Fire Retardant Shelterbelt Design Notes for SE Australia developed from 2018 to 2020 with particular reference to the Far South Coast of NSW

by Dean Turner

Increasing wind speeds

I became interested in native plant fire retardance as a result of a science experiment my son developed in Year 6 in response to a nearby fire. He developed a standard method to test the time that green leaves took to catch fire. Some of the results from native trees growing around us were surprising. This was in 2011.

I am an active Landcare member in the Bermagui/Coolagolite area having planted almost 20000 trees with young people attending The Crossing Land Education Trust since 2007, designing for native habitat connection and river protection. In 2017 my brothers and I took over joint management of the family cattle farm in Victoria and began planting over 10000 trees in 3 to 5 row plantations, designing for fire retardance in addition to shelter and native habitat.

In 2019 I made a special request to the Australian Bureau of Meteorology for long-series wind rose data for the Bega weather station. The data set for 50 to 25 years ago showed astonishing differences to the data set for the recent 25 years. Wind speeds from all directions were more intense over longer periods of the day in the recent 25 years and the 9am and 3pm periods of calm had halved, in fact it was rarely calm at 3pm any more (9am and 3pm are the times of day that measurements are taken).

These experiences and observations led to questions: How do we shelter our farmland from the drying effects of these more intense, longer period winds? And, how do we maximise fire retardance in shelterbelt design to cope with disaster?

Then came the Badja Fire and the Cobargo Firestorm of 2020.

Height

Generally, a shelterbelt protects an area 10-15 times the average height of the trees with some publications claiming further.

Air pressure builds up on the windward side and decreases on the leeward side. It is this difference in pressure that drives the shelter effect and determines how much reduction in wind speed occurs and how much turbulence is created.

The amount of air pressure difference is determined by the structure of the shelterbelt. The more dense the shelter, the greater the difference in air pressure.

The structure of a belt can be altered by modifying the:

- height
- density
- number of rows
- species composition
- spacing between the trees or shrubs.

Structure can also be influenced by management eg: maintenance, pruning, thinning, watering.

Paying attention to the length, orientation and continuity of a shelterbelt will also affect its efficiency.

Using the tallest suitable shelter species in at least one row of the belt will increase the eventual area over which a shelterbelt is effective. Including a row of fast-growing pioneer species in the first windward row can provide rapid benefits and also protect species that are slower to establish. This row can later be removed or replaced and fire-retardant ground covers can be developed in the understories to assist fire suppression.

Orientation

North-south orientated shelterbelts are often the first priority for land managers as they prevent permanent shading of pastures and crops allowing them to receive sunlight at different times of the day.

Elevation

Steeper and higher areas of the hill are generally more exposed to wind. Planting along the top of a hill provides extra height which in turn increases the area sheltered. Hill top plantings can protect areas that are prone to erosion and strong winds. Gullies on a hill are also generally protected with erosion and water quality being a priority.

Plantings along the contour of a hill can trap air and create a localised frost zone unless precautions are taken. Establishing gaps within the shelterbelt or allowing the air to drain out at one end can reduce the effect but reducing the density of the belt on contour is often the preferred strategy.

Density

Density is defined as the ratio of the solid area of trees to the total area of the shelterbelt. Dense plantings will give a very calm area directly behind the belt, but can produce high turbulence for the remaining sheltered area. In areas requiring crops this can be detrimental, but for shelter for animals or buildings this can be an advantage.

If you allow some permeability, the area of reduced wind speed will extend much further. However, shelterbelts with no density near the ground can cause winds to increase as they get funnelled underneath.

Locating access lanes to fields through the middle of the shelterbelt can also allow high velocity winds to enter these openings. It is better to locate field access lanes at the ends of the shelterbelt to avoid this problem. Separate shelter plantings can also be made on either side of gateways

A shelterbelt with a vegetation density of 40 to 60% provides maximum downwind area protection, along with excellent soil erosion control.

