
Abstracts and Reports



Epidemiologic Surveillance for Substances Banned from Use in Agriculture¹

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In many Latin American countries, there are frequent news reports of severe and even fatal cases of poisoning by pesticides. However, this public health problem often does not show up in official morbidity and mortality statistics. The underreporting, as well as the severity, of pesticide poisoning cases can be explained in part by the precarious nature of health services in many areas, by errors in clinical diagnosis, and by the ineffectiveness of surveillance programs in rural areas—where such programs exist at all.

Pesticides are chemical products used in farming, floriculture, forestry, and public health campaigns (against malaria, for example) to control insect or other animal pests, weeds, or plant diseases. They may be synthetic or derived from plant extracts (1). Pesticides can be clas-

sified according to the type of pests they destroy (e.g., insecticides, molluscicides, fungicides), or according to their chemical makeup (e.g., organochlorine, organophosphorus, carbamate) (2). Their toxicity to humans varies with their chemical makeup.

Computations based on a study of the existing literature (3) placed worldwide pesticide production for the year 1985 at almost 3 million tons. Nearly 90% of the worldwide output, or 2.7 million tons according to this estimate, is used in agriculture.

The number of individuals exposed to these chemical substances is also quite high. The rural population of Latin America and the Caribbean in 1990 was approximately 126 million persons (4), out of which an estimated 5%, or 6 million persons, work or live in farming areas characterized by intensive use of pesticides (1).

Study of trends in the use of toxic agricultural chemicals in developing countries has indicated a 303% aggregate increase between 1983 and 1993 (1, 5). In Latin America, the need to modernize agriculture has significantly boosted the use of chemicals. In Brazil, for example, farmers must show proof of using at least 5% of their loan from rural credit operations for the purchase of pesticides and fertilizer (6).

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Many pesticides used in farming contain heavy metals such as arsenic, mercury, and lead. Despite a trend toward curtailing the production and use of these pesticides, there is evidence that their application continues. A case of potatoes contaminated by banned mercury compounds in the State of São Paulo in 1989 alerted health professionals associated with surveillance programs to the hazard posed by the continued use of banned substances and the urgent need for stringent measures to avert this type of problem.

In consideration of the public health dangers associated with the improper or excessive use of pesticides in general and of banned substances in particular, this report reviews the use of mercury-containing compounds in Brazilian agriculture and the main preventive and control measures needed to combat pesticide contamination emergencies.

USE OF MERCURY COMPOUNDS IN BRAZILIAN AGRICULTURE

The use of mercury-containing fungicides was most likely first introduced to Latin America in the State of Pernambuco, Brazil, in 1948 in connection with the cultivation of sugarcane (7, 8). A 1954 study of commercial farming of white potatoes in Bahia State cited evidence of the economic advantages conferred by the treatment of tubers and seeds with mercury compounds and recommended the use of these compounds throughout the country (9).

Until their eventual banning, the principal mercury compounds used in Brazilian agriculture were yellow mercuric oxide, and alkyl, aryl, and alkyl-alkoxyl mercury. Yellow mercuric oxide was generally applied to the trunks and branches of trees to control pests (10), and alkyl mercury, which is the most toxic form, was marketed as a fungicide. Aryl mer-

cury (phenylmercuric acetate) and alkyl-alkoxyl mercury (ethyl methoxy mercury chloride and ethyl ethoxy mercury hydroxide) were used intensively by Brazilian farmers for many years as fungicides. Although there are no official production and consumption data available from any Brazilian government agency, the use of these compounds on the nation's principal crops (sugarcane, soybeans, wheat, maize, potatoes, and tomatoes) is believed to have been widespread because of their low cost and powerful fungicidal properties. A 1979 sample survey of small, medium, and large sugarcane growers in the *município* of Campos, State of Rio de Janeiro, found that all these farmers, without exception, were using aryl mercury or alkyl-alkoxyl mercury fungicides (8).

Alkyl mercury products were banned nationwide in January 1975 owing to concerns over these compounds' environmental stability, effects on the human nervous system, and ability to penetrate the placental barrier. Alkyl-alkoxyl mercury and aryl mercury products continued to be marketed exclusively as seed dressings until April 1980, at which time Ministry of Agriculture/Plant Health Protection Department Directive No. 6 banned the use of all mercury-containing compounds in Brazilian agriculture. The banning followed revelation of a number of cases of mercury poisoning in the *município* of Campos (8), media reports on associated health hazards, and a statement by the National Agricultural Workers Federation (CONTAG) asking the president of Brazil to immediately ban the production, importation, marketing, and use of these compounds in farming activities. However, the ban did not automatically eliminate the risk of human exposure for two reasons: persistence of mercury in the environment and the possibility of illegal use.

A study conducted in 1982 and 1983 in Campos, Rio de Janeiro, on the potential

long-term human health effects of exposure to mercury-containing agrochemicals compared a group of sugarcane workers who had handled organomercury fungicides with another group of workers (control group), matched by age and sex, who had had no contact with these products. Even two to three years after the use of mercury compounds had been banned, the group of exposed workers showed a significantly higher prevalence of certain signs and symptoms involving, but not limited to, the nervous system (11).

As part of the same study and a follow-up one year later, hair samples collected from the root area close to the scalp (and thus reflecting recent exposure) were analyzed. Since other sources of contamination could not be identified, the higher-than-average mercury concentrations found in several samples were interpreted as stemming from the presence of residual mercury in the environment.

