



Food and Agriculture
Organization of the
United Nations

DIAGNOSING TROPICAL RACE 4 FROM FIELD TO LAB

TR4 GLOBAL NETWORK
- an initiative of the World Banana Forum -



The first step is to contact your National Plant Protection Organization (NPPO)

Early detection and diagnosis of the presence of **Tropical race 4 (TR4)**, combined with the rapid destruction of infected banana plants and on-farm restrictions, are the only ways to control and contain the fungus.

ALWAYS KEEP AN EYE OUT FOR TR4

How can a grower recognize the symptoms caused by TR4?

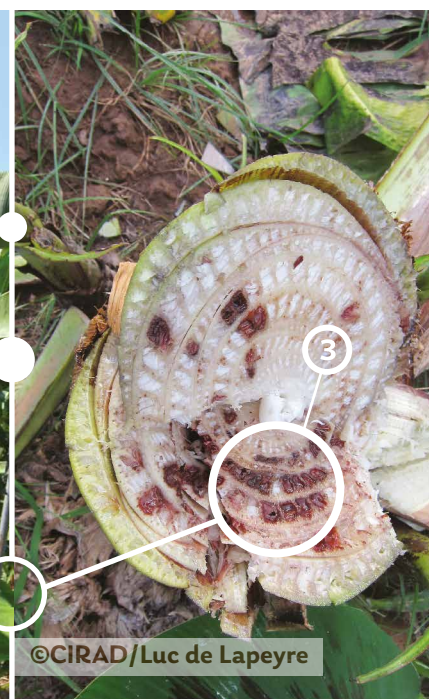
- ① Adult leaves of the plant begin to wilt and turn yellow, starting from the edge and moving towards the centre.
- ② Wilted leaves fold, forming a “skirt” around the stem.
- ③ Discolouration of the vascular system is seen in the corm and the stem.



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NOTIFYING AUTHORITIES

Call the National Plant Protection Organization (NPPO) or other relevant local, regional or national authority to report any suspected signs and symptoms consistent with TR4. Follow all prevention and control recommendations.

SPECIALIZED INSPECTION

Once the relevant authorities are notified of the potential disease, they arrive at the farm. Plants are inspected for external signs of TR4 including leaf yellowing, wilting and stem splitting. If found, the plant is cut to look for internal signs – a yellow, reddish or brown-black discolouration of the stem or corm's vascular tissue. Photos are taken of intact and cut plants.

SAMPLES¹

Samples of plant material are taken from any discoloured tissue that is found in the stem or corm as the plant is systematically examined. The plant or the stump is then marked and a sign placed on it indicating that samples have been taken. Samples can be packaged, labelled, and sent with a secure chain of custody to a specialised laboratory.

LABORATORY TESTING

A range of laboratory tests are undertaken which can take up to six weeks. Due to the possibility of false negative results, it is recommended to undertake a second round of tests.

At this point, only lab analysis can truly confirm a TR4 outbreak. Although commercial kits are available for quick field analysis, it is recommended to always carry out an analysis in a certified laboratory. This will ensure the application of control and containment measures as well as adequate information for decision making at all levels.

¹ *Queensland Government Publications*. 2018. *Diagnosing Panama TR4. Panama disease tropical race 4 Grower Kit*. [online]. Queensland. [Cited 26 September 2019]. <https://www.publications.qld.gov.au/dataset/panama-disease-tropical-race-4-grower-kit/resource/867f6607-2bdb-4861-8d4b-94602378e844>



WAITING FOR RESULTS - WHAT CAN GROWERS DO?

As a precautionary measure, don't move soil, plant material or any other risk items off the property until you have the test results.

Restrict people's access to any suspect plants. Mark and cordon off suspect plants, and the immediate surrounding area, to limit possible spread of soil or plant material.

Immediately review on-farm biosecurity measures to limit potential spread of disease around or from your property and assess the level of risk your farming activities might present.

Ensure that staff and visitors to your property have access to cleaning and disinfection equipment and are aware that vehicles, farming appliances, equipment and personnel need to meet biosecurity decontamination requirements.

OTHER DIAGNOSES - WHAT ELSE COULD IT BE?

Sometimes, what was initially suspected to be caused by TR4 turns out to be a different disease or a natural phenomenon.

Other banana wilt diseases²

Bacterial diseases like Moko disease (*Ralstonia solanacearum*), blood disease and *Xanthomonas* wilt often have external symptoms similar to that of TR4. However, leaf yellowing in these diseases often start from the younger ones to the older ones, which is different from the progression of plants affected by TR4. Also, a yellow ooze is exuded in plant tissue affected by bacteria.

Pythium root rot and *Armillaria* root rot can also display symptoms similar to TR4. *Pythium* root rot is uncommon and limited to young plants in wet environments, whereas *Armillaria* root rot is often localised to a few plants, and shows white fungal tissue in affected plant material.

Abiotic stresses³

Water-logging, drought, cold damage and lightning can all create damage to banana and plantain plants that could be wrongly identified as TR4 symptoms. For instance, symptoms of lightning include wilting and yellowing of the leaves – something also seen in TR4 affected plants.

The fungus cannot be isolated from the rhizomes and pseudostems.

2/3 Stellenbosch University. 2013. Symptomatology. Banana Fusarium Wilt in Africa. [online]. Stellenbosch. [Cited 1 October 2019]. <http://www.sun.ac.za/english/faculty/agri/plant-pathology/ac4tr4/background/symptomatology-identification/symptomatology>



KEY TAKEAWAYS

CURRENT STRAIN OF FUNGUS

The current race of the fungus causing Banana Fusarium Wilt in Cavendish cultivars (and many others) is ***Fusarium oxysporum* f. sp. *cubense* tropical race 4 (Foc TR4)**, also known as **Tropical race 4 (TR4)**.

DISEASE

Banana Fusarium Wilt
(Banana FW).

At the moment, **there is no cure** for TR4 – no fungicide or soil fumigant can effectively control or eradicate it.

The most effective approach to combat TR4 is **prevention** of its spread into clean areas and immediate containment once it is detected.

FUNGUS

The fungus that causes Banana FW is *Fusarium oxysporum* f. sp. *cubense* (Foc).

TR4 can be **transmitted through shoes**, vehicles, farm tools and equipment, **but also through drainage water**, surface run-off water and floods.

Diversification of banana and plantain crops and agroecological practices that support sustainability are another way to help prevent TR4.

International collaboration and local actions are essential to manage TR4 in affected countries.

Become part of the TR4 Global Network!

To learn more or to access resources, subscribe to our **newsletter** or visit our **website**:

TR4GN@fao.org | **www.fao.org/TR4GN**

The **TR4GN** is jointly facilitated by the World Banana Forum Secretariat - hosted by FAO's Trade and Markets Division - and by FAO's Plant Production and Protection Division.

The above recommendations were formulated by a group of specialists working on bananas and plant health as part of their participation in the TR4 Task Force of the World Banana Forum. While every effort has been made to ensure that the recommendations are based on the latest scientific knowledge available, neither the scientists nor the organizations accept any responsibility for the consequences that may arise from the use of this document.

To discover the benefits of becoming a member of the World Banana Forum and to take an active role towards a sustainable banana sector, please visit:

www.fao.org/world-banana-forum

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If you think you may have seen soil, water or plant material entering or exiting the farm, or if you have any questions, contact the phytosanitary authorities!



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