# VECTORS AND THEIR BIO-CONTROL

**Ankita Kumari[2*], Dr. Arti Prasad[1], Manoj Joshi[2], Chetana Suvalka[2], Kanistha Acharya[2]**

1. Professor and Head, Department of Zoology, UCOS, MLSU, Udaipur.
2. Research Scholars, Lab. of Public Health Entomology, Deptt. Of Zoology, UCOS, MLSU, Udaipur.

**ABSTRACT**

Vector control is an essential part for reducing vector born disease transmission.There is different strategies available for vector control. Likewise, recent introduction of safer vector control agents, such as insect growth regulators, biocontrol agents, and natural plant products have yet to gain the needed scale of utility for vector control. Integrated vector management (IVM) is defined as "a rational decision-making process for the optimal use of resources for vector control". Despite the successful employment of comprehensive integrated vector control programmes, further strengthening of vector control components through IVM is relevant, especially during the "end-game" where control is successful and further efforts are required to go from low transmission situations to sustained local and country-wide vector born disease elimination. Bacterial pesticides are promising and are effective in many countries.Bacteria *Bacillus thuringiensis* ssp. israelensis (*Bti*) is used as bacterial biopesticide. The reasons for the success of B.t.i. are cost-efectiveness and relative ease of use. Because few microbial insecticides those are only effective against larvae, these agents will likely play only mior, but in some cases important, role in most future vector control programs. The methods mentioned in the review that are being implemented for implementation needs effective inter-sectoral coordination and community participation.

**INTRODUCTION**

An arthropod species which is involved in the mechanical or biological transmission of human or animal infection is termed as vector.

The use of synthetic chemical insecticides for vector control is in decline due to high costs, the development of resistance in many target populations, and perceived risks to the environment and human health. Although chemical insecticides will remain important in vector control programs, problems they have caused, and the scarcity of new types under development, have for some time stimulated interest in alternative control agents. In search of replacements for chemicals, the pathogens and nematodes have proved as effective control measures to vectors. A significant study over the past 30 years, particularly with respect to their potential for controlling the mosquito vectors of malaria and filariasis, and the blackfly vectors of onchocerciasis (6,2,13,8,16). These studies have included the search for pathogens and nematodes, the laboratory and field evaluation of those that appeared to have the best potential for operational use, the development and assessment of methods for mass reproduction, and finally accomplishment in operational control programs followed by evaluation of cost effectiveness based on control of the target pests or vectors. Overall, these studies have resulted in 3 principal findings: l) pathogens and nematodes are only effective against the larval stages of vectors, 2) effective control typically requires repeated rather than a single application of the agent during the breeding season, and 3) to be used cost-effectively in vector control programs, a method for mass production of the control agent in vitro must exist. The first finding is simply a biological property of most of the pathogens and nematodes discovered to date; they may occur in adult stages, but seem to take their greatest toll against larvae. The second results from natural diminution, or what might be considered poor recycling potential from the standpoint of vector control. The third results from the relatively large areas that must be treated, and derives from the high costs of mass rearing control agents in organisms, such as mosquito larvae, in comparison to the lower costs of mass production for a control agent grown on an inexpensive artificial medium. The latter is only possible at present for some of the bacteria and fungi. As a result of the combination of these findings, only the bacterium, *Bacillus thuringiensis* subsp. israelensis (B.t.i.), has been used in operational vector control programs, and only in programs where larviciding has been a traditional method of vector control. Progress in developing microbials for vector control has been slow, and this situation is unlikely to improve soon.

Biological managment, 'based on the introduction of organisms that prey upon, parasitise, contend with or otherwise reduce populations of the target species', is taken into account a sensible different to the appliance of chemical insecticides in controlling mosquito vectors of disease (25). In addition to reducing both toxicity to non-target species and environmental contamination, biological control also offers reduced potential for resistance development. However, biological control agents can be comparatively expensive and logistically more challenging to deploy and maintain compared to traditional chemical agents.

