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062182

A RESUMÉ OF AGROFORESTRY RESEARCH - HELENA CATCHMENT.

1. Agroforestry in the context of Western Australian agriculture.

Farmers have been clearing land for the past 150 years. It is unlikely that they were all wrong. This suggests that agroforestry is likely to have a limited role in the southwest of this State, especially in the true wheatbelt areas.

The areas where agroforestry is believed to have a future are as follows:

a) pine plantations established by the Forests Department and by private interests.

b) in the farming areas of the lower southwest.

c) in catchment areas where remedial action to reduce stream salinity is necessary.

d) on occasional properties where it is of benefit to the farmer, e.g. Cook's, Esperance etc.

For farmers in catchment areas and in the lower southwest to become interested in agroforestry, financial incentives or legal constraints will be necessary. Agroforestry is unlikely to succeed without the full support of the Department of Agriculture and its extension staff.

2. The Helena Research in the context of agroforestry research in the southwest.

Agroforestry research is being carried out at a large number of sites. There is good integration of work between Departments and between individual research workers. This integration is occurring primarily at the research worker level.

LOCATION	DEPARTMENTS INVOLVED	WORK WHICH IS BEING UNDERTAKEN.
Yalanbee	CSIRO	Hydrology, tree arboreta, grazing damage, crop/tree interactions
Corrigin	Agriculture	Tree plots, hydrology.
Culford) Dryandra) Popanyinning)	CSIRO	Tree arboreta, hydrology, transpiration.
Helena	CSIRO, Forests, P.W.D.	Hydrology, economics of agroforestry.
Collie (a) Stene's	P.W.D., Forests, Agriculture.	Hydrology, tree arboreta, practical
(b) catchments	CSIRO, P.W.D., Forests.	Hydrology.
Blackwood Valley	Forests.	Trials on practical agroforestry.
Sunklands	Forests, Agriculture.	Economic valuation of agroforestry.
Various	Forests.	Arboreta.

3. Helena Catchment trials.

Most of the trials are located on farmland repurchased by the P.W.D. during the late 50's and early 60's. The foresight of that Department has undoubtedly saved the Helena reservoir from becoming saline. We will be visiting a number of trials.

Trial 1. Agroforestry. - to test the effect of species, planting density and planting pattern on tree growth, pasture production and economics. Planted 1978.

Trial 2. Landscape trial. - effects of tree species, position in the landscape, and width of tree belt on shallow and deep groundwater tables. Planted 1977.

Trial 3. Hill side planting. - to examine effects of dense planting of eucalypts on shallow and deep groundwater tables. Planted 1978.

Trial 4. Firewood removal. - Wellbucket - to examine the effects of a firewood cut by Wundowie on water and salt yield, deep and shallow groundwater tables. Established 1974.

Trial 5. Wellbucket - Leader trial. - testing of three varieties of clover under three densities of pine. Also cropping of lupins and oats under a pine canopy. Transpiration studies. Established 1975.

Trial 6. Reserve Bank trial. - grazing under two species of pine, on two soil types and at four canopy densities. Established 1977.

4. Main Results.

(a) Yalanbee Trials. Agroforestry systems require skilled management in the early years. Consumption and grazing damage by livestock can result in heavy mortalities of young trees. CSIRO research has shown that consumption is less if the pasture between the trees is of good quality and that spraying Ziram on the trees can effectively deter consumption for short periods.

(b) Yalanbee trials. Crops, or pasture for hay, can be grown between tree rows if these are suitably spaced. Cereal crops only reduce survival and growth of tree seedlings if the crops are grown within a metre of the trees (Figures 1 and 2). Therefore if tree rows are 8m apart hay-making or cropping could be practised on 75% of the land until year 3 when grazing sheep becomes practicable. We have established a range of spatial plantings of P.radiata into pasture and we will study the effect of these on pasture production and also the effects of the various spacings on tree form.

(c) Trials 1, 2 and 3 - No demonstrable effects on groundwater tables as yet. Tree plots have been successfully grazed (Trial 2).

(d) Trial 4 - removal of 50% of the total volume, 14% of the trees, 30 per cent of the basal area and 40% of the crown cover has not had demonstrable effects on the stream flow or groundwater tables. Estimated crown cover 11%, stems=140 per hectare (30 sph greater than 30 cms dbh).

