College of Tropical Agriculture and Human Resources
University of Hawai'i at Manoa

Erythrina 'Dominic' and 'Sophia'

Two *Erythrina* Gall Wasp-Resistant Cultivars to Replace the 'Tropic Coral' Tall Wiliwili

'Tropic Coral'

'Tropic Coral' tall wiliwili (*Erythrina variegata* 'Tropic Coral') was a cooperative plant introduction by the College of Tropical Agriculture and Human Resources, University of Hawai'i at Mānoa, USDA Soil Conservation Service, and Honolulu Botanic Gardens.

'Tropic Coral' tall wiliwili was officially released for public use in 1985, and quickly became the windbreak plant-of-choice throughout the Hawaiian Islands for crop protection and soil and water conservation due to its fastigiate (columnar) form with erect branches, ease of propagation, drought tolerance, tolerance to a variety of soil conditions, and rapid growth.

Erythrina 'Dominic'

The fastigiated architecture of 'Tropic Coral' is caused by a mutation that originated from plants grown from seed obtained from the Botanical Garden in Adelaide, Australia, by E.M. Menninger, who later provided a rooted cutting to Foster Botanical Garden in Honolulu. In 1972, cuttings were provided to the USDA Soil Conservation Service, Plant Materials Center on Moloka'i, where it was increased for introduction and distribution.

EGW

The *Erythrina* gall wasp (EGW; *Quadrastichus erythrinae*) was first collected in Hawai'i in 2005 on *Erythrina variegata*, a then-popular landscape species. It quickly spread to all islands, causing severe damage to the native *Erythrina sandwicensis*, as well as most introduced species. 'Tropic Coral' was particularly susceptible and today, it is nowhere to be found.

Symptoms

Larvae of the tiny EGW develop within plant tissues, causing the formation of galls on leaves, petioles, and stems. Leaves curl and become massively deformed, while petioles and stems become swollen. Heavy infestations cause defoliation and death of trees. Many thousands of trees have been killed by this pest.

Resistance

A polyploid (multiple chromosome sets) form of the typical broad-dome, open-branched form of *E. variegata* proved to be resistant to EGW and was introduced to the local landscape trade as *Erythrina* 'Adrien'. It was described in the Jan/Feb 2017 issue of *Hawai'i Landscape* (Leonhardt, K.W. 2017).

The mechanism for the resistance is unknown. Studies on the phytochemistry of *Erythrina variegata* have demonstrated alkaloids and flavonoids as major constituents. Different parts of *E. variegata* have been used in traditional medicine

July 2023
Subject Category: Ornamentals and Flowers, OF-58

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This information has been reviewed by CTAHR faculty

Erythrina gall wasp susceptible coral tree (*Erythrina* variegata) at left, with EGW tolerant mixoploid at right. The mixoploid plant has 23.2% tetraploid nuclei and 9.6% octoploid nuclei, as determined by flow cytometry. It was introduced to the landscape trade in 2017 with the cultivar name 'Adrien'.

as nervine sedative, febrifuge, antiasthmatic and antiepileptic. In some experiments, it has shown potential effects for treatment of some diseases like convulsion, fever, inflammation, bacterial infection, insomnia, helminthiasis, cough, cuts and wounds. It is speculated that an increase in the concentration of some phytochemicals in polyploid cells and tissues is responsible for the EGW tolerance shown by 'Adrien.' The female EGW does penetrate epidermal tissues, and a small reaction can be seen, but no galls are formed and it simply cannot carry out its life cycle on polyploid cells and tissues.

Since 'Tropic Coral' is a fastigiate mutation of the same species as 'Adrien,' the impetus was there to convert 'Tropic Coral' to a polyploid form and return it to cultivation in Hawai'i as an EGW resistant form, if a plant could be found.

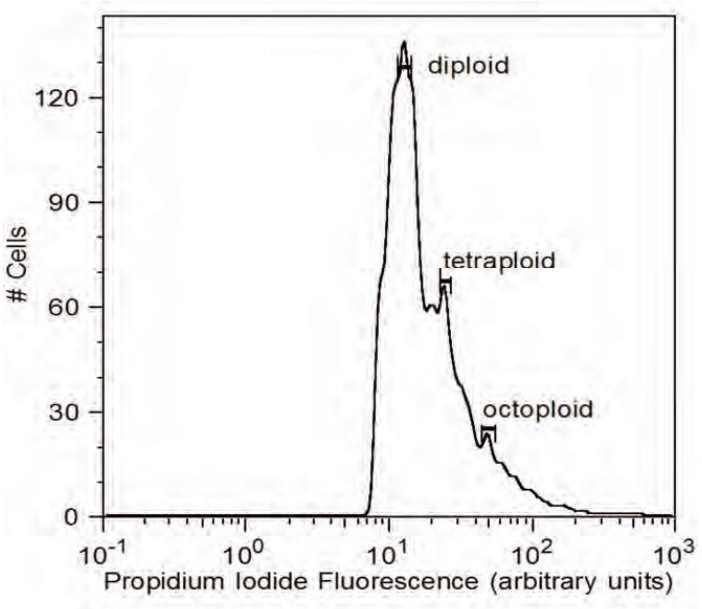
In a search of nurseries, botanical gardens, and landscapes in Hawai'i and Florida where 'Tropic Coral' had been known, not a single plant could be found. Extension agents in Hawai'i, Guam, and Florida were also unaware of any surviving plants.

