TREE BIOTECHONOLOGY PROJECT:

A TECHNOLOGY TRANSFER PROJECT IMPLEMENTATION

BY

FORRI

IN COLLABORATION WITH

MONDI FORESTS, A DIVISION OF MONDI LIMITED OF SOUTH AFRICA (TECHNOLOGY DONOR)

GATSBY CHARITABLE FOUNDATION OF UK
(FINANCIAL SUPPORT)

AND

UNDER THE AEGIS OF ISAAA, AFRI CENTER,

NAIROBI

PROGRESS REPORT (DECEMBER 2001 – MAY 2002)

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1 INTRODUCTION

The report covers the period between December 2001 and May 2002. However, it is important to link it up to the first joint steering committee (SC) and key stakeholder meeting of the Tree Biotechnology Project of Uganda (TBP-U) held on the 29 September 2001 at the Grand Imperial Hotel, Kampala. This meeting was unique in that it was attended by 5 key international stakeholders; namely, Laurence Cockroft of Gatsby Charitable Foundation (GCF), Bruce Hulett and Flic Blakeway of Mondi Forests, Sam Wakhusama of ISAAA, Benson Kanyi of Tree Biotechnology Project of Kenya (TBP-K), as well as Fred Wajje of World Vision, John Aluma and G W Otim-Nape, Deputy Director Generals of NARO, John Okorio, George Maiteki, Joe Ssenteza and James S Epila-Otara from FORRI.

Key decision were made and/or resolved at this particular meeting. Namely that:

- TBP-U would be implemented better by constructing the mini-clonal nursery at Kifu before importing clonal plants from South Africa;
- The civil work of the Kifu nursery should be done by a local firm;
- Construction of irrigation system of the Kifu nursery should be contracted to IRRICO INTERNATIONAL LTD of Kenya which had done a similar job for TBP-K;
- To allow ample time for acclimatization in Uganda clonal plants should be imported in late February/early March 2002;
- Trial and demonstration of clonal eucalyptus must be established in April/May 2002;
- Production of seedlings from pure eucalyptus species seeds sourced from South Africa should be instituted at Kifu nursery in the interim period to bridge the gap between final selection of suitable clone(s) in 2004 – 2005.

The report will largely highlight activities associated with the above 6 decisions. For clarity the report is divided into three sections:

- The construction of the mini-clonal nursery at Kifu;
- The establishment of trial and demonstration of clonal eucalyptus; and
- Seedling production at Kifu nursery

Project management and administration as well as issues pertaining to technical backstopping by Mondi Forests will also be recorded in this report.

