MULGA RESEARCH CENTRE

Occasional Report no. 4

EFFECT OF SOIL TYPE ON EARLY ESTABLISHMENT OF ECOTYPES

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EFFECT OF SOIL TYPE ON EARLY ESTABLISHMENT OF ECOTYPES

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SUMMARY

Seeds of four plant species common to sandy soils of the Swan Coastal Plain and lateritic soil of the Darling Scarp were collected from a laterite site (Lesmurdie) and two coastal plain sites (Jandakot and Yalgorup) to determine whether plant populations are adapted to the soils with respect to emergence and early growth. Germination and growth of seedlings from the different seed lots were compared in their native soils and in alien soils. The four species were *Acacia pulchella* R.Br., *A. saligna* (Labill.) H.L. Wendl., *Allocasuarina humilis* (Otto & Dietr.) L. Johnson, and *Eucalyptus marginata* Donn ex Smith.

Viability varied between seed lots. Differences in optimum germination temperatures were indicated. In *A. pulchella* the optimum was around 15°C and seed from Yalgorup had lowest optimum temperature whereas Lesmurdie seed was the most viable. In *A. saligna* the optimum was in the range 15-20°C and there were no differences between populations. Similarly with *Allocasuarina humilis* but here the range was 12-15°C. For *E. marginata* the optimum was around 15°C.

Early seedling growth indicated a degree of variation within the species tested with the exception of *Acacia saligna*. In *A. pulchella* there was evidence of one distinct ecotype on Spearwood sand (Yalgorup). The other two populations appeared to be non-specific. For *Allocasuarina humilis* both the Spearwood sand and lateritic soil (Lesmurdie) populations showed best early growth on the host soils. The Bassendean sand (Jandakot) population was non-specific. In *E. marginata* results suggest only one population, this had superior growth on lateritic soil material and other habitats appeared marginal.

INTRODUCTION

The vegetation of the Perth area is characterised by the presence of a number of plant species which occur on contrasting soil types in different topographical locations. In the context of a common mediterranean climatic regime, soils with different characteristics imply some selection pressure operating on resident populations. It may be assumed as a working hypothesis that a species of wide occurrence would have been subjected to filtering with respect to local populations. That is, the population set at a given site should be more suited to that site than other population sets. In order to test this contention, one should ideally grow plants in different places, subject to only the natural ecological factors operating. The present report describes a set of experiments where two factors, soil and seed, differed but where other factors were held constant. Thus it presents a preliminary attempt to determine whether ecotypes occur in the Perth area for four common species.

All four species occur on the sandy soils of the Swan Coastal Plain and on the lateritic soils of the Darling Scarp. *Acacia pulchella* R.Br. and *Acacia saligna* (Labill.) H.L. Wendl. distributions are given in Hnatiuk and Maslin (1980) and Maslin and Pedley (1982). These two and *Allocasuarina humilis* (Otto & Dietr.) L. Johnson (Bennett 1982) occur sympatrically over a wide area of the south- west of Western Australia. *Eucalyptus marginata* Donn ex Smith (Boland *et al.* 1984) has a more limited distribution in the higher rainfall regions of the lower south-west. All four occur at the study localities. *Acacia saligna* is smaller at Lesmurdie than at Yalgorup and Jandakot. This species tends to be opportunistic and to show rapid growth in open, disturbed sites (Fox and Wallman 1979). In Yalgorup National Park *Allocasuarina humilis* is present on both sand and limestone heath (Fox, Downes and Maslin 1980), and less abundant in the tuart woodland than *Acacia pulchella.* At Jandakot *Eucalyptus marginata* attains a shorter stature on leached sands than it reaches at both Lesmurdie and Yalgorup. Eight varieties of *Acacia pulchella* have been recognised (Maslin 1975). The populations used in this study are believed to belong to the variety *glaberrima* Meisn. in Lehm. (Maslin 1975).

Three aspects of early development were examined. Firstly, batches of seed were incubated under controlled temperatures to observe patterns of germination and to estimate generalised optima in temperatures for the species and whether different populations showed variation. The experiment also indicated the relative quality of seed from different localities.

Secondly, seeds were sown into soils from each of the areas to examine whether emergence levels and rates differed. Thirdly, seedlings were grown on, and later harvested to contrast growth in their native and alien soils. The basis of decision on whether ecotypes occur was taken to be a correlation between best growth of a seed accession in its native soil.

SOIL CHARACTERISTICS

Surface soils were taken from three localities where seeds had been collected. Two soils were used from Yalgorup representing the thin top soil and the horizon immediately below it. All four soil materials were used with *Allocasuarina humilis* and *Eucalyptus marginata*. Limited seed supplies of the *Acacia* species necessitated restriction of these species to three soil treatments. The Yalgorup subsoil was chosen in preference to topsoil as subsoil was exposed in places at seed collection areas for the *Acacia* species, whereas the other two species occurred on areas with 10cm or more of topsoil.

Soil characteristics determined were organic matter content, pH, field bulk density, field capacity, nitrogen content, phosphorus content and soil particle size. Between two and five replicates were taken to determine the different characteristics for each of the soils. The methods used to measure these characteristics follow.

To obtain organic matter 1kg of each soil was oven dried for 48 hrs at 105°C. Three samples of approximately 20g lots were then weighed of each soil and placed in crucibles. The crucibles were then heated in an electric kiln at 700°C for 1 hour. The soil lots were then reweighed and the organic content calculated by the formula:

$$\% \text{ organic content} = \frac{\text{initial weight - final weight}}{\text{final weight}} \times 100$$

Four samples of each soil were air-dried and sieved (0.5mm mesh) to give 10g replicates. These were shaken with 50ml deionised water. Extracts taken using a Buchner funnel were measured with a Beckman 5 pH meter.

Bulk density was obtained for field soils. An approximately 180mm cubic hole was dug for each replicate and all soil from the hole placed in a bag to obtain dry weight. The volume of the hole was then measured by placing a plastic bag in the hole and pouring water into the bag until the water filled the hole. Dry weight of the soil was taken after the soil was dried for 48 hrs at 105°C. Five replicates were used for each soil type. The bulk density was calculated by:

$$\text{Bulk density} = \frac{\text{dry weight of soil}}{\text{volume of soil}}$$

In the laboratory soils were packed in 7 x 7 x 10cm pots to a bulk density near the field value. A series of tests was made to determine the volume of each soil (loose) that needed to be compressed into the pot volume to give bulk densities near the field values.

Field capacity was estimated for four 7 x 7 x 10cm pots of soil at near field bulk density, for each of the soil types. The pots of soil were left to air dry for several days before the measurements were taken. Water was added to each pot until water began to drip out through the drainage holes. The volume of water added for the volume of soil gave the field capacity. In Table 1 field capacity is given as the volume of water as a percentage of pot volume (270ml).

Soil nitrogen was determined using the Kjeldahl digestion process. Three replicates were taken for each soil. Soil phosphorus content was obtained using the molybdenum blue method (Allen, 1975). Two replicates were taken for each soil.

The soil particle size distribution was obtained from the means of 3 samples of 100g of air dried soil. These were passed through successively smaller mesh sizes. For each size the soil retained was weighed and expressed as a percentage of dry weight.

Table 1 summarises the mean soil properties obtained.

TABLE 1. Soil properties of 4 soil materials.

Property	SOIL			
	Lesmurdie	**Jandakot**	**Yalgorup** (subsoil)	**Yalgorup** (topsoil)
Bulk density g ml^{-1}	1.61	1.65	1.41	1.06
Field capacity (%)	27.4	28.9	30.4	27.0
pH	5.2	7.5	6.2	5.4
Organic matter (%)	6.3	2.8	2.3	5.5
Phosphorus (ppm)	0.85	0.72	0.75	1.45
Nitrogen (%)	0.06	0.04	0.03	0.14
PARTICLE SIZE (%)				
> 2.8mm	56.5	0.6	0.0	1.3
> 0.7 < 2.8mm	17.0	15.8	6.2	40.7
> 0.3 < 0.7mm	11.7	75.6	53.4	48.7
> 0.075 < 0.3mm	9.8	7.2	37.6	7.5
< 0.075mm	5.0	0.8	2.8	1.8

Lesmurdie soil

Soil was collected from the Ridge Hill Shelf geomorphic unit (Seddon, 1972). The soil is lateritic and was formed from downslope transport and deep weathering during the Tertiary period, a period of high rainfall and tropical conditions. Lesmurdie soil had a high proportion of gravel and a higher percentage of the finest grain size than the other soils. This soil had a high organic matter content compared to the other soils, the lowest pH, 5.2, and a high bulk density. The soil had nitrogen and phosphorus levels second only to the Yalgorup topsoil. The Lesmurdie soil had one of the lower field capacities.

Jandakot soil

This soil was collected from the Bassendean Dune geomorphic unit (Seddon, 1972). The top zone of the soil is leached and white in places. The black pigment in the soil that gives it an overall grey colour is organic material. The Bassendean sand is thought to be the remnant of old coastal dunes leached of calcium carbonate (McArthur and Bettenay 1974) but there are some areas where limestone outcrops. The soil collection site was near such an outcrop which explains the high pH of 7.5.

Jandakot soil was about 90 percent of coarse to medium grain sand with the lowest proportion of any of the soils in the finest grain size. This soil had a comparatively high bulk density, and an organic matter content half that of the Lesmurdie soil and Yalgorup topsoil. The nitrogen and phosphorus levels were similar to those for the Yalgorup subsoil. The soil field capacity was one of the highest recorded.

Yalgorup topsoil

The Yalgorup soil was collected from the Spearwood Dune geomorphic unit (Seddon, 1972). The soil is one of the Spearwood sands, weathering products of the coastal limestone geological formation (McArthur and Bettenay 1974). The sands are brown or yellow quartz sands leached of carbonate and lying over limestone. At the site of collection there was a distinct upper layer or topsoil, which was partly dark brown, high in organic matter and partly leached lighter brown finer grain sand with less organic matter. The thickness of the upper layer varied and at places the yellow-brown sand was exposed or the topsoil was very thin.

Yalgorup topsoil had low pH and highest nitrogen and phosphorus content associated with forest litter and the action of micro-organisms in the organic matter. The topsoil was partly water repellent (McGhie 1979). It contained 90 percent coarse to medium grain sand. This soil had marginally lowest field capacity.

Yalgorup subsoil

The Yalgorup subsoil was not water repellent as it had little organic material mixed into the sand. The subsoil had a higher field bulk density compared to the topsoil partly due to compaction by the overlying topsoil and partly due to having less light organic material. It had the lowest organic matter content of the four soils. This soil had 90 percent of coarse to fine- grain sand and the highest field capacity. This may have been associated with the fine grain materials. It had the highest percentage of fine sand of the soils and a higher percentage of the finest grain size than either Jandakot soil or Yalgorup topsoil, but half that of the Lesmurdie soil.

Yalgorup subsoil pH was 6.2. The nitrogen and phosphorus levels were lower than Lesmurdie soil and Yalgorup topsoil but close to the values for Jandakot soil.

SEED LOTS

The seed and soil were collected during December 1982 and January 1983. The locations were: Jandakot: between Hope Road, Marriott Road and Jandakot Airport; Lesmurdie: the south end of Connor Road, Lesmurdie; Yalgorup: approximately 3km south of the Yalgorup National Park road on west side of Old Coast Road.

Sets of 20 seed from each seedlot were weighed (Table 2).

TABLE 2. Mean seed weight (mg) for three seed sources of four species (standard deviation in brackets). n = 20 throughout.

