

**Initiating a National Survey of Dollar  
Spot Disease (*Clariireedia spp.*) on  
Swiss Golf Courses to Support Future  
Biocontrol Development**

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# ABSTRACT

Dollar spot disease (DSD), caused by *Clariireedia spp.*, is a significant challenge for turfgrass health on golf courses, where intensive maintenance practices often exacerbate disease susceptibility. This three-year research project is part of a national initiative by the Swiss Golf Association aimed at eliminating pesticide use on golf courses by 2030. The study focuses on characterizing the population diversity of *Clariireedia spp.*, through field sampling, fungal isolation, and future genetic analyses. To date, fieldwork has begun at a single reference site—Golparc Signal de Bougy—where symptomatic samples were collected and processed both externally (by Epilogic GmbH) and internally for the establishment of a reference fungal strain. As the project relies on golf courses allowing access and withholding recent fungicide treatments, logistical limitations have delayed the broader collection of samples. No experimental results are available yet; however, the groundwork for sampling strategy & isolation protocols has been established.

# INTRODUCTION

## PERSISTENCE OF DOLLAR SPOT DISEASE IN TURFGRASS

Dollar Spot Disease (DSD), predominantly caused by fungi of the genus *Clariireedia*, represents a pervasive and economically damaging pathogen within managed turfgrass ecosystems, particularly golf courses (Bahri et al., 2023), where maintenance practices subject turfgrass to significant physiological stress (Marois et al., 2022; Dicklow & Popko, 2011; Salgado-Salazar et al., 2018). The genus *Clariireedia* comprises multiple species, including *C. jacksonii*, *C. monteithiana*, *C. Homeocorpa*, *C. Paspali*, *C. Hainanensis*, and *C. bennettii*, all of which are known to induce DSD symptoms (Salgado-Salazar et al., 2018). Turfgrass health and quality are critical for golf courses, which not only provide recreational and aesthetic value but also contribute to ecological functions such as groundwater recharge, erosion control, carbon sequestration, and atmospheric cooling (Sapkota et al., 2021). However, the management of DSD on golf courses is particularly challenging due to the physiological stress imposed by intensive maintenance practices, including frequent mowing, irrigation, fertilization. Research has demonstrated that all known turfgrass species are susceptible to DSD when environmental conditions such as temperature and humidity are conducive to pathogen development (Marois et al., 2022; Dicklow & Popko, 2011; Salgado-Salazar et al., 2018). Golf courses, due to their stringent management practices aimed at achieving aesthetic

and functional standards, are particularly vulnerable to severe outbreaks. These practices, while essential for maintaining optimal turfgrass quality, can also predispose turfgrass to infection by weakening natural defense mechanisms and creating favorable microenvironments for pathogen proliferation. The disease affects a wide range of turfgrass species and has been reported in various regions, including North America, Europe, and Asia (Spratling, 2024). Annual expenditures on fungicides and cultural management practices aimed at controlling DSD are estimated to exceed several million dollars globally (Allen et al., 2005). Moreover, repeated fungicide applications aimed at pathogen resistance, environmental contamination, and escalating maintenance costs (Popko & Jackson, 2014). The objective of this project is to characterize Dollar Spot disease through genotyping and phenotyping techniques, thereby developing targeted biocontrol strategies tailored to the pathogen's diversity. The complexity of DSD management is further compounded by genetic variability among *Clariireedia* species, which may contribute to differences in pathogenicity, fungicide sensitivity, and adaptability to environmental conditions (Salgado-Salazar et al., 2018). A comprehensive understanding of the genetic diversity and population structure of *Clariireedia spp.* is essential for developing targeted and sustainable management strategies.

