



Article

# Very Early Biomarkers Screening for Water Deficit Tolerance in Commercial *Eucalyptus* Clones

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**Supplementary Table S1.** Estimation of genotypic parameters from the analysis of 22\* *Eucalyptus* clones submitted to water stress (100H<sub>2</sub>O and 300PEG) and CONTROL treatments in relation to morphological, nutritional and physiological traits.

Variables	Parameters							
	h <sup>2</sup> g	h <sup>2</sup> mg	Accgen	C <sub>2</sub> int	rgloc	CVgi%	CVe%	A
PH	0.22	0.71	0.84	0.02	0.90	7.01	12.9	70.53
SD	0.13	0.54	0.74	0.05	0.70	3.76	9.42	6.58
ID	0.35	0.79	0.89	0.08	0.80	16.76	21.16	201.30
K	0.15	0.60	0.77	0.00	0.95	16.46	39.79	38.30
Mg	0.12	0.49	0.70	0.11	0.51	4.84	116.11	24.72
S	0.19	0.66	0.81	0.03	0.84	55.63	113.18	24.02
Cu	0.32	0.78	0.89	0.05	0.86	64.42	90.65	15.45
Fe	0.21	0.69	0.83	0.02	0.88	44.15	84.15	16.71
Zn	0.43	0.82	0.90	0.14	0.75	19.39	19.23	29.47
B	0.39	0.81	0.90	0.10	0.79	18.26	20.58	642.05
gs(1)	0.43	0.83	0.91	0.10	0.80	15.41	15.94	87.85

h<sup>2</sup>g: Heritability of individual plants in the broad sense; h<sup>2</sup>mg: Heritability of the genotype average; Accgen: Accuracy of genotype selection; C<sub>2</sub>int: Coefficient of determination of the effects of genotype x environment interaction; rgloc: genotype correlation between performance in the various environments; CVgi%: genotype coefficient of variation; CVe%: coefficient of residual variation; A: overall average of the experiment. PH – plant height, SD – stem diameter, ID – increment in stem diameter, concentrations of the nutrients potassium – K, magnesium – Mg, sulfur – S, copper – Cu, iron – Fe, zinc – Zn, boron – B, and physiological trait; stomatal conductivity at the 30<sup>th</sup> day of the experiment (first evaluation) – gs(1).

\*Initial analysis was performed for 19 commercial and further 3 eucalypt genotypes that were selected from other experiments and at initial testing phase.

**Supplementary Table S2.** Average, standard deviation (SD) and coefficient of variation (CV) from three replications of *Eucalyptus* clones submitted to treatments with water stress (100H<sub>2</sub>O and 300PEG) and control treatment in relation to the morphological, nutritional and physiological traits in an experiment in a completely randomized block design and split plot arrangement.

CONTROL TREATMENT									
Clone		PH	LA	ID	IH	N	K	Ca	Mg
	E-01 S	81.3333±13.5769	227.0967±13.7981	4.6333±0.5518	44.0000±11.0000	0.7986±0.0234	1.2050±0.1125	0.8460±0.2842	0.4473±0.0942
	E-02 T	78.0000±19.5192	338.0500±3.2575	4.7900±0.4392	50.1667±18.7649	0.93233±0.0445	0.9600±0.0229	0.8350±0.1579	0.4636±0.0301
	E-03 T	80.6667±5.7735	205.5700±33.2091	5.9567±0.9376	52.5667±4.5081	1.1130±0.1334	1.3187±0.2417	0.8373±0.2754	0.5180±0.1119
	E-04 S	89.3333±14.5717	261.2867±9.6050	5.1917±0.5302	60.0000±12.1392	1.2933±0.3127	1.3737±0.1353	1.0150±0.1015	0.4947±0.0669
	E-05 S	85.6667±10.2144	214.6133±15.3886	4.8833±0.9808	37.6667±11.0604	0.9170±0.0322	1.1250±0.0740	0.8393±0.1793	0.5287±0.0619
	E-06 T	99.0000±7.0000	226.2167±13.8884	4.8900±0.7938	64.5000±3.6056	1.2723±0.0092	0.9300±0.0346	0.8950±0.1788	0.3867±0.0487
	E-07 S	76.0000±7.8102	254.4133±14.2156	5.1567±2.0149	48.0667±13.9665	1.0100±0.1784	1.4573±0.2455	1.6167±0.0521	0.6227±0.0654
	E-08 T	75.6667±10.1160	238.8733±10.7346	4.8850±1.2473	55.1000±8.8386	1.1900±0.1926	1.0450±0.0150	0.7793±0.2095	0.3983±0.0191
	E-09 S	88.3333±5.0332	223.7567±2.7104	4.8583±1.4657	60.5000±4.8218	1.2260±0.1852	1.0600±0.0835	1.0250±0.1996	0.5260±0.0978
	E-10 T	88.6667±18.1750	218.4067±26.1196	6.0750±0.5074	64.1000±21.1922	1.2160±0.2481	1.2250±0.0984	0.9770±0.2505	0.5480±0.0658
	E-11 T	91.6667±8.9629	260.7067±24.5632	4.8183±0.5659	53.3333±5.8595	0.9943±0.0497	1.2450±0.0606	0.7783±0.1066	0.5660±0.0571
	E-12 T	89.0000±16.0000	331.1767±52.1804	5.3283±1.0584	62.0000±16.2558	1.0613±0.2487	1.2600±0.0676	1.1047±0.1777	0.5190±0.0456
	E-13 S	100.3333±15.0111	255.0067±44.5318	4.7917±0.2454	77.0000±12.5797	1.2880±0.2902	1.0350±0.1561	1.0490±0.1394	0.5187±0.0251
	E-14 T	98.0000±9.1652	286.0333±27.3919	5.2067±0.7786	62.7667±9.4659	1.0820±0.1118	1.1750±0.1503	0.7540±0.1883	0.3763±0.0305
	E-15 S	75.0000±9.1652	223.3933±36.0046	6.2733±0.7039	45.0000±16.3771	1.1490±0.1698	1.2700±0.1447	1.1287±0.2505	0.5417±0.0484
	E-16 T	93.6667±11.9303	203.7867±157.8541	6.0100±0.5227	69.6667±13.2035	1.1127±0.1545	1.2200±0.0433	1.1060±0.3081	0.5457±0.0661
	E-17 T	91.0000±26.8887	258.9567±74.0143	4.600±1.2823	65.8333±25.8473	1.1797±0.2073	1.5610±0.1418	1.0887±0.2775	0.4407±0.0633
	E-18 T	93.6667±8.1445	347.3967±40.9876	4.0750±0.4246	64.6667±7.4889	0.9583±0.1545	1.3187±0.1767	0.5820±0.0783	0.3157±0.0172
	E-19 S	89.6667±1.5275	255.2333±85.5253	5.9850±1.1036	65.8333±7.0770	0.9943±0.1960	1.2887±0.2079	1.0233±0.1383	0.4963±0.1445
average±SD (control)		87.6140±7.9297	254.2091±43.5604	5.1794±0.6061	58.0404±9.9746	1.0941±0.1400	1.2144±0.1630	0.9621±0.2175	0.4871±0.0764
CV (control)		9.0507	17.1357	11.7022	17.1856	12.7992	13.4189	22.6029	15.6801