	SOURCE		
Species	**Lesmurdie**	**Jandakot**	**Yalgorup**
Acacia pulchella	4.5 (1.4)	9.2 (1.7)	5.4 (2.4)
Acacia saligna	17.7 (3.7)	15.8 (3.5)	18.6 (3.4)
Allocasuarina humilis	6.1 (1.7)	2.2 (0.9)	1.4 (0.8)
Eucalyptus marginata	8.4 (2.4)	9.8 (3.8)	12.6 (5.0)

EXPERIMENTAL PROCEDURES

Controlled Temperature Germination

Three growth cabinets at 12 ± 1°C, 15 ± 0.5°C, and 20 ± 2°C, with no lighting were used. The following numbers of replicates and seeds (where one replicate occupied a single petri dish) were used:

Acacia pulchella 15 seed per petri dish. For Lesmurdie and Jandakot seed 6 replicates for each temperature. For Yalgorup seed 3 replicates for each temperature.

Acacia saligna and *Allocasuarina humilis* 20 seed per petri dish, 5 replicates for each seed source and temperature.

Eucalyptus marginata 15 seed per petri dish, 5 replicates for each seed source and temperature.

Seeds of the two *Acacia* species were pre-treated in 2cm diameter test-tubes by covering with boiling water and allowing to cool to room temperature of 21°C.

The seeds were positioned on filter paper in 9cm diameter plastic petri dishes and kept moist with distilled water.

Germination counts were made every second day until 10 days without any further germination. Germination was defined as emergence of 2-3mm of the radicle. Counts enabled calculation of germination rate and final percentage germination for each replicate. The counts also allowed the plotting of cumulative germination over time.

The germination rate was calculated using the formula:

$$\text{Germination rate} = \frac{(n_1t_1) + (n_2t_2) + \ldots (n_xt_x)}{\sum_1^x n}$$

n_x is the number of germinations on day t_x

t_x is the number of days from the start

$\sum_1^x n$ is the total number of germinations.

In effect, the formula calculates the mean day of germination. A low value means a high germination rate (and vice versa). The germination rate was calculated separately for each replicate for all seed source/temperature combinations.

Analysis of variance was calculated for each species to determine whether significant variations in final germination numbers were attained for the different temperatures and seed sources. A second analysis of variance tested variations in germination rates for individual temperatures and seed sources.

The Scheffe test was used to compare means of the separate seed source/temperature combinations. The test was also used to compare the means of combined data.

Counts were converted into percentages and graphs of germination time series drawn as cumulative percentages against time in days.

Emergence from Soils

Seeds from each of the three localities were placed in each soil type. The following numbers of replicates were used. Each replicate pot had 10 seeds:

Acacia pulchella 15 replicates for each seed source in each of Jandakot, Lesmurdie and Yalgorup subsoil.

Acacia saligna 5 replicates of Jandakot seed, and 14 replicates of each of Lesmurdie and Yalgorup seed, in each of Jandakot, Lesmurdie and Yalgorup subsoil.

Allocasuarina humilis 15 replicates for each seed source in each of Jandakot, Lesmurdie, Yalgorup-sub and Yalgorup-top soil.

Eucalyptus marginata 5 replicates of both Jandakot and Yalgorup seed and 10 replicates of Lesmurdie seed, in each of Jandakot, Lesmurdie, Yalgorup-sub and Yalgorup-top soil.

Soils were placed in 7 x 7 x 10cm square topped plastic pots to predetermined bulk density levels, near field values (Table 1). *Acacia* seed was pretreated as in the controlled temperature germination study.

All seeds were placed in the soils at a depth of approximately 0.5cm, after the soils were watered to near field capacity with distilled water. The soils were watered every day to keep the surface few centimetres of soil from drying out. The experiment was completed in the period 30th July 1983-30th September 1983. The pots were set up on benches in the School of Biology greenhouse at Curtin University.

Counts of emergent seedlings were made every 4 days and terminated after 8 weeks. These counts enabled calculation of emergence rates, using the same formula as for germination rate above.

Analysis of variance was calculated to determine whether significant differences existed in the final mean number of emergent seedlings for the different seed sources and soil types. Final emergence numbers were converted to percentages of seed sown for comparative tabular presentation.

The Scheffe test was used to compare means of the different seed source/soil type combinations. The test was also used to compare means of combined data.

Seedlings and pots used in this experiment were also utilised for the following experiment. After each count of emergent seedlings, all but the first emergent per pot were removed, leaving one plant per pot.

Early growth of emergent seedlings

Pots from the previous experiment containing single seedlings were replicates. Insufficient plants of *E. marginata* allowed only one harvest. For each of the other three species, 2 harvests of 5 plants were taken, using the same soil sets as in the emergence study.

In *Acacia pulchella* two harvests of 5 plants for each combination of soil source and seed type were taken. These harvests were at 25 and 45 days after the emergence of the majority of seedlings, corresponding to 45 and 65 days from sowing.

For *Acacia saligna* two harvests of 5 plants were also taken, but at days 30 and 45 after the emergence of most seedlings. These were 40 and 55 days respectively after sowing.

Two harvests of *Allocasuarina humilis* were taken of 5 plants from each combination at 30 and 45 days after the main emergence. These corresponded to days 45 and 60 after sowing.

The single harvest of 5 plants for each combination of soil source and seed type for *Eucalyptus marginata* was taken at 25 days from emergence, corresponding to 45 days after seed sowing.

At each harvest the following were measured: fresh root and top weight, dry root and top weight, root and stem length, leaf numbers, and for the legumes, number and size of root nodules. Dry weights were used to calculate the top root ratio for each replicate.

The main harvest value of interest was the plant dry weight, with the others of secondary importance.

Analysis of variance was used to test for significance among the mean values for harvest values between seed sources and soil types. The Scheffe test was used to compare the means of the different seed source/soil type combinations.

RESULTS

Mean seed weights are shown in Table 2. Lesmurdie had the heaviest seed of *Allocasuarina humilis*, and Jandakot of *Acacia pulchella*. Seeds of *Acacia saligna* and *Eucalyptus marginata* were heaviest for Yalgorup.

Other results are given separately by species.

Acacia pulchella

Comparative seed viability

Figure 1 presents the time course of germination for the three seed sources separately and for the three incubation temperatures. All seeds at 20°C commenced and completed germination soonest. Difference between temperatures was greatest in Lesmurdie seed where the 12°C set germinated more slowly than sets at higher temperatures. Overall viability was highest in Lesmurdie seed (Table 3) where levels exceeded 50 percent at both 15 and 20°C. Analysis of variance* showed that differences in germination derived more from seed source than temperature.

[*Significance levels for all tables given as: NS $P > 0.05$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$]

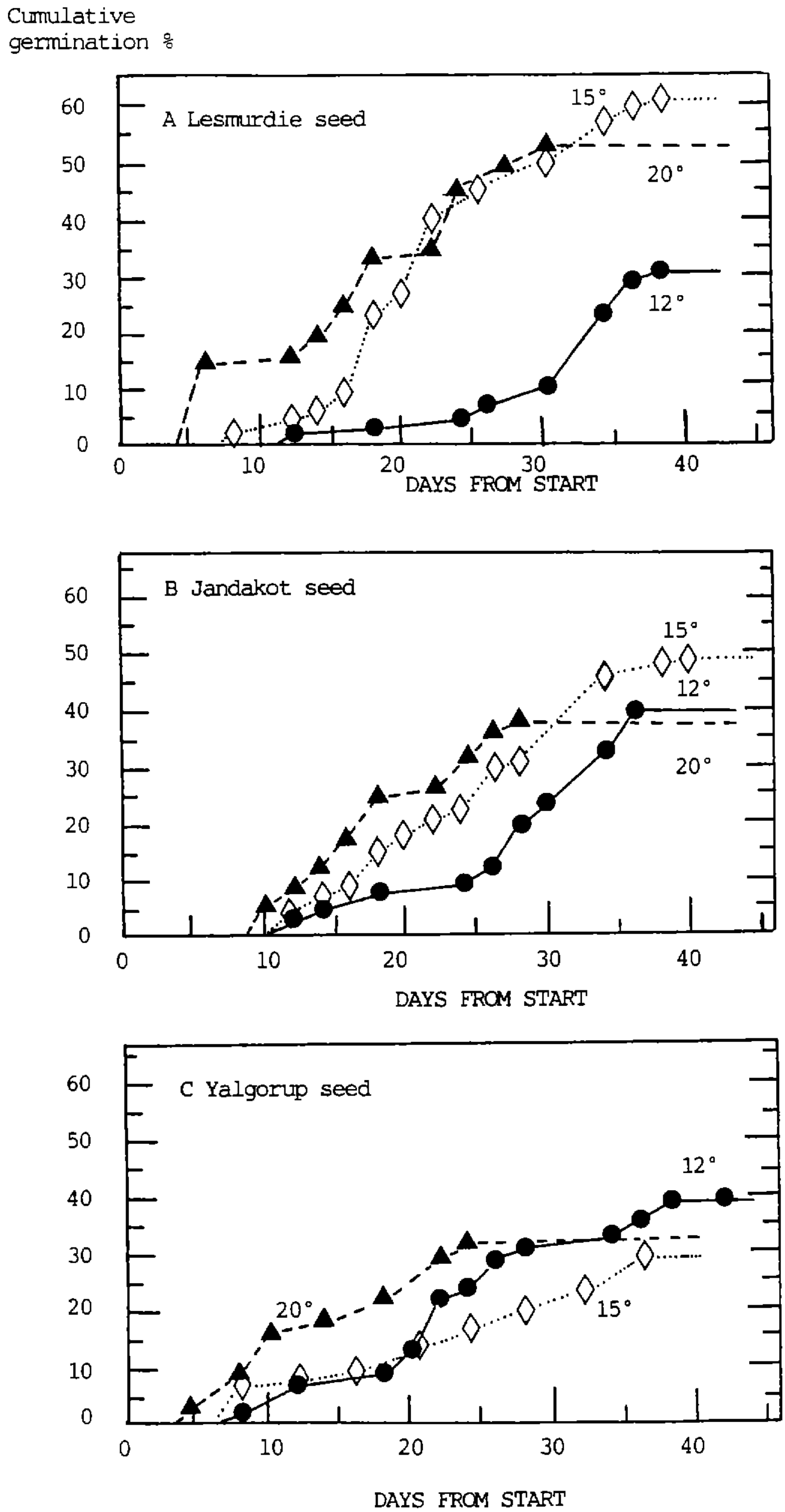

FIGURE 1. Time course of germination for **Acacia pulchella** from three accessions incubated at three temperatures.

TABLE 3. **Viability and germination rate for three sources of *Acacia pulchella* seed incubated at three temperatures.**

SEED SOURCE	12	15	20	Overall
	TEMPERATURE (°C)			
	Final germination percentage (SD based on replicate mean numbers)			
Lesmurdie	32.2(7.8)**a**	61.1(5.0)**b**	51.1(6.9)**b**	48.2(13.8)
Jandakot	38.9(16.6)**a**	46.7(8.4)**a**	36.7(5.6)**a**	40.7(11.4)
Yalgorup	37.8(7.7)**a**	28.9(7.7)**a**	31.1(7.7)**a**	32.6(7.8)
Overall	36.0(11.8)**a**	48.9(14.0)**b**	41.3(10.5)**ab**	41.4(13.0)

F temperature 7.8 **; seed source 9.3 ***; interaction 5.5 ***

Mean germination rate, days (SD based on replicate means)

	12	15	20	Overall
Lesmurdie	32 4(2 1)**a**	23.6(2.9)**b**	15.8(3.2)**c**	23.9(7.4)
Jandakot	27.2(4 3)**a**	25.1(2.8)**a**	17.9(3.2)**b**	23.3(5.3)
Yalgorup	22 0(4 6)**a**	24.0(2.9)**a**	15.0(3.8)**b**	20.3(5.3)
Overall	28.2(5.2)**a**	24.3(2.7)**b**	16.5(3.3)**c**	23.0(6.2)

F temperature 50.2 ***; seed source 3.8 *; interaction 4.0 **

Scheffe test α = 0.05 to show means which do not differ. Vertical bars link levels not significantly different for seed sources. Letters are different where levels at incubation temperatures differ significantly within a seed source.

