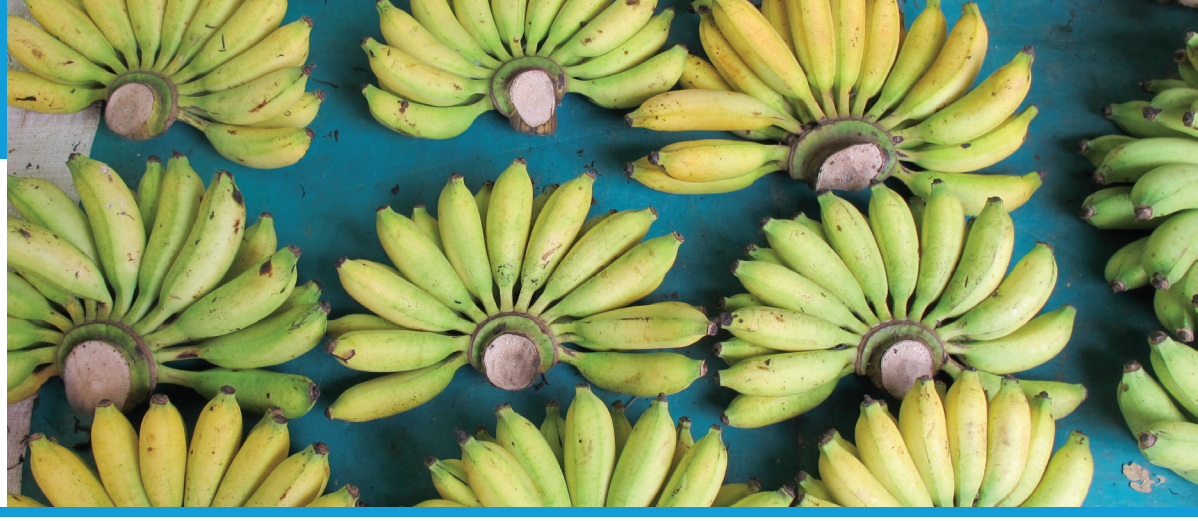


Fusarium oxysporum f. sp. *cubense* tropical race 4 of bananas: Disease spread and global loss projections

RESEARCH PROGRAM ON Roots, Tubers and Bananas

Summary: Scientists have recently estimated that tropical race 4 of the fungal pathogen *Fusarium oxysporum* f. sp. *cubense* (Foc TR4) could spread to 1.65 million hectares of current banana lands by 2040 if no significant interventions are instituted (Scheerer et al 2016). This is about 17% of the current area under production. The annual production potential of this area is estimated at 36 million tonnes with an estimated value of over 10 billion dollars at current prices. This estimate does not even take into consideration the impact of production loss on livelihoods along the banana value chains and on the environment.

Background

Tropical race 4 of the fungal pathogen *Fusarium oxysporum* f. sp. *cubense* (Foc TR4) raised major concerns after it severely affected Cavendish banana plantations in Taiwan, Indonesia, Philippines and Malaysia in the 1990s. It has since been reported in most banana producing countries across Asia and recently moved out of Asia into Africa and the Middle East (Ordonez et al 2015, Ploetz et al 2015, Mostert et al 2017).

Ploetz (2005) initially estimated that approximately 80% of the bananas produced could potentially be susceptible to the disease and that further spread was likely. Ordonez et al (2015) has estimated that over 100,000 hectares may be already affected by Foc TR4, threatening millions of smallholders worldwide because, unlike Foc races 1 and 2, more banana cultivars are susceptible to Foc TR4 (Ploetz 2005, 2007).

Since the first global alert from Bioversity International's banana programme (INIBAP) in 2003, calls for a more coordinated global programme have become increasingly frequent.

A regional training course and survey of TR4 in Asia was carried out in 2004 through the banana network for Asia and the Pacific (BAPNET). In 2009 in Latin America, OIRSA, a regional organization for plant and animal health, and Bioversity International held a TR4 workshop to mobilize the region against the disease threat. In 2010, Bioversity International's Latin America banana network (MUSALAC) and the banana

Photo: Bananas sold at the market in Malaysia. Credit: Bioversity International/P.Bordoni

industry issued a global travellers' alert in English, Spanish and French to highlight the risks posed by global movement of banana experts. As the pathogen persists in the soil for many decades and many cultivars have shown some susceptibility, concern has grown, and calls intensified for the threat of TR4 to be addressed, including the mobilization of resources and more effective plant quarantine initiatives globally (Kema and Weise 2013).

Regional TR4 task forces have been formed both in Africa and Latin America to monitor the disease and develop regional strategies to arrest its spread but the effectiveness of these networks has been severely hampered by the acute lack of resources, resulting into new countries and continents falling under the menacing disease. Furthermore, systematic information on disease incidence required to quantify the spread and impact of the disease remain unavailable partly due to difficulties in monitoring the disease by the often overtasked national plant quarantine agencies and partly because of the low levels of investment into the banana sub-sector.

