World Coffee Research

The first five years: 2012-2017

WORLD COFFEE RESEARCH™

What is World Coffee Research?

World Coffee Research is the only organization in the world applying advanced agricultural science for coffee on a worldwide, collaborative basis. WCR enables the global coffee industry to invest in advanced agricultural R&D to transform the coffee sector and make coffee a vital source of global progress in the 21st century. Companies like Keurig, Starbucks, Illy, OLAM, ECOM, Counter Culture, Intelligentsia (and over 80 others) support our cutting-edge research to create new technologies and market opportunities for farmers because they recognize it is an essential precondition for farmers to achieve sustainable livelihoods.

Using advances in agricultural science, it is possible to dramatically improve coffee yields, coffee quality, climate resilience, and farmer livelihoods.

What does WCR do?

WCR is developing the next generation of high yielding, resilient coffee varieties, while increasing quality in the cup. In addition, WCR is conducting the first global research to drive best agricultural practices, minimize inputs and environmental impacts, and maximize farmer incomes.

Why agricultural research?

Agricultural R&D—the continuous development of improved farm technologies and practices—has been a precondition profitable farming for the last 200 years.

For the world's major crops, agricultural R&D has long been the engine that creates new knowledge that is transferred to farmers through training and extension. The global average return on investment for agricultural R&D is a remarkable 43%.

Why does WCR exist?

World Coffee Research was created 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.

Coffee farming in context

Coffee agriculture is at a crossroads. Demand is rising fast. Climate change is putting unprecedented pressure on farmers and the landscapes they live and work in—while globalization gives coffee farmers other opportunities for how to make a living. By 2050, the world will require double the amount of coffee, while suitable land will decrease by up to half. There is no way to do this sustainably without investment in agricultural R&D.

Despite its ubiquity at the breakfast table, coffee agriculture lags behind most other crops. Coffee is an "orphan crop"— on the whole, coffee is one of the most under-innovated agricultural commodities in the world.

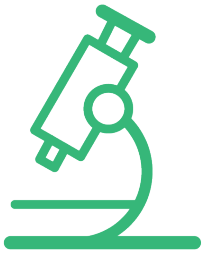
For example, there are 3,600 varieties of watermelon in the UPOV international registry of plant varieties; there are only 50 varieties of coffee —a stark indicator of how little coffee breeding has been done around the world. The result is that even where good training and extension services exist for coffee farmers, they are delivering outdated knowledge and technologies.

The global investment in coffee agricultural R&D is precariously low given the global importance of coffee agriculture.

Coffee as an agricultural crop faces an existential crisis as the price for decades of neglect in fundamental research is coming due. Only the continued strong support of the coffee industry and its leading companies, large and small, can set the stage for a viable coffee future. —Ric Rhinehart, Executive Director, SCA

Our Strategy

The seed is where it all begins. So that's where we begin, too. The coffee plant is the most important technology in the coffee supply chain—the basis for coffee quality and productivity. We conduct essential research on the plant and on the conditions that help it thrive. Our work so far has focused on three key challenges facing coffee agriculture: (1) preparing for climate change, (2) removing barries to quality, and (3) diseases/pests. **Our primary focus for solving these challenges is on the genetic improvement of coffee.** We work across six scientific domains to accomplish our work: Genetics/breeding, agronomy, phytopathology (diseases/pests), chemistry/sensory, and socioeconomics.

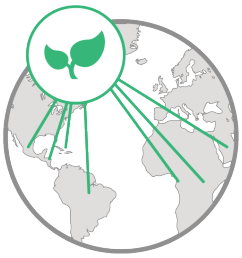


ENABLE

We generate cutting-edge, "enabling" knowledge and tools. You need a hammer to build a house, but someone has to make the hammers. We work on creating the new knowledge and tools coffee scientists need in order for their work to progress. For example, we have created new collections of genetically diverse coffees for breeders to work with, we conduct gene discovery research to help make breeding more efficient, we have developed a global strategy for the protection of coffee biodiversity, and we created the Coffee Sensory Lexicon, a new approach for evaluating coffee's flavors and aromas that scientists and industry can use to improve coffee quality.

