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Non-Destructive Wood Quality Estimation From Standing Tree In Relation To End Product haracteristics Of Fast Growth Plantation Eucalypts I Uruguay (*Eucalyptus grandis* M.)

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Introduction:

Many non-destructive methods have been developed by a lot of researchers, and new methods for the field uses are going to study.

Fast growth plantation species, for example In Uruguay, cutting rotation in *E. grandis* is 18 - 20 years, for Pinus species is 20-23.

Sustainable forest management, for example, thinning, pruning, quality improvement by genetics are the most important for fast growing species.

In addition to these, Mechanical Stress Rating Lumbers are required by utilization side (end users).

Optimization of wood processing and productions for added end product values will be important.

In this opportunity, we are aiming at wood characteristics estimation of young and small diameter thinning logs (9 to 10 years) which are taken from several sites, in Uruguay.

Repburica Oriental del

Uruguay

800,000 ha Forestation area

Plantation started from1978; Main species;

***E. globulus ssp., E. grandis*, and *Pinus taeda, P. elliottii*.**

Total plantation 800,000ha (75% Eucalypts, 24% Pinus spp.)

Materials **and methods**

***Eucalyptus grandis*:**

North ： 9-10 years old (3rd thinning stand)

South: 9-10 years old (3rd thinning stand)

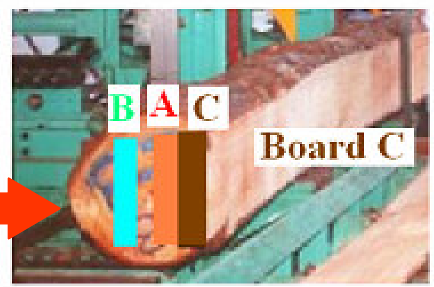
Central: 26 years old (Without management)

Materials and methods

Non destructive tests

Eucalypt forest

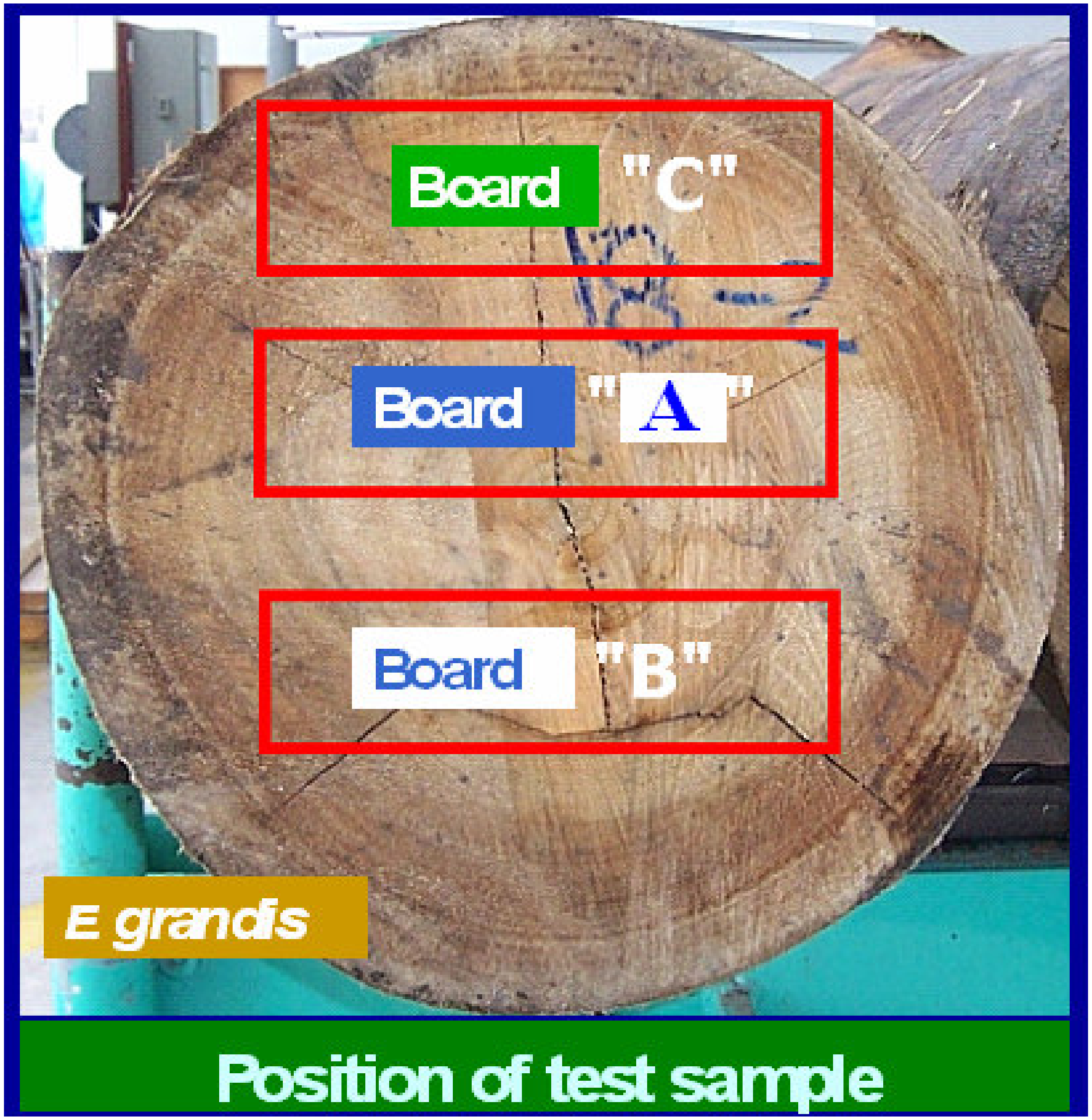
Tested sample boards



Sample boards

NEXT OPORTUNITY

LVL and Glue-Lam



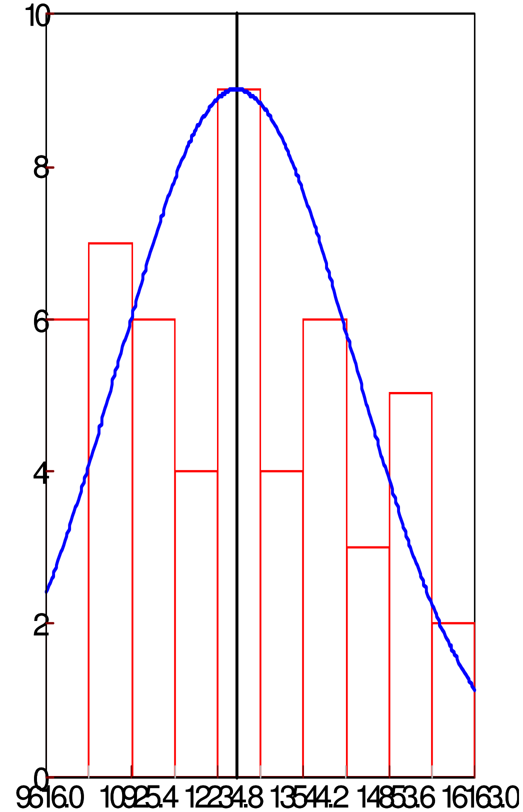
Dimension: 50 x 15 x 280cm

Non destructive test and destructive test were carried out.

