

### Supplementary Material

#### **A quantitative revision of the waterlogging tolerance of perennial forage grasses**

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**Table S1:** List of the C<sub>4</sub> and C<sub>3</sub> forage grass species, cultivar/accession/ID, waterlogging (WL) duration, growth conditions, inclusion (or not) of a recovery period, shoot and root dry mass (as % of controls), root:shoot ratio and references for data used in Fig. 1.

Species	Cultivar/accession/ ID	WL duratio n (d)	Growing conditions	Recovery after WL (d)	Shoot DM (% of controls)	Root DM (% of controls)	Root:Shoot ratio		References
							Contro l	WL	
<b>C<sub>4</sub> species</b>									
<i>Urochloa brizantha</i>	Basilisk (CIAT 606)	15	2-month-old plants waterlogged in field experiment (3 cm above soil surface by irrigation). 31/20°C day/night, 1.5 mm ppt during treatment period	No	36,6	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Urochloa brizantha</i>	Marandu (CIAT 6294)	15		No	55,8	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Urochloa brizantha</i>	Marandu	80	4-month -old plants in pots filled with sterilized soil. Waterlogged 2 cm above soil surface.	No	64,4	54,6	11,20	9,48	Mass Jr <i>et al.</i> 2016
<i>Urochloa brizantha</i>	Piata	80		No	6,4	26,1	3,36	13,73	Mass Jr <i>et al.</i> 2016
<i>Urochloa brizantha</i>	Xaraés	80		No	37,3	101,7	3,34	9,12	Mass Jr <i>et al.</i> 2016
<i>Urochloa brizantha</i>	Marandu (BRA000591)	14	21-days-old plant inundated (3 cm above soil surface) in pots with 1:1 (organic soil to sand) and fertilized.	No	38,4	19,1	0,78	0,39	Dias-Filho 2002
<i>Urochloa brizantha</i>	BRA003441	14		No	35,9	17,1	0,36	0,17	Dias-Filho 2002
<i>Urochloa brizantha</i>	BRA002844	14		No	27,0	12,6	0,57	0,27	Dias-Filho 2002
<i>Urochloa brizantha</i>	BRA004308	14		No	41,4	20,8	0,46	0,23	Dias-Filho 2002
<i>Urochloa brizantha</i>	BRA004391	14		No	42,9	47,6	0,27	0,30	Dias-Filho 2002
<i>Urochloa brizantha</i>	Marandu	14	21-days-old plant inundated (3 cm above soil surface) in pots with 1:1 (organic soil to sand) and fertilized.	No	49,5 <sup>a</sup>	n/a	n/a	n/a	Dias-Filho and Carvalho 2000
<i>Urochloa brizantha</i>	Basilisk	14		No	47,9 <sup>a</sup>	n/a	n/a	n/a	Dias-Filho and Carvalho 2000
<i>Urochloa brizantha</i>	Marandu	5	≈20-days-old plants flooded (3 cm above soil surface) in pots with 3:2 soil (organic soil to cured manure) and fertilized.	No	29,5 <sup>a</sup>	17,8	8,72	5,27	Caetano and Dias-Filho 2008
<i>Urochloa brizantha</i>	Piata	5		No	69,5 <sup>a</sup>	61,3	6,64	5,86	Caetano and Dias-Filho 2008
<i>Urochloa brizantha</i>	Arapoty	5		No	59,2 <sup>a</sup>	65,6	5,00	5,55	Caetano and Dias-Filho 2008
<i>Urochloa brizantha</i>	B163	5		No	44,7 <sup>a</sup>	51,6	5,79	6,68	Caetano and Dias-Filho

<i>Urochloa brizantha</i>	B166	5		No	52,2 <sup>a</sup>	57,1	5,12	5,60	2008 Caetano and Dias-Filho 2008
<i>Urochloa brizantha</i>	Toledo	21	21-days-old propagules waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 31.5/23.0 °C (day/night), the relative air humidity was 41.2/56.8 % (day/night) and the maximum photosynthetic photon flux density was 1910 $\mu\text{mol m}^{-2} \text{s}^{-1}$	No	59,7	22,2	0,62	0,23	Cardoso <i>et al.</i> 2014
<i>Urochloa brizantha</i>	Toledo	21	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 30.5/23.8 °C (day/night), the relative air humidity was 40,5/59,9 % (day/night) and the maximum photosynthetic photon flux density was 1800 $\mu\text{mol m}^{-2} \text{s}^{-1}$	No	59,8	23,8	0,41	0,16	Cardoso <i>et al.</i> 2013
<i>Urochloa brizantha</i>	Marandu	105	Plants with 10 cm high were waterlogged (4 cm above soil surface) in pots with Entisol type soil. 3 harvests were done during the experiment. Data taken from the third harvest.	No	127,7	n/a	n/a	n/a	Kroth <i>et al.</i> 2015
<i>Urochloa brizantha</i>	Piata	105		No	34,9	n/a	n/a	n/a	Kroth <i>et al.</i> , 2015
<i>Urochloa brizantha</i>	Xaraés	105		No	20,7	n/a	n/a	n/a	Kroth <i>et al.</i> , 2015
<i>Urochloa brizantha</i>	Marandu	28	60-days-old plants waterlogged (3 cm above soil surface) in pots with sifted soil (pH 6.6, OM 24 g/dm <sup>3</sup> )	10	74,0 <sup>b</sup>	n/a	n/a	n/a	Beloni <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	Caymán (BR02/1752)	15	2-month-old plants waterlogged in field experiment (3 cm above soil surface by irrigation). 31/20°C day/night, 1.5 mm ppt during treatment period	No	32,0	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/3809	15		No	55,6	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/1399	15		No	42,4	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/3358	15		No	84,4	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/1280	15		No	54,6	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/2321	15		No	60,7	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/4951	15		No	40,3	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/3436	15		No	55,0	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/2756	15		No	68,1	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017

