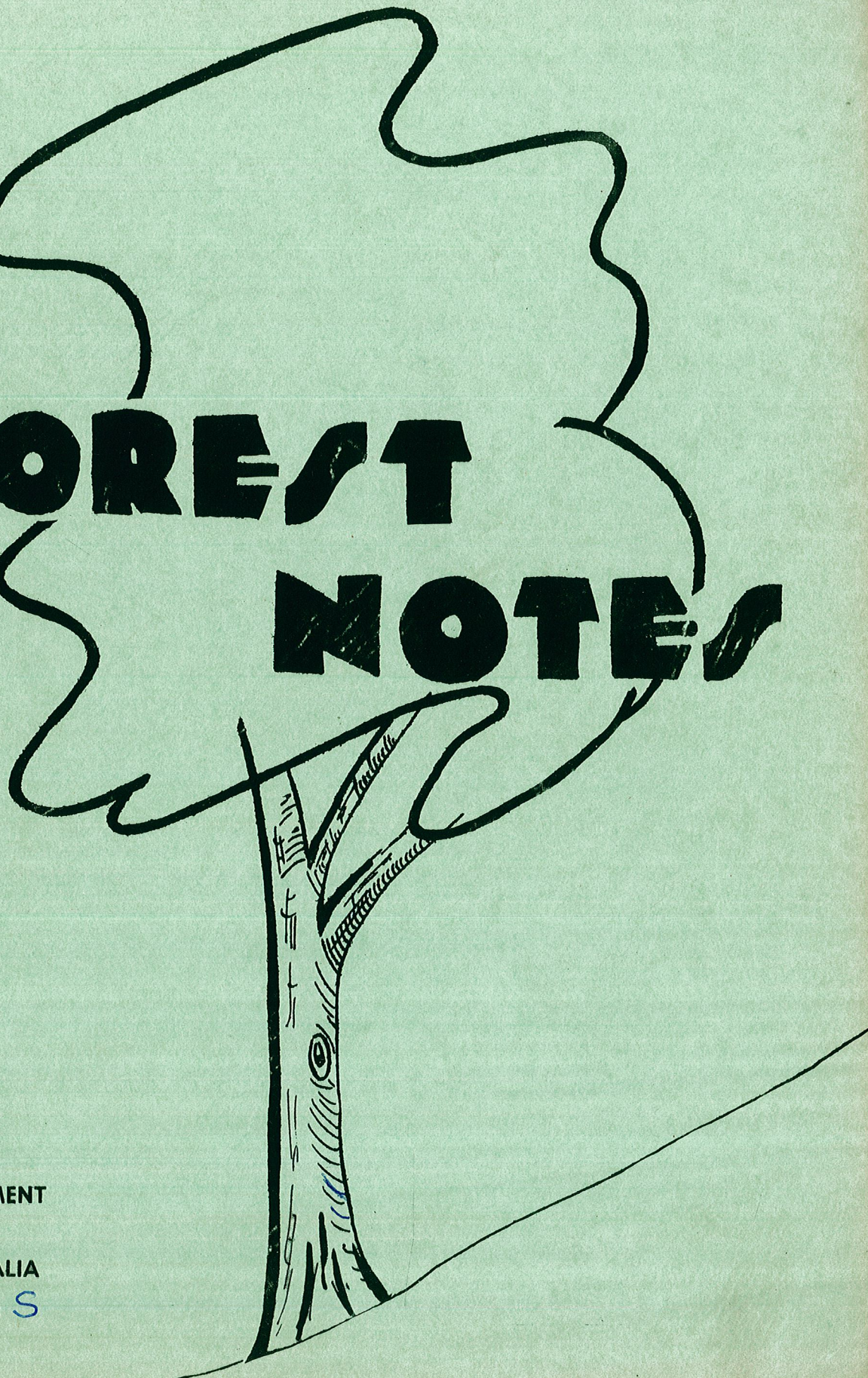
MR. SHEDLEY

FOREST NOTES



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FOREST NOTES

Special Issue on W.A. Pine Plantations

October 1969

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P.N. Hewett

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FOREST NOTES "SPECIAL ISSUE"

EDITORS' NOTE

In this issue of Forest Notes, a number of officers have contributed articles on aspects of pine plantation forestry in Western Australia. The Editors' objective was to try to produce in a small issue, general descriptions of plantation techniques as they are performed in W.A. in 1969. Not only should this be of interest to those amongst us who have little contact with plantations, but the issue itself could be of considerable historical interest in future years.

It is hoped that other "special issues" of Forest Notes will be produced. Interesting and developing fields such as fire control, karri silviculture, jarrah dieback research and safety may be covered at a rate of perhaps one special issue per year.

The editors would like to thank those authors who contributed to this issue.

R.J. Underwood, Pemberton.
P.N. Hewett, Como.

PLANTATION ESTABLISHMENT (HILLS)

by D. Spriggins

General

Nearly all our plantations, hills or coastal, have been established with the object of growing wood products that we expect to be able to sell in the future.

With wood production as the main goal, it is therefore important that the growing of these products should be run on businesslike lines, i.e. that the return from the sale of the wood products should aim to exceed the cost of growing them. We would not expect a farmer to plant a crop of potatoes if he could not sell that crop at a profit when it was ripe. Foresters should not be any the less wiser.

Not to aim for this result could lead to the situation described by Parkinson where "the British Forestry Commission was busily draining and planting poor Welsh pastures apparently unaware that the resulting crop of pit props would cost 20 times that of imported timber. By the time the trees had matured, pit props would probably have gone out of use".

