IFCS

Acutely Toxic Pesticides

Submitted to IFCS Workgroup by

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Initial Summary of the Main Factors Contributing to Incidents of Acute Pesticide Poisoning

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OVERVIEW OF FINDINGS

Cholinesterase-inhibiting pesticides (i.e. organophosphates and carbamates) have been identified as the most common causes of severe acute pesticide poisonings, some of which have resulted in deaths. The cholinesterase-inhibiting pesticides identified as causal agents in these poisonings often belong to WHO Classes Ia (extremely hazardous) and Ib (highly hazardous). Paraquat (WHO Class II, moderately hazardous) and endosulfan (WHO Class II) have also been recognized as frequent causes of severe acute pesticide poisoning, including fatal ones. The use of mixtures of pesticides is commonly observed, and it is also related to higher incidence of pesticide poisonings.

In developed countries, these hazardous pesticides are either banned or strictly controlled, and agricultural workers who handle these pesticides are supposed to wear protective equipment. However, studies in developing countries show that farmers use very hazardous pesticides with little or no protective equipment. They usually spray using backpacks, which often leak, resulting in the skin and clothing being soaked with pesticides. Furthermore, developing-country agricultural workers often spend long hours in the fields, mixing and spraying pesticides, or working in areas where spraying is taking place. In addition, washing facilities are rarely located near the agricultural fields, and workers therefore wear contaminated clothing throughout the day, and eat, drink, and smoke with contaminated hands.

The practices described above are all quite common in developing countries and have all been identified as risk factors of pesticide poisonings. A commonly recommended solution is to provide health education and training to promote the use of protective equipment and teach farmers to handle pesticides carefully. However, there is no linear relationship between the transfer of knowledge and a change in behavior, as many of the factors that contribute to pesticide poisonings in developing countries are out of workers' control (e.g., use of backpacks to spray, hot and humid climate that makes it almost impossible to wear protective equipment). Some researchers argue that different approaches are needed to prevent acute pesticide poisonings, such as banning the most highly toxic pesticides as well as implementation of alternative agricultural methods to reduce the use of pesticides.

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1. PESTICIDES IDENTIFIED IN THE OCCUPATIONAL PESTICIDE POISONING INCIDENTS AND HEALTH EFFECTS OBSERVED[1]

1.1. Cholinesterase-inhibiting Pesticides (Organophosphates and Carbamates)

Several studies found that cholinesterase-inhibiting pesticides were the class of pesticides most commonly reported as being responsible for poisonings (Keifer et al., 1996a; McConnell and Hruska, 1993; Wesseling et al., 1993, 2000)

The following are the names of the cholinesterase inhibiting pesticides identified in the studies:

- Aldicarb – WHO Class Ia (Murray et al. in press; Wesseling et al., 2001a)
- Methyl parathion – WHO Class Ia (Martin Rubi et al., 1996; Murray et al., in press)
- Parathion – WHO Class Ia (Cole et al., 2000; Martin Rubi et al., 1996)
- Terbufos - WHO Class Ia (Murrray et al., in press)
- Carbofuran[2]– WHO Class Ib (Cole et al., 2000; McConnell and Hruska, 1993; Murray et al., in press)
- Methamidophos – WHO Class Ib (McConnell and Hruska, 1993; Martin Rubi et al., 1996[3]; Murray et al., in press)
- Methomyl – WHO Class Ib (Cole et al., 2000; Murray et al., in press)
- Monocrotofos – WHO Class Ib (Murray et al., in press)
- Chlorpyriphos – WHO Class II (Martin Rubi et al., 1996; Murray et al., in press)
- Etoprophos – Not classified (Murray et al., in press)

Commonly observed signs and symptoms of the cholinesterase-inhibiting pesticides documented in the articles were:

- Vomiting, nausea, diarrhea, abdominal pain, dizziness, headache, salivation, cold sweating, weakness, miosis, muscle fasciculation and tachycardia.

1.2. Paraquat

Paraquat, a widely used nonselective contact bipyridyl herbicide, is also known as an important cause of acute pesticide poisonings. The pesticide industry claims that paraquat is most unlikely to cause serious health problems under correct conditions of use. Some studies, however, found that occupational poisonings among agricultural workers are

[1] Many of the pesticides listed in this section are known to cause chronic health problems. Chronic effects can be developed through low-dose, long-term exposures. Chronic impairments also occur as a result of severe acute pesticide poisoning. For example, chronic effects on the central and peripheral nervous systems were reported among agricultural workers who had been previously poisoned by cholinesterase-inhibiting pesticides.

[2] Trade name: Furadan

[3] Data from Martin Rubi et al., include 20% suicide cases.

common (Murray et al., in press; Wesseling et al., 2001b) and can cause serious poisonings including deaths (Wesseling et al., 1997). [4]

Health effects of paraquat reported were as follows:

- Cases of fetal paraquat poisonings in Costa Rica presented either renal or liver impairment, followed by adult respiratory distress syndrome (ARDS) or pulmonary edema (Wesseling et al., 1997).

1.3. Endosulfan

Endosulfan, an organochlorine insecticide, has been identified as the cause of occupational poisonings both in developing countries and the developed world (Brandt et al., 2000; Murray et al., in press).

Information about the health effects of endosulfan experienced by the cases was not available in the articles reviewed, except for an article on two cases from the United States (Brandt et al., 2000). The poisonings resulted in a death and a permanent neurological impairment.

1.4. Mixtures

The use of mixtures is common in agricultural practices. Some studies, both in developing countries and the United States, showed that pesticide poisonings are often caused by mixtures of pesticides (Blondell, 1997; Cole et al., 2000; Keifer et al., 1996).

Information about which particular pesticides were in the mixtures involved in the incidents was not available.[5]

- A study in Nicaragua found that 38% of incidents involved a mixture of pesticides (Keifer et al., 1996a).
- A study in Ecuador shows that mixtures were more common than single products among cases (Cole et al., 2000).
- Data from California showed that the mixtures of pesticides were the top causal agent of agricultural pesticide illness across all categories (namely, systemic, eye and skin) (Blondell, 1997).

[4] Regarding the cause of the deaths, Wesseling and colleagues found that one out of eight occupationally related deaths with oral intake were correctly recorded, and four were recorded as "suicides". This is one example of how the cause of the deaths can be misclassified.

[5] A fatal case of endosulfan poisoning (Brandt et al., 2001) combined the pesticide with two less hazardous pesticides, acephate and maleic hydrazide. However, the method used for blood analysis could not detect either maleic hydrazide or acephate, only endosulfan I, endosulfan II, and endosulfan sulfate.

1.5 Other Classes of Pesticides

- Endrin was suspected of being linked with an increase in mortality among young males in the Philippines (Loevinsohn, 1989).[6]
- Aluminum phosphide was found as a causal agent of acute pesticide poisonings in Central America (Murray et al., in press).
- Although pyrethroid is not classified as being as hazardous as cholinesterase-inhibiting pesticides, it was reported to cause acute adverse effects among sprayers in China (Chen et al., 1991) and Ecuador (Cole et al., 2000).
- Dithiocarbamate fungicides and mancozeb were also found as causal agents of acute pesticide poisonings in Ecuador (Cole et al., 2000).

1.6. List of Pesticides Causing Acute Pesticide Illness: Experience from Surveillance in Central America

It is important to note that in Central America, efforts at designing and implementing surveillance systems became part of the activities in the PLAGSALUD project, a pesticide project coordinated by the Pan American Health Organization (PAHO) and sponsored by the Danish International Development Agency (DANIDA). PLAGSALUD and the ministries of health created a list of 12 most frequently reported pesticides that cause acute pesticide poisonings: aldicarb, aluminum phosphide, carbofuran, chlorpyriphos, endosulfan, etoprophos, methamidophos, methomyl, methylparathion, monocrotophos, paraquat, and terbufos (Murray et al., in press).[7]

1.7. Pesticides Identified in Accidental Poisonings and Self-poisonings

A conclusive statement cannot be made about the pesticides identified in accidental poisonings and self-poisonings, as a comprehensive review has not been done. However, the same pesticides identified as the causal agents of occupational poisonings were also recognized as the causal agents of the following food poisonings:

- Food contamination by endosulfan, resulting in 44 cases including one death, in India (Venkateswarlu et al., 2000)
- Food contamination by malathion (an organophosphate), resulting in 60 cases, including one death in India (Chaudhry et al., 1998)
- Food contamination by methamidophos (an organophosphate), which poisoned four people in Taiwan (Wu et al., 2001)

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[6] This study was published in 1989 and is accordingly outside the timeframe for the bibliography. It is included here, however, as this is an important example of how pesticide poisonings can be misdiagnosed and how the extent of the problems can be underestimated.

