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## Supplementary Material

# Drought resistance and soil water extraction of a perennial $C_4$ grass: contributions of root and rhizome traits

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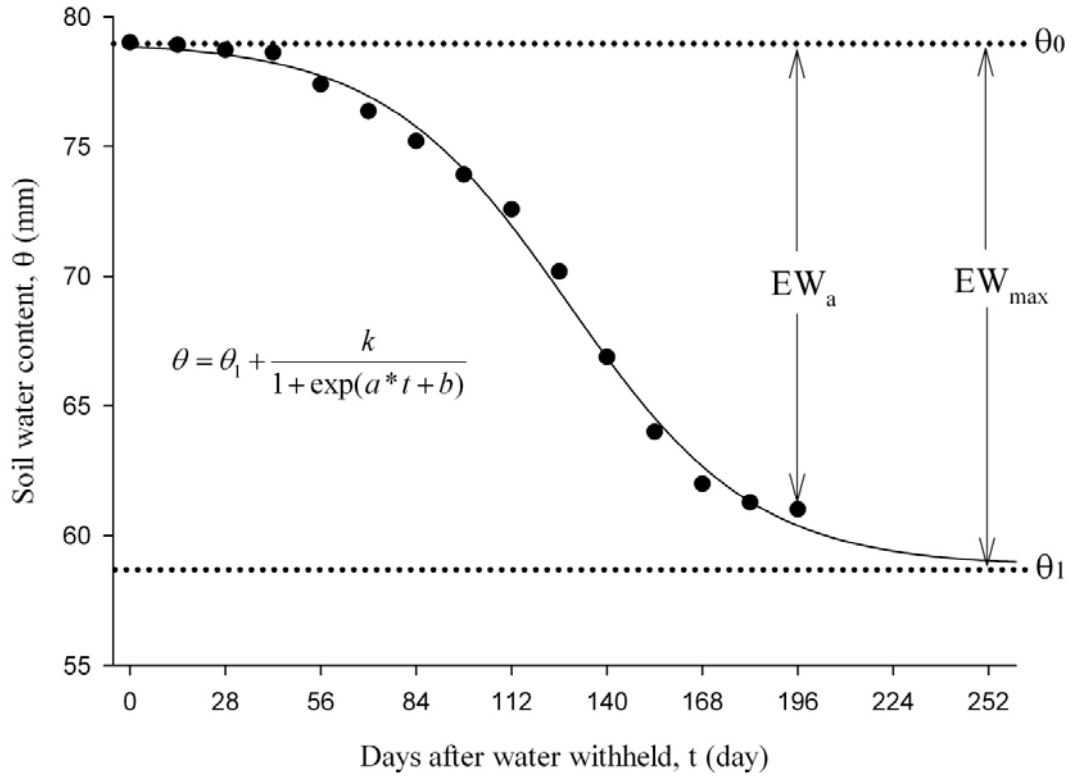



**Fig S1.** The sigmoidal model used to describe the relationship between soil water content and days after water withheld for each layer of soil profile in each experimental unit. $\theta_1$ represents the lower limit of soil water content. $\theta_0$ was the soil water content when the experiment started. Maximum extractable water ($EW_{max}$) defined as a genotypic specific estimate of the maximum amount of water the grasses were able to extract or could have extracted from each layer of the soil profile was the difference between $\theta_0$ and $\theta_1$. Actual extracted water ($EW_a$) at the end of experiment was the difference between $\theta_0$ and the final measured soil water content.

