

# Construction of yield tables for *Pinus pinea* in Tunisia

Work conducted at ISA (Portugal)

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Advancing Mediterranean Forest research Capacities

Task 4.1 : Forest inventory and modelling

# Introduction

The development of yield tables requires several steps:

- The selection and establishment of a height growth model
- fixing of productivity levels
- selection and establishment of volume equations
- Study the evolution of main and accessory stand
- Finally, presentation of the table and analysis of its contents

# The selection and establishment of a height growth model

The model derived from the equation of Lundqvist-Korf adjusted by using the General Algebraic Difference Equations (GADA)

*(Developed by sghaeir et al. - proposed for publication)*

$$(1) \quad Y = e^{X_0} \times e^{\left( -\left( \frac{35,574}{X_0} \right) \times t^{(-0,558)} \right)}$$

$$(2) \quad X_0 = \frac{1}{2} \left( LnY_0 + \sqrt{(-LnY_0)^2 + 4 \times 35,574 \times t_0^{-0,558}} \right)$$

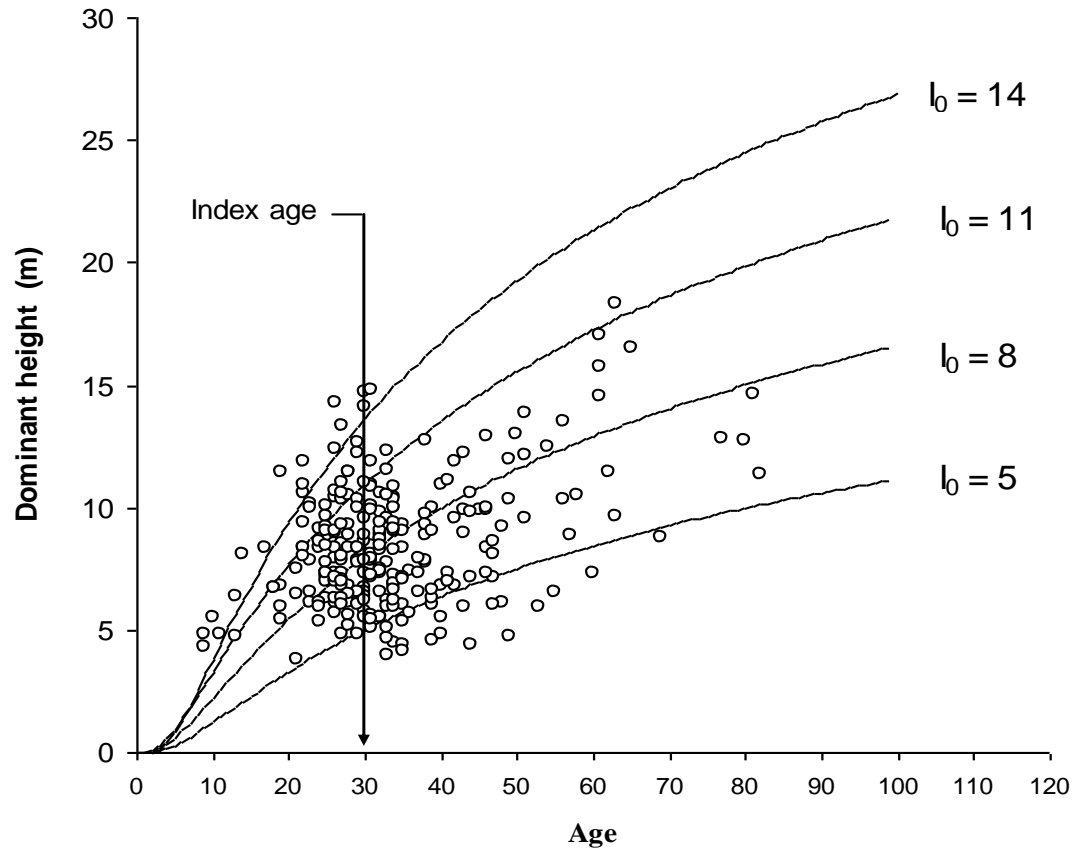
Y is the dominant height at age t

$e^{X_0}$  is the asymptote

$Y_0$  and  $t_0$  represent the dominant height and age observed

The reference age was chosen to 30 years

# Height growth model



Curves for site index of 5, 8, 11 and 14 m at reference age of 30 years overlaid on the trajectories of the observed heights over time

