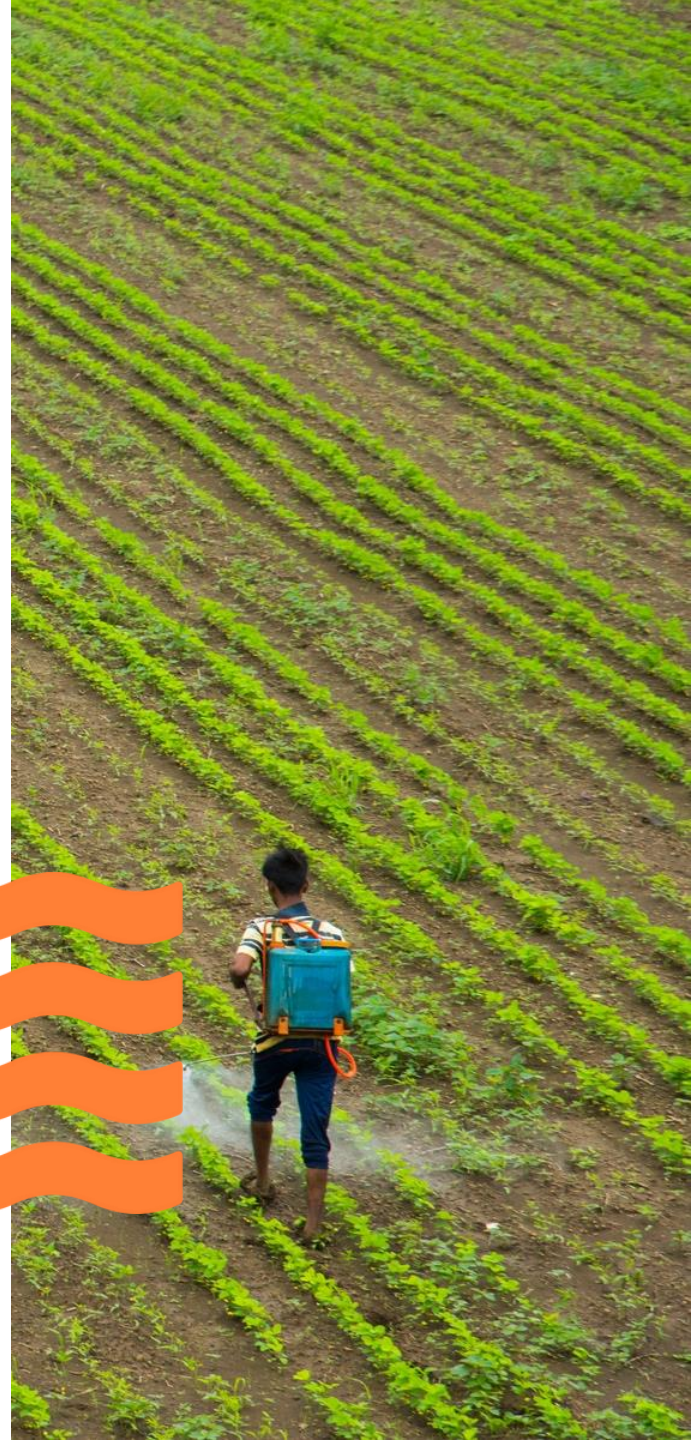
LEARNING COURSE

Alternatives to POPs
Annex B

Dichloro-diphenyl-trichloroethane (DDT)



GGKP, 2024

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POPs listed in Annex B

The Stockholm Convention on POPs listed DDT as one of the 12 initial POPs of global concern, leading to a call for its use reduction.

Parties must take measures to restrict the production and use of chemicals listed under Annex B, in accordance with the provisions of that Annex.

Dichloro-diphenyl-trichloroethane (DDT) is listed in Annex B to the Stockholm Convention (SC), with an acceptable purpose for the production and use for disease vector control in accordance with Part II of the Annex.