2 KIFU CLONAL MINI-NURSERY

2.1 Background

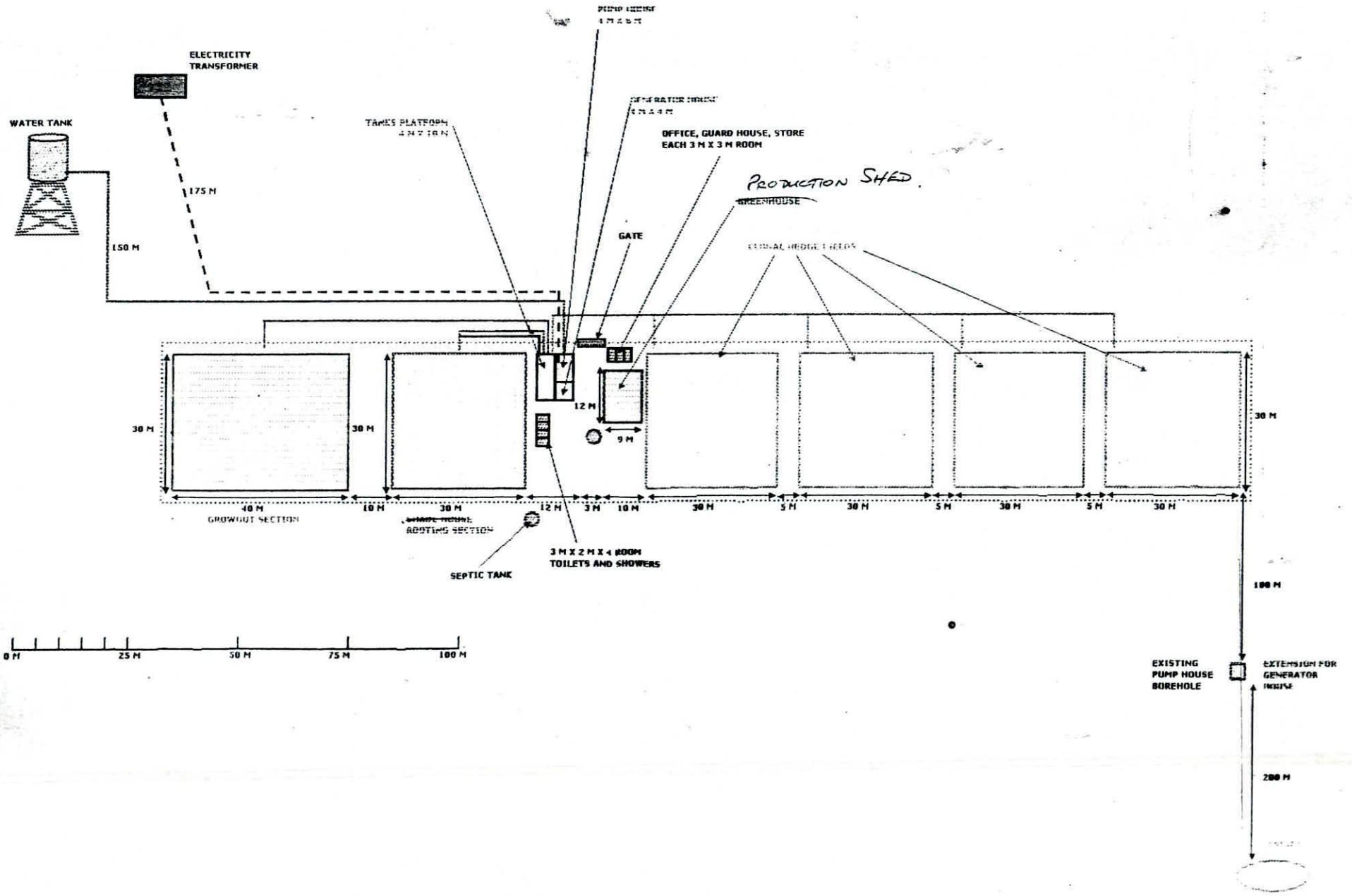
Although it is never mentioned anywhere in the project document nor in the signed financial and technology transfer agreements the characteristic features of Kifu mini-clonal nursery, except its size, had been implied to mirror those of its sister project, TBP-K. This was by design to steer clear off the pitfalls that TBP-K went through. Thus TBP-U in addition to soliciting IRRICO INTERNATIONAL LTD to construct its irrigation system also borrowed technical drawings of shedhouse, pumphouse, office and guardroom, rooting section and grow-out section from TBP-K to modify for her own use.

The project leader TBP-U, Dr J S Epila-Otara went to Nairobi on 21 October 2001 to accomplish these tasks. Consultations with Benson Kanyi, Project Manager, TBP-K as well as studying the details of contracting out civil work as well as irrigation and water reticulation led to gainful insights on the strategy TBP-U had to adopt in contacting out both civil and irrigation constructions. IRRICO INTERNATIONAL was invited and accepted to come to Uganda on 29 October to 2 November 2002 for on-site discussions with a local firm for harmonizing the construction of the two aspects of the nursery. It is important to note that this arrangement was constrained by time: namely, that within one week the bidding for civil work of the nursery had to be accomplished.

Details of the bidding process and on-site discussions with the local contractor were reported to the Chairman, TBP-U SC. The working sketch of the Kifu nursery drawn by IRRICO INTERNATIONAL LTD is presented in Fig 1.

