



Beyond Pest Control

Increased chlorophyll content, greater leaf density, better rooting: Turf scientists discuss what they are seeing in some chemical applications. **BY CLARK THROSSELL, PH.D.**

Enhanced plant health from a chemical application beyond the effects of pest control is an easy topic to discuss, but it is much harder to define what is actually happening. Most superintendents and scientists recognize instances when a compound applied to turfgrass enhances performance beyond its intended use, such as pest control. This is an example of the secondary effect of improved plant health.

Determining what changed in the turfgrass plants due to the application of a compound is a difficult question to answer. Some turfgrass characteristics that may be impacted leading to improved plant health are a more extensive root system; improved root viability; stimulation of the plant's natural defense mechanisms; suppression of a low level of disease that is not causing symptoms; stimulation of anti-oxidant production; improved carbon metabolism; and increased chlorophyll content. It is possible that a single compound would influence one or two of these characteristics but not all of them.

One of the first to identify the secondary plant health

enhancements from a pesticide leading to improved turfgrass performance was L.T. Lucas, Ph.D., a turfgrass pathologist at North Carolina State University. In the early 1990s, Dr. Lucas observed in field experiments that a combination of the fungicides Aliette (fosetyl-Al) plus Fore (Mancozeb) applied regularly to creeping bentgrass greens throughout the summer improved performance beyond disease control. He noted that for the applications to be effective they had to begin prior to the stress period (1, 5).

Scientists at Bayer investigated the components of Aliette and Fore and found that Aliette plus a pigment contained in Fore produced similar results as an application of Aliette plus Fore. Chipco Signature (aluminum tris) was the result of combining Aliette and the pigment similar to the one found in Fore. It has been used to control certain diseases and is also effective managing summer decline of bentgrass or summer stress complex by enhancing plant health (1, 5).

Building on the discoveries used to develop Chipco Signature; Bayer Environmental Science offers StressGard technology in conjunction with several fungicides. StressGard technology protects plants from UVB radiation. Turf treated with fungicides containing StressGard technology showed improved performance during stressful periods.

Author's note: *In this article, the secondary plant health effects due to pesticide applications are discussed. Other products applied to turfgrass besides pesticides, such as surfactants, can also improve plant health beyond their intended purpose.*





Charlie McElhannon, plant health technician for BASF, uses a specialty scanner called winRhizo to measure root characteristics.

Plant health and sustainability

John Cisar, Ph.D., turfgrass scientist at the University of Florida – Ft. Lauderdale, has been conducting research to document and understand plant health effects from a number of compounds. “Many compounds are used in turf management for pest control; in turfgrass systems we are just beginning to document and understand their secondary plant health benefits,” Cisar said. According to Cisar, any compound that enhances the physiological activity of turf can potentially impact plant health. Examples of changes to the physiology can include more efficient carbon metabolism which leads to more carbohydrates for root production and increased production of proline and antioxidants that help turf cope with stress.

Plant health benefits have been identified in other crops. One example cited by Cisar was the use of an insecticide to increase crop yield beyond the yield increase resulting from insect control.

According to Cisar, research on BASF’s Insignia (pyraclostrobin) has documented several plant health benefits, including the delayed senescence of leaves, which allows the leaves to continue to photosynthesize and contribute carbohydrates to the plant and increased net photosyn-

thesis by reducing respiration. Both of these physiological changes result in better rooting in stressed plants.

In Cisar’s research on bermudagrass greens, he found that when air temperatures dropped below 50 F, chilling stress discolors bermudagrass resulting in less desirable playing conditions. During the winter months in subtropical south Florida it is a common practice to treat bermudagrass greens with a fungicide to protect against leaf spot and other diseases. BASF’s Honor Intrinsic (pyraclostrobin and boscalid) improved turf quality when cold temperature spikes occurred compared to the untreated control. All treatments provided a similar level of disease control so the improvement in turfgrass quality was attributed to a change in the physiology of the plants.