Clone	S	Cu	Zn	Mn	B	A(1)	gs(1)
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E-01 S	0.1453±0.0271	2.7500±0.2783	17.0833±2.6468	588.4500±120.9385	70.7506±12.6606	5.1211±1.5586	0.0875±0.0814
E-02 T	0.2186±0.0152	6.8333±0.5299	31.5333±10.2109	441.1166±54.7761	71.4226±8.3121	6.7426±3.1922	0.0927±0.0454
E-03 T	0.2083±0.0586	5.5667±1.6073	22.9833±2.7970	733.1833±99.6431	103.1180±20.0056	8.2029±2.5522	0.1496±0.0739
E-04 S	0.2007±0.0153	9.7667±2.1865	34.1167±6.1892	602.7500±293.9926	87.4133±7.7416	7.8616±0.3625	0.0887±0.0227
E-05 S	0.2527±0.0050	4.2833±0.0577	22.0000±1.7385	650.0667±19.5395	87.9333±7.8585	9.2866±1.1863	0.1858±0.1004
E-06 T	0.1473±0.0186	3.2333±0.2754	15.2167±2.1097	561.6667±244.1549	83.4340±9.2727	7.9787±3.9519	0.2070±0.0568
E-07 S	0.3563±0.1206	7.9000±1.8682	44.9167±5.9637	721.3167±91.9536	108.6633±14.1723	8.4873±2.5901	0.1235±0.0434
E-08 T	0.1790±0.0499	4.0500±0.5292	38.6167±9.9168	450.7167±97.5635	100.7940±28.9725	7.3976±2.0841	0.1721±0.1325
E-09 S	0.2117±0.0395	7.0167±1.9035	36.1833±3.3632	615.0667±176.7506	95.1753±8.1011	11.9758±2.0082	0.3315±0.1934
E-10 T	0.2923±0.0444	5.0167±0.6331	20.6333±3.5392	842.3167±241.6634	133.1730±36.4593	8.6594±3.8341	0.2681±0.0718
E-11 T	0.2650±0.0608	5.9333±1.1558	27.1833±4.0263	605.7333±15.5327	79.8023±12.9720	7.3107±2.0620	0.1192±0.0462
E-12 T	0.2470±0.0455	7.8500±2.9013	23.6000±9.8759	828.5167±97.6453	89.2583±2.2139	8.1915±2.8663	0.1342±0.0277
E-13 S	0.2077±0.0528	5.0333±0.1041	24.6833±3.8070	622.3167±116.8338	83.7537±3.6698	9.4564±4.4057	0.3570±0.2713
E-14 T	0.1523±0.0194	5.0833±0.6331	19.1333±3.5519	493.5333±143.2128	95.4397±5.0604	10.5348±2.7015	0.3422±0.2060
E-15 S	0.3077±0.1242	7.0167±0.8694	28.1000±4.0457	658.9167±287.2198	111.2683±8.4865	6.3531±2.6275	0.1310±0.0513
E-16 T	0.2973±0.0458	5.2667±1.5495	32.6500±10.2654	703.7667±145.9077	92.6173±3.5071	5.5670±0.8785	0.0681±0.0118
E-17 T	0.1683±0.0323	6.8833±1.3967	42.3833±6.1855	619.4833±104.8569	96.2067±12.3586	5.7476±0.8907	0.0865±0.0653
E-18 T	0.1280±0.0164	5.0500±0.6946	28.4667±4.3819	483.7000±140.2780	73.5827±8.7841	5.4771±4.0084	0.0912±0.0370
E-19 S	0.2757±0.0760	4.0833±1.4145	26.1833±10.7896	436.8167±146.5568	121.0650±21.1280	4.9673±1.4025	0.0921±0.0862
<b>average±SD (control)</b>	<b>0.2243±0.0637</b>	<b>5.7167±1.7678</b>	<b>28.1930±8.3491</b>	<b>613.6544±119.8060</b>	<b>93.9406±16.5122</b>	<b>7.6480±1.8915</b>	<b>0.1646±0.0938</b>
<b>CV (control)</b>	<b>28.4019</b>	<b>30.9233</b>	<b>29.6142</b>	<b>19.5234</b>	<b>17.5772</b>	<b>24.7313</b>	<b>56.9813</b>