[7] The PLAGSALUD project conducted a region-wide underreporting study in 2000. Preliminary data analysis (not including the data from Honduras) showed that the vast majority (76%) of acute pesticide poisonings were work-related, followed by accidental poisonings and by suicides. It also indicated that rates of underreporting of pesticide poisonings were at least 98%.

- Accidental fatal poisoning of a nine-year old boy by paraquat through ingestion (Fernando, 1990).

The pesticides frequently used in self-poisonings are similar to those involved in occupational poisonings. Organophosphate pesticides were responsible for the majority of deaths, particularly in rural areas. Other pesticides included carbamates, organochlorines endosulfan and endrin, paraquat, aldrin, dieldrin, lindane, diquat, aluminium phosphide, zinc phosphide, thallium-containing rodenticides, propanil, glyphosate-surfactant herbicide ("Round-up"), the compounds abamectin and ivermectin, pyrethrins, and imazapyr (Eddleston, 2000).

2. WHO WAS AFFECTED?

Most of the statistical data for occupational poisoning in agriculture showed that male workers were affected more than women, except for two studies in Costa Rica (Wesseling et al., 1993; Wesseling et al., 2001a) and one study in the Republic of Korea (Shin et al., 1998). However, based on the results of intensified surveillance from an intervention project in South Africa, London and Bailie (2001) argue that the risks for pesticide poisoning for women appear to be underestimated.[8] In addition, the researchers who analyzed the data from the PLAGSALUD project in Central America (mentioned in section 1.6) also pointed out a gender bias (Murray et al., in press). As a field-based study in Indonesia showed, women are just as exposed to hazardous pesticides as men, if not more so, and also develop adverse health effects (Murphy et al., 1999). It is quite possible that improvement of surveillance will result in an increased number of female cases.

Furthermore, it is also common for children in developing countries to participate in agricultural practices, including applying pesticides. The available data, although limited, reveals that they too are affected by pesticides:

- Results from surveillance in Nicaragua showed that 19% of occupationally poisoned patients were less than 16 years old, the minimum legally permissible age for working with pesticides in Nicaragua (McConnell and Hruska, 1993).
- Survey data from Nicaragua showed that a higher rate of poisoning in younger male workers was to be found, and the authors suggested that lack of experience was related to this increased risk of intoxication (Keifer et al., 1996a).
- A study in Costa Rica shows that 5% of the incidents on banana plantations occurred among children between the ages of 12 and 17 (Wesseling et al., 2001b).

However, it is not just those who are directly engaged in agricultural practices who are affected by pesticides.

- A study from Nicaragua (Keifer et al., 1996b) showed that aerial drift of pesticides causes symptoms and lower cholinesterase levels in the populations living near sprayed cotton fields.

[8] The study also found that hospital and health authority sources overestimate the proportion of cases resulting from suicides, and greatly underestimate the proportion of occupational poisonings.

- A study in El Salvador identified an association between acute symptoms among family members and a farmer in the same household who had recently applied methyl parathion (Azaroff and Neas, 1999). Associations were found regardless of the performance of field labor. Female members who performed no fieldwork had higher symptoms.

3. CONDITIONS OF USE: HOW PESTICIDES WERE USED, INCLUDING APPLICATION EQUIPMENT, METHODS, TIMING AND FREQUENCY OF APPLICATION

The following are the factors that were frequently identified among cases in the pesticide poisoning data:

- Backpack spraying (Keifer et al., 1996b; Wesseling et al., 2001b)
- Application[9] of pesticides (Cole et al., 2000; Wesseling et al., 1993)
- Badly designed or defective apparatus (Meulenbelt and de Vries, 1997)
- No protective clothing (Martin Rubi et al., 1996; Meulenbelt and de Vries, 1997)
- Splashing of pesticides or spray drift (Meulenbelt and de Vries, 1997; Wesseling et al., 1997)
- Small amount of pesticide ingested during occupational activities (Wesseling et al., 1997).
- Small- to medium-sized land holdings (fewer than 140 Ha) (McConnell and Hruska, 1993)
- Lack of proper knowledge about the toxicity of the pesticides and/or about how to use the spray apparatus (Meulenbelt and de Vries, 1997)
- Inadequate guidance or instruction (Meulenbelt and de Vries, 1997)

Field-based studies in China (Chen et al., 1991), Indonesia (Kishi et al., 1995) and the Republic of Korea (Shin et al., 1998) showed that the following factors are statistically associated with pesticide poisonings:

- Skin and clothes being wetted with the spray solution (Kishi et al., 1995)
- Frequency of pesticide application (Kishi et al., 1995; Shin et al., 1998).
- Hazardous pesticides (WHO Classes Ia, Ib, and II) (Kishi et al., 1995)
- Longer duration of pesticide use (Chen et al., 1991; Shin et al., 1998).
- Greater quantity of pesticides used in the field (Chen et al., 1991)
- Using spraying equipment with leakage or stoppage during operation (Chen et al., 1991)
- Mixers (compared to sprayers) (Chain-Castro et al., 1998).

Little information was available concerning the association between crop types and higher incidence of poisoning. However, the following were found:

- Banana plantation workers were more at risk (Wesseling et al.,1993; Wesseling et al., 2000b) in Costa Rica, especially those who are engaged in application of

[9] These studies did not give any specific information about how the pesticides were applied.

nematocides, herbicide spraying, flagging, cleaning of packing plant, and washing uniforms (Wesseling et al., 2001b).

- Among 15 agricultural workers who had fetal paraquat poisonings in Costa Rica, the predominant crops were coffee (n = 6) and banana (n=3) (Wesseling et al., 1997).
- Most of the cases of organophosphate poisonings in Almeria, Spain, were greenhouse workers (Martin Rubi et al., 1996).

Describing the circumstances of poisonings, the researchers argue as follows:

- London and Bailie (2001) argued that many of the poisonings in their study occurred under "normal" circumstances.
- Wesseling et al. (1997) found that some of the exposure circumstances of the occupational paraquat poisonings that resulted in deaths are difficult to prevent in developing countries.
- McConnell and Hruska (1993) argued that working conditions typical of the developing world contributed to the 1987 epidemic of pesticide poisonings in Nicaragua.

4. INFORMATION ON RISK MITIGATION MEASURES (ENFORCEMENT, CONTROLS, TRAINING, AND AVAILABILITY OF PERSONAL PROTECTIVE EQUIPMENT)

Information about the relationships between the level of education, the extent of supervision, and frequency of training and pesticide poisonings was not readily available except for the following studies:

- A field-based study in the Republic of Korea (Shin et al., 1998) showed that not having received safety education was weakly associated with pesticide poisonings. The same study showed that education was not associated with pesticide poisoning.
- The authors of a study in the Netherlands stated that lack of agricultural education and lack of special training on the use of pesticides and toxicity contributed to poisonings (Meulenbelt and de Vries, 1996).

Having no protective equipment is a risk factor of poisoning. However, in developing countries it is not easily available, and even if it is, it does not seem practical or effective:

- Surveillance in Ecuador shows that relatively impermeable personal protective equipment was inadequate (Cole et al., 2000): Of 33 cases, 22 had boots, 12 had a plastic sheet on the back, two wore gloves, and one wore a poncho.
- Based on their study on an epidemic of pesticide poisonings in Nicaragua, McConnell and Hruska (1993), stated that "protective equipment, had they been available, cannot be worn by farmers working in the tropical sun in a humid climate where ambient temperatures reach 40°C."

