TRIAL PLANTATION OF INDIAN SANDALWOOD (SANTALUM ALBUM) AT THE FRANK WISE INSTITUTE OF TROPICAL AGRICULTURAL RESEARCH, ORD RIVER IRRIGATION AREA, KUNUNURRA

by Alan Thomson

A Joint Trial Between :

The Department of Conservation and Land Management
W.A Department of Agriculture
Sandalwood Conservation and Research Project

1 OVERVIEW

Indian Sandalwood and host trees were planted in 1986 on heavy alkaline cracking clays (black soil) at the Department of Conservation and Land Mangement's Kununurra Arboretum.
Growth has been very good with some trees reaching 4m (1990). Isolated plantings (<20 trees) had also been planted within the Ord Valley. Based on this good growth rate an expanded 8 ha operational trial was set up on black soil at the WA Agriculture Departments' Frank Wise Institute of Tropical Agricultural Research in 1990 using flood irrigation. This was a joint trial between the CALM, WADA and the Sandalwood Conservation and Regeneration Project (funded by the Australian Sandalwood Company).

2 INITIAL PLANTING OF INDIAN SANDALWOOD AT CALM ARBORETUM - KUNUNURRA

In January 1986 Indian Sandalwood seedlings (Santalum album) were planted at CALM's Arboretum, Kununurra. Seedlings were planted on heavy, alkaline cracking clay soil, locally known as "black soil", which forms the majority of cultivated soils within the Ord River Irrigation Area. The seedlings were grown at CALM's Broome Nursery using seed supplied ex India. The seedlings were planted in eleven rows, seventeen plants per row, on a 5 m x 5 m spacing (approx 180 plants). A "handful" (approx 100 g) "NPK Blue" fertilizer was applied at planting. A "host" seedling was planted immediately next to the Sandalwood seedling. Hosts were a mixture of native acacias and other local species. Seedlings were watered using trickle irrigation.

At May 1990, 84 Sandalwood and 70 host plants survived.

Growth of the surviving Sandalwood has generally been good. The superior trees reaching up to 4 m the majority at 2.5 - 3 m and the remaining at 1.5 - 2 m tall. Most trees have taken a shrub habit of "bushiness" and multiple leaders. Maximum stem

diameter is approx 15 cm at ground height. Habit may be attributable to the wide spacing.

Loss of host trees may have been through natural mortality, completion of life cycle as some of the species are naturally short lived, parasitisim by Sandalwood or a combination of these factors.
A wildfire went through some of the planting on 28/8/90. Although some of the Santalum suffered severe scorching, leading to total defoliation, all burnt trees subsequently regrew. In severe scorch cases re-shooting originated on the main stem, much like Eucalypt epicormics.

3 AGENCIES INVOLVED

CALM

Buys Santalum seed from India, grows Santalum and host seedlings at Broome Nursery.
Transport seedlings to Kununurrra and hardens off.
Set out plots in field.
Supervises planting and fertilizing.
Supervises cultural operations in consultation with WADA.

WA Department of Agriculture

Made land available at FWITAR.
Prepared Bays 8C, 8E and 8F for planting.
Labour for planting.
Labour for cultural operations.
Determining irrigation regime in consultation with CALM
Supervised cultural operations in consultation with CALM.

Sandalwood Conservation and Regeneration Project (SCARP)

SCARP provides finance for materials, labour and vehicle costs.
One Fulltime WADA employee has been funded by SCARP - using a CALM FTE. Another fulltime position was put on in January 1992.

4 SEED - P90/P91

Santalum album seed was obtained through various commercial seed merchants in India. Although quantity of seed that the project required presented no difficulties, information about the pedigree of the seed was unobtainable. Approx 5 kg of seed was supplied to Broome nursery from CALM's plot in 1989. This germinated far more readily than the Indian seed. In 1990 more seed was collected and given to Voyager

Enterprises nursery in August/Sept. This germinated readily and approx 850 seedlings were produced. Approx 100 died over the Wet due to fungal infection, leaving 720 left for planting in 1991. 1991 was the best year to date for seed production at CALM's plot. Approx 2 kg of seed was supplied to Voyager Enterprises.

Three short term hosts wre selected. Seed for Pigeon Pea (Cajanus cajan) and Acacia trachycarpa was picked from plants at FWITAR. Sesbania erabescens was picked from Lake Campion.
Long term host seed was supplied by CALM Kununurra (Lysiphyllum cunninghamhii and Cathormium umbellatum) and CALM Karratha (Acacia anevra) as well as from commercial merchants.

