e-GRO Alert

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# Nostoc: The Slimy Weed of Greenhouse

Nostoc is a genus of cyanobacteria or blue green algae that can proliferate in almost any environment. It's ability to withstand any weather, including polar, tropical, aquatic, terrestrial environments and more means it can infiltrate and colonize almost any ecosystem.

Colonies of Nostoc are made of long filamentous chains, or strands of cells that continue to elongate without separating and can go on to form both microscopic groups under the soil as well as visible mats on a surface (Fig 1).

Figure 1. Visible slimy mat of Nostoc on greenhouse walkway hard surface.

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These mats of Nostoc colonies have the ability to desiccate completely in dry conditions, and then swell back into their telltale dark green, gelatinous blobs when returned to the presence of moisture (Fig 2). For this reason, it is incredibly difficult to control the spread and movement of Nostoc colonies inside the greenhouse setting. When dry it can easily be blown around in the wind and spread to undesirable locations and when wet can be introduced to an environment by poor sanitation of tools that are used offsite, walked in on someone's shoes or clothes, or spread by transferring infected plants or growth media between locations.

***Habitat:*** Nostoc can be found growing in many different habitats including lawns, garden beds, athletic fields, paved surfaces, container nurseries, and greenhouses. They can survive in dry conditions (Fig 3), but for long-term survival they require a wet environment. Hard surfaces like the concrete in a greenhouse or compacted ground of a nursery (Fig 4) are perfect environments because the frequent irrigation stands in pools on the poorly drained ground (Parke, 2020). Greenhouses in particular, provide perfect conditions for its fast growth and production of biomass due to high humidity, high temperatures, and high light levels in addition to frequent irrigation. Finally, phosphorous is the most limiting nutrient for nostoc, so environments high in phosphorous are likely to attract it (Franklin, 2021).

***Cellular Components:*** Nostoc-like cyanobacteria are photosynthetic single-celled organisms that can live in a multicellular state called a filament (Fig 5). The jelly-like nostoc mats seen in the greenhouse and nursery are made up of these filaments. Living in this state allows the individual cells to share nutrients and cover a large area in search of sunlight, water, and nutrients. A typical cell is considered to be vegetative, but there are several different types of cells that the cyanobacteria can differentiate into when under specific pressures (Santamaria, 2016):

•Heterocysts: specialized cells that perform nitrogen fixation (Fig 6).

•Hormogonia: motile filament fragments formed under extreme drought or heat pressure that can move the cyanobacteria to a new location.

•Akinetes: very resilient spores that also form under extreme conditions, remain dormant until more favorable environmental conditions, and are capable of producing a new filament.

Figure 2: Gelatinous mass of Nostoc after absorbing moisture.

Figure 3: Desiccated Nostoc surviving on dry hard surface.

Figure 4: Gelatinous mass of Nostoc growing on hard surface of nursery where irrigation is frequent. Photo credits: Debalina Saha, MSU Horticulture.

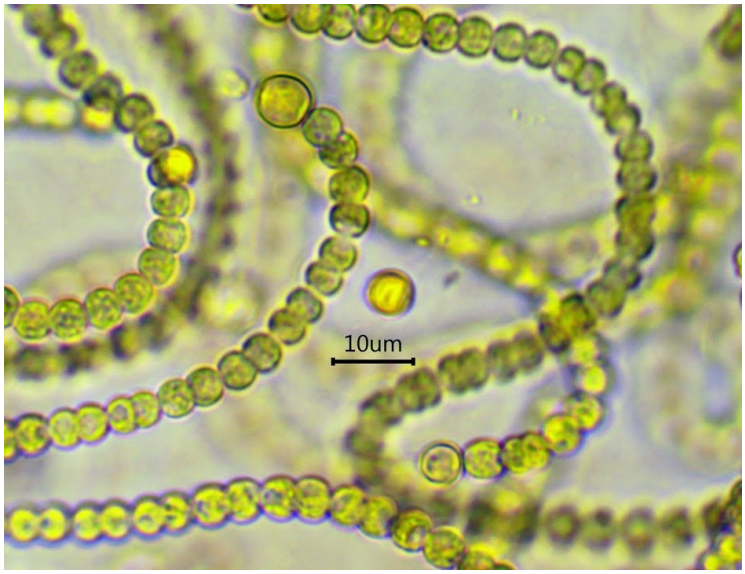


Figure 5: Nostoc filaments under microscope.

