

*Supplementary Materials*

# Breeding milestones correspond with changes to wheat rhizosphere biogeochemistry that affect P acquisition

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**Table S1.** Initial physicochemical properties of Crider silt soil.

% Sand	6.27
% Silt	82.88
% Clay	10.85
Soil Texture	silt
KCl pH	4.46
Meh-III P (mg kg <sup>-1</sup> )	6.0
Resin-Inorganic P (mg kg <sup>-1</sup> )	8.86
Bicarbonate-Inorganic P (mg kg <sup>-1</sup> )	15.82
Meh-III K (mg kg <sup>-1</sup> )	94.0
Meh-III Ca (mg kg <sup>-1</sup> )	1024
Meh-III Mg (mg kg <sup>-1</sup> )	126
Meh-III Zn (mg kg <sup>-1</sup> )	1.35
Meh-III Cu (mg kg <sup>-1</sup> )	1.16
Meh-III Mn (mg kg <sup>-1</sup> )	134
Meh-III Fe (mg kg <sup>-1</sup> )	215
Meh-III Al (mg kg <sup>-1</sup> )	731
Total N (%)	0.169
Total C (%)	1.992
Cation Exchange Capacity (meq 100 g <sup>-1</sup> )	13.40
Base Saturation (%)	53.17
Exchangeable K (meq 100 g <sup>-1</sup> )	0.30
Exchangeable Ca (meq 100 g <sup>-1</sup> )	5.73
Exchangeable Mg (meq 100 g <sup>-1</sup> )	1.07
Exchangeable Na (meq 100 g <sup>-1</sup> )	0.03

**Table S2.** Complete statistical results of two-way ANOVA for explanatory parameters informing P utilization efficiency (PUE) and root P acquisition efficiency (RPAE) by dwarfing status and era of release under sufficient and insufficient soil P.

	Sufficient P				Insufficient P			
	Dwarfing Status		Era		Dwarfing Status		Era	
	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value
Plant Growth Metrics								
Growth Stage	0.53	0.4702	3.01	0.0892	<b>4.29</b>	<b>0.0440</b>	<b>11.8</b>	<b>0.0017</b>
Main Stem Height	<b>12.53</b>	<b>0.0009</b>	0.50	0.4810	<b>8.85</b>	<b>0.0047</b>	1.77	0.1902
Number of Tillers	1.78	0.1886	1.31	0.2586	0.06	0.8061	2.99	0.0907
Number of Heads	0.06	0.8085	3.72	0.0601	1.49	0.2286	<b>5.86</b>	<b>0.0196</b>
Shoot Mass	<b>5.70</b>	<b>0.0212</b>	0.20	0.6562	1.15	0.2894	0.96	0.3327
Root Mass	0.91	0.3451	1.67	0.2034	0.24	0.6259	0.87	0.3556
Root:Shoot Ratio	1.10	0.2994	3.97	0.0525	0.00	0.9961	0.44	0.5089
Nutrient Concentrations (mg kg <sup>-1</sup> )								
Shoot Ca	0.20	0.6536	0.25	0.6216	1.78	0.1867	0.03	0.8600
Shoot K	0.15	0.6970	2.58	0.1151	<b>4.59</b>	<b>0.0374</b>	<b>5.52</b>	<b>0.0231</b>
Shoot Al	0.16	0.6901	0.64	0.4263	0.83	0.3679	0.52	0.4729
Shoot Fe	0.00	0.9751	0.40	0.5327	0.37	0.5477	1.15	0.2898
Shoot Mg	0.96	0.3322	<b>12.82</b>	<b>0.0008</b>	<b>5.76</b>	<b>0.0205</b>	<b>6.41</b>	<b>0.0148</b>
Shoot Mn	0.63	0.4297	1.38	0.2465	0.27	0.6061	1.80	0.1867
Shoot P	<b>11.27</b>	<b>0.0016</b>	0.01	0.9275	<b>11.62</b>	<b>0.0014</b>	2.58	0.1147
Root Ca	2.52	0.1201	0.00	0.9658	1.77	0.1906	0.05	0.8327

