Home among the gum trees – not necessarily so for silverleaf nightshade

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Summary Silverleaf nightshade is a widespread weed in south-eastern Australia. Despite many years of use of synthetic herbicides, populations of this deep rooted summer active weed continue to pose a problem, with more infestations occurring. As part of an innovative management strategy, the phytotoxic potential of eucalyptus species was evaluated.

Aqueous extracts were prepared from ground *Eucalyptus spathulata*, *E. salubris*, *E. brockwayii* and *E. dundasii* leaves. Germination of silverleaf nightshade seed was significantly decreased by aqueous extracts from all species.

Results suggest that compounds in the aqueous extract exhibit a phytotoxic effect on silverleaf nightshade seed germination. Further research is being conducted to determine the effect of these compounds on mature silverleaf nightshade plants. Phytochemical or possible allelopathic control of silverleaf nightshade may allow development of innovative new management options such as bioherbicides or use of agroforesty for weed management.

Keywords Silverleaf nightshade, phytochemistry, eucalyptus.

INTRODUCTION

Silverleaf nightshade (*Solanum elaeagnifolium* Cav.), a native plant of north-east Mexico and the south-west of the United States of America, is a weed in Mediterranean and temperate areas throughout Europe, Africa, Asia, the Americas and Australasia (EPPO 2006). This species was first reported in Australia in 1901 at Bingara (Leys and Cuthbertson 1977), but it was not until the 1960s that silverleaf nightshade became an important weed, and it was speculated that it has become a more widespread weed partly due to increased summer rainfall (Cuthbertson *et al.* 1976).

Typical habitat for silverleaf nightshade is found in temperate regions with 250–600 mm annual rainfall (Parsons and Cuthbertson 2001), preferably with summer rainfall patterns. Silverleaf nightshade grows on a range of soils from heavy clays to solonised brown soils, although there is some preference for lighter, sandy soils low in organic matter (Heap and Carter 1999).

Silverleaf nightshade occurs mainly in cropping and grazing situations and is a lesser problem in irrigated pastures, horticultural situations, roadsides and stock camps (Moore *et al.* 1975). Heap and Carter (1999) concluded that silverleaf nightshade establishes well on disturbed land, and is generally less invasive in undisturbed environments.

Silverleaf nightshade is difficult to eradicate, particularly once the infestation is >4 ha (Carter 1992). However, the weed can be managed to limit its spread and impact, with co-ordinated programs successful in controlling small infestations. Herbicides are the predominant control option used, although few land managers have reported eradication.

To date, there is no evidence in the literature that work has been undertaken to evaluate potential phytochemicals for the control of silverleaf nightshade. Current unpublished work in South Australia (B. Thompson pers. comm.) suggests that several *Eucalyptus* spp. have exhibited some ability to inhibit silverleaf nightshade growth within their canopy dripline.

Eucalyptus species have been widely examined for allelopathic potential (Lovett 1985, Kil and Lovett 1999, Willis 1999), with about 38 *Eucalypus* spp. evaluated for inhibitory activity against various organisms in Australia alone (Wills 1999). A diverse range of bioactive substances have been identified from the leaves, bark and roots of *Eucalyptus* spp, including water-soluble phenolics, volatile terpenes, and other plant-growth inhibitors (Silander *et al.* 1983, Guo and Yang 2006). More than 200 non-volatile secondary metabolites have already been characterised from different eucalypts (Singh *et al.* 1999).

May and Ash (1990) concluded that several *Eucalyptus* species would be capable of suppressing understorey growth via allelopathy. Del Moral *et al.* (1978) demonstrated that brown stringybark (*E. baxteri* (Benth.) Maiden & Blakely ex J.M.Black)) was capable of allelopathically suppressing the growth of dwarf sheoak (*Casuarina pusilla* (Macklin) L.A.S.Johnson) and heath tea-tree (*Leptospermum myrsinoides* Schltdl.). Research suggested that moisture, nutrients and light were not of major significance in the relationship between brown stringybark and the suppressed species.

The aim of this research is to evaluate the phytotoxic potential of *Eucalyptus* species on silverleaf nightshade.