<i>Brachiaria hybrid</i>	BR12/3377	15		No	68,2	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/4856	15		No	65,8	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/4047	15		No	69,1	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/1535	15		No	40,0	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/0062	15		No	40,4	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/5082	15		No	63,7	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/1188	15		No	21,9	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/3659	15		No	33,8	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/2316	15		No	47,7	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/1176	15		No	26,4	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	BR12/3018	15		No	13,1	n/a	n/a	n/a	Jiménez <i>et al.</i> 2017
<i>Brachiaria hybrid</i>	Mulato II	80	4-month -old plants in pots filled with sterilized soil. Waterlogged 2 cm above soil surface	No	52,6	63,8	2,56	3,11	Mass Jr <i>et al.</i> 2016
<i>Brachiaria hybrid</i>	Mulato II	21	21-days-old propagules waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 31.5/23.0 °C (day/night), the relative air humidity was 41.2/56.8 % (day/night) and the maximum photosynthetic photon flux density was 1910 $\mu\text{mol m}^{-2} \text{s}^{-1}$	No	50,6	15,9	0,86	0,27	Cardoso <i>et al.</i> 2014
<i>Brachiaria hybrid</i>	Mulato II	21	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 30.5/23.8 °C (day/night), the relative air humidity was 40,5/59,9 % (day/night) and the maximum photosynthetic photon flux density was 1800 $\mu\text{mol m}^{-2} \text{s}^{-1}$	No	55,8	20,8	0,53	0,20	Cardoso <i>et al.</i> 2013
<i>Chloris gayana</i>	Fine cut	14	Seedlings with 3 fully expanded leaves were waterlogged (7 cm above soil surface) in pots with 1:1 soil (sand to grassland topsoil). Temperature 18/28 °C and photosynthetic photon flux of	12	68,8	73,3	0,78	0,83	Imaz <i>et al.</i> 2012

			1800 $\mu\text{mol m}^{-2} \text{s}^{-1}$							
<i>Chloris gayana</i>	Fine cut	50	6-month-old plants waterlogged (10 cm above surface) during winter in pots with sand and top soil (1:1) from Flooding Pampa grasslands.	50	65,9	42,5	0,25	0,16	Imaz <i>et al.</i> 2015	
<i>Chloris gayana</i>	Fine cut	20	$\approx$ 8-month-old plants waterlogged (10 cm above surface) during spring in pots with sand and top soil (1:1) from Flooding Pampa grasslands.	30	85,3	67,8	0,32	0,26	Imaz <i>et al.</i> 2015	
<i>Chloris gayana</i>	Fine cut	70	6-month-old plants waterlogged (10 cm above surface) during winter and spring in pots with sand and top soil (1:1) from Flooding Pampa grasslands.	30	59,7	60,5	0,32	0,33	Imaz <i>et al.</i> 2015	
<i>Panicum coloratum</i>	Klein Verde	14	Seedlings with 3 fully expanded leaves were waterlogged (7 cm above soil surface) in pots with 1:1 soil (sand to grassland topsoil). Temperature 18/28 °C and photosynthetic photon flux of 1800 $\mu\text{mol m}^{-2} \text{s}^{-1}$	12	71,2	68,3	0,47	0,45	Imaz <i>et al.</i> 2012	
<i>Panicum coloratum</i>	Klein Verde	50	6-month-old plants waterlogged (10 cm above surface) during winter in pots with sand and top soil (1:1) from Flooding Pampa grasslands.	50	105,3	66,8	0,46	0,29	Imaz <i>et al.</i> 2015	
<i>Panicum coloratum</i>	Klein Verde	20	$\approx$ 8-month-old plants waterlogged (10 cm above surface) during spring in pots with sand and top soil (1:1) from Flooding Pampa grasslands.	30	65,1	64,3	0,29	0,29	Imaz <i>et al.</i> 2015	
<i>Panicum coloratum</i>	Klein Verde	70	6-month-old plants waterlogged (10 cm above surface) during winter and spring in pots with sand and top soil (1:1) from Flooding Pampa grasslands.	30	65,1	64,6	0,29	0,29	Imaz <i>et al.</i> 2015	
<i>Megathyrsus maximus</i>	Massai	80	4-month -old plants in pots filled with	No	119,1	85,2	6,74	4,82	Mass Jr <i>et al.</i> 2016	