Root K	0.15	0.7934	0.02	0.8808	0.22	0.6377	1.29	0.2627
Sufficient P					Insufficient P			
Dwarfing Status		Era			Dwarfing Status		Era	
	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value
Nutrient Concentrations (mg kg <sup>-1</sup> ), Continued								
Root Al	<b>4.87</b>	<b>0.0328</b>	2.93	0.0940	0.65	0.4228	0.09	0.7675
Root Fe	<b>5.57</b>	<b>0.0229</b>	<b>4.75</b>	<b>0.0349</b>	0.54	0.4663	0.00	0.9905
Root Mg	2.15	0.1495	0.03	0.8751	0.02	0.8857	0.81	0.3734
Root Mn	1.38	0.2471	0.00	0.9814	1.14	0.2912	0.16	0.6937
Root P	1.58	0.2152	0.59	0.4466	0.41	0.5245	0.04	0.8446
Total Nutrient Content (mg)								
Shoot Ca	<b>7.39</b>	<b>0.0092</b>	0.00	0.9795	2.76	0.1037	1.42	0.2402
Shoot K	<b>5.85</b>	<b>0.0195</b>	0.09	0.7674	2.77	0.1029	3.26	0.0776
Shoot Al	<b>4.60</b>	<b>0.0373</b>	0.45	0.5037	3.28	0.0767	0.67	0.4156
Shoot Fe	<b>7.67</b>	<b>0.0081</b>	0.61	0.4398	3.09	0.0853	<b>5.29</b>	<b>0.0261</b>
Shoot Mg	<b>4.41</b>	<b>0.0413</b>	0.67	0.4165	0.30	0.5847	3.06	0.0867
Shoot Mn	<b>4.62</b>	<b>0.0370</b>	0.03	0.8585	0.92	0.3417	2.27	0.1391
Shoot P	1.34	0.2531	0.17	0.6860	0.53	0.4686	0.00	0.9699
Root Ca	0.72	0.4014	1.65	0.2063	1.15	0.2900	0.30	0.5853
Root K	0.81	0.3718	2.55	0.1176	0.09	7.598	<b>4.34</b>	<b>0.0428</b>
Root Al	0.00	0.9829	2.18	0.1473	1.10	0.2990	0.38	0.5420
Root Fe	0.52	0.4762	0.78	0.3814	0.73	0.3988	0.95	0.3353
Root Mg	1.48	0.2298	0.35	0.5567	0.27	0.6031	0.03	0.8556

	Sufficient P				Insufficient P			
	Dwarfing Status		Era		Dwarfing Status		Era	
	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value
Total Nutrient Content (mg), Continued								
Root Mn	1.66	0.2043	0.01	0.9118	0.39	0.5349	0.02	0.8927
Root P	1.30	0.2606	0.43	0.5146	0.33	0.5687	0.95	0.3350
Bulk Soil Chemical Parameters								
pH	0.05	0.8271	0.02	0.8863	0.09	0.7617	0.02	0.8943
P	<b>5.17</b>	<b>0.0278</b>	0.01	0.9223	1.45	0.2344	1.86	0.1798
K	<b>7.64</b>	<b>0.0082</b>	0.96	0.3317	1.06	0.3087	1.91	0.1734
Ca	0.68	0.4128	0.07	0.7991	0.24	0.6298	0.02	0.8826
Mg	0.01	0.7535	0.91	0.3442	<b>4.21</b>	<b>0.0460</b>	0.06	0.8071
Zn	3.12	0.0843	0.10	0.7504	0.78	0.3822	0.27	0.6062
Cu	0.58	0.4500	2.83	0.0994	<b>4.29</b>	<b>0.0441</b>	0.02	0.8938
Fe	0.81	0.3726	2.28	0.1383	0.88	0.3532	1.95	0.1691
Mn	1.19	0.2817	<b>10.83</b>	<b>0.0019</b>	0.06	0.8070	2.93	0.0939
Al	0.22	0.6408	0.62	0.4361	1.66	0.2040	2.49	0.1213
Total N	1.74	0.1941	0.00	0.9947	1.27	0.2663	1.10	0.2988
Total C	0.03	0.8655	0.66	0.4213	0.66	0.4190	2.16	0.1480
Rhizosphere Soil Inorganic P Fractions								
Resin P	0.13	0.7251	0.02	0.8798	0.51	0.4798	<b>5.42</b>	<b>0.0243</b>
Bicarbonate P	0.44	0.5093	0.15	0.7009	<b>6.48</b>	<b>0.0143</b>	0.04	0.8452

	Sufficient P				Insufficient P			
	Dwarfing Sta- tus	Era	Dwarfing Sta- tus	Era	Dwarfing Sta- tus	Era	Dwarfing Sta- tus	Era
	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value	<i>F</i> -value	<i>p</i> -value
Rhizosphere Soil Microbial Biomass								
Total Biomass	3.08	0.0859	2.68	0.1082	0.37	0.5467	1.14	0.2916
G+ Bacteria	<b>10.90</b>	<b>0.0019</b>	0.13	0.7222	<b>5.05</b>	<b>0.0295</b>	0.06	0.8035
G- Bacteria	0.08	0.7735	<b>7.09</b>	<b>0.0106</b>	0.09	0.7892	2.48	0.1218
General Fungi	0.06	0.8040	0.04	0.8345	0.67	0.4160	1.02	0.3178
AMF	2.39	0.1287	2.94	0.0934	0.71	0.4045	0.39	0.5371
Actinobacteria	2.76	0.1035	<b>6.51</b>	<b>0.0141</b>	0.19	0.6634	3.43	0.0706
Protists	<b>5.43</b>	<b>0.0242</b>	1.63	0.2083	<b>6.96</b>	<b>0.0113</b>	0.09	0.7694

**Table S3.** Average (least squares means  $\pm$  one standard error) growth metrics and tissue nutrient concentration by cultivar dwarfing status. Parameters not sharing the same uppercase (sufficient P) or lowercase (insufficient P) letter are significantly different (Tukey's HSD,  $p < 0.05$ ).

