Figure S*1. Boundary conditions for six in-silico experiments of the virtual soil-root system. The daily evaporation and irrigation rate (left) and the prescribed transpiration rates at root collar (right).
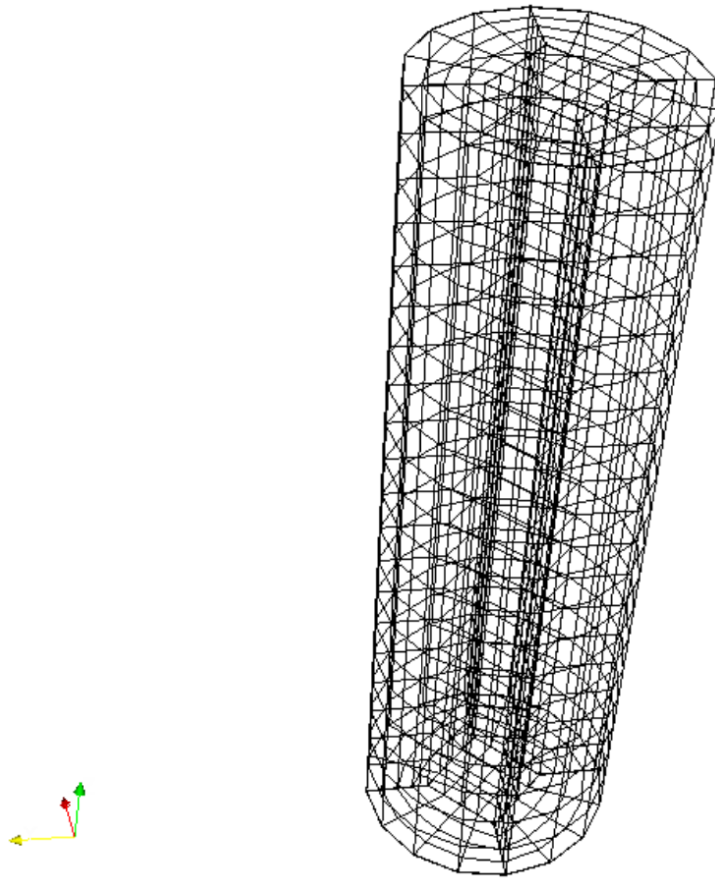
Figure S*2: A picture of the simulated pot mesh. The numerical mesh represents the soil column domain, which has a diameter of 16cm and 55cm length, was generated using the mesh generator GMesh (Geuzaine and Remacle 2009). The soil column was divided vertically into 2cm layers. Each soil layer was discretized to hexahedral elements with 16 cubic elements at the center. In total, the soil column has 1839 elements.
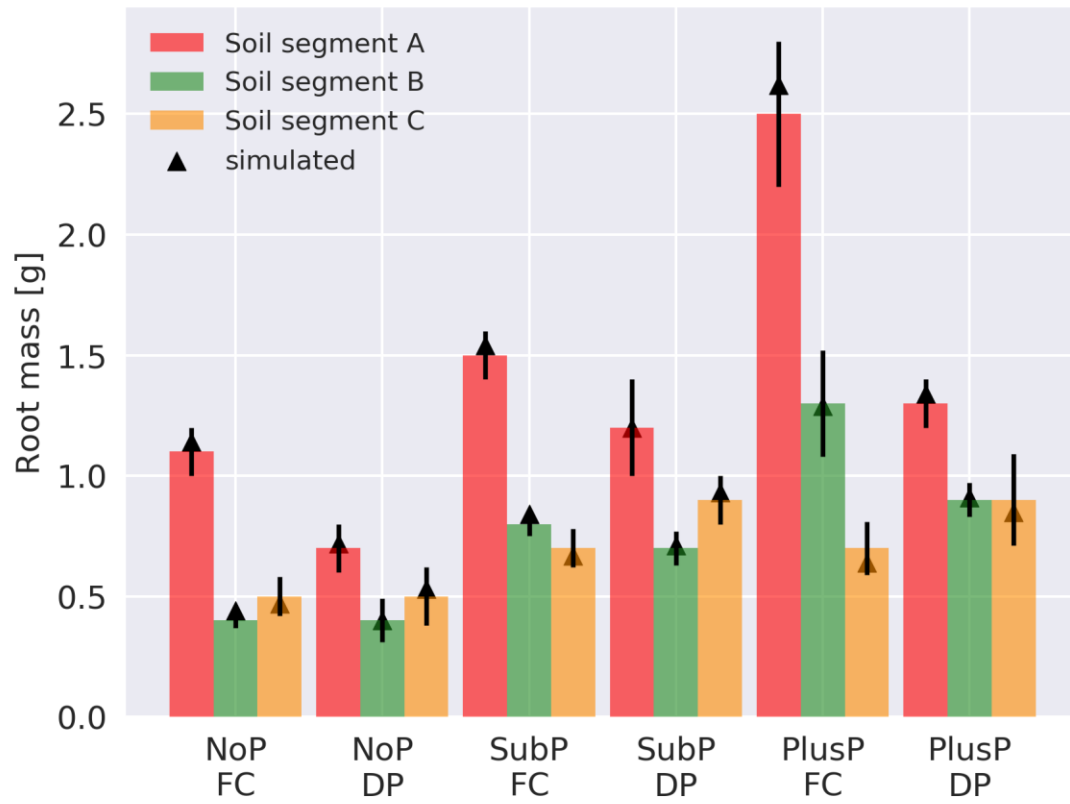
Figure S*3: The observed root mass distribution along depth (A: 0-15 cm; B: 15-30 cm; C: >30 cm) in the pot experiment (colored bars including the standard error) and the corresponding distribution simulated in CRootBox (black triangle) in all scenarios.
