EVALUATION OF THE STRAIGHTENING ABILITY IN *Pinus pinaster* Ait. PROGENIES

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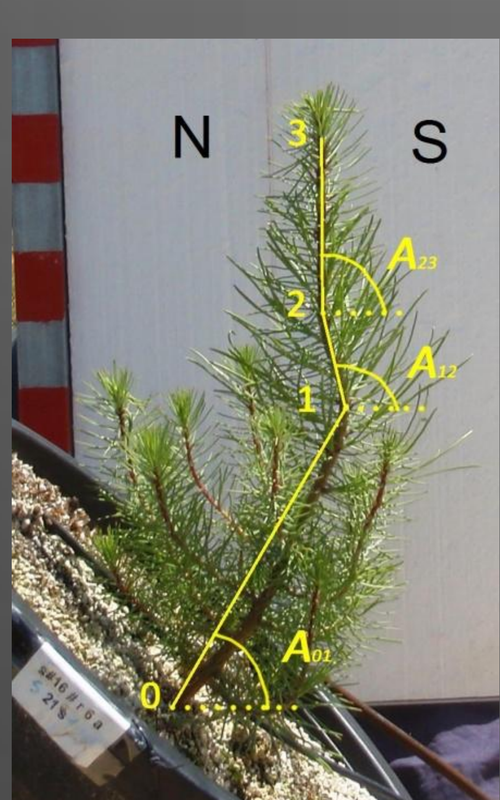
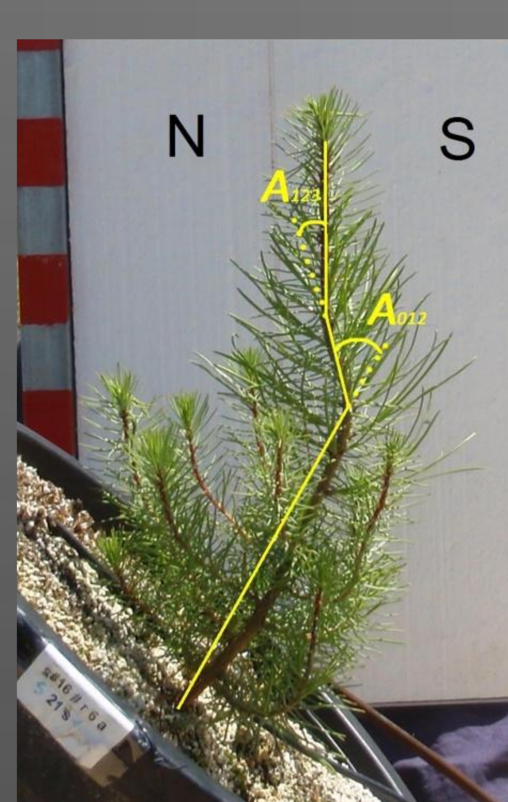
Pinus pinaster Ait. is the conifer which major volume of wood is obtained in Spain. In this pine species the quality of the wood is low due to the lack of stem straightness. In addition, stem flexuosity produces an increase in the costs of transport and manufacturing of the row material.

Recently, an alternative method for early selection of the stem straightness has been proposed, based on the efficiency of reaction wood in the stem straightening process instead of the evaluation of stem form (Sierra de Grado *et al*., 2008). Biomechanical analysis showed in artificially tilted seedlings that_differences in the secondary gravitropic and autotropic reactions in the stem straightening process are related to differences among provenances characterized by different straightness.

We studied the variability among progenies in the gravitropic and autotropic reactions, and the efficiency of compression wood in the stem straightening process, following the same method. Plants from 38 *Pinus pinaster* Ait. progenies from the Norwest Interior provenance and 6 different provenance commercial seeds controls were used. The progenies were phenotypically selected by Tragsa company in Galicia (Norwest of Spain).





When the plants were one year old, they were artificially tilted at 45º. The kinetic study of the stem form changes (angles of deviation from the horizontal) were measured based on photographs taken during a 6 month period after tilting. Subsequently, compression wood (CW) was analyzed in four stem cross sections per plant.

The CW efficiency in the straightening process (α parameter) was calculated with Fourier's biomechanical model (1994).

$$\partial C = -4 \cdot \alpha_j \cdot \frac{dR}{R^2}$$

$$\Delta A_{01}(t) \cdot = \beta * \varphi_{01}(t) + \varepsilon$$

The changes in local curvature was integrated along the stem to estimate the final angle of A_{01} predicted by the model (Φ). α is half the difference in maturation strain between the upper and lower sides of the stem and β is the estimator of α.

$\Delta A01$ Fixed effects type 3 test				
Effect	Num DF	Den DF	F-Valor	Pr > F
Progenie	43	367	3.10	<.0001
Plot	9	367	1.99	0.0400

A01fin Fixed effects type 3 test				
Effect	Num DF	Den DF	F-Valor	Pr > F
Progenie	43	367	2.98	<.0001
Plot	9	367	1.74	0.0792

A012 Fixed effects type 3 test				
Effect	NumDF	Den DF	F-Valor	Pr > F
Progenie	43	367	2.11	0.0001
Plot	9	367	2.95	0.0022

	Φ	β	ΔA01	A012fin	A01fin
h^2	-0,0162	0,4001	0,6317	0,4030	0,4215
	6 Plots		10 Plots		

All the plants followed the pattern described in previous biomechanical analysis. The ANOVA analysis shows that the effect of the progenie is significant for ΔA_{01}, A_{01fin}, $A_{012fin.}$ The heritabilities were high (> 0.4).

Our results were used to make the ranking of the progenies according to the compression wood efficiency and the secondary gravitropic movements.

- •Controls from twisted provenances .
- • Control from straight stemmed provenance (Gredos).
- •Norwest Littoral Provenance (medium-high straightness).

β	ΔA01	A01 fin	PHI	A012fin
39	39	44	22	30
32	44	30	19	2
30	30	39	36	42
44	32	2	14	11
42	2	42	7	7
24	40	40	33	15
29	7	32	4	35
37	42	25	40	4
20	33	23	1	25
38	24	33	10	13
40	10	16	8	41
33	34	35	3	5
9	31	28	16	44
31	25	29	12	16
2	14	7	39	33
26	8	22	11	8
34	11	15	25	40
10	16	13	13	21
13	13	11	27	9
28	29	12	23	32
25	28	41	28	43
15	36	34	34	39
6	12	31	43	38
17	9	4	41	28
23	37	24	5	12
7	4	37	31	6
41	15	38	6	10
8	23	19	44	23
12	35	17	35	27
18	27	3	2	20
11	18	27	32	37
36	26	6	9	31
16	3	9	18	18
27	17	26	30	22
35	20	1	17	29
43	41	18	21	34
14	6	10	15	1
4	22	21	26	36
5	43	5	37	14
21	1	43	24	19
3	38	8	42	24
19	5	20	20	26
1	21	14	29	17
22	19	36	38	3

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