The IR-4 Project
Pest Management Solutions for Specialty Crops and Minor Uses

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Beyond DDT? IR-4 and the Potential End of a Maligned Pesticide

— by Karl Malamud-Roam, IR-4 Public Health Pesticide Manager

DDT is probably both the most famous and infamous pesticide of all time – an emblem for many of all that is good and bad about chemical control of insects – and the IR-4 Project is a partner in a major global effort to evaluate the phase out of its remaining uses.

The history of DDT to today can be written in five chapters that largely reflect changing public attitudes toward chemicals in general and synthetic pesticides in particular: early discovery and evaluation; a "silver bullet" to protect public health; wide expan- sion into pest insect control; criticism and restriction; and, finally, a determined effort to find the appropriate uses for a power- ful tool.

DDT (dichloro-diphenyl-trichloroethane) was first synthesized in 1874 by an Austrian graduate student, Othmar Zeidler, at the University of Strasbourg. Othmar published an account of the molecule and how he had synthesized it, but neither he nor his advisor recognized any particularly interesting attributes in it. DDT remained in obscurity for six decades – part of a growing library of synthetic organic molecules that had been dis- covered, along with their means of synthesis, but without any known uses. This chapter came to an end in 1939, when Paul Müller, a researcher at the Geigy company in Basle, Switzerland, who had been looking for chemicals that might help control Colorado potato beetles, announced that DDT was a potent insecticide. The Swiss government retained its neutral- ity in the world war, and secretly sent samples to the Allied and Axis forces, in Nov. 1942.

The first uses of DDT were as a public health pesticide, to protect against lice and mosquitoes in war zones. 2.5 million had died of louse-borne typhus in World War I, and by late 1942 malaria was

Early Days of DDT - Delousing Soldiers and Refugees in Italy

Penn Salt Ad, Time Magazine, 1947

DDT Spraying for Gypsy Moth Control, 1958

increasingly a concern for all armies. Since 1940, the U.S. National Research Council had been organizing research among industries and foundations for an effective mosquito repellant, and U.S. military research by the medical branch of OSRD had begun in 1941. The new samples from Switzerland were rapidly handed to army and USDA researchers in Florida, and by February of 1943, DDT was shown to be one hundred times more toxic to mosquito larvae than any known alternative. In October of that year a heavy outbreak of typhus occurred in Naples and none of the customary relief measures helped. The U.S. General responsible for the area took a chance, and had 1.3 million people dusted with DDT in January 1944. In three weeks the epidemic was over – the first time in history a typhus outbreak was brought under control in winter – and DDT quickly became the tool of choice vs. insect-borne diseases, both in war zones and elsewhere. Four years later, Dr. Müller was awarded the Nobel Prize for his discovery, and for the positive results of DDT use in protecting public health.

Perhaps inevitably, the good news about DDT was spread by farmers, foresters, and housewives, as much as by public health officials, and its popularity soared. Within months of the success in Naples, a Geigy press release in 1944 touted ". . . Geigy believes that it has the support of the USDA in predicting that the general commercial production of Gerasol [DDT], when the military needs have been accommodated, will open the way to what may be regarded as a revolution in the economy of agriculture and in the quantity of the world's food output...."

As the Nobel citation noted, DDT was easy to make, cheap, effective, and exceedingly stable – often retaining its effectiveness on treated surfaces for many months. A new age of chemical control of insects had begun. In agriculture, it was widely used on many crops; foresters treated vast expanses to control gypsy moths; and householders replaced moth balls and toxic compounds based on lead or arsenic with flit guns loaded with a host of apparently safe new DDT products. The vector control story was not over – with this new tool that was effective, cheap, and apparently non-toxic to people, it was possible when the war ended to contemplate the undertaking of the global eradication of malaria! With the enthusiastic and urgent belief that time and money were of the essence, and improved anti-malarial drugs, in addition to the availability of DDT for vector control, the nascent World Health Organization (WHO) in 1955 publicly launched this campaign, and over the next decade, despite some major gaps (e.g. most of Africa!), this ancient affliction was eliminated in much of the world, and sharply reduced elsewhere.

It was too good to last. Insect resistance to the toxic effects of DDT had been rapidly noted wherever it had been widely used, and concerns were inevitable, if initially muted, about the potential impacts of persistent chemicals that had been developed as poisons, for at least some species. Rachel Carson articulated and popu- larized these concerns in her 1962 book Silent Spring, which addressed chemical use in general, but which focused on DDT and the risks associated with its indiscriminate use. The book coincided with a general public unease about new technologies, and the backlash was fast and furious – by 1972 the global campaign against malaria was essentially over, and DDT was banned for most uses in most of the world.

But if relatively wealthy Americans and Europeans could happily live without DDT, in large part because they could afford more selective and less durable alternative pest control technologies, many in the poorer parts of the world could literally not live without it. When DDT was banned in the developed countries, its popularity dropped everywhere, as donors were unwilling to supply it even where it was still legal, and in 1981 WHO pulled support for the chemical. Tragically, malaria rebounded dramatically in many places in the years after DDT was banned; while the ban was not the only reason for this, it seems likely that many people died while this effective intervention could have been used. After 25 years, WHO

acknowledged that DDT was a critical vector control tool and in 2006 again sanctioned its use for public health. It is now used widely again in India and many countries in sub-Saharan Africa, both against malaria-transmitting mosquitoes and other blood -sucking, disease-carrying insects.

The most recent chapter in the DDT saga thus reflects a tension between the competing needs to eliminate or at least control vector-borne diseases globally, and to eliminate persistent chemicals with toxic effects. The 2001 Stockholm Convention on Persistent Organic Pollutants was a global treaty to protect human health and the environment from chemicals that "remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of humans and wildlife, and have adverse effects to human health or to the environ- ment." DDT has been on its short list of chemicals targeted for global elimination since the Convention was adopted ten years ago, but its member states have also recognized the compelling need to retain vector control tools if they have no feasible and acceptable alternatives, and have sanctioned the continued use of DDT until it can be safely phased out.

The Secretariat of the Stockholm Convention, and the United Nations Environmental Program (UNEP) generally, has been collaborating with WHO and others to identify and evaluate possible alternatives to DDT, but until recently no global review of public health pesticides has been available to help support this effort. In July of this year, however, the IR-4 Project published *Public Health Pesticides: An Inventory of Chemical Tools for Vector Control* (IR-4 Special Publication-PH1, 2012, www.ir4.rutgers.edu), and UNEP staff immediately adopted the new Inventory as a resource. While it is not yet clear whether any of the materials in the Inventory will be able to fully take the place of DDT, for now, IR-4 is a major partner in the efforts to answer that question.

The Modern Face of DDT - Indoor Residual Spraying vs. Malaria in Malawi, Africa (Photo credit USAID)