It is therefore important to look critically at each aspect of current hills establishment practice, as it could be that there are better and more importantly, cheaper ways of achieving the same end.

Hills Establishment

The decision to plant in the hills has been largely due to the greater growth rates that can be obtained from P. radiata when grown on the basic soils found in the hills, i.e. average yields of $> 300^{+}_{-}$ cubic feet per annum compared with 100 + cubic feet from P. pinaster on the coastal plain.

This initial benefit in favour of a hills plantation is not however sacrosanct; for the trend in timber harvesting seems to be towards the use of large, low operating cost units designed for working on relatively flat country. As the cost of harvesting a timber crop by current methods, is a major item in the price a sawmiller etc., has to pay for his raw material, e.g. $8 for chipwood ex Gnangara out of a nett $10.70 price, it seems likely that topography of the plantation area could become increasingly important in the future. Most hills plantations already established are on reasonably steep country.

Current Establishment Practice

Current hills establishment usually follows in this order:

(a) Utilization of native timber.

(b) Initial clearing.

(c) Pre-planting hormone spraying in lieu of ploughing.

(d) Final clearing.

(e) Construction of roads, firebreaks, water points and grade drains etc.

(f) Planting.

Initial Clearing

The normal practice is for this operation to commence in summer, after all native timber that can be utilized has been removed. An alternative, the pushing down of all material so that there are no stumps left and then carrying out utilization has not been practised to date. The reasons being:

(a) The higher cost of such an operation.

(b) The greater difficulty in removing mill logs, etc.

(c) No great advantage to current plantation management.

With the development of larger type harvesting units, not suited towards dodging stumps there could, in the future, be financial advantages in total clearing.

Initial clearing is usually carried out by pushing and heaping into windrows at about two chain centres. The operation especially in the heavier timber country is best carried out by a HD.21, D8 or similar powered machine on a per acre contract basis. Provision should be made in the contract to include in the windrows, all logs and stags, etc., up to half a chain outside the soil boundary.

Windrowing is preferred to broadcast pushing because of -

(a) Less fireweeds, etc., are stimulated by burning of windrows compared with a broadcast burn. This means cheaper weed control.

(b) Weed control can take place between the windrows well prior to the final burning, thus avoiding expensive post-planting weed control.

(c) Final burning can be a more "controlled" operation than a broadcast burn.

(d) There is no significant difference in final clearing costs by either method.

Windrowing is still an expensive operation ranging from $30 per acre upwards for most hills areas. The operation is slow because logs, etc., must be lifted over intervening stumps when

constructing each windrow. Due to the presence of stumps, chaining has not been widely practised in the hills areas but could be the cheaper method if total stump removal ever becomes accepted practice.

Weed Control (Pre-planting Spray).

Due to the rich soils, weed growth is always a problem and must be checked before planting so as to avoid undue competition and costly eradication after planting.

Ploughing as a method of weed control has been generally dispensed with because of dangers of top soil loss and the greater amount of final clearing required before ploughing can take place.

The current practice of application of 245-T hormone spray by a CONNOR-MIST type spray (2 lbs. of 245-T in five gallons of water per acre) appears to give adequate weed control between the windrows if carried out in summer, 12 months after windrowing. In severe cases, a second pre-planting spray may be required in the summer prior to planting. It is emphasized that weed control should be adequate before planting. Costs vary with topography but would probably average $3 - $4/acre. On easy going an operator could cover 50 acres per day.

Final Clearing

Windrows should lie for at least two summers to ensure a thorough burn in early autumn. The operation can become expensive if attempts are made to thoroughly "clean up" the area. In most cases it is easy to exceed $20 per acre for this operation.

The amount of clearing required should be sufficient to: -

(a) Allow reasonable access for planting, pruning and fire control

(b) Permit the use of logging equipment likely to be used in the future removal of thinnings.

Generally speaking, at the time of final clearing, the interests of future loggers are not given the priority they deserve, and the comment "that's their problem" is not unknown.

To reduce the amount of final clearing required, it has been recently suggested that windrowing on up to 1 in 8 slopes should be across the contour and final clearing should aim, in one operation, to remove two out of every three chains of windrow.

Recent first thinning trials involving the complete removal of only every third row, have shown that this method has many advantages - mainly easier and cheaper logging. If this

method becomes general practice, it could be necessary in the future to ensure that every third row was fully cleared.

Much of the difficulty in disposing of windrows is peculiar to W.A., due to the durability of the native timber. In the eastern states a considerable amount of debris can be left after clearing as it is soon broken down by saprophytic fungi.

As burning is only one means of timber disposal, there could be an opening for Entomologists or Pathologists to breed a super termite or wood destroying fungi especially for this purpose.

Roading

Roading in steep country in hills areas is always expensive and with this in mind, an intensity of one mile of road to every 100 acres of planting has been set as a maximum guideline.

Roads should be located almost along the contour and at about 30 chain centres. One road should follow as closely as possible, (consistent with good grade and location), to the top soil boundary and one at the foot of the main slope.

Forming to 22 feet with adequate drainage is essential but gravelling should only be sufficient to permit access by planting and pruning crews as the roads should not be heavily used until the time of first thinning.

Water points should be constructed such that from any point within the plantation a heavy duty unit should be able to travel to, fill and return from the water point within twenty minutes.

