CHARACTERIZATION OF RELEASE PROPERTIES OF SLOW-RELEASE FERTILIZER SOURCES – N RELEASE STUDY

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OBJECTIVES

1. ESTABLISH N RELEASE CURVES FOR CRN SOURCES

2. DEVELOP LABORATORY PROCEDURES FOR EXTRACTING N FROM CRN SOURCES

3. ESTABLISH A RELATIONSHIP BETWEEN RELEASE CURVES AND EXTRACTION PROCEDURES

4. PREDICT N RELEASE BASED ON EXTRACTION

APPARATUS USED

1. 12 inch SECTION OF 3 inch PVC PIPE WITH CAPS
2. ENVIRO CLOTH FOR SOIL SUPPORT
3. 1710 g OF SAND AND 90 g ARREDONDO SOIL
4. ADDED 450 mg N FROM EACH N SOURCE
5. MIXED N SOURCE WITH ENTIRE SAND/SOIL MIX
6. ADDED 180 ml WATER (10%) BY WEIGHT
7. PLACED BEAKER CONTAINING 0.2 N SULFURIC ACID ON SURFACE OF SAND FOR AN AMMONIA TRAP
8. PLACED CAP ON SYSTEM AND SEALED WITH STOP-COCK GREASE
9. LEACHED WITH ONE PORE VOLUME (600 ml) OF 0.01% CITRIC ACID USING VACUUM FOR 2 MINUTES
10. LEACHED AT 7, 14, 28, 56, 84, 112, 140 AND 180 DAYS
11. DETERMINED NO_3, NH_4 AND UREA ON LEACHATES

LABORATORY METHOD OVERVIEW

30 g SAMPLE IN JACKETED CHROMATOGRAPHY COLUMN

UTILIZE AIR AND UPWARD SOLUTION MOVEMENT

REVERSE FLOW TO COLLECT EXTRACT

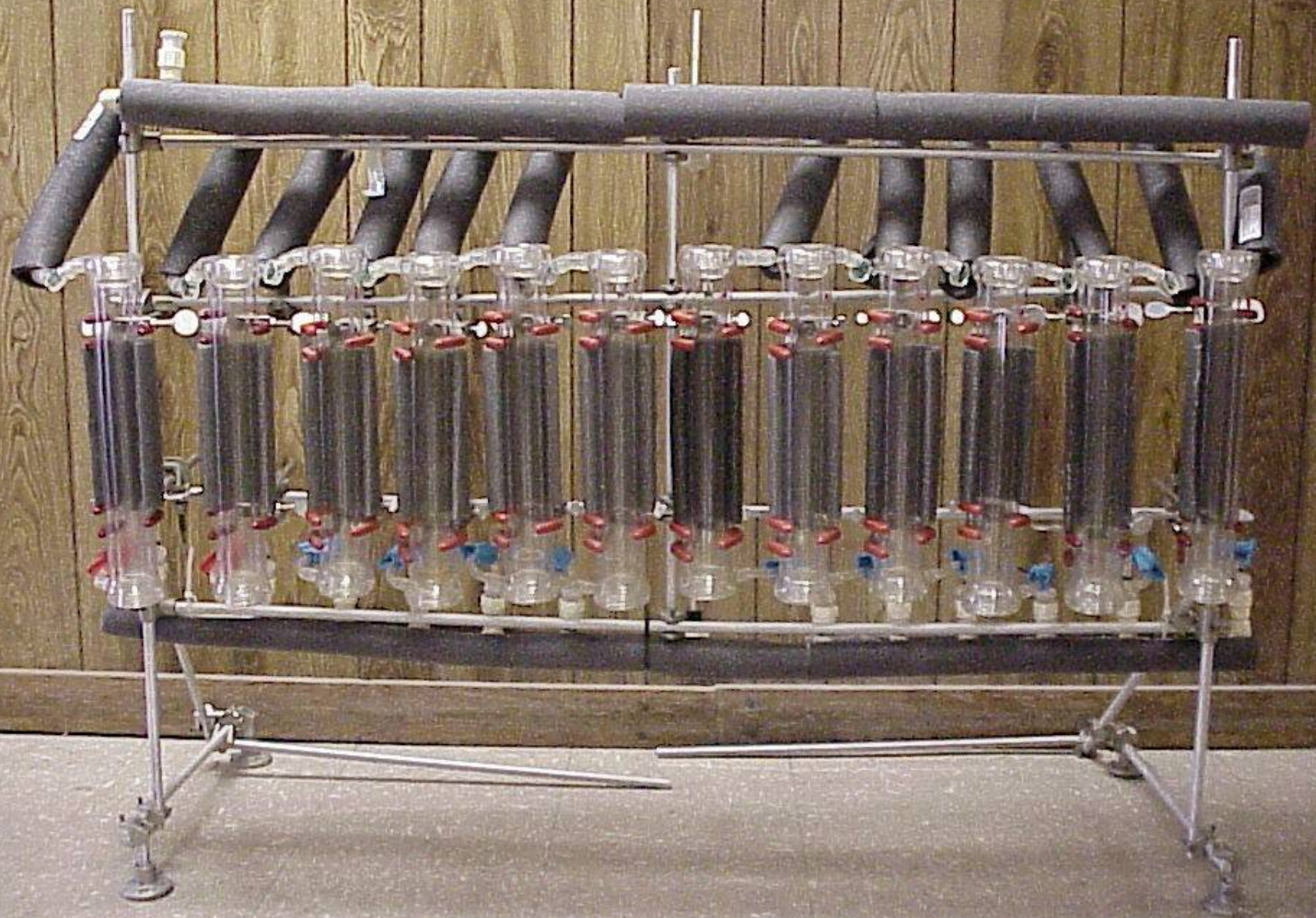 4 INCREASING AGGRESSIVE EXTRACTION SEQUENCES:

