ALTA August 19 2026

Radicle Agronomics Update

PRESENTED BY

Brad Joern

Radicle Agronomics Soil Scientist

RADICLE AGRONOMICS™

Soil Sampling



Soil Analysis





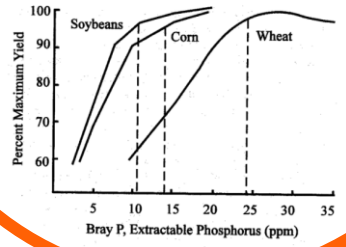








Recommendation



Application



RADICLE AGRONOMICS

Soil Sampling



Soil Analysis





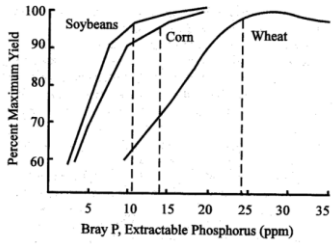








Recommendation



Application



RADICLE AGRONOMICS

Horizontal and vertical nutrient stratification





How stratified is a broadcast-fertilized and vertically tilled field?

Horizontal and vertical stratification of Radicle Lab soil test phosphorus (ppm)

	Horizontal Distance (inches)																		
Depth (inches)	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	34-36	36-38	Depth Average
0-2	46	45	45	45	44	42	44	42	43	43	44	44	42	41	43	43	43	44	44	44
2-4	46	32	31	37	37	37	41	42	42	49	46	40	40	42	44	47	47	46	40	41
4-6	9	8	9	10	9	12	28	36	28	31	23	21	34	34	43	36	33	37	31	25
6-8	6	7	6	6	7	9	10	8	8	8	7	8	8	8	11	12	12	12	16	9
8-10	5	7	5	5	6	6	8	6	6	6	6	6	6	6	6	6	7	7	8	6
10-12	5	5	5	5	5	5	6	6	6	5	5	5	5	5	5	6	6	6	6	5
0-8	27	23	23	24	24	25	30	32	30	33	30	28	31	31	35	34	34	35	32	30

The average 0-8 inch value is 30 ppm, with Individual soil core values of 23 to 35 ppm, and a C.V. of 14%.

RADICLE AGRONOMICS

How stratified is a broadcast-fertilized and vertically tilled field?

Horizontal and vertical stratification of Radicle Lab soil test potassium (ppm)

	Horizontal Distance (inches)																		
Depth (inches)	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	28-30	30-32	32-34	24-36	36-38	Depth Average
0-2	233	227	215	205	214	219	223	216	223	221	225	224	222	218	217	221	208	214	212	219
2-4	213	190	193	200	201	210	215	230	218	219	227	213	217	218	229	229	226	226	202	215
4-6	110	97	99	114	111	131	178	205	177	169	161	156	173	197	213	200	198	185	173	160
6-8	59	78	59	60	67	63	82	89	88	90	81	92	95	100	106	113	121	114	121	88
8-10	40	58	45	44	46	52	49	53	51	53	55	61	60	59	54	55	59	68	75	55
10-12	39	37	40	40	41	41	48	44	39	32	35	38	41	40	42	43	49	43	50	41
0-8	154	148	141	145	149	156	174	185	176	175	173	171	177	183	191	191	188	185	177	170

The average 0-8 inch value is 170 ppm, with Individual soil core values of 141 to 191 ppm, and a C.V. of 10%.

RADICLE AGRONOMICS

How stratified is a subsurface strip band-fertilized strip-till field?

Horizontal and vertical stratification of Radicle Lab soil test phosphorus (ppm)

	Horizontal Distance (inches)																				
Depth (inches)	0-2	2-4	4-6	6-8 Corn Row	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24 SB Row	24-26	26-28	28-30	30-32	32-34	34-36	36-38 Corn Row	38-40	40-42	Depth Average
0-2	8	7	20	11	10	9	11	10	9	8	8	9	9	9	8	8	8	14	11	7	8	9
2-4	4	5	10	12	6	5	5	6	7	5	5	5	5	5	4	5	4	7	7	4	5	6
4-6	3	9	90	53	6	4	3	5	4	4	5	24	4	5	4	4	8	90	41	5	4	18
6-8	4	3	22	8	5	5	2	3	3	3	3	3	3	6	4	3	3	6	4	6	3	5
8-10	3	3	4	3	3	3	2	2	3	3	3	3	2	3	3	2	3	2	3	3	2	3
10-12	2	2	3	3	2	2	2	2	2	3	2	2	2	3	2	2	2	3	3	3	2	2
0-8	5	6	35	21	7	6	5	6	5	5	5	10	5	6	5	5	6	29	16	6	5	9

The average 0-8 inch value is 9 ppm, with Individual soil core values of 5 to 35 ppm, and a C.V. of 91%.

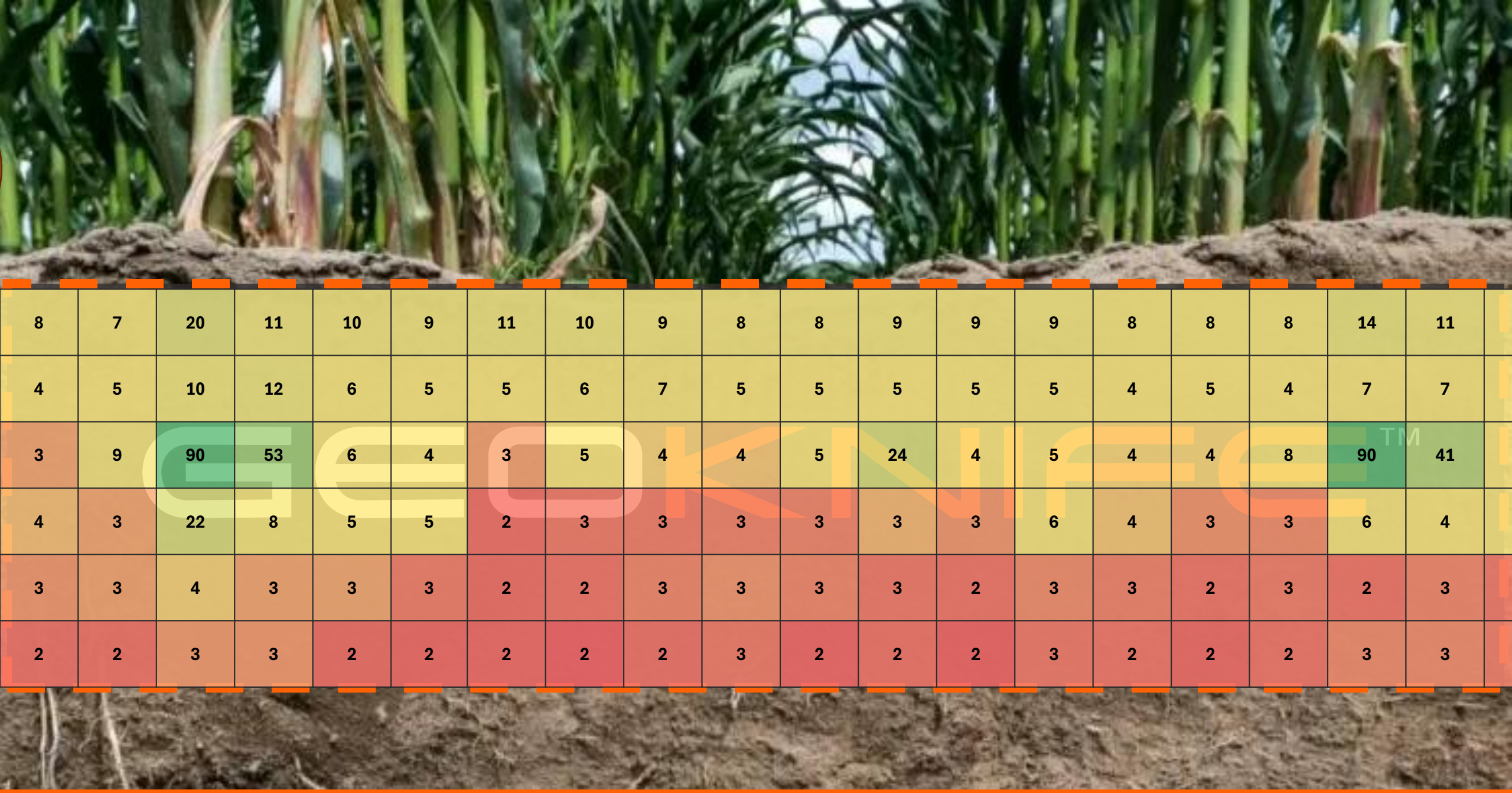
RADICLE AGRONOMICS

How stratified is a subsurface strip band-fertilized strip-till field?