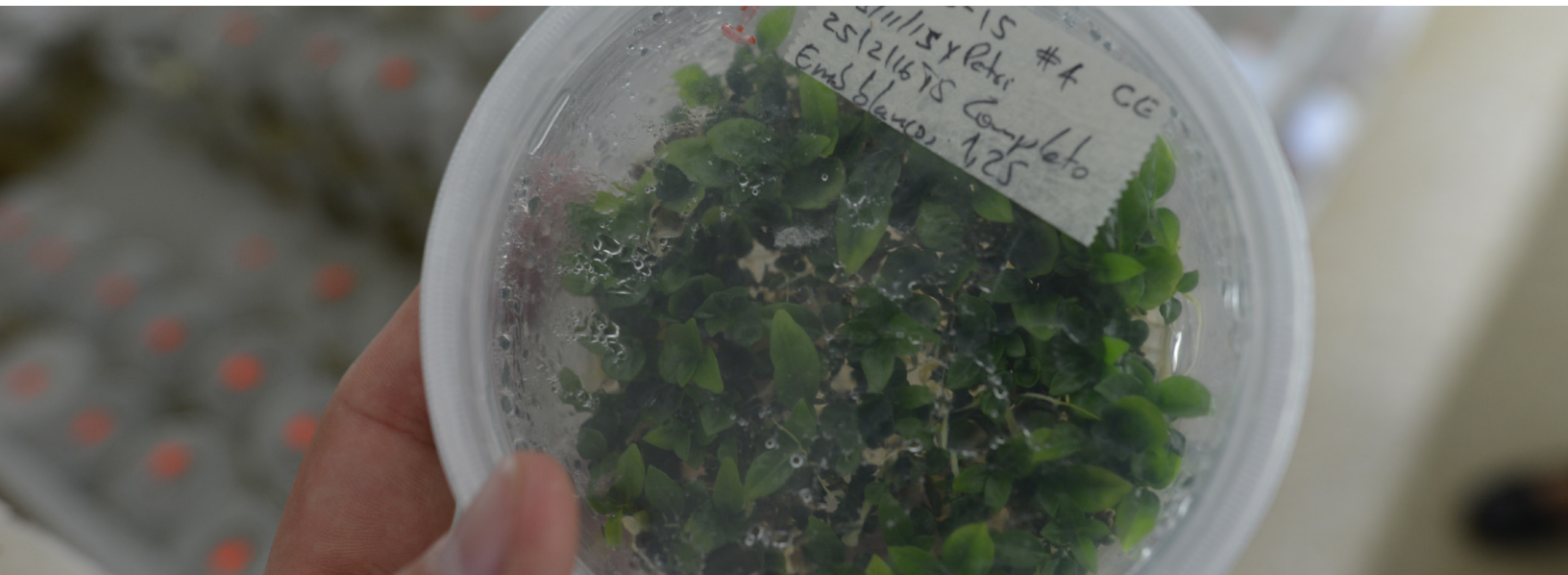
CREATE

We create new technologies. Using cutting-edge knowledge of coffee genetics and quality, we are creating the next generation of coffee varieties that will be climate resilient, disease resistant, high producing, and high quality. Simultaneously, we deliver new solutions for diseases and pests, technologies for propagating hybrid varieties, and more.



BOOST

We protect and "boost" the use of good technologies. In coffee, there is a lot of low-hanging fruit, so to speak. There are improved varieties that are not in widespread production. Existing knowledge and tools could be utilized more widely. Where it is efficient, we provide farmers with access to better information about coffee technologies that increase farmer profits, help nurseries ensure healthy and genetically pure plants, and enable the wider distribution of the best varieties, all while working to protect coffee's genetic diversity.

