***MSU’s ‘Little Gadget that Could’ Becoming Game-Changer for International Researchers***

Contact: [Jessy Sielski](mailto:sielskij@msu.edu)

Published: April 7, 2016

Two years ago, when the MSU Global Center for Food Systems Innovation chose to award an innovation grant to PhotosynQ, the young start-up project was entering the always critical proof-of-concept phase. Today, the nifty little gadget (better known as the MultispeQ) and its cloud-based data-aggregating platform called PhotosynQ are being used to battle malnutrition, drought, crop disease, and—yes, that’s right—Godzilla. (But we’ll get to that in a moment.)

**What is PhotosynQ?**

Often mistakenly used to describe the MultispeQ device itself, PhotosynQ is actually the parent platform that offers a suite of tools and resources that allow educators, researchers, farmers, and citizen scientists to measure plant, soil, water, and environmental parameters. The MultispeQ is a low-cost, handheld device that connects to the PhotosynQ platform to allow rapid measurements of many important plant health properties that can be used to enhance plant management and breeding. Measurements are instantly available and ready to be analyzed on the PhotosynQ mobile app or website. Collaborators can curate data together, across communities and countries, all in one place, allowing for both hyper-local and global scale analyses of how plants are performing.

**How did the project get off the ground?**

As a renowned researcher of photosynthesis and bioenergetics, David Kramer had been building instruments to measure photosynthesis for years, and dreamed of building a network of photosynthesis monitors to see how plants worked in the real world. He came to MSU in 2010, partly because it offered the possibility of accomplishing this goal. At MSU, he met Greg Austic—now a research technician and project manager with a background in economics, sociology and open science—their two visions meshed and PhotosynQ was born.

“We started the project with funding from the U.S. Department of Energy (Basic Energy Sciences) to understand how plants capture and store energy through photosynthesis. Once we built and tested the device, we saw that it could be used to probe plant health, so we started looking for opportunities for its use in agriculture,” explained Kramer. “One of the first opportunities that we came across was this project through GCFSI and the US Agency for International Development. What that grant allowed us to do was not only get the technology in the field locally, but also in the field in Africa. We were able to put these devices in an environment unfamiliar to us and test their utility to see if they could give us data that was interpretable and potentially useful.”

To accomplish this, Kramer and his team had to effectively build a complete product development pipeline in his lab. “That took a lot of work, and a lot of learning.” With the aid of computer aided design, 3D printing, and an eclectic team of researchers, engineers and technicians, and a large community of users, the team assembled and distributed 300 devices, many of which found their way to Africa. “The first hundred were crap,” Kramer admitted, “but this was important because we learned how to improve them from the community of users in the field.”

Manufacturing wasn’t the only thing Kramer and his team learned during that initial phase. “More than anything else during that first year in Africa, I’d say we learned more about sociology than technology, Kramer said. “Connectivity, the ability to charge the devices, familiarity with mobile phones, randomization: these were the biggest obstacles we had to overcome in that first year.”

As the year came to a close, however, everything changed for Kramer and his team. “That’s when we got our first yield data from Africa,” he said. “We had all the trials going on around the world, and then the first results came in—from Malawi, on pigeon peas. We started to do some crude analysis on one parameter, then a second, then a third, and put all this together and suddenly—boom—there was this beautiful correlation. Based on the data we were getting during the process, it was clear that we would have been able to predict yield very early in the growing process.”

Since completing the grant cycle with GCFSI, Kramer and his PhotosynQ team have earned continued support from the McKnight Foundation. PhotosynQ now ties together 670 projects, 1,088 users, and more than 207,000 data points.

**Why is PhotosynQ special?**

In addition to the ease of use and low price point ($300 per device and free platform support), what makes the PhotosynQ project unique is its open platform that encourages users to take ownership of and have significant influence on product development. As Kramer explains, “We didn't want to control the experiments. We wanted local people to define what the questions were that need to be answered. We want to enable people to do research in a way they never could have before.”

And they are.

At Cornell University, a research team is working with the Kramer Lab to develop GrainspeQ, a device that will be able to measure aflatoxin in grain. For a team at MSU working with sorghum, Kramer and his team are modifying the device to measure the thickness of a leaf (quickly and without destroying the leaf), so that a line of plants can be bred that will be resistant to pests. In Ukraine, greenhouse growers are using the device to reduce energy costs. In Ireland, the device is being used to test the effectiveness of seaweed extracts on the drought tolerance of tomato plants.

