EVALUATING THE MYCOHERBICIDE POTENTIAL OF A LEAF-SPOT PATHOGEN AGAINST JAPANESE KNOTWEED

Locations  
Canada, Netherlands, United Kingdom

Dates  
31/01/2016 - 31/12/2021

Summary  
Japanese knotweed is a highly invasive weed that impacts severely on native biodiversity and local infrastructure in its introduced range. Whilst chemicals are currently used to control the weed, this approach is costly and unsustainable. Biological control is an alternative method. The damaging leaf-spot fungus, *Mycosphaerella polygoni-cuspidati*, which attacks the plant in its native range was found not to be suitable as a classical biocontrol agent. However, the pathogen is considered to hold potential as a mycoherbicide. The aim of this project is to undertake proof-of-concept research into a potential mycoherbicide, in collaboration with the private industry.
The problem

Japanese knotweed (*Fallopia japonica*) is a highly invasive species in the UK, mainland Europe, North America and parts of Oceania.

Introduced from Japan in the mid-19th century as a prized ornamental, the plant species soon became problematic in its entire exotic range exerting detrimental impacts on both the biodiversity and local infrastructures.

Due to its ability to form dense monocultures and to regrow from tiny fragments of rhizome, Japanese knotweed is often governed by special legislation in individual countries, like in the UK where it is illegal to cause it to grow in the wild (Wildlife and Countryside Act 1981).

Currently, the weed can be partially controlled using chemicals however, this is costly and considered as unsustainable due to the ease of spread of the invasive, and the increasing restrictions in the use of herbicides in many countries.

Classical biological control programmes targeting Japanese knotweed were initiated in the UK and the USA in 2000, shortly followed by Canada in 2007. From the suite of natural enemies associated with Japanese knotweed in its centre of origin, the psyllid, *Aphalara itadori*, and the fungal leaf-spot pathogen, *Mycosphaerella polygoni-cuspidati*, were selected as having the highest potential as biocontrol agents. The psyllid has already been released in the UK and in Canada, while the leaf-spot pathogen is still undergoing evaluation as a potential agent.

What we are doing

The fungal leaf-spot, *Mycosphaerella polygoni-cuspidati*, is a damaging pathogen of *F. japonica* which is common and widespread on its host in the native range.

A thorough evaluation showed that the pathogen is not suitable as a classical biocontrol agent for Japanese knotweed as it can cause restricted disease symptoms on a couple of non-target plant species under quarantine greenhouse conditions. However, the pathogen is thought to hold promise as a mycoherbicide due to its genetic and biological properties.

Such potential mycoherbicide would be based on a single-mating type isolate allowing targeted application while preventing the fungus from reproduction, persistence and spread in the field.

To protect this idea, international patent applications held in the name of the Secretary of State for Environment, Food and Rural Affairs, UK (DEFRA) have been filed and published, and a European patent has already been granted.

Building on previous work, the aim of this project is to undertake “proof of concept” research into the potential mycoherbicide in collaboration with the private industry to assess the scope for, and, hopefully, ultimately develop a product which could be applied in much the same way as a herbicide.
Results so far

The *Mycosphaerella* leaf-spot can easily be mass-produced as fungal mycelium in liquid culture, retaining its viability and virulence. Freeze-drying, routinely used to increase the shelf-life of fungal propagules, was found unsuitable to preserve the viability of mycelial fragments of the pathogen long-term. Thus, the focus shifted to trying to induce the formation of microsclerotia, durable structures, which enable fungi to survive adverse conditions. If successful, the next step would be to assess these structures with the view to the performance of the agent in the field and to its shelf-life.

Inoculation studies with the leaf-spot, using mass produced mycelial inoculum, were first conducted under standardized quarantine greenhouse conditions. Under these conditions, application of mycelial fragments to Japanese knotweed plants consistently led to the development of necrotic leaf-spots and could affect the growth habit of treated plants. Based on a pest-risk-assessment, permission to release the pathogen from quarantine was granted by the relevant UK authorities in July 2019.

Subsequent experimental field trials conducted with potted Japanese knotweed plants in tents in the grounds of CABI UK showed that the pathogen is also able to infect and develop disease symptoms on its host under these more natural conditions. Repetition of the field trial in 2020 will help to gather further data of the disease development of *M. polygoni-cuspidati* on Japanese knotweed in this experimental set up. In collaboration with a commercial company, the leaf-spot pathogen is currently undergoing a parallel assessment in the Netherlands.

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Donors

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Partners

Agriculture and Agri-Food Canada - Lethbridge Research and Development Centre, A major biocontrol company

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