EFFECTIVENESS OF BUFFALOGRASS [*Buchloe dactyloides* (Nutt. Engelm)] FILTER STRIPS IN REMOVING DISSOLVED ATRAZINE AND METABOLITES FROM SURFACE RUNOFF

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Introduction

Atrazine is used for weed control in grain sorghum [*Sorghum bicolor* (L.) Moench] and corn (*Zea mays* L.). Recently, the presence of atrazine and atrazine metabolites in surface water has become a concern because of their potential effect on human health and aquatic ecosystems (Mersie et al. 1999).

Atrazine metabolites include deethylatrazine (DEA), deisopropylatrazine (DIA), diaminoatrazine (DA) and hydroxyatrazine (HA) (Ahrens, 1994). These metabolites differ substantially in adsorption and desorption behavior. Mersie and Seybold (1996) reported the order of sorption from highest to lowest affinity was HA > DIA > DEA for two Virginia soils. Compound specific adsorptivity may translate into retention differences in vegetative filter strips (Photograph 1).

Hypothesis

The effectiveness of buffalograss filter strips in retaining atrazine, DEA, DIA, DA, and HA will be compound specific.

Objective

Determine differences in the partitioning of atrazine, DEA, DIA, DA, and HA within a buffalograss filter strip.

Materials and Methods

The study was conducted in June 2001 at the Blackland Research Center in Temple, TX. Buffalograss plots (1x3 m) were established on a Houston Black Clay and saturated prior to study initiation. The runoff inflow concentration for all compounds was 0.1 :g mL^{-1}, and the runoff inflow rate was 750 L hr^{-1}. Runoff outflow was determined by a pressure transducer that estimated volume through pressure changes over time. Runoff outflow samples were collected at 5-min intervals (Photograph 2). Water samples were extracted by solid phase extraction and then analyzed for atrazine, DIA, DA, HA, and DEA using high performance liquid chromatography-photodiode array detection (HPLC-PDA) (Figure 1).

Statistics

The design for the runoff study was a randomized complete block with five replications. Treatment means for trapping efficiency (T_E), mass infiltrated (M_{inf}), and mass adsorbed (M_{as}) were subjected to analysis of variance. These means were separated by Fisher's least significant difference at the 5% level of significance.

Photograph 1. Vegetative filter strips are applied to production systems to reduce sediment, nutrient, and pesticide entry into surface and groundwater.

Data Calculations

The filter strip's ability to retain compounds was evaluated by determining the trapping efficiency as described by Barfield et al. (1998),

$$T_E = M_i - M_o / M_i \qquad (1)$$

where M_i represents total mass flowing onto the strip and M_o represents the mass flowing off the strip. M_i and M_o were calculated via,

$$M_i = 3\, q_i\, C_i\, dt \qquad (2)$$

$$M_o = 3\, q_o\, C_o\, dt \qquad (3)$$

where C_i and C_o were inflow and outflow concentrations, q_i and q_o were inflow and outflow rates, and t was the duration of the runoff simulation.

A mass balance for the system was calculated by,

$$M_i - M_o = M_{inf} + M_{as} \qquad (4)$$

where M_{inf} was mass infiltrated and M_{as} was mass adsorbed.

The mass infiltrated was determined by defining the infiltrated volume, V_{inf}, as the difference between inflow and outflow runoff volume. Therefore, the mass infiltrated was calculated as follows:

$$M_{inf} = V_{inf}\, C_{avg} \qquad (5)$$

where C_{avg} is the average concentration that moved across the filter strip estimated as,

$$C_{avg} = C_{iavg} + C_{oavg} / 2 \qquad (6)$$

where C_{iavg} was the average inflow concentration and C_{oavg} is the average outflow concentration.

Finally, the mass adsorbed was calculated from the following equation:

$$M_{as} = M_i - M_o - M_{inf} \qquad (7)$$

Results and Discussion

Trapping Efficiency (T_E)

Trapping efficiency was significantly different among atrazine and atrazine metabolites (p=0.025). Thirty-five percent of the atrazine mass was retained in the filter strip as compared to approximately 32% of the metabolite masses (Figure 2). Similarly, Tingle et al. (1998) reported that tall fescue [*Festuca arundinacea* (Schreb.)] filter strips reduced metribuzin losses by 27%.

Mass Infiltrated (M_{inf})

The mass infiltrated was not significantly different among compounds (Figure 3). However, infiltration accounted for approximately 63 % of the total mass retained within the strip. Similarly, Kloppel et al. (1997) concluded that runoff infiltration in the strip was primarily responsible for the retention of isoproturon, dichlorprop-p, and bifenox on a 10 m x 20 m triticale filter strip.

Mass Adsorbed (M_{as})

The partitioning of atrazine between solution and the solid surfaces was significantly different than the partitioning of the atrazine metabolites (p=0.046). Thirteen percent of the atrazine mass was retained by adsorption as compared to approximately 9 % of the metabolite masses (Figure 4). In a related study, Barfield et al. (1998) reported that adsorption to the grass thatch/soil surface accounted for a 15 % reduction in the atrazine mass entering a 4.6 m x 4.6 m bluegrass/fescue filter strip.

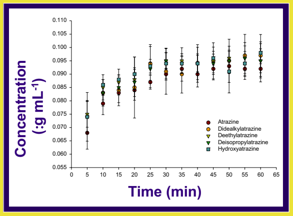

Figure 1. Compound concentration in run-off from buffalograss plots during a 60 min simulation. Vertical bars are ± one standard deviation, n=5.

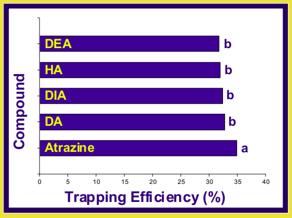

Figure 2. Trapping efficiency during the 60 min simulation. Compounds followed by the same letter are not significantly different at p# 0.05.

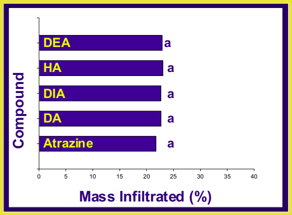

Figure 3. Mass infiltrated during the 60 min simulation. Means followed by the same letter are not significantly different at p # 0.05.

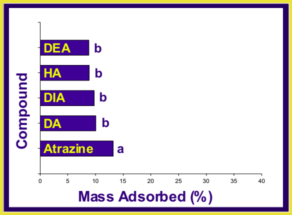

Figure 4. Mass adsorbed during the 60 min simulation. Means followed by the same letter are not significantly different at p # 0.05.

Conclusions

The effectiveness of the buffalograss filter strip in retaining dissolved organics from surface runoff was compound specific. Trapping efficiency data indicated that atrazine was preferentially retained within the strip when compared to the atrazine metabolites. Adsorption was greater for the parent molecule than the metabolites and attributed to the differences in trapping efficiency among compounds. The efficiency of the strip in retaining these compounds was primarily associated with infiltration.

Future Research

Future studies are planned to identify treatments that enhance compound retention by impacting infiltration and adsorption. For example, filter strip aeration and application of polyacrylamides to the strip may increase the mass retained by infiltration and adsorption, respectively.

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Photograph 2. Equipment used for the study including the nurse-tank, pump, applicator, runoff plot, sampling station, data-logger and capture tank.