If vegetation density is less than 20%, then the shelterbelt does not provide useful wind reduction. If density is more than 80% then excessive leeward turbulence may cause damage at a distance of approximately 8 times the height of the shelterbelt. Australian conifer shelterbelts are often single row due to their density as multi row would create turbulence issues.

Interestingly, in the northern hemisphere conifer snow protection shelterbelts have a density of 70 to 80 percent and while they provide excellent shelter they result in large drifts of snow. Increased spacing and diversity to achieve a density of 25 - 35 percent for cropland results in windspeed reduction with an even deposition of snow, rather than large drifts that will later damage crops by thawing too slowly.

Length

For maximum efficiency, the uninterrupted length of a windbreak should exceed the height of the windbreak by a ratio of at least 10:1. This ratio reduces the effect of end turbulence on the total protected area.

Preparation

On most sites deep ripping of the site will also improve water availability for tubestock plantings and should be undertaken in advance. Prior deep ripping promotes deep, strong root growth, softens the ground for planting and improves survival rates. Thorough weed control also assists establishment growth.

The most valuable rip lines run across slope ie: along the contour of the slope to slow water runoff and direct and infiltrate it into the rootzone. Well hydrated trees grow best and will be more resistant to ignition.

Rob Summers a highly experienced south coast arborist and naturalist commented that for heavy soils, cross-ripping is helpful: 'Ripping in only one direction in heavy soils may lead to a majority of root development along the direction of the rip lines and may result in subsequent failure of taller trees in high winds due to poor lateral root development.'

45 degree cross ripping is more easily achieved than 90 degree cross-ripping and much more practical. This is due to greater ease of turning with the tractor to cross your contour lines at 45 degrees. It will also reduce erosion possibilities as 90 degree rip lines across the contour rip lines would likely create erosion. Ideally rip before fencing the shelterbelt. Use a shallower than 45 degree cross-rip where your site is steeper for practical safety and erosion control reasons.

Mounding the site can be an important preparation technique for sites prone to water logging or cracking. My father achieved amazing results with this technique in reclaiming a salt affected area in heavy clay soil.

Cross Sectional width and design

Staggering trees in alternate rows will achieve more uniform density with a reduction in gaps so that they are not directly opposite each other.

Shelterbelts of 2-4 rows can provide significant benefits while not requiring large areas of land to be removed from direct productivity purposes. Biodiversity and shelterbelt health are increased through increasing the width of a belt. Tailoring the number of rows to the objective is the key to a successful belt. 3-5 rows is increasingly preferred by experienced shelterbelt designers for best results.

There should be **at least** 2 metres between the first row of plants and the fence to prevent stock from grazing on the plants. 3.5 metres or more allows a vehicle alongside the young plantings when they need more attention and can allow for slashing. Smaller trees and shrubs are generally placed on the outer row of a belt to prevent them from being shaded out by the taller species.

One aspect of design to keep in mind is the common misconception that a sloping cross-section profile enhances windbreak effectiveness. Steadily sloping profiles on the windward side can actually reduce the distance over which protection is provided. Steeper sided belts on the windward side with a lower density will shelter a larger area more effectively by providing a larger area of initial wind dissipation.

Medium to tall trees are usually spaced 3.5 to 4.5 metres apart in row 2 of the windward side. Large tree branches are less likely to fall on and damage fences if the taller trees are located in from the edge of the belt. Large shrubs can be spaced between 2.5 and 3.5 metres while smaller growing shrubs are generally placed 1.5 to 2.5 metres apart.

Cornered or Dogleg Windbreaks/Shelterbelts

A windbreak with two legs protects a greater area from winds that come from a range of directions. A common design error is not extending the windbreak beyond the area to be protected. Wind circles the end of the windbreak, increasing the windchill, turbulence and sometimes accumulating sand/soil or snow.

Soil Temperature effects

The soil temperature in sheltered areas is slightly greater than in unsheltered areas. In this way, taking advantage of higher temperature allows for earlier planting and better germination with a faster growing time to maturity.

