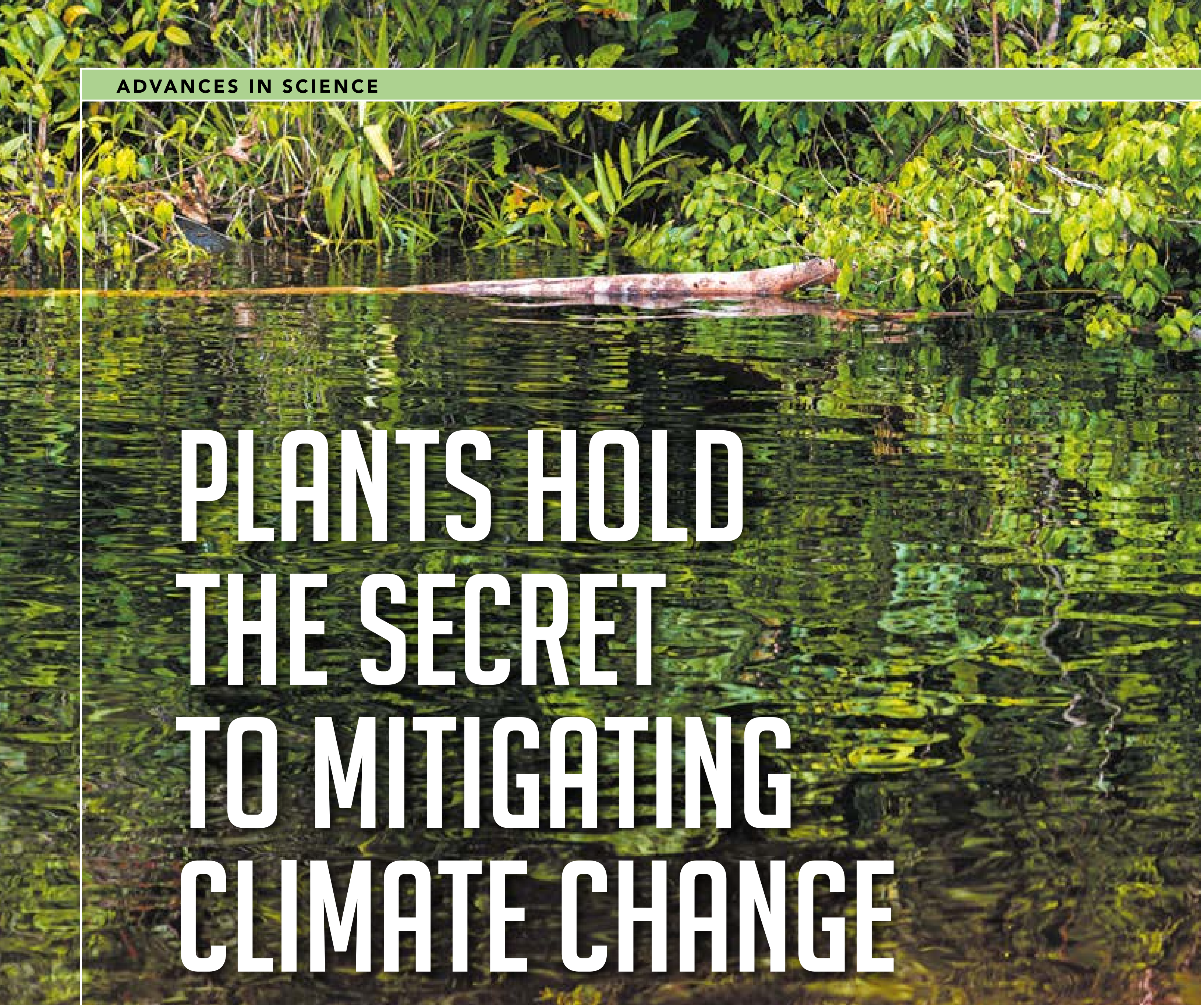


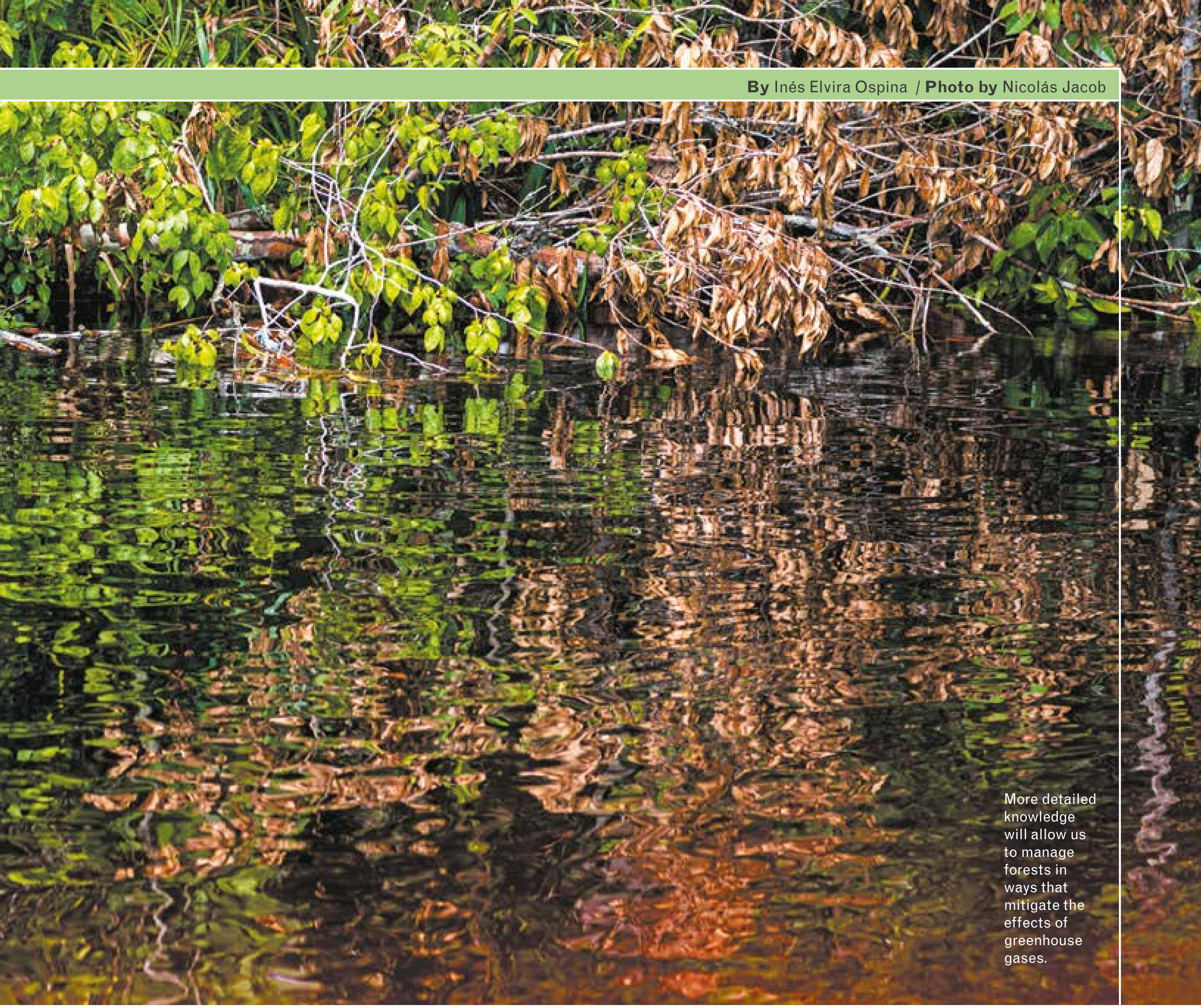
PLANTS HOLD THE SECRET TO MITIGATING CLIMATE CHANGE

Everyone knows that plants need light. Few people, however, know that carefully studying how plants use light and how efficiently they use it can make an important contribution to mitigating the effects of climate change.

If worldwide emissions of greenhouse gases (GHG) are not reduced by the year 2100, Colombia and many other places in the world will face terrible difficulties. Rising sea levels would threaten coastal towns and cities; snowcaps would melt, and the moorlands on our high plateaus, the predominant source of potable water for our towns and cities, would be significantly reduced in size.