This limited response by stakeholders and policymakers alike has resulted in large crop losses and unabated disease movement into neighbouhring countries and continents, seriously threatening the livelihoods of poor-resource smallholders. Without comprehensive economic estimates and assessments of the loss due to Foc TR4, it has not been possible to justify appropriate investment needed to institute necessary measures to control the disease and arrest its spread.

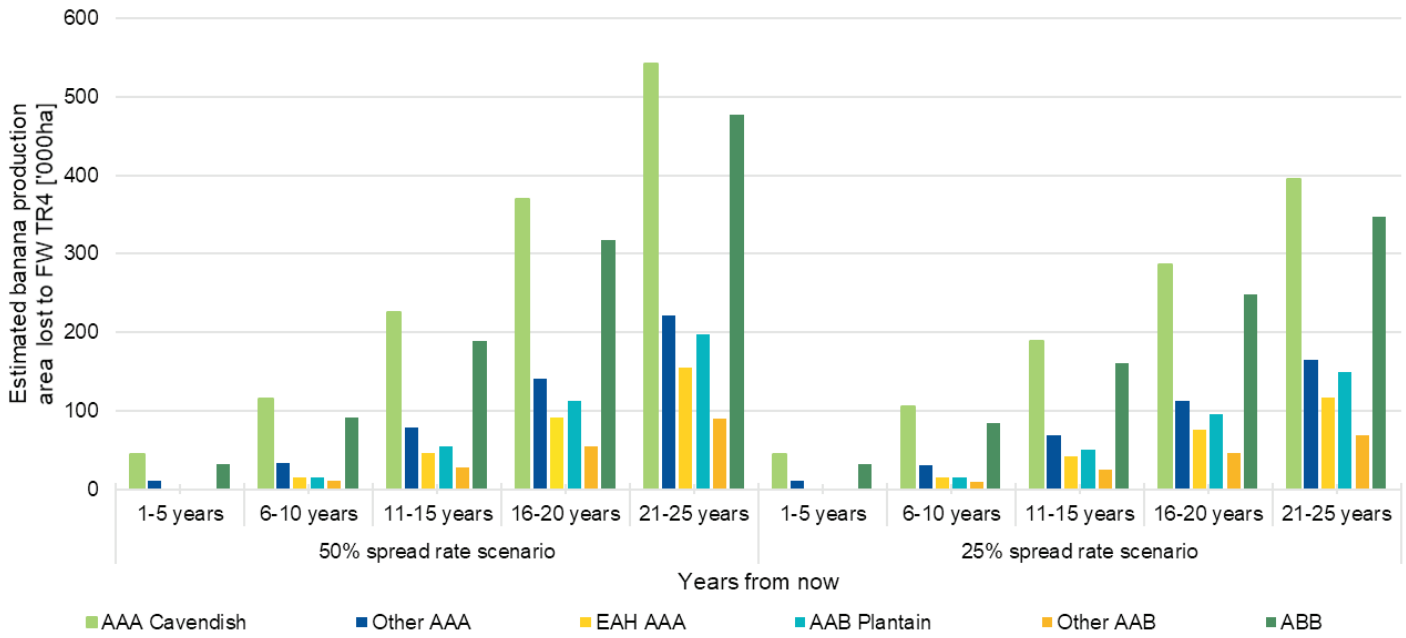
Recent assessments

Scientists at Bioversity International, within the framework of the CGIAR Research Program on Roots, Tubers and Bananas, have recently estimated the acreage, production losses and associated economic implications of Foc TR4 spread if no significant interventions are instituted in the next 20 years (Scheerer et al 2016).

They used a TR4 risk of spread scale to categorize countries

Yellow and wilted leaves are typical symptoms of I
Molina

Figure 1 – Estimated global banana production area lost to Foc TR4 ('000 ha) per cultivar group



