

Assessing Variations in Host Resistance to *Fusarium oxysporum* f sp. *cubense* Race 4 in *Musa* Species, With a Focus on the Subtropical Race 4

This article, written by Andrew Chen and colleagues, examines how different types of bananas respond to Panama Disease (also known as *Fusarium* wilt). This disease is caused by a soil-borne fungus that blocks the plant's "veins" (the xylem), preventing water and nutrients from moving up, which eventually kills the plant.

The researchers focused on two specific strains: **Tropical Race 4 (TR4)** and **Subtropical Race 4 (STR4)**. TR4 is a major threat because it can kill the Cavendish banana, which is the variety most people buy at the grocery store.

Introduction: Studying Banana Plants That Resist Panama Disease

Bananas are one of the world's most important food crops. However, banana plants face a serious threat from a disease called **Panama disease**, which is caused by a fungus called ***Fusarium oxysporum* f. sp. *cubense* (Foc)**.

The most dangerous forms of this fungus are called **Tropical Race 4 (TR4)** and **Subtropical Race 4 (STR4)**. These strains can infect Cavendish bananas, the type of banana most commonly sold in stores.

Scientists wanted to find banana varieties that naturally resist this disease so breeders can use them to develop stronger banana plants in the future.

Why Panama Disease Is a Problem

The fungus enters through a plant's roots and spreads into the stem. It blocks the tubes that carry water and nutrients throughout the plant. As a result:

- Leaves turn yellow and wilt.
- The plant becomes weak.
- The plant may eventually die.
- The fungus can survive in soil for many years.
- Fungicides usually do not control the disease.

Because the fungus stays in the soil for so long, infected fields may be unusable for growing bananas for many years.

Purpose of the Study

Researchers tested **34 different banana varieties** to see how well they could resist TR4 and STR4. They wanted to identify banana plants that could be used in breeding programs to create disease-resistant bananas.

How the Study Was Done

- Young banana plants were grown in pots.



- Scientists infected the soil with the fungus.
- Plants were observed for about 10–12 weeks.
- Researchers cut open the underground stem (called the **rhizome**) to see how much disease damage had occurred.
- Plants were rated on a scale from 1 to 8:
 - **1 = no disease**
 - **8 = plant death**

The scientists also used a special glowing (green fluorescent) version of the fungus to watch how it moved through banana plants.

What the Researchers Found

Resistant Banana Varieties

Several banana varieties showed strong resistance to both TR4 and STR4, including:

- Pahang
- Calcutta 4
- FHIA-18
- FHIA-25
- SH-3142
- SH-3362
- Pisang Jari Buaya

These plants had little or no disease damage inside their rhizomes.

Susceptible Banana Varieties

Some varieties were much more vulnerable to infection, including:

- Williams (a Cavendish banana)
- Lady Finger
- Ma848
- FHIA-26

These plants showed severe discoloration and disease symptoms.

An Interesting Discovery

Most banana varieties reacted similarly to both TR4 and STR4.

However, two varieties—**FHIA-2** and **CAM020**—were resistant to TR4 but susceptible to STR4. This suggests that banana plants may use different resistance mechanisms against different strains of the fungus.

How Resistant Plants Fight the Fungus

Using the glowing fungus, scientists compared resistant and susceptible plants.

They discovered that:

- The fungus could enter the roots of both resistant and susceptible plants.
- In susceptible plants, the fungus spread quickly through the plant's water-carrying tissues.
- In resistant plants, the fungus was stopped mostly inside the rhizome and could not spread easily.

The rhizome acted like a barrier that helped protect the rest of the plant.

Why This Matters

Finding naturally resistant banana plants is important because there is currently no effective way to eliminate Panama disease once it becomes established in soil. Resistant plants could help breeders create new banana varieties that survive the disease and protect banana production worldwide.

Important Note for Students

Scientists tested many different banana varieties, but resistance was not simply "resistant" or "susceptible." Instead, plants showed a range of responses from highly resistant to highly susceptible. This means disease resistance is often controlled by several genes working together rather than by a single factor.

Key Takeaway

Some banana varieties naturally resist Panama disease. Scientists found that resistant plants can stop the fungus from spreading beyond the roots and rhizome. These resistant plants may help breeders develop future banana crops that can survive TR4 and STR4 infections.

Shortened by ChatGPT for length and reading level

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