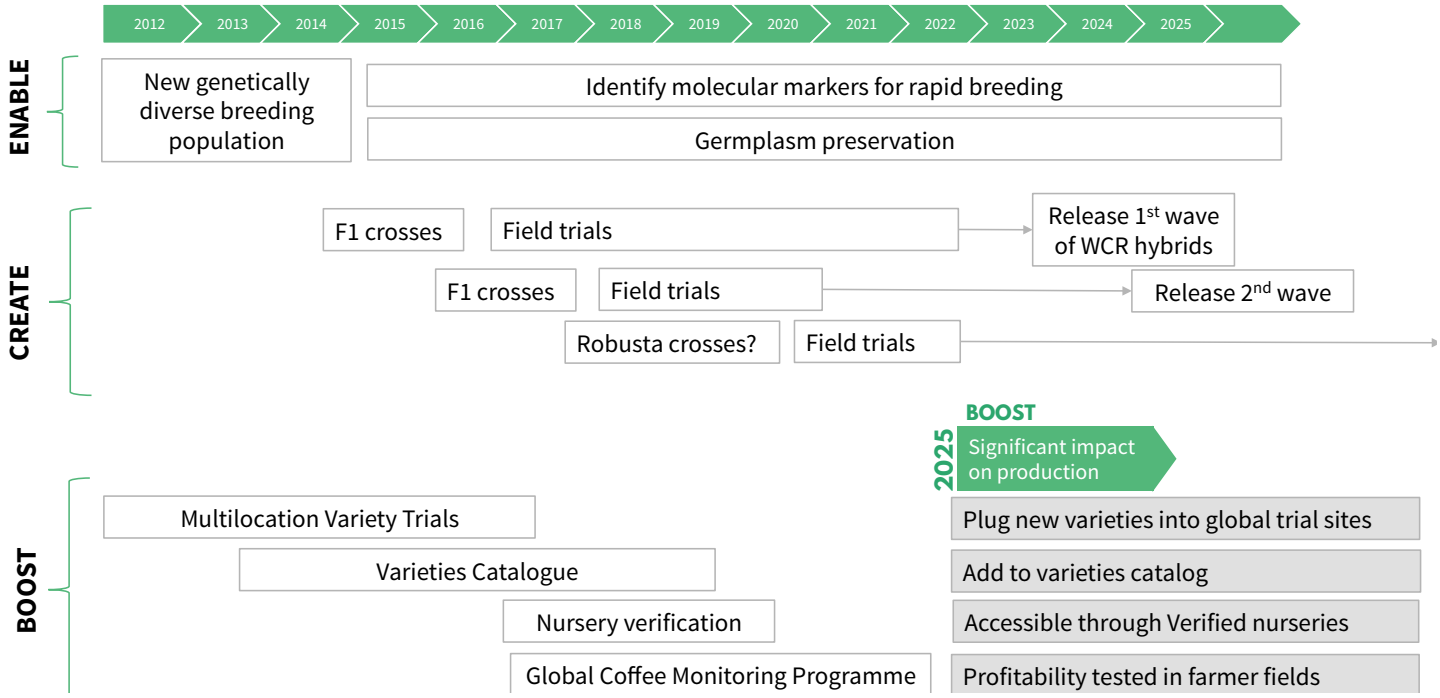


Our strategic approach

The time lag for R&D to reach farmers can be significant. Historically, for example, new variethes have spent 20-30 years in development before being released commercially for farmers, meaning that widespread adoption of an improved variety may take upwards of 40 years. For this reason, World Coffee Research works at different time scales simultaneously.

Our breeding program has in its first five years created 60 experimental F1 hybrid crosses for evaluation. Recognizing that new varieties will not be ready for commercial release until at least 2022, World Coffee Research has simultanesouly undertaken a an aggressive strategy to "boost" the use of existing varieties that will offer farmers improvement over what they currently use.

First five years strategy on genetics and breeding



WCR's programs to "boost" the use of better varieties is designed around addressing key limiting factors to the widespread use of exiting good varieties:

Problem: Farmers in many **countries don't have access** to existing better varieties because those varieties are not commercially available in their country.

Solution: **An international seed exchange** (the International Multilocation Variety Trial) of some of the top-performing varieties in the world, which allows countries to observe and test new-to-them varieties, and eventually select some of those varieties for commercialization in their country.

Problem: **Farmers don't know** about improved varieties and where/how to access them.

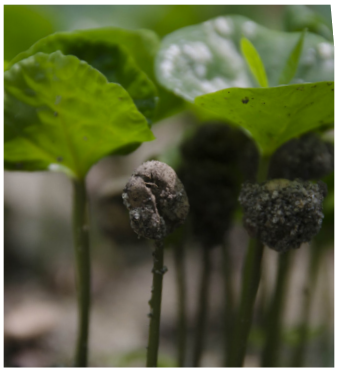
Solution: A catalog that includes all major coffee varieties in Central America (Africa forthcoming), tied to a database of certified nurseries that can provide healthy, genetically pure plants for each variety.

Problem: **Farmers aren't convinced** about adopting new varieties, and/or can't get credit for renovating their farms.

