衞生防護中心
Centre for Health Protection

Scientific Committee on Vector-borne Diseases

Alternative Mosquito Control Methods

As mosquitoes can transmit a number of diseases such as dengue fever, malaria, Japanese encephalitis, yellow fever etc., efforts have been made to control them. Control measures could be aimed at different stages of the insect in its life cycle. The measures can be classified as biological, environmental (physical) and chemical control. Integrated mosquito management approach should be adopted for getting an effective and efficient control on mosquito with minimal impact on the ecological system. It starts from identification of the species of mosquito causing the problem. One or more measures could be selected from the biological, environmental and chemical categories for controlling the target species. The intervention on mosquito breeding is monitored for assessing the need for adjusting its strength. The effectiveness of the measures is evaluated.

Biological control

2. As biological control does not cause chemical pollution, it is considered as a better method for mosquito control by many people. However, there are limitations on employing biological agents for mosquito control. The agent introduced usually has to be substantial in number for giving desirable effect and it is preferably specific as predator of mosquitoes.

3. The most commonly used predators are fishes. The essential features of a mosquito predatory fish are active top feeding and carnivorous. Moreover, the efficient fish should be small in size and is an insignificant source of food for humans. Gambusia and Poecilia are the genera extensively employed as biological agent for mosquito

control. Grass carp has also been released purposely in pond for removing aquatic vegetation that provides shelters for the mosquito larvae and pupae. One of the limitations on using fishes as the biological agent is that fishes cannot be used for abating the breeding of mosquitoes in small water bodies such as puddles, water containers, disused tires etc. The small Gambusia affinis is a surface feeder and can penetrate into shallow vegetated areas. It can grow and reproduce rapidly and tolerate a wide range of water temperature and physical conditions. The fish is an efficient predator of mosquito larvae. However, concerns have been raised by the local environmentalists that originating in South America, Gambusia as biological agent for mosquito control would upset the local ecological system. Our records in the late 1950s indicated that Gambusia affinis was already found in the local streams.

4. Although the guppy, Poecilia reticulata can tolerate moderate degree of pollution, heavily polluted water is not the suitable habitat for fishes. However, some species of mosquitoes such as Culex pipiens quinquefasciatus and Armigeres subalbatus prefer to breed in heavily polluted water. Since 1990s, we have released Poecilia reticulate, Macropodus opercularis and small number of Gambusia affinis in streams and pools in remote areas where breeding of the malaria vectors had been detected. We have also advised the public to keep Poecilia reticulata as biological control agent against mosquito breeding in ponds.

5. Other predators such as the predatory mosquito Toxorhynchites, some families of aquatic bugs and beetles, tadpoles, flatworms, nematodes, copepods etc. have been used as biological control agent against mosquitoes. Protozoa, fungi, bacteria and viruses pathogenic to mosquito larvae have also been considered as the biological control agent. However, they are still in experimental stages of development or give limited effect on the control except the Bacillus.

6. Bacillus thuringiensis israelensis (Bti) and Bacillus sphaericus (Bs) are naturally occurring bacteria. They have been used extensively as biological control agent against mosquito larvae. The larvicidal activity is dependent on the endotoxin crystals, which must be ingested by the larvae, produced by the bacteria during sporulation. The toxin hydrolyzes the epithelial cells of the gut of mosquito larvae. The larvae die within 24 hours. Bti and Bs have a highly specific mode of action and are safe to most of the non-target aquatic vertebrates and invertebrates. They are effective on larvae of mosquitoes, blackflies and chironomid midges. While Bti is effective on Anopheles larvae, Bs is more effective against Culex larvae. Currently, Bti is one of the larvicides used by the Food and Environmental Hygiene Department (FEHD). FEHD will conduct trials on the application of Bs.

7. Control of adult mosquitoes by using dragonflies, birds and bats has received much attention. It was found that the method gives little if any

effect on the densities of mosquitoes.

8. Insect growth regulators such as methroprene have been used in some countries for controlling the breeding of mosquito larvae. The regulators prevent the development of mosquito larvae rather than killing them. They are not species specific. Our tests on some samples did not give acceptable results on the abatement of the breeding of mosquito larvae.

9. Genetic control methods are usually directed against adult mosquito. Sterile-male release techniques are being studied in some countries for getting a high proportion of infertile insemination. Mosquitoes that are refractory to infection with human diseases such as malaria are released for replacing the naturally susceptible ones. Susceptible genes to malaria, for example, in the mosquito population will be “diluted” by the males with refractoriness genes. Species replacement and sex ratio distortions have also been studied by researchers for reducing the population size of disease vectors. They are still at the experimental stage. One of the difficulties in using the methods successfully is the ability to rear large number of healthy and vigorous mosquitoes for competing with wild population. Environmental (physical) control

10. Habitat modification includes harbourage alteration and source reduction can be used for mosquito control. Harbourage alteration renders the sites unsuitable for resting of adult mosquitoes and source reduction changes the larval habitat so that mosquito oviposition, hatching and larval development are prevented.

