NOTES ON INLAND ARBORETA TREE PLOTS

by A.J. Hart

This report attempts to outline in some detail for the benefit of readers, what was attempted and what has been achieved, mainly under two Working Plans 7/59 and 10/58. The period since recognized inauguration of the Inland Arboreta is now 11 - 12 years.

HISTORICAL

Although the W.P's indicate initiation in 1958 and 1959, much work had been commenced before this date and goes back to around 1951-52 with plots being established at Yuna, with Dr. Teakle's co-operation and also at Wongan Hills on areas of salt land with the co-operation of the Department of Agriculture. A plan of location of plots including some now abandoned is attached for general interest for those who may care to visit the more accessible ones.

(A) W.P. 7/59 - SOIL MOISTURE DETERMINATIONS

AIM to determine relationship between moisture content of the soil and tree growth.

OFFICER IN CHARGE D.H. Perry
Associated Personnel G.E. Brockway. Advice and direction.

Date of Inauguration August 1959.

Location

Eneabba - No.1 Plot (North Plot)
Mendels - No.1 Plot (Everett Birche's Property)
Morawa - No.1 Plot (Sandplain Plot)

SCOPE OF INVESTIGATION Field determinations will be made of the soil moisture content of the "A" and "B" horizons down to "C" horizon using a "Speedy" moisture meter. The "C" horizons of Arboreta listed are practically impenetrable to the tree roots. The "B" horizon will be sampled at the point where it rests on the "C" horizon. It is thus hoped to estimate the amount of soil moisture available to the trees on each site at various times of the year and relate this to the growth pattern of the trees.

TREATMENT Treatments will be as follows:-

1. Grass Growth
2. Tree Growth
3. Indigenous Scrub
4. Cultivation

PROCEDURE As each of the Arboreta plots is bounded by a pasture paddock these will be used as control. The soil profile will be sampled at a point about 3.00 chains from the plot to ensure that the tree roots have not invaded the site. Each site will be sampled at 5 points and each profile will be sampled 3 times as follows:--

1. Complete "A" horizon.
2. Approximately half way between the bottom of "A" horizon and the "C" horizon.
3. At a point immediately above the "C" horizon.

Each of the five surface samples taken from each site will be placed in a sealed jar and then later mixed and tested with the "Speedy". Three tests for each lot are proposed. This procedure will be carried out for each of the soil horizons on each site.

The Arboreta soils will be sampled four times a year as follows:--

About August 31st	Maximum moisture
About Nov. 30th	
About Feb. 27th	
About April 30th	Minimum moisture

It was noted at that time that disorders had developed in Arboreta trees after several years of healthy growth indicating that soil moisture is a major factor governing tree growth in drier areas. This project is designed to provide positive information on this matter. Some modification of procedure and extension of the investigation may be necessary as time goes by.

Soil moistures were sampled regularly for a period from 9/9/59 to 9/12/66.

At this stage it was felt that a review of the W.P. was necessary to assess success or otherwise in relation to the aim of the W.P.

Conclusions reached in a report on this W.P. of April 1967 indicate the following main points and findings.

1. PINUS HALEPENSIS Growth at Heitman's plot Morawa exerts a stabilizing effect on soil moisture in the "B" and "C" horizons (i.e. 5" - 24" and 25" - 35" +) which is upset when heavy rain occurs and causes increases of up to 14% in soil moisture at the "C" horizon. This effect may or may not occur under any other tree plot when development of trees is such as to use all available moisture.

Trees have always appeared thrifty and no deaths have occurred in recent years.

2. Removal of natural vegetation at Eneabba and introduction of agricultural practices has created a reservoir of moisture in the soil horizon at or below 3' which fluctuates in amount with rainfall but are always fairly high compared to tree plots. The fluctuation in moisture is considered detrimental to maintenance of good soil fertility from this point of view of surface accumulation of surplus salts.

