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IITA news
No. 2521 20–25 January 2020

How IITA discovered the fall armyworm

Isn't it interesting how seemingly unrelated events in two countries can lead to the same outcome? The story of identifying the fall armyworm in Africa is as intriguing as the pest itself.

IITA Entomologist/Biocontrol Specialist, Goergen Georg, speaking about the devastation of fall armyworm.

In 2015 Ylva Hillbur, IITA's former Deputy Director General (DDG) Research for Development was in talks with a Swedish team of researchers at the Swedish University of Agricultural Sciences who were interested in studying the African armyworm. Hillbur requested for samples of the moth from Georg Goergen, the entomologist who heads IITA's insect Biodiversity Center in Cotonou, Benin.

"I kept an open eye so that if ever we saw the moths, we'd send some to the DDG," Goergen says. We knew it would only be a matter of time since the African armyworm is a seasonal insect, which only appears in the first rains after a very long dry spell. We were also aware that it never stays long in the same place, usually a week or two, and it leaves behind only one generation in any given place before moving to the next location," says Goergen, an entomologist with ample field experience.

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Survey identifies Black Sigatoka banana disease hotspots in Uganda and Tanzania

Survey also finds disease is well established and more widespread than previously thought

Both Luwero District in Uganda and Mbarara District, Kagera Region in Tanzania have been identified as the areas most affected by the deadly banana disease, black Sigatoka which is caused by a fungus. The disease, which was found to be more severe in Uganda than in Tanzania, was also more widespread than previously thought.

This was established by a survey on the distribution and severity of the Sigatoka leaf diseases and its pathogens conducted in the two countries as part of efforts to control its spread to protect the food and income of millions of smallholder farmers growing the crop.

Banana, and especially the cooking type known as East Africa highland

Banana inflorescence and fruit infected with black sigatoka disease.

banana, is a vital staple food and income crop for over 80 million people in East Africa. However, productivity has been declining, partly due to diseases such as Sigatoka leaf diseases. Furthermore, all banana varieties grown in the two countries are susceptible to the disease.

While there are three pathogens that cause Sigatoka-leaf symptoms, the study established black Sigatoka, caused by ***Pseudocercospora fijiensis***, as the most widespread. Black Sigatoka was first reported in Tanzania in 1987 and, in Uganda in 1990, but was only present at low altitudes.

However, the pathogen distribution has recently expanded, and it is now found at higher elevations that were previously considered unsuitable for their survival. This expansion reveals a gradual adaptation of the pathogen to cooler conditions of the higher altitudes.

The study also looked at historical data and established that the temperatures have increased in the past three decades, creating a favorable environment at high altitude areas for pathogen proliferation.

Njeri Kimunye, an IITA-sponsored PhD student at Stellenbosch University, South Africa, led the study.

"Our findings are a big step forward in efforts to control this disease of banana as they have helped us to understand better where the disease is, its severity, the pathogens, and factors for its spread," said George Mahuku, IITA Senior Plant Pathologist and also a member of the international research team.

The research findings call for the deployment of an integrated disease management strategy that includes the use of resistant varieties and good agronomic practices to safeguard the livelihood of smallholder farmers in the region.

It also recommends creating awareness among the smallholder farmers on effective practices to stop the spread of the diseases as the use of fungicides is not an option for the resource-constrained, smallholder farmers growing the crop.

The study conducted between April and July 2016 surveyed 43 farms in Uganda and 81 in Tanzania. Sigatoka-like leaf diseases were observed in all the farms and plants surveyed. However, the disease severity varied significantly between countries, districts/regions within countries, altitudinal ranges, and banana cultivars.

The study was carried out by a team of researchers from IITA in Uganda and Tanzania in cooperation with researchers from the Department of Plant Pathology, Stellenbosch University, South Africa; and the Laboratory of Tropical Crop Improvement, KU Leuven, Belgium.

The survey was conducted as part of the project 'Improvement of banana for smallholder farmers in the Great Lakes Region of Africa' project. Details of the findings can be found in a paper *"Distribution of Pseudocercospora species causing Sigatoka leaf diseases of banana in Uganda and Tanzania"* published in Plant Pathology Journal, in January 2020 (issue 69, pages 50–59) (https://doi.org/10.1111/ppa.13105)

New, uninfected banana field.

Got a story to share?

Please send your story with photos and captions every Tuesday to iita-news@cgiar.org or Katherine Lopez (k.lopez@cgiar.org) and Uzoma Agha (u.agha@cgiar.org) for headquarters and Western Africa, Catherine Njuguna (c.njuguna@cgiar.org) for Eastern and Southern Africa, and David Ngome (d.ngome@cgiar.org) for Central Africa.

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March 2016

While the team in Cotonou was on the lookout, the farm manager at IITA-Ibadan, Nigeria was going on about his daily work of inspecting maize fields and spraying any pests. This was in March 2016. After the usual spraying, the farm manager noticed that this particular insect was not dying. The more they sprayed, the more the insects multiplied, and they fed audaciously. This strange insect that didn't respond to pesticides alarmed the farm manager, so he alerted Lava Kumar, IITA's virologist. Kumar informed an entomologist—Abou Togola based at IITA's Kano Station in northern Nigeria. Togola went to Ibadan and immediately recognized that this moth was different from other native African species. This is when samples were sent to IITA's biocontrol center in Cotonou for Goergen to identify.

