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The Foundation for The Gator Nation

Release Properties of Slow-Release Fertilizer Materials

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SRF Characterization Methods

1. Short-term accelerated laboratory procedure to extract N from SRF.

2. Soil incubation method to estimate N release over time.

3. Statistical correlation of the data from both methods.

Accelerated Laboratory Extraction

- Place 30 g unground sample in columns.
- Fill columns with 475 mL extraction solution from bottom.
- Reverse flow to collect extract.

Accelerated Laboratory Extraction

Four extraction sequences:

Extraction #1- 2hrs @ 25°C

Extraction #2- 2 hrs @ 50°C

Extraction #3- 20 hrs @ 55°C

Extraction #4- 50 hrs @ 60°C

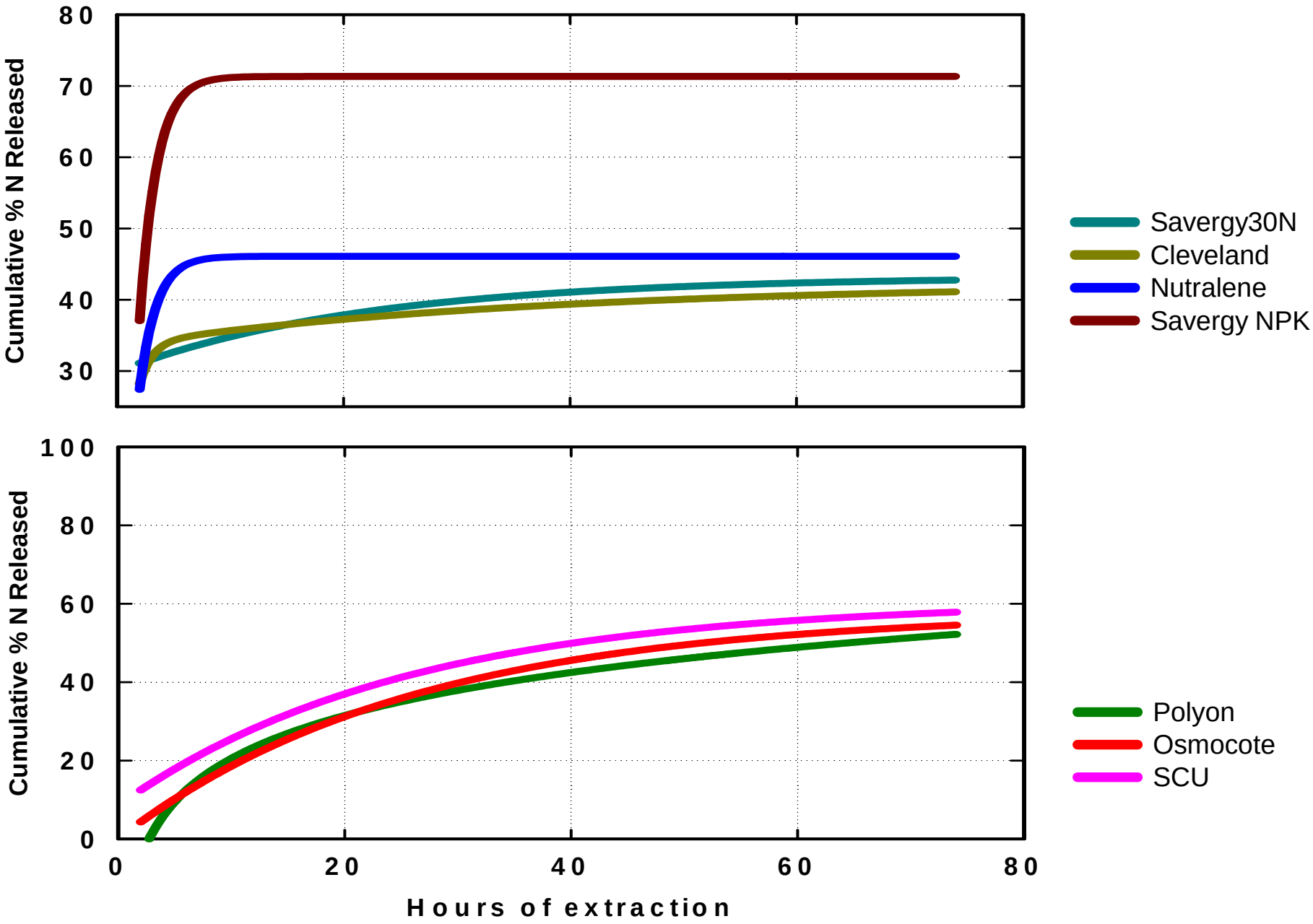
List of tested materials

Sample Description	Slow Release Materials	% N Guaranteed as SR
40-0-0	Nutralene	50% WSSAN & 35% WIN