	Sufficient P		Insufficient P	
	Wild type	Semi-dwarf	Wild type	Semi-dwarf
Plant Growth Metrics				
Growth Stage	10.5 A	10.5 A	10.5 b	11 a
Main Stem Height (cm)	59 $\pm$ 2 A	47 $\pm$ 3 B	52 $\pm$ 2 a	44 $\pm$ 3 b
Number of Tillers	2.7 $\pm$ 0.2 A	2.2 $\pm$ 0.3 A	1.8 $\pm$ 0.3 a	1.9 $\pm$ 0.3 a
Number of Heads	1.5 $\pm$ 0.1 A	1.5 $\pm$ 0.2 A	0.86 $\pm$ 0.05 a	0.95 $\pm$ 0.06 a
Shoot Mass (g)	1.3 $\pm$ 0.1 A	0.9 $\pm$ 0.1 B	0.47 $\pm$ 0.05 a	0.41 $\pm$ 0.06 a
Root Mass (g)	0.34 $\pm$ 0.05 A	0.26 $\pm$ 0.07 A	0.110 $\pm$ 0.009 a	0.10 $\pm$ 0.01 a
Root: Shoot Ratio (g g <sup>-1</sup> )	0.26 $\pm$ 0.04 A	0.32 $\pm$ 3 A	0.26 $\pm$ 0.06 a	0.26 $\pm$ 0.07 a
Tissue Nutrient Concentration (mg g <sup>-1</sup> tissue)				
Shoot P	1.2 $\pm$ 0.1 B	1.7 $\pm$ 0.2 A	1.51 $\pm$ 0.08 b	2.0 $\pm$ 0.1 a
Shoot K	25 $\pm$ 1 A	26 $\pm$ 1 A	25.9 $\pm$ 0.7 a	23.3 $\pm$ 0.9 b
Shoot Ca	4.9 $\pm$ 0.2 A	4.7 $\pm$ 0.3 A	7.3 $\pm$ 0.4 a	6.4 $\pm$ 0.5 a
Shoot Mg	1.15 $\pm$ 0.04 A	1.22 $\pm$ 0.05 A	1.32 $\pm$ 0.04 b	1.46 $\pm$ 0.05 a
Shoot Mn	0.117 $\pm$ 0.006 A	0.126 $\pm$ 0.008 A	0.123 $\pm$ 0.009 a	0.13 $\pm$ 0.01 a
Shoot Fe	0.107 $\pm$ 0.008 A	0.11 $\pm$ 0.01 A	0.17 $\pm$ 0.01 a	0.16 $\pm$ 0.02 a
Shoot Al	0.042 $\pm$ 0.006 A	0.045 $\pm$ 0.007 A	0.053 $\pm$ 0.005 a	0.047 $\pm$ 0.007 a
Root P	0.7 $\pm$ 0.1 A	0.9 $\pm$ 0.1 A	1.3 $\pm$ 0.2 a	1.4 $\pm$ 0.2 a
Root K	2.8 $\pm$ 0.8 A	2.5 $\pm$ 0.9 A	4.8 $\pm$ 0.6 a	5.0 $\pm$ 0.7 a
Root Ca	5.3 $\pm$ 0.7 A	7.0 $\pm$ 0.9 A	12 $\pm$ 2 a	14 $\pm$ 2 a
Root Mg	0.95 $\pm$ 0.07 A	1.12 $\pm$ 0.09 A	1.4 $\pm$ 0.2 a	1.4 $\pm$ 0.2 a
Root Mn	0.6 $\pm$ 0.1 A	0.7 $\pm$ 0.2 A	0.9 $\pm$ 0.1 a	1.1 $\pm$ 0.2 a
Root Fe	8.1 $\pm$ 0.9 B	12 $\pm$ 1 A	6.9 $\pm$ 0.7 a	6.1 $\pm$ 0.8 a
Root Al	5.3 $\pm$ 0.5 B	7.1 $\pm$ 0.7 A	4.6 $\pm$ 0.5 a	4.0 $\pm$ 0.6 a

**Table S4.** Average (least squares means  $\pm$  one standard error) growth metrics and tissue nutrient concentration by cultivar age class. Parameters not sharing the same uppercase (sufficient P) or lowercase (insufficient P) letter are significantly different (Tukey's HSD,  $p < 0.05$ ).