REF: Stockholm Convention

DDT production

Dichloro-diphenyl-trichloroethane (DDT) is an organo-chlorine. It was synthesized in 1874, but its insecticidal properties were discovered in 1939.

Was first used during World War II to combat malaria and typhus among civilians and troops. Subsequently, it was used as an agricultural and household pesticide, recommended as an indoor residual spraying (IRS).

India is the only producer of DDT worldwide (Hindustan Insecticide Ltd. Factories).

REF: UNEP/POPS/COP.8/INF/6 - https://chm.pops.int/Implementation/PesticidePOPs/DDT/Overview/tabid/378/Default.aspx

DDT uses

- As per Annex B:

Use	Acceptable purpose: Disease vector control in accordance with Part II of this Annex

- The Conference of the Parties (COP) of the Stockholm Convention allows the use of DDT for public health interventions for disease vector control as recommended by and under the guidance of the World Health Organization (WHO) due to the unavailability of locally appropriate and cost-effective alternatives.
- In accordance with paragraph 9 of Article 4 of the Convention, when there are no longer any Parties registered for a particular type of specific exemption no new registrations may be made with respect to such exemptions, which appear in gray text in the table.
- Indoor Residual Spraying (IRS) and Long-Lasting Insecticidal Nets (LLINs) remain the core vector control interventions for malaria and visceral leishmaniasis, the two vector-borne diseases where DDT is currently used.

REF: Stockholm Convention

Status of DDT in the Stockholm Convention

According to Part II of Annex B, among other things:

- The production and use of DDT shall be eliminated except for Parties that have notified the Secretariat of their intention to produce and/or use it.
- A DDT register is established and available to the public. In the event that a Party not listed in the DDT register determines that it requires DDT for disease vector control it shall notify the Secretariat as soon as possible in order to have its name added forthwith to the DDT register. A Party may, at any time, withdraw its name from the DDT Registry upon written notification to the Secretariat.
- Each Party that produces and/or uses DDT shall restrict such production and/or use for disease vector control in accordance with the World Health Organization (WHO) recommendations and guidelines on the use of DDT and when locally safe, effective and affordable alternatives are not available to the Party in question.
- Every three years, each Party that uses DDT shall provide to the Secretariat and the WHO information on the amount used, the conditions of such use and its relevance to that Party's disease management strategy. At least every three years, the COP shall, in consultation with the WHO, evaluate the continued need for DDT for disease vector control on the basis of available scientific, technical, environmental and economic information.

REF: UNEP/POPS/COP.11/INF/8

Status of DDT in the Stockholm Convention

At its fourth meeting held in 2009, the COP endorsed the establishment of a Global Alliance for the development and deployment of products, methods and strategies as alternatives to DDT for disease vector control. In 2011, the COP invited the United Nations Environment Programme (UNEP) to lead its implementation. During its sixth meeting held in 2013, the COP invited UNEP, in consultation with WHO, the DDT expert group and the Secretariat, to prepare a roadmap for the development of locally safe, effective, affordable and environmentally sound alternatives to DDT.

REF: https://chm.pops.int/Implementation/PesticidePOPs/DDT/Overview/tabid/378/Default.aspx

DDT benefits and challenges

- DDT proved to be a highly effective pesticide to combat malaria, typhus and other insect-borne human diseases, as well as insect control in crop and livestock production, institutions, homes and gardens.

- However, the use of DDT came with several challenges, including:
  - **Environmental persistence**: DDT has low to very low rates of metabolism and disposition, depending on ambient temperatures, a strong affinity for organic matter in soils and aquatic sediment, and it is more volatile in warmer than in colder parts of the world, which through long-range atmospheric transport results in a net deposition and thus gradual accumulation at high latitudes and altitudes.
  - **Health risks**: DDT accumulates in fatty tissue and is slowly released; it has been associated with adverse health effects in humans, ranging from liver cancer to lymphocytes DNA damage.
  - **Non-target effects**: DDT resistance is a matter of growing concern and is thought to be triggered further by the use of synthetic pyrethroids

REF: https://www.epa.gov/ingredients-used-pesticide-products/ddt-brief-history-and-status - van den Berg H. Global status of DDT and its alternatives for use in vector control to prevent disease. Environ Health Perspect. 2009 Nov;117(11):1656-63. - http://www.who.int/ipcs/publications/ehc/ehc241.pdf

Information on alternatives to DDT

The assessment of alternatives to DDT for disease vector control is focused on malaria because DDT is currently only used for malaria. Several alternative products to DDT are available for use in IRS for malaria vector control that has received formal approval from WHO.

