Coffee & climate

Lovers of coffee would be alarmed to know that their favourite bean is in danger

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Even if the world contains global warming to two °Celsius, global vegetation would be far different from what it is. While there would be an increase in tree cover in some places and drying up at others, specific crops may not survive the rise in temperature. And one such is the Arabica coffee bean.

Aaron P Davis, Delphine Mieulet, Justin Moat, Daniel Sarmu and Jeremy Haggar, from Royal Botanic Gardens, Kew and the University of Greenwich, in the United Kingdom, Diade (DIversity-Adaptation-plant DEvelopment) Institute in Montpellier, France and Welthungerhilfe, an independent German non-governmental organisation working in Freetown, Sierra Leone, however, have some good news. They write in the journal, *Nature Plants*, that there is a wild variety of coffee, which matches the current leading variety, and could do well in a warmer world.

There are two main strains of coffee that are cultivated -- the most popular is Arabica and the second is Robusta. Arabica is known for its fine flavour and accounts for 60 per cent of the coffee grown. The Arabica plant, however, is delicate and needs care to bring home the crop. Robusta is not as high in flavour, but it is a hardier plant, and accounts for nearly all the remaining 40 per cent.

Arabica was grown at higher altitudes in Ethiopia, Africa, for several centuries. But the trade shifted to Yemen, and, from the port city, Mocha, the coffee travelled to all parts of the world. And as Yemen lies in the Arabian Peninsula, the variety got the name, Arabica. It is a mild coffee, rich in natural sugars and fats, moderate on caffeine and can be brewed to have much sought-after nuances of flavour and aroma. The Arabs tried protectionism, but seeds or seedlings were soon smuggled out to other lands and the Dutch grew coffee in plantations in Ceylon, Sumatra and Java. Coffee is now grown in many places, Brazil and India being important centres, and, in value of international trade, it is the world's largest agricultural product.

The coffee plant needs reasonable warmth, and plentiful rainfall. The ground should be well drained. Coffee is hence grown in the belt between 30 °north and south of the Equator, at places with hill slopes, for efficient drainage. Areas in Africa, South America and Asia were well suited and Arabica coffee was widely cultivated. The industry, however, hit a roadblock with the emergence of Coffee Leaf Rust, a fungus that forms on the leaves. It makes the leaves wither and the plant produces less berries and hence, less coffee.

The answer was in a related variety, which could resist the fungus, and some other parasites too. The new variety was also hardier and could manage in less exacting conditions. Naturally, the variety is called Robusta, and it has become enormously popular. It has higher caffeine content, which is a reason for its resistance to pests, but it does not have the delicate flavour of Arabica. However, Robusta is cheaper, and the two varieties are almost equally popular, with some who prefer Robusta, and there is a market for blends.

Enter global warming

Rising global temperature, however, would now affect both coffee varieties. "Successful coffee farming occurs within a relatively narrow climatic envelope and is susceptible to weather perturbations throughout its growth and life cycle, rendering it sensitive to climate change," the paper in *Nature Plants* says. It is considered that by 2050, half the acreage under coffee would become unusable for quality coffee.

The paper says that there are three possible solutions. The first, to relocate cultivation, would mean finding land in places with better conditions, and over 100 million livelihoods would have to be managed. The second is to adapt farming practices, like irrigation, providing shade or covering the soil. This has some potential but involves extra costs. And the third is to develop new, climate-resistant varieties. Efforts in this direction are on, but are in the early stages, the paper says. There are some 120 other varieties that would be able to survive warmer and drier conditions, but none of them has the flavour or other attributes of Arabica and Robusta.

This is the context of the attention shifting to a wild variety, known as *Coffea stenophylla*, found in Guinea, Sierra Leone and Ivory Coast, in West Africa. This, and other wild coffee varieties, which were studied and consumed in the late 1800s and early 1900s, had gone out of focus because of the overwhelming success of Arabica and Robusta. *Stenophylla* was a noted instance, the paper says, and it cites 19th century publications that say the species had "excellent taste, as good as the 'best mocha' and possibly superior to all other coffees, including Arabica." But such references died out by the 1920s, the paper says, probably because there was no cultivation and the species was rare even in the wild.

In 2018, however, field work revealed that *stenophylla* was still there in the wild, in Sierra Leone, in West Africa. In 2020, the current authors hence obtained sample *stenophylla* coffee beans. They were then brewed and evaluated by five professional panels, in a blind exercise, against a high-quality Arabica sample, from Ethiopia, a medium quality sample from Brazil and a high-quality Robusta sample from Indonesia.

The evaluation, across the five panels, and through detailed assessment of features and tasting notes, revealed that "*stenophylla* has a complex flavour profile, natural sweetness, medium-high acidity, fruitiness and good body, as in higher quality Arabica…These results credibly corroborate historical reports," the paper says.