(e) Trials 5 and 6 - Pastures planted under older, thinned trees start off well but quickly become less dense and less productivy if tree numbers are high (Figure 3). Sheep carrying capacity is similarly reduced (Figure 4) and this is exacerbated because the tree crowns continue to grow doubling their size in 4-5 years (Figure 5). To maintain productivity of the pastures the trees must be periodically pruned or thinned.

(f) Transpiration under agroforestry - E.A.N. Greenwood.

(i) Trial 5. A radiata pine plantation near Mundaring. Evaporation from a 16 year-old, high-pruned pine and the under-lying pasture and soil was measured over a year. Total evaporation from the tree, pasture and soil accounted for all the precipitation. Over the summer, lack of soil water was the major factor controlling transpiration.

(ii) Culford trial. Four year-old eucalypt plantations on farm land in a similar rainfall to the above seem able to use more water.

Daily evaporation rates mm

	Summer-Autumn	Winter-Spring
16 year-old P.radiata	0.6	3.8
Pasture and soil	NIL	1.5
E.globulus		17
E.camaldulensis 4 y.o.		12
E.wandoo		8

g) Trial 5 and 6. Thinning increases diameter increment but reduces total volume increment. However thinned trees will eventually be larger in size and thus more valuable.

DATA FROM WELLBUCKET LEADER TRIAL

(Current Annual Increment 1977 to 1979)

STOCKING Stems per hectare	Diameter under bark. inc/yr cms.	Basal Area Under bark. inc/yr m^2	m^3 VOLUME inc/yr to 23 cm Diameter	$
126	1.26	0.7	6.6	$100
213	1.05	0.8	7.2	$110
316	0.72	0.8	7.6	$115

DATA FROM WELLBUCKET (RESERVE BANK) TRIAL

(P. radiata)

STOCKING Stems per hectare.	diameter under bark. inc/yr cm. (1977-78)	Basal Area under bark. inc/yr m^2 (1977-78)	2 Tooth wethers (1978) estimated annual carrying capacity.
NIL	NIL	NIL	10
70	1.33	0.43	8
120	1.03	0.54	6.7
150	0.86	0.62	6

Research will establish the physical production frontier between timber and grazing units (Figure 6). From these data, economic evaluations will then be possible.

(h) Parkland clearing

(i) Some farmers (e.g. Cooks) have been practicing a form of agroforestry for many years. Trees per hectare retained range from 4 to 22 and average about 10 (see aerial photos). This is done at a cost to the farmer - about two weeks extra work per 100 ha paddock, at each time of cropping (about 3 yrs). In some cases where parkland clearing has been practiced (Wrights) incipient soil salinity problems have been observed.

(ii) The distribution and clover content of pastures under scattered marri, wandoo, and jarrah trees averaging 20 m in height has been measured by CSIRO.

The wandoo influenced the pastures to 18 m from their base, the other two species only to 12 m. Both the total production and the clover content of the pasture were severely reduced close to the trees. (Figure 7).