EXTRACTION # 1 2 hrs @ 25°C WITH WATER

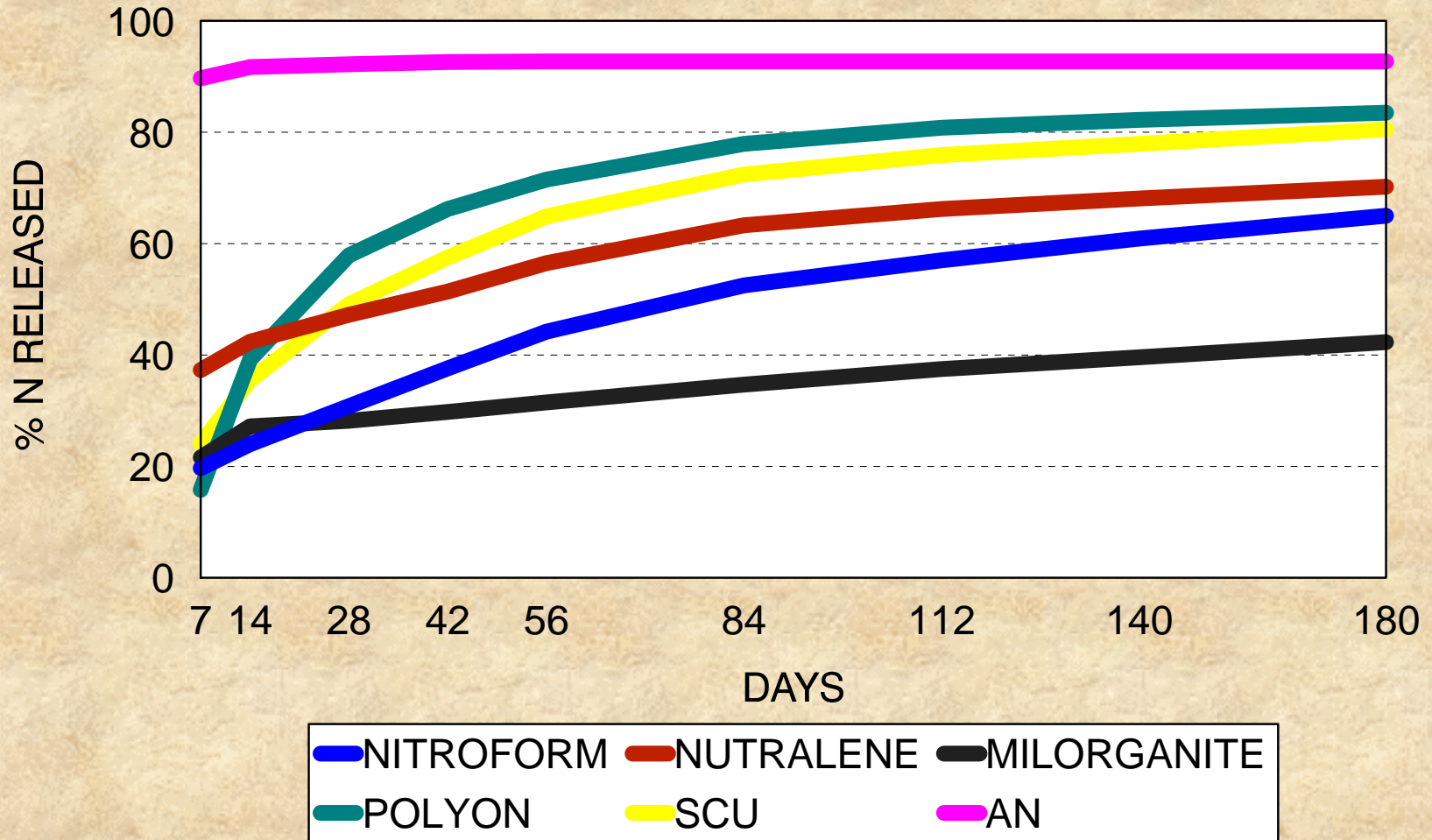**EXTRACTION # 2** 2 hrs @ 60°C WITH 0.2% CITRIC ACID

