



VECTOR

VISION

Studies Evaluate Larval Source Management To Reduce Malaria Vectors

Malaria remains the most important insect vector-borne disease throughout the tropics, killing over 1 million humans annually. Vector control efforts are centered on the adult mosquito stage to reduce the risk of infection caused by adult mosquito bites.

To supplement adult mosquito control efforts, Valent BioSciences Corporation (VBC) initiated studies over five years ago to evaluate the role of Larval Source Management (LSM) in African malaria vector control programs. LSM describes the use of tools to reduce larval survival, either through removing the water source or applying larvicides to the water source.

Although the concept of LSM has been used in some of the most successful malaria eradication efforts in modern history, this tool has been underused in African malaria programs. Resistance to full incorporation of LSM and specifically microbial larvicides into more malaria control programs has been based on four perceptions: poor efficacy, too many water sources to apply LSM, low residual, and cost effectiveness.

To address these perceptions, VBC teamed with a number of research institutions and donor agencies to empirically evaluate these issues. Results from these evaluations were presented in

November 2007 at the American Society of Tropical Medicine and Hygiene Conference in Philadelphia. The studies demonstrated that microbial larvicides not only provide the residual efficacy needed to control the major malaria vectors in Africa, but also that a number of ecological zones in Africa are conducive to the LSM approach.

In addition to the field research, economists developed financial models to determine the cost effectiveness of large-scale use of microbials in malaria programs. The results are available from the

U.S. Agency for International Development (USAID). The analyses evaluated using microbial larvicides against malaria vectors under three diverse African settings. Across diverse African habitats, the cost per person protected

per year ranged from US \$0.79 to US \$2.50, making LSM as cost effective as insecticide treated nets (ITN) and indoor residual spraying (IRS). These two techniques are being used extensively in malaria control programs in Africa today.

These project results were further disseminated to WHO, Global Fund, RBM Partnership, CDC and USAID. Additional village-scale trials that incorporate LSM with IRS and ITN are scheduled to commence in 2008.

“Microbial larvicides provide residual efficacy and are as cost-effective as insecticide treated nets and indoor residual spraying.”

Insect Control Profile

Colorado Mosquito Contractor Secure in Role as 'Front-Line Environmentalist'

His adopted state of Colorado is a perfect place to be in the mosquito control business, according to Mike McGinnis.

"Colorado is a very environmentally savvy state, and that matches well with what we do as mosquito control professionals," McGinnis says. "I've always considered us to be true front-line environmentalists because the decisions we make and how we do things in the field truly make a difference in protecting our wetlands and environment."

McGinnis operates Colorado Mosquito Control, Inc., a mosquito control contractor and consulting business that serves more than 80 county, municipal, commercial and homeowners association clients throughout the state.

He has worked in the industry since 1979, first at Clarke Mosquito Control in Chicago, then at his own business in Michigan and now in Colorado. "There aren't very many large-scale mosquito control contractors, but I've been very fortunate to work at, own or partner with most of them," McGinnis said.

McGinnis was introduced to the environmental movement as he grew to adulthood during the 1960s and '70s. And the times were changing as he began his career in mosquito control.

"The concept of integrated pest management (IPM) was just coming on in mosquito control, with chemicals like organophosphates being replaced with biological products like *Bti* and, more recently, *Bacillus sphaericus*," he said. "These are good, solid, efficacious products. Over 90 percent of our operations today are focused on larval mosquito control using VectoBac® and VectoLex® larvicides."



CMC's fleet of service vehicles, staged at company headquarters in Brighton, Colorado.



The Colorado Mosquito Control Surveillance Lab, headed by Dr. Michael Weissmann, identifies thousands of larval and adult mosquito samples per day.

Contrasting Environments

From its base in Brighton, near Denver International Airport, Colorado Mosquito Control serves customers in two very different environments: the arid suburban Front Range and the wet, high altitude rural mountain valleys. Nonresidents believe Colorado is arid, but that depends on how much snow falls in the Rockies each winter. "We can have a lot of water here if the snowfall is heavy," McGinnis commented.

Heavy snowfalls and unusual early spring rains contributed to high water levels in 2003 and 2007. Consequently, McGinnis said, West Nile virus outbreaks rose to very high levels both years. "*Culex tarsalis* will typically represent about 15 to 20 percent of the mosquito population, but we saw those numbers double during the big WNV years," McGinnis explained.

