Biocontrol of mosquito vectors of disease

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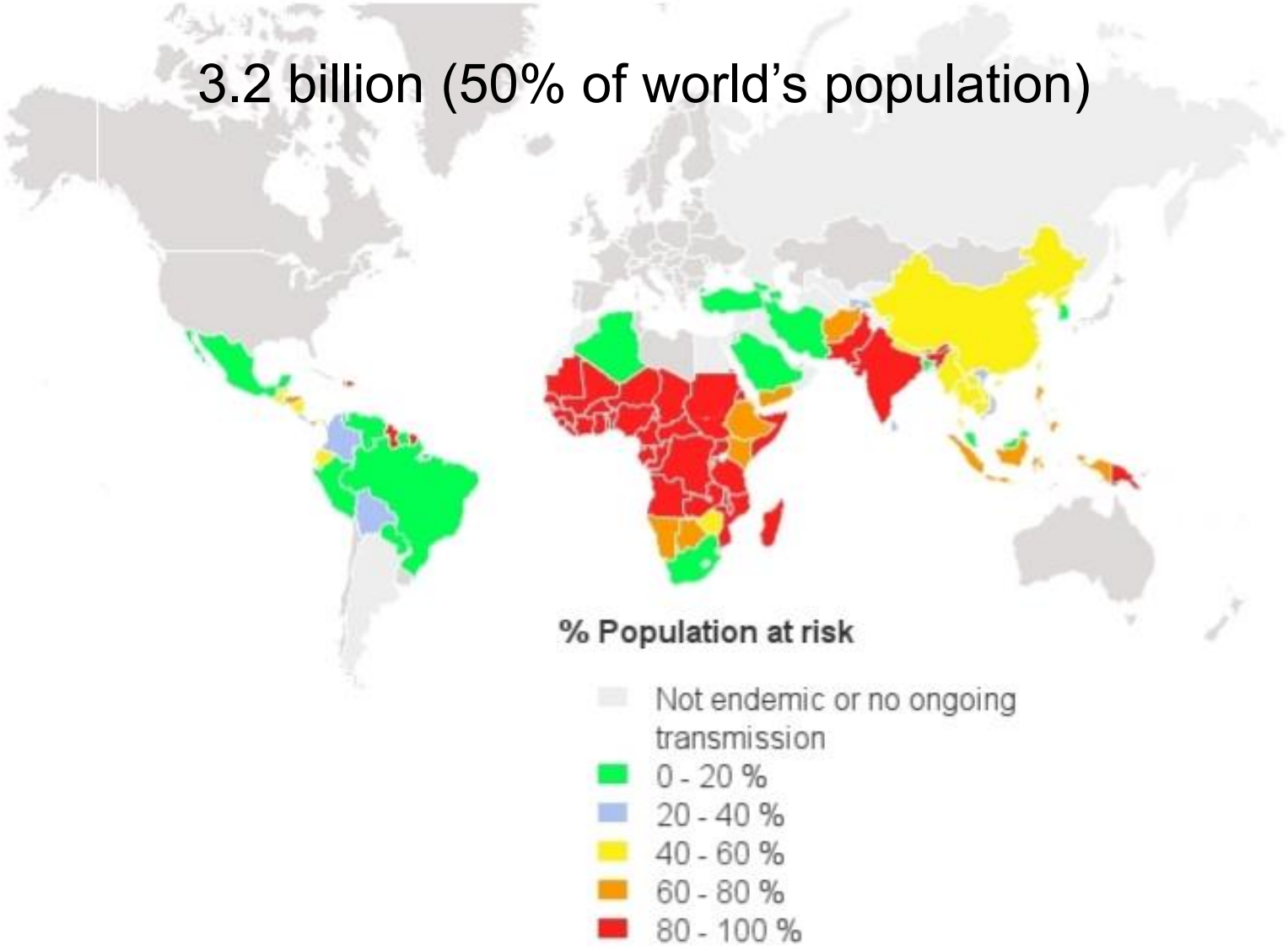
Major vector-borne diseases