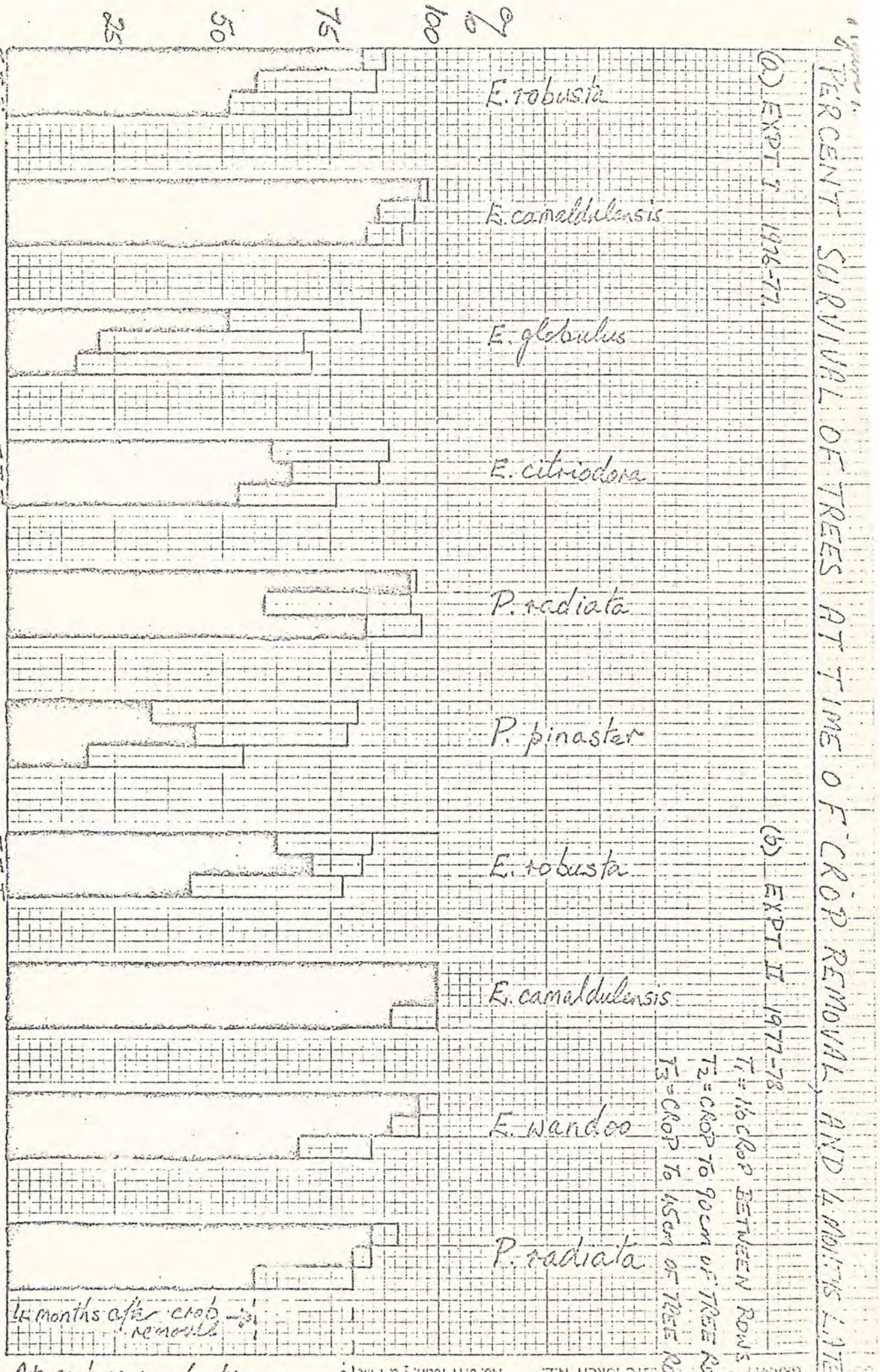
In the Reserve Bank trial under pruned 16-year-old pines, second year pastures yielded 20, 33 and 40% less under 70, 120 and 150 trees/ha respectively than control pastures on clear felled plots. The crown covers of these pine stands were 13, 25 and 28% respectively. High clover content of the pastures was maintained right up to the base of the pines.