EXTRACTION # 3 16 hrs @ 60°C WITH 0.2% CITRIC ACID

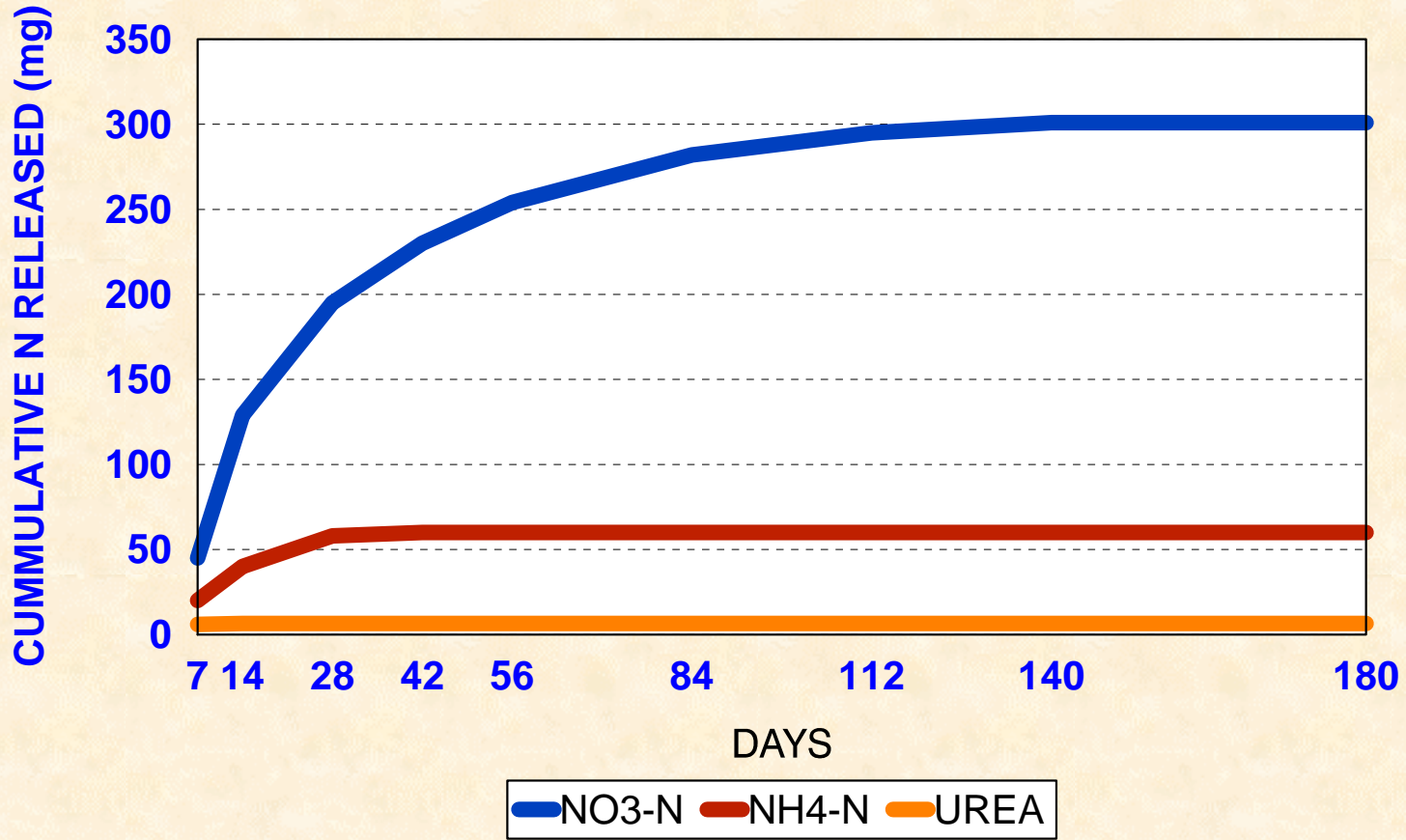**EXTRACTION # 4** 54 hrs @ 60°C WITH 0.2% CITRIC ACID

