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DEPARTMENTAL PINE NURSERY PRACTICE

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Standing Instruction
November, 1973

94/180

PREAMBLE

This guideline-instruction replaces completely the following:-

1. Weedicide treatment of planting stock, issued June 1964.
2. Instructions re nursery insecticide and weedicide spray equipment, issued January 1969.
3. ST 259 - Nursery notes - seed and planting stock (1959).
4. Nursery practice - weed control (1969).
5. Nursery weedicides - circular of 6/3/69.
6. Pinus pinaster practice - issued July 1970.

The guideline is based upon the consensus of preferred practice (Establishment Seminar Proceedings, July 1972) and Research Branch knowledge to date.

Objective

The objective of Departmental nursery practice is to produce sturdy 1-0 planting stock of *Pinus radiata* and *Pinus pinaster* capable of 100% survival and immediate getaway the first spring after planting. Preferably with a plant of this standard from every seed.

Specifications

Plant specifications may vary from Region to Region to meet the objective. A general aim for *Pinus radiata* plants can be - sturdy, not less than 10-12" of top, plenty of fine roots. Sturdiness and sectional area at the collar are more important than height as indicators of vigour. Uniformity of plants should be an aim, but plant size and type should not be fixed by current handling methods and machinery unless they ALSO meet the planting objective. If they do not, handling methods and machinery should be modified accordingly.

PART I: PINE SEEDLING PRODUCTION

SEED

Pinus radiata

1. Orchard seed will be used to the maximum available. No other seed is to be used for Departmental planting stock unless specifically so instructed.

2. Select grade non-orchard seed is reserved for selected sales.

3. Standard grade seed is to be sown for supply of plants to private sales.

4. Orchard seed will be cleaned and graded as follows:-

Grade	I	5.5 - 7.0 mm
	II	4.75 - 5.5 mm
	III	4.0 - 4.75 mm
	IV	Less than 4.0 mm

Corresponding nominal number of seeds/air-dry kg are:-

		P. radiata	P. pinaster
Grade	I	23,000	
	II	29,000	16,000
	III	34,000	20,000
	IV	42,000	25,000

5. Germinative capacity of cleaned and graded seed is normally 75% ± 15%. For sowing calculations a standard value of 75% can be applied unless advised to the contrary. Germinations of less than 50% in the nursery, tallied after the grand rush, should be investigated for cause.

Pinus pinaster

1. Seed supplied will be of orchard origin or imported, as available.

2. Quantities will always be advised in air-dry kg.

3. Germination test will be made in Adelaide for each seed lot serial and advised at time of supply.

4. Only stratified seed is to be used. Stratification is by soaking for 6-8 days followed by 6 weeks cold storage at 1°C in plastic bags.

5. Stratified seed will only be supplied when called for by Districts and not until ground preparations are complete. IMMEDIATELY ON RECEIPT, the seed is to be well-spread in a cool dry place to dry off. THIS IS CRITICAL.

6. If sowing can be done it can begin as soon as seed can move freely in seed drills.

   If seed has to be held because of development of unsuitable sowing conditions it should be further dried by leaving it spread out in a ventilated, dry, cool place. (Note: Germination processes commence irreversibly after release from the cold store. Drying is the best way to slow down the rate of embryo development.)

   If this seed is not subsequently sown it should be thoroughly dried, rebagged, labelled with its history, and the Forest Management Division notified. The Forest Management Division will conduct germination tests as necessary. It is not to be used subsequently unless so notified.

SOWING

A. Pre-treatment of seed:

1. Seed is to be moistened and a coating of fungicide applied. The aim is for most of a dose of 60 g fungicide/kg seed to adhere to the seed.

2. For fungicide, apply Captan 80 in three years of each four of pine sowings and change to Zineb for the fourth sowing, to prevent the development of tolerant strains of harmful fungi. If damping-off is expected to be serious apply overall spray (see page 9).

B. Ground preparation:

1. Seed beds should be cultivated to a fine tilth before sowing. Use of well-rotted sawdust may assist with heavier-textured soils. Ploughing should not extend to depths greater than 25 cm.

2. Incorporation to a depth of 10 cm of a "complete" fertilizer pre-sowing is required, and care needs to be taken that this is very evenly distributed, or non-uniform and/or patchily unhealthy seedlings can result.

