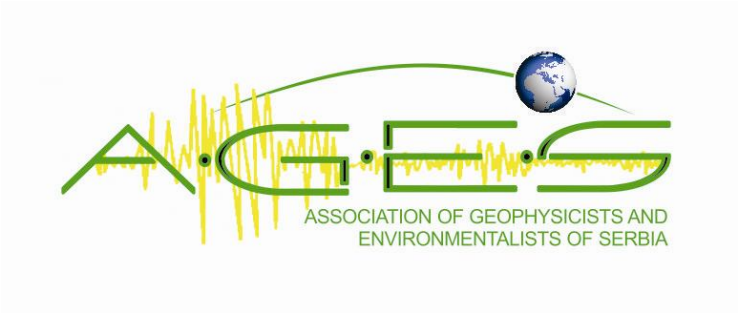

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Pesticides in geoenvironment and influential factors on health

Jovana Milosavljevic*, Maja Todorovic, Marina Cuk

Summary

Pesticides are an essential part of environment, due to intensive application of them, their residues are frequently detected in nature, surface water and groundwater, especially in soil. When pesticides and their products come to atmosphere, surface water or groundwater, they enter a hydrological cycle and thus move together with air, water and soil particles. They come to surface water and groundwater from atmosphere and soil, by discharge or drainage owing to precipitation, or by watering as well as by infiltration of groundwater or surface water. Regardless of the form in which pesticides are applied, they mostly come to soil, thus it is the environment in which the most essential pesticide changes occur. Continuous monitoring of pesticide content in soil and water is highly significant in order to act and react on time, because consequences of uncontrolled pesticide application on biocenose and man are serious and must not be neglected. Poisoning by organochlorine compounds can be lethal, poisoning by carbonates is manifested by the paralysis of respiratory organs while triazine compounds are cancerous.

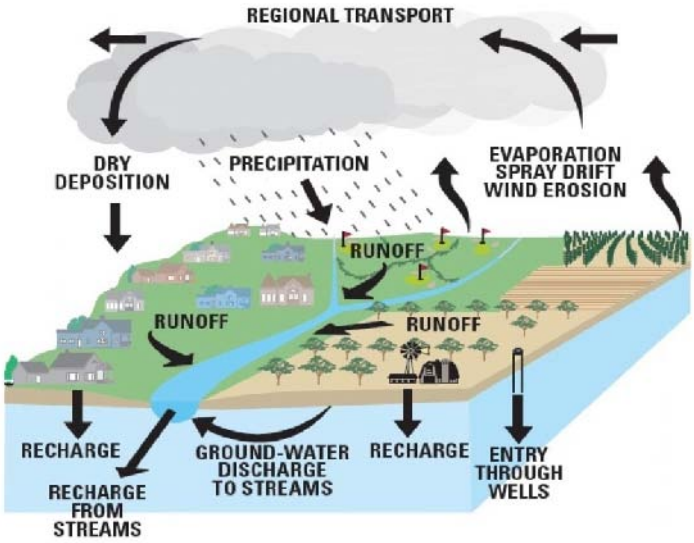
Introduction

Pesticides denote a common term for a large number of various, most frequently organic compounds which act biologically on specific plant and animal species and other organisms. Unlike the majority of pollutants which are carried into the environment without specific aim, pesticides are carried in with the purpose to help man to increase yield in agriculture, to protect grown plants and repel harmful organisms. The uncontrolled application of pesticides results in undesirable consequences on human health, useful insects, and animals, thus the control of pesticides in food, water and soil is necessary. The basic classification of pesticides is carried out on the basis of the purpose of pesticides, namely according to kind of harmful organisms that are repelled or prevented. According to this classification pesticides are divided into three large groups: zoocides- pesticides used for repelling animal species; fungicides-pesticides used for repelling of microorganisms; herbicides-pesticides for killing weed (Mojasevic M. et al., 1999). In addition to this classification, it is significant to emphasize the pesticide classification on the basis of acute toxicity according to criteria of the World Health Organisation (WHO) where, there have been singled out: extremely toxic, highly toxic, intermediate toxic and low toxic pesticides.

