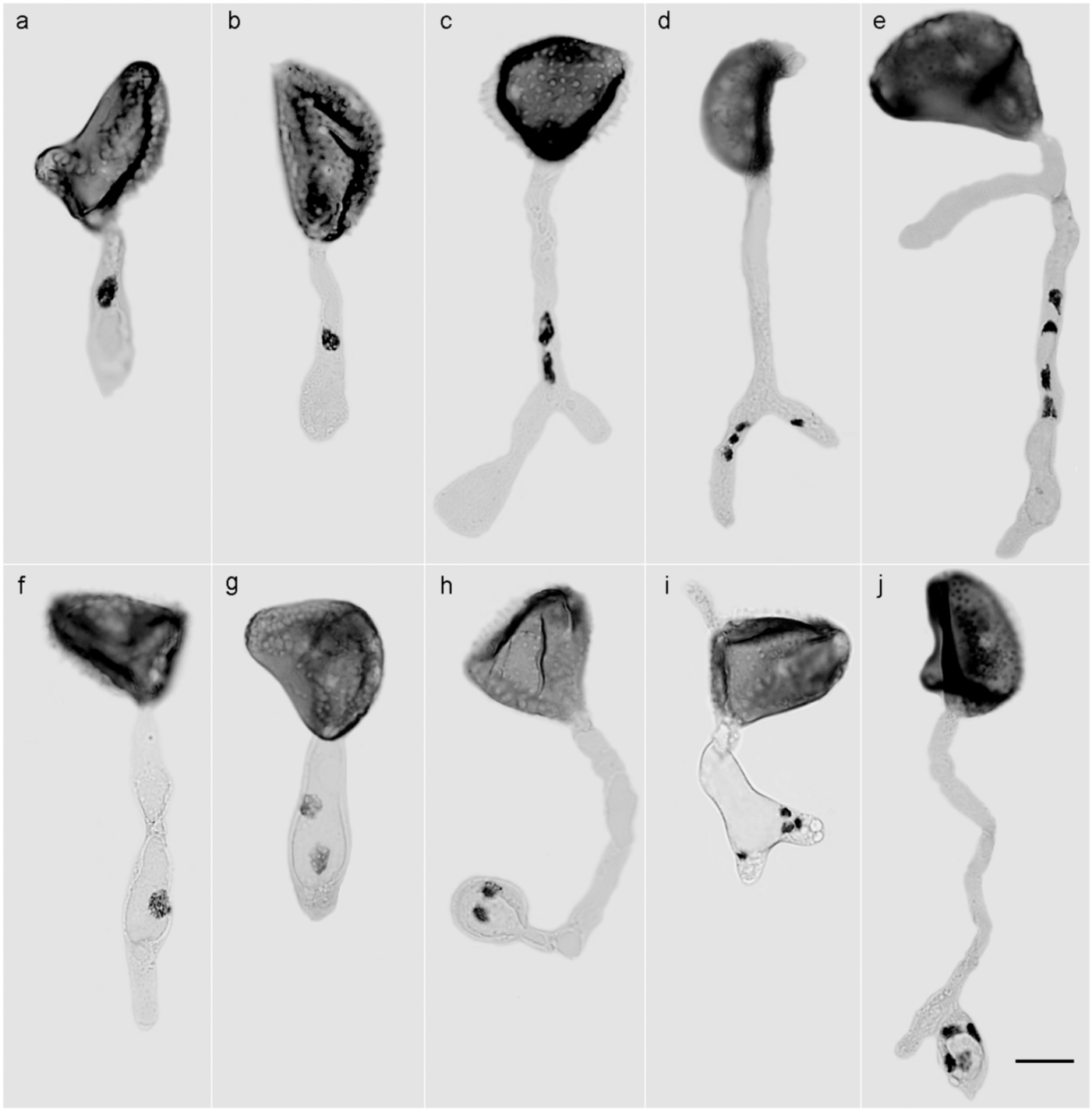
Coffee Leaf Rust (Roya) in Puerto Rico: The Silent Threat

Coffee leaf rust, known in Spanish as la roya, is one of the most significant biological threats Puerto Rican coffee has ever faced. Caused by the fungus

Hemileia vastatrix, roya has shaped the island's coffee industry in ways that rival even the major hurricanes. The disease forced the development of Puerto Rico's only locally-bred coffee varieties, Limaní and Frontón. It continues to pose active management challenges for every farm on the island. And it represents a biological risk that is likely to grow, not shrink, as climate change progresses. This article documents what roya is, how it arrived in Puerto Rico, and how the island has responded to one of coffee's most persistent adversaries.