In work with another strobilurin fungicide, Cisar found increased leaf counts and better rooting in strobilurin-treated turf than in untreated turf. “It is possible other strobilurin fungicides would have plant health benefits. We just haven’t investigated them with plant health in mind,” said Cisar.

Cisar added that plant health and sustainability go hand-in-hand. By using a compound that controls a pest along with providing plant health benefits, it may be possible to reduce inputs such as water, nutrients and pesticides. Said Cisar: “One application of a compound that improves plant health along with its primary func-

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tion provides multiple benefits, which lessens the need for other inputs, including pesticides.”

“Maintaining high quality turfgrass under stress is the practical impact of plant health promoting compounds,” said James Brosnan, turfgrass scientist at the University of Tennessee. Brosnan’s research into plant health has focused on the response of A-1 and Pennncross creeping bentgrass exposed to heat stress following applications of Insignia and Heritage (azoxystrobin). Results of the greenhouse studies showed Insignia increased visual root length of A-1 and Pennncross. Using digital analyses (i.e., winRhizo software) A-1 treated with Insignia also showed increased total root length, root surface area and increases in other root characteristics compared to untreated plants. There were no differences in turfgrass visual quality to either A-1 or Pennncross creeping bentgrass when treated with either Insignia or Heritage (2).

The results of the research have led Brosnan to caution that the effects he observed in his research were subtle and that field research is needed to confirm that effects he saw in the greenhouse have meaningful benefits to superintendents. Dr. Brandon Horvath’s research team at the University of Tennessee has recently begun researching the plant health benefits of strobilurin fungicide applications as part of disease control programs in field situations to help answer this question.

Brosnan described two other research projects he is pursuing that illustrate plant health effects using other

compounds in different facets of turfgrass management. Herbicides in the carotenoid biosynthesis inhibitor family cause susceptible plants to lose their carotenoid pigments, become bleached and eventually die. Carotenoids play an important role in protecting plants from cell membrane degradation caused by reactive oxygen species (4). Brosnan and his research group are just beginning to investigate if carotenoid biosynthesis inhibitor herbicides can be used in turf to increase antioxidant production and enhance plant health. Effects of this nature have been demonstrated in corn (3).

The second plant health project that Brosnan is undertaking is the use of herbicides in the imidazolinone family to prevent seedhead production in zoysiagrass. Initial research has shown that some of the imidazolinone herbicides are quite effective reducing seedheads in zoysiagrass and markedly improved the color and quality of the zoysiagrass. Brosnan speculated that the improved color and quality of zoysiagrass following an application of an imidazolinone herbicide may be due to the plant redirecting carbohydrates that would normally go to seedhead production to other plant processes that result in a healthier plant.

Much more to learn

Bruce Martin, Ph.D., approaches plant health from a pathology standpoint, which is understandable since he is a turfgrass pathologist at Clemson University. He views plant health as “a means to precondition creeping bentgrass and bermudagrass putting greens prior to stress to

Martin Compares Fungicide Programs

Disease management on creeping bentgrass greens during the summer in South Carolina is a challenge. To help superintendents address this challenge Dr. Bruce Martin at Clemson University has developed and compared fungicide programs for disease management. In his research, Martin is comparing the effectiveness of the entire fungicide program.

Of particular interest are Martin’s fungicide programs 13, 14 and 15, which he began testing in 2009. All three programs consist of eight separate fungicide applications, applied at label rates, on 14-day intervals beginning in mid-May. Some applications

