GLOBAL THREATS: CONTAMINATION OF SURFACE WATERS BY AGRICULTURAL INSECTICIDES

The use of agricultural insecticides — toxic substances developed to target and kill insects that damage crops — has sparked controversy since the dawn of the "chemical age", which started in the 1950s. The benefits of agricultural insecticides — for example, increased food production — are undeniable. Unfortunately, along with benefits, there are considerable unwanted effects. Ideally, insecticides must be lethal to the target insects, but not to non-target species. However, these toxic substances do not target only insects — they target many more organisms, including man. Thus, the toxic brew of agricultural insecticides threatens the ecological integrity of aquatic and terrestrial ecosystems. Indeed, agricultural systems play a significant role in global environmental degradation — among other harmful effects, they drive the loss of aquatic biodiversity.

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In 2013, a team of researchers from German and Australian institutions showed that the loss of aquatic biodiversity in regions of Germany, France, and Australia, is primarily due to the disappearance of several groups of species — stoneflies, mayflies, caddisflies, and dragonflies — which are especially susceptible to insecticides. These insects are important members of the food chain right up to fish and birds. Despite these worrisome results, the degree of insecticide contamination worldwide was unknown until two weeks ago, when results from a new study (Agricultural insecticides threaten surface waters at the global scale) showed that surface water pollution resulting from the current use of agricultural insecticides constitutes an excessive threat to aquatic biodiversity.

For the new study, researchers at the Institute for Environmental Science of the University of Koblenz-Landau evaluated, for the first time, comprehensive global insecticide contamination data for agricultural surface waters.

They examined 838 studies conducted between 1962 and 2012 and covering 2,500 aquatic sites in 73 countries, using the legally-accepted regulatory threshold levels (RTLs) as defined during the official pesticide authorization procedures.

The researchers found that insecticide contamination occurs rarely in the aquatic environment — only an estimated 2.6% of the samples contained measurable levels of insecticides. However, for the sites containing insecticides, the results were alarming — more than 40% of the water-phase samples, and more than 80% of sediment samples in which insecticides were detected, yielded concentrations that exceeded the respective RTLs. They concluded that insecticides pose substantial threats to the biodiversity of global agricultural surface waters and that the current regulatory risk assessment schemes and pesticide authorization procedures fail to protect the aquatic environment.

Ralf Schulz, one of the researchers, said in a press release: “Potential reasons for these findings are failures of current risk assessment procedures, or the non-adherence of farmers to pesticide application prescriptions.”

It is likely that the global picture emerging from the study downplays the actual impact of insecticides. Indeed, according to the researchers, data on insecticide contamination could be retrieved for only about 10% of global agricultural surface waters — thus, at this time, there is no scientific knowledge on the extent of insecticide contamination of surface waters in large parts of the world, especially

Russia and South America. Moreover, contamination of surface waters may occur at high concentrations only during a few days per year (short-term peaks) and, therefore, may go undetected. However, these short-term peak concentrations occur repeatedly and, due to the high toxicity of insecticides for aquatic organisms, lead to substantial and long-lasting adverse effects on aquatic communities. In addition, more than 80% of the samples analyzed for the presence of various pesticides contained more than one (and in some cases even up to 30) different pesticides. The resulting adverse effects of these pesticide mixtures could be substantially higher when compared to those of single compounds. These additive or synergistic effects are not considered in the current regulatory risk assessment procedures.

What are possible ways to meet the twin challenges of providing sufficient food for a growing human population and reversing the adverse impacts of agricultural pesticides on global ecosystems such as surface waters? The researchers suggest fundamental reforms of the global conventional agricultural systems and the adoption of promising approaches from organic farming.

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