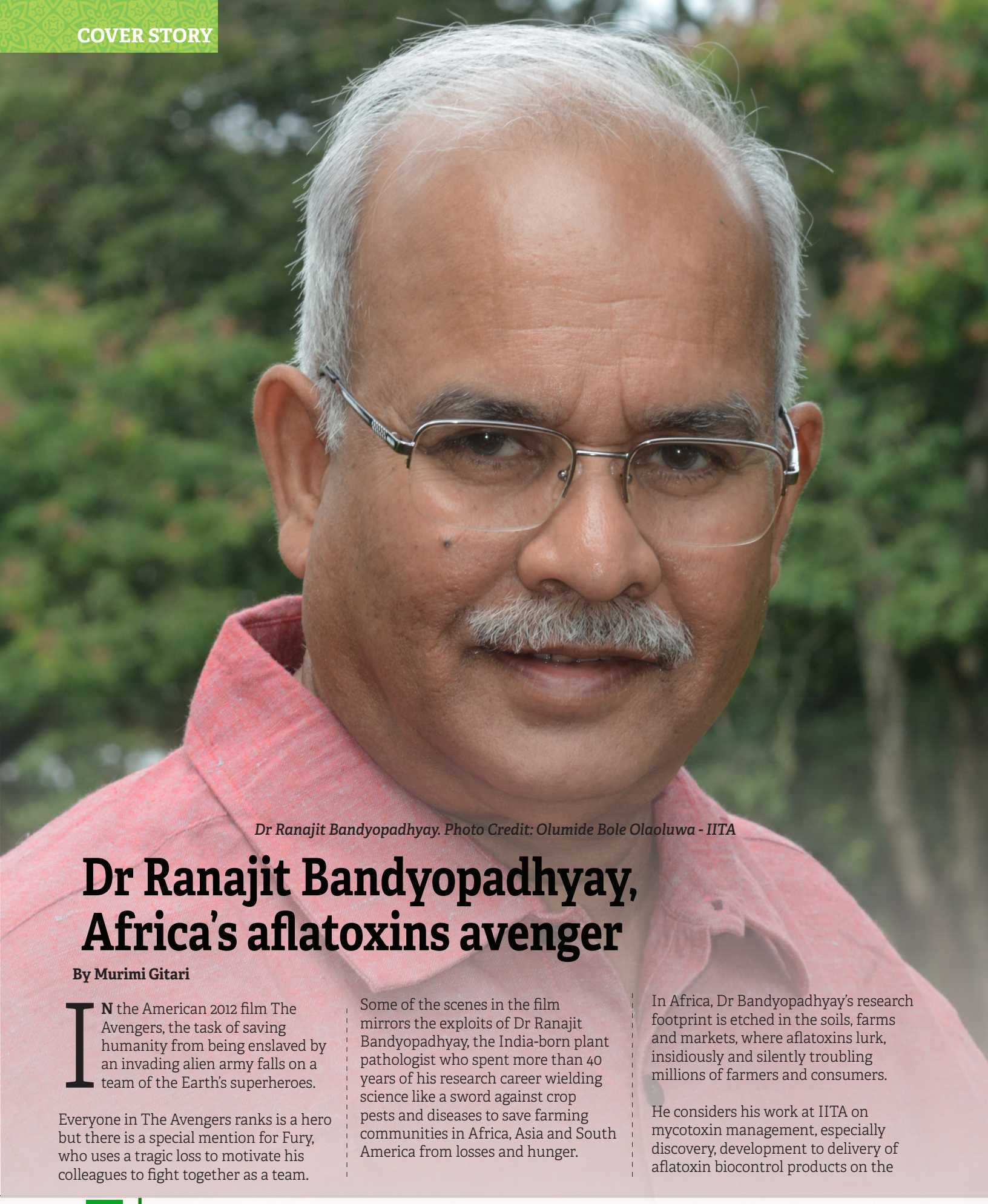

Dr Ranajit Bandyopadhyay. Photo Credit: Olumide Bole Olaoluwa - IITA

Dr Ranajit Bandyopadhyay, Africa's aflatoxins avenger

By Murimi Gitari

IN the American 2012 film The Avengers, the task of saving humanity from being enslaved by an invading alien army falls on a team of the Earth's superheroes.