5 GROWING SEEDLINGS AT BROOME NURSERY - P90/P91

Germination and survival of Santalum seedlings at Broome Nursery was originally disappointing. Germination rates and subsequent survival were poor - probably attributable to a combination of inferior quality seed and inappropriate nursery practice. At May 1990 only 260 suitable Santalum seedlings were supplied for planting. No pot hosts were planted with these Sandalwood.
In contrast, germination and survival of host seedlings was generally good. Numbers supplied for planting in June 1990 were:

Cathormium umbellatum	1 200
Lysiphyllum cunninghammii	1 140
Acacia anuera	200

Seedlings were transported to Kununurra on 11 June 1990 in standard Broome Nursery boxes stacked onto pallets carried by Bell Transport.
At Kununurra the seedlings were taken form their boxes and placed in the shade house at the CALM depot.
Both Santalum and hosts seedlings were supplied in standard 70 x 70 x 100 mm plastic pots with standard Broome Nursery soil mix.

6 CONFIGURATION OF BAY 8C - P90/P91

Originally it was planned to plant two bays with Santalum and hosts - Bay 8C (~8 ha) and Bay 10 (~10 ha). Because of insufficient seedling supply it was decided to plant only 8C and initial hindsight has shown that the operational difficulties so far encountered would have been unmanageable over 18 ha.

Bay 8C at covers approx 8.4 ha. It is rectangular in shape, approx 222 m x 383 m.
It was previously used for rice trials and had laid fallow for at least two years before the 1990

plantings. Prior to planting the bay was ploughed 3 times to plough in weed growth.

Approx 224 seed beds were mounded running east-west through the bay. Beds were 1.8 m wide by approx 210 m long. Bed width was dependent upon standard machinery configuration used at FWITAR. Beds were separated by furrows along which the irrigation water runs. Water is siphoned into the furrows from a supply channel on the eastern side of the bay and flows into a drain on the western side (Fig. 1).

7 ORIGINAL PLANTING DESIGN AT BAY 8C - P90/P91

Twelve treatments were to be examined - three host species x four spacings.

Hosts
Acacia aneura
Cathormium umbellatum
Lysiphyllum cunninghammii

Hosts were selected on the basis of
- being legumes
- ability to grow on alkaline clays in a tropical environment.
- natives

Cathormium and Lysiphyllum are native to black soils around Kununurra.
Acacia aneura is found widely distributed in arid Australia and had shown good growth rates on heavy red alkaline clays in Karratha.
Acacia bidwillii was initially selected as a host, but seed supply could not be obtained - replaced by A aneura.

Acacia trachycarpa was chosen as a short term host to be planted in the same row as Santalum. Santalum had shown good growth and survival when A trachycarpa had been used as a host on other trial plantings at FWITAR. Similarly Cajanus cajan appeared a good short term host, offering Santalum seedlings good shade and shelter in the immediate years following planting. Sesbania erabescens was initially trialled as a pot host at Broome nursery. Seed sown into the 1990 sandalwood plots at Kna shadehouse germinated in the field.

Spacings were 1 host : 1 santalum
1 host : 2 santalum
1 host : 3 santalum
2 hosts : 1 santalum

Examples of the row layout are given in Fig. 2.

Inter row spacings were primarily influenced by the need to access machinery. Between each bay (bay defied as a host/santalum spacing) there was the need to keep a free access path for machinery. Machinery would be necessary for weed control (slashing/herbicide) and maintenance of the beds. Previous experience with broadscale irrigation of trees at FWITAR had shown that the original planting beds lasts only 2 - 3 years before they start to lose their shape and no longer carry water efficiently. Where this had happened, empty beds between planted rows were reshaped into wide, shallow, spoon shaped drains in order to carry irrigation water.

Intra row spacing was primarily designed to keep the number of Santalum at approx 1000 stems/ha.

The number of plants available caused problems with the planting design. Originaly it had been planned to simply divide the available planting area (approx 6 out of the 8 ha - the remaining 2 ha in drains) in two replicates of each treatment. However, total numbers of host plants supplied meant that only 120 rows, including drains, were planted. As only 200 A.aneura were supplied it was decided two replicates using all 3 species would be planted and then plant the remaining Cathormium and Lysiphyllum in an operational manner. The trail therefore has become more of an operational trial than a statistically balanced experimental planting.