PERCENT N RELEASED OVER TIME FOR SELECTED CRN MATERIALS

TOTAL N RELEASED FROM POLYON BY FORM OVER TIME

Mean % N released from selected N sources over 189 day incubation period

N Source	7	14	28	56	84	112	140	189
--------------% of applied N released--------------								
Nitroform	14	18	20	23	28	31	35	38
Nutralene	28	35	40	45	50	53	56	58
Polyon	12	23	49	75	86	90	93	94
SCU	30	50	70	84	92	95	98	99
IBDU	8	13	21	32	42	50	56	63
Osmocote	19	25	35	55	72	81	88	94
20-2-20	37	39	41	45	48	50	52	54

Figure 1. Percentage of applied N released from selected nitrogen sources over 189 day soil incubation

SG39BSV = Sazolene 39G Balanced StdSize – **SG39BMV** = Sazolene 39G Balanced ChipSize110
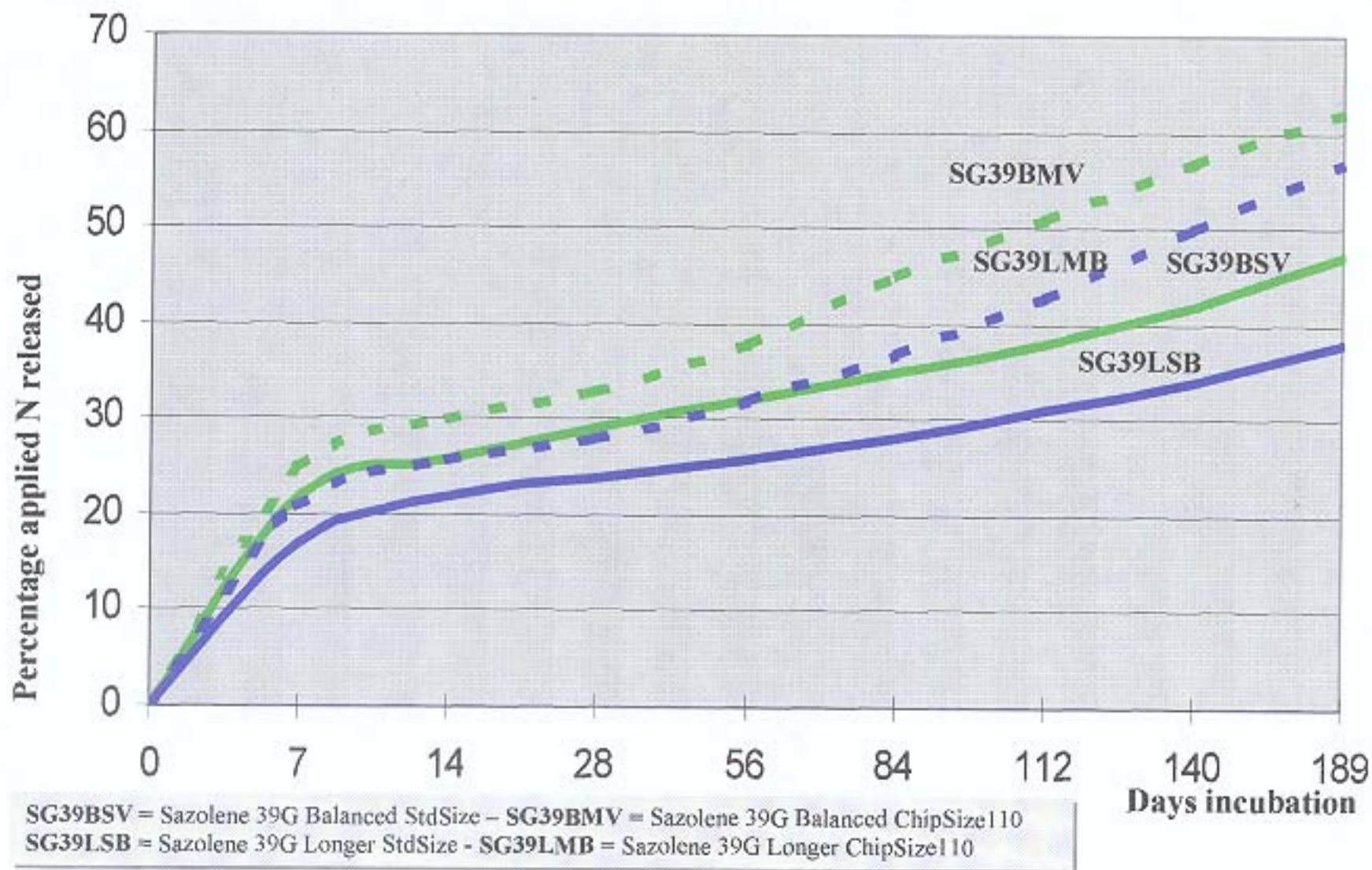**SG39LSB** = Sazolene 39G Longer StdSize - **SG39LMB** = Sazolene 39G Longer ChipSize110
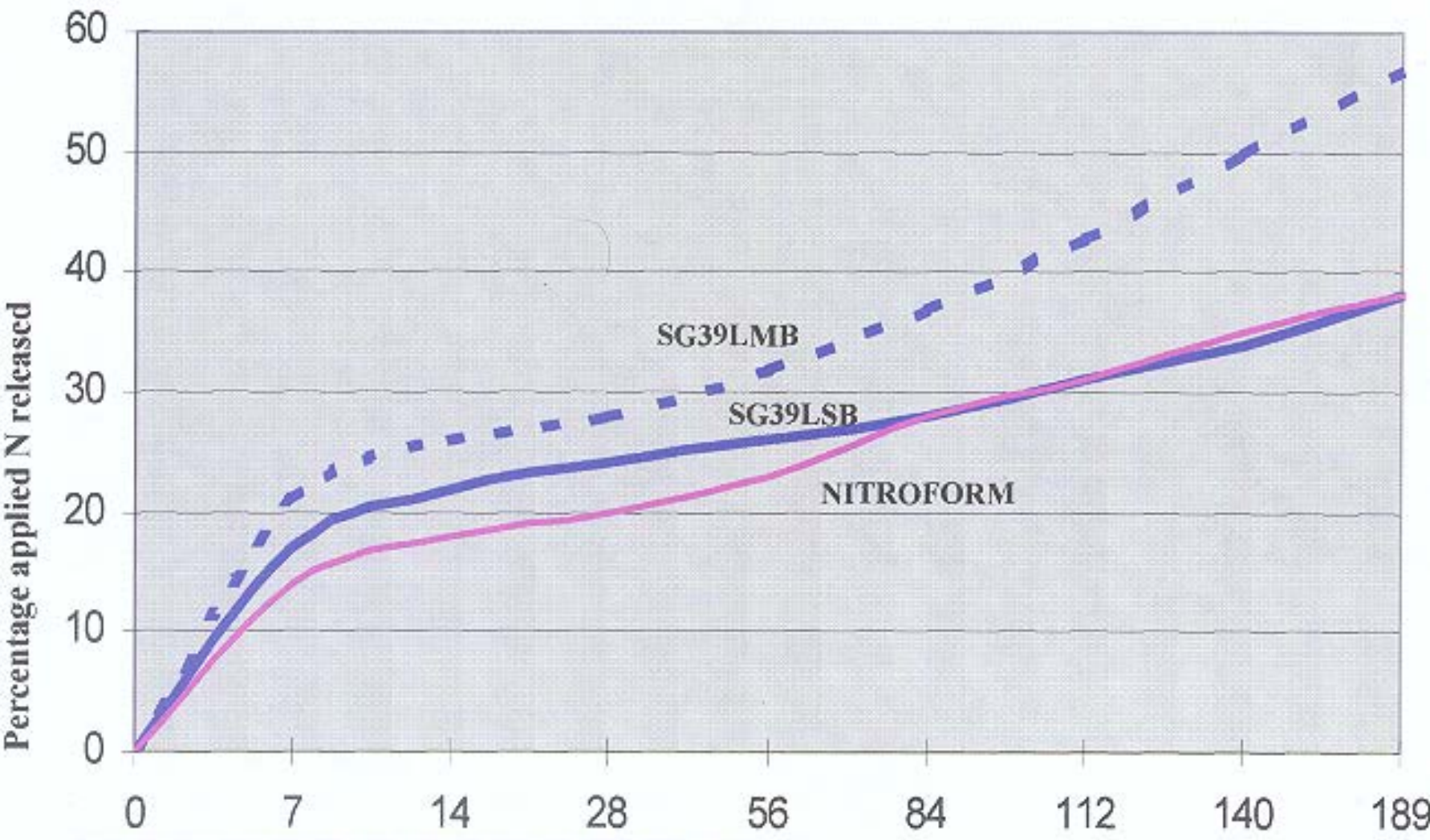
Figure 2. Percentage of applied N released from selected nitrogen sources over 189 day soil incubation