Yalgorup seed was least viable and Jandakot seed was intermediate. Within a batch the only statistically significant difference in final germination level was in Lesmurdie seed where the 12°C set produced significantly fewer germinations than those at higher temperatures.

There were more differences within incubation temperature sets with the exception of 12°C where differences between the three seed sources were slight. At 15°C Yalgorup seed produced significantly fewer germinations than the other sets. Lesmurdie seed gave significantly higher levels than Yalgorup seed at both 15 and 20°C.

The mean germination rates for Yalgorup seed were lower than other seed sources (except Lesmurdie at 15°C). Within incubation temperature sets, these differences were slight. At 12°C Lesmurdie seed took significantly longer to germinate than seed of the other sources. The germination rate was consistently faster at the highest temperature, and slower at 12°C, except for the Yalgorup set where the germination rate at 12°C was fast in comparison with other sets.

Emergence from different soils

Analysis of variance showed significant differences in the levels of emergence due to both seed and soil sources. Percentage emergence values are in Table 4. Lesmurdie seed had highest emergence levels in each of the three soils. This seed source emerged best in Yalgorup soil where the level was significantly higher than for the other two soils. Both the Jandakot and Yalgorup seed lots produced most emergents in soils local to the seed collection area. Emergence of Jandakot seed from Jandakot soil was significantly greater than for Jandakot seed in the other two soils. Yalgorup seed did not differ statistically in emergence between the three soils tested.

TABLE 4. Percentage emergence of *Acacia pulchella* from three soils to 8 weeks from sowing.

SEED SOURCE	SOIL: Lesmurdie	Jandakot	Yalgorup (S)	Overall
	(S.D. based on replicate mean numbers)			
Lesmurdie	50.7(20.5)**a**	58.7(12.5)**a**	74.7(16.0)**b**	61.3(19.1)
Jandakot	28.7(11.3)**a**	48.7(13.6)**b**	36.0(16.0)**a**	37.7(15.8)
Yalgorup	46.0(19.5)**a**	38.0(19.2)**a**	48.0(13.0)**a**	44.0(16.3)
Overall	40.6(19.6)**a**	51.4(15.4)**b**	54.3(23.8)**b**	45.8(20.6)

F soil source 7.5 ***; seed 26.6 ***; interaction 4.3 **

Scheffe test α = 0.05 to show means which do not differ. Vertical bars link levels not significantly different for seed sources in a soil. Letters are different where levels in soils differ within seed sources.

Emergence rates are summarised in Table 5. Rates were slowest for both Lesmurdie and Jandakot seed in their local soils. Yalgorup seed emerged fastest in Yalgorup soil, although seed of this set differed little in emergence time between the 3 materials. The other two (Lesmurdie and Jandakot seed sets) did well in Yalgorup soil also, although the Jandakot seed emerged most rapidly in Lesmurdie soil. Yalgorup seed emerged fastest in Jandakot soil and this material showed least variation between seed lots.

TABLE 5. Emergence rate of *Acacia pulchella*, mean days to emerge from three soils (S.D. based on replicate means).

SEED SOURCE	SOIL			
	Lesmurdie	**Jandakot**	**Yalgorup (S)**	**Overall**
Lesmurdie	34.0(3.7)	30.6(1.2)	30.2(1.5)	31.6
Jandakot	28.9(2.4)	30.2(2.1)	28.7(3.1)	29.6
Yalgorup	30.1(1.5)	30.0(2.1)	29.2(1.3)	29.8
Overall	31.0	30.3	29.7	

Early growth of emergent seedlings

At first harvest Lesmurdie seedlings had significantly lighter fresh and dry weights (Table 6) than the other seed sources for the combined soils. For the same growth parameters there were no significant differences between the soils for combined seed sources. The only significant difference in the dry top/root ratio between the soils was for the Yalgorup seed. The ratio was significantly higher in the Lesmurdie soil compared to the other soils (Table 7). Root length was significantly longer for the combined seed sources in Lesmurdie soil compared with the Jandakot soil. There were no significant differences in root length between the seed sources for the combined soil sources, but the Jandakot seed produced longest roots in each soil. Leaf number was significantly higher for Jandakot seedlings versus Lesmurdie seedlings for the combined soils. There were no significant differences in leaf numbers between the soils for the combined seed sources but Lesmurdie soil had the highest number for each seed source. There were no significant differences in stem height.

At the second harvest Yalgorup seedlings in Yalgorup soil gave heaviest fresh weight. In Lesmurdie and Yalgorup soils the Jandakot seedlings had significantly heavier fresh top weight than Lesmurdie seedlings. In Jandakot soil, Jandakot seedlings had significantly heavier fresh top weight than Yalgorup seedlings. For both fresh and dry root weights values were significantly heavier for Yalgorup seedlings in Yalgorup soil compared to seedlings in the other two soils. Dry top weight and fresh and dry root weight values were significantly heavier for Jandakot seedlings compared to Lesmurdie seedlings for combined soils. In Yalgorup soil Yalgorup seedlings had significantly heavier fresh and dry root weights than the other two seed sources. In the Lesmurdie soil the Jandakot seedlings had significantly heavier fresh and dry root weights compared to the values for the other two seed sources.

TABLE 6. Mean plant dry weights at harvest (g) for *Acacia pulchella*.

SEED SOURCE	SOIL: **Lesmurdie**	**Jandakot**	**Yalgorup (S)**	**Overall**
	Harvest 1			
Lesmurdie	.005**b**	.010**a**	.011**a**	.008**b**
Jandakot	.017**a**	.013**a**	.014**a**	.015**a**
Yalgorup	.018**a**	.014**a**	.015**a**	.016**a**
Overall	.014	.012	.013	.011
F seed source 5.27**; soil source 0.5 NS; interaction 0.8 NS				
	Harvest 2			
Lesmurdie	.020**b**	.019**a**	.016**b**	.018**b**
Yalgorup	.026**b**	.016**a**	.037**a**	.026**a**
Jandakot	.042**a**	.033**a**	.032**a**	.035**a**
Overall	.030	.023	.028	.026
F seed source 7.53 **; soil source 1.4 NS; interaction 2.83 *				

Scheffe test α = 0.05 to show means which do not differ. Letters differ where weights are significantly different for seed sources in a soil. There were no significant differences for weights in soil within a seed source.

For each of fresh root and top and dry root and top weights, Jandakot seedlings had heaviest weights and Lesmurdie seedlings the lightest. Overall the fresh top and root weights were heaviest in Yalgorup soil, lightest in Jandakot soil; and the heaviest dry top weight was for Lesmurdie soil and the lightest for Jandakot soil. The only significant difference in dry top root ratios at second harvest between seed sources was a significantly lower ratio for Yalgorup seedlings compared to Lesmurdie seedlings in Yalgorup soil (Table 7). For both root length and leaf number there were no significant differences between the soils for combined seed sources nor between the seed sources for combined soils. Root length for Yalgorup seedlings was significantly longer than the value for Jandakot seedlings in Yalgorup soil. There were no significant differences in stem height between the soils for the combined seed sources. Jandakot seedlings had significantly shorter heights than other seedlings in Jandakot soil.

TABLE 7. Mean dry top/root ratios for *Acacia pulchella*.

SEED SOURCE	SOIL: Lesmurdie	Jandakot	Yalgorup (S)	Overall
	Harvest 1			
Yalgorup	3.91**a**	2.09**b**	1.95**b**	2.65
Lesmurdie	1.47**a**	1.54**a**	2.44**a**	1.81
Jandakot	1.82**a**	0.80**a**	1.32**a**	1.31
Overall	2.40**a**	1.47**a**	1.91**a**	1.93
	Harvest 2			
Lesmurdie	2.90**a**	1.94**a**	3.48**a**	2.77
Jandakot	1.57**a**	1.80**a**	2.40**a**	1.92
Yalgorup	3.09**a**	2.79**a**	1.59**a**	2.49
Overall	2.52**a**	2.18**a**	2.49**a**	2.40

Scheffe test $\alpha = 0.05$ to show means which do not differ. Vertical bars link ratios not significantly different for seed sources. Letters are different where ratios for soil types differ significantly within a seed source.

No nodules formed on the roots of any seedlings in Jandakot soil. With Lesmurdie seedlings (for both harvests) there were no real differences in the number and size of nodules formed in Yalgorup and Lesmurdie soils. For Jandakot seedlings, nodule formation was slightly better in Lesmurdie soil than in Yalgorup soil for both harvests.

Yalgorup seedlings at harvest 1 showed no difference in nodule formation between Yalgorup and Lesmurdie soils, but at harvest 2, nodule formation was better in the Yalgorup soil. In the Lesmurdie soil at harvest 1, Yalgorup seedlings had more and larger nodules than the other seed sources. Harvest 2 nodule formation on Yalgorup and Jandakot seedlings was similar and both had much greater nodule formation than Lesmurdie seedlings. In Yalgorup soil at harvest 1 nodule formation was slightly better for Yalgorup seedlings than for the other two. At harvest 2 nodule formation was considerably better for Yalgorup seedlings than Lesmurdie seedlings

Comparing the Yalgorup and Jandakot seedlings the former had marginally better nodule formation (i.e. there were more nodules per seedling and a higher percentage of seedlings with nodules).

Acacia saligna

Comparative seed viability

Time course of germination for *A. saligna* is illustrated in Figure 2.

There was no great variation in the final level of germination between the different temperatures for any of the three seed sources. The highest level occurred at 20°C for Yalgorup seed, at 15°C for Lesmurdie seed and for Jandakot seed both 12°C and 20°C gave similar values.

Comparison between germination levels of different seed sources at each of the temperatures showed the level was significantly lower for Yalgorup seed compared to the other two sources (Table 8).

The germination rate was significantly faster at 20°C than at 12°C for Lesmurdie seed. For Jandakot seed the germination rate was significantly faster at 20°C compared to the other temperatures. For the seed sources, the rate was significantly slower at 12°C compared to the higher temperatures (Table 8).

TABLE 8. Viability and germination rate for three sources of *Acacia saligna* seed incubated at three temperatures.

	TEMPERATURE °C			
	12	15	20	Overall
SEED SOURCE	**Final germination percentage (SD based on replicate mean numbers)**			
Lesmurdie	27 (11.0)**a**	34 (9.6)**a**	25 (5)**a**	28.7 (9.2)
Jandakot	31 (5.5)**a**	26 (8.2)**a**	31 (9.6)**a**	29.3 (7.7)
Yalgorup	12 (6.7)**a**	12 (7.6)**a**	17 (7.6)**a**	13.7 (7.2)
Overall	23.3(11.3)**a**	24.0(12.3)**a**	24.3(9.2)**a**	23.9(10.7)

F temperature 0.1 NS; seed source 18.0 ***; interaction 1.4 NS

Mean germination rate, days (SD based on replicate means)

	12	15	20	Overall
Lesmurdie	14.4 (3.0)**a**	9.2 (2.9)**ab**	6.7 (1.0)**b**	10.1 (4.0)
Yalgorup	14.9 (8.0)**a**	9.8 (2.0)**a**	12.6 (1.9)**a**	12.4 (5.0)
Jandakot	28.3 (2.0)**a**	26.1 (4.2)**a**	19.9 (3.5)**b**	24.7 (4.8)
Overall	19.2 (8.2)**a**	15.0 (8.6)**b**	13.1 (6.0)**b**	15.7 (7.9)

F temperature 10.5 ***; seed source 66.9***; interaction 2.1 NS

Vertical bars link levels not significantly different for seed sources. Letters are different where levels at incubation temperatures differ significantly within a seed source.