<i>Megathyrsus maximus</i>	Tanzania	80	sterilized soil. Waterlogged 2 cm above soil surface. 3 harvests were made subsequently (3 regrowth periods)	No	136,4	296,6	5,45	11,85	Mass Jr <i>et al.</i> 2016
<i>Megathyrsus maximus</i>	PM40	14	≈2-month-old plants were flooded (5 cm above soil surface) in pots filled with oxisol and sand (3:1)	No	52,8	75,0	0,22	0,31	Silva <i>et al.</i> 2009
<i>Megathyrsus maximus</i>	PM45	14		No	26,5	29,0	0,28	0,30	Silva <i>et al.</i> 2009
<i>Megathyrsus maximus</i>	Massai	14		No	108,0	82,9	0,36	0,28	Silva <i>et al.</i> 2009
<i>Megathyrsus maximus</i>	Mombaca	14		No	74,5	74,1	0,35	0,35	Silva <i>et al.</i> 2009
<i>Megathyrsus maximus</i>	PM11	14		No	69,3	69,4	0,26	0,26	Silva <i>et al.</i> 2009
<i>Megathyrsus maximus</i>	PM34	14		No	70,8	121,8	0,21	0,36	Silva <i>et al.</i> 2009
<i>Megathyrsus maximus</i>	Tanzania	14		No	55,4	47,3	0,44	0,38	Silva <i>et al.</i> 2009
<i>Urochloa ruziziensis</i>	Common	80	4-month -old plants in pots filled with sterilized soil. Waterlogged 2 cm above soil surface.	No	81,0	70,1	6,03	5,21	Mass Jr <i>et al.</i> 2016
<i>Urochloa ruziziensis</i>	R124	5	≈20-days-old plants flooded (3 cm above soil surface) in pots with 3:2 soil (organic soil to cured manure) and fertilized.	No	33,2 <sup>a</sup>	26,7	8,15	6,54	Caetano and Dias-Filho 2008
<i>Urochloa ruziziensis</i>	44-02	21	21-days-old propagules waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 31.5/23.0 °C (day/night), the relative air humidity was 41.2/56.8 % (day/night) and the maximum photosynthetic photon flux density was 1910 μmol m <sup>-2</sup> s <sup>-1</sup>	No	67,3	17,2	0,85	0,22	Cardoso <i>et al.</i> 2014
<i>Urochloa ruziziensis</i>	44-02	21	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 30.5/23.8 °C (day/night), the relative air humidity was 40,5/59,9 % (day/night) and the maximum photosynthetic photon flux density was 1800 μmol m <sup>-2</sup> s <sup>-1</sup>	No	85,1	16,3	0,60	0,11	Cardoso <i>et al.</i> 2013
<i>Urochloa ruziziensis</i>	44-02	14	Vegetative propagules were	No	81,3	n/a	n/a	n/a	Jiménez <i>et al.</i> 2015

