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Soil Research

Supplementary Material

Comparison of soil analytical methods for estimating plant-available potassium in highly weathered soils

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Supplementary data

Table S1. Semi-quantitative mineralogy of soils by x-ray diffraction (%)

Soil	Depth (cm)	Quartz	K feldspar	Plagioclase	Kaolinite	Montmorillonite	Nontronite	White Mica
1	0-10	67	6	1	23	0	0	0
	20-30	57	23	0	18	0	0	0
2	0-10	45	40	8	5	0	0	1
	20-30	46	35	10	7	0	0	2
3	0-10	27	4	34	2	16	2	0
	20-30	21	4	18	2	35	2	0
4	0-10	97	2	1	0	0	0	0
	20-30	93	0	1	2	3	0	0
5	0-10	69	0	11	1	14	1	0
	20-30	53	0	7	1	21	1	0
6	0-10	69	13	11	2	4	0	0
	20-30	80	4	4	4	9	0	0
7	0-10	84	5	3	4	4	0	0
	20-30	73	3	5	8	8	0	0
8	0-10	99	0	0	0	0	0	0
	20-30	99	0	0	1	0	0	0
9	0-10	77	4	0	7	6	0	1
	20-30	66	5	0	9	17	0	0
10	0-10	80	7	3	4	5	0	0
	20-30	77	9	3	5	6	0	0
11	0-10	65	23	6	4	0	0	0
	20-30	62	26	4	7	0	0	0
12	0-10	65	17	1	15	0	0	0
	20-30	67	4	2	25	0	0	0
13	0-10	86	0	0	14	0	0	0
	20-30	82	0	0	18	0	0	0
14	0-10	84	12	1	1	2	0	0
	20-30	72	16	2	2	10	0	1
15	0-10	99	1	< 1	0	1	0	0
	20-30	0	54	1	4	35	0	0
16	0-10	92	3	< 1	5	0	0	0
	20-30	88	1	0	11	0	0	0
17	0-10	91	2	1	1	1	0	0
	20-30	91	2	1	2	3	0	0
18	0-10	53	21	18	1	2	0	0
	20-30	49	19	27	2	2	0	0
19	0-10	44	30	23	1	0	0	0
	20-30	45	24	25	3	0	0	1
20	0-10	46	37	14	0	1	0	0
	20-30	44	29	23	2	2	0	0
21	0-10	85	2	1	12	0	0	0
	20-30	85	1	1	13	0	0	0

Table S2. Amounts of K extracted by different extractants for 63 soil samples (mg/kg).