3. Pasture plot moisture regimes resemble tree plot conditions most closely, possibly through grass growth using up surplus moisture at the end of each winter and spring and retaining periodic summer rain by way of surface mulching effects.

4. The contention that trees deprive neighbouring fields of soil moisture does not seem to be true except in relation to areas immediately adjacent to trees: this distance from a tree edge is considered dependent on the type of soil, aspect and tree species concerned and is probably about 1½ times the width of the crown in extent.

5. Soil moisture has been sufficient to maintain a growth rate of approximately 2' per annum of height growth at North Eneabba in Euc. cladocalyx at 33' spacing and approximately 1.5' per annum in Pinus halepensis at Morawa at 15' spacing. Rainfall at these localities is regarded at present as being 27" and 15" respectively.

6. The amount of soil moisture is related directly to the rainfall for the corresponding preceding period of about 4 - 5 months.

7. The natural sandplain vegetation is capable of withstanding severe moisture stress for prolonged periods (up to 4 - 5 months) suggesting possibly a state of virtual complete growth dormancy. How this is achieved is not known.

8. Clearing of natural sandplain vegetation and re-establishment of trees at a spacing at 33' has not as yet resulted in soil moisture stresses such as experienced under natural vegetation. The recent drought, being one of the most severe in the past 30 years, provided an opportunity for testing soil moisture after an annual rainfall of approx. 11" (normally 27"). Cyclone "Ingrid" deposited approximately 3" of rainfall about 3 weeks before sampling and had evidently helped to replenish soil moisture. This indicates the porous nature of surface soils down to the hard impervious clay layer which underlays this area and the small amount of rain required to restore a reasonable level of moisture.

These investigations would show better results if used in conjunction with a dendrometer to correlate moisture levels and growth trends over a period. They have however, indicated a reservoir of soil moisture on cleared sandplain which could possibly be utilised by a deep-rooted perennial grass at suitable stockings. South African Veldt Grass could possibly be suitable and a small quantity has been sent to an interested party at North Eneabba subsequent to these tests.

It has been recommended that measurements be continued for another 5 years at North Eneabba by which time soil moisture should be causing stress in tree growth which is basically what it was aimed to determine and how this affects tree growth. As seen at Morawa in Pinus halepensis, these trees have maintained a fairly constant 1.5' height growth per annum to the present time, over an 18 year period. No disorders have yet been observed in this species.

However, Euc. occidentalis at the last inspection, had exhibited at least 1 death. Other losses in this species were seen elsewhere and it is anticipated that suitability of this species will need drastic revision as a result of the recent drought.

The manner in which Pinus halepensis and sandplain vegetation is able to withstand low soil moisture levels for prolonged periods is one of continued intrigue.

(B) W.P. 10/58 SEMI ARID AND ARID COUNTRY ARBORETA

AIM OF THE EXPERIMENT To collect all the available data possible on the trees and plants which can be grown in these regions with particular attention to relating species to rainfall and soil type.

Date of Inauguration 1st April 1958

SCOPE OF INVESTIGATION The arboreta listed below have been established for some years and many are now considered abandoned for research purposes.

*Moora	...	Road Board
Mingenew (2)	...	Geraldton Road Eregulla Springs
Morawa	...	J. Heitman's Property
Mendels	...	E. Birch's Property
*Yuna	...	R. Warr's Property
Wongan Hills	...	Research Station
*Jennacubbine	...	Mrs. Clarke's Property
Southern Cross	...	Forests Reserve East of Town
*Bruce Rock	...	Recreation Ground
*Newdegate	...	Pilot Farm.Agriculture Dept.
Dryandra	...	Forest Settlement.

(*No longer used for research purposes)

It is now intended to initiate the following studies of the aboreta listed:-

1. Prepare an accurate plan of each plot giving the exact location of each tree and its name. Dead trees will be included.

2. Carry out a soil survey of each plot and prepare a soil map. Collect soil samples for analyses and make one eighth scale soil profile models for the main soil types.