Horizontal and vertical stratification of Radicle Lab soil test potassium (ppm)

	Horizontal Distance (inches)																				
Depth (inches)	0-2	2-4	4-6	6-8 Corn Row	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24 SB Row	24-26	26-28	28-30	30-32	32-34	24-36	36-38 Corn Row	38-40	40-42	Depth Average
0-2	107	113	109	136	127	125	109	94	99	131	147	151	95	100	91	103	121	119	110	120	106	115
2-4	48	63	66	56	51	46	47	54	59	63	57	56	48	49	49	55	69	59	59	55	46	55
4-6	34	34	42	35	37	30	33	35	44	40	51	54	47	54	47	49	50	53	47	45	34	43
6-8	25	23	21	26	24	23	24	25	31	32	33	38	30	28	38	36	35	33	41	33	34	30
8-10	30	25	30	29	30	26	25	25	32	26	22	22	23	24	26	22	20	21	19	21	21	25
10-12	17	17	21	16	17	13	13	14	21	20	18	16	18	18	19	17	15	19	14	17	16	17
0-8	53	58	59	63	60	56	53	52	58	66	72	75	55	58	56	61	69	66	64	63	55	61

The average 0-8 inch value is 61 ppm, with Individual soil core values of 52 to 75 ppm, and a C.V. of 10%.



8	7	20	11	10	9	11	10	9	8	8	9	9	9	8	8	8	14	11
4	5	10	12	6	5	5	6	7	5	5	5	5	5	4	5	4	7	7
3	9	90	53	6	4	3	5	4	4	5	24	4	5	4	4	8	90	41
4	3	22	8	5	5	2	3	3	3	3	3	3	6	4	3	3	6	4
3	3	4	3	3	3	2	2	3	3	3	3	2	3	3	2	3	2	3
2	2	3	3	2	2	2	2	2	3	2	2	2	3	2	2	2	3	3

GEOKNITE™


RADICLE
AGRONOMICS



How does soil sampling method impact sampling error and soil test values in this broadcast-fertilized and vertically tilled field?

Average soil sampling error measured by coefficient of variation.

Sampling Method	P	K	Ca	Mg	pH	BpH	CEC
GeoKnife	10.8	10.9	3.2	2.6	0.7	0.5	3.4
10 Core AUTO	11.3	11.5	3.5	4.4	0.8	0.4	3.2

Average soil test values.

Sampling Method	P	K	Ca	Mg	pH	BpH	CEC
GeoKnife	20	135	2562	497	6.2	6.9	18.3
10 Core AUTO	28	181	2521	492	6.1	6.9	18.2

How does soil sampling method impact sampling error and soil test values in this subsurface strip band-fertilized strip-till field?

Average soil sampling error measured by coefficient of variation.

Sampling Method	P	K	Ca	Mg	pH	BpH	CEC
PP Prototype	9.0	6.9	5.6	5.9	1.3	0.6	4.6
12-Core AUTO	22.0	11.0	12.3	6.7	1.2	0.8	7.4

Average soil test values.

Sampling Method	P	K	Ca	Mg	pH	BpH	CEC
PP Prototype	10	72	3434	440	6.1	6.8	23.4
12-Core AUTO	14	78	3702	430	6.1	6.8	24.7

Soil Sampling



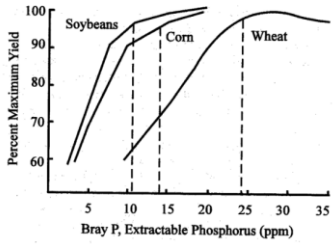
Soil Analysis








Recommendation



Application



RADICLE AGRONOMICS



Scooping

Scooping is a challenge we need to address

RADICLE AGRONOMICS

ALP Data on Scoop Density

ALP Program - Participant Web Summary Report - Cycle 59 - Spring 2026

Mehlich-3, Scoop Density (SubTestCode 156) in the Mehlich-3 Mult-Element Property Groups — **Data units: g/cm3**

	SRS2601			SRS2602			SRS2603			SRS2604			SRS2605		
WebCode	Sample Mean	Z Score	k Score	Sample Mean	Z Score	k Score	Sample Mean	Z Score	k Score	Sample Mean	Z Score	k Score	Sample Mean	Z Score	k Score
3BVEBL	**1.18**	-0.41	0.00	**1.18**	0.95	0.00	**1.18**	-0.12	0.00	**1.18**	2.11	0.00	**1.18**	0.29	0.00
6CF2LD	**1.35**	0.86	0.57	**1.10**	0.39	0.97	**1.30**	0.74	0.56	**1.00**	0.63	1.93	**1.23**	0.75	0.34
6RTDD7	**1.14**	-0.68	0.20	**0.89**	-0.99	0.31	**1.08**	-0.81	0.35	**0.85**	-0.58	0.61	**1.02**	-1.19	0.18
KCAQLM	**1.41**	1.29	0.60	**1.19**	0.99	1.00	**1.36**	1.16	1.06	**1.02**	0.82	0.53	**1.27**	1.16	1.10
TKA9CH	**1.14**	-0.70	0.34	**0.97**	-0.42	0.15	**1.07**	-0.88	0.18	**0.85**	-0.52	0.30	**1.03**	-1.10	0.18
ULL88Q	**1.23**	-0.01	0.20	**1.02**	-0.11	0.00	**1.21**	0.12	0.47	**0.90**	-0.12	0.30	**1.11**	-0.36	0.31
VH2FVN	**1.35**	0.83	1.70	**1.05**	0.11	0.32	**1.30**	0.72	0.13	**0.93**	0.12	0.44	**1.19**	0.40	0.19
VMCTDM	**1.11**	-0.95	0.20	**0.93**	-0.68	0.93	**1.04**	-1.14	0.35	**0.81**	-0.87	0.53	**1.12**	-0.29	2.86
WJRZ2K	**1.24**	0.01	0.50	**0.95**	-0.56	0.31	**1.08**	-0.80	0.46	**0.85**	-0.59	1.24	**1.07**	-0.72	0.19
Z4JFRH	**1.37**	1.00	2.44	**1.27**	1.54	2.62	**1.24**	0.27	2.80	**0.97**	0.38	1.86	**1.20**	0.48	0.51

Mehlich-3, Scoop Density (SubTestCode 156) in the Mehlich-3 Mult-Element Property Groups — **Data units: g/cm3**

	SRS2601	SRS2602	SRS2603	SRS2604	SRS2605
Grand Median	1.24	1.04	1.20	0.92	1.15
Median Abs Dev	0.10	0.09	0.11	0.07	0.06
Avg Within Lab SD	0.03	0.04	0.03	0.02	0.06
Labs Included	10	10	10	10	10
Labs Reporting	10	10	10	10	10

ALP Data on Scoop Density

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6CF2LD	**1.35**	0.86	0.57	**1.10**	0.39	0.97	**1.30**	0.74	0.56	**1.00**	0.63	1.93	**1.23**	0.75	0.34
6RTDD7	**1.14**	-0.68	0.20	**0.89**	-0.99	0.31	**1.08**	-0.81	0.35	**0.85**	-0.58	0.61	**1.02**	-1.19	0.18
KCAQLM	**1.41**	1.29	0.60	**1.19**	0.99	1.00	**1.36**	1.16	1.06	**1.02**	0.82	0.53	**1.27**	1.16	1.10
TKA9CH	**1.14**	-0.70	0.34	**0.97**	-0.42	0.15	**1.07**	-0.88	0.18	**0.85**	-0.52	0.30	**1.03**	-1.10	0.18
ULL88Q	**1.23**	-0.01	0.20	**1.02**	-0.11	0.00	**1.21**	0.12	0.47	**0.90**	-0.12	0.30	**1.11**	-0.36	0.31
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VMCTDM	**1.11**	-0.95	0.20	**0.93**	-0.68	0.93	**1.04**	-1.14	0.35	**0.81**	-0.87	0.53	**1.12**	-0.29	2.86
WJRZ2K	**1.24**	0.01	0.50	**0.95**	-0.56	0.31	**1.08**	-0.80	0.46	**0.85**	-0.59	1.24	**1.07**	-0.72	0.19
Z4JFRH	**1.37**	1.00	2.44	**1.27**	1.54	2.62	**1.24**	0.27	2.80	**0.97**	0.38	1.86	**1.20**	0.48	0.51

