

AESS Interdisciplinary Environmental Studies
and Sciences Series

Martha Richmond

Cancer Hazards: Parathion, Malathion, Diazinon, Tetrachlorvinphos and Glyphosate

The 2015 IARC Classifications:
Implications for Regulation,
Environmental Justice, and Global Health

AESS Interdisciplinary Environmental Studies and Sciences Series

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The 2015 IARC Classifications: Implications
for Regulation, Environmental Justice,
and Global Health

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As someone with a background in public health, especially environmental health, I have long been interested in the impact of toxins on communities, especially underserved communities. The hazards posed by pesticide use, especially its extensive use in developed and less developed countries, are clearly an area of concern. I was quite fortunate to visit twice and to be sponsored by the University of the Free State in South Africa to visit as a guest lecturer. I was able to meet with several faculty from the QwaQwa campus as well as the main campus in Bloemfontein. Special thanks go to Hennie Claassen of the QwaQwa campus who sponsored my second visit, made the necessary arrangements, and who also spent many hours taking me to visit emerging farms, speak with farmers, and learn more about the issues and challenges regarding farming as well as pesticide and herbicide use in South Africa. Hennie also provided me with opportunities to become better acquainted with the presence of agroindustry in farming communities.

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Introduction

From the time that plant cultivation became established, unwanted pests—insects, plants, and molds—have threatened crops, frequently leading to poor yields or even complete losses. To combat pests and minimize loss, farmers throughout history have developed a number of “pesticides.” With the exception of a few organic chemicals extracted from natural sources, historically most pesticides were inorganic substances, including some highly toxic compounds such as those containing mercury and arsenic. Many were “home-grown” and used in small amounts rather than produced in large volumes; or they came from natural sources such as pyrethrum, extracted from chrysanthemums. However, with the growth of modern chemical methods in the late nineteenth and twentieth centuries, the development of compounds more targeted to pests and, theoretically, less harmful to humans and farm animals became a possibility. Additionally, these compounds were generally produced by industrial organizations and were more readily available. This development became an incentive for the growth of the large agrochemical industry.

Whatever their etiology, pesticides and herbicides are intended to be acute toxins to the targeted species: to quickly kill unwanted pests or plants, while, in theory, not posing a significant danger to larger populations. This includes the larger ecosystem; farm animals; people working in agricultural, pest removal, or landscape applications; those living in close proximity to such activities; or members of the general public who might consume food or be exposed to fibers from agricultural products treated with the pesticides. Quantitatively, this means that for the target species, acute toxicity, generally measured as LD₅₀ or mean lethal dose, is orders of magnitude smaller than the LD₅₀ of humans and related species.

A large number of what might be considered the “first generation” of pesticides were chlorinated hydrocarbons. This included substances such as the pesticides dichlorodiphenyltrichloroethane (DDT), dichlorodipenyldichloroethylene (DDE), dieldrin and endrin, or herbicides such as dichlorophenoxyacetic acid (2,4-D) or trichlorophenoxyacetic acid (2,4,5-T), all of which are deemed to pose significant dangers, not only to those working directly with them but to the general population and the larger environment. A distinct disadvantage of these substances is that, because they are lipid-soluble, they bioaccumulate, both in individuals who come

into contact with them and also because they concentrate through the food chain. Today, all are deemed to pose significant dangers, not only to those working directly with them but also to the general population and the larger environment.

In contrast, the organophosphate pesticides as well as the herbicide glyphosate, because they are water-soluble, were seen as having a distinct advantage. They were generally metabolized to easily excreted products, or, in some cases, eliminated without metabolic transformations. Thus, while a number of chlorinated hydrocarbon pesticides and herbicides have been banned or highly restricted for use through regulatory processes, especially in developed countries, the use of organophosphate substances has grown dramatically. However, coupled with the development of GM seeds in the 1980s and 1990s, this large growth has led to significant environmental persistence. This was a consideration by the International Agency for Research on Cancer (IARC), in choosing to evaluate four organophosphate pesticides as well as the organophosphate herbicide glyphosate in 2015. Results of their findings were published in a 2017 Monograph entitled, "Some Organophosphate Insecticides and Herbicides." IARC, an agency of the World Health Organization, has published a series of monographs, beginning in 1972. Each publication provides findings and conclusions of expert panels who have examined evidence from peer-reviewed publications and government data to assess the carcinogenic hazards of a variety of materials. The 2017 Monograph details findings from the review panels that concluded tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate pose a carcinogenic hazard.

The reaction to the 2017 Monograph has been strong and frequently polarized. Commercial entities and other organizations allied with or speaking for these groups have challenged the IARC designations in a number of ways: attacking the scientific basis of findings; claiming bias of those participating in the IARC reviews; and stating that the need for food security mandates pesticide and herbicide use. This has been especially true with respect to glyphosate, in part because of the development of Roundup Ready™ genetically modified seed, marketed by Monsanto. Negative responses to the glyphosate classification include publications in the lay press, congressional hearings in the US, extensive scientific publications challenging methods used in IARC assessments, and administrative changes in industries that synthesize and distribute glyphosate-containing products for use in agriculture or landscaping, presumably to lessen potential liability. In contrast, environmental and health advocacy groups have supported the IARC findings: defending the scientific basis of designations, questioning the strength of arguments for food security, and pointing out concerns about environmental spread and persistence.

Often buried in the controversies is the distinction between hazard identification and risk assessment. Hazard identification, the purpose of IARC's review process, derives from a careful examination of vetted scientific data. The goal is to identify substances that can pose a carcinogenic risk under potential exposure conditions. In contrast, risk assessment takes information on hazard identification and applies this information to various models used to develop estimates of risk for various constituencies. The constituencies include the general public, or, within the occupational sector, those who work in agricultural and landscaping industries, and who may

require exposure protection. Risk assessment generally incorporates hazard identification into various exposure models to develop quantitative information regarding safe levels of exposure and potential intake.

It is important to note that IARC's hazard assessments are intended to address potential outcomes on a global basis, which in many cases involves conditions where exposures are unknown, or, if known, are not well-regulated. This leads to questions of environmental justice. Those exposed to toxic substances through poor working conditions and lax environmental regulations and who are not adequately protected are far more likely to respond adversely. This can include both short-term reactions and long-term responses, including the development of chronic diseases such as cancer. For various reasons, these responses are often either underreported or not reported at all to the appropriate agencies. Many of those experiencing adverse reactions are members of underserved communities or live and work in underdeveloped/poorly developed geographic constituencies. They are afforded little or no protection and, furthermore, lack strong advocacy groups.

While it can be acknowledged that issues of environmental justice are often specific to given agricultural sites or specific agricultural operations, food and flower production have also become increasingly global. It is unclear how, in the production-export process, agribusiness is regulated. Hence, the potential for adverse effects of pesticide and herbicide use becomes an issue of growing complexity.

The following book focuses on the four pesticides and the herbicide assessed by IARC in 2015. It first provides a historical perspective for the introduction of each compound into agriculture and landscaping uses, documents the spread in use and the environmental impact of each, and critiques data on health effects. Particular focus will be given to chronic diseases, especially cancer or pre-cancerous conditions. The second part of the book looks specifically at the IARC review process, both in terms of its development, its general approach, and then on specific issues of the 2017 IARC Monograph. The next chapters detail and critically examine the responses to the IARC designations and implications of these responses. The final sections will discuss the larger issues of environmental justice, both in specific environments or industries as well as the global community.

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