IRRIGATION SETUP

LAND LAYOUT



2.2 Civil work

The contract agreement copied directly from TBP-K but modified for civil work of the Kifu nursery was signed by the Chairman SC and HIGSTAN TECHNICAL SERVICES LTD on 10 December 2001. The construction of shedhouse floor (9 x 12m^2), pumphouse (4 x 10m^2), office/guardhouse (3 x 6m^2) platform for water reservoir (4 x 10m^2), perimeter fence, ablution, septic tank, soak pit and supply of 7.5cm thick layer of rock ballast on 900m^2 rooting section of the nursery was officially launched by the Director General, NARO, Professor Joseph K Mukiibi on 19 December 2001.

Because of the reasons that shall be mentioned below, the construction of all except cutting/shedhouse walls and roof, has been successfully completed as shown on Plate A.

Plate A

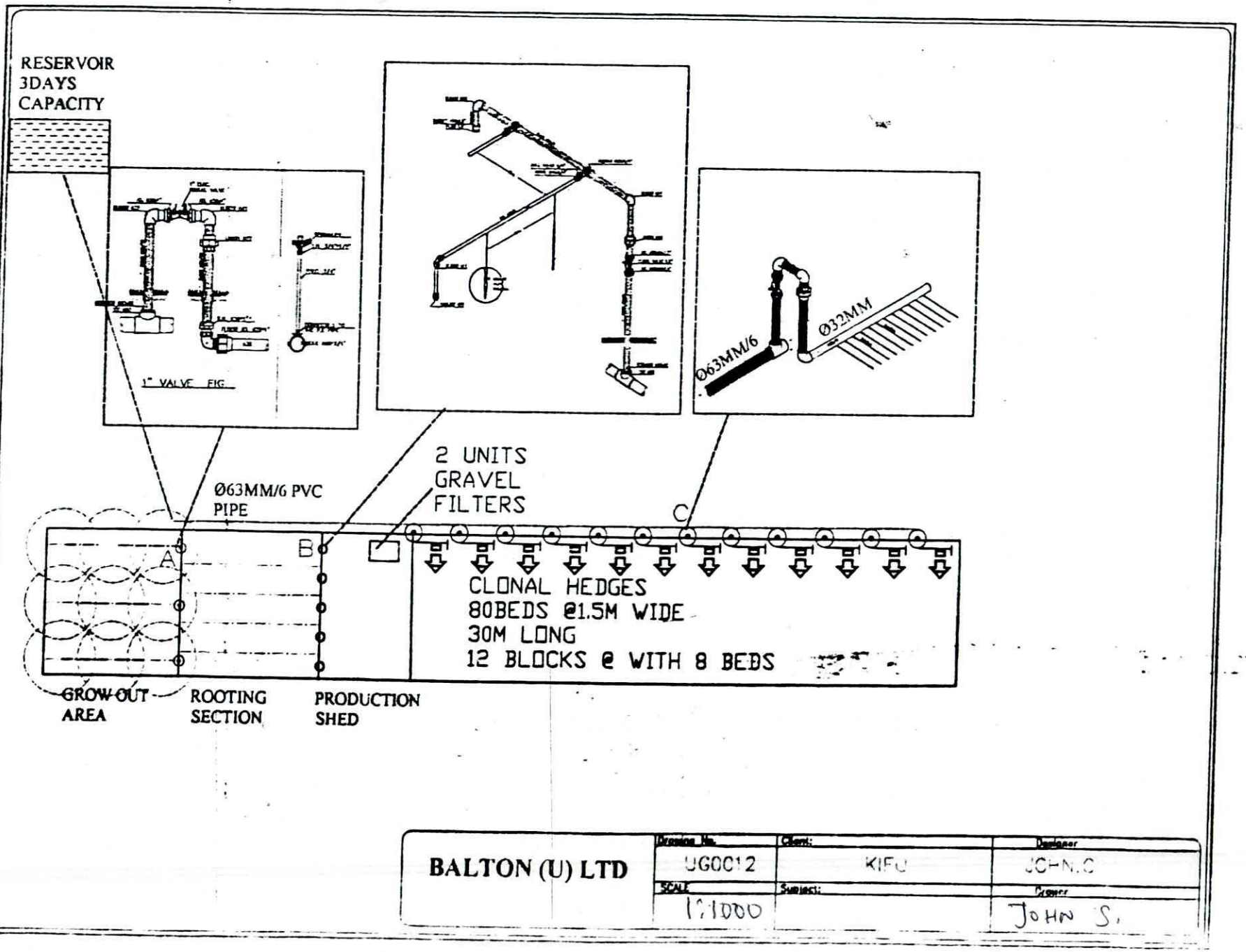


2.3 Irrigation and water reticulation

The construction of irrigation system of Kifu nursery, as mentioned earlier was designated to be contracted to IRRICO on the basis of their past experience with TBP-K. Thus between November 2001 and January 2002 IRRICO was verbally, on many occasions invited to produce a detailed bill of quantities (BQ) prior to TBP-U contracting this job to them. In response IRRICO provided 2 BQs. The first BQ in December 2001 was not costed but the second one of January 2002 was well costed. Nevertheless, none of us could understand and interpret it.

Thus a decision was made to rest it pending technical backstopping by Errol Duncan of Mondi Forests in March 2002. On inspection of the second BQ Errol Duncan advised TBP-U in a meeting of 8 March 2002 to withhold the decision on the nursery irrigation quotation received from IRRICO until Balton (U) Ltd, the local specialist has had the opportunity to send in their quotation. The reasoning behind this move was firstly due to the inappropriate high costs of the IRRICO quotations, and secondly that if a local firm was used, repairs and service provision would respectively be cheaper and expedited far more quickly than otherwise.

Balton has since sent in detail drawings of the system (Fig 2) for scrutiny by TBP-U and Errol Duncan. Errol has queried several aspects of the drawings which have been brought to the attention of Balton. The BQ which will be drawn in Israel has not yet been received by us.