			waterlogged (3 cm above soil surface) in cylinders with 1:1 (Oxisol soil:sand) mixture.							
<i>Urochloa humidicola</i>	Llanero	80	4-month -old plants in pots filled with sterilized soil. Waterlogged 2 cm above soil surface	No	163,0	140,7	2,37	2,05	Mass Jr <i>et al.</i> 2016	
<i>Urochloa humidicola</i>	Tupi	80		No	100,0	75,4	0,80	0,60	Mass Jr <i>et al.</i> 2016	
<i>Urochloa humidicola</i>		14	21-days-old plant inundated (3 cm above soil surface) in pots with 1:1 (organic soil to sand) and fertilized.	No	81,0 <sup>a</sup>	n/a	n/a	n/a	Dias-Filho and Carvalho 2000	
<i>Urochloa humidicola</i>	CIAT 26570	21	21-days-old propagules waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 31.5/23.0 °C (day/night), the relative air humidity was 41.2/56.8 % (day/night) and the maximum photosynthetic photon flux density was 1910 $\mu\text{mol m}^{-2} \text{s}^{-1}$	No	127,6	54,4	0,78	0,33	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 679	21		No	109,4	40,9	0,52	0,19	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 6133	21		No	96,3	23,9	0,44	0,11	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 16182	21		No	134,8	37,5	0,54	0,15	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 6707	21		No	88,0	35,5	0,45	0,18	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 16886	21		No	91,8	47,8	0,31	0,16	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 26152	21		No	62,4	25,3	0,59	0,24	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 6013	21		No	71,1	20,6	0,48	0,14	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 26416	21		No	74,4	36,3	0,59	0,29	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 26181	21		No	108,8	33,3	0,80	0,25	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 16866	21		No	55,5	38,0	0,48	0,33	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 16888	21		No	57,1	25,6	0,78	0,35	Cardoso <i>et al.</i> 2014	
<i>Urochloa humidicola</i>	CIAT 26570	21		Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 30.5/23.8 °C (day/night), the relative air humidity was 40,5/59,9 % (day/night) and the maximum photosynthetic photon flux density was 1800 $\mu\text{mol m}^{-2} \text{s}^{-1}$	No	170,7	52,3	0,57	0,17	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 679	21			No	133,9	36,4	0,40	0,11	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 6133	21	No		122,6	39,0	0,35	0,11	Cardoso <i>et al.</i> 2013	
<i>Urochloa humidicola</i>	CIAT 16182	21	No		135,4	34,0	0,52	0,13	Cardoso <i>et al.</i> 2013	
<i>Urochloa humidicola</i>	CIAT 6707	21	No		127,3	27,3	0,42	0,09	Cardoso <i>et al.</i> 2013	
<i>Urochloa humidicola</i>	CIAT 16886	21	No		114,3	43,8	0,30	0,12	Cardoso <i>et al.</i> 2013	
<i>Urochloa humidicola</i>	CIAT 26152	21	No		111,3	25,5	0,40	0,09	Cardoso <i>et al.</i> 2013	
<i>Urochloa humidicola</i>	CIAT 6013	21	No		97,1	23,9	0,45	0,11	Cardoso <i>et al.</i> 2013	
<i>Urochloa humidicola</i>	CIAT 26416	21	No		84,4	36,5	0,43	0,19	Cardoso <i>et al.</i> 2013	

<i>Urochloa humidicola</i>	CIAT 26181	21		No	80,4	25,5	0,49	0,16	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 16866	21		No	57,9	38,3	0,33	0,22	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 16888	21		No	49,3	25,0	0,49	0,25	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	Tully	28	Vegetative propagules were waterlogged (roots in stagnant deoxygenated 0.10% (w/v) agar nutrient solution). Modified Hoagland nutrient solution. 30/25 °C day/night air temperature.	No	57,9	138,7	0,04	0,08	Jiménez <i>et al.</i> 2019
<i>Urochloa humidicola</i>	CIAT 679	14	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (Oxisol soil:sand) mixture.	No	97,8	n/a	n/a	n/a	Jiménez <i>et al.</i> 2015
<i>Paspalum dilatatum</i>	n/a	60	Juvenile individuals were flooded (2 cm above soil surface) in pots with grassland soil (Typic Natraquoll)	No	218,0	79,1	1,48	0,54	Rubio <i>et al.</i> 1995
<i>Paspalum dilatatum</i>	Clon enclosure	37	Vegetative clones with 5-6 tillers flooded (1.5-2 cm above soil surface) in pots with sand	No	100,5	n/a	0,54	0,59	Loreti <i>et al.</i> 1994
<i>Paspalum dilatatum</i>	Clon grazing	37		No	82,5	n/a	0,56	0,56	Loreti <i>et al.</i> 1994
<i>Paspalum dilatatum</i>	n/a	60	Juvenile individuals were flooded (2 cm above soil surface) in pots with grassland soil (Typic Natraquoll)	No	135,9	n/a	0,60	0,35	Rubio and Lavado 1999
<i>Paspalum dilatatum</i>	n/a	45?	Juvenile individuals were flooded (2 cm above soil surface) in pots with grassland soil (Typic Natraquoll)	No	120,6	n/a	0,68	0,54	Rubio <i>et al.</i> 1997
<i>Paspalum dilatatum</i>	Upland clone	50	Vegetative propagated ramets were waterlogged (2 cm above soil surface) in pots with washed sand	No	85,8	74,5	0,68	0,54	Loreti and Oosterheld 1996
<i>Paspalum dilatatum</i>	Intermediate clone	50		No	101,8	94,5	0,68	0,54	Loreti and Oosterheld 1996
<i>Paspalum dilatatum</i>	Lowland clone	50		No	116,5	90,3	0,68	0,54	Loreti and Oosterheld 1996