*Tree selection for the tests (50 trees)

* Standing tree MOE: FAKOPP
  Density: Sample core
* Logs MOE: FAKOPP and FFT-Analizer (at green condition) with bark, without bark
  → Sawing
*Boards (3 positions at least): and Moisture content
* Green condition → Kiln dry (13%)
•Board MOE and MOR: FAKOPP, FFT, Universal testing machine, Density and MC. (Bending test, according to ASTM:)
* Clear small sample from each board tested MOE, MOR, Density and MC. (Bending test according to JAS) , and other mechanical properties

Eucalyptus grandis: North



MOE: Boards

Standing tree No destructive test with FAKOPP

Ultra sound propagation

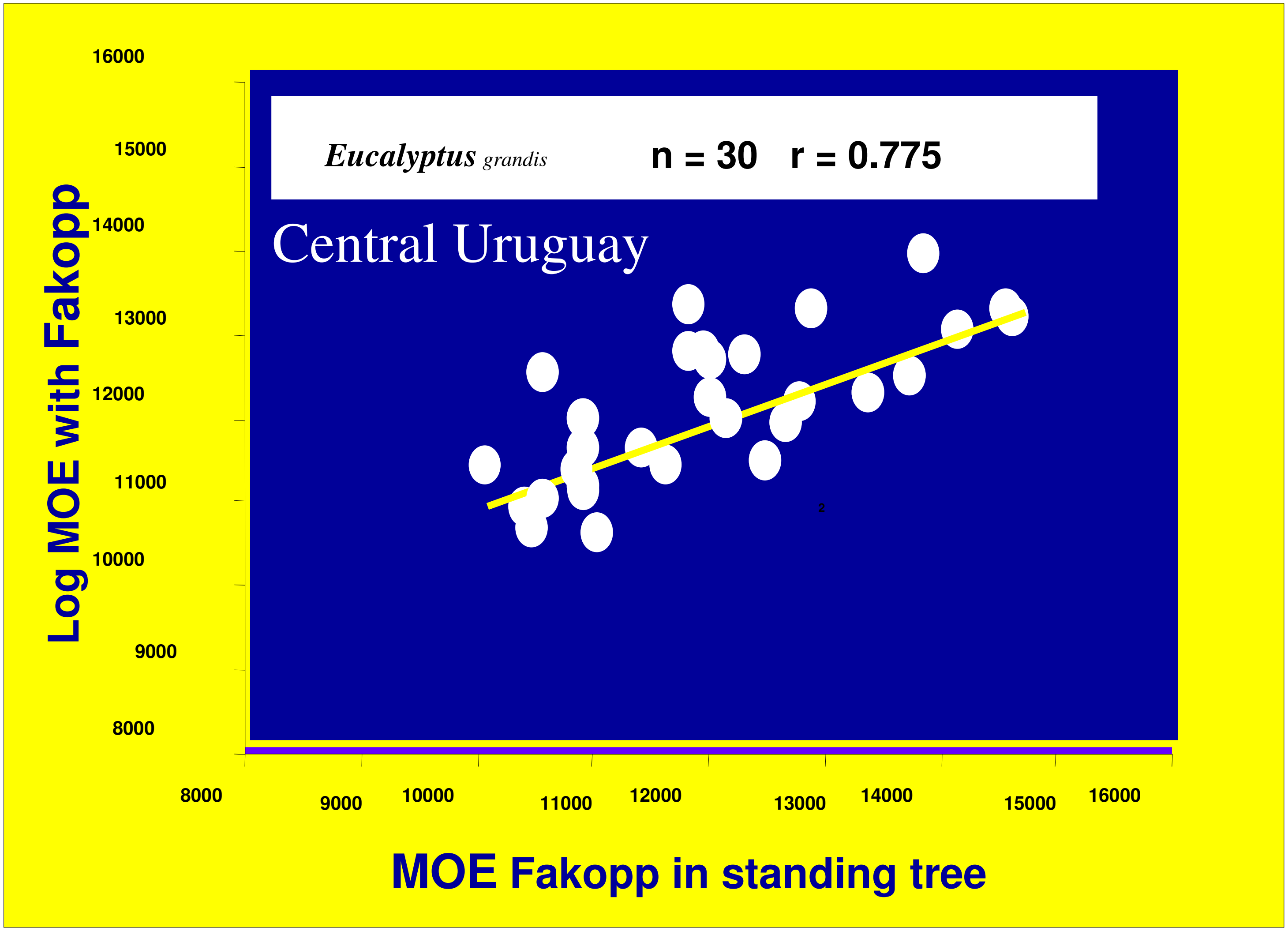
Distance from 1m to 2m

Increment core for density measurement

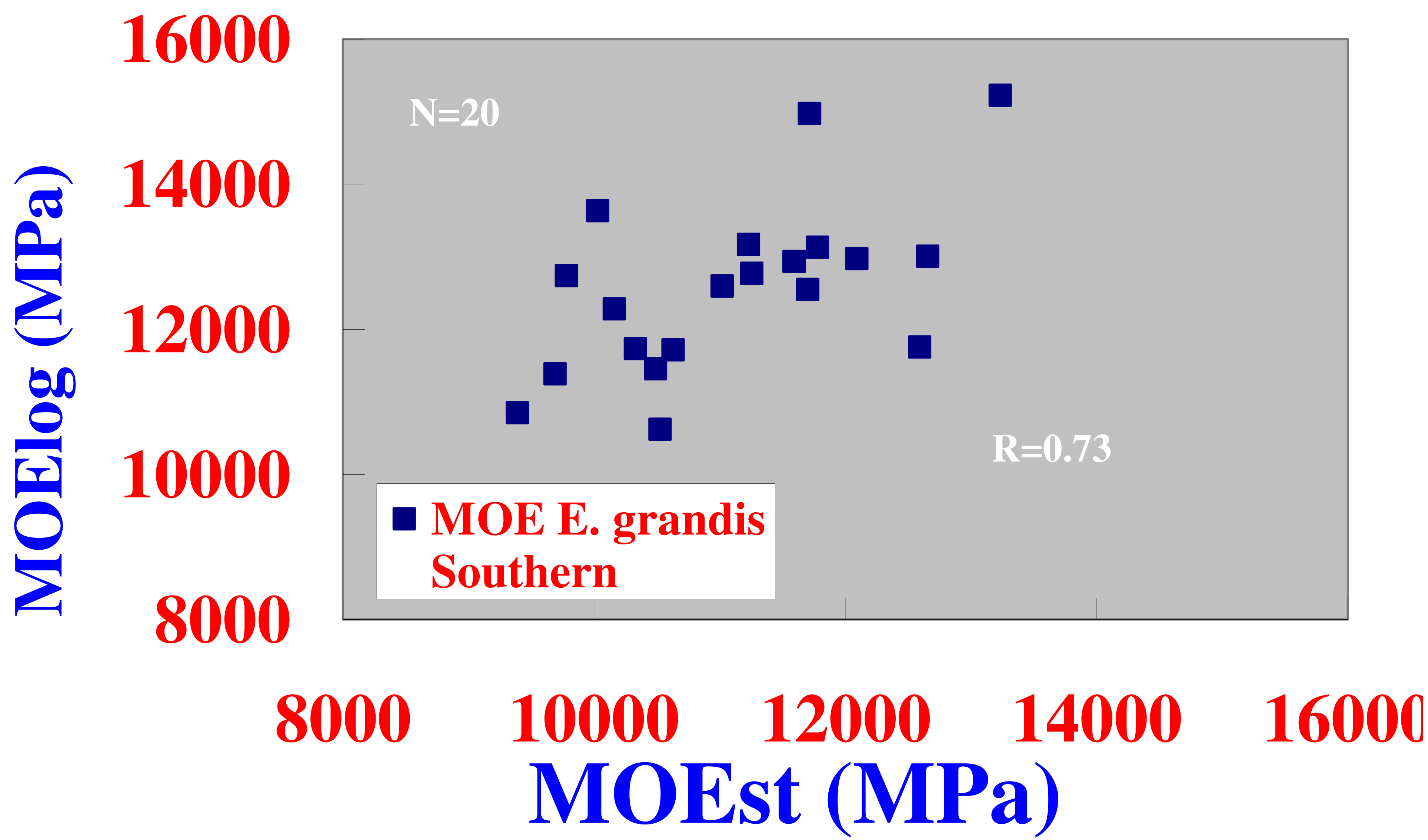
Results

1 MOEst and Log MOE (MOElog) relationships
2 MOEst and real size board MOE relationships
Radial direction and height of the stem
(MOE and MOR)
3 Relationship between growth rate and MOE, and MOR
4 Classification of dimension lumber in order to JAS
5 Estimation of the end products from standing tree MOEst