	Sufficient P		Insufficient P	
	Old	Modern	Old	Modern
Plant Growth Metrics				
Growth Stage	10.5 A	10.5 A	10.5 b	11 a
Main Stem Height (cm)	52 $\pm$ 3 A	55 $\pm$ 2 A	49 $\pm$ 3 a	46 $\pm$ 2 a
Number of Tillers	2.6 $\pm$ 0.3 A	2.2 $\pm$ 0.2 A	2.1 $\pm$ 0.3 a	1.6 $\pm$ 0.3 a
Number of Heads	1.3 $\pm$ 0.2 A	1.7 $\pm$ 0.1 A	0.81 $\pm$ 0.06 b	1.00 $\pm$ 0.05 a
Shoot Mass (g)	1.1 $\pm$ 0.1 A	1.1 $\pm$ 0.1 A	0.46 $\pm$ 0.06 a	0.41 $\pm$ 0.05 a
Root Mass (g)	0.36 $\pm$ 0.07 A	0.24 $\pm$ 0.05 A	0.11 $\pm$ 0.01 a	0.100 $\pm$ 0.009 a
Root:Shoot Ratio (g g <sup>-1</sup> )	0.35 $\pm$ 0.05 A	0.23 $\pm$ 0.04 A	0.24 $\pm$ 0.07 a	0.28 $\pm$ 0.06 a
Tissue Nutrient Concentration (mg g <sup>-1</sup> )				
Shoot P	1.5 $\pm$ 0.2 A	1.4 $\pm$ 0.1 A	1.6 $\pm$ 0.1 a	1.86 $\pm$ 0.08 a
Shoot K	27 $\pm$ 1 A	25 $\pm$ 1 A	26.0 $\pm$ 0.9 a	23.2 $\pm$ 0.7 b
Shoot Ca	4.9 $\pm$ 0.3 A	4.7 $\pm$ 0.2 A	6.9 $\pm$ 0.5 a	6.8 $\pm$ 0.4 a
Shoot Mg	1.31 $\pm$ 0.05 A	1.06 $\pm$ 0.04 B	1.46 $\pm$ 0.05 a	1.32 $\pm$ 0.04 b
Shoot Mn	0.128 $\pm$ 0.008 A	0.115 $\pm$ 0.006 A	0.13 $\pm$ 0.01 a	0.118 $\pm$ 0.008 a
Shoot Fe	0.11 $\pm$ 0.01 A	0.103 $\pm$ 0.008 A	0.17 $\pm$ 0.02 a	0.15 $\pm$ 0.01 a
Shoot Al	0.047 $\pm$ 0.007 A	0.041 $\pm$ 0.006 A	0.053 $\pm$ 0.007 a	0.047 $\pm$ 0.005 a
Root P	0.9 $\pm$ 0.1 A	0.8 $\pm$ 0.1 A	1.4 $\pm$ 0.2 a	1.4 $\pm$ 0.2 a
Root K	2.6 $\pm$ 0.9 A	2.7 $\pm$ 0.8 A	5.2 $\pm$ 0.7 a	4.6 $\pm$ 0.6 a
Root Ca	6.1 $\pm$ 0.8 A	6.2 $\pm$ 0.7 A	13 $\pm$ 2 a	13 $\pm$ 2 a
Root Mg	1.04 $\pm$ 0.09 A	1.03 $\pm$ 0.07 A	1.3 $\pm$ 0.2 a	1.5 $\pm$ 0.2 a
Root Mn	0.6 $\pm$ 0.2 A	0.6 $\pm$ 0.1 A	1.0 $\pm$ 0.2 a	1.0 $\pm$ 0.1 a
Root Fe	12 $\pm$ 1 A	8 $\pm$ 1 B	6.5 $\pm$ 0.8 a	6.5 $\pm$ 0.7 a
Root Al	6.9 $\pm$ 0.6 A	5.5 $\pm$ 0.5 A	4.2 $\pm$ 0.6 a	4.4 $\pm$ 0.5 a

**Table S5.** Average total nutrient removals per plant component (least squares means  $\pm$  one standard error) by cultivar dwarfing status. Parameters not sharing the same uppercase (sufficient P) or lowercase (insufficient P) letter are significantly different (Tukey's HSD,  $p < 0.05$ ).

