'Nuru' becomes African farmers' newest ally against fall armyworm

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Fall armyworm larvae have caused an estimated $2.5 billion to $6.2 billion in damage annually to maize in sub-Saharan Africa since the pest arrived there in 2016. Credit: John C. French Sr., Bugwood.org

Penn State researchers have joined forces with the United Nations' Food and Agriculture Organization (FAO) to release the first app, called Nuru, to help African farmers recognize fall armyworm—a new and fast-spreading crop pest in sub-Saharan Africa—so that they can take immediate steps to destroy it and curb its spread.

Fall armyworm first appeared in Africa in 2016, in West Africa, and then spread rapidly across all countries in sub-Saharan Africa in 2017,

infesting millions of hectares of maize and threatening the food security of more than 300 million people. Potential damage to maize alone across just 12 producing countries is estimated to be $2.5 billion to $6.2 billion annually.

Many African farmers might have heard about fall armyworm but are seeing it for the first time. As a result, they often are unable to recognize it or are unsure of what they are facing. With the new application, growers can hold the phone next to a plant showing symptoms, and Nuru can use artificial intelligence algorithms and the phone's imaging capabilities to confirm immediately whether fall armyworm has caused the damage.

David Hughes, associate professor of entomology and biology at Penn State, noted that Nuru runs on a standard Android phone.

"An important feature of this new digital assistant is that it works when offline so farmers can use it whenever and wherever they want it," said Hughes, who led the development of the app with FAO. "Nuru is like an extension officer that is always there for farmers, in their fields."

Keith Cressman, FAO senior agricultural officer who leads FAO's digital response to fall armyworm and other pests, said the new tool will help farmers recognize this new enemy and take immediate measures to stop it.

"It complements FAO's recently launched Fall Armyworm Monitoring and Early Warning System (FAMEWS) mobile app, which builds knowledge on how and where the pest spreads, and what makes it less damaging," he said.

Nuru is a great example of a mobile-deployed, artificial-intelligence model that brings an interactive app to users who cannot depend on a

network connection, according to project team member Amanda Ramcharan, a postdoctoral fellow in entomology at Penn State.

"Mobile is a fast-growing platform for technological development, and we want to capitalize on this," she said.

An adult fall armyworm moth. Since first appearing in Africa in 2016, the pest has infested millions of hectares of maize and threatened the food security of more than 300 million people. Credit: Royal Tyler, Bugwood.org

The development of Nuru was made possible, in part, by the researchers' collaboration with technology company Google, explained Peter McCloskey, research technologist in entomology at Penn State.

"Our relationship with Google, specifically the Tensorflow mobile team led by Pete Warden, has been critical in deploying these complex models into mobile devices to run locally on-device," he said.

Penn State and FAO scientists are working on new features to make Nuru an even more powerful ally against fall armyworm.

For example, Nuru soon will be able to speak to farmers in their own language, walking them through the process of checking their crops for fall armyworm infestations, reporting armyworm population levels, and giving them advice on how to fight the pest. Nuru will speak Swahili, French, English and Twi, and will be updated with new languages continuously.

Nuru currently is embedded in the PlantVillage app, which is a free app built at Penn State in collaboration with UN FAO, international agriculture research consortium CGIAR, and other public institutions, and soon will be linked into FAO's FAMEWS app.

Once farmers connect their device online, Nuru will interface with the FAMEWS app to upload the collected data, which will be validated by national fall armyworm focal points and added to a global, web-based database.

The database analyzes data from across Africa to give a real-time, situational overview with maps of fall armyworm infestations and the measures that were most effective in reducing its impact.

"The FAO app and Nuru are integral parts of our program for sustainable management of fall armyworm," said Allan Hruska, FAO's principal technical coordinator on the fall armyworm response. "These apps feed information to farmers and extension workers so they can take action against the pest, while guiding decision-makers' response and

building everyone's understanding of this insect and its threat to food security."

He added that digital tools increasingly are becoming integral components of the FAO's systems of identification, monitoring, training and decision-making of globally important crop pests and diseases.

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