These are the warnings found in New Scenarios of Climate Change for Colombia 2011-2100, a study conducted by the Institute of Hydrology, Meteorology, and Environmental Studies -IDEAM), with United Nations assistance, which describes the changes that will be produced by the emission of GHG in Colombia throughout the present century.

By Inés Elvira Ospina / **Photo by** Nicolás Jacob



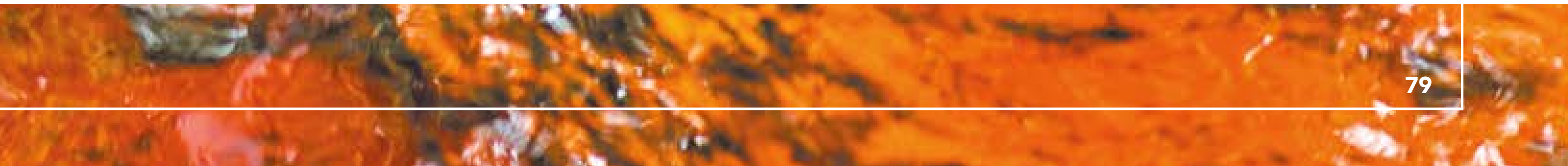
More detailed knowledge will allow us to manage forests in ways that mitigate the effects of greenhouse gases.

TIME FOR RESEARCH

These kinds of warnings make plant research a priority, since plants absorb carbon dioxide from the air through the process of photosynthesis, fix it, and turn it into biomass, counteracting global warming.