What Is Coffee Leaf Rust?

Coffee leaf rust is caused by Hemileia vastatrix, a fungus in the order Pucciniales (rust fungi). The disease attacks the leaves of coffee plants, producing characteristic yellow-orange powdery spots on the undersides of affected leaves. Infected leaves eventually yellow, brown, and fall from the plant. Severe infections can defoliate a coffee plant within weeks, preventing the plant from photosynthesizing and producing cherries. In extreme cases, the disease kills the plant entirely.

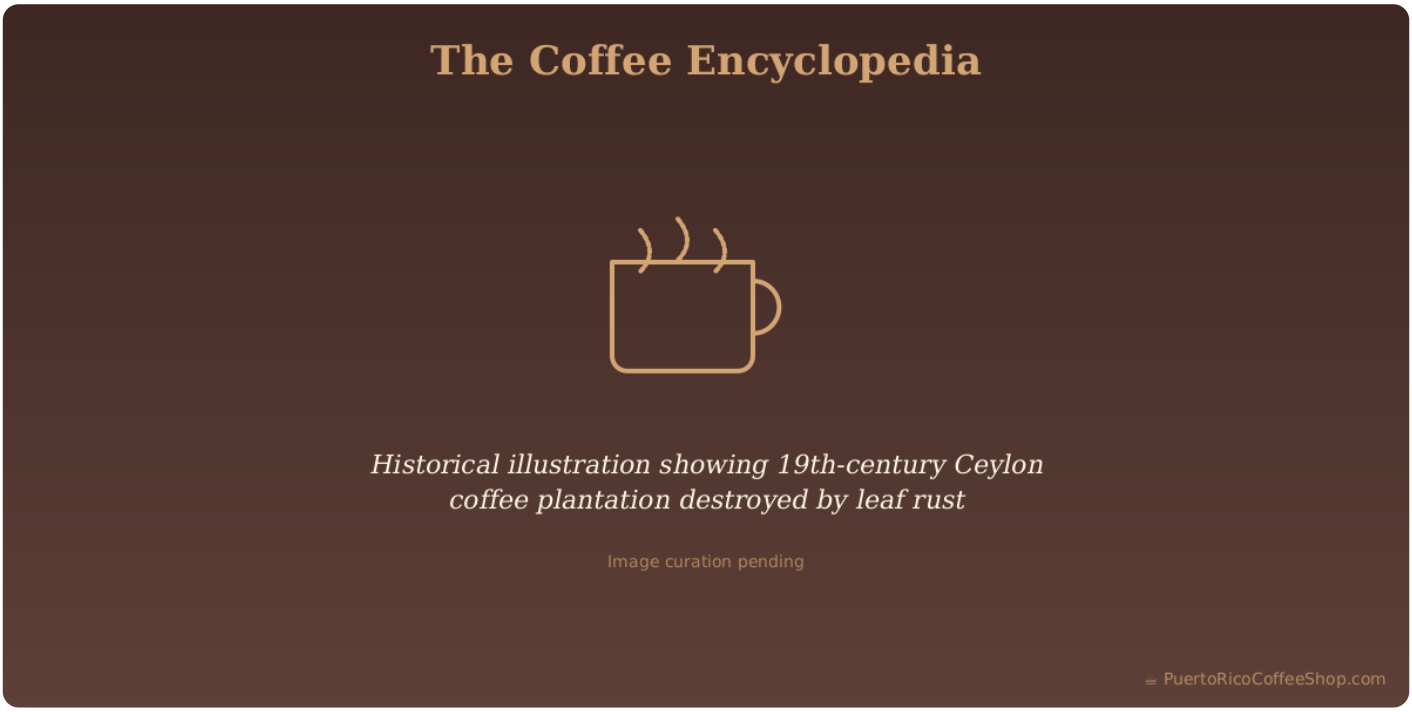


The fungus spreads through microscopic urediniospores that travel on wind, rain splash, insect vectors, human clothing, and animal movement. A single infected leaf can produce millions of spores, each capable of initiating a new infection on any susceptible coffee plant it reaches. The disease requires specific conditions to thrive — moderate temperatures, high humidity, and surface water on leaves — all of which are standard

features of coffee-growing tropical climates including Puerto Rico.