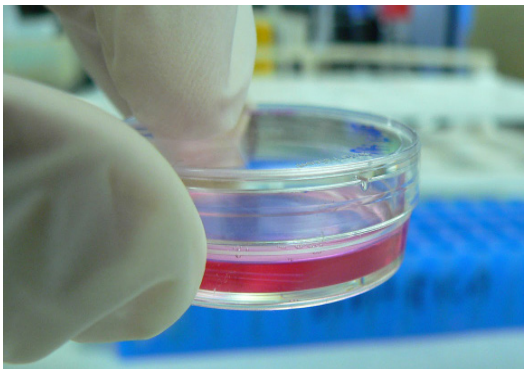
Solution: An international network of **on-farm profitability trials** (1200 in 20+ countries) that examines which combination of improved varieties and improved agronomic practices move the needle for the farmer on profitability, yield, and quality. Additionally, a socioeconomics study of barriers to farmer upatake of new varieties.

What WCR has delivered

In its first five years, World Coffee Research has build an exceptionally strong foundation for global coffee R&D. In the next 5-10 years, we will build on that foundation to accelerate new technology development and build partnerships to ensure that research results reach farmers worldwide.



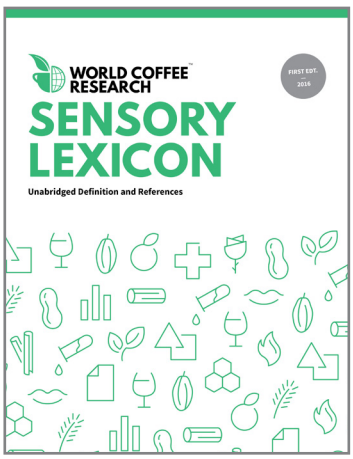


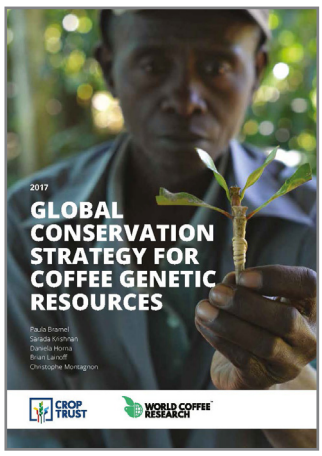



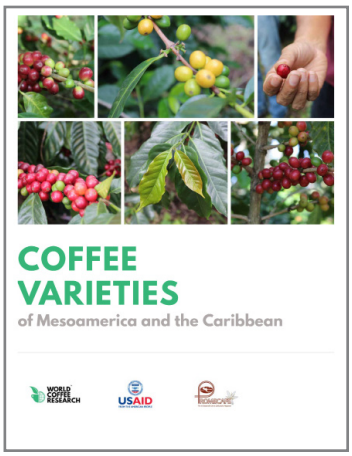
In our founding 5-year research strategy, written in 2011, we wrote: "The major thrust of the WCR Research Strategy is to create a toolbox of coffee varieties, genetic resources and accompanying technologies and to disseminate them strategically and collaboratively in producing countries to alleviate current and future constraints to the supply chain of fine Arabica coffees." That has been the focus of our work these past five years, with one major shift: Recognizing that the threats of climate change are more significant than was initially imagined, we have expanded our focus to also include Robusta.

World Coffee Research has already delivered impressive results: In just five years, we have established 60 new coffee varieties in development, two global breeding hubs, and an unprecedented international network of research trials to test variety performance, agricultural approaches for climate resilience, and to track and control coffee disease/pest movement. A comprehensive description of our work and what we have delivered can be found in Table 1.

Highlighted publications





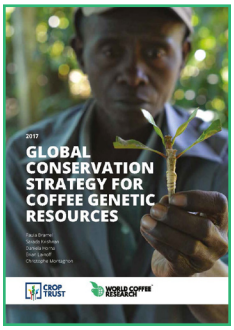


Six things the coffee industry didn't have before World Coffee Research

1 Global breeding program

Coffee has never had a **global** effort to coordinate coffee breeding. By drawing on the latest breakthroughs in coffee genetics, and working in collaboration with and providing support to individual country breeding programs, we are creating the next generation of coffee varieties to meet the challenges of the 21st century. Our breeding program prioritizes increasing farmer profitability, recognizing that different types of farmers have different needs. That means we are evaluating candidate varieties for cup quality, for smallholder resillience potential, for climate-smart traits like drought and frost tolerance, and for yield and disease resistance.

