

## A magic bullet for the Northern Australian neem nightmare?

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**Summary** Planted as a shade tree in many Kimberley communities, neem (*Azadirachta indica* A.Juss), is now a highly invasive weed, harming the natural environment, agricultural production and cultural sites across the region and northern Australia. In 2013, neem was ranked among the Kimberley's top environmental weeds, and voted the highest priority weed at the 2015 'Kimberley Weed Forum'. The Northern Territory lists neem as a Class B and Class C weed, yet it remains undeclared in Queensland and Western Australia. In 2017, Environs Kimberley developed the Interim Kimberley Neem Management Plan which, for the first time, collated Kimberley mapping data, presented case studies and made recommendations; including trialling new control technology and advocating for improved recognition of neem as a serious weed at a state and national level.

Currently, Environs Kimberley is working with several groups to run experimental control trials, and Nyikina Mangala Rangers to undertake control and mapping of neem at Oongkalkada, an important cultural site. Control poses a wide range of challenges for land managers, including low efficacy of some treatment methods, cost of equipment and materials, labour intensity and occupational, health and safety risks in remote areas. The control method being trialled uses dry herbicide in capsules developed by Bioherbicides Australia. Previously with one option of control, operators might spend a day sweating it out with chainsaws and loppers to treat a relatively small area of neem infestation. Use of the capsules could allow hundreds of trees to be treated per person per day at reduced cost and greatly improved human and environmental safety.

**Keywords** Neem, Northern Australia, weed control, herbicide technology.

### INTRODUCTION

Neem (*Azadirachta indica* A.Juss) is a weed tree invading and dominating areas in tropical Australia, and impacting natural, cultural, agricultural and other values across the Kimberley, Northern Territory and Queensland. Neem is able to invade and quickly expand into intact natural areas, directly reducing the diversity and abundance of native species and inter-

fering with natural ecosystem processes (Northern Territory Government Department of Environment and Natural Resources 2015). It is not compatible with agricultural crops owing to its aggressively invasive nature (Northern Territory Government Department of Environment and Natural Resources 2015). Neem is also encroaching on significant Aboriginal cultural sites, having a medium to high impact (Beames *et al.* 2017). Such weed problems can affect the health and well-being of people and country, as well as cultural economies including foods and medicines (Duff 2012, Duff and Weir 2013).

Neem is thought to have originated in India and Myanmar and has a rich cultural and medicinal history (Biosecurity Queensland 2016). It has insecticidal properties and strong links with Ayurvedic medicine (Kumar and Navaratnam 2013). It is used in a range of products including for health and cosmetics, cleaning and agriculture. These attributes are behind unsuccessful attempts to grow commercial quantities in northern Australia, with plantations established from 1965–1988. The species was also heavily promoted to communities, townships and cattle stations in the Kimberley as a shade tree, and these individuals are now acting as source populations, allowing the species to be spread into important ecosystems. Seeds germinate in abundance around parent trees, displacing natives. Birds eat the fruit and spread seeds widely, especially under resting or roosting trees. Large eucalypts and boab trees in the Kimberley are now being suffocated by neems, which kill the parent tree and reduce the germination of new stands (Biosecurity Queensland 2016, Reynolds *et al.* 2018). In the East Kimberley, there are large infestations that land managers and government are increasingly unable to control.

Neem was voted as the top priority weed by attendees at the inaugural 2015 Kimberley Weeds Forum. It had previously been identified by the then Western Australian Department of Environment and Conservation as a top environmental weed in a 2013 Weed Prioritisation Process.

The Northern Territory Government listed neem as a Class B and Class C weed under the *Weeds Management Act* in 2015. This means that neem may no

longer be brought into the Northern Territory, and land managers are required to control the growth and spread of neem. Queensland conducted an Invasive Plant Risk Assessment on neem in 2008, which was subsequently revised in 2016 (Biosecurity Queensland 2016). They noted neem has become naturalised and is spreading into native habitat, and that, while there is a lack of data to enable robust decision-making, the high seed production could result in substantial growth of populations in the future. To date, the Western Australian Government has taken no investigative or legislative action regarding neem. A handful of groups and individuals continue to advocate for a range of actions to address the significant threat posed by neem to the Kimberley environment and communities.

