

Hosts of the Parasitic Alga *Cephaleuros virescens* in Louisiana and New Host Records for the Continental United States

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Cephaleuros virescens Kunze is a plant-pathogenic green alga (Chlorophyta) that belongs to the family Trentepohliaceae. *C. virescens* occurs worldwide in tropical and subtropical regions (Africa, India, China, Japan, Australia, Central and South America, West Indies, continental United States, and Hawaiian Islands), generally between 32° north latitude and 32° south latitude where temperature and moisture conditions are suitable (9). The alga is a common plant parasite along the Gulf Coast of the southern United States, occurring as far north along the Atlantic coast as North Carolina (17). *Cephaleuros* is the phycobiont of two parasitic lichen species, *Strigula camplanata* (Fee) Mont. and *S. elegans* (Fee) Mull. Arg., which also occur commonly in the southern United States but are not often recognized as parasites (7,14,16).

C. virescens is the species most often cited in the literature as a plant parasite (9). However, *C. parasiticus* Karsten was recently identified in Louisiana (3,8) as the causal agent of a magnolia leaf spot that was erroneously described as being caused by the fungus *Glomerella cingulata* (Ston.) Spauld. & Schrenk (4). In contrast to *C. virescens*, which grows on its host's epidermis but beneath the cuticle layer, *C. parasiticus* occurred intercellularly in leaf spots on *Magnolia grandiflora* L. and caused a large amount of tissue destruction.

C. virescens is the incitant of leaf, stem, and fruit diseases on economically important tropical plants such as tea (*Camellia sinensis* (L.) O. Kuntze), pepper (*Piper nigrum* L.), coffee (*Coffea arabica* L.), oil palm (*Elaeis guineensis* Jacq.), litchi nut (*Litchi chinensis* Sonn.), vanilla (*Vanilla planifolia* Andr.), guava (*Psidium guajava* L.), cacao (*Theobroma cacao* L.), and citrus (*Citrus* L. spp.) (9,13,17-19). Leaf spot infections are the most common form of parasitism, but since the alga is strictly subcuticular, these infections are usually of minor importance on most hosts (9-11,17,18).

Wellman (17), however, reported instances of defoliation of coffee and mango in Central America caused by "numerous infections" of *C. virescens*. A severe foliage disease of guava that was caused by *Cephaleuros* was also reported in Florida (12). Stem infections of host plants are more damaging and may result in swelling, bark splitting, and tissue and twig death (9,10,13,17-19).

A *C. virescens* host list from Brazil (2) included 214 plants listed by the complete Latin binomial, 119 listed by the genus only, and 115 listed by the common name only, for a total of 448. Wellman (17,18) recorded nearly 200 hosts of *C. virescens* from the American tropics. The published host list for the continental United States contained about 40 species through 1960 (15,19). Revised Florida host lists (1,11) contain 157 plant species and cultivars, many of which are tropical plants from central and southern Florida. These lists also contain 27 species that are susceptible to stem infections by *Cephaleuros*.

A host list of *C. virescens* from Louisiana was begun in 1972 and included 145 plant species by 1977 (5,6). Most collections were made within a radius of about 80 miles of Baton Rouge. The northernmost point at which *C. virescens* was collected was Vicksburg, Mississippi, about 32.5° north latitude. The list presented here contains 218 plant genera, species, and cultivars from 62 families. Of this number, 167 are new host records for the continental United States. The following 10 plant families account for over one-half, i.e., 117, of the hosts listed: Aquifoliaceae, 15; Caprifoliaceae, 7; Compositae, 7; Ericaceae, 8; Fagaceae, 12; Leguminosae, 8; Magnoliaceae, 7; Oleaceae, 8; Rosaceae, 32; and Theaceae, 13.