Total Nutrient (mg)	Sufficient P		Insufficient P	
	Wild type	Semi-dwarf	Wild type	Semi-dwarf
Shoot P	1.7 $\pm$ 0.1 A	1.5 $\pm$ 0.2 A	0.64 $\pm$ 0.07 a	0.72 $\pm$ 0.09 a
Shoot K	34 $\pm$ 3 A	24 $\pm$ 3 B	12 $\pm$ 1 a	10 $\pm$ 2 a
Shoot Ca	6.1 $\pm$ 0.5 A	4.1 $\pm$ 0.6 B	3.4 $\pm$ 0.4 a	2.7 $\pm$ 0.4 a
Shoot Mg	1.5 $\pm$ 0.1 A	1.1 $\pm$ 0.2 B	0.59 $\pm$ 0.06 a	0.55 $\pm$ 0.07 a
Shoot Mn	0.15 $\pm$ 0.01 A	0.11 $\pm$ 0.01 B	0.053 $\pm$ 0.005 a	0.046 $\pm$ 0.006 a
Shoot Fe	0.14 $\pm$ 0.01 A	0.10 $\pm$ 0.02 B	0.070 $\pm$ 0.005 a	0.055 $\pm$ 0.007 a
Shoot Al	0.060 $\pm$ 0.008 A	0.045 $\pm$ 0.008 B	0.021 $\pm$ 0.002 a	0.016 $\pm$ 0.002 a
Root P	1.6 $\pm$ 0.4 A	0.8 $\pm$ 0.5 A	0.096 $\pm$ 0.008 a	0.10 $\pm$ 0.01 a
Root K	0.59 $\pm$ 0.09 A	0.5 $\pm$ 0.1 A	0.35 $\pm$ 0.03 a	0.37 $\pm$ 0.04 a
Root Ca	1.5 $\pm$ 0.2 A	1.2 $\pm$ 0.3 A	0.8 $\pm$ 0.1 a	1.0 $\pm$ 0.1 a
Root Mg	1.1 $\pm$ 0.2 A	0.6 $\pm$ 0.3 A	0.103 $\pm$ 0.008 a	0.10 $\pm$ 0.01 a
Root Mn	2.7 $\pm$ 0.8 A	0.9 $\pm$ 1 A	0.071 $\pm$ 0.008 a	0.079 $\pm$ 0.001 a
Root Fe	3.3 $\pm$ 0.7 A	2.5 $\pm$ 0.9 A	0.71 $\pm$ 0.09 a	0.6 $\pm$ 0.1 a
Root Al	1.5 $\pm$ 0.3 A	1.5 $\pm$ 0.4 A	0.44 $\pm$ 0.05 a	0.36 $\pm$ 0.06 a

**Table S6.** Average total nutrient removals per plant component (least squares means  $\pm$  one standard error) by cultivar age classification. Parameters not sharing the same uppercase (sufficient P) or lowercase (insufficient P) letter are significantly different (Tukey's HSD,  $p < 0.05$ ).