3. The standard mixture to be used comprises:-

   100 kg/ha ammonium sulphate
   200 kg/ha superphosphate (single) + 0.12% lindane
   50 kg/ha potassium sulphate

   One year in each four this mixture plus trace elements should be applied in the form of 350 kg/ha of Adelaide & Wallaroo Fertilizer Ltd. "Special Mix No. 47".

4. Prescription variations should not be made without reference to the Forest Management Division so that they can be based upon appropriate seedling analyses.

C. Sowing

1. Sowing will be by Stanhay seeder as exclusively as practicable.

2. Sowing rate with both species is to be such that preferably 30-35 evenly-spaced seedlings per metre are produced; certainly NOT MORE THAN 40 per metre. If this spacing is not attained by sowing it should be produced by appropriate thinning in the row.

3. Spacing between drill lines should be as close as the Stanhay and/or mechanical weeding permit.

4. Sowing depth on lightly-rolled beds should be about 0.5 cm. Raked-only beds should be sown at about 1 cm depth.

   On heavy soils seed lines may be covered with quartz sand or a mixture of sand and sawdust.

5. Time of sowing:

   P. radiata: Time of sowing is not critical until late September/mid-October, but sowing is best completed by the end of August.

   P. pinaster: With stratified seed, P. pinaster can be sown in autumn or spring, depending upon soil, season, and locality; but sowing later than mid-August should be avoided whenever possible. There appears to be no advantage to sowing in autumn in South-eastern nurseries.

NUTRITION

Fertilizer should be applied as follows in spring and autumn when plants are actively growing, in order to promote stem and root growth and to build-up adequate reserves in the seedlings at time of lifting.

8 weeks after emergence:	200 kg/ha ammonium sulphate or 80 kg/ha urea in 1 000 l/ha water applied by boomspray. Allowance needs to be made for increase in volume as urea dissolves.
4-6 weeks before anticipated lifting date:	100 kg/ha ammonium sulphate, except that at each 4th year of use of a bed, add NPK + trace elements instead. "Special Mix No. 47" is suitable. 200 kg/ha superphosphate (single) 50 kg/ha potassium sulphate OR, liquid formulations such as TOPSOL 12-6-6 or Nufarm Wuxal or equivalent, can be used as alternatives at 200 kg/ha, applied in 1 000 l/ha water.

Care should be taken to apply solid dressings to the soil between the rows of seedlings and to avoid contact with the plants as much as possible. Fertilizer is best applied on cool, moist days, and especially if showers are expected.

Bulking dressings of solid fertilizer with sawdust, sand, or wood shavings, improves uniformity of distribution.

Beds must be weed-free at the time of application.

Appearance of stunting, chlorosis, necrosis, or unthriftiness should be reported to the Research Branch as soon as noticed.

PLANT SIZE CONTROL

Pinus radiata

1. If plant height needs to be controlled it can be done by pollarding (topping).
2. Root pruning or wrenching is not to be practised at this stage.
3. Pollarding should not be practised except to control height and then only if essential.

Pinus pinaster

1. Tap root severence is preferable in light soil nurseries and can be done by root pruning or undercutting to about 15 cm depth.
2. Machine undercutting is preferable.
3. Side root pruning with disc cutters in conjunction with machine undercutting is best.
4. Undercutting and root pruning should be repeated regularly once begun and should be carried out several times between January and May. If the soil is dry to a depth of 5-8 cm or more, pruning is best delayed until more than 5 mm (20 pts.) of rain falls within a 48 hour period.

LIFTING

1. Damage to plant roots by handling or by exposure must be continually checked, this being a major cause of slow getaway.

2. Lifting more than 24 hours before planting should be specifically avoided whenever at all practicable.

3. Mechanical lifting bars are preferable to spade lifting where practicable.

4. Best storage and transport is plastic bags and all handling systems should be modified towards their use. Plastic bags containing plants must NEVER be exposed to direct sunlight or to frost.

5. Puddling before packaging or transport is optional but will provide protection from exposure damage for up to 20 minutes, if exposure is unavoidable.