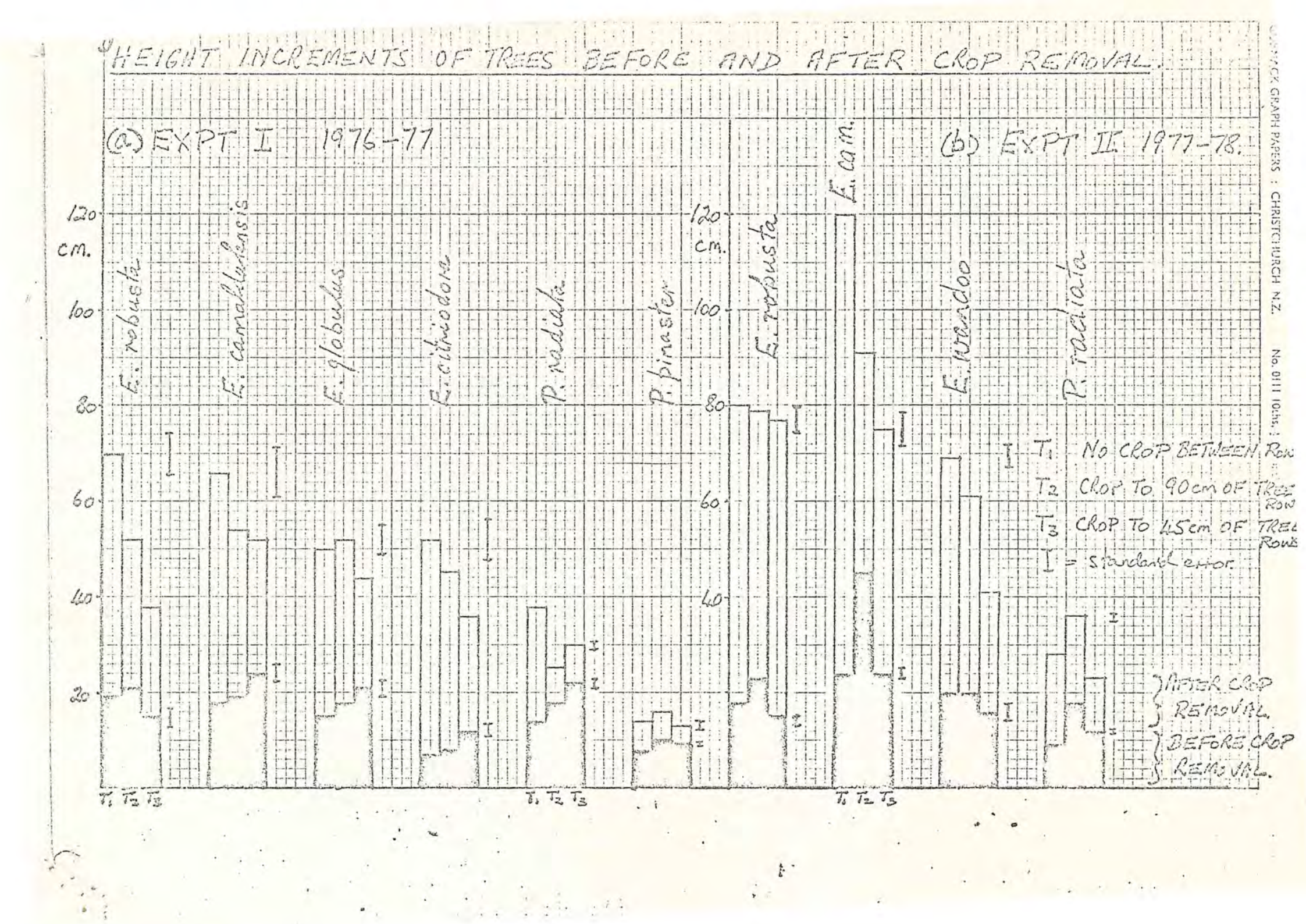
(iii) In some Collie sub-catchments PWD and CSIRO scientists are monitoring the groundwater elevations in strategically cleared sites.

In one study they have left strips of native forest across the slope occupying 10, 20 or 30% of the land surface. These are separated by 100, 150 or 300 m of pasture. In another area they have removed trees and understorey vegetation to create a park land with 25 trees/ha and sown pasture between. The effects of clearing various soil and topographic land units (eg. duricrus upper slopes) are also being measured.

(iv) Transpiration studies by B. Carbon (CSIRO) indicate that native plants in the understorey layers transpire very actively in the winter and spring months. Most plants transpire little in summer, though some are atypical. The effects of clearing understorey on hydrology are not adequately quantified.

G.W. ANDERSON
F. BATINI.


PERCENT SURVIVAL OF TREES AT TIME OF CROP REMOVAL AND 4 MONTHS LATER
25
50
75
100
%
(a) EXPT I 1976-77.
E. robusta
E. camaldulensis
E. globulus
E. citriodora
P. radiata
P. pinaster
T1 T2 T3
(b) EXPT II 1977-78.
E. robusta
E. camaldulensis
E. wandoo
P. radiata
T1 = NO CROP BETWEEN ROWS
T2 = CROP TO 90cm OF TREE ROW
T3 = CROP TO 45cm OF TREE ROW
4 months after crop removal
At crop removal time
GRAPH PAPER
CHRISTCHURCH N.Z.
No. 0111 10 Dec. 1 & 1 inch


HEIGHT INCREMENTS OF TREES BEFORE AND AFTER CROP REMOVAL.
(a) EXPT I 1976-77
(b) EXPT II. 1977-78.
cm.
120
100
80
60
40
20
E. robusta
E. camaldulensis
E. globulus
E. citriodora
P. radiata
P. pinaster
E. tereticornis
E. cam.
E. grandis
P. radiata
T1 T2 T3
T1 T2 T3
T1 T2 T3
T1 No CROP BETWEEN ROW
T2 CROP TO 90cm OF TREE ROW
T3 CROP TO 45cm OF TREE ROWS
I = standard error
AFTER CROP REMOVAL.
BEFORE CROP REMOVAL.
CUSTACK GRAPH PAPERS : CHRISTCHURCH N.Z. No. 0111 10cm.