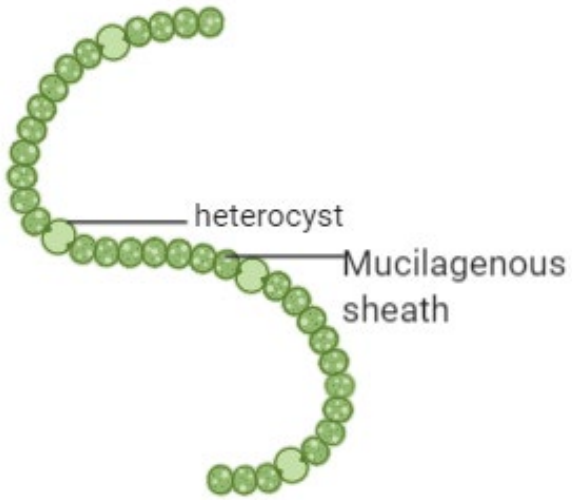


Figure 6: Cellular components of a Nostoc filament.

***Nostoc as a beneficial organism:*** Nostoc can be a helpful organism in some situations when looking at nutrient levels and soil moisture content. Some beneficial aspects of Nostoc as it relates to other organisms it may interact with at a research site include nutrient sharing and soil moisture maintenance. This kind of cyanobacteria is photosynthetic, making them attractive to other organisms for symbiotic relationships with an exchange of energy. The additional ability of the Nostoc genus to fix atmospheric nitrogen and sequester atmospheric carbon - therefore increasing the usable input into the surrounding soil or substrate - makes the Nostoc mat itself a good growth media for other organisms to use to grow on terrestrial surfaces that they otherwise would not be able to. Additionally, the presence of Nostoc over the top layers of soil or growing media around a plant can create a shield-like effect from the sun and reduce water evaporation from that soil. This increases the soil moisture potential, which significantly improves a plant's ability to remain hydrated during periods of drought.

***Harmful effects of Nostoc in greenhouse production:*** While Nostoc makes symbiotic relationships with other organisms, there is still an element of competition between organisms sharing the same resources. Although it is true that Nostoc contributes to nutrients in the soil, it is also responsible for using those resources to increase its own presence. The possible overgrowth of Nostoc that threatens greenhouses and production sites can also lead to competition for light and moisture as well, depending on the specific morphology of the plant in relation to the growth of Nostoc. Contamination of greenhouses can also create large areas of very slippery biomass that poses a safety hazard for growers and greenhouse workers who work at the site. Issues that can stem from contamination can also be aesthetic. For greenhouses or other sites that work with the sale of ornamental plants or agricultural plants for which aesthetics affect the use or sale of the product, a heavily Nostoc colonized crop of plants has a very real potential to cause a heavy financial loss.

**Management:**

***Nonchemical methods:*** Maintaining roper sanitation practices is the main goal of Nostoc control. Examples of precautions to take could be using separate tools for each site or sanitizing them before using them at a different location. Caution should also be taken by the plant handlers to keep personal equipment like boots and gloves clean and free from any possible residues or contaminants.

***Chemical methods:*** Pelargonic acid (Scythe) has been shown to be extremely effective at killing nostoc colonies and preventing their regrowth for three to seven weeks after application. However, this is a broad-spectrum herbicide that is highly toxic to nursery and greenhouse crops, so it should be used very carefully (Parke, 2019). Studies at the University of Florida have found that certain chemicals are more or less effective depending on the surface nostoc is growing on. Hydrogen peroxide + peroxyacetic acid (Zerotol 2.0) was more effective on gravel and pelargonic acid (Scythe) was more effective on plastic, while sodium carbonate peroxyhydrate (TerraCyte PRO) and generic bleach were effective on both. Finally, copper sulfate has been shown effective at controlling nostoc in some studies, but it stimulated nostoc growth in others. Regardless, it is not registered for ground application and may cause severe damage to surrounding ecosystems (Laughinghouse et al., 2019). Due to common nostoc being made up of several species of cyanobacteria all the above chemicals may prove more or less effective when used at any given nursery or greenhouse. It is always recommended not to apply these chemicals on top of the ornamental pants as severe injury can occur.

Also, it is highly suggested to read the label of the herbicide/chemical before application.

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