



ANNUAL REPORT **2018**

A close-up photograph of a pair of hands, likely belonging to a farmer, holding a young coffee seedling. The hands are weathered and have some soil on them. The seedling has three green leaves and a long, thin stem. The roots are visible, extending from the stem down towards the bottom of the frame. The background is blurred, showing more of the hands and some green foliage.

**Creating the future
of coffee**



TABLE OF CONTENTS

WHO WE ARE • WHAT WE DO	4
OUR PARTNERSHIP APPROACH	6
ADVANCED RESEARCH	14
APPLIED RESEARCH	24
MULTILOCATION TRIALS	34
FARMER FIELD TRIALS	40
TECHNOLOGY TRANSFER	48
2018 FINANCES	55
TEAM • MEMBERS • PARTNERS	57

ABOUT THIS REPORT

This report covers World Coffee Research activities, highlights, and results for the period from January 1, 2018, to December 31, 2018.

Left: Passing down knowledge—Francisco “Paco” Anzueto, a 40-year veteran coffee scientist and WCR experiments coordinator, works alongside Lucile Toniutti, WCR’s new molecular breeder. Photo credit: Devon Barker (@devonbarker)

WHO WE ARE

A collaborative, not-for-profit research organization, we were formed by the global coffee industry in 2012, recognizing that transforming coffee growing into a profitable, sustainable livelihood that can meet rising demand while also safeguarding natural resources will necessarily require innovation in coffee agriculture. WCR enables the global coffee industry to invest in agricultural innovation to empower producers.



MISSION

To grow, protect, and enhance supplies of quality coffee while improving the livelihoods of the families who produce it.

WHAT WCR DOES

World Coffee Research drives collaborative research to ensure the future of coffee.

WCR uses advanced and applied research in coffee genetics and agronomy to create new varieties, agronomic approaches, and market opportunities for farmers to become more resilient and profitable, especially in the face of significant threats like climate change.

WCR research is executed in partnership with leading scientists and institutions in producing countries and around the world.

WCR's technology pipeline delivers solutions that address major threats to global supplies of quality coffee and that improve profitability for coffee farmers.

IMPACT

Using advances in agricultural science, it is possible to dramatically improve coffee yields, coffee quality, climate resilience, and farmer livelihoods to a degree that was previously thought to be impossible.

WCR's globe-spanning research is designed to deliver:



Higher-quality coffee



More productive and efficient coffee farms



Higher profits for farmers

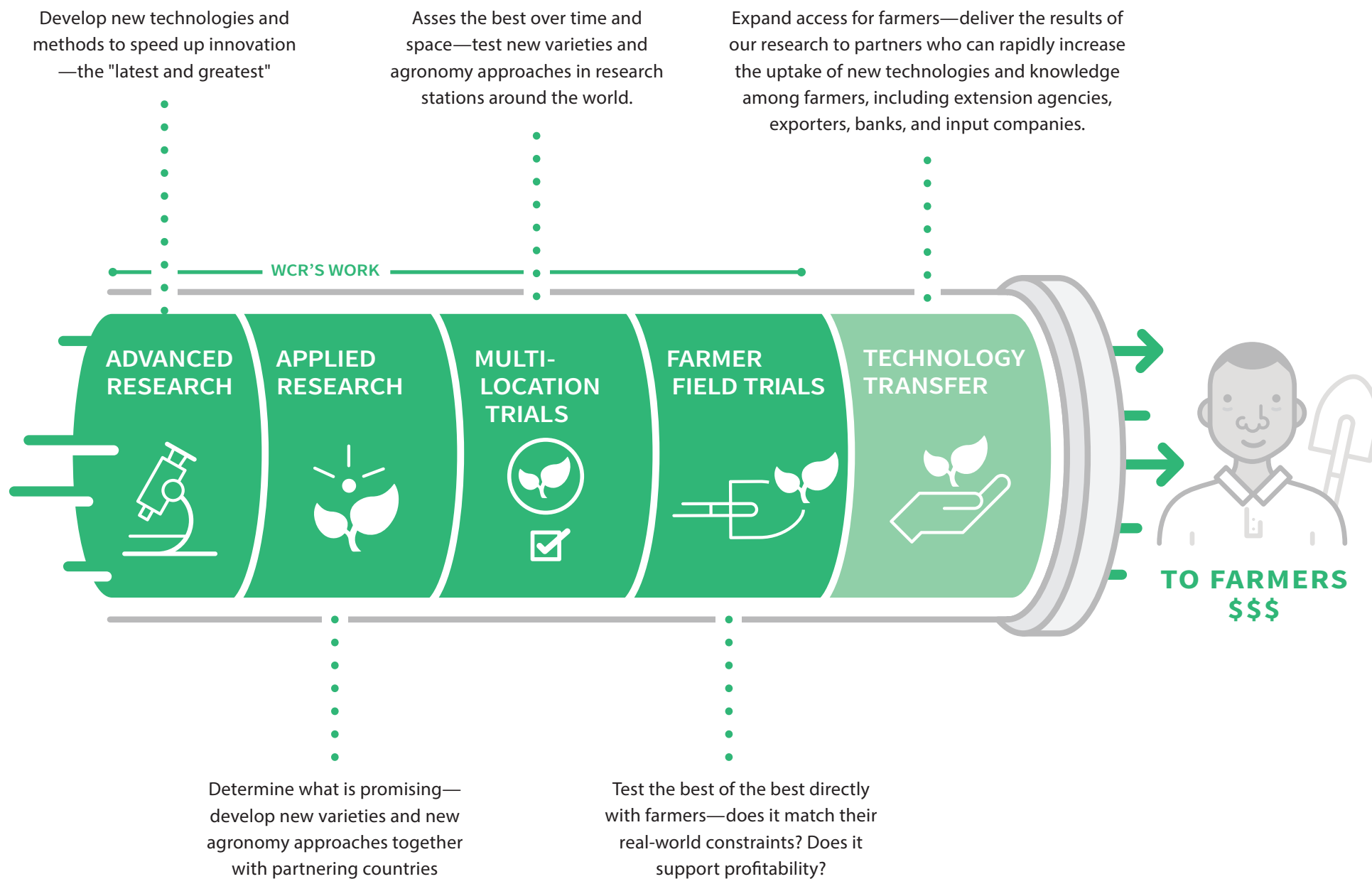


Manuelle Tzorin of the Solola Tribe in Montanillo, Guatemala, with a new F1 hybrid plant; Tzorin is participating in a study of F1 hybrids among smallholders. So far, he prefers the hybrids over his older Caturra plants, which were badly affected by coffee leaf rust. Photo credit: Devon Barker (@devonbarker)



FOLD OUT TO SEE OUR PROCESS

THE TECHNOLOGY PIPELINE



COLLABORATIVE, OPEN, GLOBAL PARTNERSHIP APPROACH

We rely on deep collaboration with local research institutions, coffee organizations, governments, and NGOs to carry out a common, ambitious research agenda. In each country, we begin with the national coffee institute or organization to align our work to their strategy. Together, we agree on research activities that World Coffee Research and the country can undertake collaboratively.

We work with 67 partners, including 27 government institutes and research organizations.

See full list of partners on p. 65.

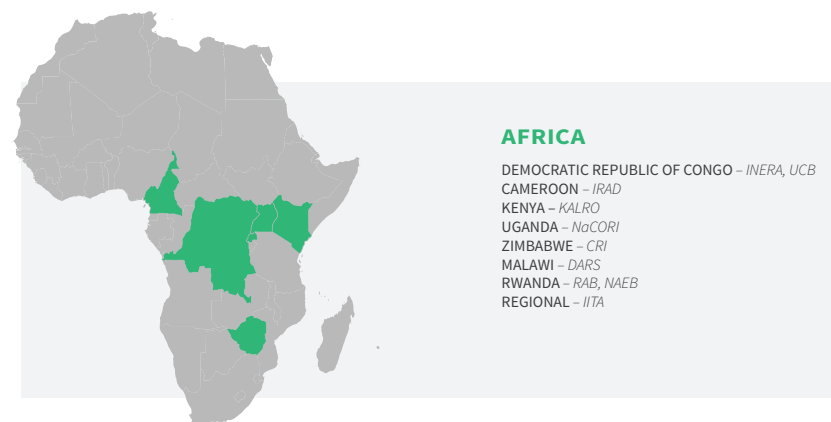
WCR LOCATIONS

FRANCE:
EUROPEAN HQ

UNITED STATES:
AMERICAN HQ

EL SALVADOR:
RESEARCH FARM

COLLABORATING INSTITUTIONS



REDEFINING SUSTAINABILITY

WHY THE FUTURE OF COFFEE DEPENDS ON AGRICULTURAL R&D

It sounds almost too obvious to mention: If coffee farming isn't working for coffee producers, they'll quit growing coffee. And indeed, in many parts of the world—for example, El Salvador, Costa Rica, and Kenya—this is already happening. Coffee growers face mounting challenges from drought to disease, from low prices to lack of credit—and so begin to seek out more profitable uses of their land. If producers can't make enough money growing coffee and instead sell their land to developers, or start growing a more profitable crop, the environmental and social sustainability of coffee will not matter.

Especially under threat is the rich diversity of coffee origins currently available to roasters and consumers. It's unlikely that producers in many countries will be able to compete in the long term with Brazil, Vietnam, and Colombia, which have made significant investments in agricultural research and development to help their coffee growers become more efficient.

Fewer farmers, less origin diversity—that is the likely future that coffee faces without significant innovation and investment to support coffee producers around the world to remain profitable and continue farming.

The purpose of WCR's coffee agricultural R&D, which we conduct together with national coffee institutes and universities around the world, is to ensure that coffee growing remains a profitable livelihood that can meet rising demand while also safeguarding natural resources.

Agricultural R&D is especially powerful when it is focused on improving profitability. This is uncommon in traditional agricultural R&D, where the focus is often yield or disease resistance, but it's a core focus of the work we do at WCR. The member-funded Global Coffee Monitoring Program, a network of hundreds of trials located directly in coffee farmers' fields, invites farmers to be participatory researchers, investigating which combinations of improved varieties and agronomic practices produce the highest yields, the highest cup quality, and—most importantly—the highest profit (see p. 41).

“It's almost always the case that farmers with the technology to keep their costs low and stay in the market win out in the end. That's why we need to continue to invest in research, so smallholders can thrive too.”

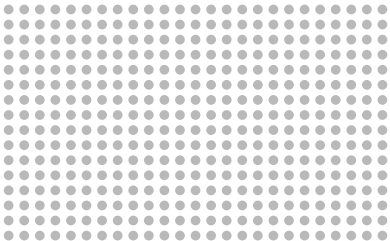
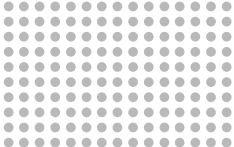


—Edwin C. Price, Texas A&M University agricultural economist



A GOOD INVESTMENT

For tree crops like coffee, the global rate of return on investment is a whopping 88%.

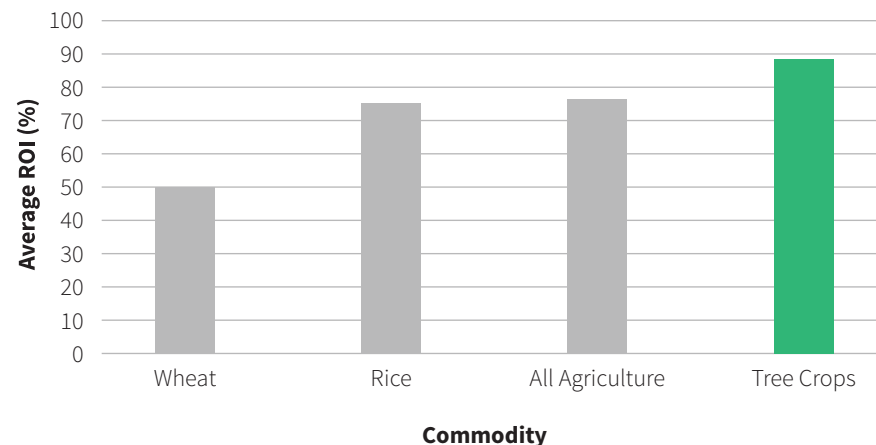
Investments in coffee agricultural R&D are surprisingly low compared with other major crops. Of all the main tree crops in the world, coffee is the least explored. From 125 wild species, fewer than 60 varieties of arabica and robusta have been developed to support global commercial coffee production.