This list contains representatives common to the Gulf Coast except for the tropical areas of southern Florida. Noteworthy in the Louisiana list is the large number of deciduous plant species that are leaf spot hosts of *C. virescens*. Early literature described hosts of the alga as commonly having leathery, long-lived leaves (16,17). Wellman (17), however, found *C. virescens* parasitizing the soft, tender foliage of tomato and tobacco in the American tropics. The recognition of algal parasites on many deciduous and herbaceous species is

difficult, since algal thalli may be less than 1 mm in diameter at the time of leaf drop and therefore easily overlooked. Examples of this type of host from the Louisiana list are species of *Acer*, *Alnus*, *Betula*, *Carpinus*, *Campsis*, *Lonicera*, *Sambucus*, *Solidago*, *Cornus*, *Diospyros*, *Quercus*, *Liquidambar*, *Carya*, *Lagerstroemia*, *Liriodendron*, *Platanus*, *Ulmus*, *Lantanna*, *Vitis*, and *Celosia*.

Leaf spot damage to the majority of *C. virescens* hosts in this study was of a minor nature and usually limited to death of cells just beneath the algal thallus. Tissue necrosis was verified on representative samples of each host by hand lens and/or binocular microscopic examination. Microscopic examination of algal leaf spot sections from *Magnolia grandiflora* revealed death of two to four cell layers, including the epidermal cells, beneath the algal thallus. Occasionally, tissue necrosis extended through the entire leaf to the lower epidermis of some hosts, including *M. grandiflora*. Leaf spots almost always occurred only on the upper leaf surfaces; an exception was *Camellia japonica* L., on which algal thalli often grew on both leaf surfaces. The most damaging infections were those on twigs and branches of woody species that resulted in swelling, bark cracking, and tissue death. In southern Louisiana, 2- and 3-year-old twigs and branches of pecan (*Carya illinoensis* (Wangenh.) C. Koch) and sycamore (*Platanus occidentalis* L.) are frequently infected with *C. virescens*, and infected bark is often killed and sloughed (*unpublished*). The effect of these infections on vigor, growth, and fruit production of the trees has not been determined.

The addition of 164 species and cultivars to the known hosts of *C. virescens* in the continental United States brings the total to 287 (combined Louisiana and Florida lists). This is not far short of the frequently cited Batista and Lima host list from Brazil (2) containing 307 different genera and species. Hosts common to both lists include tropical plants grown in Florida.

The plant families and genera are listed here in alphabetic order, followed by the host common name and plant organ on which the algal infection was observed. *Hortus Third* (1976) was the principal source for currently accepted scientific

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names and authorities for cultivated plants. The severity of infection is noted only in instances when host response was moderate to severe or leaf spotting was especially heavy. An asterisk (*) indicates a new host record for the continental United States.

ACERACEAE

Acer distylum Siebold & Zucc.*; maple; stem.
A. negundo L.*; box elder; leaf, stem.
A. rubrum L.*; red maple; leaf, stem.

AMARANTHACEAE

Celosia cristata L.*; cockscomb; leaf.

ANACARDIACEAE

Rhus copallina L.*; dwarf sumac; leaf.
R. radicans L.*; poison ivy; leaf.

ANNONACEAE

Asimina triloba (L.) Dunal; pawpaw; leaf.

APOCYNACEAE

Allamanda cathartica L.*; common allamanda; leaf.
Nerium oleander L.; oleander; leaf, stem.
Vinca major L.*; periwinkle; leaf.
V. major L. cv. *Variegata**; variegated periwinkle; leaf.

AQUIFOLIACEAE

Ilex × *altaclarensis* (Dallim.) Rehd. cv. *Wilsonii**; holly; leaf.
I. ambigua (Michx.) Torr. var. *montana* (Torr. & A. Gray) Ahles*; mountain holly; stem.
I. aquifolium L.*; English holly; leaf.
I. × *attenuata* Ashe; holly; cv. *Fosteri*,* leaf, stem; cv. *Oriole*,* stem.
I. cassine L.; cassine; leaf, stem.
I. cornuta Lindl. & Paxt.; Chinese holly; cv. *Burfordii*, leaf, stem; cv. *Rotunda*, leaf.
I. cornuta × *I. ciliospinosa*; holly; cv. *Albert Close*,* leaf, stem; cv. *William Cowgill*,* stem; cv. *Edward Goucher*,* stem.
I. glabra (L.) A. Gray*; inkberry; leaf, stem.
I. integra Thunb.*; mochi tree; leaf.
I. integra × *I. pernyi* cv. *Elegance**; holly; leaf, stem.
I. myrtifolia × *I. opaca* cv. *Tananger**; holly; leaf.
I. opaca Ait. cv. *Humei*; American holly; stem.
I. vomitoria Ait.*; holly; leaf, stem.
I. vomitoria Ait. cv. *Folsom Weeping**; holly; leaf, stem.
I. verticillata (L.) A. Gray*; winterberry; leaf, stem.