29-3-4	Methylene Ureas	25% WIN
32-2-3	Methylene Ureas	15% WSSAN & 10% WIN
Sagalene 40N	Methylene Ureas	40% WIN
Savergy 30N	Methylene Ureas	30% WIN
Savergy NPK 25	Methylene Ureas	
Cleveland 38N	Methylene Ureas	38% WIN
38-0-0	Nitroform	18% WSSAN & 72% WIN

List of tested materials

Sample Description	Slow Release Materials	% N Guaranteed as SR
31-0-0	IBDU	90% WIN
28-4-10	Sulfur Coated Urea	15% CSRN
38-0-0	Sulfur Coated Urea	95% CSRN
19-6-12	Osmocote	95% CSRN
43-0-0	Polyon	95% CSRN
35-0-4	AN & SCU	71% CSRN
32.5-0-4	Urea & Nitroform	14% WSSAN & 54% WIN
20-2-20	KNO_3 & Nitroform	60% WIN

PERCENT N EXTRACTED OVER 74 HOURS



Soil Incubation Methodology

1. 12 inch section of 3inch PVC pipe with caps.
2. 1710 g of sand and 90 g Arredondo soil.
3. Add 450 mg N from each SRF source.
4. Mix N source with entire sand/soil mix.
5. Add 180 ml water (10%) by weight.
6. Place beaker containing 20 mL of 0.2 M H_2SO_4 on surface as ammonia trap.

