# Pesticide Fate Research: *Always More Questions!*

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Many scientists will tell you how good research will lead to more questions than answers and this can be frustrating to turf managers and to those who provide research dollars. I am going to use pesticide fate research as an example of how this works.

When a pesticide is applied to a turf, the active ingredient(s) will first come into contact with the surfaces of the leaves. The leaves of all turfgrass plants are covered with a wax layer called the cuticle, which protects the leaves from desiccation, injury and disease. The waxy surface will repel water just as any waxy surface will, but when the water solution contains an active ingredient that will not dissolve in water (nonwater-soluble) the pesticide is attracted (adsorbed) to the similar leaf surface. Many of our active ingredients are relatively nonwater-soluble (less than 300 ppm), and they must be mixed with surfactants to get them into an emulsion (EC) that can be sprayed. If these compounds are nonwater-soluble, why would irrigation or rainfall be effective for moving them off of a waxy leaf to which they are strongly adsorbed? Why do pesticide labels recommend "watering-in" applications? An even more important question is why would the pesticide move off of the waxy leaf, through a thatch layer that is comprised of nonwater-soluble organic plant tissues, through a soil that is rich in nonwater-soluble organic matter and all the way to the groundwater?

My Master thesis research conducted at Michigan State University under the direction of Dr. Bruce Branham demonstrated how readily organic compounds will adsorb to leaves and thatch but this research led to even more questions. The inactive ingredients in a pesticide (emulsifiers, surfactant, solvents, etc.), which improve the efficacy and spreadability of the pesticide, suspend the active ingredient in water to form an emulsion. The active ingredient will be surrounded by many of the inactive ingredient's molecules making the whole complex (micelle) water soluble. How long following an application to a turf does this water solubility enhancement end? Once the material has dried on the leaf? We may never know because the inactive ingredients in the pesticides are usually proprietary (trade secrets). Once manufacturers are forced to reveal their recipes, competition for better products will diminish. Are the manufacturers going to reveal what makes their product better than all of the rest?

Now we have established how well compounds will absorb to leaves and thatch, but then what happens to them? The active ingredients in pesticides are usually very large organic compounds that are easily degraded by sunlight or microorganisms and they may be volatile. The abundant turfgrass leaves will intercept the compounds and expose them to sun, wind, traffic, etc., and the thatch is a great environment for microorganisms. Therefore, future research will probably demonstrate that our pesticides are quickly degraded under normal turf management conditions.

What is degradation? Many turf managers are led to believe that once degradation has occurred the entire compound is no longer in existence, but that is not the case. Many of you have small children who have a set of building blocks. Their creative little minds will often throw some conglomeration of blocks together into a structure that we as "grown-ups" really do not understand (i.e. chemistry). The child will be satisfied with their creation for awhile until they either destroy it altogether, or they rearrange certain pieces. Let's assume our children are not so destructive, and they decide to swap a red block for a blue block. The structure still maintains its identity even though a small change has been made. Now let's think of the structure as a single molecule of active ingredient in a pesticide. If one swap is made

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