EFFECTIVENESS OF BUFFALOGRASS FILTER STRIPS IN REMOVING DISSOLVED METOLACHLOR AND METOLACHLOR METABOLITES FROM SURFACE RUNOFF

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Introduction

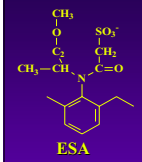
- Metolachlor - chloroacetamide herbicide.
- Used for weed control in corn and sorghum.
- Detected in ground and surface waters (Goolsby et al. 1994).
- Degrades rapidly in soil $T_{1/2}$ = 15-30 days.

Metolachlor

Metolachlor Metabolites

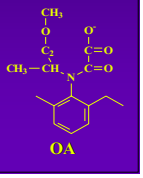
- Detected in surface and ground water (Kolpin et al. 2000).
- Higher frequency (Baker et al. 1993).
- Higher concentrations (Kolpin et al. 1996).
- > 80% mass chloroacetamide compounds in ground and surface water consisted of the sulfonic and oxanilic acid degredates (Kalkhoff et al. 1998).

Metolachlor OA and ESA



ESA

- Transformations are biologically mediated.
- Detoxification pathways from plants and soil microorganisms via glutathione conjugation (Field et al. 1996).
- Ionic metabolites that are highly water-soluble (Phillips et al. 1999).
- Adsorption and desorption processes differ among metolachlor and metolachlor metabolites (Novak et al. 2000).



OA

Vegetative Filter Strips

- Suspended solids
- Inorganic compounds
- Organic compounds
  - Infiltration
  - Adsorption

Dillaha et al. 1989 / Barfield et al. 1998

Hypothesis

- The effectiveness of a buffalograss filter strip in retaining dissolved metolachlor, metolachlor ESA, and metolachlor OA will be compound specific.

Objective

- Construct a mass balance whereby the trapping efficiency (T_E), mass adsorbed (M_{ads}), and mass infiltrated (M_{inf}), can be compared among metolachlor, OA, and ESA.

Materials and Methods

Soil Data

Surface layer characteristics of Houston Black Clay (fine, smectitic, thermic Udic Haplusterts)[a].

slope	sand	silt	clay	OM	pH	CEC[b]
----------%----------						
3-5	9	33	58	2.4	7.1	61.6

[a] Information taken from Soil Interpretation Lab Data Reports from the Texas State Soil Office of the USDA-NRCS.
[b] milliequivalents 100 g^{-1}

Field Descriptions

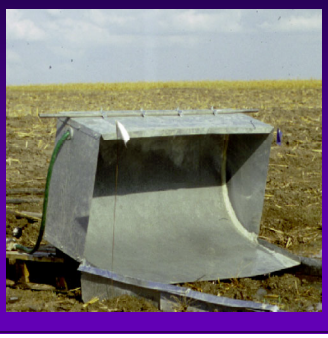
- Nurse tank
- Pump
- Applicator
- Buffalograss plot
- Sample collection
- Data logger

Nurse Tank

- Application (0.12 ug mL^{-1})
  - Metolachlor
  - OA
  - ESA
- Hoffman et al. 1995

Application Device

- Wolfe et al. 2000
- Sheet flow
- Easy field calibration
- 750 L hr^{-1}



Sample Collection and Analysis

- 1 x 3 m buffalograss plots
- Irrigated to saturation
- 5-min intervals
- Solid Phase Extraction (SPE)
- HPLC-PDA

Runoff Volume Collected

- Pressure transducer
- Data logger
- 1-min interval
- Volume = $\Pi r^2 h$

Equations

- Trapping efficiency (T_E)
  $T_E = M_i - M_o / M_i$
  $M_i = \Sigma q_i C_i d_t$
  $M_o = \Sigma q_o C_o d_t$
- Mass balance
  $M_i - M_o = M_{inf} + M_{as}$

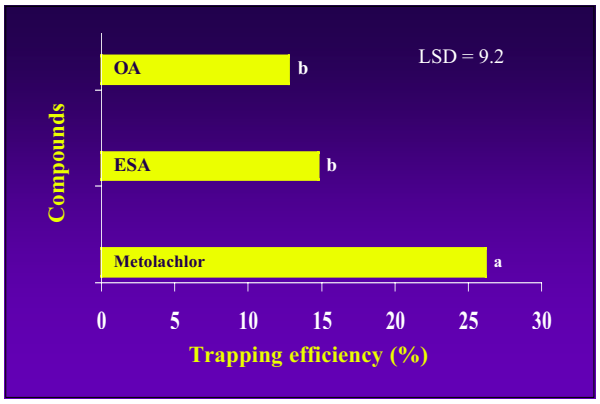
Barfield et al. 1998

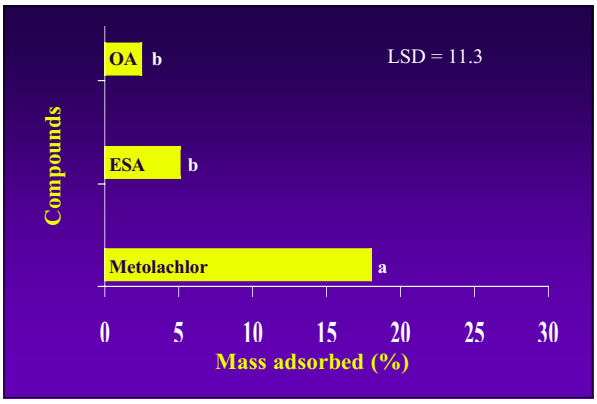
Equations

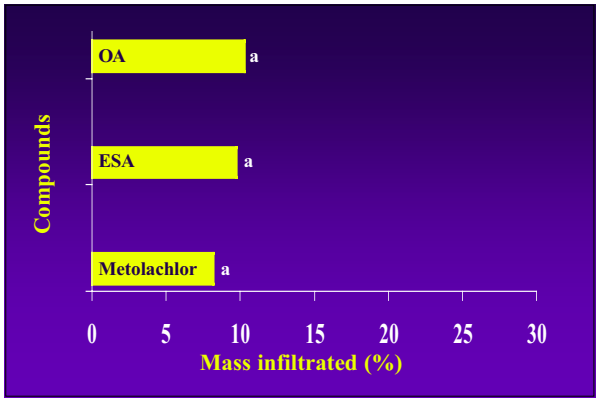
- Mass infiltrated (M_{inf})
  $M_{inf} = V_{inf} C_{avg}$
  $V_{inf} = V_i - V_o$
- Mass adsorbed (M_{ads})
  $M_{ads} = M_i - M_o - M_{inf}$

Statistics

- RCB
- Five replications
- Treatment means subjected to analysis of variance
  - T_E
  - M_{ads}
  - M_{inf}
- Means separated by Fisher's LSD







Conclusions

- Retention was compound dependent.
- Trapping efficiency data indicated that metolachlor was preferentially retained within the strip when compared to the metabolites.
- Metolachlor adsorption was significantly greater than metabolite adsorption and likely attributed to the differences in trapping efficiency among compounds.
- Even under saturated conditions, infiltration played an important role in compound retention.

Future Research

- Infiltration
  - aeration
  - tillage
- Adsorption
  - vegetation
  - PAM
  - zeolites