

## **The impact of the Polyphagous Shothole Borer on Pecan trees in South Africa**

**(Subtitle) A SAPPA funded research project**

In May 2017 the Polyphagous Shot Hole Borer (PHSB) was discovered on pecan trees in the Jan Kempdorp area. It has since been detected on pecans on several farms surrounding JanKempdorp. In February this year it was also found infesting a few pecan trees in the Nelspruit area.

The PHSB is native to Southeast Asia where it is not really known as a serious pest. However, it gained the attention of farmers and researchers after it started killing trees in Israel and the United States (California) about 15 years ago.

The research team working tree diseases at the Forestry and Agricultural Biotechnology Institute (FABI) in Pretoria was first alerted to the presence of PSHB in South Africa in February 2017. Dr Trudy Paap was doing a survey of tree diseases in the KwaZulu-Natal National Botanical Gardens, Pietermaritzburg, where she found a lane of large London Plane trees infested with PSHB. Following the subsequent discovery on pecan trees later that year, the presence of the PSHB has since been confirmed in Durban, Johannesburg, George, Knysna, Bloemfontein, and Nelspruit.

### **What is the PHSB?**

The PSHB belongs to large group of about 3400 beetle species referred to as ambrosia beetles. These beetles bore into dead or dying trees in which they construct a network of tunnels, known as galleries. The beetles cannot digest wood and therefore cultivate their own, specific fungi that grow as mould on the surface in these galleries. The fungi then degrade wood, extracting and concentrating nutrients, and usually forming rather large spores ('seed') that serve as food to the beetles and their larvae.

The life cycle of the beetle starts when a mated female bore through the bark into the living sapwood of a tree. She constructs a gallery and inoculates the sides of the tunnels with the symbiotic fungus, that then starts growing to form a 'garden'. Each female beetle lays an average of 34 eggs in the galleries. These hatch and usually include one male for every 10 females. The larvae mature in the galleries. The male fertilizes the females (his siblings) in the galleries, where they will stay until conditions are right for the the fertilized females to leave the host in search of a new host tree, where the cycle repeats. Several life cycles can be repeated every year.

The PSHB has been reported to carry three fungal symbionts: *Fusarium euwallaceae*, *Graphium euwallaceae* and *Paracremonium pembeum*. *Fusarium euwallacea* serves as primary food source for the adults and their larvae. When the tree starts dying and nutrition declines, the abundance of *F. euwallacea* declines and *G. euwallacea* eventually becomes the main food source for the beetle. The role of *P. pembeum* is not yet fully understood and requires further investigation.

### *Fusarium* dieback

In susceptible tree species the *Fusarium* fungus causes dieback, that can lead to tree death. This occurs due to the *Fusarium* blocking the flow of nutrients through the vascular system of the trees. External symptoms differ between different tree species, ranging from watery stains, as found on pecans, to sugary fountains, found on avocados. When the bark is removed, staining can usually, but not always, be seen around the tunnel in the cambium. When one removes the cambium and outer layer (about 5 to 10 mm) of sapwood, vertical fungal streaks are present.

It is important to note that firstly, not all infested trees will die, and secondly that the beetle can insert the fungus in many trees, but only reproduces in a much smaller number of tree species. A *reproductive host* is a tree species where the beetle and fungus establishes successfully and where the beetle breeds and multiplies. Non-reproductive host trees are those where the fungus is inserted, but where the beetle either leaves the tree again, or dies in the tree without reproducing (often being trapped in resin that the tree produces as defense). Reproductive host trees are the priority for control measure as they are a reservoir for the beetles, from where they disperse, infesting surrounding trees, resulting in the further spread of the disease.

In South Africa about 80 species of trees, of which 35 are native trees, have thus far been reported as susceptible to PSHB attack and infection by the *Fusarium* fungus. About 20 of these species are reproductive host, including English oaks, various types of maples, willows, planes, and the castor bean weed. A continuously updated list of confirmed host trees in South Africa can be viewed at [www.fabinet.up.ac.za/pshb](http://www.fabinet.up.ac.za/pshb).

To date pecan trees are the only species where the PSHB has been found in commercial orchards. Although it has been found on avocado trees in private gardens in Johannesburg and Knysna, it has not been found in orchards yet. Other fruit and nut trees that have been reported to be infested, but without serious disease development, are macadamia, peach, citrus, grapevine, guava and plum trees.

### **The impact on pecan trees**

The long-term impact of *Fusarium* disease on pecan trees remains unsure. It has not caused serious disease on these trees in California. However, we have seen many trees infested in orchards in the JanKempdorpe area. Interestingly, we have seen that beetles can infest the same trees repeatedly over different seasons. This means that the *Fusarium* fungus is inoculated into the living xylem tissue over and over again, and we know that *Fusarium* fungus starts to form streaks which means it can grow in the living tree tissue. However, we are not sure whether these fungi will eventually kill the trees, or have a negative impact on yield. As mentioned above, we know that the fungus can kill some trees in a matter of months, but that other trees die slowly over a period of several years.

### **SAPPA funded research project**

To fix a bakkie's engine, you need to understand how it works! As PSHB has not been a problem on pecans in other parts of the world, and its impact varies great between different tree species, there are several aspects of its impact on pecan trees that we still do not understand. Without this knowledge, it is impossible to make any predictions on disease development or to recommend treatments.

SAPPA has thus engaged with the Forestry and Agricultural Biotechnology Institute (FABI) at the University of Pretoria on a two year research project to find answers to these questions. This work will be done in collaboration with the Pecan Disease Programme at the University of the Free State. The project's aims are to:

- Assist SAPPA in diagnosing PSHB infestations on farms of their members
- Monitor the presence and spread of PSHB in all pecan growing areas in South Africa, but with a well-designed focused study in the JanKempdorpe area
- Determine whether the *Fusarium* and *Graphium* fungi can cause disease, and if so, to what level, on different pecan cultivars
- Determine the life cycle (flying times and seasons) of the beetle in pecan orchards
- Possibly test different chemical treatments to protect for registered products

Throughout the course of this two year project, we shall continuously provide SAPPA and their members with relevant information about the PSHB, based on our results and results from research elsewhere in the world. If you think you might have PSHB infestations in your orchards, please contact Hardus du Toit of SAPPA, who shall channel enquiries to us.

This research project is run in conjunction with several other PSHB research projects co-ordinated from FABI. These include projects investigating the impact and mitigation of PSHB on avocados, macadamias, native trees, urban forests, as well as exploring biological control options.

Authors: Shawn Fell (MSc student) and Prof. Wilhelm de Beer (research leader)

IN COLOURED BOX

### **A new species name for the beetle**

The PSHB was until recently known as *Euwallacea fornicatus*. However, genetic studies showed that *E. fornicatus* consists of four different beetle species. The real *E. fornicatus* infests tea plantations in Asia, Florida and Australia, and is now referred to as the Tea Shot Hole Borer A. *Euwallacea whitfordiodendrus*, an old species name, that was treated for many years as a synonym of *E. fornicatus*, is now used for the Polyphagous Shot Hole Borer (PSHB). The other two species in the complex are *E. kuroshio* (Kuroshio Shot Hole Borer) and *E. fornicatior* (Tea Shot Hole Borer B). It is important to distinguish between these species as they differ in pathogenicity and infest different host trees and occur in different countries. The correct name is needed to find the correct and most appropriate information on each species.