Acaciothrips ebneri, a new biological control agent for the invasive prickly acacia (*Vachellia nilotica* subsp. *indica*) in Australia

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Summary Prickly acacia (*Vachellia nilotica* subsp. *indica*) was introduced into Australia in the 1890s as a drought resistant species for shade, fodder and ornamental purposes. It has since become invasive, being widespread throughout grazing areas in northern, central, and western Queensland and coastal, semi-arid and arid areas elsewhere in northern Australia. It has been designated as a Weed of National Significance. The plant exhibits a number of negative impacts on local ecosystems and agricultural production. Biological control is the most economically viable management option for prickly acacia in Australia. Six agents have been released for prickly acacia with only two agents, a seed-feeding beetle (*Bruchidius sahlbergi*) and a leaf-feeding moth (*Chiasmia assimilis*), have established, and with limited impacts. Native range surveys were directed to Ethiopia and Senegal based on genetic and climatic matching. A gall-inducing thrips (*Acaciothrips ebneri*) was prioritised from Ethiopia for host specificity testing in Brisbane, Australia where host specificity testing was completed for 59 test plant species. The gall thrips is host specific and has been approved for release by Australian Government. It is the first gall insect released for prickly acacia in Australia. Field releases commenced in January 2023 and are continuing, across sites along inland and coastal areas in Queensland. There are early signs of field establishment, host damage, and dispersal of the gall thrips. Future research will focus on monitoring its establishment, dispersal, and impact on prickly acacia.

Keywords prickly acacia, thrips, gall induction, biological control, Australia.

INTRODUCTION

Prickly acacia (*Vachellia nilotica* subsp. *indica* (Benth.) Kyal. & Boatwr.; Fabaceae), originating from the Indian subcontinent and East Africa, is designated as a Weed of National Significance and a declared invasive species in Australia. This thorny tree typically grows 4-5 meters tall, occasionally reaching heights of up to 10 meters. Prickly acacia poses a significant threat to the rangelands of northern Australia, forming dense, thorny thickets that limit water access for livestock, diminish pasture productivity, and endanger - native flora and fauna (Spies and March 2004).

Mechanical and herbicidal methods used to control prickly acacia are considered uneconomical. Biological control, which offers a sustainable long-term solution, was initiated in Australia in the early 1980s (Mohyuddin, 1981). Six biological control agents have been introduced into Australia since 1985 (Dhileepan *et al.* 2009, 2014). Among these agents, only two agents, a seed-feeding beetle (*Bruchidius sahlbergi* Schilsky (Lepidoptera: Bruchidae) from Pakistan, and a leaf-feeding moth (*Chiasmia assimilis* Warren (Lepidoptera: Geometridae) from Kenya and South Africa have become established (Dhileepan *et al.* 2009). However, the impact of *B. sahlbergi* on prickly acacia has been minimal (Radford et al. 2001), and *C. assimilis* has only established in coastal areas, but not widely in the arid inland regions where major infestations of prickly acacia occur (Palmer *et al.* 2007). The other introduced agents (*Homichloda barkeri*, *Chiasmia inconspicua* and *Cometaster pyrula*) did not establish.

Biological control has continued to be a primary focus for managing prickly acacia in Australia. Consequently, research on its native range has expanded to include previously unexplored regions in Africa. According to literature (Dwivedi 1993) and herbarium records (Dhileepan *et al.* 2018), *V. nilotica* subsp. *indica* and other subspecies of *V. nilotica* with moniliform (bead-like) fruit pods are naturally found in Ethiopia. Following assessments of field host range and damage potential, *Acaciothrips ebneri* (Karny) (Thysanoptera:

Phlaeothripidae), a gall-inducing thrips that induces shoot-tip rosette galls in Ethiopia, has been identified as a promising biological control agent for prickly acacia in Australia (Dhileepan *et al.* 2018). In this study, we give an update on the host specificity tests and field release and monitoring of this gall-inducing thrips in Australia.

MATERIALS AND METHODS

No-choice host specificity tests: Based on preliminary host specificity tests conducted in South Africa (Dhileepan *et al.* 2018), the gall thrips from Ethiopia was imported into a high-security quarantine facility in Brisbane, Australia for colony establishment and detailed host specificity testing. A colony of gall-inducing thrips, sustained on prickly acacia was utilized in all host specificity trials. No-choice tests were performed by releasing randomly selected newly emerged adults into insect-proof mesh cages (60×60×90 cm) containing one potted test plant or a control prickly acacia plant. Each replicate included at least one control prickly acacia plant and a minimum of five replicates were conducted for each test species. The control and test plants were observed for a minimum of four weeks to record adult survival, gall induction and development, followed by an additional two weeks after all adults had died. In total, 59 test species (subfamily Caesalpinioideae 50 species, subfamily Faboideae 7 species, subfamily Dialioideae 1 species, subfamily Cercidoideae 1 species) underwent screening during the host-specificity testing (Shi and Dhileepan, 2024).

