INTEGRATION OF PRESCRIBED FIRE AND SUB-LETHAL CHEMICAL DEFOLIATION FOR CONTROLLING SHRUB POPULATIONS IN AUSTRALIAN SEMI-ARID WOODLANDS

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Summary
It is postulated that cost-effective control strategies for resprouting shrubs can be developed by integrating strategically timed defoliations imposed initially by prescribed fire followed by chemical defoliation. The hypothesis proposes that secondary defoliation of young coppice regrowth using sub-lethal applications of environmentally acceptable chemicals, must be undertaken in the autumn no later that one year after fire. Preliminary results in terms of chemical activity, are extremely promising even though these sprays were applied to five-year-old coppice of two resprouting species. Two months after application, significant defoliation had been achieved with several chemicals applied at half the concentration normally recommended for root kill of woody species. At lower rates, defoliation was still increasing 6 months after treatment, presumably through gradual translocation.

Introduction

Dense shrub encroachment is seriously restricting the restoration of productive grazing systems over large areas of the semi-arid poplar box (*Eucalyptus populnea*) and mulga (*Acacia aneura*) woodlands of eastern Australia (1) stretching from Cobar in central New South Wales to Charleville in central Queensland and encompassing some 500,000 km^2. Several management options are currently available for controlling shrubs although their use over extensive paddock areas, typical of Australian rangelands, is heavily constrained by cost factors (3). Furthermore, detailed research over the past decade has clearly shown that single treatment options for shrub management are generally unsuccessful in providing long-term solutions (7). One approach that has shown considerable promise for treating large areas of shrub-infested range is prescribed fire (2). Whilst fire generally kills topgrowth of all shrub species, resprouters such as budda (*Eremophila mitchellii*), turpentine (*E. sturtii*) and some punty bush (*Cassia nemophila*) regenerate rapidly after fire by coppicing at ground level. Trials using artificial fuel have shown however that such species are vulnerable if a second defoliation can be applied one year later but only in the autumn (6). The only way secondary defoliation can be imposed so soon is by using chemical defoliants. If such materials could be used at low concentrations to mimic fire defoliation, then chemical defoliation may prove to be a cost-effective option for broadscale use. This paper briefly summarises results obtained from preliminary screening studies of several chemical defoliants applied over a range of dosage rates to coppicing *Eremophila* shrubs.

Methods and materials
An experiment examining the defoliation response by coppice regrowth of two problem species, budda (*Eremophila mitchellii*) and turpentine (*E. sturtii*), to eleven chemicals (seven arboricides and four dessicants) applied at six concentrations of active ingredient, was established in November, 1990 on "Bundoon Belah", 40 km west of Cobar, N.S.W, where large blocks within a paddock had been chained, windrowed and burnt in 1986. Treatments were randomised in six blocks (c. 200m x 50m) with application rates (0, 12%, 50%, 75% and 100% of active ingredient concentration suggested for root kill by the arboricides and 0, 50%, 100%, 135%, 170% and 200% of suggested rates for the dessicants) arranged as main plots split for shrub species. The arboricides used in this study were CT Roundup (450 g/L Glyphosate), Arsenal (250 g/L Imazapur + 60 g/L Isopropylamine), Garlon (600 g/L Triclopyr), Grazon (300 g/L Triclopyr + 100 g/L Picloram), Brushoff (600 g/L Metsulfuron Methyl), Velpar (250 g/L Hexazinone), Starane (300 g/L Fluroxpyr) while the dessicants were Gramoxone (200 g/L Paraquat), Ethrel (480 g/L Ethephon), Pix (38 g/L Mepiquat) and Harvade (600 g/L Dimethipin). None of these materials are currently registered for the purposes described in this paper. Duplicate plants were sprayed in each plot at low volume (2 sweeps of 30 ml each per coppice) using an Ag-murf Gas Gun(R) powered by propane gas. The aerial biomass of each coppice was estimated prior to spraying using a double sampling technique. Treated plants were regularly monitored and rated for both effect (i.e. change in leaf colour) and defoliation (0=no effect and 10=100% effect).

Results and discussion
While it is too early to make definite statements on particular chemicals and rates of application, early results from these screening studies are extremely promising. Although around half can probably be eliminated from further trials, some defoliants induced rapid defoliation, especially at higher rates (e.g. CT-Roundup), whereas others produced progressively greater defoliation over time (e.g. Arsenal), even at lower rates as shown in Figure 1. Further studies are required to refine dosages, especially on young coppice regrowth (i.e. one season's growth). Such treatment is seen, *a priori*, to be more efficient because there is less canopy surface to be treated and chemicals may be more physiologically active when applied to young leaves. If sub-lethal concentrations are effective, then large-scale testing of such treatments would logically follow. Large paddock size (up to 8,000 ha) may dictate the need for appropriate operational procedures involving both aerial ignition for primary fire treatment (5) and aerial spraying for secondary treatment (4).

With the advent of ultra low volume spraying (1-5 L/ha) using spinning cage atomisers, small droplet size can result in significant spray dispersal during broad swathe spraying. Such a reduction in application volume, even if only at low volumes such as 5-15 L/ha, is likely to be the most cost-effective spray technology for semi-arid rangelands, with more country being sprayed per load in regions where good quality water is limiting. The economic feasibility of successful fire-chemical defoliation strategies needs to be established before they will be widely accepted. A guide to the economics of integrated shrub control is provided by benefit-cost analysis. Using heuristic data, a 20-year partial budget was constructed to examine the net benefits derived from autumn fire (years 0 and 5) and chemical defoliation (year 1)

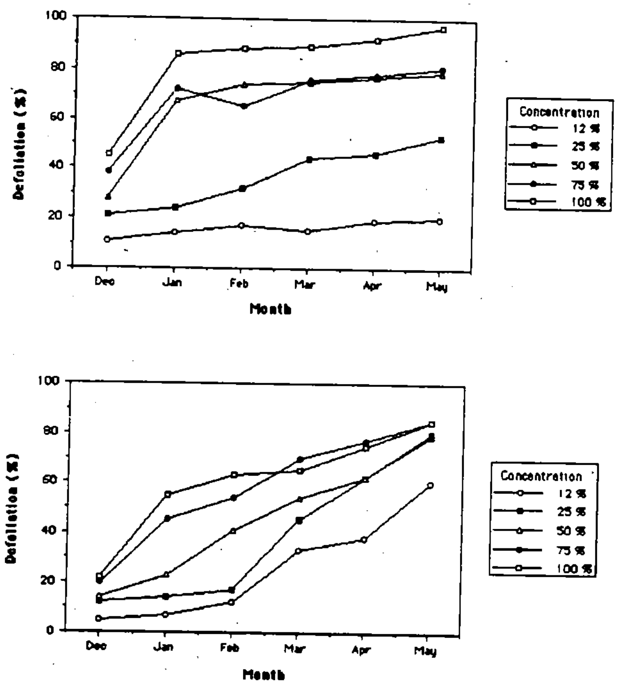

Fig. 1. Cumulative defoliation of budda coppice following spraying with Roundup (above) and Arsenal (below) applied at five concentrations.

treatments applied to a shrub-infested 4,000 hectare paddock (7). Net present value (NPV) of the combined flows of benefits and costs discounted at 10%, excluding the the cost of chemical agents but including aerial application costs, was calculated to be of the order of $8.50. On the basis of the assumptions used, this figure represents the maximum justifiable cost per hectare that can be incurred if chemical treatment is to remain profitable.

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