MOEst and Log MOE (MOElog) relationships



Standing tree MOE and Log MOE



Relationship between MOEst and MOElog Southern

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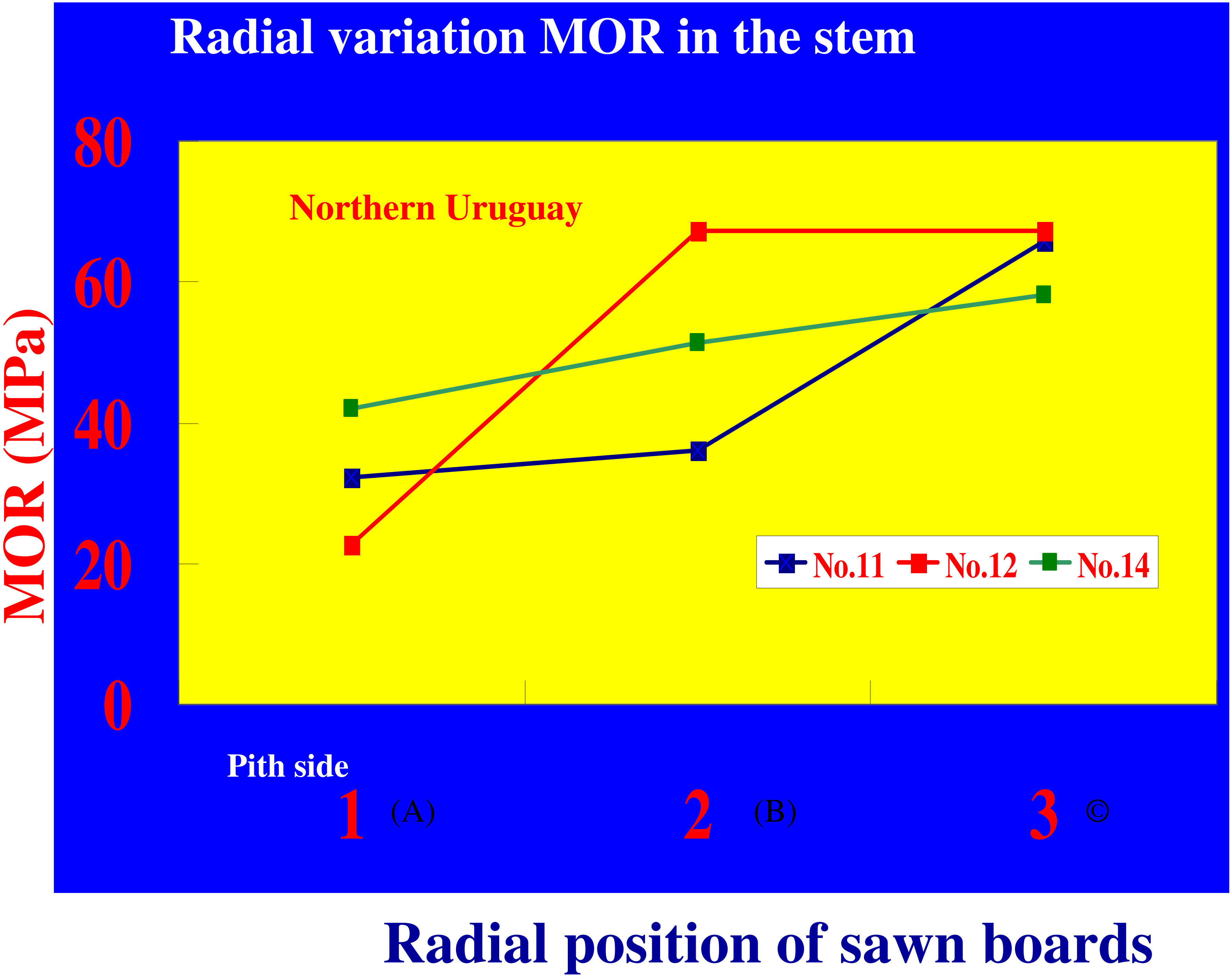
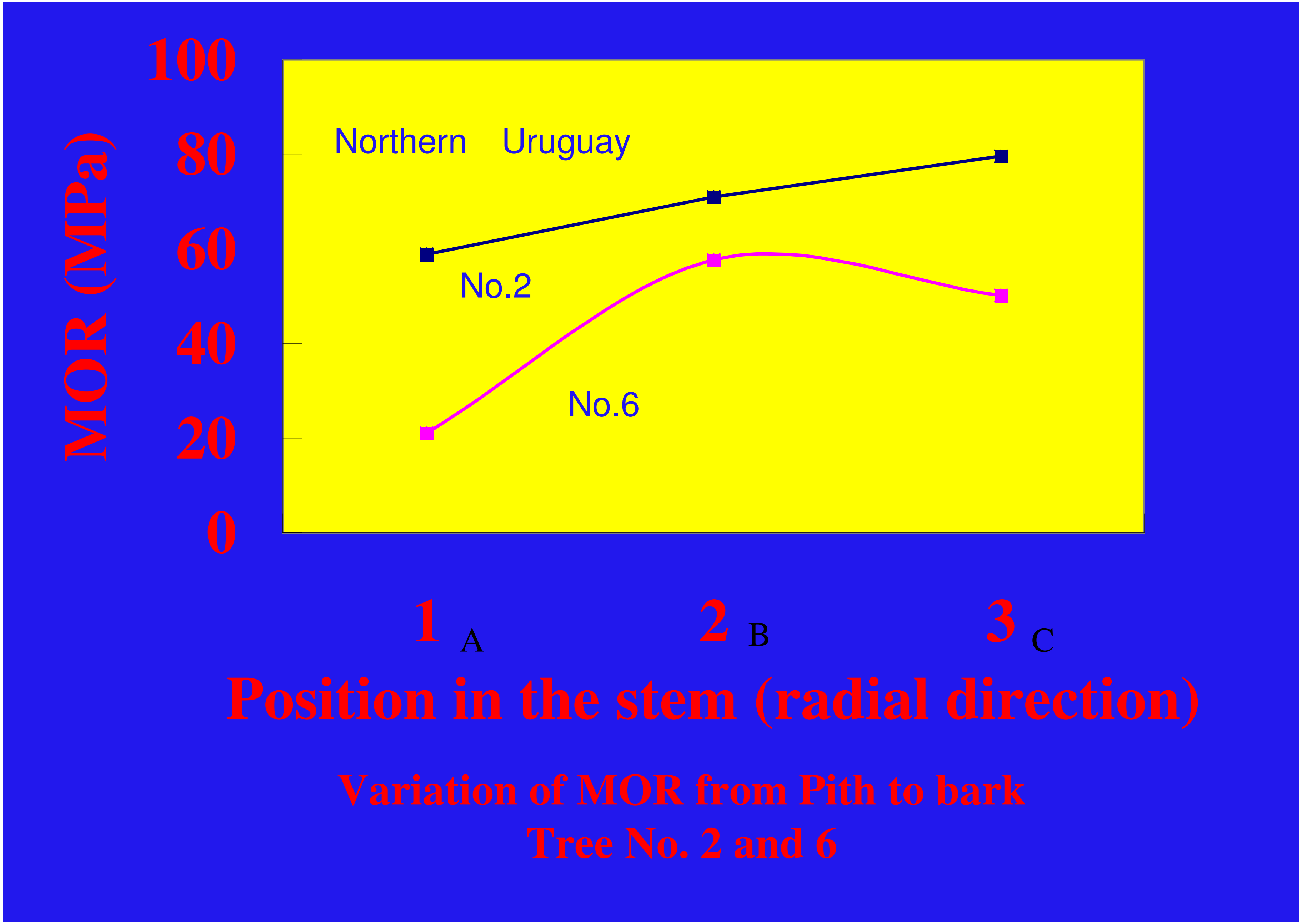
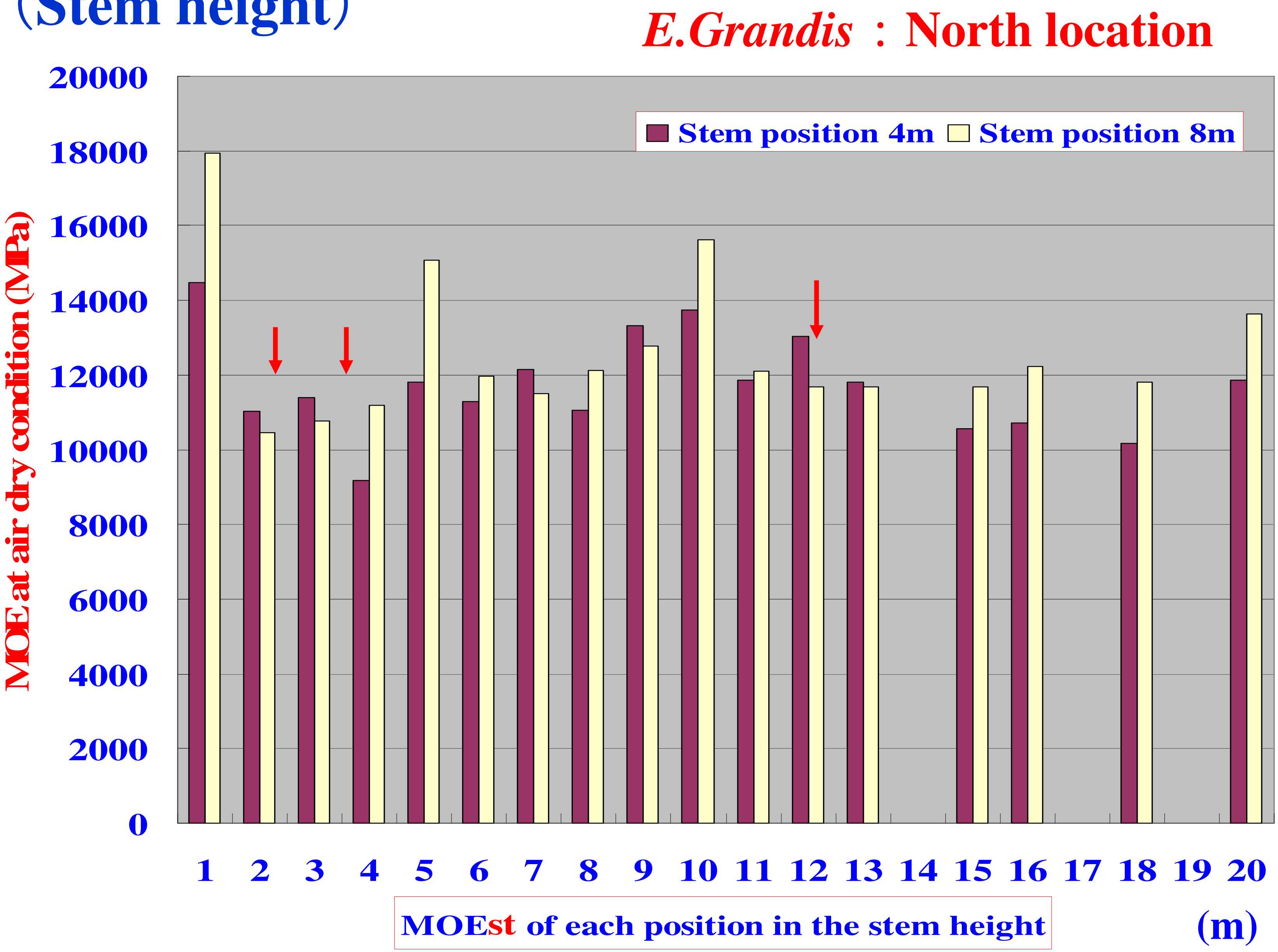