# Equations of volume

model type	Equation	$R^2_{ajd}$	Biais	Sa (m <sup>3</sup> )	Sr (%)	Insignificant coefficient
1	$V = b_0 + b_1 C + b_2 C^2$	0.932	$-2.293 \cdot 10^{-4}$	0.030	16.55	0
2	$V = b_0 + b_1 C + b_2 C^2 + b_3 C^3$	0.934	$-1.979 \cdot 10^{-4}$	0.0297	18.06	0
3	$\log(V) = b_0 + b_1 \log(c)$	0.941	$2.618 \cdot 10^{-3}$	0.0312	16.97	0
4	$V = b_0 + b_1 C + b_2 C^2 + b_3 C^3 h$	0.9501	$-4.31 \cdot 10^{-2}$	0.0545	33.96	1
5	$\log(V) = b_0 + b_1 \log(c) + b_2 \log(h)$	0.9665	$2.427 \cdot 10^{-3}$	0.0235	12.52	0
6	$C^2/v = b_0 + b_1/h$	0.7184	$5.368 \cdot 10^{-3}$	0.0281	13.31	0

One entry

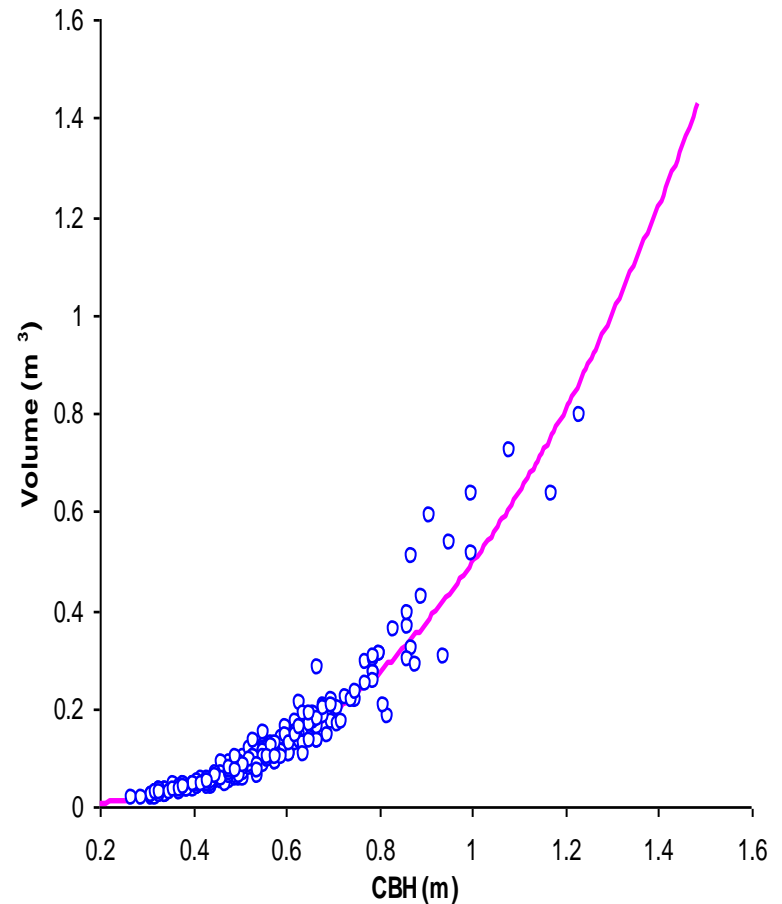
