Main supplementary figures and tables

This document contains 1 figure and 6 tables submitted as supplementary to the manuscript titled *Direct foliar phosphorus uptake from wildfire ash*, by Lokshin et al.

Contents

The dissolution of fire ash particles by HCl (red), H_2NaCO_3 (orange) and NaOH (green) acids. According to these results, most of the P inside a fire ash is found in a Ca-P complexes. A significant portion (21%) is classified as labile P which readily dissolves when exposed to a weak base.
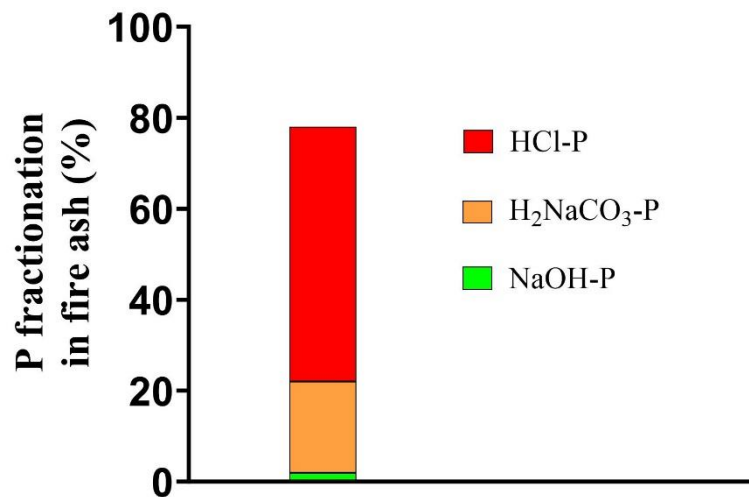
Table S1 – XRD and XRF data of the fire ash particles

XRD - fire ash sample	%
Calcite ($CaCO_3$)	80
Hibschite (($Ca,Fe)_3(Al,Fe)_2SiO_4(OH)$)	1.4
Larnite/orthosilicate ($Ca_2(SiO_4)$)	17.4
Analcime ($K_8Al_8Si_{16}O_{48}$)	1.2
Possible trace sulfates and/or phosphates	<0.5%

XRF - fire ash sample	
Element	Conc. (%)
O	31.8
Na	0.1
Mg	0.7
Al	1.3
Si	4.4
P	1.0
S	1.3
Cl	2.2
K	5.2
Ca	48
Ti	0.3
Cr	0.0
Mn	0.1
Fe	2.9
Ni	0.0
Cu	0.0
Zn	0.1
Br	0.0
Rb	0.0
Sr	0.2
Zr	0.0
Ba	0.0

