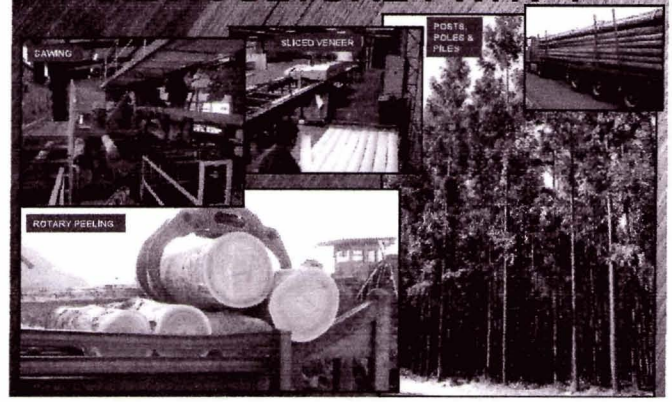
THE FUNDAMENTALS OF HIGHER-VALUE EUCALYPT SILVICULTURE

HIGHER-VALUE EUCALYPT SILVICULTURE : WHY ?



THE FUNDAMENTALS OF HIGHER-VALUE EUCALYPT SILVICULTURE

YOU MAY HAVE BEEN TAUGHT ..... THE OPTIMUM ... IS THE ONE PRODUCING THE MOST ... VOLUME TO DO THAT .....

... QUALITY, NOT QUANTITY !!

WHAT ARE THE CHARACTERISTICS OF LOGS BEST SUITED TO CONVERSION BY SAWING TO PRODUCE HIGHER-VALUE, KILN-DRIED LUMBER ? WHAT ARE PRODUCTION OBJECTIVES OF THE SILVICULTURE WE APPLY ?

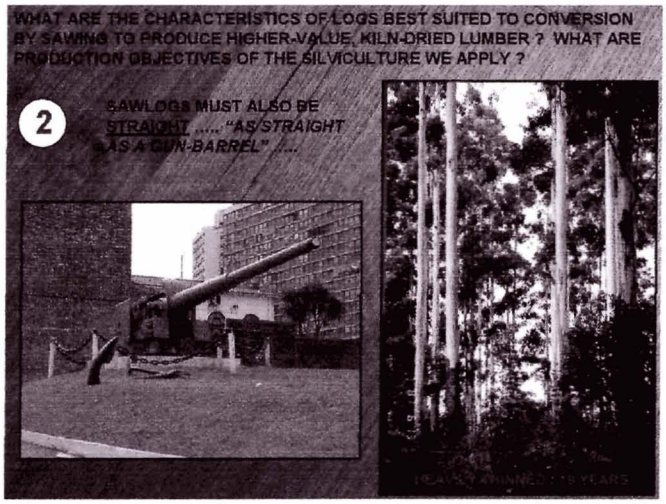
1

WITHIN 20 YEARS :

LARGE LOGS (Dq > 50 CM.)
WIDE RANGE OF LUMBER SIZES

... AND, FROM PRUNED SECTIONS ....

... HIGH-GRADE LUMBER COMMANDING HIGHEST POSSIBLE PRICES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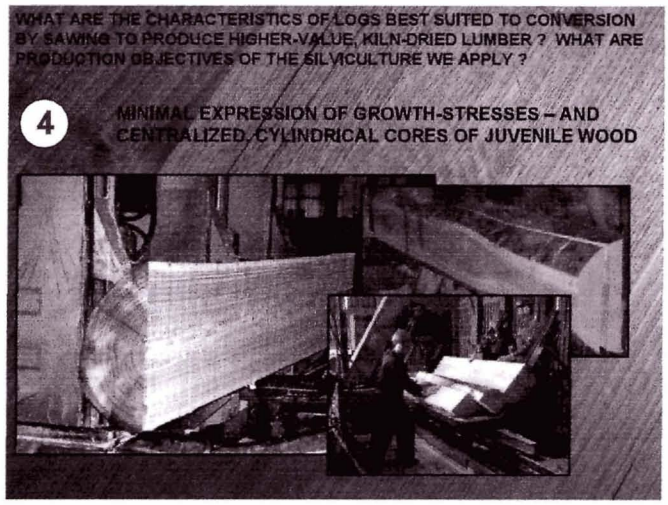
2
SAWLOGS MUST ALSO BE STRAIGHT ..... "AS STRAIGHT AS A GUN-BARREL" /....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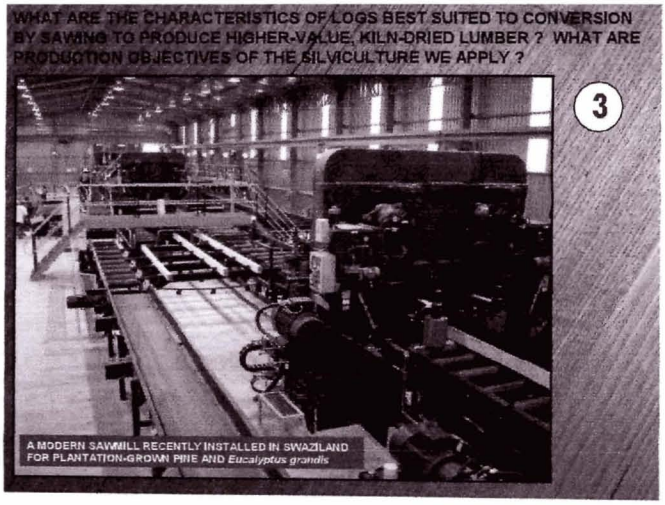
4
MINIMAL EXPRESSION OF GROWTH-STRESSES – AND CENTRALIZED, CYLINDRICAL CORES OF JUVENILE WOOD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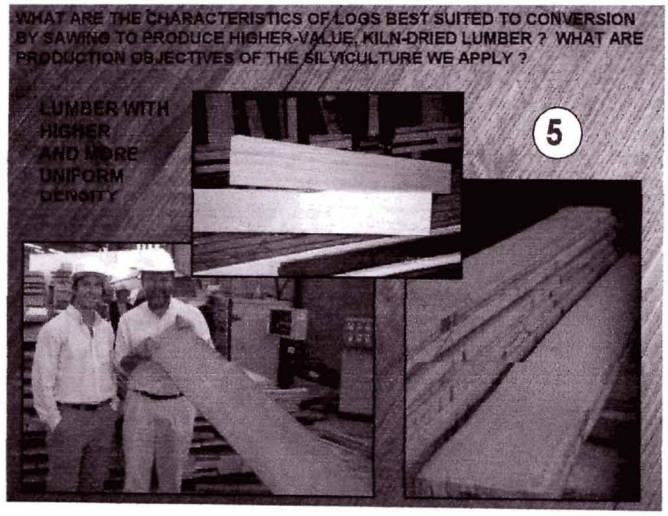
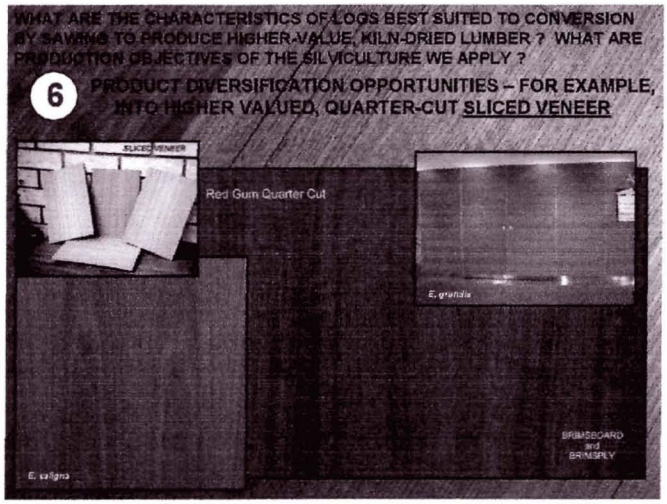
3
A MODERN SAWMILL RECENTLY INSTALLED IN SWAZILAND FOR PLANTATION-GROWN PINE AND *Eucalyptus grandis*