- Malaria
- Dengue, Chikungunya, Zika Virus, Yellow fever, West Nile, Japanese encephalitis
- Lymphatic filariasis, schistosomiasis
- Leishmaniasis (visceral and cutaneous)
- Chagas disease
- Human African Trypanosomiasis

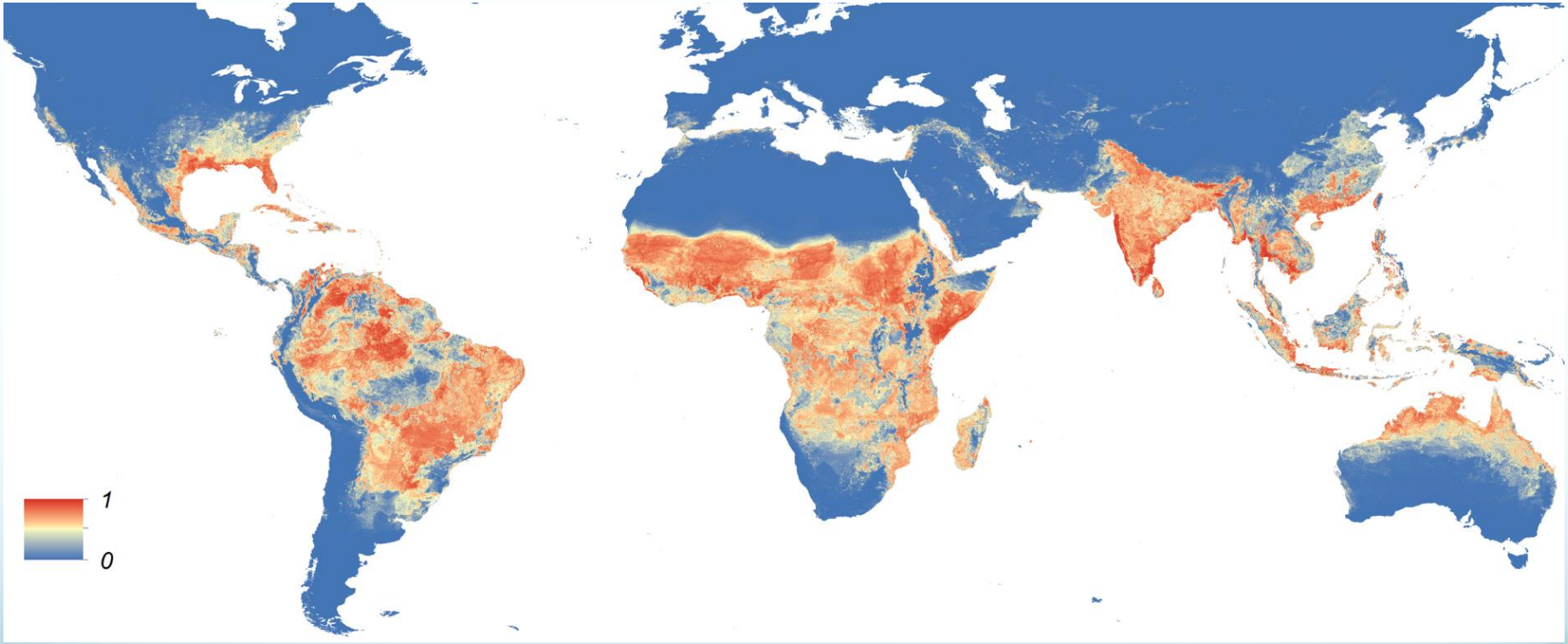
% Population at risk of malaria, 2013

3.2 billion (50% of world's population)