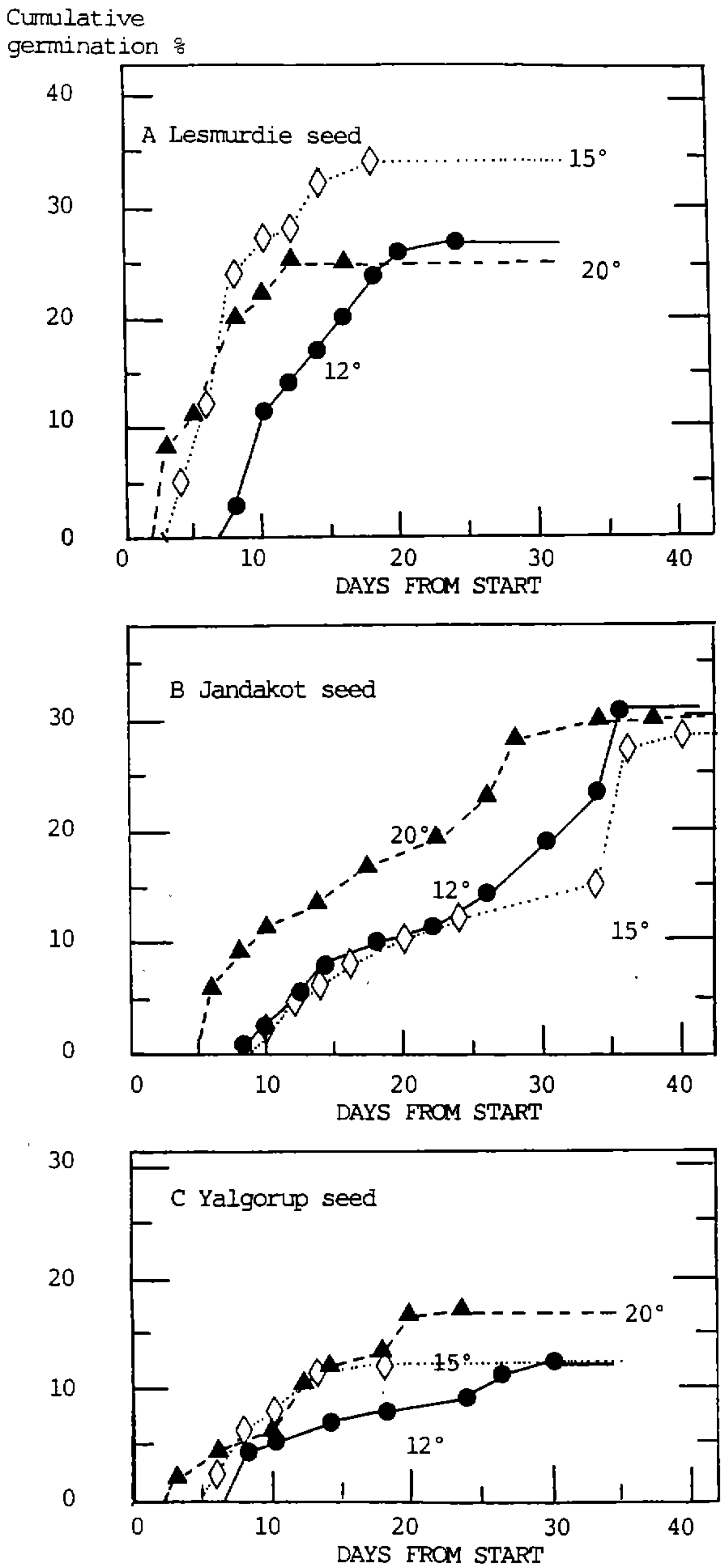

FIGURE 2. Time course of germination for **Acacia saligna** from three accessions incubated at three temperatures.

The germination rate was significantly slower for Jandakot seed at all three temperatures compared to the other seed sources, and Lesmurdie seed were marginally faster at all temperatures than Yalgorup seed.

Emergence from different soils

There were no significant differences in emergence level between the soils for any of the seed sources. Jandakot seed had significantly higher emergence levels in all soils compared to the other seed sources. Lesmurdie seed had significantly higher emergence in Lesmurdie and Yalgorup soils than the Yalgorup seed (Table 9).

TABLE 9. Percentage emergence of *Acacia saligna* from three soils to 8 weeks from sowing.

SEED SOURCE	SOIL: Lesmurdie	Jandakot	Yalgorup (S)	Overall
	(S.D. based on replicate mean numbers)			
Jandakot	86.0 (16.7)a	96.0 (8.9) a	90.0 (12.3)a	90.7 (12.8)
Lesmurdie	35.0 (16.1)a	31.4 (17.5)a	39.3 (17.3)a	35.2 (16.9)
Yalgorup	14.3 (10.9)a	23.6 (15.0)a	11.4 (7.7) a	16.4 (12.5)
Overall	33.9 (27.9)a	37.9 (29.3)a	35.2 (29.8)a	35.7 (28.8)

F soil source 0.65 NS; seed source 148 ***; interaction 1.89 N.S.

Scheffe test $\alpha = 0.05$ to show means which do not differ. Vertical bars link levels not significantly different for seed sources in a soil. Letters are different where levels in soils differ for seed sources.

Overall emergence rates for both seed sources and soils were similar (Table 10). Yalgorup seed emerged at the fastest rate from Jandakot soil. The slowest set was Lesmurdie seed in Yalgorup soil. These rates mirror the percentage emergence values. Both Jandakot and Yalgorup seed sets showed slowest emergence rates for their native soils.

TABLE 10. Emergence rate of *Acacia saligna*, mean days to emerge from three soils (S.D. based on replicate means).

SEED SOURCE	SOIL			
	Lesmurdie	**Jandakot**	**Yalgorup (S)**	**Overall**
Lesmurdie	20.7 (3.9)	21.3 (4.9)	22.5 (4.4)	21.5
Jandakot	20.3 (5.2)	22.0 (4.5)	19.2 (2.7)	20.5
Yalgorup	19.4 (5.7)	18.5 (4.6)	20.2 (6.9)	19.4
Overall	20.1	20.6	20.6	

Early growth of emergent seedlings

At first harvest the only significant difference in the four weight parameters was that Lesmurdie seedlings had significantly higher fresh root weight in Jandakot soil than in Lesmurdie soil. For Lesmurdie seedlings all four parameters were highest in Jandakot soil and lowest in Lesmurdie soil. With Yalgorup seedlings the highest value for each of the four parameters was recorded from seedlings in Jandakot soil. In Jandakot soil Lesmurdie seedlings had significantly higher fresh and dry top weight and fresh root weight than Jandakot seedlings. For the four parameters for each of the soils the Lesmurdie seedlings had highest values with the exception of dry root weight. In Yalgorup soil the Yalgorup seedlings had the second highest weights for all four parameters except dry root weight, for which this set had the heaviest weight.

TABLE 11. Mean plant dry weights at harvest (g) for *Acacia saligna*.

SEED SOURCE	SOIL: Lesmurdie	Jandakot	Yalgorup (S)	Overall
	Harvest 1			
Lesmurdie	.055**a**	.071**a**	.068**a**	.065**a**
Jandakot	.060**a**	.045**b**	.049**a**	.052**a**
Yalgorup	.046**a**	.034**b**	.064**a**	.048**a**
Overall	.053	.050	.061	.055
F seed source 2.94NS; soil source 0.99NS; interaction 1.17NS				
	Harvest 2			
Lesmurdie	.108**a**	.096**a**	.117**a**	.107**a**
Jandakot	.092**ab**	.064**a**	.104**a**	.087**ab**
Yalgorup	.086**b**	.076**a**	.066**a**	.075**b**
Overall	.096	.078	.096	.090
F seed source 3.74 *; soil source 2.24 NS; interaction 1.04 NS				

Scheffe test $\alpha = 0.05$ to show means which do not differ. Letters differ where weights are significantly different for seed sources in a soil. There were no significant differences for weights in soil within a seed source.

For dry top ratio there were no significant differences between soils for any seed sources. In Lesmurdie soil the Jandakot seedlings had a significantly lower ratio than Lesmurdie seedlings. In Jandakot and Yalgorup soil, Lesmurdie seedlings had significantly longer root length values than Jandakot seedlings. In Lesmurdie soil Jandakot seedlings had significantly longer root lengths than Yalgorup seedlings. Jandakot seedlings had root lengths significantly longer in Lesmurdie soil compared to Yalgorup soil.

TABLE 12. Mean dry top/root ratios for *Acacia saligna*.

SEED SOURCE	SOIL: Lesmurdie	Jandakot	Yalgorup (S)	Overall
Harvest 1				
Lesmurdie	1.55**a**	1.23**a**	1.15**a**	1.31
Yalgorup	1.11**a**	0.95**a**	1.16**a**	1.08
Jandakot	0.92**a**	0.72**a**	1.07**a**	0.90
Overall	1.20**a**	0.97**a**	1.12**a**	1.10
Harvest 2				
Lesmurdie	1.59**a**	1.01**a**	1.06**a**	1.22
Jandakot	1.22**a**	1.01**a**	0.94**a**	1.06
Yalgorup	1.48**ab**	0.94**b**	1.88**a**	1.43
Overall	1.43**a**	0.99**b**	1.30**ab**	1.24

Scheffe test $\alpha = 0.05$ to show means which do not differ. Vertical bars link weights not significantly different for seed sources in a soil. Letters are different where ratios for soil types differ significantly within a seed source.

Yalgorup seedlings had both leaf number and stem height greater in Yalgorup than in Jandakot soil. There were no significant differences in leaf number between seedlings for any of the soils. Jandakot seedling height was significantly taller in Lesmurdie soil than in Yalgorup soil. In the Jandakot soil height was significantly less for Yalgorup seedlings than the other two sources. For all harvest values except dry top root ratio, the greatest values for the combined soil sources' seedlings were recorded for Lesmurdie seedlings and the lowest values for Yalgorup seedlings.

At second harvest weight parameters showed no significant differences between soils for any seedlings but highest values were obtained from the Lesmurdie soil. For all sources combined top weight was significantly heavier in Lesmurdie soil than in Jandakot soil.

Fresh top and root weights were significantly heavier for Lesmurdie seedlings than for Yalgorup seedlings in all except Jandakot soil. Fresh root weight was significantly greater for Lesmurdie seedlings in

Jandakot soil. Dry top weight in Lesmurdie soil was significantly heavier for Lesmurdie seedlings than Yalgorup seedlings. Dry root weight in Yalgorup soil was significantly lower for Yalgorup seedlings. In Yalgorup soil dry top root ratio was significantly greater for Lesmurdie seedlings compared to Yalgorup seedlings. Dry root weight in Yalgorup soil was significantly lighter for Yalgorup seedlings. In Yalgorup soil dry top root ratio was significantly greater for Yalgorup seedlings. The ratio was also significantly greater for Yalgorup seedlings in Yalgorup soil than in Jandakot soil. There were no significant differences in root length, leaf number or stem height between the soils for any of the seed sources. Root length in Yalgorup soil was longer for Jandakot seedlings than Yalgorup seedlings. Leaf number for combined soils was significantly higher for Jandakot seedlings than Yalgorup seedlings. For stem height in Jandakot soil, Yalgorup seedlings had significantly shorter values than either of the other two seed sources and for combined soil sources seedling height was significantly greater for Lesmurdie seedlings than Yalgorup seedlings.

