= Cryptothecia rubrocincta =

Cryptothecia rubrocincta is a species of lichen in the Arthoniaceae family of fungi . The species is distributed in subtropical and tropical locations throughout the southeastern United States , as well as Central and South America , and has been collected infrequently in a few locales in Africa . The body of the lichen forms continuous , circular crust @-@ like patches on dead wood , readily recognizable by the prominent red pigment . The older , central region is covered with red , spherical to cylindrical granules . Moving outwards from the center , zones of color may be distinguished , the first gray @-@ green , the second white , and finally a bright red cottony rim . The red and green colors of this unmistakable woodland lichen give the appearance of a Christmas wreath , suggestive of its common North American name , the Christmas wreath lichen . The red pigment , called chiodectonic acid , is one of several chemicals the lichen produces to help tolerate inhospitable growing conditions .

= = Taxonomy and naming = =

The classification of the genus Cryptothecia has been unclear , and historically , C. rubrocincta has been placed in several different genera . Like all lichens , C. rubrocincta is an association of a fungus (the mycobiont) with a photosynthetic organism (the photobiont) , in this case , an algae . Initially , it was unknown whether the mycobiont component of C. rubrocincta was an ascomycete or a basidiomycete . Although the vast majority of lichen mycobionts are from the Ascomycota , in 1937 German lichenogist Friedrich Tobler believed the mycobiont to be a basidiomycete , because he interpreted some unusual microscopic structures to be clamp connections , structures associated only with the basidiomycete fungi . In another publication later that year , he specified the mycobiont to be a hymenomycete , and described the monotypic genus Herpothallion to supersede the old name Chiodecton sanguineum . Although Vernon Ahmadjian corroborated the presence of clamp connections in the species when he studied the species ' cytology in 1967 , other researchers did not find clamp connections in specimens collected from different countries . Further doubt was cast on the possibility of a basidiomycete mycobiont with the discovery of the depside confluentic acid in 1966 , concentric bodies in 1975 , and woronin bodies in 1983 , as all of these characteristics are restricted to Ascomycetes .

The International Code of Botanical Nomenclature states that names of fungi adopted by Fries in Systema Mycologicum vols . 1 ? 3 are sanctioned , that is , they are conserved against earlier homonyms and competing synonyms . This means that the name Hypochnus rubrocinctum has priority over Byssus sanguinea . The type material of H. rubrocinctum was examined by Christian Gottfried Ehrenberg in Berlin ; it has since been destroyed , probably during the Second World War . The drawing in Erhenberg 's 1820 publication serves as the lectotype . The species was transferred to the genus Cryptothecia by Swedish lichenologist Göran Thor in 1991 , on the basis of its similarity with C. striata such as the thallus with radiate ridges , granular isidia , and presence of para @-@ depsides (gyrophoric acid in C. striata and confluentic acid in C. rubrocincta) .

The red and green of C. rubrocincta give it a Christmas wreath look , hence its common North American name , the Christmas wreath lichen . The specific epithet is derived from the Latin words ruber " red " and cinctus " girdled / encircled " or " banded " . The other epithet sanguineum is the neuter form of the Latin adjective sanguineus " bloody " .

= = Description = =

Cryptothecia rubrocincta is a crustose lichen , because it grows in the form of a surface crust . The thallus , or body of the lichen is spread out flat and can be either tightly to loosely attached to the growing surface . It is 0 @.@ 15 ? 0 @.@ 30 mm thick , and can be smooth , or have low radiating ridges . The older , central region of the lichen surface has many reproductive structures called isidia ; they resemble granules that are 0 @.@ 1 ? 0 @.@ 4 by 0 @.@ 1 mm . The species relies entirely on vegetative means to reproduce , and is not known to have any sexual structures . From the

center outwards , three color zones can be differentiated in mature specimens ; the first grayish @-@ green , the second white , and finally a bright red cottony rim .