ARALIACEAE

Hedera helix L.; English ivy; leaf.

ASCLEPIADACEAE

Matelea carolinensis (Jacq.) Woodson*; climbing milkweed; leaf.

BERBERIDACEAE

Mahonia bealei (Fort.) Carriere*; Oregon grape holly; leaf.
M. fortunei (Lindl.) Fedde*; Chinese mahonia; leaf.
Nandina domestica Thunb.*; heavenly bamboo; leaf.

BETULACEAE

Alnus japonica (Thunb.) Steud.*; Japanese alder; leaf (moderately severe).
Betula nigra L.*; river birch; stem (moderately severe).

Carpinus caroliniana T. Walt.*; American hornbeam; leaf.

BIGNONIACEAE

Bignonia capreolata L.*; cross vine; leaf.
Campsis radicans (L.) Seem. ex Bur.*; trumpet vine; leaf.

CALYCANTHACEAE

Chimonanthus praecox (L.) Link*; winter-sweet; leaf.

CAPRIFOLIACEAE

Lonicera fragrantissima Lindl. & Paxt.*; bush honeysuckle; leaf.
L. japonica Thunb.*; Japanese honeysuckle; leaf.
Sambucus canadensis L.*; American elderberry; leaf.
Viburnum dilatatum Thunb.*; linden viburnum; leaf.
V. japonicum (Thunb.) K. Spreng.*; Japanese viburnum; leaf.
V. odoratissimum Ker-Gawl.; sweet viburnum; leaf.
V. suspensum Lindl.; sandankwa viburnum; leaf.

CELASTRACEAE

Euonymus fortunei (Turcz.) Hand.-Mazz.*; wintercreeper euonymus; leaf.

COMPOSITAE

Aster ericoides L.*; heath aster; leaf.
A. prealtus Poir.*; aster; leaf.
Baccharis halimifolia L.*; groundsel bush; stem.
Solidago altissima L.*; goldenrod; leaf.
S. rugosa Mill.*; goldenrod; leaf.
Trilisa odoratissima (Walt.) Cass.*; deer's tongue; leaf.
Verbesina walteri Shinners*; wing-stem crownbeard; leaf.

CORNACEAE

Aucuba japonica Thunb.; Japanese acuba; leaf.
Cornus drummondii C. A. Mey.*; roughleaf dogwood; leaf.
C. florida L.*; flowering dogwood; leaf, stem.

CUPRESSACEAE

Cupressus sempervirens L.*; Italian cypress; stem.

CYRILLACEAE

Cliftonia monophylla (Lam.) Britt. ex Sarg.*; buckwheat tree; leaf.
Cyrilla racemiflora L.*; leatherwood; stem.

EBENACEAE

Diospyros kaki L. f.; Japanese persimmon; stem.
D. virginiana L.*; common persimmon; leaf, stem (severe).

ELAEOAGNACEAE

Elaeagnus pungens Thunb.*; thorny elaeagnus; leaf.

ERICACEAE

Lyonia lucida (Lam.) C. Koch*; tetterbush; leaf.
Pieris japonica (Thunb.) D. Don ex G. Don; Japanese pieris; leaf.
Rhododendron canescens (Michx.) Sweet; wild azalea; leaf (severe), stem (severe).
R. obtusum (Lindl.) Planch.; cultivated azalea; leaf, stem.
R. serrulatum (Small) Millais*; wild azalea;

leaf (severe), stem (severe).