Soil Incubation Apparatus

Incubation Lysimeters

Ammonia Trap

Leaching Procedure

7. Leach with one pore volume (500 ml) of 0.01% citric acid using vacuum for 2 minutes.

8. Leach at 7, 14, 28, 56, 84, 112, 140 and 180 days.

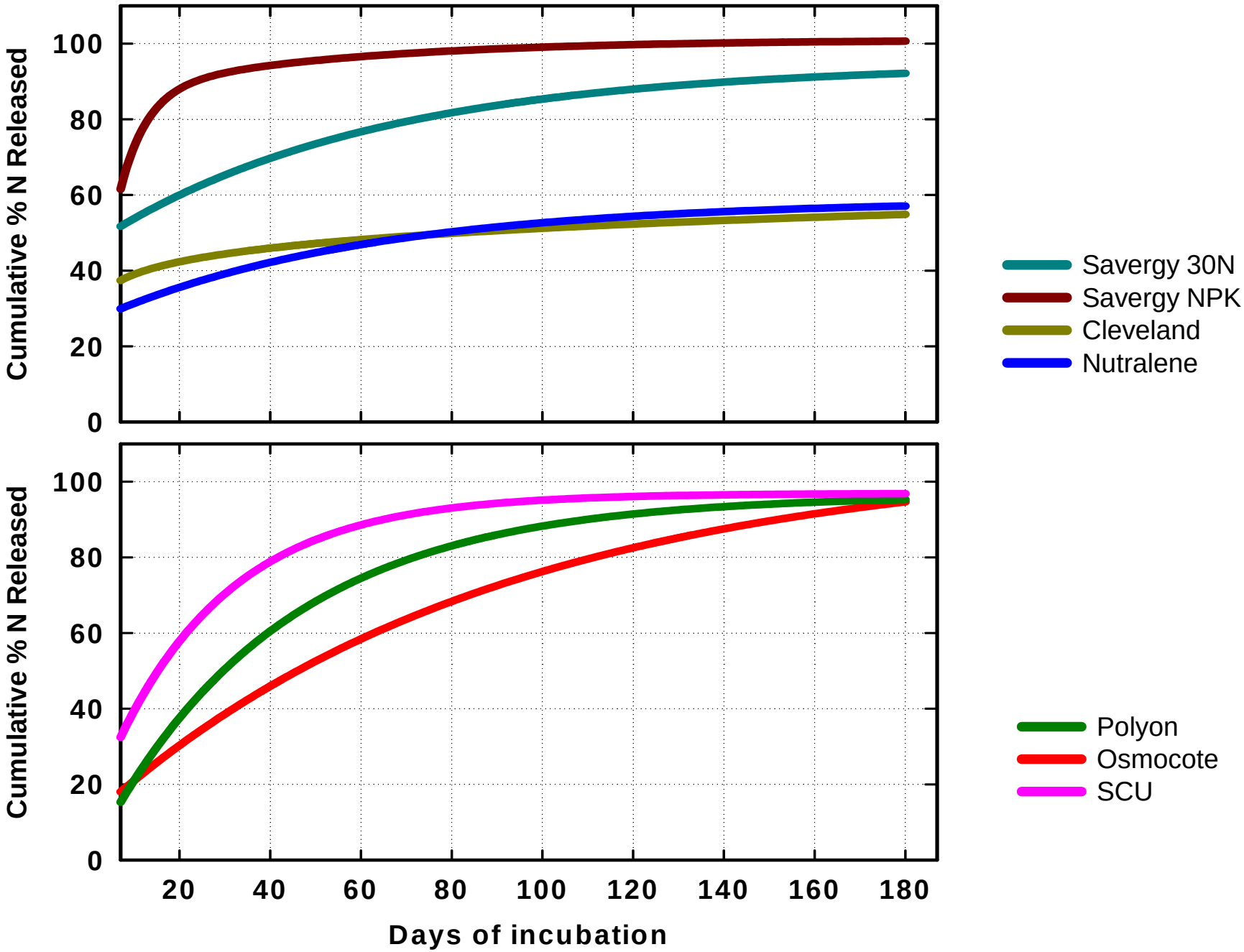
9. Determine total N on leachates.

Leaching Procedure

Column Leaching

Leachates

PERCENT N RELEASED OVER TIME



Conclusions

- All fertilizer materials fitted non-linear regression curves.
- SRF materials can be grouped according to release characteristics.
- Several additional soil incubation and accelerated lab extraction studies need to be run to establish reproducible equation.

Soil Incubation Method Optimization

1. Soil Ratio Study

- Objective: To evaluate the effect of different soil ratios on N release rates from SRF.

-Soil Ratios: **45g – 90g – 180g**

2. Temperature study

- Objective: To evaluate the effect of different temperatures on N release rates from SRF.

- Temperatures: **70°F - 77°F - 95°F**

List of selected fertilizer materials

Sample Description	Slow Release Material
38-0-0	Nitroform
39-0-0	Sulfur Coated Urea
19-6-12	Osmocote
37-0-0	Polymer Sulfur Coated Urea
43-0-0	Polyon
18-6-8	Nutricote
6-3-2	Biosolid

