

## **Appendix 3: Association of pesticides with crops and crop types**

(After WHO, 2004a)

A wide range of pesticides can potentially be found in drinking-water, usually at very low concentrations. Because chemical analysis can be difficult, common practice is to determine what substances are used in the catchment, and thus determine the monitoring and other risk management practices that are needed. However, the nature of pesticide use is such that concentrations in surface water may be very variable and intermittent. Any monitoring will require careful planning if it is to generate useful data. Some pesticides are not very mobile in soil and, if found in water, they may be adsorbed to particulate matter. Many of the pesticides in current use are broken down rapidly in the environment.

In many countries, groundwater in agricultural areas contains very low concentrations of pesticides, which are not of concern to health. Generally, pesticides in groundwater at levels that are of concern to health occur only at sites where open wells allow pesticide-contaminated runoff to be washed directly to the watertable, or where large volumes of pesticides have been mixed and spilt on bare soil where the water table is very shallow. The risk of pesticides being present at high concentrations can usually be assessed through a detailed sanitary survey of an area. Chemical analysis for pesticides is generally not necessary; also, it is expensive and beyond the analytical capacity of many countries. Pesticides used in paddy fields can be a particular problem where there is overflow or drainage into water bodies that may be used as drinking-water sources.

Three of the pesticides considered in the World Health Organization's (WHO's) *Guidelines for Drinking-water Quality* (WHO, 2004b) — chlorpyrifos, dichlorodiphenyltrichloroethane (DDT) and its metabolites, and pyriproxyfen — are used as larvicides to control the aquatic larval stages of insects of public health significance. In considering these chemicals, a suitable balance needs to be struck between the protection of drinking-water quality and the control of insects of public health significance. However, it is important that every effort should be made to keep the concentration of any larvicide as low as is reasonably possible.

This appendix lists various crops, together with the insecticides and herbicides that may be associated with their production. It thus provides a starting point for determining the pesticides of interest in a particular catchment. Such a listing cannot be definitive; for example, sometimes a pesticide may be used that is not specifically recommended for control in a particular crop. This situation can occur for various reasons, such as lack of access to more appropriate pesticides.

Once the pesticides of interest have been determined, it is then necessary to examine the type of application, the likely weather conditions, the nature of the soil and water sources, and the chemical nature of the pesticide (i.e. stability, octanol–water coefficient, binding, water

solubility and, where appropriate, binding capacity to soil organic matter), to determine the risk that the chemical will reach water sources. This is discussed in Section 5 of Chapter 5.

The pesticides considered in Table A3.1 are those for which the WHO has set guideline levels in drinking-water. The crops included were chosen based on the world's 30 major crops, on a harvested area basis, according to 2002 statistics from the Food and Agriculture Organization of the United Nations (FAO).

Table A3 only shows the known, major uses for particular pesticides. There will also be many minor uses of each pesticide, not stated in the literature because the manufacturers consider the use to be insignificant. In general, similar suites of pesticides are used on different crops in a related group. For example, many more sorghum pesticides may be used on millet than is shown in the table, and similar pesticides are likely to be used on chickpeas and cow peas. The table is also based on approved or recommended uses for each pesticide. In countries where pesticide use is poorly regulated, farmers and growers might use a much greater range of pesticides on each crop than is shown, particularly if the pesticides do not cause unacceptable damage to the crop. In particular, many insecticides could be used on a much wider range of crops than is shown, without damage to the crops (unlike herbicides). It is possible that most of the insecticides shown in Table A3 could be used on most of the crops shown.

For these reasons, in areas where current and past pesticide use is not well documented, it is best to develop standard suites of pesticides for analysis, including as many of those shown in the table as possible and in particular all the insecticides. The whole suite should then be used during analysis.