WHAT ARE THE CHARACTERISTICS OF LOGS BEST SUITED TO CONVERSION BY SAWING TO PRODUCE HIGHER-VALUE, KILN-DRIED LUMBER ? WHAT ARE PRODUCTION OBJECTIVES OF THE SILVICULTURE WE APPLY ?
LUMBER WITH HIGHER AND MORE UNIFORM DENSITY
5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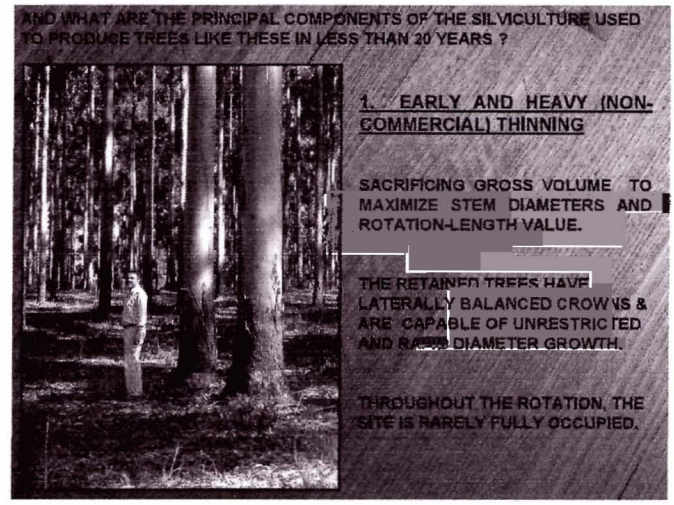
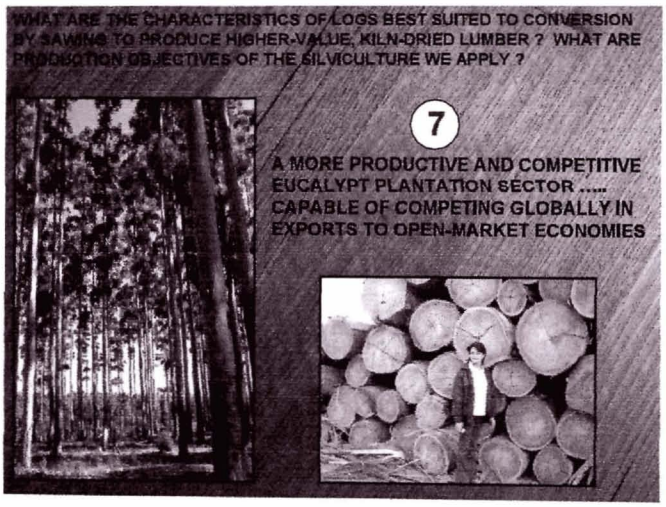
6
PRODUCT DIVERSIFICATION OPPORTUNITIES – FOR EXAMPLE, INTO HIGHER VALUED, QUARTER-CUT SLICED VENEER
SLICED VENEER
Red Gum Quarter Cut
E. grandis
BRIMBOARD and BRIMPLY
E. saligna


AND WHAT ARE THE PRINCIPAL COMPONENTS OF THE SILVICULTURE USED TO PRODUCE TREES LIKE THESE IN LESS THAN 20 YEARS ?
1. EARLY AND HEAVY (NON-COMMERCIAL) THINNING
SACRIFICING GROSS VOLUME TO MAXIMIZE STEM DIAMETERS AND ROTATION-LENGTH VALUE.
THE RETAINED TREES HAVE LATERALLY BALANCED CROWNS & ARE CAPABLE OF UNRESTRICTED AND RAPID DIAMETER GROWTH.
THROUGHOUT THE ROTATION, THE SITE IS RARELY FULLY OCCUPIED.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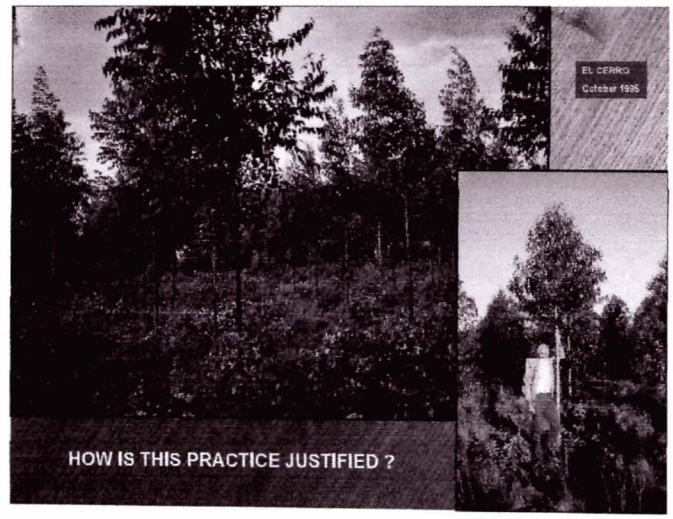
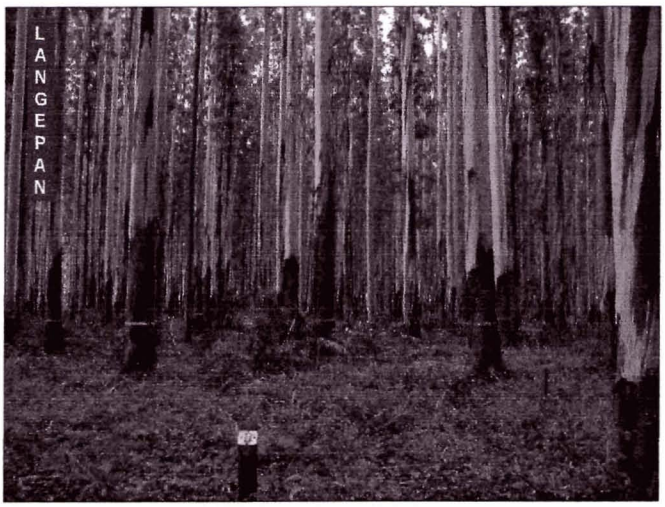
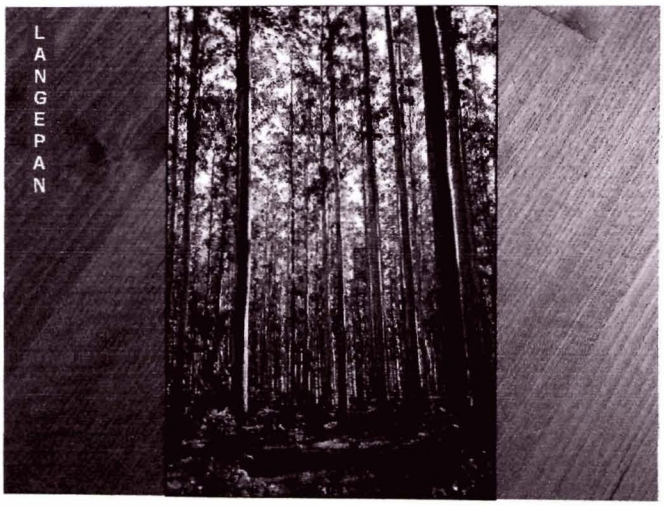
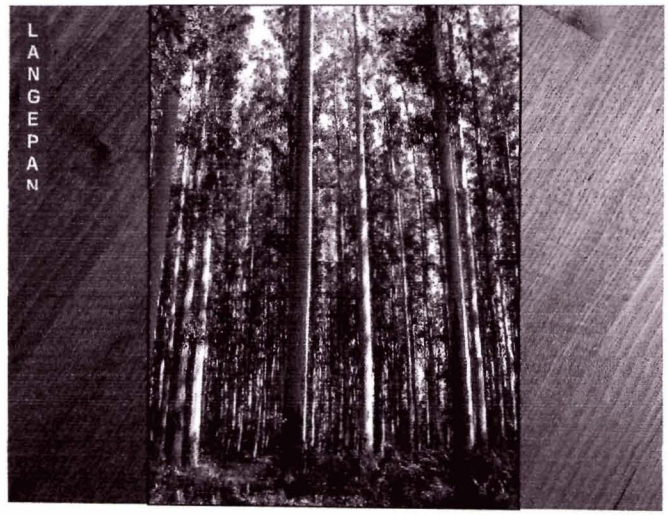
7
A MORE PRODUCTIVE AND COMPETITIVE EUCALYPT PLANTATION SECTOR ..... CAPABLE OF COMPETING GLOBALLY IN EXPORTS TO OPEN-MARKET ECONOMIES


EL CERRO
October 1995
HOW IS THIS PRACTICE JUSTIFIED ?