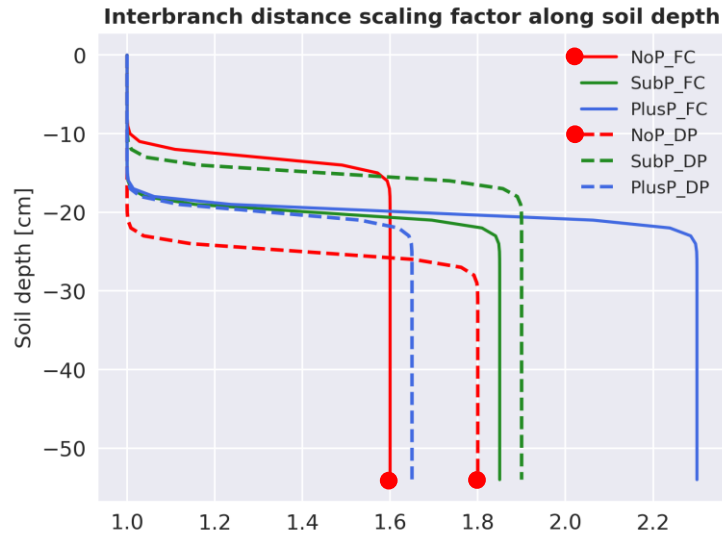
Figure S*4: The interbranch distance scaling factor, k_s, along the soil depth. This figure shows the scaling factor of the interbranch distance of the laterals on nodal roots, following the particular root mass distribution in each scenario. This is described by Equation 8, Supplementary Text S2.
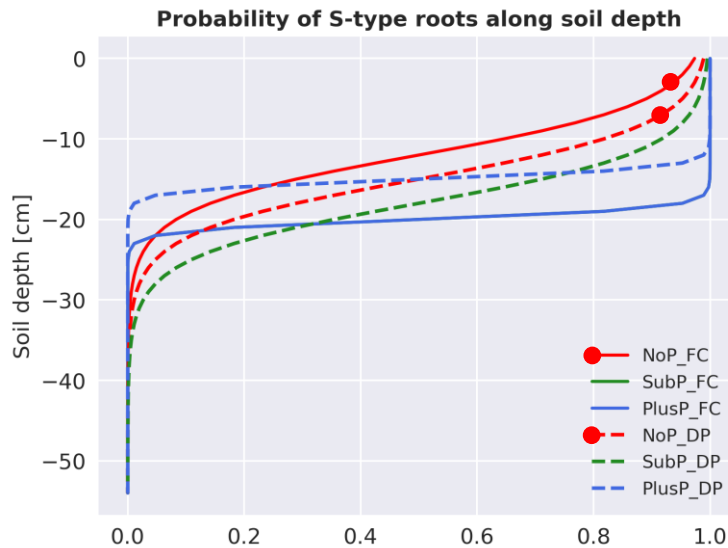

Figure S*5: The probability of the S-type roots along the soil depth. This figure shows a high probability of the S -type laterals starting to emerge from the nodal roots in the top soil until the transition depth. Below the transition depth and in the subsoil layer, there are no S-type laterals (zero probability), but only L-type laterals emerging from the nodal roots. The lines for SubP-FC and PlusP-FC overlap on the figure. This is described by Equation 7, Supplementary Text S2.