3. Make a contour map of each plot using 2'6" contours.

4. Collect soil samples in April of some years for moisture determinations. To collect such data and information as is possible relating to the moisture requirements of tree species under test.

5. To determine suitable espacement distances for various species and soil types.

6. Write up a complete history of each plot, the heights attained to that date by each individual including the heights of dead trees and the date of their death. Clearing, soil preparation, pasture, fertilisers, subsequent tending.

7. Obtain rainfall data for the nearest weather station to the arboretum commencing with the year the trees were planted.

PROGRESS RESULTS AS AT APRIL 1969

Conclusions reached to that date extracted from a report of 29th April, 1970 are as follows:--

1. Tree establishment in rural and wheatbelt areas of rainfall as low as 11" per annum has been proven, with good prospects of establishment to 8" rainfall per annum.

2. The list of recommended species as provided in the Department Catalogue has been extended following establishment of the plots.

3. A recommended list of species for inland areas where plots are established has been drawn up and already submitted to H.O. This covers various types of rainfall also.

4. In association with W.P. 7/59 it is inferred that tree growth exerts a stabilizing influence on soil moisture movements in the soil profile and thereby mitigates and assists in preventing soil surface accumulation of salts and also in reclamation of land affected by salt in like fashion, although other remedial measures are required in conjunction with tree plantings and pasture to recover or be re-established.

5. Together with W.P. 7/59, tree growth does not appear to encroach to a great extent on soil moisture in neighbouring fields as evidenced by soil moisture graphs of W.P. 7/59. Rainfall has an important influence on this encroachment obviously. Generally, this is contrary to popular conception in this context and the lack of the vegetation is considered in part due to toxic effects of large concentrations of tanin from trees, as well as moisture removal.

6. From the recommended lists of species it is possible to select species for a variety of purposes, tall medium or low height windbreaks, as well as decorative and ornamental purposes over a wide range of soils and rainfall. The comment made in the progress report of December 1959 bears reiteration, "in view of the huge areas of light land now being farmed the need to provide trees on this country where nature grew none, is a pressing one".

7. From observations made, it is considered the use of Tamarix sp. for salt land reclamation is not entirely justified. Growth rates are low; the best being approximately 2' per year and this on montemorillonite soils and Coastal loams, to which they seem uniquely adapted in inland soils. There use as sheep fodder is poor, as better quantities could be available from faster growing Euc. species which as per (4) above show definite proof of some re-establishment of soil moisture stabilisation.(Gunyide plot).

8. Overall results have indicated that most successful establishment figures have been obtained where regular maintenance to remove competition and pest refuges has been carried out.

GENERAL

1. To assess the success or otherwise of this experiment in relation to species suitable for planting from those originally selected, all plots were analysed using a classification into 5 classes viz:-

A.B.C. and D. These were 4 arbitrary classes of relative thrift, vigour, and associated height growth of the species concerned: the 5th class recorded deaths. The basic criteria used in assessing stock in plots was uniformity of specimens present for assessment. Results of this assessment are shown in the table below and represent a break down of 5,261 observations.

CLASSIFICATION OF TREES IN PLOTS ACCORDING TO THRIFT, HEIGHT UNIFORMITY AND VIGOUR

Classification	Percentage of Stock
A	84.00
B	8.30
C	2.30
D	0.90
Losses	4.50
Total	100%

This table is shown for brevity, as a table of plots surveyed in this way is lengthy and confusing.

2. Because of the severity of the recent drought, considered to be the worst for 30 years, a unique opportunity presented itself for checking the drought resistance of species already planted. It is intended to check this during 1970.

(C) W.P. 7/67 SALT LAND PLANTINGS

AIM i. To assess suitability of different Eucalypt species for planting in salt-affected land.

ii. Suitability of placement of species in salt-affected land in relation to topography and salt land occurrence.

iii. To assess amelioration of salting process by trees planted.

