

Coffee leaf rust is bad news

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When I think of Ceylon — Sri Lanka — I think of tea, but that's because I wasn't alive 150 years ago. In the 1860s, coffee was the island's most important crop. Coffee leaf rust, a fungus, put paid to the coffee, but only after a global downturn in coffee prices, and planters switched to tea. The rust, however, is not the reason the Brits drink tea rather than coffee, just one of the things I learned from Stuart McCook, who has studied the history of coffee leaf rust and what it might hold for the future.

Stuart McCook: My name is Stuart McCook. I am a historian at the University of Guelph in Ontario, Canada, and my research focuses on the environmental history of coffee. Most recently I've published a book called *Coffee is Not Forever* which is a global history of the coffee leaf rust.

Coffee leaf rust is a fungus which is native to equatorial Africa. You can think of it running from western Africa in Liberia through to the eastern part of Africa; Kenya, Ethiopia, and places like that.

Jeremy: Of course, it didn't stay in Africa. When coffee went global, so, eventually, did coffee leaf rust. We'll get to that.

First, though, there's something we need to get out of the way right at the outset. Like many of the diseases that attack our favourite commodities, in the short term, at least, coffee leaf rust is not a threat to your coffee.

Stuart: Some of my very earliest media interviews on this about 10 years ago — and this is in Canada — and they're saying, "Well, what is the meaning of this for Canadians?" The short answer is, well, not much. [chuckles] Then I started to think about, well, what does that mean more generally and really the burdens of a lot of these diseases are born almost exclusively by the producers who are economically and almost in every other respect the most vulnerable people in this whole chain.

¹ <https://www.eatthispodcast.com/coffee-rust/>

Jeremy: That's definitely something to bear in mind.

But back to coffee leaf rust. The man who identified the fungus, the Reverend Michael Berkeley, who also identified the cause of potato late blight, named it *Hemileia vastatrix*. Hemileia means half smooth, and describes the shape of the spores. And vastatrix is devastating.

Stuart: The interesting thing is, it's not inherently devastating but it was given its name at a moment when it became devastating.

In the wild, it's a minor disease. You can think of it as in some ways not unlike athlete's foot. It's irksome but not anywhere close to fatal or even particularly inconvenient, but one of the big stories of the rust is that as people started to change the way they farmed coffee and they moved coffee to new environments they, unfortunately, created the situations in which this minor disease could become much more severe.

Jeremy: How did it manifest itself to, as it were, western coffee growers?

Stuart: Well, it first manifested itself in Ceylon, which in the mid 19th century was actually a coffee island. It's now, of course, famed for being a tea island but this is before that.

What happens, the way the fungus begins is, it starts its life as a spore. You can think of it as almost baking flour; very, very fine particles. The spore lands on the underside of a leaf of the coffee tree and in the presence of water droplets, it will germinate and it will penetrate the leaf tissue and essentially feed off the leaf tissue. A British biologist in the early 20th century described these fungi as the vampires of the vegetable world. I kind of like that turn of phrase. When the fungus completes its life cycle, it breaks out and then releases hundreds of thousands of new spores which then go on to infect adjacent plants.

How this matters from a farmer's perspective is, leaves that have many of these lesions — they are orange rust-colored spots — the leaves fall off prematurely and the leaves, of course, are a major source of nutrients for the trees. So, if the leaves fall off, the fruits don't develop at all. The fruit doesn't develop properly but then there's also what are called secondary losses, which means that the branches that are going to bear the next year's crops also don't

develop fully. So, there's short term losses and intermediate-term losses.

Jeremy: Can the tree actually recover?

Stuart: Yes. I mean, this is one of the things that makes the disease, or made the disease, hard to read for farmers. Even under intensive cultivation situations, what happens is the trees will bear very heavily one year and then in part, they're a little bit exhausted, even healthy trees I mean here. And what the rust did initially was it kind of amplified that cycle. The troughs got lower. But then if you look at the average amount of production from one season to the next, in Ceylon at least it declined fairly rapidly.

I will say that when you see a tree that's had a bad rust infestation, it looks really bad, because a bad infestation can strip a tree almost entirely of its leaves and it looks dead. But the next year, it will throw a new set of leaves and start over again.