In the area next to an east-west windbreak, the soil temperature is significantly higher towards north side due to heat reflection by the windbreak. On the south side of an east-west windbreak, the soil temperature especially in the early spring is low because of the shading effect developed by the windbreak.

During summer, shelterbelts will protect pasture and crops from moisture losses by reducing the impact of hot drying winds. Shelterbelts can also reduce erosion by wind during summer months when soils may be barer. Ideally belts should form a grid using north-south and east-west orientations.

Excluding the entire planting area from all possible browsing animals is a priority. Wire netting and solid fencing is the best strategy. Individual plant guards are helpful but less successful with larger animals. Access gates make planting and watering easier and allow for use of the area as a crash graze drought reserve paddock when plantings are mature enough to withstand stock rubbing.

Humidity effects

The relative humidity in sheltered areas is 2% - 4% higher than in open areas, depending on the shelterbelt density. Since high humidity decreases the rate of plant water use, crop or pasture production is more efficient in sheltered areas compared to unsheltered areas.

Species

Locally native species generally have higher survival and establishment rates.

Locally native species also provide valuable habitat for local wildlife species.

Multiple-row windbreaks can be used to produce high value specialty woods, fruit and nuts, woody floral stems and medicinal plants.

Fodder species can be used in a shelterbelt to provide a food source. These plants can be grazed directly by stock or cut and provided to stock. Removing fodder from the belt can compromise its ability to provide shelter. Shelterbelts can also be viewed as drought reserve paddocks.

Single species rows are often used to keep uniformity of shelter performance. However, diversity does provide insurance against insect attack, disease and nutrient deficiencies so consider alternating two species with similar or compatible growth forms in each row.

Fire retardance

***Fire Resistant plants* -** won't burn in the face of continued flame.

***Fire Retardant plants* -** won't burn in the first wave of bushfire but may burn once dried out.

High moisture contents of 'leaves' and low surface area to volume delays ignition CSIRO 1996 (Gill and Moore).

Trees with large fleshy leaves, ideally as round as possible, are especially useful to extinguish flying embers; those with small leaves or lobed or lacy leaves are less effective. High salt content and low volatile oil content also delay ignition. (quoted in numerous RFS and CFA publications over many years)

Comments from John Champagne, an experienced permaculture designer in the SE region, based at Brogo:

'With species selection the need for hardiness in local conditions needs to be emphasised. These treebelt systems usually aren't irrigated so they'll need hand watering after planting until the first big rain event and then have the capacity to survive."

Prolonged drought or lack of rainfall before a fire attack can dry out species to the extent that they may be ready to burn. John noted that his pittosporum which looked green and healthy with regular rainfall did dry out completely before the 2020 fires with lots of burnable leaf drop underneath.

"We planted our shelterbelt at the top of the property for wind and fire protection about 20 years ago. One species we used throughout was Acacia floribunda which was great for about 15 years. Then they got leggy and all died in the drought of 2019… standing sticks waiting for a firestorm to send embers down to our house. Spent a lot of time with a chainsaw removing them all and will replace them with longer lived species. There's always the need for continual management and re-designing over long periods of time. "

Merryn Carey, an experienced local seed saver and Landcare nursery operator at Dignams Creek, noted that "faster-growing equals shorter-lived (but) short lived species do have their place in a windbreak succession plan." Merryn likes Acacia floribunda as "it Is one of the few wattles that can be cut back hard and it resprouts readily. The cut branches make a rich rapidly composting mulch and the nitrogen fixing nodules on the root systems decompose to feed the longer-lived trees … trees growing on good deep soil will live longer than the same tree planted on shallow topsoil with hard subsoil."