Everyone in The Avengers ranks is a hero but there is a special mention for Fury, who uses a tragic loss to motivate his colleagues to fight together as a team.

Some of the scenes in the film mirrors the exploits of Dr Ranajit Bandyopadhyay, the India-born plant pathologist who spent more than 40 years of his research career wielding science like a sword against crop pests and diseases to save farming communities in Africa, Asia and South America from losses and hunger.

In Africa, Dr Bandyopadhyay's research footprint is etched in the soils, farms and markets, where aflatoxins lurk, insidiously and silently troubling millions of farmers and consumers.

He considers his work at IITA on mycotoxin management, especially discovery, development to delivery of aflatoxin biocontrol products on the

continent as the most significant of his scientific contributions.

"During early 2000s, several studies and events underscored the pervasiveness of aflatoxins in the African food systems, undermining health, food security, animal productivity and trade. There were several reports of aflatoxin-related deaths in Kenya, child stunting in West Africa, and farmers' inability to meet aflatoxin standards leading to income losses and crop destruction. Moved by seriousness of aflatoxins as a cross-sectoral concern in Africa, I maintained a singular vision on drastically reducing the number of Africans who get poisoned by aflatoxins from the food they grow," he says.

The success of aflatoxin biocontrol spearheaded by USDA-ARS in late 1990s in the US encouraged him to adapt, and improve the biocontrol approach for African agroecosystems. Together with Peter Cotty of USDA-ARS, he founded an Africa-wide Aflasafe initiative in 2003. This initiative improved and scaled up the aflatoxin biological control technology based on the use of atoxigenic strains of *Aspergillus flavus* to competitively exclude aflatoxin producers and limit aflatoxin crop contamination in several African nations. Jointly with his team, they collected and evaluated about 125,000 *A. flavus* isolates from 22 African nations following a rigorous selection process to identify widely distributed and locally adapted native atoxigenic groups, which were formulated into country-specific (and sometimes regional) multi-strain bioprotectants generically named Aflasafe.

The biocontrol technology was named as one of the top-three innovations for post-harvest loss management at the 1st All-Africa Post-Harvest Congress and Exhibition in Nairobi in 2017.

The Aflasafe team, together with the national agriculture research system, engaged thousands of maize and groundnut farmers to demonstrate that Aflasafe products are highly effective in reducing aflatoxin accumulation in maize and groundnut while simultaneously working patiently with biopesticide regulators. This has culminated in the registration of country-specific Aflasafe products for commercial use in Nigeria, Kenya, Senegal, The Gambia, Burkina Faso, Zambia, Tanzania, Ghana, Mozambique, and Malawi. Two more products were registered for Democratic Republic of Congo and Uganda in 2024. Additional products are under development for Benin, Mali, Cameroon, Niger, Ethiopia, Sudan, Rwanda, Togo, Sierra Leone, Mandagascar and Burundi.

"For farmers to use the biocontrol technology, it must be registered,

NAFDAC group in front of the Aflasafe factory. Photo Credit: IITA

Celebrating the end of treating groundnut fields in The Gambia for effectiveness trials that led to registration. Photo Credit: Amadou Lamine Senghor

manufactured, distributed and promoted for commercial use. Although the technology was initially developed by a team of plant pathologists, it was clear that post-discovery aspects of scalable biocontrol technology needed more than the expertise of plant scientists. Therefore, over the years, I built a team with members from diverse disciplines, many of them unconventional for traditional agricultural systems and even less conventional for research to benefit smallholder farmers," Dr Bandyopadhyay says.

With a team of plant pathologists, food scientists, plant breeders, industrial engineers, postharvest specialists, biocontrol experts, social scientists, commercialisation specialists, administrative specialists, monitoring and evaluation personnel, communication specialists, it has been possible to further develop, test, register and commercialise aflatoxin biocontrol.

Together with Peter Cotty, Dr Bandyopadhyay designed an Aflasafe manufacturing plant, secured grants to construct it, and led a team that built a manufacturing facility in Nigeria to meet the growing demand for Aflasafe products across Africa. With support from multiple donors, including USAID, Bill & Melinda Gates Foundation (BMGF), AGRA, USDA-FAS, and French Development Agency, the development, technology transfer, and commercialisation of Aflasafe is in full progress in 22 countries. More than 150,000 farmers have since treated maize and peanut fields with Aflasafe manufactured in plants operated by either the private sector or a national government, and six African countries have included the technology in their national agriculture investment plans.

