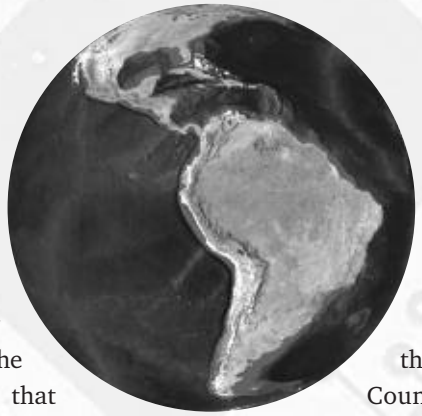
CONNECTING TO LATIN AMERICAN SCIENCE NETWORKS

TWAS RESEARCH FELLOWS ARE FINDING THAT POSTS IN LATIN AMERICA, THOUGH SOMETIMES FAR FROM HOME, ARE ADVANCING THEIR WORK ON AGRICULTURE, HEALTH, POLLUTION AND OTHER FIELDS.



For young scientists at the early stages of their careers, access to a mentor with a lifetime of experience and knowledge is priceless. But, while such brilliant minds in every scientific field live and work throughout the developing world, promising young scientists don't always have the financial resources they need to tap that expertise.

Latin America is a region rich with expertise in many fields, where young scientists from all over the world can nurture their scientific knowledge, establish professional bonds and gain a challenging but irreplaceable new experience living and working in another country – even another continent. TWAS gives young scientists such opportunities through its postdoctoral and PhD fellowships. These programmes allow young scientists from one developing country to conduct research in another nation in the South with equipment and mentorship that would normally be unavailable to them.

The Academy awards these fellowships in partnership with numerous organizations globally, two of them in Latin America: the National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico*, or CNPq), in Brazil, and the National Science at Technology Council (*Consejo Nacional de Ciencia y Tecnología, or CONACyT*) in Mexico. These councils provide living expenses and TWAS provides travel support and incidental local expenses.

Four postdoctoral scientists – from as far away as India and Egypt – show how TWAS research fellowships in Latin America are advancing science throughout the world.



FIGHTING FARM PESTS WITH THEIR OWN DISTANT KIN

An Egyptian mite taxonomist in Brazil

Bright-yellow, web-spinning creatures called two-spotted spider mites are an unwelcome visitor in many farms. They're found on undersides of leaves and feed on plants through needle-like mouthparts that pierce the plant's tissue and suck out its sap. If the mites grow out of control, the leaves fall off and the plants die. The mite is found in both fields and greenhouses, devouring everything from trees to fruit and vegetable crops.

How can farmers keep these pests under control? One answer is predatory mites, such as *Phytoseiulus persimilis*, a reddish little creature that pounces on spider mites and feasts on them. Farmers can buy small packets of the helpful mites and empty them on the leaves of plants infested with harmful mites. The more predatory mites researchers identify, the more weapons farmers have in the battle to save their crops.

Egyptian mite taxonomist Reham Ibrahim Ahmed Mohamed Abo-Shnaf looks for, studies and describes new species of predatory mites. Crop-eating mites are a problem for Egyptian farmers, and Egyptian scientists have historically been interested in predatory mites as a solution. Over 50 phytoseiid species have been reported from Egypt, as well as about 25 species of other mites. But Egyptian researchers who have been studying them for decades are either retired or about to retire, said Abo-Shnaf, so there is a need for younger researchers to fill those gaps.

Abo-Shnaf said she is particularly fond of taxonomy and happy to help resolve a problem in her home country. "In Egypt we have a lot of companies producing predatory mites for biological control", Abo-Shnaf said. "Also they can be exported abroad to different countries."

Abo-Shnaf is getting the experience she needs through her postdoctoral fellowship at the Universidade de São Paulo, Brazil. At the Brazilian lab, Abo-Shnaf uses a large library with detailed descriptions of species from all over the world. To identify new species of mites, she compares her specimens to the descriptions of all species of a related genus. If the mite is unique enough, she asks her supervisor to confirm her suspicions that it's a different species before labeling it such.

So far, she has discovered four species of predatory mites farmers can explore using as crop guardians: two from the Rhodacaridae family, which tend to live in soil and decaying organic matter, and two from the Phytoseiidae family, which especially love to eat spider mites. She has one paper submitted to the journal *Zootaxa*, describing the Rhodacaridae mites, and the second study on the new Phytoseiidae mites is still in progress. Her fellowship began in January and will last until the end of February 2014.

She said she has acquired invaluable knowledge from the fellowship, in particular from working with professor Gilberto José de Moraes, a world authority on mite control and taxonomy. "This fellowship is very useful for me because I have the opportunity to learn and know more about taxonomy under a famous professor", Abo-Shnaf said. She said the fellowship also provides her with a well-equipped laboratory, which includes microscopes connected to computers that can photograph the mites she's studying.

