

Supplementary Material

Changes in morphological traits associated with waterlogging, salinity and saline waterlogging in *Festuca arundinacea*

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Table S1. Codes, morphotypes, breeding status and owner of 39 accessions of *Festuca arundinacea*. Accession codes were ranked from lowest (accession code = 1) to highest (accession code= 39) plant relative growth rate at control conditions (aerated, non-saline).

Accession code	Accession name	Morphotype	Breeding status	Owner
1	Tunisia	Mediterranean	CC	PGG Wrightson
2	Rizar IGP12	Continental	CC	PGG Wrightson
3	ARFA439	Continental	GC	INTA Pergamino
4	ARFA020	Continental	GC	INTA Pergamino
5	Temora	Mediterranean	CC	PGG Wrightson
6	Persistent HT13B1	Continental	GC	INIA La Estanzuela
7	IGP6	Mediterranean	CC	PGG Wrightson
8	ARFA440	Continental	GC	INTA Pergamino
9	Bar2025	Continental	CC	Barenbrug
10	Brava INTA	Continental	GC	INTA Pergamino
11	Lujan INTA	Continental	GC	INTA Pergamino
12	Malma	Continental	CC	Gentos
13	Barolex	Continental	CC	Barenbrug
14	MED100	Mediterranean	CC	Gentos
15	Quantum	Continental	EL	PGG Wrightson
16	INIA Aurora	Continental	CC	PGG Wrightson
17	Rizomat	Continental	CC	PGG Wrightson
18	ARFA115	Continental	GC	INTA Pergamino
19	ARFA058	Continental	GC	INTA Pergamino
20	ARFA036	Continental	GC	INTA Pergamino
21	INIA Fortuna	Continental	CC	PGG Wrightson
22	Barverde	Mediterranean	CC	Barenbrug
23	Royal Q100	Continental	CC	Gentos
24	Quantum II	Mediterranean	CC	PGG Wrightson
25	ARFA521	Continental	GC	INTA Pergamino
26	Don Armando	Continental	EL	Romat Armando
27	Carona	Continental	CC	Biscayart
28	Arizona	Mediterranean	CC	Gentos
29	ARFA363	Mediterranean	GC	INTA Pergamino
30	ARFA016	Mediterranean	GC	INTA Pergamino
31	Federación	Continental	EL	FAUBA
32	ARFA060	Continental	GC	INTA Pergamino
33	Baguala	Continental	GC	INTA Pergamino
34	Aprilia	Mediterranean	CC	Baya Casal
35	AS1132	Continental	EL	PGG Wrightson
36	Taita	Continental	CC	Gentos
37	Typhoon	Continental	CC	PGG Wrightson
38	Baralta	Continental	CC	Barenbrug
39	ARFA034	Continental	GC	INTA Pergamino

* Breeding status: CC (commercial cultivar), GC (germplasm collection), EL (experimental line)

Table S2. Total biomass of 39 *Festuca arundinacea* accessions at initial harvest (i.e. after 35 days from seeds imbibition, at control conditions) and after 21 days subjected to

control (aerated, non-saline), waterlogging (stagnant, non-saline), salinity (aerated, 150 mM NaCl) and saline waterlogging (stagnant, 150 mM NaCl) treatments. Values are means \pm SE of 10 replicates.