- **2 global breeding hubs** (Central America, East Africa)
- **60 F1 hybrid crosses** with 46 in field testing; eventual release of 2-3 planned for each region starting in 2023. Some varieties will have expected **yield increases of 20-40%** and cup quality porential of **90+ points**



- Using modern agricultural science to shorten the time from the creation of new varieties to their delivery to farmers from **30 to 10 years**

A **global strategy** for conserving and utilizing coffee germplasm

2 Seeding a seed sector

In 2017, WCR launched the WCR Verified℠ Program—the first global standard to certify that coffee seed producers and plant nurseries are producing healthy and genetically pure plants. The program recognizes that the coffee value chain does not start with the farm—it starts wtih the seed, and that all coffee farmers deserve to have access to healthy plants. It is a first step toward establishing a more profeesional seed sector for coffee.

- In 2016-2017 evaluated nurseries sold genetically verified plants to more than **10,000 farmers** in Central America for the renovation of over **5,000 hectares** using **20 million trees**.
- Expected future impact: **Professionalized seed sector** that can support continuous breeding and the delivery of new varieties to farmers worldwide.
- **Billions of healthier trees** to farmers over the next decades.

3 Open-access information for farmers and agronomists

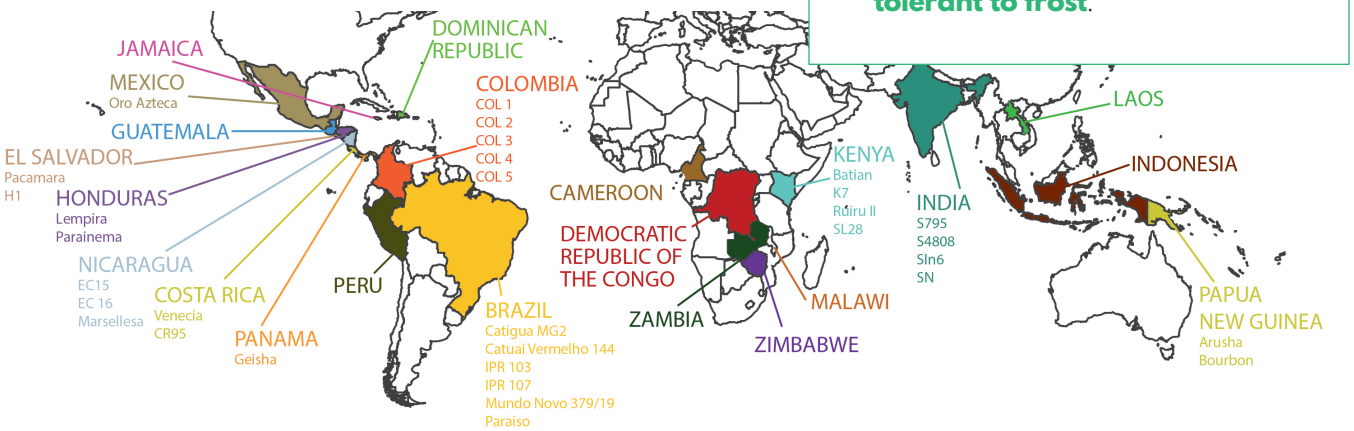
World Coffee Research is working to close the information divide by providing farmers, agronomists, researchers and others involved in the coffee value chain open access to knowledge and resources they need to prosper. In five years, we have produced a number of unprecended publications for the coffee industry, and made them all available for free.

- **Coffee Variety Catalog** **> 20,000 farmers, technicians, and nurseries** in nine Promecafe countries have received copies of the *Coffee Varieties of Mesoamerica and the Caribbean* catalog, which provides for the first time an objective resource for climate-smart decision-making when it comes time to renovate their farm with new varieties. The online catalog has been accessed **36,000 times**.
- **Coffee leaf rust technical manual**. **15,563 coffee producers and technicians** have downloaded a comprehensive Spanish-language technical manual on the integrated management of coffee leaf rust—this is the first manual to address the full scope of options for fighting rust, including climate-smart approaches that do not just rely on fungicide applications.

4 A global coffee seed exchange

Beginning in 2012, WCR established the world's largest coffee variety performance trial and seed exchange—the **International Multilocation Variety Trial**. If countries find a variety that performs better than their current standard, we will assist them in arranging to bring the new variety into the country for commercial production. No program has ever previously achieved this level of coordination among coffee producing countries. It has the potential to significantly increase global coffee production. The platform will also allow us to rigorously study how different varieties perform in different environments, what researchers call the genetic x environment (GxE) interaction, the results of which will enable smarter breeding in the future.

