

Biomonitoring has been used in assessing exposure of persons using small application devices inside residences, where exposures are considerably less and occur over a longer period than in an open-field agricultural use (Kreiger et al., 2001). Generally measurements indicate exposure more accurately as they reflect the extent of dermal absorption through the skin over the whole body and the effect of excretion of the pesticide. In addition to urinary monitoring, the possibility of using saliva samples to monitor exposure has been considered (Donovan et al., 2000; Fenske and Day, 2005). The Committee on Toxicology (COT) Working Group on Organophosphates considered whether single, prolonged or repeated exposure to low doses of organophosphate compounds (OPs) can cause long-term adverse health effects (Anon, 1999c). Other sources of information on assessing pesticide exposure include Chester (1993), Curry et al. (1995) and the International Centre for Pesticides and Health Risk Prevention, a Collaborating Centre on Occupational Health, specialising in pesticides, which is based in Milan, and publishes a newsletter Pesticide Safety News in English, Italian and Spanish.

First aid If a spray operator becomes ill, while working, the doctor must be informed of the name of the active ingredient and given as much information as possible by showing the doctor a leaflet or label about the chemical. Treatment by a doctor will depend very much on the type of poisoning. When using an organophosphate or carbamate (anticholinesterase), an injection of atropine is useful, but suitable antidotes for organochlorine poisoning are not available. A person, who has ingested liquid that contained paraquat, can be treated by ingesting large quantities of Fuller's earth, which absorbs the herbicide. Morphine should not be given to patients affected by pesticide poisoning. A first-aid kit and a supply of clean water for drinking and washing any contaminated areas of the body should be readily available. Some of the symptoms of poisoning such as a headache may be due to effects of working for a long period in direct sunlight without sufficient protection, such as wearing a hat, and to dehydration by not drinking sufficient water. On large-scale spraying programmes first-aid kits should be carried in vehicles and aircraft. People regularly involved in applying organophosphate pesticides should have a routine medical examination to check the cholinesterase levels in their blood plasma. A cholinesterase monitoring rule was introduced in Washington State, USA, in 2004 as there was concern about the effect of organophosphate and N-methyl carbamate sprays being applied. During 2004, following baseline tests carried out on 2630 employees, 20% of the 580, who were monitored, experienced cholinesterase depression, necessitating the employer to evaluate pesticide handling practices. By 2010, the number with cholinesterase depression has been reduced to 3%, indicating that the programme had enabled the state authorities to monitor worker safety and health better. The monitoring was not linked to any specific pesticide, application method or crop being treated, but some of the poisonings occurred following the use of tractor-mounted air-blast orchard sprayers. Irrespective of the cause of poisoning, it emphasised the importance of engineering controls and working practices, including correct protective clothing to minimise exposure. A change to using less-toxic pesticides is indicated whenever possible as this would reduce the need for routine monitoring. In many countries there are dedicated poisons centres from which medical doctors can get advice on treatment. Information about poison centres in the USA are given by Calvert et al. (2010). There are also web pages giving advice such as <http://www.ccohs.ca/oshanswers/chemicals/pesticides/firstaid.html> and

<http://psep.cce.cornell.edu/Tutorials/core-tutorial/module10/index.aspx> In contrast some tropical countries lack the expertise (Ngowi et al., 2001a), yet it is in these countries that some of the most toxic pesticides are still used without trained staff. Thus occupational poisoning has continued to be a serious problem among farm workers, for example, those in the coffee growing areas of Tanzania (Ngowi et al., 2001b).