RESERVOIR
3DAYS
CAPACITY
1" VALVE FIG
Ø63MM/6
Ø32MM
Ø63MM/6 PVC
PIPE
2 UNITS
GRAVEL
FILTERS
A
B
C
CLONAL HEDGES
80BEDS @1.5M WIDE
30M LONG
12 BLOCKS @ WITH 8 BEDS
GROW OUT
AREA
ROOTING
SECTION
PRODUCTION
SHED
BALTON (U) LTD
Drawing No.
UG0012
Client:
KIFU
Designer
JOHN.C
SCALE
1:1000
Signature:
Name
JOHN S.

3 TRIAL AND DEMONSTRATION OF EUCALYPTUS CLONES

3.1 Importation of clones

After protracted consultations (N Denison and E Kietzka in 2000, and Bruce Hullet, Flic Blakeway and Errol Duncan in 2001) Mondi Forests Ltd donated to TBP-U the following clones: TAG5, GU 7, GU 8, GU 21, GU 607, GU 609, GC 514, GC 540, GC 550, GC 578, GC 784 and GC 796. TBP-U placed an order for these clones and Mondi airfreighted them in specially wax-coated carton boxes (Plate B) to Uganda on 2 March 2002.

Plate B



Through prior arrangement, TBP-U cleared the plants immediately on their arrival at the airport and kept them overnight at Nakawa. On Sunday 3 March 2002 the plants were taken to Kifu nursery and re-constituted into the tubes. The packaging and journey from Kwabonambi – South Africa to Uganda affected the plants in various ways. Root plugs for the older clones (GC 540 and GC 550) were in excellent condition (Plate C). Whereas the plugs for the majority of the clones remained intact (eg Plate D), those of GU 607 and GU 609 were greatly disturbed. The mixture of vermiculite and perlite had apparently dried and fallen off the root plugs and thus buried most of the plants (see Plate E). This damage caused burning of the older foliage and obviously made the re-constituting of these two clones very difficult as can be seen on Plate F.

Plate C



Plate D



Plate E



Plate F



The consequence of the damage among the re-constituted plants was immediate: the few young apical leaves wilted. And on 4 March 2002 a good number of GU 607 and GU 609 were dead. In an attempt to rescue and boost the health of the survivors, forest soil was added to their root plugs. Most of them responded positively. Nevertheless, they remained fragile and as will be stated later, it appears the long-term effect of such damage resulted in poor survivorship of outplanted plants.

