WA Agricultural Research Collaboration

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Polyphagous Shot-Hole Borer – Fusarium Dieback: WAARC Research Priority Areas

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Issue

The Polyphagous Shot-Hole Borer Fusarium dieback pest-disease complex (PSHB-FD) is highly invasive, with a wide range of plant species impacted through loss of limbs, decreased production, and in some cases, death. PSHB-FD is exotic to Australia and was first detected in Western Australia (WA) in 2021. Despite the nationally funded eradication response coordinated by Department of Primary Industries and Regional Development (DPIRD), continues to threaten agriculture, natural resources and the urban canopy in WA.

Action

The Western Australian Agricultural Research Collaboration (WAARC) was asked to identify targeted research projects with the goal of protecting agriculture assets in Western Australia (WA). Importantly, the research must also support current eradication activities and be cognisant of public sentiment around maintaining the urban canopy.

Development of the targeted research projects commenced with a workshop aimed at agreeing on priority research ideas (that can be developed into research projects) amongst key expert stakeholders. Four predefined interconnected priority research areas were used to help focus discussions. The stakeholders included WAARC's partners and experts from universities, research institutes, industry bodies and local governments. This is a summary of the outcomes of that process.

Results

The results of the workshop are captured in two additional documents; a TalkBook which is a summary of the events of the day and a BlueSheet which is a one-page summary of the conclusions of the day. Workshop participants discussed current knowledge and eradication efforts, concerns from industry and local governments, and identified information gaps particularly around PSHB-FD in WA.

KEY RESEARCH PRIORITY AREAS

After discussing current knowledge, the national eradication response, concerns from industry and local governments, and key information gaps, participants generated a pool of research topics under the priority areas listed above that would assist in the control and eradication of PSHB-FD in WA. Critical research focuses under each priority area are listed below, noting the priority areas were renamed to more accurately reflect their emphasis.

1. Host, Pathogen, Pest, Environment and their interactions.

Establishment and spread of disease requires susceptible hosts, a conducive environment, a competent pathogen, and some means for the pathogen to transmit to new hosts. As the WA PSHB-FD is unique, understanding its biology and interactions in the WA environment, including new hosts, is essential to develop and improve innovative strategies for its detection, surveillance, control and eradication. Research into how PSHB reproduces, spreads, and interacts with its environment, as well as the dynamics between the beetle and its suite of symbiotic fungi (and how collectively this leads to disease in some hosts but not others), will provide foundational knowledge necessary to inform effective detection, surveillance and control strategies.

Potential research topics include:

- PSHB biology and behaviour.
- PSHB associated fungi biology and ecology to develop a better understanding of the fungi associated with PSHB in WA.
- Incorporate knowledge of WA PSHB and associated pathogen biology, ecology, behaviour and population dynamics into modelling efforts to inform surveillance and control efforts.
- The pathogenicity of PSHB-FD for economically and ecologically important hosts.
- Determination of host-pathogen-pest dynamics to understand the ecological impact, effectiveness of control methods and predict future outbreaks.
- The effect of environmental variables such as water and temperature on PSHB-FD infestations, virulence, and host susceptibility.

2. Innovative Control Strategies- chemical and biological control strategies

'Control strategies' refers to the various methods and techniques used to manage, reduce, or eliminate a pest population—in this case, the PSHB and its associated fungi. An integrated pest management strategy[1] may incorporate all or a selection of chemical, biological, and

[1] Integrated pest management (IPM) combines the use of biological, cultural and chemical practices to control insect pests in agricultural production. It seeks to use natural predators or parasites to control pests, using selective pesticides for backup only when pests are unable to be controlled by natural means.

