (ironwood) in Guam, China and possibly Hawaii



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## HISTORY

Likely native to the island of Guam, ironwood is considered an integral member of the natural landscape. It is propagated for windbreaks, reforestation, erosion control on beaches and hillsides and for its foliage, which is used as a mulch.



## BOTANICAL CHARACTERISTICS



The tree is an evergreen angiosperm, with needle-like jointed branchlets that bear anatomical minute tooth-shaped leaves. Within the Mariana Islands, trees may live to 95 years and obtain height and circumference measurements of 13.7 m and 2.9 m, respectively.

## HABITAT AND DISTRIBUTION



In Guam, ironwood grows in low pH volcanic and bottomland soils and high pH limestone and beach soils. Ironwood thickets are a component of Guam's forest surveys, where it is considered a secondary forest species. It grows nearly everywhere with the exception of undisturbed limestone forests.

## IMPORTANCE

*Casuarina equisetifolia* is one of the most common trees occurring on frost-free beaches anywhere in the world and constitutes some 3% of all trees planted in tropical areas. Ironwood's ability to thrive under Guam's harsh conditions of salt spray, typhoon force winds, and drought has been largely responsible for it being one of the dominant trees in the Marianas.



## POSITIVE ABIOTIC FACTORS

Trees in sandy shores of Guam respond to water availability by producing a long tap root system when the water level is low and longitudinal roots when the water level is high.



## IRONWOOD DECLINE ONSET



Ironwood trees on the island of Guam are in the midst of a decline that was first noticed in 2002. By 2009, there were dozens of stands of dead and dying trees across Guam.

## SYMPTOMATOLOGY IN CHINA



Photo provided by Dr. Chonglu, Zhong Chinese Academy of Forestry.

Bacterial wilt in ironwood has been known to occur in China since 1964. Symptoms are more severe than those associated with trees in Guam. In Guam die back generally precedes death, and the formation of bacterial ooze is limited, whereas in China tree death is rapid and copious amounts of ooze often forms.



Photo provided by He Xue-You, Fujian Academy of Forestry.

## GUAM IRONWOOD DECLINE CONTRIBUTORS

Biotic factors	Emerging factors	Relevance
Branch dieback	<i>Pestalotiopsis</i>	*
Root rot	<i>Fusarium</i>	*
Wood rot	<i>Ganoderma australe</i>	****
Xylem residing bacteria	<i>Ralstonia solanacearum</i>	***
	Wetwood bacteria	**
Nematodes	<i>Helicotylenchus</i>	*
Insects	Termites	**
	<i>Selitrichodes casuarinae</i>	*
Abiotic factors	Emerging factors	Relevance
Weather	Typhoon damage	*
Management	Poor tree care practices	*
Site environment	Poor site selection	**
Host genetics	Lack of genetic diversity	**

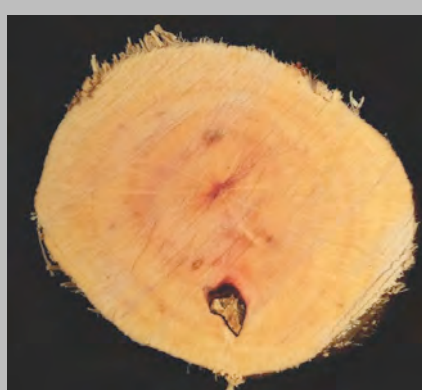
Low \* to High \*\*\*

## SYMPTOMATOLOGY IN GUAM

Symptom progression of ironwood tree decline begins with thinning of foliage (right tree) with little or no internal discoloration progressing to die-back of branches (left tree) and extensive internal discoloration.



Left tree



Right tree

## CULTIVAR SELECTION



To increase genetic diversity within Guam's ironwood population, tree seeds from 11 countries were out planted in 2012, and all quickly established. The fastest growing geographically paired provenances were from the Solomon Islands, Vanuatu, Malaysia, and China. The slowest were from Australia, Kenya, and Guam.

## R. SOLANACEARUM IN HAWAII?



In 2017, symptoms of rapid tree death were reported on a 4-mile stretch of ironwood trees at the Maui Mountains Watershed by Watershed Program Manager, Chris Brosius. Though *R. solanacearum* has not been reported in Hawaii's ironwood trees, the likelihood of its presence is high considering it has been confirmed in Hawaii on other hosts.

Photo provided by Chris Brosius, Program Manager West Maui Mountains Watershed.

## ACKNOWLEDGEMENTS:

Chris Brosius, Chonglu Zhong and He Xue-You.  
This work is supported by MacIntire-Stennis FAIN no. NI18MSCFRXXXG061/project accession no. 1005476 from the USDA National Institute of Food and Agriculture.

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