

Strategies to reduce diffuse sources of herbicides and nutrients into surface water

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Abstract

The objective of this study was to quantify soil loss and losses of herbicides and nutrients (N, P) from diffuse sources like surface runoff, interflow and tileflow from a slopy (7 %) agricultural area in Germany (Haarstrang, Northrhine-Westfalia) during a 5 years longing field study (1997 – 2002) with crop cultures such as corn, rape and wheat, managed under 3 different tillage systems (conventional-tillage, conservation tillage, no-tillage). For each type of tillage where field erosion plots with drainage systems ($n = 2$) were installed, an automated device for surface runoff and soil loss measurements was developed to answer the main questions of the study. How much water and soil does run off the field erosion plots? Which quantities of applied herbicides and nutrients (N, P) will be washed out, and in which concentrations? During the complete field study the highest mean surface runoff was up to 8 % of precipitation for one rainfall event under conventional tillage, and up to 2 % under conservation tillage. No registered surface runoff occurred under the no-tillage-system. Under conventional tillage with rape culture the mean soil loss was up to 3 t/ha/a^{-1} , with corn up to $1,3 \text{ t/ha/a}^{-1}$ and with wheat up to $0,01 \text{ t/ha/a}^{-1}$. There were no evidential freights of soil sediment within interflow and tileflow. Highest mean losses of applied herbicides and nutrients (Chlortoluron and Isoproturon $0,01 \text{ g/ha/a}^{-1}$, Metazachlor $1,15 \text{ g/ha/a}^{-1}$, Metolachlor 1 g/ha/a^{-1} , Pendimethalin $0,6 \text{ g/ha/a}^{-1}$, Terbuthylazin $1,5 \text{ g/ha/a}^{-1}$, N $0,4 \text{ kg/ha/a}^{-1}$, P $0,1 \text{ kg/ha/a}^{-1}$) are being determined under conventional tillage. Conservation tillage and no-tillage markedly reduced sediment, herbicide and nutrient losses between 70 – 100 % in all crop cultures after 5 years of field study. Maximum concentrations in surface runoff for chlortoluron and isoproturon in dissolved matter occurred between $1 - 8 \mu\text{g/l}$, for metazachlor, metolachlor and terbuthylazin $87 - 98 \mu\text{g/l}$, for pendimethalin $1,4 \mu\text{g/l}$, for nitrogen 37 mg/l and for phosphorus until 1 mg/l . Appeared concentrations for chlortoluron and isoproturon, metazachlor, N and P within interflow and tileflow were approximately as high as evident concentrations in surface runoff. On account of undefinable watersheds of the drainage system, it was unable to calculate quantities of herbicides and nutrients.

Author keywords: field study, tillage system, surface runoff, herbicide and nutrient loss