6. Counting of plants for official record is not required other than for sales for non-departmental use.

PROTECTION

Pre-emergent period

A. Fungi - An overall spray of 60 kg/ha of 80% Captan wettable powder can be applied in beds expected to show high incidence of damping off. Apply Zineb in every 4th year of pine sowings (see A2, page 4).

B. Insects

1. Cutworm - Should be adequately controlled by the lindane in the pre-sowing fertilizer. If not, treat with 0.2% water solution of DDT as a cover spray of soils.

   If invasion is occurring from adjacent grass areas apply to a band ca. 0.7 m wide over the edge of grass, a buffer treatment consisting of 1% DDT in diesel or fuel oil.

2. Other insects - Refer to Forest Management Division without delay.

C. Birds

Noise devices and 2-3 cm mesh spread over the beds are the only known presently satisfactory methods.

Small areas of valuable seed lots have been protected successfully with a thin layer of pine needle litter spread to camouflage seed husks carried up on the cotyledons.

Shooting of protected species requires a special permit; applications can be made through the Assistant Chief, Forest Management Division.

Post-emergent period

A. Fungi

Damping-off - Spray foci of infection with suspension of 80% wettable Captan in water at the rate of 60 kg/ha WITHOUT DELAY. Use just enough water to wet the soil without run-off. Apply Zineb in every 4th year of pine sowings (see A2, page 4).

B. Insects

1. Cutworm - as above; spray over pines.

2. Grasshoppers - Notify Forest Management Division.

3. Other insects - Refer to Forest Management Division.

C. Birds

Noise devices and mesh spread over beds are the only satisfactory methods; maintain until primary leaves develop.

D. Other pests

Notify Research or Protection Branches, Forest Management Division.

E. Sand-blast

Useful practice to counter sand-blast may be:-

(i) Sowing rows E-W (South-eastern Region)
(ii) Sowing windbreaks of oats
(iii) Mulching
(iv) Watering

F. Watering (Irrigation)

Watering is not to be applied in normal circumstances. In the event of drought spells and in Northern Region nurseries, fine-spray irrigation can be applied at critical periods. Each irrigation should add about 10 mm (40 pts.) of irrigation.

Once irrigation has begun in summer it must be continued at frequent intervals until relieving rains occur.

G. Soil wash

Practices useful for countering soil wash are:-

(i) Maintenance of good organic matter status in soil.

(ii) Sowing of rows across the slope.

(iii) Levelling of beds into broad/shallow terraces. ([illegible] could be done [illegible])

(iv) Sowing of rows of oats along contours at about 3-bed intervals.

(v) Maintenance of belts of mown grass across the slope at 3, 6 or 9-bed intervals as a permanent feature.

WEED CONTROL

1. All weed chemical weed control will be by selective herbicides after testing and screening by the Research Branch.

2. Only the following chemicals are currently approved for use:-

Pre-emergent weedicides

Chemical	Products	Rate	
Diquat-paraquat mixtures	Triquat (I.C.I.) Paradi (Ciba-Geigy)	1.0 kg a.i. per ha	Knockdown only. Used to kill all germinated seeds after sowing pines.
Dacthal	Dacthal W75 (Agchem)	15 kg a.i. per ha	Germination inhibitor only. Residual effect 8-10 weeks. Very efficacious in nurseries where runner sorrel is not a serious problem. Fully compatible with Triquat and Paradi.
Nitrofen	TOK E25 (Agchem)	4.5 kg a.i. per ha	Safe pre- and post-emergent herbicide (at rate recommended) on many species up to 2-3 leaf stage. Very effective on sorrel from seed and runners provided they are treated by 5-6 leaf stage. Residual period normally 6 weeks.

Post-emergent weedicides

Chemical	Products	Rate	
Mesoran	Brasoran W.P. (Ciba-Geigy)	P. radiata 4.0 kg a.i. per ha	Can safely be applied at the prescribed rate within 1-2 weeks of the grand-rush of germination. When Dacthal pre-emergent has been used this is usually unnecessary. Treat seedling weeds at 2-3 leaf stage. Residual period normally 6 weeks.
		P. pinaster 2.0 kg a.i. per ha	Within 12 weeks of emergence: thereafter at 4 kg a.i./ha.
Solan	Dakuron 50 (Agchem)	P. radiata 4.5 kg a.i. per ha	An alternative herbicide to Mesoran. MUST NOT BE APPLIED WITHIN 8 WEEKS OF PINE EMERGENCE. Safe at prescribed rate thereafter. Residual period normally 6 weeks.
		P. pinaster	NOT TO BE USED.