**Supplementary Table S3.** Average water potential (MPa) of leaves of 19 commercial clones submitted to control treatment and water deficit simulation based on water restriction (100 H<sub>2</sub>O) and application of polyethylene glycol solution (300 PEG). The water potential was accessed in two periods, from 3:00 am to 5:00 am (dawn) and from 1:00 pm to 3:00 pm (afternoon).

Clone	Treatment	Water potential					
		Control		300 PEG		100 ml water	
		dawn	afternoon	dawn	afternoon	dawn	afternoon
E-01 S		-0.08±0.14	-0.58±0.16	-0.48±0.52	-1.08±1.21	-0.45±0.10	-1.10±0.35
E-02 T		-0.08±0.14	-0.42±0.10	-1.43±0.31	-1.50±0.35	-0.68±0.32	-1.43±0.28
E-03 T		-0.35±0.05	-0.57±0.20	-1.37±0.03	-1.68±0.13	-0.35±0.10	-1.10±0.15
E-04 S		-0.10±0.17	-0.67±0.20	-1.12±0.56	-1.48±0.87	-0.38±0.13	-1.05±0.48
E-05 S		-0.25±0.23	-0.85±0.13	-0.62±0.64	-1.77±0.95	-0.53±0.09	-0.85±0.38
E-06 T		-0.10±0.17	-0.58±0.08	-1.03±0.09	-1.37±0.43	-0.33±0.03	-0.93±0.38
E-07 S		-0.35±0.05	-0.68±0.20	-0.15±0.28	-0.38±0.38	-0.42±0.08	-0.63±0.23
E-08 T		-0.12±0.20	-0.47±0.20	-0.62±0.17	-1.27±0.94	-0.48±0.25	-1.15±0.30
E-09 S		-0.17±0.14	-0.58±0.13	-0.92±0.13	-1.23±0.24	-0.33±0.08	-0.83±0.18
E-10 T		-0.13±0.23	-0.50±0.15	-0.78±0.61	-1.03±0.58	-0.43±0.06	-1.05±0.15
E-11 T		-0.27±0.03	-0.65±0.13	-0.97±0.69	-1.35±0.65	-0.65±0.35	-1.15±0.30
E-12 T		-0.17±0.14	-0.52±0.03	-0.63±0.36	-1.10±0.76	-0.38±0.06	-0.63±0.08
E-13 S		-0.23±0.20	-0.65±0.23	-0.93±0.20	-1.37±0.48	-0.43±0.08	-0.93±0.48
E-14 T		0.00±0.00	-0.60±0.23	-0.77±0.52	-1.08±0.92	-0.47±0.08	-1.08±0.38
E-15 S		-0.27±0.23	-0.68±0.28	-0.42±0.60	-1.10±0.28	-0.48±0.14	-0.72±0.23
E-16 T		-0.37±0.06	-0.70±0.35	-0.72±0.38	-1.08±0.12	-0.45±0.10	-0.80±0.10
E-17 T		-0.18±0.28	-0.50±0.15	-0.43±0.53	-0.58±0.65	-0.52±0.00	-0.95±0.20
E-18 T		-0.10±0.20	-0.65±0.38	-0.33±0.23	-0.83±0.56	-0.40±0.03	-0.73±0.03
E-19 S		-0.20±0.16	-0.50±0.33	-0.58±0.26	-1.05±0.28	-0.65±0.26	-1.20±0.23

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T = tolerant to water deficit; S = susceptible to water deficit. Control treatment – daily irrigation according to the nursery protocol; 300 PEG treatment – irrigation as in Control in addition to the application of 100 ml solution of 300 g L<sup>-1</sup> PEG 6000; and 100 H<sub>2</sub>O treatment – irrigation restricted to 100 ml H<sub>2</sub>O daily. Average ± standard deviation **Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.