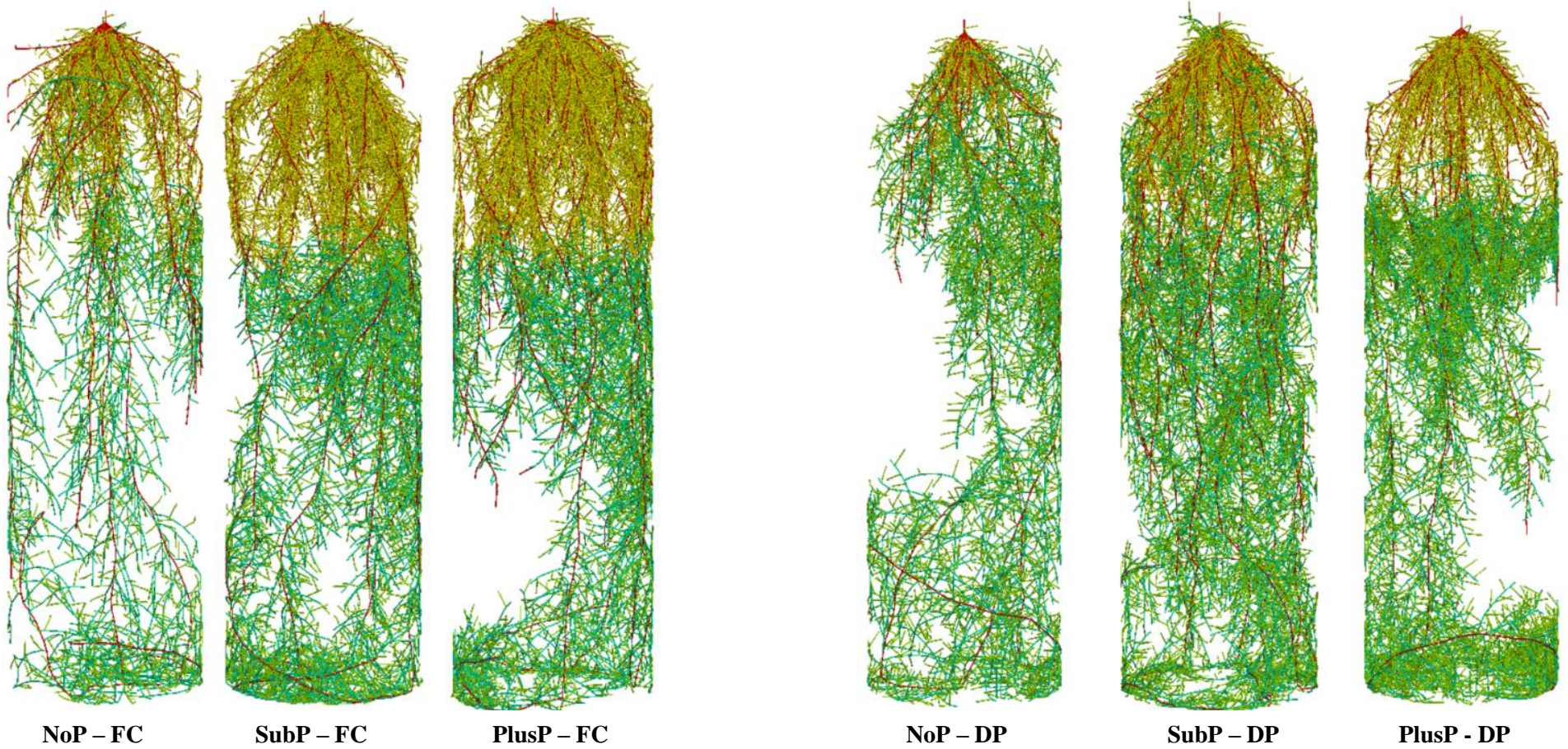| NoP – FC | SubP – FC | PlusP – FC | NoP – DP | SubP – DP | PlusP - DP |

Figure S*6: The simulated root systems from CRootBox showing the different root types (nodal roots = red; S-type roots = yellow; L-type roots = green) and the corresponding emergence.