In Jandakot soil nodule formation was less than in the other soils. At harvest 1 no nodules had formed on Jandakot seedling roots and only a few on one of the seedlings harvested for the other sources. At second harvest all Jandakot seedlings were nodulated slightly, and 2 of each of Yalgorup and Lesmurdie seedlings also had a few nodules. In Lesmurdie soil best nodulation was on Lesmurdie seedlings for first harvest, but by second harvest nodule formation was nearly as good on Jandakot seedlings. In Yalgorup soil nodule formation was better than in Lesmurdie soil, and formation was much greater in Lesmurdie and Yalgorup soil compared to Jandakot soil. Yalgorup seedlings had the greatest nodule formation of the seed sources at both harvests in Yalgorup soil but the difference was less at harvest 2 with nearly as good nodule formation for Lesmurdie and Jandakot seedlings as for Yalgorup seedlings.

The Lesmurdie seedlings had slightly greater nodule formation in the Lesmurdie soil for both harvests. The Jandakot seedlings at harvest 1 had the greatest nodulation in Yalgorup soil. By harvest 2 nodulation was equally good in the Lesmurdie and Yalgorup soils and nodulation was poorest in the Jandakot soil. The Yalgorup seedlings had much greater nodule formation for both harvests in Yalgorup soil.

Allocasuarina humilis

Comparative seed viability

Figure 3 illustrates the time course of germination. The highest final level of germination for the Lesmurdie and Yalgorup seed was at 12°C. For Lesmurdie seed germination was significantly higher at 12°C compared to 15°C. For Yalgorup seed the final level of germination was significantly higher at 12°C than 20°C. There were no significant differences between temperatures for Jandakot seed.

Lesmurdie seed had the highest level of germination at all three temperatures. At 12°C Lesmurdie seed germination was significantly higher than Jandakot. At 20°C Lesmurdie seed germination was significantly higher than that of Yalgorup (Table 13).

TABLE 13. Viability and germination rate for three sources of *Allocasuarina humilis* seed incubated at three temperatures.

	TEMPERATURE °C			
	12	15	20	Overall
SEED SOURCE	**Final germination percentage (SD based on replicate mean numbers)**			
Lesmurdie	79(10.8)**ab**	57(9.7) **b**	64(8.2)**a**	66.7(13.1)
Jandakot	53(11.5)**a**	40(10.6)**a**	54(14.3)**a**	49.0(13.1)
Yalgorup	64(8.2) **a**	52(13.0)**ab**	39(4.2)**b**	51.7(13.6)
Overall	65.3(14.6)**a**	49.7(12.7)**b**	52.3(14.0)**b**	55.8(15.2)
F temperature 9.6***; seed source 12.4 ***; interaction 3.0 *				
	Mean germination rate (SD based on replicate means)			
Lesmurdie	19.6(0.8)**a**	9.3(0.8)**b**	7.9(0.8)**c**	12.3(5.4)
Jandakot	21.1(0.7)**a**	9.8(0.6)**b**	9.2(0.6)**b**	13.4(5.7)
Yalgorup	21.7(0.7)**a**	10.3(1.0)**b**	9.9(0.7)**b**	13.7(5.7)
Overall	20.8(1.2)**a**	9.8(0.9)**b**	9.0(1.1)**c**	13.2(5.5)
F temperature 181 ***; seed source 21 ***; interaction 1.1 NS				

Vertical bars link levels not significantly different for seed sources. Letters are different where levels at incubation temperatures differ significantly within a seed source.

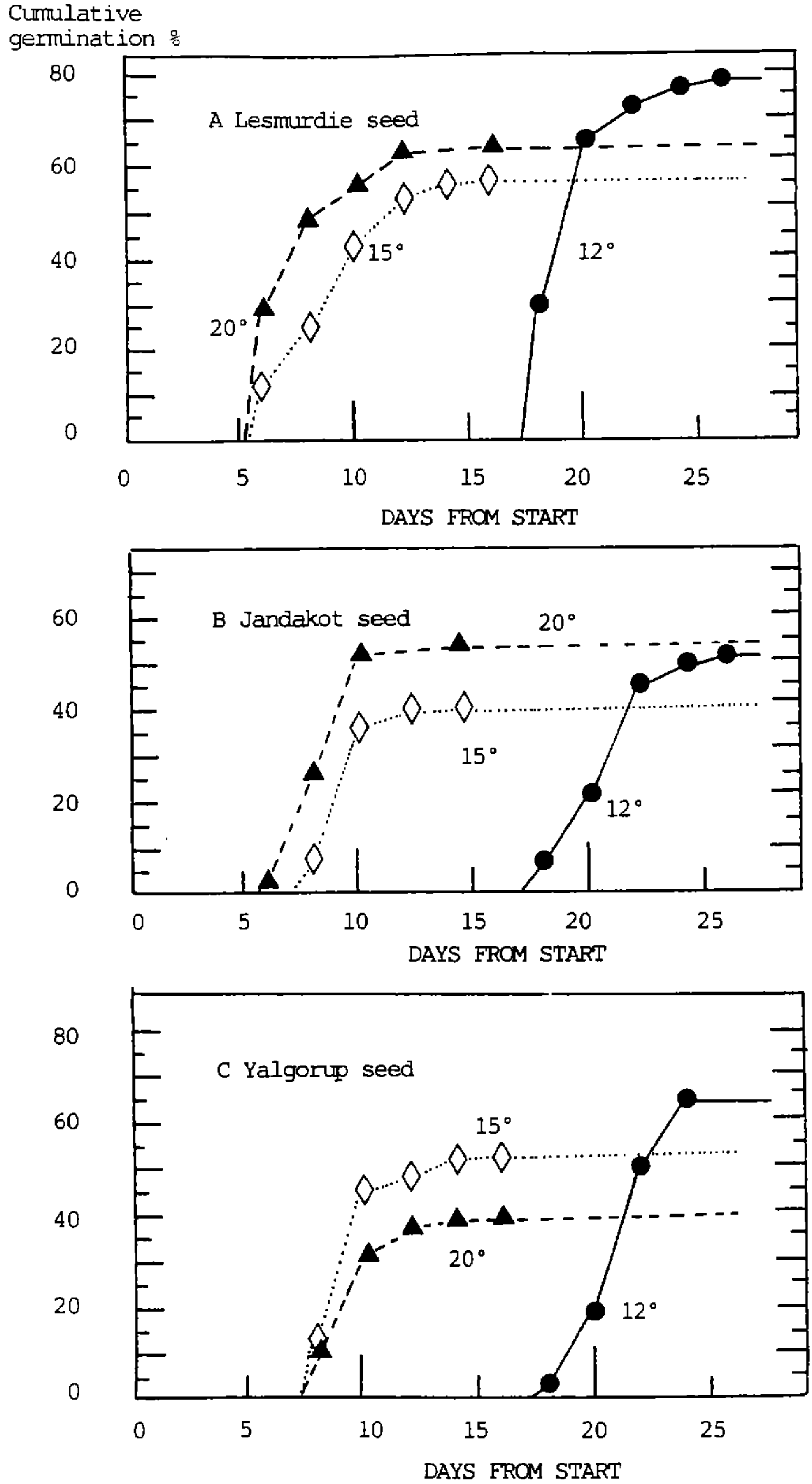

FIGURE 3. Time course of germination for **Allocasuarina humilis** from three accessions incubated at three temperatures.

Both Yalgorup and Jandakot seed germination rates were significantly slower at 12°C compared to the other temperatures. For Lesmurdie seed the germination rate varied significantly between each temperature with the fastest rate at 20°C and the slowest at 12°C. The germination rate was faster for Lesmurdie seed at 12°C and 20°C compared to the other two seed sources (Table 13).

Emergence from different soils

Jandakot seed for combined soils had significantly lower emergence levels than the other 2 sources (Table 14).

TABLE 14. Percentage emergence of *Allocasuarina humilis* from four soils to 8 weeks from sowing.

SEED SOURCE	SOIL: Lesmurdie	Jandakot	Yalgorup(S)	Yalgorup(T)	Overall
Lesmurdie	48.0(25.4)a	58.0(16.1)a	55.3(23.3)a	48.7(33.4)a	55.0(25.9)
Yalgorup	48.0(19.0)a	53.3(28.7)a	53.3(19.9)a	56.0(22.9)a	52.7(22.5)
Jandakot	30.7(16.7)a	43.3(20.6)a	46.0(18.4)a	36.0(24.7)a	39.0(20.7)
Overall	42.2(21.8)a	54.9(24.2)a	51.6(20.6)a	46.9(28.0)a	48.9(24.1)

F soil source 2.61NS; seed source 8.51***; interaction 0.78NS

Scheffe test α= 0.05 to show means which do not differ. Vertical bars link levels not significantly different for seed sources in a soil. Letters are different where levels in soils differ for seed sources.

A few trends were apparent in the emergence rates (Table 15). Overall Lesmurdie seed had a faster rate of emergence than Yalgorup seed and the emergence rate from Yalgorup topsoil was slowest.

TABLE 15. Emergence rate of *Allocasuarina humilis*, mean days to emerge from four soils (S.D. based on replicate means).

SEED SOURCE	SOIL: Lesmurdie	Jandakot	Yalgorup(S)	Yalgorup(T)	Overall
Lesmurdie	18.4(1.0)	18.7(1.5)	19.0(2.5)	21.3(2.7)	19.4
Jandakot	21.5(3.0)	20.1(3.2)	18.9(1.2)	21.0(3.8)	20.4
Yalgorup	22.5(3.2)	21.4(2.8)	22.7(4.0)	23.0(5.5)	22.4
Overall	20.8	20.1	20.2	21.8	

Early growth of emergent seedlings

For the first harvest fresh top weights were significantly heavier for Yalgorup seedlings in Yalgorup topsoil compared with the other soils. The Yalgorup seedlings had significantly heavier weights than other seed sources in Yalgorup topsoil. Both Lesmurdie and Yalgorup seedlings had significantly heavier fresh root weight in Lesmurdie soil compared to other soils.

TABLE 16. Mean plant dry weights at harvest (g) for *Allocasuarina humilis*.

	SOIL				
SEED SOURCE	**Lesmurdie**	**Jandakot**	**Yalgorup(S)**	**Yalgorup(T)**	**Overall**
	Harvest 1				
Lesmurdie	.027**a**	.013**b**	.017**ab**	.016**ab**	.018
Jandakot	.014**a**	.009**a**	.011**a**	.011**a**	.011
Yalgorup	.020**a**	.009**a**	.016**a**	.012**a**	.015
Overall	.019**a**	.011**b**	.015**ab**	.013**ab**	.014
F seed source 17.61***; soil source 18.56***; interaction 2.68*					
	Harvest 2				
Lesmurdie	.040**a**	.025**a**	.029**a**	.030**a**	.031
Jandakot	.033**a**	.016**a**	.018**a**	.027**a**	.023
Yalgorup	.040**ab**	.023**b**	.020**b**	.051**a**	.033
Overall	.037**a**	.021**b**	.022**b**	.036**a**	.021
F seed source 7.86**; soil source 11.69***; interaction 3.35**					

Scheffe test α = 0.05 to show means which do not differ. Vertical bars link weights not significantly different for seed sources in a soil. Letters are different where weights in soil differ within a seed source.

Dry top weights were significantly heavier for Lesmurdie seedlings in Lesmurdie soil than for the other two sources. Lesmurdie seedlings also had significantly heavier dry top weight in Lesmurdie soil than in both Yalgorup topsoil and the Jandakot soil. Dry root weight showed no significant differences between the seed sources in the different soils. Lesmurdie seedlings had significantly heavier dry root weight in the Lesmurdie soil than in the other soils. Yalgorup seedlings had significantly heavier dry root weight in the Lesmurdie soil than in Yalgorup topsoil and Jandakot soil.

