Fusarium wilt of banana

Fusarium oxysporum f.sp. cubense

Photo: Denis Persley, Department of Agriculture and Fisheries

Leaves turn yellow, first at the margins and later hang down.

Photo: Denis Persley, Department of Agriculture and Fisheries

Water-conducting parts of the leaf turn red, brown or black.

SUMMARY: Fusarium wilt of banana and plantains is a fungus that invades the roots and stem, blocking the water conducting channels and causing leaves to turn yellow, dry and collapse. It is spread through movement of soil, on equipment and especially on contaminated planting material. There are four strains: three can be contained by cultural methods and resistant varieties, but a recent variant (TR4) attacks dessert bananas and plantains, putting both industry and smallholder production at serious risk. Recently, the fungus has spread from southeast Asia to Australia, Jordan and Mozambique.

KEY SIGNS

The first sign is a yellowing at the margins of older leaves, advancing towards the midrib. Leaves turn brown, dry and eventually collapse. Disease symptoms move progressively from older to younger leaves until only a few of the youngest leaves remain green and erect, with the older ones forming a 'skirt' around the stem. Eventually, all the leaves will collapse. On some varieties the stems split as well. Internally, brown, red and yellow rings occur in the stem, at first at the centre and later, in cases of severe infection, spreading throughout the stem. Suckers may also show symptoms. Eventually, all parts above and below ground will die and rot.

MANAGEMENT

Prevention – what to do before signs are seen

Cultural approaches: Management of fusarium wilt is extremely difficult as the fungus remains alive in the soil for many years and there are no fungicides or cultural controls that can be usefully applied against it. The only solutions are to: (i) keep it out in the first place; (ii) establish methods for early detection; (iii) observe strict hygiene measures; and (iv) use resistant varieties.

The following advice applies to all strains of fusarium wilt. However, such is the threat from TR4 that national and regional biosecurity authorities need to ensure that the fungus does not spread within Africa (or elsewhere in the world) but, should a new introduction occur, have the necessary authority to apply quarantine regulations to limit its impact. Transfers of varieties between countries should follow the *Technical Guidelines for the Safe Movement of Germplasm*.

Tolerant and resistant varieties do exist. Some FHIA (Honduran Agricultural Research Foundation) varieties (e.g. 01, 02, 18, and 25) have resistance to TR4 and, in Taiwan, Cavendish variants from tissue culture have also proven resistant. Check whether these are available locally.

Never use suckers for planting from plants that show symptoms of fusarium wilt, even though they may appear to be healthy, as the fungus may be in the roots. Use clean planting material, preferably from disease-free certified plants. If these are not available, growers should be encouraged to take suckers only from areas that have not shown symptoms of the disease, preferably from growers' own farms which have been monitored for disease.

Spores of the fungus can be transferred in soil, so avoid sharing farm machinery and equipment (e.g. shovels, knives and ladders) with other growers, and remove debris and soil from machinery, equipment, vehicles and footwear before entry to any

farm, even farmers' own farms. Ensure that all members of the family (and other workers) know about the disease, and the hygiene rules to keep it out of the farm and/or under control.

Control – what to do after signs are seen

Cultural approaches: If an infected plant is detected, disturb the soil as little as possible. Dig out the plant with its root mass and suckers, and burn everything on the spot. Do not chop the plant into pieces. Use a herbicide (e.g. glyphosate) to hasten death of infected plants, then leave plants to die in place. Consider removing a ring of plants around the diseased one. This is done in case the disease has already spread to adjacent plants via root-to-root contact – never mind that they look healthy, they may develop the disease later.

If possible, fence infected areas so that people do not spread the disease in soil on footwear, and clean the tools used to remove plants with sodium hypochlorite bleach. As a future caution, dig drains to divert surface run-off (and irrigation) water if it flows through infested areas. Furthermore, do not replant with the same or another fusarium wilt susceptible variety, and monitor the remaining plants every two weeks.

CAUSE

Fusarium wilt, also known as Panama disease, is the most serious disease affecting bananas. It is caused by the soil inhabiting fungus *Fusarium oxysporum* f.sp. *cubense*. It only infects banana and relatives.

The fungus grows in the soil and invades bananas through the fine (hair) roots. Spores are produced inside the water-conducting channels of the root and stem (xylem), and these and the growth of the fungus block the flow of water and cause a wilt. Fusarium wilt can remain alive in soil for long periods – perhaps indefinitely – as resistant spores, in infested plant debris or in the roots of other plants that are hosts.

Spread of fusarium wilt over short distances is by root-to-root contact, in surface run-off water, in soil attached to vehicles, tools, footwear and in unsterilized potting composts. Over longer distances, both within and between countries, spread occurs in infected planting material.

There are four distinct races of this fungus and one is divided into two strains. Tropical Race 4 (TR4) is the most serious as it affects a large number of varieties, including the popular Cavendish. All four of the races invade roots by travelling through the water-conducting tissues (xylem).

- Race 1 infects Gros Michel, but not Cavendish, and some plantains
- Race 2 generally infects cooking bananas
- Race 3 infects only Heliconia species
- Race 4 infects most varieties including Cavendish. There are two important strains: i) Subtropical Race 4 produces symptoms in Cavendish after a period of cold stress, and ii) Tropical Race 4 attacks Cavendish in tropical and sub-tropical conditions.

IMPACT

Race 1 forced the banana export industry to change from Gros Michel to Cavendish in the 1950s when fusarium wilt decimated production. Other races have appeared since then. It is estimated that 80% of global production is now under threat from TR4, which, if it spreads to Latin America, the Caribbean and West Africa, will have dire social and economic consequences. Not only will it devastate production, but also the livelihoods and food security of millions of smallholders who grow more than 85% of the crop. Additionally, there are potential environmental and biodiversity impacts as uncontaminated land would be cleared for cultivation, and difficult-to-grow varieties abandoned.

DISTRIBUTION

Fusarium wilt probably originated in Southeast Asia, but was first reported from Australia in 1876. Subsequently, it spread globally and is present in most parts of Asia, Africa and the Americas. It is now spreading in Pacific islands. The aggressive race TR4, which was first detected in Asia in the 1990s, it is now found in Taiwan, Indonesia, Malaysia, the Philippines, China and northern Australia. Outbreaks were recently reported from Mozambique (2013) and Jordan (2014).

FURTHER READING

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