CROP	SPECIES → VARIETIES
CORN (MAIZE)	6 → 20,000 
APPLES (MALUS)	62 → 7,500 
ORANGES (CITRUS)	33 → 1,200 
COFFEE (COFFEA)	125 → 60 

Sources: Royal Botanic Gardens, Kew; Missouri Botanic Gardens; UPOV.

Experience with other crops gives us a strong signal that investments in coffee R&D will pay off: the median global return on investment for agricultural R&D in general is about 40%. The average rate of return for tree crops is even higher: 88%.

Average return on investment for agricultural R&D in different crops



From diseases and pests, to irrigation and plant nutrition, to genetics and climate adaptation, there are vast technical areas for coffee R&D to improve yields and profitability for farmers. Read on to discover some of the work we're doing in each of these areas.

“If you wait until you are attacked before investing in an army for protection, you will lose. The time for building the R&D army for coffee is yesterday. Climate change, coffee leaf rust, declining yields: These challenges are already at our doorstep.”

—Tim Schilling, WCR CEO

WHAT WE DID AND DISCOVERED IN 2018



Launched a new coffee breeding hub for Africa.

See p. 27

"The creation of new, highly adaptable varieties will improve coffee productivity and quality gains across Africa."

—Job Chemutai, coffee breeder, Uganda
National Coffee Research Institute (NaCORI)



Expanded a massive network of farmer field trials that will produce unprecedented data on how to improve farmer profitability. See p. 40

"Doing all this hands-on work at my farm makes me feel confident that my coffee will be better in the future."

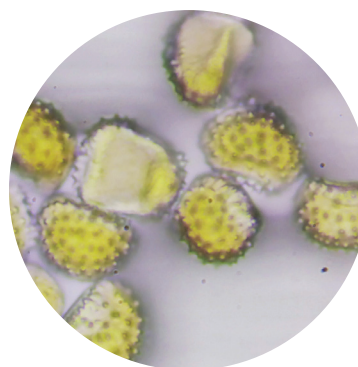
—Raphael Baluku, coffee farmer,
Western Uganda



Published the first fully open-access arabica coffee genome, from an Italian partnership led by illycaffè and Lavazza. See p. 15

"A brilliant example of public-private sector collaboration, and an important step to support coffee growers around the world, who are already facing the damages of climate change."

—Andrea Illy, chairman, illycaffè



Launched the first global effort to sequence the coffee leaf rust genome. See p. 20

"Coffee leaf rust has been around for hundreds of years. It can't be wiped out, but we can avoid epidemics. By applying the wide range of solutions in our toolbox, we can help control rust to the point that farmers can live with it."

—Dr. Christophe Montagnon,
WCR chief science officer



Made a breakthrough discovery of molecular markers predicting pollen-free plants. See p. 16

"This discovery enables a huge gain of time and money for breeding new F1 hybrids that may be able to be propagated by seed."

—Lucile Toniutti, WCR molecular breeder



ADVANCED RESEARCH

Accelerating the pace of innovation



In order to speed up the pace of coffee agricultural R&D, WCR works to produce “enabling” knowledge, technologies, and methods. These allow WCR researchers and partner research centers around the world to execute breeding and agronomy research more quickly, efficiently, and with better results. In 2018, we had a number of advanced breakthroughs.

The first fully open-access arabica genome



Multiple teams of scientists have been involved in a decade-long effort to sequence the *Coffea arabica* genome. In 2018, World Coffee Research was honored to make public the first fully open-access arabica genome for coffee researchers around the world to utilize. Open-access genome research will accelerate scientific efforts to ensure the future of coffee agriculture, providing powerful molecular tools to coffee breeders.

About the genome:

- Partnership led by illycaffè and Lavazza, together with Istituto di Genomica Applicata, IGA Technology Services, DNA Analytica, and the universities of Trieste, Udine, Padova, and Verona
- **36,864**: Genomic fragments cloned into bacterial artificial chromosomes (BACs) and sequenced in 96 pools of 384 clones
- **488 BILLION**: Base pairs produced, corresponding to 132 genome equivalents
- **1.3 GB**: Genome estimate, based on a k-mers analysis
- **96**: Independent assemblies generated, using ABySS and SSPACE software
- **1.51 BILLION**: Base pairs contained in the final sequence, divided into 164,254 scaffold sequences
- **78,311**: Genes predicted and functionally annotated
- Available for download online at: worldcoffeeresearch.org/genome

Unleashing the power of the genome: Male sterility



WCR molecular breeder Lucile Toniutti in the field.

New arabica F1 hybrid varieties are the most important technological innovation for coffee farmers in the last 30 years (see p. 28 for more), but currently they are difficult and expensive to mass produce. The cost and accessibility of F1 hybrids would improve markedly if it were possible to mass-produce F1 hybrids as seed instead of by cloning plantlets. Using the newly released open-access genome (see p. 15), WCR researcher Lucile Toniutti, in collaboration with CIRAD and AGI, made a significant breakthrough that will bring us one step closer to this reality.

Toniutti worked with a population of trees that originated from a parent with a naturally occurring mutation: no pollen production (a trait called “male sterility”). When F1 hybrid crosses are made with one male-sterile parent, it allows inexpensive seed gardens to be established to mass-replicate F1 hybrid seed cheaply. The strategy involves first developing additional male sterile varieties. But identifying the plants that picked up the male sterility trait is costly and time-consuming—each plant must be checked for pollen production at the time of flowering, which requires waiting 2-3 years for trees to mature to produce flowers. By contrast, if male sterility could be identified using DNA markers, checking could be done on baby plants as young as 6 weeks old.

Toniutti’s findings were twofold:

1. She found the major region in the genome controlling male sterility occurs on Chromosome 7 of the *C. canephora* subgenome of *C. arabica*. One hypothesis is that an extra deletion on the canephora subgenome is the cause of male sterility.
2. She identified a handful of markers that can be used by breeders—starting immediately—to screen candidates for male sterility to make new F1 crosses.

“This discovery enables a huge gain of time and money for breeding new F1 hybrids that may be able to be propagated by seed.”

—Lucile Toniutti, WCR molecular breeder

What is quality? Narrowing targets for breeding

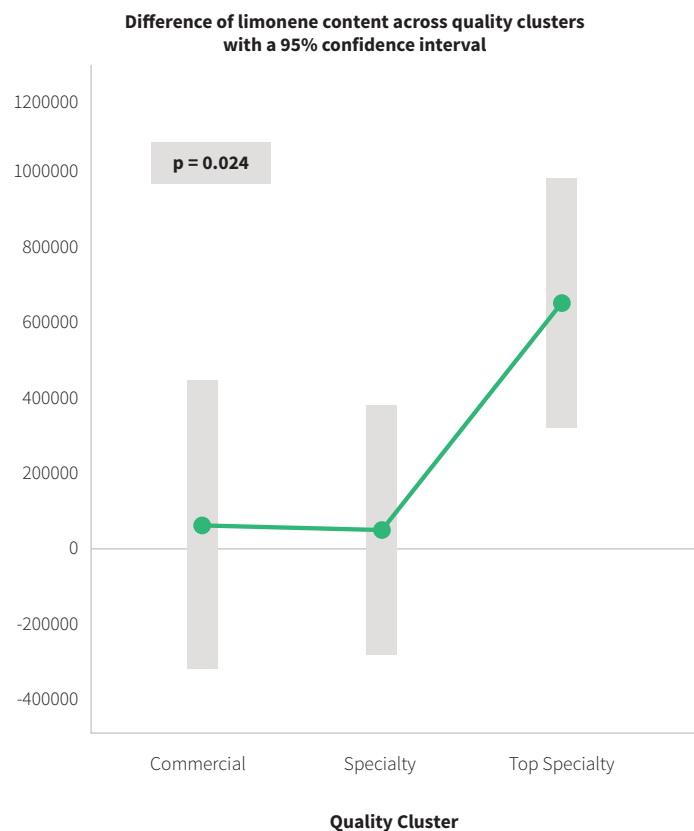
In order for coffee breeders to truly incorporate the improvement of cup quality into their agenda, it is necessary to define objective targets for quality. This means looking for specific coffee flavors or aromas that are linked to the perception of quality by coffee buyers, and whether those attributes are associated with specific chemical or genetic attributes inside the green coffee bean.

This is difficult to do: Individuals have different definitions and perceptions of what quality means. But in 2018, WCR tested a novel approach for discerning coffee quality and relating it to the chemistry of green coffee samples. Using a signal detection method, 60 coffee samples were tasted and scored in their degree of “specialty-ness” by expert cuppers. Statistical cluster analysis revealed that the coffees could be grouped into three quality categories, which we called top specialty, specialty, and commercial.

Sensory descriptive analysis using the WCR Sensory Lexicon and volatile organic chemistry analysis were performed on a representative subset of the samples, which revealed the following:

- Coffees in the top-specialty cluster had zero “negative” flavor or aroma attributes, and at least two favorable flavor or aroma attributes
- Out of all the various volatile organic compounds found, a compound called limonene appeared to be the most discriminant (meaning that its presence or absence predicted which quality category a coffee would fall into)— see figure p. 18

Limonene appears to be a good chemical proxy for quality as perceived by expert cuppers. This opens the way for breeders to screen for the presence or absence of limonene in breeding populations when cup quality is a desired outcome. Searching for molecular markers related to limonene will further speed up genetic progress. Such markers could be used to test previously unused genetic material (including noncommercial varieties, or even wild relatives of arabica and robusta) to determine its quality potential for breeding.



Volatile organic compound (VOC) analysis reveals that limonene appears to be a good chemical proxy for quality as perceived by expert cuppers. Its presence was highly correlated with coffee samples in the top-specialty cluster. Limonene is documented in the literature to be associated with citrus, flowery, and fruity aroma.

New global breeding populations for all



The Core Collection contains 100 genetically diverse arabica trees that breeders can use to make new crosses. The Core Collection was recently sent to the Rubona Research Station in Rwanda.

To make improved varieties of coffee, breeders everywhere need access to “improved populations”—collections of genetically diverse trees they can tap into for desirable characteristics such as flavor, increased yield, disease resistance, better rootstocks, or other beneficial economic and environmental traits. Improved populations are the raw materials that breeders use to create high-performing varieties tailored to local conditions, farmer types, and markets.

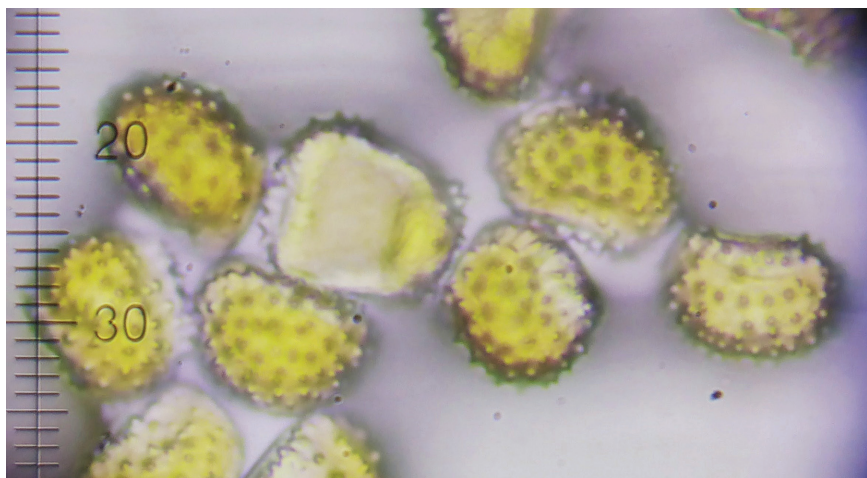
The WCR Core Collection is a population of 100 coffees representative of the genetic diversity of arabica. Together with our partners, we will work to create populations improved for selected traits from this genetically diverse breeding pool. The Core Collection is actively being used by WCR breeders and has been distributed to other breeders globally to support their own work.