The Global History of Roya

Coffee leaf rust has a long and destructive history in global coffee production. The disease was first described in Africa in the 1860s and soon devastated the coffee industries of Ceylon (now Sri Lanka), Java, and other Asian coffee-producing regions. Ceylon's coffee industry, which had been among the largest in the world, collapsed entirely between 1870 and 1880 due to roya. Farmers converted their former coffee estates to tea production, which is why Sri Lanka today is known for tea rather than coffee.

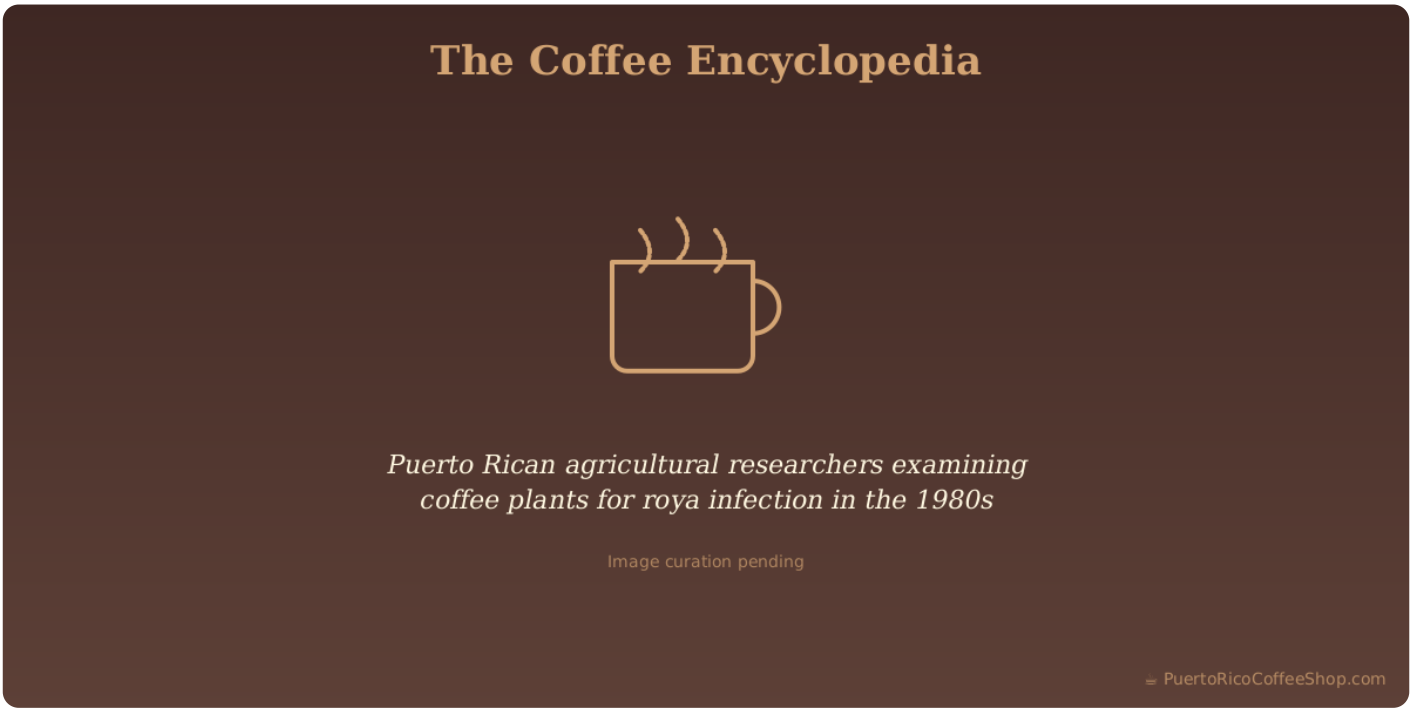


The disease reached the Western Hemisphere in 1970, when it was discovered in Brazil. From there it spread steadily through Central America, the Caribbean, and eventually all coffee-producing regions of the Americas. Puerto Rico detected its first cases of roya in the early 1980s, and the disease has been present on the island continuously since then. A major regional epidemic between 2012 and 2013 damaged

coffee crops on approximately 70% of farms across Latin America, causing over $3 billion in damage — an event that serves as a reminder of what roya can still do under the right conditions.