Table S2 – ICP-MS data of the control plants, fertilizers and fire ash perticles

Foliar application experiment
412 ppm chamber

sample (ppm)	Biomass	Mg	P	K	Ca	Mn	Fe	Ni	Cu	Zn
Control 412 #1	1.03	2749	715	21928	7257	52	75	1.3	2.9	23
Control 412 #2	1.29	2828	860	21147	7266	45	112	2.3	10.8	24
Discarded plant										
Control 412 #4	1.51	2814	686	23832	7462	33	97	2.4	3.7	22
Control 412 #5	1.38	2863	663	21883	7684	38	94	1.0	2.7	24
Control 412 #6	1.61	2513	704	19705	6531	19	69	1.3	3.3	23
850 ppm chamber										
Control 850 #1	1.35	2585	727	23099	6323	22	71	1.0	1.9	23
Control 850 #2	1.16	3848	827	27768	7922	61	79	0.2	2.8	39
Control 850 #3	1.79	2785	607	20121	7118	50	67	1.2	2.5	25
Discarded plant										
Control 850 #5	1.51	2847	759	27272	7572	21	88	2.2	4.7	26
Control 850 #6	1.68	3180	640	24460	8732	31	93	1.6	2.9	29
Root application experiment										
412 ppm chamber										
sample (ppm)	Biomass	Mg	P	K	Ca	Mn	Fe	Ni	Cu	Zn
Control 412 #1	1.04	2993	862	20480	6808	64	118	1.7	5.7	37
Control 412 #2	1.95	5733	707	30854	10567	63	119	1.3	4.7	58
Control 412 #3	1.28	4865	567	29117	11069	57	123	2.0	7.4	64
Control 412 #4	1.46	4485	720	28665	10389	66	131	1.0	5.2	61
Control 412 #5	1.67	5666	740	29223	11566	104	101	0.9	5.0	64
Discarded plant										
850 ppm chamber										
Control 850 #1	1.09	3747	762	27685	8279	58	98	0.2	3.4	49
Lost sample										
Discarded plant										
Control 850 #4	1.44	4741	820	31501	9608	62	77	0.2	3.2	55
Control 850 #5	1.46	3692	820	25098	7757	56	64	0.1	2.6	48
Control 850 #6	0.97	3015	712	19211	7511	37	69	0.1	2.6	35
Fertilizers and dust types										
+P fertilizer		1226	713	6000	10.6	76	151	0.4	5.6	50
-P fertilizer		1214	35	7808	6.7	70	136	0.4	5.1	48
Fire ash sample 1		22591	6070	23910	238430	510	7283	13	75	242
Fire ash sample 2		23152	6248	24542	245073	526	7508	14	78	244

Table S3 – ICP-MS data of the foliar treated plants

412 ppm room

sample (ppm)	Biomass	Mg	P	K	Ca	Mn	Fe	Ni	Cu	Zn
Fire ash foliar-treated 412 ppm #1	2.35	2552	691	22993	7034	38	106	0.8	3.1	33
Fire ash foliar-treated 412 ppm #2	2.24	2584	654	20730	7347	32	64	0.8	2.7	19
Discarded plant										
Fire ash foliar-treated 412 ppm #4	1.72	2173	660	18840	5879	31	65	0.9	2.7	21
Fire ash foliar-treated 412 ppm #5	1.71	2534	746	20654	6904	38	88	1.7	2.9	23
Fire ash foliar-treated 412 ppm #6	2.66	2285	642	21986	6732	44	114	1.3	4.5	19

850 ppm room

sample (ppm)	Biomass	Mg	P	K	Ca	Mn	Fe	Ni	Cu	Zn
Fire ash foliar-treated 850 ppm #1	1.89	2458	590	22706	7151	47	93	1.4	2.5	20
Fire ash foliar-treated 850 ppm #2	2.33	2407	623	23189	6929	41	82	0.6	2.7	18
Fire ash foliar-treated 850 ppm #3	1.07	2510	751	22602	6849	24	57	0.9	2.4	23
Fire ash foliar-treated 850 ppm #4	2.39	2084	586	20249	6200	31	98	1.2	3.4	19
Discarded plant										
Fire ash foliar-treated 850 ppm #6	1.54	2503	685	22349	7414	32	79	0.6	2.0	18

Table S4 – ICP-MS data of the root treated plants

412 ppm room

sample (ppm)	Biomass	Mg	P	K	Ca	Mn	Fe	Ni	Cu	Zn
Fire ash root treated 412 ppm #1	1.21	3279	883	34888	7383	39	81	2.2	29.1	38
Fire ash root treated 412 ppm #2	1.47	4059	489	27365	8318	42	77	1.2	53.1	37
Fire ash root treated 412 ppm #3	1.59	4735	905	27677	8561	51	93	0.9	4.6	45
Fire ash root treated 412 ppm #4	1.58	5071	619	33414	9820	49	84	0.9	4.8	49
Fire ash root treated 412 ppm #5	1.33	5121	828	38921	11100	75	109	0.9	4.9	70
Discarded plant										