The list goes on…and on.

**So, what was that thing you said about Godzilla?**

Come with me for a moment—if you will—to the Great Barrier Reef. One of the seven great wonders of the natural world, the reef is large enough to be seen from outer space. With its magnificent natural beauty and the stunning ocean life it supports, it’s no surprise that the attraction has become a $3 billion tourist attraction for Australia. And if the fishing and tourism industries worldwide are taken into account, that number jumps to $40 billion annually.

Unfortunately, coral reefs around the world are in serious trouble. A rise in ocean temperatures is causing a widespread phenomenon known as coral bleaching, which essentially means that the coral is sick. Some corals can recover, but if water temperatures are too warm for too long, the corals will die, having a devastating impact on the ecosystem, ocean life, food sources, and economies.

This year has been especially devastating for coral reefs due to the 2015-16 El Niño, appropriately named “the Godzilla El Niño.” A [Discovery News article](http://news.discovery.com/earth/oceans/great-barrier-reef-coral-bleaching-is-worst-in-its-history-160404.htm) (April 4, 2016) stated, “the northern part of the world’s largest coral reef ecosystem is experiencing ‘the worst mass bleaching event in its history,’ according to [a statement](http://www.coralcoe.org.au/media-releases/coral-bleaching-taskforce-documents-most-severe-bleaching-on-record) released in late March by the Australian Research Council.”

Atsuko Kanazawa, a research scientist and developer in the MSU Plant Research Laboratory, studies coral bleaching in the Pacific and Caribbean. To better understand why some coral dies from bleaching while adjacent coral is mysteriously healthy (and what, if anything, can be done to fix the problem), she teamed up with the Kramer Lab to develop CoralspeQ, a spin-off of the MultispeQ device that will not only add a completely new layer of data to her research, but also do it in an inexpensive, rapid, and far-reaching way.

“There are similar devices out there,” admits Kanazawa, “but they’re bulky, complex, and incredibly expensive. They’re in the neighborhood of $20,000 each, and they are difficult to use.

“Learning how to use the device is just not practical for researchers like us who are not marine biologists. I learned how to use the CoralspeQ device in just a few seconds. Most coral bleaching takes place at snorkeling depth, so the CoralspeQ can easily meet those needs. And at about $500 per device, if I break one, it’s no big deal. And also, that price will allow us to distribute 300 devices this year. And really, to find the answers to the questions we’re asking, we need bulk data from numerous locations.”

Additionally, coral health is determined by its color, and right now, researchers quite literally “eyeball it” by using a coral health chart card, which strongly resembles a color swatch spectrum card you might find at your local Home Depot. This takes a trained eye. Not only can the CoralspeQ device measure photosynthetic efficiency of the coral, but it also can detect the coral pigments with incredible precision—and then automatically aggregate all the data on the PhotosynQ platform.

“This device and the platform are changing the way we do our research, and they have the potential to show us things we hadn’t thought possible before,” concluded Kanazawa.

**Where does the team see PhotosynQ in five years?**

Since the device being used until this point has technically been a beta version, Kramer and his team are looking forward to the initial launch of MultispeQ 1.0, which will boast (in addition to a snazzy new shell) a number of new features. One of the most notable will be a component that detects precisely how plants handle water and carbon dioxide. “Much like a human mouth when it opens to breathe, a plant’s stomata open to intake carbon dioxide,” Kramer explains. “But also like a human mouth, when the stomata are open, moisture escapes. And when it comes to plants (particularly those in areas of drought), that balance is critical.”

When asked what he would like to see from PhotosynQ five years from now, Kramer said, “I would like to see tens of thousands of these things around the world so that we can really understand what photosynthesis is and what plants are doing. I want to see small communities around the world glued together through this platform. If that happens, we’re going to be able to see data in a way that has never been done before, and that will lead to scientific advances never possible before. We want to be surprised by what people do with it.”

If the next five years are anything like the first two, we think he will be.

*Jessy Sielski is the Communications Director for the MSU Global Center for Food Systems Innovation.*