Note: Both these chemicals effectively control Buchanweed, clovers and medics, summer grass, fog grass, wheat grass, flatweeds and capeweed, which are resistant to TOK E25. These two chemicals are complementary to TOK E25 and compatible with it.

3. General application

The efficiency of residual weedicides is optimal during the germination to the 2-3 leaf stages of weed growth. In most cases, weeds which have grown beyond the 4-5 leaf stage will be resistant to dose rates not harmful to pine seedlings and control cannot be expected.

Successful use depends upon correct dosage, correct time of application, correct repeat application as necessary, use of uncontaminated equipment, and application under conditions as near ideal weatherwise as practicable.

For correct dosage, refer to this instruction, READ THE LABEL, CHECK THE CALCULATIONS, and CHECK THE EQUIPMENT for correct flow and uniformity along boom. Most reports of aberrant weedicide effects have been traced to equipment and operation troubles.

The correct rates are set out above.

The general susceptibilities of likely nursery weeds to these dose rates are set out in table herewith.

For correct timing, refer to the alternative regimes set out below.

These are designed so that treatments are repeated AS THE NORMAL RESIDUAL EFFECT FADES, and should be applied regardless of the stage of development of recurring weeds. Heavy rains may reduce this residual period, in which case re-application should be advanced in accordance with observed development of the oldest susceptible weeds towards the 2-3 leaf stage.

4. General regimes for weed control

Proper attention must be given to SAFE working practices when chemicals are being handled.

A. Sandy nurseries

Regime 1: For light soils in South-east where regrowth of runner sorrel not a serious problem.

Pre-emergent: Dacthal plus Paradi at week 2 or 3 * from sowing

* Week 2 when stratified P. pinaster has been sown.

Post-emergent:	TOK E25 plus Brasoran at	week 12
	Repeat at	week 18
	Repeat at	week 24
	TOK E25 only at	week 30
	TOK E25 only ** at	week 36
	TOK E25 plus Brasoran at	week 42
	If necessary, repeat at	week 46

Regime 2: Where runner sorrel is a serious problem

Pre-emergent:	Paradi plus TOK E25 at	week 2 or 3 *
Post-emergent:	TOK E25 only at (depending on weed growth)	weeks 7-9
	TOK E25 + Brasoran at	week 15
	Repeat at	week 21
	Repeat at	week 27
	TOK E25 only	week 33
	TOK E25 plus Brasoran	week 39
	If necessary, repeat at	week 45

* Week 2 when stratified P. pinaster has been sown.

** Include Brasoran only if susceptible seedlings are present, especially clovers and capeweed.

B. Non-sandy nurseries

Regime 3: For loam and clay-loam soils in the Adelaide Hills and North.

Pre-emergent:	Dacthal plus Paradi at	weeks 2 or 3 *
Post-emergent:	TOK E25 plus Brasoran	week 12
	Repeat at	week 18
	Cultivate/Mechanical weed	week 24
	TOK E25 plus Brasoran	week 26
	Cultivate/Mechanical weed	week 32
	TOK E25 plus Brasoran	week 36
	Repeat, if necessary	week 42

* Week 2 when stratified P. pinaster has been sown.

WEED SPECIES IN PINE NURSERIES

Susceptibility to Recommended Herbicides at rates shown

(from germination to 2-3 leaf stage)

S = susceptible R = resistant M = moderately V = very - = no information

Refer to WEED CONTROL Notes 2 and 3 for usage.