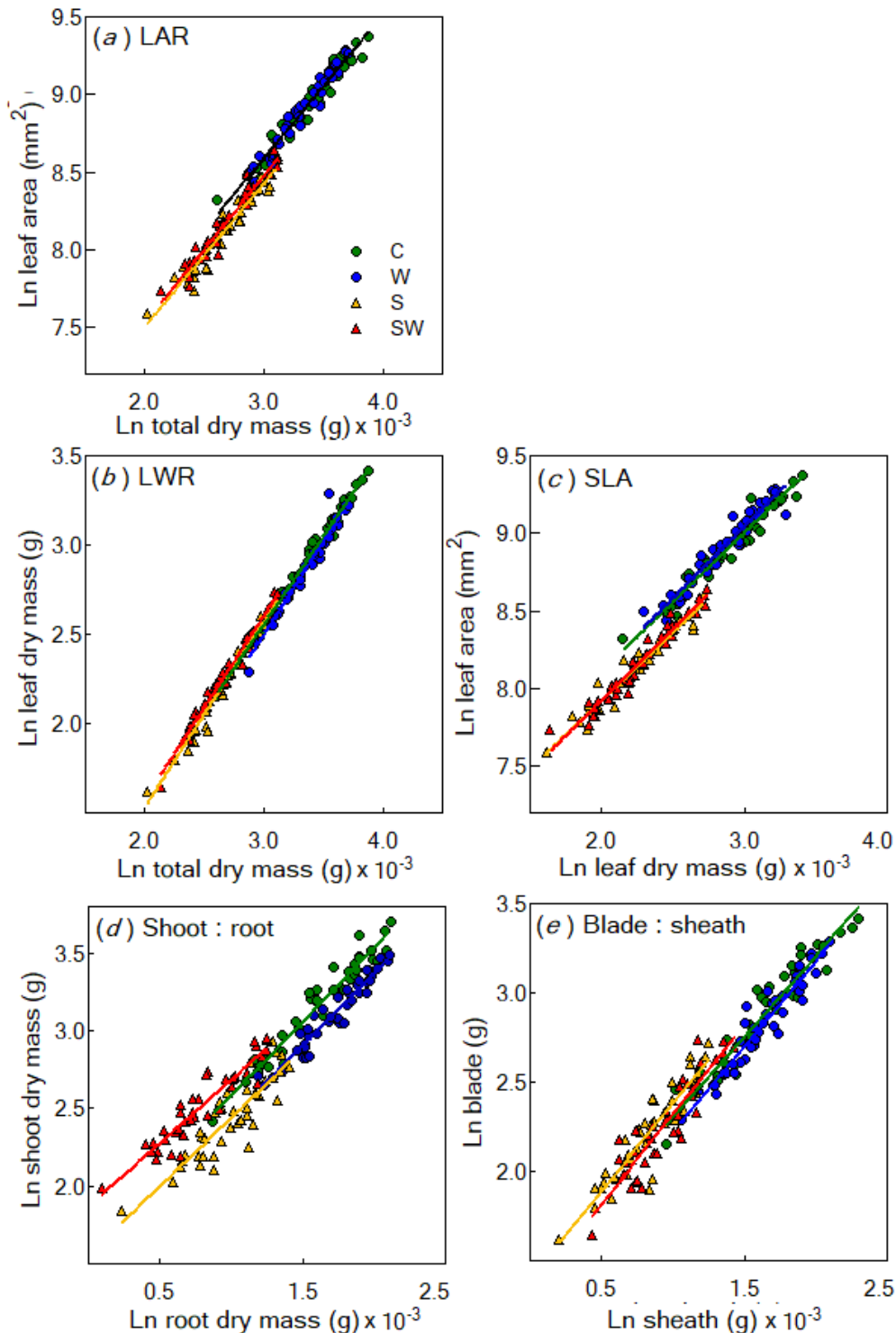
Accessions	Total biomass (g pl ⁻¹)				
	Initial	Control	Waterlogging	Salinity	Saline waterlogging
1-Tunisia	0.018 \pm 0.003	0.21 \pm 0.04	0.27 \pm 0.05	0.14 \pm 0.02	0.18 \pm 0.03
2-Rizar IGP12	0.009 \pm 0.001	0.14 \pm 0.03	0.18 \pm 0.04	0.10 \pm 0.02	0.10 \pm 0.01
3-ARFA439	0.014 \pm 0.001	0.19 \pm 0.02	0.27 \pm 0.03	0.11 \pm 0.02	0.11 \pm 0.01
4-ARFA020	0.021 \pm 0.003	0.31 \pm 0.04	0.32 \pm 0.04	0.14 \pm 0.02	0.14 \pm 0.02
5-Temora	0.019 \pm 0.002	0.30 \pm 0.05	0.32 \pm 0.03	0.21 \pm 0.03	0.23 \pm 0.01
6-Persistent HT13B1	0.011 \pm 0.003	0.19 \pm 0.03	0.25 \pm 0.03	0.12 \pm 0.01	0.11 \pm 0.01
7-IGP6	0.012 \pm 0.001	0.20 \pm 0.03	0.22 \pm 0.02	0.11 \pm 0.01	0.11 \pm 0.01
8-ARFA440	0.015 \pm 0.001	0.26 \pm 0.03	0.21 \pm 0.01	0.11 \pm 0.01	0.13 \pm 0.01
9-Bar2025	0.012 \pm 0.002	0.20 \pm 0.02	0.23 \pm 0.06	0.08 \pm 0.01	0.12 \pm 0.02
10-Brava INTA	0.023 \pm 0.002	0.39 \pm 0.04	0.33 \pm 0.02	0.21 \pm 0.03	0.21 \pm 0.02
11-Lujan INTA	0.020 \pm 0.002	0.36 \pm 0.05	0.40 \pm 0.03	0.22 \pm 0.02	0.22 \pm 0.02
12-Malma	0.013 \pm 0.001	0.23 \pm 0.02	0.24 \pm 0.03	0.11 \pm 0.01	0.12 \pm 0.02
13-Barolex	0.022 \pm 0.003	0.37 \pm 0.04	0.31 \pm 0.03	0.15 \pm 0.03	0.18 \pm 0.02
14-MED100	0.015 \pm 0.001	0.27 \pm 0.03	0.22 \pm 0.02	0.14 \pm 0.02	0.12 \pm 0.01
15-Quantum	0.023 \pm 0.004	0.39 \pm 0.05	0.41 \pm 0.04	0.18 \pm 0.02	0.22 \pm 0.03
16-INIA Aurora	0.020 \pm 0.002	0.37 \pm 0.04	0.40 \pm 0.05	0.19 \pm 0.02	0.21 \pm 0.03
17-Rizomat	0.017 \pm 0.003	0.29 \pm 0.04	0.27 \pm 0.03	0.17 \pm 0.02	0.17 \pm 0.02
18-ARFA115	0.017 \pm 0.002	0.29 \pm 0.03	0.30 \pm 0.04	0.16 \pm 0.02	0.15 \pm 0.02
19-ARFA058	0.015 \pm 0.003	0.25 \pm 0.04	0.25 \pm 0.03	0.15 \pm 0.01	0.13 \pm 0.02