5. CONCLUSIONS

A commonly recommended solution to occupational pesticide poisoning is to provide health education and training to promote the use of protective equipment and to teach farmers to handle pesticides carefully. However, even when they are aware of the hazardous effects of pesticides, they can't necessarily change their behavior (Meulenbelt and de Vries, 1996; Van der Hoek et al., 1998). Many of the factors that contribute to pesticide poisonings, especially in developing countries, are out of the control of the agricultural workers (e.g., use of backpacks to spray, hot and humid climate that makes it almost impossible to wear protective equipment). In other words the typical working conditions in the developing world contribute to pesticide poisonings (McConnell and Hruska, 1993). The circumstances of the exposures of some cases of acute pesticide poisonings seem difficult to prevent (Wesseling et al., 1997). Some researchers suggest that different approaches are needed to prevent acute pesticide poisonings, such as banning the most highly toxic pesticides and implementing alternative agricultural methods to reduce the use of pesticides (Brandt et al., 2001; Kishi et al., 1995; McConnell and Hruska, 1993; Murphy et al., 1999; Van der Hoek et al., 1998).

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Description of the Annotated Bibliography

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1. SCOPE OF THE BIBLIOGRAPHY

This bibliography is not intended to be a comprehensive listing of all available reports, but an initial compilation of evidence of the problem. The following was the focus of the reports collected: severe human health poisoning incidents during occupational exposure to pesticides; severe, non-occupational poisoning due to food contamination, off-target application, or other factors. The time frame was the past ten years, but significant reports outside of this time frame were also reviewed. Efforts were made to include reports covering the scope of problems developing countries and countries with economies in transition currently experience with acutely toxic pesticides, but reports from developed countries were also included.

The bibliography includes reports and documentation on the current situation in a representative range of countries, presenting a reliable qualitative description and assessment of the problems. The bibliography was not limited to reports published in English.

2. SELECTION CRITERIA

The articles in the bibliography represent a range of:

- Incidents from different geographic and climatic regions which represent the range of conditions of use;
- Agricultural production (e.g., Do some crops result in higher incidents? Size of farm?);
- Type of effects (e.g., severity; number of incidents);
- Possibility of identifying pesticide product; if not, reasons for difficulty.

However, it was impossible to find any studies that examined the impact of pesticide application method except for “application in field/greenhouse”. Other stages of use, from seed treatment to post-harvest, are not covered in the bibliography.

3. SOURCES CONSIDERED

Priority was given to peer-reviewed published literature. Other sources of the reports considered include the following: national governments, international organizations, public interest groups. the pesticide industry; and the medical/public health community. The Working Group assisted in gaining access to the documents. Most of the articles reviewed were from the peer-reviewed literature due to their greater availability and the short time given for the entire assignment.

4. EXPERIENCES AND CHALLENGES IN CREATING THE BIBLIOGRAPHY

For the peer-reviewed literature, the Medline database was searched for articles on acute pesticide poisoning on humans published in the past ten years. It was not always possible to screen by reading titles and abstracts. When it was not possible, the full reports were collected and read to determine whether or not the articles met the selection criteria. In the end, it took a long time to identify the articles that meet these criteria. Several papers identified through the references cited in the papers were also screened for the selection criteria.

Finding certain types of specific information in the articles and making templates was difficult, as the studies often did not contain it. For example, only a limited number of articles mentioned the names of the pesticides associated with specific pesticide poisonings, just as very few gave details about the specific conditions of pesticide use.

5. POSSIBLE LIMITATIONS

Although efforts were made to include articles from different regions, there were not many articles that met the selection criteria. As a result, it was not possible to get an even range of articles from each region. However, given that the basic conditions of agricultural workers across these regions are in general broadly similar, it can be concluded that the problems identified are likely to be representative of those regions as a whole.

However, in areas where no data are available, it is even more likely that bigger problems exist. Some anecdotal evidence suggests that in these countries even more hazardous pesticides are being used, leading to more severe pesticide poisoning. These countries, however, often do not have the resources to conduct research, and the problems therefore remain unrecognized.

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Annotated Bibliography –
Initial Evidence and Analysis of the Extent of the Problem

Human Health Incidents

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Title: Agrochemicals exposure and health implications in Githunguri Location, Kenya

Author: Kimani, V.N., Mwanthi M. A.

Date of publication: 1995 Aug

Type of report: Study published in East African Medical Journal 1995: 72(8): 531-535

Time period covered: 1987-1990

Geographic location: Africa/ Kenya/ Kimabu District/ Githunguri

Identification of pesticide: Not specified.

Conditions of use:
The specific conditions of use in relation to the incidents of pesticide poisoning were not given in the article. The general information about the study area and the farmers in the study were as follows:

- More than 95% of the farmers in the study reported an extensive use of pesticides.
- The area is ethnically dominated by Kikuyu.
- 24 percent of the respondents were illiterate, 76% had some degree of literacy. Many of the literate individuals, however, made little sense out of the agrochemical container labels which were written in both English and Swahili languages.
- Coffee and tea are the cash crops while maize, beans and vegetables are the subsistence crops grown.

Description of incident, adverse effects and their severity:
Data gathered from the district hospital records showed that the majority of the cases of acute chemical poisoning referred to the health facilities were predominantly males, although 68% of farmers who handled agrochemicals all year round were women and girls. The possible explanations were: many of the sprayers were men; men are more likely to be away from home than women and have an opportunity to attend to their needs; men are likely to have more money for the health facility than most women; women either ignored the symptoms, or women did not feel that their health conditions were given as great a priority as their daily activities.

The reported health conditions which were attributable to agrochemical exposure included both acute and chronic conditions. The most common complaints reported included: eye and skin irritation, irritation of the nose, asthmatic attacks, respiratory conditions, nausea and vomiting.

Of 133 total poisonings, eight cases died (six suicides, one accident, and one undetermined) while 125 cases survived (41 suicides, 9 accidents, and 75 undetermined).

Title: Challenges for improving surveillance for pesticide poisoning: policy implications for developing countries

Author: London, L., Bailie, R.

Date of publication: 2001 Jun

Type of report: Intensified surveillance from an intervention project published in Int J Epidemiol 2001; 30(3):564-70

Time period covered: 1987-1992

Geographic location: Africa/ South Africa/ Western Cape

Identification of pesticide: Not specified in the article

Conditions of use:
Of 57 cases in 14 poisoning events identified, poisonings directly related to occupation involved 86% of the cases and 43% of the poisoning events, whereas suicide involved 9% of the cases and 36% of the poisoning events.

Two events were mass poisonings and occupational, affecting 20 and 24 people respectively. All other poisoning events but one involved one person only, predominantly on farms. The mass poisoning of 20 workers (all but one of them were male) happened when spray from a tractor-driven unit drifted over workers in an adjacent field. (South African legislation makes no provision for posting to keep workers out of sprayed areas.)

Description of incident, adverse effects and their severity:
The farm store was the most common source of the poison (77 % of cases). The age of victims ranged from 13 to 59 years (median 29 years). Poisoning rates reported in the study area increased almost 10-fold during the intervention period (from 4.2 to 40.5 per 100 000).

Based on the findings, the authors concluded the following: Compared to intensified surveillance, hospital and health authority sources greatly underestimate the proportion of cases due to occupational poisoning, and overestimate suicide as a proportional cause. In addition, the risk for women appears to be underestimated from routine notifications.

Title: A foodborne outbreak of organophosphate poisoning

Author: Chaudhry, R., Lall, S. B., Mishra, B., Dhawan, B.

Date of publication: 1998 Jul 25

Type of report: Case report published in BMJ 1998; 317(7153): 268-9.

Time period covered: 1997

Geographic location: Asia-Pacific/ India

Identification of pesticide: Malathion

Conditions of use:
On July 6, 1997, 60 men aged 20-30 years attended a communal lunch cooked in the community kitchen. Investigation showed that on the morning of the outbreak the kitchen had been sprayed with pesticide containing marathon. The raw ingredients for cooking were stored in open jute bags.

