IRM for Vector Control

Insecticide Resistance Action Committee

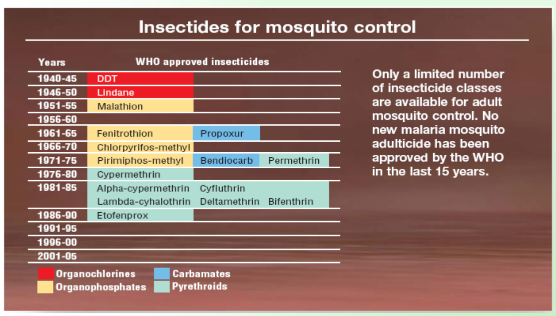
www.irac-online.org

Importance of IRM in Vectors

Insecticide resistance in public health vectors can profoundly affect public health through the possible re-emergence of vector borne diseases. Surveillance wherever possible is essential to proactively react once a change in susceptibility of a public health pest to an insecticide is observed. To this end the World Health Organization has published methods for the surveillance of resistance development to insecticides, e.g. by simple, rapid diagnostic dose bioassays for mosquitoes.

Mode of Action

An important aspect impacting resistance development in insect species important to public health is the availability of only a limited number of classes of insecticides registered for vector control. Since the advent of synthetic insecticides only four chemically different classes of insecticides are (or have been) used to treat adult mosquitoes, i.e. organochlorines (nowadays mostly banned), organophosphates, carbamates and pyrethroids

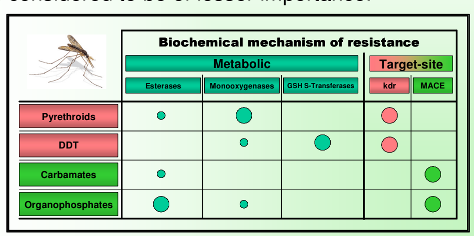


Managing Resistance

As with agricultural practices, the best option currently is the rotation of different modes of action rather than alternating members of one chemical class or different chemical classes addressing the same target site. The presence of kdr resistance renders DDT and pyrethroids less effective, whereas carbamates and organophosphates can still be used. If MACE (modified acetylcholinesterase) as a mechanism is not present, rotational use of organophosphates and carbamates can be considered where product labelling and local regulations permit. In addition, the use of larvicides in conjunction with pyrethroids can support resistance management through rotation of MoA across different life stages. Effective long-term resistance management is necessary, but many factors need to be considered (including regional availability of insecticides) to successfully implement strategies in order to effectively control insect vectors.

Mechanisms of Resistance

Major biochemical mechanisms conferring resistance to important classes of insecticides in mosquitoes. A large spot indicates an important resistance mechanism; a smaller spot means this mechanism has been described but is considered to be of lesser importance.



Mode of Action Classification

Biochemical mode of action of chemical classes of WHO-recommended insecticides for the control of mosquito larvae and adults, and their IRAC classification group (IRAC)[1]

Life stage	Target site (mode of action)	Chemical class	IRAC	Examples
Adults	Acetylcholinesterase	Organophosphate	1A	Fenitrothion, malathion, pirimiphos-methyl
		Carbamate	1B	Bendiocarb, propoxur
	Voltage-gated sodium channel	Pyrethroid	3	α-Cypermethrin, bifenthrin, deltamethrin, ethofenprox, λ-cyhalothrin, permethrin
		DDT	3	DDT
Larvae	Acetylcholinesterase	Organophosphate	1A	Fenthion, chlorpyriphos, pirimiphos-methyl, temephos
	Chitin biosynthesis	Benzoylureas	15	Diflubenzuron, triflumuron, novaluron
	Juvenile hormone (JH) mimic	JH analogues	7A	Methoprene
		Pyriproxyfen	7C	Pyriproxyfen
	Midgut-membrane disruption	Microbials	11A1	*Bacillus thuringiensis*
			11A2	*Bacillus sphaericus*

1. Including larvicidal and adulticidal insecticides. This mode-of-action classification is regularly edited and updated to include new products. Please refer to: www.irac-online.org for the complete mode of action list.

IRAC IRM Monograph

A publication produced by IRAC:

- Multi-authored
- 10 Chapters incl. figures & tables
- 5,000 copies printed (Dec. 2006)
- Available free of charge
- Funded by the Bill & Melinda Gates Foundation
- Copies via the IRAC website