## TAXONOMIC CLASSIFICATION AND REPRODUCTIVE STRATEGIES OF THE PATHOGEN

Fungi are eukaryotic, heterotrophic organisms classified within their kingdom, Fungi. They are characterized by their cell walls composed of chitin and their ability to reproduce both sexually and asexually (Deacon, 2006). They often reproduce via spores, which are highly resistant and well-adapted for dispersal, whether through sexual or asexual means. They have a unique mode of nutrient acquisition through absorption. The kingdom of Fungi encompasses a diverse range of organisms, including yeasts, molds, mushrooms, and pathogenic fungi. The genus *Clariireedia* (pathogenic fungi) belongs to the order Helotiales within the class Leotiomyces, which is part of the phylum Ascomycota. Fungi are classified into several major phyla based on their reproductive structures and molecular phylogenetics: Ascomycota, Basidiomycota, Zygomycota, Chytridiomycota, and Glomeromycota. *Clariireedia spp.* It belongs to the Ascomycota phylum, commonly referred to as "sac fungi" or Ascomycetes. In this group, sexual spores, known as ascospores, are produced within sac-like structures called asci. Species within the genus *Clariireedia* responsible for Dollar Spot Disease, such as *C. jacksonii*, *C. monteithiana*, *C. Homeoecorpa*, *C. paspali*, *C. Paspali*, *C. Hainanensis* and *C. bennettii*, are primarily characterized by asexual reproduction. Asexual reproduction in *Clariireedia* involves the production of mycelia, conidia, and substratal stromata (compact masses of mycelium).

This vegetative propagation remains the predominant mode of reproduction observed under natural and experimental conditions, driving the pathogen's dissemination and infection across various turfgrass species. This vegetative growth and reproduction occur without the formation of sexual structures and remains the dominant reproductive strategy observed under natural and experimental conditions. However, recent research has revealed evidence suggesting a potential for sexual reproduction in *Clariireedia*. Studies have identified the presence of mating type locus (MAT1-1 and MAT1-2) in various isolates of *Clariireedia jacksonii* (Wada, et al., 2012 & Putman et al., 2015). The discovery of these genes implies a latent capacity for sexual reproduction, although it is not commonly observed. The identification of these mating type genes has important implications for understanding the genetic diversity and evolutionary potential of the species (Salazar et al., 2018).

## TAXONOMY AND PHOTOSYNTHETIC PATHWAYS OF TURFGRASS SPECIES

All grasses belong to the *Poaceae* family, which is further divided into various subfamilies based on their physiological characteristics, photosynthetic mechanisms, and environmental preferences. The primary subfamilies relevant to turfgrass management are *Pooideae*, *Panicoideae*, and *Chloridoideae*. The *Pooideae* subfamily predominantly comprises C3 grasses, commonly referred to as cool-season grasses, while *Panicoideae* and *Chloridoideae* include C4 species adapted to warmer climates (Huo, 2024). C3 and C4 grasses exhibit fundamental differences in their photosynthetic processes, which influence their distribution and suitability for different environments (Spratling, 2024). C3 grasses, such as those in the *Pooideae* subfamily, utilize the Calvin cycle during photosynthesis, forming a three-carbon molecule called PGA as the initial product. This process is most efficient under temperate, cool, and moist conditions. However, C3 grasses are susceptible to photorespiration, a wasteful process that increases under hot, dry conditions, reducing their photosynthetic efficiency and overall vigor. In contrast, C4 grasses, which are commonly found in the *Panicoideae* and *Chloridoideae* subfamilies, have evolved a specialized photosynthetic pathway that produces a four-carbon molecule during the initial step of photosynthesis. This adaptation allows C4 species to minimize photorespiration and enhance water-use efficiency, making them highly effective under warm, sunny, and dry environments. As a result, C4 grasses generally exhibit superior heat tolerance and resilience in conditions where C3 grasses struggle (Sage & Monson, 1999). The *Pooideae* subfamily is particularly prominent among cool-season grasses and includes species commonly cultivated on golf courses due to

their aesthetic qualities, functional resilience, and adaptability to temperate climates. Notable members of this subfamily include *Agrostis stolonifera* (Bentgrass), *Poa pratensis* (Kentucky Bluegrass), *Lolium perenne* (Perennial Ryegrass), and *Festuca arundinacea* (Tall Fescue). *Agrostis stolonifera* is widely used on golf greens due to its fine texture, tolerance to low mowing, and capacity to form dense, uniform surfaces. This species is particularly suited to high-maintenance environments where aesthetics and playability are prioritized. *Poa pratensis*, commonly known as Kentucky Bluegrass, is valued for its attractive coloration, moderate drought resistance, and suitability for fairways and residential lawns. Its rhizomatous growth habit enables it to recover effectively from damage, making it a preferred choice for high-traffic areas (Beard, 2002). *Lolium perenne* (Perennial Ryegrass) is frequently used for sports fields and overseeding purposes due to its rapid establishment, fine texture, and excellent wear tolerance. However, it is less drought-resistant compared to other cool-season species and requires frequent irrigation during dry conditions. *Festuca arundinacea* (Tall Fescue), although coarser in texture compared to other cool-season grasses, is recognized for its drought tolerance and ability to withstand a wide range of environmental conditions.