Construction costs vary with topography and amount of rock but would probably average $2000 per mile. The work is best done by contract dozer after final clearing had been completed. A D.7E with rippers is usually the minimum class machine required. It pays dividends to expend adequate officer time in selection and supervision of construction.

Grade Drains

Where the plantation is on water supply catchment areas, grade drains have been used between the contour road systems to prevent erosion and excessive turbidity in the water supply.

The grade drain consists of a drain formed by a grader or D4, so that run-off is collected and discharged into the main gullies on a 1 in 30 or less grade. Care is required in selection and construction. Stumps on the alignment are often a problem and are either removed during initial clearing by pushing, or explosives at the time of construction. Costs of construction are approximately $2/chain.

Firebreaks

In the past, provision and maintenance of firebreaks has been an expensive item which has been of questionable value in fire control. Current thinking is to dispense with conventional internal cleared firebreaks and to rely on roads, control burnt strips and access rows as fire control lines.

External breaks adjoining hardwood forest are to be the external road only, improved by the removal of stags up to five chains outside the boundary and all ground wood debris to 1 chain outside. Regular burning to be practiced in adjoining hardwood forest. It is considered that this is a realistic approach to protection of a hills plantation.

Planting

Considerable progress has been gained in recent years by the use of piecework hand planting and planting rates have risen to in excess of 1,000 plants per man day at rates of ± $1/100 plants.

Hand planting will probably continue whilst less than total clearing and stump removal is an accepted practice. A planting gun, capable of imbedding seedlings into the ground could be a further refinement and cost saver.

Conclusion

Hills establishment methods must be constantly critically examined for it is easy to accept the view that because a practice has been carried out that one way for many years, it is the only way.

In considering whether to alter existing practice, the major criterion should be whether it will alter the cost to the manufacturer of his raw wood material.

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A MAN, A BOY AND AN M.F. 165

by

P.C. Richmond

The man is Ted Lorkiewicz, the boy the most recent school leaver to join the Departmental employee ranks, and the M.F. 165 the newest and most reliable heavy wheeled tractor available. Together they form the essence of the subject of this article, "The Nannup Pine Nurseries".

There are in effect three separate nurseries. Firstly the Town Nursery, situated in Nannup itself, in two portions of 3.2 and 416 acres. The area is practically level with only very slight slope. Adjacent to the Blackwood River the soil is a sandy river silt with not very good structure. When the river rises thirty feet and is really in flood, so is the nursery and F.D. House No. 628, with four feet of the Blackwood over the nursery, as happened during the winter of 1964. Fortunately there were no plants in the nursery, but the house was occupied!! In this nursery is grown all the Pinus pinaster raised by Nannup Division.

Next we have the Lower Crouch nursery just over six miles from Nannup off the Bridgetown Road, an area of 5 acres. This was an old orchard on a south-easterly aspect, with a very fertile reddish brown loam soil, and the slope would average out at about one in seven. Pinus radiata has been grown in this nursery every year since 1962, with no fallowing, and continues to produce good plants.

With the thought that the Lower Crouch could not continue for ever, another nursery site was sought of reasonable slope and aspect, large enough to fulfil the radiata requirements and allow for rotational fallow. Needless to say the ideal could not be found, but a reasonable site was developed between the Lower Crouch and Bridgetown Road. This is an area of 13 acres with a north-westerly aspect and an average slope of one in nine. It has been a rough grazing pasture covered with bracken. After intensive ploughing with a Connor-Shea, blasting of tree stumps, picking-up and more picking-up, there was the semblance of a potential nursery. The soil is a brownish loam with clay patches and small pockets of loose stone. It does not appear to be such a fertile soil as found in the older radiata nursery. The first sowing in this nursery, now known as Upper Crouch Nursery, was a very small plot in 1964. The preparations referred to were carried out in 1966, and the first two acres of seed bed sown. Since then, sowing of radiata has continued each year on an ever increasing scale.

Regarding the techniques at present current in this Division, generally speaking they are much the same for the radiata and pinaster. After completion of the lifting, usually about mid-July, everyone breathes a sigh of relief, the Nurseryman has a well earned three weeks leave, and by the time he returns all the nursery areas have been cleaned up and levelled using a spring-tined cultivator. Quantity of seed allocated from Head Office is known, acreage calculated, for instance 1968/69 there were 4 acres pinaster and nearly 9 acres radiata. On the area selected for sowing, fertilizer is spread with the conventional tractor mounted spreader at the rate of 180 lbs potato manure "E" and 70 lbs Blood and Bone to the acre. This is turned in using a single furrow reversible moulboard plough, ploughing to a depth of approximately nine inches. At this stage I should say we would be using two tractors or even three if, as happened last year, we were able to borrow another plough. This area is again cultivated, mainly to retain a reasonable level surface. Fertilizer is then spread over the total nursery area and cultivated into the top two or three inches of soil. Seed-beds are marked out with the nursery tractor wheels set on 68 inch centres. To keep a perfectly straight line when doing this is very necessary for future operations. To do this is quite an art and even a very experienced tractor driver will mark out a few raggedy old beds before acquiring the hang of the art.