Description of incident, adverse effects and their severity:
All developed nausea, vomiting, and abdominal pain over the next three hours of eating the contaminated meal (chapatti, cooked vegetables, pulese, and halva). They were taken to a local primary healthcare center and received treatment, and 56 were discharged the same day. The condition of the remaining four patients deteriorated. They developed symptoms of the intermediate syndrome. One of them, a 20-year-old man had miosis, sweating, impaired consciousness, hypotensions, and muscle weakness, and developed respiratory impairment. On day 10 he had a cardiac arrest and could not be revived. He had eaten at least eight chapatti while the others had eaten three or four. The three patients developed mild generalized muscle weakness, respiratory distress, and a lower level of consciousness. They responded to treatment and were discharged a week later.

Title: An epidemiological study on occupational acute pyrethroid poisoning in cotton farmers

Author: Chen, S. Y., Zhang, Z. W., He, F. S., Yao, P. P., Wu, Y. Q., Sun, J. X., Liu, L. H., Li, Q. G.

Date of publication: 1991 Feb

Type of Report: Cross-sectional survey with 3113 pyrethroid sprayers published in British Journal of Industrial Medicine 1991;48:77-81

Time period covered: 1987 and 1988

Geographic location: Asia-Pacific/ China/ Gaocheng county

Identification of pesticide: Deltamethrin, fenvalerate, cypermethrin

Conditions of use:
The general conditions found among the study participants:

- None of the sprayers wore masks or gloves.
- Most of them kept their upper extremities bare and wore only sandals during spraying.
- Most of the spraying operation did not comply with safe handling.

The factors related to the symptoms:

- Young men
- Longer spraying durations
- More pyrethroid use in the field
- Using spraying equipment with leakage or stoppage during operating

Description of incident, adverse effects and their severity:
Of 3113 sprayers studied adverse effects of pyrethroid exposure were found in 834 of them (26.8%) manifested as abnormal facial sensations, dizziness, headache, fatigue, nausea, or loss of appetite. Ten subjects developed significant systemic symptoms and had signs of listlessness or muscular fasciculation, were diagnosed as having mild occupational acute pyrethroid poisoning with a prevalence of 0.31% in subjects exposed to pure pyrethroid and 0.38% in subjects exposed to pyrethroid organophosphate mixtures. The survey showed that 2173 subjects (69.8%) were not aware of the toxicity of pyrethroid.

Title: An unusual case of fetal accidental paraquat poisoning

Author: Fernando, R., Harendra De Silva, D. G., Amarasena, T. S.

Date of publication: 1990 Jan

Type of report: Case report published in Forensic Science International, 1990;44:23-6.

Time period covered: Not specified

Geographic location: Asia-Pacific/ Sri Lanka/ Morawaka (a small southern town)

Identification of pesticide: Paraquat (Gramoxone)

Conditions of use:
A nine-year-old boy felt thirsty on his way home from shopping. He found an empty bottle thrown on the wayside and used it to drink water from a nearby cemented water tank. The label of the bottle had the name Gramoxone (paraquat).

Description of incident, adverse effects and their severity:
The child developed diarrhea and vomiting and was admitted to a peripheral hospital. He later developed abdominal pain, subcutaneous emphysema and difficulty in breathing. Following transfer to a district hospital and then to a teaching hospital, poisoning with paraquat was suspected only on day 11 of the illness. On persistent questioning, on day 13 of the illness the child remembered his contact with paraquat the day prior to the onset of illness. The child died on day 17 and the histology of the lung showed typical changes of paraquat poisoning.

The author emphasized the need for proper disposal of empty containers of all poisonous substances as well as education of the general public, including schoolchildren, on preventive aspects of poisoning.

Title: Relationship of pesticide spraying to signs and symptoms in Indonesian farmers

Author: Kishi, M., Hirschhorn, N., Djajadisastra, M., Satterlee, L. N., Strowman, S., Dilts, R.
Date of publication: 1995 Apr

Type of report: Field-based prospective study published in Scandinavian J Work Environ Health. 1995;21:124-133

Time period covered: Not specified

Geographic location: Asia-Pacific/ Indonesia/ Central Java/ Tegal and Brebes districts

Identification of pesticide:
Hazard levels of pesticides (WHO Ia, Ib, and II) were related to an increased number of signs and symptoms of pesticide poisoning.

Commonly used pesticides among the study participants were captafol, triazophos, fenobucarb (BPMC), chlorpyriphos[10], mancozeb, probineb, and Flufenuxuron

Conditions of use:
Factors significantly and independently associated with the number of signs and symptoms:

- Spraying frequency
- Application of pesticides with higher WHO hazard grades
- Farmers' clothes being wetted with the spray solution

A dose-effect relationship was found between the increasing number of organophosphates used per spray operation and neurobehavioral signs and symptoms.

None of the agricultural workers in the study wore industry-recommended protective gear.

Description of incident, adverse effects and their severity:
The study participants consisted of 204 farmers who farm their own lands and 24 professional sprayers. In 21% of 894 spray operations observed, the agricultural workers studied had three or more neurological, intestinal or respiratory signs or symptoms of pesticide poisoning (functional criteria for pesticide poisoning). Nine percent of the workers in the study later recalled at least one serious episode of pesticide poisoning requiring medical attention during the past year. The authors argued that for farmers in the tropics, full protective equipment is too hot and too costly to maintain; agricultural workers thus accept becoming ill by pesticides as part of their job. They recommended that the frequency of spraying should be reduced through training in integrated pest management and that licensing and sale of the most hazardous pesticides should be regulated.

[10] alt. spelling: c*hlorpyrifos*

Title: Insecticide use and increased mortality in rural Central Luzon, Philippines

Author: Loevinsohn, M. E.

Date of publication: 1987 Jun 13

Type of report: Study published in Lancet 1987; 1(8546):1359-62

Time period covered: 1961-1984

Geographic location: Asia-Pacific/ Philippines/ Central Luzon/ Nueva Ecija

Identification of pesticide:
Cyclodiene and hexachlorocyclohexane (CYC-HCH) insecticides (organochlorine), particularly endrin

Conditions of use: Not specified.

Description of incident, adverse effects and their severity:
Widespread use of insecticides was followed by an increase in non-traumatic mortality among rural men. In 1982 the use of endrin, the most widely used and toxic CYC-HCH insecticide was banned. In the following two years, mortality attributed to strokes decreased for all men compared with the incidence immediately before the ban. The decrease was significantly greater in the younger men. The overall increase in non-traumatic mortality among rural men between the periods of low and high use of insecticides was 27%.

The author concluded that the results suggest that the currently accepted figure of 10,000 deaths annually worldwide due to accidental intoxication with insecticides is a substantial underestimate.

Title: Health effects of pesticide use among Indonesian farmers: Part I: exposure and acute effects.

Author: Murphy H., Sanusi A., Dilts R., Djajadisastra M., Hirchhorn N., Yuliantiningsih S.

Date of publication: 1999

Type of report: Field-based prospective study published in J Agromedicine 1999;6:61-85.

Time period covered: Not specified

Geographic location: Asia-Pacific/ Indonesia/ west Sumatra/ Sub-district of Alahanpanjang

Identification of pesticide:
Information on specific pesticides in relation to the incidents is not available in the article.

Pesticides commonly used by the respondents: Organophosphates, Carbamates, Organochlorines, Pyrethroid, Thiocarbamates, Triadimeton, Triazol, Urea, Thiophthalimide, Teflubenzuron, Chlorothalonil. Use of mixtures of pesticides was very common. Regarding mixtures, all but one spray operator had at least one class Ia, Ib, or II insecticides in her tank.

Conditions of use:
The specific conditions of use in relation to the incidents of pesticide poisoning were not given in the article.

The general conditions observed among the farmers in the study were as follows:
- 78% wore some sort of head covering.
- Very few wore protective eye wear (2%), masks (1%), or waterproof rubber footwear (4%).
- 47% wore long pants.

Description of incident, adverse effects and their severity:
- 68% experienced two to five symptoms of acute pesticide poisoning after spraying sessions.
- Compared to controls, the sprayers had significant neurologic signs such as staggering gait, muscle fasciculation (eyelid twitching) and tremors.

Title: Pesticide poisoning and its related factors among Korean farmers

Author: Shin, D. C., Kim, H. J., Jung, S. H., Park, C. Y., Lee, S. Y., Kim, C. B.