- **4:** Number of sites that have received the Core Collection (a new African Breeding Hub in Rubona, Rwanda [see p. 27], CATIE in Costa Rica, Starbucks’ Finca Alsacia in Costa Rica, and WCR’s research farm Flor Amarilla in El Salvador)
- **14:** Number of accessions from the Core Collection that have been used to make new F1 hybrid crosses to date
- **3:** Number of Core Collection sites where extensive data evaluation was completed in 2018 (vegetative growth data, and yield and cup quality data for some sites)

In addition, WCR is studying with CIRAD a population of arabusta (*C. arabica* x *C.*

canephora) hybrids, for rust resistance and adaptation to climate change.

Know your enemy: The coffee leaf rust genome



Researchers at Purdue University are racing to sequence the genome of coffee leaf rust.

Coffee leaf rust is one of the biggest challenges faced by coffee farmers in many parts of the world. The disease has wreaked havoc on coffee production, particularly in Latin America, since an outbreak in 2012. But the fight against rust has been persistently hampered by one key fact: We know very little about the fungus.

In 2018, WCR launched a major new research effort together with Purdue University, led by world-renowned rust expert Dr. M. Catherine Aime, to develop a comprehensive understanding of the biology of coffee leaf rust, from its reproductive processes to an annotated genome. One of the most critical goals of the work is the development of molecular markers that would allow researchers to quickly and cheaply test rust that appears on coffee trees to figure out which race it is.

Some highlights of the work so far:

- **19:** Number of molecular marker candidates for rapid identification of *H. vastatrix* races
- **600 MILLION:** The number of reads completed and assembled in the initial phases complete in early 2019
- **6:** Number of rust specimens being used for the genome assembly
- **8:** Number students and post-docs working on the rust genome
- **1,280:** Number of man-hours spent by Dr. Aime's lab on the genome

- **4:** Number of months of computation time required to assemble the genome

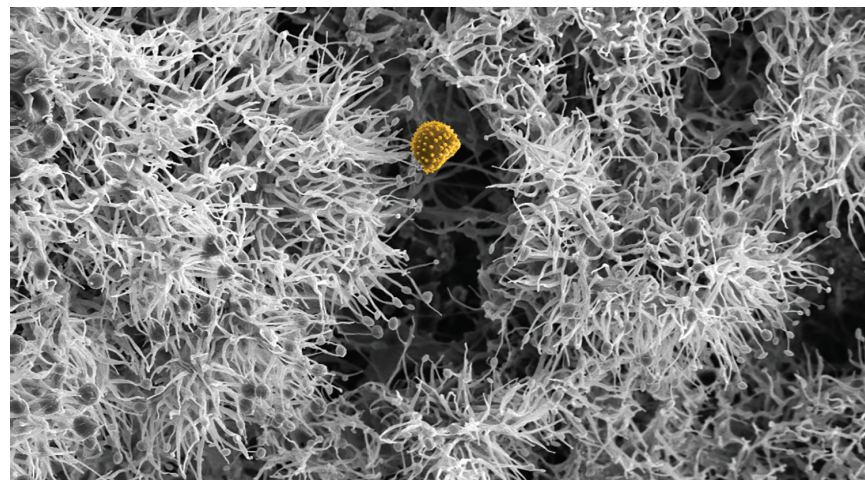
Biological control of coffee leaf rust

Costly fungicides and pesticides aren't the only ways to control pests and diseases on a farm. In the wild, coffee leaf rust has its own range of natural enemies. "Classical biological control" reunites pests with their natural enemies.

World Coffee Research is working with researchers Dr. Robert Barreto and Dr. Harry Evans at Universidade Federal de Viçosa in Brazil to identify and evaluate some of the natural enemies of rust. The researchers, together with a team of PhD students, spent much of 2018 evaluating samples collected in wild coffee forests.

Highlights:

- **4:** Number of collecting missions to collect microorganisms that coexist with coffee leaf rust in the wild, in cooperation with local partner scientists in Africa
- **1,509:** Number of microorganisms isolated
- **12:** Fungi isolated from diseased rust pustules and selected as potential mycoparasitic biocontrol agents (e.g., show promise in inhibiting rust)
- **9:** Fungi isolated from healthy coffee plants and selected as potential endophytic "bodyguard" biocontrol candidates (e.g., show promise in inhibiting rust)
- **22:** Number of new species described as part of the work, awaiting publication
- **6:** Number of Ph.D. theses concluded or in process based on this work—students are from Paraguay, Cameroon, Colombia, Ethiopia, and Mexico



Scanning electron microscope image of a coffee leaf rust spore (stained orange) surrounded by a

colony of the fungus *Akanthomyces* (newly discovered species) which has destroyed the rust colony.
Photo credit: Robert Barreto.

Major results so far include:

- The diversity of fungi attacking coffee rust is huge—there are more fungal pathogens on coffee rust than there are on coffee. The shelf of natural enemies is full of options.
- A rigorous screening of candidates for use as biological control agents of coffee leaf rust shows that some do having an effect under controlled conditions comparable to fungicide applications in terms of reduction of coffee leaf rust severity on coffee plants.
- The completion of a doctoral dissertation: “*Trichoderma* spp. associated with coffee in Africa: taxonomy and potential uses for the biological control of coffee leaf rust and plant growth promotion” by Maria del Carmen Herrera Rodriguez, at Universidade Federal de Viçosa

First international collaborative and precompetitive robusta research meeting

As climate change continues to impact global coffee production, the *Coffea arabica* species of coffee is losing its ability to perform in many coffee-producing zones due to warmer temperatures, increased plant diseases, and other factors. In some countries, such as India, farmers are already switching to *Coffea canephora* (robusta), which is generally resistant to disease and more heat-tolerant than arabica, in large numbers.

This topic was the focus of the first international, collaborative, precompetitive Robusta Research Planning Meeting, which took place October 2-3 at the offices of the International Coffee Organization (ICO) in London. The purpose of the meeting was to discuss, define, and share a common vision of the main research and development priorities for robusta breeding efforts globally.

Participants

Co-organized by World Coffee Research (WCR) and Nestlé, the meeting brought together global stakeholders including representatives from ICO and CIRAD; robusta research centers in producing countries such as Côte d’Ivoire, Indonesia, India, Uganda, Vietnam,

Mexico, and the members of Promecafe; and coffee companies including Nestlé, Jacobs Douwe Egberts, Lavazza, Mercon Group, and Neumann Kaffe Gruppe.



Stakeholders from the robusta coffee sector met in London to discuss precompetitive research priorities for robusta breeding.

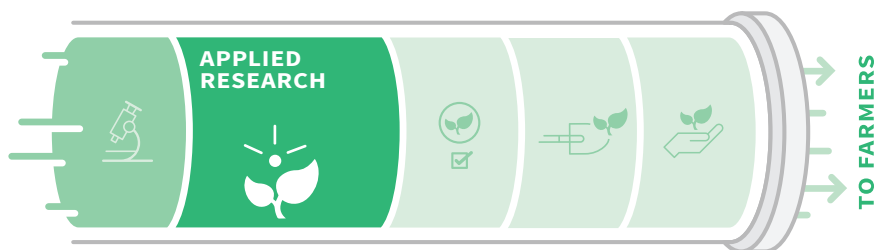
Key takeaways:

- Robusta-growing areas are facing increased drought and heat; in Vietnam, nematodes are a major threat, and in Côte d’Ivoire, coffee leaf rust is surging.
- Two main objectives for robusta breeding should be increasing the standard quality of robusta (clean cup, lowered bitterness), and the creation of new, higher-quality robusta varieties.
- *C. canephora* has a wide genetic diversity (much wider than *C. arabica*). Furthermore, it is easy to cross *C. canephora* with other diploid species such as *C. congensis* or *C. liberica*. The Agronomic Research Institute of Côte d’Ivoire (CNRA) has one of the biggest coffee germplasm collections in the world. It was agreed that supporting the maintenance, evaluation, and use of CNRA’s germplasm collection is a top priority.
- Most robusta farmers are not using the best available varieties today; reasons for that range from a lack of an efficient seed sector to the hesitation of farmers to drop old



APPLIED RESEARCH

Creating the future of coffee through breeding and agronomic research



resilient varieties.

Coffee has never had a global effort to coordinate coffee breeding and advanced agronomy research for coffee agriculture until now. Making use of breakthroughs in advanced research, World Coffee Research scientists and partners around the world are creating new varieties and agronomic approaches.

Global coffee breeding strategy—A network of global hubs

As a precompetitive, global research organization, WCR's objective is to foster a global increase in coffee breeding, whether it is undertaken by national institutes, universities, or private companies. The knowledge we generate with partners to support breeding innovations is made available without restriction as long as it follows international laws and treaties and does not violate WCR's "no GMO" policy.

Toward that end, in 2018 a new infrastructure to support the rapid increase of coffee breeding globally was put into place: a network of regional breeding hubs, hosted by local partners and supported by WCR. WCR's advanced research feeds the hubs; countries from around the region use the hubs to make new crosses specific to their goals.

What is a breeding hub?

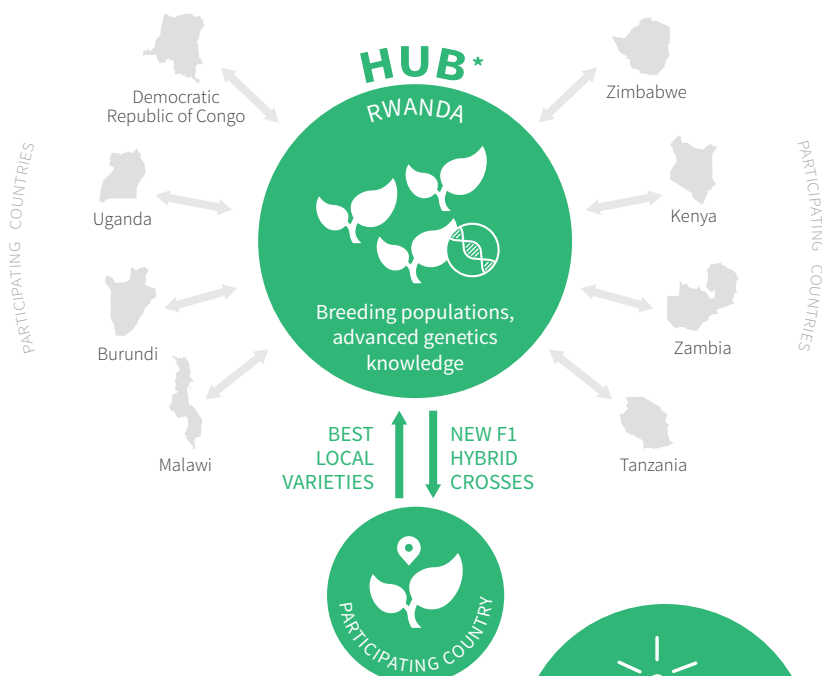
- A breeding hub is an efficient system of making use of the best resources in a region (e.g., Central America, East Africa, Asia) to create new varieties tailored for the needs of each participating origin country.
- A breeding hub is located at and coordinated by a national coffee institute in the region (the breeding hub host country).
- A breeding hub serves not only the country where it is located, but also the surrounding region. The breeding hub allows breeders from nearby countries to make crosses that solve the specific problems found in their origin.
- A breeding hub is a place where breeders can receive training, and where students can work and defend their thesis (master's and Ph.D.) in connection with local or international universities.