Merryn comments that “while species selection may help with slowing a fire, choosing fire retarding species is not a magic bullet: soil preparation, maintenance and siting are also vitally important to enhance effectiveness of any of the plants chosen. Mulching down windfalls, thinnings and groundcover periodically (in autumn) will speed up decomposition”

Merryn drew attention to the fact that “a deep-rooted species growing in the appropriate site for its type will be better able to cope with the extremes of drought and thus be less flammable. A normally fire retardant species in a very dry and dessicated condition (however) can prove more flammable. For example dessicated Lillypillys growing on a dry hard ridge top may ignite quicker than Hakeas in the same windbreak. Around Dignams Creek in the 2020 fires, plants that were used to having their feet in water were hanging limply when the creek dried back and they lost their constant water supply – they burnt very rapidly when the fire came through. In normal conditions these species would be far more fire resistant. A fire retarding shelterbelt may be most effective with some availability of supplementary watering, especially when designing one that is to protect assets. A very occasional deep watering will avoid dessication without promoting unnecessary lush growth over summer. Locating the shelterbelt strategically can allow it to act as an ember net to catch and slow fire through grassland and help to lead fire around and away from assets once alight as fire follows the fuel line to some extent.”

Many species on the fire retarding list may suffer badly in fires as they absorb embers and radiant heat. In terms of protecting or sheltering assets, some may be sacrificial. Friends at Wandella who fought the fire with full face breathing masks had sufficient radiant heat protection behind bushy deciduous trees planted immediately around their house despite thick bush being close. This allowed them to spray water over the trees from their garden hoses onto the fire. Their deciduous trees all had to be cut back severely afterwards but many have resprouted as a result of previous supplementary watering.

Merryn noted that “a Casuarina cunninghamiana or river oak shelterbelt near Surf Beach seemed to slow the fire, with the mulch under trees just smouldering, but later many of the trees needed replacing due to the damage they suffered. An adjoining Melaleuca windbreak went up like a torch but came back quickly after the rains”. Although the Melaleucas act as a windbreak normally, they do not serve as a fire retardant shelterbelt.

Fire Retardant Native Trees - those not native to the Far South Coast of NSW have a line through

Acacia spp	fleshy leaved wattles are better than feathery ones (“non-local wattles are likely to become invasive eg: A. podalyrilfolia, baileyana, fimbriatal” – Jackie Miles. “As they rely on fire to regenerate, any non-local wattles in a shelterbelt that experience a fire, will definitely come up in large numbers afterward as a potential weed” – Rob Summers)
Acacia falciformis	Mountain Hickory or Broad leaved Hickory
Acacia floribunda	Sally or Gossamer wattle (prefers damper locations)
Acacia implexa	Lightwood or Hickory wattle
Acacia maidenii	Maidens wattle (prefers damper locations)
Acacia mearnsii	Black wattle (one of the more retardant feathery wattles. Rapid growing, thick shade producing pioneer, good at quickly suppressing grass growth underneath. But ‘they only live about 15-20 years, then die and collapse producing copious combustible debris…and they are big enough for their removal to be quite a task.’ – Stuart Cameron. Removal by 10 years recommended.