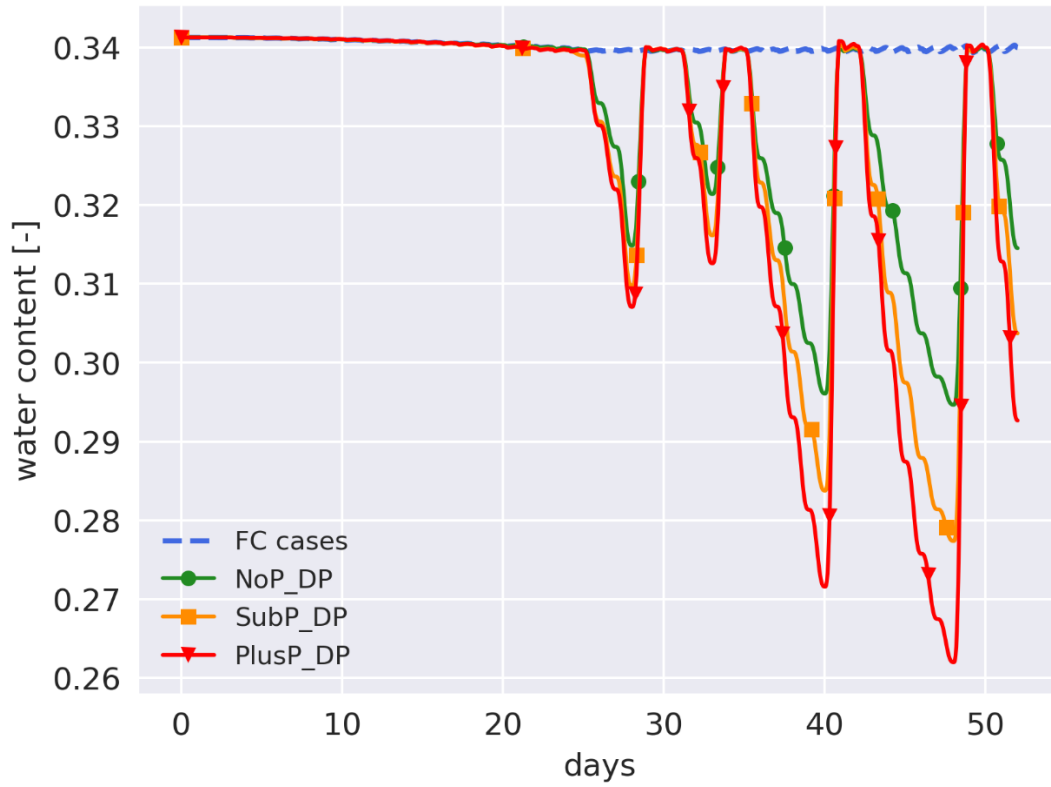
Figure S*7: The dynamics of the water content (cm^3 cm^{-3}) in the soil during the simulation period.
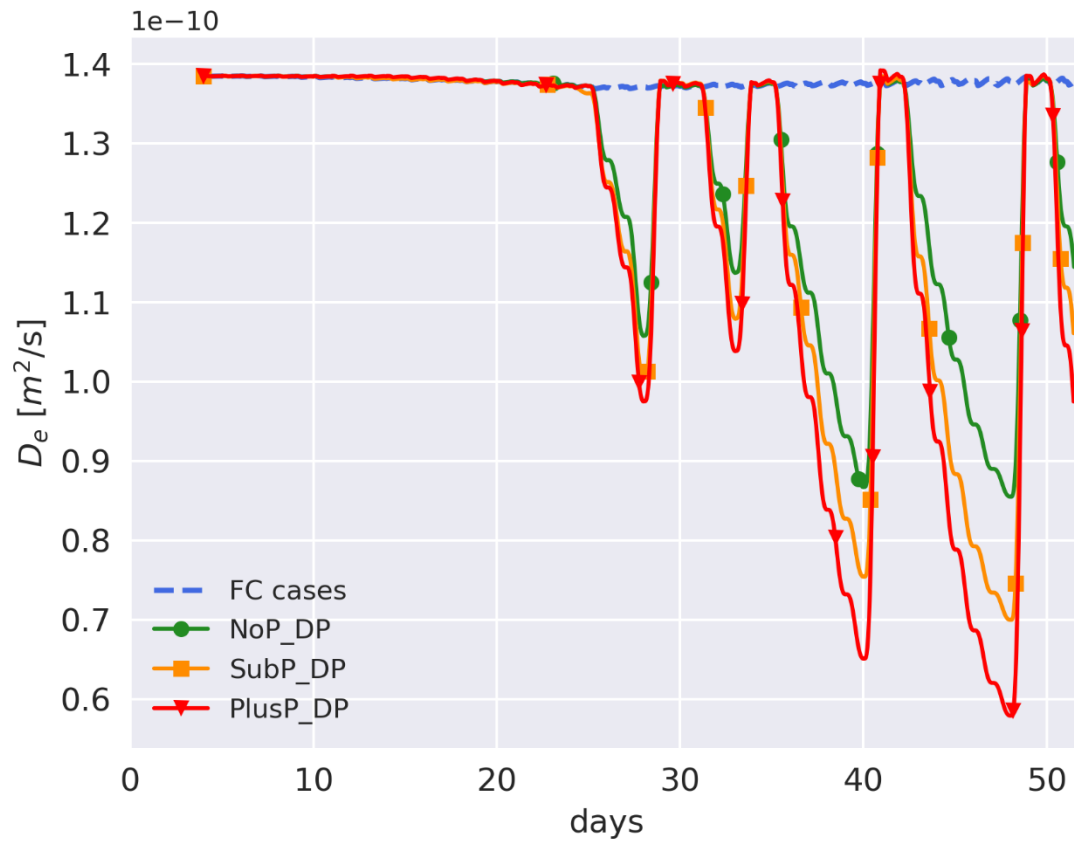

Figure S*8: The effective P diffusion coefficient (m²s^{-1}) at the root surface (extracted from rhizosphere models). Under DP, the diffusion coefficient clearly drops during drying.