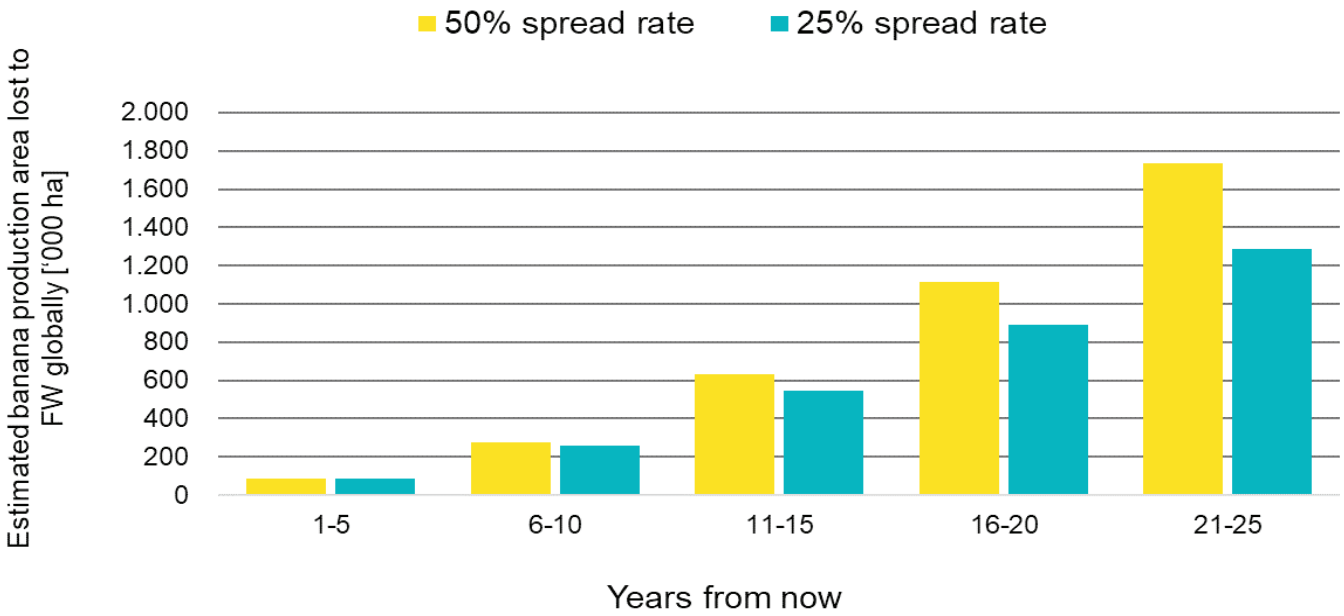
Fusarium wilt. Credit: Bioversity International/A.

according to the risk of TR4 arrival and the rate of internal spread of the disease within the country. Key factors linked to the likelihood of TR4 to reach a country were identified from risk analyses conducted in Africa, Latin America and Asia. They included the importance of monocropped Cavendish bananas, global banana traffic to and from the country, quality of plant health border controls, risk of informal border crossings, rigor of internal plant quarantine measures, and land and other links to countries where TR4 is currently present. The rate of internal spread was subsequently estimated based on the rigor of internal quarantine measures, the importance of Cavendish bananas, and the importance of banana for national research investment and public policy. Differential rates of spread were proposed for the internal spread index by cultivar group. Initial rates of spread were proposed for the first five years with an increase of 50% in the rate for each successive five year block. In addition, a second scenario with a 25% increase was computed to determine sensitivity to the rate of spread.

In terms of acreage that would be lost for each cultivar group, the study estimated that with a 50% spread rate scenario, projected crop acreage losses in 2039 for Cavendish (AAA) would stand at 542,920 ha, other AAAs at 222,000 ha, East African Highlands AAAs at 155,370 ha, AAB Plantains at 197,720 ha, other AAB at 89,660 ha (68,850 ha), and ABB at 477,170 ha (Figure 1), making a total banana acreage of 1.65 million hectares, globally (Figure 2). This is about 17% of the current area under banana production. Accordingly, the annual production potential of this area was estimated at 36 million tonnes with an estimated value of over 10 billion dollars at current prices. Halving the spread rate to 25% still resulted in a crop acreage loss of 1.26 million hectares.

However considering the indirect consequences and social effects on the livelihoods of the smallholder producers, subsistence farmers, the workers and the locals, the real socio-economic impact is probably significantly greater than here projected. Moreover it is feared

Figure 2 – Estimated global banana production area lost to Foc TR4 ('000 ha)



that the disease may be already present in some other countries where capacity for detection is limited.

Conclusions

This analysis provides a rapid first estimate of the possible future spread of Foc TR4 and the quantified losses using a transparent index approach based on expert estimates. Emerging scientific results can be incorporated easily into the calculations, e.g. cultivar susceptibility still being conducted, with new results expected in the next few years. In order to fine-tune the model, further expert feedback and field studies are needed. More complete bio-economic and spatial models would serve to target investments into exclusion measures and research in recovery practices. In the meantime, use will be made of the results above to engage the global, regional and national stakeholders in an effort to raise awareness about the catastrophe in-the-waiting as posed by Foc TR4, and to appeal for definitive actions to be taken immediately.

Cross-section of the pseudostem showing the reddish to dark brown discolouration typical of Fusarium wilt. Credit: A.Javellena. Courtesy of www.musarama.org

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For more information on Foc TR4 see http://www.promusa.org/Tropical+race+4+-+TR4

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