Potential Movement of Certain Pesticides Following Application to Golf Courses

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Goals:

- *To obtain and develop mathematical equations for predicting the potential movement of pesticides through golf course greens constructed according to USGA guidelines.*
- *To determine the potential runoff movement of pesticides from golf course fairways on Piedmont soils and to develop management strategies for reducing the movement.*

The objectives of our research program are to evaluate the potential movement of pesticides and fertilizer components following application to golf courses and to develop Best Management Practices to reduce the potential for pesticide transport to potable water systems.

Results indicate that only very small quantities of the pesticides applied to simulated golf course greens are transported through the root zone and into surface water. The more water soluble pesticides (i.e., 2,4-D; dicamba; and mecoprop) were found to have short residence time under the sod due to rapid microbial degradation of the molecules. The pesticides with lower water solubilities (i.e., benefin, pendimethalin, dithiopyr, chlorothalonil, and chlorpyrifos) had higher soil sorption capacities, increasing their residence time in the root zone and allowing for biotic and abiotic degradation even if the half-lives were fairly long.

In some areas of the United States, as much as 70 percent of the rainfall/irrigation water can be lost from fairways as surface runoff. Results of our research indicate that fairly high quantities of the more water-soluble pesticides (i.e., 2,4-D; mecoprop and dicamba) are transported from the treated fairway. The less water-soluble pesticides are more resistant to transport in surface water.

Up to five times more pesticide was transported from fairways near field capacity compared to those near the wilting point. Sequencing irrigation prior to and following pesticide application reduces the

quantity of analyte to be transported in surface water runoff.

More pesticide was transported from dormant sod than green sod. Pressure injection of pesticides reduced the pesticide transport in surface water by 6 fold and did not influence the quantity transported through the root zone.

A buffer zone between the point of application and the exit point did not reduce the fraction of applied pesticide transported in surface-water solution. It only dilutes the concentration due to less area treated. The less water-soluble pesticides have a longer residence time on the foliage, resulting in as much as 20 percent of these pesticides to be removed with the leaf clippings.

Future research will be directed toward the development of practices for reducing the potential movement of chemicals applied to golf courses. Methods of application, types of analyses and formulations, sequencing of irrigation and chemical application, methods for increasing the infiltration/percolation rate of the soil, and use of pesticide absorbents on the soil surface will be investigated. These strategies for pesticide application and site management will be tested in the simulated greens for transport through the root zone. Models will be refined/developed to predict the potential for pesticide movement from golf courses.

We anticipate developing a project for determining the urban contribution to the watershed load of contaminants. The Atlanta watershed to be used will include one 18-hole golf course. The watershed-scale research is the next level following the development of the models from small plot research data. The conclusion of the project will be the development of a complete guide of Best Management Practices for applying chemicals to golf courses based on valid data.

Table 11. Influence of soil moisture content at first simulated rain event following treatment (24 HAT) on the applied pesticide transported in runoff water at 24 and 48 HAT. Fraction trasported is the percent (%) of applied pesticide and water transported.

Pesticide	Application rate	Soil Moisture 24 HAT	Fraction Transported 24 HAT	48 HAT	Total : AVE
	--- kg ae ha^{-1} ---	----- % -----	---------- % pesticide : %water ----------		
2.4-D	2.24	10.9[1]	2.6 : 16	0.9 : 42	3.5 : 29
Dicamba	0.56	10.9	3.1 : 16	1.6 : 42	4.7 : 29
Mecoprop	1.68	10.9	1.3 : 16	0.6 : 42	1.9 : 29
2,4-D	2.24	18.5[2]	7.3 : 44	2.3 : 70	9.6 : 57
Dicamba	0.56	18.5	9.7 : 44	4.9 : 70	14.6 : 57
Mecoprop	1.68	18.5	9.5 : 44	4.9 : 70	14.4 : 57

[1] Simulated dry soil treatment where the soil moisture content was near wilting point (soil moisture content at 15 bar = 8.4%).

[2] In previous experiments, routine pesticide applications were made at a soil moisture content between 18 and 19%.