CRC Forestry research into alternative management strategies to mitigate mammal browsing damage in plantations

Researchers have been investigating alternatives to 1080 poisoning at the CRC for Temperate Hardwood Forestry and CRC for Sustainable Production Forestry for the last 10 years. In this time significant research outcomes have been presented that may offer some alternative strategies to mammal browsing control. Any one of these alternative strategies used in isolation may not be as effective as current control strategies. If, however, they are used as an integrated pest management strategy then a combination of the below alternatives may decrease browsing in plantations to a level that is acceptable by tree growers.

Current knowledge based on previous research in the forestry CRCs:

1. *The blue gums, Eucalyptus globulus, have natural resistance*

It has been shown that naturally occurring genetically different populations of *E. globulus* differ in their plant defensive chemistry and consequently in their resistance to the brushtail possum and pademelon. While browsing mammals still consumed foliage from all of the *E. globulus* populations they ate significantly less of some populations than others. This clear genetic basis to defensive chemistry and resistance suggests that it may be possible to deploy naturally more resistant seedlings in nursery operations and plantation establishment. This research is continuing to investigate if other foliage types (sapling and adult foliage) exhibit similar genetic differences and if similar patterns are evident for the shining gum, *E. nitens*.

2. *Environmental conditions of seedlings alters the palatability to animals*

Research has demonstrated that the conditions in which seedlings are grown in the nursery can greatly alter the palatability of those seedlings to herbivores. *Eucalyptus nitens* seedlings that were grown under a high nutrient regime, that is, a high fertiliser load, were much more susceptible to browsing than seedlings grown under a low nutrient regime. It has also been shown that the effects of genetic based natural resistance in *E. globulus*, as mentioned above, can be removed under a high fertiliser regime. Consequently, growing seedlings under lower nutrient regimes in nurseries prior to deployment into the plantation may offer the seedlings a certain level of protection against browsing.

3. *Repellants deter browsing*

The application of the repellant, Wallaby Repellant 1 (WR1) on the leaves of *E. nitens* seedlings greatly reduced the amount of browsing these seedlings received in the field compared to seedlings that were not covered in the repellant. This effect was still evident even up to 10 weeks after planting. WR1 also greatly reduced the intake of *E. nitens* seedlings by pademelons in captive feeding trials. Growth rate trials showed that the application of the repellant did not affect the growth rate of seedlings over 80 days since planting, compared to control seedlings with no repellant. These results suggest that the application of repellants in the nursery before seedlings are deployed in the field may provide seedlings with protection from browsing. Further research into the need for re-application in the field and additional repellants is being conducted.

4. *The use of cover crops and vegetation management on plantations reduces browsing*

Research has shown that growing seedlings amongst naturally occurring vegetation (bracken) on a plantation reduces the amount of browsing on those seedlings, compared to seedlings grown on bare ground. Bracken not only hides the seedlings so browsing mammals take longer to find them, but it also provides an unpalatable patch for browsing mammals to feed in. Consequently mammals choose not

to feed in the bracken, as they prefer not to eat it, and seedlings are offered a degree of 'protection' from being associated with poor quality food. Planting unpalatable cover crop vegetation (bitter lupin) on plantations also provides seedlings with a certain level of protection. *Eucalyptus nitens* seedlings growing within bitter lupin were browsed significantly less than seedlings not protected by bitter lupin. These results suggest that vegetation can be managed on a plantation to provide seedlings protection from browsing.

5. *Plantation characteristics influence the amount of damage on plantations*
Extensive field research has indicated that the area-to-perimeter ratio of a plantation, the proportion of perimeter-to-forested edges, and the amount of closed canopy in forests surrounding coupes can all influence the degree to which a coupe is likely to be browsed by mammals. Coupes with smaller area-to-perimeter ratios received less browsing damage while coupes with a lower proportion of their perimeter next to forested edge also received less browsing damage. Coupes that were surrounded by forests with denser canopy cover also received less damage, most likely due to the fact that possums prefer to shelter in more open canopy forests. The presence of windrows on coupes also resulted in increase damage to seedlings by pademelons as windrows offered daytime shelter habitat for this species. Consequently, these results suggest that plantation or coupe design can greatly influence the amount of damage observed on a coupe.

The next important steps in this research:

The focus of future research in this field is to ensure successful implementation of the above management strategies in plantation forestry. Working closely with industry partners, we hope to achieve this by addressing some of the below aims:

1. Testing various combinations of the above strategies in large-scale field trials. This will require intensive field trials, statewide; to test one, two, and multiple alternatives in various combinations to specify which strategies work best in different environments where different browser species are prevalent. This will be best achieved over two to three planting seasons. Examples of particular questions that will be addressed here include: 1) Does the use of cover crops provide seedling protection without hindering seedling growth and promoting weed establishment? 2) Do the preferred combinations of strategies help prevent browsing by all of the major browsers or does a different combination of strategies need to be used for each browser species?

2. Extending the natural resistance research of *E. globulus* into different life phases of the tree and into *E. nitens*. At present, most of the knowledge of natural resistance has focused on the juvenile coppice (re-growth) foliage and it is vitally important to know whether this resistance is present in seedlings (when trees first go in the ground) and sapling and adult foliage (possums can still damage trees of these ages). We also need to extend this research into *E. nitens*, which is one of the dominant species planted in forestry operations, to assess if genetic based resistance that is evident in *E. globulus* is also present in *E. nitens*. This would provide the option of deploying more naturally resistant *E. nitens* in plantations. This research will involve both captive trials and field trials to assess animal preferences to foliage and laboratory work to assess the natural chemical resistance of the different foliage.

3. Testing different foliage repellants and systemic repellants. There are new repellants available for testing (e.g. "Possum shot" from NZ.) and we aim to increase our research to test the application and success of these repellants in deterring browsing. Additionally, the use of systemic repellants (repellants applied to the soil surrounding the seedling) has not yet being investigated.

4. Understanding how much variation there is within statewide possum populations. One of the main questions not yet addressed is whether browser preference for foliage, particularly more resistant foliage, is uniform statewide. Plantations are statewide and consequently it is crucial to understand if more highly-selected resistant plants are resistant to browsers across the state. Just as plant populations differ in natural resistance across the state, animal populations may also exhibit genetic based variation in preferences and abilities to consume selected seedlings. An understanding of this may indicate which particular seedling stock may be best used in certain areas and may provide an indication of animal mobility at a broad and local scale across fragmented landscapes.

5. Extend the risk modeling of plantation characteristics that influence browsing. Excellent research by a previous PhD student highlighted certain coupe characteristics that affect whether a coupe will be browsed or not. This research needs to be extended in order to develop models that can predict the likelihood of a coupe being browsed and determine what coupe characteristics can be changed on an individual coupe basis (at the operations stage) to decrease the likelihood of browsing.

Communication and implementation of new research:

The research team from the past two CRCs has an excellent record for publishing research in high calibre international scientific journals, for presenting research at national and international conferences and for communicating results successfully to industry partners through technical reports, seminars, newsletters and field days. Consequently, future research in this field will be communicated and disseminated to relevant parties successfully by similar strategies.

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