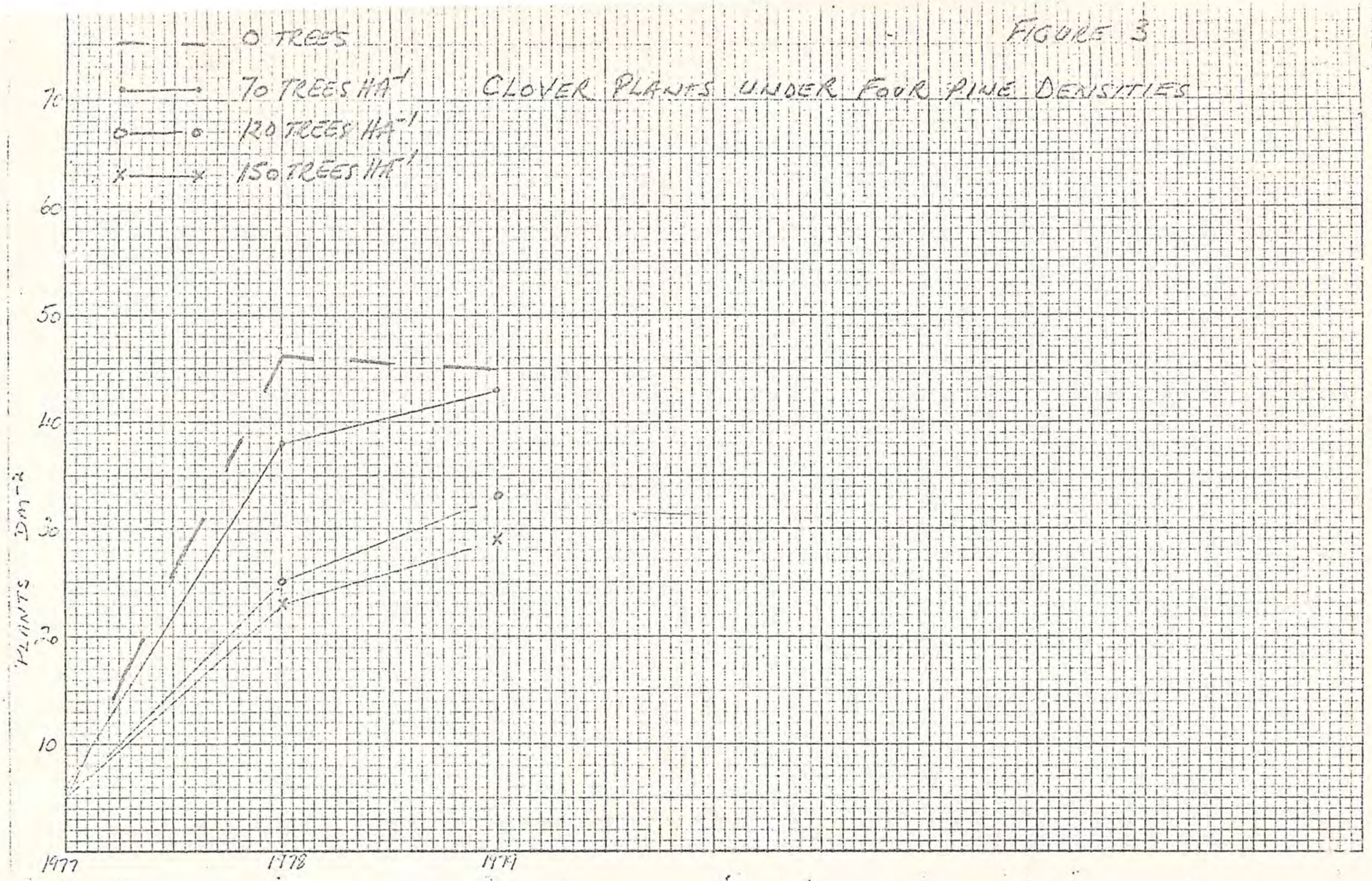