A FUNGUS TO TARGET DISEASE-CARRYING MOSQUITOES

An Indian entomologist in Brazil

Diseases such as malaria, dengue, and chikungunya fever have proven to be maddeningly stubborn foes for doctors and biologists, who are constantly seeking new ways to keep the mosquitoes that carry them under control.

One such possibility is a fungus called *Metarhizium anisopliae,* which has a devastating effect on the disease-carrying mosquitoes such as *Aedes aegypti* and *Anopheles stephensi*. The green-coloured fungus infects all mosquito stages. The insects cannot handle the fungus growing out of control in their bodies, and die.

Siva Kamalakannan is an entomologist from the Bharathiar University, Coimbatore, in India and specializes in pest control with botanical insecticides. Through a TWAS fellowship at *Instituto de Patologia Tropical e Saúde Pública* at the *Universidade Federal de Goiás in Goiâina*, Brazil, he researches ways to improve the fungus' ability to infect mosquitoes so that it can kill as many mosquito larvae as possible. This fungus infects over 200 insect species, including termites, locusts and – most critically – mosquitoes. "As early as 1879, fungi from this genus were being evaluated for control of wheat chafer beetles, *Anisoplia austriaca*, and sugar beet curculio, *Cleonus punctiventris*, in Ukraine", said Kamalakannan.

Kamalakannan and his colleagues in Brazil are working on formulations of *M. anisopliae* associated with insecticidal plants in order to develop effective weapons against mosquitoes that are inexpensive to produce.

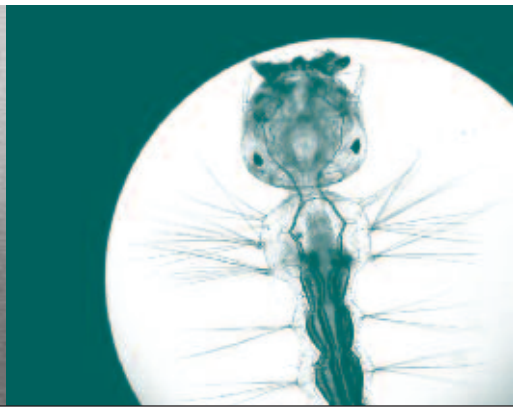
Anopheles stephensi, a major malaria carrier in India, and its larvae are commonly found in storage water and rain pools. *Aedes aegypti* transmits dengue fever and chikungunya, which are major problems in Kamalakannan's home country of India. Kamalakannan noted that there were more than 11,000 suspected cases of chikungunya in 2012 in India, and that the dengue virus has been on the rise in southern India since 2010.

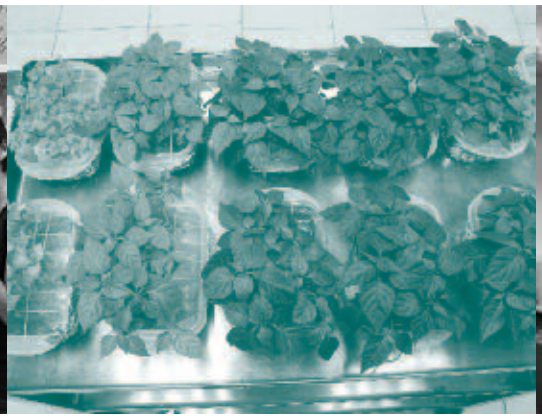
Kamalakannan's work focuses on combining the use of infective spores with plant products that also kill mosquito larvae. Specific plant compounds, such as azadiractin from the Neem tree that is native to much of South Asia, increase how vulnerable the larvae are to fungal infection, and these new formulations will be more effective against the larvae at breeding sites compared to conventional biological larvicides.

> ***Mosquito larvae cannot handle the fungus growing out of control in their bodies, and die.***

At *Universidade Federal de Goiás*, Kamalakannan has the opportunity to work under supervision of experienced scientists such as Wolf Christian Luz and Éverton Kort Kamp Fernandes. "This fungus kills eggs, kills larvae, and kills adults", said Luz. "The purpose of the formulation in Kamalakannan's studies is to increase the effectiveness and survival of the spores in the water, and their contact with aquatic larvae."

Kamalakannan also has access to high-quality equipment for specific formulation techniques, which is essential for the development of new, innovative larvicides. "People in Brazil are nice and it's an important experience", said Kamalakannan.




GETTING THE MOST OUT OF A POPULAR FERTILIZER

A Cuban agricultural biologist in Mexico

The habanero pepper is one of the most widespread crops in the Yucatán region, and researchers are looking for ways to yield more peppers. Through a TWAS fellowship, María de Lourdes Villalonga Santana of Cuba was able to go to the Yucatán and study the effects of this new approach to supplying habanero peppers with nutrients at *Centro de Investigación Científica de Yucatán* (CICY) in Merida, Mexico.