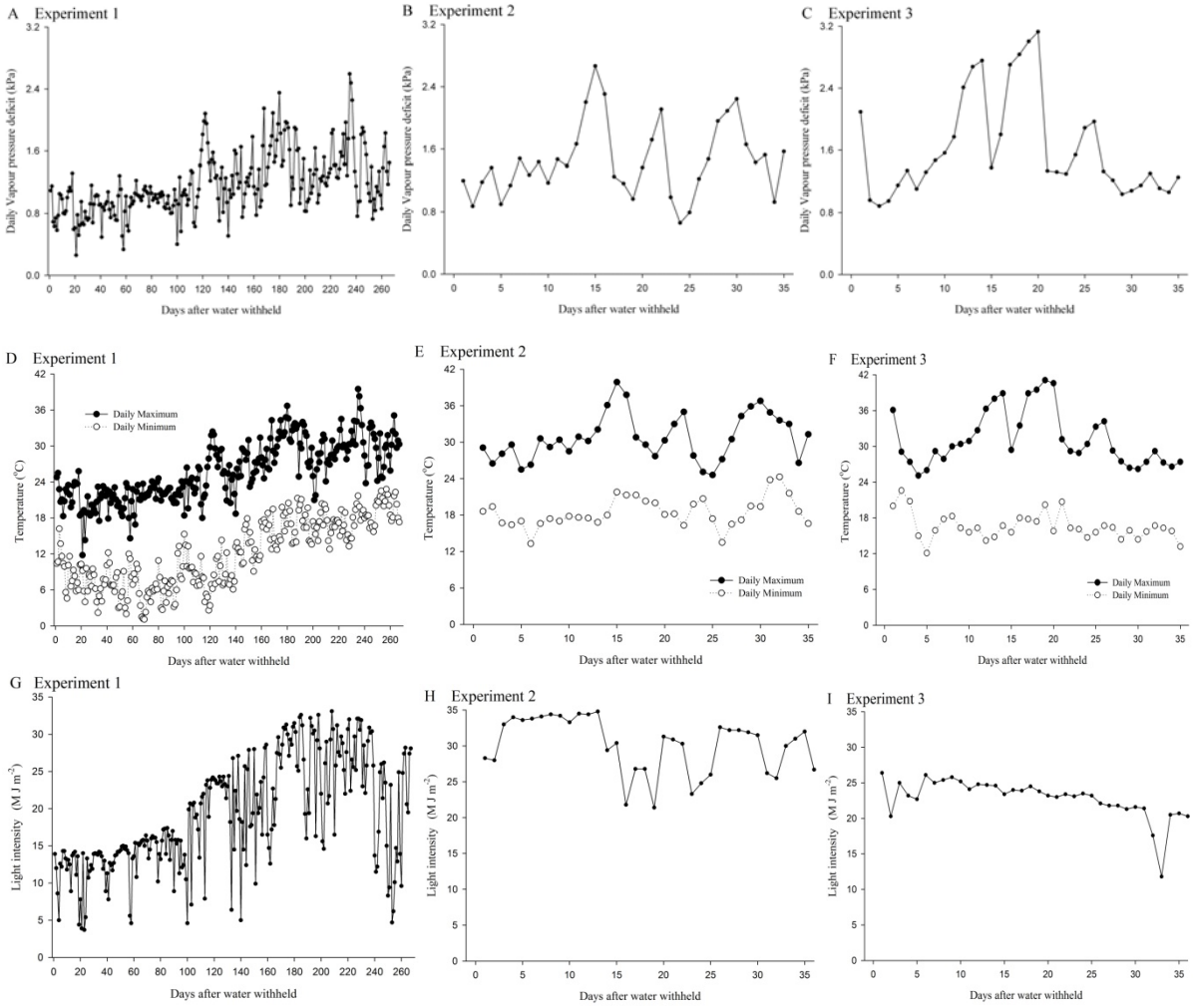



**Fig S2.** Daily vapour pressure deficit (A-C), daily maximum and minimum temperature (D-F) and light intensity (G-I) observed during experiments 1, 2 and 3. Experiment 1 was conducted under a rainout shelter in a Sub-Tropical environment ($ST_{env}$), Gatton QLD, and Experiment 2 and 3 were conducted under natural drought conditions in a Mediterranean environment ($Med_{env}$), Shenton Park, WA.