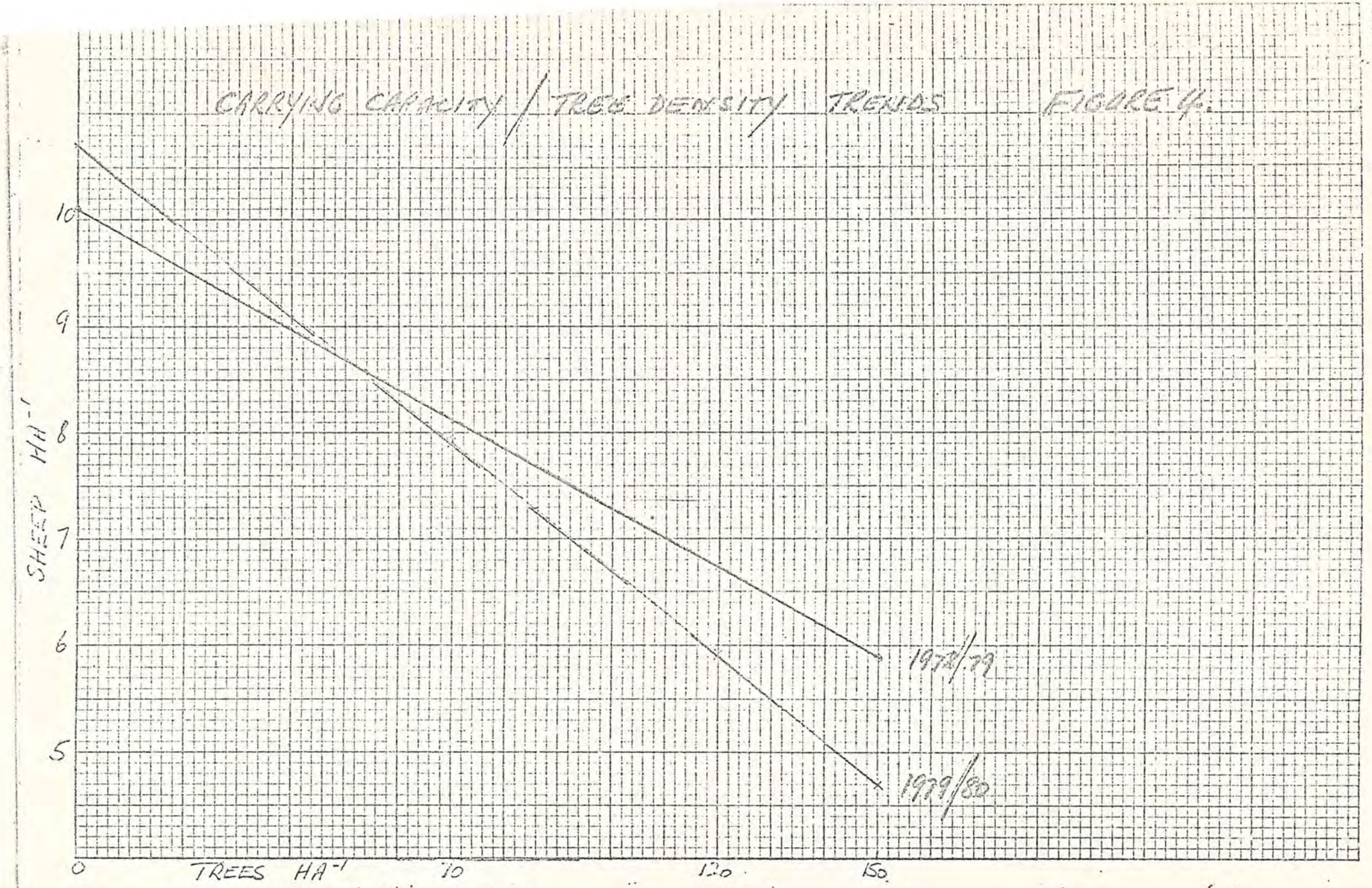


