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*Supplement of*

**The effect of drought and interspecific interactions on depth of water uptake in deep- and shallow-rooting grassland species as determined by  $\delta^{18}\text{O}$  natural abundance**

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## Supplementary Material

**Table S1.** The main and combined effects of water supply (control, drought), community (*L. perenne* monoculture, *T. repens* monoculture, *C. intybus* monoculture, *T. pratense* monoculture, equi-proportional mixture) and soil depth interval (0-10, 10-20, 20-30, 30-40 cm<sup>a</sup>) on the soil moisture content and the  $\delta^{18}\text{O}$  of soil water in Tännikon 2011 and Reckenholz 2012.

| Model                            | Tännikon 2011 |         |       |                                  |     | Reckenholz 2012 |         |      |                                  |     |
|----------------------------------|---------------|---------|-------|----------------------------------|-----|-----------------|---------|------|----------------------------------|-----|
|                                  | df            | SMC     |       | $\delta^{18}\text{O}$ soil water |     | df              | SMC     |      | $\delta^{18}\text{O}$ soil water |     |
|                                  |               | F-value | $p^b$ | F-value                          | $p$ |                 | F-value | $p$  | F-value                          | $p$ |
| Water supply                     | 1             | 53.3    | ***   | 136.1                            | *** | 1               | 627.2   | ***  | 77.0                             | *** |
| Community                        | 4             | 0.6     | ns    | 4.3                              | *   | 4               | 4.2     | 0.07 | 3.2                              | ns  |
| Depth                            | 3             | 3.6     | *     | 68.1                             | *** | 4               | 13.8    | ***  | 105.1                            | *** |
| Water supply × Community         | 4             | 0.6     | ns    | 0.3                              | ns  | 4               | 2.3     | ns   | 2.3                              | ns  |
| Water supply × Depth             | 3             | 34.2    | ***   | 29.7                             | *** | 4               | 39.1    | ***  | 7.1                              | *** |
| Community × Depth                | 12            | 0.8     | ns    | 1.5                              | ns  | 16              | 0.5     | ns   | 2.4                              | **  |
| Water supply × Community × Depth | 12            | 0.5     | ns    | 0.5                              | ns  | 16              | 1.8     | 0.07 | 2.0                              | *   |

<sup>a</sup> During 2012, the 0-10 cm soil depth interval was split into 0-5 and 5-10 cm

<sup>b</sup> Levels of significance are indicated as: ns = non significant, \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$

**Table S2.** The main and combined effects of water supply (control, drought) and community (*L. perenne* monoculture, *T. repens* monoculture, *C. intybus* monoculture, *T. pratense* monoculture, equi-proportional mixture) on aboveground dry matter yield in Tännikon 2011 and Reckenholz 2012.

| Model                    | df | Tännikon 2011 |       | Reckenholz 2012 |      |
|--------------------------|----|---------------|-------|-----------------|------|
|                          |    | F-value       | $p^a$ | F-value         | $p$  |
| Water supply             | 1  | 7.3           | *     | 41.7            | ***  |
| Community                | 4  | 28.5          | ***   | 47.4            | ***  |
| Water supply × Community | 4  | 1.7           | ns    | 2.7             | 0.08 |

<sup>a</sup> Levels of significance are indicated as: ns = non significant, \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$

**Table S3.** The main and combined effects of water supply (control, drought) and species (*L. perenne*, *T. repens*, *C. intybus*, *T. pratense*) on the proportional contribution of each species to the dry matter yield of the equi-proportional mixture in Tännikon 2011 and Reckenholz 2012.

| Year | Model                  | df | Tännikon 2011 |       | Reckenholz 2012 |     |
|------|------------------------|----|---------------|-------|-----------------|-----|
|      |                        |    | F-value       | $p^a$ | F-value         | $p$ |
| 2011 | Water supply           | 1  | 0.0           | ns    | 0.0             | ns  |
|      | Species                | 3  | 42.3          | ***   | 14.0            | *** |
|      | Water supply × Species | 3  | 3.8           | *     | 0.2             | ns  |
| 2012 | Water supply           | 1  | 0.0           | ns    | 0.0             | ns  |
|      | Species                | 3  | 42.3          | ***   | 14.0            | *** |
|      | Water supply × Species | 3  | 3.8           | *     | 0.2             | ns  |

<sup>a</sup> Levels of significance are indicated as: ns = non significant, \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$

**Table S4.** The main and combined effects of water supply (control, drought), diversity (monoculture, mixture) and species<sup>a</sup> (*L. perenne*, *T. repens*, *C. intybus*, *T. pratense*) on the proportional water uptake from the 0-10 cm soil depth interval (PCWU<sub>0-10</sub>) and the inferred depth of water uptake in Tånikon 2011 and Reckenholz 2012.