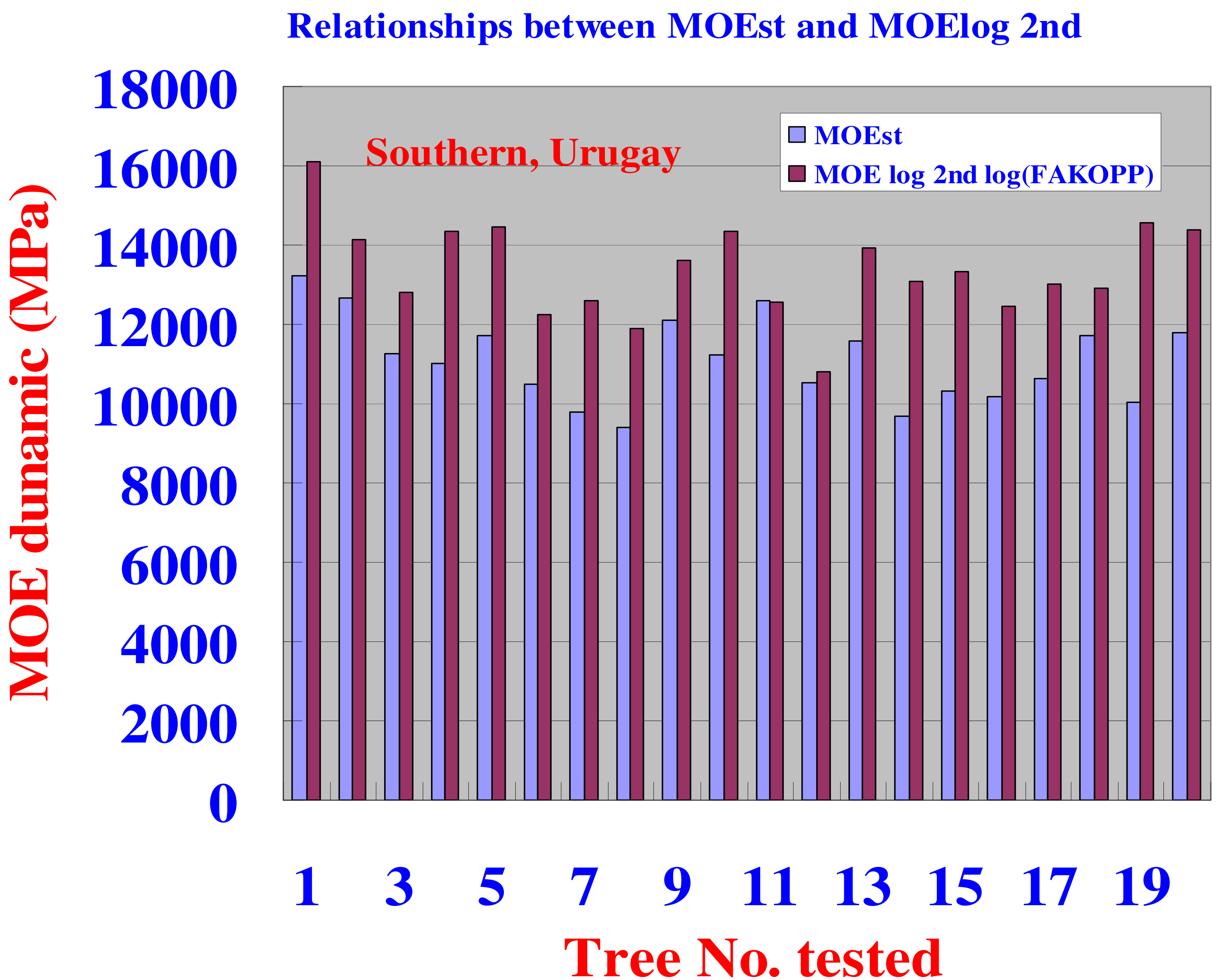
Radial variation MOR in the stem
80
60
40
20
0
MOR (MPa)
Northern Uruguay
No.11
No.12
No.14
Pith side
1 (A)
2 (B)
3 ©
Radial position of sawn boards


