Soil and climate effects on *Pinus pinea* growth in inland Alentejo

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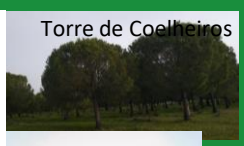
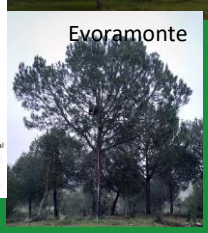
Background

In Portugal *Pinus pinea* occurs mainly in southwest coastal areas, but it can also be found in inland southern Portugal. It is known that the site (soil and climate) can influence this forest tree species development.





Objectives

Analyse the development of stands under different soil and climate conditions in inland Portugal.

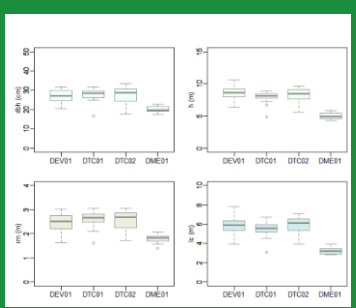
Materials and methods

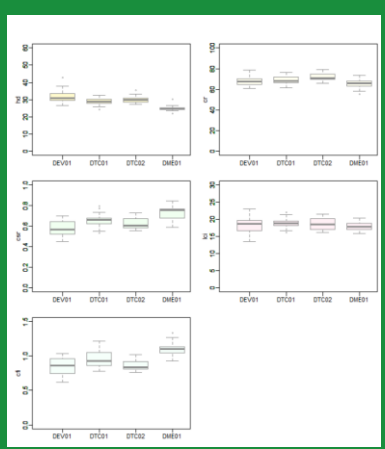
Four plots were established in stands of circa 30 years, and dendrometric, soil and climate variables were collected. Plot stand structure was evaluated with absolute density measures, diameter and height distributions and structure indices. Soil map units and physical and chemical soil properties were determined. Air temperature and precipitations were evaluated monthly, quarterly and annually, between 2014 and 2020.

Results

Absolute density measures were similar for all plots, diameter and height distributions were representative of even aged stands, and structure indices indicated stable trees with balanced crowns.

Plot	N (treesha^{-1})	G (m^{2}ha^{-1})	CC (%)
DEV01	150	8.8	24.9
DTC01	129	7.9	24.3
DTC02	133	8.0	24.1
DME01	61	1.9	5.6



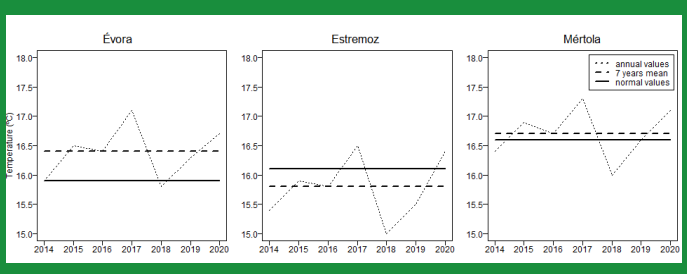


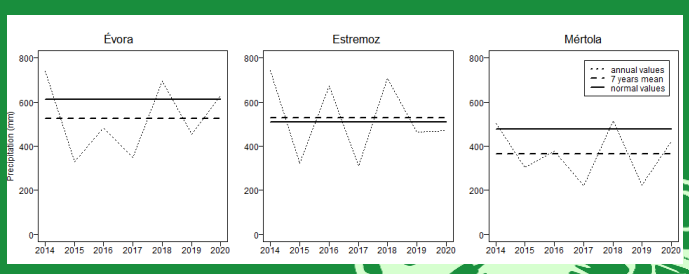
Soils show differences between plots in texture, soil organic carbon, carbon and nitrogen ratio, cation exchangeable capacity, and extractable nutrients.

Plot	Depth (cm)	Fine Fraction (<2 mm)				Text code	SOC	N	C/N	pH (1:2.5)		Exchange Cations						
		CS	FS	Silt	Clay					H_2O	KCl	Ca^{2+}	Mg^{2+}	K^+	Na^+	NAC	CEC	NCS
		(g kg^{-1})					(g kg^{-1})					(cmol$_c$ kg^{-1})						(%)
DEV01	0–20	408	266	166	160	SL	7.25	0.8	9.1	5.85	4.49	2.75	0.89	0.44	0.05	4.13	8.86	46.6
DEV01	20–50	521	197	132	150	SL	3.07	0.6	5.1	5.38	3.70	1.68	0.89	0.37	0.04	2.98	8.24	36.2
DTC01	0–20	460	294	90	156	SL	8.18	0.9	9.1	6.12	4.43	4.41	1.98	0.21	0.08	6.68	8.77	76.2
DTC01	20–50	416	236	117	231	SCL	3.94	0.5	7.9	6.42	3.97	5.22	2.29	0.51	0.11	8.13	13.06	62.3
DTC02	0–20	375	366	117	142	SL	7.08	0.8	8.8	5.97	4.44	4.28	1.98	0.18	0.08	6.52	10.55	61.8
DTC02	20–50	420	295	112	173	SL	2.78	0.7	4.0	6.18	4.16	4.97	2.6	0.22	0.09	7.88	11.44	68.9
DME01	0–20	390	184	269	157	L	18.10	0.6	30.2	5.80	4.60	2.19	1.46	0.40	0.45	4.5	10.61	42.4
DME01	20–50	412	151	233	204	L	5.86	0.5	11.7	5.50	4.00	1.75	1.46	0.63	0.61	4.45	8.88	50.1

CS is coarse sand (2-0,2 mm), FS fine sand (0,2-0,02 mm), Silt (0,02-0,002 mm), Clay (< 0,002 mm); Texture code (S - sandy, L - loam, C – clay); SOC - Soil organic carbon; N - total nitrogen; NAC - Non-acid cations, CEC - Cation exchange capacity, NCS - Non-acid cations saturation (NAC/CEC).

There were differences in thermal amplitudes and precipitation levels between the plots, which were reflected in the growth of *Pinus pinea*. The plots with lower water stress showed a trend towards higher tree growth.





Final considerations

The plot with lower annual precipitation and higher temperature had the lowest growth. In all plots, the imbalance between potassium and magnesium, and iron and manganese, might have affected tree growth.

Acknowledgments

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