DIRECT SOWING OF TREES FROM SEED

SOUTH COAST OF W.A.

INTRODUCTION

There is an indicated need for shelter belts to protect soils and livestock on the treeless South Coast plain of Western Australia.

The cost of planting seedlings of indigenous species in the numbers required is expensive and because of this plantings have been limited to the extent of being non effective.

Direct sowing of tree seed has been found to be cheap and successful and could overcome the main objections farmers have to implementing wide scale shelter plantings.

SOUTH COAST - REGIME

The South Coast of W.A. is an ancient peneplain. The soils which were formed in a wetter climatic era are highly leached and low in nutrients. These soils are sandy surfaced and overly gravel and/or impermeable clays at depths varying from 0" - 36" and sometimes deeper.

The indigenous vegetation is low schlerophyllous scrub up to 2 metres in height with few species obtaining tree height.

The climate is strongly Mediterranean in type with two-third annual rainfall received in a 6 - 7 month winter growing season. Winds are an almost constant feature of the climate and frequently reach gale force with the approach and passage of winter cold fronts.

AGRICULTURE OF THE REGION

Agriculture became possible following correction of nutrient deficiencies (Phosphorous, Nitrogen and Trace Elements). In the past twenty five years, millions of acres of the scrub plain have been cleared for cereal and livestock farming.

The removal of the protective scrub and its replacement by clover pastures and cereal crops has exposed the soil at certain times to the ravages of the strong winds and to the hazards of salinity in areas where water tables have risen.

Modern farm equipment has efficiently removed all the scrub and it is not infrequent to see whole farms with not a vestige of the original indigenous vegetation remaining. Vegetation strips left as protection for the soil and livestock unfortunately have limited persistence and are soon decimated by stock grazing pressures imposed.

Wind erosion has occurred on lighter, poorly structured soils, especially in the autumn period when pasture residues have been removed by grazing, or in early winter when land is being prepared and sown with crop. Standard cultivation techniques have been found to be a particulary hazardous means of land preparation for cereal growing; hence chemical weed control and direct drilling have become a more commonly adopted procedure due to maintenance of protective residues on the surface. Stubble mulch farming is becoming a widely used technique on the better soils in the drier sections of the area and the retained stubble has the advantage of reducing near ground wind speeds.

Tree shelter belts as a means of reducing wind velocity have been planted in isolated places, but their numbers and spacings are generally insufficient to cause more than a modest protection to small areas.

Severe winds unaccompanied by rain which preceded the passage of cold fronts in 1980 and 1981 wrought severe erosion to pasture and cropland and estimates of 100,000 hectares of germinating crop sand blasted in both years were recorded.

Salinity prior to clearing was evident only in major drainage lines and in swamps and depressions where external drainage was absent. The development of agriculture has in twenty five years brought about increased areas affected by salinity. Such has occurred due to the replacement of perennial native scrub plants with high transpiration rates with the less efficient water users; i.e. cereal and pasture plants. Perennial pasture species are unfortunately not highly successful in the agricultural system generally employed on the South Coast.

At present only 1.5% of the cleared land has been affected by salinity; however, the area is likely to increase considerably in the future unless drainage of the saline water is possible or species able to lower the saline water table are planted. Such plants as lucerne have been used elsewhere in Australia and overseas and have had a dramatic effect on reducing the water table levels. However, varieties available are not agronomically suitable for our agricultural system.

If our agriculture is to remain stable, we must contend with the problem of wind and salinity. In addition to improved technology for cropping and careful grazing management, the widespread planting of trees must become an additional aid in overcoming our twin problems.

TREES IN THE LANDSCAPE

Trees play a dual role -

(a) to reduce wind velocity; and
(b) to maintain saline water tables sufficiently deep to prevent surface salination.

To be effective in both roles, more scientific study should be undertaken to determine planting densities and locations.

There has been considerable research on the effect of trees on reduction of wind velocity and firm recommendations have been made by soil conservation authorities; however, it is only recently that studies have been initiated on the part that trees can play in maintaining a stable water table.