8 PLANTING SANTALUM AND HOST SEEDLINGS - P90

Personnel

Planting of Santalum and host took place on 25 - 27 June 1990. Planting was undertaken by A.Thomson and D.Grosse - CALM Operations Officers East Kimberley; one full time WADA employee; three casual WADA employees. One CALM wages employee assisted in Kununurra with dispatch of plants from the CALM shade house.

Technique
Holes were pre-dug with a planting spear - distance between each hole being measured with a cut-to-length stick. Planters followed up with trays of plants in wheelbarrows. Seedlings were removed from their plastic pots and any compacted roots slightly teased before firming down in holes. After planting, ~ 100 g of NPK Blue fertilizer was "heeled" into the bed approx 30 cm away from each seedling. Planted beds were watered the afternoon that planting had finished.

Numbers of seedlings planted were

A.aneura	199
C.umbellatum	1096
L.cunninghamii	1096

Two rows of Santalum were planted. Each Santalum had had either a pigeon pea or Sesbania erubescens seed placed with it as a pot host. As well an Acacia trachycarpa seedling was planted appox 0.5 m away from it in the same bed to act as a short term host.

9 DIRECT SEEDING OF SANTALUM SEED - P90

Six rows of Santalum seed were directly sowed into the soil. The seed was treated with a two per cent gibberellic acid solution and fungicide prior to sowing and was sowed approx 2 - 3 cm below ground. Three to four seeds were placed in each planting. Three to four Pigeon pea seeds were directly sowed into the same beds approx 0.5m away from the Santalum seeds.
The sandalwood seed failed to germinate, whilst virtually every pigeon pea seed germinated. These were ploughed in in October 1990

10 INITIAL SURVIVAL - P90

Initial survival of host seedlings was good. As at August 1990 survival of seedlings was

A.aneura	185	93% survival
C.umbellatum	1 052	96% survival
L.cunninghamii	1 095	92% survival

Initials urvival of the two rows of sandalwood was poor. Of approx 130 planted only approx 90 remained. Most of the deaths could be attributed to planting shock, with the small, < 10 cm, stunted seedlings withering within the first few weeks. More mortality occurred over the 90/91 Wet. Those surviving and with the best growth were generally associated with S erubescens, which had grown to 2.5 m over the Wet and then died by June 91.

11 WEED CONTROL

1990/1991 was an average Wet season for Kununurra. Weed growth was prolific, aided by the fact that machinery could not access the black soil. Weed control consisted of a combination of hand weeding, mechanical slashing by lawn mower and herbicide application. Herbicide was `Roundup'.

Hand weeding was necessry to find the sedlings amongst the weeds and once located and cleared around, the lawn mower and herbicides could be used. The lawn mower, although fitted with a power drive, was difficult to push on the black soil and was generally ineffective.
Herbicide application was the best method of weed control. Once weeds had been knocked down with herbicide, as much as possible any new weed growth was

sprayed whilst still in the seedling stage to maintain a "clean bed".

12 GROWTH OF P90 HOSTS

A.aneura had survived planting and the first Wet the best of the three hosts (approx 90 per cent survival). Average growth for the first year was 1 m. Form was generally good with most plants having a broad conical shape. Some pruning was done of lower branches where they impeded access.

C.umbellatum had good survival (approx 90 per cent) and growth had been good - average height 0.8 m. Unfortunately, form was poor with virtually all plants losing their apical dominance and becoming shrubby. Hand pruning was done to improve form and allow access.

L.cunninghamii had shown good survival after planting. However plants lost their apical dominance and became shrubby, almost to the point of being prostrate. This effected their survival as they became smothered by weeds over the Wet, while some were killed during cultural operations as the plants could not be seen. Survival was approx 80 per cent with average height after one year 0.5 m.

A.trachycarpa and C.cajun grew well over the Wet. However growth was "too good" in that these hosts overtopped the santalum very quickly and appeared to adversely effect survival and growth. Also, form of the santalum growing underneath these hosts was effected. The santalum lost apical dominance and became shrubby with multi leaders. It was decided to discontinue using these two species as intermediate hosts.