It is difficult to tell why the vermiculite on root plugs of GU 607 and GU 609 disintegrated. Comparatively, the vermiculite for these two clones was noticeably black, a contrast to the grey colouration for the rest of the 10 clones.

The plants were acclimatized in the shade of papyrus mats strung over wooden framework. Watered twice daily the plants became ready for planting in April/May 2002.

3.2 Preparing trial sites

Prior to the establishment of trial and demonstration of clonal eucalyptus in the 5 target sites, three essential tasks needed to be accomplished in February and March 2002 to meet the planting time set for April 2002. These tasks were:

- The mounds of two termite species: *Macrotermes natalensis* and *Macrotermes bellicosus* occurring within and adjacent to the experimental fields had to be destroyed using termiticide Regent 3G.
- The experimental fields had be ploughed twice before planting could be done.
- The experimental fields had be fenced with barbed wire to keep output livestock from within and outside the ARDC farms.

3.2.1 Poisoning termites

Regardless of nest sizes, recommended application rate of approximately 100 gm per mound of Regent 3R was used to poison varying numbers of termite mounds as tabulated below.

Place	Date	Number of mounds
Ikulwe	18 February 2002	40
Serere	20 February 2002	10
Ngetta	21 February 2002	27
Abi	23 February 2002	25

Termite species composition varied from site to site: at Ikulwe termites were *M. natalensis*; a preponderance of *M. bellicosus* occurred in Serere while at Ngetta and Abi both *natalensis* and *bellicosus* were encountered. Similarly, because of a combination of the material used in nest construction and architectural location of internal vents, the ease with which termite moulds was poisoned depended on the species. The vents leading to the population of *natalensis* were easier to open than was the case for *bellicosus* which located their vents deep (>.5m) within the mounds. One curious species of termite found in Serere which nested subterraneanally; with vents opening on the ground surface also proved difficult to poison. Poison administered through these natural vents apparently did not hit the population as evidenced by hundreds of soldiers found guarding entrances of these previously poisoned vents at the planting time (Plate G).

Plate G



3.2.2 Ploughing trial fields

Onset of rain determined the ploughing of the experimental fields. Rain came late in both Ngetta and Abi and thus experimental fields were ploughed as late as early April 2002 compared to Serere, Ikulwe and Kifu which because rain started in the middle of March 2002 experimental fields were ploughed in late March 2002. Because of the late ploughing Ngetta and Abi fields had to be disked instead of a second ploughing to make them ready for April planting. Notwithstanding, however, these fields were much better prepared (Plates H and I) than the Serere and Ikulwe experimental fields (Plates J and K).

3.2.3 Fencing

Although originally planned to be done soon after second ploughing, fencing was done on adhoc basis because of delayed ploughing. Indeed for Ngetta, fencing exercise began by planting posts on parallel longer sides of the unploughed experimental field. At Ikulwe fencing was done as the second ploughing was taking place. Abi was fenced soon after establishing the trial and demonstration. Kifu trial is yet to be fenced. In all cases 200 2m long, celcure-treated eucalyptus poles were embedded in 25x35cm deep holes with concrete mixture of 1:3:6; cement:sand:aggregate respectively.

3.3 Establishing trials

Several considerations denoted the strategy that was adopted for establishing trials of clonal eucalyptus at the various sites.

- Inter-trial distances and road condition
- Distances to trial sites from Kifu
- Welfare of the clones en route to trial sites
- Vulnerability of clones to subterranean termites.

Because of long distances between trial sites and, from Kifu as well the need to minimize mortality of clones en route, the establishment of the trials was divided into three stages: Ikulwe-Serere leg, (>600km) Ngetta-Abi leg (>240 km) and Kifu.

Similarly to minimize mortality due to the subterranean termites, every plant was protected with 33 gm of Regent 3G as explained below. Consideration for the welfare of the clones influenced

how the transportation of the clones (Plate L) and planting operations (Plates H-K) were organized.