850 ppm room

sample (ppm)	Biomass	Mg	P	K	Ca	Mn	Fe	Ni	Cu	Zn
Discarded plant										
Fire ash root treated 850 ppm #2	1.56	2687	640	26257	7146	50	67	0.2	2.9	39
Fire ash root treated 850 ppm #3	1.44	3103	793	25534	7563	44	77	0.1	3.0	30
Fire ash root treated 850 ppm #4	0.96	2239	689	20422	5736	30	68	0.1	2.1	23
Fire ash root treated 850 ppm #5	1.21	2817	682	21645	6957	35	70	0.1	2.9	26
Fire ash root treated 850 ppm #6	1.02	2465	662	23181	6889	36	86	0.2	2.7	26

Table S5 – Leaf pH

plant #	number of leaves measured	pH values
plant # 1	leaf 1	1.11
	leaf 2	1.25
	leaf 3	1.2
	leaf 4	1.1
plant # 2	leaf 1	1.19
	leaf 2	1.1
	leaf 3	1.16
	leaf 4	1.19
plant # 3	leaf 1	1.11
	leaf 2	1.18
	leaf 3	1.11
	leaf 4	1.26
plant # 4	leaf 1	1.09
	leaf 2	1.13
	leaf 3	1.12
plant # 5	leaf 1	0.99
	leaf 2	1.23
	leaf 3	1.25
plant # 6	leaf 1	1.26
	leaf 2	1.2
	leaf 3	1.26
plant # 7	leaf 1	1.26
	leaf 2	1.2
	leaf 3	1.26
plant # 8	leaf 1	1.26
	leaf 2	1.2
	leaf 3	1.26

plant #	number of leaves measured	pH values
plant # 9	leaf 1	1.26
	leaf 2	1.2
	leaf 3	1.26
plant # 10	leaf 1	1.26
	leaf 2	1.2
	leaf 3	1.26
plant # 11	leaf 1	1.26
	leaf 2	1.2
	leaf 3	1.26
plant # 12	leaf 1	1.26
	leaf 2	1.2
	leaf 3	1.26
	leaf 4	1.2
plant # 13	leaf 1	1.25
	leaf 2	1.13
	leaf 3	1.12
plant # 14	leaf 1	1.11
	leaf 2	1.11
	leaf 3	1.11
plant # 15	leaf 1	1.04
	leaf 2	1.04
	leaf 3	1.18
plant # 16	leaf 1	1.06
	leaf 2	1.16
	leaf 3	1.15

Table S6 – Plant's holding capacity of fire ash particles

Plant #	Number of branches tested	branch weight (~0.5 g) before fire ash application	branch weight after application of fire ash particles	total holding mass
plant # 1	branch 1	0.502	0.618	0.116
	branch 2	0.545	0.666	0.121
	branch 3	0.485	0.586	0.101
plant # 2	branch 1	0.511	0.673	0.162
	branch 2	0.499	0.708	0.209
plant # 3	branch 1	0.508	0.662	0.154
	branch 2	0.482	0.597	0.115
plant # 4	branch 1	0.433	0.545	0.112
plant # 5	branch 1	0.434	0.524	0.09
plant # 6	branch 1	0.453	0.527	0.074
	branch 2	0.481	0.607	0.126
plant # 7	branch 1	0.48	0.63	0.15
	branch 2	0.48	0.65	0.17
plant # 8	branch 1	0.525	0.69	0.165
	branch 2	0.49	0.65	0.16
plant # 9	branch 1	0.509	0.645	0.136
	branch 2	0.496	0.644	0.148
	branch 3	0.515	0.675	0.16
plant # 10	branch 1	0.512	0.605	0.093
	branch 2	0.526	0.687	0.161
plant # 11	branch 1	0.519	0.641	0.122
	branch 2	0.515	0.642	0.127
plant # 12	branch 1	0.506	0.636	0.13
	branch 2	0.525	0.624	0.099