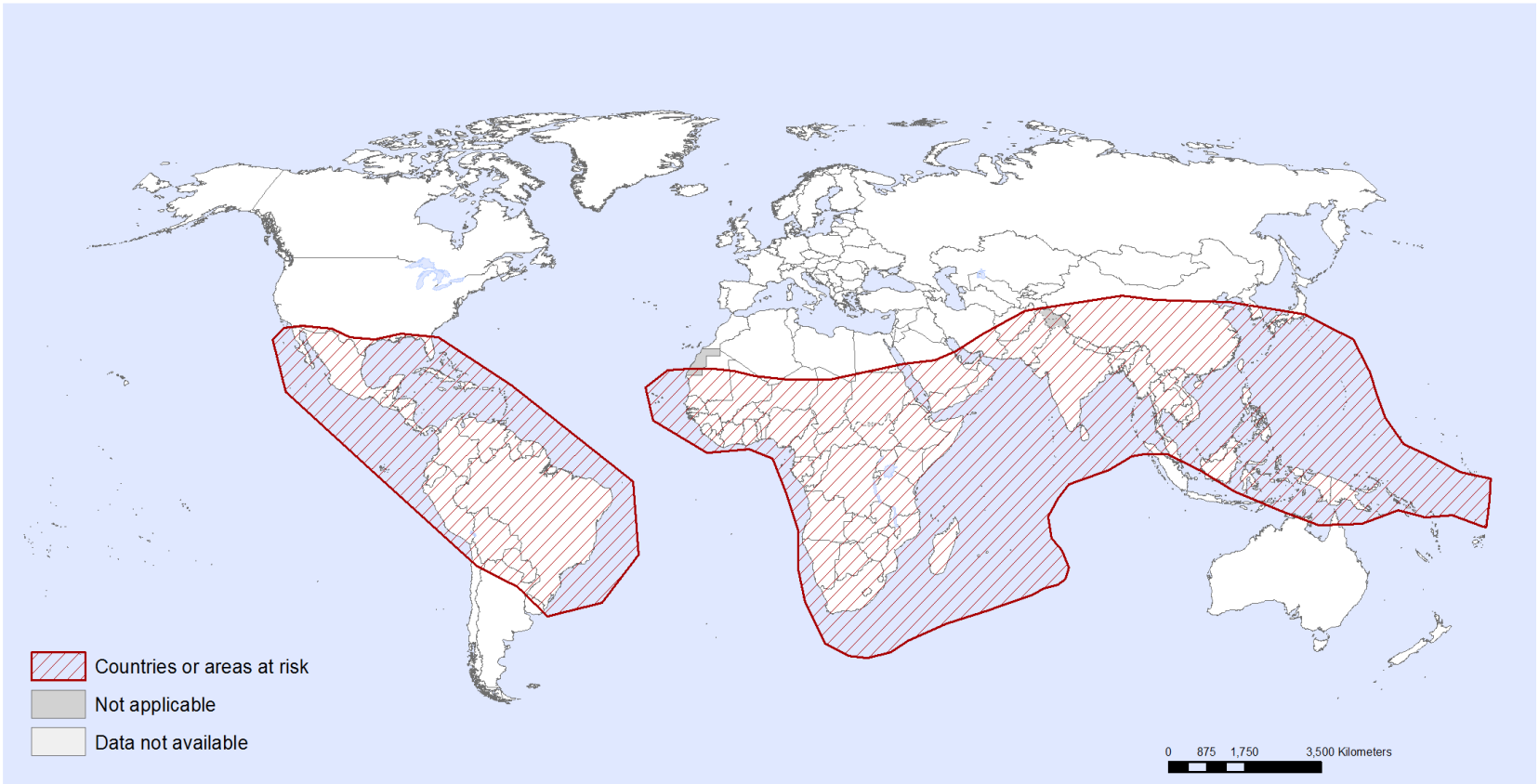


Aedes-borne diseases

Dengue: 128 countries, 390 million infections;
3.9 billion people at risk



Chikungunya, countries or areas at risk in 2015

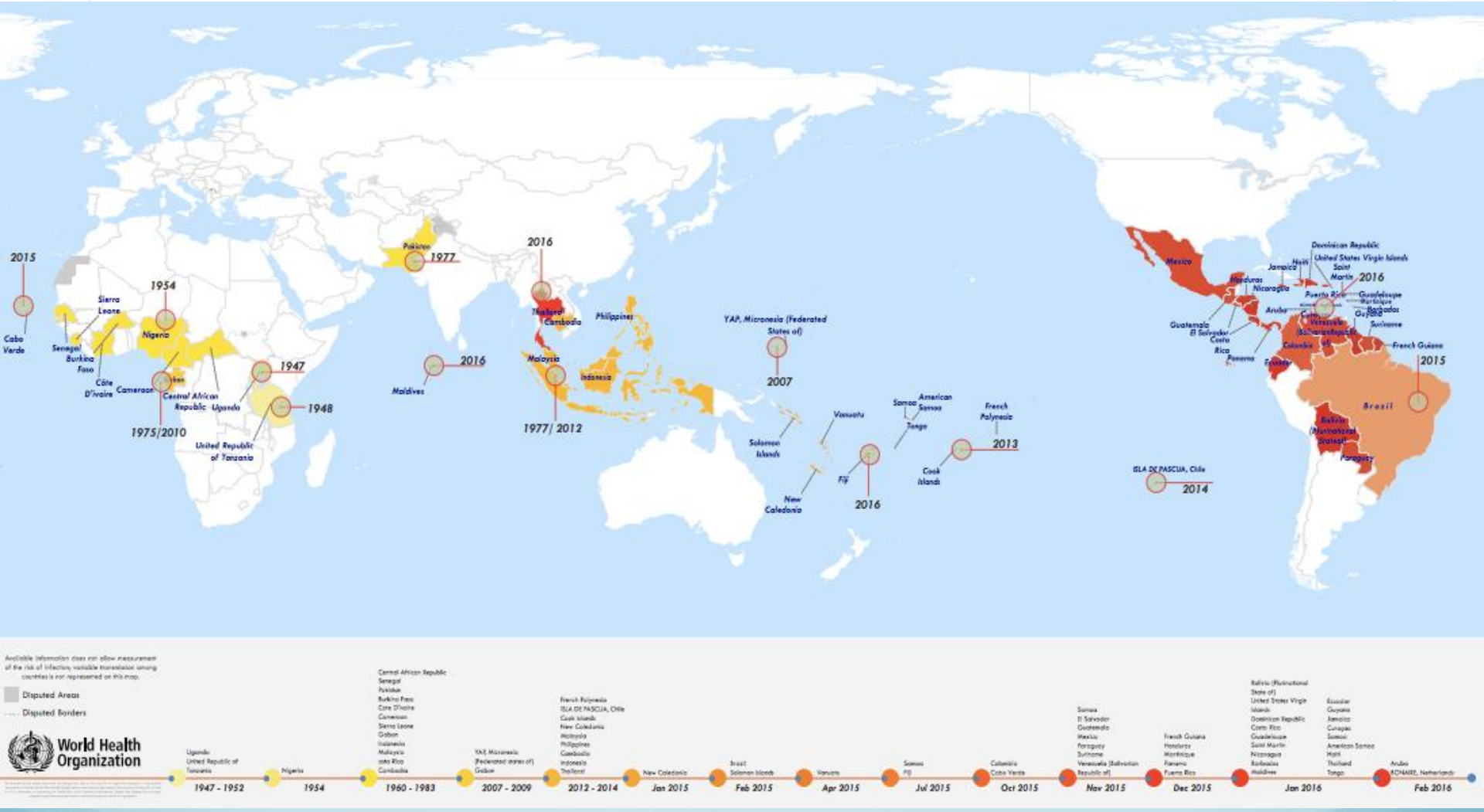


The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: Adapted from Fields virology
5th ed. Vol. 1. Philadelphia,
Lippincott Williams & Wilkins, 2006:1047.
Map Production: International Travel and Health (ITH)
World Health Organization

