Advancing farms and farmers

by Luis Wilfrido Atienza

Filipino farms and farmers are essential to keeping the country fed. Despite their key role in our food supply, many farmers are extremely poor and live in unideal conditions. With most of their money going to supporting themselves and their families, they can hardly afford tools and technology that could make their difficult jobs easier.

Getting affordable and usable technology in the hands of our farmers will ensure the dependability and quality of the food they produce, help them make a living, make their jobs more doable, and improve their quality of life.

Scientists from the University of the Philippines Diliman developed a cheap and portable device capable of detecting the presence of organophosphates on crops. Their work was published in the *Philippine Journal of Science* in 2018 (see below).

Organophosphates are a type of chemicals commonly used to kill insects and other pests that threaten farmers' crops. But while these chemicals may be effective in controlling pest populations, they can be harmful to humans and other organisms. This is why one important step in the harvest and distribution of crops is making sure that harmful doses of these pesticides are no longer present when the crops reach customers. Inventing ways to detect the presence of organophosphate pesticides is crucial.

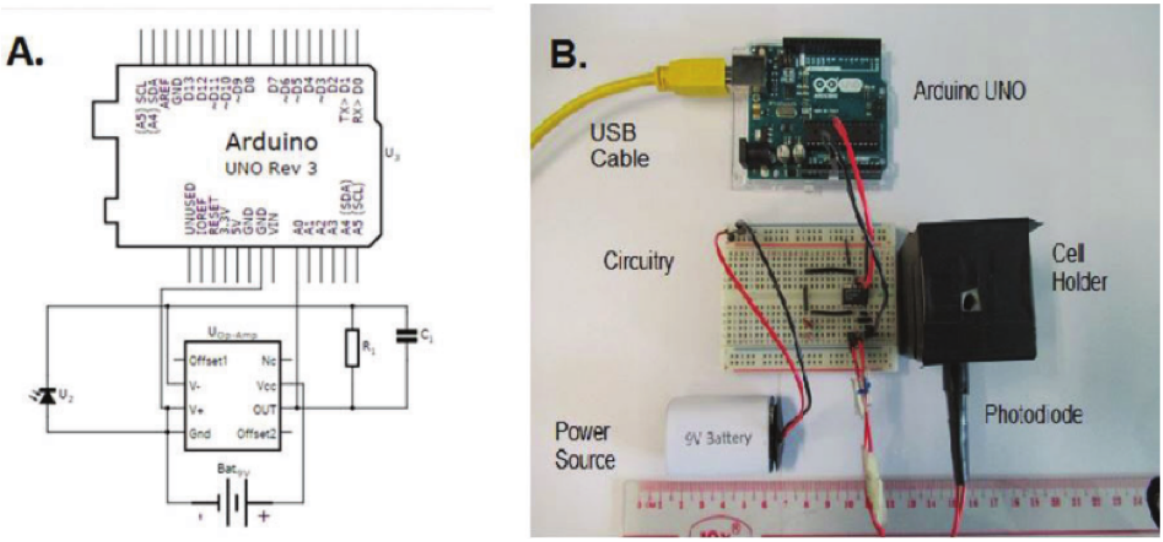
Devices and tests that can detect the presence of pesticides on crops are aplenty. However, most are expensive or require technical expertise. By using simple electronic parts, the scientists invented a device that is effective, portable, and cheap for the average farmer to use with only some training.

The device (see photo) is operated by an Arduino UNO, a type of microcontroller. Think miniature computers that can be integrated into different types of machines and programmed for a variety of tasks. Microcontrollers such as those made by Arduino tend to be cheap and can be used even by those with very little knowledge of electronics. They are versatile and effective and potentially usable in more complex projects.

To detect the presence of organophosphates, the scientists relied on the principle of chemiluminescence: light is released as a result of a chemical reaction.

To create this type of reaction, the scientists used luminol, well known for its use by the police to detect invisible traces of blood in crime scenes. Its chemiluminescent reaction with blood generates the glowing blood streaks and splatters seen on television and in movies.

The scientists combined luminol and hydrogen peroxide to create a reaction that released light. When a type of organophosphate called chlorpyrifos (CPF) is added to this mix, the CPF affects the hydrogen peroxide, causing the reaction to emit less light.



A schematic diagram (A) and actual image (B) of the device created by the researchers.

The scientists prepared a solution and loaded it into a special container inside the cell holder of the device. The photodiode sensed the amount of light being released by the reaction. This information was processed by the Arduino and sent through a USB cable to a computer, where the scientists viewed the data.

The device helped the scientists differentiate a solution containing only luminol and hydrogen peroxide from a solution containing luminol, hydrogen peroxide, and CPF (which should emit less light).

After testing and calibrating the device, the scientists were in fact able to use the device to detect the difference in the light emitted by these two solutions. They also tested if the device could detect nonorganophosphate pesticides and found that the device could detect the presence only of organophosphates such as CPF.

This is a great success for the scientists. They showed the chemiluminescence principle to be viable for the detection of CPF and other organophosphates. They also invented a device with mostly very cheap and easily accessible materials, meaning that the final version will probably be much cheaper than currently available organophosphate detection methods. They also managed to make the device compact and portable, meaning that it could easily be distributed to farmers even in remote locations.

While the device is not ready for distribution quite yet, further work is promising: the scientists can refine the design to make the device even easier to use, figure out ways to distribute the device to farmers and train them in its use, and make it more usable directly in the field.

REFERENCE

Buenaventura AE, Yago AC. Chemiluminescence detection of chlorpyrifos vis luminol-H_2O_2-ferricyanide system using microcontroller-based photometer. Philipp J Sci 2018; 147:753–62.

Luis Wilfrido Atienza graduated from the Ateneo de Manila University, with a BS in Biology and a minor in poetry. He currently works as a writer for a medical communications agency and spends some of his free time writing about science.