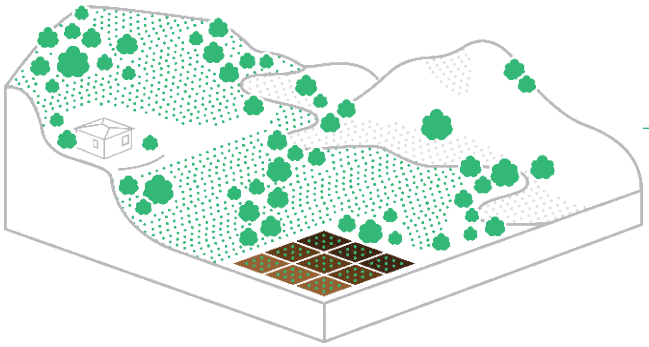
- **35 top-performing varieties** were provided by 11 countries
- Varieties have been shipped to **24 participating countries**
- In Feburary 2016, the trial returned it's first major result: the discovery that a number of newer F1 hybrid varieties are **tolerant to frost**.



5 "Big data" for coffee

WCR is building the world's largest network of on-farm trials (1,200 sites by 2023)—called the **Global Coffee Monitoring Program**—to test how different combinations of varieties and climate-smart agricultural interventions affect yield, coffee quality, and—most importantly—profitability for farmers. The trials will provide farmers with hard date to secure loans for making their farms more resilient. This trial is our largest and most ambitious program to date. It provides for the first time a science-based global data set on agricultural practices, which will redefine farmer training protocols. Crucially, the trial also serves to familiarize farmers with improved varieties and farming approaches, acting as a key mechanism for disseminating new technologies and knowledge to producers worldwide.

- By 2022, **1,200 trials** in farmer fields in over **20 countries**, representing the diversity of coffee production systems
- By 2025, over **500,000** healthy, high performing **coffee trees** will be distributed to farmers around the world.
- Through the inclusion of farmer field days to share the results with neighboring farmers, we expect to reach **60,000 farmers**.



6 Unprecedented collaboration

We connect **67 organizations**—coffee research institutes, national coffee institutes, NGOs and private sector organizations—**in 27 countries** to execute our ambitious research agenda. The existence of WCR is itself a success, bringing together countries and organizations that might otherwise see themselves as competitors to achieve an unprecedented global, collaborative agricultural research program for coffee. WCR's existence is a recognition from the coffee industry that the challenges of the future cannot be met without a collaborative approach.

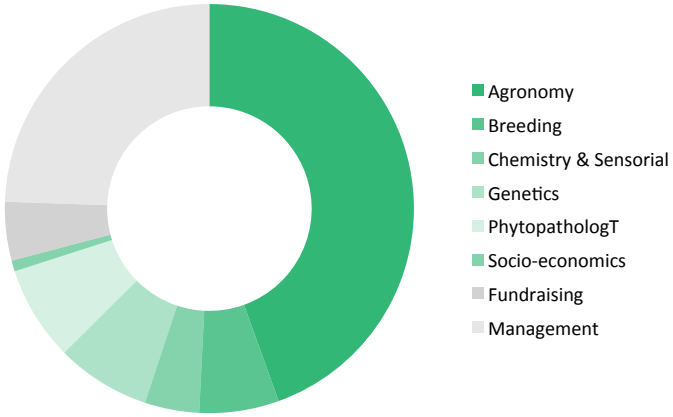
- ABECAFE
- ACO The African Coffee Organization/Research and Development
- ACRN African Coffee Research Network
- AFCA Africa Fine Coffees Association
- APLU American Public Land Grant Colleges and Universities
- ANACAFE Guatema National Coffee Association
- BSE
- C. Dorman Rwanda
- Catholic Relief Services
- CABI Centre for Agricultural Bioscience International
- CATIE Tropical Agricultural Research and Higher Education Center, Costa Rica
- CIAT International Center for Tropical Agriculture, Colombia
- Coffee Industry Board (CIB)
- CIC Coffee Industry Corporation,
- Papua New Guinea
- CIRAD French Agricultural Research Centre for International Development
- CCRI Central Coffee Research Institute, India
- CODOCAFÉ Consejo Dominicano del Café Dominican Republic
- CRI Coffee Research Institute, Kenya
- CRI Coffee Research Institute, Zimbabwe
- Crop Trust, Germany
- DARS Department of Agricultural Research Services, Malawi
- Denver Botanic Garden
- EMBRAPA CAFÉ Brazilian Coffee Research Consortium
- ECOM Trading, Inc.
- Finca Aquiares, Costa Rica
- Fundaçion Aggie de El Salvador
- Global Coffee Review (WCR Media Partner)
- Great Lakes Coffee Company
- Hanns R. Neumann Stiftung Foundation
- HARC Hawaii Agriculture Research Center
- ICAFÉ Instituto del Café de Costa Rica
- ICCRI Indonesian Coffee and Cocoa Research Institute
- IHCAFÉ Instituto Hondureño del Café
- IITA International Institute of Tropical Agrculture
- Indian Coffee Board Research and Development
- INECOL Institute of Ecology, Mexico
- INERA National Institute for Agricultural Research, Democratic Republic of Congo
- INTA Instituto Nicaragüense de Tecnología Agropecuaria
- IRAD Institute for Agricultural Research for Development, Cameroon
- J.Hill & Cia, S.a. de C.V., El Salvador
- JNC Junta Nacional de Peru
- KALRO Kenya Agricultural and Livestock Research Organization
- Kansas State University
- Mercon
- Ministerio de Agricultura y Riego de Perú
- Ministerio de Desarrollo Agropecuario (MIDA)
- NAEB, National Agricultural Export Development Board
- Nicafrance, Nicaragua
- Norman Borlaug Institute for International Agriculture at Texas A&M University
- Northern Coffee Corporation Ltd., Zambia
- NSF Intternational
- OLAM
- Peruvian National Coffee Board
- PROMECAFE – Regional Cooperative Program for the Technical Development and Modernization of Coffee Culture
- Royal Botanic Gardens, Kew
- RTC, Rwanda Trading Company
- RWACOF Exports
- Rwashoscco
- San'a University, Yemen
- Starbucks Corporation & Finca Alsacia
- Starbucks Foundation
- Southern Cross University, Australia
- Technoserve
- Texas A&M University
- UCB Catholic University of Bukavu, Democratic Republic of Congo
- UFV Universidade Federal de Viçosa, Brazil
- USAID United States Agency of International Development
- USDA Coffee Research Program