Soil	Depth cm	Water K	$CaCl_2$ K	$AgTU^+$ K	Colwell K	NH_4OAc K	TBK_{1h}	TBK_{4h}	Nitric K	*Aqua regia* K
						mg/kg				
1	0-10	48.98	121.65	215.42	291.32	298.32	493.01	546.06	517.13	680
	10-20	3.25	12.28	44.64	95.82	78.26	233.64	331.30	237.21	470
	20-30	1.91	8.50	45.69	67.70	59.15	213.06	336.07	195.01	440
2	0-10	17.40	60.85	115.60	154.12	141.21	263.42	353.29	291.85	510
	10-20	2.09	15.19	61.45	65.86	57.22	133.43	193.93	142.23	340
	20-30	1.90	14.49	38.21	54.98	49.34	105.26	154.33	108.83	310
3	0-10	25.30	136.44	528.38	542.26	408.56	877.52	984.97	822.75	1400
	10-20	2.44	28.72	111.07	119.79	118.84	189.84	221.12	237.31	530
	20-30	1.31	18.35	65.71	89.84	88.22	129.85	149.38	163.30	420
4	0-10	12.58	21.57	39.50	39.53	38.19	44.03	45.70	55.68	120
	10-20	3.73	10.49	24.29	19.85	20.47	21.56	24.63	30.34	86
	20-30	29.40	28.13	70.47	78.74	91.46	136.90	142.93	184.96	810
5	0-10	11.17	68.77	362.11	360.77	478.96	905.83	1032.59	1176.66	3700
	10-20	5.77	43.09	266.62	259.85	383.00	732.43	815.61	1191.14	3900
	20-30	4.44	35.61	209.01	226.61	316.37	623.12	678.22	1224.14	3600
6	0-10	7.61	51.57	242.00	137.46	128.16	230.37	231.14	247.24	660
	10-20	7.93	11.68	43.54	68.82	81.02	150.02	180.20	213.32	830
	20-30	4.11	9.90	39.48	52.42	74.95	148.93	159.52	221.33	920
7	0-10	25.34	119.27	190.16	260.54	234.22	344.73	385.11	338.22	720
	10-20	6.46	36.43	88.55	124.64	120.98	227.39	247.49	217.38	690
	20-30	9.26	29.88	81.99	118.44	128.27	296.52	268.06	238.15	880
8	0-10	29.40	39.32	47.75	68.89	58.57	66.14	63.84	66.97	70
	10-20	20.39	26.61	47.88	42.79	40.55	36.35	40.29	35.77	38
	20-30	15.42	21.25	41.36	30.35	30.39	27.07	33.36	26.26	31
9	0-10	30.13	111.89	241.46	277.28	305.16	550.51	630.33	503.63	1200
	10-20	2.63	26.14	85.83	104.75	101.30	391.43	535.69	319.24	1300
	20-30	2.19	16.61	66.62	73.25	82.72	404.80	555.67	325.27	1500
10	0-10	25.90	66.19	152.98	212.53	204.63	483.30	563.75	382.60	1000
	10-20	7.80	23.71	65.18	113.17	107.57	355.60	447.44	246.86	910
	20-30	1.50	5.91	44.25	83.33	70.15	352.43	449.22	223.04	1100
11	0-10	35.30	66.55	138.31	203.11	196.04	471.87	629.44	387.06	1000
	10-20	13.78	50.37	125.44	188.67	163.88	524.24	705.36	324.14	1400
	20-30	12.57	56.59	146.35	202.33	181.81	602.22	753.65	389.64	1600
12	0-10	41.06	108.93	201.41	309.67	277.53	422.61	439.46	321.85	600
	10-20	5.42	23.23	51.88	135.70	117.55	243.69	298.23	147.46	470
	20-30	2.35	13.80	49.69	117.39	94.63	234.57	292.33	141.55	500
13	0-10	9.77	27.76	49.10	100.81	81.97	108.37	119.52	119.55	210
	10-20	0.95	2.87	12.91	23.70	18.90	27.52	33.15	26.86	110
	20-30	1.53	3.90	17.26	22.26	21.47	24.24	29.91	23.28	76
14	0-10	110.05	430.87	908.73	1166.94	1047.34	1530.99	1582.13	1446.84	2800
	10-20	49.34	268.10	658.21	831.64	960.57	1436.13	1456.05	1315.78	3600
	20-30	51.20	181.39	550.60	950.24	993.52	1606.49	1571.69	1626.32	3800
15	0-10	35.21	92.12	169.63	213.13	210.74	301.38	331.57	366.60	1100
	10-20	68.04	84.16	250.97	318.22	369.06	697.28	799.27	729.89	3500
	20-30	20.36	112.70	461.49	618.74	813.39	1319.00	1571.75	1860.08	7200
16	0-10	15.24	36.21	67.83	76.75	69.88	72.90	77.37	65.92	100
	10-20	5.68	14.59	23.61	45.03	39.11	42.37	53.87	43.35	81
	20-30	8.50	22.36	35.62	54.40	51.65	56.64	67.21	56.42	82
17	0-10	35.49	120.89	189.95	258.93	242.41	298.01	360.37	252.27	490
	10-20	11.96	37.23	74.69	101.64	104.21	159.55	219.58	123.40	310
	20-30	2.69	10.02	31.78	51.00	43.21	99.16	151.86	65.51	240
18	0-10	2.52	12.50	44.96	63.77	52.66	218.79	366.70	236.15	890
	10-20	1.86	10.35	44.89	51.95	43.54	237.20	399.62	209.12	950
	20-30	1.44	6.35	38.88	36.18	33.33	188.02	348.73	208.17	790
19	0-10	19.01	43.85	91.30	111.50	95.92	148.85	187.93	167.90	420
	10-20	13.57	41.32	90.39	90.38	87.24	129.88	179.39	192.89	440
	20-30	15.28	44.23	66.69	100.33	89.16	141.10	196.42	197.96	460
20	0-10	3.84	11.05	34.07	43.69	40.12	77.41	100.23	116.46	250
	10-20	1.53	4.66	24.71	30.14	28.28	68.41	105.15	158.49	370
	20-30	1.54	5.40	19.57	30.49	27.27	70.41	120.51	216.15	140
21	0-10	3.70	18.61	50.11	60.28	61.03	72.56	81.23	77.15	150
	10-20	1.71	7.84	26.33	36.17	36.76	44.92	48.68	48.74	110
	20-30	0.97	4.34	20.91	29.46	24.70	30.82	35.74	33.94	84