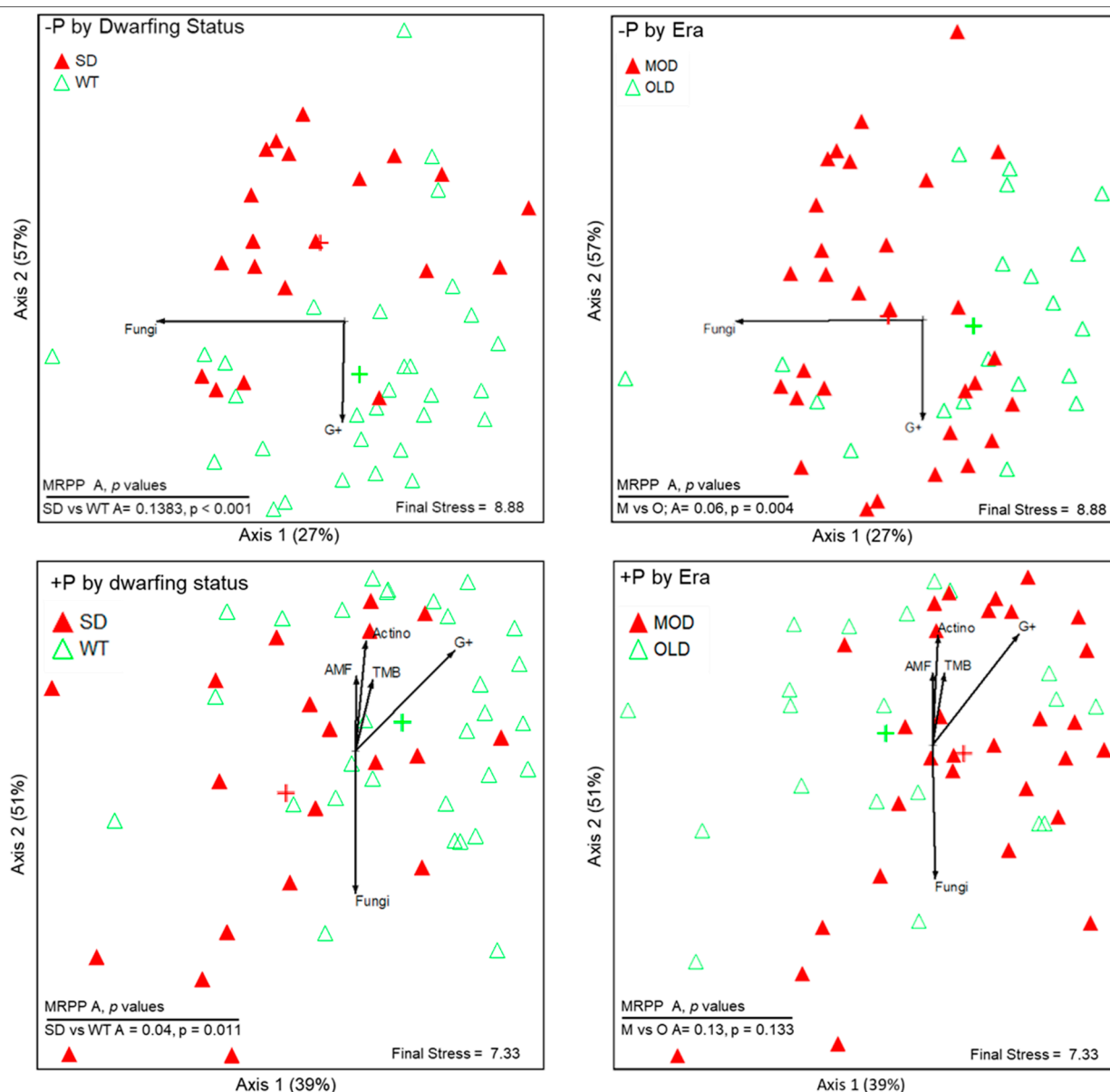
Total Nutrient (mg)	Sufficient P		Insufficient P	
	Old	Modern	Old	Modern
Shoot P	1.6 $\pm$ 0.2 A	1.6 $\pm$ 0.1 A	0.67 $\pm$ 0.09 a	0.68 $\pm$ 0.07 a
Shoot K	29 $\pm$ 3 A	28 $\pm$ 3 A	12 $\pm$ 2 a	9 $\pm$ 1 a
Shoot Ca	5.1 $\pm$ 0.6 A	5.1 $\pm$ 0.5 A	3.3 $\pm$ 0.4 a	2.8 $\pm$ 0.4 a
Shoot Mg	1.4 $\pm$ 0.2 A	1.2 $\pm$ 0.1 A	0.63 $\pm$ 0.07 a	0.51 $\pm$ 0.06 a
Shoot Mn	0.13 $\pm$ 0.02 A	0.12 $\pm$ 0.01 A	0.055 $\pm$ 0.006 a	0.044 $\pm$ 0.005 a
Shoot Fe	0.13 $\pm$ 0.02 A	0.13 $\pm$ 0.01 A	0.072 $\pm$ 0.007 a	0.053 $\pm$ 0.005 b
Shoot Al	0.055 $\pm$ 0.008 A	0.050 $\pm$ 0.008 A	0.020 $\pm$ 0.002 a	0.017 $\pm$ 0.001 a
Root P	1.4 $\pm$ 0.5 A	1.0 $\pm$ 0.4 A	0.11 $\pm$ 0.01 a	0.093 $\pm$ 0.008 a
Root K	0.6 $\pm$ 0.1 A	0.41 $\pm$ 0.09 A	0.41 $\pm$ 0.04 a	0.31 $\pm$ 0.03 b
Root Ca	1.6 $\pm$ 0.3 A	1.2 $\pm$ 0.2 A	1.0 $\pm$ 0.1 a	0.9 $\pm$ 0.1 a
Root Mg	0.9 $\pm$ 0.3 A	0.7 $\pm$ 0.2 A	0.10 $\pm$ 0.01 a	0.101 $\pm$ 0.008 a
Root Mn	2 $\pm$ 1 A	1.7 $\pm$ 0.8 A	0.08 $\pm$ 0.01 a	0.074 $\pm$ 0.008 a
Root Fe	3.4 $\pm$ 0.9 A	2.4 $\pm$ 0.7 A	0.7 $\pm$ 0.1 a	0.6 $\pm$ 0.09 a
Root Al	1.9 $\pm$ 0.4 A	1.1 $\pm$ 0.3 A	0.42 $\pm$ 0.06 a	0.37 $\pm$ 0.05 a

**Table S7.** Average (least squares means  $\pm$  one standard error) soil physicochemical data and microbial group concentration by cultivar dwarfing status. Parameters not sharing the same uppercase (sufficient P) or lowercase (insufficient P) letter are significantly different (Tukey's HSD,  $p < 0.05$ ).