Plate L



Thus in order to minimize mortality of the clones, planting at a site was done within 6 – 8 hours using a labour force which ranged from 20 – 26 per site. To achieve this, the planting operation was divided into 4 successive tasks: pegging, digging the holes, poisoning the holes and actual planting of the clones. A gang of about 4 – 6 people pegged the area followed by another group of > 20 persons pitting while 2 – 4 persons poisoned the holes with Regent 3G. Once there tasks were completed, labour was dissolved into a planting crew. The planting crew was divided into two: young men and women fell in one group and older persons fell in another. The young men and women were taught how to plant clones. Essentially two things were demonstrated: how to tease the clones out of the tubes by squeezing the tube at the ridges, and how to ensure that the roots of the clones were not damaged or bent during planting by placing the plant on the palm and gently directing it into the planting hole, back-filling with poisoned soil and firming lightly around the plant. The older men were assigned to planting the guardrows with local seedlings. Prior to actual planting the crew was warned about the potential of poisoning one self with Regent 3G. The performance of these tasks are partly illustrated on Plates H (Ngetta), I (Abi), J (Ikulwe) and K (Serere).

Plate H



Plate I



Plate J



Plate K



3.4 Weeding

Serere field was poorly ploughed so that by the time of planting on 18 April 2002 it was already very weedy (Plate J) and thus needed weeding soon there after. Similarly because of heavy rain weeds grew rather profusely at Ikulwe (Plate M) planted on 17 April 2002 and Ngetta (Plate N) planted on 29 April 2002 and as such those trials also needed to be weeded in May 2002. Abi trial established on 1 May 2002 is still clean and thus needs no weeding.

Plate M



Plate N



4 ESTABLISHING 'RESEARCH' CLONAL HEDGE

Similar techniques used in establishing the trials was used in establishing 'research' clonal hedge at Kifu. A total of 2262 clonal plants spaced at 0.5 x 0.5m within the hedge planted 1m from another one (Plate O) were used to establish a hedge covering an area 62m^2 for producing research materials. The research clonal hedge likewise was established on a rainy day of 15 May 2002. Survivorship is yet 100%. When blanking of the trials at the five sites is completed sometime in June/July, the remaining plants shall be used to expand the clonal hedge.

Plate O



5 PLANT SURVIVORSHIP

Except at Ikulwe, all the trials in which 16 plants per clone were assigned randomly to a plot of a block; spaced at 2.5 x 2.5m within and between lines, and replicated 4 times (Table 1) were , by sheer coincidence established in the rain thus effectively ensuring good plant survival.

Table 1. Trial layout at Kifu, Ikulwe, Serere, Ngetta and Abi

BLOCK 4	GC 540 P40	GU 8 P41	GC 514 P42	GU 21 P43	GU 7 P44	GC 784 P45	GC 578 P46	GC 796 P47	GC 550 P48	GU 609 P49	GU 607 P50	CONTROL P51	TAG 5 P52
BLOCK 3	GU 609 P27	CONTROL P28	GC 578 P29	GC 514 P30	GC 796 P31	GU 21 P32	GU 607 P33	GC 540 P34	GC 784 P35	GU 7 P36	GC 550 P37	TAG 5 P38	GU 8 P39
BLOCK 2	GU 607 P14	GC 550 P15	GU 7 P16	GC 784 P17	GU 8 P 18	TAG 5 P19	CONTROL P20	GU 21 P21	GC 578 P 22	GC 540 P23	GC 796 P24	GU 609 P25	GC 514 P26
BLOCK 1	TAG 5 P1	GU 7 P2	GU 8 P3	CONTROL P4	GC 540 P5	GC 514 P6	GU 21 P7	GC 550 P8	GC 796 P9	GU 607 P10	GC 578 P11	GC 784 P12	GU 609 P13

Notwithstanding however, plant mortality occurred as shown in Table 2.

Table 2. Mortality of clones one month after planting at four trial sites (% based on 64 plants per site).