Field releases: The gall-inducing thrips have been approved for field release by Australian Government in October 2022. Mass-rearing was immediately initiated after the approval in a temperature-controlled glasshouse at Ecosciences Precinct, Brisbane, Queensland. Both adults and mature galls were released from December 2022 and currently ongoing. Releases were made on five mature prickly acacia trees per site with actively growing shoot tips. In each tree, adults were released and mature galls were tied on five shoots with actively growing shoot tips.

Field monitoring: Field monitoring started in March 2023 after first field release. Five released trees were monitored regularly, and number of galls per shoot/branch were recorded (10 branches were selected per tree) and proportion of shoot-tip diebacks were also recorded at a later stage after a few months of release of the agent.

RESULTS

No-choice host specificity tests: In no-choice host specificity tests, gall induction, oviposition and larval development occurred only on prickly acacia. There was no gall induction, oviposition and larval development on any of non-target test species.

Field releases: These releases have been conducted at both coastal and inland locations in Australia, targeting areas indicated as climatically suitable based on the CLIMEX model. Efforts to validate the model included releases near permanent water bodies such as dams and lakes, as well as in areas distant from water bodies in each property. In total, 32 sites were identified and chosen for release of the insect agents on prickly acacia plants in central, north and northwest Queensland since December 2022.

Figure 1. Rosette galls by *Acaciothrips ebneri* causing shoot-tip dieback on prickly acacia.

Field monitoring: Several monitored sites have been discovered with establishment of the insect galls (Figures 1-7). Thrips gall induction has not only been found on prickly acacia shoot-tips, but also on both inflorescence (Figure 2) and early young developing fruits (Figure 3), which have never been observed in the glasshouse conditions due to prickly acacia plants not knowing to produce flowers and fruits under potted conditions. Initial monitoring at most release sites has shown evidence of gall induction and development. However, the extent and intensity of gall development varied significantly among sites. Sites near permanent water bodies exhibited widespread gall incidence with up to 100% of shoots with shoot-tip dieback symptoms, in some cases. Notably, dispersal distances exceeding 3 km have been observed at some release sites. Juvenile plants are more likely to be susceptible to gall thrips attack than mature trees.

Figure 2. Evidence of gall induction by *Acaciothrips ebneri* on prickly acacia inflorescence in Queensland, Australia.

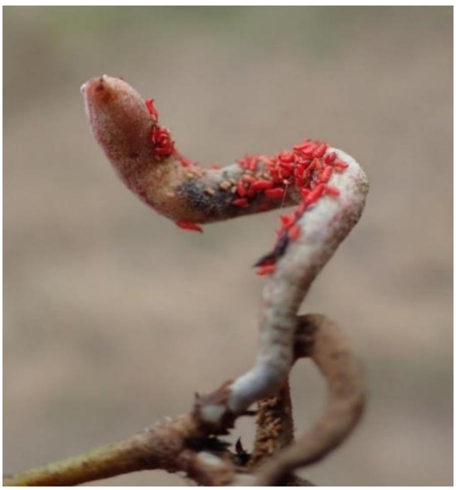

Figure 3. Evidence of gall induction by *Acaciothrips ebneri* on developing prickly acacia fruit with aggregating larvae and adults in Queensland, Australia.

DISCUSSION

Field establishment of previously released biocontrol agents on prickly acacia has been limited due to climatically unsuitability. The gall-inducing thrips was prioritized based on field host specificity and climatic suitability. Gall-induction on shoot terminals and axillary meristems resulted in shoot tips dieback. Host specificity testing results showed the gall thrips is very specific, hence it was approved by Australian Government. Differential establishment and damage potential of gall thrips have been recorded amongst coastal and inland sites, possibly due to variations in climate conditions, presence of predators (e.g. ants and spiders) or lack

Figure 4. Gall induction by *Acaciothrips ebneri* in the shoot-tips of juvenile prickly acacia plant in Queensland, Australia.

of actively growing shoot tips of prickly acacia. More field releases are planned at unestablished sites in the inland regions of Queensland where major infestations occur. Further research and monitoring will continue to check the establishment, dispersal and impact of gall thrips on prickly acacia under field conditions.

Figure 5. Thrips gall induction on seedlings of prickly acacia plant in a private property near Hughenden in Northwest Queensland, Australia.

Figure 7. Thrips gall induction and causing shoot tips dieback on a mature prickly acacia tree in Queensland, Australia.

Figure 6. Thrips gall induction causing shoot tips dieback on juvenile prickly acacia plant in Queensland, Australia.

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