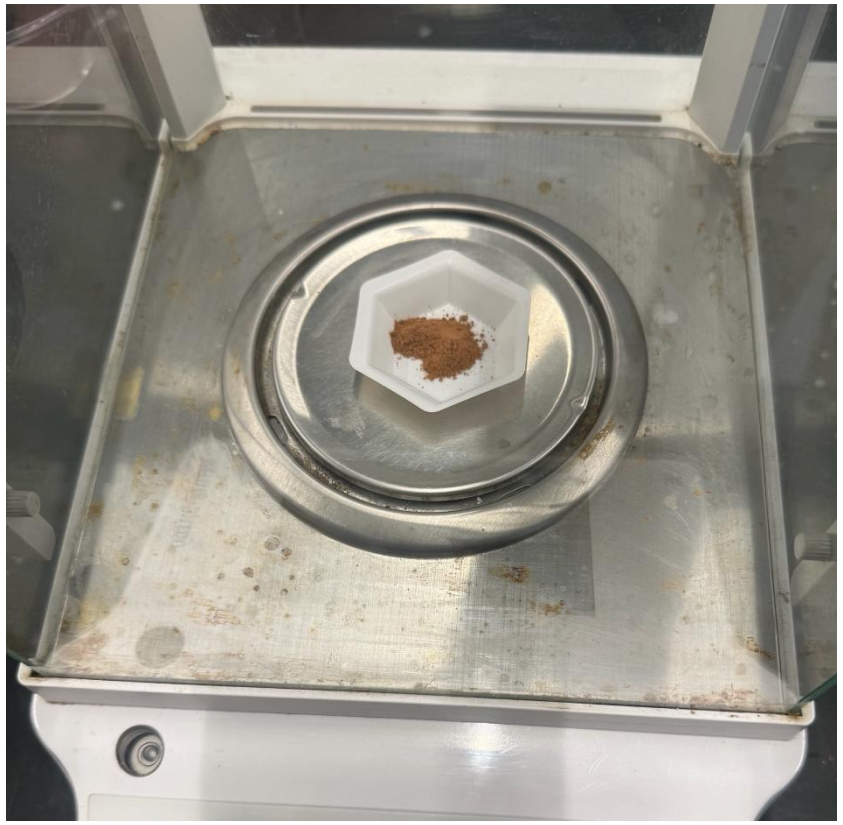
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Avg Within Lab SD	0.03	0.04	0.03	0.02	0.06
Labs Included	10	10	10	10	10
Labs Reporting	10	10	10	10	10

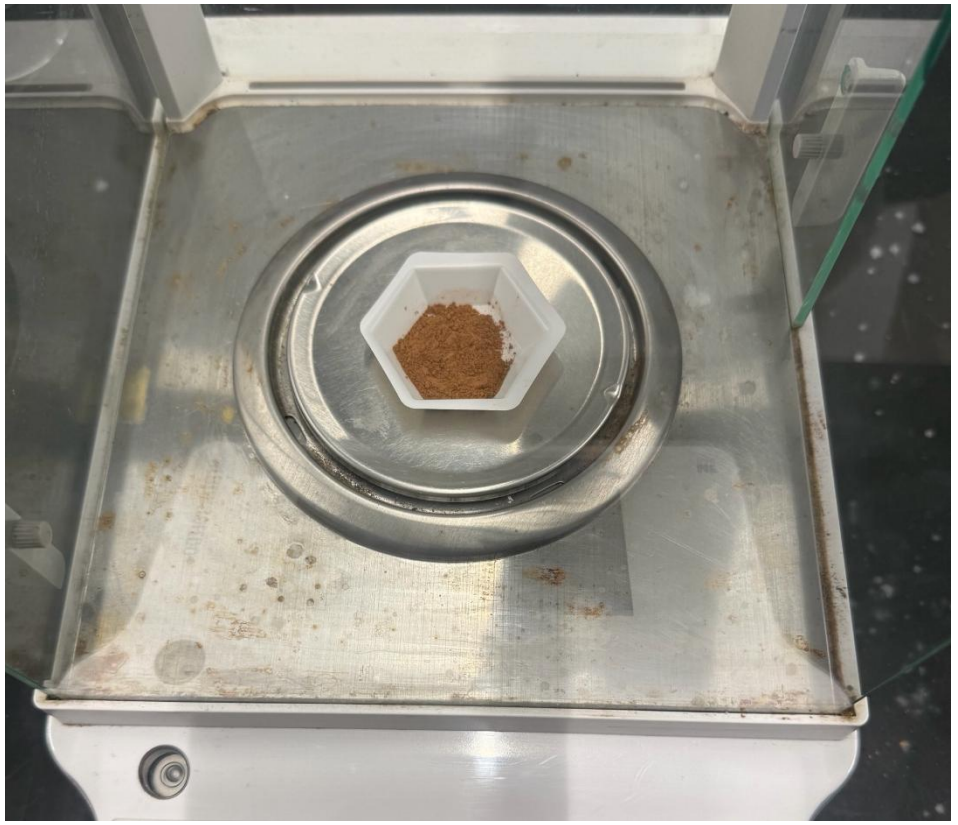
RADICLE AGRONOMICS

Impact from Scooping Variation

- Low Density Mehlich 3 Extraction

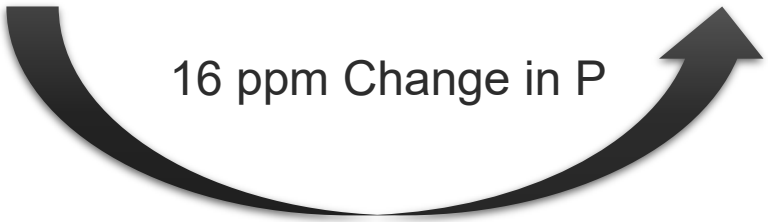


- High Density Mehlich 3 Extraction



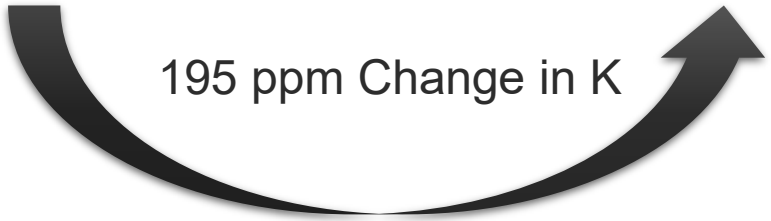
Extraction Results Soil 2604

ALP Soil 2604			
Low Density		High Density	
P (ppm)	K (ppm)	P (ppm)	K (ppm)
58	449	74	644



Extraction Results Soil 2604

ALP Soil 2604			
Low Density		High Density	
P (ppm)	K (ppm)	P (ppm)	K (ppm)
58	449	74	644



ALP Data on Scoop Density

ALP Program - Participant Web Summary Report - Cycle 59 - Spring 2026

Mehlich-3, Scoop Density (SubTestCode 156) in the Mehlich-3 Mult-Element Property Groups — **Data units: g/cm3**

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WebCode	Sample Mean	Z Score	k Score	Sample Mean	Z Score	k Score	Sample Mean	Z Score	k Score	Sample Mean	Z Score	k Score	Sample Mean	Z Score	k Score
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6CF2LD	**1.35**	0.86	0.57	**1.10**	0.39	0.97	**1.30**	0.74	0.56	**1.00**	0.63	1.93	**1.23**	0.75	0.34
6RTDD7	**1.14**	-0.68	0.20	**0.89**	-0.99	0.31	**1.08**	-0.81	0.35	**0.85**	-0.58	0.61	**1.02**	-1.19	0.18
KCAQLM	**1.41**	1.29	0.60	**1.19**	0.99	1.00	**1.36**	1.16	1.06	**1.02**	0.82	0.53	**1.27**	1.16	1.10
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ULL88Q	**1.23**	-0.01	0.20	**1.02**	-0.11	0.00	**1.21**	0.12	0.47	**0.90**	-0.12	0.30	**1.11**	-0.36	0.31
VH2FVN	**1.35**	0.83	1.70	**1.05**	0.11	0.32	**1.30**	0.72	0.13	**0.93**	0.12	0.44	**1.19**	0.40	0.19
VMCTDM	**1.11**	-0.95	0.20	**0.93**	-0.68	0.93	**1.04**	-1.14	0.35	**0.81**	-0.87	0.53	**1.12**	-0.29	2.86
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Z4JFRH	**1.37**	1.00	2.44	**1.27**	1.54	2.62	**1.24**	0.27	2.80	**0.97**	0.38	1.86	**1.20**	0.48	0.51