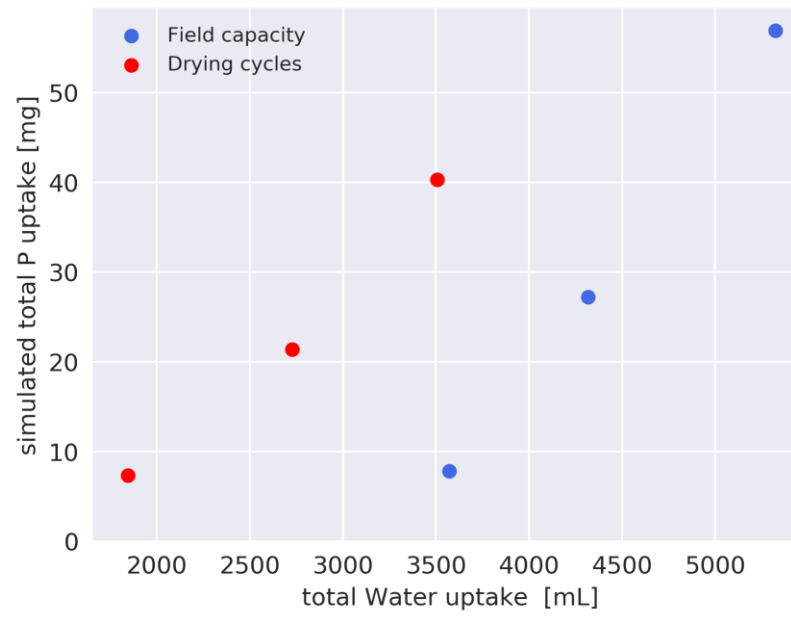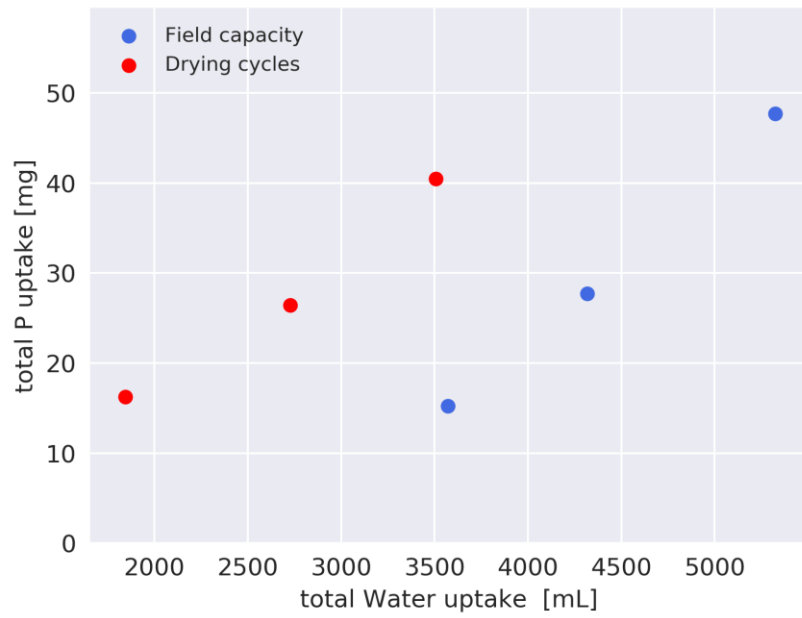
Figure S*9: The relation between water uptake and the measured (left) and simulated (right) P uptake for each scenario.
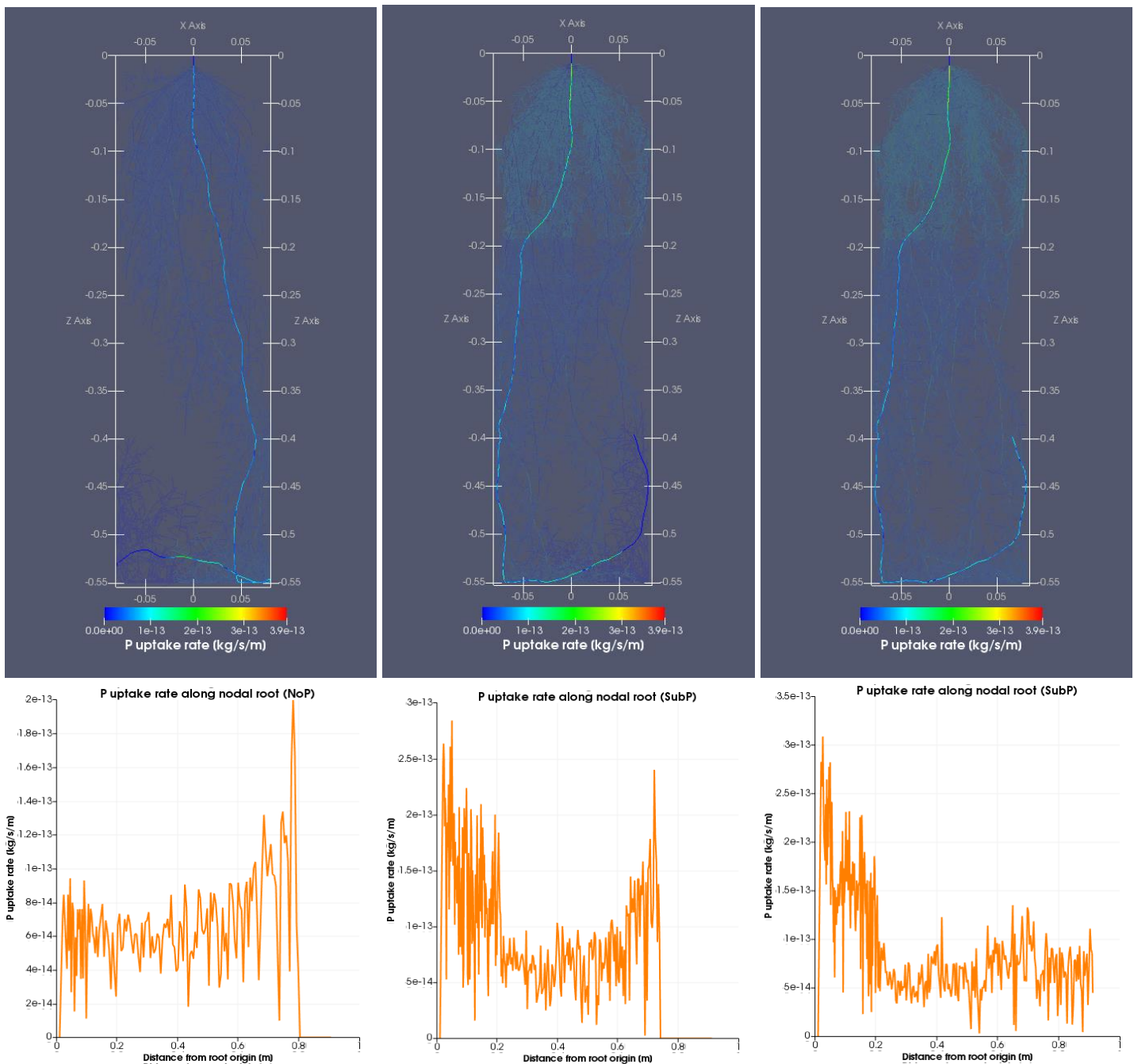
Figure S*10: The simulated P uptake rate along a nodal root (kg s^{-1} m^{-1}) versus the distance from the root origin for (i) a growing root under NoP conditions (Left), (ii) a growing root under SubP conditions (Middle); (iii) a non-growing root under SubP conditions (Right) Note that the dark blue extensions with zero uptake beyond the root tips of the growing roots in (i) and (ii) represent the final extent of the root at the end of the simulation, i.e. to be developed at the moment of presentation.
