

HONOURING THE BEST AND BRIGHTEST

TWAS PRIZES RECOGNIZE ACHIEVEMENTS OF SCIENTISTS FROM THE SOUTH

Drought and salinity in dry regions can make the soil less fertile, causing challenges for farmers and suffering among the people they feed. But, as work by one recently honoured Uzbek researcher's work shows, there's a clever way to help crops survive using tiny, industrious microbes.

Microbes that seek out plant roots as a safe place to thrive in rough conditions know a few ways to help out their host plants. Scientists can use such root bacteria to keep ailing crops healthy through trying times of nutrient-poor soil. These microbes, called 'plant growth promoting rhizobacteria', have given scientists clues on how to improve the endurance of ailing crops.

Dilfuza Egamberdieva of the National University of Uzbekistan in Tashkent and her colleagues determined how the bacteria stimulates plant growth under environmental stress and created new ways to use salt-tol-



erant bacteria to help boost the health of crops. They also discovered that the roots of some plants growing in salt-rich soils contained high levels of bacteria that could infect humans, explaining some diseases that commonly infect Uzbek farmers.

Egamberdieva is one of the 12 winners of the 2012 TWAS Prizes for scientific excellence, all of whom attended the TWAS General Meeting this October in Buenos Aires, Argentina, and gave presentations on their research. The TWAS Prizes are awarded every year to scientists in eight different fields: agriculture, biology, chemistry, earth science, engineering, mathematics, medicine and physics, and are among the highest honours given to scientists in the developing world, each carrying a cash prize of USD15,000.

Egamberdieva hopes to apply her new agricultural technique in Uzbekistan soon to boost the yield of eco-



Left to right: Cotton boll opening (Photo: Flickr/Judy Baxter); TWAS Prize winner Ann-Shyn Chiang (second from left), China. On previous page: TWAS Prize winner Dilfuza Egamberdieva, Uzbekistan. (Photos: Roque Silles)

nomically important crops such as wheat, cotton, tomatoes and cucumbers. The country uses 4.4 million hectares for agriculture, but excessive salt from the Aral Sea basin has rendered more than half of it under-productive.

Globally, about 52% of the land used for agriculture shows soil degradation. Land impoverishment is often due to salt infiltrations in the ground, which weaken the plants and lower the yield. Salt inhibits ‘nodulation’, the development of tiny nodules on plants’ roots, limiting plant growth. The bacteria Egamberdieva study convert the atmospheric nitrogen absorbed by plants into a more usable compound, ammonia.

“We have already completed some experiments, both in protected greenhouses and in open fields, working in close contact with local farmers”, said Egamberdieva, who is also engaged in promotional campaigns with the Uzbek government and in outreach campaigns among farmers. Soon, Egamberdieva hopes, she will receive the green light to test her findings on actual agricultural fields.

FRUIT FLY BRAIN-MAPPING

Research commended by the TWAS Prize doesn’t just help feed the world, but can shed light onto the funda-

mentals of cutting-edge scientific fields such as neuroscience. One example is research by TWAS Prize in Biology winner Ann-Shyn Chiang of National Tsing Hua University, Taiwan, China, into the neural networks of fruit flies.

It is difficult even to imagine what it’s like in the brain of a fruit fly. But research by Chiang and his colleagues gave science tremendous insight into the minuscule drosophila fruit fly’s brain and its 130,000 neurons. Their research also helped bring Taiwanese science into prominence with a string of publications in prestigious journals.

Born in Taiwan, Chiang graduated from National Chung-Hsing University in 1981, received his Master of Science from National Taiwan University in 1983, and left his home country to obtain his PhD from Rutgers University in New Jersey (USA) in 1990. He returned to Taiwan in 1992 to be an instructor at National Tsing Hua University, and in 2001 took his sabbatical to study fruit fly memory at Cold Spring Harbor Laboratory in New York.

In 2004, Chiang founded the Brain Research Center at National Tsing Hua University, aiming to understand how genes and neural circuits combine to create the fruit fly behavior scientists can observe. He then

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constructed a comprehensive map of connections among fruit fly neurons that govern the insect's sense of smell and in 2007 published the first paper in the influential journal *Cell* to come from Taiwanese scientists.

Chiang later published another map revealing brain-wide neural networks in the fruit fly. The study managed to barcode 16,000 neurons in the drosophila brain and in 2010 *The New York Times* called the work the first step toward decoding the human brain. An open-access database of images showcasing the fruit fly brain down to individual cells is even available at www.flycircuit.tw.

