QUALITY OF SEEDLINGS RAISED AT THE GNANGARA NURSERY, MAY 1989

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Summary:-

CALM's nursery at Gnangara W.A. annually grows various species of pines as seedlings and cuttings. Cultural conditions are not necessarily uniform throughout the nursery. In May 1989, the mycorrhizal status of the pine seedlings and cuttings was assesssed for the first time.

This report records the weight and mycorrhizal status of the seedlings and cuttings grown in the nursery. The top weights of 1 year old P. radiata seedlings and cuttings ranged from 6.11 g to 13.8 g (fresh wieght) and from 1.7 g to 3.9 g (dry weight). In this same group of P. radiata seedlings and cuttings, the proportion of mycorrhizal roots ranged from 20.9% to 79.2%. It also compares seedlings of Pinus pinaster raised at Gnangara with seedlings grown in a private nursery. The top weights of 1 year old P. pinaster seedlings, ranged from 13.4 g to 25.7 g (fresh weight) and from 3.8 g to 8.1 g (dry weight). The proportion of mycrorrhizal roots in the P. pinaster seedlings ranged from 0.6% to 30.2%.

Introduction:-

In 1989 pine seedlings and cuttings for planting in CALM's estate were raised at the Gnangara nursery. During the next few years pine production will be moved to the west Manjimup nursery and the Gnangara nursery will be closed. The size and mycorrhizal status of the pine seedlings grown at the Gnangara nursery is not routinely measured. Application of chicken manure to one area of the nursery in spring 1988 resulted in high mortality of many seedlings. The following survey records the weight and mycorrhizal status of Pinus radiata and P. pinaster grown at the Gnangara nursery in 1989. As all the P. pinaster seedlings were raised in an area where chicken manure had been applied, P. pinaster seedlings from a private nursery were used as a comparison.

Method:-

Plants from Gnangara Nursery, collected 22-5-89

(I) SAMPLING PROCEDURE:

All the plants were randomly selected. Each treatment comprised of 3 replicate samples (20 plants per sample). Each of the sample was then

divided into 2 sub-samples of 10 plants each. One set of the sub-samples was then used for single plant weight measurements. The other set of sub-samples was used for mycorrhizal assessment.

(II) WEIGHT MEASUREMENTS:

The 30 plants from the 3 replicate sub-samples were weighed singly. Each plant was cut with a pair of secateurs to separate the tops from the roots and the fresh weights recorded. The tops and roots of each plant were then placed in a labelled brown bag, dried at 70°C for 2 days, and reweighed.

(III) MYCORRHIZAL ROOT ASSESSMENT:

In each of the other 3 replicate sub-samples the root systems of the 10 plants were washed to remove soil particles and other foreign matter. The fine lateral roots were then stripped from the plants and weighed.

Four 0.2 g samples of fine lateral roots were taken from each bulk sample. The proportion of mycorrhizal and non-mycorrhizal roots in each of the four sub-samples was assessed by a modification of the Newman method (Newman 1966).

Briefly, this modified method consists of counting the number of mycorrhizal and non-mycorrhizal root pieces which cut across a random transect formed by a cross-hair graticule placed in the eye-piece of a dissectiing microscope. Roots which demonstrated dichotomous branching and pronounced roundness of root tips were considered as mycorrhizal.

When all four of the 0.2 g sub-samples of roots had been scored, they were re-bulked, dried and weighed.

The tops of the 10 plants in each sub-sample were then bulked and the fresh weights recorded. The dry weights were obtained after drying for 2 days at 70°C.

Plants from the Private Nursery

Since only 35 plants of 1 year old P. pinaster were obtained at a later date (13-7-89), no single-plant weight measurements were made. The plants were randomly divided into 3 samples of 10 plants each. Fresh and dry weight measurements were taken from each 10-plant samples. Mycorrhizal status was assessed by the modified Newman method as described above.

Results:-

A. Fresh and dry weights (Table 2&3)

The results show that:

A1. Shoots

Among the P. radiata seedlings and cuttings (i.e. codes 1,2,3,4 & 7) there was no significant difference in the fresh and dry shoot weights of plants from codes 1,2,4 & 7. The seedlings with sawdust and nitrogen treatment (code 3) were not significantly different to the untreated seedlings (codes 1 & 7), but were significantly lighter than the untreated cuttings (code 4). The seedlings with chicken manure added to the soil (code 2) were not significantly different to the untreated seedlings (codes 1 & 7), but were significantly heavier than those which were given sawdust and nitrogen (code 3).