Acacia melanoxylon	Blackwood (prefers damper locations. 'This wattle is native to the escarpment near Candelo, Wyndham etc' – Rob Summers)
Acronychia oblongifolia	Yellowwood (('local gully/rainforest species more stunted in exposed situations' – Rob Summers)
Androcalva rossii (formerly Commersonia)	Brush Kurrajong or Native Hemp (suckers readily, pioneer species of temperate rainforest)
~~Angophora costata~~	~~Smooth barked Apple or Gum Myrtle~~
Banksia integrifolia	Coast Banksia (prefers damper locations)
Brachychiton populneus	Kurrajong (very slow growing)
Casuarina cunninghamiana	River Oak (very palatable to livestock as drought fodder, may sucker, longer lived in damper conditions)
Corymbia maculata	Spotted Gum (shed bark and leaves can create deep litter as it matures)
Elaeocarpus reticulatus	Blueberry Ash (hard to germinate so may be difficult to obtain)
Eucalyptus baueriana	Blue Box (prefers damper locations)
~~Eucalyptus pauciflora~~	~~Snow Gum~~
~~Eucalyptus saligna~~	~~Sydney Blue Gum~~ (range extends north of Batemans Bay so it is only just out of the NSW Far South Coast list of local species)
Ficus coronata	Sandpaper fig (prefers damper locations)
Ficus rubiginosa	Damon, Port Jackson or Rusty Fig (slow growing and palatable to stock; hardy but not to frost. 'It is certainly decidedly resistant to fire. I've observed how one at Goalen Head produced an extensive unburnt 'island' midst a fire-scorched zone some years back as the fire could not progress very far under its expansive canopy, thereby preserving a number of more fire sensitive rainforest species. The fig's scorched tips recovered well post fire too' – Stuart Cameron)
Hedycaria angustifolia	Austral Mulberry ('local gully/rainforest species more stunted in exposed situations' – Rob Summers)
~~Melia azedarach var. australasica~~	~~White Cedar~~ (**fire resistant,** fruits poisonous to humans and dogs, **'**not local south of Milton, tree can become a weed from bird dispersal, cedar moth or cape lilac hairy caterpillars strip trees and breed prolifically being a nuisance near housing' – Jackie Miles)
Myoporum acuminatum	Waterbush, Pointed Boobialla or Mangrove Boobialla ('my favourite native tree recommendation to clients due to its thick fleshy leaves and ability to withstand exposure, including salty winds – Rob Summers)
Myrsine howittiana	Muttonwood ('local gully/rainforest species more stunted in exposed situations' – Rob Summers)
Pittosporum undulatum	Sweet Pittosporum ('a native that can be very invasive and I would not be planting them. I can vouch for their fire retardant effect though, fire on our place went out about 10m after entering thickets' - Jackie Miles)
~~Podocarpus elatus~~	~~Plum Pine~~
Syzygium smithii (formerly Acmena smithii)	Lilly-pilly (prefers damper locations, available nursery varieties may not be locally adapted)
Tristaniopsis laurina	Kanooka or Water gum (prefers damper locations)

Fire Retardant Native Shrubs (those not native to SE Australia area have a line through them)

Acacia floribunda	Sally or Gossamer wattle (prefers damper locations)
~~Acacia pravissima~~	~~Ovens Wattle~~
Acacia sophorae	Coastal Wattle (can be invasive away from its coastal habitat)
Acacia terminalis	Sunshine Wattle (only short lived however)
~~Acacia vestita~~	~~Hairy Wattle~~
Atriplex cinerea	Saltbush or Orache. I have used it on our family farm in Victoria near the coast and it has shown rapid growth with strong grass suppression in basalt and sandy soils. Likely to be short lived but excellent in the establishment phase.
Banksia marginata	Silver Banksia (slow growing and palatable to stock)
~~Brachychiton aecerifolius~~	~~Flame Tree~~
Correa spp	Bell Flowers (‘probably only obtainable as cutting grown cultivars so can be very expensive’ – Jackie Miles)
Cyathea australis	Rough tree fern (‘can’t be transplanted, unlike Dicksonia so probably hard to obtain and expensive’ – Jackie Miles)
Dianella spp.	Flax lillies (‘in cultivation they do tend to form mats, unlike the isolated stems in the bush, so they are probably quite useful. D. caerulea and D. revoluta are hardier while D.tasmanica prefers cooler, moister situations’ – Jackie Miles)
Dodonaea spp.	Hop Bush
~~Eremophila maculata~~	~~Emu Bush~~
~~Grevillea barklyana~~	~~Gully Grevillea~~
~~Grevillea robusta~~	~~Silky Oak~~ (‘invasive and it creates a lot of leaf litter, so not preferred. I would be wary of planting any grevilleas as they may encourage nuisance native birds like rainbow lorikeets and bell or noisy miners’ – Jackie Miles)
Hakea dactyloides	Finger Hakea (may be hard to obtain)
Hakea eriantha	Tree Hakea (‘local alternative to H. salicifolia or Willow-Leafed Hakea which is widely planted and can be invasive’ – Merryn Carey)
Hakea macraeana	Willow Needlewood (good windbreak for a few years but not very drought hardy)
~~Leucophyta brownii~~	~~Cushion Bush~~
~~Maireana spp~~	~~Bluebushes, Cottonbush~~ (not local and potentially invasive)
Lomandra longifolia	Lomandra (not a strong recommendation due to inner dry leaves being retained, ‘but less flammable than grass and they resprout quickly if they do get burnt’- Jackie Miles)
~~Melaleuca nodosa~~	~~Prickly leaved paperbark~~ (not local and may be invasive)
Melocytis dentatus (formerly Hymenanthera dentata)	Tree violet (hard to propagate and hence obtain, prefers damper locations)
Notelaea venosa	Black Oliveberry (‘hard to propagate and hence obtain’ – Jackie Miles)
Pomaderris aspera	Dogwood (‘hard to obtain this local species’ – Jackie Miles)
~~Scaevola crassifolia~~	~~Cushion fanflower, Thick-leaved fanflower~~
Solanum spp	Kangaroo Apples (‘S.aviculare is the common local species with S.vescum appearing only after wildfire, both very short lived’ – Jackie Miles)