The role of World Coffee Research is to provide pre-breeding materials, expertise, and connectivity with other global hubs and with WCR's network of global trial sites.

Breeding hubs will also send candidate varieties into World Coffee Research's global network of trials—the International Multilocation Variety Trial (30+ sites in 22 countries),

New varieties are being developed now in collaboration with coffee institutes around the world.

- Latest-model varieties being tested now in farmer fields for release over the next five years
- Climate-smart varieties being created now for testing in five years and release in ten years



HOW IT WORKS

- Each country sends its best local varieties and coffee breeders to the hub.
- The hub assists and trains the country breeder to make new F1 hybrid crosses between local varieties and improved breeding populations, making use of WCR molecular genetics tools to decrease time and increase success.
- The participating country takes the new crosses home to test for performance in local conditions. The best varieties are released.

★ One hub per major region—Africa, Latin America and Asia—hosted by a national coffee institute partner.

RESULTS

- Locally adapted new varieties created by each participating partner
- Exponential global increase in coffee variety innovation benefiting producers

countries to create their own locally relevant new varieties.

Spotlight on the African Breeding Hub



Coffee researchers from the Democratic Republic of Congo visit the new African Breeding Hub at Rubona, Rwanda. Left to right: Jules Masimane (UCB), Pascal Gakwaya Kalisa (WCR), Christiane Mas (UCB), Lucile Toniutti (WCR), Paul Mulemangabo (INERA), and Christophe Montagnon (WCR).

- Hosted by the Rwanda Agriculture Board (RAB)
- Established in 2018 in Rubona, Rwanda
- Has received WCR's Core Collection—a collection of 100 genetically diverse coffees that serve as a breeding pool
- Has received 32 F1 hybrid crosses made by WCR in Central America to evaluate performance in East Africa. Is evaluating them side-by-side with 8 F1 crosses created in Rwanda by RAB.
- Introducing molecular breeding approaches to be used by breeders at the hub to speed up variety development.
- The first regional breeders workshop will be held in March 2019.

and the Global Coffee Monitoring Program (1,100 sites in 30 countries).

World Coffee Research advanced research feeds the regional breeding hubs, which host local

F1 Hybrids—Redefining what's possible for coffee producers

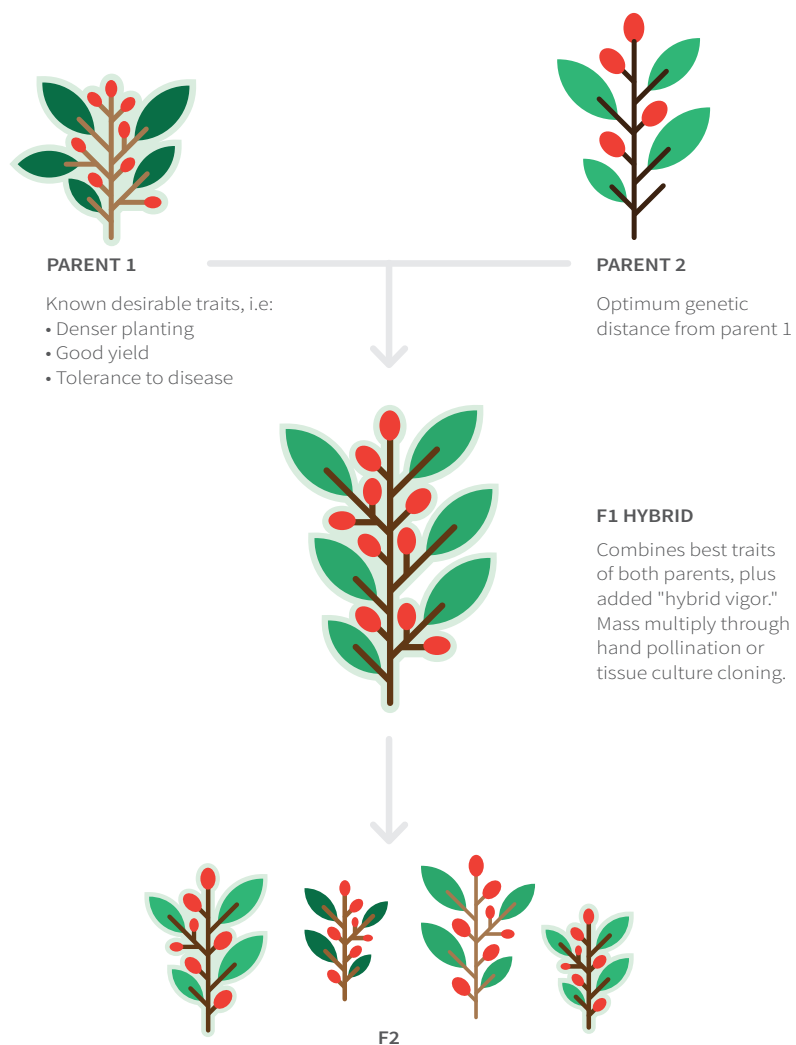
Because of their remarkable performance, F1 hybrid varieties have the potential to radically transform coffee production in the coming decades.

While these varieties are still relatively new to coffee farmers and the industry, it is difficult to imagine a future without them. No varieties in the past have been able to combine traits that matter to both farmers and consumers in quite the same way. F1 hybrids will be key to helping coffee producers remain profitable and resilient in the



From Left: Hector Ixcoy and Juan Alberto Meaquin of the K'iche' Tribe talk with Juan Charuc, an Anacafe field technician, discussing yields of Centroamericano, an F1 hybrid variety. Photo Credit: Devon Barker (@devonbbarker)

face of climate change.



The second generation (e.g., plants created from seeds of the F1 hybrid) will "segregate." The result is a group of plants that vary widely in performance, and do not achieve the ideal combination of traits of the F1 hybrid. For this reason, it's recommended that farmers don't use F2 seeds.

WHAT CAN AN F1 HYBRID DO?

- Increase yields by up to 50%
- Tolerate diseases and pests more effectively
- Tolerate more extreme weather (cold, heat)
- Tolerate wide ranges of soil types
- First harvest 2 years after planting instead of 3
- Score 90+
- Produce more profit per hectare

What is an F1 hybrid?

Common questions about F1 hybrids

Is F1 a variety?

It's a class or type of varieties made by crossing two genetically distant parents and using the first generation (F1) progeny. There are many F1 hybrid crosses being tested right now, some of which will be released for farmers in the coming years.

What makes F1 hybrids outperform other varieties?

An F1 hybrid contains a complete mix of the genetics of both parents. This higher genetic potential means it is more likely to be adaptable across a wide range of environments. F1 hybrids are known to have a higher level of adaptability and performance due to “hybrid vigor”—they produce more cherry than either of the parents would and are more tolerant of diseases and pests than each parent would be alone. F1s eliminate many of the tradeoffs of the past—for example, coffee leaf rust resistance versus quality. F1s can be immune to rust and still score

over 90 points in cupping evaluations.



Julian Lopez grows the F1 hybrid Centroamericano on his farm in Guatemala. Photo Credit: Devon Barker (@devonbbarker)

Are there drawbacks?

The main drawback of F1 hybrids is that they are more expensive and harder to mass produce—typically they need to be purchased from experienced nurseries. If you try to save and use the seed of a good F1 plant on your farm (which would be the F2, or second generation originating from the initial cross), all the various combinations of the dominant and recessive traits from the two parent plants will be expressed in the F2 generation. So the farmer will get a bunch of baby plants that are extremely diverse—some taller, some shorter, some strong, some weak. But guaranteed, very few will look and behave like the really amazing F1 she has growing in her field. The only way to ensure that you have the great performance is to have the first generation offspring of the cross (e.g., the F1) itself, and the main way to mass produce them today is to produce clones in labs. World Coffee Research and others are reducing the cost of F1 hybrids and conducting research to enable the mass production of F1s from seed.

Are F1 hybrids worth the higher cost?

Ultimately, the choice about costs versus benefits belongs to the farmer. But in general, F1 hybrids have such substantially improved performance over traditional varieties, that yes, they do justify the higher cost. For example, an F1 hybrid might cost \$.75 versus a traditional seedling that cost \$.25. For the added \$.50, the F1 hybrid plant will have its first harvest two years after planting instead of three (an entire year of income generation added), plus increased yield of up to 50% every year that the plant is in production. The farmer will face fewer losses due to disease, and will maintain the ability for high cup-quality scores if they are in a suitable environment to produce it. In 2018, nine of the top 20 coffees in the Nicaragua Cup of Excellence competition were F1 hybrids.

Are there any F1 hybrids available to farmers right now?

In some parts of the world, yes. Some of the available F1s are: Centroamericano (also called H1), Casiopea, Milenio, Mundo Maya, Starmaya, and Ruiru 11. In 2018, multiple of these varieties scored in the top 10 in Cup of Excellence competitions around the world. For more information on these varieties, visit: varieties.worldcoffeeresearch.org.

Are F1 hybrids genetically modified?

No. World Coffee Research has a policy against genetic modification. Crosses are made using traditional methods—literally painting pollen from the flower of one tree onto the flower of another. But we use advanced genetics to determine which parents to cross.

Accelerating F1 hybrid breeding

In new regional breeding hubs, World Coffee Research and its partners are preparing the next generation of F1 hybrid varieties, aiming to release locally adapted selections for farmers in Central America and Africa by 2025.

- **54:** Number of hybrid crosses made to date
- **4:** Number of complex hybrid crosses (cross made between an F1 hybrid and an inbred line) made to date
- **3:** Number of countries where new hybrids are being tested in the field (El Salvador, Costa Rica, Rwanda)
- **3:** Number of different altitudes (900, 1,100 and 1,500 m) where hybrids are being grown for eventual cup quality evaluations in 2019

Researchers will evaluate and select the best-performing crosses, focusing on key traits of interest identified by local breeders and experts. Priority targets include:

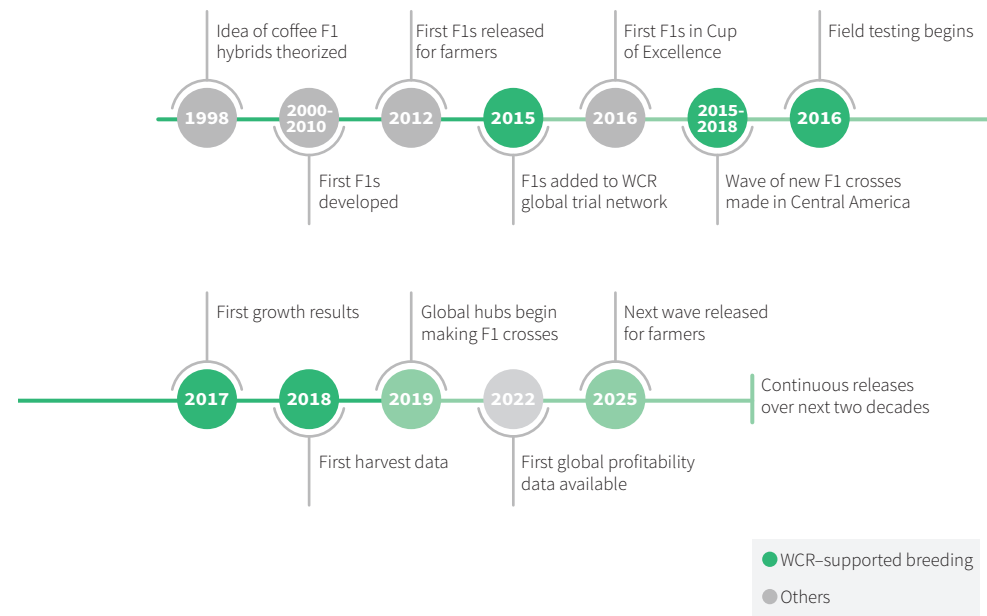
- Disease resistance/tolerance
- Cup quality
- Productivity
- Traits linked to climate resilience and stress tolerance (drought, heat, light, cold)
- Traits linked to harvest (e.g., uniform ripening time) and production efficiency (e.g., dwarf/tall)
- Fertilizer efficiency



Green cherries on a three-year-old Centroamericano F1 hybrid tree. Photo Credit: Devon Barker (@devonbbarker)



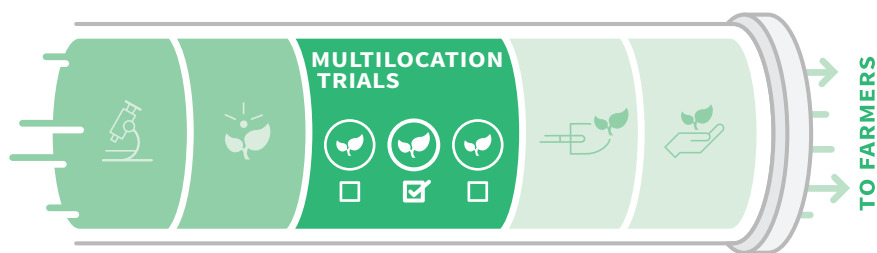
Some of the F1 hybrid crosses made by World Coffee Research to date.