Main Species Used to Date Have Been:--

1. Euc. sargenti - salt river gum.
2. Euc. spathulata - Swamp Mallet.
3. Euc. camaldulensis - River gum.
4. Euc. kondinensis - stocking gum.
5. Euc. cladocalyx nana - Dwarf Sugar gum.
6. Platypus heterophylla (Euc.) - Coastal Moort.
7. Tamarix aphylla - Athal tree.
8. Euc. planchoniana - Bastard Tallow wood.

To date Numbers 1, 2, 3, 6 and 7 have shown good tolerance particularly 6 (Euc. platypus heterophylla) with a rapid rate of growth.

Plantings made with these species were replicated, in part, at both Avondale and Wongan Hills Agricultural Research Stations.

Two types of stock have been used to date, normal potted stock and stock grown in long plastic tubes and bags in an endeavour to place roots of the seedlings below the high salt concentrations. The levels of salt encountered are shown in Table 4 along with growth rates per annum of species at present under test with survival %'s and numbers.

This trial has demonstrated that the use of Tamarix aphylla on salt areas does not normally give rapid rate of growth - as mentioned earlier, this species seems more suitable to coastal limestone, sandy loams and montmorillonite soils. The surprising aspect of this trial has been the success of River gums and Coastal Moort, but then this fact was plain for all to see in many places, as it naturally inhabits brackish water courses and near the sea fronts respectively.

Whilst not wishing to be optimistic it is felt that were adequate plantings made with the faster growing Eucalypts, along the edge of salt areas, some reclamation could be achieved in reasonable time and at least contain the spread of such areas. This belief is based on the result of soil tests and an appreciation of the way in which this problem arises in relation to soil moisture. It is also worth noting that it is considered ill-advised to remove natural vegetation from along water courses and natural drainage channels because of the likelihood that surface salting will ensue with consequent loss of utility.

The list of species included here is by no means exhaustive of those known to be resistant to salt; rather it is the aim to test Eucalypts because of faster growth and ease of establishment with prospects of natural regeneration when established.

