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A tiny beetle and its deadly fungus is threatening South Africa's trees

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The polyphagous shothole borer is tiny - but a fungus it's commonly associated with can be deadly for trees. Wilhelm de Beer

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Sandton is Johannesburg's economic hub – home to numerous companies' headquarters and the Johannesburg Stock Exchange. And now it has a new, unwelcome resident: a tiny beetle that could lay waste to several tree species found in the suburb and potentially the wider Johannesburg area. This is particularly concerning, as Johannesburg is considered one of the world's largest urban forests, with more than 10 million trees.

The polyphagous shothole borer, or *Euwallacea fornicatus*, seems to be a newcomer to South Africa. It was discovered in the country for the first time in 2017 by Dr Trudy Paap, a postdoctoral fellow at a biotechnology institute at the University of Pretoria.

During a survey for diseases in the KwaZulu-Natal Botanical Gardens in Pietermaritzburg, Paap found a lane of infested plane trees. The identity of the beetle was subsequently confirmed and the tiny beetle – they are each about 2mm long – has been found at work in gardens and roadsides in Johannesburg, about 500 km from Pietermaritzburg.

The beetle isn't alone. It carries several fungal species with it when it infests living trees. One of these, *Fusarium euwallacea*, seems to be a permanent associate of the beetle. This fungus can eventually kill a beetle-infested tree.

The beetle and the fungus have devastated trees in California in the US as well as in Israel. Insecticides aren't effective because the beetles bore deep into the wood. The only known method of managing the spread is to cut down infested trees and burn them. But research is underway to find more effective methods.

A threat to native forests and fruit trees

In late January my colleagues and I at the Forestry and Agricultural Biotechnology Institute were contacted by Niel Hill, an urban forestry consultant in Johannesburg. He was concerned about several dying trees in the Sandton area. Symptoms varied on different tree species from patches of white powdered wood (called frass), to blotches of oozing resin, on the bark surrounding the beetles' entrance holes. On some trees he had also spotted small, elevated lesions on the bark resembling shotgun wounds.

Hill said that trees had already started dying with these symptoms in 2015, but the cause was unknown. Microscopic and DNA tests in the the institute's laboratories confirmed that the polyphagous shothole borer and its fungus had arrived in Sandton.

The tree species affected in the Sandton area include non-native ornamental trees such as Japanese and Chinese maple, London plane, kapok, and liquid amber. Several paper bark trees, native to South Africa, were also heavily infested and dying.

The polyphagous shothole borer doesn't appear to have done much damage to trees in Southeast Asia, its place of origin. That's probably because tree species evolved with the beetle and the fungus and have developed resistance towards them. It might also be because there are natural enemies controlling populations of the beetle in its native habitat.

But it's a different story in California in the US and in Israel. The beetle and its fungus were introduced in these countries during the past 15 years and have caused serious damage, especially on avocado trees.

Paap's work has confirmed that the South African beetle and fungus are the same genotypes as those found in Israel and California.

An extremely wide range of host tree species

Astonishingly, surveys in two botanical gardens in Los Angeles have shown that the beetle-fungus complex can infest more than 200 tree species from 58 plant families. This is quite unusual; forest pests usually affect trees of the same genus or family.

The lists of infested trees from California include important crop trees like avocado, macadamia, pecan, peach, orange and grapevine. Some of the susceptible trees are South African species that have been planted in the Los Angeles botanical gardens . These included the cabbage tree, common calpurnia, monkey plum, dwarf and common coral trees, and the honey flower, also sometimes called kruidjie-roer-my-nie.

The fact that native South African tree species are susceptible is particularly worrying. Although the California study provided some clues about the range of tree species susceptible, scientists simply don't know and cannot predict what the beetle and fungus will do in South Africa – on crops like avocado or on native trees.

This has prompted the institute to start several research projects that range from developing fast DNA-based diagnostic tools for the fungus and beetle, to possible control measures.

During the past week scientists and government officials, representing the Department of Agriculture, Forestry and Fisheries and the Johannesburg City Parks and Zoo met with our team to discuss next steps. A working group has been set up to co-ordinate monitoring the spread of the beetle and managing research efforts. It will also advise government agencies, municipalities, industry and private tree growers.

Next steps

The public can help, too. We've made an appeal to gardeners to watch out for the beetles. Details including photographs of the symptoms, GPS coordinates or a street address, the host tree species and the reporter's contact details can be sent to diagnostic.clinic@fabi.up.ac.za.

We're also appealing to people not to spread the problem by moving plant material with signs of beetle infestation. Instead, infested branches should be cut into small pieces and put into refuse bags, sealed and kept in direct sunlight. The heat from the sun will kill the insect and its larvae. Alternatively, wood should be burnt on site.

California **Beetles** **Fungi** **Pests** **Insecticides** **Tree pests** **Plant disease** **plant biotechnology** **avocado crop pests**