But then, despite similarity in taste and aroma, the paper says, *stenophylla* differs widely from Arabica and Robusta -- evolutionary history is not shared, the areas of occurrence are widely separated, and environmental requirements are different. The paper estimates the mean temperature that suits *stenophylla* as 25-26 °C against 19.0 °C for Arabica. This is a margin of 6.8 °C, and there is a comparable margin in respect to Robusta.

The finding, that the new variety thrives at a higher temperature, opens the doors to developing an alternative to Arabica and Robusta in the face of climate change. But this apart, the paper notes that specialising the strains of Arabica and Robusta had effectively reduced the diversity of coffee strains. Crossbreeding, for flavour gains, resulted in loss of resilience. But with *stenophylla* entering the list of available species, this aberration could be corrected, the paper says.

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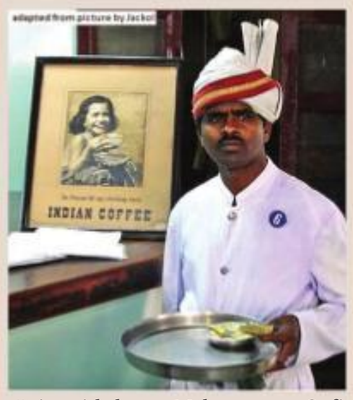
Indian coffee & Coffee Houses



It is said that a 16th century Sufi pilgrim smuggled coffee seeds from Mocha and brought them to Chikmagalur at the foothills of the Western Ghats. And since the 19th century, the potential for export led to vast areas under coffee in the hilly parts of south India.

In 1942, the Coffee Board was set up to regulate coffee production. To popularise coffee outside south India, the Board opened Coffee Houses in most cities in India. These became iconic centres, where aromatic coffee and quality snacks were served by turbaned waiters.

In 1957, it was considered that Coffee Houses had served their purpose and should be shut down. And the staff, mostly from Kerala, were offered a termination bonus. A delegation, led by A K Gopalan, the Marxist leader, however, met Jawaharlal Nehru and it was decided that instead of shutting down, each of the Coffee Houses would be offered to the staff working there, if they agreed to form an association. About half the Coffee Houses hence continued, under an umbrella Association of Coffee Houses. In time, in the face of competition, most of them closed down, with the premises, which were at prime locations, fetching handsome returns. Only a handful of the original Coffee Houses are working now, except in the city of Jabalpur, in Madhya Pradesh, which has eight outlets and houses the headquarters of the Indian Coffee Workers' Cooperative Society.

PLUS POINTS

Delta blues

The Delta variant of Covid-19 is associated with approximately double the risk of hospitalisation compared with the Alpha variant, according to a new nation-wide study in the United Kingdom. Two vaccine doses still provide strong protection against the Delta variant -- which was first identified in India -- but it may be at a lower level compared with the Alpha variant, early evidence suggests.

Based on data analysed from 5.4 million people in Scotland, the Delta variant is now the dominant form of Covid-19 cases in the country, overtaking the Alpha variant, which was first identified in Kent. During the period studied -- 1 April to 6 June 2021 -- there were 19,543 community cases and 377 hospitalisations where a specific variant of Covid-19 was confirmed. Of them, 7,723 cases and 134 hospitalisations were found to have the Delta variant. People with underlying conditions were more at risk of being hospitalised, researchers said.

The researchers said that to increase confidence in these early findings, the research needs to be repeated in other countries and settings. The team also said that because of the observational nature of the study, data about vaccine effectiveness should be interpreted with caution and it is not possible to make a direct comparison between both vaccines.

Chris Robertson, professor of public health epidemiology in the University of Strathclyde's department of mathematics and statistics, and head of statistics at Health Protection Scotland, was a partner in the study. He said, "It is important to recognise that these are preliminary results using rapidly accessible data. A fuller understanding will come when the results presented are combined with similar analyses from other data sets in the UK."

Jim McMenamin, Covid-19 National Incident Director for Public Health Scotland said, "These results provide early encouragement that two doses of either Pfizer-BioNTech or Oxford-AstraZeneca vaccines significantly reduce the risk of infection against both the Alpha or new Delta variants. They also show the vaccines offer protection against the risk of hospitalisation with the new Delta variant. Though no vaccine can be 100 per cent protective, they provide the best protection against Covid-19 and it remains important to get both doses when offered."

Vaccines were found to reduce the risk of being admitted to hospital, but strong protective effects against the Delta variant were not seen until at least 28 days after the first vaccine dose. In community cases at least two weeks after the second dose, the Pfizer-BioNTech vaccine was found to provide 79 per cent protection against infection from the Delta variant, compared with 92 per cent against the Alpha variant.