SG39LSB = Sazolene 39G Longer StdSize
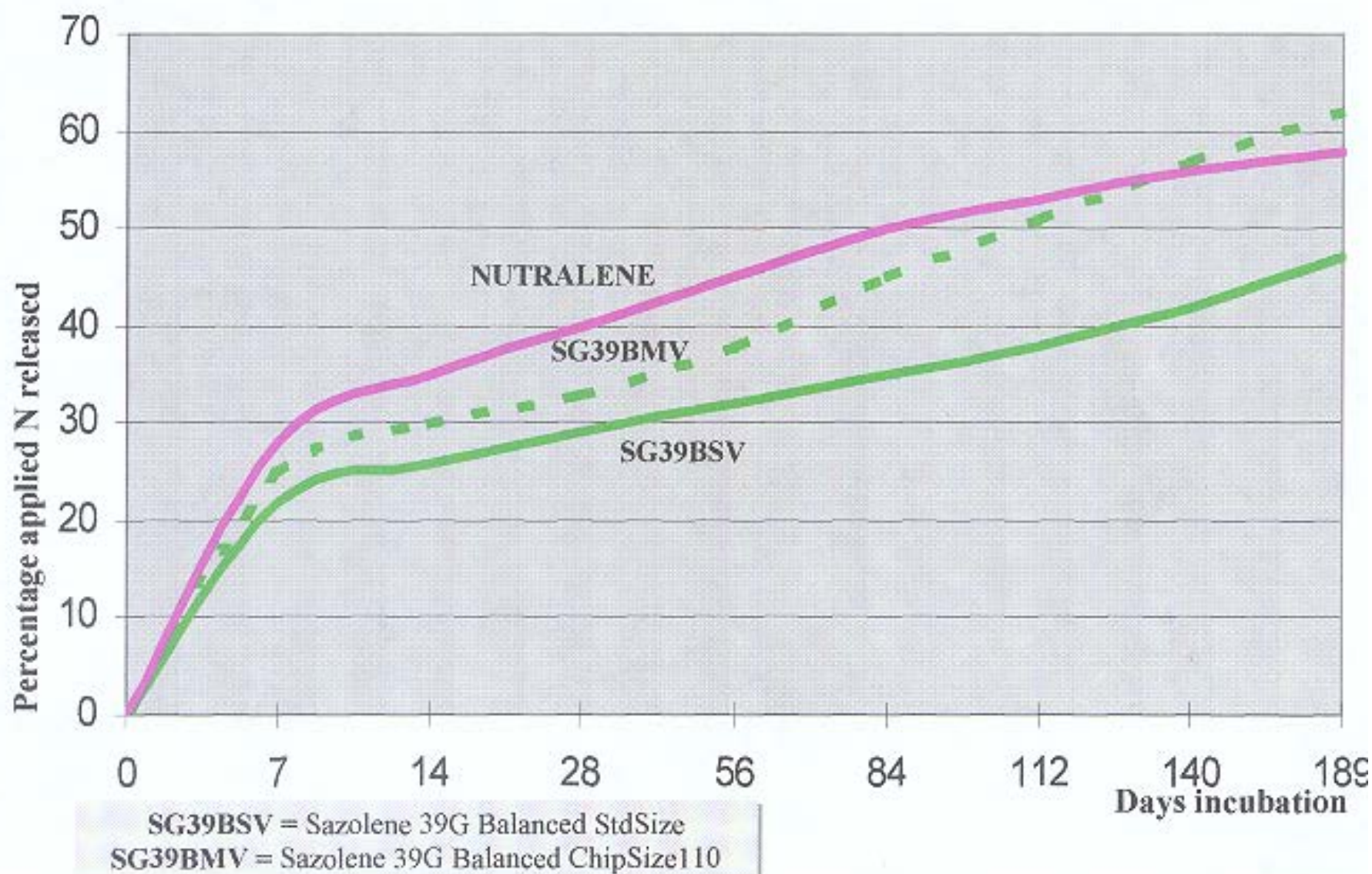SG39LMB = Sazolene 39G Longer ChipSize110

# Figure 3. Percentage of applied N released from selected nitrogen sources over 189 day soil incubation

NUTRALENE

SG39BMV

SG39BSV

Percentage applied N released

Days incubation

SG39BSV = Sazolene 39G Balanced StdSize
SG39BMV = Sazolene 39G Balanced ChipSize110