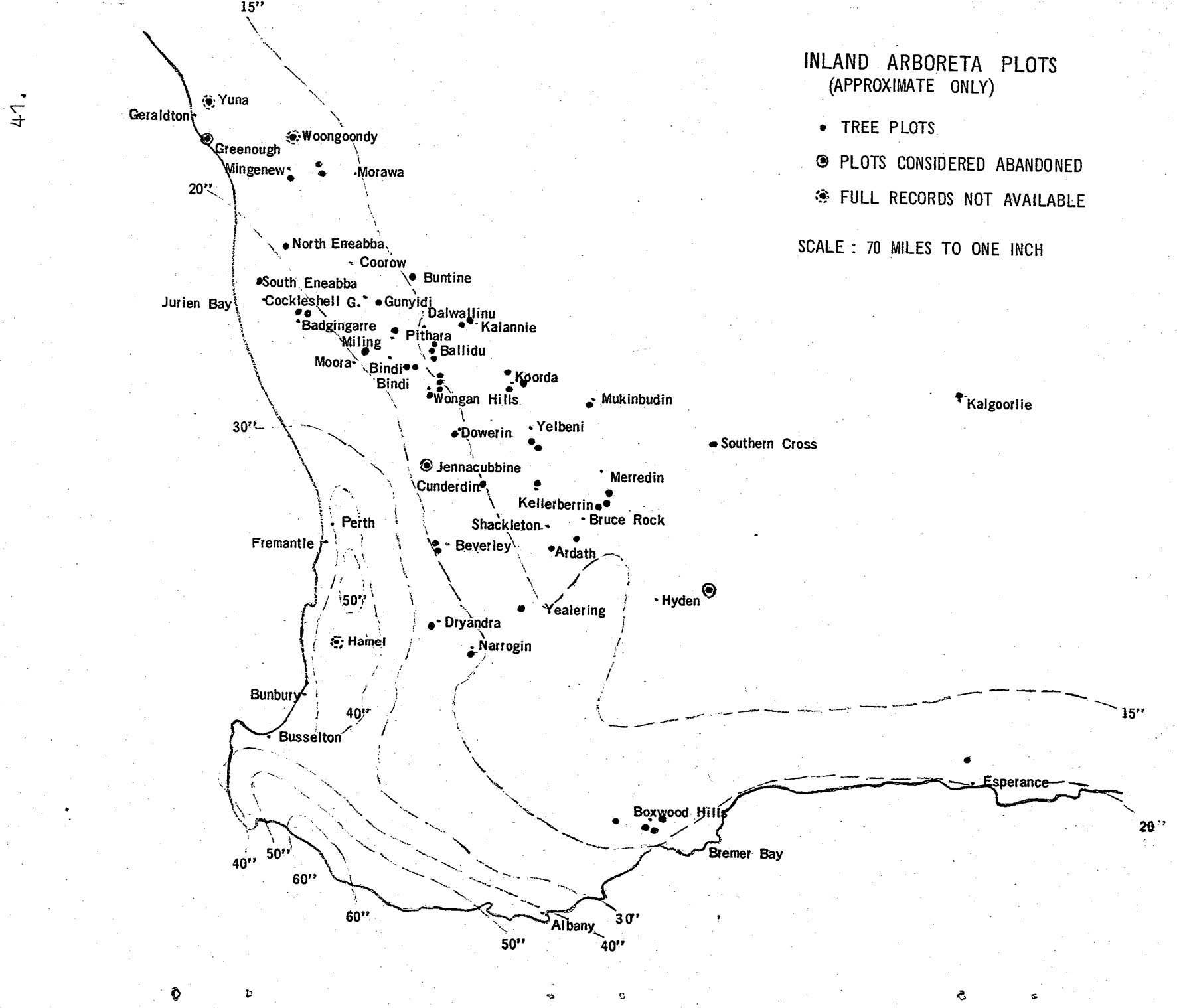
If any reader is interested in any particular aspect of these experiments please contact the writer.

FUTURE ACTION: Because of the outstanding success of plantings with River Gums, a new W.P. 28/68 has been implemented to test various provenances of River gums collected throughout Australia and one from Zanzibar for resistance to insect attack primarily. This Working Plan calls for establishment of 373 seedlings of the 11 provenances in six of the already established tree plots throughout the wheatbelt.

The provenances to be tested are summarised briefly in Table 3. Three of these are currently being tested in West Pakistan by Quadri.

It is also intended to test plastic mesh tree guards during this trial. Observations to date indicate considerable damage through not removing guards, the main damage being constriction of root and branches causing fracture under wind pressures. These are necessary in early stages of growth because of rabbit attack.

Information is still being obtained from the salt land plantings and further attention will be given to this aspect of species tolerance as opportunity offers.


INLAND ARBORETA PLOTS
(APPROXIMATE ONLY)
• TREE PLOTS
PLOTS CONSIDERED ABANDONED
FULL RECORDS NOT AVAILABLE
SCALE : 70 MILES TO ONE INCH
15"
20"
30"
40"
50"
60"
Yuna
Geraldton
Greenough
Woongoondy
Mingenew
Morawa
North Eneabba
Coorow
Buntine
South Eneabba
Jurien Bay
Cockleshell G.
Gunyidi
Dalwallinu
Kalannie
Badgingarre
Pithara
Miling
Ballidu
Moora
Bindi
Bindi
Koorda
Wongan Hills
Mukinbudin
Kalgoorlie
Dowerin
Yelbeni
Southern Cross
Jennacubbine
Cunderdin
Merredin
Kellerberrin
Bruce Rock
Shackleton
Perth
Fremantle
Beverley
Ardath
Hyden
Yealering
Dryandra
Narrogin
Hamel
Bunbury
Busselton
Esperance
Boxwood Hills
Bremer Bay
Albany