Although weather is a factor, many of the mosquito problems McGinnis's company deals with have come from human manipulation of water, he said. The highly populated corridor from Denver north to Fort Collins, east of the Front Range, is still heavily agricultural. Alfalfa and grass hay are important crops and require flood irrigation several times during the April–September growing season. *Aedes* species hatch with every flood, and the tailwaters support big populations of *C. tarsalis*. *Culex pipiens* are also prevalent in the suburban and urban areas, McGinnis said.

"Most urban and suburban customers along the Front Range don't want to see adult mosquitoes or adulticiding," McGinnis explained, "so our focus on larviciding is very important. We are continuously

conducting surveillance, species identification, testing for disease presence and treating as needed.”

In contrast, flood-irrigated hay pastures in the mountain valleys of central Colorado generate “huge amounts” of mosquitoes along with their hay crops, but only once or possibly twice during the season.

Technology Boosts Efficiency

As a private business operator, McGinnis said he constantly searches for ways to improve operational efficiency. He made a great leap forward in the past few years by using GIS, GPS and data management tools to accomplish that.

“We have a historical database of all our larval sites: dates of inspections, whether they are wet or dry, whether larvae were present, whether we treated and the product we used – more than a half million records,” he explained. “Using that information, we created an algorithm that helps us target our most active, prolific sites.”

“We all know larval control is labor intensive,” he said. “Using this system helped us improve our efficiency by 30 percent over last year, as measured by acreage treated per site visit.”

McGinnis said he believes the pressure to be more and more environmentally conscious will increase. “We are deeply cognizant of our role in controlling pests and diseases while minimizing our environmental impact. Improved efficiency will help us do that,” he said.



Mosquito catches from CDC light traps are retrieved, rough-sorted and identified to species in the CMC laboratory. The data are stored in a database and analyzed.

Chikungunya Virus: Emerging Disease Challenges Public Health Officials

Malaria and Dengue Fever are global epidemics well known to vector control specialists. You may also be familiar with recent reports of the emerging disease Chikungunya virus (CHIKV). If not, you’ll likely hear more about Chikungunya in the coming years.