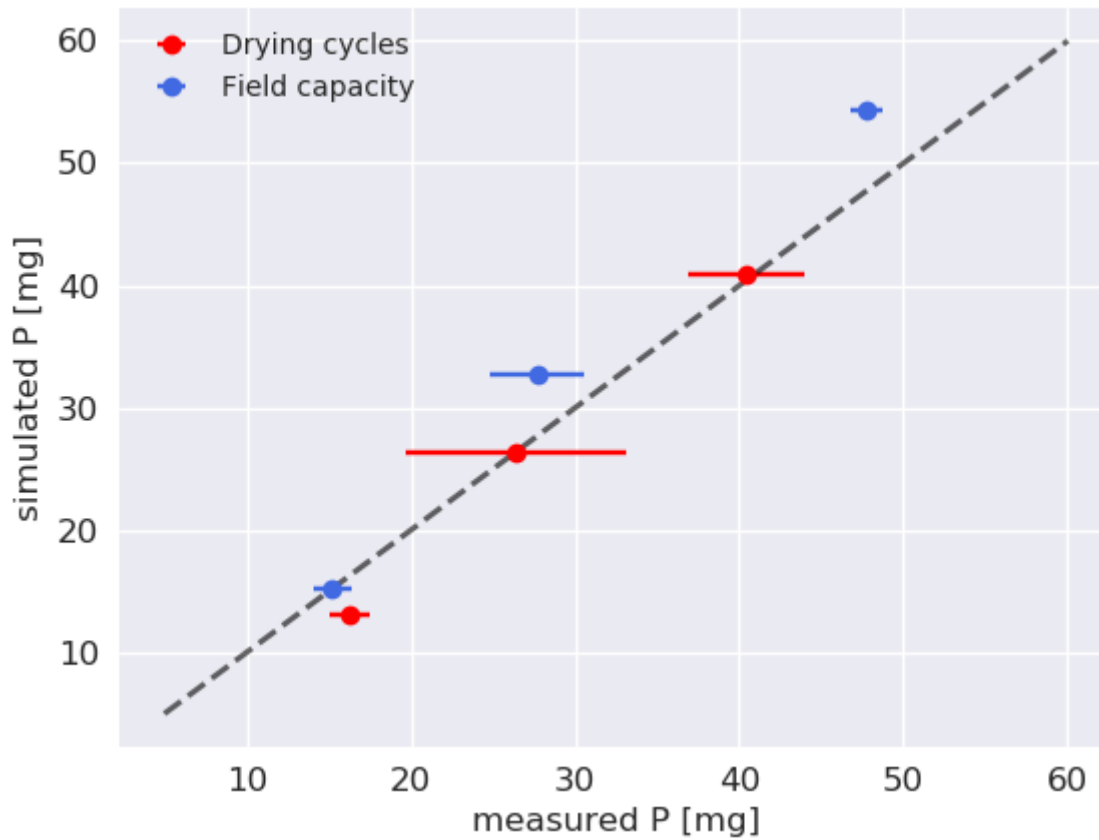
Figure S*11: The re-simulated P uptake per plant versus the measured P uptake per plant in the lab experiment (including the standard error from the mean) by using a small Km (1.55E-05 kg m^{-3}) and a small Vmax (1.84E-10 kg m^{-2} s^{-1}). The measured value of total P uptake was calculated for the dry shoot and dry root mass after measuring shoot P concentration, and assuming an equal P concentration in the root. Rice root systems were grown and simulated on a P deficient soil with three P treatments in the topsoil (No P amendment (NoP), a suboptimal rate (SubP), and a non-limiting rate (PlusP)) and two water regimes (Field Capacity (FC) and Drying Periods (DP)).

