

Dollar Spot: Sclerotinia Homoeocarpa no longer: room for Clarireedia

Through Romain GIRAUD - October 8, 2018



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Preamble

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and article is based on the publication published in the journal “ *Fungal Biology* ” in August 2018 resulting from the work of USDA , Rutgers University , North Carolina and Ohio . It is available for free in English by clicking on the following link:

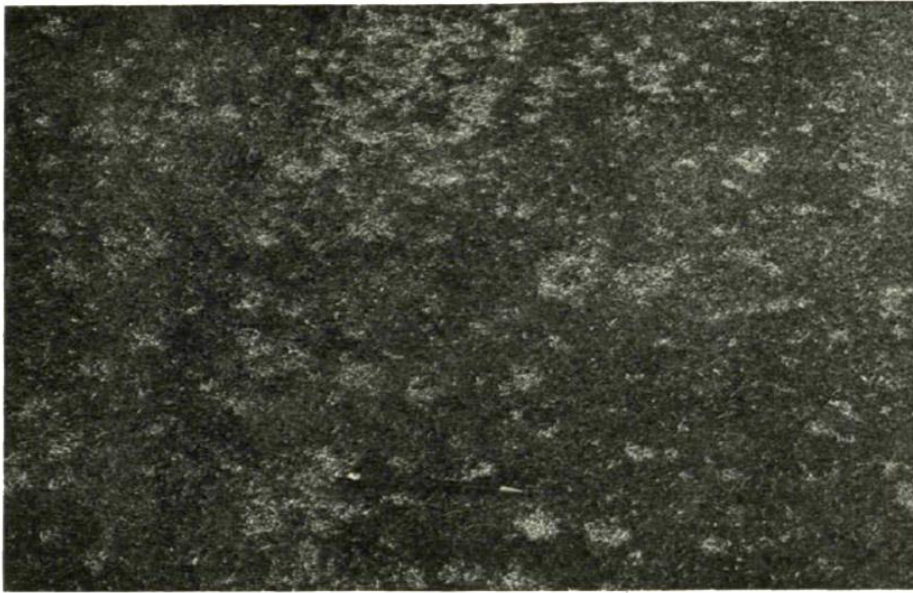
Salgado-Salazar et al., 2018, Clarireedia: A new fungal genus comprising four pathogenic species responsible for dollar spot disease of turfgrass, *Fungal Biology*, 122 (8) , 761-773

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The magazine “Golf Course Management” has also devoted an article to it in English which can be consulted on the [following link](#) .

History of the *dollar spot* classification

The first dollar spot report dates from 1927 ¹ . At the time, *John Monteith* described it then as the “ *small brown patch* ” because of the leaf lesions (see figure 2) observed similar to the “transverse burns” of the *brown patch* but a formation of circular spots not exceeding the size of a dollar coin on flush-cut lawns (see Figure 3). The term “ *small brown patch* ” was replaced in 1932 by “ *dollar spot* ” to avoid confusion with the “ *large brown patch* ” caused by *Rhizoctonia solani* ² (see figure 1).



Dollar-spot or small brown-patch; showing the typical speckled appearance of turf affected with this disease. The pencil will serve to indicate the relative size of spots

Figure 1: Extract from the first article on dollar spot: photograph of the pathogen by J. Monteith. (Source: Monteith, 1932) - License: "Can You Identify Brown-Patch?" By the archives of the University of Michigan .

In 1935, FT Bennett also characterized the pathogenic fungus causing *dollar spot* as a new species: *Rhizoctonia monteithiana* because of the name of its first observer³. However, this new name was never officially validated because of its non-conformity with the new nomenclatures of the time. In 1937, Bennett proposed a valid name for the fungus following further observations, withdrawing his first nomenclature proposal. It was then that the fungus of the Ascomycete family took the name used until today: "*Sclerotinia homoeocarpa*"⁴. Indeed, Bennett notices that the structures from which the sporophores emerge resemble aggregates of microsclerotia and classifies the fungus in the genus *Sclerotinia* (*Sclerotiniaceae*).



Figure 2: Leaf lesions characteristic of the dollar spot in burns perpendicular to the blade. Photography: R. Giraud.