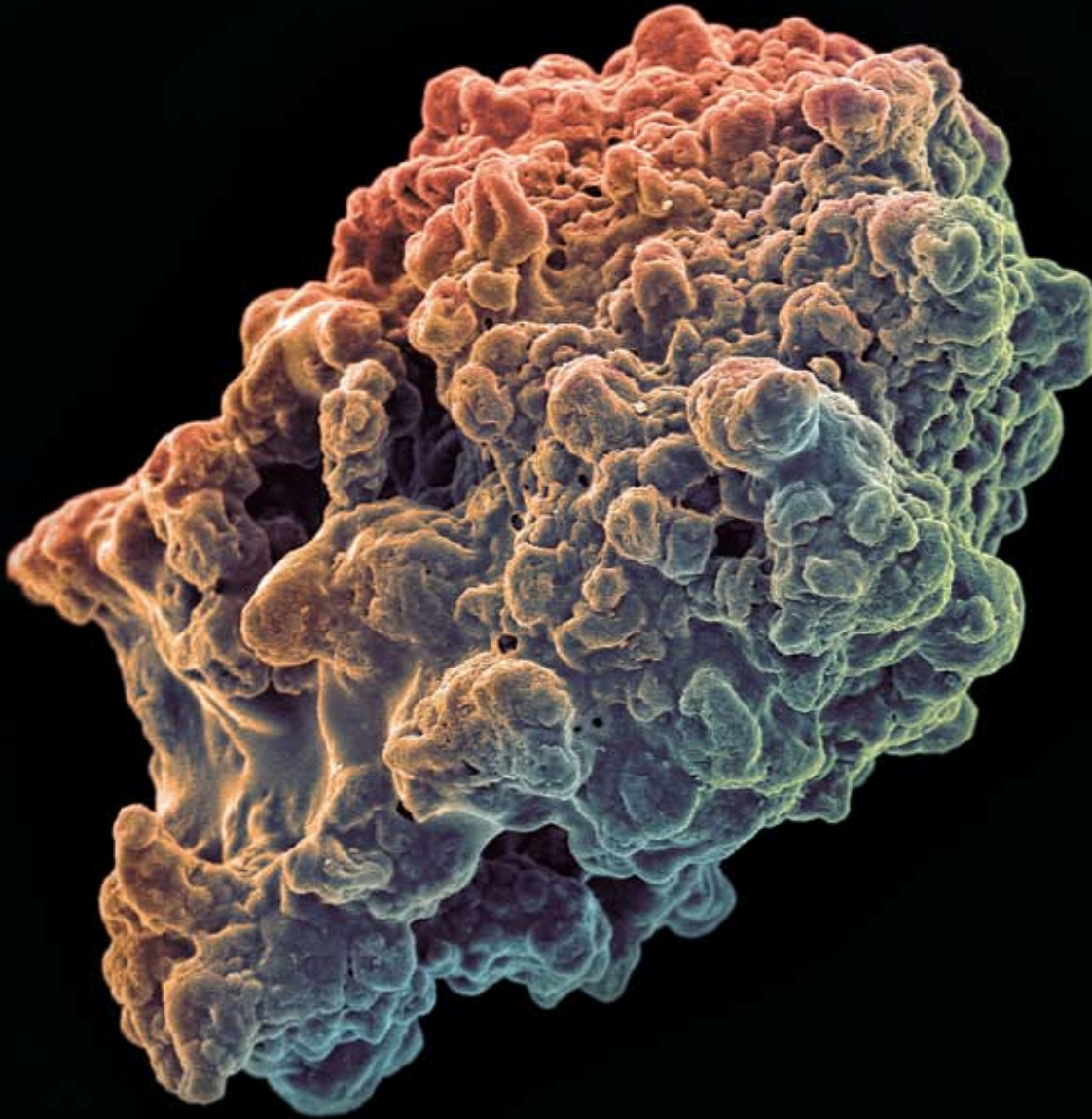
CHIKV is an alphavirus transmitted to humans through the bites of *Aedes aegypti* (primary vector) and *Aedes albopictus* (Asian tiger) mosquitoes. Since it was first discovered in Africa in 1952, major outbreaks have been documented in Africa and Southeast Asia, and recent outbreaks in India and Italy demonstrate a much wider global range. Possible causal agents responsible for the growing distribution of CHIKV are of keen interest to vector control specialists, with discussions centered on immigration patterns of *A. albopictus*, global warming and human demographics.

The symptoms of CHIKV include fever, rash involving the limbs and trunk, arthritis affecting multiple joints, headache, nausea, vomiting and muscle pain. The time from infection to illness can be from two to 12 days. Acute Chikungunya fever typically lasts a few days to a couple of weeks but, as with other arboviral fevers, some patients experience extended fatigue lasting several weeks. However, unlike

dengue, some patients experience debilitating joint pain that may last for weeks or months. Severity of the disease and its duration is less in younger patients, who typically recover within 15 days.

How do you prevent CHIKV? No vaccine or specific antiviral treatment is available for CHIKV. The best way to avoid CHIKV is to prevent mosquito bites by using insect repellent, wearing long sleeves and pants and removing mosquito breeding sites where possible. Since *A. aegypti* and *A. albopictus* are typically active during the day, screening homes and sleeping under bed nets will offer minimal protection. Thus, vector control is especially important in controlling CHIKV.

Current Valent BioSciences Corporation research is focused on targeting larval habitats in rural and urban settings with select applications of VectoBac WG using a number of platforms. It appears that local larval habitat productivity of the key vectors varies among countries and land uses, requiring a flexible application platform to deliver the optimal larvicide dose. Let’s hope that a combination of vector control and personal protection interventions will prevent CHIKV from reaching the scale of global epidemic.



Single granule of VectoLex® WDG. Embedded in the matrix of a single granule are more than 30 million *Bacillus sphaericus* protein toxins. VectoLex WDG (water dispersible granule formulation) offers the storage stability of a dry product with the application versatility of a liquid formulation. This image, captured from a scanning electron microscope (SEM), is the result of an electron beam interacting with the atoms composing the specimen coating to produce various kinds of information. The SEM covers a wide range of magnifications (about X25 to X250,000) and has been a powerful tool in the entomological and materials science fields.

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