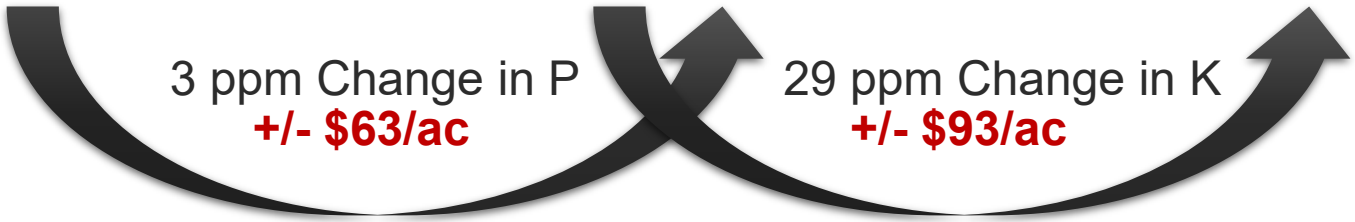
Mehlich-3, Scoop Density (SubTestCode 156) in the Mehlich-3 Mult-Element Property Groups — **Data units: g/cm3**

	SRS2601	SRS2602	SRS2603	SRS2604	SRS2605
Grand Median	1.24	1.04	1.20	0.92	1.15
Median Abs Dev	0.10	0.09	0.11	0.07	0.06
Avg Within Lab SD	0.03	0.04	0.03	0.02	0.06
Labs Included	10	10	10	10	10
Labs Reporting	10	10	10	10	10

RADICLE AGRONOMICS

Extraction Results Soil 2601

ALP Soil 2601			
Low Density		High Density	
P (ppm)	K (ppm)	P (ppm)	K (ppm)
8	141	11	170



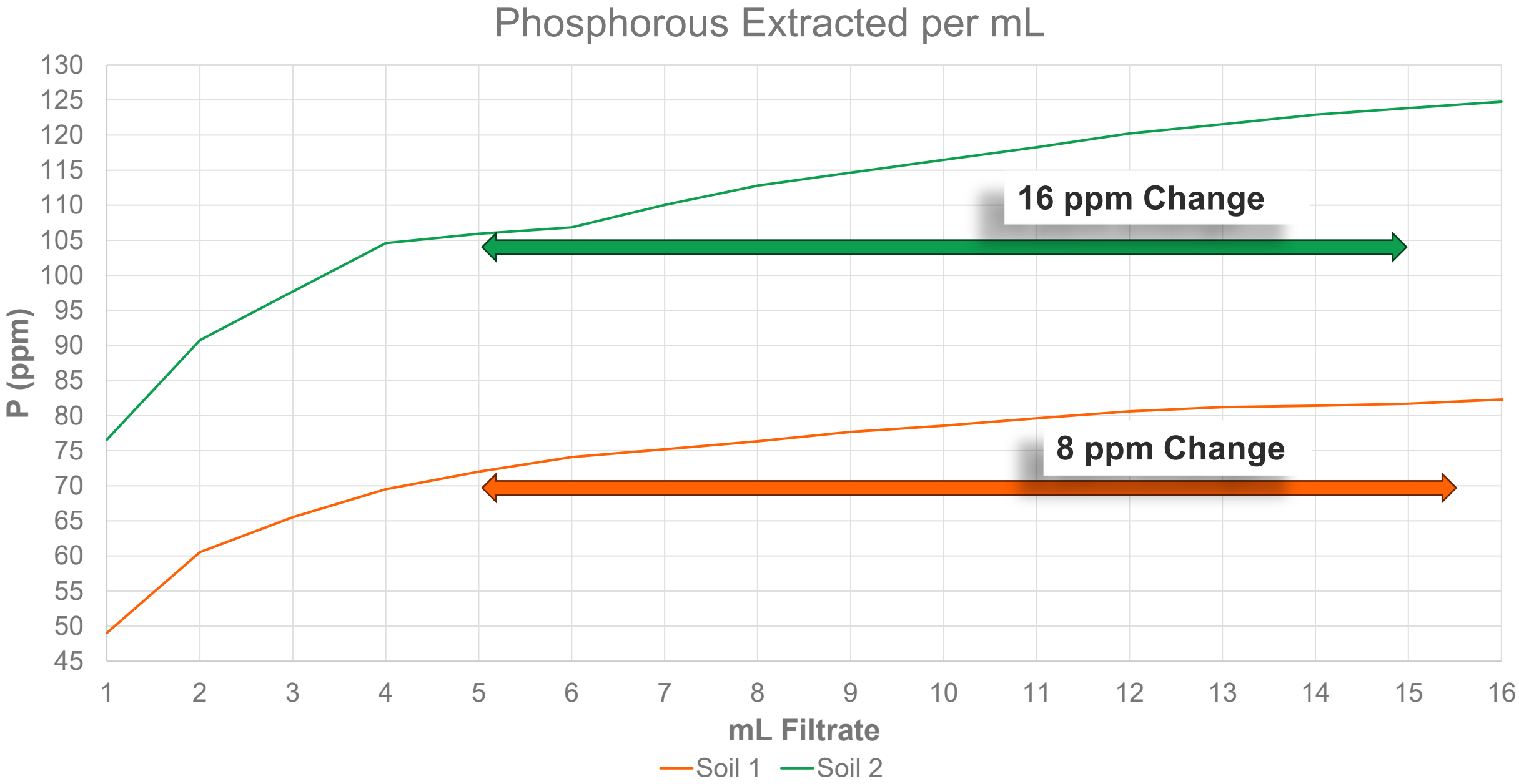
**Prices determined by the University of Kentucky fertilizer recommendations and current fertilizer prices*