World Health Organization

Zika Virus distribution 1947–2016



Countries & territories with active Zika virus transmission

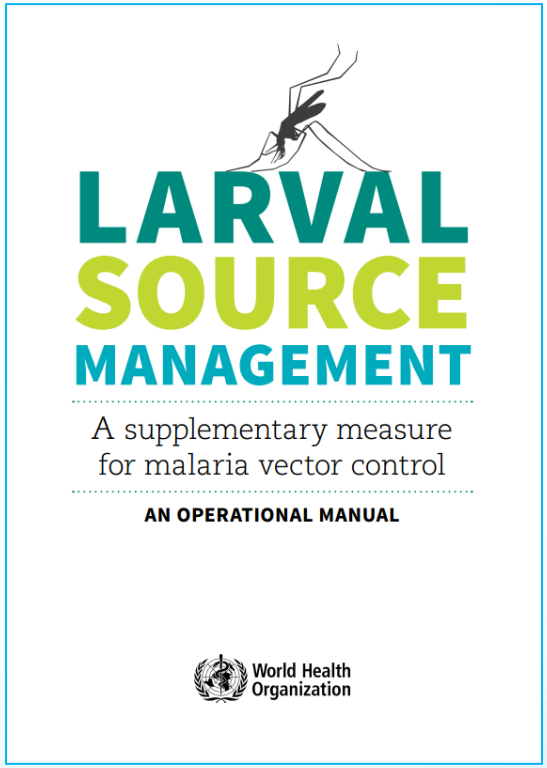
Source: www.cdc.gov

Core vector control tools

- Long-lasting insecticidal nets
- Indoor residual spraying
- Space spray (fogging) products
- Mosquito larvicides incl. biocontrol products
- Repellents
- Aircraft disinsection products
- Rodenticides
- Moluscicides

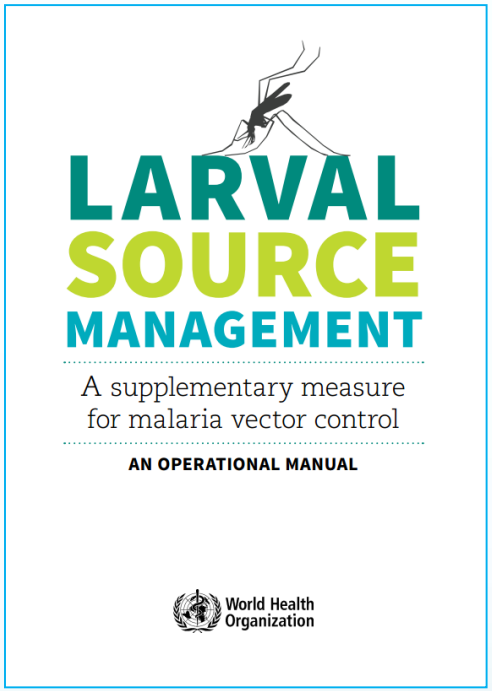
Larval source management: *conditions for the efficacy*

- Mosquito breeding places are fixed and findable
- High intervention coverage to reduce major reduction in vector density
- High human population density to justify frequent application of larvicides
- Community participation in environmental management



Larval source management: *tools & methods*

- Chemical larvicides
- Bacterial larvicides
- Insect growth regulators
- Oils and surface agents
- Biological control with fish
- Environmental management



Larval Control

- 38 countries used larval control as a malaria intervention in 2013
- This number increased to 48 in 2014
  - 45 countries used biological control of chemical larviciding
- *Bti* and *B. sphaericus*
  - WHO global survey, 2000–2009
  - Mainly used for dengue control
  - Some quantities used for malaria control

Source: WHO – World Malaria Report 2015

WHO systems for pesticide evaluation and use

WHO Pesticide Evaluation Scheme (WHOPES)

- Normative functions - guidelines for
  - efficacy testing, standard operating procedures
  - human risk assessment
  - development of pesticide specifications
- Policy development in life-cycle management of pesticides
- Country support in vector control
- Partnerships and collaboration

WHO systems for pesticide evaluation and use

- **WHO Prequalification unit**
  - Evaluation of dossier for product listing
  - Develop a quality assurance system
  - Post-marketing surveillance
- **WHO Vector Control Advisory Group (VCAG)**
  - Assessment of public health value of new VC tools