**Vector Biology**

Adult females of many mosquito species are bite humans, using the blood meals for egg production. However, about 60 species of the genus Anopheles can transmit malaria. Anophelines generally bite at night and habitually rest on a surface (such as the wall of a house) before or after feeding. As with all mosquitoes, the juvenile stages are aquatic, and they prefer slow-moving or still water in which they can stay close to the water surface with their breathing orifices open to the air. Although malaria is transmitted exclusively by anophelines, only certain species are important vectors of the disease. Several factors determine both the importance of each species as a vector of malaria (or other diseases) and the options for control. A good understanding of the biology and ecology of the principal vectors is essential to the development of an integrated vector control approach. These factors include the following:

_ Time of biting (evening, dawn, night)

_ Flight range of the vector (usually 3 kilometers)

_ Feeding preferences of adult female mosquitoes (humans or animals)

_ Adult behavior—particularly, preference for biting and resting indoors (endophagic, endophilic) or outdoors (exophagic, exophilic)

_ Larval habitat preferences (e.g., pools vs. containers, brackish vs. fresh water, full sun vs. shade)

_ Resistance to insecticides

**OBJECTIVE OF VECTOR CONTROL:--**

● To reduce female vector density to a level below which epidemic vector borne disese transmission will not occur.

● Eliminating or reducing the number of larval habitats in the domestic environment will control the vector borne disease.

**Importance of Biological control of vectors**

The advantages of biological larval control agents in comparison to chemical controls can include(1) their effectiveness at relatively low doses, (2) safety to humans and non-target wildlife (including natural predators of mosquito larvae), (3) low-cost of production in some cases, and (4) lower risk of resistance development ( 26 ).

**Vector control interventions against vector born disease**

Lacking extensive use of transmission-blocking drugs or vaccines, vector control remains the preferred strategy for reducing malaria transmission. It is the only available method "capable of bringing intense or moderate transmission down to the low levels where elimination is within reach" (5) Insecticide-treated nets (ITNs), indoor residual spray (IRS), and source reduction (SR) all are the major vector control tools. Certainly some tools are more appropriate depending on the mosquito's behaviour and environment. All interventions require careful planning, trained staff for implementation, thorough supervision and evaluation, free or low-cost access and sustainability (WHO ).

The following sections review recent literature on the effects of three types of vector control interventions—environmental management, biological control, and chemical control—as tested at the field level. As vector control focuses on the mosquito, many researchers have used only entomological indicators of effectiveness, without addressing the impacts of the interventions on the incidence or prevalence of the disease itself. Conversely, some studies have examined the overall effects on malaria of field programs incorporating several different vector control interventions at once. In these cases, though data are available on the incidence and prevalence of vector born disease, the role of any one of the interventions in producing changes in the disease burden is less clear.

**Integrated vector management (IVM)**

Integrated Vector Management (IVM) is "a rational decision-making process to optimize the use of resources for vector control" defined by the World Health Organisation as. IVM is based on the promotion and use of a range of interventions – alone or in combination – selected on the basis of local information of the vectors, diseases and the many factors that affect transmission. The IVM approach addresses several diseases concurrently, because many vectors can transmit more than one disease and some interventions are effective against several vector born disease . IVM is most effective strategy because it uses two or more vector control methods, with each method targeting a setting most susceptible to that intervention. Although Indoor redusal spray, Insectiside treated net, and source reduction are all effective independently, they complement each other and have a synergistic impact when used together (17). IVM involves a "rational decision-making process for the optimal use of resources for vector control" (1). IVM requires reconsidering the combination of vector control methods over time, as the environment, epidemiology, and resources change. In 2004, the World Health Organization recommended IVM globally for the control of all vector-borne diseases (1).