Time (d)	Cumulative % N released			Contrast	
	1 (45g)	2 (90g)	3 (180g)	2 vs 1	2 vs 3
		----------Osmocote----------			
7	43	30	54	**	***
81	94	87	100	**	***
180	100	100	100	NS	NS
		----------Poly-S----------			
7	11	13	19	NS	**
81	52	50	64	NS	**
180	68	75	82	NS	NS
		----------Polyon----------			
7	17	15	24	NS	**
81	68	77	81	***	*
180	72	89	87	***	NS
		----------Nutricote----------			
7	2	3	2	NS	NS
81	41	46	64	NS	***
180	64	67	85	NS	**

Time (d)	Cumulative % N released			Contrast	
	1 (45g)	2 (90g)	3 (180g)	2 vs 1	2 vs 3
	----------Sulfur Coated Urea----------				
7	43	31	45	**	**
81	73	62	71	**	**
180	79	77	80	NS	NS
	----------Nitroform----------				
7	19	15	22	**	**
81	22	23	28	*	**
180	25	31	38	***	***
	----------Biosolid----------				
7	33	40	41	NS	**
81	45	49	52	**	*
180	48	52	57	**	**

NS = not significant, * = significant P<0.05, ** = significant P<0.01 and *** = significant P<0.001.

Conclusions- Soil Ratio Study

- Overall, for coated-fertilizer materials, soil ratio had no effect on N release rate.
- Soil ratio effect was likely due to change in soil moisture content.
- For SRF materials dependent on microbial degradation, soil ratio had an effect on N release.

Time (d)	Cumulative % N released			Contrast	
	1 (70ºF)	2 (77ºF)	3 (95ºF)	1 vs 2	1 vs 3
			----------Osmocote----------		
7	30	48	50	**	**
81	87	100	100	**	**
180	100	100	100	NS	NS
			----------Poly-S----------		
7	13	18	18	**	**
81	50	70	75	***	***
180	75	78	87	NS	**
			----------Polyon----------		
7	15	30	49	**	***
81	77	97	100	**	***
180	89	100	100	NS	**
			----------Nutricote----------		
7	3	2	16	NS	***
81	46	57	77	***	***
180	67	78	95	***	***

Time (d)	Cumulative % N released			Contrast	
	1 (70ºF)	2 (77ºF)	3 (95ºF)	1 vs 2	1 vs 3
	----------Sulfur Coated Urea----------				
7	31	41	41	***	***
81	62	59	76	*	**
180	77	71	86	**	***
	----------Nitroform----------				
7	15	20	20	**	**
81	23	30	37	**	***
180	31	38	50	**	***
	----------Biosolid----------				
7	40	38	50	*	**
81	49	51	63	NS	***
180	52	56	68	**	***

NS = not significant, * = significant P<0.05, ** = significant P<0.01 and *** = significant P<0.001.

Conclusions- Temperature Study

- For coated-fertilizer materials, there was no difference on N release rate between 70 & 77ºF.
- For all materials, there was a great difference in N release rate for 70 vs 95ºF.
- Therefore, it is recommended to incubate the soil columns at a range of 70 – 77ºF.

Lab Extraction Method Optimization

Four extraction sequences:

Standard protocol-

Extraction #1- 2hrs @ 25°C

Extraction #2- 2 hrs @ 50°C

Extraction #3- 20 hrs @ 55°C

Extraction #4- 50 hrs @ 60°C

Laboratory Extraction Optimization

Objective: To test the ruggedness of the method. It includes varying parameters:

1. Extraction time
2. Sample size
3. Temperature levels

1. Extraction Time Study

Extraction Number	TIME 1 (hr) SHORT	TIME 2 (hr) NORMAL
1	2:00	2:00
2	1:45	2:00
3	18:00	20:00
4	50:00	50:00
TOTAL	71:45	74