Figure S*12: Depletion radii in the rhizospheres (Top) and the P uptake rates of root segments in the rhizospheres (Bottom) for each scenario during the simulation period of 52 days. The center line represents the mean value, while different color shades represent the 25-75 percentiles (interquartile range) and the 5-95 percentiles of the root segment uptake rates.
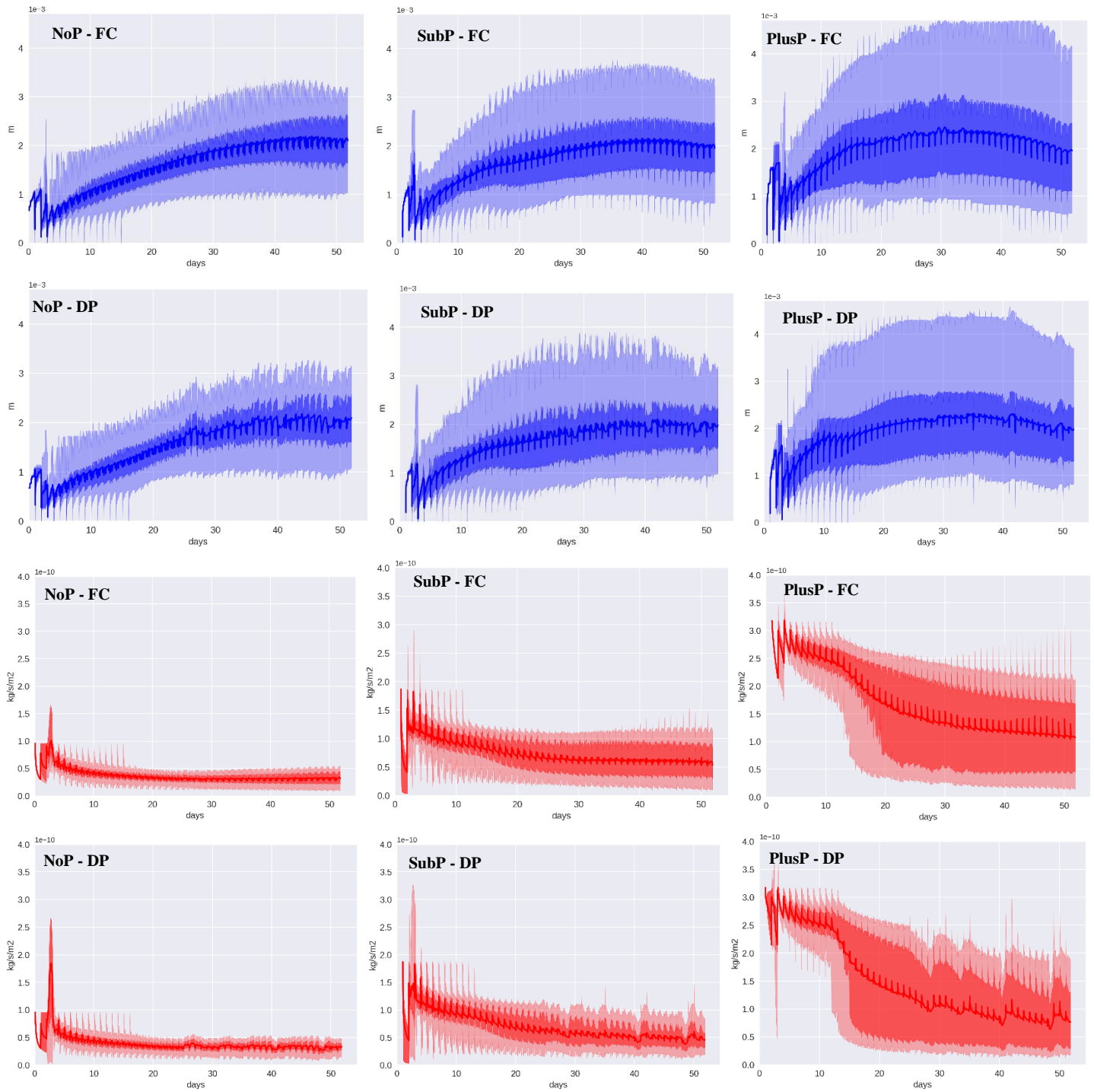
Table S1: Daily irrigation rate [ml/day] per treatment. For the drying periods, five drying intervals were included from the 25th - 27th; 31st - 32nd; 35th - 39th; 42nd - 47th and 50th - 51st day.