He became the adjunct International Faculty of the Kavli Institute for Brain and Mind at the University of California, San Diego, in 2011, and Chiang and his colleagues discovered that long-term memory formation requires the creation of new proteins in only a small number of neurons in the fruit fly brain. This finding was published in *Science* in 2012 and was the first full article in *Science* from Taiwanese scientists.

MAKING AIDS IN AFRICA SURVIVABLE

The TWAS Prize also raises the profile of research that helps solve some of the most pressing health issues in the developing world.

Of the 33 million people living worldwide with HIV, the majority are in sub-Saharan Africa, and the virus spreads mostly through sexual intercourse. About half the adults living with HIV/AIDS are women, and women younger than 24 in sub-Saharan Africa are

eight times more likely to have HIV than young men of the same age range.

In South Africa specifically, more people suffer from HIV infection than any other nation in the world — an estimated 5.7 million, according to 2007 figures from the US Agency for International Development. However, thanks to greater access to antiretroviral treatments in Africa, AIDS is a chronic but manageable condition instead of a certain death sentence.

Work by TWAS Prize in Medical Sciences winner Quarraisha Abdool Karim of the Centre for the AIDS Programme of Research in South Africa has had a massive influence on understanding the spread of HIV in that country, and especially its effect on women. She also led the trial that provided the first clinical evidence that tenofovir gel, an antiretroviral drug, can prevent sexually transmitted HIV and genital herpes in women. This discovery has been a key finding in AIDS prevention and is the culmination of two decades of research.

Karim's contributions in programmes and research complement her passionate promotion of human rights. She has extensive policy experience that stems from her term as the first director of the South African National HIV/AIDS and STD Program established by the Nelson Mandela government shortly after the country's first democratic elections in the mid-1990s.

Karim's work has also been instrumental in the education of other scientists. She directs the Columbia University-Southern African Fogarty AIDS International Training and Research Program, which trained more than 300 young scientists in HIV and tuberculosis



Left to right: TWAS Prize winners Quarraisha Abdool Karim (centre); Yu Jun; Chen Xiao-Ming; Swapan Kumar Pati; Patrick George Eriksson; Abdul Latif Ahmad.

Below: The group of prize winners honoured at the 24th TWAS General Meeting. (Photos: Roque Silles)

research in South Africa, Namibia, Swaziland and Lesotho. The programme has enabled and supported the growth of scientific study in South Africa, and trainees now play leading roles in almost every major AIDS research center in South Africa.

She is also a consultant to numerous United Nations organizations and AIDS-related expert committees on HIV prevention, TB-HIV treatment, gender, ethics, treatment access in low-resource areas, and research capacity building.

MORE 2012 PRIZE WINNERS

Yu Jun, a geneticist with the Beijing Institute of Genomics in China, and winner of the TWAS Prize in Agricultural Sciences, has been a leader in the study of plant genomes, particularly rice, for which he and his colleagues built a series of databases. His research contributed not only to the stronger understanding of basic structure of the rice genome, but insights into how to build vigorous hybrid species and how rice genomes vary.

Sun Yat-Sen University chemist **Chen Xiao-Ming** from China is a winner of the TWAS Prize in Chemistry. He has researched the creation, structures and properties of coordination polymers – interlinked networks of metallic atoms and organic molecules. Chen pioneered



the study of how the metal atoms assemble with binding organic molecules called ligands to create coordination polymers.

Graphene, the extremely light two-dimensional pure-carbon substance, has opened up many new possibilities for miniaturized electronic devices. **Swapan Kumar Pati**, a materials chemist with the Jawaharlal Nehru Centre for Advanced Scientific Research in Bangalore, India, and winner of the TWAS Prize in Chemistry, studies the properties of graphene by observing how electrons behave when released into thin nanometer-scale strips of graphene and their nanoribbons.

Patrick George Eriksson of the University of Pretoria

Left to right: The opening ceremony of the 24th TWAS General Meeting. TWAS Prize winners Fernando Codá Marques; Kalyanmoy Deb; Gao George Fu; Juan Pablo Paz. A collection of TWAS prizes on display. (Photos: Roque Silles)



in South Africa and his colleagues have recently begun to challenge concepts like the ‘great oxidation’ a tipping point at which oxygen produced by living organisms began to accumulate in the atmosphere about 2.4 billion years ago. Eriksson, the winner of the TWAS Prize in Earth Sciences, has a long history of key findings in the study of Earth’s deepest history.