| Year | Model                              | df | Proportional uptake from 0-10 cm |       | Inferred depth of water uptake |      |
|------|------------------------------------|----|----------------------------------|-------|--------------------------------|------|
|      |                                    |    | F-value                          | $p^b$ | F-value                        | $p$  |
| 2011 | Water supply                       | 1  | 0.0                              | ns    | 0.5                            | ns   |
|      | Diversity                          | 1  | 92.8                             | **    | 6.4                            | 0.06 |
|      | Water supply × Diversity           | 1  | 29.4                             | *     | 0.4                            | ns   |
| 2012 | Water supply                       | 1  | 4.5                              | 0.07  | 0.0                            | ns   |
|      | Species                            | 3  | 10.9                             | **    | 12.3                           | **   |
|      | Diversity                          | 1  | 0.0                              | ns    | 0.2                            | ns   |
|      | Water supply × Species             | 3  | 1.3                              | ns    | 1.8                            | ns   |
|      | Water supply × Diversity           | 1  | 0.0                              | ns    | 0.1                            | ns   |
|      | Species × Diversity                | 3  | 10.0                             | **    | 5.7                            | *    |
|      | Water supply × Species × Diversity | 3  | 3.7                              | 0.05  | 1.9                            | ns   |

<sup>a</sup> For 2011, only data for one species (*T. pratense*) were available, and the factor species was omitted from the model.

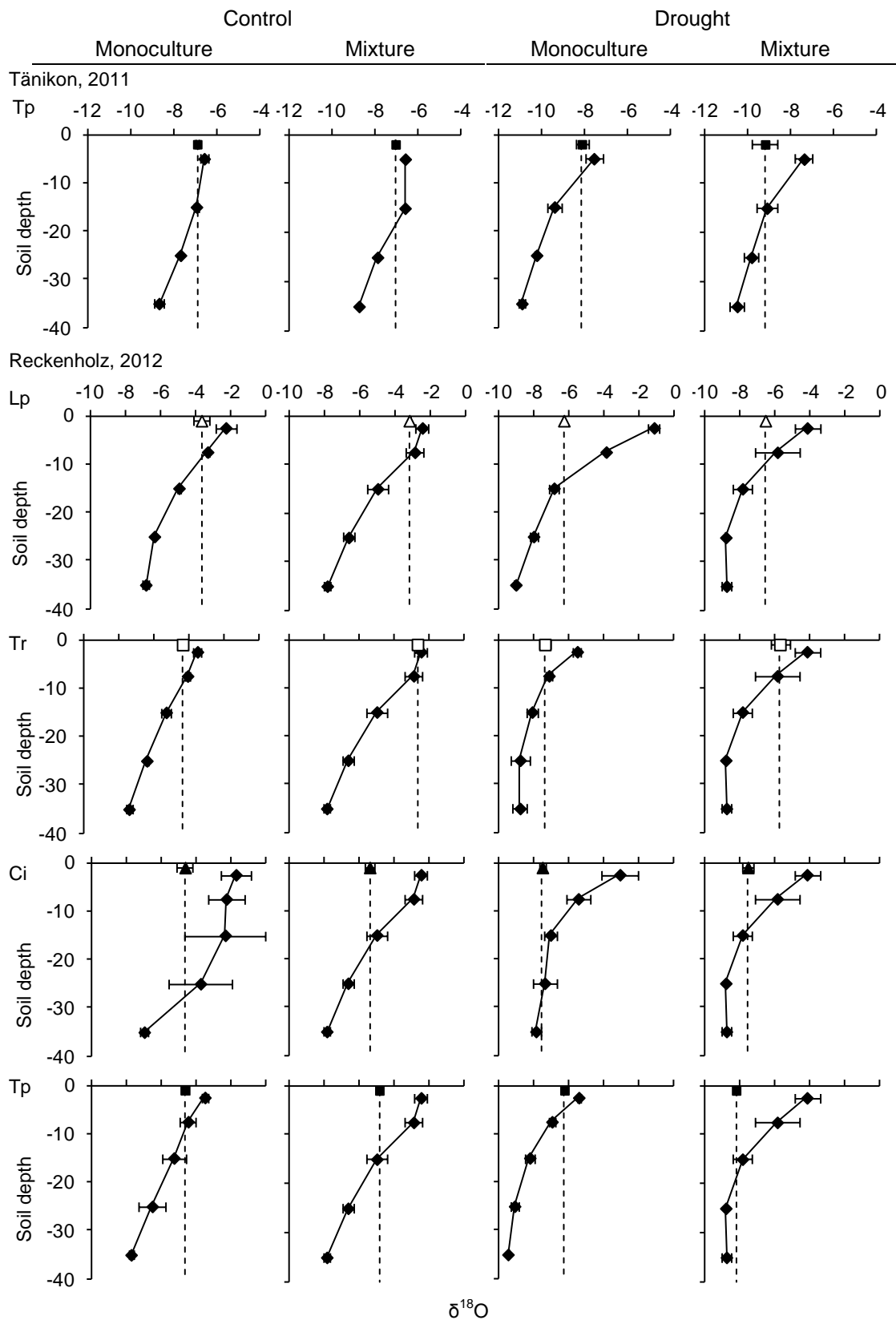
<sup>b</sup> Levels of significance are indicated as: ns = non significant, \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$