R. sp. hybrid cv. *Formosa*; cultivated azalea; leaf (moderately severe), stem (moderately severe).

Vaccinium arboreum Marsh*; tree huckleberry; leaf.

V. ashei Reade; rabbit-eye blueberry; leaf (moderately severe), stem (moderately severe).

EUPHORBIACEAE

Sapium sebiferum (L.) Roxb.*; Chinese tallow tree; leaf.

FAGACEAE

Castanea mollissima Blume*; Chinese chestnut; leaf, stem.
Quercus acutissima Carruth.*; sawtooth oak; stem (severe).
Q. alba L.*; white oak; leaf, stem.
Q. chenii Nakai*; oak; leaf.
Q. laevis Walt.*; turkey oak; leaf.
Q. muehlenbergii Engelm.*; yellow chestnut oak; leaf.
Q. myrsinifolia Blume*; Chinese evergreen oak; stem (severe).
Q. nigra L.*; water oak; leaf.
Q. prinus L.*; chestnut oak; leaf.
Q. robur L.*; English oak; leaf, stem (severe).
Q. velutina Lam.*; black oak; leaf.
Q. virginiana Mill.; southern live oak; leaf, stem.

FLACOURTIACEAE

Idesia polycarpa Maxim.*; ligiri tree; stem (severe).

GRAMINEAE

Arundinaria gigantea (Walt.) Muhlenb.*; canebrake bamboo; leaf.

HAMAMELIDACEAE*

Liquidambar styraciflua L.*; sweet gum; leaf, stem.
Sycopsis sinensis D. Oliver*; leaf (severe).

HIPPOCASTANACEAE

Aesculus pavia L.*; red buckeye; leaf.

JUGLANDACEAE

Carya aquatica (Michx. f.) Nutt.*; bitter pecan; leaf.
C. cordiformis (Wangenh.) C. Koch*; bitternut hickory; stem.
C. glabra (Mill.) Sweet*; pignut hickory; leaf.
C. illinoensis (Wangenh.) C. Koch; pecan; leaf, stem (severe).
Juglans nigra L.*; black walnut; stem.
J. regia L.*; English walnut; stem.

LAURACEAE

Cinnamomum camphora (L.) J. Presl; camphor tree; leaf.
Laurus nobilis L.*; sweet bay; leaf.
Lindera benzoin (L.) Blume*; spicebush; leaf.
Persea americana Mill.; avocado; leaf.
P. borbonia (L.) K. Spreng.; red bay; leaf.
Sassafras albidum (Nutt.) Nees*; sassafras; leaf.

LEGUMINOSAE

Albizia julibrissin Durazz.*; mimosa; stem.
Cercis canadensis L.*; redbud; leaf, stem.
Cladrastis lutea (Michx. f.) C. Koch*; yellowwood; stem.
Dalbergia sissoo Roxb. ex DC.*; sissoo; stem.
Desmodium Desv. sp.*; beggar's-ticks; leaf.
Erythrina crista-galli L.*; cocks spur coral tree; leaf.
Maackia amurensis Rupr. & Maxim.*; amur maackia; leaf, stem.

Wisteria sinensis (Sims) Sweet; Chinese wisteria; leaf.

LILIACEAE

Hemerocallis L. sp. hybrid*; daylily; leaf.
Smilax L. sp.*; greenbriar; leaf.

LYTHRACEAE

Lagerstroemia indica L.; crape myrtle; leaf.

MAGNOLIACEAE

Liriodendron tulipifera L.*; tulip tree; stem.
Magnolia acuminata (L.) L.*; cucumber tree; leaf.
M. grandiflora L.; southern magnolia; leaf, stem.
M. × soulangiana Soul.-Bod.; Chinese magnolia; leaf, stem.
M. tripetala L.*; umbrella magnolia; leaf, stem.
M. virginiana L.; sweet bay; leaf.
Michelia figo (Lour.) K. Spreng.; banana shrub; leaf.