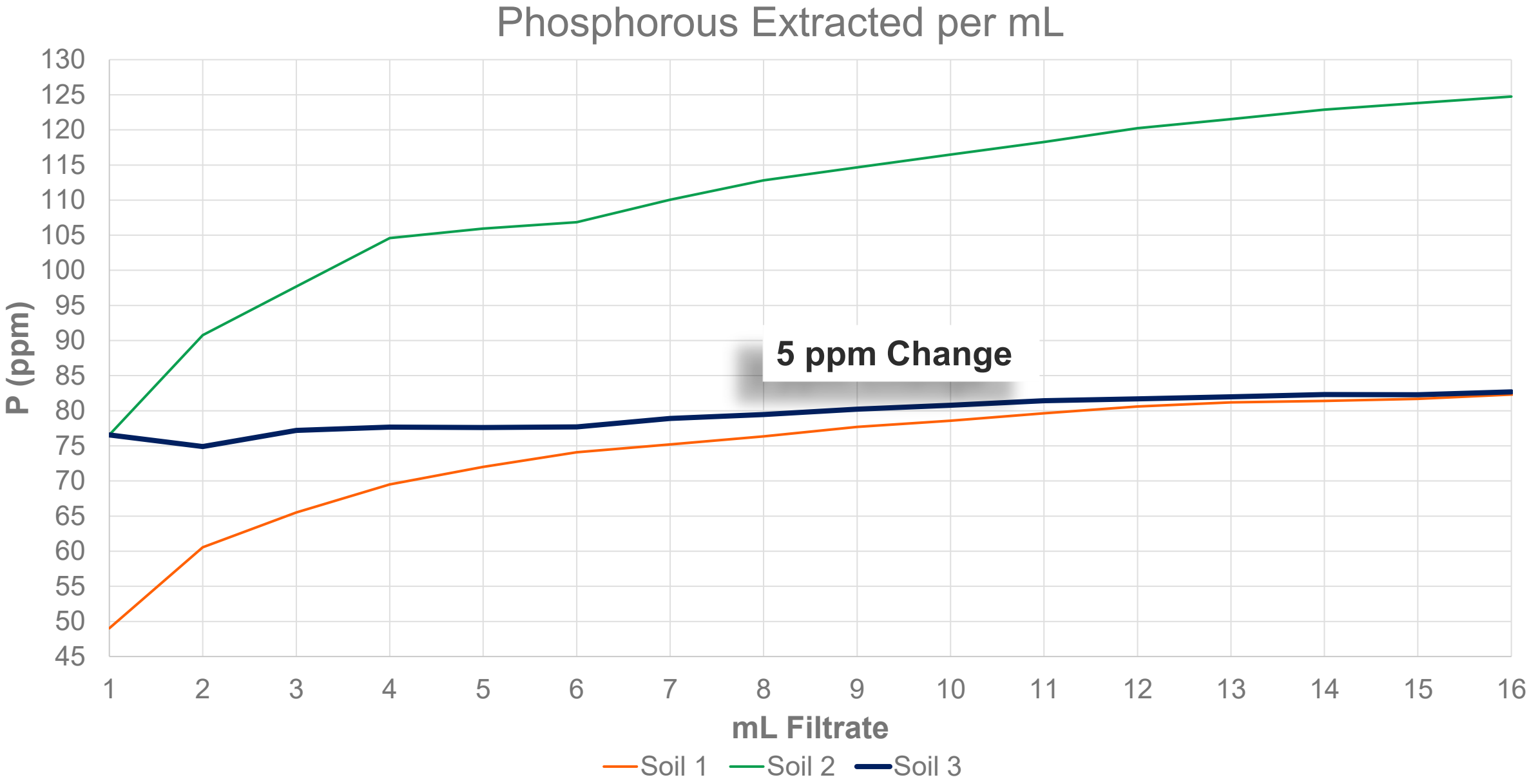


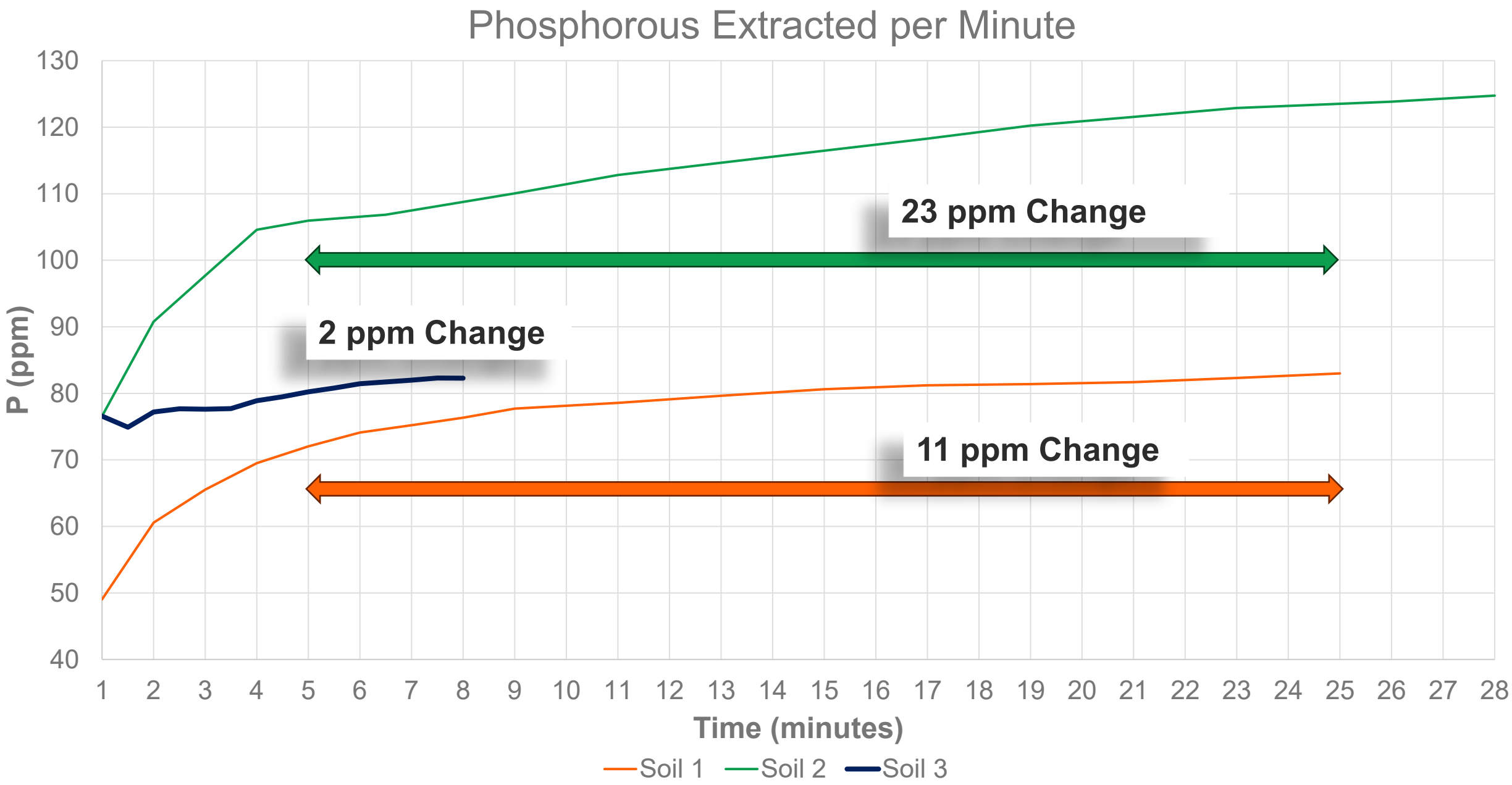
Filtration Timing

How long do you wait for a sample to filter?

RADICLE AGRONOMICS


Phosphorous Extracted per mL
P (ppm)
130
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
16 ppm Change
8 ppm Change
mL Filtrate
Soil 1
Soil 2


Phosphorous Extracted per mL
P (ppm)
130
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
mL Filtrate
5 ppm Change
Soil 1
Soil 2
Soil 3


Phosphorous Extracted per Minute
130
120
110
100
90
80
70
60
50
40
P (ppm)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Time (minutes)
23 ppm Change
2 ppm Change
11 ppm Change
Soil 1
Soil 2
Soil 3



Chemical Quality

How do you know your extractant was made correctly?

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Mehlich 3 Issues from 2 Manufacturers

- Manufacturer A
- pH = 2.5

Soil 1	Ca (ppm)	Mg (ppm)	P (ppm)
Manufacturer A	15917	502	6

- Manufacturer B
- pH = 2.5

Soil 1	Ca (ppm)	Mg (ppm)	P (ppm)
Manufacturer B	6783	303	0.8

Mehlich 3 Issues from 2 Manufacturers

- Manufacturer A
- pH = 2.5

Soil 1	Ca (ppm)	Mg (ppm)	P (ppm)
Manufacturer A	15917	502	6

- Acid Titration = 0.213 N

- Manufacturer B
- pH = 2.5

Soil 1	Ca (ppm)	Mg (ppm)	P (ppm)
Manufacturer B	6783	303	0.8

- Acid Titration = 0.04 N

12. A computer or calculator, used for calculation of the concentrations of phosphorus in the soil

Mehlich 3 Extracting Solution

0.2 N CH_3COOH (acetic acid, glacial: 99.5 percent, fw 60.04, 17.4 N), 0.25 N NH_4NO_3 (ammonium nitrate: fw 80.05), 0.015 N NH_4F (ammonium fluoride: fw 37.0), 0.013 N HNO_3 (nitric acid: 68 to 70 percent, fw 63.02, 15.5 N), 0.001 M EDTA [$(HOOCCH_2)_2NCH_2CH_2N(CH_2COOH)_2$ ethylenedi

0.2 + 0.013 = 0.213

a

2. Ammonium fluoride, EDTA stock solution (3.75 M NH_4F: 0.25 M EDTA)
   a. Add 1,200 mL of distilled water to a 2 L volumetric flask.
   b. Add 277.8 g of ammonium fluoride and mix.
   c. Add 146.1 g EDTA to the solution.
   d. Bring solution to 2 L, mix thoroughly and store in plastic (stock solution for 10,000 samples).
3. Mehlich 3 extractant preparation
   a. Add 8 L of distilled water to a 10 L carboy.
   b. Add slowly 700 mL of concentrated sulfuric acid.
   c. Cool and dilute to a final volume of 1,000 mL. This solution may be blue, but will clear when diluted for use.
   d. Store in the dark under refrigeration.