**Table S5.** The main and combined effects of water supply (control, drought), diversity (monoculture, mixture) and species pair (*L. perenne*–*T. repens*, *L. perenne*–*C. intybus*, *L. perenne*–*T. pratense*; *T. repens*–*C. intybus*, *T. repens*–*T. pratense* and *C. intybus*–*T. pratense*) or rooting-depth pair (shallow, mixed, deep<sup>a</sup>) on the proportional similarity of the proportional water uptake from the 0-10 cm and 10-40 cm soil depth intervals in Reckenholz 2012.

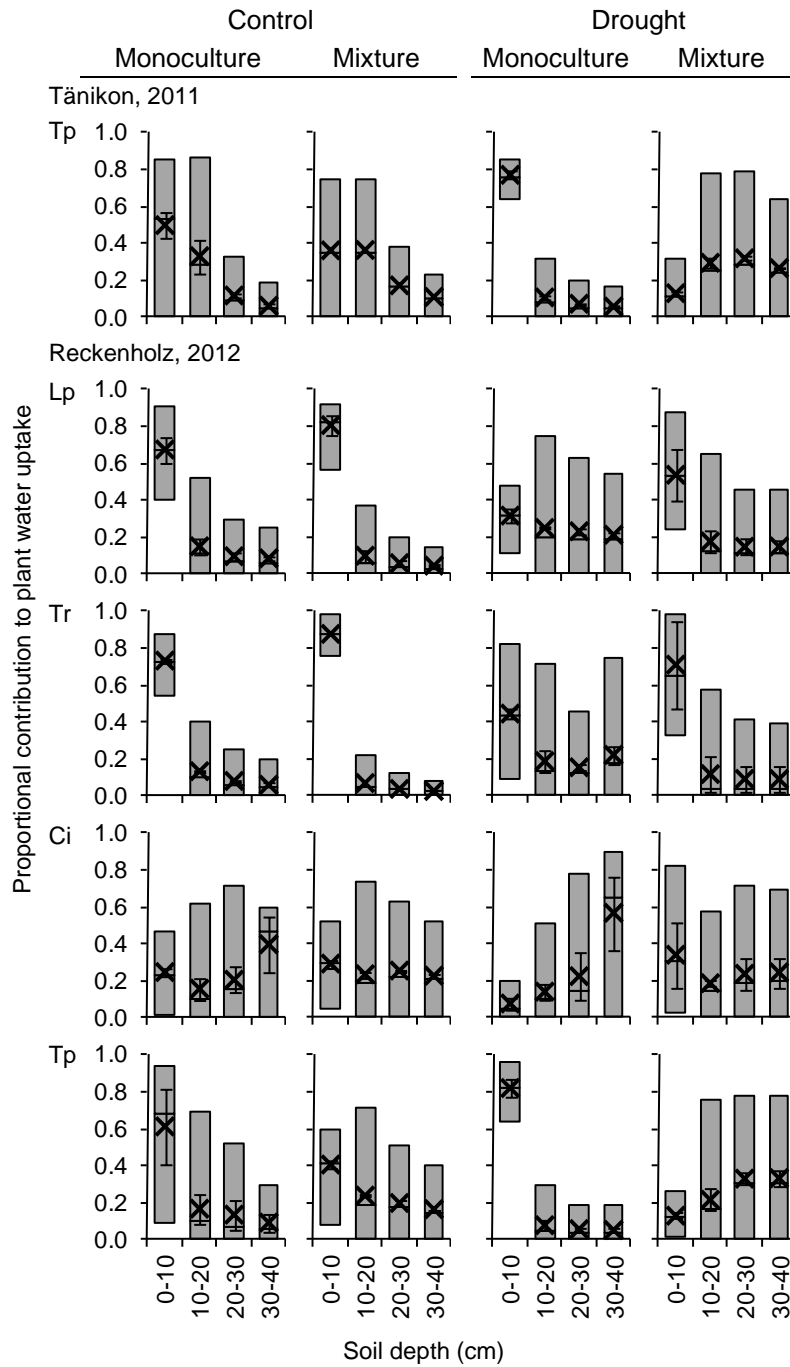
|                             | df | F-value | $p^b$ |                          | df | F-value | $p$ |
|-----------------------------|----|---------|-------|--------------------------|----|---------|-----|
| Water supply                | 1  | 0.8     | ns    | Water supply             | 1  | 0.9     | ns  |
| Diversity                   | 1  | 0.0     | ns    | Diversity                | 1  | 0.0     | ns  |
| Species pair                | 5  | 2.4     | 0.05  | RD pair                  | 2  | 5.8     | **  |
| Water supply × Diversity    | 1  | 3.0     | ns    | Water supply × Diversity | 1  | 1.8     | ns  |
| Diversity × Species pair    | 5  | 7.5     | ***   | Diversity × RD pair      | 2  | 9.1     | *** |
| Water supply × Species pair | 5  | 5.3     | **    | Water supply × RD pair   | 2  | 2.3     | ns  |

