

MANAGING WOODY WEEDS WITH FIRE IN THE SEMI-ARID WOODLANDS OF N.S.W.

W.G. Date

Department of Agriculture, PO Box 286
Cobar N.S.W. 2835

Summary. The semi-arid woodlands of N.S.W. are experiencing an invasion of woody shrubs and a reduction of grasses and forbs coupled with increasing soil degradation. The shift from grass to shrub dominance has severely reduced the viability of many pastoral enterprises. An understanding of the resilience of key species to the combined pressures of fire, grazing and variable rainfall, is essential for the management of these rangelands. These shrubs (woody weeds) are disadvantaged to varying extents by fire, whereas grasses generally are not, and for this reason fire can be an effective tool for woody weed management in the semi-arid woodlands. There is little doubt that prescribed burning is the only practical method available for controlling woody weeds on a large scale and must be introduced to the ecosystem to restore and reinstate the natural balance between trees, shrubs and grasses in the eastern semi-arid woodlands of N.S.W.

INTRODUCTION

A major problem facing graziers in the semi-arid rangelands of N.S.W. is the encroachment of native woody shrubs. This region receives only 300-450 mm of rain much of which is unreliable and unseasonal. The great extremes in the availability of soil moisture influence the character of the vegetation; available soil moisture acts as the driving force in the system followed by the availability of soil nutrients. It appears that the physiological attributes that ensure survival through droughts dominate over those that favour production. These shrubs are commonly termed "woody weeds" and it has been estimated that in western N.S.W. over 20 million ha has already been affected or is under threat by woody weed encroachment (2).

This problem was identified in the 1880's only 20 years after European settlement in the region. Early settlers described the country as "open parkland" scattered with trees and shrubs being dominated by vigorous perennial grasses. These once productive grazing lands are fast becoming dominated by inedible woody weeds which compete with grasses and herbage for moisture, nutrients and light. The influence of other factors such as grazing pressure and fire also affect plant death and regeneration. The main woody weeds which now dominate the vegetation are: mulga, *Acacia aneura*, white cypress pine, *Callitris columellaris*, punty bush, *Cassia eremophila*, narrow-leaf hopbush, *Dodonaea attenuata*, budda, *Eremophila mitchellii*, and Turpentine, *Eremophila sturtii* (1). With the exception of mulga these shrubs are generally unpalatable and unaffected by grazing sheep or cattle.

Woody weed encroachment is not a natural regeneration process but will continue to occur because the environment has changed to suit these particular species. There has been a shift in the point of balance in favour of shrubs. Prior to European settlement widespread shrub establishment events and wildfires were closely coupled. During these uncommon wet periods (10-30 years) abundant grass growth and shrub establishment occurred which at a later time enabled the plant community to be burnt by either Aboriginal or lightning strike fires. Fire at this time killed most woody weed seedlings and reduced the mature shrub component of the vegetation (5). Over the decades the steps taken by settlers to reduce the incidence of fire allowed these seedlings to grow unhindered and establish into mature woody weeds. Once established, they competed with native grasses and caused large areas of the soil surface to

become bare and exposed. Soil degradation then occurred in the form of soil erosion and compaction. The natural competition that exists between vigorous perennial grasses and woody weed seedlings has been shown to reduce the establishment of some species of shrubs (Harrington, unpublished data). These dense stands of highly palatable perennial grasses have been selectively removed from the rangelands by livestock and to a lesser extent the pressure of grazing wildlife (7). The early pioneers were ill prepared to manage grasses, which were resilient to fire but not to grazing. The increased provision of watering points coupled with smaller properties and increased production demands has resulted in overgrazing. Not only did these grasses compete with the woody weed seedlings, they provided fuel for widespread fire to occur. A reduction in the perennial grass component meant that the natural elimination of woody weed seedlings went unchecked and led to a shrub increase. Fuel production for fires now mainly depends on the cool season, unpalatable short lived speargrasses, *Stipa* spp. During the 20th Century 1920, 1956 and 1974 have been years when widespread shrub establishment has taken place.

EFFECTS OF WOODY WEEDS

A serious reduction in the productive potential of these rangelands has occurred due to changes in soil and vegetation induced by pastoral use. To maintain viable animal production in these areas the country must be managed to achieve maximum forage growth by reducing the woody weed content of the vegetation.

Soil erosion. Beneath dense stands of mature shrubs the soil is bare except in exceptionally favourable seasons. This condition reduces water infiltration and increases soil erosion to the extent that the surface soil is commonly removed (3). This increases the grazing pressure on the remaining pastures which in turn become more susceptible to soil erosion and infestation by woody weeds.

Grazing capacity and production. As the density of woody weeds increase, pasture production and grazing capacity decreases (2). These shrubs compete directly for moisture, nutrients and light. Between the decades 1931-40 and 1972-81 a 30% decline in sheep numbers has occurred in the Cobar District and has been attributed to shrub encroachment (3). Mature shrubs spaced five metres apart over an entire paddock will more than halve grazing capacity (2). Apart from the quantity of pasture available the poor quality speargrass pastures reduce livestock performance. This is reflected in low reproductive performance, wool growth and body tissue production (1).