MATERIALS AND METHODS

Leaves from gimlet (*E. salubris* F.Muell.) and swamp mallet (*E. spathulata* Hook) were collected from saplings in a trial plot near Ungarie, NSW, while leaf samples from dundas mahogany (*E. brockwayi* C.Gardner) and dundas blackbutt (*E. dundasii* Maiden) were collected from mature trees on the roadside near Melrose, South Australia. Leaf samples from yellow box (*E. melliodora* A.Cunn. ex Schauer) and capeweed (*Arctotheca calendula* (L.) Levyns) were collected from near Wagga Wagga, NSW, as controls. Mature silverleaf nightshade berries were collected from a field near Leeton, NSW.

Eucalypt leaf samples were dried at 40°C for 72 hours prior to being ground through a 1 mm sieve. Aqueous extracts from the four eucalyptus species were formed by incubating 10 g powder in 100 mL deionised water at 20°C for 72 hours. Solutions were filtered through muslin cloth and centrifuged at 5000 rpm for 5 min. The supernatants (extracts) were collected and stored frozen until required.

Silverleaf nightshade berries were crushed through a 2 mm sieve and seeds collected and stored at 4°C prior to use. Four extract concentrations (0, 25, 50 and 100%) were established by diluting the extract with deionised water, with 4 mL of solution added to each Petri dish. Thirty seeds were placed on filter paper in Petri dishes and incubated for 14 days at 25/15°C (8/16 hrs cycle) before counting germinated seeds. Three replicates of each treatment were conducted.

Germination percentages were arcsin transformed prior to being subjected to ANOVA and significantly different means separated using Fishers protected LSD.

RESULTS

All concentrations of the aqueous extracts from the four eucalyptus species of interest significantly reduced germination compared to untreated controls ($P < 0.01$) (Figure 1). All four species reduced germination to less than 5% at 100% extract concentration. Both yellow box and capeweed did not reduce germination at lower extract concentrations, and were less inhibitory than the other four extracts at 100% concentration.

DISCUSSION

Preliminary results from the trials reported here suggest that germination and seedling growth of silverleaf nightshade can be inhibited by compounds present in aqueous extracts from several eucalyptus species.

Preliminary investigations have also been carried out to measure the impact of eucalyptus phytotoxicity on root growth of silverleaf nightshade. Root growth can be inhibited by up to 91%, depending on eucalyptus species and extract concentrations (data not shown).

The potential impact of the aqueous extracts on seedlings and young plants emerged from root stock will be critical in the usefulness of these compounds as herbicidal agents for controlling silverleaf nightshade in the field. Should the impact observed on seeds also occur in plants in the field, there is the potential to develop a new herbicide, similar to the mesotrione herbicide developed from crimson bottlebrush (*Callistemon citrinus* (Curtis) Skeels) for control of a range of broadleaf weeds (Cornes 2004). Further research is underway to determine the phytotoxic potential of eucalyptus trees on the root stock regeneration of silverleaf nightshade and to identify substances responsible for such inhibition.

ACKNOWLEDGMENTS

The authors thank Bob Thompson (NSW Department of Primary Industries, West Wyalong) and Kevin Teague (Natural Resources Management Board, Melrose) for assistance in collecting eucalyptus leaf samples.

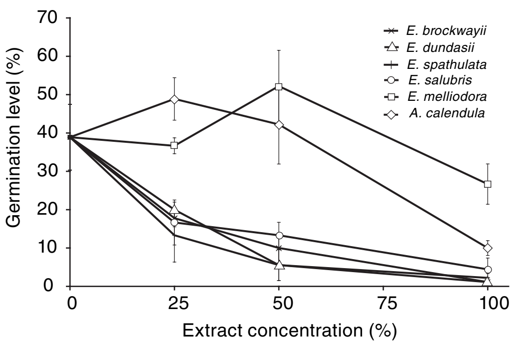

Figure 1. Effect of aqueous leaf extracts from selected eucalypt species and capeweed on germination of silverleaf nightshade seeds.

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