In 1945, H. Whetzel reviewed the taxonomy of the *Sclerotiniaceae* family and restricted the genus *Sclerotinia* to fungi producing apothecia from tubular sclerotia, which was not the case for *Sclerotinia homoeocarpa*⁵. The latter indeed produces a flat stroma and not true sclerotia. Whetzel concluded because of this morphological characteristic that *S. homoeocarpa* would look more like species like *Rutstroemia* or *Lambertella*, organisms classified in 1997 in a new family: the *Rutstroemiaceae*⁵. Whetzel proposed in 1946 to reclassify *S. homoeocarpa* but never did so formally⁶. Thus, the pathogenic fungus that gave rise to *dollar spot* retained a generic name that was taxonomically incorrect, but official from a nomenclature point of view.



Figure 3: Symptoms of the dollar spot on the golf green. Photography: R. Giraud.

S. homoeocarpa very rarely produces sexual spores, it reproduces only by sterile hyphae or stromas⁷. Since Bennett's first observations, only one study from 1970 reports the observation of strains producing apothecia but these are sterile⁸. In 1973, Jackson isolated and observed a strain from the United Kingdom capable of producing ascospores (sexual spores), with characteristics close to the strain described by Bennett in 1937⁹. Jackson compares the strain to the species *Rustroemia* but does not dare to reclassify *S. homoeocarpa* due to the lack of unanimity shown by the genus *Rustroemia* in the eyes of taxonomists¹⁰.

From 1973 until the advent of DNA-based technologies in the 1990s and although many scientists agree that *S. homoeocarpa* is not a true *Sclerotinia*, long debates have taken place between taxonomists concerning the exact nomenclature of the fungus⁷. Many alternative species are also proposed (*Lanzia*, *Lambertella*, *Moellerodiscus*, *Poculum* or *Rustroemia*) without an official decision on the classification^{5,11-13}.

The 90s marked the beginning of a new technological area with rDNA allowing phylogenetic analyzes to be carried out. Various studies are then carried out on *dollar spot* but the results are contradictory due to high genetic variability and the low number of strains used. Several evidences show all the same the probable membership of the fungus in the genus *Rustroemia*¹⁴⁻¹⁵. The reclassification of the fungus is still referred for the fifth time¹³.

A new study that ends the debate

Recently, researchers from USDA, Rutgers University, North Carolina and Ohio have looked to resolve the issue. With more than 4,000 pathogenic fungal strains causing the symptoms of *dollar spot* on different host plants throughout the world, the research group has genetically and morphologically studied

the characteristics of these fungi ⁷. The genetic information has undergone phylogenetic analysis, a tool used to determine genetic links between organisms and build phylogenetic trees. This latest analysis shows that there is not one but 4 different species of fungus that cause *dollar spot* and that these fungi do not belong to any known genus described so far ⁷.

A new genre: *Clarireedia*

A new genus, called "*Clarireedia*" was therefore created to classify these pathogenic fungi ⁷. The new name is a tribute to C. Reed Funk, a scientist renowned for his work in the genetic improvement of turf varieties with regard to dollar spot resistance ("*Clarus*" means "*known*" in Latin and "*reedia*" refers to "*Reed*"). 4 species of dollar spot are now described within the genus *Clarireedia* (see figure 4):

- > *C. jacksonii*
- > *C. monteithiana*
- > *C. homoeocarpa*
- > *C. bennettii*

Due to the virtual absence of reproductive structures (asci, ascospores although some species develop sterile apothecia) or distinct morphological characteristics, differentiation can only be done through molecular phylogenetic analyzes ⁷.