**BIOPESTICIDES AND VECTOR CONTROL:**

In last years, it has been witnessed, an increased interest in the usage of bio-pesticides as effective tool for mosquito control. Several bio-control agents were screened for their potency, mammalian safety and environmental impact. Many organisms have been investigated as possible agents for vector mosquito control, including bacteria, viruses, fungi, nematodes, protozoa, fishes and invertebrate predators. More recently, scientists have overcome many of the barriers established by early research through additional studies evaluating a). The role microbial particle behavior in the water column in extended residual control. b) Sub-lethal dose effects of microbial larvicides on mosquito populations. c) The economic cost/benefits of microbial against dengue and malaria vectors. This latest research supports further integration of microbial larvicides into integrated vector management programs worldwide and the utility of microbial mosquito larvicides in organized Larval Source Management (LSM) programmes for malaria control (12). Biopesticides are biochemical pesticides those are naturally occurring substances that control pests by nontoxic mechanisms. They are living organisms (natural enemies) or their products (phytochemicals, microbial products) or byproducts (semiochemicals) which can be used for the management of pests that are injurious to crop plants. Biopesticide are biological pesticides which based on pathogenic microorganisms specific to a target pest offer an ecologically resonance and effective solution to pest problems. They create less hazard to the environment and to human health.These biopesticides include biofungicides (*Trichoderma*), bioherbicides (*Phytopthora*) and bioinsecticides (*Bacillus thuringiensis, B. sphaericus*). The potential benefits to agriculture and public health programmes through the use ofbiopesticides are considerable (9).

The advantages of using biopesticides are(in place of other chemical ones are based on these factors:

- Ecological benefit; naturally less harmful and less environmental load.
- Biopesticides are target specificity designed to affect only one specific pest or, in some cases, a few target organisms,
- Environmental valuable ; often useful in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems.

- Suitability; when used as a component of an integrated pest management (IPM) programs, biopesticides can put in greatly.

  Biopesticides range from plant products to biotic products of microbial origen.

**Biological control**

Many organisms help to regulate vectrol born disease naturally through predation, parasitism and competition. Biological control refers to the introduction or manipulation of these organisms

to suppress vector populations. Predators, particularly fish, and the bacterial pathogens *Bacillus thuringiensis* var. *israelensis* and *Bacillus sphaericus* that attack the larval stages of the mosquito at present , the main biological control agents that have been successfully employed against vectors (4). In the genera *Metarhizium* and *Beauveria* (fungal pathogens) show promise as larvicides (19).

The advantages of biological larval control agents in comparison to chemical controls can include their effectiveness at relatively low doses, safety to humans and non-target wildlife (including natural predators of mosquito larvae), low-cost of production in some cases, and lower risk of resistance development (26).

**Bacterial control**

The use of bacterial agents against insects of medical importance (primarily, against mosquitoes and black flies) began in the late 70's of the 20$^{th}$ century. Bacterial pathogens used for insect control are spore-forming and rod-shaped. It was connected with the invention of the microorganism *Bacillus thuringiensis* ssp. israelensis (*Bti*).The main advantage of biological agents when compared to chemical ones is selectivity and over most chemical larvicide is the low risk to human health and environment. *Bti* and *Bs* toxins do not typically persist or accumulate it the environment or in body tissues and are not toxic to vertebrate and most non – target aquatic organism (24). India, and Cuba (and possibly other countries) and are commercially available. In addition to liquid and water-soluble powder formulations that are similar to many chemical insecticides, Bti and Bs products available or under development include slow-release granules and briquettes (3). In Burkina Faso, researchers have experimented with local production of slow-release granular formulations, using imported bacilli (22,21). In Peru, communities in Piura State have used Bti culturedin coconuts to control malaria vectors breeding in fish farm ponds (23).

**Larvivorous fish**

Predatory fish (particularly in the family Cyprinodontidae) that eat mosquito larvae, particularly in the family Cyprinodontidae, have been used for mosquito control for at least 100 years (15). Prior to the 1970s, the most commonly used species of fish was *Gambusia affinis affinis* (Baird & Girard) (Cyprinodontiformes: Poeciliidae), a freshwater species inhabitant to the south-eastern U.S.A. This species was introduced widely around the world.

