The Incredible Disappearing Fungicide

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It is considered by many one of the most uninteresting aspects of being a turfgrass manager. Right now, most of you are thinking of that one thing you dread from an interest standpoint more than anything else. Some of you are thinking of board meetings, others of sitting through an 8 hour educational session at the Golf Industry Show, others still of trying to listen to one of the faculty or staff talk at the WTA Summer Field Day while the brats are grilling mere feet away. All those things may be tough to beat, but what I'm thinking of is sprayer calibration. I see this first hand as one of the instructors, along with Dr. Jim Kerns and P.J. Liesch, of the Turf and Ornamental Pesticide Applicator Safety Training Sessions. I imagine calibrating sprayers is the sole reason many superintendents hire interns, and even I fully admit pulling out the calculator and the graduated cylinder containers doesn't get my juices flowing either, and I'm supposed to really like this stuff.

But let me tell you why it's important, and not the normal reasons that I coax with such effort out of the crowds at the Pesticide Training Sessions. Yes it saves you money and it's the law and it's critical for effectively controlling disease; all very important things. But the main reason you should calibrate is because even the best calibrated machine is still going to lose upwards of 90% of the fungicide between the time you put it in the tank and 1 hour after the fungicide has been applied to the turf. When the margin for error is this small, even an extra percentage or two of fungicide lost due to improper calibration can be the difference between disease control and disease breakthrough.

As part of my fungicide degradation research, I measured the concentration of cholorothalonil and iprodione in the initial water mixture in the tank, at the spray from the nozzles, and finally on the leaf blades one hour following the application. A 2 nozzle research boom was used, and both fungicides were sprayed using 8004 Flat Fan nozzles. Chipco 26GT (iprodione) at the rate of 4 fl oz/1000 ft2 in 2 gallons of water per 1000 ft2 and Daconil WeatherStik (chlorothalonil) at the rate of 5.5 fl oz/1000 ft2 in 2 gallons of water per 1000 ft2 were initially analyzed by the Pesticide Analysis Laboratory with the Wisconsin Department of Agriculture, Trade, and Consumer Protection (WDATCP). WDATCP also analyzed solutions of both pesticides after they were sprayed into plastic receptacles. WDATCP analyzed the initial solution and the spray solution using a method known as Gas Chromatography/Electron Capture Detection (GC/ECD). In a separate experiment, both fungicides were applied to turfgrass and then the turfgrass was analyzed for fungicide concentration 1 hour later in our lab. Our lab used an enzyme-linked immunosorbent assay (ELISA) method to measure the concentration of both iprodione and chlorothalonil on the leaf blades.

What we found was that the concentration of both fungicides drops a minor amount from the solution in the tank to the spray coming out of the nozzles, but then drops a tremendous amount between the solution emanating from the nozzles and the leaf blades one hour following application (Figure 1). From our analysis, the concentration of iprodione drops from 3635 parts per million (ppm) in the tank, to 3090 ppm coming out of the nozzles, to just 350 ppm on the leaf blades one hour following application. The concentration of chlorothalonil shows a similar drop, from 7370 ppm in the tank to 6590 coming out of the nozzles to 1000 ppm on the leaf blades. This amounts to a 90% drop in fungicide concentration from tank to leaf 1 hour later for iprodione and an 85% drop for chlorothalonil. No matter how you slice it, those are significant numbers.

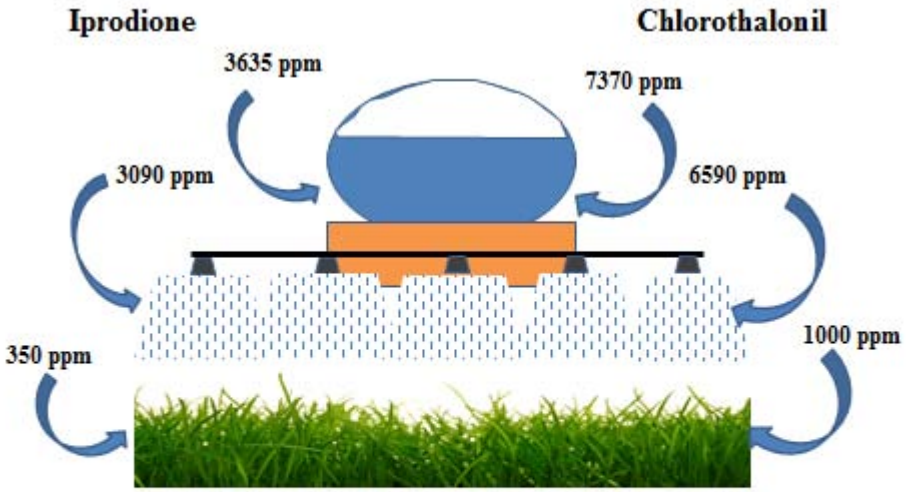

Figure 1. The drop in concentration of both iprodione and chlorothalonil can reach 90 and 85%, respectively, from the tank to the turfgrass leaf blades one hour following the fungicide application.

The 10-15% drop in concentration from the tank to the spray solution is fairly minor and can likely be explained by escape of small fungicide particles into the atmosphere. But what can explain the further 75-80% drop in concentration from there to the leaf blade 1 hour later? This is an interesting, complex question without an answer at present. There is almost certainly a significant portion of the spray that never reaches the turf, blowing off into the atmosphere as drift. There is also probably a minor degree of volatization of each fungicide shortly after it reaches the leaf blade, which may be more significant in warmer temperatures. A significant portion may transform into non-active molecules due to chemical reactions with other molecules or organisms on the leaf blade. In addition, each fungicide may break down in the presence of sunlight (photodegradation) while each fungicide is still in a liquid solution on the leaf blade. Our research has shown that photodegradation plays a minor role in fungicide degradation in a winter environment on a relatively dry leaf blade, but other research has shown that pesticides in liquid solution break down fairly rapidly. Plant and microbial metabolism may also play a role, though how much can be broken down in just one hour remains to be seen.

Clearly, the loss of so much fungicide in such a short period of time has large consequences for disease control. Determining the degree of influence that these factors have on turfgrass fungicide degradation could lead to methods for mitigating those losses, and potentially towards reducing the amount of fungicide we add into the tank. Years of research will need to be implemented to investigate each of these factors individually under a variety of conditions before any general recommendation can be made. In the meantime, make sure the intern knows how to calibrate this summer, every percent counts.

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