MOR (MPa)
100
80
60
40
20
0
Northern Uruguay
No.2
No.6
1 A
2 B
3 C
Position in the stem (radial direction)
Variation of MOR from Pith to bark
Tree No. 2 and 6

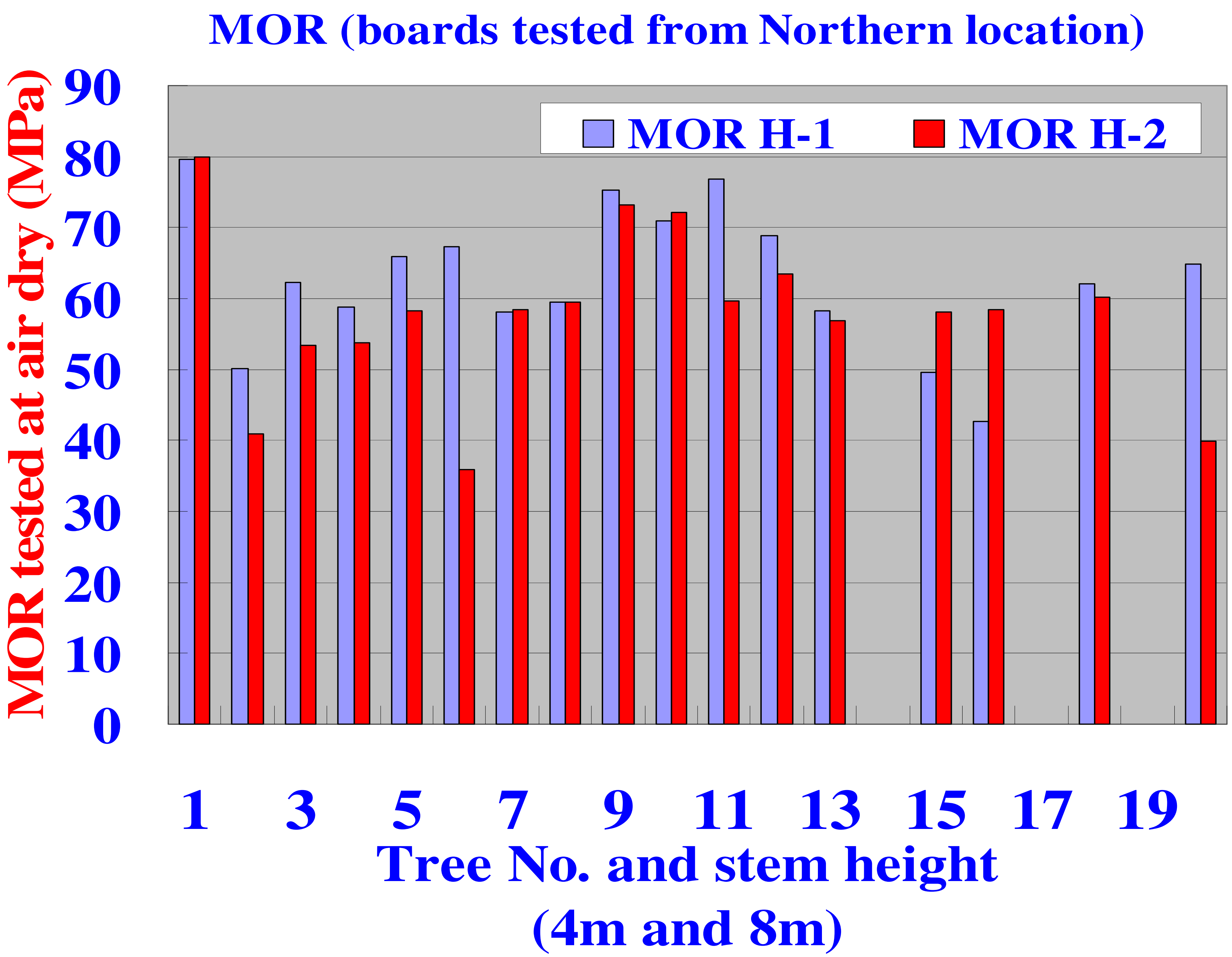
（Stem height）



Tree No. and position of sawn board (Outer location of stem)



Relationships between MOEst and MOElog 2nd
Southern, Urugay
MOEst
MOE log 2nd log(FAKOPP)
MOE dunamic (MPa)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1
3
5
7
9
11
13
15
17
19
Tree No. tested


MOR (boards tested from Northern location)
MOR tested at air dry (MPa)
0
10
20
30
40
50
60
70
80
90
MOR H-1
MOR H-2
1
3
5
7
9
11
13
15
17
19
Tree No. and stem height
(4m and 8m)