MULTILOCATION TRIALS

Testing coffee varieties in our international trial network



Together with partners in 22 countries, World Coffee Research has built an unprecedented international network of research trial sites to test variety performance and farming approaches, track and control coffee disease/pest movement, and—perhaps most important of all—build collaborative research capacity with partners in coffee-producing countries.

International Multilocation Variety Trial



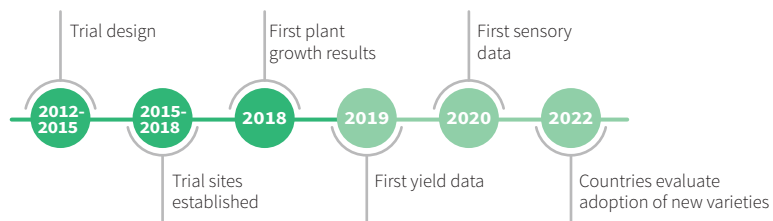
WCR Scientific Director Christophe Montagnon explains the trial design at an IMLVT site in Nicaragua.

WCR's first major program, beginning in 2012, was to establish the world's largest coffee variety performance trial and seed exchange—the International Multilocation Variety Trial, or IMLVT. The trial brings 31 of the world's best arabica varieties to two dozen countries for rigorous testing and evaluation. Each participating country conducts the trial collaboratively with World Coffee Research, assigning researchers to install, monitor, and maintain the research plots and conduct agronomic evaluations. No program has ever previously achieved this level of coordination among coffee-producing countries.

- **31:** Number of varieties each country receives
- **22:** Number of countries that have received plants
- **8,235:** Total number of plants shipped
- **31:** Total number of sites with plants in the ground
- **21:** The number of trial sites in 2018 that produced coffee cherry for the first time

In 2018, three new countries received plants: Puerto Rico, Uganda, and Zimbabwe. Two countries installed new trials: Rwanda (3 sites), and Mexico.

Countries observe the varieties and if they determine that one (or many) are well-adapted to local conditions and perform better than their current standard, WCR assists them in arranging the commercial release of the variety. By dramatically altering the available options for farmers in many countries, farmers are empowered with new and better tools to help them achieve profitability.



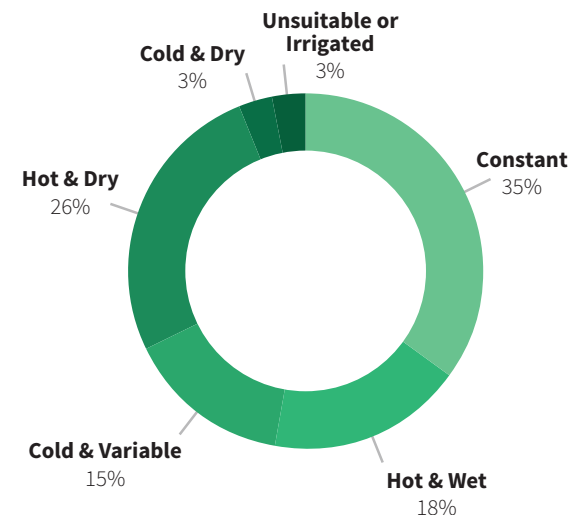
What are the right varieties for the coming climate?

IMLVT sites around the world have been located in a diverse set of environments so that coffee researchers can rigorously evaluate which varieties perform best in each. This is what researchers call the genetic x environment (GxE) interaction.

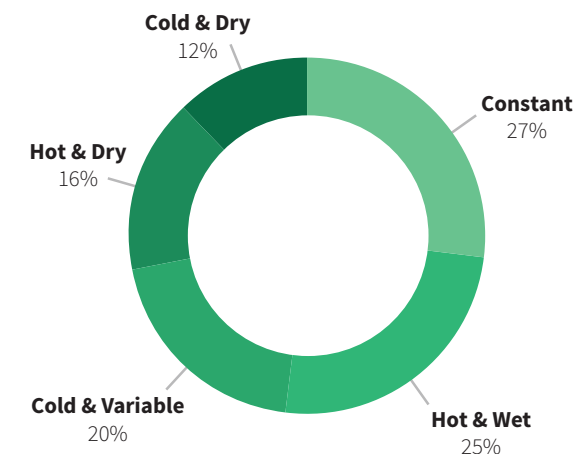
For example, currently 25% of IMLVT sites are located in hot, dry zones (see figure at right). Plants that go in the ground today will still be growing on farms 20 years from now—but many coffee-producing regions are predicted to become much hotter and drier over that time period. The varieties that do well today in hot, dry IMLVT sites will be good bets for farmers who live in areas predicted to become more hot and dry over the next 10-20 years.

In the future, as countries develop new varieties out of their breeding programs, the best candidates can be forwarded to the IMLVT trial network for global testing across diverse environments to identify the best for each environment.

IMLVT SITES



ARABICA PRODUCTION OVERALL



Proportion of IMLVT sites in each of the coffee-suitable climates identified by Bunn et al. (2015).

IMLVT: 27 partners and counting

WCR coordinates and collaborates with national coffee institutions and research centers in each country to execute the trial. The country assigns coordinators and researchers to monitor the trial, collect data, harvest and cup the coffees, etc.



Major sponsors of WCR's Multilocation Variety Trials include:

- Coffee Alliance for Excellence (CAFÉ) Project to improve incomes for coffee-farming households in Peru, led by TechnoServe Peru, funded by USAID
- Feed the Future Democratic Republic of the Congo Strengthening Value Chains (SVC) Activity in South Kivu, led by Tetrattech, funded by USAID

Expanding the multilocation trial network

In 2019, the multilocation trial network will expand significantly as we establish new robusta-focused trials in multiple countries. In addition, we will begin establishing a series of Multilocation Agronomy Trials (MLATs), testing how agronomic practices interact with different environments (the “management x environment” or MxE interaction), with the goal of identifying best practices for different soil types and climates. The first MLAT was installed in Democratic Republic of Congo in 2018.

PARTNER PROFILE: IMLVT Kenya



One of two IMLVT sites in Kenya, at Koru.

IMLVT trials have been established by researchers at the Coffee Research Institute at two sites in Kenya—Koru in Western Kenya and Ruiru in central Kenya. The sites have very different climates in terms of rainfall, soils, and even temperature. Kenya will be watching the performance of varieties closely to see how they do compared with current local standards: Batian, K7, Ruiru 11, and SL28.

- Plants were received between November 2014 and June 2017. A total of 29 varieties have been planted. Early evaluations began in 2017.
- Early data indicate there is significant variation in agronomic traits and rust susceptibility for the different varieties.
- Early data also indicate that some varieties clearly vary in performance between the two sites; the first full genetics x environment evaluations will be done in 2019.



FARMER TRIALS

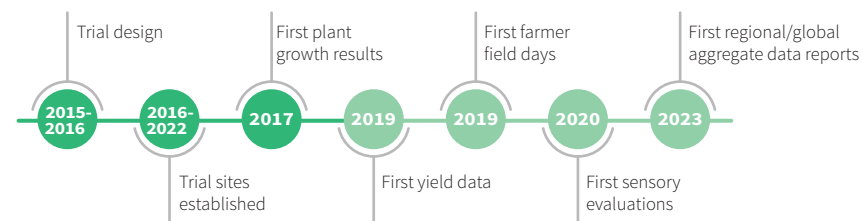
Participatory farmer research on which combinations of varieties and agronomic practices deliver the highest yields, quality, and profits to farmers



The Global Coffee Monitoring Program (GCMP) is an unprecedented global effort to assess and improve profitability for coffee farmers. WCR member support is building the world's largest network of trial sites in coffee farmer fields (1,100 sites by 2022). Situated in real farm conditions and managed by the farmers themselves, with support from partnering agronomists, the trials generate predictive big data on which combinations of varieties and climate-smart agronomic practices work best where and under what conditions, and which provide the highest returns to the farmer.

Ultimately, the results of this research will advance global knowledge about the effects of varieties, climate, and environment on coffee production and quality. And it provides the most comprehensive data yet on the impact of investing in coffee farm renovation, technology adoption, and climate and disease monitoring.

- **6:** Number of new countries added to the program in 2018 (Honduras, Mexico, Peru, Rwanda, Uganda, and Democratic Republic of Congo)
- **150:** Number of trial sites in farmer fields installed across 10 countries by the end of 2018 (of 1,100 planned by 2022)
- **3:** Number of sites that produced a first harvest of coffee cherry in 2018 (from the first trials in El Salvador, installed in 2016)



Unprecedented global coffee data

Unlike a traditional “demonstration plot” that aims to show a farmer a different way of doing things, GCMP on-farm trials are scientific research sites, and the farmers themselves are part of the research team. The data collected will provide the farmer with, for example, solid information to assist them in securing loans for making their farms more resilient.

The data will be aggregated to provide, for the first time, a science-based, global data set of varieties and agricultural practices across a hugely diverse range of climate conditions and farming systems, from large estates to smallholder plots. This will redefine global understanding of which coffee-farming approaches will be best where. The knowledge generated from the trials will be shared with WCR members and partners and applied throughout their networks and supply chains, contributing to a ripple effect of farm improvement around the world.

Designing each trial



A newly planted On Farm Technology Trial (OFTT) site in El Salvador, as seen by drone. Photo credit: Roberto Villalta

At each trial site, called an On Farm Technology Trial (OFTT), two new varieties and two climate-smart agronomy practices are tested against the variety and practices the farmer is already using. WCR scientists, regional experts, partner organizations, and farmers determine the varieties to include in the trials based on a producer's priorities: yield, disease resistance, cup quality, environmental suitability, and availability. A menu of climate-smart agronomy practices for each country is developed out of workshops with local coffee agronomy specialists to determine the existing coffee farming systems, their specific challenges, and agricultural practices to improve yield and profits. Each farmer and partner organization is presented with the menu and chooses two practices that he or she would like to implement.

FOCUS ON THE FARMER: Antonio Arévalo (La Libertad, El Salvador)



"I believe in coffee production, but a profitable one."

—Antonio Arévalo

It has been harder and harder for Antonio Arévalo to remain profitable on his farm, Tierra Baja, in El Salvador, in a country that was once famous for its arabica production. His farm is low for arabica—under 1,000 meters. Because of this, he is unable to sell his cherries for a premium based on flavor. In recent years, he has struggled with droughts that he attributes to global climate change. And because of the prevalence of coffee leaf rust at this altitude, it's also necessary for him to have rust-resistant varieties that will help him minimize losses due to the fungus. In 2017, he received trees that were supposedly rust-resistant, but the plants were the incorrect variety. As a result, Mr. Arévalo's new trees are now showing rust—a major blow.

But through the GCMP, Mr. Arévalo has been able to obtain genetically pure, rust-resistant arabica plants to test on his farm. He received Marsellesa, a rust-resistant pure line variety, and Centroamericano, a new F1 hybrid variety. He is testing them at two different planting distances, and with different temporary shade species. Over the coming years, Arévalo will work alongside other producers from ABECAFE, the Asociación de Beneficiadores y Caficultores de El Salvador, to take careful measurements and calculate which combinations deliver the most profit.

