Biological Control 82 (2015) 52–60

Contents lists available at ScienceDirect

Biological Control

journal homepage: www.elsevier.com/locate/ybcon

Risk assessment of the *Acacia cyclops* dieback pathogen, *Pseudolagarobasidium acaciicola*, as a mycoherbicide in South African strandveld and limestone fynbos

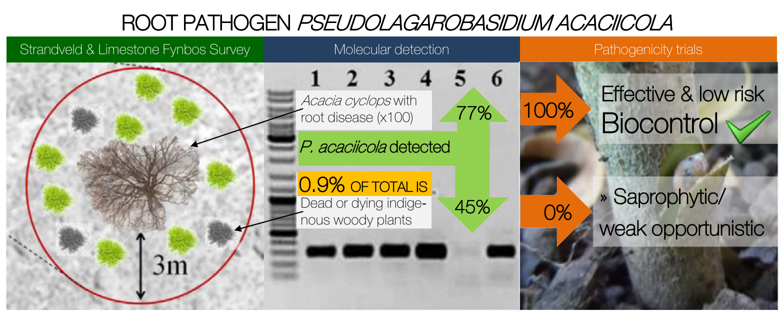
L.J.D. Kotzé [a], A.R. Wood [b,*], C.L. Lennox [a]

[a] Department of Plant Pathology, University of Stellenbosch, Stellenbosch 7600, South Africa
[b] ARC-Plant Protection Research Institute, Private Bag X5017, Stellenbosch 7599, South Africa

HIGHLIGHTS

- *Pseudolagarobasidium acaciicola* causes dieback of *Acacia cyclops* in South Africa.
- In a field survey 0.9% of indigenous plants were dead around 100 killed *A. cyclops*.
- Of these *P. acaciicola* was confirmed in 45% by use of a species-specific primer.
- None of these species were killed in inoculation trials.
- This is the first time this approach to undertake a risk assessment has been used.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 25 July 2014
Accepted 16 December 2014
Available online 24 December 2014

Keywords:
Pseudolagarobasidium acaciicola
Acacia cyclops
Bioherbicide
Mycoherbicide
Risk assessment
Fynbos
Strandveld

ABSTRACT

Acacia cyclops, an invasive weed in South Africa, has become a major threat to the fragile biodiversity of strandveld and limestone fynbos vegetation. The locally occurring *A. cyclops* dieback pathogen, *Pseudolagarobasidium acaciicola*, is under consideration as a mycoherbicide to control *A. cyclops*. To determine the level of risk posed to surrounding indigenous plants when using *P. acaciicola* as a mycoherbicide, a field survey was performed to record dieback and mortality incidence among indigenous woody plant species around diseased *A. cyclops* trees. Subsequently, DNA extractions were made from the roots of all dead or dying indigenous woody plants recorded, and *A. cyclops* trees, to verify if *P. acaciicola* was present. A mortality rate of 0.9% of indigenous plants was recorded and *P. acaciicola* was confirmed as present in 45% of these dead plants. Presence of *P. acaciicola* was confirmed in 77% of the sampled *A. cyclops* trees. Pathogenicity trials revealed susceptibility of some native Fabaceae species to stem inoculations in the nursery and, to a lesser extent, in the field. The optimum growth temperature for *P. acaciicola* was determined as 30–35 °C. Aside from being pathogenic to *A. cyclops*, results from this study suggest that *P. acaciicola* is primarily a saprophyte and possibly a weak opportunistic pathogen on some indigenous Fabaceae. Due to the very low incidence of mortality, and demonstrated limited pathogenicity, it is concluded that the use of *P. acaciicola* as a mycoherbicide on *A. cyclops* poses a sufficiently low risk to any indigenous vegetation to warrant its widespread use.

* Corresponding author.
E-mail address: wooda@arc.agric.za (A.R. Wood).

http://dx.doi.org/10.1016/j.biocontrol.2014.12.011
1049-9644/

1. Introduction

After being introduced to South Africa in 1835 to stabilize sand dunes (Poynton, 2009), the Western Australian tree *Acacia cyclops* A. Cunnex G. Don (Fabaceae, Mimosoideae), became one of the most invasive tree species in the country (Henderson, 2007). It is now distributed all along the coastal belt in the Western-, Eastern- and Northern Cape provinces of South Africa from Hondeklipbaai to East London (Coates Palgrave, 2002) (Fig. 1). It thrives most in limestone fynbos and "strandveld" (quaternary beach dune vegetation) (Henderson, 1998) which are economically marginal for stock grazing. Although invasive, *A. cyclops* has become economically important in areas where very few native trees grow. The wood is used for fuel and profits made from sales of wood benefit many poor local communities. Mechanical clearing is costly and therefore its implementation is limited and biological control is required for effective management of this alien invasive plant. Two classical biocontrol agents have been released in South Africa: a seed-feeding weevil, *Melanterius servulus* Pascoe (Coleoptera: Curculionidae), introduced in 1991, and the small fluted galler midge, *Dasineura dielsi* Rübsaamen (Diptera: Cecidomyiidae), introduced in 2001 (Impson et al., 2004). Although both agents have been locally successful in reducing reproduction, they do not have a significant effect on the growth rate or mortality of *A. cyclops* trees (Impson et al., 2011). With long-term control strategies rarely implemented in non-agricultural ecosystems (Evans, 2000), future management strategies should focus on the development and implementation of cheaper, more user-friendly and environmentally compatible products for use in these ecosystems, which ultimately play a major role in the functioning of agricultural lands (Power, 2010). A viable solution to address this large scale problem is the introduction of a biological control agent that would significantly increase the mortality rate of *A. cyclops*.