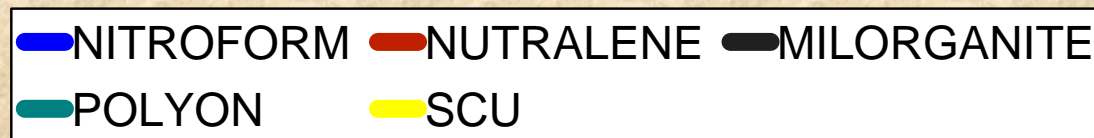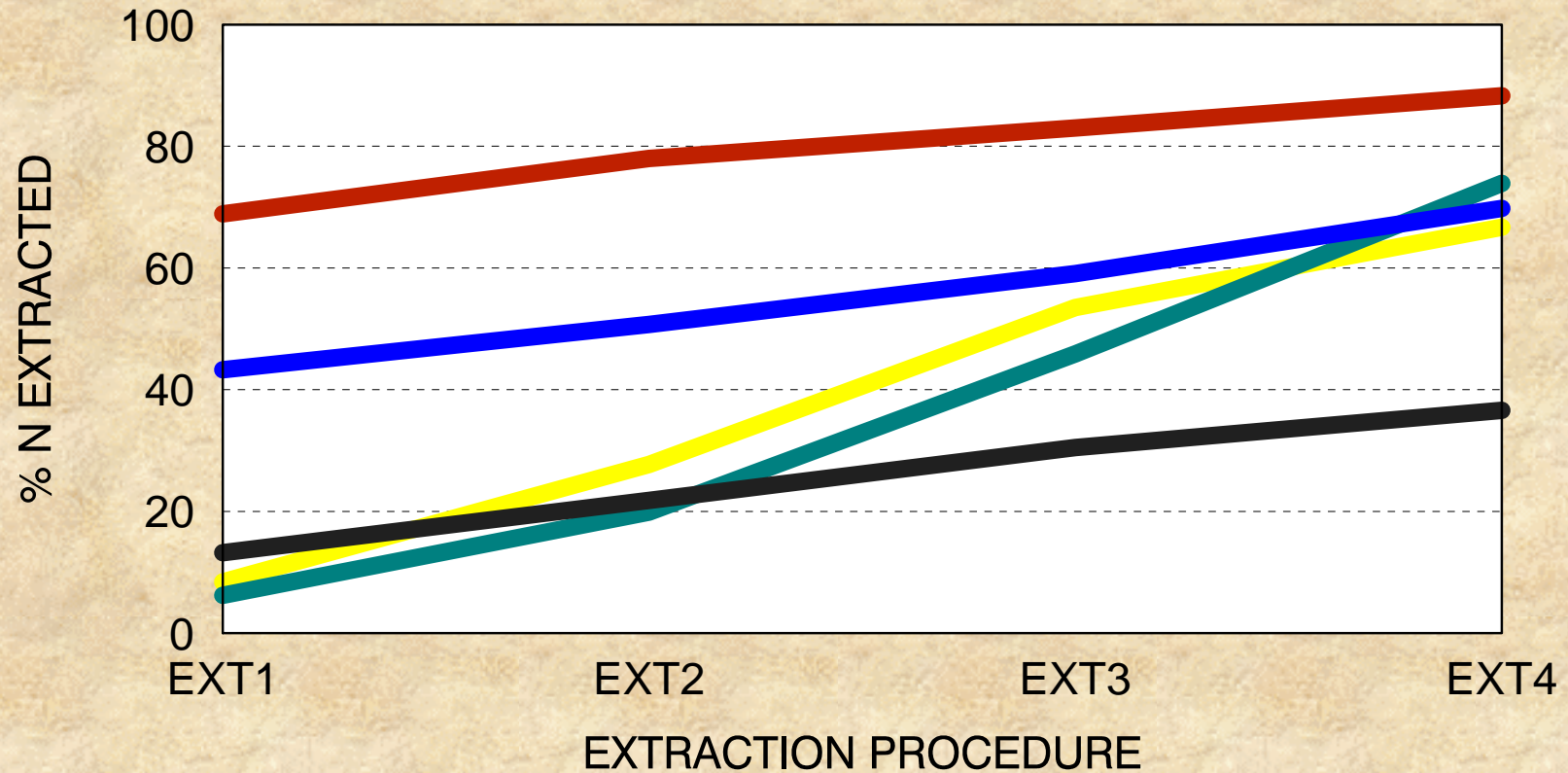# Figure 4. Percentage of applied N released from selected nitrogen sources over 189 day soil incubation