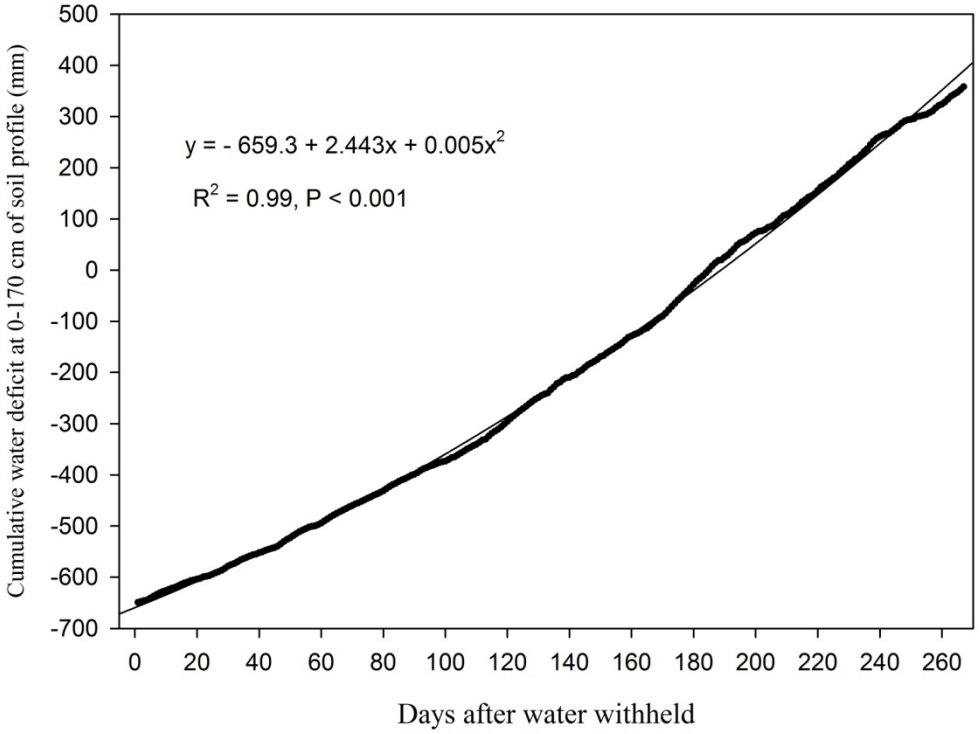
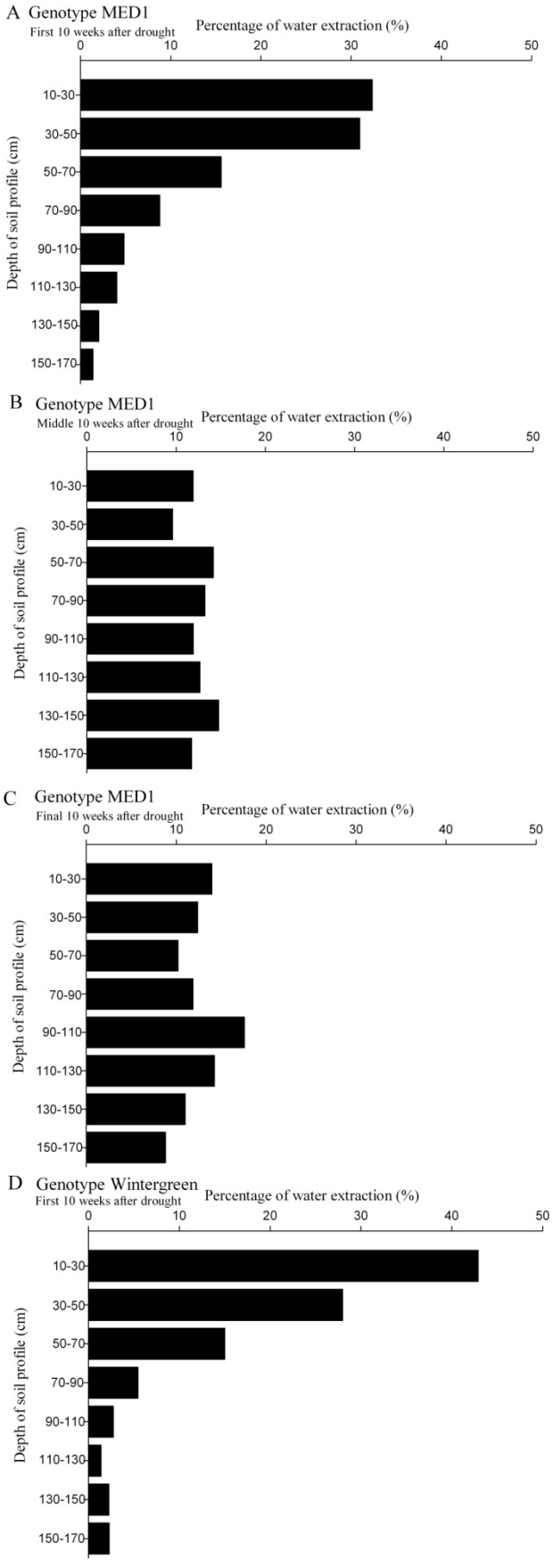
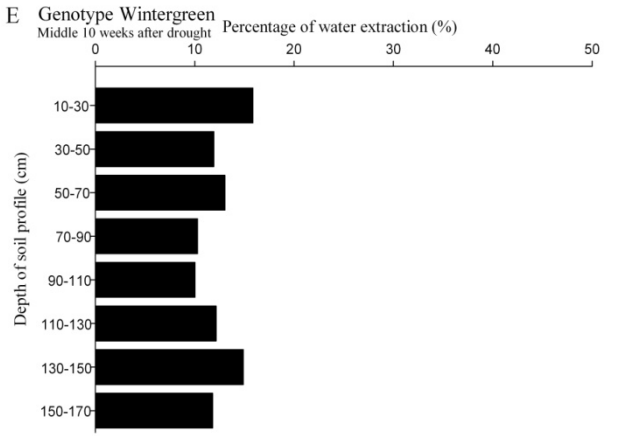
