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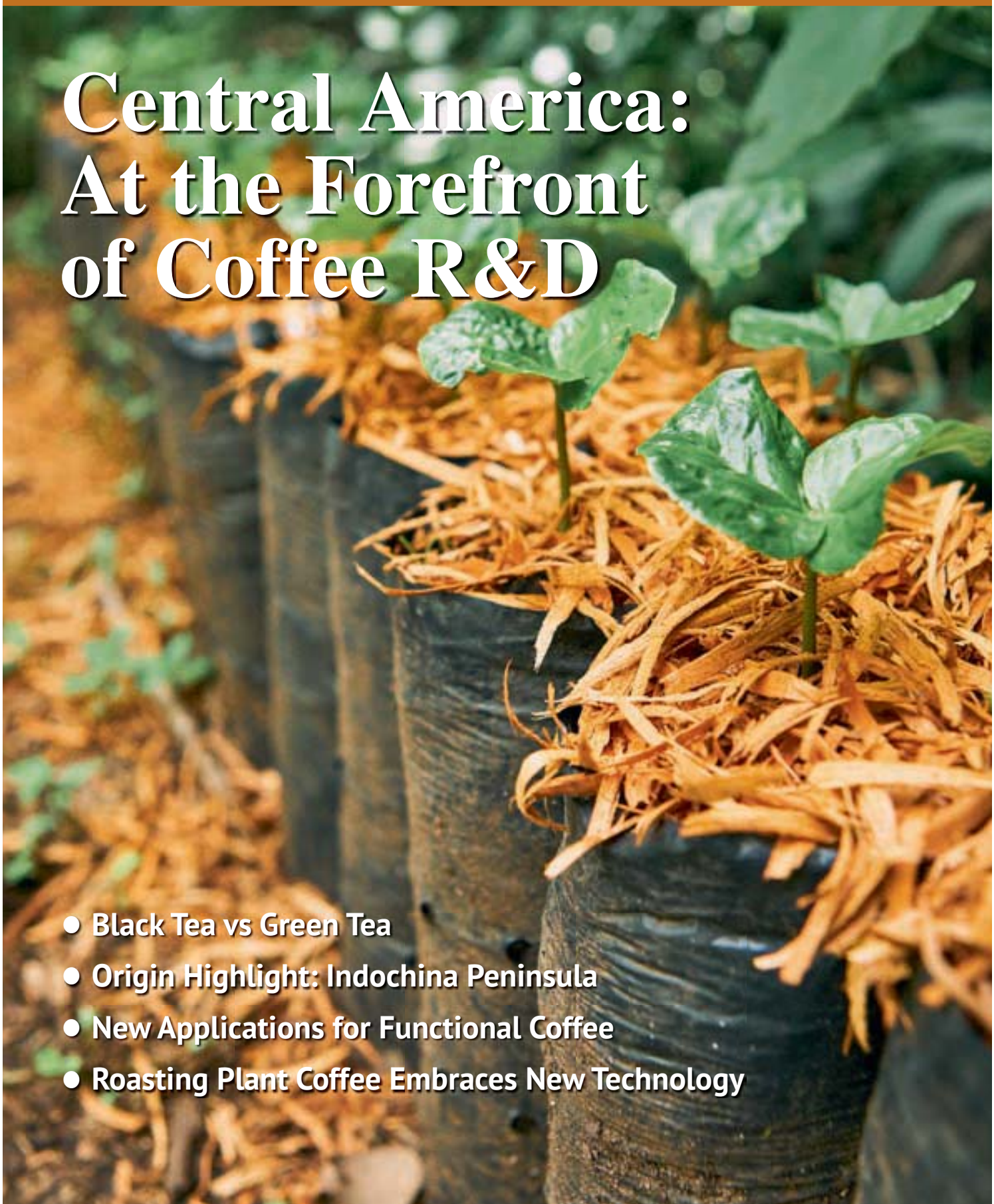