Date of publication: 1998

Type of report: Survey of 1032 farmers published in La Medicina del Lavaro 1998: 89 (suppl. 2): S129-35.

Time period covered: September 1990

Geographic location: Asia-Pacific/ Korea/ Kyunggi Province (KP) and Chulabuk Province (CP)/ Kangwha County (in KP) and Wanju Country (in CP)

Identification of pesticide: Not specified

Conditions of use:
Risk factors in pesticide poisoning:
- Sex (female)
- Days of consecutive pesticide use
- Hours of pesticide use per day (longer than five hours per day)
- Not having received safety education (weakly associated)
- Compliance with safety guidelines for application

Variables that were not significantly associated with poisoning:
- Age
- Education
- Wearing protective gear
- Compliance with safety guidelines for personal hygiene after pesticide use

Description of incident, adverse effects and their severity:

During summer farming 21.9% of the subjects experienced suspected pesticide poisoning - 18.8% mild poisoning, and 2% more serious poisoning.
Poisoning groups and correspondent symptoms were as follows:
- “suspected” - headache, dizziness, chest tightness
- “mild” - nausea and vomiting, abdominal pain, diarrhea, cold sweating, excessive salivation, numbness of the extremities
- “moderate” or “severe” - muscle spasm, dysarthria, dyspnoea, cyanosis, paralysis, unconsciousness.

Title: The health impacts of pesticide use on sugarcane farmers in Fiji

Author: Szmedra, P.

Date of publication: 1999

Type of report: Survey published in Asia-Pacific Journal of Public Health 1999;11(2):82-8

Time period covered: December 1998

Geographic location: Asia-Pacific/ Fiji/ Viti Levu (Fiji's principal island)

Identification of pesticide:
The specific pesticides in relation to the incidents of pesticide poisoning were not given in the article. The farmers in the study reported the use of the following pesticides: 2,4-D (chlorophenoxy herbicide), diuron, paraquat, MCPA, 2,4-D+Dicamba, glyphosate

Conditions of use:
Of the 144 farmers surveyed 84.7% claimed to use gloves, overalls and boots, 1.4% used overalls, 5.6% used shirts and pants, and 2.3% used face masks when handling, mixing, or applying pesticides. 8.3% claimed to use no protective measures.

Description of incident, adverse effects and their severity:
A relatively large number of the farmers in the study reported suffering from acute pesticide poisoning symptoms as a direct result of pesticide exposure including headache, rash, blurred vision, difficulty in breathing, skin lesions, and tingling in the fingers.

Title: Pesticide poisoning: a major health problem in Sri Lanka

Author: Van der Hoek, W., Konradsen, F., Athukorala, K., Wanigadewa, T.

Date of publication: 1998 Feb-Mar

Type of report: Study published in Soc Sci Med 1998; 46(4-5):495-504.

Time period covered: June 1991 - December 1994

Geographic location: Asia-Pacific/ Sri Lanka/ North Central province/ Thambuttegama Division

Identification of pesticide: Fifty-four different pesticides were responsible for 526 cases of poisoning registered at Thambuttenama hospital, mostly caused by organophosphate insecticides (unspecified).

Conditions of use:
- Self-inflicted (suicide) 68%
- Spraying 19%
- Accidental ingestion 13%

Description of incident, adverse effects and their severity: Most of the patients (n=526) were young adults and 70% were males. Forty-two deaths were reported and all were suicides. Ten were caused by endosulfan poisoning and seven by monocrotophos. In 16 fatal cases the exact chemical could not be identified, mostly because they were mixtures kept in unlabeled containers.

In addition to the review of hospital records, the authors conducted interviews and observations with 30 farm families to collect data regarding farmers' practices and perceptions concerning pesticide use. The findings are as follows:
- Farmers use hazardous pesticides, such as monocrotophos (WHO class Ib, highly hazardous pesticides) and other classes Ib and II (moderately hazardous) pesticides.
- For the cultivation of chilies, farmers use pesticides frequently as preventive measure.
- Sales promotion activities by agrochemical companies and credit facilities promoted this excessive pesticide use, not counteracted by agricultural extension service.
- Hazardous practices when applying pesticides were not due to lack of knowledge, but to the impossibility of applying recommended protective measures under the conditions.

The authors argued that the current emphasis on programs to promote "safe use of pesticides" to reduce occupational exposure through education and training of farmers wouldn't be effective because farmers are already aware of the hazards and safety precautions. The authors concluded that enforcement of legislation to restrict availability of the most hazardous pesticides and promotion of alternative non-chemical methods of pest control are important to prevent acute pesticide poisoning.

Title: Endosulfan poisoning--a clinical profile.

Author: Venkateswarlu, K., Suryarao, K., Srinivas, V., Sivaprakash, N., Jagannadharao, N. R., Mythilai, A.

Date of publication: 2000 March

Type of report: Case report published in J Assoc Physicians India 2000; 48(3):323-5.

Time period covered: Not specified

Geographic location: Asia-Pacific/ India

Identification of pesticide: Endosulfan

Conditions of use: Forty-four individuals consumed food (idli and tea) which was accidentally contaminated by endosulfan. The food was served in a road side tea stall in a rural area. The half filled bottle of pesticide with its lid open, which was kept on a shelf above, fell accidentally into the wet flour used for making idlis.

Description of incident, adverse effects and their severity:
Of 44 people affected, 39 were men and 5 were women. One died due to status epilepticus and it was confirmed that the death was due to asphyxia. Duration of unconsciousness was less than 12 hours for 18 patients, 12 to 24 hours in 12 patients, and greater than 24 hours in two patients. The symptoms presented among patients were nausea and vomiting, altered sensorium, GTC seizures, giddiness, combativeness, diarrhea, pain in abdomen, kerosene smell in breath, and photopsia.

Title: Food poisoning due to methamidophos-contaminated vegetables

Author: Wu, M. L., Deng, J. F., Tsai, W. J., Ger, J., Wong, S. S., Li, H. P.

Date of publication: 2001

Type of report: Case report published in J Toxicol Clin Toxicol 2001; 39(4):333-6.

Time period covered: One incident occurred in December 1996; the timing of the other three incidents was not specified.

Geographic location: Asia-Pacific/ Taiwan

Identification of pesticide: Methamidophos

Conditions of use: Consumption of vegetables contaminated by methamidophos.

Description of incident, adverse effects and their severity:
The clinical manifestation included vomiting (4/4), nausea, diarrhea (4/4), abdominal pain (4/4), dizziness/headache (4/4), salivation (4/4), cold sweating (4/4), weakness (4/4), miosis (3/4), tachycardia (3/4), muscle fasciculation (2/4), urinary incontinence (1/4), hypertension (1/4), and bradicardia (1/4). Reduced level of erythrocytes and plasma cholinesterase and the presence of methamidophos in the vegetable leftovers confirmed the clinical diagnosis of organophosphate poisoning. The implicated vegetables in these incidents contained methamidophos concentrations of 52 to 510 times the maximal reduce limit of methamidophos of 0.5 ppm for leaf vegetables.

The authors stated that methamidophos had not been permitted for use on leaf vegetables with small leaves or on paddy vegetables since 1994, but because it is cheap and highly potent, the illegal use of methamidophos is still common among farmers. They argued that the easy accessibility of pesticides, overuse of pesticide, indiscriminate handling and storage, and lack of understanding of serious consequences are the major problems. They also argued for public information campaigns on pesticide usage and legislative control of organophosphate insecticide.

Title: Acute health effects associated with non-occupational pesticide exposure in rural El Salvador.

Author: Azaroff, L. S., Neas, L. M.,

Date of publication: 1999 Feb

Type of report: Environ Research, Section A. 1999;80:158-164.

Time period covered: Not specified

Geographic location: Latin America and Caribbean/ El Salvador

Identification of pesticide: Methyl parathion

Conditions of use:
Acute symptoms of non-occupational pesticide exposure in agricultural communities in rural El Salvador were investigated. (Farmers' skin, clothing, and equipment contaminated with acutely toxic pesticides were considered to be sources of exposure to farmers' family members.)