Jeremy: What happened in Ceylon, in Sri Lanka?

Stuart: Well, nobody had had any experience with this before. What had happened was that coffee had managed to circulate globally through Yemen and the disease for a while at least remained contained on the African continent. Most coffee growers weren't even aware of it.

It came as a real surprise to the growers of Ceylon and they were able to ride out the epidemic a little bit through the 1870s in part because coffee prices remained relatively high for growers and in fact grew fairly rapidly during the 1870s. Even as they were losing production, in many cases, their revenue was still going up. So, they could coexist with the disease. They weren't necessarily happy about it. But then in the 1880s, as Brazilian production began to expand globally and coffee prices began to fall, coffee for many farmers in Ceylon was no longer profitable. They couldn't manage the rust and the low prices together. They pretty much *en masse* abandoned coffee for tea. That's how Ceylon became the tea island we know today.

Jeremy: You're quite clear that this has nothing to do with why the Brits drink tea rather than coffee. The story is that that's what made the Brits drink tea.

Stuart: It's such a beautiful story. I really felt bad [laughs] about blowing it up because it is a lovely story. It's one I told myself when I started teaching this, but it defies logic. I mean, Ceylon only became a major coffee producer in the 1840s and the British coffee drinking tradition is a lot older than that. Also if you just look at the evidence, Great Britain sourced its coffee from all around the world and Ceylon was only a small part of that. Wherever we're going to look for the great British consumption switch from coffee to tea, you're not going to find it with the coffee rust in Ceylon.

Jeremy: Somehow, rust got to Ceylon and combined with low prices devastated the industry there. But coffee, as you said, was already growing in Brazil. Did rust follow coffee around? Did it threaten other coffee plantations or was it restricted to Ceylon?

Stuart: It remained restricted to Ceylon for a very short period of time but then within a few years had reached the coffee farms of southern India, which were fairly significant, and then by the 1870s and 1880s had reached the Dutch East Indies and in particular, of course, the island of Java. But also Sumatra which had been up until that point ... the Dutch East Indies was the world's, I think, third largest coffee producer. Their arabica farms were devastated at a fairly large scale. What had happened in part was that coffee farmers had been able to push arabica production cultivation at a certain point to its ecological limits both in terms of temperature and humidity. In the Dutch East Indies, they grew a lot of arabica at fairly low altitudes in wet environments. Those warm and wet environments were perfect for the fungus to prosper. That's what ultimately led the Dutch to switch to robusta.

Jeremy: Because robusta is resilient?

Stuart: Yes.

Jeremy: Once they'd identified it as a fungus and worked out how it was being transmitted and how it was moving from plant to plant, country to country, how did the West respond to the disease? Are there fungicides that can deal with it or ... what's the response?

Stuart: One of the things that is useful to think about when you're thinking about crop diseases is ... I think we often focus on the fungus. A disease is really a combination of three things: the pathogen, in this case, the fungus; a susceptible host; and the

environmental conditions and particularly the conditions of the farm but also the larger environmental conditions. If you're going to control a disease, generally control methods have focused on one of those three things.

Certainly, in the late 19th and early 20th century, one of the ways of controlling the rust was to use fungicides. The 19th century, late 19th century, is the great age of chemistry. Chemistry really comes into its own as a discipline and so there are all these new chemicals being developed which make their way out into the field. Certainly, coffee planters in the eastern hemisphere were experimenting with chemicals, and they could find chemicals that would basically coat the leaves with copper sulfide and that would prevent the fungus from germinating and penetrating the plants. The challenge there is that fungicides require a lot of technology, a lot of labor, and basically a lot of money. In many cases, even though it was a technical solution, the solution just wasn't economically viable for a lot of coffee farmers, unless you were a very large farmer and very well-capitalized.

Jeremy: Then you mentioned also the susceptible host and the environment. The susceptible host thing is what underpins some of the move to robusta.