Basic ways of pesticide spreading

Pesticides, like all chemical compounds are included in the process of matter and energy cycling. The length of cycling of various compounds is varied, and unstable compounds do not pass through all cycling phases, thus pesticides with high volatilization and low chemical persistence disintegrate relatively fast and do not accumulate in an environment, while stable and lipophilic pesticides accumulate highly intensively in hydrobionts. Pesticides enter the hydrologic cycle from point sources which are characterised by specific release into environment at one point (pesticide plants, spilling and pouring out of pesticides, waste dumps, wastewater treatment plants) and from nonpoint sources being diffuse and distributed widely. Nonpoint sources are prevailing pesticide sources entering surface water and groundwater – water discharge into streams from agricultural and town land, pesticide leaking into groundwater in the areas where it is used, pesticide precipitation from the atmosphere (Giliom R. et al., 2006).

When pesticides and their products come to the atmosphere, surface water and groundwater enter the hydrological cycle and move together with air, water or soil particles depending on physical and chemical characteristics of pesticides (Figure 1).



Water	Lindane	Aldrin	Heptachlorine	DDT
Danube	0.450	0.030	-	-
Sava	0.550	-	-	-
Tisa	0.199	0.030	-	0.021-0.033
Begej	0.490-0.552	-	-	0.020-0.047
Tamiš	0.490	-	0.004	0.02-0.03

conductivity of an aquifer are high, which enables relatively fast movement (Milosavljevic J., 2011). Deep groundwater is mainly less contaminated by pesticides than shallow water as it takes water long time from the surface to reach deep groundwater. Also, deep aquifers are frequently protected by overlying layers of low permeability which additionally decelerates movement, resulting in rare occurrence of pesticides in deep groundwater (Giliom R. et al.2006).
Regardless of the way and form of the application of pesticides they, mostly, enter the soil, and it represents media in which the most essential changes of pesticides occur. The interaction of soil with both surface water and groundwater is highly significant because washing away from treated land is direct danger for their contamination, quality and the survival of biocenosis (surface water). For all this reasons, continuous monitoring of pesticide content in soil is required.

Since 2005 the Soil Contamination Investigation Programme on the territory of Belgrade has been realized within which the content of some pesticides has been determined. In the latest realized Soil Contamination Investigation Programme on the territory of Belgrade in 2010 the investigation of the content of hazardous and harmful materials in soil, in surroundings of public fountains with spring water was brought into focus, as well as the investigation of soil in the sanitary protection zone of the Belgrade water system source. Results of analyses of 66 soil samples on 33 locations indicate to increased concentrations of some parameters, most frequently of DDT (in 19 examined samples) which in addition to soil contamination can have impact on the contamination of the Belgrade water system source (Secretariat for Environmental Protection and City Institute for Public Health, 2010). Within the sanitary protection zone of Belgrade water system source, in the area of Usce, the presence of DDT residue was recorded in three soil samples in concentrations of 17.0-85 mg/kg, which is relevantly higher in relation to the limit value for DDT and its metabolites being 0.01 mg/kg (Regulations on Allowed Concentration of Hazardous and Harmful Matters in Soil and Water for Watering and Methods of their Investigation, Official Gazette of RS, Vo 23/94). Such high concentrations of DDT residue, nevertheless of the fact that its application was abandoned a decade ago pointed out that this organic pollutant is an essential soil pollutant as its application left long-term consequences. Additionally, the DDT presence in soil samples from this location is hazardous as well due to the possibility of easy transfer to groundwater with what its quality suffers. In soil samples in the neighbourhood of public fountains, there has been determined the increased content of hazardous and harmful matters which can lead to the deterioration of drinking water quality and potentially endanger health of consumers. DDT residues have been detected in 13 samples in concentrations of12.0-834.0 mg/kg. The most significant deviations have been specified in the surroundings of the Hajducka cesma fountain in Kosutnjak park, which is in relation with unfavourable impacts of washing away during precipitation from higher parts of Kosutnjak in the direction of the fountain. Analyses carried out in the year 2010 have pointed out that in water of the Hajducka cesma fountain there is no DDT content exceeding which was detected in soil, but the question is whether or when the soil contamination in the surroundings can have a negative impact on the quality of drinking water from this facility visited by lot of people. Although DDT concentrations in some samples exceed the limit value for uncontaminated soil prescribed by the Regulations, they are significantly lower than values requiring the application of a soil remediation procedure. However, unless wide measures are undertaken with the result of both soil and indirectly water contamination reduction, concentrations of hazardous and harmful matters can reach remediation level fast.