Description of incident, adverse effects and their severity:
In the five communities studied, several acute symptoms were associated with living with a farmer who had applied methyl parathion within the past 2 weeks. These included cramps in limbs (odds ratio 2.1, 95% confidence interval 1.2-3.7), chest pressure (OR 2.3, 95% CI 1.3-4.0), change in defecation (OR 2.3, 95% CI 1.3-4.1), feeling dazed (OR 2.4, 95% CI 1.3-4.4), and eyes tearing (OR 2.5, 95% CI 1. 4-4.5). Associations were found regardless of whether the individuals reporting the symptoms had themselves performed field labor. This exposure was also associated with higher numbers of symptoms among females not engaged in fieldwork. The farmer's household reported use of other acutely toxic pesticides, including paraquat, was not associated with reported acute symptoms.

Title: Pesticide poisoning in Mexican seasonal farm workers

Author: Chain-Castro, T. J., Barron-Aragon, R., Haro-Garcia, L.

Date of publication: 1998 Jul-Sep

Type of report: Study of 200 seasonal farm workers employed in a small area in northeast Mexico published in Int J Occup Environ Health 1998; 4(3): 202-3.

Time period covered: October 1995 - May 1996

Geographic location: Latin America and Caribbean/ Mexico/ Sinaloa state/ Culiacan Valley

Identification of pesticide: Not specified

Conditions of use:
The authors found that pesticide mixers had the highest risk of pesticide poisonings, followed by mixer/sprayers.

Of the 200 workers studied, 45% were migrants from southern Mexico, and 70% were men. Most were about 20 years old; 59% could read at third-grade level. Twenty-four percent of the workers declared that they had received some training in pesticide use in that agricultural season. Thirty percent did not wear personal protective gear. (Whether or not these are related to the incidence rate of pesticide poisoning was not mentioned in the article.)

Description of incident, adverse effects and their severity:
Twenty percent had experienced acute pesticide poisoning at least once during the season investigated, and were evaluated and observed by a physician 4.6 (± 1.2) times in a public or private hospital or clinic. The number of years worked as a seasonal farm worker did not change the incidence rate of pesticide poisoning.

Authors concluded that the lack of training and lack of use of personal protective equipment are major contributors to the high incidence of acute pesticide poisoning.

Title: Economic burden of illness from pesticide poisonings in highland Ecuador.

Author: Cole, D. C., Carpio, F., Leon, N.

Date of publication: 2000 Sep

Type of report: Study published in Rev Panam Salud Publica 2000; 8(3):196-201

Time period covered: 1991-1992

Geographic location: Latin America and Caribbean/ Ecuador/ Carachi province/ canton of Montufar

Identification of pesticide:
Fifty cases were formally reported during the year of surveillance. Mixtures were more common than single products. Carbofuran (29 cases), methamidophos (11 cases), and mancozeb (15 cases) were the most common products. One case reporting methomyl and two cases reporting parathion were also found. Over 80% of the reported poisonings were with WHO category I cholinesterase inhibitors (*WHO Classification of pesticides by hazard*). Other products reported were from less hazardous WHO categories (II-IV), including dithiocarbamate fungicides and some pyrethroid insecticides.

Conditions of use:
Of the 50 cases, 33 occurred among agricultural workers (32 male, one woman). Twenty-eight of these 33 cases reported pesticide applications as the work task just prior to poisoning. Relatively impermeable personal protective equipment was inadequate, being limited to boots (23 of 33 cases), a plastic sheet on the back (12 of 33), gloves (2 of 33), or a poncho (1 of 33).

Of the 17 other pesticide poisoning cases, 9 involved accidental settings, with 8 of those 9 among children. Intentional ingestion of pesticides occurred in the remaining 8 cases.

Description of incident, adverse effects and their severity:
The clinical picture reflected the pesticides used, with cholinergic nervous and gastrointestinal symptoms among all the cases with carbamate and organophosphate exposure. Of the 50 cases, 48 had three or more symptoms and signs, and 37 had five or more symptoms and signs. Five of 8 intentional cases, 6 of 9 accidental cases, and 8 of 33 occupational cases underwent hospitalization. Severe clinical manifestations of such poisoning occurred in those who eventually died (5 intentional cases and 1 accidental case).

Title: Estimating underreported pesticide poisonings in Nicaragua

Author: Keifer, M., McConnell, R., Pacheco, A. F., Daniel, W., Rosenstock, L

Date of publication: 1996 Aug

Type of report: Cross-sectional survey of 633 workers published in Am J Ind Med 1996; 30(2):195-201

Time period covered: Last three weeks of August 1988

Geographic location: Latin America and Caribbean/ Nicaragua/ Region II

Identification of pesticide:
Thirty-eight percent of incidents involved a mixture of pesticides. Organophosphates were most commonly reported as being responsible for poisonings.

Conditions of use:
Most poisonings (65.6%) occurred while backpack spraying.

Description of incident, adverse effects and their severity:
Twenty-five percent described a pesticide poisoning in the preceding 12 months, and almost one-half (48%) described having been made ill by pesticides at some point in time. Only 35% of treated poisonings were reported to the registry by the treating clinicians, leaving 65% of all medically treated pesticide poisoning unreported.

Respondents reported at least three symptoms characteristic of cholinesterase inhibiting pesticide overexposure in 74.2% of all reported “poisoning or illness.”

Title: Symptoms and cholinesterase activity among rural residents living near cotton fields in Nicaragua

Author: Keifer, M., Rivas, F., Moon, J. D., Checkoway, H.

Date of publication: 1996 Nov

Type of report: Occup Environ Med 1996; 53(11):726-9

Time period covered: End of 1990 cotton spraying season (August-December).

Geographic location: Latin America and Caribbean/ Nicaragua/ 2 km from the outskirts of Leon

Identification of pesticide:
Limited information was available. The following pesticides were identified as possibly having been applied to the adjacent fields during the 1990 season: methyl parathion; two pyrethroids; cypermethrin; gamma-syhalothrin, an insect growth regulator; and a locally prepared mixture of organophosphates and pyrethroid.

Conditions of use:
A community surrounded by actively sprayed cotton fields (the exposed community) was compared to a socio-economically similar community far from agricultural spraying (the control community).

Description of incident, adverse effects and their severity:
Most acute symptoms and chronic symptoms showed significant associations with residence in the exposed community. The proportion of subjects complaining of one or more chronic or acute symptoms was significantly higher for the exposed community (87%) than for the controls (53%). The mean AChE value was significantly lower for residents of the exposed community (4.9 vs 5.3 IU/dl). The authors concluded that the findings indicated a strong association between exposure to aerial pesticides and symptoms.

Title: An epidemic of pesticide poisoning in Nicaragua: implications for prevention in developing countries

Author: McConnell, R., Hruska, A.J

Date of publication: 1993 Nov

Type of report: Am J Public Health 1993; 83(11):1559-62

Time period covered: June-July 1987 (two months)

Geographic location: Latin America and Caribbean/ Nicaragua

Identification of pesticide:
- Carbofuran* (carbamate insecticide) 46%
- Methamidophos[11] (Organophosphate) 31%
- Chlorpyriphos (Organophosphate) 6%
- Methyl parathion 2%

*At the time of the study, carbofuran was imported from Mexico. Thirty percent of the carbofuran poisonings for which the type of formulation was indicated reportedly involved powder (a severely restricted formation in most of the developed world because of the easy absorbance by the respiratory tract).

Conditions of use:
- Occupational 91% (368 of 404)
- Accidents 8%
- Suicide attempts 1%

Of the occupationally exposed patients, 86% occurred among maize farmers. During 1987, pesticides were subsidized and as a result, farmers increased the number of applications in maize from 4.2 to 6.3 per season. 82% of occupational poisonings occurred on small to medium land holdings (fewer than 140 hectares).

Description of incident, adverse effects and their severity:
Of the occupationally exposed patients for whom sex was reported, 96% (353 of 368) were male. The mean age was 27 years, and 19% (71 of 366) of the patients were less than 16 years old, the minimum legally permissible age for working with pesticides in Nicaragua. Forty-one percent (166 of 404) of occupational poisonings were relatively more severe occurrences reported from hospitals. Four deaths were recorded: three were suicides and one was a non-occupational accident. Three of the four deaths were caused by the insecticide methamidophos.