Two entry

# Equations of volume

Selected model for *P. pinea* in Tunisia

$$V = 50,45 \times 10^{-2} \times C^{2,6553}$$

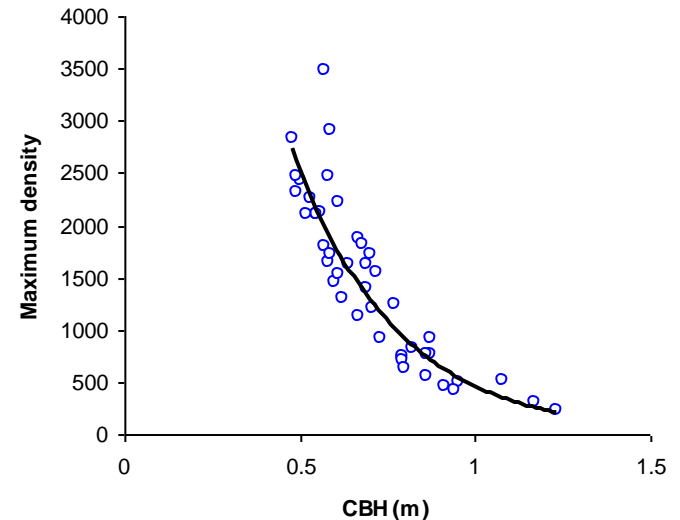
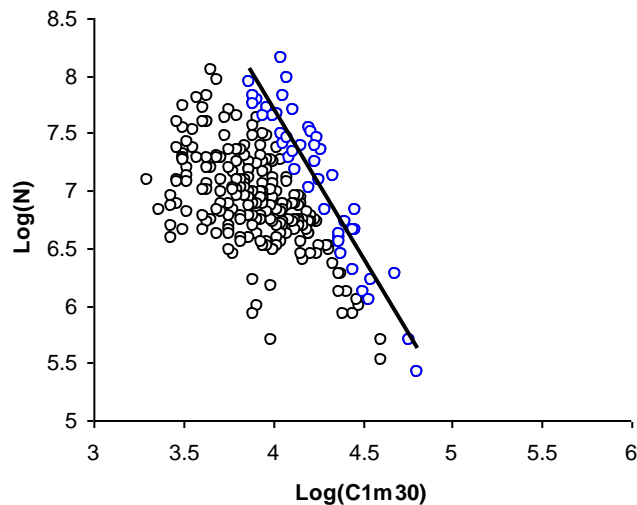
$$R^2 = 0.931 \quad R^2_{adj} = 0.931$$



# Sub models

## Stand density evolution

The method used here is based on the maximum density  
(Oliviera, 1985)



$$\text{Log}(N) = -2.5802 * \text{Log}(CBH) + 18.051$$
$$R^2 = 0.8725$$

$$N_{\max} = 13405.4 \times e^{-2.3985 \times C}$$
$$R^2 = 0.954$$

# Sub models

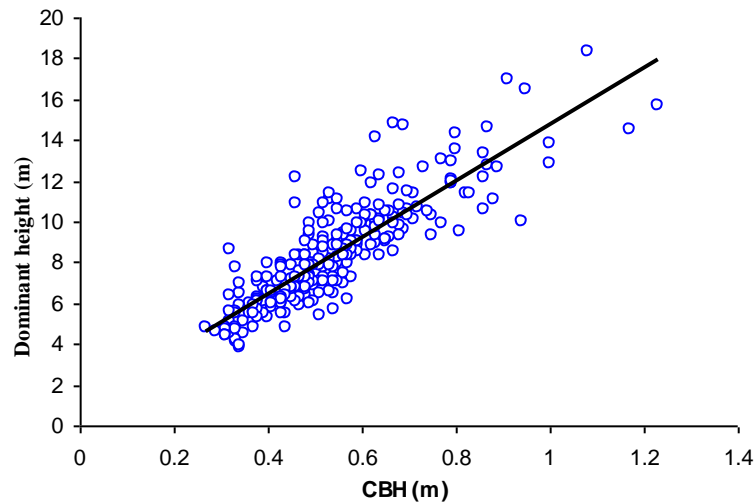
Others relations to construct **stand yield tables**

