EFFECTS OF TURFGRASS THATCH AND MAT LAYERS ON PESTICIDE TRANSPORT

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Most turfgrass thatch pesticide sorption studies have concentrated on determining the amount of pesticide that is sorbed to thatch at sorption equilibrium. There is a good reason for this. Most pesticide transport models require that equilibrium soil-water pesticide sorption coefficients be used to predict the movement of pesticides in soils. In addition, the equilibrium soil-water pesticide sorption coefficient, after being normalized to account for the presence of organic matter, has become the most widely accepted number used to rate the leaching potential of a pesticide.

An assumption made when using equilibrium soil-water sorption coefficients to model pesticide movement is that the pesticide will reside in the soil solution long enough for actual sorption equilibrium to be achieved. This assumption is not valid in soils exhibiting preferential flow and may not be valid for thatch as well. Precipitation that washes pesticides off turfgrass foliage readily moves through thatch. Because water moves through thatch rather quickly pesticide movement within this layer may actually be more dependent on the instantaneous or short term sorptive behavior of pesticide to thatch.

We conducted a study to evaluate the effect of residence time on the sorption of pesticides to turfgrass thatch. The combined thatch and mat layers of two turfgrass species, bentgrass and zoysiagrass, were examined along with the soil directly underlying the mat of each turf. The zoysiagrass thatch and mat were obtained from a 6 year old stand of Meyer zoysiagrass that contained a 1.3 inch thick thatch+mat layer. The bentgrass samples were obtained from a 3.5 year old stand of Southshore creeping bentgrass that had a 0.9 inch thick thatch+mat layer. Solution residence times as brief as 15 minutes and has long as 48 hours were examined for 2,4-D and carbaryl. Sorption kinetics and sorption isotherms were determined for the two pesticides using a modified flow technique. The technique we used does not involve shaking of the sample, thus minimizes destruction of any small aggregates that may be present in the media.

The effect of residence time on 2,4-D sorption to the thatch+mat was markedly different than 2,4-D sorption to the underlying soil. Sorption of 2,4-D to soil was nearly instantaneous whereas sorption to the thatch+mat was more time dependent. There was no difference in 2,4-D sorption kinetics of the two turfgrass species thatch+mat material. The quantity of 2,4-D sorbed to the thatch+mat increased 72% as the solution residence time increased from 15 minutes to 24 hours. However, even at residence times as brief as 15 minutes, 2,4-D sorption to the thatch+mat was three times greater than to the underlying soil. The 2,4-D kinetic data suggest that use of a equilibrium sorption coefficient to represent 2,4-D sorption in the thatch+mat layer would under predict 2,4-D leaching losses from the thatch and mat whenever a high amounts of rainfall occurred shortly after applying 2,4-D to the turf.

In the case of carbaryl, there was no difference in sorption kinetics of the thatch+mat and the sorption kinetics of the underlying soil. Equilibrium sorption of carbaryl to the thatch+mat, and to the underlying soil, both occurred within 4 hours. Given the more hydrophobic nature of carbaryl it was not surprising to see that this pesticide achieved equilibrium sorption more quickly than did 2,4-D.

Not surprisingly, both turfgrass species thatch+mat had much higher pesticide sorptive capacities than the soil beneath the thatch and mat. There was, however, little difference in the sorptive capacities of the two turfgrass species thatch. This was true for both 2,4-D and for carbaryl.

We also examined the effect of the thatch and mat layers on the movement of 2,4-D and carbaryl in a separate series of transport studies. In these studies, we removed 4 inch deep undisturbed columns of soil that either had a surface thatch and mat layer, or were devoid of these layers. The columns were removed from the same lawn areas described previously.

We examined the leaching of 2,4-D and carbaryl under what can only be described as a "near worst case scenario" event. The columns were attached to a vacuum chamber device that maintained the columns at field capacity (-100 Kpa) throughout the experiment. Each pesticide was surfaced applied to the columns and the pesticide allowed to sorb to the thatch, mat and soil (or soil only in the columns that were devoid of a thatch and mat layer) for 24 hours. After the 24 hour sorption period, the columns received 0.4 inches per hour of simulated rainfall continuously until little change in the pesticide concentration of the leachate was observed. Leachate samples were collected throughout the experiment permitting pesticide breakthrough curves to be constructed for each column.

The transport study results are summarized in the Table 1. The data show that substantial amounts 2,4-D and carbaryl were transported out of the columns. Leaching losses were greater for carbaryl than for 2,4-D. It needs to be pointed out, however, that approximately 8 times more rainfall (4 inches verses 32 inches) was needed to leach carbaryl from the columns, than was needed to leach 2,4-D.

The presence of bentgrass thatch and mat reduced 2,4-D transport when compared to columns that contained only the soil beneath the mat. A similar trend was also apparent in the columns used to evaluate carbaryl transport, however, the difference between the two bentgrass column treatments was not large enough to be declared statistically significant. The bentgrass columns used in the carbaryl transport were collected on a different date than the columns used in the 2,4-D study. The columns used in the carbaryl transport study were found to contain earthworm channels. Preferential, or bypass, flow likely that took place in these channels. This, in turn, would have reduced the effectiveness of the bentgrass thatch and mat to inhibit carbaryl transport.

Table 1. Percent of 2,4-D and carbaryl leached from columns containing surface thatch and mat layers and columns devoid of these two layers.

Column ID	2,4-D	Carbaryl
	% leached	
Bentgrass thatch+mat	17.5	52.9
Bentgrass soil	43.1	65.7
Zoysiagrass thatch + mat (ZT)	29.0	60.8
Zoysiagrass soil (ZS)	34.3	78.2

Our sorption and transport research has demonstrated that the turfgrass thatch and mat layers can inhibit pesticide transport even under conditions that highly favor pesticide leaching. The thatch and mat layers however, are not a sponge like material that readily adsorb all pesticides. The speed and extent to which a pesticide-thatch takes place is dependent on the chemistry of the pesticide and compostion of the turfgrass thatch and mat layers. The physical structure of the thatch and mat layers may also influence pesticide transport.