

GC2030 Literature and technical review: Biological controls

Biological controls for turf have been available for a while at this point but have not become more widespread due to the inconsistency of results.

In 2012 Skorulski reported that a number of biological-control compounds for the suppression of dollar spot were sold in the USA. However, then he reported that additional field work required to determine the efficacy of biological-control products and how they can best be used in the field.

Skorulski, J. 2012. Getting the Upper Hand on Dollar-Spot Disease. *USGA Green Section Record*, Vol. 52 (18), September 5.

Recent work has seen some developments regarding efficacy in turf. In *Rolling plus biological control of Microdochium patch* Kowalewski *et al.* found moderate levels of control from two specific strains of the Trichoderma species and a bacteria Bacillus subtilis. The biological control products BW136N (*Trichoderma harzianum* Rifai strain T-22 + *Trichoderma virens* (J.H. Mill. Giddens & A.A. Foster) Arx strain G-41) and Rhapsody (*Bacillus subtilis* strain QST 713) were found to have tested positively for control of Microdochium patch disease on annual meadow-grass greens turf. Applications of BW136N and Rhapsody reduced the severity of Microdochium patch as measured by AUDPC compared to the control (66 and 50% reduction, respectively). Because of the lack of complete control of Microdochium patch, as a standalone control method, the turf quality was considered unacceptable for putting greens by the researcher. In addition to other measures they offer potential for symptom reduction.

<https://www.golfdom.com/rolling-plus-biological-control-of-microdochium-patch/>

Biocontrol products (ie Bacterial and tea tree oil) have been shown by Koch not to work effectively by themselves against dollar spot, but he says that they could be used as a tank mix product to help increase effectiveness of existing fungicide programs. These products might become more viable he believes for those that have newer bentgrass varieties with higher resistance to dollar spot.

Koch explains the way biocontrol agents work. They control disease by colonising the surface of the plant or root and 'crowd out' the pathogen. For example, it is believed that the bacteria Pseudomonas works as a biocontrol agent against Take-all Patch in this manner by colonising the roots and crowding out the fungus. Another way that biocontrol agents can provide disease control is through the stimulation of plant defence responses (plant elicitors). Millions of dollars of research is being poured into improving the field efficacy of biological fungicides, he reports.

He states that the new field of phytobiomes may offer new biological control path through improved understanding of how all the various microbes on, around, and within the plant interact with each other and with potential pathogens. The phytobiome is a term that relates to a plant in a specific ecological area (biome). It includes the plant itself, the environment and all micro- and macro-organisms living in, on or around the plant.

Koch tested a number of biological products in 2017 for dollar spot reduction. Double Nickel is a strain of Bacillus amyloliquefaciens bacteria registered for use on turf and Serenade OPTI is a strain of Bacillus subtilis bacteria not currently registered for use on turf. While these products did not provide acceptable dollar spot control on their own throughout the season, he believes that it's possible that these products or products like them could be used within an Integrated Pest Management Programme.

Koch, P. 2017. Biological fungicides for Dollar spot control. *Grass Roots*, November/December, Vol 46, 14-17. <https://archive.lib.msu.edu/tic/groot/article/2017nov.pdf>

In 'Low-impact' Pesticides, Clarke *et al.* report that biological fungicides such as Ecoguard (*Bacillus licheniformis*), Companion (*Bacillus subtilis*) and Turf Shield (*Trichoderma harzianum*), can suppress diseases that can occur on sports and landscape turf such as dollar spot. They point out that university research has shown these products to be

effective in suppressing certain turfgrass diseases when used on a preventive basis, but they have not been shown to effectively control turf diseases on a curative basis or when conditions are conducive to severe disease development. Furthermore, they state that research has shown that these products are most effective when used in combination or alternation with reduced rates of synthetic fungicides.

<http://archive.lib.msu.edu/tic/updat/article/2011sum16.pdf>

Endophytes

Together with improved genetics, more effective and efficient cultural practices, endophytes have a potential role to play in increasing turfgrass quality with fewer chemical inputs. Endophyte-infected grasses tend to be comparatively vigorous, especially under conditions of minimal fertilisation and irrigation.

An endophyte of turfgrass is a fungus that lives within the plant. The fungus grows between plant cells and into the developing seed. The endophyte does not affect the appearance of the plant. Endophytes are transferred from plant to plant via seed and not by mycelium. Endophytic fungi are associated with both forage and turf types of tall fescue and perennial ryegrass as well as fine fescues. These fungi are from the genus *Epichloë*.

The relationship between a grass plant and its fungal endophyte is symbiotic. The grass host provides nutrients for the endophyte, and the endophyte produces bioactive compounds that help protect the plant from drought stress and pests (insects and diseases). These toxic compounds, alkaloids, can deter insects from feeding or cause "antibiosis" effects which alter the life cycle of the insect. Endophytic grasses have shown high resistance to foliar-feeding insects such as billbugs, chinch bugs, sod webworms, and fall armyworms, insects which are common to the USA.

In fine fescues, endophytes suppress some fungal pathogens such as dollar spot. The mechanism of disease resistance may be due to the presence of similar or related endophyte-produced alkaloids, new compounds, or phytoalexins produced by plants in response to endophyte infection. Endophytic grasses are only temporarily affected by fungicides.

Not all turf species are compatible with endophytes, however. Not all varieties that benefit from endophytes are infected with viable (alive within seed) endophyte. Belanger et Clarke commenced research in 2018 to understand the mechanism of dollar spot resistance in a fungal endophyte (*Epichloë festucae*) infected strong creeping red fescue with a view to adapting it for use in other turfgrasses such as creeping bentgrass.

<https://turf.umn.edu/news/endophytes-friendly-fungi-turfgrass>

<https://ag.umass.edu/turf/fact-sheets/endophyte-enhanced-grasses>

<https://apsjournals.apsnet.org/doi/pdf/10.1094/PD-90-0994>

https://usgatero.msu.edu/tero_browse.html

A few factors are hampering wider introduction of endophyte grasses. Turfgrass seed producers are concerned about endophytes because they want to sell harvested grass residue (straw and hay) as animal feed. Some of the bioactive compounds produced by endophytes, while beneficial to the plant, can be detrimental to livestock and birds. Ergot alkaloids (eg ergovaline) are associated with fescue toxicosis of livestock. Endophyte strains that benefit the plant without being harmful to livestock are known as novel, selected, or livestock friendly. It is also known that viability of the endophyte can be lost within two years or less when seeds are subjected to variable temperatures and humidity and that storage conditions can affect the loss. Low-humidity cold storage (below 4°C) is required to maintain viability of the endophyte and seed germination.

https://www.researchgate.net/publication/236736583_Biology_and_Applications_of_Fungal_Endophytes_in_Turfgrasses

<https://oregonstate.edu/endophyte-lab/files/ext-pub-nov-2016.pdf>