$$H_{dom} = f(CBH)$$



$$H_{dom} = 0.9135 + 13.8352 \times CBH \quad \text{with } R^2 = 0.859$$

$$C_{1.30} = (H_{dom} / 13.8352) - 66.027 \times 10^{-3}$$



# Stand yield tables (1)

ESTIMATE OF TOTAL VOLUME BY THE METHOD OF MAGIN										
SITE INDEX		14								
KM	0.7 if Hdom<=10	0.6 if Hdom<=10			0.4 if Hdom<=10					
t	Hdom m	CBH m	Nmax	Ni-Ni+10	v m3	V m3/ha	v1/2 m3	KM	Vsec m3/ha	Vtot m3/ha
20	9.96	0.65	2789.62		0.16	455.85				455.85
25	12.13			1404.85			0.30	0.60	252.29	
30	14.00	0.95	1384.77		0.44	602.67				854.97
35	15.63			572.89			0.60	0.60	205.87	
40	17.08	1.17	811.88		0.76	619.14				1077.30
45	18.36			280.30			0.94	0.40	104.86	
50	19.52	1.34	531.57		1.11	588.94				1151.96
55	20.57			155.73			1.28	0.40	79.75	
60	21.52	1.49	375.84		1.45	545.96				1188.73
65	22.39			94.84			1.62	0.40	61.47	
70	23.19	1.61	281.00		1.79	502.42				1206.66
75	23.94			61.87			1.95	0.40	48.23	
80	24.63	1.71	219.14		2.11	462.36				1214.83
85	25.27			42.56			2.26	0.40	38.53	
90	25.87	1.80	176.58		2.42	426.77				1217.77
95	26.44			30.54			2.56	0.40	31.31	
100	26.97	1.88	146.03		2.71	395.57				1217.88

# Stand yield tables (2)

Fw 0.3  
 Site Index : 14  
 Periodicity : 5

Stand Yield Table for *Pinus pinea* in Tunisia with method of Oliveira

Age	Principal stand						Thinning			Increments		
	Hdom	N	CBH	G	Vp	Ns	Vs	Vs-acum	Vtot	mai	ci	
20	9.96	1119.47	0.65	38.11	182.93	890.29	272.92	272.92	455.85	22.79	39.91	
25	12.13	755.35	0.81	39.50	218.21	364.12	437.20	710.12	655.41	26.22	39.91	
30	14.00	566.89	0.95	40.36	246.72	188.46	608.25	1318.36	854.97	28.50	22.23	
35	15.63	454.54	1.06	40.95	270.41	112.36	695.72	2014.08	966.13	27.60	22.23	
40	17.08	380.96	1.17	41.38	290.52	73.57	786.77	2800.86	1077.30	26.93	7.47	
45	18.36	329.48	1.26	41.71	307.89	51.49	806.74	3607.59	1114.63	24.77	7.47	
50	19.52	291.63	1.34	41.97	323.09	37.85	828.86	4436.45	1151.96	23.04	3.68	
55	20.57	262.72	1.42	42.18	336.56	28.91	833.79	5270.24	1170.35	21.28	3.68	
60	21.52	239.97	1.49	42.35	348.59	22.75	840.14	6110.38	1188.73	19.81	1.79	
65	22.39	221.63	1.55	42.50	359.44	18.34	838.26	6948.64	1197.70	18.43	1.79	
70	23.19	206.54	1.61	42.63	369.28	15.09	837.38	7786.03	1206.66	17.24	0.82	
75	23.94	193.91	1.66	42.73	378.27	12.63	832.48	8618.50	1210.74	16.14	0.82	
80	24.63	183.19	1.71	42.83	386.52	10.72	828.31	9446.81	1214.83	15.19	0.29	
85	25.27	173.99	1.76	42.91	394.13	9.21	822.17	10268.98	1216.30	14.31	0.29	
90	25.87	165.99	1.80	42.99	401.18	8.00	816.59	11085.57	1217.77	13.53	0.01	
95	26.44	158.98	1.84	43.06	407.74	7.01	810.09	11895.65	1217.83	12.82	0.01	
100	26.97	152.78	1.88	43.12	413.86	6.20	804.02	12699.68	1217.88	12.18		

A large-scale nursery of young pine trees. The trees are densely packed in rows, growing under a black shade net supported by a series of vertical metal poles. The ground is covered with dark brown mulch. In the background, there are more rows of trees and a white container. The sky is visible through the netting.

*Thanks for your  
Attention*