The nurseries are now ready for sowing. This would be about the beginning of September with the soil still moist from the winter rains. A dry spell is required for the sowing. Any rain and the soil is too moist, which causes the seeding machines to clog up. Assuming the weather and soil conditions to be just right, the surface of the seed beds are raked giving a good tilth to the top couple of inches of bed. Seeding can now be carried out with the "multi-seeder". This is a machine devined, devised, designed and developed between the Nannup Division and Manjimup Workshops. It is basically a frame with seven Mintern seed boxes in a double bank which can sow either 5 rows 10 inches apart, 6 rows 8 inches apart or 7 rows 6.6 inches apart. Drawn by the M.F. 165, running on a roller which levels and firms the beds. It also drives a chain to a shaft which agitates the number of seeders which have been engaged. At the rear of the frame is a platform on which a second man sits to ensure the seed boxes are kept filled from a hopper on top of the frame and also to make sure all engaged seeders are functioning properly at all times. For turning and transport the multi-seeder is fitted on the three point linkage and can be lifted by the tractor. Given a good run, seeding of the Nannup nurseries can be carried out within a period of seven working days. Great care must be taken to ensure each seeder is callibrated between species and

also when changing to a different graded seed size. Until this last season all sowing at Nannup was 5 rows 10 inches apart. Last year the sowing was 6 rows 8 inches apart, to date it would appear there has been no adverse effect to the stock. Next season it is hoped to try a sowing density of 7 rows 6.6 inches apart. It can be appreciated if this higher density sowing is successful there should be a considerable saving on preparation and weed control, however it is anticipated heavier application of fertilizer will be necessary.

Next begins the long campaign of weed, fungal and insect control. Starting with a pre-emergence spray application of "Simazine" (Gesatop), as soon as practical after sowing, at the rate per acre of 1¼ lbs on the light sandy soil and 1½ lbs on the heavier loam nurseries. If there is any show of weeds prior to the germination of the pine seedlings, the weeds can be eliminated with an application of 16 ozs. "Diquot" (Reglone), with 16 ozs. "Paraquot" (Grammaxone), mixed in water with a suitable spreader. Needless to say one has to be sure there is no germination of pine seedlings! Generally speaking, insect control has been carried out as soon as any insect damage is noticed, usual application is 2 pints of 15% D.D.T. per acre. A common pest is a small green caterpillar which eats the radiata cotyledons and/or primary needles. A thought on insect control; instead of applying D.D.T. as a very effective insecticide, one should be more specific and obtain the most effective insecticide for the insect which has to be eliminated. A warning, D.D.T. has been used so please don't eat the Pines!! During the growing season mineral oil is used to keep the weeds down. This season, after a visit to Gnangara where their success with this was noted and committed to memory, we applied 66% power and 33% lighting kerosene with good results. "Damping off" always occurs in the pinaster nursery but only during the wet spring years in parts of the older radiata nursery. To combat this, we have to date followed the "Forester's Manual" and applied "Cheshunt", however perhaps quicker results could be obtained with some of the modern fungicides.

It is hoped next season to greatly reduce the weed problem in the pinaster nursery with a pre-emergence application of "Dacthal" at 10 lbs per acre over the whole nursery. Trials of this weedicide during the past two seasons have shown it to be particularly effective in the almost total elimination of crab-grass, (Digitatia Sanguinalis), as a serious weed and also very effective in keeping couch-grass, (Cynodon Dactylon), within manageable proportions. To anyone who has had to deal with the control of both these grasses they will appreciate what a break-through this promises to be, I sincerely hope!! Dacthal is quite an expensive weedicide!!

During the summer months, generally after Christmas with a bit of luck, irrigation is necessary. Firstly in the pinaster nursery and continued after the first watering at approximately fortnightly intervals until the first heavy rains. In the radiata nurseries watering depends on the season, usually two or three weeks after it is necessary in the town nursery and thereafter another couple of times during the summer. The irrigation is carried out with 3" aluminium piping and "rain-spray" sprinklers. Direct to the Nannup town water supply for the pinaster, although the Blackwood River can be utilised early in the season before the level drops and the water is too saline. For the Lower Crouch nursery the East Nannup Brook is a permanent stream close by the nursery. The irrigation water is pumped with a '2" high lift centrifical p.t.o. driven pump' attached to the M.F. 165 by the three-point linkage. A very powerful, mobile and versatile pump, which can also be very useful at a fire. To date, a dam below the Upper Crouch Nursery has proved adequate, however in a severe summer this may not be so.

For the last few years root pruning or under-cutting has been carried out, the object being to cut the tap root six inches below the nursery level to encourage the plant to produce a more fibrous root system. Also by root-pruning every two or three weeks with a very sharp rigid blade drawn by the tractor, theoretically there should be less shock than just one undercutting just prior to lifting and planting. However at the present time this is debatable as results from two field trails in last years planting showed better survival in the non-root pruned stock!!

The final item on the nursery year calendar, lifting, commences at the beginning of June. This year, 1968/69, we have to lift 1,500,000 Pinus radiata and 950,000 Pinus pinaster, which is a slight increase over previous years. The target is to lift an average of 100,000 plants per day. To achieve this, the nursery crew is augmented with an Overseer, tractor driver, two employees and six female casual employees. It is found the females are much quicker and more dexterous at handling, sorting and counting plants and thus perferable to bringing regular forestry workers into the nursery. To speed up the lifting and improve the working conditions, a couple of years ago a sorting machine was introduced; this machine is usually known as "Hills Hurdy-gurdy". It was manufactured in the Manjimup Workshops and has certainly achieved the objects set out for it. The lifting operation works with the tractor under-cutting with a tilted blade to loosen the plants which are pulled by hand and placed on the conveyer belt of the sorting machine. On the machine the plants are sorted and counted into twenty-fives and

placed in receptacles on an endless belt. This belt is clutch operated by the person bundling, tying and dropping 5 by 100 bundles of plants into the wet sack fixed on the side. The full sack is dropped on the ground, wrapped and secured, loaded onto a trailer which, when full, plants are taken to a dump in the nursery where they are kept damp to await collection.