Goergen was excited to receive the samples thinking it must the African armyworm that the DDG had asked for. However, when the specimen arrived, he was surprised. "It was different from what I knew! Surely, it was a species belonging to Spodoptera but there are over 30 species of Spodoptera although Africa had eight species by then," he says. "We first received caterpillars (larvae) and the adults (moths) came later. Based on the genitalia, we identified the moths as the fall armyworm—at this point, excitement reached fever pitch." Why were you excited, I asked? "New information is always exciting. We knew it to be an important pest that required us to move fast. However, you can only publish such information when you are 200% sure. If one is wrong, one can ruin their own and the institute's reputation," Goergen responded. In ensuring that he was 200% sure, Goergen asked Kumar, the virologist, to DNA barcorde the samples and they matched the barcodes of genomic databases in the US. By early June 2016, they were absolutely certain that it was indeed the FAW. The scientists notified the Nigerian Agricultural Quarantine Service (NAQS) about new pest, and with their consent, made this information public by publishing it in a journal in October 2016. It took 16 months from when the paper was published to the first major outbreak on the continent. "The first outbreaks were seasonal and contained. However, we knew that this would be a long-lasting problem—when the fall armyworm gets a foothold on the continent, there is nothing you can do to stop it because it's a migratory insect, which can fly over 50 km per night. That explains how such a tiny insect can colonize an entire continent in a short time."

What followed, a year later in 2017, was a unified and terrified outcry from farmers and governments on the continent. The damage caused by the worm based on only 11 of the 45 affected African countries is estimated at between US$2.5 and 6.2 billion. Farmers in some countries lost 100% of their crop. In April 2017, FAO and CIMMYT in collaboration with partners such as IITA, ***icipe***, CABI, and some African governments, organized the first meeting in Nairobi, Kenya that brought together affected countries and sought to develop a strategy for the effective management of FAW.

While FAO decided to take an active role in coordinating partners' activities and plans to provide sustainable solutions to the FAW challenge, a series of awareness workshops organized by IITA, CIMMYT, and USAID were conducted in various western, eastern, and southern African countries. It soon became clear that there is no single solution to control the new pest, which called for an Integrated Pest Management approach. At IITA, efforts currently include biological control using natural enemies and developing biopesticides, advocacy and awareness raising, the development of an App for early detection of FAW by farmers as well as breeding for resistance in support of efforts led by CIMMYT.

2018

In 2018, the outcry from farmers was less vibrant than the two preceding years, so one can wonder why? "FAW is still with us but is less pervasive as initially, conditions for outbreaks were particularly conducive. Today moth populations are still important, but farmers no longer panic when their maize is damaged and have learned from past seasons how to minimize damage." However, both Kumar and Goergen agree on one thing, "The fall armyworm is bound to stay and become a lasting threat in the newly invaded regions. We need to use an integrated pest management strategy. Pesticide application is one of them, but it is not sustainable. Not all farmers can afford pesticides since they are expensive and if used excessively, they induce pesticide resistance, destroy the environment, kill beneficial insects, and make our food unsafe since overuse leads to pesticide residue in food. Pesticides should be used only when necessary, we should look at environmentally compatible options like biocontrol—the use of natural enemies," Goergen advises.

Fall armyworm is a stem borer, which attacks different parts of the maize plant.
Photo by G. Goergen, IITA.

IITA to work with Osun State in raising agribusiness ambassadors

On 23 January, the Osun State Commissioner for Education, Hon Folarunsho Oladoyin visited IITA Ibadan campus with his Assistant, Bukola Elufisan and the Special Adviser to the Governor on Education, Jamiu Olawumi. The purpose of their visit was to collaborate with IITA through the IITA Youth Agripreneurs (IYA) and Start Them Early Program (STEP) platforms, to raise agribusiness ambassadors in Osun State.

Kenton Dashiell (right), introducing IITA to the Commissioner and his team.

Concerned about the high rate of unemployment, with youth increasingly graduating into a no-job system, Osun State is seeking better ways to create more employment opportunities. Also, the State intends to improve its educational system while working to solve the problem of unemployment.

Following the advice of Akinwumi Adesina, President of the African Development Bank (AFDB), Hon Oladoyin considered partnering with IITA in solving the problem of unemployment through agriculture. According to the commissioner, "Adesina said 'the best and easiest way to solve the problem of unemployment in Africa is to use the resources we have,' and agriculture is the resource we have."

The plan is for IITA to train 20 ambassadors that will complement the work of the STEP and IYA teams in Osun State. The essence of the training is to equip the ambassadors with the required knowledge and skills to run and sustain the program in the absence of the IITA team, including training others. "If they are not well trained, they might end up drowning the interest of students in agriculture rather than encouraging them," he said.

Hon Jamiu mentioned that not only should agribusiness ideas be introduced to primary and secondary schools, but also extended to tertiary institutions and every institution that runs agricultural programs in Osun State. "I think Osun State is a better place to go with STEP and IYA because we have set-up structures that can accommodate these programs," he said.

Aside from changing the mindset of students and unemployed youth towards agriculture, the Commissioner also suggested that there should be a shift in the mindset of the employed from white-collar jobs to agriculture through a mindset-change program. Hon Folarunsho also emphasized o the need to construct a School of Agriculture where practical training and resources will be made available in Osun State.

Kenton Dashiell, IITA Deputy Director General, Partnerships for Delivery (P4D), agreed to the idea of IITA assisting in drafting the training plan and budget. However, this would be after an official letter has been sent to that effect from the Commissioner.

The Special Adviser to the Governor on Education, Jamiu Olawumi, responding to the presentation of IYA and STEP coordinators.