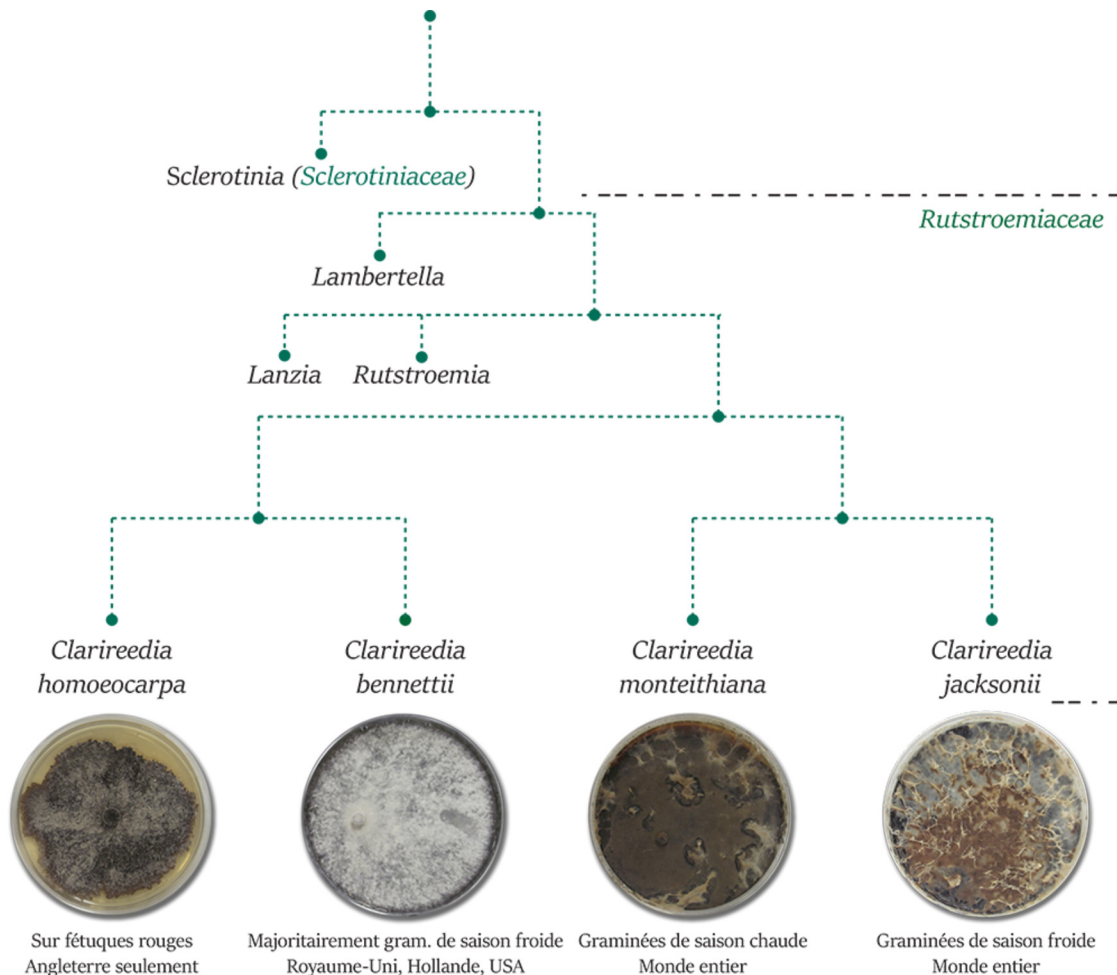


Figure 4: Genetic tree and classification of new species causing dollar spot. Diagram: R. Giraud

Description of new species

Clarireedia jacksonii: the majority species on cold season grasses

Clarireedia jacksonii was named after Noel Jackson, a pathologist who worked on *dollar spot* in the 1970s. Its distribution is worldwide and only affects cold-season grasses (bentgrass, red fescues, bluegrass and English raygrass) ⁷. This species is capable of producing apothecia, however sterile under in-vitro conditions on agar medium.

In our latitudes, it is therefore the species that causes *dollar spot* and its name replaces that of *Sclerotinia homoeocarpa*.

Clarireedia monteithiana: the majority species on warm season grasses

Clarireedia monteithiana, was named in reference to John Monteith, the scientist who discovered dollar spot in 1927. The species is distributed worldwide and has only been found on warm season grasses such as dogs or paspalums ⁷.

These first two species are responsible for the majority of dollar spot epidemics encountered throughout the world (71% of the strains studied).

Clarireedia homoeocarpa

Clarireedia homoeocarpa, much less common. This species only affects red fescues and has only been isolated in the UK. Probably *Rhizoctonia monteithiana* described by Bennett in 1935 ³. This is the second species where apothecia have been observed (see figure 5).