Central America: At the Forefront of Coffee R&D

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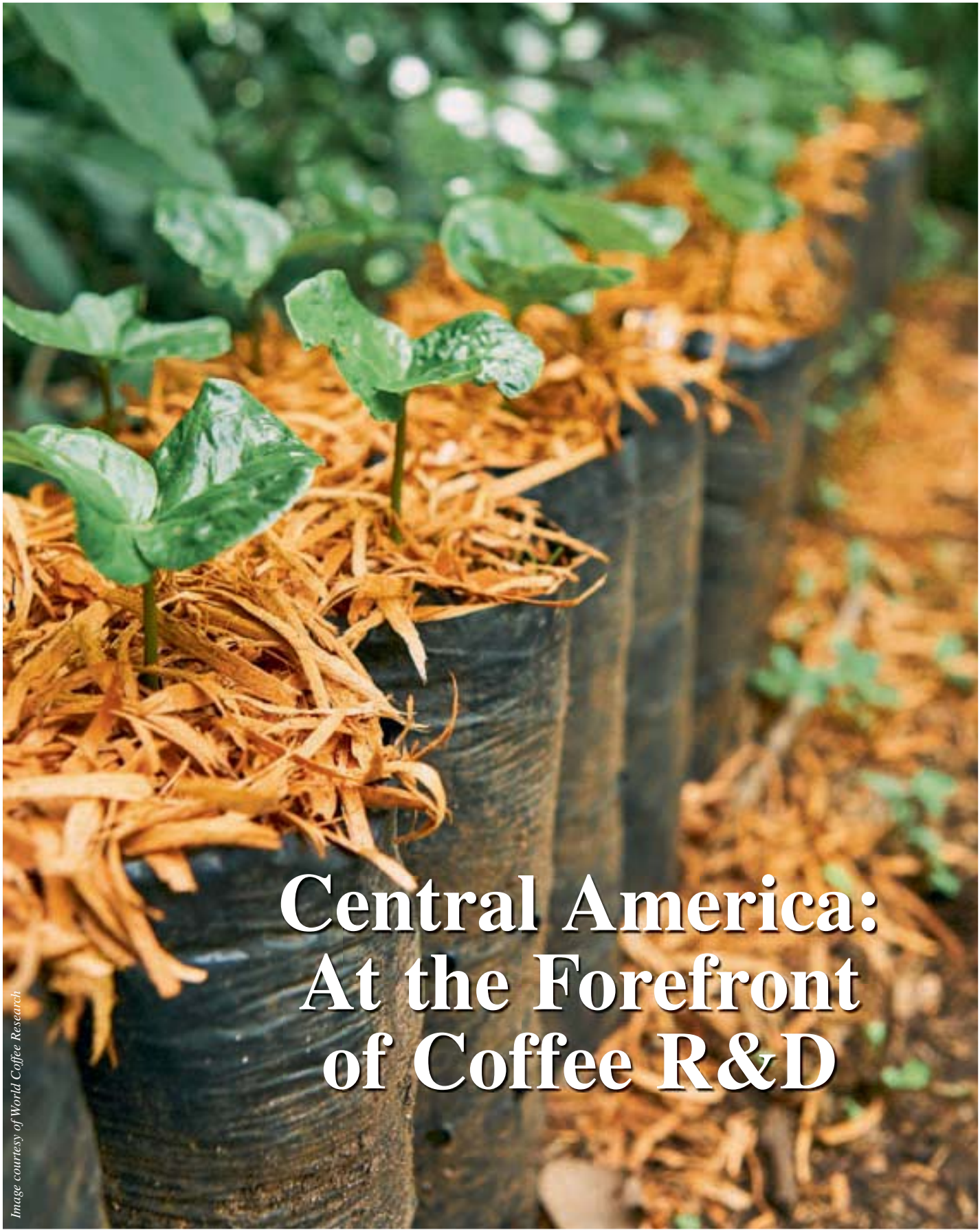

Central America: At the Forefront of Coffee R&D

Image courtesy of World Coffee Research

Central America is home to many of the world's most important coffee research and development projects. Participatory research involving producers is the new norm, generating localised strategies that account for the realities of managing both smallholder and commercial farms.