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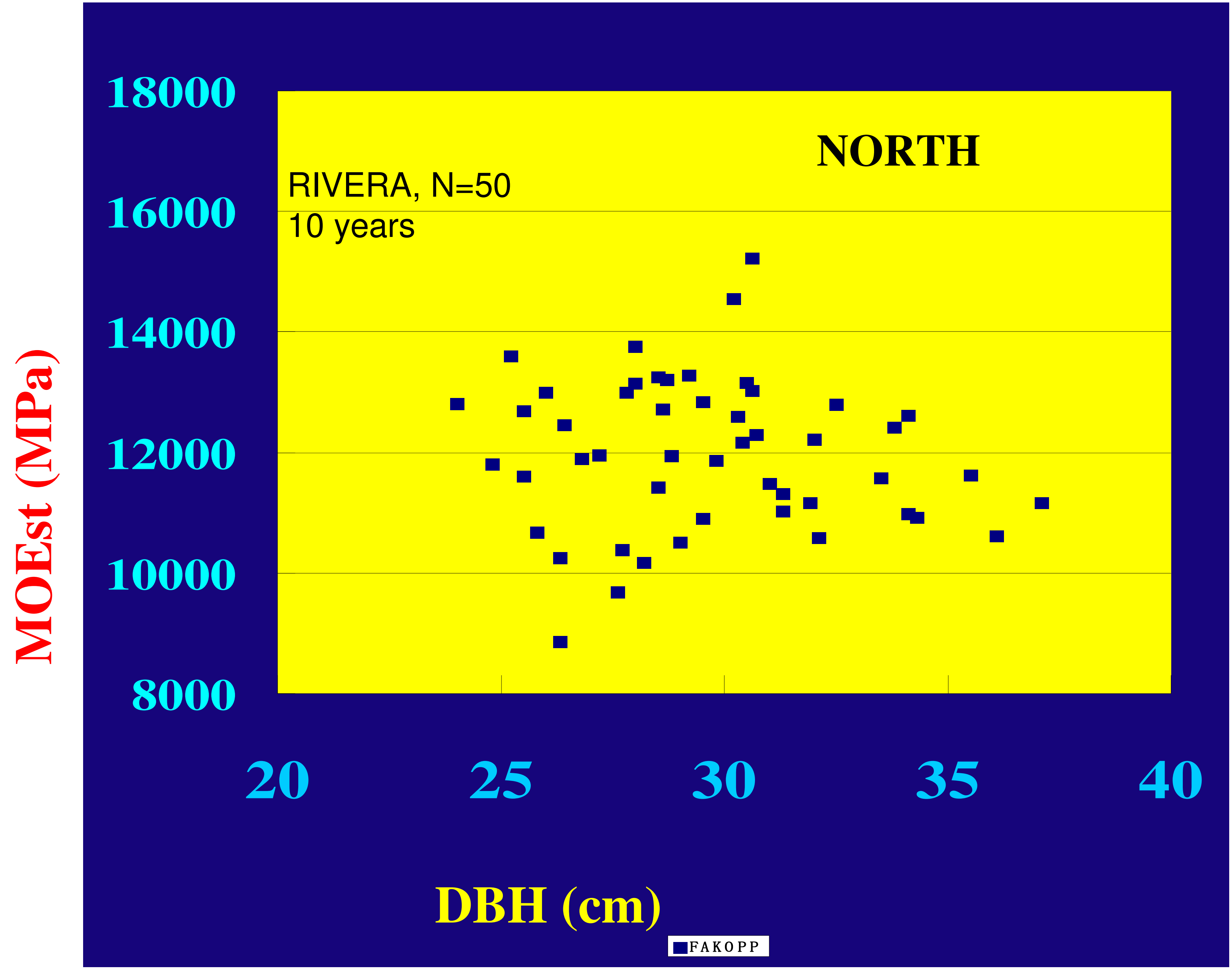