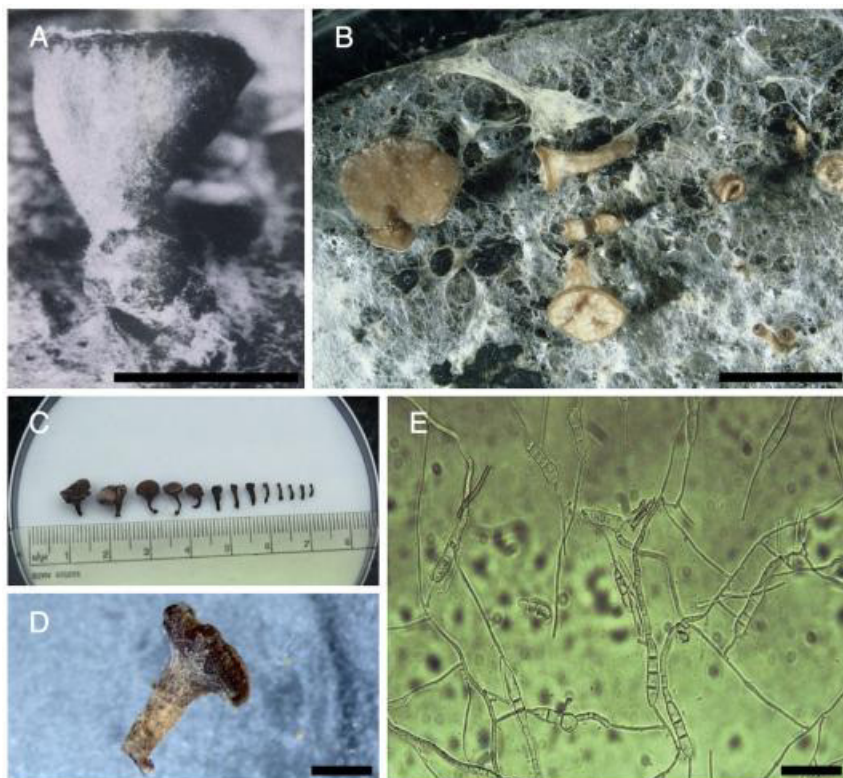


Figure 5: *Clarireedia Homoeocarpa*: the only species where apothecia were observed. However, they remain sterile. (Source: Salgado-Salazar et al., 2018). **License:** " *Clarireedia homoeocarpa* neotype material. "By the publisher Science Direct under license CC BY-NC-ND 4.0

Clarireedia bennettii

Clarireedia bennettii was named after FT Bennett who was the first to describe the pathogen causing dollar spot⁴. The latter species is described by Bennett in 1937⁴ and was isolated from an unknown species of turf. It is found on the debris of dead plants in the United Kingdom, the Netherlands, and the USA⁷.

What you must remember

- > The dollar spot was discovered in 1927 and the fungus *causing* the symptoms observed was incorrectly referred to as *Sclerotinia homoeocarpa* from 1937 until 2018.
- > Over time, many researchers have hypothesized that the pathogen does not belong to the genus *Sclerotinia*. It is only today with the help of new molecular techniques based on phylogenetic analysis that scientists have been able to link the pathogenic fungus to a new genus: *Clarireedia*.
- > 4 different species of *Clarireedia* were identified in a study published in August 2018. 4 fungi and not just one are at the origin of the *dollar spot*.
- > In our latitudes, *Clarireedia jacksonii* is responsible for the disease. The name "*Sclerotinia homoeocarpa*" is therefore no longer in use and replaced by *Clarireedia jacksonii*, pronounced "*klariridia jakssoni*" ([click here to access the google translate page which pronounces the new name of the pathogen rather well, just click on the speaker on the left](#)).

conclusion and perspectives

This new classification of the fungi at the origin of *dollar spot* marks a significant advance after more than 80 years of work and debate. In addition, the discovery of 4 different species (and probably others locally) underlines the strong biological diversity present in this genus.

This major discovery will now make it possible to study the influence of this diversity on control methods (cultivation methods, fungicides, biocontrol) and perhaps to find better adapted and more effective solutions depending on each species.

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