	Sufficient P		Insufficient P	
	Wild type	Semi-dwarf	Wild type	Semi-dwarf
Bulk Soil Physicochemical Variables				
pH	4.77 $\pm$ 0.08 A	4.79 $\pm$ 0.1 A	4.87 $\pm$ 0.08 a	4.8 $\pm$ 0.1 a
P (mg kg <sup>-1</sup> )	5.7 $\pm$ 0.4 A	4.2 $\pm$ 0.5 B	6.1 $\pm$ 0.2 a	5.8 $\pm$ 0.2 a
K (mg kg <sup>-1</sup> )	55 $\pm$ 2 B	66 $\pm$ 3 A	87 $\pm$ 2 a	85 $\pm$ 3 a
Ca (mg kg <sup>-1</sup> )	1432 $\pm$ 48 A	1498 $\pm$ 64 A	1525 $\pm$ 47 a	1487 $\pm$ 61 a
Mg (mg kg <sup>-1</sup> )	117 $\pm$ 2 A	118 $\pm$ 3 A	119 $\pm$ 1 a	114 $\pm$ 2 b
Mn (mg kg <sup>-1</sup> )	150 $\pm$ 8 A	142 $\pm$ 9 A	141 $\pm$ 7 a	143 $\pm$ 8 a
Fe (mg kg <sup>-1</sup> )	84 $\pm$ 5 A	77 $\pm$ 6 A	103 $\pm$ 6 a	97 $\pm$ 7 a
Al (mg kg <sup>-1</sup> )	716 $\pm$ 9 A	723 $\pm$ 11 A	762 $\pm$ 9 a	743 $\pm$ 11 a
Cu (mg kg <sup>-1</sup> )	2.9 $\pm$ 0.1 A	3.0 $\pm$ 0.1 A	2.9 $\pm$ 0.2 b	3.5 $\pm$ 0.2 a
Zn (mg kg <sup>-1</sup> )	1.41 $\pm$ 0.04 A	1.52 $\pm$ 0.05 A	1.29 $\pm$ 0.4 a	1.35 $\pm$ 0.5 a
Total N (%)	0.165 $\pm$ 0.002 A	0.169 $\pm$ 0.003 A	0.166 $\pm$ 0.001 a	0.163 $\pm$ 0.002 a
Total C (%)	1.72 $\pm$ 0.03 A	1.73 $\pm$ 0.03 A	1.76 $\pm$ 0.02 a	1.74 $\pm$ 0.03 a
Rhizosphere Hedley P Fractions (mg kg <sup>-1</sup> )				
Resin P	5.2 $\pm$ 0.4 A	5.5 $\pm$ 0.6 A	3.7 $\pm$ 0.3 a	3.3 $\pm$ 0.3 a
Bicarbonate P	12.8 $\pm$ 0.6 A	12.2 $\pm$ 0.7 A	11.2 $\pm$ 0.4 b	12.9 $\pm$ 0.5 a
Microbial Biomarker Concentration (nmol g <sup>-1</sup> )				
Total Biomass	42 $\pm$ 1 A	40 $\pm$ 1 A	40.5 $\pm$ 0.8 a	40 $\pm$ 1 a
G+ Bacteria	12.8 $\pm$ 0.4 A	11.3 $\pm$ 0.5 B	12.3 $\pm$ 0.3 a	11.2 $\pm$ 0.4 b
G- Bacteria	18.9 $\pm$ 0.5 A	18.8 $\pm$ 0.6 A	18.4 $\pm$ 0.4 a	18.6 $\pm$ 0.5 a
General Fungi	1.28 $\pm$ 0.06 A	1.25 $\pm$ 0.08 A	1.10 $\pm$ 0.06 a	1.18 $\pm$ 0.08 a
AMF	1.38 $\pm$ 0.05 A	1.30 $\pm$ 0.05 A	1.27 $\pm$ 0.06 a	1.32 $\pm$ 0.07 a
Actinobacteria	6.9 $\pm$ 0.2 A	6.6 $\pm$ 0.3 A	6.8 $\pm$ 0.2 a	6.7 $\pm$ 0.2 a
Protists	0.58 $\pm$ 0.02 B	0.67 $\pm$ 0.03 A	0.56 $\pm$ 0.02 b	0.63 $\pm$ 0.02 a

**Table S8.** Average (least squares means  $\pm$  one standard error) soil physicochemical data and microbial group concentration by cultivar age classification. Table 3. Parameters not sharing the same uppercase (sufficient P) or lowercase (insufficient P) letter are significantly different (Tukey's HSD,  $p < 0.05$ ).