Roya Arrives in Puerto Rico

When roya was detected in Puerto Rico in the early 1980s, the island's dominant coffee varieties were Typica, Bourbon, and Caturra — all three highly susceptible to the disease. Agricultural researchers at the Agricultural Experimental Station in Adjuntas immediately recognized that the industry faced a long-term structural threat. Without rust-resistant varieties suited to Puerto Rican conditions, the island's coffee production would likely collapse over the following decades, just as Ceylon's had a century earlier.

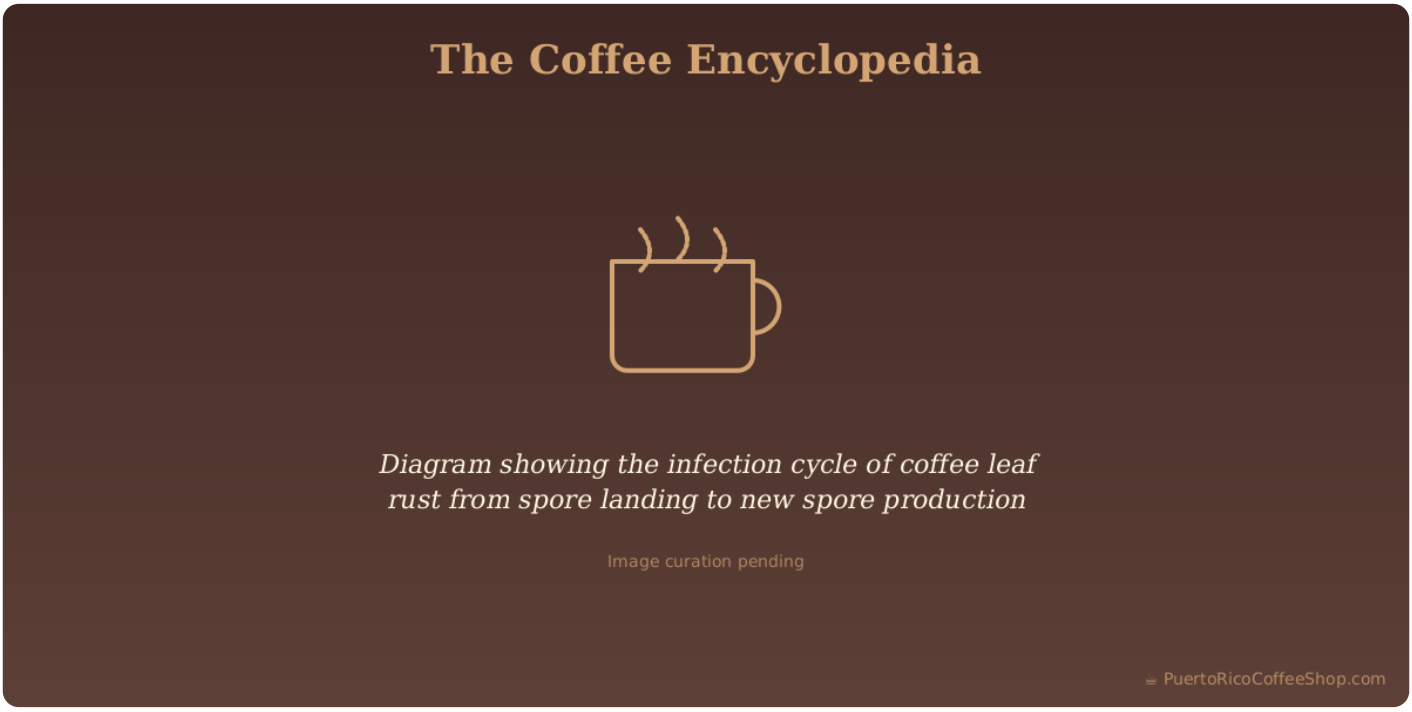


The response was immediate and sustained. Puerto Rican coffee scientists began breeding programs to develop rust-resistant varieties. They crossed the Timor Hybrid — a naturally occurring Arabica-Robusta cross that provided rust resistance — with Villa Sarchi, a high-quality Costa Rican variety. The resulting hybrid, named Limaní after the

