Is It Going to Be a White Bedding?

Ammonium or urea-based nitrogen fertilizer increases the odds of producing L-glutamine, which encourages the production of 'snow white' fungal isolates such as *Helminthosporium*

By Michael J. Healy, Ph.D

I had run into a brick wall, so to speak. My doctoral dissertation dealt with the pathogenicity of fungal isolates obtained from creeping bentgrass and annual bluegrass putting green turf. I had numerous isolates of *Helminthosporium* (since renamed Bipolaris), obtained from putting green turf at 26 golf courses.

At the time, no turfgrass scientist thought of *Helminthosporium* as anything other than a true and potentially serious turf pathogen. I had also made numerous isolations of *Curvularia* and *Fusarium* species from the same samples of putting green turf. The status of *Curvularia* as even a weak pathogen was almost universally in doubt; and for *Fusarium* (as a summer disease), only slightly less so.

The L-glutamine had been exuded in guttation fluid and prevailing low relative humidity allowed the L-glutamine to accumulate on leaf blades and tips as white deposits.

I didn't wish to get involved in any controversial research — just focus my research on *Helminthosporium*, obtain my Ph.D. and exit the University of Illinois. But I was having problems getting my isolates of *Helminthosporium* to infect greenhouse- and growth chamber-grown creeping bentgrass and annual bluegrass turf. Getting infection in the greenhouse or growth chamber should have been a breeze; attempting successful inoculation and infection in the field far more uncertain.

Summer snow

At the time I was doing the research, the predecessor of our modern Internet — the Arapanet — was still several years away from its startup. So a trek down to the main agricultural library was the primary route to increasing one's knowledge base. I recall that it was late one evening when I came across an article written by a researcher at the Connecticut Agricultural Research Station in the early 1940s. The researcher had been called out to observe a Kentucky bluegrass lawn that had turned snow white seemingly overnight.

This event had taken place not in the winter but in the summer. What the researcher determined was that a heavy application of an ammonium fertilizer had preceded the "snow white" event and that the plants had

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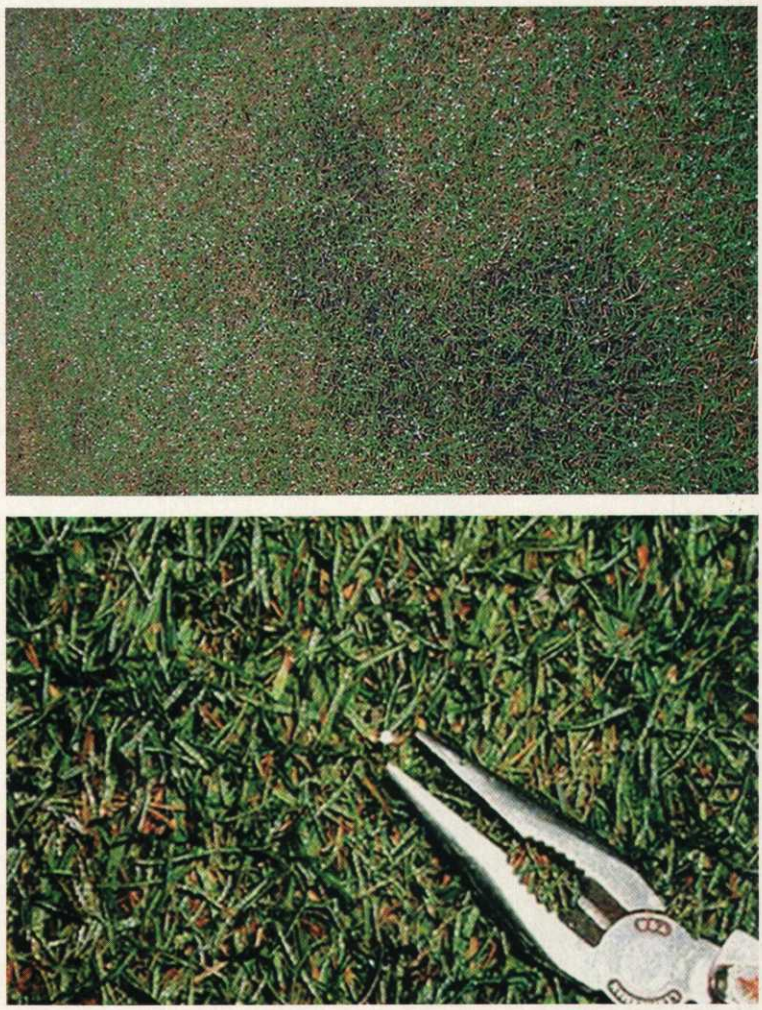

Top: White deposits form on Tifdwarf turf maintained as approaches in Naples, Fla., area, in fall 2002. Bottom: Deposit found on ryegrass overseed on a fairway of a course in Gulf Shores, Ala. Preceding both events was an application of ammonium or urea-based nitrogen fertilizer.