Recommendations made indicate that belts of trees planted at right angles to the most destructive winds can effectively reduce the wind velocity considerably for up to twenty times the height of the trees on the lee side and two or three times the height on the windward side. A permeable shelter belt is less prone to producing eddies and is therefore more desirable. The reduction of wind velocity is of extreme importance in prevention of wind erosion and has also been found to have a profound effect (up to 25%) on the production of pasture or crops. From this must be deducted the loss of production within twenty metres of the shelter belt; however, the net effect is possibly an overall increase of 15% - 20% in pasture and crop production.

SHELTER BELTS

From observations made during the periods of gale force winds in 1980 and 1981, it would seem desirable that for protection of very light and erodible soil, tree shelter belts 15 - 20 chains apart would prevent major dust and soil loss when combined with a suitable farming system. The shelter belts would need to be 40 feet wide and consist of at least three rows of trees. Two of these rows would need to be taller species and one of low or medium growth habit.

If one calculates from this, it is found that a farm of 2500 acres would require 15,000 trees to be fully protected by tree belts.

The cost of establishing this number of trees would be exorbitant. The cost of seedlings alone would be close to $10,000, but to this would need to be added the cost of planting; the cost of fencing and watering through the first summer, etc. It would be my estimate that when all costs are added together the total would exceed $30,000 to $40,000.

In reviewing our own farm situation, it was patently obvious that tree planting could not be contemplated on older land in any other than a small scale. However, the situation was quite different on new land that was being developed where fencing costs could be eliminated if a successive cropping programme were undertaken during the initial three years. It was hence decided that trees should be sown in the year of the first crop. By the time the land was sown to pasture and ready for stocking, the trees would be sufficiently tall to avoid damage from grazing sheep.

The cost of tree seedlings was then reviewed. Having planted many trees from seed into pots with success, I could not see why direct drilling of seed in situ could not be equally successful if carried out under favourable conditions of soil moisture and temperature.

Our first practical attempt was made in 1975 when two plots of a few acres each were seeded. One plot was dwarf sugar gums, the other was swamp yates. The results were most encouraging and led to further plantings in 1976. Prompted by these successes, we have planted in most years since and at no time did we experience anything other than excellent establishment.

While initially we sowed blocks to pure strain of the one species, we are now mixing 10 or more eucalypt varieties, plus native acacias and casuarinas, etc., together with exotic species such as pines on suitable soils. The mix of varieties is determined by soil type.

Not all seed germinates in the first year and successive germinations occur in second and even third years.

The rate of growth is quite staggering - seed planted in spring of one year can attain the height of 6 ft. or more by the spring of the following year without any watering.

Two years after planting, the taller growing species have reached 10 ft. or more in height and by the end of the third year, 15 ft. or more.

METHODS OF LAND PREPARATION

The land is prepared in the standard manner as for crop establishment on new land; viz. chain, burn, and plough (for preference, blade plough or rip). The land is left in a fallow condition for eight months prior to reploughing and raking. Seeding of the cereal crop takes place in June, leaving unsown strips at right angles to prevailing winds.

At the completion of our cereal sowing programme, we then direct drill the tree seed in the strips left unsown to cereal.

TIME OF PLANTING

All our tree seed plantings have been made in August/September. This has been through the force of circumstances due to a large cropping programme on newer land. It would be my belief that autumn/winter planting would be equally successful and may be better under drier wheatbelt conditions as the soil moisture reserves are more likely to be favourable for germination at this time.

RATE OF SOWING

For medium size seed, viz. sugar gum, tuart, yate, etc., one breakfast cup of seed (including chaff) per acre is sufficient to give an establishment rate of 200-500 seedlings per acre. For smaller seed,

viz. salmon gum, river gum, etc., lesser amounts would give an adequate seedling establishment.

METHOD OF SOWING

One bag of super copper zinc (165 kgs per hectare) fertiliser is spread across the fertiliser box of a standard combine. The necessary amount of seed to sow one acre is then spread on the fertiliser and mixed. A second bag of fertiliser is then placed in the fertiliser box plus more seed. The whole is again mixed. The procedure is continued until the combine holds sufficient fertiliser and seed for the area to be sown.