The total number of prequalified IRS products is 27; all these products are available on the market.

Insecticide class	Insecticide compound	Number of prequalified products	Third-generation products
Carbamate	Bendiocarb	2	n/a
Neonicotinoid	Clothianidin	2	SumiShield® 50WG; Klypson 500WG
Neonicotinoid+pyrethroid	Clothianidin+deltamethrin	2	Fludora® Fusion; 2GARD
Organophosphate	Pirimiphos-methyl	2	Actellic® 300CS
Pyrethroid	Alpha-cypermethrin	10	n/a
	Bifenthrin	1	n/a
	Deltamethrin	3	n/a
	Etofenprox	1	n/a
	Lambda-cyhalothrin	4	n/a

REF: UNEP/POPS/COP.11/INF/8

Information on alternatives to DDT

- Three candidate products for IRS are currently under evaluation for prequalification by WHO.

Product name	Insecticide compound	Insecticide class	Expected at market
VECTRON® T500	Broflanilide	Meta-diamide	soon
Sylando® 240SC	Chlorfenapyr	Pyrrole	soon
Imergard™ WP	Perlite	Mineral	n/a

REF: UNEP/POPS/COP.11/INF/8

Information on alternatives to DDT

- **VECTRON® T500** represents a promising product that has newly entered the prequalification pipeline since the previous DDT expert group report
- **Sylando® 240SC** consists of relatively slow-acting insecticide chlorfenapyr, which belongs to the pyrrole insecticide class
  - Previous results showed a moderate effect (<80% mortality of mosquitoes) but prolonged residual activity on pyrethroid-resistant malaria vectors.
- **ImergardTM WP** is a mineral insecticide with expanded perlite (100%) as an active ingredient
  - Results from a small-scale experimental hut study showed promising efficacy levels and residual activity against pyrethroid-susceptible and resistant malaria vectors.

Screening assessment on POPs characteristics of the chemical alternative of DDT

- **Aim**

  To assess the POP characteristics and other hazard indicators of the insecticides recommended by WHO for disease vector control in IRS as alternatives to DDT.

- **Objective**

  To provide hazard-based information on the alternatives with respect to the POP criteria in Annex D of the Stockholm Convention and other relevant hazard criteria.

- **Limitations**

  The assessment provides only an indication as to whether or not the insecticide meets the numerical thresholds in Annex D of the Stockholm Convention, and does not analyse monitoring data or other evidence as provided for in Annex D, so failure to meet the thresholds should not be taken as a determination that the insecticide is not a POP.

REF: UNEP/POPS/POPRC.8/INF/30

Results: Alpha-cypermethrin

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Stable to hydrolysis at acidic conditions • No accumulation in water or sediment • Does not fulfil the persistence criteria according to Annex D 1 (b) (i)	• log Kow (octanol-water partition coefficient) of 5.5 • BCF (bioconcentration factor) in fish was 910 L/kg • Does not fulfil the bio-accumulation criteria according to Annex D 1 (c) (i)	• Low potential • Unlikely to fulfil the Annex D 1 (d) (iii) criteria	• Very toxic to aquatic life with acute and long lasting effects • High toxicity toward honey bees and other pollinators • Fulfils Annex D 1 (e) (ii)	• Acute oral and inhalation toxicity is approximately 2–4 times greater than that of Cypermethrin • Classified by EU-GHS for oral acute toxicity category 3 • Not listed in the EU endocrine disrupter database • Not classified for carcinogenicity, mutagenicity or reproductive toxicity according to the GHS system in the EU • Did not induce delayed neurotoxicity • Fulfils Annex D 1 (e) (ii)

* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Results: Bendiocarb

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Hydrolytically degraded depending on the pH • On soil surfaces photolytic degradation was fast • Degrades reasonably rapidly in the aquatic environment • Does not meet the persistency criteria of Annex D 1 (b) (i)	• log Kow (octanol-water partition coefficient) of 1.7 • BCF (bioconcentration factor) in fish was 6 L/kg • Does not fulfil the bio-accumulation criteria according to Annex D 1 (c) (i)	• The active substance is not considered volatile • Unlikely to fulfil the Annex D 1 (d) (iii) criteria	• Highly toxic to aquatic organisms • Highly toxic to terrestrial organism • Fulfils Annex D 1 (e) (ii)	• Acute systemic toxicity qualifying for GHS category 3 • Not classified for carcinogenicity or mutagenicity by EU-GHS • Not classified for reproductive toxicity • No immunotoxicity is reported • Critical effects appear to be cholinesterase inhibition and related neurotoxic effects • Fulfils Annex D 1 (e) (ii)

* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Results: Bifenthrin

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• DT50 values (12°C) in water/sediment range from 176 to 524 days (for the whole system) • DT50 values (12°C) in soil range from 252 to 695 days • Meets the Annex D 1 (b) (i) criterion.	• log Kow (octanol-water partition coefficient) of 6.6 • Lower bioaccumulation potential • Fulfils the bio-accumulation criteria according to Annex D 1 (c) (i)	• Low potential • Unlikely to fulfil the Annex D 1 (d) (iii) criteria	• High toxicity to aquatic organisms • Highly toxic to bees • Fulfils Annex D 1 (e) (ii)	• No EU-GHS harmonized classification is actually available • No relevant mutagenic potential • No specific adverse fertility or developmental effects observed • listed in the EU endocrine disrupter database within category 1 (persistent in the environment or produced at high volumes and shows evidence of endocrine disruption activity in at least one species using intact animals) • Did not induce delayed neurotoxicity • Fulfils Annex D 1 (e) (ii)

DT50: period required for 50 percent dissipation (under laboratory conditions)
* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Results: Cyfluthrin

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Susceptible to photolytic degradation in aqueous media and soil • Does not meet the Annex D 1 (b) (i) criterion.	• log Kow (octanol-water partition coefficient) of 6 • BCF (bioconcentration factor) in fish was 506 L/kg • Does not meet the bio-accumulation criteria according to Annex D 1 (c) (i)	• No conclusive information on the Annex D 1 (d) (iii) criteria	• High toxicity to aquatic organisms • Highly to moderately toxic to mammals • Fulfils Annex D 1 (e) (ii)	• Classified by EU-GHS for acute toxicity category 2 for oral and 3 for respiratory exposure. • Neither genotoxic nor carcinogenic nor a reproductive toxin • Did not induce delayed neurotoxicity • Fulfils Annex D 1 (e) (ii)

* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Results: Deltamethrin

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Degrades at a relatively fast to moderate rate and is not expected to accumulate in soil • Potential to persist in aquatic environments • Moderately to highly persistent in terrestrial environments • Likely to meet the Annex D 1 (b) (i) criterion.	• log Kow (octanol-water partition coefficient) of 4.6-6.2 • BCF (bioconcentration factor) in fish was 1.400 L/kg • Likely not meet the bio-accumulation criteria according to Annex D 1 (c) (i)	• Moderately fast degradation in air • Unlikely to fulfils the Annex D 1 (d) (iii) criterion	• Highly toxic to fish and arthropods • Very toxic to aquatic life with acute and long lasting effects • Fulfils Annex D 1 (e) (ii)	• Classified by EU-GHS for acute toxicity category 3 for oral and respiratory route • Neither genotoxic nor carcinogenic • Representing a type II pyrethroid the critical effect is neurotoxicity • Fulfils Annex D 1 (e) (ii)

* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

Results: Etofenprox

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Rapidly and completely degraded in soil and water without giving rise to significant or persistent degradation products • Does not meet the Annex D criterion 1 (b) (i)	• log Kow (octanol-water partition coefficient) >5 • BCF (bioconcentration factor) in fish was 3.921 L/kg • Does not meet the criterion 1 (c) (ii) of Annex D	• Very low potential • Unlikely to fulfils the Annex D 1 (d) (iii) criterion	• High toxicity to aquatic organisms • Toxic to bees • Fulfils Annex D 1 (e) (ii)	• Low acute toxicity • Neither genotoxic nor carcinogenic • Listed in the EU database for endocrine disrupters within category 3b, which means that insufficient data are available for an evaluation of respective effects

* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

Results: Fenitrothion

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Results show no signs of persistence on the environment (soil/water) • Does not meet the Annex D criterion 1 (b) (i)	• log Kow (octanol-water partition coefficient) <5 • Depuration in fish is considered to be fast • Does not meet the criterion 1 (c) (ii) of Annex D.	• Not expected to persist in air • Unlikely to fulfil the Annex D 1 (d) (iii) criterion	• High toxicity to aquatic organisms • Highly toxic to honeybees and earthworms • Chronic effects in avian reproductive testing were observed • Fulfils Annex D 1 (e) (ii)	• Low acute toxicity • Not classified for carcinogenicity or mutagenicity by EU-GHS • Not classified for reproductive toxicity • Listed in the EU endocrine disrupter database within category 1 which means it shows evidence of endocrine disruption activity in at least one species using intact animals • Fulfils Annex D 1 (e) (ii)

* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Results: Lambda-cyhalothrin

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Moderately persistent and degrade slowly through biotic and abiotic mechanisms • Does not meet the Annex D criterion 1 (b) (i). However, under anaerobic conditions in aquatic environment half-live is prolonged and persistency under low temperatures cannot be excluded	• log Kow (octanol-water partition coefficient) >5 • BCF (bioconcentration factor) values indicate high potential of bioaccumulation • Close to meet the criterion 1 (c) (ii) of Annex D.	• Low potential • Unlikely to fulfil the Annex D 1 (d) (iii) criterion	• Highly toxic to aquatic species • Highly toxic to mammals • Fulfils Annex D 1 (e) (ii)	• Classified for acute toxicity category 4 for the dermal route, category 3 for the oral route and category 2 for the respiratory route • Not likely to be carcinogenic to humans • Representing a type II pyrethroid the critical effect is neurotoxicity • Fulfils Annex D 1 (e) (ii)

* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Results: Malathion

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Susceptible to pH dependant hydrolytic degradation • Rapid break-down in water/sediment systems • Does not meet the Annex D criterion 1 (b) (i)	• log Kow (octanol-water partition coefficient) 2.75 • Experimentally derived BCF (bioconcentration factor) of 103 • Does not meet the criterion 1 (c) (ii) of Annex D.	• Rapid degradation in air • Does not fulfil the Annex D 1 (d) (iii) criterion	• High toxicity to aquatic organisms • Moderately toxic to avian species and less toxic to mammals • Slightly toxic to earthworms, but highly toxic to bees • Fulfils Annex D 1 (e) (ii)	• Low acute systemic toxicity qualifying for acute oral GHS class 4 • Not classified for carcinogenicity, mutagenicity or reproductive toxicity according to the GHS system in the EU • Genotoxicity results are inconclusive • Suggestive evidence for carcinogenicity • Listed in the EU endocrine disrupter database within category 2 • Did not induce delayed neurotoxicity • Fulfils Annex D 1 (e) (ii)

* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Results: Pirimiphos-methyl

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Suspected to volatilize from soil surfaces • No experimental DT50 values for water available • Does not meet the Annex D criterion 1 (b) (i)	• log Kow (octanol-water partition coefficient) 3.9-4.2 • Estimated BCFs (bioconcentration factor) below 1000 • Does not meet the criterion 1 (c) (ii) of Annex D.	• Low potential • Does not fulfil the Annex D 1 (d) (iii) criterion	• Highly toxic to birds, aquatic species and invertebrates • Classified according to EU-GHS as aquatic acute and chronic category 1 • Fulfils Annex D 1 (e) (ii)	• Low acute systemic toxicity that qualifies for GHS category 4 • Not classified for carcinogenicity, mutagenicity or reproductive toxicity or specific target organ toxicity according to the GHS system in the EU • No specific immunotoxicity • Not listed in the EU endocrine disrupter database • No induce delayed neurotoxicity • Fulfils Annex D 1 (e) (ii)

DT50: period required for 50 percent dissipation (under laboratory conditions)
* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Results: Propoxur

Persistence	Bioaccumulation	Long-range environmental transport (LTR)	Ecotoxicity*	Toxicity to human health**
• Moderate persistence on soil • DT50 value of 2 days (for water/sediment system) • Does not meet the Annex D criterion 1 (b) (i)	• log Kow (octanol-water partition coefficient) 0.14 • BCF (bioconcentration factor) 75 • Does not meet the criterion 1 (c) (ii) of Annex D.	• Half-life in air of 4 hours • Does not fulfil the Annex D 1 (d) (iii) criterion	• Highly toxic to aquatic organisms • High acute toxicity for birds and mammals • Moderate toxicity to honey bees and is assumed to be harmful for other arthropods • Fulfils Annex D 1 (e) (ii)	• EU GHS category 3 for acute oral toxicity • Classified by US EPA as group B (probable human carcinogen) • No reported concern for reproductive toxicity • Neurotoxic effects were observed • Fulfils Annex D 1 (e) (ii)

DT50: period required for 50 percent dissipation (under laboratory conditions)
* (including pollinator toxicity)
** (including mutagenicity, carcinogenicity and adverse effects on the reproductive, endocrine, immune or nervous systems)

REF: UNEP/POPS/POPRC.8/INF/31

Alternative methods of vector control

WHO distinguishes between two types of interventions

- Interventions for **large-scale deployment** are those that have demonstrated their public health value and are broadly applicable to populations at risk of malaria in most epidemiological and ecological settings.
  - Two interventions for large-scale deployment are available, ITNs and IRS.
- **Supplementary interventions** are applicable for specific populations, situations or settings and hence are not broadly applicable.
  - WHO has issued conditional recommendations for two supplementary interventions: larviciding and house screening.

REF: UNEP/POPS/COP.11/INF/8

Large-scale deployment intervention: ITNs

- Dominant method of malaria vector control which is recommended for large-scale deployment
- Main alternative method to IRS
- Prequalified ITN products:

ITN class	Insecticide compound/synergist	Prequalified products	Next-generation products
Pyrethroid-only nets	Alpha-cypermethrin	7	n/a
	Deltamethrin	7	n/a
	Permethrin	1	n/a
Pyrethroid-PBO nets	Alpha-cypermethrin, PBO	2	DuraNet® Plus; VEERALIN®
	Deltamethrin, PBO	3	Permanet® 3.0; Tsara® Boost; Tsara® Plus
	Permethrin, PBO	1	OLYSET® Plus
Dual-insecticide nets	Alpha-cypermethrin, chlorfenapyr	1	Interceptor® G2
	Alpha-cypermethrin, pyriproxifen	1	Royal Guard®

REF: UNEP/POPS/COP.11/INF/8

Large-scale deployment intervention: ITNs

- Pyrethroid-only ITNs may lose effectiveness in areas where vectors are pyrethroid resistant.
- Dual-insecticide nets contain a pyrethroid plus an insecticide of another class with different modes of action.
- In areas with pyrethroid-resistant malaria vectors, the need for new net options may be addressed by pyrethroid-PBO nets and dual-insecticide nets.

