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Herbicides Metolachlor and Metribuzin loss in Surface Runoff from Field

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1. INTRODUCTION

In intensively farmed areas, such as the warm, humid climate area in the Lower Mississippi Valley, large quantities of fertilizers and pesticides are used in crop production. Baton Rouge, LA has a warm, humid climate along with clay soils with high water tables. Therefore, it is an excellent site for conducting a water pollution experiment, as the results can then be applied throughout the Lower Mississippi Valley and perhaps extended into other areas of the Southeastern United States. In LA, metolachlor, and metribuzin are used as the herbicides for the pre-emergence control of annual grasses and broadleaf weeds in soybean, corn, cotton, and peanut production.

The objectives of this study were to identify the runoff properties of metolachlor, and metribuzin in fields and then evaluate the runoff water quality in relation to E.P.A. advisory levels for drinking water.

2. MATERIALS AND METHODS

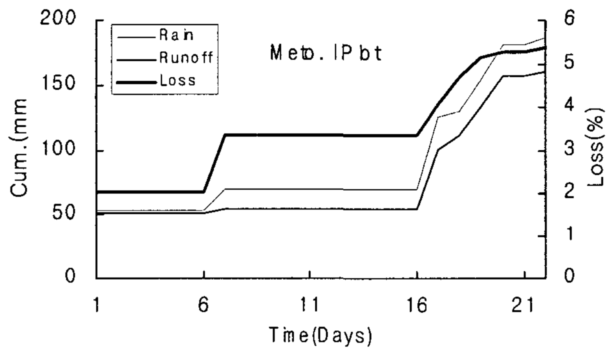
This study was conducted at the Ben Hur Farm at the Louisiana Agricultural Experiment Station (LAES). It is located about 6 km south of Baton Rouge, LA on the Mississippi River alluvial flood plain with a 0.1% slope. The soil is classified as Commerce clay loam (fine-silty, mixed, superactive, nonacid, thermic Fluvaquentic Epiquepts). Plot (3.36 ha) had surface drainage. Earthen dikes, at least 0.3 m high, were constructed around each field to define its boundary. All surface runoff was measured using H-flumes. A turbo 8EC (Mobay Co.) containing 78.67% of metolachlor and 17.41% of metribuzin was applied at a level of 2757 g/ha for metolachlor and 609 g/ha for metribuzin to plot on June 18. Soybeans were planted in the plots in July and harvested in October.

An automatic water sampler was installed at each H-flume. Five-hundred mL samples of surface runoff water were taken from each H-flume at 20 minute intervals during surface runoff events.

3. RESULTS AND DISCUSSION

Concentration in Runoff

The concentrations of metolachlor and metribuzin in the runoff water decreased from 221.5 ng/mL to 9.0 ng/mL and from 56.2 ng/mL to 1.5 ng/mL 22 days after application, respectively. To evaluate the pollution potential from metolachlor, and metribuzin used in fields, the concentrations of these herbicides in the runoff water need to be compared with the EPA advisory levels for drinking water. The metolachlor concentration in the runoff water remained higher than the 175 ng/mL metolachlor EPA advisory level until 2.5 days after application. The metribuzin concentration in the runoff water was also higher than the 10 ng/mL metribuzin EPA advisory level until 15.4 days after application. Therefore, according to the EPA advisory levels for drinking water, in LA, the metolachlor and metribuzin levels would appear to present a risk early in the application season when runoff events occur.



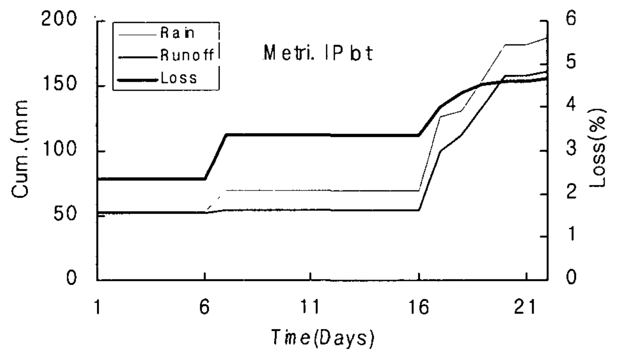


Figure 1. Loss of metolachlor and metribuzin in runoff water from plot applied with 2759g/ha and 609g/ha, respectively.

Losses in Runoff

The total runoff loss of metolachlor was 4.67% of the application amount over a period of 22 days after application. On the day of application, 2.34% of the applied amount was lost because of severe rainfall conditions due to 53.3 mm of precipitation occurring several hours after application. Therefore, excluding the application day, the metolachlor loss was only 2.33% of the applied amount over the ensuing period of 21 days (Fig. 1).

The total runoff loss of metribuzin was 5.36% of the applied amount over a period of 22 days after application. However, when excluding the initial loss 2.04% on the application day due to heavy rainfall, the metribuzin loss was only 3.32% of the applied amount over the ensuing 21 days. Accordingly, since high losses of metolachlor and metribuzin occurred on the application day due to heavy rainfall (Fig. 1), the timing of pesticide application in regards to rainfall would appear to be critical to pesticide loss.

Relationship Between Runoff Water and Soil

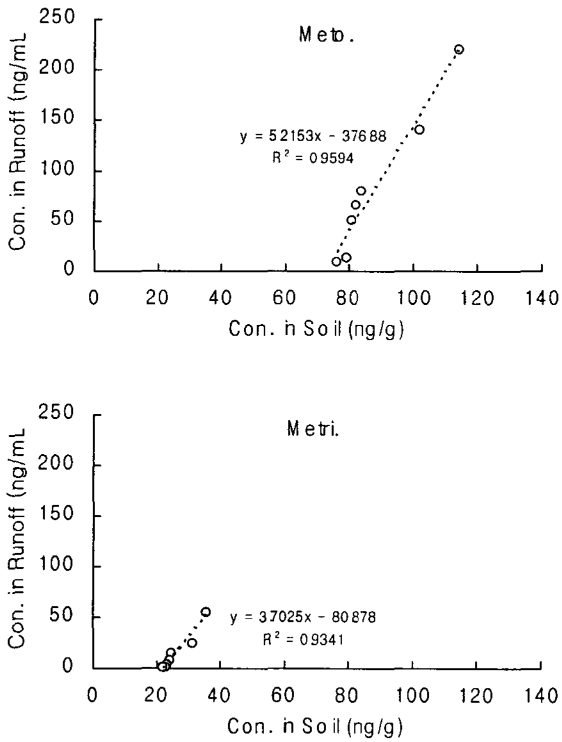


Figure 2. Relationship between concentrations of metolachlor and metribuzin in runoff water and their concentrations in top 0-15 cm of soil layer.

Leonard proposed a relationship between the herbicide concentration in the runoff water and the herbicide concentration in the top soil layer. It would thus appear reasonable to use this relationship to anticipate the concentrations in field runoff water. The herbicide concentration data for the runoff water and soil (top 15 cm) produced the following corresponding equations (Fig. 2):

(i) Runoff Conc. (ng/g) of Metolachlor = 5.2153 × (Soil Conc. ng/g) - 376.88 (R^2 = 0.95)

(ii) Runoff Conc. (ng/g) of Metribuzin = 3.7025 × (Soil Conc. ng/g) - 80.878 (R^2 = 0.93)

The equations for metolachlor and metribuzin in Fig. 2 were then used to anticipate the concentrations in the field runoff water. When partitioning, the runoff water phase was found to be the highest when the soil surface concentration was also the highest.

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