Weed	Dacthal 15 kg a.i./ha	Nitrofen 4.5 kg a.i./ha	Mesoran 4.5 kg a.i./ha	Solan 4.5 kg a.i./ha
1. Buchan weed (Hirschfeldia incana)	S	R	S	S
2. Capeweed (Arctotheca calendula)	S	R	VS	VS
3. Chickweed, common (Stellaria media)	S	R	VS	S
4. Chickweed, mouse-ear (Cerastum glomeratum)	S	R	VS	S
5. Clover, cluster (Trifolium glomeratum)	-	R	VS	VS
6. Clover, Sub (Trifolium subterraneum)	MS	R	VS	VS
7. Clover, white (Trifolium repens)	MS	MR	VS	VS
8. Couchgrass (Cynodon dactylon)	R	S seedlings only	R	R
9. Crassula (Crassula macrantha)	S	S	S	S

Weed	Dacthal 15 kg a.i./ha	Nitrofen 4.5 kg a.i./ha	Mesoran 4.5 kg a.i./ha	Solan 4.5 kg a.i./ha
10. Fathen				
(Chenopodium album)	S	MS	VS	S
(Chenopodium pumilo)	S	S	S	MS
11. Flatweed (catsear) (Hypochoeris radiata)	S	MR	S	S
12. Fog grass (Holcus lanatus)	S	R	-	-
13. Fumitory (Fumaria officinalis)	-	S	-	-
14. Medic, black (Medicago lupulina)	-	MS	VS	MS
15. Sorrel	seedlings only			
(Rumex angiocarpus)	S	S	MR	R
(Rumex acetosella)	S	S	MS	MR
16. Sow thistle, prickly (Sonchus asper)	S	S	S	S
17. Spurry (Spergula arvensis)	S	S	S	S
18. Summer grass, Crab grass (Digitaria sanguinalis)	VS	MR	MR	MR
19. Wheat grass, common (Agropyron scabrum)	R	R	-	R
20. Wireweed (Polygonum aviculare)	S	)S at 2-leaf stage)MR when older	S	S
21. Rye grass (Lolium spp.)	S	R	-	-
22. Oats * (Avena spp.)	R	R	-	-

* May also be used deliberately, as a low windbreak.

Weed	Dacthal 15 kg a.i./ha	Nitrofen 4.5 kg a.i./ha	Mesoran 4.5 kg a.i./ha	Solan 4.5 kg a.i./ha
Other weeds occasionally observed - reported in literature				
1. Nightshade (Solanum nigrum)	S	S	-	-
2. Shepherds Purse (Capsella bursa-pastoris)	S	S	-	-
3. Portulaca spp.	S	S	-	-
4. Nettle, small (Urtica urens)	S	S	-	-
5. Plantain (Plantago spp.)	S	S	-	-
6. Yellow-flowered oxalis (Oxalis corniculata)	-	R	-	-
7. Winter grass (Poa annua)	S	-	-	-

PART II: ROTATIONAL CROPPING

GENERAL WORKING

1. In general nursery productivity maintenance is to be pursued by rotational cropping. There should be enough nursery area to ensure that the rotations are completed each time.

2. The cycle should be 3 or 4 years of legume, cereal, fallow, pine. Legume and cereal can be sown singly or in combination. Sowing time can be spring or autumn except that the last crop before pines must be incorporated at least 8 months before pines sown for fallowing. A pre-sowing fertilizer should be used. Adelaide & Wallaroo Ltd. "Special Mix No. 47" at 700 kg/ha is suitable.

3. Suitable alternative crops are:-

   For general use

W.A. White lupin, var Uniharvest (preferred) or N.Z. Blue lupins	-	135 kg/ha
Avon oats (S.E.) or Kherson oats (Central Region)	-	45 kg/ha
Peas (Dunn's Field)	-	200 kg/ha

   For light soils

   Serradella (Pitman's var Uniserra) at 5 kg/ha (dehulled)

   When combined, sowing rates are usually:-

   Lupins 35 kg/ha + oats 60 kg/ha

   Peas 135 kg/ha + oats 45 kg/ha

   Bacteria inoculation with a suitable strain of Rhizobium is recommended for legumes each time they are sown. These cultures normally have to be ordered several weeks in advance. Lime pelleting is not essential with these legume species. Superphosphate must not be applied on the same day as seed is sown. Serradella requires lupin inoculum.

4. Opportunity should be taken to control weed species not readily handled by chemical means in the presence of pine seedlings e.g. convolvulus, sorrel, couch grass.

In the absence of the crop, drastic controls can be applied, provided that spray drift is avoided, but beware of use of hormone weedicides near or within areas of susceptible crops. Use large output, large droplet-size jets with spray pressure less than 240 kPa (35 lb./in^2). Spraying is best done in calm conditions, on to DRY foliage before 10 a.m. Avoid spraying if day temperatures are likely to exceed 22^{o}C.