The dense shrub canopy also creates important stock management problems. The barrier to visibility and mobility increases mustering costs and effectiveness. The use of aircraft to aid mustering is now a common practice in these areas.

Effective disease control is often impossible due to ineffective musters particularly in winter. Blowfly and lice control become very difficult tasks.

Feral pigs and goats shelter in dense scrub and compete successfully with other animals for remaining pasture. Lamb weaning percentages can be reduced by up to 40% due to predation by feral pigs.

EFFECTS OF FIRE ON WOODY WEEDS

There is clear evidence that periodic fire will control woody weed populations

to acceptable levels but the degree of reduction being dependant on the species. Some shrubs have adapted fires and have the ability to resprout or coppice after being burnt. Budda and turpentine possess this ability to resprout as they possess thick bark at the base of the stem which restricts heat penetration and subsequent death of the underlying meristematic tissue. In contrast mulga, narrow-leaf hopbush and white cypress pine have a low resistance to fire as these species rely on seed for regeneration after adult plants are killed by fire.

The proportion of the woody weeds that are burnt and killed by fire in a given area will primarily depend on the species present and their abundance. As these shrubs mature they increase their tolerance to fire and some species become almost fire resistant.

Although mortality of adult species differs between species, all shrubs which are less than 10 cm high (approx. 2 years old) are killed by fire (5) (Fig 1). This knowledge can be used to advantage since widespread shrub establishment events and development of high grass fuel loads usually occur together.

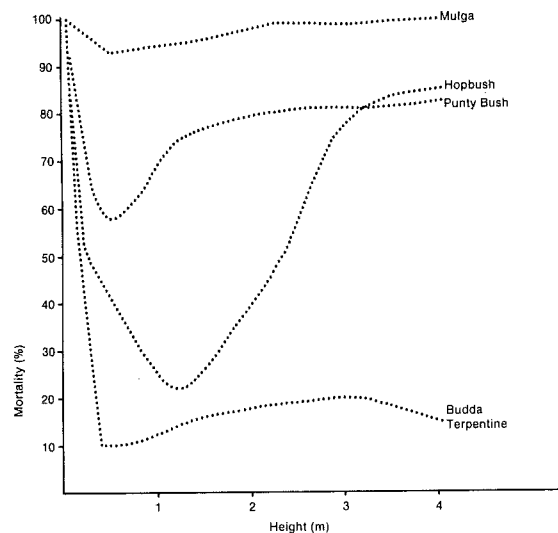


Figure 1. Response of various shrub species to fire at different heights (taken from Hodgkinson *et al.* 5)

Seeds of some shrub species are easily killed. The germination of many seeds is promoted by fire although few establish as germinations are restricted to specific areas of high fire intensity and conditions favouring establishment following a fire are rare.

The season and fire intensity have little influence on shrub mortality (6). But since fuel loads are often very patchy in distribution burning when temperatures and windspeeds are high and humidity low, will maximise the area burnt out and therefore kill more shrubs.

Fire does little damage to grasses in comparison with shrubs. Both short and long lived grasses are generally resilient of fire because their growing points are protected from heat damage by soil and leaf sheaths. On average 5% of grasses are killed by fire (5).

The quantity and timing of effective rainfall post fire determines subsequent

pasture production. If dry conditions are experienced then forage production will be lower on burnt areas whereas the reverse is true if rainfall is above average. Generally undesirable grasses such as variable speargrass, *Stipa variabilis*, and wiregrass, *Aristida* spp., are removed by fire.

DISCUSSION

Prescribed burning is the key to controlling woody weeds and has the potential to restore shrub invaded country to a more productive state. The proportion of sprouting species and the level of recruitment of hard seeded species, coupled with the scarcity of fuel, are limiting factors in planning an effective burn.

Many woody weeds have the ability to regenerate after fire either by coppicing or from seed, hence a second burn is sometimes necessary.

Seedlings of all shrub species are killed by fire consequently a fire soon after a widespread shrub establishment will eliminate young shrubs, kill a proportion of mature shrubs and severely reduce the biomass of the survivors. Biomass reduction will benefit pasture growth for 10-20 years; the estimated time taken for shrubs to regain their pre-fire size.

Destocking to conserve fuel prior to burning is important if prescribed fires are to be carried out. Unfortunately economic pressures due to diminishing carrying capacity and increasing management costs due to shrub encroachment, has forced overgrazing.

Prescribed fires also play a major role in wild fire hazard reduction in reducing the risk and damage from wildfires.

Large scale demonstration prescribed fires have been successfully carried out by CSIRO and N.S.W. Department of Agriculture within these semi-arid woodlands and has increased awareness of the advantages arising from the use of burning as a tool for woody weed management.

Reintroducing fire will not recreate the original balance because of the damage done to the soil and the greater grazing pressures that now prevail. Using prescribed fires will restore the previous forage potential of these areas and the restored dominance by grass will protect the soil. The woody weeds will never be eradicated and in light densities will cycle nutrients and provide cover for a variety of animals.

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