The fresh and dry shoot weights of the P. pinaster seedlings grown in the Gnangara nursery (code 6) was significantly lighter than those from the private nursery (code 8). But when compared to the P. radiata seedlings and cuttings also grown in CALM's Gnangara

nursery, the fresh and dry shoot weights of the P. pinaster seedlings were only significantly greater than the seedlings given the sawdust and nitrogen treatment (code 3), and showed no significant difference to the others (codes 1,2,4, and 7).

A2. Roots

There was no significant difference in the fresh and dry root weights of the untreated P. radiata seedlings (code 1) and the untreated P. radiata cuttings (code 4), they (code 1) were significantly heavier than the untreated seedlings grown in a compacted area of the nursery (code 7).

The fresh root weight of the untreated seedlings (code 1) was also significantly greater than those given the sawdust and nitrogen treatment (code 3) and the chicken manure treatment (code 2).

The fresh root weight of the P. pinaster seedlings grown in the Gnangara nursery (code 6) was significantly lighter than that of the P. pinaster seedlings from the private nursery (code 8).

A3. Shoot:root ratios

Among the P. radiata seedlings and cuttings, the fresh weight shoot:root ratios ranged from 2.2:1 to 3.8:1, and the dry weight shoot:root ratios ranged from 2.4:1 to 4.1:1. In both cases the untreated seedlings (code 1) had the lowest shoot:root ratio, and the seedlings from the chicken manure added area (code 2) had the highest shoot:root ratio.

As for the two samples of P. pinaster seedllings, CALM's pinaster seedlings had the higher shoot:root ratios (i.e. 5.4:1 (fresh weight) and 4.7:1 (dry weight)) and the pinaster seedlings from the private nursery had the lower shoot:root ratios (i.e. 3.6:1 (fresh weight) and 3.9:1 (dry weight)).

B. Fresh and dry weights of fine lateral roots (Table 4)

The results show that:

The untreated P. radiata seedlings (code 1), the untreated P. radiata seedlings from the compacted area of the Gnangara nursery (code 7) and the untreated P. radiata cuttings (code 4), all have significantly greater fresh weight and dry weight of fine lateral roots when compared to those from codes 2,3,6 and 8.

Although the P. pinaster seedlings from the private nursery had significantly heavier fresh and dry whole root systems, the fresh and dry weights of their fine lateral roots were not significantly different to those of the P. pinaster grown in Gnangara nursery, but were significantly less than those of P. radiata (codes 1,4 and 7).

C. Mycorrhizal roots (Table 5)

The results show that:

The proportion of mycorrhizal roots in the untreated 1 year old cuttings (code 4) and the untreated 1 year old seedlings (code 1) was 79%. The proportion in the untreated 1 year old seedlings from the compacted area (code 7) was significantly less (i.e. 57%). The proportion in the seedlings from the sawdust treated area (code 3) was significantly lower (37%) than those from the untreated (codes 1 and 4, (79%)) and the untreated compacted (code 7, (57%)) areas. The proportion in the seedlings from the chicken manure area was significantly lower (20.9%) than those from the untreated (codes 1 and 4, (79%)), untreated compacted (code 7, (57%)) and sawdust-added (code 3, (37%)) areas.

The proportion of mycorrhizal roots in the 1 year old P. pinaster seedlings was alarmingly low (0.6%). Significantly lower than P. pinaster seedlings grown in a private nursery (30.2%).

Conclusion:-

The seedlings grown in sawdust and nitrogen (code 3) and chicken manure (code 2) amended areas showed a significantly lower proportion of mycorrhizal roots when compared to those grown in unamended areas. They also have significantly lesser weight of fine lateral roots. At the same time, there was no significant difference in shoot weights when compared to those from the untreated areas.

There were significant differences in shoot weights, weights of whole root system and proportions of mycorrhizal roots between P. pinaster grown in Gnangara nursery and those grown in the private nusery. But there was no significant difference in the fresh and dry weights of fine lateral roots.

References:-

Newman, E.I. (1966).

A method of estimating the total length of root in a sample. Journal of Applied Ecology 3:139-145.

