



The Resistant Mosquito

Video Transcript

The biology of mosquitoes

Let's take a look at our insectary at the Swiss Tropical and Public Health Institute. We breed different Anopheles species for research purposes. Anopheles mosquitoes lay single eggs that float on the water surface. The larvae hatch from the eggs and go through four larval stages before they develop into pupae. After a few days, the adult mosquito hatches from the pupae.

In a tropical climate, larvae spend 9-12 days developing into adults – given that there is enough water, and strong rainfalls don't flush them out. Mosquitoes feed on sugar juices from plants, and only female mosquitoes require blood meals. They need the proteins to produce their eggs. Only older female Anopheles mosquitoes can transmit malaria.

Mosquitoes are at their most vulnerable in the larval stages, since they are confined to their breeding sites. In urban areas, breeding sites can be found and dealt with by emptying the water, preventing adult mosquitoes from reaching them, or with the use of larvicides.

In more rural settings, it can be extremely difficult to find all the breeding sites, as they can even include animal hoof prints. Therefore, most malaria control programmes focus on controlling adult mosquitoes, or on protecting humans from mosquito bites.

When and where are mosquitoes most vulnerable to control interventions? Let's take a look at some examples.

Blood-fed females have to rest to digest their blood meal. Indoors, these mosquitoes can be tackled using insecticide sprays, where walls and ceilings are coated with a residual insecticide. Outdoors, some countries use space sprays in emergency situations to reduce mosquito densities.

Since both male and female mosquitoes need sugar juices for energy supply, attractive toxic sugar baits are another option for managing mosquitoes. A sugar solution is treated with an insecticide and placed in a device. Mosquitoes feed on it and they die. Attractive toxic sugar baits are an interesting additional tool for malaria control programmes. However, further investigations on their impact are needed.



Another example are ovitraps. Ovitrap aim to lure the female mosquito to lay her eggs in a container, where the larvae can be prevented from developing into adults, rather than in natural breeding sites that are harder to find and treat.

Depending on the situation, we have a few additional possibilities of controlling mosquitoes.

For example, mosquitoes often form swarms for mating. Researchers are looking to identify ways that these swarms can be detected and treated with a targeted insecticide application. This method is not widely used at this stage, but some studies report promising results.

Another possibility being investigated is to trap the female mosquitoes that are seeking a blood meal by luring them with odours that mimic humans. Mosquito trapping is not a widely used method in malaria control. However, some studies show that it can be an effective additional control intervention in malaria programmes. This method is well-received by the population since the solar panels used to power the traps also provide energy for LED lamps and phone charging.

Most Anopheles mosquitoes don't exclusively feed on humans, but also on animals such as cattle. These can be treated with a topical insecticide, or an endectocide, to further reduce local mosquito densities.

Finally, let's take a look at what we can do outdoors and indoors to protect ourselves from mosquitoes. To reduce the chance of mosquitoes feeding on humans outdoors, we can use spatial repellents and personal protection measures. This includes repellents for the skin or clothes, as well as wearing long-sleeved shirts and trousers.

We can prevent indoor encounters with mosquitoes by screening windows, doors and open eaves so that they can't enter. Sleeping under Long-Lasting Insecticidal Nets, or LLINs, is one of the most effective ways to prevent mosquito bites. LLINs also have a community effect, since they turn every bed into an effective mosquito trap and therefore also protect others that do not sleep under a net.

There is no so-called "silver bullet" when it comes to mosquito control. However, the most effective and sustainable vector control programmes take a holistic approach called integrated vector management. This includes a range of control measures applied in parallel in order to reduce the interaction of mosquitoes and humans.