Villalonga and her colleagues are studying urea, an important fertilizer rich with nitrogen that plants need, and urease, an enzyme that prompts urea to decompose and release nutrients into the soil. The aim of her research is to create an agricultural tool that will increase the fertility of soils by increasing the concentration of urease, getting more urea to decompose and providing habanero plants with more nutrients.

Villalonga hopes her research will also help agriculture in her home country of Cuba.

One way to get a molecule like urease to do what you want it to do is to make it more stable, and one way to make it more stable is trap it in a little molecular cage. When contained in a tight area, the molecule is easier to control in conditions that would normally degrade it and make it less useful, such as high temperature.

So Villalonga and her colleagues drip urease and sodium alginate slowly into a calcium chloride solution, which then turns into calcium alginate capsules – small spheres about 5 millimetres wide – that catch the urease enzyme in the middle. "These capsules are soft to the touch but resistant, similar to small rubber balls", said Villalonga.

They studied the effects of immobilized urease on the pepper plant's growth in a lab, and found that the capsules improved the effectiveness of the urease. The next step, she said, would be to test the immobilized urease in the field.

Studying habanero peppers is a unique experience, she said, because scientists currently know little about how habanero pepper plants absorbs nutrients on the chemical level, and how those nutrients influence the growth of the plant. She hopes her research will also help agriculture in her home country of Cuba, and thinks a variety of legume and grass crops that are spread thin over a wide area agriculturally could serve as starting point. "With the experience gained at CICY, I can conduct similar research in agricultural crops of interest for my country", said Villalonga.

Villalonga said she enjoys working in Merida. "That city always fills me with satisfaction", she said. "The people there always make me feel at home."

"The stay of Dr. Villalonga in my work group was very successful", said Ileana Echevarría Machado at CICY. "She could learn methodologies that until then had not been made and also conveyed all her experience to the group, strongly supporting the training of master and doctoral students."

STRIPPING THE MYSTERY FROM A COMMON POLLUTANT

A Nigerian toxicologist in Brazil

What do rubber, carpets, glues, flame retardants, pesticides and plastics have in common? Factories that produce those items also produce 4-vinylcyclohexene, also known as VCH, which scientists suspect might cause infertility in women.

Factories directly release VCH into the air, soil and water through waste streams. It also slips into water supplies indirectly because it doesn't biodegrade quickly in soil. Once VCH gets in the water, it's consumed by fish, which are then eaten by people. Occupationally, workers may take in VCH through inhalation or contact with the skin at factories where it is generated as a byproduct.

When VCH comes in contact with living organisms, the living cells chemically convert them to related toxic molecules called VCM and VCD. Scientists have already shown that these compounds are toxic to ovarian follicles in female rats.

Biochemist Amos Abolaji from the Biochemistry Department of the University of Ibadan, Nigeria, has a TWAS postdoctoral fellowship that supports his research at the Federal University of Santa Maria in Brazil on the effects of these three chemicals, which are produced not just in Nigeria but in developed or developing countries throughout the world. "Ovarian follicles are the basic units of the ovary", he said. "They are made up of spherical aggregations of cells and they contain a single oocyte, or immature egg. Any agent that is toxic to the basic unit of the ovary, the follicles, will affect the egg."

Abolaji is testing those three chemicals on fruit flies. Fruit flies are a popular model organism because they have about 75% of the disease-causing genes that humans have, Abolaji said, and they're also easy to care for and reproduce rapidly. The goal is to understand just how these chemicals interact with ovaries. So he mixes the chemicals into the flies' food and watches what happens.

The research is ongoing. For now, they have found that VCH, VCM and VCD reduce the fruit flies' survival rate after as few as seven days of exposure. They also found that VCH reduced the fruit flies' levels of acetylcholinesterase, an enzyme that influences communication both between nerve cells in the brain and where nerves interact with muscles. "If the activity of this enzyme is inhibited by toxicants, the normal functioning of the brain will be altered", said Abolaji. That, in turn, could affect ovaries, which receives instructions from the brain to produce estrogen and progesterone, hormones needed for reproduction.

Working on this research topic entails the use of expensive substances that are difficult to obtain, and Abolaji said he was thankful for the opportunity through the fellowship. "Working at the Federal University of Santa Maria afforded me the opportunity to use facilities not available in Nigeria", he said. "I am also privileged to interact and learn from my supervisor, Professor João Batista Teixeira da Rocha and other seasoned academics at the Federal University of Santa Maria. They are all very open, accommodating and willing to assist."

Rocha, who is Abolaji's supervisor, praised his strong motivation, adding that it reflects past Nigerian students whose work was hosted by his lab. "We are also expecting to do a more stable collaboration with Dr. Abolaji after his return to Ibadan", Rocha said. ■

Sean Treacy