12-9-89

Table 1. *Pinus radiata* and *P. pinaster* seedlings used in the survey.

Species	Codes	Cultural Conditions	Nursery Beds
P. radiata	1	1 yr old seedlings	10
	7	1 yr old seedlings (compacted site)	7,8,9
	2*	1 yr old seedlings & sawdust & chicken manure	(see figure 1)
	3*	1 year old seedlings & sawdust & N fertilizer	(see figure 1)
	4	1 year old cuttings	12
	5*	2 year old seedlings	1 & 2
P. pinaster	6*	1 year old seedlings & sawdust & chicken manure	(see figure 1)
	8	1 year old seedlings (private nursery)	

The nursery plan is shown in Figure 1.

* (i) Sawdust added to Beds 1 & 2 in September 1985

(ii) Urea added to Beds 1 & 2 in 1987 (4.7 tons per hectare)

Table 2. Fresh Weights of Shoots and Roots

	Code	Fresh Weight (g)		Shoot:Root Ratio
		Shoot	Root	
P. radiata seedlings	1	10.7 BCD	4.9 B	2.2:1
P. radiata seedlings (compacted area)	7	10.0 BCD	3.1 CD	3.2:1
P. radiata cuttings	4	13.8 B	4.3 BC	3.2:1
P. radiata seedlings (sawdust & nitrogen)	3	6.11 D	2.0 D	3.1:1
P. radiata seedlings (chicken manure)	2	11.4 BC	3.0 CD	3.8:1
P. pinaster seedlings (chicken manure)	6	13.4 B	2.5 D	5.4:1
P. pinaster seedlings (private nursery)	8	25.7 A	7.1 A	3.6:1

Means in a column followed by the same letter ar not significantly different ($p > 0.01$).

Table 3. Dry Weights of Shoots and Roots

	Code	Dry Weight (g)		Shoot:Root Ratio
		Shoot	Root	
P. radiata seedlings	1	2.8 BC	1.2 B	2.4:1
P. radiata seedlings (compacted area)	7	2.6 BC	0.7 CD	3.7:1
P. radiata cuttings	4	3.9 B	1.0 BC	4.1:1
P. radiata seedlings (sawdust & nitrogen)	3	1.7 C	0.5 D	3.4:1
P. radiata seedlings (chicken manure)	2	3.1 BC	0.8 CD	4.1:1
P. pinaster seedlings (chicken manure)	6	3.8 B	0.8 BCD	4.7:1
P. pinaster seedlings (private nursery)	8	8.1 A	2.1 A	3.9:1

Means in a column followed by the same letter are not significantly different ($p > 0.01$).

Table 4. Fresh and Dry Weights of Fine Lateral Roots

	Code	Fresh Weight of Fine Lateral Roots (g)	Dry Weight of Fine Lateral Roots (g)
P. radiata seedlings	1	0.8 A	0.1 A
P. radiata seedlings (compacted area)	7	0.7 A	0.1 A
P. radiata cuttings	4	0.8 A	0.1 A
P. radiata seedlings (sawdust & nitrogen)	3	0.3 B	0.04 B
P. radiata seedlings (chicken manure)	2	0.2 B	0.03 B
P. pinaster seedlings (chicken manure)	6	0.07 B	0.01 B
P. pinaster seedlings (private nursery)	8	0.2 B	0.04 B

Means in a column followed by the same letter are not significantly different ($p > 0.01$).

Table 5. Mycorrhizal Status of Pine Seedlings from Gnangara and Private Nurseries, May/July 1989

	Code	Proportion of Mycorrhizal Roots (%)
P. radiata seedlings	1	79.2 A
P. radiata seedlings (compacted area)	7	57.1 B
P. radiata cuttings	4	79.0 A
P. radiata seedlings (sawdust & nitrogen)	3	37.0 C
P. radiata seedlings (chicken manure)	2	20.9 D
P. pinaster seedlings (chicken manure)	6	0.6 E
P. pinaster seedlings (private nursery)*	8	30.2 C

Figures in cloumn with the same letter are not significantly different ($p > 0.01$).

*Private nursery plants assessed in July 1989.