<i>Paspalum dilatatum</i>	n/a	60	Plants naturally established in soil mesocosms extracted from the grassland flooded (6 cm above soil surface)	No	88,7	n/a	n/a	n/a	Grimoldi <i>et al.</i> 2005
<i>Paspalum dilatatum</i>	n/a	30	Plants collected from a lowland grassland and grown for 6 month in glasshouse conditions were waterlogged (0,2-0,5 cm over soil surface) in 4L plastic pots filled with sand and topsoil (1:1) from the grassland (3,3% organic carbon).	No	97,5	91,3	0,63	0,59	Manzur <i>et al.</i> 2020
<b>C<sub>3</sub> species</b>									
<i>Thinopyrum ponticum</i>	Hulk	14	33-days-old plants (3 fully expanded leaves) were partially submerged (half its height) in pots with sand and topsoil (Natracualf; 1:1). Mean temperature of 13,8 °C. 10-13 h photoperiod and PAR inside the glasshouse was around 921 mmol m <sup>-2</sup> s <sup>-1</sup> .	14	48,3	61,5	0,18	0,23	Iturralde Elortegui <i>et al.</i> 2020
<i>Thinopyrum ponticum</i>	Hulk	14	48-days-old plants (5 fully expanded leaves) were partially submerged (half its height) in pots with sand and topsoil (Natracualf; 1:1). Mean temperature of 15,5 °C. 10-13 h photoperiod and PAR inside the glasshouse was around 1130 mmol m <sup>-2</sup> s <sup>-1</sup> .	14	156,7	143,6	0,21	0,19	Iturralde Elortegui <i>et al.</i> 2020
<i>Thinopyrum ponticum</i>	Tyrell	15	33-days-old plants were waterlogged (roots in stagnant deoxygenated 0.1% (w/v) agar nutrient solution). 25/20 °C and relative humidity 60/80% (day/night), 12 h photoperiod and PAR at plant level of 400–500 μmol m <sup>-2</sup> s <sup>-1</sup>	No	64,7	35,2	0,40	0,47	Teakle <i>et al.</i> 2013
<i>Thinopyrum ponticum</i>	Tyrell	35	Sward of plants were grown in pots with sand collected from the field (pH 5.2 and 8.6 g/kg organic C) and waterlogged (1cm above surface) with nutrient solution. Every 3 days nutrient	No	73,2	121,4	n/a	n/a	Jenkins <i>et al.</i> 2010

			solutions from waterlogged pots were drained for approximately 1 h and re-waterlogged. Plants were harvested at weekly intervals after the imposition of the treatments. 23/5 °C (day/night)							
<i>Dactylis glomerata</i>	Omea	15	42-days-old plants were waterlogged (1 cm above soil surface) in pots with 1:1 soil (sand to 3% OC topsoil)	15	94,4	64,6	1,20	0,82	Ploschuk <i>et al.</i> 2017	
<i>Dactylis glomerata</i>	Clone A	84	Vegetative propagules waterlogged (1 cm above surface) in pots with soil	No	40,7	42,1	0,32	0,33	Etherington 1984	
<i>Dactylis glomerata</i>	Clone L	84		No	55,3	46,9	0,68	0,58	Etherington 1984	
<i>Dactylis glomerata</i>	Clone A	97	Vegetative propagules waterlogged (1 cm above surface) in pots with peat-soil mixture. Average temperature 20 °C	No	93,9	n/a	n/a	n/a	Etherington and Thomas 1986	
<i>Dactylis glomerata</i>	Clone L	97		No	97,2	n/a	n/a	n/a	Etherington and Thomas 1986	
<i>Dactylis glomerata</i>	Sparta	15	Approx. 8-weeks-old plants waterlogged (kept in trays with a continuous water level of between 5 and 8 cm ) in pots	No	67,0	n/a	n/a	n/a	Klaas <i>et al.</i> 2019	
<i>Festuca arundinacea</i>	Malma	15	42-days-old plants were waterlogged (1 cm above soil surface) in pots with 1:1 soil (sand to 3% OC topsoil)	15	104,5	53,0	1,08	0,55	Ploschuk <i>et al.</i> 2017	
<i>Festuca arundinacea</i>	Rebel XLR	28	Plants with 4 leaves waterlogged (water up to surface) in pots with potting soil. Temperature 25 /20°C (day/night)	No	76,1	56,9	1,14	0,85	Liu <i>et al.</i> 2017	
<i>Festuca arundinacea</i>	Dovey	21	Plants were waterlogged (water level at soil surface) in pots with sand and potting compost (1:4). Temperature was 20,2/18,5 (day/night) and 66,5% humidity	No	95,1	73,9	0,28	0,22	Jansen <i>et al.</i> 2005	
<i>Festuca arundinacea</i>	Stonewall	28	4-month-old plants were waterlogged (up to soil surface) in pots with sand and topsoil (1:1)	No	261,2	80,4	n/a	n/a	Zhang <i>et al.</i> 2013	
<i>Festuca arundinacea</i>	Barverde	14	46-days-old plants waterlogged (roots in stagnant deoxygenated 0.05% (w/v) agar nutrient solution). 26/12 °C	14	75,8	33,9	0,62	0,28	Menon-Martínez <i>et al.</i> 2021	
<i>Festuca arundinacea</i>	Bar 2025	14		14	81,8	70,0	1,16	0,99	Menon-Martínez <i>et al.</i>	