neighborhood in Adjuntas where it was developed, was officially released to Puerto Rican farmers in 1994 after decades of evaluation. A parallel breeding effort produced Frontón. These two varieties remain Puerto Rico's only locally-bred coffee cultivars and are grown nowhere else in the world.

The Mechanism of Infection

Understanding how roya spreads and infects coffee plants helps farmers design effective management strategies. The fungus requires water on leaf surfaces to germinate. When spores land on a wet leaf, they produce a germ tube that enters the leaf through stomata — small pores on the leaf's underside. Inside the leaf, the fungus grows between plant cells and eventually produces new spores that erupt through the lower leaf surface as the characteristic orange powdery pustules.



Under ideal conditions, the entire cycle from spore landing to new spore production takes about 3-4 weeks. A single infected leaf then becomes a source for thousands of new infections, creating exponential disease pressure during favorable weather. This is

why a small initial infection can explode into a farm-wide epidemic within a single growing season, and why early detection and rapid response are essential for effective management.

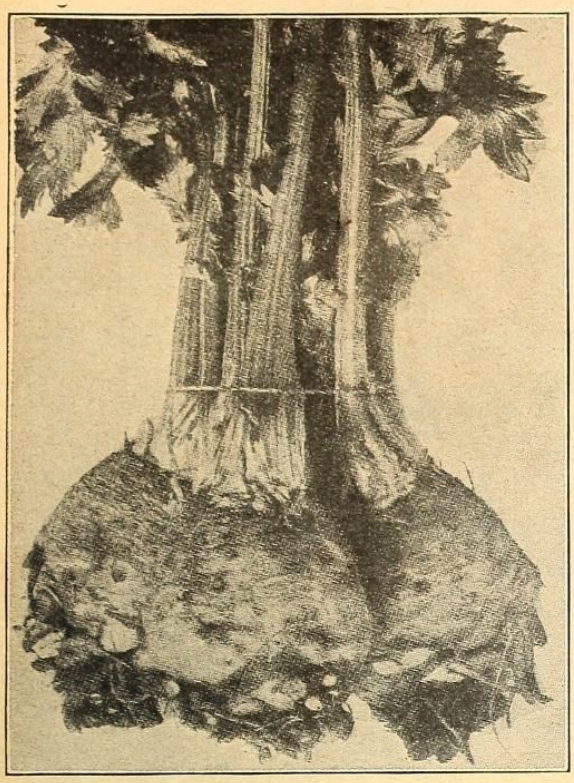
Symptoms Farmers Watch For

Experienced Puerto Rican coffee farmers inspect their plants regularly for early signs of roya. The most diagnostic symptom is the orange-yellow powdery spot on the underside of leaves, typically 1-2 centimeters across. On the upper surface, these spots appear as small yellow patches. As infection progresses, leaves turn yellow, brown, and fall from the plant. Severe infection results in defoliation, stunted growth, reduced cherry production, and in extreme cases plant death.

Farmers typically check plants during the rainy season, when disease pressure is highest. High-altitude farms with cool, wet microclimates face the greatest risk. Farmers particularly monitor the most productive trees, as heavily-loaded coffee plants are often more susceptible to fungal infection due to resource allocation between fruit production and plant defense. Certain varieties — especially Typica and Bourbon — require more frequent inspection than resistant varieties like Limaní.

Management Strategies in Puerto Rico

Puerto Rican farmers use a combination of strategies to manage roya. Variety selection is the first line of defense. Planting Limaní, Frontón, Marsellesa, Obatá, or other rust-resistant varieties dramatically reduces the disease pressure a farm must manage. Some farms maintain small plots of susceptible heritage varieties like Typica for specialty purposes, but most production acreage is dedicated to resistant cultivars.



Large Smooth Prague Celeriac.