Larvivorous fish also show assure in controlling malaria vectors in human-made containers, particularly in urban areas. Fish are utilized in each Africa and India to manage vectors that breed in human-made water asset structures such as wells, and barrels. In associate degree geographic region in African nation (7) found that the autochthonal fish, *Aphanius dispar dispar* (Day) (Cyprinodontiformes: Cyprinodontidae:fish family, Arabian pupfish), effectively suppressed Associate in Nursing.

On Grande Comore Island, where the vector *An. gambiae s.s.* breeds only in human-made reservoirs, the introduced fish, *Poecilia reticulata* Peters (Cyprinodontiformes: Poeciliidae, Guppy), provided year-long suppression of larval and adult mosquito populations and significantly reduced malaria incidence . In the bulk of the breeding sites on the island, the fish reproduced successfully, thus reducing the need to restock. A number of studies have found that both introduced fish species ( *Gambusia affinis* and *Poecilia reticulata* ), and native species are effective at suppressing *An. stephensi* populations breeding in containers in India (14,10,18,12). A pilot project conducted in Goa, India, combined the use of the native fish *Aplocheilus blockii* in large breeding sites and Bti in smaller habitats and significantly reduced malaria transmission (11).

**Fungai as vector control**

Fungi area unit vital natural regulators of insect populations and have potential as myco pesticide agents against various insect pests in agriculture. These fungi infect their hosts vectors by penetrating through the cuticle, gaining access to the hemolymph, producing toxins, and grow by utilizing nutrients present in the haemocoel to avoid insect immune responses . Fungi may be applied in the form of conidia or mycelium which sporulates after application. The use of fungai as alternative to insecticide or combined application of insecticide with fungal entomopathogens could be very useful for insecticide resistant management . Fungal species happiness to the genera *Coelomomyces, Culicinomyces, Beauveria, Metarhizium, Lagenidium,* and Entomophthora were principally thought-about in vector born disease control (20). The use of bacterial agents against insects of medical importance (primarily, against mosquitoes and black flies) began in the late 70's of the 20th century. Bacterial pathogens used for insect control are spore-forming and rod-shaped. They occur commonly in soil, and most insecticidal strains have been isolated from soil samples.

## Conclusion

A wide range of chemical, biological, and environmental management techniques may be used to control vectors. Nonchemical approaches generally require considerable information about vector ecology, distribution of larval habitats, and local environmental conditions. Moreover, these interventions tend to be effective only under certain conditions, and successful control in one location may not be analytical of results elsewhere. Chemical control, particularly IRS, appears more time after time effective crosswise a wide range of vectors and environmental conditions, even though problems with insecticide resistance and concerns about pesticide exposure risks suggest that selective and limited applications of this technique may be desirable. Environmental management was successfully applied early in the 20th century to ensure that no water of the quality required by an identified local vector species was available. Its application is not, however, generally applicable, and its implementation must be designed with close attention to the local ecological, socioeconomic, political, and cultural setting. Interventions targeting vectors of diseases are essentially the most effective strategies to control vector-borne diseases. Furthermore, a promising strategy would be to eliminate the aquatic juvenile or larval stages of vectors rather than the infective adult stage. Establishing a biocontrol agent needs associate understanding of the mechanisms that a predator directly or indirectly affects the community composition. This is additionally vital for beneathstanding under what set of environmental conditions a predator are effective in reducing mosquito populations. Sometimes the presence of predators could cause a relaxation of intra- and interspecies competition. If the predator,s negative effect on the larval population via consumptive effects of reduced intra- and interspecific competition is outweighed by its positive non-consumptive effects of reduced competition, then the introduction of larval predators might result in more rather than fewer mosquitoes.

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