Ascorbic Acid Stock Solution

1. Dissolve 13.2 g of ascorbic acid in distilled water and dilute to a final volume of 100 mL.
2. Store in the dark under refrigeration.

Molybdate Solution

1. Prepare fresh daily by adding 25 mL of acid molybdate stock solution to a volumetric flask containing about 800 mL of distilled water.
2. Mix thoroughly.
3. Add 10 mL of ascorbic acid stock solution.
4. Add distilled water to a final volume of 1,000 mL.

Procedure

1. Scoop 2 g of soil (see Chapter 2).
2. Add measured volume of soil to a 50 mL Erlenmeyer flask, tapping the scoop on the funnel or

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Mehlich 3 Issues from 2 Manufacturers

- Manufacturer A
- pH = 2.5

Soil 1	Ca (ppm)	Mg (ppm)	P (ppm)
Manufacturer A	15917	502	6

- Acid Titration = 0.213 N

- Manufacturer B
- pH = 2.5

Soil 1	Ca (ppm)	Mg (ppm)	P (ppm)
Manufacturer B	6783	303	0.8

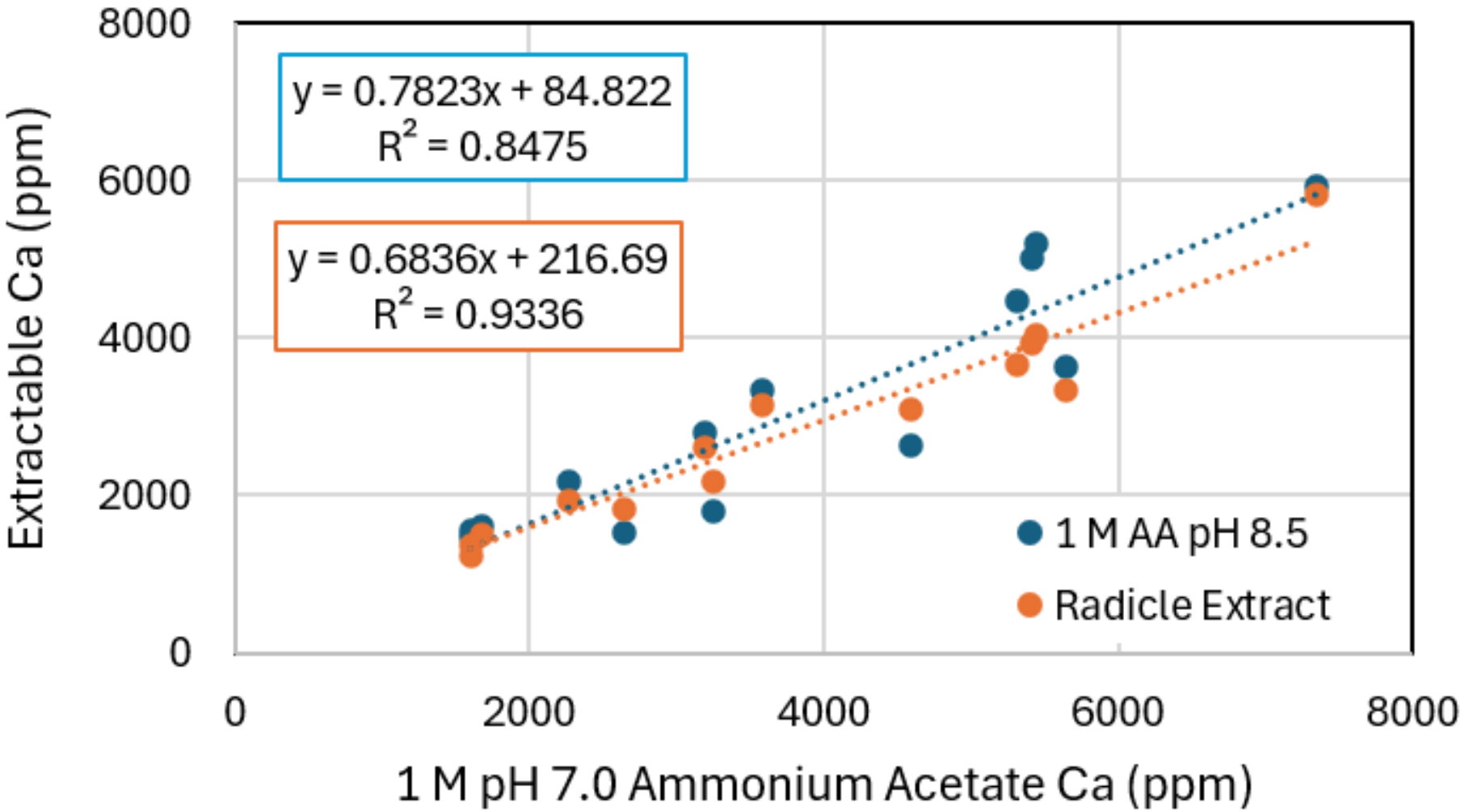
- Acid Titration = 0.04 N

What's the right method for exchangeable bases?

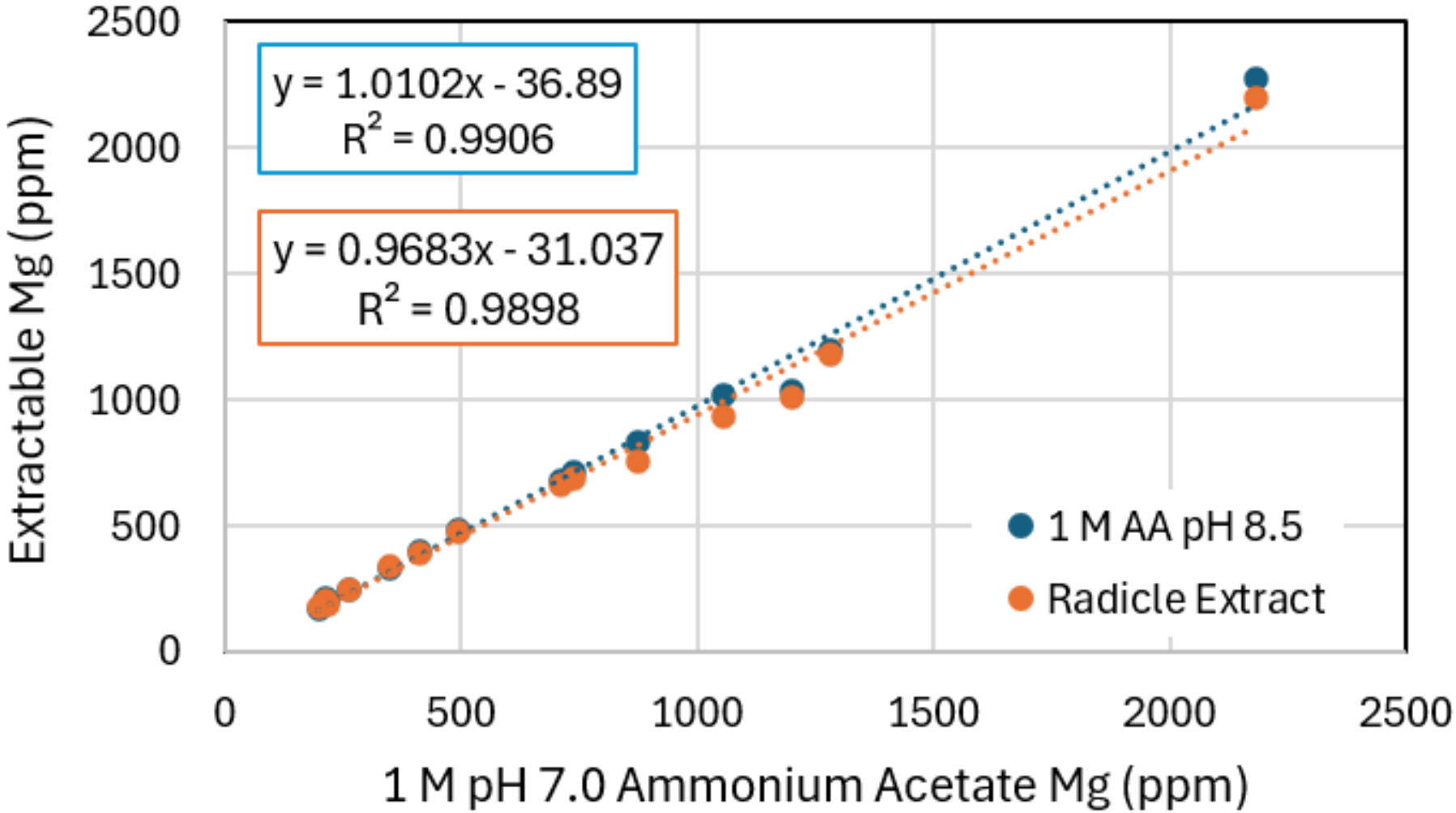
It's certainly not Mehlich 3…

- 1 M ammonium acetate pH 7.0?
- 1 M ammonium acetate pH 8.5?
- Something else?