LANGEPAN


LANGEPAN


LANGEPAN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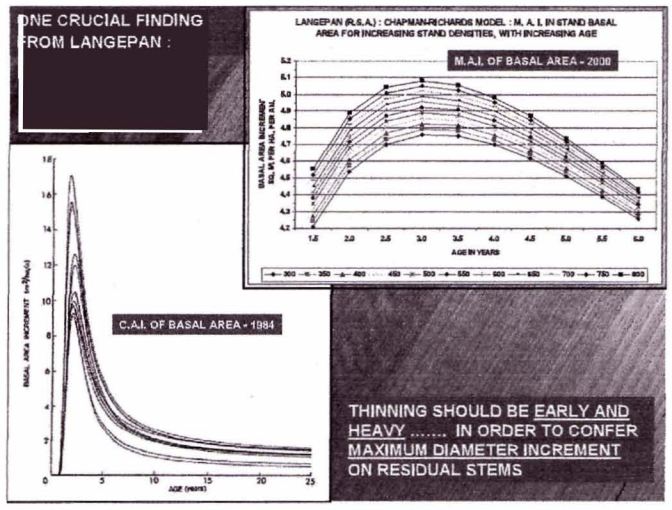
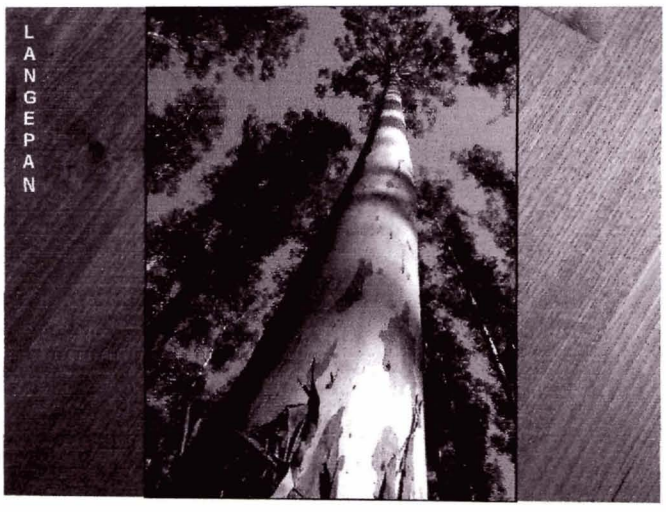
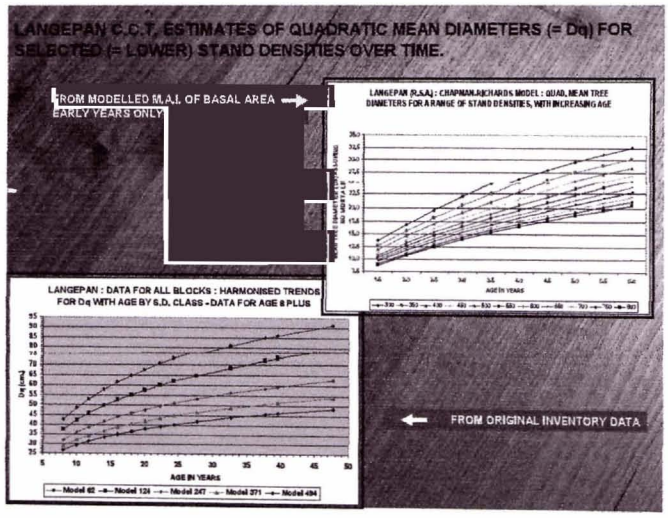
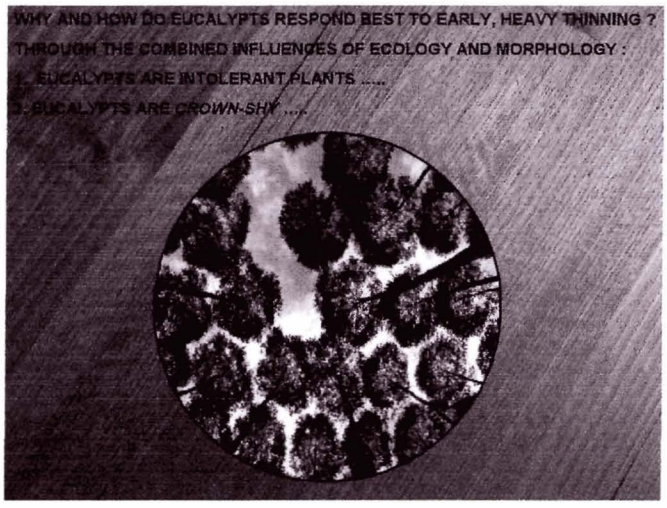
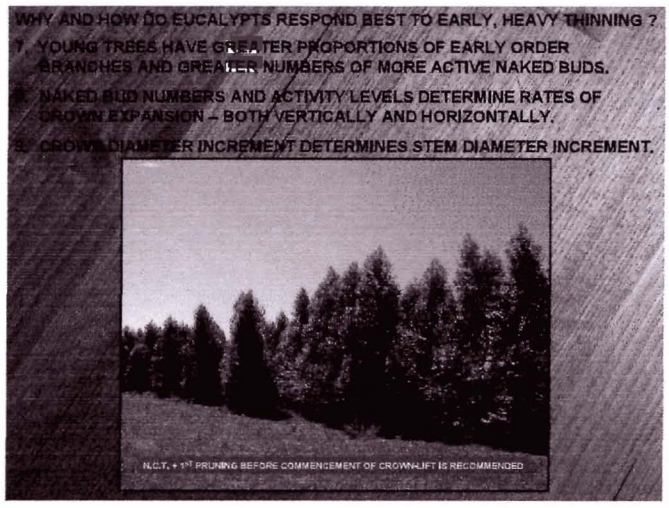
LANGEPAN


ONE CRUCIAL FINDING FROM LANGEPAN :
LANGEPAN (R.S.A.) : CHAPMAN-RICHARDS MODEL : M. A. I. IN STAND BASAL AREA FOR INCREASING STAND DENSITIES, WITH INCREASING AGE
M.A.I. OF BASAL AREA - 2000
AGE IN YEARS
C.A.I. OF BASAL AREA - 1984
THINNING SHOULD BE EARLY AND HEAVY ..... IN ORDER TO CONFER MAXIMUM DIAMETER INCREMENT ON RESIDUAL STEMS