<i>Festuca arundinacea</i>	Baralta	14		14	100,3	95,1	0,96	0,91	2021 Menon-Martínez <i>et al.</i> 2021
<i>Festuca arundinacea</i>	Royal Q100	14		14	87,2	79,2	1,01	0,92	Menon-Martínez <i>et al.</i> 2021
<i>Festuca arundinacea</i>	Tunisia	14	day/night air temperature; 61% mean relative humidity; 5.28 MJ m <sup>-2</sup> mean incident PAR.	14	98,3	90,3	0,88	0,80	Menon-Martínez <i>et al.</i> 2021
<i>Festuca arundinacea</i>	Aprilia	14		14	81,4	66,4	1,18	0,96	Menon-Martínez <i>et al.</i> 2021
<i>Festuca arundinacea</i>	Cajun II	14		14	72,7	67,5	1,24	1,15	Menon-Martínez <i>et al.</i> 2021
<i>Lolium perenne</i>	Nth African6	28		One clonal tiller was waterlogged (1 cm above soil surface) in pots filled with coarse river sand. Average temperature of 20 °C in a glasshouse.	No	80,3	62,0	0,51	0,40
<i>Lolium perenne</i>	2182	28	No		66,5	46,1	0,43	0,30	McFarlane <i>et al.</i> 2003
<i>Lolium perenne</i>	2178	28	No		40,6	38,4	0,28	0,27	McFarlane <i>et al.</i> 2003
<i>Lolium perenne</i>	Aurora6	28	No		120,3	72,5	0,41	0,25	McFarlane <i>et al.</i> 2003
<i>Lolium perenne</i>	Genotype B + Endophyte	49	Vegetative clones with 4 tillers were flooded (5 mm below the brim) in pots with quartz sand mixed with nutrient solution	21	133,8	n/a	n/a	n/a	Hesse <i>et al.</i> 2005
<i>Lolium perenne</i>	Genotype M + Endophyte	49		21	96,4	n/a	n/a	n/a	Hesse <i>et al.</i> 2005
<i>Lolium perenne</i>	Tivoli	163	1-year-old plants were watered to reach 1,25 times field capacity in pots (undefined loam soil; 87 seeds/pot). Five harvests were done.	No	85,4	n/a	n/a	n/a	Laidlaw 2009
<i>Lolium perenne</i>	Catalina	7	aprox. 4-month-old plants waterlogged (pots in plastic containers with Hoagland solution at the soil surface) in pots with sand. All plants were cut to the same height of 5 cm before stress treatments. 20/17 °C (day/night); 65% relative humidity; photosynthetically active density of ≈400 μmol m <sup>-2</sup> s <sup>-1</sup> and 10-h light period	No	94,3	128,6	0,40	0,55	Yin <i>et al.</i> 2017
<i>Lolium perenne</i>	Inspired	7		No	100,0	71,6	0,53	0,38	Yin <i>et al.</i> 2017
<i>Bromus catharticus</i>	Jerónimo	15	42-days-old plants were waterlogged (1 cm above soil surface) in pots with 1:1 soil (sand to 3% OC topsoil)	15	100,7	73,0	0,96	0,70	Ploschuk <i>et al.</i> 2017

<i>Poa pratensis</i>	Bewitched	28	4-month-old plants were waterlogged (up to soil surface) in pots with sand and topsoil (1:1)	No	146,9	80,4	n/a	n/a	Zhang <i>et al.</i> 2013
<i>Poa pratensis</i>	Unique and Serene (no cultivar effect)	5	Plants were waterlogged (up to soil surface) in pots with topsoil and coarse river sand (1:1). Temperature of 20/15 °C (day/night), and photosynthetic photon flux of 600 $\mu\text{mol m}^{-2} \text{s}^{-1}$	No	86,5	n/a	n/a	n/a	Wang <i>et al.</i> 2009
<i>Poa pratensis</i>	Moonlight	30	Vegetative propagated plants were waterlogged (up to soil surface) in pots with topsoil and sand (1:1). Temperature of 23/17 °C (day/night) and photosynthetic photon flux of 600 $\mu\text{mol m}^{-2} \text{s}^{-1}$	No	n/a	51,7	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Midnight II	30		No	n/a	51,3	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Serene	30		No	n/a	57,9	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Champagne	30		No	n/a	51,0	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Unique	30		No	n/a	50,0	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Awsome	30		No	n/a	40,0	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Limousine	30		No	n/a	44,0	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Julia	30		No	n/a	65,9	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Eagleton	30		No	n/a	72,7	n/a	n/a	Wang and Jiang 2007
<i>Poa pratensis</i>	Kenblue	30		No	n/a	70,0	n/a	n/a	Wang and Jiang 2007
<i>Phalaris aquatica</i>	Mate	15	42-days-old plants were waterlogged (1 cm above soil surface) in pots with 1:1 soil (sand to 3% OC topsoil)	15	145,1	124,1	0,96	0,83	Ploschuk <i>et al.</i> 2017

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<sup>a</sup> values of relative growth rate (RGR)

<sup>b</sup> values only of leaves

**Table S2:** Summary table of the C<sub>4</sub> and C<sub>3</sub> forage grass species showing cultivar/accession/ID, waterlogging (WL) duration, growth conditions, type of measurement performed to evaluate root aeration, type of root evaluated, root porosity under control and waterlogging conditions and references for data used in Fig. 2.

