**Novel mosquito control strategies in the fight against malaria***

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In spite of more than 100 years of a battle for its control, malaria still ranks as one of the most widespread and prevalent infectious diseases. Because of its specific biological and ecological characteristics the disease flourishes in resource-poor tropical countries. Vector control is considered the most effective method for control of malaria through interruption of parasite transmission. Currently such efforts consist mainly of the application of indoor spraying with insecticides (IRS) and the use of insecticide-treated bed nets (ITNs). Whereas in many areas these tools have led to significant reductions in malaria morbidity and mortality, they alone cannot eradicate the disease. Recurrent problems with these methods include the rapid development of insecticide resistance, high recurrent costs and logistics of timely distribution and application. For these reasons the Laboratory of Entomology of Wageningen University has chosen to look for alternative strategies of malaria vector control. The biology and behaviour of the vector and its interactions with natural enemies are prominent in our strategy. Our research aims to develop simple tools that interrupt the natural life cycle of the mosquito by deflecting the mosquitoes away from their human hosts, and by exposure of the insects to natural pathogens that are lethal to them.

*Host-seeking behaviour* – Mosquitoes need blood for reproduction. Several malaria vectors (*Anopheles* species) favour humans as their principle blood host. During blood feeding malaria parasites can be ingested by the mosquito or transferred from the mosquito to the human host. Research in Wageningen has shown that human odour is the principle cue with which the mosquitoes locate their blood hosts (Takken & Knols, 1999). In laboratory and field studies we demonstrated that mosquitoes locate their hosts from a distance, and that the composition of the host odour determines its attractiveness (Mboera et al., 1997, Smallegange et al., 2005). Currently, work is in progress to elucidate the chemical components of human odour that are responsible for the attractiveness of humans to malaria mosquitoes (Zwiebel & Takken, 2004). We anticipate that this research will lead to the development of a powerful odour bait that can be used to lure mosquitoes away from human dwellings and trap them into a killing device (see below). In this way malaria transmission can be reduced using a novel tool that is independent from the use of insecticides.

*Novel biological control* – Given the problems with insecticide resistance, the search for biological control agents is receiving priority in our research. A few years ago we discovered that a soil-borne fungus, *Metarhizium anisopliae* can infect and kill adult malaria mosquitoes (Scholte et al. 2003). This fungus has been used before to infect and kill locusts, termites and tsetse flies. Spores of the fungus, either in dry form or formulated in sunflower oil adhere to the cuticula of mosquitoes upon contact, germinate and grow into the insect. Some 6-8 days later the mosquito dies of the infection and the fungus produces new spores when growing out of it. In a pilot study in Tanzania, we applied the spores in sunflower oil onto black pieces of cotton cloth (3 $m^2$) that were fitted against the ceilings of local houses in a rural village. We monitored the fate of mosquitoes resting on these targets and found an infection rate of 23% (Scholte et al., 2005). We modeled the potential impact of this on malaria transmission and calculated that the number of infectious bites received per person in that area would drop from 264 to 62, a dramatic reduction. Concurrently, colleagues in Edinburgh demonstrated that mosquitoes infected with both malaria parasites and fungus had much impaired transmission capability, as the fungus interfered with the development of the parasite (Blanford et al., 2005). The exact mechanism of kill and interference with the parasite remains unknown to date. We have also observed that mosquitoes infected with the fungus are less likely to take blood meals on humans and have a lowered reproduction (i.e. they lay fewer eggs)(Scholte et al., 2006). Our research now focuses on the mass production of the fungus, optimization of delivery and formulation methods and further evaluation of the impact of this tool on malaria transmission (Knols and Thomas, 2006). For this we have projects in Tanzania, South Africa and Ghana. Ultimately we hope to expand the limited arsenal of insecticide-based tools for malaria vector control with a 'green' and sustainable method that can alleviate the burden of malarial disease in many parts of Africa and beyond.

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