Finally, what do these plants cost to raise? For the 1967/68 nursery year, both species, it cost per 1,000 plants $3.90 to raise and $2.13 to lift and bag, a total of $6.03. Which was $1.92 better than the previous year and it is anticipated there will be a further improvement this year.

THE ESTABLISHMENT OF P. PINASTER IN THE BANKSIA BUSH COASTAL SANDS.

by D. Lejeune

To understand the opportunity for large scale low coast plantation establishment within approximately 30 - 40 miles of the key market in W.A. one requires an appreciation of the forest type and methods of establishment.

Forest Type

The largest trees are normally Banksias, Sheoaks and Christmas Trees with low density Jarrah and Coastal Blackbutt in scattered areas.

Soil Types

Two soil types are recognised, the Bassendean sands (white) e.g. Gnangara, and the Spearwood sands (yellow) e.g. Yanchep and Moore River. Acceptable Bassendean sands are typified by a shallow water table which compensates for the poor fertility of the soil. Acceptable Spearwood sands are any which are not underlain by shallow limestone. Although the water table is normally deep, they have a far better moisture holding capacity.

The selection of plantable Bassendean sands is now being done by an ecological approach. The occurence of Jarrah, Marri or dense Blackboys are obvious indicators of water availability. Less well known species of undergrowth also indicate whether a site is too dry, acceptable or too wet.

The selection of plantable Spearwood sands can be done from photos providing they are not on the eastern boundary where there is a transition between the two types. In this zone it is necessary to return again to the ecological approach.

It has been found a definite advantage to select acceptable sites at least 5 years in advance to enable proper planning. A dozed boundary is made and this appears on photos and plans. Areas to be cleared are protected from fire at least four years before chaining to allow the initial burn to run. This probably surprises the southern foresters.

Clearing Procedure

(1) Removal of millable timber. From the above it is obvious that millable timber is generally absent.

(2) Initial clearing using two large dozers with chain and pushing or cutting any trees which cannot be chained. This is done entirely by contract and prices have been as low as $1.00/ac. in bush with no jarrah and

up to $1.55 in an area with 50% jarrah.

One summer is ample drying time for light bush. The initial burn follows.

(3) Final clearing is done using a dozer with a wide front mounted rake. Rakes up to 26' have been used. Where there is no heavy material, wheel tractors drawing scrub rakes can be used for economy. This work also lends itself to contract. Windrows or heaps are formed and these can be kept burning using a small machine. The only handwork really necessary is picking up the few stumps etc. when heaps do not burn completely. Because of machine planting it is necessary to have the ground much cleaner than in hand planting. Prices have been as low as $2.20/ac.

Ploughing

Use Fordson 4 x 4 and Chamberlain tractors drawing Chamberlain 14 disc ploughs.

Piecework has proved highly successful with ploughing reducing the time for the job by about 30%. This is due to long hours worked. Piecework is about to be commenced with furrow lining and a similar result is anticipated.

Furrow Lining

Fordson 4 x 4 tractor now pulls four furrow liners attached to a bar spanning four rows. This reduces costs and halves the number of tractors required.

Planting

The above tractors drawing twin two man planting machines. For odd rows, short runs etc., single two man machines are used.

Initial Supering

2 oz. per tree of either super or zinc super is applied as soon as planting is complete. Four rows at a time can be covered using four men with super bins on a specially constructed tractor mounted platform. However, some is still done by each man carrying his supply of super.

Cost does not vary with the method but with need for zinc super.

Possible Reductions in Cost

No great reductions are anticipated. The cost effect of some refinements in clearing will be minimal. There is certainly scope for a big reduction in supering costs and ultimately it is anticipated that super will be applied at time of planting or from the air.

Future Costs of Establishment

Looking ahead for say 10 years and basing costs on today's value of the dollar the following costs might be anticipated as average.

Initial Clearing	$ 1.20
Final Clearing	$ 2.60
Ploughing	$ 1.50
Furrow Lining	$ 0.50
Planting	$ 3.50
Applying Fertiliser	$ 4.50
	$13.80

These costs include all contracts, wages, plant and materials.

GNANGARA NURSERY

by

A. Robertson

Due to the current expansion of plantation establishment in the Wanneroo Division the nursery at Gnangara has been extended to 35 acres to meet with increased demand for plants. About 11 acres is used annually for pines.

In planning for efficient management the following has been considered with the aim to reduce hand work to a minimum and the nursery is sown with the idea of doing all subsequent work with the use of a M/F Tractor and various implements and to this end the beds are sown in groups of 4 rows at 12" intervals which can be straddled with the tractor. Four Mintern seeders attached to the 3 point linkage are used at present, but it is hoped to use more modern seeders as the Forests Department have purchased some which can sow six rows.

Soils

The soils are white sands low in fertility and moisture holding capacity. Organic matter is the main if not the only means of holding nutrients against leaching. Tests have shown that in order to double the nutrient level, the organic matter content would need to be trebled.

Green Cropping

In the past, as general practice, crops of N.Z. Lupins and oats have been sown immediately after lifting pines. In late summer these are "rotary hoed" in for self sowing in the following season. After this another crop of pines is sown. This has been the only means of lifting the level of organic matter.

Above a level of 4% organic matter, seedlings do not experience any prolonged water stress. Below 2% these are repeated crises from November 30 onwards.