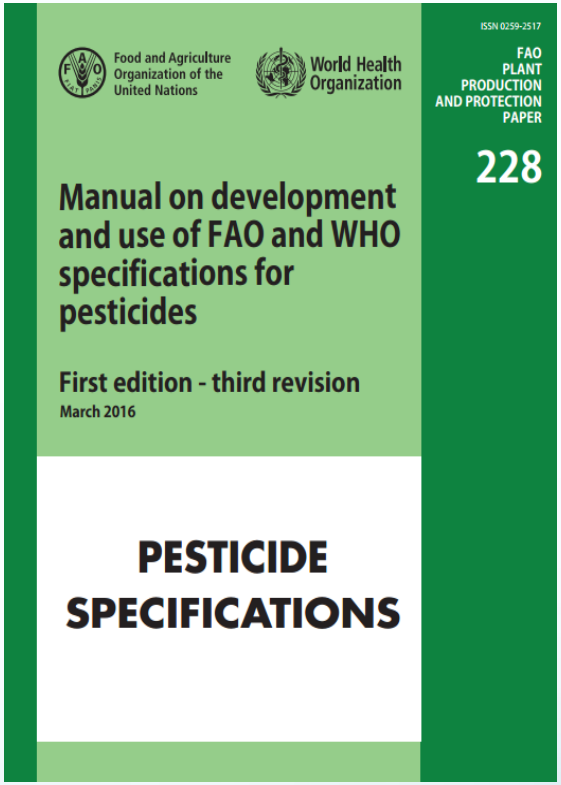
Larvicide evaluation: data requirements

1. *Safety assessment*
   - *Hazard assessment (for AIs)*
   - *Human Risk Assessment (for formulated product)*
2. *Efficacy testing*
   - Laboratory testing
   - Small-scale field testing
   - Large-scale field testing

3. *Product specification – for quality control*

Pesticide specifications

- FAO/WHO Joint Meeting on Pesticide Specifications (JMPS)
- Dossier submitted by manufacturers
- Data requirements and procedures given in the FAO/WHO Manual



WHO recommended bio-larvicides

Microbial pesticides	Dosage (active ingredient)		
	Open water bodies		Container-breeding
	(g/ha)	(mg/m^2)	(mg/L)
***B. t. israelensis*, strain AM65-52 (3000 ITU/mg), WG**	125–750	12.5–75	1–5
***B. t. israelensis, strain* AM65-52 (200 ITU/mg), GR**	5,000–20,000	500–2000	-
***B. t. israelensis* (*strain* AM65-52 + *B. sph* strain ABTS-1743; 50 Bsph ITU/mg), GR**	5,000–20,000	500–2000	60–80
***B. t. israelensis, strain* 266/2 (≥ 1200 ITU/mg), SC**	30–50L	3–5 mL	0.01–0.04mL

WHO recommended chemical larvicides

Insecticide compounds and formulation(s)	Dosage (active ingredient)		
	Open water bodies		Container-breeding
	(g/ha)	(mg/m^2)	(mg/L)
Chlorpyrifos EC	**11–25**	**1.1–2.5**	**-**
Diflubenzuron DT, GR, WP	**25–100**	**2.5–10**	**0.02–0.25**
Novaluron EC	**10–100**	**1–10**	**0.01–0.05**
Pyriproxyfen GR	**10–50**	**1–5**	**0.01**
Fenthion EC	**22–112**	**2.2–11.2**	**-**
Pirimiphos-methyl EC	**50–500**	**5–50**	**1**
Temephos EC, GR	**56–112**	**5.6–11.2**	**1**
Spinosad DT, EC, GR, SC	**20–500**	**2–50**	**0.1–0.5**
Spinosad 83.3 monolayer DT	**250–500**	**25–50**	**-**
Spinosad 25 extended release GR			
a. Open bodies of water	**250–400**	**25–40**	**-**
b. Control of Culex quinquefasciatus in open bodies of water with high organic matter	**1000–1500**	**100–150**	**-**

Use of bacterial larvicides in vector control, 2000–2009

Source: WHO Global Survey, 2010

Quantities in tonnes or kilolitres

Species	Disease	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Bacillus thuringiensis israelensis	Malaria	8	2	12	4	13	8	31	5	2	0.1
	Dengue	0.5	293	255	145	139	142	153	140	108	74
	Ross River virus	-	-	-	2	5	0.5	-	-	0.0	-
	Onchocerciasis	1	1	-	-	-	-	-	-	-	-
	Unspecified	-	-	0.1	-	-	-	26	20	2	2
	Total	9	295	267	151	156	150	209	165	113	76
Bacillus sphaericus	Malaria	-	26	0.2	3	209	103	141	161	211	302

Thank You