**Table A3.1 Association of insecticides and herbicides with crops and crop types**

<b>Crop</b>	<b>Insecticides</b>	<b>Herbicides</b>
<i>Cereals</i>		
Barley	aldrin <sup>a</sup> ; dieldrin <sup>a</sup> ; dimethoate; lindane	chlorotoluron; cyanazine; 2,4-D; 2,4-DB; dichlorprop; isoproturon; MCPA; MCPB; mecoprop; pendimethalin
Maize	aldicarb; aldrin <sup>a</sup> ; dieldrin <sup>a</sup> ; carbofuran; lindane	alachlor; atrazine; cyanazine; 2,4-D; fenoprop; metalochlor; pendimethalin; simazine; terbuthylazine
Millet	1,3-dichloropropene	2,4-D
Oats	aldrin <sup>a</sup> ; dieldrin <sup>a</sup> ; dimethoate; lindane	cyanazine; 2,4-D; 2,4-DB; dichlorprop; MCPA; MCPB; mecoprop; pendimethalin
Rice (paddy)	carbofuran; dimethoate	2,4-D; MCPA; MCPB; molinate; pendimethalin
Rye	dimethoate; lindane	chlorotoluron; 2,4-D; 2,4-DB; dichlorprop; isoproturon; MCPA; MCPB; mecoprop; pendimethalin
Sorghum	aldicarb; carbofuran	atrazine; 2,4-D; metalochlor; pendimethalin; terbuthylazine
Wheat	aldrin <sup>a</sup> ; dieldrin <sup>a</sup> ; dimethoate; lindane	chlorotoluron; cyanazine; 2,4-D; 2,4-DB; dichlorprop; isoproturon; MCPA; MCPB; mecoprop; pendimethalin
<i>Fibre crops</i>		
Flax fibre and tow	1,3-dichloropropene	MCPA; trifluralin
Seed cotton	aldicarb; aldrin <sup>a</sup> ; dieldrin <sup>a</sup> ; carbofuran; dimethoate; endrin <sup>a</sup>	alachlor; cyanazine; metalochlor; pendimethalin; trifluralin
<i>Fruits</i>		
Apples	1,2-dichloropropane <sup>a</sup> ; 1,3-dichloropropene; dimethoate; lindane; methoxychlor <sup>a</sup>	2,4-D; pendimethalin; simazine
Bananas	aldicarb; carbofuran	simazine
Citrus fruits	aldicarb; dimethoate	metolachlor; pendimethalin; simazine; trifluralin
Grapes	1,2-dichloropropane <sup>a</sup> ; 1,3-dichloropropene; carbofuran; dimethoate; lindane; methoxychlor <sup>a</sup>	2,4-D; metolachlor; pendimethalin; simazine; terbuthylazine; trifluralin
<i>Oilcrops</i>		
Coconuts		2,4,5-T
Groundnuts in shell	aldicarb; carbofuran; 1,2-dichloropropane; 1,3-dichloropropene; ethylene dibromide	alachlor; 2,4-DB; MCPB; metalochlor; pendimethalin; trifluralin

<b>Crop</b>	<b>Insecticides</b>	<b>Herbicides</b>
Oil palm fruit		simazine; 2,4,5-T; terbuthylazine
Olives	1,2-dichloropropane <sup>a</sup> ; 1,3-dichloropropene	simazine; terbuthylazine
Rapeseed	carbofuran; lindane	alachlor; cyanazine; simazine; trifluralin
Soybeans	aldicarb; carbofuran	alachlor; cyanazine; 2,4-DB; metalochlor; pendimethalin; trifluralin
Sunflower seed	carbofuran; lindane	alachlor; metalochlor; pendimethalin; trifluralin
<i>Pulses</i>		
Beans (dry)	aldicarb; 1,2-dichloropropane <sup>a</sup> ; 1,3-dichloropropene; dimethoate; lindane; methoxychlor <sup>a</sup>	cyanazine; pendimethalin; simazine; terbuthylazine; trifluralin
Chick-peas	dimethoate	cyanazine; MCPA; MCPB; pendimethalin; simazine; terbuthylazine; trifluralin
Cow peas (dry)	1,2-dichloropropane <sup>a</sup> ; 1,3-dichloropropene; dimethoate; methoxychlor <sup>a</sup>	cyanazine; MCPA; MCPB; pendimethalin; simazine; terbuthylazine; trifluralin
<i>Roots and tubers</i>		
Cassava	dimethoate	metolachlor; pendimethalin
Potatoes	aldicarb; aldrin <sup>a</sup> ; carbofuran; 1,2-dichloropropane; 1,3-dichloropropene; dieldrin; endrin <sup>a</sup> ; ethylene dibromide; dimethoate	cyanazine; MCPA; metalochlor; pendimethalin; terbuthylazine
Sweet potatoes	aldicarb; 1,2-dichloropropane; 1,3-dichloropropene; methoxychlor <sup>a</sup>	
<i>Sugar crops</i>		
Sugar beet	aldicarb; carbofuran; 1,2-dichloropropane; 1,3-dichloropropene; ethylene dibromide; dimethoate; lindane	metalochlor; trifluralin
Sugar cane	aldicarb; carbofuran	alachlor; atrazine; cyanazine; 2,4-D; fenoprop; metalochlor; simazine; terbuthylazine; trifluralin
<i>Vegetables</i>		
Cabbages	1,2-dichloropropane <sup>a</sup> ; 1,3-dichloropropene; dimethoate; lindane; methoxychlor <sup>a</sup>	metolachlor; trifluralin
Onions	1,2-dichloropropane <sup>a</sup> ; 1,3-dichloropropene; lindane	trifluralin
Tomatoes	1,2-dichloropropane <sup>a</sup> ; 1,3-dichloropropene; dimethoate; lindane; methoxychlor <sup>a</sup>	trifluralin
<i>Other crops</i>		
Cocoa beans	dimethoate; lindane	simazine; terbuthylazine
Coffee (green)	aldicarb; carbofuran; dimethoate	simazine; terbuthylazine

Crop	Insecticides	Herbicides
Natural rubber		simazine; 2,4,5-T; terbuthylazine

a Superseded pesticides (materials believed to be no longer manufactured or marketed for crop protection use).

## References

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