Dr Bandyopadhyay's team constructed or helped to construct six more plants in Kenya, Senegal, Tanzania, Nigeria, Democratic Republic of Congo and Burundi. Two more manufacturing facilities have been approved for construction in Uganda and Mozambique.

The initiative has led to a landmark publication reporting a 10-year study on the efficacy of Aflasafe in Nigeria. That is the longest-running, most extensive study on efficacy of any biocontrol product or management practice for aflatoxin alleviation across the globe. The study firmly establishes biocontrol as a vital tool in the fight against aflatoxins.

The efforts spearheaded by Dr Bandyopadhyay have sparked considerable interest by Governments and the private sector in Africa

to develop and adopt biocontrol technology as part of an integrated management system for aflatoxins. Governments of Senegal, The Gambia, Nigeria, Tanzania, Uganda and Malawi have incorporated scale-up of the biocontrol technology in their National Agriculture Investment Plans. Several countries in Asia amd Europe also expressed interest in aflatoxin biocontrol and asked Dr Bandyopadhyay's guidance.

Dr Bandyopadhyay began his work in international agricultural research in Africa in the 1980s with work on sorghum ergot. He had just joined ICRISAT as a sorghum pathologist immediately after completing his PhD in 1980.

"I could not have asked for more as a young inexperienced professional since ICRISAT provided a great mission-oriented, multi-disciplinary, supportive and international work environment. ICRISAT's mandate was to improve productivity of five crops commonly grown in the semi-arid tropical regions and the livelihood of people living therein. Africa was a priority region for ICRISAT. Ergot was one of the several sorghum diseases that evoked scientific curiosity due to its unique disease development process and the appalling damage potential," he notes.

His initial research in India in the early 1980s emphasised pathogen biology, pollen-pathogen interactions, epidemiology and host plant resistance. Sorghum ergot is also of concern in Africa. Therefore, ICRISAT, Institute of Agriculture Research (IAR, Ethiopia) and l'Institut des Sciences Agronomique Rwanda (ISAR) began a collaborative research program under the aegis of East Africa Cereals and Legumes Research Network of the African Union during the mid-1980s. Through this collaboration, they established field sites in Arsi Negele (Ethiopia) and Rubona and Karama (Rwanda) where they developed inoculation techniques and resistance evaluation methods; evaluated a large number of sorghum germplasm; and identified ergot resistant sorghum germplasm (including local landraces) of value to breeders as well as farmers.

"We also identified several collateral hosts on which the pathogen overseasons. An important component of the project was capacity development. During this period, I used to spend three months each in Ethiopia and Rwanda and developed lasting friendships with several national researchers," he says.

In 2005, he also started a collaborative research project with Dr Glen Hartman (USDA-ARS at the University of Illinois) to elucidate the identity, distribution and damage-causing potential of the soybean rust pathogen in various geographic areas and their virulence on soybean possessing different resistance genes.

Together with a PhD student Mathias Twizeyimana and post-doc Peter Ojiambo, they sought to determine the role of environment in disease development and developed various methods for resistance evaluation. They identified germplasm resistant

Dr Ranajit Bandyopadhyay with extension workers and farmers in The Gambia.
Photo Credit: Amadou Lamine Senghor'

to all known pathogen variants in Nigeria and selected resistant germplasm used to breed a series of rust-resistant high-yielding cultivars that were released in Nigeria (in 2009) for general cultivation by farmers, and as breeding stock in the USA. A few of these resistant varieties were also released later in southern Africa. The outcome of focused research programme helped to contain soybean rust within five years. Soybean rust, caused by a notoriously variable pathogen, is a devastating disease that can completely defoliate a healthy crop within two weeks.

Dr Bandyopadhyay was born in Jamshedpur, India to parents who were refugees from Bangladesh. His parents believed in giving quality education as a path to progress and sent him to boarding schools when he was 10 years old. He would later on complete his secondary education specialising in agriculture in Ramakrishna Mission Vidyalaya, Narendrapur in 1970.