20-ARFA036	0.016 \pm 0.002	0.32 \pm 0.04	0.32 \pm 0.03	0.15 \pm 0.02	0.14 \pm 0.01
21-INIA Fortuna	0.024 \pm 0.002	0.46 \pm 0.05	0.36 \pm 0.06	0.17 \pm 0.02	0.21 \pm 0.03
22-Barverde	0.012 \pm 0.001	0.21 \pm 0.02	0.23 \pm 0.03	0.13 \pm 0.01	0.15 \pm 0.03
23-Royal Q100	0.020 \pm 0.002	0.36 \pm 0.04	0.37 \pm 0.03	0.16 \pm 0.02	0.17 \pm 0.02
24-Quantum II	0.021 \pm 0.001	0.44 \pm 0.06	0.34 \pm 0.04	0.20 \pm 0.02	0.15 \pm 0.02
25-ARFA521	0.016 \pm 0.003	0.29 \pm 0.04	0.24 \pm 0.04	0.12 \pm 0.02	0.11 \pm 0.01
26-Don Armando	0.022 \pm 0.002	0.49 \pm 0.08	0.37 \pm 0.03	0.20 \pm 0.02	0.18 \pm 0.02
27-Carona	0.018 \pm 0.002	0.35 \pm 0.04	0.34 \pm 0.06	0.09 \pm 0.01	0.13 \pm 0.02
28-Arizona	0.011 \pm 0.002	0.19 \pm 0.03	0.18 \pm 0.03	0.11 \pm 0.03	0.11 \pm 0.01
29-ARFA363	0.008 \pm 0.001	0.18 \pm 0.02	0.21 \pm 0.03	0.11 \pm 0.01	0.11 \pm 0.01
30-ARFA016	0.018 \pm 0.002	0.39 \pm 0.04	0.32 \pm 0.04	0.17 \pm 0.02	0.18 \pm 0.02
31-Federación	0.015 \pm 0.002	0.32 \pm 0.04	0.27 \pm 0.02	0.17 \pm 0.02	0.13 \pm 0.02
32-ARFA060	0.016 \pm 0.002	0.36 \pm 0.04	0.26 \pm 0.03	0.15 \pm 0.03	0.18 \pm 0.02
33-Baguala	0.017 \pm 0.001	0.41 \pm 0.05	0.31 \pm 0.02	0.15 \pm 0.02	0.17 \pm 0.02
34-Aprilia	0.011 \pm 0.002	0.25 \pm 0.02	0.19 \pm 0.02	0.12 \pm 0.02	0.12 \pm 0.02
35-AS1132	0.017 \pm 0.004	0.34 \pm 0.03	0.27 \pm 0.03	0.18 \pm 0.02	0.14 \pm 0.02
36-Taita	0.015 \pm 0.002	0.39 \pm 0.04	0.35 \pm 0.03	0.14 \pm 0.02	0.14 \pm 0.01
37-Typhoon	0.012 \pm 0.001	0.32 \pm 0.04	0.28 \pm 0.02	0.13 \pm 0.01	0.14 \pm 0.02
38-Baralta	0.015 \pm 0.002	0.42 \pm 0.06	0.36 \pm 0.04	0.14 \pm 0.02	0.17 \pm 0.02
39-ARFA034	0.006 \pm 0.001	0.20 \pm 0.03	0.18 \pm 0.04	0.11 \pm 0.02	0.08 \pm 0.01