MALVACEAE

Hibiscus syriacus L.*; althaea; leaf, stem.

MENISPERMACEAE

Calyocarpum lyoni (Pursh) Gray*; cup seed; leaf.

MORACEAE

Broussonetia papyrifera (L.) Venten.*; paper mulberry; leaf.
Ficus carica L.*; fig; stem.
F. pumila L.*; climbing fig; leaf.
Maclura pomifera (Raf.) C. K. Schneid.*; osage orange; leaf.

MYRICACEAE

Myrica cerifera L.; wax myrtle; leaf, stem.

MYRSINACEAE

Ardisia crispa (Thunb.) A. DC.; Christmas berry; leaf.

MYRTACEAE

Callistemon citrinus (Curtis) Stapf; crimson bottlebrush; leaf.
Eucalyptus camphora R. T. Bak.*; broad-leaved sally; stem.
E. nova-anglica Deane & Maid.*; New England peppermint; leaf.
Feijoa sellowiana O. Berg.; pineapple guava; leaf.

NYSSACEAE

Nyssa sylvatica Marsh.*; black gum; leaf, stem.

OLEACEAE

Fraxinus caroliniana Mill.*; water ash; leaf.
F. pennsylvanica Marsh. (Borkh.) Sarg.*; green ash; leaf, stem.
Jasminum mesnyi Hance*; Japanese jasmine; leaf.
Ligustrum japonicum Thunb.; wax-leaf privet; leaf, stem.
L. lucidum Ait.*; glossy privet; leaf.
L. sinense Lour.*; Chinese privet; leaf.
Osmanthus fragrans (Thunb.) Lour.*; sweet olive; leaf.
O. heterophyllus (G. Don) P. S. Green; false holly; leaf.

OSMUNDACEAE

Osmunda regalis L.*; royal fern; leaf.

PLATANACEAE

Platanus occidentalis L.; eastern sycamore; leaf, stem (severe).

POLYGONACEAE

Brunnichia ovata (Walt.) Shinners*; ladies eardrops; leaf.

POLYPODIACEAE

Cyrtomium falcatum (L. f.) K. Presl; holly fern; leaf.

RHAMNACEAE

Rhamnus caroliniana Walt.*; Indian cherry; leaf.

ROSACEAE

Chaenomeles japonica (Thunb.) Lindl. ex Spach*; Japanese flowering quince; leaf.
C. speciosa (Sweet) Nakai*; flowering quince; leaf, stem.
Cotoneaster apiculatus Rehd. & E. H. Wils.*; cranberry cotoneaster; stem.
C. dielsianus E. Pritz ex Diels*; cotoneaster; stem (severe).
C. lucidus Schlechtend.*; hedge cotoneaster; stem (severe).
Crataegus douglasii Lindl.*; hawthorn; leaf.
*C. × Lavalleyi**; hawthorn; stem.
C. pinnatifida Bunge*; hawthorn; leaf.
Eriobotrya japonica (Thunb.) Lindl.; loquat; leaf.
Malus angustifolia (Ait.) Michx.*; southern wild crab apple; leaf.
M. floribunda Siebold ex Van Houtte*; showy crab apple; leaf.
M. pumila Mill.*; common apple; stem.
M. × robusta (Carriere) Rehd.*; flowering crab apple; stem.
M. silvestris Mill.*; crab apple; leaf.
Photinia Lindl.* PI 325008; photinia; leaf.
P. glabra (Thunb.) Maxim.*; Japanese photinia; leaf.
P. serrulata Lindl.*; Chinese photinia; leaf.
Prunus caroliniana (Mill.) Ait.*; cherry laurel; stem.
P. serotina J. F. Ehrh.*; black cherry; stem.
P. triloba Lindl.*; flowering almond; stem.
Pyracantha coccinea M. J. Roem.; fire thorn; leaf, stem (severe).
P. fortuneana (Maxim.) H. L. Li*; fire thorn; stem.
P. koidzumii (Hayata) Rehd.*; Formosa fire thorn; stem.
Pyrus calleryana Decne.*; ornamental pear; leaf.
P. × lecontei Rehd. cv. Kieffer*; pear; leaf.
P. pyrifolia (Burm. f.) Nakai*; sand pear; stem.
Raphiolepis indica (L.) Lindl.; Indian hawthorn; leaf, stem.
Rosa sp. hybrid; hybrid tea rose*; leaf, stem.
R. laevigata Michx.*; Cherokee rose; leaf.
Rubus sp.; wild blackberry; stem.
R. trivialis Michx.*; southern dewberry; leaf.
Spiraea × Vanhouttei (C. Briot) Zab.; bridal-wreath; stem (moderately severe).