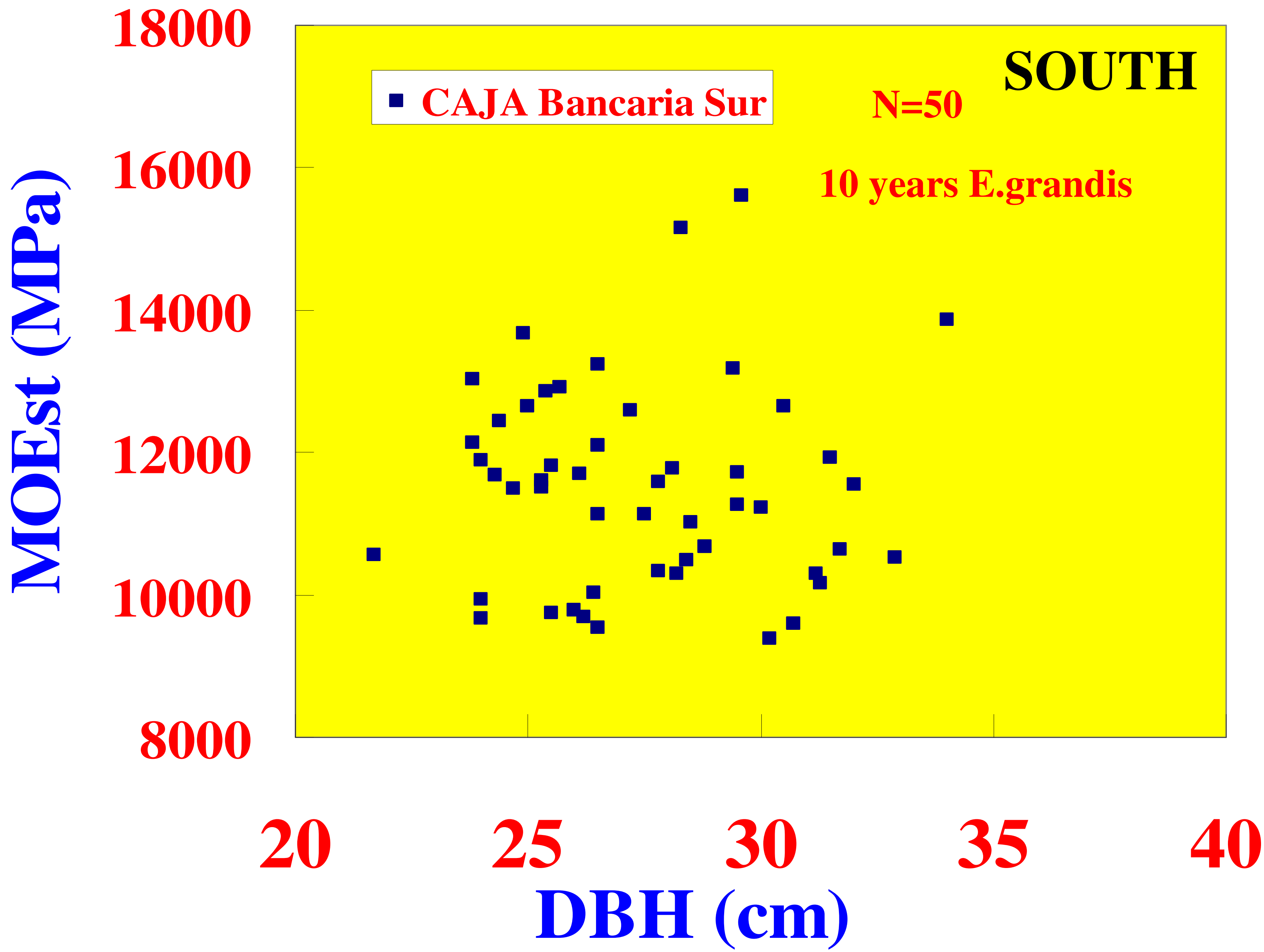
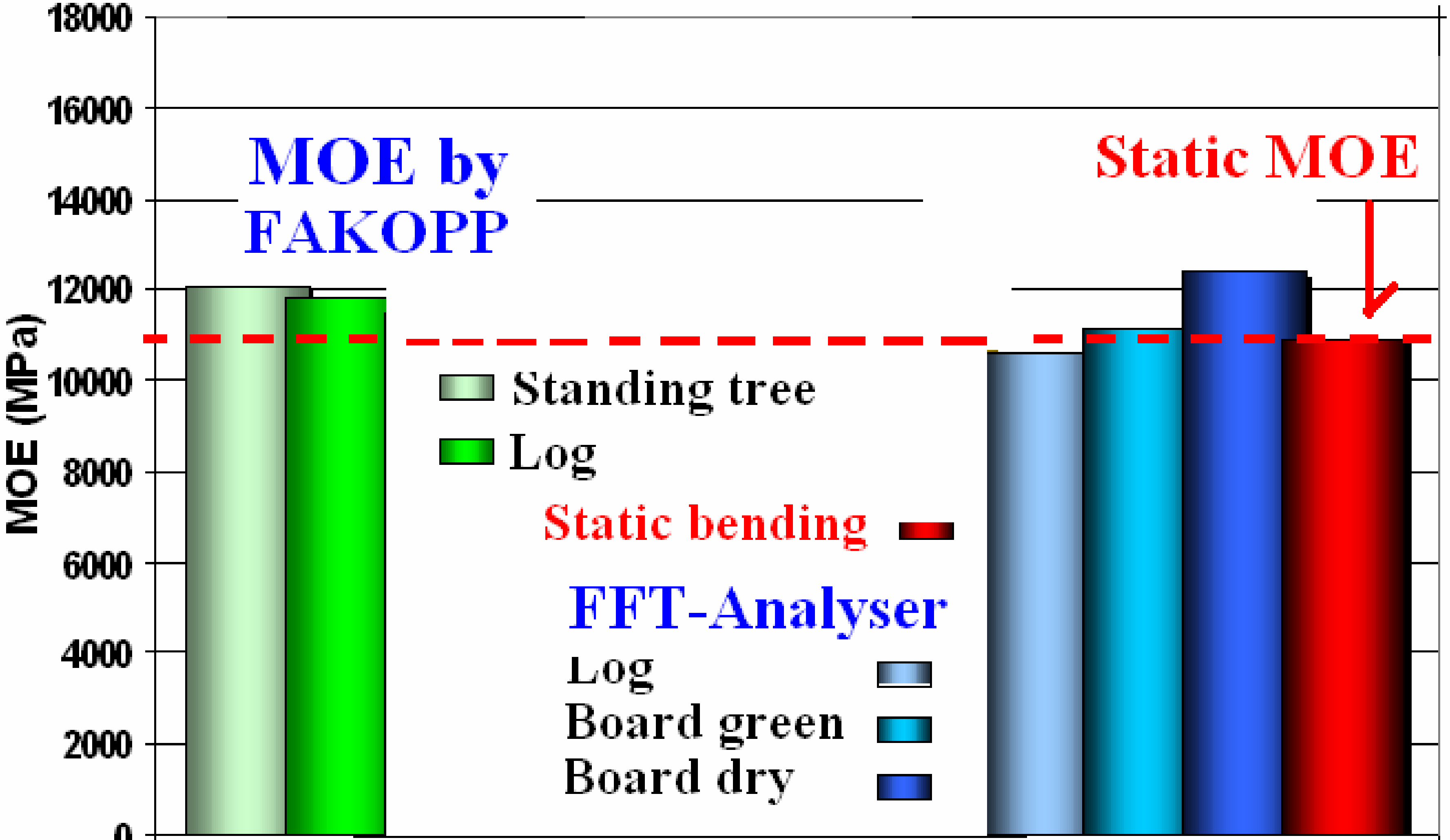
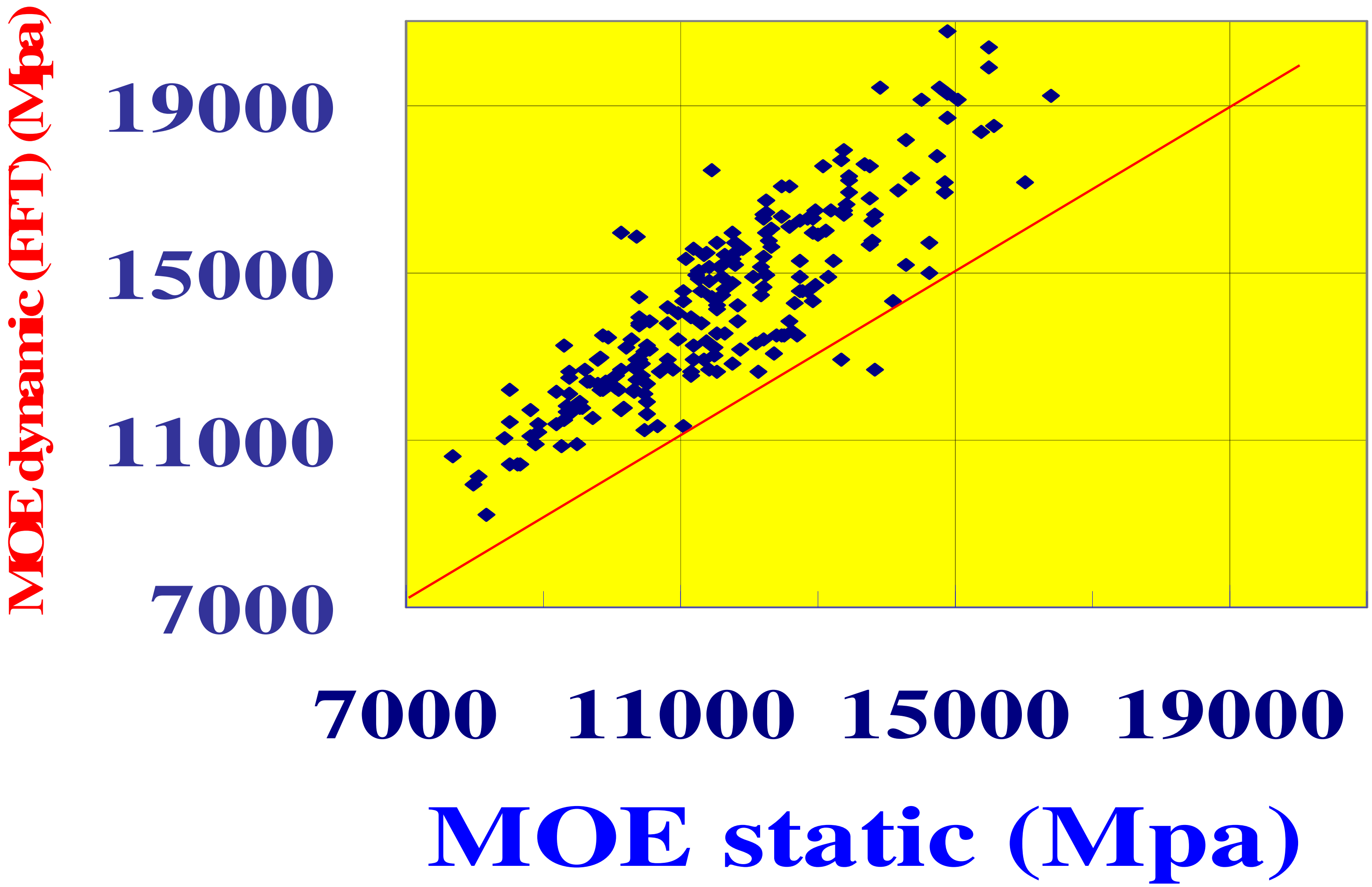