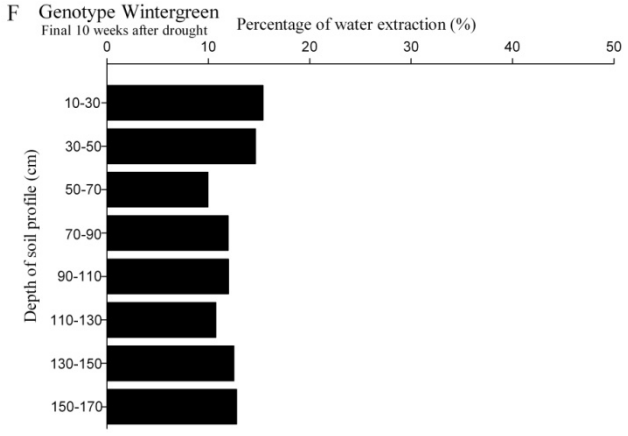
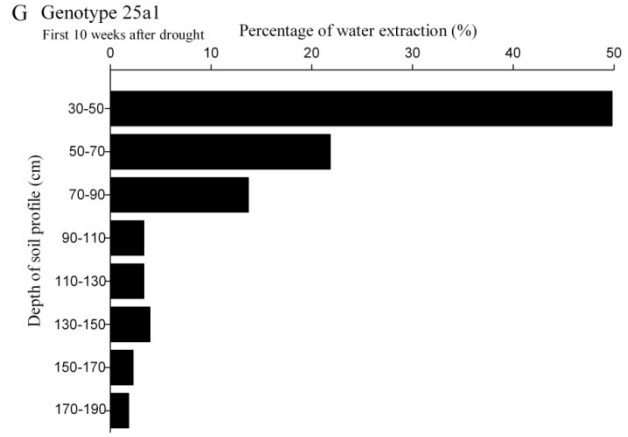