By Rachel Northrop

Coffee in Central America is in a perilous position given climate change and low market prices, but investigations into the interaction between genetics, agronomics and environment provides new tools and knowledge to empower Central America's producers to become resilient and sustainable growers of coffee that meets consumers' quality and taste expectations.

Since its founding in 2012, World Coffee Research (WCR), based in College Station, Texas, has focused on correcting the paucity of genetic diversity planted in the world's coffee fields by increasing the diversity of genetic material available to coffee breeders. WCR's Breeding Program develops varieties that offer producers more options and agility to grow coffee given their specific conditions.

"We now have 56 F1 hybrid crosses in field evaluation in both Costa Rica and El Salvador at different altitudes. They will be producing their first real harvest this year," reported Hanna Neuschwander, communications director for WCR.

In 1998-99, a consortium led by CIRAD, (the French Agricultural Research Centre for International Development, an international cooperation organization based in Paris) together with Promecafe (the Cooperative Regional Program for the Technical Development and Modernization of Coffee Agriculture, a research network across Central America and the Caribbean with its main offices in Guatemala City) and CATIE (Tropical Agronomic Centre for Research and Teaching, a regional centre dedicated to research and postgraduate education in agriculture, management, conservation and sustainable use of natural resources based in Turrialba, Costa Rica), started working on F1 coffee hybrids. It took around ten years to develop the first hybrids, which are now fully productive in farmers' fields, most notably Centroamericano (also referred to as H1). In their germplasm collection, CATIE has 1,000 Arabica accessions, plants that were collected 40-50 years ago, mostly in Ethiopia. Neuschwander described how "WCR conducted a study to identify a subset of 100 plants from that thousand, which represents as much genetic diversity as possible across the whole collection."

This core collection of 100 varieties captures 92 percent of the genetic diversity in CATIE's gene bank and is now being used as a breeding pool for new F1 hybrids. The process begins by "choosing one variety that is already grown or already known and has either the cup potential, high yield, or constellation of traits you are looking for. In order to create a vigorous offspring, a genetic distance matrix is used to find a match from the Core Collection that is the optimal genetic distance away from that existing cultivated variety," Neuschwander explained. "The two varieties are crossed together to make hybrid offspring."

The private sector is also investigating hybrid varieties and is committed to openly sharing its findings. Starbucks' global head of coffee research and development, Carlos Mario Rodriguez, is based at Hacienda Alsacia, the company's coffee farm in Poás de Alajuela, Costa Rica. "Hacienda Alsacia serves as a testing ground for experiments in varieties and hybrids to breed trees that are climate resistant. These seedlings have been donated to farmers in Costa Rica, and we are testing in other regions with the goal to support farmers and improve their living conditions," said a spokesperson for Starbucks.

Starbucks' open-source agronomy approach shares critical learnings that protect coffee from climate change and disease, including varieties of disease-resilient trees and advanced soil management techniques. "Farmer Support Centers assist farmers in setting up their own test plots on their farms, explain the importance of spacing the trees correctly, and help farmers understand the right balance of elements that comprise healthy growing conditions," said a Starbucks spokesperson. Developing new varieties and researching their performance, however, is only part of the puzzle of advancing coffee.

Agronomy and Education

Delivering genetically pure plant material of new varieties into the hands of farmers is a challenge due to the logistics, training and verification process required to disseminate seedlings through nurseries. Another challenge is education – if farmers do not know what a new variety is or how to manage it, then they are unlikely to plant it on their farm.