	Ngetta		Serere		Ikulwe		Kifu	
Clones	Number of plants	%	Number of plants	%	Number of plants	%	Number of plants	%
GU 7	2	3.1	17	26.6	6	9.4	5	7.8
GU 8	2	3.1	3	4.7	8	12.5	6	9.4
GU 21	1	1.5	15	23.4	3	4.7	5	7.8
GU 607	3	4.7	12	18.8	8	12.5	6	9.4
GU 609	1	1.5	24	37.5	10	15.6	11	17.2
GC 514	1	1.5	13	20.3	7	10.9	0	0
GC 540	1	1.5	5	7.8	1	1.5	7	10.9
GC 550	0	0	2	3.1	4	6.3	4	6.3
GC 578	1	1.5	5	7.8	1	1.5	2	3.1
GC 784	1	1.5	10	15.6	3	4.7	10	15.6
GC 796	2	3.1	9	14.1	3	4.7	5	7.8
TAG 5	1	1.5	6	9.4	9	14.1	2	3.1
Control	0	0	6	9.4	3	4.7	2	3.1

Plant survival was remarkably good at Ngetta where mortality was below 5%. Mortality at Ikulwe and Kifu were comparatively milder compared to Serere (Table 2). Several factors were suspected to have predisposed the clones to mortality hazards (agents).

- Health and vigour status of the clones at planting time
- Size of clonal plants
- Soil moisture content at planting time
- Seedbed preparation

Obviously the local seedlings and the much older clones e g GC 540 and GC 550, with well composed root plugs (Plate C) survived better in all the sites compared to clones which never recovered fully from stress they suffered en route to Uganda e g GU 607 (Plate P). Serere registered highest mortality simply because the majority of plants were cut off during weeding that unfortunately was done by a much younger, unsupervised labour force engaged by the farm manager, Mr Bernard Otekat. Mortality in Ikulwe was probably caused by poor rainfall this place has experienced over the last months of the year.

Plate P



6 BEATING UP

Ngetta and Serere have been fully blanked for mortality on 25 May 2002 and 27 May 2002 respectively. To enhance establishment of the clones at Ngetta and Serere, the plants were watered liberally (Plate Q) twice daily for one week. Ikulwe and Kifu are yet too dry to allow beating up.

Plate Q



7 OUTREACH

TBP-U has produced and distributed over 300 brochures in several fora/occasions wherever FORRI has been invited to participate. It is also important to record here that without any intention whatsoever, the planting crew and the onlookers; especially on the days these trials were established (e.g. Plate R) have been outreached. Such *silent* outreaching exercise continues at Ngetta, Abi and Ikulwe trial sites, which were by design, are located along the main roads to towns and township.

Plate R



8 MANAGEMENT AND ADMINISTRATION

8.1 Meetings

Within the last six months, the joint Steering and Technical Committees held a meeting on 8 March 2002. This meeting was attended by Errol Duncan. And as indicated earlier, a number of important decisions were made.

8.2 FORRI Support

FORRI has contributed immensely in two aspects of TBP-U:

- Financial management
- Transportation and communication

The TBP-U fund is managed by the account section of the Institute. And because of the decision made to channel the bulk of money thus far released (£57,000) to nursery

construction. TBP-U has continued to use vehicles both for the field works described above as well as movements between Nakawa and Kifu nursery.

Similarly, TBP-U has over the last six months used computing and communication facilities of FORRI. In its part, TBP-U has provided financial support to FORRI in the area of vehicle service and repairs, and occasionally paid e-mail bills.

8.3 Visits

Although this report only covers December 2001 to May 2002, there was one pivotal visit made on 21 – 25 October 2001 during which the project leader, Dr Epila-Otara visited Nairobi to discuss with both Benson Kanyi and IRRICO the construction of the mini-clonal nursery at Kifu. The results of this visit have been discussed in details elsewhere and briefly in the earlier parts of this report. The project leader made two additional visits in 2002:

29 – 31 January 2002	• Discuss irrigation with IRRICO
10 – 17 March 2002	• Accompanying Errol Duncan on backstopping TBP-K
TBP-Uganda was visited on:	
1 – 2 November 2001	• IRRICO to discuss construction of Kifu nursery
19 December 2001	• Director General NARO, Professor J.K Mukiibi.
7 February 2002	• Sue Parrot commissioned by Gatsby to study the progress and implementation of TBP-U.
3 – 5 March 2002	• Michael Njuguna, Benson Kanyi, Victoria and Melody to accompany Errol Duncan on backstopping visit to TBP-U.
4 – 10 March 2002	• Errol Duncan to backstop TBP-U.