The lichen has a distinct prothallus ? fibers of whitish fungal hyphae at the edge that lack photobiont , and which project beyond the thallus onto the growing surface . The prothallus is red to whitish in the inner part , red the in outer part . The surface of the thallus does not have a well @-@ defined cortex , an outer layer of well @-@ packed hyphae . The medulla (a loosely arranged layer of hyphae below the cortex and photobiont zone) is whitish but the lower part is red . It has few to many calcium oxalate crystals that are 3 ? 8 ?m diameter . The hyphae of the medulla have many such crystals on the walls , that are 1 ? 2 ?m in diameter . The algal photobiont (technically a phycobiont , as it is a green algal photosynthetic partner) is from the genus Trentepohlia . Normally , the algae is long and filamentous ; when in the lichen state , it is divided into shorter filaments . The alga has a large chloroplast that contains droplets of beta @-@ carotene . The lichen is heteromerous , meaning that the mycobiont and photobiont components are in well @-@ defined layers , with the photobiont in a more or less distinct zone between the upper cortex and the medulla . Cells are single or a few cells aggregated , with dimensions of about 8 ? 15 by 5 ? 11 ?m .

The yeast Fellomyces mexicanus , an anamorphic member of the Cuniculitremaceae family , was discovered growing epiphytically on the lichen in 2005 .

= = Distribution and habitat = =

The lichen is widely distributed in the southeastern United States ; in 1954 the north border of its distribution was given as a line passing through southern Louisiana , Mississippi , Alabama and Georgia . Although the northern limit was extended to southern Delaware , the author later revised his opinion , and the northern limit is thought to be North Carolina . In North Carolina , it is found on Smith Island , a notable location because it represents the northern limit of the distribution of cabbage palmetto (Sabal palmetto) . The presence of this 6 meter (20 ft) tree interspersed among the dominant tree species Quercus virginiana give the island a subtropical appearance ? consistent with the lichen 's preferred climate .

Cryptothecia rubrocincta is also widespread in tropical and subtropical areas of the West Indies and Central and South America . In South America in is found north of Chile and Argentina . It is rarer in Africa , having only been collected from three geographically widely separated mountain regions : São Tomé and Príncipe , Tanzania , and DR Congo . The lichen may be found at altitudes ranging from sea level to 2 @,@ 600 metres (8 @,@ 500 ft) (in Colombia) .

The lichen typically grows on rough bark in sheltered and shaded habitats in moist and dense subtropical forests . More rarely , it is found on rocks or on leaves . In the USA it occurs in hammocks (hardwood forests) and swamps which have standing water , at least part of the year . It is also common in oak or oak @-@ pine scrub vegetation . The species is often associated with Cryptothecia striata in the USA .

= = Chemistry = =

Cryptothecia rubrocincta is easily recognized by the bright red pigment in the thallus . The pigment , first isolated from the species by Hesse in 1904 , is called chiodectonic acid . The lichen also contains the colorless depside compound confluentinic acid . A 2005 study employed the technique Raman spectroscopy to determine the chemical composition of the differently colored zones . The white crystalline zone contains calcium oxalate dihydrate , or weddellite , a chemical substance found in other lichens and extremophiles growing on calcium @-@ rich surfaces . Some have suggested that the calcium oxalate serves in the organism 's survival strategy : the storage of water as a crystalline hydrate is essential for periods of drought in desiccated environments , and calcium oxalate has been identified as dissuading herbivores . Because the lichen grows on calcium @-@ poor surfaces , calcium ions are thought to be acquired from rain , bird droppings , and airborne particles .

The chemicals in the red @-@ colored zone include an aromatic quinone , beta @-@ carotene ,

and chlorophyll . The quinone is deep @-@ red colored pigment chiodectonic acid , thought to function as a radiation protectant ; in combination with beta @-@ carotene , which has an established role in cellular DNA repair following exposure of the organism to UV @-@ damage , such radiation protectants are often found in lichens and in extremophilic situations and are essential for survival .

The lighter @-@ colored pink zone , located on the inside of the red zone , contains a mixture of chiodectonic acid , beta @-@ carotene and calcium oxalate dihydrate , the red and white mixture of the chiodectonic acid and the calcium oxalate giving rise to the characteristically lighter color .

The elliptical brown @-@ colored flecks , which can be observed in both the red and pink zones of the thallus , are made of confluentic acid and calcium oxalate monohydrate . The monohydrate is thought to be a more chemically stable metabolic byproduct of calcium oxalate dihydrate ; the function of confluentic acid in the brown flecks is unclear .