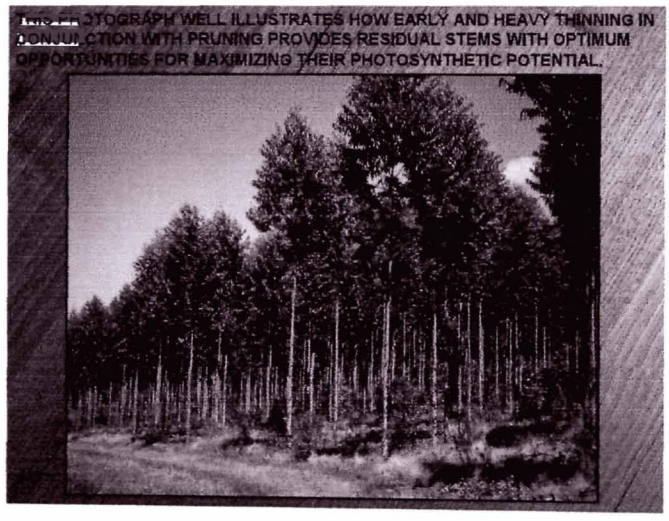

LANGEPAN

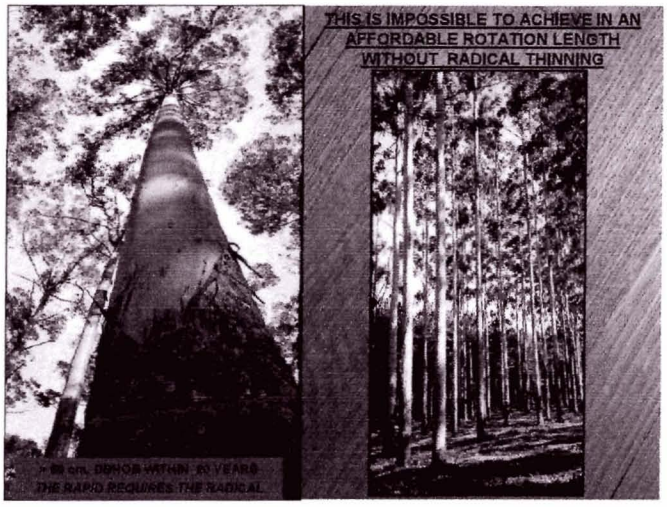

LANGEPAN C.C.T. ESTIMATES OF QUADRATIC MEAN DIAMETERS (= Dq) FOR SELECTED (= LOWER) STAND DENSITIES OVER TIME.
FROM MODELLED M.A.I. OF BASAL AREA
EARLY YEARS ONLY
LANGEPAN (R.S.A.) : CHAPMAN-RICHARDS MODEL : QUAD. MEAN TREE DIAMETERS FOR A RANGE OF STAND DENSITIES, WITH INCREASING AGE
AGE IN YEARS
LANGEPAN : DATA FOR ALL BLOCKS : HARMONISED TRENDS FOR Dq WITH AGE BY S.D. CLASS - DATA FOR AGE 8 PLUS
AGE IN YEARS
FROM ORIGINAL INVENTORY DATA

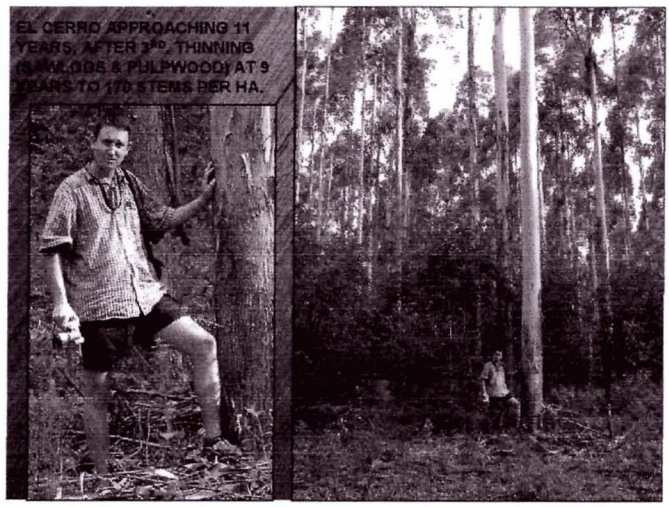

WHY AND HOW DO EUCALYPTS RESPOND BEST TO EARLY, HEAVY THINNING ?
THROUGH THE COMBINED INFLUENCES OF ECOLOGY AND MORPHOLOGY :
1. EUCALYPTS ARE INTOLERANT PLANTS .....
2. EUCALYPTS ARE CROWN-SHY .....

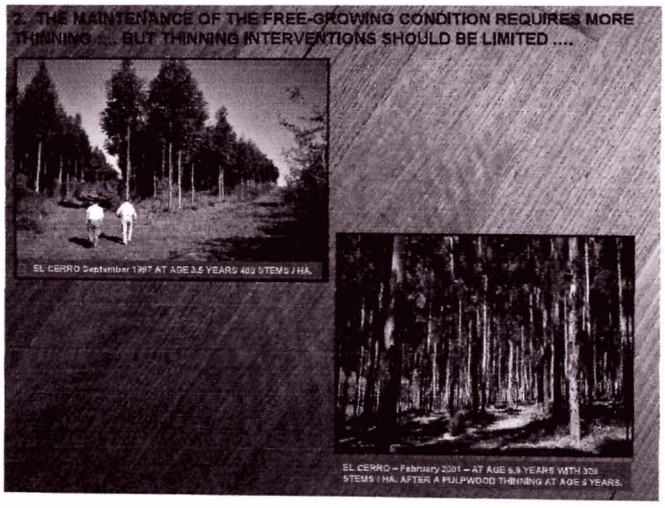

WHY AND HOW DO EUCALYPTS RESPOND BEST TO EARLY, HEAVY THINNING ?
7. YOUNG TREES HAVE GREATER PROPORTIONS OF EARLY ORDER BRANCHES AND GREATER NUMBERS OF MORE ACTIVE NAKED BUDS.
8. NAKED BUD NUMBERS AND ACTIVITY LEVELS DETERMINE RATES OF CROWN EXPANSION – BOTH VERTICALLY AND HORIZONTALLY.
9. CROWN DIAMETER INCREMENT DETERMINES STEM DIAMETER INCREMENT.
N.C.T. + 1ST PRUNING BEFORE COMMENCEMENT OF CROWNLIFT IS RECOMMENDED

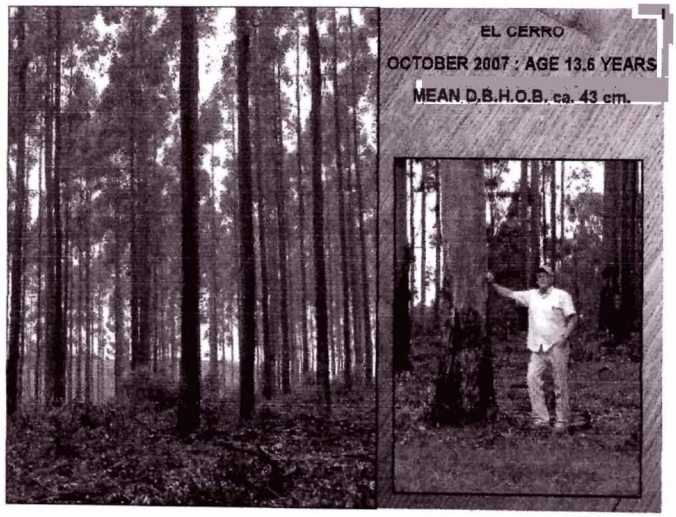

WHY AND HOW DO EUCALYPTS RESPOND BEST TO EARLY, HEAVY THINNING ?
3. EUCALYPTS HAVE FOUR METHODS OF PRODUCING LEAVES .....
4. NAKED BUDS ARE CAPABLE OF CONTINUOUS, RAPID GROWTH .....
5. SIMULTANEOUSLY EXPANSION OF NAKED BUDS WITH MERISTEMS .....
6. IN HIGHER BRANCH ORDERS, NAKED BUDS ARE BOTH FEWER AND LESS ACTIVE .....

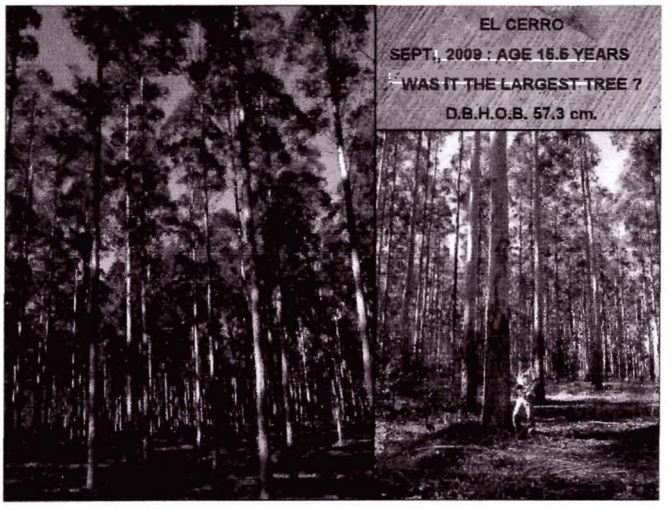

THIS PHOTOGRAPH WELL ILLUSTRATES HOW EARLY AND HEAVY THINNING IN CONJUNCTION WITH PRUNING PROVIDES RESIDUAL STEMS WITH OPTIMUM OPPORTUNITIES FOR MAXIMIZING THEIR PHOTOSYNTHETIC POTENTIAL.