After his high school education, he joined G. B. Pant University of Agriculture and Technology in the same year for B.Sc. (Hons) Agriculture & Animal Husbandry (1970 to 1974) and continued for M.Sc. in Plant Pathology (1974 to 1976) in the same university supported by a fellowship from the Indian Council of Agriculture Research.

Wanting a change and with a fellowship from the University Grants Commission, he then moved to Haryana Agriculture University for PhD in Plant Pathology from the year 1976 to 1980. Within a few days after completing PhD, he joined the ICRISAT at Patancheru (India) as a sorghum pathologist.

In his 22-year stint at ICRISAT, he took two sabbaticals – one at Cornell University and another at Texas A&M University. In 2002, he moved to the International Institute of Tropical Agriculture (IITA) at Ibadan (Nigeria).

"I was drawn into plant pathology after taking an undergraduate course from my mentor Prof. Y.L. Nene. Learning about the famines and hardships caused by plant diseases and seeing first-hand top class agriculture research conducted at the university to control plant diseases in the 1970s triggered my impetus to pursue a research career in international plant pathology. As an undergrad student worker, I volunteered to inoculate crops, evaluate fungicides and cross-pollinated triticale and the results fascinated me. I am fortunate that my desire to apply science and technology to control plant diseases and improve livelihoods of farmers was fulfilled during my 43 years association with the Consultative Group on International Agriculture Research (CGIAR)," Dr Bandyopadhyay says.

The Americans Phytopathological Society (APS) honored Dr Bandyopadhyay with the Fellow award and the Excellence in International Service award. He has received several other awards from IITA and ICRISAT, National Grains sorghum producers Board of North America, The African Union (Agents of Change for Aflatoxin Mitigation award), and the World Mycotoxin Journal. He was a Stirring Committee member of the African Unions Partnership for Aflatoxin control in Africa (PACA) and chaired its Technical Sub- Committee.

He has mentored over 60 scientists, Postdocs, students, and technicians from 23 countries; and built laboratory infrastructure in 10 African countries. The has authored nearly 220 research journal, articles, books and book chapters.

Being in his third year as a scientist emeritus, Dr Bandyopadhyay says that it has been quite a different life away from leading an active and expanding Africa-wide Aflasafe Initiative that he co-founded in 2003 at IITA.

"Days and sometimes nights were packed with planning new projects, interaction with team members, going to the lab and farmers' fields, traveling to meetings and conferences, troubleshooting and monitoring progress, discussions with collaborators, looking for opportunities to make impact, and so on. Those were exciting times and provided fulfilling experiences," he says.

As a Scientist Emeritus, he now provides strategic advice to the Aflasafe Initiative. He is also trying to start a new project to expand IITA's aflatoxin biocontrol work in India, his home country, where aflatoxin is a serious but neglected issue.

"I also took up a few advisory roles such as organizing the scientific content of the 16th International Congress of Plant Pathology, planning a new One Health project in Asia, development of plant disease products for Africa. I am fortunate to have an understanding wife and sons who had graciously put up with my hectic work schedule including long absences from home. We now spend more time with each other and with family and friends. We have traveled a bit and more are in the offing," he says.

Dr Bandyopadhyay and his family settled down in Delhi after returning from Africa where they live in a joint family with his son and daughter-in-law. He notes that his typical day is quite full but flexible and relaxing as he makes his own pace. In the morning or evening, he walks for an hour and tend plants in their terrace garden. Then, with his wife and they enjoy their morning tea and breakfast together, which was a rarity during active work life.

"Before and after lunch I work for some time on most days interacting with Dr Alejandro Ortega-Beltran (my successor, now ably leading the Aflasafe Initiative) and others, responding to mails, checking for and reading new scientific literature, editing or reviewing research articles," he notes.

Following the active work life in Africa and beyond , he now has the flexibility and space for many things that he feels he had neglected or for which he did not have time. He has found the joy of relaxed family life, pleasures of family vacations, and getting back to roots. He has also joined the practice of Nichiren Buddhism, which has been spiritually uplifting and as well got reconnected with a small circle of school and college friends after a long time. Together with a few neighbourhood retired people (some with agriculture science background), they have begun to catalogue birds in the park in their locality.