The combine is set to just graze the surface. Following harrows, chains, or bushes are used to cover the seed.

It has been my experience that $\frac{1}{4}$" sowing is as deep as one should plant the smaller seed. However, a slightly larger seed, e.g. lemon scented gum, maculata, etc., $\frac{1}{2}$" is possibly more ideal. For very large seeds (red flowering gums, acacias, kurrajong, pines) 1" would possibly be satisfactory.

Pot trials have demonstrated that sowing depths can have a big effect on germination.

After harvest stubbles are burnt if possible. The land is then reploughed and prepared again for crop, which in our case must be cereals, lupins we appreciate would be better but unfortunately do not perform reliably in our situation. The belts of young trees are top dressed only in the second growing year with agras fertiliser. A cereal crop is sown in the third year, together with clover.

This third crop stubble and undersown clover is possible to graze after harvest with little risk of damage to the growing trees.

SEED COLLECTION

Eucalypt and casuarina seed is very easily collected and extracted. The method I employ is firstly locate and select a superior tree type of the species required. Check the maturity of the fruiting capsules. A rule of thumb I have found to be successful is to only collect from trees that are close to flowering or flowering. The one year old capsules which in most instances are still held in the tree contain fully developed and viable seed.

Whole branches approximately 1" in diameter and 6-10 ft. in length are sawn off. These are then laid out in a big heap on a tarpaulin to dry. After one or two weeks of dry weather the seed capsules open and the seed sheds. The branches are removed and the seed remaining sieved to remove leaves and small twings. It is then stored in calico bags after a dusting with malathion. This seed is viable for many years if stored in a dry place.

The amount of seed collected per seed capsule varies considerably with the species. Tuart, sugar gum and maculata - three species which have prolific pod development yield well. A one ton utility load can yield half to one kg. of seed, including its associated resinous chaff. Seed can be purchased from the Forestry Department or Kimberly Seeds.

SPECIES OF TREES USED

On our deeper soils (60 cms sand/gravel or clay) we prefer to sow a mixture which contains tuart, tall and dwarf sugar gum, maculata, yate, lemon scented gum, river red gums, karri, bicostata, cas. cunninghamriana and other unidentified cas. species, jam, kurrajong and callitus pine plus pinus pinaster.

On shallow soils (15 cms sand to clay on surface) we would exclude tuart and Tasmanian blue gum and karri, pines, etc. and substitute more sugar gum, maculata, yate, plus additional species such as salmon gum and Mallett.

GERMINATION AND EARLY GROWTH

Eucalypt species appear to germinate very slowly, the rate being strongly related to temperature and moisture. If soils remain moist at sowing depth the germination takes approximately three weeks. Species however vary greatly in the time required for germination, some appearing in ten days other not for four-five weeks. The percentage of seed which actually germinates successfully has been difficult to determine but it may only be 5% or less.

The nature of the soil has a considerable influence on germination and early survival of seed. On shallow soils which hold their moisture well one cup full of seed can result in a plant density of one seedling per 3-4 sq. metres. On drier, deeper sands one seedling per 10 sq. metres is more common.

To overcome the low germination of seed on drier and deeper soils we are now pelletting our seed this year with clay and a water absorbing polymer in the hope that the pellet would be more effective in retaining a moisture regime around the seed under conditions where the soil moisture could be limiting for periods during germinations.

The technique of pelletting seed with clay is similar to that used for lime pelleting sub clover seed.

The seed being first sieved to remove chaff, it is then rotated in a mixing bowl (the household mixmaster being quite suitable).

Methofas solution is then added as a spray in small amounts while the seed is being rotated. When the seed itself becomes entirely damp finely ground attapulgite clay (available from Mallina Holdings) or kaolin is added. After further mixing more methofas is added, plus more clay.