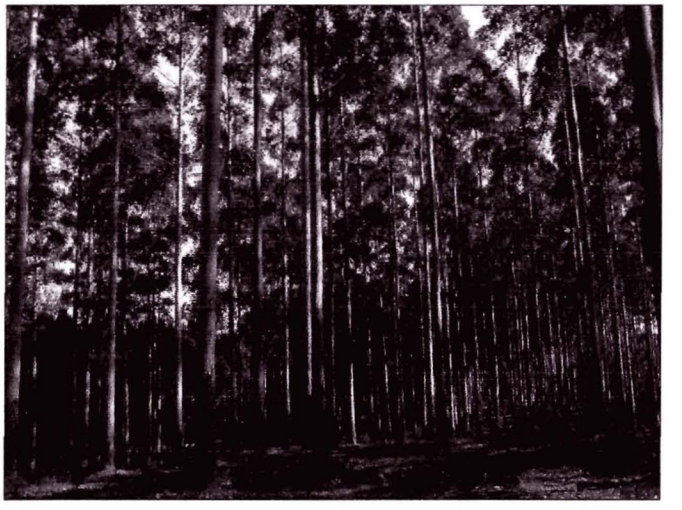

THIS IS IMPOSSIBLE TO ACHIEVE IN AN AFFORDABLE ROTATION LENGTH WITHOUT RADICAL THINNING
> 60 cm. DBHOB WITHIN 20 YEARS
THE RAPID REQUIRES THE RADICAL

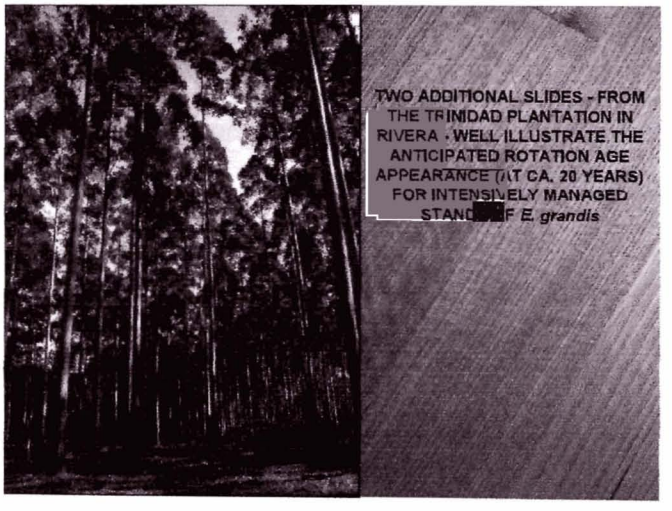

EL CERRO APPROACHING 11 YEARS, AFTER 3RD. THINNING (SALOBOS & PULPWOOD) AT 9 YEARS TO 170 STEMS PER HA.

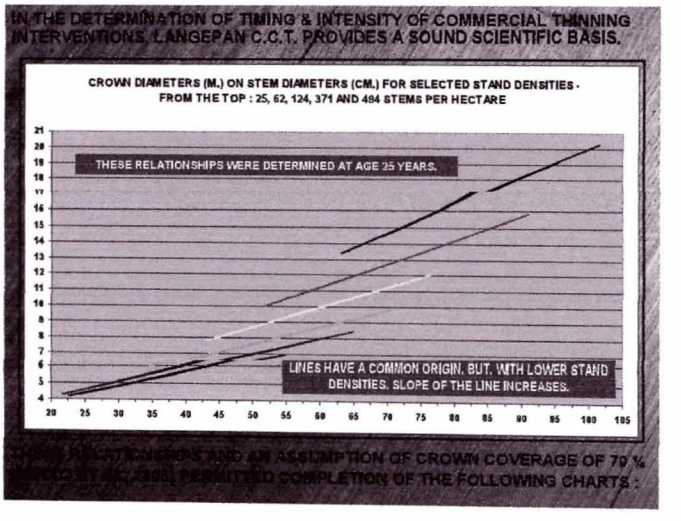

2. THE MAINTENANCE OF THE FREE-GROWING CONDITION REQUIRES MORE THINNING .... BUT THINNING INTERVENTIONS SHOULD BE LIMITED ....
EL CERRO September 1997 AT AGE 3.6 YEARS 400 STEMS / HA.
EL CERRO – February 2001 – AT AGE 6.9 YEARS WITH 309 STEMS / HA. AFTER A PULPWOOD THINNING AT AGE 6 YEARS.

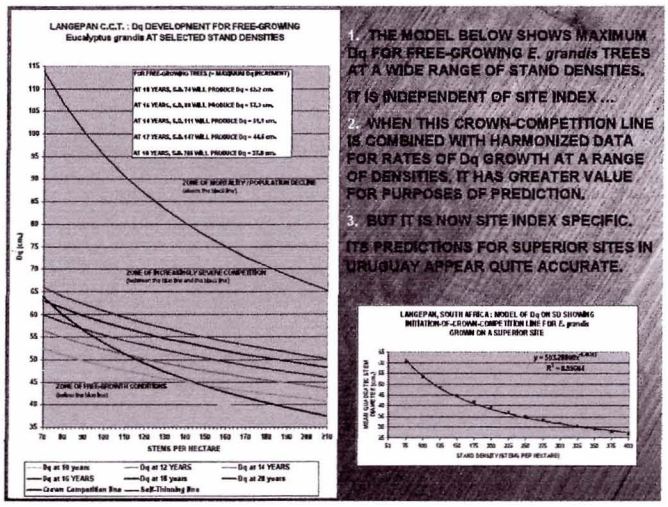

EL CERRO
OCTOBER 2007 : AGE 13.6 YEARS
MEAN D.B.H.O.B. ca. 43 cm.


EL CERRO
SEPT., 2009 : AGE 15.6 YEARS
WAS IT THE LARGEST TREE ?
D.B.H.O.B. 57.3 cm.

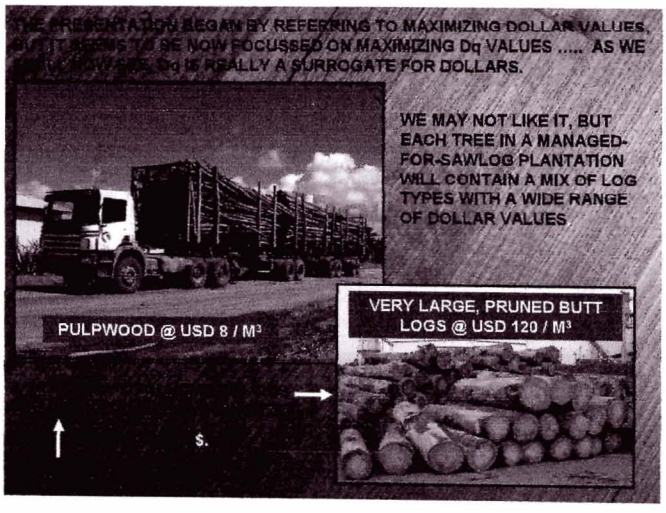


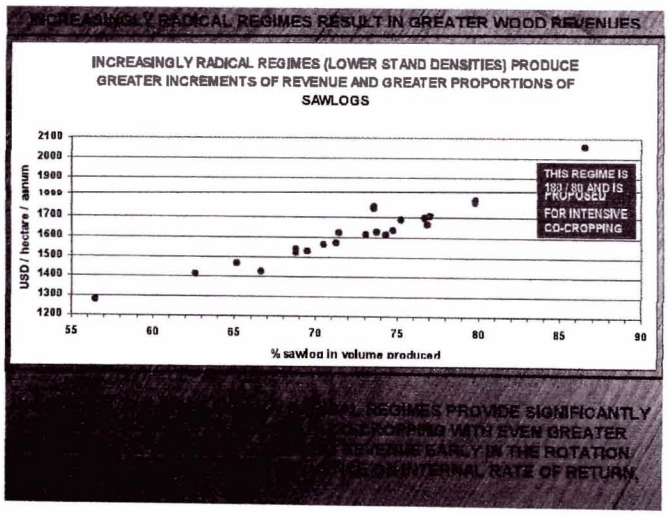

TWO ADDITIONAL SLIDES - FROM THE TRINIDAD PLANTATION IN RIVERA - WELL ILLUSTRATE THE ANTICIPATED ROTATION AGE APPEARANCE (AT CA. 20 YEARS) FOR INTENSIVELY MANAGED STANDS OF *E. grandis*