Four volunteer seedlings on the UH Mānoa campus were found in 2015 and increased to more than 200 plants. Polyploid plants were obtained by treating shoot meristems with a 0.05% oryzalin solution for five consecutive days.

Creation of Polyploids

In order for a plant cell to divide and make new cells, there is a phase where chromosomes double in a single cell (anaphase) and then that cell divides (cytokinesis) to make two daughter cells of the same chromosome number. A dividing diploid (2N) cell under the influence of oryzalin will double its chromosomes, but the normal division of that cell into two daughter cells is prevented; thus, chromosomes are left to be doubled (tetraploid, 4N) in a single cell. Once removed from the presence of oryzalin, that cell retains its doubled number of chromosomes and divides as a tetraploid (4N) cell, producing more 4N cells, which become 4N tissues and a 4N plant (a very oversimplified explanation).

Following oryzalin treatments, 26 plants of various ploidy levels were identified by flow cytometry, increased and field planted at CTAHR's Waimanalo Research Station, where the EGW was plentiful.



Ploidy determination of 'Adrien' by flow cytometry.

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Sophia on left, 'Dominic' on right.

Confirmation of Polyploids

Flow Cytometry is a laser-based, biophysical technology used in quantifying nuclear DNA to determine ploidy level, the number of sets of chromosomes in the nucleus of a biological cell. First, the DNA is extracted from the plant cells, then stained with an iodine-based solution (propidium iodide), then suspended in a stream of fluid and passed by an argon beam and an electronic detection apparatus. Usually about 20,000 nuclei are "beamed" to obtain a reliable measurement.

Most of the polyploid plants were susceptible and died, along with the untreated control plants. However, two individuals appeared to be resistant and were increased for further observation. These have now been increased to more than 200 plants each, and the resistance to the EGW remains strong. These two cultivars are hereby released to the Hawai'i nursery and landscape trade as *Erythrina* 'Dominic' and 'Sophia', named for two of the first author's grandchildren.

Cutting propagation of *Erythrina* 'Dominic' under 70% shade, without mist, in Waimanalo.

About 'Dominic' and 'Sophia'

'Dominic' and 'Sophia' have a somewhat columnar plant architecture but not the extremely erect branches of their parent, 'Tropic Coral'. 'Dominic' and 'Sophia' were less than two feet tall, in one gallon pots when they were planted at the Waimanalo Research Station in 2018. They are now about 15 feet tall, and would be taller except that cuttings have been routinely harvested for propagation and increase. Their vigor and rate of growth resembles that of 'Tropic Coral'.

'Dominic' and 'Sophia' appear to be identical, although genetically they are unique individuals. We do not see any obvious distinctions between them for foliage, flowers, flowering season, growth rate or habit, ease of propagation, EGW resistance, or general appearance. And they are both sterile. Since the mother block planting for cutting production is less than two years old, and since we have grown them only at the UH Research Station at Waimanalo, there is much we don't know about these plants.

Propagation

Tip cuttings and stem sections of about 1 to 1.5 feet root easily in perlite without rooting hormone or mist. In a recent trial, we placed 1,000 such cuttings in 100 3-gal pots (10 cuttings per pot) half filled with perlite – and over 900 rooted in less than six weeks. Those cuttings were distributed to the USDA National Resource Conservation Service on Moloka'i and to several botanical gardens and nurseries on O'ahu.

Availability

A landscape tree field day at the Waimanalo Research Station is being planned for July 21, 2023. Unrooted cuttings of 'Dominic' and 'Sophia' will be available at that time. Following that, interested parties can make arrangements with their Extension Agent.

Reference

Leonhardt, K.W. 2017. 'Adrien', An *Erythrina* Gall Wasp Tolerant Coral Tree. *Hawai'i Landscape Magazine*. Jan/Feb 2017.

Acknowledgements

This work was supported by the USDA National Institute of Food and Agriculture, Hatch project 819, managed by the College of Tropical Agriculture and Human Resources, University of Hawai'i at Mānoa.

Additional funding was provided by the Hawai'i Department of Agriculture, Specialty Crop Block Grant program.

Larvae and Pupae stages: (left) Eggs hatch <3 days, (middle) larvae feeding initiates galling, (right) egg to adult in 21 days. *Photo courtesy of Hue.*

Damage done by the *Erythrina* Gall Wasp to foliage, at left, and to petiole and soft stem tissues at right.

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