For dry top root ratio there were no differences between seed sources for soils. Yalgorup seedlings had a significantly higher ratio in Yalgorup top soil than in Yalgorup subsoil and Lesmurdie soil (Table 17).

TABLE 17. **Mean dry top/root ratios for *Allocasuarina humilis*.**

SEED SOURCE	Lesmurdie	Jandakot	Yalgorup(S)	Yalgorup(T)	Overall
	Harvest 1				
Lesmurdie	2.12**a**	2.85**a**	3.28**a**	2.87**a**	2.79
Jandakot	2.02**a**	2.21**a**	2.90**a**	3.03**a**	2.54
Yalgorup	1.23**b**	3.60**ab**	2.25**b**	4.34**a**	2.85
Overall	1.81**b**	2.89**a**	2.81**b**	3.41**a**	2.73
	Harvest 2				
Lesmurdie	2.88**b**	6.03**a**	4.89**ab**	3.46**ab**	4.32
Jandakot	1.72**a**	3.21**a**	4.10**a**	3.10**a**	3.03
Yalgorup	2.05**ab**	3.26**ab**	4.39**a**	1.38**b**	2.77
Overall	2.22**c**	4.17**ab**	4.46**a**	2.65**bc**	3.37

Scheffe test $\alpha = 0.05$ to show means which do not differ. Vertical bars link weights not significantly different for seed sources in a soil. Letters are different where ratios for soil types differ significantly within a seed source.

Root length was significantly longer for Jandakot seedlings in Jandakot soil than for Yalgorup seedlings in the Jandakot soil. Lesmurdie seedlings had significantly longer root length in Yalgorup subsoil than Jandakot seedlings. Lesmurdie seedling root length was significantly longer in Lesmurdie soil and Yalgorup subsoil than in Yalgorup topsoil and Jandakot soil. Jandakot seedling root length was significantly longer in Lesmurdie soil than in Yalgorup subsoil. The root length of Yalgorup seedlings was significantly longer in Lesmurdie and Yalgorup subsoil than in Yalgorup topsoil and Jandakot soil. Lesmurdie seedlings had significantly taller stem height in Lesmurdie soil compared to other soils and Lesmurdie seedlings had significantly higher stem height than the other seed sources in Lesmurdie soil. In Yalgorup subsoil Lesmurdie seedlings had significantly taller stem height than Jandakot seedlings.

All second harvest fresh top weights showed no significant differences between the seed sources for the soils. Yalgorup seedling fresh top weight was significantly heavier in Yalgorup topsoil than in Yalgorup subsoil. In Yalgorup topsoil Yalgorup seedlings had significantly heavier fresh root weight than the other two seed sources. Yalgorup seedlings had significantly heavier fresh root weight in Yalgorup topsoil than in either of the Jandakot soil or Yalgorup subsoil. Fresh root weight was also significantly heavier in Lesmurdie soil compared to Yalgorup subsoil. There were no significant differences in dry top weight between the seed sources for any soil. Top weight values were significantly heavier in Yalgorup topsoil than in Yalgorup subsoil. In Yalgorup topsoil the Yalgorup seedlings had significantly heaviest dry root weight. Yalgorup seedlings had significantly heaviest dry root weight in Yalgorup topsoil, and they were also significantly heavier in Lesmurdie soil than Yalgorup subsoil.

Jandakot seedling dry root weight was significantly heavier in Lesmurdie soil than in other soils. Jandakot soil dry top/root ratio was significantly higher for Lesmurdie seedlings than for the other two seed sources. For Lesmurdie seedlings the ratio was significantly lower in Lesmurdie soil than in Jandakot soil. In Yalgorup seedlings the ratio was significantly lower for the seedlings in Yalgorup topsoil compared to the seedlings in Yalgorup subsoil (Table 17).

There were no significant differences in root length between the seed sources for any soils, however root length was longer in Lesmurdie soil than in Yalgorup subsoil. The root length of Yalgorup seedlings was significantly taller in Yalgorup subsoil. In Jandakot soil stem height was significantly longer for Lesmurdie seedlings compared to Jandakot seedlings. Lesmurdie seedlings grew taller in Lesmurdie soil than in Yalgorup subsoil. Jandakot seedlings had significantly taller stem height in Yalgorup topsoil and Lesmurdie soil than in Yalgorup topsoil, and in Lesmurdie soil than in Yalgorup subsoil and Jandakot soil. The Yalgorup seedlings had greater stem height in Yalgorup topsoil and Lesmurdie soil than in Jandakot soil and Yalgorup subsoil.

Eucalyptus marginata

Comparative seed viability

The time course of germination in *E. marginata* is given in Figure 4.

There were no significant differences in the final level of germination between the temperatures for any of the three seed sources. Comparison of final germination levels at each temperature shows that Yalgorup seed germination level was considerably lower at 12°C and 20°C than the other seed sources. At 15°C Lesmurdie seed germination level was significantly higher than the other two seed sources (Table 18).

TABLE 18. Viability and germination rate for three sources of *Eucalyptus marginata* seed incubated at three temperatures.

SEED SOURCE	TEMPERATURE °C 12	15	20	Overall
	Final germination percentage (SD based on replicate mean numbers)			
Lesmurdie	72.0(19.7)**a**	89.3 (7.6)**a**	56.0(3.7) **a**	72.4(18.1)
Jandakot	62.7(12.1)**a**	56.0(13.8)**a**	64.0(10.1)**a**	60.9(11.8)
Yalgorup	40.0(14.1)**a**	36.0(19.2)**a**	32.0(5.6)**a**	36.0(13.5)
Overall	58.2(20.1)**a**	60.4(26.4)**a**	50.7(15.5)**a**	56.4(21.1)

F temperature 2.4 NS; seed source 31.3 ***; interaction 3.5 *

Mean germination rate days(SD based on replicate means)

SEED SOURCE	12	15	20	Overall
Lesmurdie	18.8(0.7)**a**	9.1(0.3)**c**	12.4(1.1)**b**	13.4(4.2)
Jandakot	21.9(0.5)**a**	9.3(0.7)**c**	12.8(0.9)**b**	14.7(5.5)
Yalgorup	22.7(2.8)**a**	10.5(2.7)**b**	9.8(0.7)**b**	14.4(6.5)
Overall	21.1(2.4)**a**	9.6(1.7)**c**	11.7(1.6)**b**	14.1(5.4)

F temperature 260 ***; seed source 3.0 NS; interaction 7.3 ***

Vertical bars link levels not significantly different for seed sources. Letters are different where levels at incubation temperatures differ significantly within a seed source.

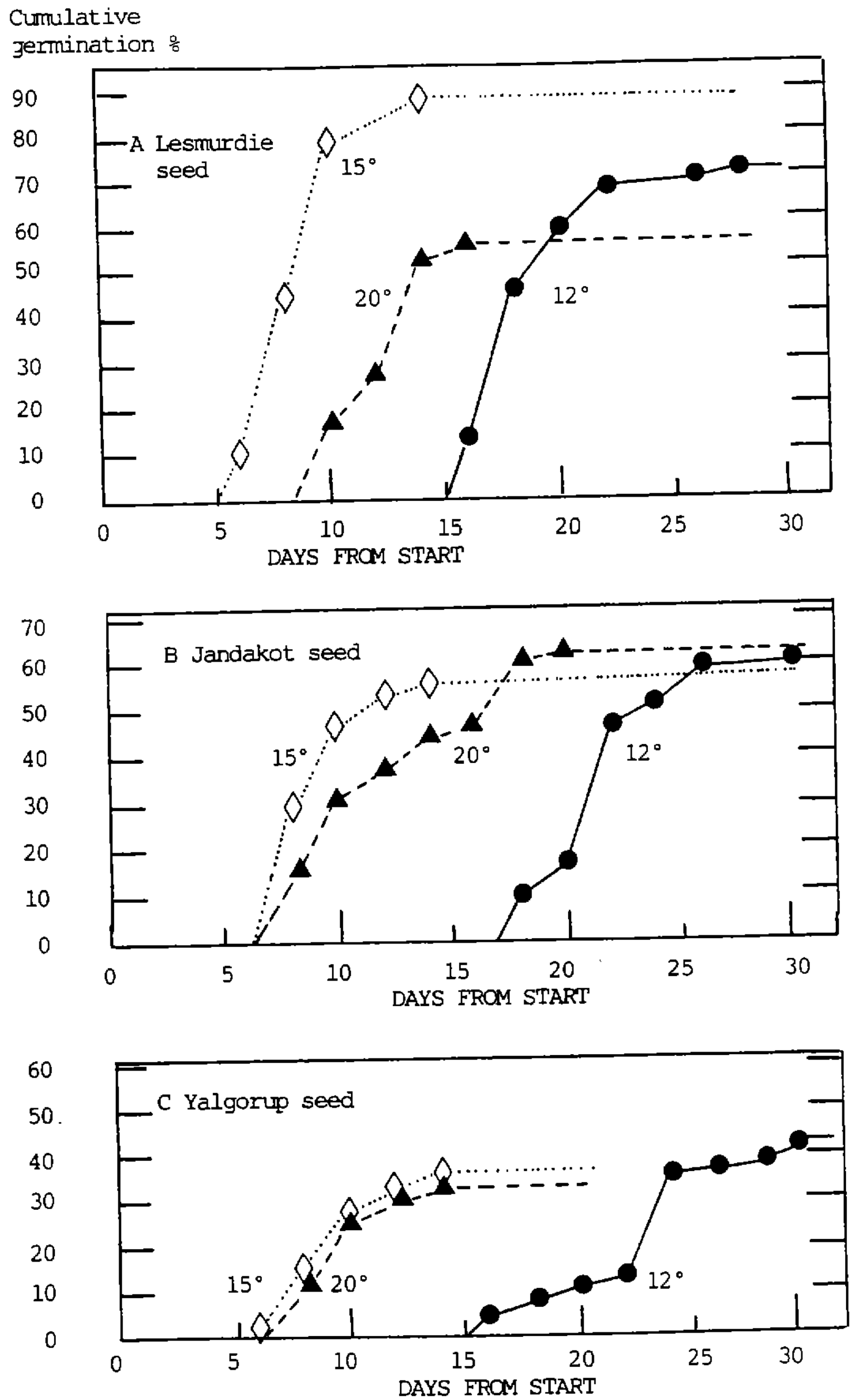

FIGURE 4. Time course of germination for **Eucalyptus marginata** from three accessions incubated at three temperatures.

For Lesmurdie and Jandakot seed, germination rates were significantly different for all temperatures, with the fastest rate at 15°C, and the slowest at 12°C. For Yalgorup seed germination rate was significantly lowest at 12°C. Comparison of germination rates for different seed sources at each temperature shows that the Lesmurdie seed germination rate was significantly fastest at 12°C. At 20°C Yalgorup seed germination was significantly faster than other seed.

Emergence from different soils

Of the combined soil sources Lesmurdie seed had significantly highest emergence levels and Yalgorup seed had significantly lowest levels. Lesmurdie seed had significantly higher emergence in Lesmurdie soil than Yalgorup seed. In Jandakot soil Lesmurdie seed had significantly higher emergence than the other two seed sources. In Yalgorup subsoil the emergence of Yalgorup seed was significantly lowest (Table 19).

TABLE 19. Percentage emergence of *Eucalyptus marginata* from four soils to 8 weeks from sowing.