2. Sample Size Study

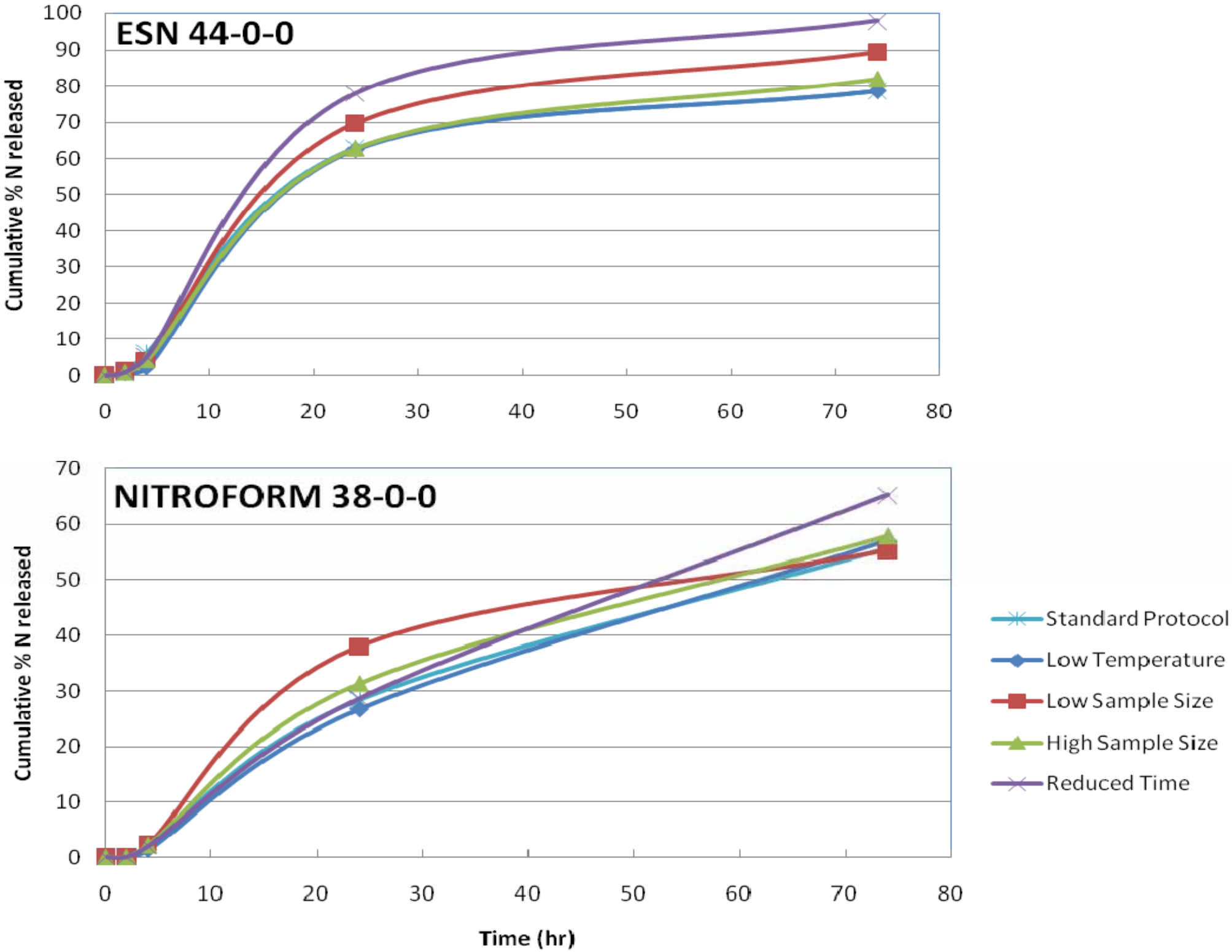
SIZE 1 (g) LOW	SIZE 2 (g) NORMAL	SIZE 3 (g) HIGH
27	30	33