13 GROWTH OF P90 SANDALWOOD

Those sandalwood that survived had grown to about 1 m at the end of the wet season (March). They had a general growth habit of a clean stem to half their height topped off by a bushy crown containing many branches and these branches having many branchlets. Best growth was on those plants associated with an S.erebescens.

14 1991 PLANTINGS

Seedlings

More sandalwood and host seedlings were planted in 8C in 1991. Planting pattern had been altered so that there was an empty bed (drain) between nearly every

planted bed. This was done to facilitate access following the weed problem encountered over the Wet.

A contract had been let to Voyager Enterprises to raise 2 500 sndalwood seedlings in 3 l poly bags at $2.14 ea. Seed supplied from India gave generally poor germination whilst seed collected from the CALM Kna plot germinated readily. Some seedling deaths occurred over the Wet in the Voyager nursery - 100 deaths out of 1 000 seedlings. The efforts of Tony Edwards at Voyager is acknowledged as he trialled germination techniques, soil mixes, fertilisers and showed keen interest in the project. Seedlings produced by Tony had good form, vigour and survival in the field.
Broome Nursery also grew santalum but continued to experience germination and survival problems.

Broome grew hosts in 100 mm pots - A.aneura, C.umbellatum and Dalbergia melanoxylon. These and some Santalum were transported to Kna by Bell Freight. Some deaths occured during transit and the seedlings were then held in CALM's shadehouse for two weeks to acclimatise and then placed outside the shadehouse for two weeks to harden off - with some mortalities. The double handling effort was also considerable.

Herbicides

A small trial was established to see if residual herbicide could be used to decrease `RoundUp' use. A Simazine (3 l per ha) and Surflan (6 l per ha) mixture that had been successfully trialled at the Cashew Farm was sprayed on a clean bed and sandalwood and hosts planted (the mix had killed all weeds bar one species of creeper and had no toxic effect on cashew trees). After four weeks no effect could be seen on either santalum or host seedlings and the mixture was sprayed onto all bare planting areas on 8C and incorporated into the soil by irrigating.
This application appeared to have no detrimental effect on survival or growth of seedlings.

Planting

The first period of planting was in the week of 24 June 91. Holes for Santalum were dug using post hole shovels, whilst planting spears were used for host holes.

Seedlings planted were
710 Santalum
900 A.aneura
168 C.umbellatum
140 D.melanoxylon

On 2 September 91, 262 Santalum were planted and minor infilling of hosts took place.

On 18 September 91, 648 Santalum were planted.

Of these, 108 seedlings had been grown by Dave Frewe from seed collected from the Murdoch Plots and 138 were from Broome.

A S.formosa seed had been sown into each Santalum pot.

Murdoch Assistance

CALM transported Santalum and Neem seedlings from Perth to Kna. These were kept in the CALM shadehouse, some were repotted and then planted in 8C.
400 santalum and 50 Neem hosts were planted.

15 INTERMEDIATE HOST

Observations in the Voyager nursery and in 8C suggested that Sesania erascebens was a good short term host. However seed supply was not assured and it only survived one Wet season. Further observations on Block 2A suggested that Sesbania formosa was a good host. These trees probaly live to 5-10 yeas on black soil and are amongst the best species for fixing nitrogen. Extremely fast growing, they would offer santalum shelter but would not effect form becuse of their columnar form. Being a tree with few branches and a soft timber they are easily managed for cultural operations.

16 BIRD DAMAGE

The June plantings sufferred heavily from corella damage. Approx 30 per cent of Santalum, and 80 per cent of the host plantings were effected by the birds snipping off the seedlings at ground level. While most of the Santalum, Cathormium and Dalbergia reshot, the Aneura suffered approx 60 per cent mortality. The birds returned for a second attack and many of the plants that had started to reshoot were cut off again. Bird deterrent measures were implemented.

16 GROWTH OF P90 STOCK

As at March 1992 survival of the the P90 sandalwood was approx 50 per cent. Most mortality had occured as a result of transplant shock immediately after planting and during the hot Build Up season. Average height of survivors was 1.5 - 2 m with a few individuals reaching 2.5 m. Form was generally good - sapling like - but a few plants had been effected by being overtoped by A.trachycarpa.

Growth and survival of P90 hosts was -

A.aneura - Approx 80 per cent survival and had best growth with tallest plants reaching 2.5 - 3 m. Form

was conical and for plantation purposes generally neat. Many trees flowered and at August 1992 were beginning to set seed.