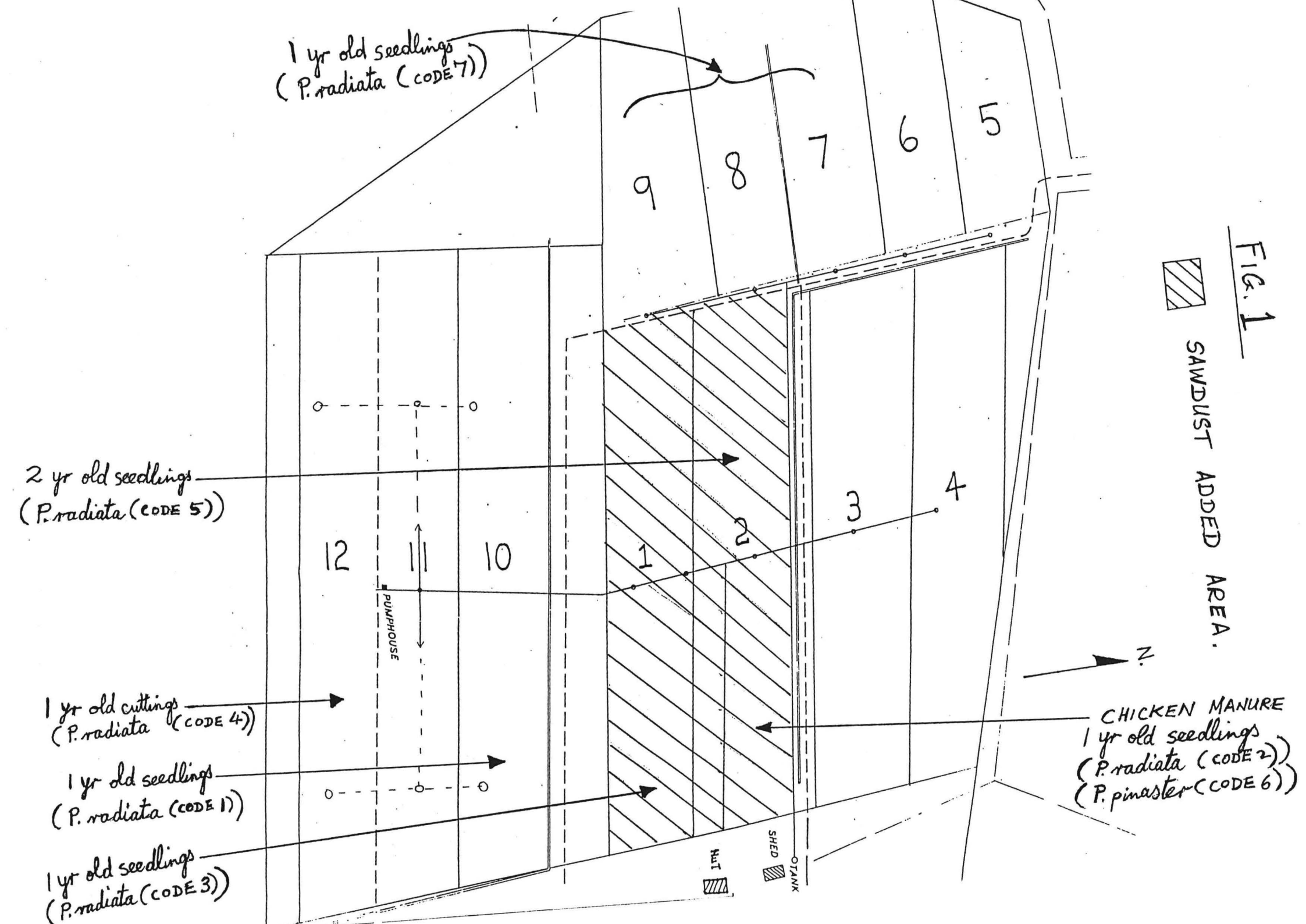
1 yr old seedlings
(P. radiata (CODE 7))
9
8
7
6
5
2 yr old seedlings
(P. radiata (CODE 5))
12
11
10
1
2
3
4
PUMPHOUSE
1 yr old cuttings
(P. radiata (CODE 4))
1 yr old seedlings
(P. radiata (CODE 1))
1 yr old seedlings
(P. radiata (CODE 3))
CHICKEN MANURE
1 yr old seedlings
(P. radiata (CODE 2))
(P. pinaster (CODE 6))
SAWDUST ADDED AREA.
HUT
SHED
TANK
N

FIG. 1