SEED SOURCE	SOIL				
	Lesmurdie	**Jandakot**	**Yalgorup(S)**	**Yalgorup(T)**	**Overall**
Lesmurdie	56.0(18.4)**ab**	53.0(18.3)**ab**	62.0(15.5)**a**	35.0(23.2)**b**	51.5(21.0)
Jandakot	38.0(16.4)**a**	22.0(17.9)**a**	48.3(18.4)**a**	27.5(9.8)**a**	35.0(18.5)
Yalgorup	20.0(14.1)**a**	6.0(5.5)**a**	20.0(18.7)**a**	30.0(14.1)**a**	19.0(15.6)
Overall	42.5(22.2)**a**	33.5(25.8)**a**	48.1(23.6)**a**	32.1(18.4)**a**	39.3(23.3)

F soil source 4.01 *; seed 24.4 ***; interaction 2.24 *

Scheffe test $\alpha = 0.05$ to show means which do not differ. Vertical bars link levels not significantly different for seed sources in a soil. Letters are different where levels in soils differ for seed sources.

Lesmurdie seed emergence level was significantly higher in Yalgorup subsoil than in Yalgorup topsoil.

The emergence rate of seed in the Yalgorup topsoil overall was slower than in the other soils, and the emergence rate was fastest in the Lesmurdie soil. Lesmurdie seed emergence rate was fastest in the Lesmurdie soil. Yalgorup seed overall had marginally faster emergence rate than the other seed sources.

TABLE 20. Emergence rate of *Eucalyptus marginata*, mean days to emerge from four soils (S.D. based on replicate means).

SEED SOURCE	SOIL				
	Lesmurdie	**Jandakot**	**Yalgorup(S)**	**Yalgorup(T)**	**Overall**
Lesmurdie	27.8(2.7)	29.8(3.5)	28.2(1.6)	33.3(2.7	29.8
Jandakot	26.2(2.2)	30.0(3.7)	28.2(2.6)	28.8(1.6)	28.3
Yalgorup	24.2(1.5)	25.0(0.0)	28.8(2.5)	29.2(4.4)	26.8
Overall	26.5	28.6	28.4	31.2	

Early growth of emergent seedlings

Only one harvest was taken for *Eucalyptus marginata*. Yalgorup seedlings had significantly heaviest fresh top and root weights in Yalgorup topsoil. Yalgorup seedlings also had significantly heavier fresh root weight in Lesmurdie soil than in Jandakot soil.

Lesmurdie seedlings had a heavier fresh top weight in Lesmurdie soil than in Jandakot soil. Jandakot seedlings had significantly heavier fresh top weight in Lesmurdie soil than in Jandakot soil and Yalgorup topsoil. The fresh top weights of Yalgorup seedlings were heavier in Lesmurdie soil compared to Jandakot and Yalgorup subsoil. Lesmurdie seedlings produced significantly heavier fresh root weight in Lesmurdie soil compared to Yalgorup topsoil. Yalgorup seedlings had significantly heavier fresh root weight in Lesmurdie soil and Yalgorup topsoil than in Jandakot soil and Yalgorup subsoil.

There were no significant differences in dry top and root weight between seed sources for any soils. Yalgorup seedlings had significantly heavier dry top weight in Lesmurdie soil than in Jandakot soil. Both Lesmurdie and Jandakot seedlings had significantly heavier dry root weight in Lesmurdie soil than in the Yalgorup topsoil. The Yalgorup seedlings had significantly heavier dry root weight in Lesmurdie soil than in any of the other soils.

TABLE 21. **Mean plant dry weights at harvest (g) for *Eucalyptus marginata*.**

SEED SOURCE	SOIL: Lesmurdie	Jandakot	Yalgorup(S)	Yalgorup(T)	Overall
Lesmurdie	.106**a**	.044**a**	.072**a**	.048**a**	.068
Jandakot	.118**a**	.042**b**	.059**b**	.043**b**	.064
Yalgorup	.142**a**	.051**b**	.054**b**	.096**ab**	.086
Overall	.119**a**	.045**b**	.062**b**	.063**b**	.069

F Seed source 2.68 NS; soil source 15.68 **; interaction 1.62 NS

Scheffe test α = 0.05 to show means which do not differ. Letters are different where weights in soils differ within a seed source.

For the parameters dry top and root weight and fresh top and root weight, significantly heaviest values for the combined seed sources were attained in Lesmurdie soil.

Dry top root ratio was significantly greater for Jandakot seedlings compared to Yalgorup seedlings in Yalgorup topsoil. The Jandakot seedlings also had a clearly higher ratio in Yalgorup topsoil than in both Lesmurdie and Jandakot soils (Table 22).

TABLE 22. Mean dry top/root ratios for *Eucalyptus marginata*.

	SOIL				
SEED SOURCE	**Lesmurdie**	**Jandakot**	**Yalgorup(S)**	**Yalgorup(T)**	**Overall**
	Harvest 1 (only)				
Jandakot	4.02b	4.78b	5.46ab	8.99a	5.81
Lesmurdie	3.40a	3.55a	3.02a	6.06a	4.01
Yalgorup	3.64a	6.74a	6.00a	5.19a	5.39
Overall	3.69b	5.02ab	4.82ab	6.75a	5.07

Scheffe test α = 0.05 to show means which do not differ. Vertical bars link weights not significantly different for seed sources in a soil. Letters are different where ratios for soil types differ significantly within a seed source.

There were no differences in root length between the seed sources for any of the different soils. Jandakot seedlings had significantly longer root lengths in Lesmurdie soil compared to Jandakot soil. Yalgorup seedlings grown in Yalgorup topsoil had more leaves than seedlings grown in Jandakot soil and Yalgorup subsoil. Yalgorup seedlings grown in Yalgorup topsoil also had significantly more leaves than other seed sources. Jandakot seedlings grown in Lesmurdie soil had more leaves than seedlings grown in Yalgorup topsoil.

Yalgorup seedlings had significantly taller stem lengths in Yalgorup topsoil than Jandakot seedlings. Lesmurdie seedlings had significantly taller stem length in Lesmurdie soil than in Jandakot and Yalgorup topsoil.

For the combined seed sources the root length, leaf number and stem heights were greater in Lesmurdie soil than in Jandakot soil. Root length was also longer in Lesmurdie soil compared to Yalgorup topsoil. Leaf numbers were significantly higher in Lesmurdie soil than in Yalgorup topsoil.

For combined soil sources the greatest values for all parameters excluding the dry top root ratio, were for Yalgorup seedlings. Yalgorup seedlings had higher fresh weight for the combined soils than the other two seed sources. Yalgorup seedlings had higher leaf numbers overall than Jandakot seedlings.

DISCUSSION

Acacia pulchella

The species is a common understorey component of a variety of forest ecosystems throughout the south-west of Western Australia. Six varieties of the species are recognised (Maslin 1975); one of these, *A. pulchella* var. *glaberrima* is especially common on the poor sandy soils of the Swan Coastal Plain and on the lateritic soils of the Darling Range (Maslin 1975). Like other Western Australian legumes the species has strongly seasonal nodulation, with virtually no nodules being found to persist through the hot, dry summer months (Lange 1959).

Seed source had a greater influence on total germination than incubation temperature. Temperature affected the rate of germination more than did the seed source. The rate was faster at higher temperatures.

Lesmurdie seed was most viable (48%) and Yalgorup least (33%). The differences were significant except at 12°C. Highest germination was at 15°C, but Yalgorup seed germinated best at 12°C. There was no difference in germination between 15 and 20°C. However at 20°C germination was fastest. Lesmurdie seed took longest to germinate at 12°C, where Yalgorup was fastest.

More Lesmurdie seed emerged, but at a slower rate, in each of the soils tested. Its best result was in Yalgorup soil and poorest in Lesmurdie soil. Both Jandakot and Yalgorup seed had highest levels of emergence in their respective native soils. Jandakot seed was twice as heavy as Lesmurdie seed.

For this species emergence was clearly linked to viability and Yalgorup soil provided the best medium.

At 45 days best yield was obtained from Jandakot seedlings in Lesmurdie soil. Only Yalgorup seedlings grew faster in their native soil. The greatest difference between soils was in root growth where Yalgorup seedlings in Yalgorup soil produced most. These roots were well nodulated and the concordance between seed source and soil for Yalgorup was greatest. Growth of Jandakot seedlings reflects heavier seed weight for this source.

There was no evidence to indicate that Lesmurdie seedlings were any more suited to their native soil than other soils. Growth may have been depressed through higher nutrient status limiting nodule formation in the Lesmurdie material. That the other two seed sources produced more dry matter in Lesmurdie soil probably reflected higher seed weights more than nutrition status.

Growth of Jandakot seedlings in their native soil was poor, possibly a result of lower nodulation activity at higher pH. Jandakot soil also dried out more rapidly and gave poor nodulation for all seed sources. However, nodules did form on roots of *Acacia saligna* in this soil.

The contribution of nitrogen fixation to the early growth of the species is probably not great judging by work that estimated nitrogen fixation, as a proportion of the nitrogen accumulated by first year seedlings as 7-12% (Monk, Pate and Loneragan 1981).

Both the growth and temperature study results suggest the Yalgorup population differed from the Lesmurdie and Jandakot populations with respect to early growth and the optimum temperature for germination. The temperature study indicated that the Yalgorup seed had a lower optimum temperature than the seed from Lesmurdie and Jandakot. The growth study indicated the Yalgorup seedlings were probably more suited to early growth in the Yalgorup soil than in the other soils. The study also indicated that the Yalgorup population gave better early growth, especially root growth, in the Yalgorup soil than the Lesmurdie and Jandakot populations, and probably therefore than the species in general.

Considering the seed quality of the three seed sources the Lesmurdie seed had marginally greater percentage seed viability, based on the temperature and germination in soils study. The Jandakot seed was heaviest, nearly double the weight of the other two seed sources. The Jandakot seedlings exhibited the greatest growth overall, and the fastest emergence rate (only slightly higher than the Yalgorup seedlings). The heavier Jandakot seed may explain the faster growth and emergence of the Jandakot seedlings.

Overall the three populations did not grow significantly better in any of the three soils. As a germination environment the Lesmurdie soil was overall marginally inferior to the other soils - both final emergence and emergence rate were lower in the Lesmurdie soil. The higher proportion of fine grain sizes - silt and clay in the Lesmurdie soil may explain the poorer germination values recorded from this soil. The coarser pores can be filled by the finer grains near the surface on watering and this reduces aeration and can form a crust that can slow emergence as the shoots have to penetrate the crust (Russell 1973). A crust was observed to form on the surface of the Lesmurdie soil between waterings.

Acacia saligna

The species is commonly a shrub, but it also grows into a small tree especially in areas away from competition with other plants. The species is very common on the poor sandy soils of the Swan Coastal Plain (Maslin 1974). It also grows on swampy sites, rocky hills, river banks and the slopes of the Darling Range (Hall and Turnbull 1976). It readily forms root nodules which favour establishment and rapid growth under crowded conditions and on low nitrogen soils (Roux and Middlemiss 1963).

There were no differences in total germination between temperatures of incubation. The rate of germination increased with temperature. Yalgorup seed was least viable (14%) and differences between seed sources incubated at different temperatures mainly arose from the poor showing of this source. For the other two sources viability was 29 percent.

The rate of germination differed with Jandakot seed taking much longer at all temperatures, this being probably a function of seed weight as Jandakot seed was much lighter than the others.

The optimum temperature for germination of this species lay in the region of 15-20°C.

Germination in soils was not correlated with seed origin and no source performed best in its native soil. Performance reflected viability with Jandakot seeds outperforming petri dish germination, giving best numbers in all soils and Yalgorup seeds poorest.

Subsequent growth also did not match seed/soil sources. Thus no one population appeared more suited to its native soil than the others used.

There was some evidence that early growth of Yalgorup seedlings was better in Yalgorup soil. However, any differences were lost by harvest 2. In comparison with Lesmurdie and Jandakot soils, root growth appeared retarded in the Yalgorup soil by harvest 2. Possibly the pot size restricted growth. In this species root growth is comparatively rapid. The dry top root ratio increased from harvest 1 to harvest 2. Initially better growth of Yalgorup seedlings in Yalgorup soil may have been partly due to greater nodule formation of the Yalgorup seedlings in Yalgorup soil than in other soils.