RUBIACEAE

Gardenia jasminoides Ellis; common gardenia; leaf.
G. jasminoides Ellis cv. Prostrata; dwarf gardenia; leaf.
Mitchellia repens L.*; partridgeberry; leaf.

RUTACEAE

Citrus reticulata Blanco; satsuma orange; stem.
Zanthoxylum clava-herculis L.*; southern prickly ash; stem.

SALICACEAE

Populus alba L.*; white poplar; stem.
Salix nigra Marsh*; black willow; stem.

SAPINDACEAE

Koelreuteria paniculata Laxm.*; varnish tree; leaf.
Sapindus utilis Trab.*; soapberry; leaf, stem.

SAXIFRAGACEAE

Hydrangea macrophylla (Thunb.) Ser.*; French hydrangea; leaf.
Philadelphus coronarius L.*; mock orange; leaf.

SOLANACEAE

Solanum pseudocapsicum L.; Jerusalem cherry; leaf.

STERCULIACEAE

Firmiana simplex (L.) W. F. Wight*; Chinese parasol tree; leaf.

STYRACACEAE

Halesia diptera Ellis*; silver-bell; stem.

SYMPLOCACEAE

Symplocos tinctoria (L.) L'Her.*; common sweetleaf; leaf.

TAXODIACEAE

Cryptomeria japonica (L. f.) D. Don*; Japanese cedar; leaf.

THEACEAE

Camellia cuspidata (Kochs) Hort. Veitch ex R. Pearson*; camellia; leaf.
C. dubia Sealy*; camellia; leaf.
C. japonica L.; common camellia; leaf (severe), stem (severe), seedpod (severe).
C. reticulata Lindl.*; camellia; leaf.
C. sasanqua Thunb.; sasanqua camellia; leaf (severe), stem (severe).
C. sinensis (L.) O. Kuntze; tea; leaf (moderately severe).
C. tenuiflora Cohen Stuart*; camellia; leaf.
Cleyera japonica Thunb.; cleyera; leaf.
Franklinia alatamaha Marsh*; Franklin tree; stem (severe).
Gordonia axillaris (Roxb. ex Ker-Gawl.) D. Dietr.*; gordonia; leaf.
G. lasianthus (L.) Ellis; loblolly bay; leaf.
Stewartia malacodendron L.*; silky camellia; stem.
Ternstroemia gymnanthera (Wight & Arn.) T. Sprague*; ternstroemia; stem.

ULMACEAE

Celtis laevigata Willd.*; sugarberry; leaf.
Ulmus alata Michx.*; winged elm; leaf, stem.
U. americana L.*; American elm; leaf, stem.

VERBENACEAE

Callicarpa americana L.*; French mulberry; leaf.
Lantanna camara L.*; lantana; leaf.
Vitex agnus-castus L.*; chaste tree; leaf.

VITACEAE

Ampelopsis arborea Koehne*; pepper vine; leaf.
Parthenocissus quinquefolia (L.) Planch.*; Virginia creeper; leaf.
Vitis rotundifolia Michx.*; muscadine grape; leaf.

ZINGIBERACEAE

Hedychium coronarium J. Konig*; ginger lily; leaf.

ACKNOWLEDGMENTS

I thank Dale Newsom, Martin and Paula Piehl, Beatrix Exner, Wray Birchfield, Shirley Tucker, and Lowell Urbatsch for assistance in identifying plant specimens.

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