The GCMP is perhaps even more important for Mr. Arévalo than it might be for a farmer in another country. El Salvador currently does not have a formal coffee institute dedicated to overseeing nursery tree production (ensuring healthy plants and genetic traceability), to bringing new varieties to producers, or to providing extension and training programs. The program connects him with agronomist support and genetically pure new varieties that would otherwise be harder to access.

At the end of the day, he'll be able to take all of his data to the bank to secure loans to fully renovate his farm. If arabica farming doesn't pencil out, he's thinking of switching to robusta—in fact, this year he planted 1,000 robusta clones to see how they would do. If Mr. Arévalo does become one of growing number of arabica farmers switching to robusta, it will be because he was able to make an informed decision based on rigorous data from his own field, something too few coffee farmers have.



PARTNER HIGHLIGHT: Great Lakes Coffee, Uganda

GLC agronomist leading agribusiness training session with farmer groups in Western Uganda. Photo credit: Koen Sneyers Photography

Muthaganzwa Sanairi has been busy the last few months—clearing land, receiving baby trees, and working alongside farmers across western Uganda to plant the coffee trees according to a strict gridded design. Mr. Sanairi is an agronomist with Great Lakes Coffee, a family-owned coffee exporting company that sources 100 percent traceable coffee. Great Lakes is one of two dozen coffee companies working with World Coffee Research to install hundreds of trials in farmer fields—part of the Global Coffee Monitoring Program. To make each trial in the Global Coffee Monitoring Program a reality, WCR must identify partners who are committed to assisting farmers to implement and maintain the trials,

and to help the farmers collect rigorous data over five years. WCR typically funds 50 percent of a trial, with a supply chain partner covering the other half, usually by providing their agronomy staff to work with participating farmers.

One such farmer is Raphael Baluku. His farm is adjacent to a road, and neighbors driving past the neat rows of baby coffee trees have been taking notice. “It’s an attraction to other neighboring coffee farmers who pass by every day,” Mr. Baluku says. “They have been asking me a lot of questions.”

Those trees include the farmer’s current variety, SL14, and two new varieties—SL28 and Batian—and improved agronomic practices. Soon enough, both Mr. Baluku and his neighbors will have a chance to see what knowledge is gleaned from the trials and how they can apply it to their own farms. One of Mr. Sainari’s most important roles is to assist farmers in hosting Farmer Field Days to bring together neighboring farmers to learn from the trials.

But it’s not only farmers who will learn from the trials. Partners like Great Lakes have access to a huge amount of data from the sites they support, including reports on variety performance and factors influencing production, including soil characteristics, annual weather data, vegetative growth, disease prevalence, and bean and cup quality. In total, this provides partners with a wealth of information they can use to invest in and strengthen their supply chains.

I am already seeing an improved future—I have new varieties at my farm and have learned other management practices. Doing all this hands-on work at my farm makes me feel confident that my coffee will be better in the future.”

—Raphael Baluku

26 partners and counting

Information dissemination is built right into the research design of the Global Coffee Monitoring Program. Each trial is structured to involve as many supply chain partners as possible—usually the farmer, as well as his or her co-op, exporter, and/or an NGO that works directly with the farmer in their field providing technical support. Partners sponsor trials on farms in their own value chains, while increasing farmer profitability at the local level. These are the supply chain and funding partners for trials established in 2018:

	GUATEMALA ALFONSO ANZUETO CARLOS RIVAS FEDECOVERA FECCEG FUNDA ECO HANNS R. NEUMANN STIFTUNG / USAID
	EL SALVADOR ABECAFE
	HONDURAS HANNS R. NEUMANN STIFTUNG / USAID HONDUCAFE/EFICO
	COSTA RICA BENEFICIADORA SANTA EDUVIGES ECOM RUIVARBO S.A.
	PERU TECHNOSERVE PERU / USAID ECOM (ASOCASEL)
	NICARAGUA ECOM CATHOLIC RELIEF SERVICES MERCON
	MEXICO CAFE CALIFORNIA (NEUMANN GROUP)
	RWANDA C. DORMANS (ECOM) INTERNATIONAL WOMENS COFFEE ALLIANCE RWACOF (SUCAFINA) RWANDA TRADING COMPANY (WESTROCK) SUSTAINABLE HARVEST
	UGANDA GREAT LAKES COFFEE / KEURIG DR. PEPPER UGACOF (SUCAFINA)
	DEMOCRATIC REPUBLIC OF CONGO UNIVERSITE DE BUKAVU AND COOPERATIVES / USAID

Major sponsors of the Global Coffee Monitoring Program include:

- WCR members
- Alliance for Resilient Coffee, led by Hanns Neumann Stiftung Foundation, funded by USAID
- Coffee Alliance for Excellence (CAFÉ) Project to improve incomes for coffee-farming households in Peru, led by TechnoServe Peru, funded by USAID
- Feed the Future Democratic Republic of the Congo Strengthening Value Chains (SVC) Activity in South Kivu, led by Tetrattech, funded by USAID
- EFICO Group
- Keurig Dr. Pepper



PARTNER WITH US

Bring smarter farming and improved livelihoods to your supply chain.

Contact us at info@worldcoffeeresearch.org to talk with us about becoming a partner in the Global Coffee Monitoring Program.



TECHNOLOGY TRANSFER

Getting healthy plants and new knowledge to farmers



The best plants and farming practices in the world aren't worth a thing if they are not available to the farmers who need them. Though WCR is not a seed company or extension service, our work doesn't stop with creating and testing the best new technologies and knowledge. It extends to programs that make them accessible to farmers.

Coffee's missing seed sector



Most coffee plants are produced by small, untrained nurseries in remote areas.
Photo credit: Devon Barker (@devonbbarker)

When it's time to plant a new tree, most farmers either produce new ones from seeds collected in their fields or from neighbors, or obtain them from small local nurseries. On the surface, this sounds good: self-sufficient farmers making their own plants. But more often than not, it's a key constraint to profitability.

Why? The vast majority of farmers do not know the variety they grow in their fields, do not know that more appropriate varieties exist that could increase their profitability, and do not have access to better plants. Is it resistant to rust? Will it tolerate droughts? Does it have the quality I seek for the market? This information is either not available or not clear to farmers. This matters because different varieties do different things. And if farmers don't know or can't trust what they have, they are exposed to huge risk.

Plants obtained from local nurseries are rarely better than what a farmer can produce him or herself. In most cases, these nurseries take or buy seeds from local farmers or institutions but do not take into consideration the genetic purity of the seed—in other words, they often don't know for certain what variety they are selling. Training is limited or nonexistent for most nursery owners, who have scarce access to technical assistance.

WCR Nursery Development Program

In 2018, WCR launched a new program to support its long-term goal to build a strong and professional coffee seed sector that doesn't leave out smallholder farmers. The WCR Nursery Development Program builds the capacity of small nurseries to produce genetically pure and healthy seedlings for smallholder farmers in countries around the world. Nursery staff are trained on best practices both for plant production and for business management, and are assisted to locate genetically pure seed stock.

Over the years, the program will result in expanded access to improved, resilient varieties for smallholders—leading to increased production and profits. The program also builds stronger rural organizations and creates new entrepreneurial business opportunities in coffee-farming communities.

- **2:** Technical training guidebooks created in 2018 that will be available in 2019
- **5:** Number of countries where active in 2018 (Perú, Puerto Rico, Honduras, Costa Rica, and Nicaragua)
- **23:** Number of nurseries trained in 2018
- **2.5 MILLION:** Number of seeds produced by trained nurseries in 2018
- **10+ MILLION:** Number of plants expected from trained nurseries in 2019

Major sponsors of WCR's work to improve the coffee seed and plant sector include:

- Coffee Alliance for Excellence (CAFÉ) Project to improve incomes for coffee-farming households in Peru, led by TechnoServe Peru
- Maximizing Opportunities in Coffee and Cacao in the Americas (MOCCA) Program in El Salvador, Guatemala, Honduras, Ecuador, and Peru, led by TechnoServe, funded by United States Department of Agriculture
- Feed the Future Democratic Republic of the Congo Strengthening Value Chains (SVC) Activity in South Kivu, led by Tetra Tech, funded by United States Agency for International Development
- The Starbucks Foundation
- Keurig Dr. Pepper

SPOTLIGHT: Rebuilding Puerto Rico's coffee sector after Hurricane Maria



Coffee trees destroyed by Hurricane Maria on the farm of Ramon Reyes, Hacienda Moraika.

In September 2017, Hurricane Maria wreaked devastation on Puerto Rico's coffee farms. It's estimated that 20 million trees (15-30% of the trees on the island) must be replaced. At the same time, the island's capacity to produce new seedlings was severely impacted by the hurricane. World Coffee Research, together with a consortium of local stakeholders on the island, is working to ensure that Puerto Rico's nurseries are rebuilt and that the island's farmers have access to the best possible planting material to ensure the long-term success of producers who want to continue cultivating coffee. Major funding for this work is provided by the Starbucks Foundation.

"With this program we have the opportunity to be part of the future of coffee in Puerto Rico. It is the purest example of our ability to have a direct impact and guarantee a bright future for coffee on the island knowing that the basis of a good harvest begins with the right care of the seed."

—Virginia Rivera, Starbucks Coffee Puerto Rico

WCR joins PROMECAFE

In November 2018, WCR was accepted as a full member (category: technical partner) of the Central American Regional Cooperative Program for the Technological Development and Modernization of Coffee Cultivation (PROMECAFE), a body that integrates national coffee institutes across Central America, Mexico, Peru, the Dominican Republic, and Jamaica. Through this partnership, WCR will be working to build a strong foundation for the sharing of research results and the transfer of improved technologies to farmers across the region.

Making climate-smart farm renovation a reality

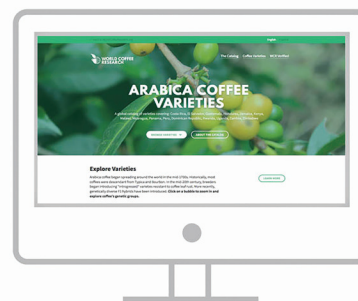
Almost no one disagrees that the replacement of old, diseased coffee trees with new, disease-tolerant, high-quality varieties, accompanied by climate-smart agricultural practices tailored to local conditions, is the gold standard for ensuring vibrant future coffee production. The renovation of old farms may be nowhere as important as in El Salvador, where coffee production dropped precipitously (declining by 70% between the 2010/2011 and 2013/2014 seasons) due to the disastrous effects of a coffee leaf rust epidemic.

But in order to renovate their farms, producers need access to credit, which banks have historically been hesitant to extend to coffee farmers. In order to be a good candidate for low-interest loans, coffee producers would need to be able to show that their planned renovation is likely to produce a return on investment—and that their farms will remain viable in the face of a changing climate.

World Coffee Research was approached by IDB Invest to build a decision-support tool to accomplish exactly this goal. The geo-referenced decision support system (DSS) recommends specific varieties, climate-smart practices, and other inputs that will reduce risk from major production constraints and a changing climate, tailored to the existing eco-geographic zone of each farm. In other words, it tells both farmers and investors what is most likely to work, taking into account predictions of climate shifts over the next 35 years.

The pilot decision support tool focuses on 115 farms in El Salvador managed, owned, or administered by three exporters. It works by overlaying granular, predicted climate shifts onto the GPS locations of all 115 farms, along with other biophysical characteristics, such as soil erosion, biodiversity, and agroecological classes. Users are able to play with different renovation plans (e.g., what percentage of land will be renovated, choice of variety, % shade cover, fertilizer package, etc.) for each specific location to generate in real time an estimate of the time to return on investment. The tool is expected to assist El Salvador to increase investment in renovation, staving off further abandonment of coffee farms (currently at 30%), the deepening of the labor crisis, and conversion of coffee-forested land into other, less environmentally friendly agricultural uses.