	Sufficient P		Insufficient P	
	Old	Modern	Old	Modern
Bulk Soil Physicochemical				
pH	4.79 $\pm$ 0.1 A	4.77 $\pm$ 0.08 A	4.86 $\pm$ 0.1 a	4.85 $\pm$ 0.08 a
P (mg kg <sup>-1</sup> )	5.0 $\pm$ 0.5 A	4.9 $\pm$ 0.4 A	5.8 $\pm$ 0.2 a	6.1 $\pm$ 0.2 a
K (mg kg <sup>-1</sup> )	59 $\pm$ 3 A	63 $\pm$ 2 A	84 $\pm$ 3 a	87 $\pm$ 2 a
Ca (mg kg <sup>-1</sup> )	1475 $\pm$ 63 A	1455 $\pm$ 49 A	1512 $\pm$ 61 a	1500 $\pm$ 48 a
Mg (mg kg <sup>-1</sup> )	119 $\pm$ 3 A	116 $\pm$ 2 A	117 $\pm$ 2 a	116 $\pm$ 1 a
Mn (mg kg <sup>-1</sup> )	159 $\pm$ 9 A	134 $\pm$ 8 B	148 $\pm$ 8 a	136 $\pm$ 7 a
Fe (mg kg <sup>-1</sup> )	75 $\pm$ 6 A	87 $\pm$ 5 A	95 $\pm$ 7 a	104 $\pm$ 6 a
Al (mg kg <sup>-1</sup> )	714 $\pm$ 11 A	725 $\pm$ 9 A	741 $\pm$ 12 a	764 $\pm$ 9 a
Cu (mg kg <sup>-1</sup> )	3.1 $\pm$ 0.1 A	2.8 $\pm$ 0.1 A	3.2 $\pm$ 0.2 a	3.2 $\pm$ 0.2 a
Zn (mg kg <sup>-1</sup> )	1.46 $\pm$ 0.05 A	1.48 $\pm$ 0.04 A	1.34 $\pm$ 0.05 a	1.30 $\pm$ 0.04 a
Total N (%)	0.167 $\pm$ 0.003 A	0.167 $\pm$ 0.002 A	0.166 $\pm$ 0.002 a	0.164 $\pm$ 0.001 a
Total C (%)	1.74 $\pm$ 0.03 A	1.71 $\pm$ 0.03 A	1.77 $\pm$ 0.03 a	1.72 $\pm$ 0.02 a
Rhizosphere Hedley P Fractions (mg kg <sup>-1</sup> )				
Resin P	5.3 $\pm$ 0.5 A	5.4 $\pm$ 0.4 A	3.0 $\pm$ 0.3 b	4.0 $\pm$ 0.3 a
Bicarbonate P	12.3 $\pm$ 0.7 A	12.7 $\pm$ 0.6 A	12.1 $\pm$ 0.5 a	11.9 $\pm$ 0.4 a
Microbial Biomarker Concentration (nmol g <sup>-1</sup> )				
Total Biomass	42 $\pm$ 1 A	40 $\pm$ 1 A	41 $\pm$ 1 a	39.4 $\pm$ 0.8 a
G+ Bacteria	12.0 $\pm$ 0.5 A	12.1 $\pm$ 0.5 A	11.8 $\pm$ 0.4 a	11.7 $\pm$ 0.3 a
G- Bacteria	19.6 $\pm$ 0.6 A	18.1 $\pm$ 0.5 B	19.0 $\pm$ 0.5 a	18.0 $\pm$ 0.4 a
General Fungi	1.26 $\pm$ 0.08 A	1.28 $\pm$ 0.06 A	1.09 $\pm$ 0.08 a	1.19 $\pm$ 0.06 a
AMF	1.38 $\pm$ 0.05 A	1.30 $\pm$ 0.04 A	1.32 $\pm$ 0.07 a	1.28 $\pm$ 0.07 a
Actinobacteria	7.0 $\pm$ 0.3 A	6.5 $\pm$ 0.2 A	7.0 $\pm$ 0.2 a	6.6 $\pm$ 0.1 a
Protists	0.65 $\pm$ 0.03 A	0.60 $\pm$ 0.02 A	0.60 $\pm$ 0.2 a	0.59 $\pm$ 0.02 a



**Figure S1.** Nonmetric multidimensional scaling (NMDS) ordination biplots of Hellinger transformed microbial biomarker group FAMES showing the separation in microbial communities based on dwarfing status (semi-dwarf vs. wild type) and era (modern vs. old) in insufficient (-P) or sufficient (+P) conditions. The NMDS resulted in a 3D solution with only the two dominant axes being shown which cumulatively explain 90% (+P) and 84% (-P) of the overall variance in the dataset. Results from multiple regression permutation procedure (MRPP) to test for the differences between groups are shown in each panel. PLFA biomarker group concentrations with  $r^2 > 0.30$  between the variable and axis score are displayed as vectors. Vectors indicate strength (length of arrow) and direction of graphed relationships.