[11] Alt. spelling: *methamidofos*

The authors concluded that unsafe working conditions such as manual application of pesticides and the use of backpack sprayers, the introduction of a hazardous powdered formulation of carbofuran highly restricted in the developed world, and agricultural subsidies that encouraged the use of hazardous pesticides all contributed to the epidemic. They argued that protective rubber gloves and respirators, had they been available, couldn’t have been worn by farmers working in the tropical sun in a humid climate where ambient temperatures reach 40°C.

Title: Pesticide Illness Surveillance in the Developing World: Putting the Data to Work

Author: Murray, D., Wesseling C., Keifer M, Corriols, M., Henao, S.

Date of publication: Int J Occup Environ Health 2002; 8:243-248.
Type of report: Analysis of data from a region-wide underreporting study based on 32,245 questionnaires to be published in Int J Occup Environ Health 8.

Time period covered: The underreporting study was conducted in 2000.

Geographic location: Latin America and Caribbean

Identification of pesticide:
The study was conducted by the PLAGSALUD project, a pesticide project in Central America coordinated by the Pan American Health Organization (PAHO). PLAGSALUD and the ministries of health created a list of 12 most frequently reported pesticides that cause acute pesticide poisonings: aldicarb, aluminum phosphide, carbofuran, chlorpyriphos, endosulfan, etoprophos, methamidophos, methomyl, methylparathion, monocrotophos, paraquat, and terbufos.

Conditions of use:
The study found that 76% were work-related poisonings, followed by accidental poisonings and by suicides in a low proportion for all countries* combined.
(*The data from Honduras was not included.)

Description of incident, adverse effects and their severity:
Preliminary analysis of the study indicated 98% underreporting of pesticide poisonings and a regional estimate of 400,000 poisonings per year (1.9% of the general population). It is estimated that annually 4.9% of those who use or are otherwise exposed to pesticides may suffer a symptomatic episode of pesticide poisoning.

Title: Pesticide poisonings in Costa Rica

Author: Wesseling, C., Castillo, L., Elinder, C. G

Date of publication: 1993 Aug

Type of report: Descriptive epidemiologic study published in Scand J Work Environ Health 1993; 19(4):227-35.

Time period covered: 1980-1987

Geographic location: Latin America and Caribbean /Costa Rica

Identification of pesticide:
Cholinesterase inhibitors caused 71% of the reported occupational accidents, 63% of the hospitalizations, and 36% of the deaths. Paraquat caused 21% of the occupational accidents, 24% of the hospitalizations, and 60% of the deaths.

Conditions of use:
Ninety percent (1617 of 1800) of the occupational poisonings occurred among agricultural field workers. 87% of them during the application of pesticides and 10 % during mixing, the carrying of containers of cleaning equipment, during work in or near areas being sprayed or after reentrance into recently sprayed crops.

Description of incident, adverse effects and their severity:
Between 1980 and 1986 altogether 3330 persons were hospitalized and 429 died. Hospitalizations and deaths were 13 and 11 times, respectively, more frequent among agricultural workers than among the rest of the population. The yearly incidence of symptomatic occupational pesticide poisonings among agricultural workers was estimated at 4.5%.
High-risk groups for occupational poisonings included young adult agricultural workers aged 15-29 years, female workers, and banana plantation workers. Hospitalizations from occupational pesticide exposure also occurred among children under 15 years of age.

Title: Time trends of occupational pesticide-related injuries in Costa Rica, 1982-1992

Author: Wesseling, C., Hogstedt, C., Fernandez, P., Ahlbom, A.

Date of publication: 2001 Jan-Mar

Type of report: Survey carried out three times over a ten-year period, published in Int J Occup Environ Health 2001; 7(1):1-6

Time period covered: The months of June of the years 1982, 1987, and 1992

Geographic location: Latin America and Caribbean/Costa Rica

Identification of pesticide: Not specified

Conditions of use: Not specified

Description of incident, adverse effects and their severity:
The overall incidence rates in 1982, 1987, and 1992 were 1.8, 2.7, and 2.5 per 1,000 agricultural workers, respectively. Rates among female workers increased (3.1, 3.7, 5.4) and were higher than male workers (1.7, 2.6, 2.3).

The topical lesions increased (1.2, 1.4, 2.1) consistent with an increased use of fungicides. Systemic poisonings peaked in 1987 (0.6, 1.2, 0.5), related to the introduction of the extremely toxic aldicarb on banana plantations around 1985.

Title: Unintentional fatal paraquat poisonings among agricultural workers in Costa Rica: report of 15 cases

Author: Wesseling, C., Hogstedt, C., Picado, A., Johansson, L.

Date of publication: 1997 Nov

Type of report: Analysis of the exposure circumstances of 15 fatal occupational paraquat poisonings published in Am J Ind Med 1997; 32(5):433-41

Time period covered: 1980-1991

Geographic location: Latin America and Caribbean/Costa Rica

Identification of pesticide: Paraquat

Conditions of use:
Five fatalities were due to ingestion of a mouthful of paraquat concentrate. Five fatalities were due to the intake of a smaller amount; three cases were associated with dermal exposure, and in two cases there was no evidence of either oral or dermal exposure. Several cases concerned diluted paraquat spray. The authors argued that the circumstances of the exposures in several cases seem difficult to prevent in developing countries. All (n=15) deceased workers were men. Twelve were farmers or farm laborers between the age of 15 and 54, and three belonged to the informal labor sector: a farmer aged 78 and two children aged 10 and 13.

Crops: Coffee (n=6), banana (n=3), tobacco (n=1), vegetables (n=1), pasture (n=1), palm (n=1), plantain (n=1), nonspecific (n=1).

Description of incident, adverse effects and their severity:
All patients died from adult respiratory distress syndrome (ARDS) or pulmonary edema, preceded by either renal (n-14) or liver impairment (n=10).

Regarding the cause of the deaths, the authors found that only one out of eight occupationally related deaths with oral intake were correctly recorded, and four were recorded as “suicides.” This is one example of how the cause of the deaths can be misclassified.

The authors concluded that “although more conclusive studies are warranted, their findings emphasize measures to restrict paraquat use in the developing countries”.

Title: Pesticide-related illness and injuries among banana workers in Costa Rica: a comparison between 1993 and 1996

Author: Wesseling, C., van Wendel de Joode, B., Monge, P

Date of publication: 2001 Apr-Jun

Type of report: Int J Occup Environ Health 2001; 7(2) :90-97

Time period covered: For the years 1993 and 1996

Geographic location: Latin America and Caribbean/ Costa Rica/ Atlantic Region (the catchment of the National Insurance Institute office in the city of Guapiles.

Identification of pesticide:
In both years, incidents involving herbicides were most frequently reported (1.2 vs. 0.8 per 100 banana plantation workers). Paraquat was the individual pesticide most often associated with illness in both years, despite a considerable decrease in 1996. Cholinesterase-inhibiting nematocides-insecticides were the second most frequent cause of illness, with an incidence rate of 0.7% per 100 workers in both years.

Conditions of use:
The five most hazardous jobs were application of nematocides, herbicide spraying, flagging, cleaning of packing plant, and washing of uniforms.
Nematocides were applied in 2 cycles per year, one active ingredient at a time. The alternative active ingredients most used were terbufos and carbofuran. The method of applying nematocides was by backpack for granulated formulations with personal protective equipment. Herbicide spraying was done in six or more cycles per year, one or more active ingredient at a time. Paraquat and glyphosate were the most commonly used herbicides. Sprayers used backpacks for liquid formulation, sometimes wearing partial personal protective equipment.