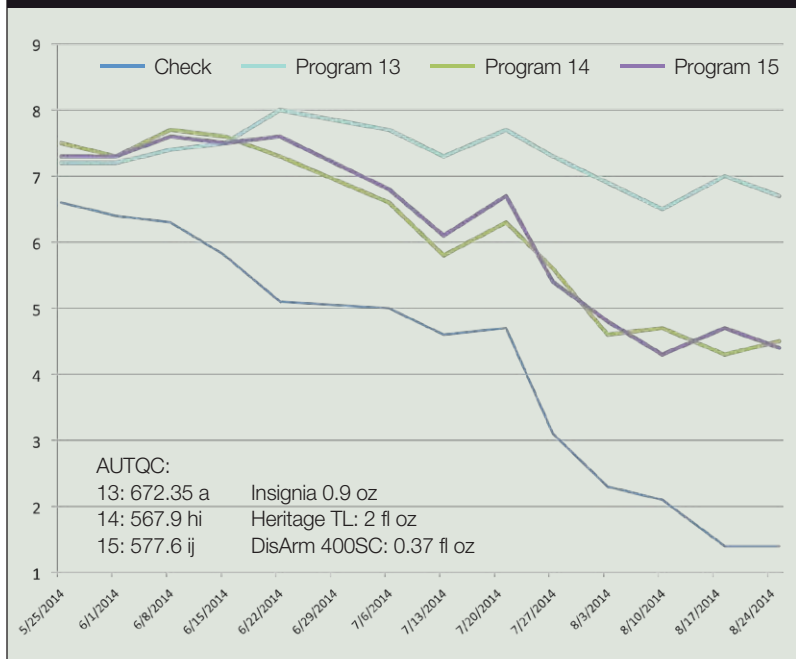
contain a mixture of two active ingredients. All three programs are the same except for the strobilurin fungicide used for two of the eight applications. Insignia is used in program 13, Heritage TL in program 14 and Disarm (fluoxastrobin) in program 15.

Results from 2010 comparing these three fungicide programs are on the next page. Area Under the Turfgrass Quality Curve (AUTQC) is a data analysis method used to integrate the effectiveness of the fungicide programs over the entire season. The greater the AUTQC value, the better the program performed. Program 13 provided significantly better season-long disease con-

trol than programs 14 and 15. AUTQC for programs 14 and 15 was statistically similar. The summer of 2010 was the most stressful in the history of Florence, S.C. Even fungicide program 13 was barely acceptable and turfgrass quality declined in late summer.

The reason for the better performance of program 13 is not completely understood. One possible explanation is better control of pythium root rot/root dysfunction with Insignia, which is in program 13. Previous research by Martin showed Insignia to provide a high level of control of pythium root rot/root dysfunction. Whether the inclusion of Insignia in program 13 improved plant health beyond disease control will need to be determined in detailed lab studies.

EFFECTS OF STROBILURIN FUNGICIDES IN A CONSISTENT PROGRAM



Comparing the three fungicide programs from Martin's 2010 research.

two characteristics that a plant health-promoting compound would likely impact.”

Martin's research has examined the effectiveness of fungicide programs designed to provide season-long disease control on creeping bentgrass greens in the stressful climate of South Carolina. When comparing fungicide programs, in which all fungicides are applied at label rates, Martin's research has consistently shown that fungicide programs that include two applications of Insignia provide more uniform, denser turf while providing equal disease control compared to programs that include other strobilurin fungicides.

While Martin is sure of the disease control and improved turf performance he has observed from fungicide programs that include Insignia, he isn't sure of the reasons for the improved turfgrass performance. He hypothesizes that one reason may be the control of a low level of pathogens that don't create symptoms yet diminish turf performance. A low level of pathogens may only be a problem in the most stressful summers. As an example, Martin cited his observations that *Pythium* root dysfunction is more of a problem in hot, stressful summers and that Insignia works well to control *Pythium volutum*, the casual organism of *Pythium* root dysfunction. Martin added that much research remains to be done to pinpoint the reasons for improved turfgrass performance beyond what can be explained by disease control.

better cope with the prolonged summer heat. Promoting better rooting and activating natural plant defense mechanisms are

superintendents remain focused on pest control, primarily diseases, and what compound provides the most effective control at the cheapest price.

As scientists, Cisar, Brosnan and Martin want to know if the secondary plant health benefits from particular compounds that they see are having a meaningful agronomic impact and are consistent and repeatable in the field. Answering these questions will lead to using the products most effectively to not only control a pest but also enhance turfgrass health and performance.

There is much to be excited about in the developing field of plant health, though we have much still to learn. ■

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