Comparing the environmental impact of herbicides

A recent study has compared the chemical environmental impacts of using the weed controller glyphosate on glyphosate-tolerant (GT) crops, with the use of other herbicides on non-GT crops. Glyphosate used on GT crops had lower environmental impacts than herbicides used on non-GT crops, but the persistence of AMPA (a break-down product of glyphosate) in soils could be a problem in the future.

Glyphosate is considered less harmful than other herbicides since it is rapidly broken down after application making it less persistent in the environment. However, young crops are normally sensitive to glyphosate. To help overcome this problem, some crops have been genetically modified to be resistant to glyphosate. Using glyphosate on these crops may reduce overall environmental impacts from herbicides, depending on the quantity of glyphosate used in the long term, as there may be less use of other, more harmful, herbicides on non-GT crops. However, more information about the potential toxicity and environmental impact of break-down products from herbicides is needed before robust conclusions can be drawn.

The study compared the environmental impacts of weed control using glyphosate on GT oilseed rape, GT sugarbeet and GT maize with the impacts of the most commonly used herbicides applied to non-GT crops: sulcotrione on maize, metamitron on sugarbeet and trifluralin and metazachlor on oilseed rape. Three main break-down products from different herbicides were also included in the assessment: AMPA from glyphosate; CMBA from sulcotrione; and M4 from metazachlor.

The long-term fate of the herbicides and their break-down products in the soil, air and groundwater were modelled over a twenty year application period based on various rotational scenarios of actual cropping systems. Previous studies by the researchers had found that the model compared well with actual field trials and could be used to estimate concentrations of herbicides and their break-down products under various local soil and climate conditions, as was done in this study. These estimated concentrations were used to model the overall impacts of the herbicides and their break-down products on freshwater, terrestrial ecosystems and human health, based on the potential toxicity of these chemicals to different organisms. The potential toxicity of AMPA, CMBA and M4 was assumed to be the same as that of their parent compound.

The type of soil significantly affected the persistence of all herbicides and their break-down products, suggesting comparisons between the effects of herbicides should only be made under similar soil conditions. Of all herbicide break-down products, AMPA had the longest persistence time in all the test soils, and accumulated most where GT crops were grown frequently.

Although the field trials and modelling demonstrated that glyphosate did not leach under the root zone for any of the cropping systems, there was significant leaching of AMPA. The amount of AMPA that could reach groundwater from all three soil types studied would be higher than sulcotrione; higher than CMBA and metamitron in two of the three soils, and lower than M4 in all the soils.

Overall the study demonstrated that farming systems that used glyphosate were considered to have less impact on human health (in terms of exposure through food and water ingestion and respiratory intake), and on the groundwater and air compartments than those relying on other herbicides. Further research is needed on the fate and toxicity of AMPA, as larger applications of glyphosate could occur, especially on GT-maize, which would lead to increased accumulation of AMPA in the environment. The study assumed the toxicity of AMPA to be the same as glyphosate, but if further research suggests that AMPA is more toxic than glyphosate, this could cancel some of the benefits of using glyphosate as a weed controller.

Contact: laure.mamy@versailles.inra.fr or benoit.gabrielle@agroparistech.fr or barriuso@grignon.inra.fr
Theme(s): Agriculture, Chemicals