Cumulative industry investment

Worldwide, agricultural R&D gives a reliably high return on investment (global mean: 43%), but research benefits typically lag behind research spending by 15-20 years. World Coffee Research allows the coffee industry for the first time to invest in a global program of agricultural R&D. Slightly more than half of our of funding comes directly from coffee industry contributions, from companies large and small. We are able to nearly double the value of that investment by matching industry funds with grant funding, leverage, and in-kind contributions from our partners.

Income 2010-2017

Proportion of expenses 2010-2017



- Industry contribution to precompetitive agricultural R&D via WCR: **$7.8 million**
- Industry contribution to sustainability efforts in the same period: **$2.45 billion**
- Global value of coffee production in the same period: **$1.28 trillion**
- Industry spending on precompetitive agricultural R&D via WCR as a percentage of global production value of coffee in the same period: **.0007%.** The recommended investment in ag R&D is **1%** of GDP.

Our donors

- 1 Lounge Coffee & Roasters
- Allegro Coffee
- Ally Brazil
- Amcafe USA
- Arab Coffee
- Arbuckle Coffee
- Atlas
- Batdorf & Bronson
- Black Tap Coffee
- Bourlaug Institute
- Bridge Coffee
- Buckman Coffee
- Bunn
- C-coop
- Camel Coffee
- Caravela
- Center for Conflict & Development
- Coffee Libre
- Coffee Nexus
- Coffee Review
- Coffee Source
- Community Coffee
- Counter Culture Coffee
- Crop to Cup
- Cuperus Coffee
- Curtis Tribute
- Darkwoods Coffee
- DaTerra Brazil
- Driftaway Coffee
- Dunn Bros Coffee Franchising, Inc
- Eight O'Clock/Tata
- Equator Coffee
- Farmer Brothers
- Foodbuy
- GAE Rock
- Gavina
- Genius Coffee
- Green Mountain Coffee Roasters
- Greenfolia
- Greenway Coffee Co.
- Hans Neuman Stiftung Foundation
- Has Bean Coffee
- Honey Coffee Japan
- Illy
- Insight Beverages
- Intelligentsia Coffee and Tea
- InterAmerican Coffee
- Intercontinental Coffee
- Irving Farm
- Japan Roaster Network
- Java City
- Kaldi's Coffee
- Key Coffee
- Kickapoo
- Kyokuto Fadie
- La Marzocco International, LLC
- La Minita
- MARS
- Marubeni Food Corp
- Mercon
- Mikatajuku
- Mr. Espresso
- NEAT Coffee
- OLAM
- OLAM Americas
- Old City Coffee
- Origin Coffee Roasters
- Orsir Coffee Co.
- Ozo Coffee
- Ozone Coffee Roasters
- Pacific Espresso
- Peet's Coffee & Tea
- Philz
- Probat
- Prufrock
- Quaffe
- Rave Canada
- Rave Coffee
- Red Cedar Coffee Co
- Reunion Island
- RGC Coffee
- Robin Nance
- Rogers Charitable Fund
- Rose N Crantz
- Rose Park
- Ross Street Roasting
- Royal Cup
- S&D Coffee Roasters
- Salt Spring Coffee
- Sarutahiko Coffee, Inc
- SCAE
- Southern Viking Trading Co, LLC
- Specialty Coffee Association of Europe
- Specialty Coffee Association of Japan
- Spyhouse Coffee
- Square Mile
- Starbucks
- Sucafina
- Sweet Maria's Coffee
- Swiss Water Decaf
- Tate Coffee Roasters
- Taylor Street Roasters
- Taylors of Harrogate
- Terarosa/Haksan
- TetraTech
- The J.M. Smucker Co.
- TMR Café Services
- Toa Coffee Ltd
- Toby's Estate
- Tony's Coffee
- Tony's Coffee and Teas
- UCC
- Union Hand Roasted Coffee
- Vessel Coffee
- Walker Coffee
- Wilbur Curtis
- Workshop Coffee