“More detailed knowledge will allow us to better manage our forests to mitigate the effects of GHG. Much immediate knowledge can come out of research that seems very basic and lacking in practical applications, but this can lead to innovation and new ideas,” says Camilo Rey Sánchez, forest engineer and researcher on the project carried out by the Group on Functional and Ecosystemic Ecology of the Faculty of Natural Sciences and Mathematics of the Universidad del Rosario.

The idea for the research was developed by Juan M. Posada, chair of the Biology Department and expert in plant ecophysiology and ecosystem ecology, during his postdoctoral work at McGill University in Canada, and later as a professor at El Rosario. To carry it out, researchers had to expose trees native to the Bogotá Savanna to the same total quantity of daylight, but distributed differently during the day: “One group of trees would have constant light, unchanging throughout the day; another would have light that increased in intensity as time went by, peaking at noon; and a third would be exposed to



← Research on plants is a priority because they use photosynthesis to absorb carbon dioxide from the air, then fix it and turn it into biomass, counteracting global warming.

very low light all day long but with a very high intensity peak at noon," explains Posada.

LED LAMPS

These conditions and the need for exact results required very precise control of the light to which trees would be exposed. The researchers examined the LED bulbs available in Colombia and internationally, but problems with the color spectrum, especially with far-red light, convinced them to make their own lamps.

After several studies and tests, they found the combination of white and far-red bulbs that was closest to a natural light spectrum. "They are very strong lamps. When located 20 centimeters from the objective, they are able to emit light at about half the intensity of sunlight at noon." says Posada.

COMBINING AREAS OF KNOWLEDGE

The lamps have 121 LED bulbs: 97 white ones and 24 far-red ones, organized into 11 columns and 11 rows. Once we had our design, we found technicians who could build the circuits and program them.

"First we built a prototype and tested it extensively using a photo meter to get it just right. The far-red LED bulbs were hardest to graduate because we had to focus the light on the plant," recounts Luis Alejandro Quiroz, electronic engineer and associate researcher at the International Physics Center.

THE GROUP ON FUNCTIONAL AND ECOSYSTEMIC ECOLOGY AT THE UNIVERSIDAD DEL ROSARIO CONDUCTED A RESEARCH PROJECT FOR WHICH IT HAD TO MAKE ITS OWN HIGH TECHNOLOGY LED LAMPS, WHICH WERE CRUCIAL TO THE RESULTS

The next step was to develop the electronics. Each bulb needed to be controlled individually, so Quiroz designed a control card and had it manufactured in Taiwan for reasons of cost and speed. Once the required lamps and the 17 cards were ready, the engineer chose three lamps at random for optimization. Then Rey Sánchez fine-tuned the rest.

"We made a user interface from which the lamps were controlled. It had a button to turn them on and off and another button to manage what I called 'change of treatment,' which was an Excel table where we entered the data on the quantity of light and times of exposure," says Quiroz.

Juan M. Posada, chair of the Biology Department and expert on plant ecophysiology and the ecology of ecosystems, directed research that simulated the solar spectrum and allowed us to closely observe photosynthesis and the factors that influence it as key elements in an improved response to climate change.

The researchers measured the plants' photosynthesis and found that the way light was distributed significantly affected them.

"That's how we were able to manage the three groups with different treatments, all from the same computer," he recounts, attributing much of the experiment's success to Posada's leadership. "Also to the positive collaboration of the participants. In one respect, we had a good research question and were up to solving it, and in another, the consistency in the day-to-day work," adds Quiroz.

THE MOMENT OF TRUTH

With the components of the experiment ready, all that was left was to assemble them. The 15 lamps were the first to arrive at the University's Entrepreneurship Center in a container that kept out all sunlight. Rey Sánchez still remembers how complicated it was to combine the watering system, the lamps, and their height in relation to the plants in order to correctly focus light on them.

The experiment involved a total of 15 seedlings, each with a lamp above it. They were randomly divided up to receive the three different treatments that would expose them to the same quantity of light, but at different intensities, for 12 hours.

They were monitored for three months and measured daily by Rey Sánchez, who also checked that everything was working correctly. Only two lamps failed. He also checked the data and measurements made during the preceding hours. Once the experiment was completed, the results confirmed the hypothesis put forward; the growth of seedlings depends to a great extent on the efficiency with which they can utilize light.

"The plants were significantly affected by the way that light was distributed. Those exposed to constant light did best, and those that had peak light at noon performed worst, because leaves are not very efficient at using very intense light. They grew to one half the size of the others, and their stems were very long and thin. They performed less photosynthesis, and their efficiency was low," affirms Posada.

The positive results of this cutting-edge research, which was submitted to a top-level international journal, were largely obtained through simulation of the solar spectrum, and they confirmed the relevance of conducting similar studies with different native species.

Rey Sánchez is convinced that observing photosynthesis in detail, along with light, water, CO_2 concentration, and temperature –the factors that influence it– will tell us which plants respond best to climate change and, therefore, contribute most effectively to counteracting the effects of greenhouse gases.