"We found that producers were skeptical about what the term hybrid meant; they thought they were transgenic plants, especially when they heard that they couldn't be propagated by seed," said Leonardo Lombardini, outgoing director of the Center for Coffee Research and Education at the Borlaug Institute for International Agriculture, part of the Texas A&M University system in College Station, Texas, which is tackling producer training through its Resilient ▷

Coffee in Central America project. The program provides producers with access to hybrid plantlets and to education to understand hybrids. Lombardini shared, "We use hybrids in demonstration plots so that farmers can observe first-hand their performance, resistance to rust, and high cup quality."

The Resilient Coffee in Central America project, sponsored by USAID, is designed around 100 demonstration plots in Guatemala, El Salvador and Honduras. The plots include a standard variety, Anacafe14 in Guatemala, for example, planted alongside other varieties. Researchers, together with farmers, record and analyse the performance of different varieties in their local conditions.

Roger Norton, the Borlaug Institute's regional director for Latin America and the Caribbean, noted that "hybrid varieties were selected for planting in the demonstration plots for their relatively high resistance to leaf rust and their productivity. For example, Centroamericano H1 has more branches per tree, more berries per branch, heavier berries, and excellent cup quality derived from the Ethiopian Arabica that is one of its genetic strains. It starts yielding in two years instead of three. We are demonstrating a way out for farmers."

The producers who volunteer to participate in managing demonstration plots tend to be innovative farmers and, in many cases, part of cooperatives. Begun in October 2017, the Resilient Coffee project brings farmers to each other's fields to exchange information. "Nothing has been done without consulting the farmers," Lombardini said. "We help farmers set up the plots and give them the plants, but then we expect them manage the plots the way they manage their farms. We respect what they do and don't want to impose anything that is outside of their normal operation." This participatory research approach allows farmers take ownership of new varieties and practices by dedicating their own resources to cultivating them.

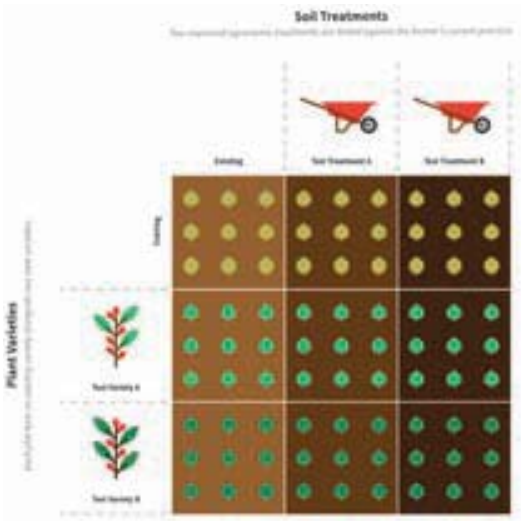

Image courtesy of Starbucks Coffee

(Above) Starbucks Coffee's Hacienda Alsacia in Costa Rica serves as a testing ground for experiments in coffee varieties and hybrids.

(Below) World Coffee Research's Global Coffee Monitoring Program plot grid diagram.

As a pre-competitive organization for sustainable development across the coffee industry, the Global Coffee Platform (GCP), based in Bonn, Germany, has inaugurated Country Platform initiatives to identify and address country-specific challenges. The Honduran Country Platform is the first in Central America and is currently developing their National Sustainability Curriculum. According to Melissa Salazar, GCP program manager, "Now is a perfect time for all local stakeholders to get involved and co-create the tools pivotal to achieve the future sustainability of the Honduran coffee sector."

Topics in discussion include the development of a gender policy, an examination of the use of agrochemicals, and a deeper investigation into child labour. "The opportunity to learn and exchange enables Platforms to improve their effectiveness and accelerate their country's journey towards coffee sustainability," shared Salazar.

For the Resilient Coffee in Central America project, the interaction between nine regional technical experts and producers begins by "looking at the farmer's context and what he or she is doing already," noted Thomas E Lacher Jr, incoming director for the Center for Coffee Research and Education at the Borlaug Institute. "Training by technical experts helps mitigate future disease outbreaks through better management. The first project publication included recommendations for management of soil and crops in the context of the climate forecast for that country."

