# Biological control agents are observed on *Mimosa pigra* six and 12 years after their release in the Northern Territory, Australia

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**Summary** Two biological control agents (a rust and a seed feeder) released to assist with control of *Mimosa pigra* (mimosa) in the mid 1990s. Both agents, based on 1990s surveys were believed to have failed to establish.

However, recent (dates) surveys have shown that both agents did in fact establish and are now having an effect on mimosa.

These findings highlight the importance of long term monitoring when evaluating an agent's establishment and spread. We discuss the implications of our findings for future biological control programs.

**Keywords** Mimosa, biological control, weed management, rust.

## INTRODUCTION

*Mimosa pigra* L. (mimosa) is a thorny shrub native to South and Central America and Mexico. In Australia mimosa typically reaches 4 m and often up to 6 m in height and easily outcompetes native vegetation to form monocultures. It is believed to have been first introduced into the Northern Territory in the late 19th century (Miller and Lonsdale 1987) and it is now estimated that approximately 140 000 ha of the Northern Territory are occupied by mimosa with numerous interconnecting stands spanning over many thousands of hectares of floodplains of the Daly, Finniss and Adelaide River catchments (Unpublished data: Department of Natural Resources Environment The Arts and Sport, Weed Management Branch). Mimosa also occupies large areas of land on the Mary River catchments and Oenpelli floodplains.

Biological control of mimosa began with the introduction of two stem boring moths, *Neurostrota gunniella* (Busk) and *Carmenta mimosa* Eichlin and Passoa in 1989. Between 1989 and 2012, 13 insects have now been released. Some agents have been quick to establish and spread; others have shown a significant time lag between release date and detection or establishment. In some cases (for example, the weevil *Chalcodermus serripes* Fahraeus and the rust *Diabole cubensis* (Arthur and J.R. Johnston) Arthur), this delayed time of detection resulted in both agents being considered not to have established.

*D. cubensis*, a microcyclic rust, was first released on mimosa in 1996, with further releases until 1999. Agent releases were carried out in the coolest part of the year to best match the environmental conditions found in its native range. Multiple releases were carried out on two sites on the Finniss River and six sites in the lower Adelaide River catchments. Monitoring for establishment was conducted at one site from each of the two catchments. Evaluations at three, six and nine weeks post-inoculation showed no visible signs of establishment; despite successful inoculations (Hennecke 2006).

The weevil *C. serripes*, the larvae of which feed on green seed, was first released in 1996 through to 2002. Ostermeyer and Grace (2007) concluded that establishment had not been achieved, despite an adult being observed at a release site 13 months after a release. The authors suggested the agent had not established due to unsuitable climatic conditions and/or insufficient release numbers, due to rearing difficulties. Rearing difficulties were attributed to the diapauses of pupae. These difficulties were later overcome and releases supplemented with adults obtained from overseas populations.

## RESULTS

In 2011 *D. cubensis* was found, by chance, in high numbers in the Finniss River catchment in ongoing mimosa field surveys. The location was approximately 36 km from the nearest release sites of the Finniss River.

Since the discovery, visual surveying for *D. cubensis* has been included in all field surveys of mimosa. The rust has since been found at another site close to the first recent detection location (Finniss River) and at second site in the Daly River catchment, a further 75 km from the first location.

In 2008, a monthly field survey conducted at a long-term monitoring site, used for the release of numerous insects including *C. serripes*, weed management staff identified the weevil in high numbers. Field surveys of mimosa elsewhere were modified to include visual searches for *C. serripes.* The agent has subsequently been detected at numerous sites in the Daly River region and across the Finnish River catchment

indicating that the insect is both well established and widespread. Spectacular results have been witnessed at sites where high numbers of *C. serripes* have largely defoliated flowers and growing tips.

## DISCUSSION

One of the reasons for the lag in detection could be related to the agents' lifecycles and the difficult environment in which mimosa exists. The lifecycle of *C. serripes* is such that adults only emerge after rainfall significant enough to break diapauses (Heard *et al.* 1999). The floodplain where mimosa typically inhabits becomes easily inaccessible with the onset of the Wet season and remains so for many months, after which time *C. serripes* would be again pupating in the soil, thereby avoiding detection.

*D. cubensis* however is considered a Dry season rust since it requires low temperatures only seen between May and September. The mimosa at the site where the *D. cubensis* was first found, was the dominant understorey, with a *Melaleuca* sp. (melaleuca) canopy. The microclimate is likely to have provided more conducive conditions for a higher density of spores which made it more detectable. The distances the rust has travelled suggest that it has been spreading over time, either at an undetectable level or in habitat which is difficult to survey.

Mimosa under melaleuca is typically wet for long periods, and has less sunlight available — conditions which generally do not host high numbers of biological control agents (Elliott and Casanova 2012). Mimosa at these sites is extremely difficult to control using herbicides, fire or mechanical forces. As such, the value of the rust as a biological control agent in these habitats is high if it can be proved to be damaging. Further research is required.

The discovery of the rust 12 years after, and the seed feeding weevil six years after their original release, highlights the importance of continuing to mass rear in order to optimise the chance of establishment and to reduce the time it may take to observe the effectiveness of the agent in the field.

The detection of these two biological control agents would have been even further delayed if the mimosa biological control program was not still ongoing with the release of the final agent *Nesaecrepida infuscata* (Schaeffer). Fortunately this agent has had sufficient resources to overcome difficult rearing needs and is now established in high numbers at a number of sites.

These findings also raise important questions about the methodology used to measure establishment success, and for how long monitoring should occur.

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