Arabica Varieties Catalog + WCR VerifiedSM



**Available online and
free to download at**
varieties.worldcoffeeresearch.org



**To find or become a
VerifiedSM nursery visit**
varieties.worldcoffeeresearch.org/verified

Coffee farmers should be able to make informed decisions about which variety will work best for their situation and needs. That's why World Coffee Research created an online, open-access varieties catalog.

- **11:** Number of new varieties added to the catalog in 2018
- **6:** Number of new countries covered by the catalog (Kenya, Malawi, Rwanda, Uganda, Zambia, and Zimbabwe)

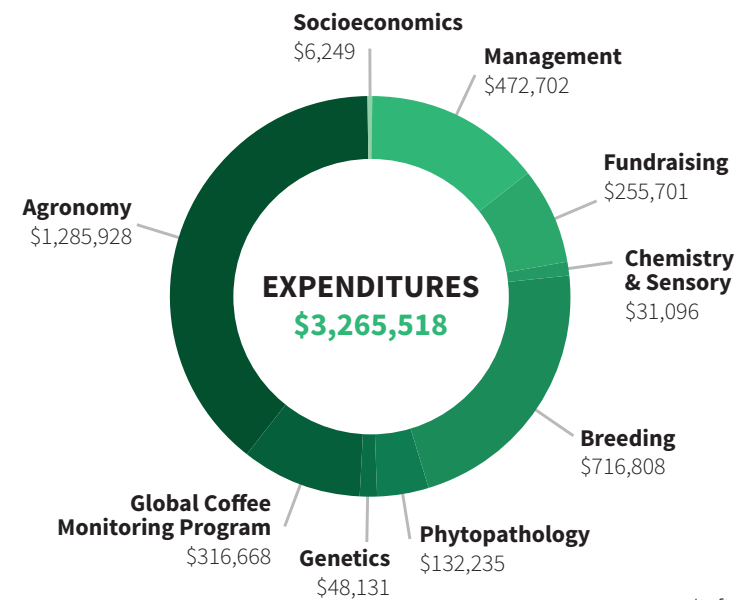
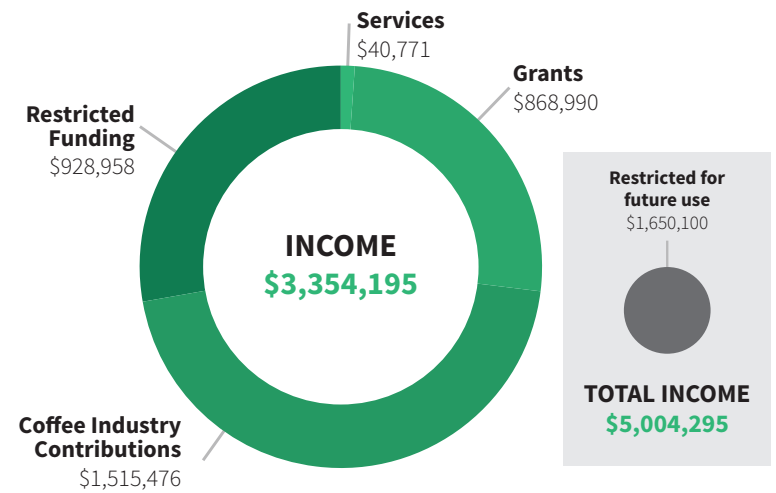
The catalog integrates with a registry of WCR VerifiedSM nurseries so that users can readily locate trusted sources for healthy, genetically pure plants.

In 2017, WCR launched the WCR VerifiedSM Program in Central America. WCR VerifiedSM is the first global standard to certify that coffee seed producers and nurseries are producing healthy and genetically pure plants. The program recognizes that the coffee value chain starts with the seed, and that all coffee farmers deserve to have access to healthy plants.

As efforts to replant and renovate significant coffee areas ramp up in the next decade, the Verified program aims to certify nurseries capable of producing billions of healthy, genetically pure trees to farmers worldwide.



2018 FINANCES*



*Pre-audit figures

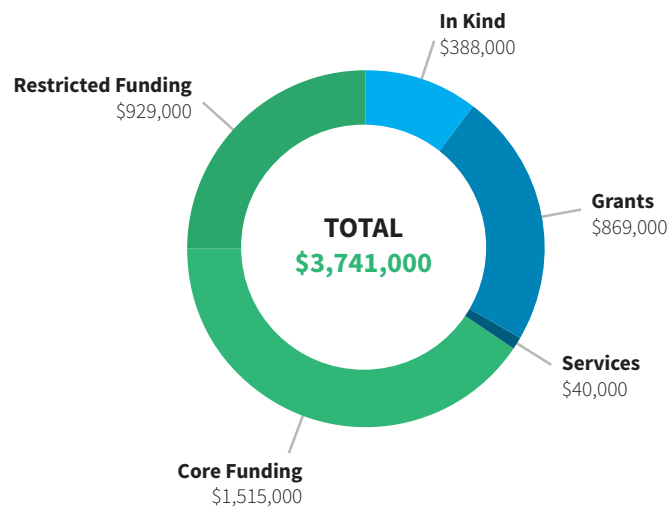
2018 YEAR-END FINANCIAL POSITION

Cash: \$1,771,892	Liabilities: \$606,148
Other Assets: \$2,529,845	Net Assets: \$3,695,589
Total: \$4,301,737	

INVESTMENT IMPACT

By leveraging in-kind contributions from partners, along with grant dollars, public funds, and service income, we are able to increase the impact of WCR member contributions.

For every dollar contributed by donors in the coffee industry, WCR conducts **\$1.53** worth of research



TEAM

Our core scientific and administrative team apply their expertise in coffee, genetics, plant science and diseases, and sensory science to create and execute an ambitious research agenda.

- Tim Schilling, *CEO*
- Christophe Montagnon, *Scientific Director*
- Kraig Kraft, *Global Programs Director*
- Danielle Knueppel, *Global Coffee Monitoring Program Director*
- Greg Meenahan, *Partnership Director*
- Hanna Neuschwander, *Communications Director*
- Siaska Castro, *Administration and Finance Director*
- Salvador Urrutia Loucel, *Latin American Regional Director*
- Julio Alvarado, *Research Technician*
- Francisco (Paco) Anzueto, *Breeding and Agronomic Experiments Coordinator*
- James Astuhuaman, *Peru Country Representative*
- Sara Bogantes, *Central America GCMP Coordinator*
- Josue Callejas, *El Salvador Country Agronomist*
- Elly Castro, *Nicaragua Country Agronomist*
- Elisabeth Fillmore, *Communications Assistant*
- Nicole Freeman, *Contracts & Grants Manager*
- Pascal Gakwaya Kalisa, *East Africa GCMP Coordinator*
- Koleen Hall, *Business Manager*
- Molly McLain, *Partnership Associate*
- Viviana Medina, *Puerto Rico Coordinator*
- Maureen Namugalu, *Uganda Country Agronomist*
- Maud Nicolas, *WCR Europe Business Manager*
- Jose Paiz, *Guatemala Country Agronomist*
- Solene Pruvot-Woehl, *IMLVT Project Leader*
- Sylvain Roulain, *Research & Development Agronomist*
- Hector Andres Santos Rojas, *Honduras Country Agronomist*
- Lucile Toniutti, *Molecular Breeder*
- Emilia Umaña, *Nursery Development Specialist*

In 2018, WCR's team grew to **28**.

SCIENTIFIC ADVISORY GROUP

These internationally renowned scientists are at the top of their fields, and volunteer their time to help guide and provide feedback on WCR's research agenda.

- M. Catherine Aime, *Fungal Pathology Expert, Purdue University*
- Walter Baethgen, *Climate Change Expert, Earth Institute, Columbia University*
- Elisabeth Guichard, *Sensory Expert, French National Agronomic Research Institute (INRA)*
- Kyle Murphy, *Socioeconomics Expert, Jameel Poverty Action Lab (J-PAL)*
- Seth Murray, *Quantitative Genetics Expert, Texas A&M University*

BOARD OF DIRECTORS

WCR board members are some of the most important leaders and thinkers from coffee companies around the world. They work hard behind the scenes, setting direction and monitoring results.

- Tracy Ging, *S&D Coffee and Tea (Chair)*
- Shawn Hamilton, *Java City (Treasurer/Secretary)*
- Mike Keown, *Farmer Brothers (Vice Chair)*
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- Frank Dennis, *Swiss Water*
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- Monique Oxender, *Keurig Dr. Pepper*
- Eric Poncon, *ECOM*
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- Marc Schonland, *Royal Cup*
- Brett Smith, *Counter Culture Coffee*
- Furio Suggi Liverani, *illycaffè*
- Jim Trout, *The J.M. Smucker Company*
- Doug Welsh, *Peet's Coffee & Tea*
- Keith Writer, *Bettys & Taylors of Harrogate*

COLLABORATING RESEARCHERS AND STUDENTS

Researchers and graduate students from around the world are working on problems and projects identified as essential by World Coffee Research core scientific staff.

- M. Catherine Aime, *Purdue University*
- Jacques Avelino, *CIRAD*
- Roberto Barreto, *Universidade Federal de Viçosa, Brazil*
- Benoit Bertrand, *CIRAD*
- Espoir Bissimwa Basengere, *Universite Catholique de Bukavu*
- Melanie Bordeaux, *Fundacion Nicafrance*
- Jean-Christophe Breitler, *CIRAD-INECOL*
- Christian Bunn, *CGIAR*
- Edgar Chambers, *Kansas State University*
- Jane Cheserek, *KALRO, Kenya*
- Phillipe Courtel, *Fundacion Nicafrance*
- Harry Evans, *Universidade Federal de Viçosa*
- Joseph Kimemia, *Kenya*
- Trish Klein, *Texas A&M University*
- Rachel Koch, *Purdue University*
- Sarada Krishnan, *Denver Botanical Gardens*
- Simon Martin, *Rwanda Agriculture Board*
- Christiane Mas, *Universite Catholique de Bukavu*
- Elias de Melo, *CATIE*
- Fabienne Moreau, *ADNiD*
- Paul Mulemangabo, *INERA/RAB*
- Luciano Navarini, *illycaffè*
- Surya Prakash, *CCRI, India*
- Carlos Rodriguez, *Starbucks*
- Sara Sarmiento Salcedo, *postdoctoral fellow, Universidade Federal de Viçosa*
- Susanna Schuller, *JNC, Peru*
- William Solano, *CATIE*
- Paul Songer, *Songer & Associates*
- Ucu Sumirat, *ICCRI, Indonesia*
- Paulo van der Ven, *RD2 Vision*

Students

- Julio Alvarado, *master's student, Illy University*
- Kifle Belachew, *Ph.D. student, Jimma University*
- Fabián Echeverría Beirute, *Ph.D. student, Texas A&M University*
- Marina Bracale, *Ph.D. student, Universidade Federal de Viçosa*
- Taya Brown, *Ph.D. student, Texas A&M University*
- Adans Agustín Colmán, *Ph.D. student, Universidade Federal de Viçosa*
- Jorge Diaz-Valderrama, *graduate student, Purdue University*
- Terratas Kijpornyongpan, *graduate student, Purdue University*
- Miraine Ndacnou, *Ph.D. student, Universidade Federal de Viçosa*
- Thaisa Nobrega, *Ph.D. student, Universidade Federal de Viçosa*
- Maria del Carmen Herrera Rodriguez, *Ph.D., Universidade Federal de Viçosa*
- Juan Whiting, *Ph.D. student, Foundation for Conflict and Development*

In 2018, WCR worked with **42** researchers around the world who helped execute our scientific agenda.

MEMBERS

MEMBERS

WCR members—companies and organizations large and small—help set the global agenda for coffee research. Their support is the foundation for a vibrant and sustainable coffee sector.