Synoum glandulosum	False Rosewood ('local rainforest species and unlikely to thrive in exposed situations and hard to obtain' – Jackie Miles)
Trema tomentosa, (formerly Trema aspera)	native peach or small poison peach (rainforest pioneer, prefers damper locations 'one self-sown in our garden got to about 6m high, but only lived 20 years' – Jackie Miles)

Groundcovers -	**all are fire resistant**
Ajuga australis	Austral bugle
~~Brachyscome~~	~~Native daisies~~
Carpobrotus glaucescens	Pigface ('the local pigface is easily confused with the introduced C. aequilateris so be careful that you don't plant a possible weed' – Jackie Miles)
Chenopodium spp (formerly Rhagodia)	Berry Saltbushes and Goosefoots ('the only local species is C. glaucum, but only in saltmarsh areas' – Jackie Miles
Cheilanthes spp	Rock ferns ('hard to obtain and said to be poisonous to stock so other ferns would be better' – Jackie Miles)
Doodia spp	Rasp ferns
Doodia aspera	Prickly rasp fern ('Hardy local fern less flammable than grass but will still burn in dry conditions' – Jackie Miles)
Dichondra repens	Kidney weed
~~Eremophila~~	~~Emu bush~~
~~Myoporum parvifolium~~	~~Creeping Boobialla~~ ('probably good immediately around the house' – Jackie Miles)
Pellaea falcata	Sickle fern ('Hardy local fern less flammable than grass but will still burn in dry conditions' – Jackie Miles)
Rhagodia candolleana	Seaberry saltbush
Scaevola aemula	Fairy Fan Flower ('commonly appears after fires, but I suspect it only lasts a year or two. Certainly looks retardant' – Jackie Miles)
Scaevola calendulacea	Dune Fan Flower ('grows naturally on beaches, has a fleshy fruit that may be dispersed by birds' – Jackie Miles)
Tetragonia tetragonoides	Warragul greens or native spinach

Non-native Trees	
Almond	all
Apricot	all
Bay	all
Carob	all very hardy
Cherry	all (prefers damper locations and cooler summers)
Citrus	all
Chestnut	all (prefers damper locations and cooler summers, the prickly seed cases are a concern if children play anywhere nearby)
Feijoa	all
Ficus	all including edible Figs (extensive root system)