**Fig S3**. The relationship between days after water was withheld (DAWW) and cumulative water deficit (CWD) for Experiment 1, based on the soil water storage in the 0-170 cm profile of the sub-tropical environment ($ST_{env}$), Gatton, south-east QLD. CWD was calculated based on the method modified from Poirier et al. (2012) i.e. CWD equals cumulative daily potential evapotranspiration (PET) minus total stored soil water between 0-170 cm at the beginning of the drought period. The total soil water at the beginning of the drought period was 659 mm and the CWD on day 260 was 973 mm.


A Genotype MED1
First 10 weeks after drought
Percentage of water extraction (%)
0
10
20
30
40
50
Depth of soil profile (cm)
10-30
30-50
50-70
70-90
90-110
110-130
130-150
150-170
B Genotype MED1
Middle 10 weeks after drought
Percentage of water extraction (%)
0
10
20
30
40
50
Depth of soil profile (cm)
10-30
30-50
50-70
70-90
90-110
110-130
130-150
150-170
C Genotype MED1
Final 10 weeks after drought
Percentage of water extraction (%)
0
10
20
30
40
50
Depth of soil profile (cm)
10-30
30-50
50-70
70-90
90-110
110-130
130-150
150-170
D Genotype Wintergreen
First 10 weeks after drought
Percentage of water extraction (%)
0
10
20
30
40
50
Depth of soil profile (cm)
10-30
30-50
50-70
70-90
90-110
110-130
130-150
150-170


E Genotype Wintergreen
Middle 10 weeks after drought
Percentage of water extraction (%)
0
10
20
30
40
50
Depth of soil profile (cm)
10-30
30-50
50-70
70-90
90-110
110-130
130-150
150-170


F Genotype Wintergreen
Final 10 weeks after drought
Percentage of water extraction (%)
0
10
20
30
40
50
Depth of soil profile (cm)
10-30
30-50
50-70
70-90
90-110
110-130
130-150
150-170


G Genotype 25a1
First 10 weeks after drought
Percentage of water extraction (%)
0
10
20
30
40
50
Depth of soil profile (cm)
30-50
50-70
70-90
90-110
110-130
130-150
150-170
170-190

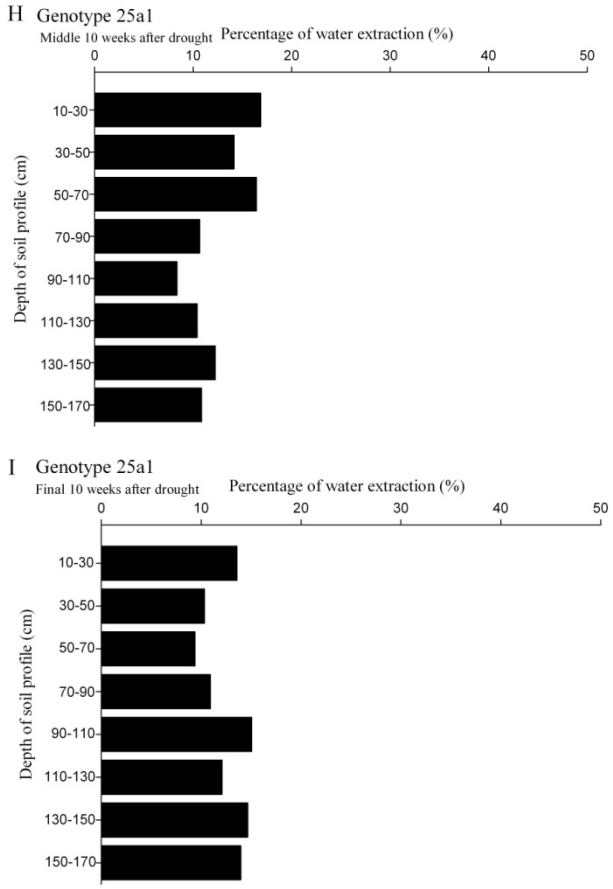



**Fig S4.** Percentage of genotype extracted water at each depth to the whole soil profile (10-170 cm) during the first 10 weeks, middle 10 weeks and final 10 weeks after water was withheld for genotypes MED1 (A-C), Wintergreen (D-F) and 25a1 (G-I) in the experiment conducted under drought stress in the field at a Sub-Tropical environment ($ST_{env}$).