#### INTERIM NEEM MANAGEMENT PLAN

The Interim Neem Management Plan (Beames *et al.* 2017) benchmarks current knowledge and understanding of neem biology and ecology, along with the history of its spread and impacts in the Kimberley. For the first time, the plan collated distribution points from multiple operators, mostly non-government organisations and committed individuals, to create a Kimberley neem distribution map. Case studies were used to share knowledge, observations and experiences of neem management to inform Kimberley project priorities and enhance control practices. The plan includes results from a qualitative stakeholder survey conducted by Environs Kimberley in 2017. The results of the survey demonstrate the significant concerns about neem among stakeholders as well as capturing information about efficacy of current control methods.

To best apply the information compiled and forge a positive future where neem invasion can be prevented and contained in the Kimberley, the plan presented 11 recommendations. A key recommendation was to conduct applied research on herbicide capsule technology, a new method described within the plan, to determine its capacity to assist in neem eradication.

#### NEW METHODS IN WOODY WEED CONTROL

Recent technological and methodological developments are enabling Kimberley people to trial large-scale control of neem and other woody weeds, improving the efficacy, efficiency and cost effectiveness of programs, while reducing human and environmental risks.

For example, Nyamba Buru Yawuru Land and Sea Team have adapted older methods of treating young woody weeds, by using long nozzle containers to apply a thin line of liquid herbicide around sapling stems (up to 5 cm diameter at breast height (DBH)), in effect ring-barking without the need to paint or spray

herbicide. This reduces effort and time involved and improves occupational health and safety for operators.

The second method utilises technology developed by Bioherbicides Australia and promises an even greater gain in occupational health and safety, and an efficient use of human and financial resources. Preliminary results show the method can be applied to neem trees from 5 cm DBH upwards and involves drilling a hole in the trunk and inserting a capsule that contains dry herbicide, followed by a wooden plug. The auto-applicator allows insertion of up to 30 capsules and plugs before requiring refilling. Results will be made publicly available and disseminated to stakeholders.

Should trials of the capsule method prove to be effective, treatment of neem will still require an integrated approach utilising a variety of methods to control it at various life stages, undertake follow-up treatment and manage seed bank and spread. This may include foliar spraying and hand-pulling of seedlings across different seasons, burning, revegetation and other changes to land management such as grazing regimes and the management of feral animal populations. There is also a need for more research aimed at determining the best treatment programs for different land management scenarios and environments across northern Australia.

Weeds on private lands are at risk of low management input as landowners have less access to weed management resources, training and time to undertake control. These new methods present exciting community engagement and participation opportunities, as the reduced costs, risk and greater efficacy will mean that private landholders can more easily undertake their own control activities.

#### PROGRESS ON RECOMMENDATIONS

Environs Kimberley has begun to respond to the recommendations in the Interim Neem Management Plan, by leading collaborative actions to control neem. We outline progress in the Kimberley against each recommendation below. A more thorough evaluation should be conducted by regional experts and operators at a second Kimberley weed forum, scheduled for October 2018, 12 months after the date of publication of the first neem plan.

- 1. Undertake comprehensive distribution and density mapping of neem, particularly in unsurveyed areas of the Kimberley region** This is underway. Preliminary discussions have been held with Aboriginal ranger groups and other stakeholders in the Kimberley to identify neem spatial data not currently accessible through databases. A