Liquidambar	Sweetgum or Stargum (extensive root system)
Loquat	all (are likely to be invasive and the winter fruiting habit means it helps fruit fly to overwinter, so not recommended)
Hazelnut	all (prefers damper locations and cooler summers)
Magnolia grandiflora	Southern Magnolia or Bull Bay (extensive root system)
Malus	apple trees (prefers damper locations and cooler summers)
Mulberry	all (extensive root system)
Nectarine	all (prefers damper locations)
Peach	all (prefers damper locations)
Pear	all
Pecan	all
Persimmon	All (prefers damper locations)
Pomegranate	all
Prunus	all plums including ornamental
Pyrus	Pears (most ornamentals)
Quercus	deciduous oaks only (caution as the larger deciduous trees produce a large volume of dry winter leaves to rake and mulch before summer)
Quince	(will sucker)
Ulmus chinensis	Chinese Elm
Walnut	all (prefers damper locations and cooler summers)

Non-native shrubs

Aloe spp	Large succulents (most are invasive, caution)
Artemisia spp	Wormwood or Angels Hair
Camellia spp	Camellias
Chaenomeles japonica	Flowering Quince
Coprosma sp.	NZ mirror bush (invasive, not recommended)
Escallonia (Sth America)	(Caution, may be invasive)
Hydrangea macrophylla	Hydrangea
Plectranthus (Africa)	Spurflowers (some can be invasive, 'there's a native P. graveolens that is quite fleshy and hardy found near rock outcrops' – Jackie Miles)
Photinia	popular hedging plant, related to apples ('the flowers smell vile and it has fleshy fruits so could be invasive but I have only seen it in the bush once' – Jackie Miles)
Santolina	spurflowers
Sambucus	Elderberry (fleshy fruits …definitely invasive on the tablelands, possibly not widely planted enough yet on the coast to become so here – Jackie Miles)
Strelitzia (South Africa)	Crane flower or Bird of Paradise Flower is non-invasive
Viburnum tinus	Laurustinus

Non-native Ground Covers	
Mesembryanthemum (South Africa)	Fig Marigold or African Pig Face succulent (possibly invasive)
Nepeta	Catmint ('lots of the mints are invasive in moist soils, not sure about this' – Jackie Miles)
Succulents	('caution as a number of succulents such as Bryophyllum, Agave, Aloes etc… can be serious weeds in native bush areas'- Rob Summers 'Some of the smaller ones may be OK immediately around the house, but I would not plant them any further afield' – Jackie Miles)

Native Tubestock Mix: 1 part sand, 1 part cocopeat, 1 part perlite, 1 part rice hulls, 1 part compost/local forest soil which contains native microorganisms beneficial to the native plants you are growing ('since the drought rice hulls have gone into stock feed. Composted pinebark fines is an alternative' - Merryn Carey)

Native Seedling Mix: 2 part sand, 1 part perlite, 1 part cocopeat

Seedballs Recipe: This is a method of supplementary planting into rough or steep areas where plantation style planting is not suited (also highly successful in deserts).
The seedball will hold its seeds until at least 50mm of rain falls allowing for beneficial germination conditions.
1 part seed mix
0.25 part cayenne pepper insurance (80% of scattered seed can be lost to ants, insects, birds etc)
3 parts compost or coco peat or peat moss
5 parts clay
2 parts water
1 cement mixer and 2 sheets of corrugated iron to lay out the balls on to dry
(**aim for no bigger than a small marble size for each seedball around 1cm diameter maximum.**)

Shelterbelt preferences for South Eastern Australia

Of highest priority is a 3 to 5 row north south hilltop shelterbelt designed to achieve a 50 to 60 % density. Incorporate high value timbers as a retirement policy and give some thought to later animal fodder and drought reserve value of the space with gate locations to assist. Selection of native species to: assist biodiversity, reduce fire intensities, provide a bad weather shelter and a drought reserve area can all be balanced in good design. An aeroplane wing cross-sectional design with the broadest and steepest edge facing the strongest wind direction will maximise the shelter and moisture benefit effects across the greatest distance of pasture or cropland. A shelterbelt frequency of 10 to 15 times the maximum tree height across a property is preferable for best results.

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