Impact of pesticide on human health and consequences of pesticide application

Harmful effects of pesticides are consequences of irrational and unprofessional handling, as well as misuse or accidents thereby victims are people, animals and environment. Numerous examples indicate that pesticides brought into the labour and the environment, endanger humans and other living beings in direct contact, when staying in any of the fields, entering the body through the sprayed fruit, etc. Consequences of pesticide application on biocenosis and man are serious and must not be neglected. Poisoning by organochlorine matters is characterized by serious final outcome from convalescence via hard health damages to decease. Lethal outcome occurs most frequently at accidental ingestion, more rarely as a consequence of inhalation. In both cases immediate cause of death is the function failure of vital centres in the form of paralysis of a respiratory centre, asystolia or

lung oedema. Carbamates are selective herbicides and insecticides that are being used more and more. The main way of carbamate enter into an organism is via the digestive tract, and more rarely via the respiratory system. Irritated effects on skin and a mucous membrane of the respiratory tract and even a comatose state and the paralysis of the respiratory centre which can end lethally are typical for the effect of carbamates.

Poisoning by triazine compounds (atrazine, amozine, simazine, amitrole, comarole) is a frequent phenomenon in practice. These matters are in crystalline state, they are poorly soluble and resistant to diluted acids. The ways of penetrating into an organism and a clinical picture of acute and chronic poisoning are similar to halogen carbon-hydrogen derivates. Their specificity is that in experimental conditions they show cancerous properties (Amidzic B., Biocanin R., 2005).

Numerous examples of mass poisoning by pesticides such as poisoning by well-marked wheat in Iraq in the years 1955-1959 and in the year 1971 when a pesticide on the basis of mercury (Granosan) was used point to the threat of pesticides for human health. The outcome of this case is 200 dead, while permanent consequences (blindness, deafness, constant fatigue, tremor, etc.) have been noticed with survivors. Owing to the consequences of poisoning by methylisocyanate in the Indian town of Bhopal 1500 people died and 200 000 people survived but with permanent damages in 1984.

Pesticides in drinking water are a great threat, therefore the EU Drinking Water Directive requires that pesticide concentration in water does not exceed 0.1 μg/l of a single pesticide in drinking water and 0.5 μg/l of all pesticides in water (98/83/EC). In spite of that, examples related to pesticides in drinking water are not rare. Although atrazine was forbidden in France as early as 1995 the concentration did not fall at 52% measuring points. Intensive poisoning was recorded on 35% locations there. In the year 2001 pesticides were detected at 27% sources in Denmark, and in the year 2000 about 9% sources were poisoned and useless according to law in Great Britain (Environment Agency, 2002).

Conclusion

Nowadays more than 55 000 various chemical compounds, products of chemical activity of man are known to enter the environment in various ways. The share of pesticides and their metabolites is only about 0.9%. However, consequences of uncontrolled application of pesticides are significant and must not be neglected, which is proved by examples of mass poisoning by pesticides with lethal outcome, and by examples of contaminated sources of drinking water which represent the basis for the existence of people. In order to reduce the number of examples of this kind, it is necessary to establish monitoring which will include monitoring of pesticide content in water, air, and soil (in hydrological cycle, pesticides move through these media and their relation is direct) that will enable adequate reaction right on time but also draw up programmes for better making and handling of pesticides in order to avoid harmful consequences owing to accidents and unprofessional handling with them.

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