The winner of the TWAS Prize in Engineering Sciences, **Abdul Latif Ahmad** of *Universiti Sains Malaysia*, engineers membranes – thin films that only allow certain chemicals from any given substance to pass through them – for uses that range from medical diagnosis to environmental protection. Some of Ahmad’s most significant work has been on membrane technology to better control the release of effluent from palm oil mills into the environment.

Kalyanmoy Deb, an engineer with the Indian Institute of Technology, researches algorithms that emulate evolution and how they can optimize machine learning – the ability of artificial intelligence to learn from information. He is widely known for his influential research using evolutionary principles to develop decision-making procedures that take multiple criteria into account. He won the TWAS Prize in Engineering Sciences.

A mathematician with the National Institute of Pure and Applied Mathematics in Brazil, **Fernando**

Codá Marques, has made several major contributions to differential geometry, solving and yielding results from numerous problems mathematicians have been working on for decades. The most prominent work by Marques, who won the TWAS Prize in Mathematics, is a complete proof of the Willmore Conjecture, which predicts the equilibrium state of a curved surface with one hole – shaped like an inner-tube.

Microbiologist **Gao George Fu**, winner of the TWAS Prize in Medical Sciences, is a pioneer in the study of germ transmission – influenza in particular – between species. His team at the Institute of Microbiology of the Chinese Academy of Sciences studied the virus H5N1, commonly known as bird flu, predicting that the virus’ spread through the birds’ migratory flight paths in a study

published in *Science* in 2005. His team has tracked bird flu’s spread around the world ever since.

How do the reliable rules of classical physics emerge from the erratic and random quantum world of the incomprehensibly small? **Juan Pablo Paz** of the University of Buenos Aires in Argentina studies that border between the worlds of the intuitive and counterintuitive, and won the TWAS Prize in Physics for his work on ‘decoherence’, which is the loss of quantum information into its environment. ■

The 12 winners of the 2012 TWAS Prizes for scientific excellence attended the TWAS General Meeting in Buenos Aires, Argentina.

◆◆◆ Sean Treacy and Cristina Serra



WINNERS ANNOUNCED FOR 2013 TWAS PRIZES

At the Buenos Aires meeting, the Academy announced the 14 winners of the 2013 TWAS Prizes. They are invited to present on their research at the 2014 General Meeting, which will take place Muscat, Sultanate of Oman. The winners:

- Zhu Yongguan of Xiamen, China, received the Agricultural Sciences prize for his research on arsenic pollution in soil and plants, especially rice.
- Xu Guoliang of Shanghai, China, received the Biology prize for his work on the role of genetic changes in the development of mammals.
- Sue Duan Lin-Chao of Taipei, Taiwan, China, gained the Biology prize for her work on RNA degradation in bacteria.
- Ayyappanpillai Ajayaghosh of Kerala, India, received the Chemistry prize for his work that led to a new class of soft functional materials.
- Chung-Yuan Mou of Taipei, Taiwan, China, received the prize in Chemistry for work on tiny porous structures that have chemical and biomedical applications.
- Li Xia of Guangzhou, China, won the prize in Earth Sciences for his work on models simulating land uses and planning for sustainable land development in China.
- Indranil Manna of Kanpur, Uttar Pradesh, India, won the prize in Engineering Sciences for work on nanometric materials.
- Mohammad Ahmad Al-Nimr of Irbid, Jordan, won the prize in Engineering Sciences for his work on understanding the behavior of environmentally friendly devices, systems and processes that use, generate, convert, store and manage energy efficiently.
- Artur Avila of Rio de Janeiro, Brazil, won the prize in Mathematics for his contributions to several mathematical theories dealing with, for example, systems in a low number of dimensions.
- Mei-Hwei Chang of Taipei, Taiwan, China, received the prize in Medical Sciences for her work proving the effect of a hepatitis B vaccine in preventing a common kind of liver cancer and promoting the idea of vaccines to prevent cancer.
- Turgay Dalkara of Ankara, Turkey, got the prize in Medical Sciences for work on mechanisms leading to brain damage and migraines following a lack of blood reaching the brain.
- Rajesh Gopakumar of Allahabad, India, received the prize in Physics for his discovery of duality symmetry between a class of two-dimensional conformal field theories and higher-spin theory in three-dimensional anti-de Sitter space.
- Marcos Pimenta of Belo Horizonte, Brazil, received the Physics prize for his contribution to our understanding of the optical and electronic properties of carbon nanomaterials.
- Zhang Linxiu of Beijing, China, won the TWAS-Celso Furtado Prize in Social Sciences for her policy-relevant studies on rural development in China.