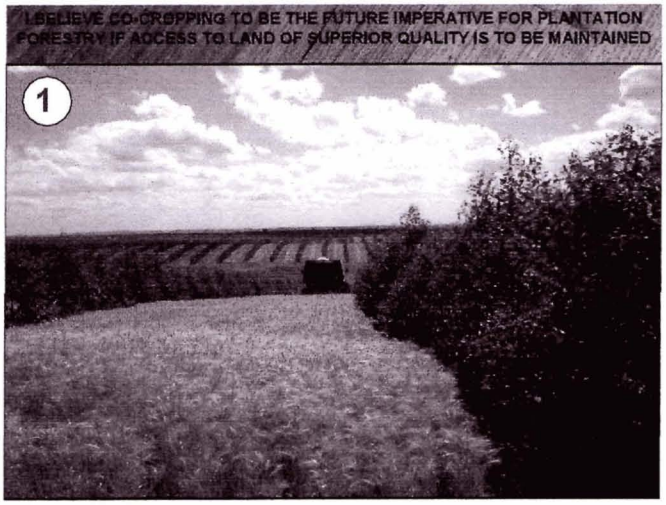

IN THE DETERMINATION OF TIMING & INTENSITY OF COMMERCIAL THINNING INTERVENTIONS, LANGEPAN C.C.T. PROVIDES A SOUND SCIENTIFIC BASIS.
CROWN DIAMETERS (M.) ON STEM DIAMETERS (CM.) FOR SELECTED STAND DENSITIES - FROM THE TOP : 25, 62, 124, 371 AND 494 STEMS PER HECTARE
THESE RELATIONSHIPS WERE DETERMINED AT AGE 25 YEARS.
LINES HAVE A COMMON ORIGIN, BUT, WITH LOWER STAND DENSITIES, SLOPE OF THE LINE INCREASES.
21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4
20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105

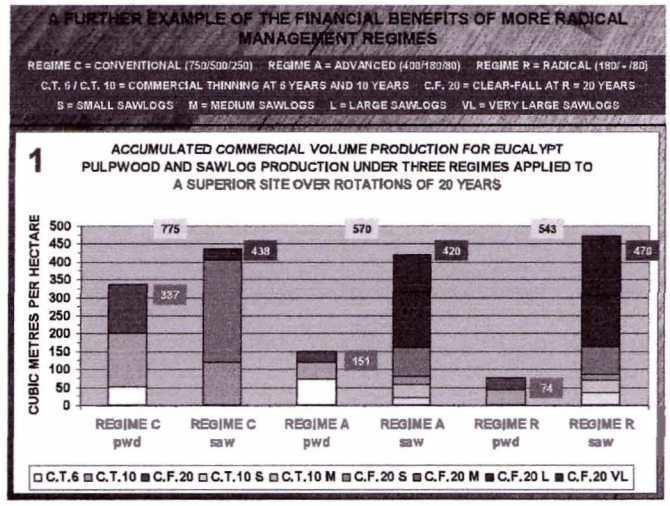

LANGEPAN C.C.T. : Dq DEVELOPMENT FOR FREE-GROWING
Eucalyptus grandis AT SELECTED STAND DENSITIES
1. THE MODEL BELOW SHOWS MAXIMUM Dq FOR FREE-GROWING E. grandis TREES AT A WIDE RANGE OF STAND DENSITIES.
IT IS INDEPENDENT OF SITE INDEX ...
2. WHEN THIS CROWN-COMPETITION LINE IS COMBINED WITH HARMONIZED DATA FOR RATES OF Dq GROWTH AT A RANGE OF DENSITIES, IT HAS GREATER VALUE FOR PURPOSES OF PREDICTION.
3. BUT IT IS NOW SITE INDEX SPECIFIC.
ITS PREDICTIONS FOR SUPERIOR SITES IN URUGUAY APPEAR QUITE ACCURATE.
STEMS PER HECTARE
Dq at 10 years
Dq at 12 YEARS
Dq at 14 YEARS
Dq at 16 YEARS
Dq at 18 years
Dq at 20 years
Crown Competition Line
Self-Thinning Line

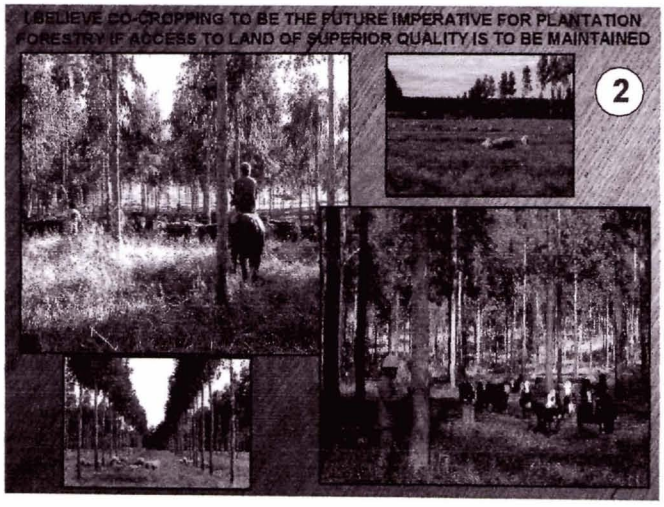

THE MONEY TREE – WHERE FEWER TREES MEAN MORE DOLLARS
PULPWOOD LOGS
> 8 CM. S.E.D.U.B.
38 M3/HA. @ USD 8 = $ 306
SMALL UNPRUNED SAWLOGS
25 TO 30 CM. S.E.D.U.B.
30 M3/HA. @ USD 25 = $ 760
MEDIUM PRUNED SAWLOGS
31 TO 40 CM. S.E.D.U.B.
100 M3/HA. @ USD 60 = $ 5,982
LARGE PRUNED SAWLOGS
41 TO 50 CM. S.E.D.U.B.
196 M3/HA. @ USD 85 = $ 16,686
VERY LARGE PRUNED SAWLOGS
> 50 CM. S.E.D.U.B.
108 M3/HA. @ USD 125 = $ 13,213
AT R = 20, Dq = 51.1 CM. & A.S.V. = 5.114 M³
EXAMPLE : REGIME G ASSUMING 5 M. LOGS
- ESTABLISH 1,000 STEMS PER HECTARE
- AT AGE 2, N.C.T. TO 200 STEMS / HA.
- AT AGE 10, THIN TO 100 STEMS / HA.
- ASSUMED SITE INDEX : 34.8
- ROTATION : 20 YEARS
- MEAN ANNUAL INCREMENTS :
- TOTAL WOOD : 29.9 M³ / HA./AN.
- COMMERCIAL WOOD : 28.6 M³/HA./AN.
- SAWLOGS : 24.2 M³/HA./AN.