NORTH
RIVERA, N=50
10 years
MOEst (MPa)
18000
16000
14000
12000
10000
8000
20
25
30
35
40
DBH (cm)
FAKOPP



Growth rate and MOEst Southern

MOE obtained by diferent methods





MOE dynamic (FFT) (Mpa)
19000
15000
11000
7000
7000
11000
15000
19000
MOE static (Mpa)

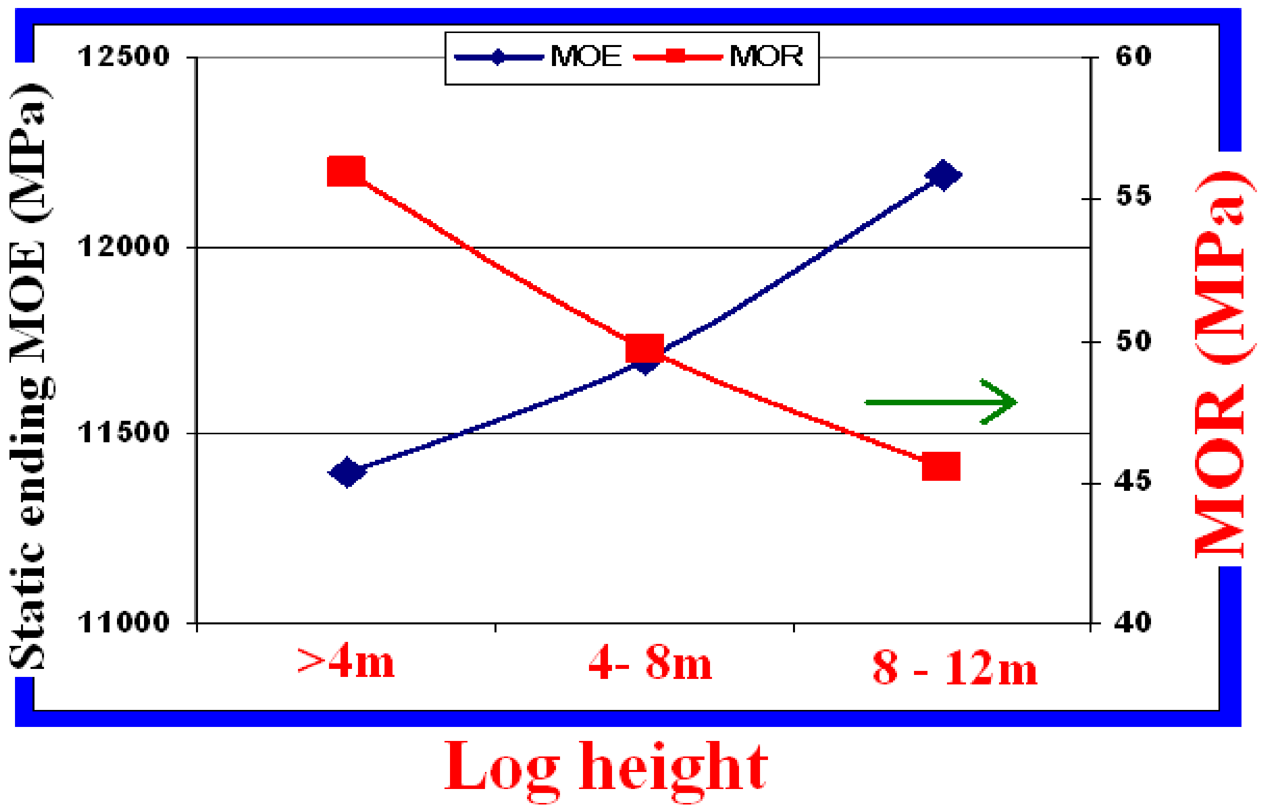
Emergency!!

MOR value according in the stem height. Especially, in case of real size boards.

1) **Juvenile wood (not so much influence like as conifer species, however,,,**
2) **Defects; knots, ,**
3) **MOR has higher sensibility than MOE**
   Small clear sample: MOR 2 times greater than real size boards.

Mean value of MOE and MOR（Static bending）

Position of log tested	NO. of boards tested	Static test		Basic density (g/cm³)
		MOE (MPa)	MOR (MPa)	
4m	76	11402	55,9	0,447
8m	78	11696	49,6	0,429
12m	77	12190	45,6	0,451



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ACCORDING TO JAS

Categories JAS	MOE 10^3kgf/cm^2	MOE (MPa)	Dimension lumber BA No. of board	Dimension lumber BA (%)	Dimension lumber B No. of board	Dimension lumber B (%)	Dimension lumber C No. of board	Dimension lumber C (%)
< E 50	< 40	< 3920	---	---	---	---	---	---
E 50	40 - 60	3920-5880	---	---	---	---	---	---
E 70	60 - 80	5880-7850	1	1,4	1	1.1	---	---
E 90	80 - 100	7850-9810	26	35,6	14	15,2	3	3,2
E 110	100 - 120	9810-11770	31	42,5	43	46,7	32	33,7
E 130	120 - 140	11770-13730	13	17,8	25	27,2	33	34,7
E 150	140 - 160	13730-15690	2	2,7	8	8,7	24	25,3
> E 150	> 160	> 15690	---	---	1	1.1	3	3.2
Percent of board surpass grading value for construction According to JAS				98,6		98.9		100

E110: < 99%,

E 130: board A; 20%, B; 34%, C; 63%

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MOE of dimension lumber
(dry condition : MPa)

Estimation value of MOE

Non destructive MOE in the stem
of standing tree (by FAKOPP)
(green condition : MPa)

Greater MOE for
structural members
MOE >16,000

MOE > 13,000

Médium MOE for
structural uses
10,000 – 13,000

MOE : 8,000 – 11,000

Low MOE for
interior uses
8,000 – 10,000

MOE < 7,000

Estimation of end products by standing tree MOE (MPa)

Conclusions

1) MOEst and MOElog : High correlation

2) Radial variation: Increasing from pith to bark (less influence than conifer sp.)

3) Growth rate and MOE: very low relationships

4) Influences of the stem height: MOE increasing, MOR has a tendency to decrease, and in case of real size boards are more evident

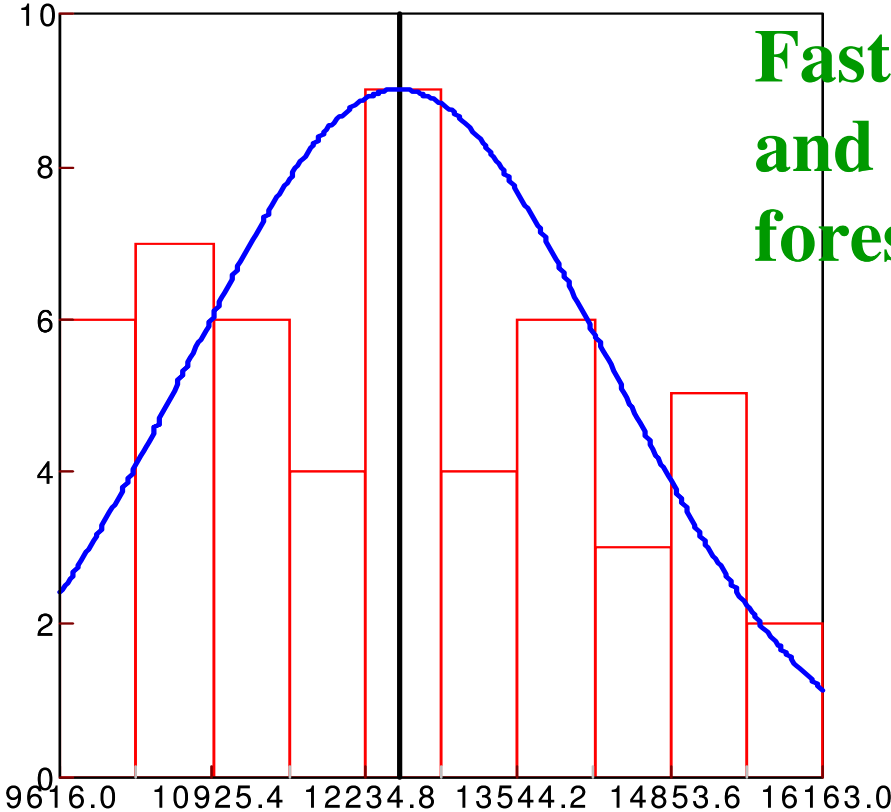
5) Relationship stem height: If! No.1 log MOE is greater No2, No.3 log has a tendency to greater one. However MOR is decrease.

→ **Importance of forest management (Clear cutting surface)**

6) Structural uses: Majority of boards are acceptable

7) Wood quality estimation: very useful for the many research fields.
Consideration: Moisture content, Properties of dynamic MOE, Defects, etc.

（**OWARI**：完、オワリ）



Fast growth Eucalyptus spp. and Pinus spp. Sustainable forest management

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Donde?

Thank you for your careful attention ! !