IR-4: The New Partner in the Search for Public Health Pesticides

by Karl Malamud-Roam, Stanton E Cope and Daniel Strickman

The IR-4 Project, a consortium of federal and state facilities that has long assisted the development and registration of sustainable pest control technologies for small market agriculture, has recently joined the US military and the US Department of Agriculture (USDA) in an effort to fill the toolbox of pesticides used for protecting public health. This is the latest in a series of public and private actions which recognize both the critical need for an adequate supply of public health pesticides (PHPs), and the need for public support to ensure the availability of these tools. In this article, we discuss the status of the PHP toolbox and reasons for concern, we introduce some key participants working to fill the toolbox and keep it full, and we focus on the tasks and prospects for the nascent IR-4 Public Health Pesticides Program.

PUBLIC HEALTH PESTS, PUBLIC HEALTH PESTICIDES, AND THE SHRINKING PHP TOOLBOX

There is a wide range of public health pests, which are animals (frequently arthropods) that can make you sick, either by vectoring pathogens, causing allergic reactions and secondary infections following bites, or simply through their nuisance value. Mosquitoes, ticks, sand flies, bed bugs, and their kin collectively sicken and kill millions of people annually and cause untold discomfort and lost productivity around the globe. Unfortunately, there is not a large enough set of safe, effective, and affordable tools available to combat these threats to our health, and the toolbox has been getting smaller.

Pesticides are not the only way to fight public health pests – screens and other exclusion methods, biological control, and habitat management practices that reduce pest abundance are all important – but public health pesticides are critical tools both for individuals and families and for the public entities charged with protecting their health. PHPs include all chemicals, both natural and synthetic, that help control any public health pests, but for now, at least, PHP research is focused on arthropods. PHPs are often characterized by their primary modes of action as toxicants, growth regulators, repellents and attraction inhibitors, attractants (for traps), etc, but these distinctions are not always clear. For example, both DDT and permethrin are effective insect toxicants and repellents, as are the many pyrethroids and botanical products have been formed into mosquito coils.

Some new PHPs have come onto the market in recent years, including topical repellent active ingredients for personal protection, as well as etofenprox and spinosad-based products for wide-area use, but in general the toolbox has been getting smaller for many years. In addition, resistance development, which is more likely when the range of chemical tools is limited, means that some materials that are on the market may be locally ineffective.

THE SEARCH FOR NEW PHPs

The last decade has seen a renewed interest in PHP and their availability, largely because of the continuing high morbidity and mortality associated with malaria, especially in Africa, and the slow progress in developing an effective vaccine against this disease. A renewed commitment to combating malaria and a renewed focus on the insects that transmit it, after a gap of several decades, has been reflected in the global Millennium Development Goals, the President's Malaria Initiative, the formation of numerous aid and advocacy groups, and the funding priorities of the Gates Foundation and other philanthropists. While most of these efforts have focused on distribution of insecticide-treated nets and other interventions, important PHP research and development has also occurred as a result, much of it sponsored by the Innovative Vector Control Consortium (IVCC) in Liverpool, or the National Institutes of Health, and some of it addressing diseases beyond malaria.

An additional major motivation for PHP innovation in recent years has been the deployment of US and allied military personnel in combat areas, particularly in

Iraq and Afghanistan, where they have been exposed to a wide range of relatively unfamiliar vector-borne diseases. A particular problem has been cutaneous leishmaniasis, transmitted primarily by the sand fly *Phlebotomus papatasi*, which has sickened thousands of deployed warriors. Additionally, many common mosquito adulticides have not worked adequately in some environments, especially hot deserts, where soldiers, sailors, airmen, or marines are deployed. Finally, humanitarian missions by the military, such as providing assistance after the 2009 earthquakes in Haiti, have pointed out limitations in the existing PHP toolbox.

In response to a need for safe and effective new tools to protect our troops, the military's Armed Forces Pest Management Board (AFPMB) and the USDA's Agricultural Research Service (ARS) rekindled the PHP development partnership that years ago brought us DEET, the aerosol pesticide can, ultra low volume (ULV) application technology, and many other innovations. Started in 2004, the Deployed War-Fighter Protection Program (DWFP) has been a highly productive research consortium, funding both ARS and outside researchers, and generating papers, patents, and incipient products for development; see http://www.afpmb.org/dwfpresearch.htm. By 2008, the DWFP research and product discovery pipeline was flowing fast, and the DWFP began moving into its next phase – product development and registration.