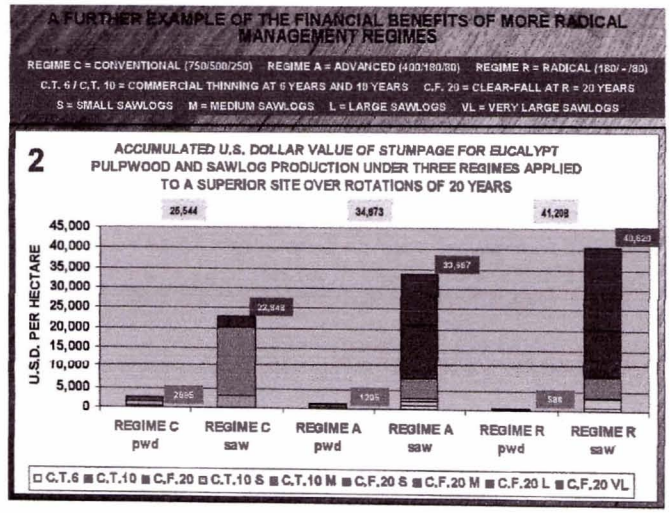

THE PRESENTATION BEGAN BY REFERRING TO MAXIMIZING DOLLAR VALUES, BUT IT NEEDS TO BE NOW FOCUSSED ON MAXIMIZING Dq VALUES ..... AS WE HAVE NOW SEEN, Dq IS REALLY A SURROGATE FOR DOLLARS.
WE MAY NOT LIKE IT, BUT EACH TREE IN A MANAGED-FOR-SAWLOG PLANTATION WILL CONTAIN A MIX OF LOG TYPES WITH A WIDE RANGE OF DOLLAR VALUES
PULPWOOD @ USD 8 / M³
VERY LARGE, PRUNED BUTT LOGS @ USD 120 / M³
$.


INCREASINGLY RADICAL REGIMES RESULT IN GREATER WOOD REVENUES
INCREASINGLY RADICAL REGIMES (LOWER STAND DENSITIES) PRODUCE GREATER INCREMENTS OF REVENUE AND GREATER PROPORTIONS OF SAWLOGS
USD / hectare / annum
% sawlog in volume produced
THIS REGIME IS 197/80 AND IS PROPOSED FOR INTENSIVE CO-CROPPING
RADICAL REGIMES PROVIDE SIGNIFICANTLY
CO-CROPPING WITH EVEN GREATER
REVENUE EARLY IN THE ROTATION
INTERNAL RATE OF RETURN.


I BELIEVE CO-CROPPING TO BE THE FUTURE IMPERATIVE FOR PLANTATION FORESTRY IF ACCESS TO LAND OF SUPERIOR QUALITY IS TO BE MAINTAINED
1


A FURTHER EXAMPLE OF THE FINANCIAL BENEFITS OF MORE RADICAL MANAGEMENT REGIMES
REGIME C = CONVENTIONAL (750/500/250) REGIME A = ADVANCED (400/180/80) REGIME R = RADICAL (180/ - /80)
C.T. 6 / C.T. 10 = COMMERCIAL THINNING AT 6 YEARS AND 10 YEARS C.F. 20 = CLEAR-FALL AT R = 20 YEARS
S = SMALL SAWLOGS M = MEDIUM SAWLOGS L = LARGE SAWLOGS VL = VERY LARGE SAWLOGS
1
ACCUMULATED COMMERCIAL VOLUME PRODUCTION FOR EUCALYPT
PULPWOOD AND SAWLOG PRODUCTION UNDER THREE REGIMES APPLIED TO
A SUPERIOR SITE OVER ROTATIONS OF 20 YEARS
CUBIC METRES PER HECTARE
500
450
400
350
300
250
200
150
100
50
0
775
337
438
570
151
420
543
74
470
REGIME C pwd
REGIME C saw
REGIME A pwd
REGIME A saw
REGIME R pwd
REGIME R saw
C.T.6 C.T.10 C.F.20 C.T.10 S C.T.10 M C.F.20 S C.F.20 M C.F.20 L C.F.20 VL


I BELIEVE CO-CROPPING TO BE THE FUTURE IMPERATIVE FOR PLANTATION FORESTRY IF ACCESS TO LAND OF SUPERIOR QUALITY IS TO BE MAINTAINED
2


A FURTHER EXAMPLE OF THE FINANCIAL BENEFITS OF MORE RADICAL MANAGEMENT REGIMES
REGIME C = CONVENTIONAL (750/500/250) REGIME A = ADVANCED (400/180/80) REGIME R = RADICAL (180/ - /80)
C.T. 6 / C.T. 10 = COMMERCIAL THINNING AT 6 YEARS AND 10 YEARS C.F. 20 = CLEAR-FALL AT R = 20 YEARS
S = SMALL SAWLOGS M = MEDIUM SAWLOGS L = LARGE SAWLOGS VL = VERY LARGE SAWLOGS
2
ACCUMULATED U.S. DOLLAR VALUE OF STUMPAGE FOR EUCALYPT
PULPWOOD AND SAWLOG PRODUCTION UNDER THREE REGIMES APPLIED
TO A SUPERIOR SITE OVER ROTATIONS OF 20 YEARS
U.S.D. PER HECTARE
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
26,544
2695
22,848
34,973
1295
33,967
41,208
588
43,628
REGIME C pwd
REGIME C saw
REGIME A pwd
REGIME A saw
REGIME R pwd
REGIME R saw
C.T.6 C.T.10 C.F.20 C.T.10 S C.T.10 M C.F.20 S C.F.20 M C.F.20 L C.F.20 VL

IT WOULD BE WRONG NOT TO MAKE SOME REFERENCES TO WOOD QUALITY

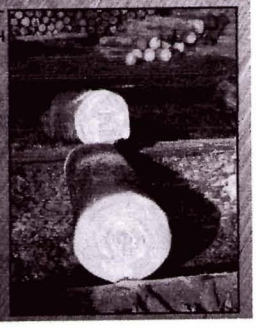
1. AS STATED, AN IMPORTANT BASIC OBJECTIVE IS TO PRODUCE LUMBER WITH HIGHER AND MORE UNIFORM DENSITY.

RESEARCH WITH *E. grandis* IN SOUTH AFRICA (Malan & Hoon (1992), Maree & Malan (2000), Malan (2005)), AND WITH *E. saligna* IN HAWAII (De Bell et al, 2001), SUGGESTS THAT FASTER GROWTH PRODUCES WOOD WITH HIGHER DENSITY.

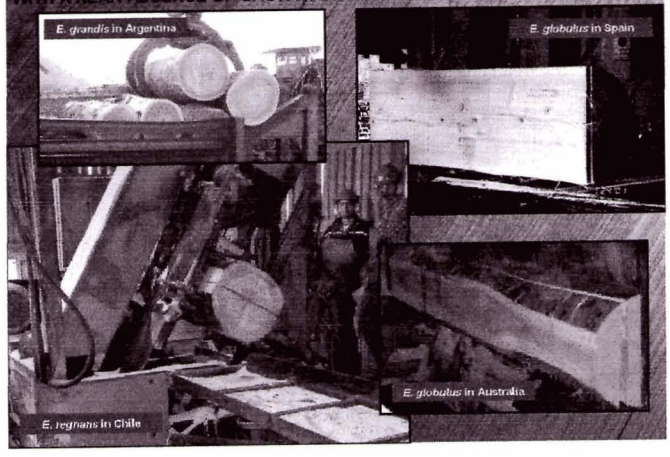
2. AND, ALSO AS STATED, ANOTHER IMPORTANT BASIC OBJECTIVE IS TO PRODUCE LOGS WITH LOW LEVELS OF GROWTH STRESSES.

THIS CONTRAST

REQUIRES A THEORY ABOUT THE CAUSES OF GROWTH STRESSES ..... AND I DO NOT SUBSCRIBE TO THE CONCEPT THAT THEY ARE INEVITABLE .....



ILLUSTRATIONS OF SAWMILLING LARGER LOGS FROM FREE-GROWN TREES WITH A NEAR ABSENCE OF GROWTH STRESS EXPRESSIONS :



I BELIEVE THAT GROWTH STRESSES ARE REACTIONS TO FACTORS IN THE TREE'S ENVIRONMENT .....