Stuart: Correct, yes. It grows very well in precisely the warm and wet lowlands where arabica had been most susceptible to the rust. The Dutch really promote its cultivation and to a large extent, the coffee production in Java and Sumatra recovers on the basis of robusta, and then robusta spread to a lot of other areas as well as a replacement for arabica coffee. In many respects, robusta is fantastic. Agronomically, it's resistant to the rust. It's good at low altitudes. It looks great. It's got more caffeine for that matter. The only problem is, it tastes bad. Or at least, the markets decided that it tasted bad.

Jeremy: There is still a snobbishness about robusta, although I've heard people say you can get perfectly good robustas.

Stuart: I was in India earlier this year and I had an amazing cup of robusta. It was smoky and complicated, and definitely not arabica but definitely a really good and really interesting cup of coffee.

Jeremy: Okay. Let's get back to the environment because this is really an interesting one. One of the things you said at the outset was

that rust likes humidity, and it requires a wet leaf and what have you. We've got this thing about shade-grown coffee versus, I guess, open-grown coffee, sun-grown coffee. I would have thought that shade-grown coffee would be more susceptible to rust for the reason that it doesn't get dried out by the sun quite so quickly. Is that an issue?

Stuart: It is an issue. The connections between shade and rust are really, really complicated. Much ink has been spilled in the scientific literature on exactly this question. Certainly, one of the things that can happen in a shaded environment is they can be more humid. On the other hand, having let's say a more agro-ecologically complex landscape — so thinking not just about shade, but the biological diversity — will also act, to a certain extent, as a barrier against the diffusion of the rust. It's not simple, because one of the things that makes large monoculture farms so susceptible, is that if you've got an infected tree that is surrounded by thousands or tens of thousands of other genetically identical trees, you can think about it as almost like nuclear fission or something like that. A single lesion releases 100,000 spores, and then they float through this coffee farm and infect 1,000 trees, and it explodes geometrically very, very quickly. Whereas in a more agrobiodiverse farm, the opportunities for the fungus to reproduce itself are not as great.

Jeremy: So far we've been talking mostly about the eastern hemisphere, but Brazil, Colombia, they're developing huge coffee industries. Were they threatened by the rust? Were they wary of it?

Stuart: Absolutely. Yes, they were. For a long time the Americas, which by the late 19th century produced most of the world's coffee — in fact, I think 1885 Brazil produced about 80% of the world's coffee — the Americas had remained largely free of the rust and wanted to remain so. Then after about World War II, as the rust started spreading through Central and Western Africa, they realized that the writing was on the wall.

Indeed, the rust crossed over to Brazil in the 1970s and then made its way through Latin America in the 1970s and 1980s. By this point, the global coffee industry was fairly heavily regulated and governments were heavily involved in coffee production and in coffee research. It was often easier for farmers to get loans and technical support for things like fungicides to control the rust. Then a lot of the governments also focused on the susceptible host part of the

triangle and breeders were working furiously to develop varieties of arabica that were rust-resistant.

Jeremy: You mentioned that it got into Brazil and then spread through South America, Latin America, Central America. They had a long time to prepare for it. How come it got away from them?

Stuart: Ultimately because there's no way of stopping it really. Fungi are almost inexorable. They are carried by people. They can travel apparently thousands of kilometers on winds and it was certainly conceivable that they could have been carried across the South Atlantic on winds from Angola over to Brazil. Then, really, once it's rooted in an ecosystem, it's hard to get it out short of essentially eradicating all of the coffee.

Jeremy: It didn't eradicate the coffee industry.

Stuart: No. There's a couple of things going on. One is certainly in Latin America, one of the big responses, particularly in Brazil, Colombia, Costa Rica, and in pockets elsewhere, Mexico, was what they called technification. This is the move to the intensively cultivated Green Revolution-style sun coffee, using high yielding dwarf arabicas, which means you could plant a lot more arabicas. These coffees were still susceptible to the rust, but they were ... The economic logic behind technification was you produce so much more coffee, that you could pay for the costs of chemical spraying and chemical fertilizers to manage the rust.

The other thing that happened was that some landscapes in Latin America, some of the highlands of Brazil, particularly Minas Gerais, parts of Colombia, and the highlands of Central America, are high enough and cool enough that the rust is present, but not a major problem because the macro-environmental conditions — the climate, the weather — are inimical to the rust. You could coexist with it reasonably easily. Many farmers did up until 10 years or so ago.