The case of the contaminated potatoes in the *município* of São João Batista in the State of São Paulo is a clear example of the use of banned chemicals. According to a written report and data from the files of the São Paulo State Health Department/Health Surveillance Center (12), two agricultural engineers submitted a complaint in August 1989 alleging that the potato crop was contaminated with mercury. Since that area produces 60% of the state's potato crop, which is marketed to a potential consumer population of 20 million people in three states, the complaint was taken very seriously and received wide publicity.

The Health Surveillance Center tested 1 002 potato samples and classified 36% as unfit for consumption due to elevated mercury levels. Tests for abnormal mercury concentrations in the blood of agricultural workers proved negative, which was to be expected since the tests were performed a year after the potato crop

was planted and thus well beyond the half-life of mercury in blood. The investigation found that the potatoes had been contaminated by a fertilizer whose formula contained as much as 3.18 grams of metallic mercury per kilogram, added as an antifungal agent.

EPIDEMIOLOGIC SURVEILLANCE FOR BANNED AGRICULTURAL PRODUCTS

The conduct of epidemiologic surveillance programs in rural areas to prevent and control health hazards associated with the use of toxic agricultural chemicals—legal or illegal—is an extremely difficult task, owing to the extensive geographical areas involved, the number of workers potentially exposed, and the variety of products in use. Major obstacles to the conduct of epidemiologic surveillance programs include identifying the target population and establishing the toxicity of the chemicals. These and other factors need to be taken into account both in designing epidemiologic surveillance programs and in evaluating their performance.

The rural agricultural workers that constitute the primary at-risk population are generally employed in response to temporary labor demands generated by single-crop farming practices. The existence of a temporary work force undermines the efficiency of epidemiologic surveillance programs.

Information on the use of banned chemicals is more difficult to obtain than information on authorized substances, since the use of banned substances is subject to criminal prosecution. Production-related and economic data will be of little value in epidemiologic surveillance operations for banned agricultural products. Where a formal surveillance program exists, it might consider conducting specific field studies to expose the use

of banned pesticides. In the absence of a surveillance program or when faced with the urgent need to investigate suspected use, a special plan of action will be necessary, involving field investigations of production processes and toxicological studies of the foods involved.

Background demographic and socioeconomic data on the at-risk population, as well as information on production and climatic factors that could affect pesticide use, are generally available from government agencies. Morbidity and mortality records, although plagued by underregistration in much of Latin America, and information furnished by agronomists, health care professionals, academic researchers, the media, and the community at large could serve as the basis for launching investigations of a suspected problem.

When conducting an investigation, epidemiologists need to describe the agricultural work process in detail in order to establish which workers come into direct contact with the substances in question. Attention must also be directed to marketing outlets and the various components of their operations (preparation of the products, transportation to the crop site) and to disposal of packaging materials after use.

Another important step is environmental monitoring of plants, soil, and water, as well as toxicological studies of the human population to establish exposure levels. There should be redundancy in the collection and testing of food samples.

PREVENTION AND CONTROL

Once a problem has been discovered—whether by epidemiologic surveillance, filing of a complaint, or chance—a number of measures can be taken to protect the environment and human health.

The first and most significant protective measure is the precautionary inter-

diction of foodstuffs either suspected or confirmed to be contaminated. This action will entail determining the likely distribution route and sales outlets of the food products in question, notifying local and national health and agriculture authorities of the contamination, and alerting the public to the possible location of food already on the market.

After taking emergency action to avert widespread exposure, the next step is for epidemiologic surveillance program personnel to retrospectively identify the chain of events leading to the use of banned substances in order to uncover causative factors. Regular environmental monitoring and inspections should follow to detect the presence of the banned pesticide and residual environmental concentrations liable to represent hazardous exposure levels.

With regard to the exposed population, the first emergency measure is diagnosis of possible cases of poisoning for immediate treatment. It is important to note that concentrations of many potentially poisonous chemicals in standard biological samples, such as blood and urine, may be normal once the exposure period has ended and that, despite these normal values, the subject may show clinical signs of chronic poisoning. When emergency treatment is called for, health professionals will often require refresher training on therapeutic procedures.

Educational activities are important, first, because the groups at risk, particularly workers, have a right to know the hazards associated with their exposure and, second, because people who understand the hazards are better able to assist in surveillance, prevention, and control measures. The public is generally familiar with the visible signs of exposure to hazardous substances (such as skin rashes or fainting), so educational programs should provide information on exposure routes, systemic effects, and ways to prevent exposure.

CONCLUSION

Occupational as well as nonoccupational exposure to agricultural pesticides in rural areas is a fact of life. Unfortunately, the level of institutional development in the environmental health field in Latin America is still too weak to permit the widespread organization of environmental epidemiologic surveillance programs, particularly for problems arising as a result of accidents or from the importation, production, sale, and use of officially banned products.

The use of banned mercury compounds in Brazil underscores the importance of epidemiologic field studies to uncover these types of situations. In the absence of systematic control efforts on the part of epidemiologic surveillance programs, such studies constitute the major source of information for the introduction of protective measures by health officials.

Development of programs for environmental surveillance as well as for prevention and control of the rural population's exposure to toxic agricultural chemicals is essential to reduce the dangers associated with pesticide use. It must be underscored, however, that problems characteristic of rural areas—cultural, social, economic, and occupational—can hinder efforts to set up these programs. The possibility of clandestine use of banned chemical agents only makes the need more urgent.

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