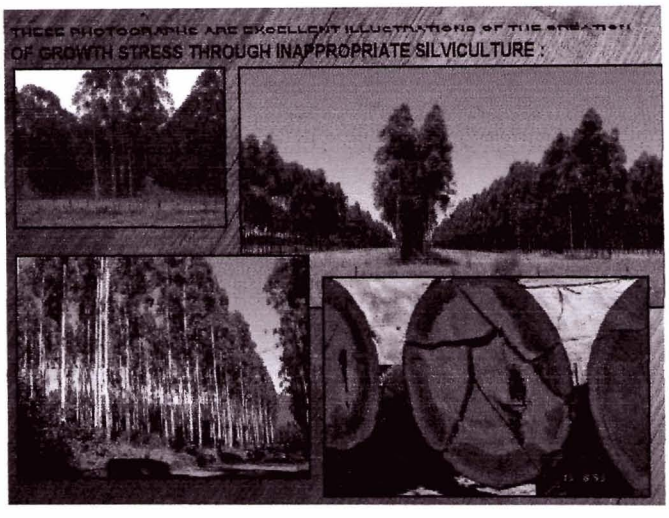
AND THE MOST IMPORTANT OF THESE IS THE MANNER IN WHICH THE CROWN OF THE TREE DEVELOPS .....

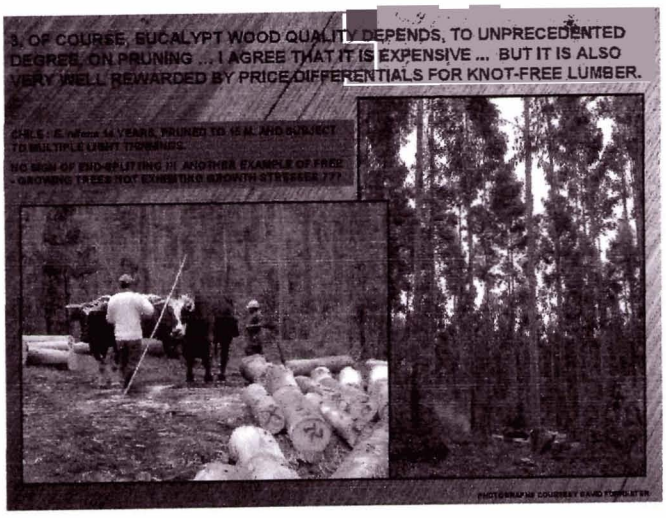
IF THAT CROWN DEVELOPMENT IS RESTRICTED BY COMPETITION FOR SPACE BY CROWNS OF OTHER TREES, THEN GROWTH STRESSES ARE SUGGESTED AS LIKELY .....

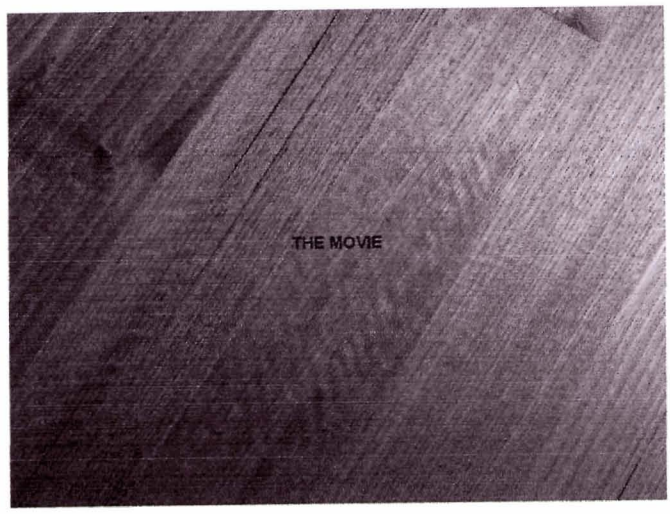
BUT IF THERE IS NO COMPETITION FOR SPACE FROM CROWNS OF OTHER TREES, THEN GROWTH STRESSES COULD BE EXPECTED TO BE MINIMAL .....

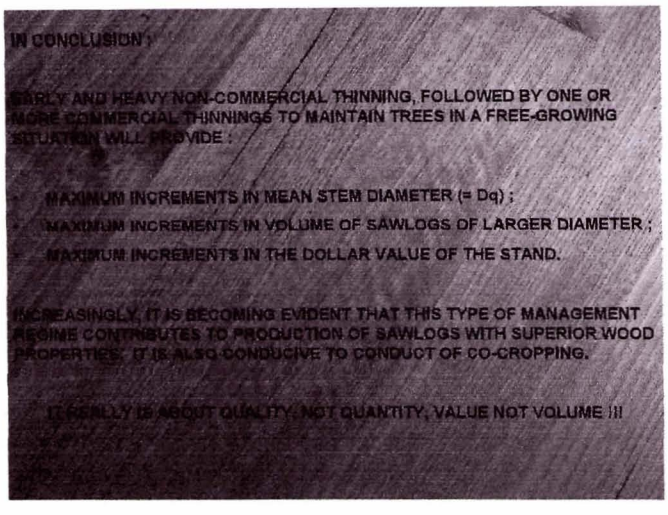
COLLECTIVE EXPERIENCE WITH SAWMILLING MANY FREE-GROWN TREES OF LARGER DIAMETER (SEVERAL SPECIES IN SEVERAL COUNTRIES) POINTS TO THE PROBABILITY THAT THE THESIS HAS MERIT AND THAT MANAGEMENT-PROGRAMMING REGIMES MAY PROVIDE THIS ADDITIONAL BENEFIT.

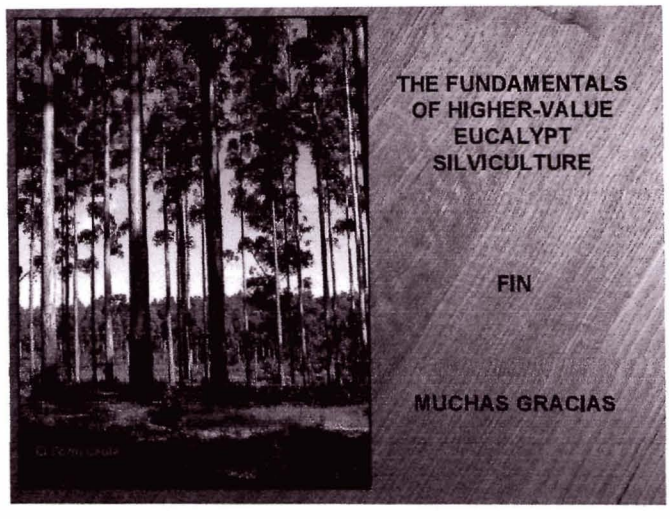
THESE PHOTOGRAPHS ARE EXCELLENT ILLUSTRATIONS OF THE CREATION OF GROWTH STRESS THROUGH INAPPROPRIATE SILVICULTURE :




3. OF COURSE, EUCALYPT WOOD QUALITY DEPENDS, TO UNPRECEDENTED DEGREE, ON PRUNING ... I AGREE THAT IT IS EXPENSIVE ... BUT IT IS ALSO VERY WELL REWARDED BY PRICE DIFFERENTIALS FOR KNOT-FREE LUMBER.


THE MOVIE


IN CONCLUSION :
EARLY AND HEAVY NON-COMMERCIAL THINNING, FOLLOWED BY ONE OR MORE COMMERCIAL THINNINGS TO MAINTAIN TREES IN A FREE-GROWING SITUATION WILL PROVIDE :
MAXIMUM INCREMENTS IN MEAN STEM DIAMETER (= Dq) ;
MAXIMUM INCREMENTS IN VOLUME OF SAWLOGS OF LARGER DIAMETER ;
MAXIMUM INCREMENTS IN THE DOLLAR VALUE OF THE STAND.
INCREASINGLY, IT IS BECOMING EVIDENT THAT THIS TYPE OF MANAGEMENT REGIME CONTRIBUTES TO PRODUCTION OF SAWLOGS WITH SUPERIOR WOOD PROPERTIES. IT IS ALSO CONDUCIVE TO CONDUCT OF CO-CROPPING.
IT REALLY IS ABOUT QUALITY, NOT QUANTITY, VALUE NOT VOLUME !!!


THE FUNDAMENTALS OF HIGHER-VALUE EUCALYPT SILVICULTURE
FIN
MUCHAS GRACIAS