## DOLLAR SPOT DYNAMICS: BIOLOGY, DISPERSAL & ADAPTABILITY OF *CLARIREEDIA SPP*

Pathogenic fungi possess a high evolutionary potential, particularly when they reproduce rapidly (Beard, 2002). This adaptability is driven by spontaneous mutations, genetic recombination (in the case of sexual reproduction), and natural selection, especially under the selective pressure exerted by fungicide applications. As a result, certain fungal strains can develop resistance to chemical treatments, making the associated diseases increasingly challenging to manage over the long term. Species responsible for Dollar Spot are necrotrophic pathogens that infect the leaves of turfgrass, primarily spreading through asexual propagation. Symptoms include circular, discolored patches measuring 2 to 5 cm, with white, cottony mycelium under humid conditions (Agrios, 2005). Dispersal occurs via wind, water, mowing equipment, or other mechanical means. DSD manifests as straw-colored lesions spreading across leaf blades, eventually forming circular patches resembling silver dollars (See Figure 1). The fungus survives unfavorable conditions within infected plants, plant debris, or stromata (on leaf surfaces). The disease thrives at temperatures between 15.5°C and 32°C, especially during warm days, cool nights, and when heavy dew is present. It can be active from mid-May to mid-October. Spread occurs through mowers, golf carts, golf shoes, wind, and water, with severity increasing in dry soils with low nitrogen fertility, high humidity, and moderate temperatures (Marois et al., 2022).

These pathogens are particularly harmful to grass species, especially in temperate regions where temperature and humidity conditions favor fungal growth. Studies indicate that *Clariireedia spp.* Exhibits significant genetic variability influenced by spontaneous mutations, genetic recombination, and adaptive selection (Salgado-Salazar et al., 2018). Biotypes within the fungal species exhibit genetic or physiological differences that affect their behavior, aggressiveness, turfgrass host preference, fungicide sensitivity, and environmental requirements (Dicklow & Popko, 2011). These variations explain why DSD may persist despite effective control measures against other strains. The pathogens ability to adapt and mutate, especially in response to fungicide application, makes management even more challenging (Putman et al., 2015).

## MATERIALS & METHODS

### STRATEGIC SITE SELECTION FOR POPULATION GENETIC ANALYSIS OF *CLARIREEDIA SPP.* IN SWISS GOLF COURSES

Understanding the genetic variability within *Clariireedia spp.* populations is critical to developing Integrated Management strategies (ITS) aimed to reduce the incidence of Dollar Spot Disease and limiting fungicide dependency. To capture the full spectrum of environmental, climatic, and agronomic variables influencing pathogen diversity, a strategic and heterogeneity-driven site selection approach was adopted across Switzerland. The objective was to ensure comprehensive sampling of *Clariireedia spp.* populations across ecologically distinct golf course environments. Based on these criteria SwissGolf proposed following courses:

GOLF NAME	ADDRESS	SITE N°
Golf & Country Club Zürich (Zumikon, ZH)	Weid 9, 8126 Zumikon	1
Wylihof Golf Club (Soleure, SO)	Wylihof 12, 4542 Luterbach	2
Golfparc Signal de Bougy (Vaud, VD)	Rte du Signal, 1172 Bougy-Villars	3
Golfclub Interlaken-Unterseen (Bern, BE)	Seestrasse 117, 3800 Unterseen	4
Golf Club Alvaneu Bad (Grisons, GR)	Albulastrasse 174, 7473 Alvaneu	5