Large-scale deployment intervention: IRS

- Highly effective for malaria control in a range of transmission settings where local vectors are susceptible to the insecticides used and where intervention coverage is adequate
- Some communities reported that Actellic® 300CS left a bad smell and caused residual stains on walls, whilst Fludora® Fusion and SumiShield® were found to be odourless and have a side benefit of killing bedbugs
- Prequalified third-generation IRS products have been proven to have an above-80% efficacy against pyrethroid-resistant and susceptible mosquitoes
- Concerns have been raised about the affordability of third-generation IRS products in the context of malaria control budgets, however, they are cost-effective (defined as the cost to gain a unit of a health outcome) as stand-alone vector control intervention and when added as a supplementary intervention to ITNs.

Supplementary interventions: Larviciding

- 21 larvicide products have been prequalified by WHO.
- WHO recommends the regular application of larvicide products to water bodies (larviciding) for malaria control as a supplementary intervention to ITNs or IRS in areas with ongoing malaria transmission where aquatic habitats are few, fixed and findable.

Insecticide class	Insecticide compound	Nr of prequalified products
Bacterial larvicide	*Bacillus thuringiensis israelensis*	2
	Bacillus thuringiensis israelensis + *Bacillus sphaericus*	1
Insect growth regulator	Diflubenzeron	3
	Novaluron	1
	Pyriproxifen	3
Mechanical barrier	Polydimethylsiloxane	1
Organophosphate	Pirimiphos-methyl	1
	Temephos	3
Spinosyn	Spinosad	6

REF: UNEP/POPS/COP.11/INF/8

Supplementary interventions: House screening

- WHO recommends the use of screening of houses with netting for the prevention and control of malaria in areas with ongoing malaria transmission.
- There are no products for house screening that received formal approval from WHO.

Suitability of alternative methods

- ITNs have been an effective tool for reducing malaria morbidity and mortality across a range of epidemiological settings
  - The nets have benefits at the community level by reducing vector populations, particularly where vectors have a strong preference to feed on humans.
- ITNs have proven to be a highly cost-effective intervention.
- The effect of ITNs requires a high proportion of the population to be compliant with using nets consistently, which is not easily achievable in some populations.

REF: UNEP/POPS/COP.11/INF/8

Suitability of alternative methods

- Pyrethroid-PBO nets were found to be more effective than pyrethroid-only nets at up to two years of use in areas with high pyrethroid resistance in malaria vectors.
- WHO suggests not co-deploying ITNs and IRS and that priority be given to delivering either ITNs or IRS at optimal coverage and to a high standard.
- Larviciding and house screening can be suitable supplementary interventions to the main interventions ITN or IRS under specific environmental and housing conditions.

REF: UNEP/POPS/COP.11/INF/8

Benefits of adopting alternatives

- All IRS products that have been prequalified by WHO have been found suitable insofar as their quality, entomological efficacy and safe use are concerned.
- The prequalified third-generation IRS products have been proven to have an above-80% efficacy against pyrethroid-resistant and susceptible mosquitoes.
- Third-generation IRS products have been found to be cost-effective as stand-alone vector control intervention and when added as supplementary interventions to ITNs (Insecticide-treated nets).
- ITNs have been an effective tool for reducing malaria morbidity and mortality. Besides protecting sleepers, the nets have benefits at the community level by reducing vector populations, particularly where vectors have a strong preference to feed on humans.
- In areas with high pyrethroid resistance in malaria vectors, pyrethroid-PBO nets were found to be more effective than pyrethroid-only nets at up to two years of use.

Final remarks

- The global production and use of DDT declined substantially in recent years, while the toolbox of next-generation products for indoor residual spraying (IRS) has been further expanded.
- Various IRS products prequalified by WHO are available as alternatives to DDT.
- WHO recommends two interventions for large-scale deployment for malaria vector control, IRS and ITNs.
- Larviciding and house screening are recommended as supplementary interventions, applicable in specific situations only.

REF: UNEP/POPS/COP.11/INF/8