cultural[2] control activities. Effective control is critical for PSHB-FD because it affects both urban, natural and agricultural environments, posing significant risks to biodiversity, agriculture, and urban canopy health. The goal of the current national incident response is to eradicate all PSHB-FD from WA. Research into additional control strategies is important because there is no one-size-fits-all solution, and different environments and tree species require specific approaches. Each method needs to be tested for efficacy, environmental impact, and long-term sustainability. By comparing the efficacy of different eradication tools and approaches (including the current gold standard of tree removal) and by using integrated pest management principles, it may be possible to build an eradication framework decision key where different techniques are used in different situations (e.g. trees or areas of high economic or ecological value) to collectively achieve eradication of PSHB-FD across WA. By understanding the best ways to eradicate PSHB-FD, we can mitigate its damaging effects and prevent further spread. Potential research topics include:

- Chemical treatments to eradicate the PSHB or *Fusarium*; consider different chemistries and application methods and use across a broad range of hosts and environments.
- Biological control agents such as nematodes and other insects, bacteria, fungi, or viruses that disrupt the lifecycle of PSHB or its associated Fusarium fungus- both evaluating commercial biological controls that are already available and novel ones potentially identified in priority area 1;
- Novel cultural control methods such as alternative approaches to mechanical tree removal, investigate use of selective tree removal "buffer zones";
- Protectants and Repellents to reduce borer population, redirect from hosts and prevent primary infestation and potential reinfestation in treated trees.
- Assessment of new attractants that might be used to improve detection and control.

3. New approaches to improve detection and surveillance efficiency and success

Detection and surveillance are crucial to eliminate the PSHB-FD. Detection refers to the probability of detecting a pest in an infested area and is strongly dependent on detection method and effort as well as environmental conditions. It is a key factor to determining eradication success. A strong understanding of detection allows for robust and effective design of surveillance strategies. Early detection is vital because it allows for timely intervention, limiting the pest's ability to establish and spread. Surveillance provides continuous data, enabling stakeholders to track the pest's movements and evaluate the effectiveness of control measures. Without efficient detection and surveillance, PSHB-FD

[2] Cultural control is the non-chemical management of pests using manual or mechanical means to change the soil and crop environment to discourage pest establishment.

could infest or reinfest areas undetected, leading to significant impacts and dramatically increasing costs of eradication.

In addition to enhancing on the ground detection and surveillance techniques, the use of predictive tools like modelling could also be beneficial. Modelling refers to a process of creating a representation or simulation of a real-world system using a suite of inference and simulation approaches. Models are important for understanding how quickly PSHB-FD might spread under different scenarios, its potential ecological and economic impacts, whether control and detection methods are adequate, and how we might optimally allocate resources to surveillance and control to maximise success under WA conditions. This knowledge allows for proactive decision-making, helping prioritise resources (e.g., for surveillance), target interventions, and prevent widespread infestations. Moreover, modelling helps evaluate the effectiveness of different control strategies by simulating outcomes over time, thus ensuring a more informed approach to pest management.

Potential research topics include:

- Assessing the performance of different detection tools (such as in-field molecular assays, improved traps to capture PSHB, e-nose/detector-dogs, AI-based identification systems, and remote sensing) to allow for faster diagnostics in localised areas (noting this would also require development and testing of the detection tools);
- Modelling the potential spread of PSHB to support prediction of where it is likely to establish new populations;
- Modelling the potential impact of PSHB on agricultural and urban environments;
- Estimating detection probability of various methods in various settings;
- Identifying factors influencing host and site occupancy: which hosts and sites are most susceptible to infection, considering the effectiveness of control efforts and environmental effects on colonisation);
- Estimating dispersal to understand both active (by PSHB) and passive (transport by humans) dispersal;
- Developing population dynamic models to test various control and surveillance scenarios to understand likely effectiveness of proposed interventions and advise on the times and places they will be most effective.
- Developing risk mapping to understand how risk changes through space and time i.e., the chance of an infestation and its consequences. This can inform surveillance and community education programs.
- Developing predictive diagnostics which makes use of circumstantial data to inform in-field diagnostic decisions to speed up in-field assessment and decision-making.
- Assessing the value of citizen science / community involvement in providing a passive surveillance network.