Description of incident, adverse effects and their severity:
In both 1993 and 1996, most of the cases of pesticide-related illness or injury concerned banana plantation workers (78% of 678 cases and 85% of 453 cases respectively). On banana plantations approximately 90% of the incidents occurred among workers less than 50 years old, and 5% concerned children between the ages of 12 and 17, in both study years. Women accounted for 11% of the reports in 1993 and 17% in 1996.
The overall incidence of pesticide-related illness among banana workers diminished from 4.0 per 100 workers in 1993 to 2.6 per 100 workers in 1996, due to a marked decline in topical injuries, whereas systemic poisonings remained the same. Signs and symptoms of topical injuries included contact dermatitis with and without infections, chemical skin burns, eye lesions, allergic skin reactions, and local manifestations involving the upper respiratory tract (burning sensation in the throat and nosebleeds).

Title: Epidemiology of pesticide poisonings in the United States, with special reference to occupational cases

Author: Blondell, J

Date of publication: 1997 Apr-Jun

Type of report: Review article published in Occupational Medicine. 1997: 12: 209-220.

Time period covered: 1990-1994

Geographic location: Western European and Other Groups/USA/California*
(*Though this article deals with occupational pesticide poisonings in the United States, information regarding agricultural poisonings was available from California only.)

Identification of pesticide, description of incident, adverse effects and their severity:

Top ten active ingredients associated with agricultural pesticide illness by time of illness, 1990-1994.

Systemic
Combinations (n=730), sulfur (n=103), chlorpyriphos (n=66), chlorine (n=43), mevinphos (n=41), sodium hypochlorite (n=40), metam-sodium (n=32), aluminum phosphide (n=23), glyphosate (n=22), methomyl (n=21).

Eye
Combinations* (n=334), sulfur (n=122), glyphosate (n=63), sodium hypochlorite (n=54), chlorine (n=34), metam-sodium (n= 30), propargite (n=22), chlorpyriphos (n=19), sodium chlorite (n=12), copper hydroxide, diazinon (tie) (n=11).

Skin
Combinations (n=470), sulfur (n=139), glyphosate (n=46), metam-sodium (n=42), propargite (n=38), chlorpyriphos (n=16), chlorine (n=13), copper hydroxide (n=13), methyl bromide (n=12), sodium hypochlorite (n=12).

Title: Exposure to endosulfan in farmers: two case studies

Author: Brandt, V. A., Moon, S., Ehlers, J., Methner, M. M., Struttmann, T.

Date of publication: 2001 Jun

Time period covered: Case report published in American Journal of Industrial Medicine. 2001: 39: 643-649.

Time period covered: 1993

Geographic location: Western European and Other Groups USA

Identification of pesticide: Endosulfan

Conditions of use: Both cases had ample opportunity for endosulfan exposure while mixing concentrated endosulfan with water and applying the solution to tobacco with boom sprayers pulled by tractors.

Case 1 mixed and applied two less toxic pesticides, acephate (an insecticide) and maleic hydrazide (a herbicide) to tobacco plants. No respirator or gloves were worn while mixing or spraying the product. Ambient temperature was 62-82F with winds 0-7 miles per hour. While pouring concentrated endosulfan into a 55-gallon drum, the farmer spilled some on his bare hand and wiped it on his pants without washing his hands. The laboratory results showed that the clothing worn by the farmer contained measurable levels of endosulfan, strongly suggesting the potential for dermal absorption existed.

Case 2 mixed and sprayed endosulfan on tobacco for 5 hours and had repeated hand and possibly oral contact with the concentrate and tank mix. He mixed 5-6 quarts of endosulfan concentrate with 300 gallons of pond water without washing or wiping his hands. Neither gloves nor a respirator were used. Ambient temperature was 70-75F. His clothes appeared soaked and he neither showered nor changed clothes during the exposure period. He reportedly drank and smoked while spraying the tobacco.

Description of incident, adverse effects and their severity:

Case 1 (confirmed case)

A 37-year old male Caucasian farmer died after exposure to endosulfan.
A few hours after the onset of the exposure on the day of the incident, the farmer reported nausea, vomiting, headache, and coughing to a family member but continued spraying tobacco until 4:30 PM. At 6:05 PM he was found unresponsive by a family member and transported by emergency medical services to the nearest hospital.

Case 2 (possible case)

A 43-year old tobacco farmer experienced generalized convulsions and was hospitalized. Final diagnoses at the tertiary care hospital included endosulfan epilepticus and toxic encephalopathy. Five years after the incident he suffered neurological impairment.

Title: [Poisoning caused by organophosphate insecticides. Study of 506 cases.]

Author: Martin Rubi, J. C., Yelamos Rodriguez, F., Laynez Bretones, F., Cordoba Escamez, J., Diez Garcia, F., Lardelli Claret, A., Blanco Coronado, J. L., Vicente Rull, J. R.

Date of publication: 1996 Mar

Type of report: Study published in Rev Clin Esp 1996; 196(3):145-9

Time period covered: 1981-1992

Geographic location: Western European and Other Groups/ Spain/ Almeria

Identification of pesticide:
Methamidophos* (n=234), chlorpyriphos (n=81), methyl parathion (N=40), parathion (n=36), diazinon (n=4), dimethoate (n=3), fenitrothion (n=2)
(* Use of methamidophos had been forbidden in this province.)

Conditions of use:
Route of exposure
- Cutaneous / Respiratory 78% (395 cases)*
- Ingestion 22% (111 cases)

(* Most of them were greenhouse workers.)

Causes of pesticide poisonings
- Accidental (occupational) 80% (n=405)
- Suicides 20% (n=101)

Accidental poisonings occurred in agricultural workers who did not use adequate protective measures. The pesticides related to the poisonings were the most used in this area.

Description of incident, adverse effects and their severity:
Organophosphate poisonings were more frequent among men (88%). The median age was 35.

Commonly observed signs and symptoms were miosis, salivation, sudorasis, vomiting, abdominal pain, thoracic pain, and tremor/fasciculations.

The authors argued the need for workers' education as well as legislative changes that would better control the use and storage of pesticides, as well as commerce in them.

Author: Acute work-related poisoning by pesticides in The Netherlands; a one year follow-up study

Title: Meulenbelt, J., de Vries, I.

Date of publication: 1997

Type of report: Prospective study published in Przegl Lek 1997; 54(10):665-70

Time period covered: 1991

Geographic location: Western European and Other Groups/ The Netherlands

Identification of pesticide:
Cholinesterase inhibitors, calcium cyanide, bifenthrin, dinitro-ortho-cresol, tolclofosmethyl, methyl bromide, 1, 3-dichloropropene.

Conditions of use:
In 79% of the cases splashing of pesticides or spray drift led to the exposure. In most accidents (74%) imperfect technical design or technical defects were important risk factors for exposure. Wearing no protective clothing contributed considerably when the pesticides were spilled (30 cases). Of the workers affected, 82% o were full-time professionals occupied in agriculture. One third of the affected people had received no agricultural education and/or no special training in the use of pesticides. Although most workers were aware of the risk of using pesticides, they were still careless in taking adequate protective measures.

Description of incident, adverse effects and their severity:
In the 37 cases symptoms consisted of skin and/or eye lesions (23 cases) and systemic health effects (14 cases). Exposure to the soil disinfectant 1,3-dichloropropene, resulted in severe skin damage. Direct contact of pesticides with the eyes invariably resulted in local irritation. Severe systemic poisonings occurred after exposure to organophosphate and carbamate insecticides and the soil disinfectant methyl bromide.

Author: Patterns and problems of deliberate self-poisoning in the developing world

Author: Eddleston, M

Date of publication: 2000 Nov

Type of report: Literature review published in QJM 93, 715-31

Time period covered: 1980-2000

Geographic location: Global (developing countries)

Identification of pesticide:
Organophosphate pesticides were responsible for the majority of deaths, particularly in rural areas. Other pesticides included carbamates, organochlorines endosulfan and endrin, and paraquat. Other pesticides included aldrin, dieldrin, lindane, diquat, aluminium phosphide, thallium-containing rodenticides, propanil, glyphosate-surfactant herbicide ('Round-up'), the compounds abamectin and ivermectin, pyrethrins, and imazapyr.

Conditions of use: Self-poisoning

Description of incident, adverse effects and their severity:
Epilepticus, convulsions, coma, cardiogenic shock, respiratory and renal failure, metabolic acidosis, and death.

Editorial revisions, Cathleen M. Barnes, October 21, 2002