CHICORY

Large-Rooted or Coffee—Sow the seed early in spring in moderately rich ground in rows 2½ feet apart and thin to 3 inches in the row. The young leaves are used as a salad. The roots when dried and ground are used to mix with coffee.

Pkt., 5c; oz., 20c; ¼ lb., 60c; 1 lb., $2.00.

Witloof Chicory (French Endive)—Used as a winter salad. Sow the seed in June in drills 12 inches apart, selecting deep, rich soil. Long parsnip-like roots are formed which should be taken up early in November and the leaves cut off about 1½ inches from the neck and all shoots trimmed off; the lower end of the roots may also be cut so as to have all a uniform length of 8 to 10 inches. A trench should be opened 16 to 18 inches deep and the roots placed upright in it 1½ inches apart, and filled in with light soil, which places the neck of the roots about 8 inches below the level. If a quick growth is desired a covering of manure 10 inches deep may be used. In a month's time the leaves will be ready for use, and should be taken up cutting off the blanched head with a portion of the root attached. The roots may also be forced in a cellar covered to exclude light. **Pkt., 10c; oz., 25c; ¼ lb., 75c; 1 lb., $2.50.**

CHIVES Schnittlauch.

Used principally for seasoning salads. Sow the seed early in spring, or divide clumps of plants, which are hardy and multiply rapidly.
Seed—Pkt., 10c; oz., $1.00; ¼ lb., $2.50.
Plants—Per clump, 20c.

CELERIAC (Turnip-rooted Celery).

Grown for its bulbous roots which are excellent for soups and stews, or cooked and sliced as a salad. Seeds are sown and plants transplanted the same as ordinary celery, only that it is not necessary to earth up the plants. Set the plants in rich soil in rows two feet apart and six inches apart in the row. The roots will keep over winter in a cellar packed in sand, or outdoors covered with earth and straw.

Large Smooth Prague—Extra Selected Stock—An improvel strain with very large, smooth roots. **Pkt., 10c; oz., 25c; ¼ lb., 75c; 1 lb., $2.50.**

CHERVIL

An annual plant resembling parsley, possessing a pleasing aromatic flavor. The young leaves are used for flavoring soups and in mixed salads. Sow the seed early in spring in rich soil in drills 1 foot apart, where it will have partial shade. The seed germinates slowly.
One ounce to 100 feet of drill.

Curled—Used for flavoring soups and salads. **Pkt., 5c; oz., 15c; ¼ lb., 40c; 1 lb., $1.50.**

CORN SALAD

Sow in shallow drills 1 foot apart during August and September, covering the plants with straw before hard frost.
One ounce to 40 feet of drill.

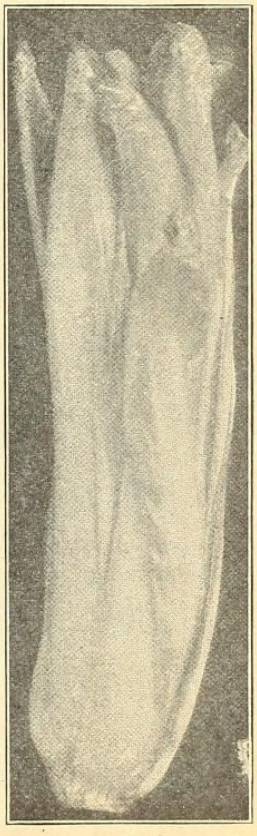
Large-Leaved—Used as a fall and winter salad. **Pkt., 5c; oz., 15c; ¼ lb., 40c; 1 lb., $1.25.**

CRESS

Extra Curled or Pepper Grass—Grown for its pungent leaves which should be cut when about 2 inches high for use in mixed salads. Sow the seed in rich soil, either in shallow drills or boxes. One ounce to 100 feet of drill. **Pkt., 5c; oz., 15c; ¼ lb., 40c; 1 lb., $1.25.**

Upland Cress—A hardy perennial sort growing flat on the ground, doing best in cool weather. Only the young leaves should be used, as it becomes bitter with age. **Pkt., 5c; oz., 20c; ¼ lb., 50c.**

Water Cress—Grows readily in shallow fresh water or along the edges of shallow streams. Sow the seed in pans of wet earth and transplant when well started. **Pkt., 10c; oz., 40c; ¼ lb., $1.25.**



Witloof Chicory.