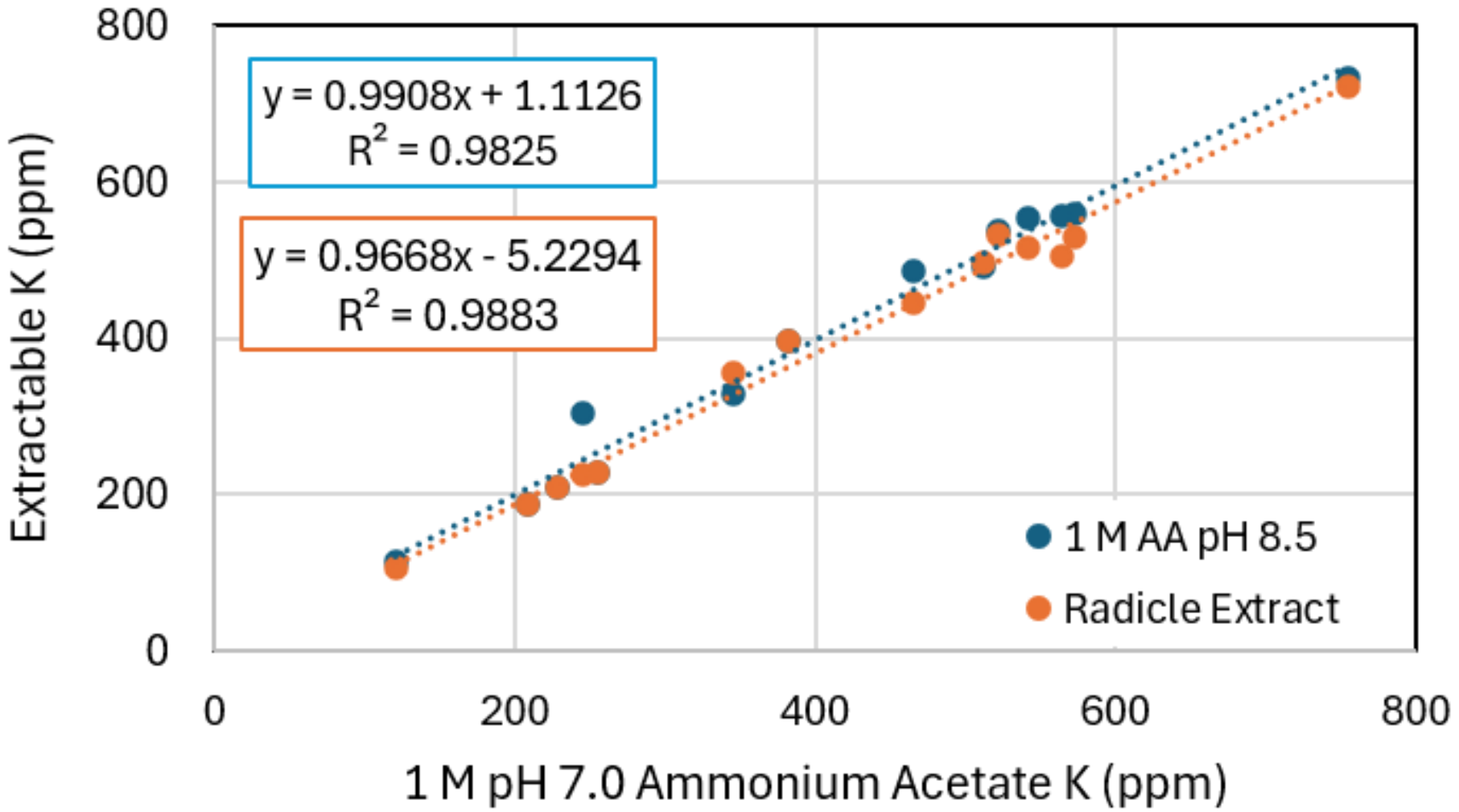
Calcium extracted by 1 M ammonium acetate pH 7.0, 8.5, and Radicle Extract (soil pH 7.0–7.9)



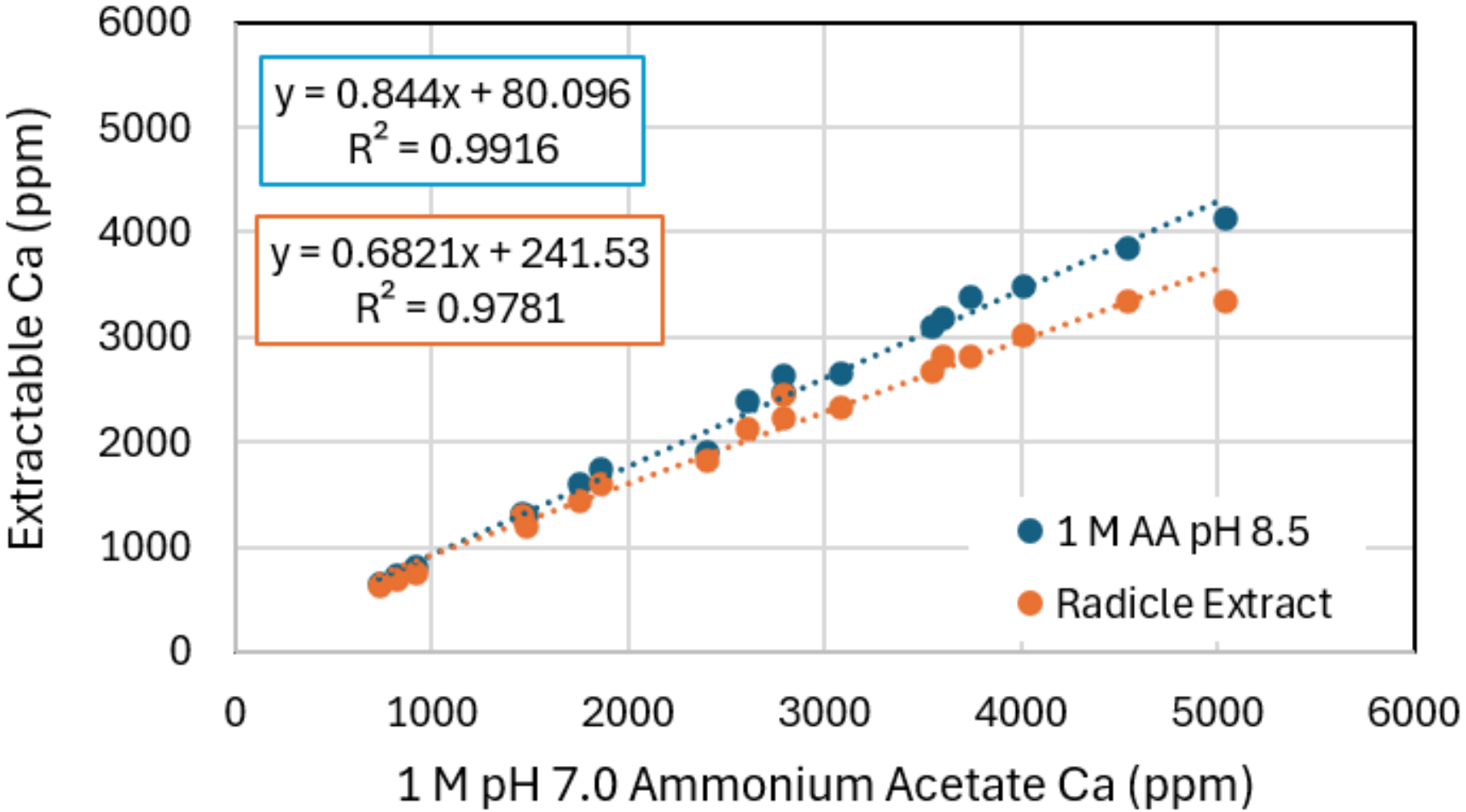
Magnesium extracted by 1 M ammonium acetate pH 7.0, 8.5, and Radicle Extract (soil pH 7.0–7.9)



