

Insecticide Mode of Action Classification: Mosquito larvicides with WHO Prequalification

Introduction

Insecticides have been extensively used since the 1940s to control the mosquito vectors of disease, and have been a vital component in the fight against malaria. However, resistance to some insecticides has developed and is widespread in populations of the major mosquito vector species. As insecticide resistance continues to develop and spread, there is a real danger that these valuable tools will be lost. An understanding of insecticide modes of action (MoA) groups is a fundamental step in developing Insecticide Resistance Management (IRM) programmes.

Insecticides contained within WHO prequalified mosquito larvicide products

MoA Group 1.

Acetylcholinesterase (AChE) inhibitors: Inhibit AChE, causing hyperexcitation. AChE is the enzyme that terminates the action of the excitatory neurotransmitter acetylcholine at nerve synapses.

1B Organophosphates:
Pirimiphos-methyl
Temphos

MoA Group 5.

Nicotinic Acetylcholine Receptor (nAChR) Allosteric Modulators – Site I: Allosterically activate nAChRs, causing hyperexcitation of the nervous system. Acetylcholine is the major excitatory neurotransmitter in the insect central nervous system.

5 Spinosad

MoA Group 7.

Juvenile hormone mimics: Pre-metamorphic instar - disrupt and prevent metamorphosis

7C Pyriproxyfen

MoA Group 11.

Microbial Disruptors of Insect Midgut Membranes: Protein toxins that bind to receptors on the midgut membrane and induce pore formation, resulting in ionic imbalance and septicaemia.

11A *Bacillus thuringiensis* (Bt) and the insecticidal proteins they produce
11B *Bacillus sphaericus* (Bs)

MoA Group 15.

Benzoylureas - Inhibitors of Chitin Biosynthesis affecting CHS1: Inhibit the enzyme that catalyses the polymerization of Chitin.

15 Diflubenzuron
Novaluron

MoA Group UNM.

Non-Specific Mechanical Disruptors.
UNM Polydimethylsiloxane

For further information refer to:
www.irc-online.org



Aedes aegypti larva courtesy of Syngenta



Anopheles stephensi pupae courtesy of Syngenta

Notes:

Prequalification relates to products, not individual insecticides or insecticide mode of action groups.

Refer to the WHO Prequalification website to identify prequalified Vector Control products www.who.int/pq-vector-control/en/

Prequalified MoA groups correct as of November 2021

Insecticide Resistance Management

- Plan: IRM should be considered an integral part of any vector control programme and included during the planning phase.
- Monitor: The susceptibility status of the target mosquito populations should be monitored regularly to guide the design of the IRM programme, and choice of intervention.
- Rotation: Guided by susceptibility monitoring data, plan to rotate insecticides by MoA group, either temporally or spatially. In the absence of susceptibility data, the rotation of products between IRAC MoA classes is recommended.
- Mixtures: The use of mixtures of insecticides will have the greatest IRM benefit if the insecticides in the mixture are from different MoA classes, and the target mosquito population is fully susceptible to both.

Mosquito vector control should be undertaken within an Integrated Vector Management (IVM) programme that includes multiple approaches to control mosquitoes.

Further reading:



Prevention and management of insecticide resistance in vectors and pests of public health importance
www.irc-online.org



Global Plan for Insecticide Resistance Management in Malaria Vectors
<https://apps.who.int/iris/handle/10665/44846>