- more comprehensive mapping program is needed and requires input and funding from the state.
2. **Work with stakeholders to identify the current and potential ecological, cultural, agricultural and other values threatened by neem invasion** Funding for a research project should be sought to investigate this. Environs Kimberley has commenced preliminary discussions with potential research partners.
  3. **Conduct applied research with on-ground weed control projects and universities/academics to test new herbicide capsule technology and its capacity to eradicate neem** This is underway. Environs Kimberley is leading field trials in the west Kimberley to compare costs, risks and success rates of some of the current and emerging control methods. More comprehensive research is needed to answer questions such as: optimal application rates for dry herbicide capsules; impacts of herbicide capsules on the environment and people; and strategies for regional control.
  4. **In line with both the Northern Territory and Queensland, the state of Western Australia to conduct a weed risk assessment/invasive plant assessment for neem** State cooperation is being sought.
  5. **Further develop documentation and advocate for the listing of Neem under the *Biosecurity and Agriculture Management Act 2007*, in line with the listing of this weed under corresponding legislation in the neighbouring Northern Territory** This is underway. Preliminary work commenced by the Kimberley Rangelands Biosecurity Association on a submission to Western Australian Department of Primary Industries and Regional Development (DPIRD) requesting that neem be considered for listing as a declared pest. Environs Kimberley and several other groups have provided letters of support for this process.
  6. **Develop a pan-northern taskforce to share neem information, develop documentation and advocate for national recognition of the current and potential impact to northern Australian systems i.e. WoNS** Environs Kimberley is maintaining current relationships with stakeholders in order to help progress this in the future.
  7. **Address gaps in the Western Australian 'off label' permit to allow effective herbicide treatments to be applied** Results of current trials coordinated by Environs Kimberley will be submitted to DPIRD and discussion held regarding permit structure.
  8. **Develop a focused public education and awareness communication strategy to ensure the public and the nursery industry understand the implications of neem establishment and spread in the Kimberley, are prepared to undertake measures required to manage and control neem, and are engaged in communities. Early identification and control of new outbreaks** Environs Kimberley is in the preliminary phase of awareness raising, through media and community events is building on work carried out previously and by current partners. There is a need for a comprehensive awareness campaign targeting communities across the Kimberley. Initial feedback suggests interest and support from current and potential partners.
  9. **Work with the four Kimberley shires to introduce measures that will prevent new introductions of neem; require neem to be removed from any new developments and support landowners to remove and control it** Environs Kimberley is maintaining current relationships with stakeholders in order to help progress this in the future.
  10. **Investigate the feasibility of formally gazetting neem as a weed under the local laws of the four Kimberley shires and assess what, if any, influence this may have on the state to secure greater recognition of neem as a weed** No progress.
  11. **Work with the five Kimberley towns, Aboriginal communities and pastoral stations to remove and replace neems that were once planted as shade trees** Environs Kimberley has initiated discussions with some groups. There are a range of factors influencing uptake, including propagation and availability of local provenance replacement species and an absence of funding for materials and extension work.

#### COLLABORATION AND LEADERSHIP

Environs Kimberley has been working with Aboriginal ranger groups and their communities, pastoralists, environmental community groups and scientists to coordinate and support weed management projects since 2007. The isolated location and challenges around access to resources makes collaborating and engaging with a variety of partners an integral part of doing

business and working on Country in the Kimberley. A number of groups and individuals are leading this collaborative approach and key guidelines are emerging to improve working relationships and outcomes (e.g. Lincoln *et al.* 2017). Earlier work by Duff (2012) showed that processes and priorities of weed control need to have greater consideration for the vast native title lands and Traditional Owners throughout the Kimberley and that certain mechanisms for engagement, support and participation are better than others.

While developing the neem plan the authors received information from weed operators and land managers about trends in weed management resourcing, particularly in relation to the staff and funding allocated to combatting weed spread across northern Australia (L. Beames, pers. comm.). Funding for weed control in Australia's tropics continues to be inadequate, with little long-term, consistent program funding. This plays a large role in dismantling effective working relationships and control programs. Neem control is dually beset by a lack of legislative prioritisation and targeted funding.

#### CONCLUSION

Several groups have been working alongside Environs Kimberley to implement the recommendations outlined in the Interim Neem Management Plan, both explicitly and implicitly through management plans (e.g. Healthy Country Plans). The organisation intends to secure further funding and resources to progress recommendations and identify and reach targets. The authors aim to seek further collaboration with research institutions and government departments to improve understanding of the challenges and threats posed by neem and enlist greater support and leadership across northern Australia for better protection of natural and cultural assets.

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