C.umbellatum - Approx 80 per cent survival with tallest trees approx 2 m. Form was poor with most trees having 2 - 4 main branch leaders which have to be pruned for tractor access.

L.cunninghammii - Approx 70 per cent survival with tallest trees 1 - 1.5 m. Form was poor with most trees having no apical dominance and multiple main branches.

17 GROWTH OF P91 STOCK

P91 sandalwood had been severely effected by corrella attack. As at 30 June 1992 approx 500 remained - 36 per cent survival. Best growth was on those associated with a S.formosa, reaching 1- 1.5 m with a bushy crown atop a woody stem 3 - 4 cm diameter. Those not associated with S.formosa were generally 0.5 m tall with a small, sparse crown and a thin stem. The S.formosa had grown into a tree 4 -5 m tall with a 15 - 20 cm stem.

P91 hosts had also been effected by corrella damage. Survival of A.anuera was approx 60 per cent with average height 0.5 m. C.umbellatum survival was approx 50 per cent with average height 0.5 m while D.melanoxylon survival was approx 30 per cent and 0.3 m tall.

Survival of the Murdoch sandawood and neem was very low, probaly less than 20 per cent.

18 SEEDLING SUPPLY AND CHOICE OF SPECIES - P92

All seedlings were grown at Voyager Enterprises nursery.

Sandalwood

Sandalwood seed was obtained from India, the CALM Kununurra plot and FWI plots. Generally the `fresh' seed from the CALM and FWI plots germinated readily while the imported Indian seed was not as viable.

Sandalwood was ordered in three pot sizes :

- 3 litre poly bags. Known to grow seedlings that survive planting out in black soil. $2.14 (balance of 1991 contract) and $3.40 ea.

- 1.5 litre poly bags. Cheaper than 3 litre bags and easier to handle. $1.98 ea.

- 100 mm plastic pots. Cheaper than bags and very easy to handle. Used in 1986 CALM plot plantings on black soil. $1.00 ea.

The seedlings in 3 l bags were generally between 20 - 40 cm tall, the lower part of the stem was usually woody and branches were usually present. The stock in 1.5 l bags was generally 15 - 25 cm tall, occaisonal woody stems and little branching. The sandalwood seedlings in 100 mm pots was 10 - 20 cm tall, green stems and no branching.

10 770 sandalwood seedlings were ordered but only 6 450 were delivered. Approx 500 had died over the Wet season and Indian seed gave poor germination rates.

A seed pedigree of selected superior (larger) trees from CALM and FWI plots was established but was lost when these sedlings became mixed up with the rest of the seedlings when they were shifted to hardenening off areas (nurseryman Tony Edwards was on leave when the shifting took place).

All sandalwood seedlings had a minimum of four weeks to harden off, the majority had eight to ten weeks.

All the 1.5 litre bags and 100 mm pots had a S.erebecens seed sown in them. Germination of these seeds was poor, approx 5 per cent. This fresh seed had been collected from Parry Lagoons Nature Reserve in April 92 and from plants in Bay 8C.

Hosts

Hosts were grown in 100 mm plastic pots costing $1.00 each.

Selection of hosts was on criteria of being a legume and either being known to grow on irrigated blsck soil or being a a high value timber from tropic regions.

Hosts selected were Acacia aneura, Acacia coreacea, Albizzia lebbeck, Cassia siamea, Dalbergia latifolia, Dalbergia melanoxylon, Dalbergia sissoides, Peltophorum pterocarpum and Pterocarpus indicus.

Dalbergia cochinchinensis seed was sown but failed to germinate. D.latifolia, D.melanoxylon and P.indicus all had low germination rates.

Hosts were hardened off for a minimum of three weeks before planting. Both sandalwood and host seedlings were grown in a light, free draining soil mix.

20 PREPLANTING TREATMENT OF BAYS 8E AND 8F - P92

Two bays were allocated for planting, 8E and 8F. In 1991 both had been planted with maize.

Bay 8E was 7.44 ha in area with plabting beds 365 m long.
Bay 8F was 5.36 ha in ares with planting beds 143 m long (Fig 1)

Both bays had been left bare over the previous Wet season and were configured as Bay 8C with 1.8 m wide beds. The centre of beds were deep ripped to assist in easier hole digging and aid in root penetration.