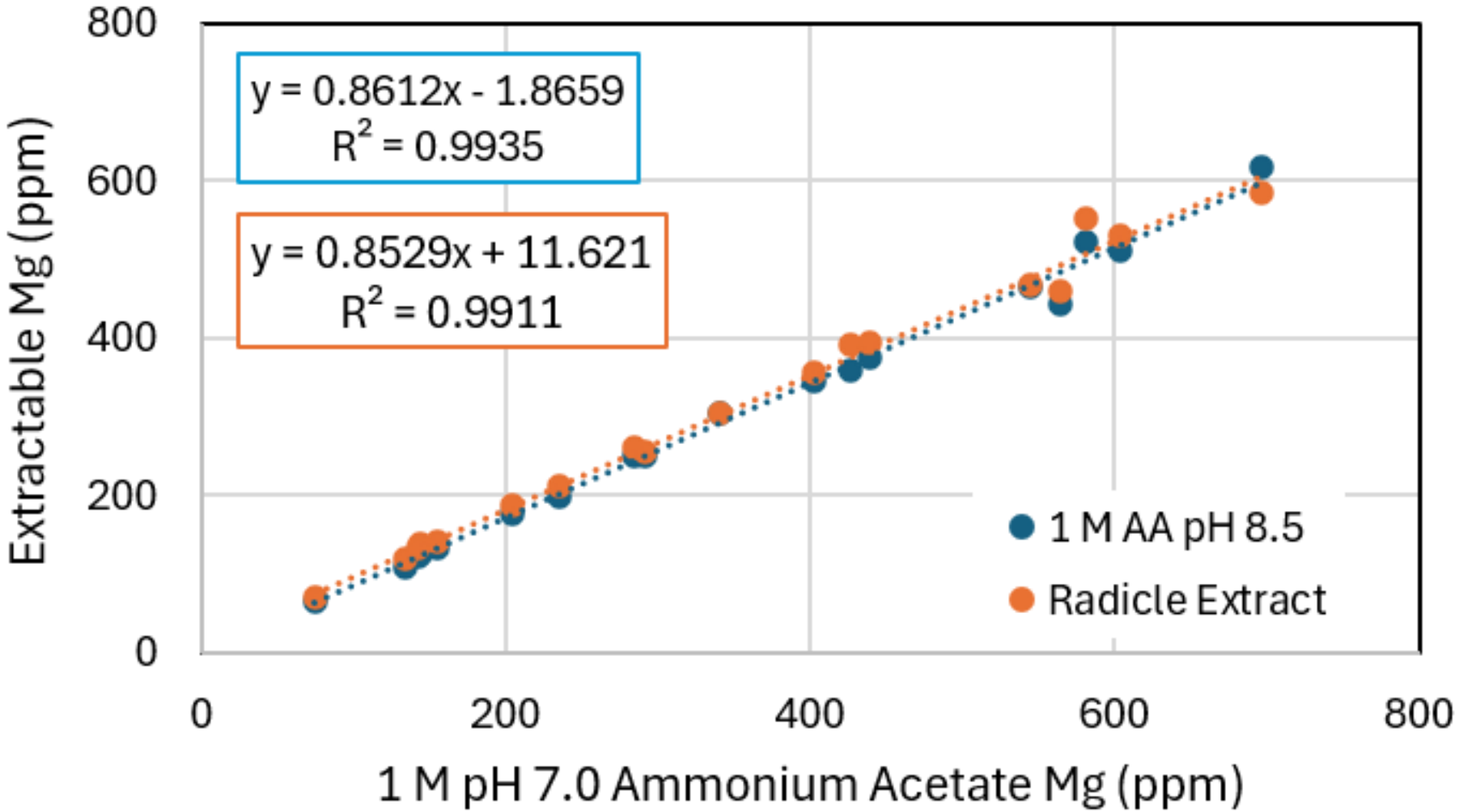
Potassium extracted by 1 M ammonium acetate pH 7.0, 8.5, and Radicle Extract (soil pH 7.0 – 7.9)



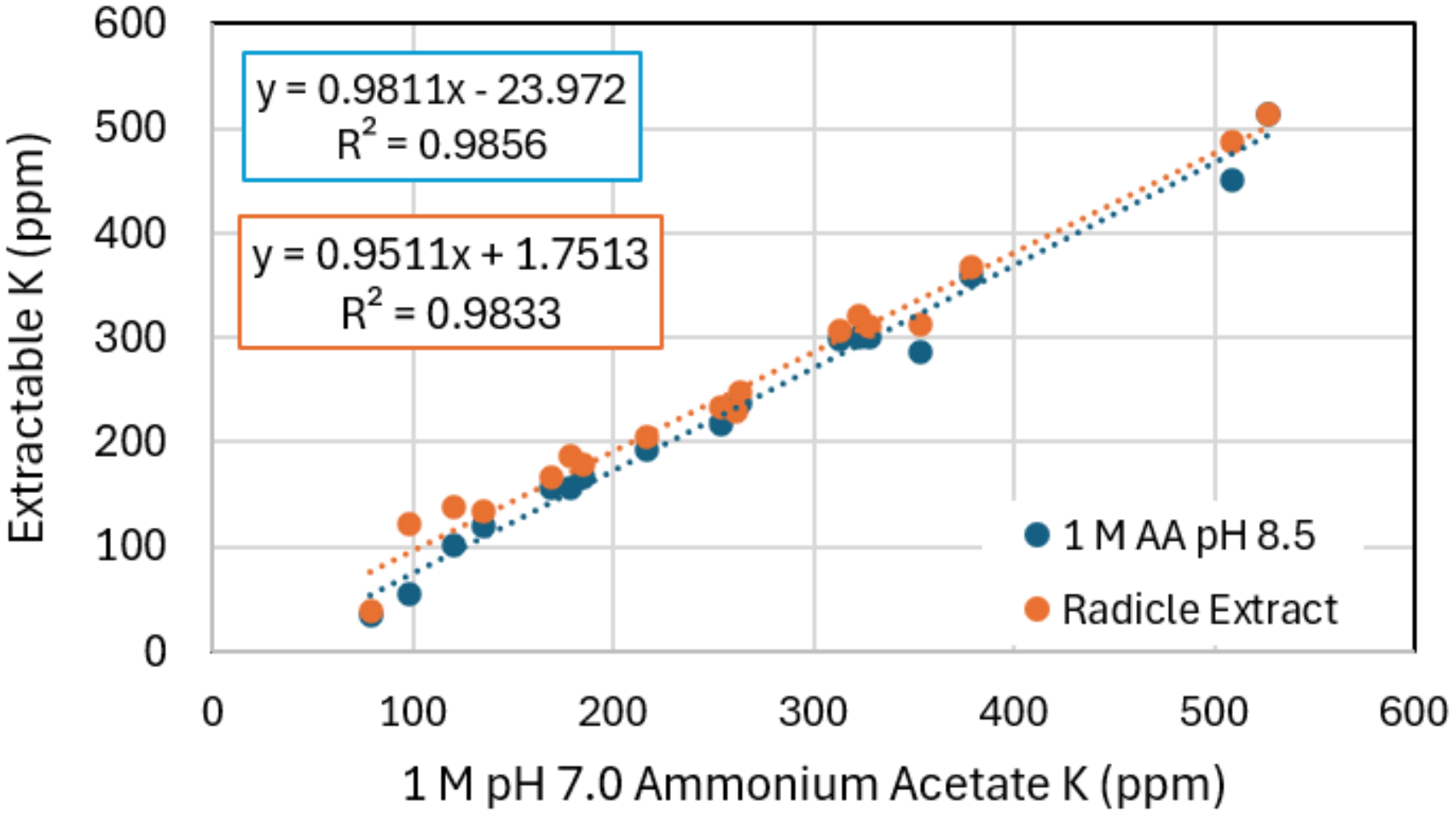
Calcium extracted by 1 M ammonium acetate pH 7.0, 8.5, and Radicle Extract (soil pH 4.7– 6.7)



Magnesium extracted by 1 M ammonium acetate pH 7.0, 8.5, and Radicle Extract (soil pH 4.7– 6.7)



Potassium extracted by 1 M ammonium acetate pH 7.0, 8.5, and Radicle Extract (soil pH 4.7– 6.7)



Thank you for your time!!!

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