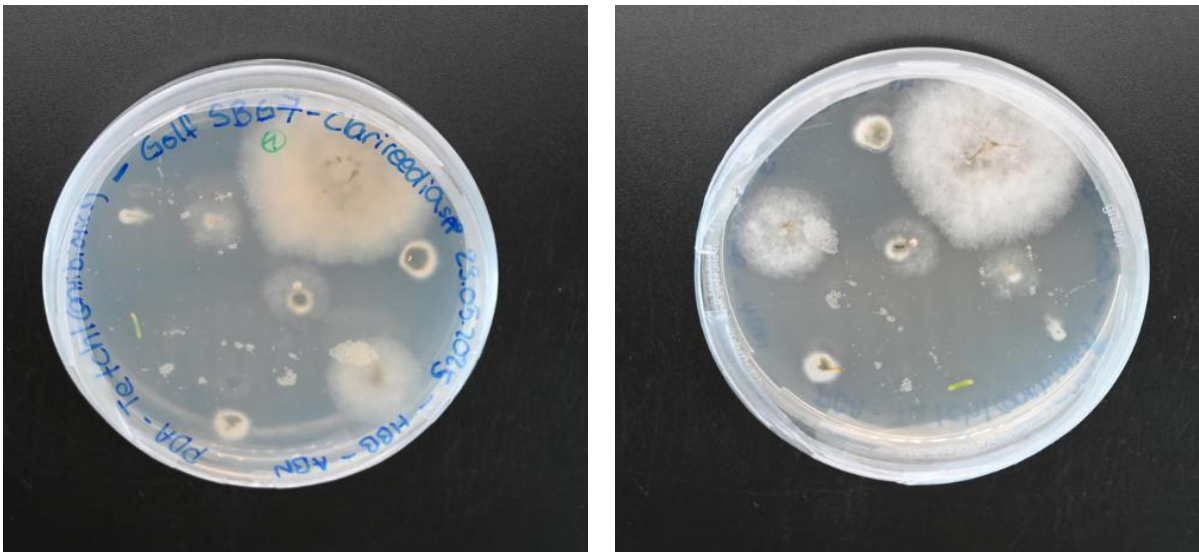
Field observations and fungal isolation work were conducted exclusively at site No. 3, Golfparc Signal de Bougy (Vaud, VD). The sampling activities began recently, on May 22, 2025. Visits to the other sites included in the study are planned for June.

## SAMPLE PROCESSING AND FUNGAL ISOLATION



Figure 2. Sample collection for fungal isolation. Left: A turf plug being extracted from a symptomatic area using a soil core sampler. Right: The collected sample stored in a labeled 50 mL falcon tube.

Sampling involved extracting ~10 cm<sup>3</sup> of organic material from the upper root zone using sterile scoops (See Figure 2). Samples were immediately transferred into labeled containers and shipped for isolation to Epilagic GmbH (Epilagic GmbH, Leipzig, Germany), a company specializing in molecular diagnostics and genetic analysis and a subset of samples was retained for in-house fungal isolation to establish a reference *Clariireedia spp.* strain for future laboratory work. To establish a reference strain, a subset of leaf samples was selected for fungal isolation under sterile conditions. Only leaves were used, roots and soil were carefully avoided to reduce contamination. Preference was given to leaves showing visible mycelial growth after one day of incubation at 4°C. Surface sterilization was performed by immersing the selected leaves in 70% ethanol for one minute to eliminate epiphytic fungi and bacteria. The sterilized leaves were then rinsed in ultrapure Elga water to remove residual ethanol. Finally, individual leaves were placed on potato dextrose agar (PDA) plates supplemented with tetracycline and chloramphenicol (PDA Tet/Chl) to suppress bacterial growth and promote selective fungal development (See figure 3).



**Figure 3.** Fungal growth observed after 96h our incubation from sample SB\_G7.1 plated on PDA supplemented with tetracycline and chloramphenicol (PDA Tet/Chl). Multiple fungal colonies, including presumptive *Clariireedia spp.*, developed from turf tissue collected at Golfparc Signal de Bougy.

# DISCUSSION & CONCLUSION

This project represents the beginning of a long-term effort to better understand and manage dollar spot disease in golf course turfgrass within the context of sustainable and pesticide-free practices. As part of Switzerland's broader ambition, led by the Swiss Golf Association, to eliminate pesticide use on golf courses by 2030, our study is designed to contribute meaningful insights toward this transition. The project is planned to span three years, acknowledging that meaningful data collection and analysis in real-world field conditions require both time and adaptability.

At this early stage, no definitive results are yet available. The successful execution of the field component is heavily dependent on external factors, particularly the collaboration of golf courses. Participating sites must agree to host sampling activities and, crucially, must not have recently applied fungicides targeting dollar spot. This introduces significant logistical challenges in terms of scheduling visits, coordinating with greenkeeping teams, and identifying untreated disease outbreaks at the appropriate stage for sampling.

As such, this conclusion is not one of final findings, but rather a reflection on the project's context and my own progression during this phase. During my stay at FiBL, I have learned—and continue to learn—extensively, not only about plant pathology and molecular diagnostics, but also about the operational realities of field-based research in applied agricultural science. From protocol development and laboratory techniques to stakeholder coordination and project planning, this experience has greatly enriched my scientific skillset.

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