Species	Cultivar/ accession/ ID	WL duration (d)	Growing conditions	Measurement and root type	Root porosity (%)		References
					Control	WL	
<b>C<sub>4</sub> species</b>							
<i>Urochloa brizantha</i>	Toledo	21	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 30.5/23.8 °C (day/night), the relative air humidity was 40,5/59,9 % (day/night) and the maximum photosynthetic photon flux density was 1800 μmol m <sup>-2</sup> s <sup>-1</sup>	Aerenchyma in nodal root (2, 5, 10 and 11-14 cm behind the root tip)	-	15,6	Cardoso <i>et al.</i> 2013
<i>Brachiaria hybrid</i>	Mulato II	21	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 30.5/23.8 °C (day/night), the relative air humidity was 40,5/59,9 % (day/night) and the maximum photosynthetic photon flux density was 1800 μmol m <sup>-2</sup> s <sup>-1</sup>	Aerenchyma in nodal root (2, 5, 10 and 11-14 cm behind the root tip)	-	16,8	Cardoso <i>et al.</i> 2013
<i>Chloris gayana</i>	Fine cut	14	Seedlings with 3 fully expanded leaves were waterlogged (7 cm above soil surface) in pots with 1:1 soil (sand to grassland topsoil). Temperature 18/28 °C and photosynthetic photon flux of 1800 μmol m <sup>-2</sup> s <sup>-1</sup>	Aerenchyma; 2 cm from the tip	36,2	54,3	Imaz <i>et al.</i> , 2012

<i>Panicum coloratum</i>	Klein Verde	14	Seedlings with 3 fully expanded leaves were waterlogged (7 cm above soil surface) in pots with 1:1 soil (sand to grassland topsoil). Temperature 18/28 °C and photosynthetic photon flux of 1800 $\mu\text{mol m}^{-2} \text{s}^{-1}$	Aerenchyma; 2 cm from the tip	35,1	46,8	Imaz <i>et al.</i> 2012
<i>Urochloa ruziziensis</i>	44-02	21	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 30.5/23.8 °C (day/night), the relative air humidity was 40,5/59,9 % (day/night) and the maximum photosynthetic photon flux density was 1800 $\mu\text{mol m}^{-2} \text{s}^{-1}$	Aerenchyma in nodal root (2, 5, 10 and 11-14 cm behind the root tip)	-	18,3	Cardoso <i>et al.</i> 2013
<i>Urochloa ruziziensis</i>	44-02	14	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (Oxisol soil:sand) mixture.	Aerenchyma; average of 3 cross-sections from the tip: 0-5, 5-10-10-15 cm	0,37	19,2	Jiménez <i>et al.</i> 2015
<i>Urochloa humidicola</i>	CIAT 26570	21	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (soil:sand) mixture. 30.5/23.8 °C (day/night), the relative air humidity was 40,5/59,9 % (day/night) and the maximum photosynthetic photon flux density was 1800 $\mu\text{mol m}^{-2} \text{s}^{-1}$	Aerenchyma in nodal root (2, 5, 10 and 11-14 cm behind the root tip)	14,5	34,4	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 679	21			13,5	29,3	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 6133	21			13,3	28,3	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 16182	21			13,2	29,6	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 6707	21			10,4	28,9	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 16886	21			11	31,5	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 26152	21			11,8	29,8	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 6013	21			15,3	31,2	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 26416	21			9,5	29,7	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 26181	21			9,6	28,8	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 16866	21			14	28,3	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	CIAT 16888	21			10,8	31,5	Cardoso <i>et al.</i> 2013
<i>Urochloa humidicola</i>	Tully	28			Vegetative propagules were waterlogged (roots in stagnant	Porosity buoyancy method in four to	15,56