Use of Peat

Experiments with quantities of 1, 2 and 3 inches of moist peat accompanied by about 2 cwt. per acre of nitrogen fertiliser have produced a marked increase in pine growth and health. The use of lime in these experiments did not produce significant results.

Recently 1,000 cubic yards of peat has been excavated by dragline from local deposits. It is proposed to spread this where required with the objective of lifting the organic matter content above 2% throughout the nursery.

In beds where organic matter is 3% or more it has already been shown that repeated crops of pine can be raised. It is, therefore, hoped to reduce or eliminate the need for green cropping.

Irrigation

Experiments have shown that watering produces good development of superficial laterals in the top 6" of soil. Without watering a strong tap root develops with fewer superficial laterals.

For best growth in the field, superficial laterals are necessary as there is an obvious limit to planting depth using planting machines. Hence, watering is reduced to the minimum to sustain life and satisfactory growth. The use of peat should reduce the need for watering in the poorer sections. Root wrenching is not done.

Size of Beds and Plant Production

The aim is to have long beds to facilitate the use of machinery. The aim is to produce between 9 and 12 seedlings per foot. Higher rates result in plants smaller than the optimum 7 - 14" height.

Topography

Topography is ideal as the area is flat.

Drainage

A deep drain runs through the nursery. This is necessary, as the water table is only 5 feet below the level of the nursery in summer.

Location

Proximity to Headquarters (30 chain) is ideal for management purposes.

Fertilizers

Nutrifert is applied at 2 cwt. per acre at time of sowing.

Weedicide

Recent successful trials include application of Dacthal at 12 lbs. per acre applied immediately after sowing. This gives approximately 6 weeks free of weeds till the seedlings are strong enough to be treated with B.P. Pine Spray. B.P. Pine Spray is obtained from B.P. Australia, and is a mixture of Power Kero and lighting kero to an aromatic content of 28%.

Dowpon has been used repeatedly to reduce the amount of perennial grasses in the drains and verges.

Diseases

Formaldehyde has been used on limited areas at the rate of 140 gallons per acre mixed at 1 part Formaldehyde to 9 parts water.

Formaldehyde is applied by a dribble bar from 100 gallon tank mounted on tractor about three weeks before sowing takes place, but this is difficult to apply as it gives of strong pugnent fumes; it is hoped that some other mixture can be used in the near future. Application is used for low lying beds where "damping off" occurs. Results are good in the 1st year with survival increased and weeds greatly reduced. However, it is very expensive and resedual effect is weak.

Insects

Insects are not a major problem, but some damage occurred in the past from black beetle and grasshoppers. Dieldren is used to kill these.

Lifting

A Fergie 65 tractor pulls a cutter approximately 10" below the ground level of each bed. Above the horizontal cutter there is a vertical separator between each row. This loosens the plants sufficiently to be lifted and bagged.

The tractor is fitted with an outrigger on which bags are attached to receive the plants as it moves slowly along the bed. The outrigger is shaped so that the bag for a particular row is in a convenient position for the lifter.

No counting of individual plants is done and is not necessary for daywork planting.

Production and Costs

Current production is about 3,500,000 P. pinaster plants per annum. Normally no other species are sown. Latest costs are:

Cost per 1,000 plants to raise	$1.55
Cost per 1,000 to lift and bag	$0.69

RESEARCH INTO PROBLEMS OF PINUS PINASTER PLANTATION ESTABLISHMENT

by

J. Havel

Basis of the Research

This work is centred on Wanneroo, and is largely carried out under the direction of Inspector Havel by T.A. Edminston and two assistants. To a large degree it is the follow-up of site studies carried out earlier, in that it seeks to find answers to problems associated with differential productivity on various sites. For this reason the findings of the site studies will be briefly recapitulated.

On the Coastal Plain, the main determinants of pine growth are the availability of soil moisture and the capacity of the soil to provide nutrients. The second part refers to retention of applied nutrients rather than to initial reserves of nutrients which are low throughout the coastal plain.

There are four broad categories of sites with respect to moisture availability -

1. Broad flats with ground water close to the surface, but never above the surface.

2. Swamps and swamp margins with ground water rising above the surface in winter and spring.

3. Grey sand dunes with unfavourable soil conditions except in winter.

4. Yellow sand dunes, underlain by limestone, lacking ground water storage.

Of these four categories, the first provides optimum conditions for pine growth, particularly where coupled with organic matter accumulation, and presents no problem. The less severe case of the second category should be amenable to improvement through drainage and mounding, and large scale operational trial using an imported mounding plough is planned for this winter. The third category is usually associated with unfavourable nutritional conditions and on our present knowledge cannot be brought into effective production. The fourth category presents the greatest challenge.