Cultural practices form the second line of defense. Pruning to improve air circulation, weeding to reduce humidity at ground level, removing infected leaves when spotted, and maintaining overall plant health through proper nutrition all reduce disease pressure. Chemical management is used selectively. Copper-based fungicides are the traditional treatment and are generally safe for organic-certified farms. Synthetic fungicides provide more targeted action but are used more sparingly due to cost and environmental considerations.

The Genetic Erosion Problem

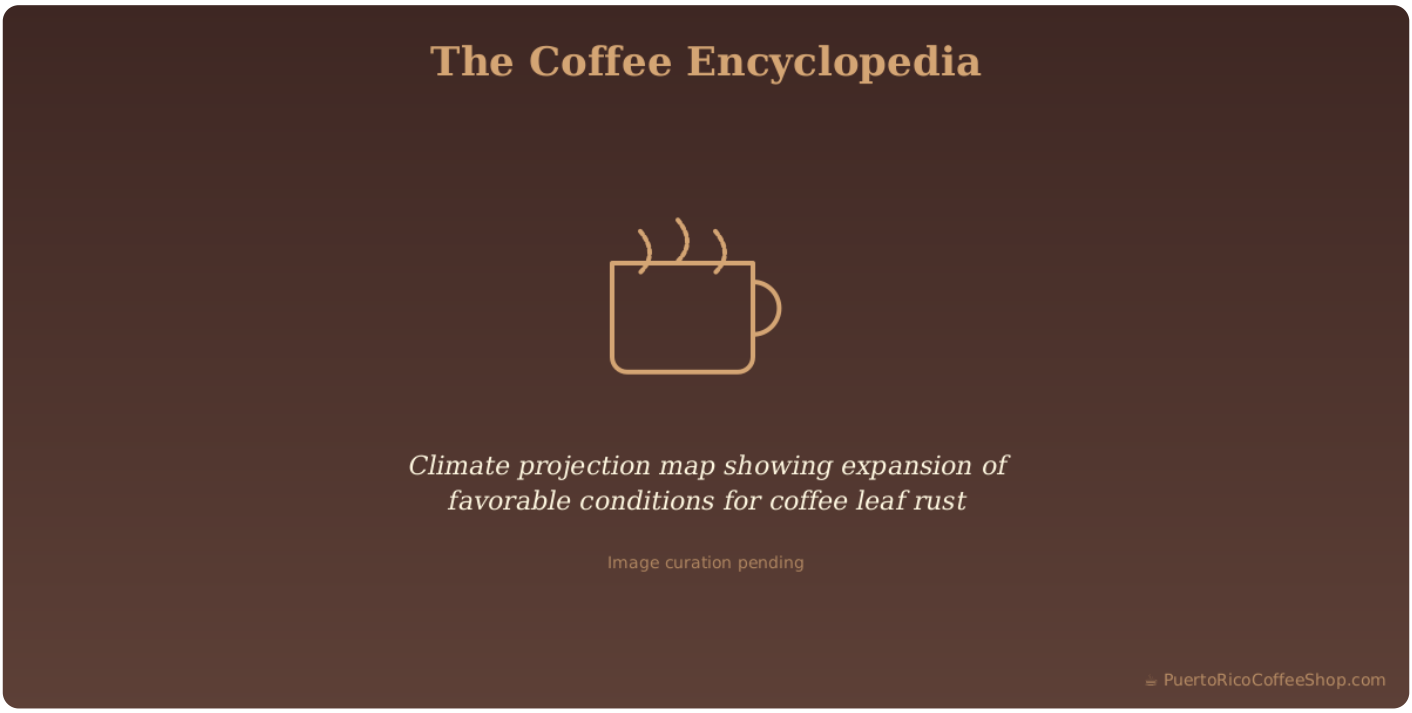
One of the more alarming developments in recent years is the breakdown of rust resistance in Puerto Rico's supposedly resistant varieties. After Hurricane Maria, World Coffee Research conducted DNA testing on Puerto Rican seedlots and found that both Limaní and Frontón had undergone significant genetic mixing through decades of informal seed propagation. Many "Limaní" seedlots were found to be genetic blends rather than pure hybrids, and their rust resistance had correspondingly weakened.