$(AgTU)^+$: Silver thiourea; TBK_{1h} and TBK_{4h}: K extracted byTetraphenyl borate for 1h and 4h;

Table S3. Correlation coefficients (r) for linear relationships between various forms of K and soil properties for 63 soil samples

	Water K	$CaCl_2$ K	$AgTU^+$ K	Colwell K	NH_4OAc K	TBK_{1h}	TBK_{4h}	Nitric K
$CaCl_2$ K	0.885**							
$AgTU^+$ K	0.764**	0.930**						
Colwell K	0.788**	0.933**	0.974**					
NH_4OAc K	0.731**	0.879**	0.956**	0.980**				
TBK_{1h}	0.655**	0.808**	0.927**	0.945**	0.967**			
TBK_{4h}	0.611**	0.765**	0.893**	0.907**	0.932**	0.990**		
Nitric K	0.538**	0.691**	0.866**	0.863**	0.926**	0.944**	0.937**	
Aqua regia K	0.385**	0.495**	0.705**	0.698**	0.801**	0.851**	0.870**	0.939**

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table S4. Average of plant biomass, shoot K concentration and total K uptake from pot experiment.

Soil	Depth cm	Plant biomass g/pot	Shoot K concentration %	Total K uptake mg/kg soil
1	0-10	10.76	3.12	167.96
	20-30	7.40	1.49	55.04
3	0-10	10.57	2.64	139.39
	20-30	9.28	1.32	60.94
4	0-10	7.37	0.61	22.34
	20-30	6.18	2.19	67.46
6	0-10	8.09	2.21	89.19
	20-30	8.09	1.02	41.34
7	0-10	7.73	2.51	96.65
	20-30	7.53	2.19	82.41
8	0-10	8.76	0.52	22.52
	20-30	4.90	0.57	13.97
9	0-10	8.67	3.11	134.49
	20-30	5.65	1.88	53.05
10	0-10	8.87	2.52	110.38
	20-30	5.94	1.23	36.49
11	0-10	9.43	2.22	103.55
	20-30	8.44	2.38	100.42
12	0-10	9.48	3.06	144.77
	20-30	3.36	2.19	36.71
13	0-10	8.53	1.14	48.54
	20-30	2.57	0.79	10.08
14	0-10	9.26	3.06	140.92
	20-30	12.16	2.75	166.90
15	0-10	10.65	2.24	116.41
	20-30	10.02	3.15	157.27
16	0-10	8.20	0.85	34.78
	20-30	6.36	0.71	22.66
17	0-10	6.19	0.99	30.75
18	0-10	5.03	0.86	21.64
	20-30	5.79	0.74	21.28
19	0-10	8.63	1.17	50.08
	20-30	8.23	1.14	46.73
20	0-10	3.29	0.83	13.63
	20-30	4.10	0.62	12.54
21	0-10	5.97	0.98	29.09
	20-30	4.38	0.59	12.98

Table S5. Step-wise multiple regression equations relating the most predictive soil K forms and soil properties to shoot dry biomass, shoot K concentration and total K uptake after log transformation

Soils	Model Formula	Adjusted R^2	BIC
Biomass	Y= 1.604 log($CaCl_2$ K) + 1.992	0.647	137.036
	Y= 1.660 log($CaCl_2$ K) + 0.021 KBC + 1.660	0.670	133.550
Shoot K concentration	Y= 0.808 log(NH_4OAc K) – 2.092	0.815	43.467
	Y= 0.874 log(NH_4OAc K) – 0.225 pH – 1.149	0.850	38.355
	Y= 0.792 log(NH_4OAc K) – 0.226 pH – 0.011 Sand content + 0.060	0.875	34.119
	Y = 0.701 log(NH_4OAc K) – 0.279 pH – 0.012 Sand content + 2.069 EC + 0.602	0.891	31.301
Total K uptake	Y= 47.178 log(NH_4OAc K) – 151.251	0.895	320.256
	Y= 45.589 log(NH_4OAc K) – 9.969 OC – 152.124	0.913	315.733
	Y= 40.932 log(NH_4OAc K) – 9.486 OC + 92.525 EC – 137.962	0.924	312.935
	Y= 41.776 log(NH_4OAc K) – 7.584 OC + 121.480 EC – 6.875 pH – 104.533	0.932	311.121