Lesmurdie seedlings had the slowest root growth in Lesmurdie soil with better growth in both of the other soils. The reason for this is unclear. Overall the seedlings of the three seed sources did not show lower root growth in Lesmurdie soil.

By harvest 2, top growth overall was greater in Lesmurdie soil than in the Jandakot soil. This increase in growth may have been accounted for by greater nitrogen and phosphorus levels in the Lesmurdie soil. For the other aspects of growth no differences between soils were apparent.

The overall growth of Lesmurdie seedlings was better than growth of the Yalgorup and Jandakot seedlings. Poorer growth of Yalgorup seedlings overall may have been due to lesser nodule formation, particularly in alien soils. Differences in growth were unlikely to have been due to differences in seed weight.

There was no evidence that the populations of the species differed with respect to early growth and emergence in the soils. There was no evidence of any population being more suited to its native soil than the other soils nor any population more suited to its native soil than the other populations in that soil. Also the seed sources did not differ with respect to optimum temperature for germination.

Both temperature and germination in soil studies indicated that Yalgorup seed had lowest percentage seed viability. The Jandakot seed had highest percentage viability. The seed weights did not differ greatly between the seed sources. Jandakot seed had the lowest seed weight and this may partly explain the slower germination rate at all temperatures and the initially slower growth of the Jandakot seedlings compared to the Lesmurdie seedlings.

Initial plant growth was similar in all three soils but after forty five days top growth was overall higher in the Lesmurdie soil. None of the three soils appeared to offer a superior germination environment.

Allocasuarina humilis

The species is usually a low spreading shrub and is widespread throughout the south-west of Western Australia (Bennett 1977). The species is common on sand (Erickson *et al.* 1979) but is also found on lateritic soils.

The heavier Lesmurdie seeds had higher viability and germinated at a faster rate than the other sources. The overall response to temperature was consistent and suggests that the optimum occurs towards the lower end of the range used, i.e. 12-15°C, although rate of germination was slow at 12°C.

There was little correlation between seed source and germination in native soils. Yalgorup had highest germination in its native soil (topsoil) of all the sources. Jandakot seed was poorest on all soils, reflecting lower viability of this seed source.

Both Lesmurdie and Yalgorup seedlings exhibited greater growth in their native soils than in the other soils. Jandakot seedlings had greater growth in Lesmurdie soil and Yalgorup topsoil but did not show greater growth in native soil than the other seed sources.

Initially, the Lesmurdie seedlings grew better in their native soil. This trend was not continued to the second harvest. By harvest 2, the dry top root ratio had increased and the roots had reached the bottom of the pots. Root growth was restricted probably influencing total plant growth whereas the other seed sources were not yet restricted by pot size. Lesmurdie seedlings initially had highest values for most of the growth parameters and the fastest growth compared to the other seed sources in Lesmurdie soil. This suggests that the Lesmurdie population was more suited to its native soil than the species in general with respect to early growth, although the seed weight advantage cannot be discounted.

Yalgorup seedlings did not initially grow better in their native soil but at harvest 2 root growth was faster in native soil, and all aspects of growth were clearly better in the topsoil than the subsoil. The Yalgorup population of the species occurs where the topsoil was 12-20cm deep over subsoil. Plants from this population may not grow as well initially and may not become established as easily at sites where subsoil is exposed. Only Yalgorup seedlings were able to overcome problems associated with the water-repellent nature of the topsoil, as indicated by greatest root weights and a lower dry top root ratio in the Yalgorup topsoil by harvest 2.

The species, as represented by the three populations, grew better in the Lesmurdie soil than in the Jandakot soil and Yalgorup topsoil initially, especially with reference to root growth. At forty five days growth was better overall in Lesmurdie soil compared to Jandakot soil and Yalgorup subsoil, while growth in the Lesmurdie and Yalgorup topsoil for the seed sources overall was not significantly different.

The Lesmurdie seedlings overall had best shoot growth possibly due to greater seed weight.

Yalgorup and Lesmurdie populations seem more suited to their native soils than the other soils, and more suited to their native soils compared to the other populations, with respect to early growth.

Eucalyptus marginata

The main area for this species is in a long belt 30-50km wide along the Darling Ranges from near Mundaring (50km east of Perth) southwards to near Albany (Hall, Johnston and Chippendale 1975). The species has its best development on the well-drained gravels capped with laterite on the slopes of the Darling Range, whereas on the poor sands of the Coastal Plain, height is reduced and form deteriorates (Hall, Johnston and Chippendale 1975). On the limestone ridges of the Spearwood dunes the species is replaced by *E. gomphocephala* (tuart) (Hall, Johnston and Chippendale 1975) but it is still present between the ridges on Spearwood sands.

Yalgorup seeds were 50 percent heavier than Lesmurdie seeds, which were only slightly lighter than those from Yalgorup. Yalgorup seed had lowest viability (36%) and Lesmurdie highest (72%). Differences between incubation temperatures were not significant for germination level attained although there were differences in the rate of germination. Both Lesmurdie and Jandakot seed germinated fastest at 15°C whereas Yalgorup seed did so at 20°C but was not significantly faster than 15°C. Thus an optimum temperature is probably around 15°C for this species.

None of the sources germinated best in native soil. Lesmurdie seed, reflecting higher viability, germinated better in all soils. Similarly Yalgorup seed was poorest in all soils.

The only seed source with faster seedling growth in native soil than the other seed sources was Yalgorup. The native soil was the Yalgorup topsoil - seeds were collected from trees growing where there was 4-10cm of topsoil over the subsoil. Some evidence suggested that Yalgorup seedlings performed better in Yalgorup topsoil compared to Yalgorup subsoil. Differences were only statistically significant for fresh top and root weights and leaf number.

Overall, the species grew faster in the Lesmurdie soil. The Yalgorup population was more suited to the Yalgorup topsoil than the species in general but did not grow better in the Yalgorup soil than in the Lesmurdie soil. These soils had higher nitrogen and phosphorus levels than the other soils, with higher organic matter content and lower field capacities.

The other seed sources did not grow equally well in both the Lesmurdie soil and Yalgorup topsoil. They were unable to develop a root system rapidly in Yalgorup topsoil. For all seed sources combined Jandakot soil had slowest growth.

The germination in soils and temperature studies indicate Yalgorup seed had lowest viability and Lesmurdie seed marginally higher viability than Jandakot seed. The Yalgorup seed was heavier but there was a large variation in seed weight. The Yalgorup seedlings had highest growth overall and a faster emergence rate. The heavier Yalgorup seed possibly had a higher amount of phosphorus stored in the seed (Yalgorup topsoil had the highest phosphorus level). The phosphorus reserve is important to early growth as shown by work in which *E. diversicolor*, a small seeded species and *E. calophylla*, a large seeded species, were grown in soil without phosphorus added, the latter obtained 20 x the growth of the former (Barrow 1977). Large seed reserves of phosphorus would give seedlings an advantage in becoming established on phosphorus deficient soils (Grundon 1972) and all soils in the study were low in phosphorus.

The only population to do well in the Yalgorup topsoil was the Yalgorup population. Overall the seedlings had the lowest growth in the Jandakot soil, possibly due to the high pH. The species usually grows on more acid soils. The pH of the Jandakot soil collected was higher than normal for Bassendean sand, and the site collection may have been near a limestone outcrop. No trees of this species were growing near the site of soil collection.

The Yalgorup topsoil provided a marginally poorer germination environment with fewer seeds germinating and a lower emergence rate. Greater seed weight of the Yalgorup source dominated the results for *Eucalyptus marginata*.

CONCLUSIONS

Of the four species examined accessions of all but *Acacia saligna* provided evidence of some site/seed correlation. For *Eucalyptus marginata* all sources grew best on the lateritic soil and worst on the Jandakot soil. The optimum temperature for germination was similar for all three seed sources. In all but one case the heaviest seed produced greatest mean dry weight in each soil, despite higher viability and emergence of the lighter seed. The implication is that in *Eucalyptus marginata* one population was sampled. This species grows best on the lateritic soil, its main occurrence, and the other habitats are comparitively marginal.

Differences in *Allocasuarina humilis* suggested at least two populations. Most seed germinated at the lower temperature used but both Lesmurdie and Jandakot accessions germinated fastest at 20° compared with Yalgorup at 15°C. The Lesmurdie seed was four times heavier than Yalgorup seed and three times that of the Jandakot seed. Superior seed weight was associated with faster germination, earlier emergence and greatest top growth in the Lesmurdie accession. Despite this two accessions (Lesmurdie, Yalgorup) produced best growth on their native soils, whereas the other (Jandakot) had poorest growth on its native soil. The Lesmurdie and Yalgorup populations differ, and the Jandakot population appears to be intermediate.

Acacia pulchella from Yalgorup showed evidence of ecotypic status in giving best yield on Yalgorup soil where it outperformed the other two. This accession commenced germination earlier at the lower temperature used. The Jandakot seed was twice as heavy as the other two. It grew best on Jandakot soil and outperformed the other two on lateritic soil. The light seeded Lesmurdie accession had its best performance on Lesmurdie soil but was outyielded there by the other two, heavier seeded, sets.

There was no correlation of seed with soil in *Acacia saligna*. Mean seed weight differed least between accessions and differences in germination tests were slight. It is possible that the experimental time was too short for exhaustion of seed reserves.

The study indicates that both seed weight and soil nutrient status had some effects on the results. Confirmation of differences may be examined by growing accessions from differing localities in carefully standardised soils and by sorting out comparable seed weights more critically. The patterns of seed weight response indicated that lighter seed was more viable in *Acacia pulchella* and *Eucalyptus marginata*. Heavier seed was least viable in *Allocasuarina humilis*. Emergence from soil was generally lower than petri dish estimated viability, with one exception, but the pattern of light/heavy response was similar. The exception was in the case of *A. saligna* where Jandakot seed emerged from soils in much higher proportions than the germination test had indicated. Lighter seed of all but *Allocasuarina humilis* showed best emergence from soils, and generally took slightly longer for emergence.

In each of *Acacia pulchella, Allocasuarina humilis* and *Eucalyptus marginata* heaviest seed sources generally produced greatest mean dry weights in each soil. The conclusions relating to ecotypes largely rest on the exceptions. These were in *Acacia pulchella* where the second heaviest source (Yalgorup) was best on Yalgorup soil; *Allocasuarina humilis* the lightest seed (Yalgorup) was best on Yalgorup topsoil; and in *E. marginata* the lightest seed (Lesmurdie) was best on Yalgorup subsoil. *Acacia saligna* seed from Lesmurdie, the second heaviest, produced greatest mean dry weight in all three soils tested.

In the case of the growing media Lesmurdie soil provided best conditions for 8 of the 12 seed source/soil contrasts in terms of dry matter yield. The same number of contrasts produced lower yields in Jandakot soil. Plants of *Acacia pulchella* failed to nodulate in Jandakot soil and nodulation was poor in this soil for *A. saligna*. This is probably associated with the higher pH of the Jandakot material. Three of the 6 contrasts for *Acacia* seed sources gave best dry weights in Lesmurdie soil. In the other 3 the Yalgorup subsoil gave highest yields and Lesmurdie soil second highest. For the two *Acacia* species nodulation appears to have been more important than inherent soil fertility.

For the two non-legume species where four soils were utilised the distinction between good and poor growth was more pronounced. Five of the 6 contrasts produced most dry matter in Lesmurdie and least in Jandakot soil. The exception was *Allocasuarina humilis* with highest yield in Yalgorup topsoil and lowest in Yalgorup subsoil.

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