Potential Movement of Certain Pesticides Following Application to Golf Courses

Dr. Albert E. Smith
Dr. David C. Bridges

University of Georgia

Goals:

- *To obtain and develop mathematical equations for predicting the potential movement of pesticides through golf course greens constructed according to USGA specifications.*

- *To determine the potential runoff movement of pesticides from golf course fairways on Piedmont soils and to develop management strategies for reducing the movement.*

Funding provided by USGA for the previous project (1991-1994) resulted in the development of facilities at the Georgia Experiment Station and the initiation of a research program to determine the potential movement of pesticides following application to golf courses.

Data indicated that only small quantities (<1%) of the applied 2,4-D DMA, dicamba DMA, mecoprop DMA, dithiopyr, chlorpyrifos, and chlorothalonil are transported through the sod and the lysimeters. In summary, it appeared that the dynamics of a well maintained sod contribute to a high adsorption and decomposition rate for these pesticides, and the GLEAMS model, developed for agricultural row-crops, underestimates the dynamics of the ecosystem around the sod.

Research has been continued to document movement of additional pesticides through the lysimeters and to resolve the differences between the GLEAMS model prediction of analyte transport and data obtained from the lysimeters.

Results of recent studies indicated that only small quantities of methyl bromide and bromide ion were transported through the outside lysimeters following treatment with methyl bromide. It can be concluded that the small quantities transported would be of minor importance compared to the quantities released as a gas following fumigation.

Plots to determine the potential transport of pesticides in runoff water from treated plots during storm events were developed on soils typical of the Piedmont region. As much as 40 to 70% of the rainfall left the

plots as runoff during simulated storm events. The collected surface water contained moderately high concentrations of treatment pesticides having a high water solubility.

Data for nine analytes resulted in a high correlation ($r^2 = 0.91$) between the fraction of analyte transported and the water solubility for the analyte when fit to a quadratic equation. Less than 1% of the applied chlorothalonil, chlorpyrifos, benefin, and pendimethalin was transported from the plots in the runoff water. On the other hand, as much as 9 to 16% of the 2,4-D, dicamba, mecoprop, and nitrate were transported in the surface water from the first two simulated storm events.

Compared to broadcast application, pressure injection decreased the fraction of 2,4-D (7.4 times) and trichlorfon (5.2 times) transported, and the inclusion of a buffer strip between the points of treatment and water collection did not significantly reduce the fraction of analyte transported under saturated soil conditions. Research on reducing the potential movement of pesticides in surface water will be continued.

Leachate collected from lysimeters under practice greens at the Town and Country Club golf course contained only trace quantities of chlorothalonil, chlorpyrifos, and OH-chlorpyrifos. Slightly more OH-chlorothalonil and nitrate were determined in the leachate in response to treatments with chlorothalonil and fertilizer.

Results of a project designed to determine the potential herbicide exposure from kneeling on a treated golf course green indicate that an average sized golfer can kneel as many as 20,000 times on greens, at 6 hours after a treatment with 2,4-D, mecoprop, and dicamba, before receiving an exposure equal to the NOEL (No Observed Effect Level).

The fraction of applied analyte transported from runoff plots and the analyte concentration in runoff water from a storm event that occurred 24 hours after treatment application. The highest percentage of applied analytes transported from the treated plots have the highest water solubility.

Analyte	Application rate	Fraction transported	Conc. at 24 HAT
	(kg ae/ai ha^{-1})	(%)	(ppb)
Nitrate-N	24.4	16.4	12,500
Nitrate-N D[1]	24.4	64.2	24,812
Dicamba-DMA	0.56	14.6	360
Dicamba-DMA D[1]	0.56	37.3	752
Mecoprop-DMA	1.68	14.4	810
Mecoprop-DMA D[1]	1.68	23.5	1,369
2,4-D-DMA	2.24	9.6	800
2,4-D-DMA D[1]	2.24	26.0	1,959
2,4-D-LVE	2.24	9.1	812
2,4-D-DMA P[2]	2.24	1.3	158
2,4-D-DMA B[3]	2.24	7.6	495
Trichlorfon	9.15	32.5	13,960
Trichlorfon P[2]	9.15	6.2	2,660
Chlorothalonil[5]	9.50	0.8	290
Chlorpyrifos[6]	1.12	0.1	19
Dithiopyr	0.56	2.3	39
Dithiopyr-G[7]	0.56	1.0	26
Benefin	1.70	0.01	3
Benefin-G[7]	1.70	0.01	6
Pendimethalin	1.70	0.01	9
Pendimethalin-G[7]	1.70	0.01	2

[1]D = applied to dormant bermudagrass.
[2]P = pressure injection application.
[3]B = 2 m buffer strip between treatment and collection.
[4]Trichlorfon + dichlorvos metabolite.
[5]Total for chlorothalonil and OH-chlorothalonil.
[6]Total for chlorpyrifos and OH-chlorpyrifos.
[7]G = granule application.