Jeremy: It's interesting you mention that, because about 10 years or so ago, we started hearing this story that climate change was going to devastate coffee because higher cooler areas — well, they were still going to be higher — but cooler areas, drier areas were going to become warmer and wetter. Has that happened?

Stuart: Yes. It's starting to happen and it's happening in complicated ways and it manifests itself in different ways.

At lower altitudes, I understand that farmers are, in some cases, abandoning arabica in part just because the conditions aren't good in general for cultivating arabica. What you hear people talking about is arabica moving up the mountainside as farmers abandon coffee production in lower areas and then move up to higher altitudes. Beyond those raw temperature things, one of the other less visible impacts of climate change is its impact on diseases and pests. One of the things that has helped historically keep rust in check in a lot of places, is that a lot of the coffee lands have well-marked dry seasons. What happens over the dry season is that a lot of the rust essentially dies off and so it helps keep the population of rust in control. As rainfall patterns change, as the dry seasons are less well-marked, it means that more of the rust, more of the inoculum, survives from one season to the next. The other thing is, even during a growing season, a slightly warming temperature means that you can have several more generations of the rust reproduce and propagate over the course of a single growing season. And this, of course, is just one disease.

Jeremy: [laughs] Let's stick with the one disease. One of the things that struck me about this particular campaign, and I've seen it coming in all forms, and from all places that would like us to pay attention to climate change, and that think maybe that by threatening our favorite beverage, they're going to manage that, is, it doesn't actually seem to impact coffee drinkers. The outbreaks of diseases ... there is still coffee on the shelves. It's what you said about Ceylon right at the outset, I mean. It's a global market, and prices may change and sources of supply may change, but we can afford it. We keep drinking coffee. It's not actually having any impact.

Stuart: Not right now. I mean, I think part of the problem is that a lot of the outbreaks that I've been describing have been limited to one geographical area. In some ways, the big challenge of the global coffee industry since the last 120 years has been chronic global overproduction. Shortfalls in one area can typically be made up with excess production in other areas. The one thing I would say that, as we look forward to the next 10, or 20, or 50 years is that climate change is going to be hitting all of the coffee lands simultaneously. It might not be hitting them all with equal intensity, and it might not be hitting them all in the same way, but some of the forecasts about what climate change is going to do to coffee in general, are somewhat alarming.

Jeremy: What that suggests to me is that tying climate change to the cup of coffee with your breakfast, possibly is not going to have much impact, but thinking about the long term future for coffee ... When was the last coffee shortage? I mean it just doesn't seem to be something that people can get hold off?

Stuart: No, I mean, there had been a brief supply crisis. I think the last one I can think of was early 1950s probably. I think the one thing I would say is that for the people who really enjoy the high-quality specialty coffee, a lot of the world's finest coffees are perhaps ironically grown in some of the most ecologically fragile areas, the ones most susceptible to a lot of the things I'm describing here. Those are places where substitutes are harder to find. If you're just talking about commodity coffee, there's a lot of that produced all around the world. But the world's best coffees, those are only grown in a handful of landscapes.

Jeremy: Those specialty coffees, which are something of an elite taste, those might suffer as it were disproportionately?

Stuart: They may. Yes, but there is a lot of work to be done. I suppose one of the lessons of the countries that have successfully managed the coffee rust, and the places that have successfully managed the coffee rust, is it takes a collective effort. It takes states that are willing to invest in it, it takes farmer associations that are willing to invest in it. Grappling with this problem is beyond the capacity of any individual farmer.

Jeremy: That's interesting. As a tangent, when the main market is geographically and ecologically distinct from the producing countries, what's the best way for them to contribute?

Stuart: This is a good question. I mean, one of the things, of course, that has been very popular in the last generation or so are certified coffees, and those offer a greater ... offer farmers more of a living wage, and also offer other different kinds of benefits. I think those are ones that can really help. But some of the other stuff is a little bit more ... it's a little bit harder for consumers to really help. It involves choices made by larger businesses or governments about what kind of support they're willing to offer.