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taken up ammonium ions and converted one amino acid, glutamic acid, to a second amino acid, L-glutamine.

The L-glutamine had been exuded in guttation fluid and prevailing low relative humidity had allowed the L-glutamine to accumulate on leaf blades and tips as white deposits.

So the thought occurred to me: What would happen if I inoculated my target turfgrass plants with fungal spores immersed in various concentrations of L-glutamine?

Fungal free-for-all

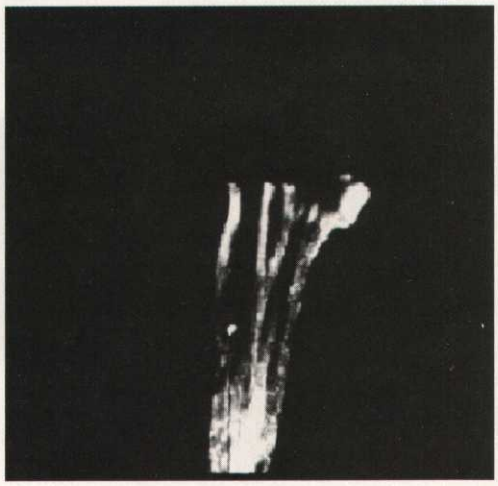
What I found almost immediately was that bathing my *Helminthosporium* spores in a dilute L-glutamine solution made them easily able to infect and cause visual symptoms in both creeping bentgrass and annual bluegrass leaf tissue. And the same end result was also true for inoculations of Curvularia and Fusarium.

Using thin layer chromatography, I was able to prove that both creeping bentgrass and annual bluegrass produce L-glutamine in response to an application of either an ammonium or urea-based nitrogen fertilizer. And the same end-result occurred on real putting green turf in the field.

Spores bathed in a dilute L-glutamine solution produced multibranched hyphae along with numerous infection structures called appressoria.

I could apply urea or ammonium nitrate at 1 pound actual nitrogen per 1,000 square feet as a solution at 4 p.m. and identify L-glutamine as being in the guttation fluid collected at 6 a.m. the next day.

So what did L-glutamine do to increase the pathogenicity of a known pathogen (*Helminthosporium*) along with debatably nonpathogenic isolates of *Curvularia* and *Fusaium*? The answer seemed to be in the fungus spore germination and infection process. Spores bathed in a dilute L-glutamine solution produced multi-branched hyphae along with numerous infection structures called appressoria.



Accumulation of L-glutamine on an annual bluegrass leaf tip

Let us now fast-forward to the early 21st century. *Helminthosporium* (Bipolaris) is still considered an important turfgrass pathogen while the status of *Curvularia* is still being debated. So what can be said for sure regarding production of L-glutamine by turfgrass species and the possibility of a "smoking gun" — i.e. L-glutamine — being responsible for fungal disease severity on golf course turf?

It seems clear from research (both old and new) that many monocots (grasses) produce L-glutamine as a response to the uptake of nitrogen in its ammonium form. The production of white deposits of nearly pure L-glutamine on leaf blades and tips is an unusual event and based on unusual atmospheric conditions. Such a condition allows this amino acid to accumulate and dry on leaf material before being washed or mowed off.

It is extremely likely that L-glutamine is produced often as a response to the application of an ammonium or urea fertilizer but goes unnoticed as it remains dissolved in either guttation fluid and/or dew.

Beginning attempts to increase fungal disease severity on putting green turf by application of a dilute solution of L-glutamine have not proven successful. Nor is there a clear understanding as to conditions that maximize (or minimize) the production of L-glutamine as a consequence of nitrogen fertilization.

In no case do we recommend the avoidance of ammonium or urea forms of nitrogen, as they are the basis of many successful turfgrass fertilization programs.