A. cyclops dieback was first recorded in South Africa in 1969 along the Garden Route (Taylor, 1969). By the early 1980s dead and dying *A. cyclops* were a common occurrence, especially between George and Still Bay in the Western Cape. The disease has spread over most of the distribution area of *A. cyclops* in South Africa (Wood and Ginns, 2006). The causative agent, *Pseudolagarobasidium acaciicola* Ginns (Polyporales, Basidiomycota) was isolated from *A. cyclops* roots (Wood and Ginns, 2006). *P. acaciicola* is difficult to isolate due to secondary fungi taking over the root system by the time the tree begins to die-back. *P. acaciicola* has only been isolated in South Africa and is therefore believed to be native. In addition, three specimens collected in kwaZulu–Natal by P. A van der Bijl (PREM 602, 669 and 674) from a dead tree stump, initially misidentified as *Irpex modestus* Berk., have been identified as *P. acaciicola* (Nakasone and Lindner, 2012). This suggests that *P. acaciicola* occupies a greater variety of habitats than currently assumed and that this species could be saprophytic as well as pathogenic. *P. acaciicola* has been tested as a mycoherbicide and proven successful in the nursery and the field (Wood and Ginns, 2006). Mycoherbicides still form a minor part of weed management, although some investments are being made in this field as agricultural producers are forced by the public, research development and environmental degradation to move away from chemical control. Mycoherbicides like Stumpout®, Hakatak® and Biochon® have successfully been used against invasive weeds (Morris et al., 1999). The primary concern for using *P. acaciicola* as a mycoherbicide is the potential threat to native species in the diverse Cape Floristic Region. Indigenous plant species in the same family, the Fabaceae, are most likely to be at risk (Pemberton, 2000). There are, however, no indigenous plants within the subfamily Mimosoideae, to which *A. cyclops* belongs, in the Cape flora (Goldblatt and Manning, 2000).

This study focusses on estimating the level of risk posed to plants native in the invaded range when using *P. acaciicola* as a mycoherbicide against *A. cyclops* and aims to provide evidence as to whether the fungus should be made available for public use.

2. Materials and methods

2.1. Field survey

Two areas were selected within the distribution range of *P. acaciicola*, one near Still Bay and one within Walker Bay Nature Reserve (Fig. 1). These study areas included a wide range of plant species and excluded any extremely dense stands of *A. cyclops*, as few or no native plants grow within these stands. One hundred dead or diseased *A. cyclops* trees, in total, were identified within the two study areas. The number of indigenous woody plants within a 3 m radius of each of these *A. cyclops* trees was recorded. The indigenous plants were visually classified as being either healthy, dying or dead. The roots from all dead or dying indigenous

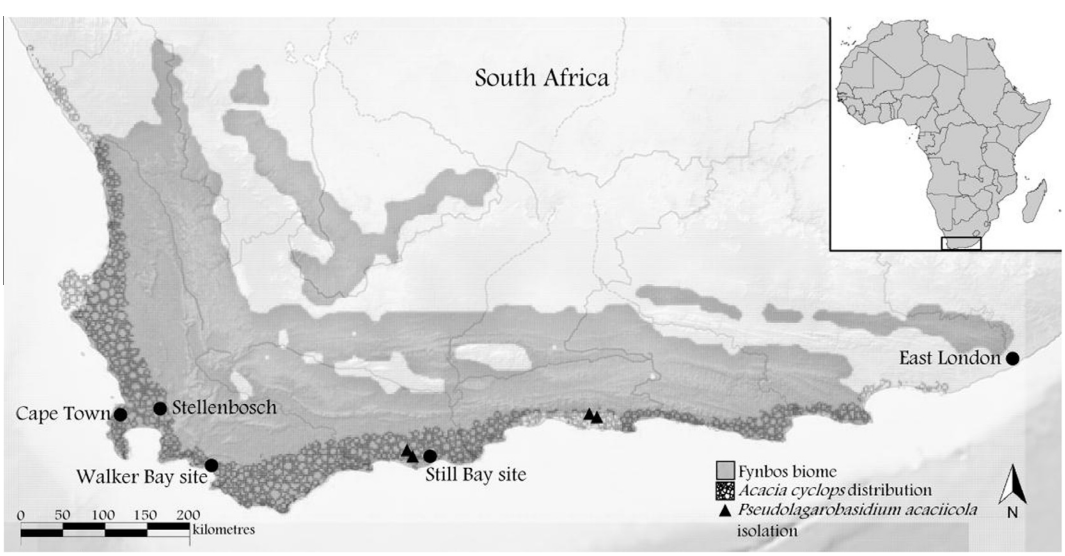


Fig. 1. A map of South Africa indicating the locations within the distribution range of *Acacia cyclops* where *Pseudolagarobasidium acaciicola* has been isolated (Wood and Ginns, 2006) as well as the two field sites within the fynbos biome.