We have included a water absorbing polymer in the clay material, one which is reputed to absorb several hundred times its own weight of water. We have preferred to use attapulgite clay as it also absorbs moisture and retains it better than the kaolin clay.

The seed/clay pellet can be developed to quite a large size. We have preferred to cease development when the pellet is approximately 2-3 mm in diameter.

Following germination seedling growth is rapid, and indeed much faster than that obtained from planting seedlings which when planted from pots suffer a considerable growth check. Under favourable conditions sugar gums grow at rate of at least $1\frac{1}{4}$ metres per annum and retain this rate for at least eight years.

We have not been able to deep rip (1+ metres) prior to sowing but evidence from elsewhere proves conclusively that such a technique results in better growth as it allows for better and deeper root development, especially on shallow soils.

It is our intention to rip deeply 10 metres away from the tree lines to reduce lateral development which can have a significant effect on crop and pasture growth adjacent to tree belts.

SEED SOWING ON OLD PASTURE LAND

Direct seeding on old pasture land has been attempted on only one occasion. From our results it would appear that weed competition is critical for eucalypt seedlings. Our established and growth rate was approximately only half of that we expected from new land.

When we attempt further sowings on old land, the tree lines will be graded with a heavy road grader to remove 2 to 3 inches of soil before planting. In this way we will ensure weed-free conditions for 2 years.

Chemicals may be just as effective but as little is known of the effects of these on eucalypt and other species and rather than run undue risks, we will use mechanical means which we know will have no harmful effects.

It has been reported that spray seeding to kill pasture in close proximity to native trees frequently results in a seed germination of these species, if the ground is not disturbed by cultivation. Such a technique may be worthy of trial to extend native species along paddock margins or around clumps of trees left in a paddock. Much of our indigenous vegetation is becoming mature and regeneration would be desirable before we lose these plants altogether.

SPECIES OF TREES USED

Our early work concentrated on 3 or 4 main species. The seed of these was readily available and germinated well. However, we now

believe that more species must be used to give a range of heights and densities to ensure the best possible wind-break shelter.

Our best early success was with tuart, sugar gums (tall and dwarf varieties), Tasmanian blue gum and yate, all types with large seeds with good germination potential.

We sowed a very composite mixture in 1982 including the following species:

Eucalyptus Gomphocephala	Tuart
Eucalyptus Cladocalyx	Tall Sugar Gum
Eucalyptus Cladocalyx Var Nana	Dwarf Sugar Gum
Eucalyptus Maculata	Spotted Gum
Eucalyptus Occidentalis	Swamp Yate
Eucalyptus Citriodora	Lemon Scented Gum
Eucalyptus Camaldulensis	River Red Gum
Eucalyptus Rudis	Flooded Gum
Eucalyptus Leucoxylon (Pink)	Pink Flowering Yellow Gum
Eucalyptus Heterophylla	Coastal Moort
Eucalyptus Globulus	Tasmanian Blue Gum
Eucalyptus Globulus Subsp. Bicostata	Eurabbie
Eucalyptus Caesia	Gungurru
Eucalyptus Diversicolor	Karri
Eucalyptus Botryoides	Bangalay
Eucalyptus Salmonophloia	Salmon Gum
Eucalyptus Astringens	Brown Mallet
Eucalyptus Calophylla (Pink)	Marri - Red Gum
Casuarina Cunninghamiana	River Sheoak
Acacia Acuminata	Jam
Acacia Pendula	Weeping Myall
Acacia Salicina	Native Willow
Geifera Parviflora	Wilga
Brachychiton Gregorii	Desert Kurrajong
Brachychiton Populneum	Kurrajong
Callitrus Glauca	White Cyprus Pine
Pittosporum Phillyreoides	Weeping Pittosporum
Pinus Canariensis	Canary Is. Pine
Pinus Pinaster	Pinaster Pine
Ceratonia Siligua	Carob

In conclusion it must be stated that our sowings have been made in a 475-500 mm rainfall area. However, in some years of planting only 350 mm have been received and even this rainfall has resulted in successful establishment.

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