The same clone of the Fusarium fungus is infecting Cavendish bananas in several countries across the world, according to scientists at Wageningen University & Research (UR) centre.

They say this shows the Fusarium clone, also known as Panama Disease Tropical Race IV (TR4), is continuing to spread despite global quarantine measures.

Panama is caused by the *Fusarium oxysporum f.sp. cubense* fungus, with the TR4 strain infecting many local banana varieties as well as the widely exported and highly susceptible Cavendish.

The soil-borne fungus enters the banana plant through the root and eventually kills the entire plant. Banana-growing plots infested with the fungus remain contaminated for many years.

Large areas of banana plantations in countries such as Jordan, Mozambique, China, the Philippines, Pakistan and Australia are no longer suitable for banana farming as they have become infested with TR4.

There are currently no means of combating the disease; only quarantine measures can prevent banana plantations from becoming infested.

DNA investigation

The researchers at Wageningen UR analyzed the DNA of many fungus specimens from eight countries where the fungus has recently been identified in order to trace how the disease has come to spread to different locations.

The team found the strains of the fungus that were collected were genetically identical.

"This research demonstrates that the quarantine measures and information provided around the globe apparently have not had the desired effect," said Gert Kema, a banana expert at Wageningen UR.

He added that not only is the TR4 fungus strain a clone, but all Cavendish bananas share the same genes.

'The Cavendish banana is very susceptible to TR4. Therefore, the fungus can spread easily due to the worldwide monoculture of Cavendish bananas," Kema said.

"That's why we have to intensify awareness campaigns to reach small and large-scale growers in order to help them with developing and implementing quarantine measures preventing the fungus from continued spreading."

Worldwide approach needed

To stop further spreading, the researchers are working with a large number of partners in different locations across the globe to develop short-term solutions for Panama disease management.

'We are gaining more and more insight into the scope of the issue," Kema said.

"The ability to quickly identify infected banana plants and infested soils is extremely important in this respect.

"However, eventually we have to come up with long-term solutions, particularly host resistance, which can only be developed in strong multidisciplinary alliances with various partners and industry."

The research was carried out by Wageningen UR in cooperation with the University of Queensland and Diversity Arrays Technology Pty Ltd in Australia and the University of Florida in the United States.

The results from the research appeared today in the scientific journal *PLOS Pathogens.*

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