Management of Dry, Weakly Leached Sites

The relatively high content of inorganic colloids in the soil means that the initial content of nutrients is slightly better than for the third category, and that nutrients applied, in particular phosphorus, are not leached out so rapidly. The growth of pines which occurs mainly in spring is therefore quite good on these sites, so good in fact that it rapidly exceeds the capacity of the soil to supply water during the long summer drought. Native vegetation tends to stabilise itself at a density which matches the moisture reserves. Neutron probe studies of soil moisture down to the depth of 23 feet indicate that whereas under native vegetation the soil is completely rewetted each winter, under a dense unthinned stand of pines this no longer happens. Instead a dry zone develops at depth, and rises higher and higher until in a year of below-average rainfall the pines use up water early in the dry season and respond by dropping much of their foliage or even dying. The problem is most acute in the north, where unfortunately the bulk of our plantations will go in future. It is accentuated by occurrence of limestone. The first step is the avoidance of very shallow soils by site classification before planting. The second step is the determination of stand density, which can be carried on a particular site. In order to achieve this, a large thinning experiment has been established in our oldest pine plantation north of Yanchep. It covers the full range of sites in that area. The treatments consist of reducing the density, expressed in terms of basal area, stepwise from the high level of 107 sq.ft/acre to a very low level of 31 sq.ft/acre, and maintaining it there. Apart from measuring the response of the trees in terms of diameter and volume increment, a detailed hydrological study has been intergrated with the thinning experiment. The amount of rain falling in the district is being related to the amount that falls through the canopy and that runs down the stems, as well as to the rate and extent of rewetting of the soil. The optimum treatment will obviously be the one which combines the best growth rate with annual rewetting of the soil without any subsoil drainage, that is, the one that gives full utilization of the site without drought danger. It is intended to further widen the scope of study by incorporating fertilization into the design.

Management of Strongly Leached Sites

A similar experiment on the grey sands and flats in the Gnangara area is intended to study the effect of the water regime on the growth rather than the survival of the pines. The drought

danger is low because ground water is present at depth, and consequently a dense stand can be supported. However, whereas in unthinned stands diameter growth ceasea early, in heavily thinned stands it continues well into the dry season.

Fertilization of Yellow Sands

The change in emphasis from the grey sands at Gnangara to yellow sands at Yanchep has necessitated revision of our fertilizer application. Experiments currently in progress aim at determining what quantity per acre, and what form of phosphatic and zinc fertilizers give the best results on these sites.

Fertilization of Highly Leached Grey Sands

An important fertilizer trial has been established to find a way of handling the so called "sub flats" at Gnangara, which combine reasonable moisture conditions at depth with very rapid leaching of applied fertilizers. At present the initial application of superphosphate to the base of the trees is largely lost through leaching in three to four years. In past second application could not be carried out until after low pruning at age seven, when tractor-drawn fertilizer spreaders could be employed. By then, stagnation set in and resulted in a considerable loss of increment. Two alternatives are now under study. The first concerns merely the feasibility of earlier fertilization, for which the obvious solution is the use of aerial application. A large scale trial, monitored in detail by the research branch, showed that the method is eminently suitable for coastal plantation. Improvements have been suggested in the method application to avoid spilling the fertilizer, at relatively high rates, onto adjacent firebreaks. The second alternative is to apply more fertilizer, or less soluble form of fertilizer, in the initial treatment at the time of planting. This too is being investigated in a relatively large, complex experiment which should indicate the best combination of type and quantity of fertilizer and timing of application.

Row Thinning

The high cost of marking for first thinning and the difficulty in extracting individual trees has led to a local trial of row thinning, already practised by some paper companies. The experiment, initiated by Inspector van Noort, spans a very wide range of sites. In low-thinning, the main silvicultural problem is the retention of sufficient number of final crop trees of goof form. The ultimate solution to this will come through tree breeding. There is also a marked difference in the proportion of suitable trees between sites, so that the method will present less problems on poorer, drier sites where the economic aspects of thinning are most critical.

Nursery Studies, Maintenance of Soil Conditions

Research into nursery problems has taken the form of operation study to detect the areas of weakness. The three main weaknesses were found : the maintenance of adequate organic matter content in our very poor sandy soils. The loss of seedlings through damping-off and root-rot and the competition by weeds. The level of organic matter in the soil was found to be the main determinant of moisture and fertilizer retention, and through it of seedling growth. Past methods of maintaining this level through green cropping was found to clash in timing with other nursery operations, in that the lupins had to be sown earlier, too late or harvested too early. In any case, the large increase in the rate of production made the taking up of two thirds of the nursery under green crops impracticable. The discovery of large local deposits of peat provided a very cheap alternative. In anticipation of the problems which arise from heavy application of peat, such as excessive acidification and lowering of nitrogen availability, a comprehensive experiment incorporating four rates of peat, four rates of urea and four rates of agricultural lime was established. Some of the sixty-four possible combinations led to marked improvement of growth, others depressed growth and brought on various deficiency symptoms.

Soil Sterilization

In studying the problem of seedling mortality it was found that once this commenced, control was difficult, and that it was far better to anticipate the problem by sterilizing soil in the susceptible portions of the nursery. The main reagent used initially was formaldehyde, and the optimum combination of method, timing and quantity of application was defined. Current trials involving other reagents indicate that Di-trapex is more effective and easier to apply by mechanical means. A bonus benefit of soil sterilization is the initial control of weeds. On the other hand, too heavy a rate of application can lead to interference with mycorrhiza.

Weed Control

After a number of weedicide trials involving several types of weedicides applied under a wide range of conditions, a combination of pre-emergent application of Dacthal, followed where necessary by post-emergent application of a power and lighting kerosene mixture has been recommended. Weeds have now largely ceased to be a problem in the nursery.

Future Developments

What of the future? With many long term trials under way, much of future effort will need to go into their maintenance. The anticipated changes are not so much in the nature of investigations as in the use that is made of them. Much of the information that has come in, or is coming in from experiments dealing with individual problems needs to be reworked into a larger more complete story by a process that is now coming into prominence in forestry research, namely simulation. The basis of this is simply this : if we know how the species we are growing responds to certain combinations of site, fertilizer and thinning treatments, it should be possible, by means of mathematical models and computer analysis, to fill any gaps in our knowledge. Not only that, we should be able to predict what kind of tree crop these treatments will produce over a specified period of time. If the crop can be priced, and cost assigned to each operation involved in producing it, we have the means of comparing the economic benefits of the various treatment combination. Ultimately we hope to be able to select the one that is financially most advantageous.