Table 1. Key deliverables 2012-2017

WHAT	HOW	APPROACH	DOMAIN	PROGRESS
New varieties for climate change, quality, production, disease resistance	Global F1 hybrid breeding program with regional hubs, using existing germplasm	ENABLE	Breeding	60 F1 crosses made and in evaluation (created using new WCR core breeding population) 2 hubs established: Central America, East Africa
	Expand access to un-utilized germplasm through conservation (enable Robusta breeding and advanced breeding)	ENABLE	Genetics	Released global strategy w/ Crop Trust 2017
	Enable rapid, intelligent breeding through molecular marker discovery without GM	ENABLE	Genetics	Genetic linkage map study underway
	Incorporate quality targets to improve cup quality across all breeding	ENABLE	Chemistry/ sensory	Published WCR Sensory Lexicon 2016 Underway: ID sensory/chemistry targets for quality in breeding
Knowledge to transform Good Agricultural Practices to Best Agricultural Practices, raise farmer profitability	Global network of on farm trials -- variety/agronomy interaction, ROI and profitability	BOOST	Agronomy	Global platform launched 2017; 19 of 1200 sites in place.
	Test disease/pest management approaches and compile best practices for farmers	CREATE	Diseases / pests	Rust best practices technical manual published 2017; farmer version in 2018 Testing approaches on WCR farm
Disease/pest early warning system	Global network of on farm and research station variety trials	ENABLE	Diseases / pests	40 research station sites in 24 countries; 1200 farmer field sites in 20 countries by 2022
Enable sector-wide renovation with best-quality existing genetic material	Provide "variety intelligence" on expected variety performance and regional situation	BOOST	Agronomy	Published Central American coffee catalog: 2015 Africa version coming 2018
	Global network of on-farm trials—best-bet local and regional varieties for ROI	BOOST	Breeding / Agronomy	Global platform launched 2017; 19 of 1200 sites in place. 500,000 improved variety trees distributed by 2022.
	Enable new market segment: Quality-assured nurseries and seed	ENABLE		WCR Verified certification standard launched 2017
	Expand access to international best varieties through international variety exchange	BOOST	Breeding/ Agronomy	International Multilocation Variety Trial in place in 24 countries – countries currently evaluating

Table 1. Key deliverables 2012-2017, continued

Enable smart adaptation to climate change	Define suitable coffee areas and model future suitability globally	CREATE	Agronomy	Published first global model for arabica unsuitability 2015—suitabile land will decline by half Definition/modeling of future suitability underway
	Global network of on-farm trials, testing which combination of climate-smart agriculture approaches like soil conservation, shade, etc., produce highest benefits in yield, quality, profitability	BOOST	Agronomy	Global platform launched 2017; 19 of 1200 sites in place
Determine barriers of farmer uptake of new technologies	PhD research of adoption barriers in Yepocapa, Guatemala with smallholders in F1 hybrid renovation program	ENABLE	Socio-economics	Ongoing