Table S3. Equations of allometric relationships of Figure S1 for the morphological traits of 39 *Festuca arundinacea* accessions subjected to control (aerated, non-saline),

waterlogging (stagnant, non-saline), salinity (aerated, 150 mM NaCl) and saline waterlogging (SW: stagnant, 150 mM NaCl) treatments for 21 days. All slopes are not significantly different from 1 (95% CI; except for shoot:root under SW) or from each other. The y-intercepts that are significantly different from the control treatment for each component are highlighted in bold (95% CI).

Treatment / Component	Control	Waterlogging	Salinity	Saline waterlogging
Leaf area ratio	0.88 x + 5.95	0.99 x + 5.59	0.92 x + 5.66	0.95 x + 5.64
Specific leaf area	0.89 x + 6.33	0.92 x + 6.28	0.88 x + 6.17	0.91 x + 6.09
Leaf weight ratio	0.98 x - 0.40	1.05 x - 0.64	1.04 x - 0.55	1.03 x - 0.48
Shoot : root	0.95 x + 1.63	0.92 x + 1.52	0.88 x + 1.56	0.82 x + 1.87
Blade : sheath	0.90 x + 1.40	0.96 x + 1.26	0.98 x + 1.40	1.00 x + 1.31

Fig. S1. Allometric relationships between: leaf area and plant biomass (LAR; *a*), leaf



biomass and plant biomass (LWR; *b*), leaf area and leaf biomass (SLA; *c*), shoot and root biomass (*d*), and blade and sheath biomass (*e*; considering blades as equivalent to leaves) of 39 *Festuca arundinacea* accessions subjected to control (C: aerated, non-saline), waterlogging (W: stagnant, non-saline), salinity (S: aerated, 150 mM NaCl) and saline waterlogging (SW: stagnant, 150 mM NaCl) treatments for 21 days. Each symbol represents the mean value (average of 10 replicates) of a single accession at the corresponding treatment. Refer to Table S3 for detailed information on the allometric equations.

Fig. S2. Relationships of net assimilation rate (NAR) versus tolerance index of 39 *Festuca arundinacea* accessions subjected to waterlogging (stagnant, non-saline; *a*), salinity (aerated, 150 mM NaCl; *b*) and saline waterlogging (stagnant, 150 mM NaCl; *c*) treatments. All relationships are shown as % of controls. All relationships are shown as % of controls. Pearson's correlation coefficient (*r*) and linear regression are shown when the correlations are significant ($P < 0.05$). Dotted line indicates NAR and tolerance index = 1 (i.e. similar to control).