			Irrigation rate [ml/day]			
Day	NoP-DP	NoP_FC	SubP-DP	SubP-FC	PlusP-DP	PlusP-FC
1	71.7	71.7	71.7	71.7	71.7	71.7
2	111.2	111.2	111.0	111.0	110.8	110.8
3	71.2	71.2	70.7	70.7	70.3	70.3
4	63.7	63.7	62.9	62.9	62.4	62.4
5	61.1	61.1	60.1	60.1	59.4	59.4
6	72.4	72.4	71.1	71.1	70.2	70.2
7	86.1	86.1	84.6	84.6	83.5	83.5
8	79.6	79.6	79.0	79.0	77.7	77.7
9	126.1	126.1	126.3	126.3	124.9	124.9
10	89.7	89.7	90.7	90.7	89.2	89.2
11	75.7	75.7	77.6	77.6	75.9	75.9
12	73.5	73.5	76.2	76.2	74.3	74.3
13	127.9	127.9	131.5	131.5	129.4	129.4
14	81.4	81.4	85.9	85.9	83.7	83.7
15	106.6	106.6	111.9	111.9	111.3	111.3
16	76.0	76.0	82.2	82.2	83.2	83.2
17	58.8	58.8	65.8	65.8	68.3	68.3
18	54.0	54.0	61.8	61.8	66.0	66.0
19	90.9	90.9	99.6	99.6	105.3	105.3
20	69.4	69.4	79.0	79.0	86.3	86.3
21	58.0	58.0	68.4	68.4	77.3	77.3
22	77.2	77.2	87.2	87.2	95.8	95.8
23	88.1	88.1	97.7	97.7	106.0	106.0
24	69.0	69.0	69.0	78.2	86.2	86.2
25	0.0	96.6	0.0	105.3	0.0	113.0
26	0.0	88.4	0.0	96.6	0.0	104.0
27	0.0	175.1	0.0	182.9	0.0	190.0
28	377.5	117.7	447.6	125.1	488.5	131.8
29	95.1	95.1	106.8	106.8	115.0	115.0
30	91.8	91.8	107.6	107.6	117.3	117.3
31	0.0	131.7	0.0	151.8	0.0	163.0
32	0.0	141.5	0.0	160.9	0.0	176.4
33	292.7	108.7	371.1	127.6	431.8	147.2
34	130.9	130.9	149.3	149.3	173.1	173.1
35	0.0	192.3	0.0	210.1	0.0	238.1
36	0.0	132.3	0.0	156.5	0.0	185.8
37	0.0	166.4	0.0	197.1	0.0	227.7
38	0.0	162.2	0.0	199.3	0.0	231.2
39	0.0	166.3	0.0	204.3	0.0	237.1
40	560.5	156.2	724.5	195.2	891.9	228.8
41	125.9	137.0	176.8	176.8	211.3	211.3
42	0.0	183.1	0.0	223.9	0.0	259.2
43	0.0	185.4	0.0	225.1	0.0	265.7
44	0.0	198.7	0.0	237.3	0.0	283.2
45	0.0	214.3	0.0	251.7	0.0	303.0
46	0.0	214.4	0.0	250.7	0.0	307.2
47	0.0	213.0	0.0	243.9	0.0	308.2
48	577.6	232.8	791.0	258.3	995.7	330.4

49	225.5	247.7	267.8	267.8	317.0	347.7
50	0.0	257.6	0.0	272.2	0.0	359.9
51	0.0	267.5	0.0	276.6	0.0	372.2