11. Accessibility of water to adult mosquito can be altered or eliminated by ditching, draining, covering and filling. Shredding of disused tires, proper disposal of water containers, alteration of flow rate of water, disturbance of water surface, removal of shelters such as vegetation and refuse in water bodies etc. can interfere the breeding of mosquitoes.

12. Larval habitats vary in size. Some of the water bodies cannot be covered, filled or drained because of ecological or technical reasons. It may be too costly to drain or fill the water bodies. Converting sloping edges of ponds/pools with exposure of muddy areas to almost vertical banks with deep water (impoundment) can reduce the breeding of Aedes mosquitoes.

13. Increase sunlight on water by trimming overhanging vegetation prevents breeding of mosquitoes which prefer shaded habitats. Removal of rooted and floating vegetation reduces breeding of mosquitoes such as the species of Mansonia which require plants to obtain their oxygen supplies.

14. Emphasis on environmental modifications including straightening of watercourse and maintaining a sunlit water surface has been made for

prevention of malaria vectors breeding in Hong Kong. Proper management of small containers, clearing of choked drains, filling of small holes etc. are the methods adopted and promoted for preventing the breeding of dengue fever vectors locally. Draining of water and keeping ditches and ponds free from aquatic vegetation are the methods used for controlling the vectors of Japanese encephalitis breeding in the territory.

Chemical control

15. Larvicides are applied to water where mosquito larvae develop or where it may provide a habitat for mosquitoes. Currently, light mineral oils and insect-growth regulators and some organophosphates such as temephos and malathion are used as mosquito larvicides in many countries. As mineral oils and organophosphates can also kill other aquatic animals such as fish and crustaceans in the water body, these chemicals should be applied only when absolutely necessary.

16. Larvicides have very little residual effect. As the life cycles for mosquitoes are about 7 days, larvicides have to be applied on larval habitats at about every 7 days. Most insecticides will not kill mosquito eggs. They mainly directed at killing larvae. They are not very efficient at killing the pupae though mineral oils can also kill pupae. However, a product that can form a monomolecular film (MMF) over water surfaces when applied to water bodies is commercially available. The film will suffocate mosquito larvae and pupae. It can kill the eggs and emerging adults as well. Tests on the monomolecular film will be conducted by FEHD for assessing its applicability.

17. Chemicals including mineral oil and temephos are the larvicides being used by the FEHD. They are applied to water bodies which cannot be eliminated immediately but killing of the larvae is necessary for prevention of transmission of mosquito-borne diseases or solving the nuisance problem.

18. Adulticides are applied to surfaces where adult mosquito will rest or in the air where it flies. Insecticides with residual effect are applied to the interior surfaces of walls for killing indoors resting adult mosquitoes such as the endophagic malaria vectors. The insecticides used usually have effects on mosquitoes for two to three months. Space spraying, the spreading of insecticidal droplets in the air to kill adult mosquitoes, will kill all the flying insects in the sprayed areas. It is conducted in emergency situations when an outbreak of mosquito-borne disease is already in progress or may occur and a substantial reduction in the mosquito population has to be achieved rapidly. The insecticides used usually have knock-down effect but very little residual effect on mosquitoes.

19. The application of adulticides, for both residual (using deltamethrin) and space sprayings (using S-bioallethrin + permethrin), by the

FEHD is limited to the target areas and in frequency needed to abate further transmission of the mosquito-borne diseases including malaria, dengue fever and Japanese encephalitis as appropriate. Space spraying would also be conducted for reducing the population of Aedes albopictus in areas with ovitrap indices greater than 40%.

Other methods

20. Traps may be used for capturing adult mosquitoes. The attractant used could be the carbon dioxide released by breaking down propane into water and carbon dioxide. The warm water vapours with carbon dioxide attract biting insects such as mosquitoes. Octenol, 1-octen-3-ol, has been used as attractant for attracting mosquitoes over a distance of about 30 m down-wind from the trap. This attractant mainly attracts zoophagous mosquitoes. Some traps have a dim light as attractant. As light is not very attractive to mosquitoes, some mosquito traps have a fan to suck the insects flying nearby into some collection chamber or bag. Considerable number of other flying insects such as beetles, moths and flies will be captured by the trap. Traps are effective when they are operating correctly, properly maintained, and properly set. Their effectiveness could be affected by a breeze. There could be more attacks by mosquitoes if the location for setting the trap is inappropriate. Setting of the traps can, however, be included as one of the protective measures for people against mosquito attacks.

21. It has been demonstrated that device emitting sonic energy, in the frequency range of 18 to 36 kilohertz, could cause the air in the spaces inside mosquito larvae to resonate violently. The internal membranes and organs of mosquito larvae are disrupted and air bubbles are formed in the bodies of the larvae. The larvae stop moving quickly and die. However, further tests on the effects of the sonic energy on related non-target aquatic insects or other invertebrates have to be conducted.

22. The FEHD has been adopting the integrated mosquito management approach by using a combination of mosquito control methods in abating the breeding of mosquitoes with medical importance. Surveillance on the breeding of the target species is being conducted regularly. Environmental (physical) approach is the core for controlling the mosquito supplemented with biological and chemical control methods. Besides, legislative control has been added as one of the measures in our mosquito management.

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