This genetic erosion has practical consequences. Farmers who plant what they believe to be resistant Limaní find that some of their plants show susceptibility to rust infection. The rescue project launched by World Coffee Research and the Hispanic Federation addresses this problem by identifying genetically pure mother plants, establishing controlled seed gardens, and training nurseries on proper propagation practices. Over time, the genetic purity of Limaní and Frontón is being restored, but the process takes years and requires sustained institutional support.

Climate Change and Roya

Climate change has significant implications for coffee leaf rust management. Warming temperatures expand the geographic range of favorable conditions for the fungus, potentially pushing rust to higher altitudes than it previously reached. Changes in rainfall patterns alter the humidity and moisture conditions that the fungus requires. Combined

with the broader stresses that climate change places on coffee plants — heat stress, water stress, changing bloom timing — rust pressure may intensify rather than ease in coming decades.



Puerto Rico's position in the tropical Caribbean makes it particularly vulnerable to these climate-driven changes. Higher-altitude farms that historically experienced less rust pressure may face increasing disease challenges. Lower-altitude farms that struggle with rust today may become unviable for coffee production entirely. Variety development, cultural practices, and broader farm management must all evolve to meet this changing threat.

The Broader Lesson

Roya's story in Puerto Rico illustrates a broader truth about coffee: the crop is biologically vulnerable, and its long-term viability depends on continuous investment in research, breeding, genetic conservation, and agronomic innovation. The development of Limaní and Frontón shows what is possible when institutional capacity is mobilized against a disease threat. The genetic erosion problem shows what happens when that

institutional attention wavers. The current rescue project demonstrates that damage done can be repaired, but only with sustained effort across many years.

For Puerto Rican coffee to thrive over the coming decades, management of roya — alongside management of hurricanes, climate change, labor challenges, and market competition — must remain a central priority. The island's experience provides both cautionary lessons and hopeful ones for other coffee-producing regions facing similar biological threats.

Key Facts — Coffee Leaf Rust in Puerto Rico

- Pathogen: Hemileia vastatrix, a rust fungus in order Pucciniales
- Common name in Spanish: la roya
- First detected in Puerto Rico: early 1980s
- Major regional epidemic: 2012-2013 across Latin America ($3 billion+ in damage)

- Puerto Rican response: development of Limaní (released 1994) and Frontón varieties
- Main susceptible traditional varieties: Typica, Bourbon, Caturra
- Main resistant modern varieties: Limaní, Frontón, Marsellesa, Obatá, H1 Centroamericano
- Infection cycle: approximately 3-4 weeks under favorable conditions
- Primary management: variety selection, pruning, selective fungicide, genetic purity
- Current challenge: genetic erosion of Limaní and Frontón rust resistance

Frequently Asked Questions

What is coffee leaf rust? Coffee leaf rust is a fungal disease caused by Hemileia vastatrix that attacks coffee plant leaves, producing characteristic orange-yellow pustules on the underside. Severe infection leads to defoliation, reduced yields, and can eventually kill the plant.

When did roya arrive in Puerto Rico? The disease was first detected in Puerto Rico in the early 1980s. It has been continuously present on the island since then, with severity varying year to year depending on weather conditions and farm management practices.

How is Puerto Rico fighting roya? Puerto Rico relies on a combination of rust-resistant varieties (Limaní and Frontón developed locally), cultural practices (pruning, weeding, infected leaf removal), and selective use of copper-based fungicides. The Agricultural Experimental Station at Adjuntas leads ongoing research.

Why did roya cause the development of Limaní and Frontón? Puerto Rico's traditional coffee varieties — Typica, Bourbon, Caturra — are all highly susceptible to coffee leaf rust. Without rust-resistant varieties, the island's coffee industry faced potential collapse. Limaní and Frontón were specifically bred at the Adjuntas Experimental Station to resist the disease while maintaining acceptable cup quality.

Is coffee leaf rust getting worse with climate change? Yes. Climate change expands the geographic and altitudinal range of conditions favorable for Hemileia vastatrix, and stressed coffee plants are more susceptible to infection. Management of roya is expected to become more challenging rather than easier in the coming decades.

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