<sup>a</sup> Rooting-depth pairs: shallow (*L. perenne*–*T. repens*), mixed (*L. perenne*–*C. intybus*, *L. perenne*–*T. pratense*, *T. repens*–*C. intybus*, *T. repens*–*T. pratense*) and deep (*C. intybus*–*T. pratense*)

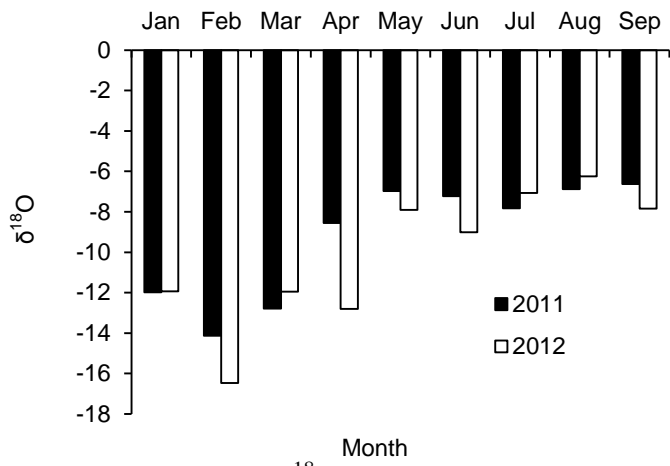
<sup>b</sup> Levels of significance are indicated as: ns = non significant, \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$



**Figure S1.** Mean ( $\pm$ SE,  $n = 2$  for all soils and plants,  $n = 1$  for plants in the case of Tänikon-*T. pratense*-Control-Mixture and Reckenholz-*T. repens*-Control-Mixture)  $\delta^{18}O$  values of soil water (—,  $\blacklozenge$ ) and plant xylem water for *L. perenne* ( $\triangle$  Lp), *T. repens* ( $\square$  Tr), *C. intybus* ( $\blacktriangle$  Ci) and *T. pratense* ( $\blacksquare$  Tp) species grown in monoculture or mixture under control or drought conditions in Tänikon, 2011 and Reckenholz, 2012. The point at which the  $\delta^{18}O$  signature of the plant xylem (---) intersects with the soil water  $\delta^{18}O$  line (—) corresponds to the estimated mean depth of water uptake (see Fig. 2a-e).



**Figure S2.** Box plots of the proportional contribution of each soil layer (0-10, 10-20, 20-30 and 30-40 cm) to plant water uptake of *Lp* (*L. perenne*), *Tr* (*T. repens*), *Ci* (*C. intybus*) and *Tp* (*T. pratense*) grown in monoculture or mixture under control and drought conditions in Tänikon (2011) or Reckenholz (2012). Lower, middle and upper boundaries of the bars represent the 1<sup>st</sup> percentile, 50<sup>th</sup> percentile and 99<sup>th</sup> percentile of the proportional contribution, respectively. The mean (×) and SE of the mean proportional contribution ( $n = 2$  in all cases except for Tänikon-*T. pratense*-control-mixture and Reckenholz-*T. repens*-control-mixture, where  $n = 1$ ) are also included.



**Figure S3.** Monthly  $\delta^{18}\text{O}$  isotopic composition of rainfall (station St. Gallen, data from the Swiss National Network for the Observation of Isotopes in the Water Cycle, ISOT), during 2011 and 2012.