



RESEARCH FINDINGS 2011

Fire and smoke: smoke can be used as a tool to enhance germination and predict the soil seed bank and help increase restoration success.

Look before you plant: the use of smoke water to test the soil seedbank

KATINKA RUTHROF • MICHAEL CALVER • BERNARD DELL • GILES HARDY

Land managers are often faced with a high degree of uncertainty regarding the level of weed species in the existing soil seedbank. This can make strategic land management planning difficult. If the soil seed bank could be analysed, it may be used as a predictive tool for land managers.

Aqueous smoke (smokewater) or aerosol smoke enhance seed germination in many ecosystems. We explored a glasshouse-based method using smokewater as an inventory tool to help determine the soil seedbank. This approach is relatively inexpensive and may help predict the potential weed soil seedbank and provide more information to land managers to making management decisions.

Methods & Results

We investigated the use of smokewater to examine the weed seedbank for soil samples collected from three sites in Ludlow Tuart Forest: a degraded tuart (*Eucalyptus gomphocephala*) forest site (currently managed for weeds), an ex-mine site, and an ex-pine plantation site. Each of the three management sites were paired with a site in the adjacent native forest – referred to here as the paired 'off-site'.

Soil samples (each 10 x 10cm to 2cm depth) were taken just prior to the start of the winter rains. The 150 soil samples (25 samples from each of the six sites) were air-dried and half of each were treated with diluted smokewater.

Soil samples were maintained in a glasshouse and germinants counted at 3 and 10 months (see Figure 1).



Figure 1 Seedling trays in the glasshouse at three months.

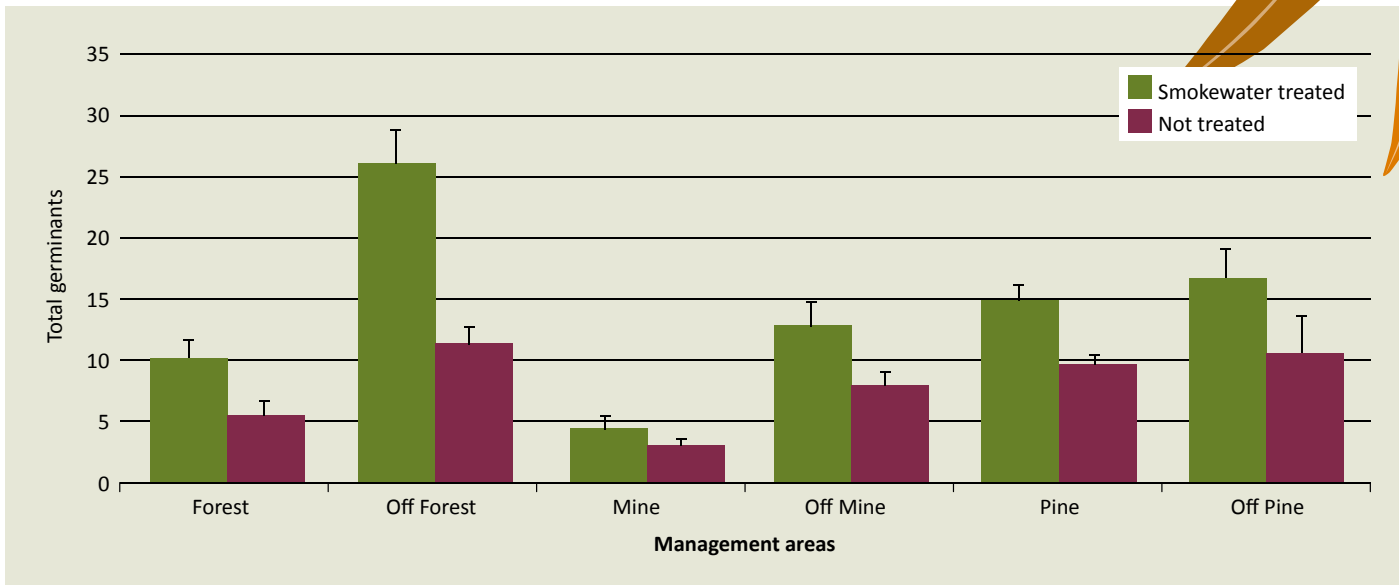
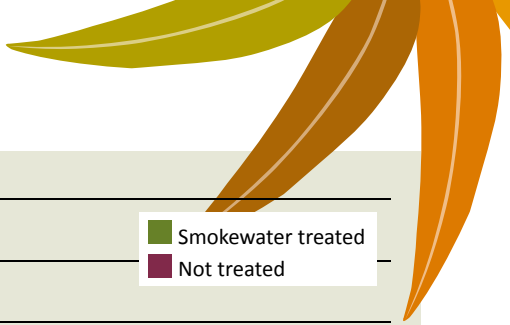


Figure 2 Germination from soil samples collected from three management areas and paired sites ('Off-') in the Ludlow Tuart Forest, with and without the addition of smokewater. Values are mean (+ SE) number of germinants averaged over 25 soil samples.

For all sites, germination density rates were significantly higher for the smokewater-treated samples relative to those not treated. Seed germination was also higher for the 'off-site' samples. There was a difference in germination density between the three management areas, with the ex-mine site having the lowest germination, followed by the forest site, and the ex-pine plantation site having the highest germination (see Figure 2).

Weed species dominated the seedling trays, particularly annual veldt grass (recorded in 54 % of trays and from all sites). Other weeds noted included dune onion weed (7 %, all sites) and arum lily (2 %, only in the 'off-forest' trays). The only native species recorded emerging was the mid-canopy dominant, WA peppermint (*Agonis flexuosa*) (5 %) which was recorded in all forest sites (not the ex-pine plantation and ex-mine site samples).

Conclusions & Recommendations

Smokewater significantly increased the germination from the soil seedbank. Significant differences in the level of germination of weed species from the soil seedbank were also observed between the three management sites.

Rather than basing requirements for weed management on land use history, the use of smokewater can provide land managers with a greater level of understanding of the composition of the soil seedbank. This would allow:

- *Prioritisation of management options*, including project type, site selection, timeline of activities and cost-effectiveness. For example, managers may wish to postpone treatment until financial resources can match the amount of weed management input required, or budget and plan for a particular suite of weed control methods, depending on the invasive species found in the soil seedbank.

- *Selection of appropriate species for revegetation*. Managers can select a particular native species mix and planting/seeding density that would favour target species. For example, plants with particular functional traits (e.g. high competitive ability in the face of particular invasive species, composition and abundance) may be selected for.

Future trials should test:

- Seed germination response to different smoke concentrations; or smoke in addition to heat; and
- Different restoration strategies, based on the soil seedbank composition as well as prior land use and management.

For more information, contact Katinka Ruthrof

E: k.ruthrof@murdoch.edu.au

Acknowledgements

We would like to thank the Department of Environment and Conservation, Bemax Cable Sands, and The Botanic Gardens and Parks Authority.

References

1. This article is an excerpt from: Ruthrof, K. X., Calver, M. C., Dell, B. and Hardy, G. (2011) Look before planting: using smokewater as an inventory tool to predict the soil seedbank and inform ecological management and restoration. *Ecological Management and Restoration* 12: 154-157.



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