Both bays were sprayed with a pre-emergent herbicide mixture of 3 l Simizine and 6 l Surflan per ha. This was watered in three weeks prior to planting. The effect of the herbicide mix on sandalwood and host seedlings had been examined in a small field trial with no adverse effects.

Although both bays were black soil, there were slight differences in soil characteristics between them. 8F had numereous small river rocks in it and had a lighter, granular texture. 8E was heavier texture and a slightly darker colour.

21 PLANTING DESIGN OF BAYS 8E AND 8F - P92

The planting design used in 8E and 8F was based on experience gained from planting Bay 8C, getting as much root contact between sandalwood and hosts as possible and maximising the number of stems per ha. No experimental treatments were examined as experience had shown that survival and growth of sandalwood had more to do with weather conditions, bird attack and cultural operations than spacing, host ratio etc.

Each planting bed had a sandalwood and host planted alternately along it and beds were planted in offset `pairs' so that there was a bed pattern of planted bed, planted bed, bare bed; planted bed, planted bed, bare bed and each sandalwood would be in close proximity to at least three hosts (Fig 3).

Each row contained a mixture of host species so that if one, or several species failed, whole beds or blocks of beds would not be bare of hosts.

Bay 8F was planted first because of the channel and drain layout. It had a more varied mixture of host species than 8E due to the numbers available. A.anuera, A.lebbeck and C.siamea were available in most numbers and were used to `bulk' the host plantings. S.formosa was planted in the two to four host positions at each end of the beds to give a fast growing wind

break around the bays. Additionally, each sandalwood had a S.formosa seedling planted approx 0.5 m away from it to act as a short term host and a `shelter' tree to ameliorate the severe conditions of the Build Up and Wet seasons. S.formosa seedlings were pricked directly out of seed trays and planted bare rooted.

Bay 8F had all the 3 l poly bag stock and all the 1.5 l poly bag stock planted in it. Bay 8E had all the 100 mm pot stock planted in it.

22 PLANTING BAYS 8E AND 8F - P92

Planting commenced in 8F on 12 May and finished on 19 May 1992. Planting commenced in 8E on 20 May and finished on 2 June 1992.

Seedlings were transported from the Voyager nursery by ute and trailer. Planting was done by hand into shovel dug holes. Seedlings were watered thoroughly before planting into the field and furrow watering occurred that night.

CALM employed three casuals for the planting, using SCARP funds and the Ag Dept provided three or four workmen for planting as well as digging holes in advance. A tractor was provided for the duration of the planting.

Weather conditions during the planting period were fine with maximum temperatures of 34 - 38 C between 1100 - 1400 hours. Drying north-east winds blew intermitently, generally after 0900 hours.

23 NUMBERS OF SEEDLINGS PLANTED - P92

Bay 8E -	Sandalwood	3 282 in 100 mm pots
	Hosts	3 222 in 100 mm pots
Bay 8F -	Sandalwood	2 320 in 3 l poly bags
		848 in 1.5 l poly bags
	Hosts	3 102 in 100 mm pots

24 INITIAL SURVIVAL OF P92 SEEDLINGS

As at 20 August 1992 the 3 l poly bag had approx 90 per cent survival, the 1.5 l bags approx 70 per cent survival and the 100 mm pot sandalwood approx 5 per cent survival. Host survival was approx 70 per cent.

There was no apparent pattern in the mortality of the sandalwood. Some plants had died due to being too dry, while one immediately adjacent to it would have its roots in damp black soil and be dead also. The only discernable trend was that the larger plants in the 3

l bags which had woody lower stems had the best survival. Recommend that for 1993 plantings sandalwood seedlings be larger and have a woody lower stem, even if this means some pot bounding of roots. Similarly for hosts a larger woodier stemmed seedling is recommended.

25 FAILURE OF P92 PLANTINGS

By October 1992 survival of P92 was approx 10 per cent. Mortality was attributed to extreme weather conditions, small size of the seedlings and effect of the pre-emergent herbicide mixture. Although the small scale field trial had shown no adverse effects, subsequent investigation revealed that the mixture would cause mortality by coming into contact with the roots of the seedling as the planting hole was backfilled.

Bay 8E and 8F were ploughed in in December 1992

26 APPOINTMENT OF SANDALWOOD RESEARCH RESEARCH OFFICER

A Sandalwood Research Officer was appointed to Kununurrea in November 1992. Jointly funded by CALM (25%), SCARP (25%) and ACIAR (50%).