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Movement of Triazine Herbicides in Conventional, Reduced Tillage, and No-Tillage Corn Production

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MOVEMENT OF TRIAZINE HERBICIDES IN CONVENTIONAL, REDUCED TILLAGE, AND NO-TILLAGE CORN PRODUCTION

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Herbicides are applied to over 90 percent of the corn acreage in Kentucky and triazine herbicides are used the most. Conservation tillage methods are often used to prevent soil erosion and to conserve soil water. However, as tillage is decreased the dependence on herbicides for weed control often increases. Minimizing herbicide movement from the application sites to non-target areas, such as ground and surface waters, is necessary to maintain optimum water quality.

DESCRIPTION OF THE STUDIES CONDUCTED

Experiments were conducted in the 1986-87 and 1987-88 growing seasons to monitor the movement of Atrazine, Bladex, and Princep in surface water moving off the field and in water moving through the soil to a depth of 36 inches.

The herbicides were applied to corn grown by either conventional, reduced (chisel plow), or no-tillage methods. Conventional tillage consisted of moldboard plowing and disking in the spring and resulted in a smooth, clean seedbed. The chisel plowing (reduced tillage) in the spring resulted in a rough surface which left about 50% of the previous corn residue. No-tillage plots were not disturbed except by the planter so that more than 95% of the soil surface was covered by the previous year's corn residues. Corn was planted in early May of each year. Atrazine, Bladex, Princep and Roundup were applied as a tank mixture to all plots. Atrazine 4L was used at a rate of 2 qts per acre, Bladex 4L at 3 qts per acre and Princep 4L at 2 qts per acre in a broadcast surface application immediately after corn planting.

The plots were enclosed with a metal border to facilitate collection of runoff water and prevent water from adjacent areas moving across the plots. Water was collected from the plots after each rainfall that was sufficient to result in runoff. Soil samples were collected to a depth of three feet immediately after herbicide application and at 1, 2, 3, 5 and 11 months after application. The experimental site was on a Maury silt loam soil with a slope of about 9%. This is a well drained soil on which it has been shown that most water percolation occurs rapidly through large pores.

RESULTS

Only small quantities of each herbicide were found in the surface runoff water during each year of the study (Table 1). Total herbicide loss in surface runoff water was no more than, and usually much less than, 0.4% of that applied in any year or tillage method. More water moved off the conventionally tilled and no-till treatments compared to the reduced tillage, and as a result, more of the herbicides were detected in the runoff water from these plots compared to the others. Herbicides were most susceptible to moving in the runoff water immediately after application. Of the total herbicides found in surface runoff water, over 90% was collected during the first month after application. Runoff during the first month in 1986 was from a one-inch rainfall within 24 hours after application. In 1987, runoff during the first month occurred 7, 21, 28, and 31 days after application from 0.5, 1.6, 1.5, and 1.7 inches of rainfall, respectively.

Most of the herbicides remained in the top 8 inches of soil in each year of this study (Table 2). None of the herbicides were detected below 8 inches in the 1986-87 growing season. However, there was some movement of herbicide into the 16 to 24 inch depth in the 1987-88 growing season. The herbicide detected most often at the lower depths was Princep and this was attributed to the greater persistence of this herbicide compared to Atrazine and Bladex.

Results from these studies suggest that these triazine herbicides which are so widely used on corn do not readily move from the site of application, and the quantities that do move are very low. Further, none of the herbicides were detected in the soil below 24 inches during this two year study.

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Table 1. Herbicide loss in runoff water in the 1986-87 and 1987-88 growing season.

Tillage	Atrazine	Bladex	Princep
	--------(percent of applied)------		
1986-87			
Conventional	0.14	0.09	0.13
Chisel	0.07	0.06	0.06
No-till	0.10	0.12	0.10
1987-88			
Conventional	0.26	0.07	0.34
Chisel	0.01	0.01	0.03
No-till	0.01	0.004	0.02

Table 2. Triazine herbicide concentrations in the soil during the 1987-88 growing season.[1]

Months after Application	Soil Depth	Tillage		
		CT	RT	NT
	(in)	---(parts per million)---		
0	0-8	0.883	0.386	0.140
1	0-8	0.050	0.032	0.052
1	9-16	0.001	0.0014	0.003
1	17-24	0	0.0003	0.0011
2	0-8	0.054	0.023	0.021
2	9-16	0	0	0.0017
2	17-24	0	0	0.0006
3	0-8	0.037	0.024	0.009
5	0-8	0.036	0.011	0.009
11	0-8	0.009	0.008	0.003

[1]Concentrations are averages of Atrazine, Bladex and Princep. Only those depths at which herbicides were detected at any sampling time are shown.
CT=conventional, RT=reduced (chisel), NT=no-tillage.

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