The Resilient Coffee in Central America project strengthens farms and farmers with site-specific agronomic strategies, varieties and diversification capacities before the next crisis strikes.

Economics and Environment

The Coffee Diversification in Mesoamerica project, a collaboration between research institutions and coffee cooperatives in Mexico and Nicaragua and the Community Agroecology Network, based in Santa Cruz, California, uses similar participatory action research, where all actors participate in designing and implementing research activities, analysing findings and implementing new practices. Central to the program are exchanges, where farmers from Nicaragua and Mexico visit each other's communities to observe effective diversification strategies in practice and share their methods for implementation.

After travelling to Nicaragua, Rigoberto Hernández Jonapá, Mexico coordinator for the project and member of CESMACH cooperative in Chiapas, reflected that "Producers in Nicarauga were young! And they had experimental producers, something we are now doing in Mexico, too." Advancements are fuelled by farmers' willingness to convert their fields into research stations, where new genetic materials and existing agronomic strategies can be tested under diverse and fluctuating climate conditions.

Coffee research in Central America today is a departure from traditional investigations that prioritised productivity or disease resistance alone. Participatory research also emphasises producers' profitability and the economics of making coffee production viable in different environments.

At WCR, the pipeline of projects flows from the lab to the field. "The breeding program creates new varieties, furthered by local breeders using resources at regional breeding hubs; International Multi-Location Variety Trials test new genetics for suitability in different climates; and farmers in the Global Coffee Monitoring Program (GCMP) test two suitable varieties plus the farmer's current main local variety under three variations on local agronomic practices to compare with the performance of a traditional local variety," explained Neuschwander. The final comparative evaluations in the GCMP record costs of labour, inputs, and overall management to determine the most profitable combination of genetics and agronomic practices.

Neuschwander said that in each plot WCR has a grid of nine subplots testing two variables: varieties and climate smart agronomic treatments. In Honduras, for example, farmers are testing Lempira, Parainema, and Centroamericano. Farmers then choose from a menu of agronomic treatments to add two additional management practices to the baseline of what they are already doing.

Treatments include spacing between trees, type or density of shade, soil conservation, contour barriers to prevent erosion, trenches for water conservation, fertilizer dosing, and compost applications.

Image courtesy of the Borlaug Institute

The Borlaug Institute's Resilient Coffee in Central America project provides producers with access to hybrid plantlets and to education to better understand hybrids.

Globally, the program will include 1000 plots in 20 countries on different kinds of farms, from smallholder properties where coffee is one of a few subsistence crops to large commercial farms. By the end of 2019, the network will have more than 250 sites planted in 17 countries. (Central America is the most advanced region for the trial.) Data analysis of the subplots over five years will show what is working in different regions for different kinds of farms and which combinations produce the highest profitability. Neuschwander expects there might be "situations where producing less coffee is more profitable because the amount of labour or the input cost was so high. It's about massively fine tuning our knowledge of what is working for farmers in a more realistic agricultural context."

This process, from genetic research to testing in farmers' fields, creates a trial network through which new genetic material can flow. "It's a classic agricultural R&D pipeline," Neuschwander noted, "but WCR built it all simultaneously, populating it with the varieties that are available and the best practices that have already been identified."

While test plots on producers' properties do require additional investment from and exposure to risk for the link that is already the most pressed in the supply network, the shift towards participatory research involves producers directly in the development process. This inclusion produces results that are locally relevant and immediately applicable, exposing the optimal combinations of agronomy and genetics to keep coffee economically and environmentally viable in Central America.

Rachel Northrop has been covering coffee for *T&CTJ* since 2012, while she lived in Latin America's coffee lands writing *When Coffee Speaks*. She is based in Miami, Florida. She may be reached at northrop.rachel@gmail.com.