CUTTING AND HARVESTING THE PINE CROP

TECHNIQUES AND PRACTICES

by

P.N. Hewett

Production of pine logs as thinnings from plantation areas has been proceeding for about 35 years and the first thinnings at Mundaring were cut in 1932. Logging began on a very small scale due to the limited area of plantation and the absence of a demand for pine in a market well supplied with choice hardwoods. The knotty, non-durable pine was, understandably, considered to be inferior, and the small dimensions of early logs did little to encourage the trade.

The volume available grew faster than the demand and until 1960, even those plantations close to the Perth market were only sporadically thinned, and the buyers market tended to be prejudiced against the slightly darker, more aromatic Pinus pinaster while favouring the better known Pinus radiata which was lighter in colour, less aromatic and available in some larger sizes.

Present Practice

Demand has risen sharply in recent years and the curves on Graph 1, plotted on a semi-log scale show trends in volume utilised for various categories over an eight year period from 1960-61 to 1967-68. Logs have been grouped into four categories to avoid cluttering the graph -

Chipwood	logs for particle board and "larboard".
Mill Logs	all case and sawmill sizes.
Posts	includes struts, strainers, rails and pearling poles.
Peelers	all material which is converted to veneer or plywood.

Range of Products

Although the main volume users for pine are chipwood, case and peelers, there are many other applications including Larboard building panels, wood wool, mouldings, posts, rails, clothes pegs, treated (creosote, Tanolith) building materials, roof trusses, interior beams (laminated), furniture framing and so on. When a paper pulping factory is built in W.A. the demand will increase even further.

Sources of Supply and Processing Sites

Logs in varying quantities are being produced from sixteen plantation centres -

Pimelea	Grimwade	McLarty	Mundaring
Margaret River	Collie	Gleneagle	Gnangara
Nannup	Harvey Weir	Jarrahdale	Collier
Ludlow	Myalup	Carinyah	Somerville

Departmental sawmilling and barking now occurs in five centres - Pemberton, Margaret River, Ludlow, Grimwade and Harvey.

Private usage - logs, baulks, boards and minor produce are centred at -

Boddington	Kelmscott
Busselton	Metropolitan Area
Picton	Wanneroo

Methods of Production

All of the common methods of producing the logs are in use -

day-work, piece-work, contracts.

The present system is based entirely on chainsaw felling and bucking and most extraction and loading used the Army "blitz" jib crane. There is a Skidder working at Nannup and trials with Front End forks and Massey Ferguson skidders have been carried out at three centres.

Future Development

The methods of log production, marketing and utilisation at present in use should be considered as transitional, and are subject to continuous but relatively slow changes. The handling of large numbers of small logs has always been expensive and is likely to remain so. The stumpage return for most log classes is too small to warrant expenditure on expensive sophisticated machinery unless the total through-put of logs is large in some centres, or unless the machinery is sufficiently mobile and buyer storage facilities adequate to allow seasonal operations on a multiple shift basis. Most countries of the world have found that contractors who fall, snig and haul the logs prove most effective and the trend in W.A. is not markedly different. However, there are only approximately eighty people employed in cutting and hauling pine logs at present, and these are scattered

in relatively small groups over some 14 or 15 geographical centres. It appears then that the onus is on the Forests Department to introduce a range of equipment and develop methods which overall contractors may later be able to apply.

Some progress in this direction has already been made. The F.R.I. Utilisation teams have been to W.A., there is one rubber tyred snigger working in the plantations and modified agricultural/industrial tractors are already in use.

By mid year 1969 a 4 x 4 Forwarder, a half track and hydraulic cranes will be on the job. The new equipment already at work and on order will cost some $40,000. When this capital investment is compared with the 1967-68 total pine log volume of 47,860 loads under bark, it becomes obvious that there is a very definite limit to the amount of plant introduction that can be done. If these machines prove successful in various field conditions, it may be possible to gradually extend the range of new equipment. Alternatively the results may provide contractors with an example and an incentive to make similar progress.

Other developments overseas have occurred in two directions - log harvester machines of the Beloit type and tree felling secateurs. A harvester is being developed in Australia by the Forest Research Institute but since these machines are designed for large scale, 24 hours a day clear felling operations, their scope in W.A. is very limited. However, one local distributor has a tree secateur available mounted on a tracked vehicle, and depending upon price it could have an application for clear felling in the older plantations. Its practicability seems limited however, because trimming, cross cutting and skidding are responsible for 70% of the cost of log production.

VOLUME OF LOGS BY CLASSES IN CUBIC FEET

Year	Chip	Mill	Post/Poles	Peelers	Totals
1960-61	14,950	1,290,971	732	89,048	1,395,701
1961-62	2,850	1,352,767	2,562	76,906	1,435,085
1962-63	3,850	1,375,022	2,980	79,156	1,461,008
1963-64	5,350	1,676,577	2,240	97,416	1,781,583
1964-65	208,350	1,921,671	23,690	126,946	2,280,657
1965-66	330,295	1,446,809	15,011	83,635	1,875,000
1966-67	325,202	1,578,967	29,334	73,822	2,007,000
1967-68	598,152	1,590,880	95,571	108,410	2,393,000