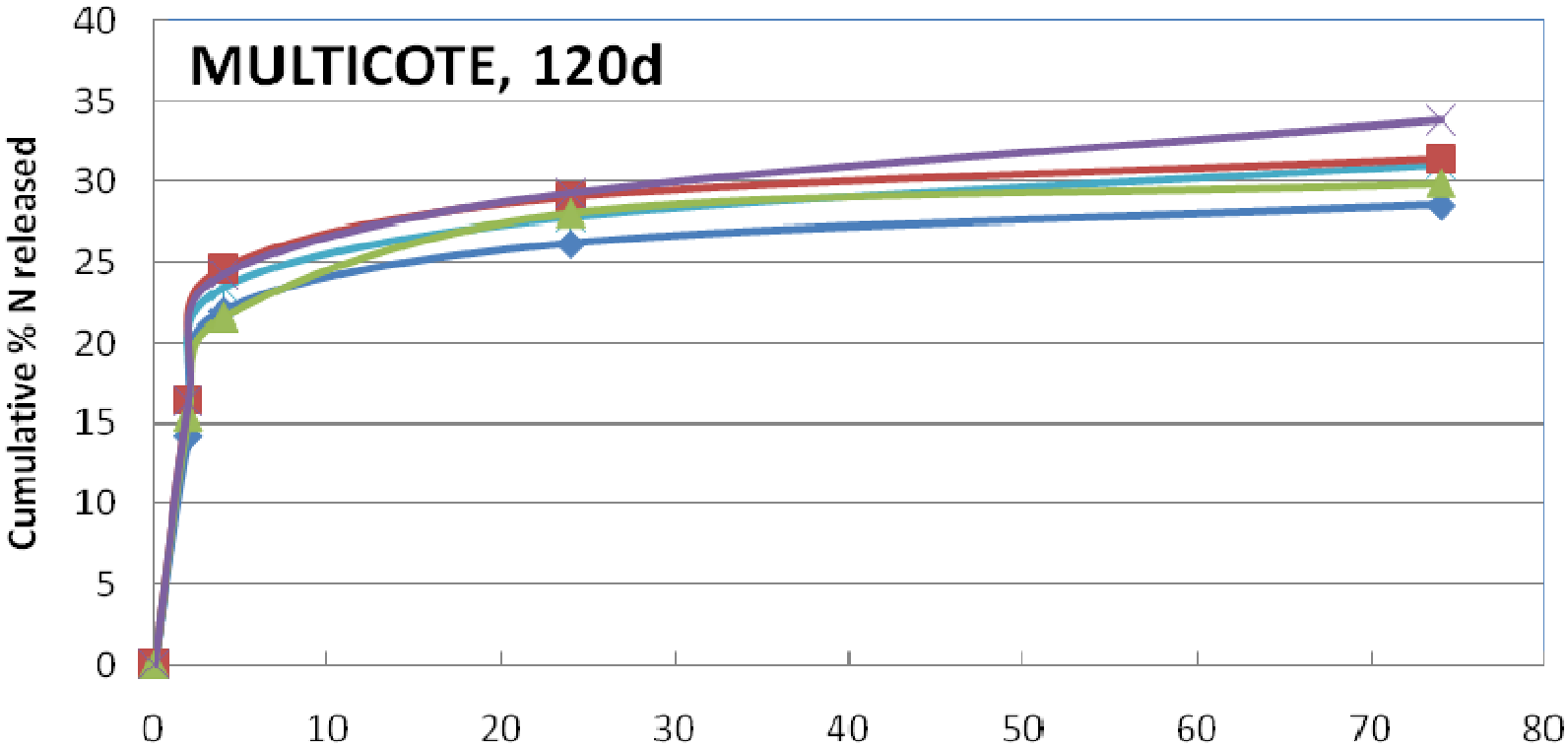
3. Temperature Study

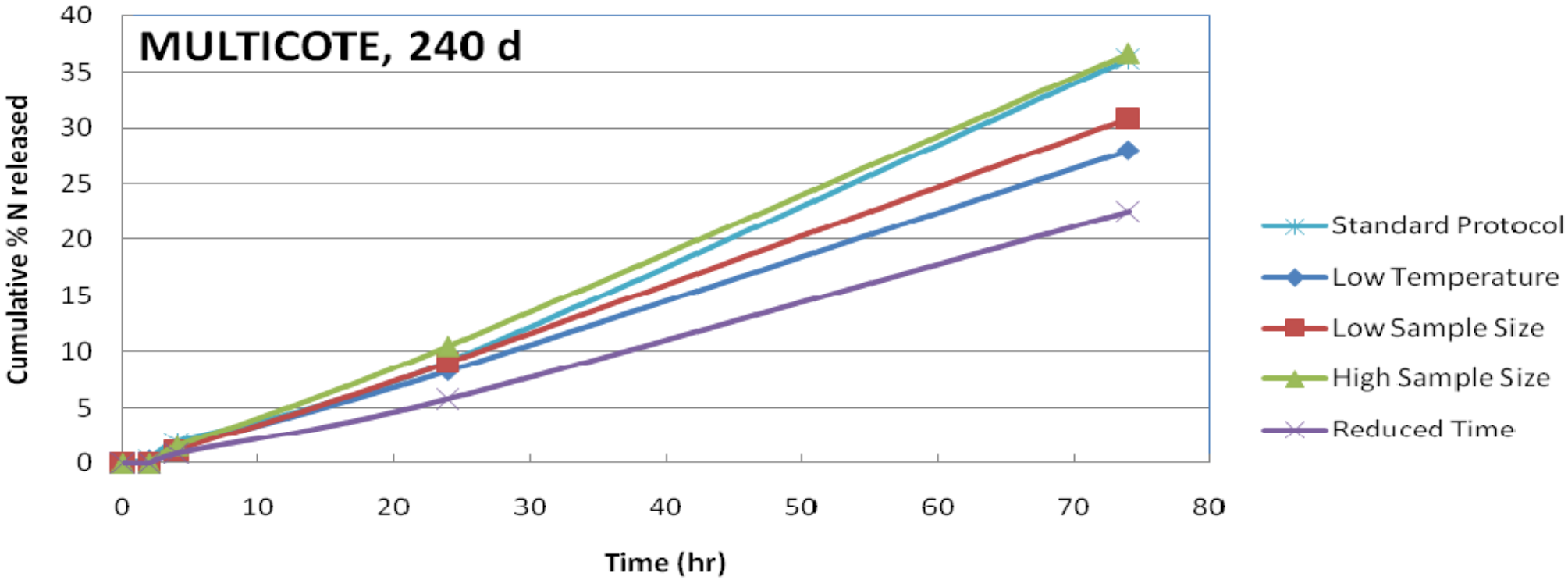
Extraction Number	Hours of Extraction	TEMP 1 (°C) LOW	TEMP 2 (°C) HIGH
1	2	25	25
2	2	55	60
3	20	55	60
4	50	55	60

List of selected fertilizer materials

Sample Description	Slow Release Material
44-0-0	ESN
38-0-0	Nitroform
15-7-15	Multicote, 4 months
15-7-15	Multicote, 8 months


ESN 44-0-0
Cumulative % N released
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
NITROFORM 38-0-0
Cumulative % N released
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
Time (hr)
Standard Protocol
Low Temperature
Low Sample Size
High Sample Size
Reduced Time


MULTICOTE, 120d
Cumulative % N released
0
5
10
15
20
25
30
35
40
0
10
20
30
40
50
60
70
80


MULTICOTE, 240 d
Cumulative % N released
0
5
10
15
20
25
30
35
40
0
10
20
30
40
50
60
70
80
Time (hr)
Standard Protocol
Low Temperature
Low Sample Size
High Sample Size
Reduced Time

Conclusions- Lab Extraction Method

- Overall extraction time, sample size and temperature levels had no effect on N release.

- Future work: Single Lab Validation