WHY ARE PHPs INCREASINGLY RARE?

Over the last few decades, regulatory requirements covering pesticides have increased, yet private industry has seen inadequate financial incentives to invest heavily in the PHP realm. Costs are high, increasing, and unpredictable; the market is small and unpredictable; regulatory requirements between countries are inconsistent, so the market is fragmented; and concerns about liability and litigation are ever-present. While ensuring pesticide safety and public confidence is essential, high regulatory costs can stifle innovation (the "Precautionary Principle") or drive products from the market even when there little or no evidence that they pose significant risks (see article about Resmethrin in this volume).

Resistance is a major problem in many areas; so that even when some materials are on the market, they may not be locally effective. In addition, vector-borne disease cases have been relatively rare in the developed world (ie, the lucrative markets) for a number of years, while many members of the public in these countries are increasingly risk adverse regarding chemicals in general and pesticides in particular. This means that vocal advocates for PHPs are also increasingly rare, even among those of us that use these tools in our daily work.

FIFRA and the Food Quality Improvement Act recognized that PHPs deserve special regulatory attention, because of the key role they can play in disease prevention, but public dollars to match these statements of Congressional intent and public commitment have been scarce. In particular, the FQPA authorized federal spending of up to $12.5 million per year for regulatory support for PHP's, but these moneys have never (yet) been appropriated.

For more information, visit the IR-4 PHP program website at http://ir4.rutgers.edu/publichealth.html or contact Program Manager Karl Malamud-Roam at kmr@aesop.rutgers.edu.

IR-4 AND THE PHP PROGRAM

Once a new compound or product has been discovered and its efficacy against public health pests demonstrated, the next steps in converting a concept into a usable PHP product include proving its safety, identifying the best formulation, patenting intellectual property to protect commercial partners, and, last but not least, obtaining registration from the US Environmental Protection Agency (EPA). Pesticide registration is critical for two reasons – first, it is a legal requirement before the new product can be sold or used in the US, which is important both for military use in state-side facilities, and for developing the market required by commercial partners. In addition, EPA registration serves as an independent review of the safety of a PHP, both to humans and the environment, which reassures both our troops and foreign governments when products are used overseas. In fact, it is a general military policy that only EPA-registered pesticides will be used, wherever in the world our troops may be deployed.

Registration support for new pest control technologies for small markets has been the mission of the IR-4 Project since it was created in 1963, so it was a clear choice when DWFP needed a new partner to help bring novel PHPs through registration to the field. A consortium of USDA facilities, land-grant universities, and state agricultural experiment stations, IR-4 has served growers of low-acreage crops and other minor users of pesticides over almost 50 years as a liaison with both EPA and the pesticide developers and registrants. In addition to advising users and potential registrants, IR-4 has analytical labs and test sites, and conducts high quality studies to support registrations when this is recognized as in the public interest.

In 2008, agreements between DWFP, ARS, and IR-4 led to the formation of the IR-4 Public Health Pesticide Program, which expands the traditional mission of IR-4 to include the facilitation of the development and registration of PHPs. As with new tools for small market agriculture, IR-4 provides advice and regulatory assistance for new PHPs, as well as direct research as budgets allow. In addition, the IR-4 PHP Program also collaborates with EPA and user groups on improved integration of chemical tools into Integrated Vector Management (IVM) strategies, support for the regulatory needs of existing PHPs, development of standardized data dossiers and other methods to streamline the PHP regulatory process, research, and outreach. The program works to identify and register PHPs for use globally, as well as within the US, through collaboration with IVCC and other global partners. Finally, The IR-4 Public Health Pesticides Program maintains the only public access database specifically dedicated to public health pesticides. Available through http://ir4.rutgers.edu/publichealth/publichealthDB.cfm, the PHP Database complements other public information on pesticide chemistry and toxicology by bringing together data on the efficacy of chemical tools against specific public health pests, PHP use patterns, and PHP regulatory status inside and outside the US.

We will probably always face the threats of disease vectors and vector-borne diseases, but rest assured that there is a significant global effort to ensure the availability of PHPs now and in the future, and that the AFPMB, USDA ARS, and IR-4 are at the forefront of this effort.

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