156 companies and individuals supported WCR's work in 2018, an increase of **51%** over the prior year.

\$250,000 to \$500,000



\$100,000 to \$249,999



\$50,000 to \$99,999

- Allegro Coffee
- Caravela Limited
- Community Coffee Company
- Foodbuy
- illycaffè
- Jacobs Douwe Egberts - JDE
- Mars Drinks
- Peet's Coffee & Tea
- Probat Werke
- Rogers Charitable Fund
- S&D Coffee

\$20,000 to \$49,999

- La Marzocco
- Massimo Zanetti Beverages
- Royal Cup Coffee
- Swiss Water Decaffeinated Coffee

\$10,000 to \$19,999

- Beck Flavors
- Counter Culture Coffee
- Descamex
- EFICO Group
- Falcon Coffees
- Fres-Co System USA
- Gaviña & Sons
- Intelligentsia Coffee
- Java City
- Key Coffee
- Louis Dreyfus Company Suisse
- OLAM Specialty Coffee
- Philz Coffee
- Sucafina
- Taylor's of Harrogate
- Walker Coffee Trading

\$1,000 to \$9,999

- Arab Coffee Co.
- Atlas Coffee Importers
- Batdorf & Bronson
- C-Coop
- Cafcom
- Camel Coffee Co.
- Coffee by Tate
- Coffee Libre
- Driftaway Coffee
- DRWakefield
- Dunn Brothers Coffee
- Equator Coffee & Teas
- Honey Coffee/Izaki Coffee Co.
- InterAmerican Coffee (US)
- Irving Farm Coffee Roasters
- Kaldi's Coffee
- Kickapoo Coffee Roasters
- Kyokuto Fadie Co.
- Mr. Espresso
- OLAM Specialty Coffee of Europe
- Origin Coffee
- Orsir Coffee Co.
- Pacific Espresso
- Rainforest Alliance & UTZ
- Rave Coffee
- Sarutahiko Coffee
- Singing Rooster
- Single O
- Small Batch Coffee Roasters
- Specialty Coffee Association of Japan
- Specialty Coffee Association UK Chapter

\$1,000 to \$9,999

- Sustainable Harvest
- Sweet Maria's
- Tata Coffee
- The Coffee Source
- The Seed
- Toa Coffee Co.
- Transcend Coffee
- Vides58 Coffees
- Wilbur Curtis
- Workshop Coffee

Up to \$999

- Amcafe USA
- Be Brave
- BlendIn Coffee Club
- Blowback Coffee Roasters
- Bolt Coffee Company
- Brian Gaffney
- Bridge Coffee Co.
- Buckman Coffee Factory
- Café Cultura Laboratorio
- Café Virtuoso
- Calendar Coffee
- Camino Real Coffee Roasters
- Caravan Coffee
- Colour Coffee Roasting
- Crankhouse Coffee
- Crop to Cup Coffee Importers
- Curve Roasters
- Dark Woods Coffee
- Dispatch Coffee
- Fulcrum Coffee
- Genius Shan
- Highlands Coffee
- Greenway Coffee Company
- Huckleberry Roasters
- InterContinental Coffee Trading
- Ken's Koffee
- Marigold Coffee
- NEAT Coffee
- Nicolas Rivolta
- North Fork Coffee Roasters
- OLAM International
- Ome Project
- Ozo Coffee
- Pedro Ros Casanova
- Prescott Coffee Roasters
- Raquel Lohmann
- Red Cedar Coffee Co.
- Red Goni Coffee
- Rimini Coffee
- Roast House Coffee
- Rose N Crantz Roasting Co.
- Rose Park Roasters
- Ross Street Roasting
- Roundtable Coffee Works
- Sightglass Coffee - Jake Robinson
- Spyhouse Coffee
- Square Mile Coffee Roasters
- Square One Coffee Roasters
- Taf Coffee
- Taiwan Coffee Laboratory
- The Beautiful Bean
- The Excellent Cup
- This Side Up Coffee
- Tony's Coffee
- Vessel Roasters
- West Cork Coffee

CHECKOFF PROGRAM PARTICIPANTS

Through the Checkoff Program, roasters and importers can directly support the future of coffee by contributing pennies per pound on every green coffee purchase.

Checkoff Participating Importers and Exporters

- Atlantic Specialty Coffee
- Atlas Coffee Importers
- Be Green Trading
- Bourbon Specialty Coffees
- Cafe Imports
- Cafe Imports Europe
- Cape Horn Coffee
- Caravela Coffee
- Caravela Limited
- Condesa Co Lab
- Crop to Cup Coffee Importers
- Descamex
- DRWakefield
- East Africa Coffee Company
- Engelhart Commodities Trading Partners
- Falcon Coffees
- Greencof
- Hacienda La Minita
- InterAmerican Coffee (UK)
- InterAmerican Coffee (US)
- InterContinental Coffee Trading
- La Bastilla Estates Coffee
- MTC Group
- N.J. Douek
- Nordic Approach
- OLAM International Limited
- OLAM Specialty Coffee
- OLAM Specialty Coffee Europe
- Onyx Coffee
- Paragon Coffee Trading
- Racafé
- Red Goni Coffee
- RGC Coffee
- Royal Coffee
- Singing Rooster
- Sustainable Harvest
- Swiss Water Decaffeinated Coffee
- The Coffee Source
- This Side Up Coffee
- Trabocca
- Twin Trading
- Volcafe Specialty Coffee
- Walker Coffee Trading
- Zephyr Green Coffee

Retailers

NDCP and Dunkin'

Checkoff Participating Roasters

- Allegro Coffee
- Blowback Coffee Roasters
- Bolt Coffee
- Café Virtuoso
- Calendar Coffee
- Camino Real Coffee Roasters
- Campos Coffee
- Caravan Coffee
- Chameleon Cold Brew
- Clifton Coffee Roasters
- Coffee by Tate
- Coffee Factory
- Colour Coffee Roasting
- Counter Culture Coffee
- Crankhouse Coffee
- Curve Roasters
- Dark Woods Coffee
- Dave's Koffiebranderij
- Dispatch Coffee
- Driftaway Coffee
- Dunn Brothers Coffee
- Equator Coffee & Teas
- Fortitude Coffee Roasters
- Greenway Coffee Company
- Huckleberry Roasters
- Intelligentsia Coffee
- Irving Farm Coffee Roasters
- Java City
- Kaldi's Coffee
- Ken's Koffee
- Marigold Coffee
- Mr. Espresso
- NEAT Coffee
- North Fork Coffee Roasters
- Origin Coffee
- Ozo Coffee
- Philz Coffee
- Prescott Coffee Roasters
- Quaffle
- Rave Coffee
- Rimini Coffee
- Roast Factory
- Roast House Coffee
- Roast N Crantz Roasting
- Rose Park Roasters
- Ross Street Roasting
- Roundtable Coffee Works
- Sample Coffee Roasters
- Single O
- Small Batch Coffee Roasters
- Spyhouse Coffee Roasting Co.
- Square Mile Coffee Roasters
- Square One Coffee Roasters
- Taylor's of Harrogate
- The Beautiful Bean
- The Excellent Cup
- Tony's Coffee
- Veneziano Coffee Roasters
- Vessel Roasters
- West Cork Coffee
- Workshop Coffee

PARTNERS

WCR's global network of coffee research institutions includes universities, consortiums, public agencies, and laboratories including private company research departments. These institutions are models of the cooperative and collaborative approach necessary to mitigate today's constraints and face tomorrow's challenges.

92 Partnering organizations contributed to our global, collaborative R&D effort in coffee in 2018.

- ABECAFE, El Salvador
- ACRN African Coffee Research Network
- ADNID
- AFCA Africa Fine Coffees Association
- Alfonso Anzueto
- ANACAFE Guatemalan National Coffee Association
- Beneficiadora Santa Eduvigis, Costa Rica
- C. Dorman, Rwanda
- Café California Mexico
- Carlos Rivas
- CATIE Tropical Agricultural Research and Higher Education Center, Costa Rica
- CIAT International Center for Tropical Agriculture
- CCRI Central Coffee Research Institute, India
- CIRAD French Agricultural Research Centre for International Development, France
- CodoCafe
- Cohonducafe
- Conservation International
- CRI Coffee Research Institute, Zimbabwe
- CRS Catholic Relief Services
- Crop Trust, Germany
- Department of Agricultural Research Services, Malawi
- EMBRAPA CAFÉ Brazilian Coffee Research Consortium
- ECOM
- EFICO Group, Belgium
- European Union Horizon 2020 Program
- FECCEG, Guatemala
- FEDECOVERA, Guatemala
- Finca Aquiares, Costa Rica
- Fundación Fonalledas, Inc., Puerto Rico
- FNC Cenicafe, Colombia
- Fundação Aggie de El Salvador
- FundaECO, Guatemala
- Global Coffee Review
- Great Lakes Coffee
- Company, Uganda
- Hacienda Barbara Panama
- Hanns R. Neumann Stiftung, Germany
- Hiu Coffee/Union Hand Roasted
- Honducafe
- ICAFE Costa Rica
- ICCRI Indonesian Coffee and Cocoa Research Institute
- IHCAFE Honduras
- Illycafe, Italy
- INECOL Institute of Ecology, Mexico
- INERA National Institute for Agricultural Research, Democratic Republic of Congo
- IWCA International Women's Coffee Alliance
- J. Hill & Cia, S.A. de C.V., El Salvador
- JACRA Jamaica Agricultural Commodities Regulatory Authority
- JNC Junta Nacional de Peru
- KALRO Kenya

- Agricultural and Livestock Research Organization
- KAWACOM, Uganda
- Keurig Dr. Pepper
- La Marzocco, Italy
- Mercon Coffee Group
- MIDA Panama
- Ministry of Agriculture of Peru
- Molinas de Honduras
- MZCPCU, Malawi
- NACORI National Coffee Research Institute, Uganda
- NAEB, National Agricultural Export Development Board, Rwanda
- NCCL Northern Coffee Corporation Ltd., Zambia
- Nicafrance, Nicaragua
- Norman Borlaug Institute for International Agriculture at Texas A&M University
- NSF International
- OLAM International Ltd.
- Procesadora del Sur Peru
- PROMECAFE – Regional Cooperative Program for the Technical Development and Modernization of Coffee Culture
- Puerto Rico Coffee Roasters
- Purdue University
- RAB Rwanda Agricultural Board
- Radio Lifeline
- RD2 Vision
- Rogers Family
- RTC Rwanda Trading Company
- Ruivarbo, Costa Rica
- Rwacof, Rwanda
- Rwashoscco, Rwanda
- San'a University, Yemen
- Songer & Associates
- Southern Cross University, Australia
- Starbucks and the Starbucks Foundation
- Sucafina, Switzerland
- Sustainable Harvest Coffee Importers
- Tetrattech
- Texas A&M Center for Coffee Research and Education
- TechnoServe Peru
- UCB Catholic University of Bukavu, Democratic Republic of Congo
- UCC Ueshima Coffee, Japan
- UFV Universidade Federal de Viçosa, Brazil
- UGACOF, Uganda
- USAID United States Agency for International Development
- USDA United States Department of Agriculture
- UTZ, The Netherlands

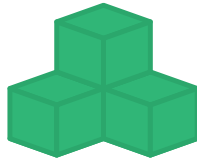
Affiliated Organizations

- ACE Alliance for Coffee Excellence
- CQI Coffee Quality Institute
- ICO International Coffee Organization
- NCA National Coffee Association
- SCA Specialty Coffee Association
- SCAJ Specialty Coffee Association of Japan

ENSURE THE FUTURE OF COFFEE



WE TURN YOUR PENNIES



INTO AMAZING RESEARCH

Through the Checkoff program, roasters can support our work by contributing pennies per pound or kilo of green coffee purchased through participating importers. See a list of participating importers and join the fight to save coffee at:

worldcoffeeresearch.org/checkoff

For information about direct investment, contact Greg Meenahan at
greg@worldcoffeeresearch.org