(a) Broad-leaf weeds generally can be controlled effectively with Dacamine 4D (R) at 4.0 l/ha product, repeated if necessary, or Brominil (R) at 1.4 l/ha product. Residual effect lasts 4-6 weeks and no application should be made within 8 weeks of the pine sowing.

(b) Complete knockdown with no residual can be achieved with paraquat, diquat or mixtures of these (e.g. Triquat (R) and Paradi (R)) at a rate of 3 kg active ingredient/ha in 4 500 litres of water (i.e. for small areas, with 20% a.i. product, use 30 ml product/ 5 litres water per 100 m^2 of ground).

(c) Add a wetting agent (Plus 50 or Agral LN) if necessary - check the label.

Weeds with runners, rhizomes and perennial grasses can be given preliminary treatment with cultivation to disturb and cut up perennating organs, raking up with harrows (spring-tine or peg) and by repeating the process more than once. With sorrel and couch the aim should be to produce a young, susceptible, even-aged lot of foliage which can be effectively killed with a suitable chemical, i.e. by producing nearly ideal conditions for chemical control.

Note: W.A. White lupin, var. Uniharvest and Uniwhite are "sweet" and suitable for grazing; N.Z. Blue lupins are "bitter" and not suitable for grazing.

5. Turning-in

The turning-in of rotation crops 5-6 months before sowing pines is as late as breakdown of residues can be achieved without the risk of noticeable nitrogen starvation of the pines.

If there is any doubt following observation of green-crop residues at the time of seed bed preparation for the pine nursery, the nitrogen applied pre-sowing of the pines should be increased to 200 kg/ha.

Generally speaking legume green crops should be turned in while still fairly succulent.

On light soils in the South-east oat stubble, especially roots, may not rot quickly, so in this Region oats should not be used within 12 months of pine sowing.

WEED CONTROL IN ROTATION CROPS

1. The following should suffice to control most rotational crops weed situations. If not, refer to Research Branch, Forest Management Division.

2. Before using READ THE LABEL.

3. Peas, lupins

   Pre-emergent (post-sowing) - Gesamil 50 (R):
   on (i) sandy soils: 0.75 kg product/ha
   on (ii) loamy soils: 1.25 kg product/ha

   Post-emergent (plants over 10 cm tall):
   Tribunil (R) at 0.75 kg product/ha

   Caution: DO NOT USE NITROFEN (TOK) ON LUPINS.

4. Serradella

   Pre-emergent:
   Gesamil 50 (R) 0.75 kg product/ha

   Post-emergent (more than 3 leaves):
   (a) Sorrel component - TOK E25 (nitrofen)
   15 kg product/ha
   (b) General selection - Tribunil (R) at 0.5 kg product/ha
   Bromoxynil at 1.0 kg product/ha

5. Oats

Post-emergent:

(a) At 2-4 true-leaf stage,
Gesagard 50 (R) at 0.5 kg product/ha

(b) Later stages, after first tillering:-

(i) Annuals: 2,4-D amine, 50% at 500 ml product/ha, preferably Dacamine 4D (R)

(ii) Perennials with runners etc.: MCPA 50%,
600 ml product/ha

plus 2,4-D amine,
300 ml product/ha

or (iii) If spray drift hazard, use: Dicamba 20%,
300 ml product/ha

plus MCPA 50%,
300 ml product/ha

6. Oats plus legumes

Pre-emergent - Gesamil 50 (R) at 0.75 kg product/ha

Post-emergent - MCPA 27% at 500 ml product/ha in 250 l/ha water

Apply only after first tillering in cereal crop and when peas are around 5 cm high.

7. Fallow

As per Note 4 in section on general working.

PART III: NURSERY RECORDS

1. All units operating a nursery must keep a permanent nursery journal AND a nursery plan for each nursery and each season. All operation and observations are to be recorded in the Nursery Journal on the standard Journal Sheets.

2. Poor results and aberrant development should be reported to the Chief Forester (S.E.) or the Supervising Forester (Hills and Northern) for referral if relevant. Sudden and/or inexplicable aberrations needing urgent action can at the same time be notified to the Chief, Forest Management Division. Other notifications to be as set out in the body of these guidelines.