FIGURE 3
CLOVER PLANTS UNDER FOUR PINE DENSITIES
0 TREES
70 TREES HA^{-1}
120 TREES HA^{-1}
150 TREES HA^{-1}
PLANTS DM^{-2}
10
20
30
40
50
60
70
1977
1978
1979



MEAN FOLIAGE BASAL AREA OF 1962 PLANTED P. RADIATA (PRUNED TO 6M)

FIGURE 5

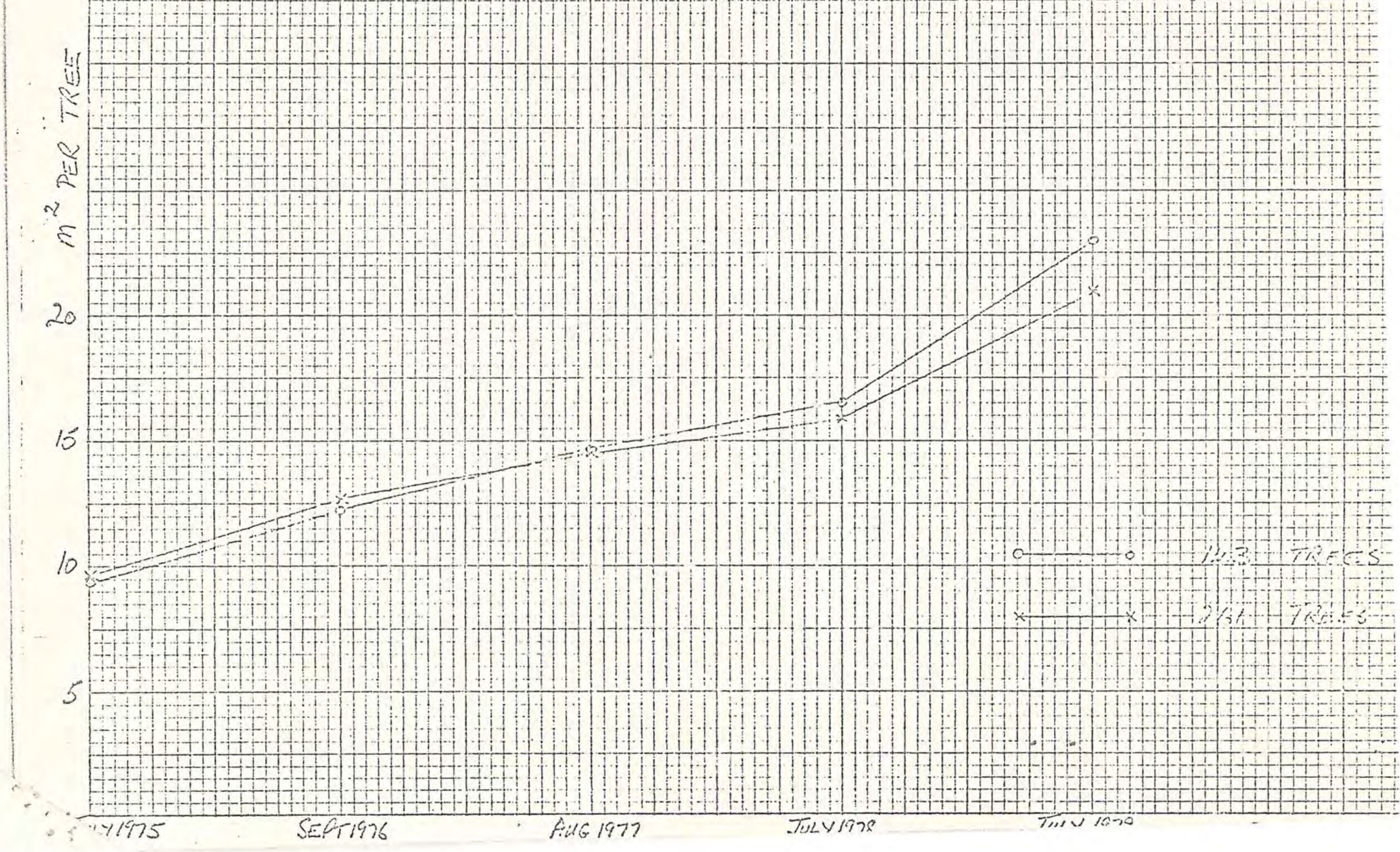


Figure 6

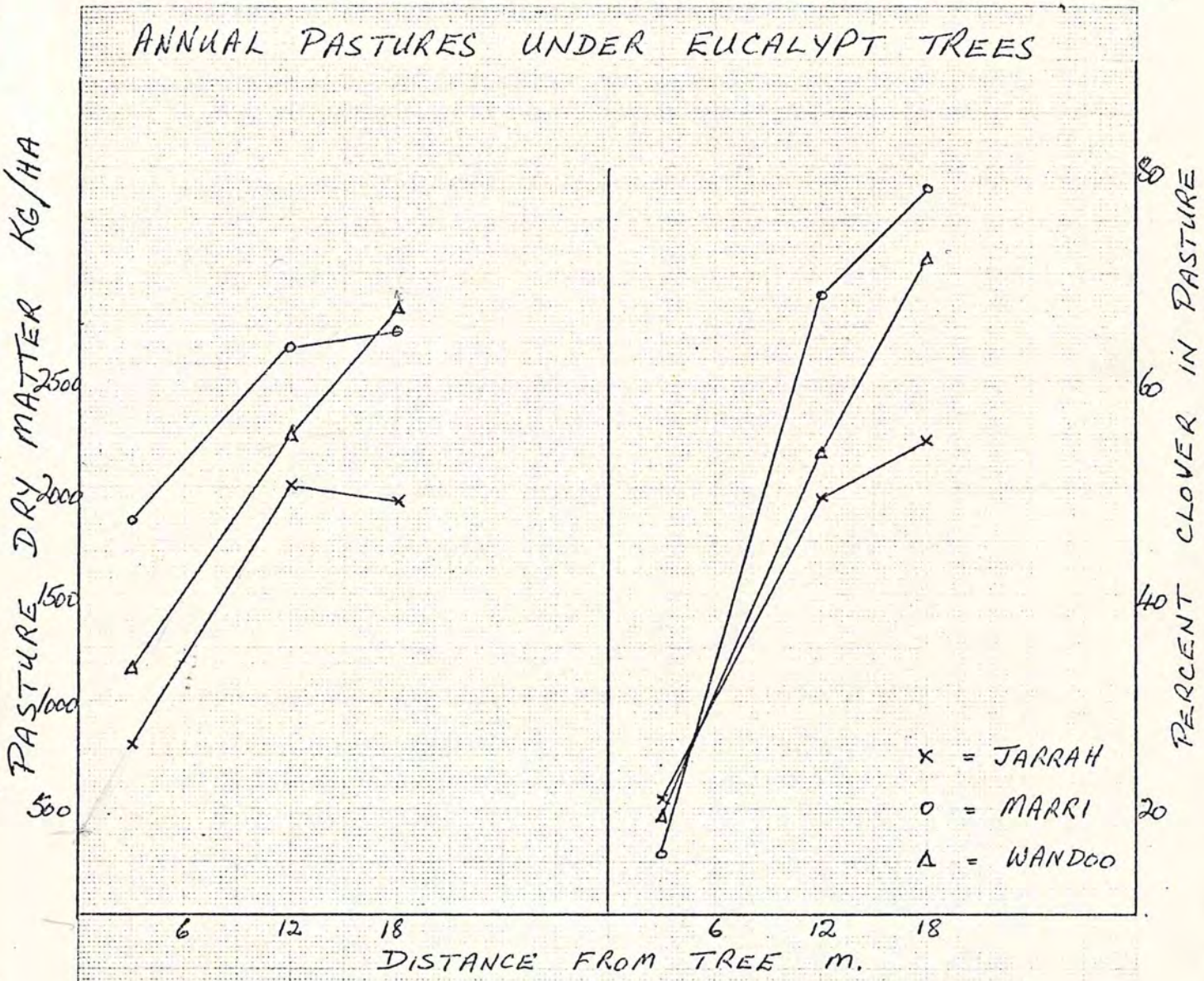
Physical Production Frontier

sheep / timber.

also need to consider

1. economic frontier
2. discounted cash flow analysis
3. financing.

FIGURE 7


ANNUAL PASTURES UNDER EUCALYPT TREES
PASTURE DRY MATTER KG/HA
2500
2000
1500
1000
500
PERCENT CLOVER IN PASTURE
60
40
20
× = JARRAH
o = MARRI
Δ = WANDOO
6
12
18
6
12
18
DISTANCE FROM TREE m.