For the same scenario, the Oxford-AstraZeneca vaccine offered 60 per cent protection against infection with the Delta variant compared with 73 per cent for the Alpha variant. This lower vaccine effect may reflect that it takes longer to develop immunity with Oxford-AstraZeneca, experts say.

Delta variant cases were identified through initial polymerase chain reaction testing results, which reveal whether what is known as the S gene is present. Delta variant cases are positive for the S gene whilst Alpha variant cases tend to be S gene negative. The research team from Strathclyde, the University of Edinburgh and Public Health Scotland, analysed a dataset as part of the "Early Pandemic Evaluation and Enhanced Surveillance of Covid-19" project, which uses anonymised linked patient data to track the pandemic and the vaccine roll out in real time.

The results are published as a research letter in *The Lancet*. Research letters are externally peer-reviewed, and their findings are usually preliminary or exploratory.

FUTURE BUILT ON THE PAST

The first mobile phone call was 75 years ago. Here's what it takes for technologies to go from breakthrough to big time

DANIEL BLISS

I have a mobile phone built into my watch. People now take this type of technology for granted, but not so long ago it was firmly in the realm of science fiction. The transition from fantasy to reality was far from the flip of a switch. The amount of time, money, talent and effort required to put a telephone on my wrist spanned far beyond any one product development cycle.

The people who crossed a wristwatch with a mobile phone worked hard for several years to make it happen, but technology development really occurs on a timescale of decades. While the last steps of technological development capture headlines, it takes thousands of scientists and engineers working for decades on myriad technologies to get to the point where blockbuster products begin to capture the public's imagination.

The first mobile phone service, for 36-kilogram telephones installed in cars, was demonstrated on 17 June 1946, 75 years ago. The service was only available in major cities and highway corridors and was aimed at companies rather than individuals. The equipment filled much of a car's trunk, and subscribers made calls by picking up the handset and speaking to a switchboard operator. By 1948, the service had 5,000 customers.

The first handheld mobile phone was demonstrated in 1973, nearly three decades after the introduction of the first mobile phone service. It was nearly three decades after that before half the United States' population had a mobile phone.

Big history in small packages

As an electrical engineer, I know that today's mobile phone technology has a remarkable number of components, each with a long development path. The phone has antennas and electronics that allow signals to be transmitted and received. It has a specialised computer processor that uses advanced algorithms to convert information to signals that can be transmitted over air. These algorithms have hundreds of component algorithms. Each of those pieces of technology and many more have development histories that span decades.

A common thread running through the evolution of virtually all electronic technologies is miniaturisation. The radio transmitters, computer processors and batteries at the heart of your mobile phone are the descendants of generations of those technologies that grew successively smaller and lighter.

The phone itself would not be of much use without cellular base stations and all the network infrastructure that is behind them. The first mobile phone services used small numbers of large radio towers, which meant that all the subscribers in a big city shared one central base station. This was not a recipe for universal mobile phone service.

Engineers began working on a concept to overcome this problem at about the time the first mobile phone services went live, and it took nearly four decades to roll out the first cellular phone service in 1983. Cellular service involves interconnected networks of smaller radio transceivers that hand off moving callers from one transceiver to another.

Military necessity

Your mobile phone is a result of over a hundred years of commercial and government investment in research and development in all of its components and related technologies. A significant portion of the cutting-edge development has been funded by the military.

A major impetus for developing mobile wireless technologies was the need during World War II for troops to communicate on the move in the field. The SRC-536 Handie-Talkie was developed by the predecessor to Motorola Corporation and used by the U S Army in the war. The Handie-Talkie was a two-way radio that was small enough to be held in one hand and resembled a telephone. Motorola went on to become one of the major manufacturers of mobile phones.

The story of military investment in technology becoming game-changing commercial products and services has been repeated again and again. Famously, the Defense Advanced Research Projects Agency developed the technologies behind the Internet and speech recognition. But Darpa also made enabling investments in advanced communications algorithms, processor technology, electronics miniaturisation and many other aspects of your phone.

Looking forward

By realising that it takes many decades of research and investment to develop each generation of technology, it's possible to get a sense of what might be coming. Today's communications technologies -- 5G, WiFi, Bluetooth, and so on -- are fixed standards, meaning they are each designed for a single purpose. But over the last 30 years, the U S's department of defence and corporations have been investing in technologies that are more capable and flexible.

Your phone of the near future might not only fluidly signal in ways that are more efficient, enable longer ranges or higher data rates, or last significantly longer on a charge, it might also use that radio frequency energy to perform other functions. For example, your communications signal could also be used as a radar signal to track your hand gestures to control your phone, measure the size of a room, or even monitor your heart rate to predict cardiac distress.

It is always difficult to predict where technology will go, but I can guarantee that future technology will build on decades upon decades of research and development.

The writer is professor of electrical engineering, Arizona State University, United States. This article first appeared on *www.theconversation.com*