			deoxygenated 0.10% (w/v) agar nutrient solution). Modified Hoagland nutrient solution. 30/25 °C day/night air temperature.	five representative roots (aprox. 100 mm length). Lateral roots were excised and main axes used.			
<i>Urochloa humidicola</i>	CIAT 679	14	Vegetative propagules were waterlogged (3 cm above soil surface) in cylinders with 1:1 (Oxisol soil:sand) mixture.	Aerenchyma; average of 3 cross-sections from the tip: 0-5, 5-10-10-15 cm	9,25	18,1	Jiménez <i>et al.</i> 2015
<i>Paspalum dilatatum</i>	Clon exclosure	37	Vegetative clones with 5-6 tillers flooded (1.5-2 cm above soil surface) in pots with sand	Porosity (pycnometer method); n/a	24,5	35,8	Loreti <i>et al.</i> 1994
<i>Paspalum dilatatum</i>	Clon grazing	37			32,0	41,1	Loreti <i>et al.</i> 1994
<i>Paspalum dilatatum</i>	Upland clone	50	Vegetative propagated ramets were waterlogged (2 cm above soil surface) in pots with washed sand	Porosity (pycnometer method)	34,4	45,0	Loreti and Oosterheld 1996
<i>Paspalum dilatatum</i>	Intermediate clone	50			35,7	48,6	Loreti and Oosterheld 1996
<i>Paspalum dilatatum</i>	Lowland clone	50			35,9	47,8	Loreti and Oosterheld 1996
<i>Paspalum dilatatum</i>	n/a	60	Plants naturally established in soil mesocosms extracted from the grassland flooded (6 cm above soil surface)	Porosity (pycnometer method); young roots	32,1	40,7	Grimoldi <i>et al.</i> 2005
<i>Paspalum dilatatum</i>	n/a	30	Plants collected from a lowland grassland and grown for 6 months in glasshouse conditions were waterlogged (0,2-0,5 cm over soil surface) in 4L plastic pots filled with sand and topsoil (1:1) from the grassland (3,3% organic carbon).	Porosity (pycnometer method); n/a	19,7	45,7	Manzur <i>et al.</i> 2020
<i>Paspalum dilatatum</i>	n/a	45	Plants naturally established in soil monolith extracted from the grassland flooded (6 cm above soil surface)	Porosity (pycnometer method); young roots	32	40,7	Insausti <i>et al.</i> 2001
<i>Paspalum dilatatum</i>	n/a	15	Adult plants were extracted in grassland soil blocks with natural vegetation in plastic containers and	Porosity (pycnometer method); n/a	28	40,2	Striker <i>et al.</i> 2008

			were flooded (6 cm above soil surface).				
<i>Paspalum dilatatum</i>	subsp. dilatatum Lowland	60	Vegetative propagated tillers were flooded (6 cm above soil surface) in pots with sand and topsoil from the grassland (1:1)	Porosity (pycnometer method); young roots	42,7	38,3	Mollard <i>et al.</i> 2008
	subsp. dilatatum Upland				32,2	32,2	Mollard <i>et al.</i> 2008
<i>Paspalum dilatatum</i>	n/a	15	Plants of similar size extracted from the grassland in soil blocks flooded (6 cm above soil surface)	Porosity (pycnometer method)	28	40,2	Striker <i>et al.</i> 2006
<i>Paspalum dilatatum</i>	n/a	50	Vegetative clones were flooded (2 cm above surface) in pots with washed sand + Hoagland solution	Aerenchyma; Roots of uniform appearance and diameter (3 cm from the root tip)	18,5	26,7	Vasellati <i>et al.</i> 2001
<b>C<sub>3</sub> species</b>							
<i>Thinopyrum ponticum</i>		14	33-days-old plants (3 fully expanded leaves) were partially submerged (half its height) in pots with sand and topsoil (Natracualf; 1:1)	Aerenchyma; 2 cm from the root tip	5,51	10,30	Iturralde Elortegui <i>et al.</i> 2020
<i>Thinopyrum ponticum</i>		14	48-days-old plants (5 fully expanded leaves) were partially submerged (half its height) in pots with sand and topsoil (Natracualf; 1:1)	Aerenchyma; 2 cm from the root tip	6,09	17,86	Iturralde Elortegui <i>et al.</i> 2020
<i>Festuca arundinacea</i>	Rebel XLR	28	Plants with 4 leaves waterlogged (water up to surface) in pots with potting soil. Temperature 25 /20°C (day/night)	Aerenchyma; 2 to 10 cm from the root tip	23	34	Liu <i>et al.</i> 2017

<i>Phalaris aquatica</i>	Unetta	36	34-days-old plants waterlogged (roots in stagnant deoxygenated 0.1% (w/v) agar nutrient solution).20/15 ° C (day/night).	Porosity (pycnometer method) for adventitious roots	18,2	33,6	McDonald <i>et al.</i> 2002
<i>Phalaris aquatica</i>	Unetta	36	34-days-old plants waterlogged (roots in stagnant deoxygenated 0.1% (w/v) agar nutrient solution).20/15 ° C (day/night).	Aerenchyma; 50 mm behind the apex of 100–200 mm adventitious roots	7.1	30.3	McDonald <i>et al.</i> 2002

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