**Table S1. Comparisons of traits between four Mediterranean bermudagrasses and other bermudagrasses in the field experiments conducted at two locations; a Sub-Tropical environment ($ST_{env}$) and a Mediterranean environment ($Med_{env}$)**

Traits include $GC_{50}$, relative water content (RWC), photosynthetic rate (Pn), canopy temperature differential (CTD), maximum extractable water ($EW_{max}$), maximum water uptake rate ($Q_{max}$), rhizome dry matter (DM), average root diameter (ARD) and root length density (RLD). Some of these traits were measured at different days after water withheld (DAWW) or depths of soil profile. Significant difference between two groups of bermudagrass genotypes are indicated by; * $P < 0.05$, ** $P < 0.01$. ns not significant

| | $ST_{env}$ | | | | $Med_{env}$ | | | |
|---|---|---|---|---|---|---|---|---|
| Measured traits | Mediterranean Bermudagrasses n=4 | Other Bermudagrasses n=14 | Level of significant difference | Note | Mediterranean Bermudagrasses n=4 | Other Bermudagrasses n=8 | Level of significant difference | Note |
| (a) GC and physiological traits | | | | | | | | |
| $GC_{50}$ (day) | 251 | 214 | ** | | 26 | 20 | ** | |
| RWC (%) | 87.1 | 80.1 | ** | 186 DAWW | 68.3 | 40.7 | ** | 21 DAWW |
| Pn (umol $CO_2$ $m^{-2}s^{-1}$) | 38.2 | 26 | ** | 185 DAWW | 3.3 | 7.4 | ** | 21 DAWW |
| CTD (°C) | 3.9 | 6 | ** | 185 DAWW | | | | |
| (b) $EW_{max}$ (mm) | | | | | | | | |
| | 222 | 203 | ** | 10-170 cm depth | | | | |
| | 23 | 20 | * | 70-90 cm depth | | | | |
| | 0.14 | 0.12 | ** | 70-90 cm depth | | | | |
| (c) RhDM (kg $m^{-2}$) | | | | | | | | |
| | 0.385 | 0.061 | ** | 0 DAWW | 2.328 | 0.393 | ** | 35 DAWW |
| | 0.39 | 0.122 | ** | 266 DAWW | | | | |
| (d) ARD (mm) | | | | | | | | |
| | 0.23 | 0.22 | ns | 30-60 cm depth at 0 DAWW | 0.21 | 0.17 | * | 0-30 cm depth at 35 DAWW |
| | 0.2 | 0.2 | ns | 90-160 cm depth at 0 DAWW | 0.22 | 0.19 | * | 30-60 cm depth at 35 DAWW |
| | 0.25 | 0.2 | ** | 30-60 cm depth at 266 DAWW | | | | |
| | 0.25 | 0.21 | * | 90-160 cm depth at 266 DAWW | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| (e) RLD (cm $cm^{-3}$) | | | | | | | | |
| | 0.19 | 0.17 | ns | 30-60 cm depth at 0 DAWW | 5.58 | 5.37 | ns | 0-30 cm depth at 35 DAWW |
| | 0.08 | 0.12 | ns | 90-160 cm depth at 0 DAWW | 2.84 | 1.72 | ns | 30-60 cm depth at 35 DAWW |
| | 0.25 | 0.21 | ns | 30-60 cm depth at 266 DAWW | | | | |
| | 0.23 | 0.21 | ns | 90-160 cm depth at 266 DAWW | | | | |