SL28S = Sazolene SC

Figure 5. Percentage of applied N released from selected nitrogen sources over 189 day soil incubation
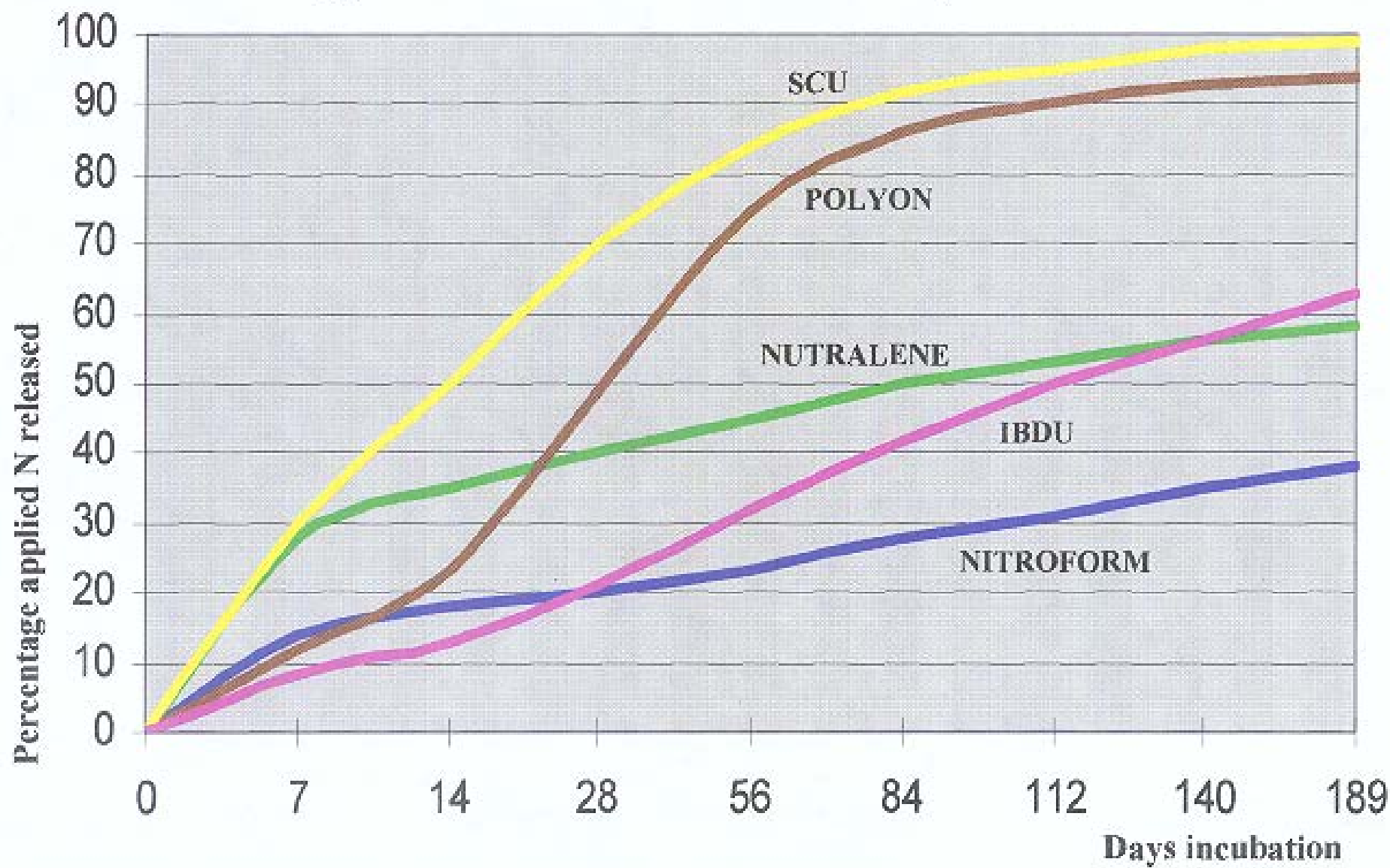
PERCENTAGE N EXTRACTED BY ACCELERATED LAB EXTRACTION

Correlation of Soil Incubation N Release and Accelerated Lab Extraction

Soil Incubation data used:

$$Nt = asym - (asym-int)*e-rate*t \qquad (1)$$

Laboratory extraction data used:

$$asym = ao + a1E1 + a2E2 + a3E3 + a4E4$$
$$int = bo + b1E1 + b2E2 + b3E3 + b4E4 \qquad (2)$$
$$rate = co + c1E1 + c2E2 + c3E3 + c4E4$$

CURVE FITTING METHODOLOGY

STEP 1. FIT NON-LINEAR REGRESSION ON N RELEASE DATA TO OBTAIN ESTIMATES OF a, b AND c

STEP 2. USE a, b AND c AS 'DATA' AND REGRESS ON EXTRACTION DATA TO OBTAIN REGRESSION EQUATIONS FOR PREDICTING a, b AND c FROM EXTRACTION DATA

STEP 3. COMPUTE PREDICTED VALUES FOR a, b AND c FROM EXTRACTION DATA

STEP 4. PLOT PREDICTED NON-LINEAR REGRESSION CURVE FOR EXTRACTION DATA ALONG WITH OBSERVED NON-LINEAR REGRESSION CURVE AND THE DATA.

POLYON
R^2 = 0.995 RELEASE CURVE

R^2 = 0.99 LAB PREDICTION

$$\%N = a - b * e^{-ct}$$

Fitted curve release data
Accelerated lab prediction
○ Release data
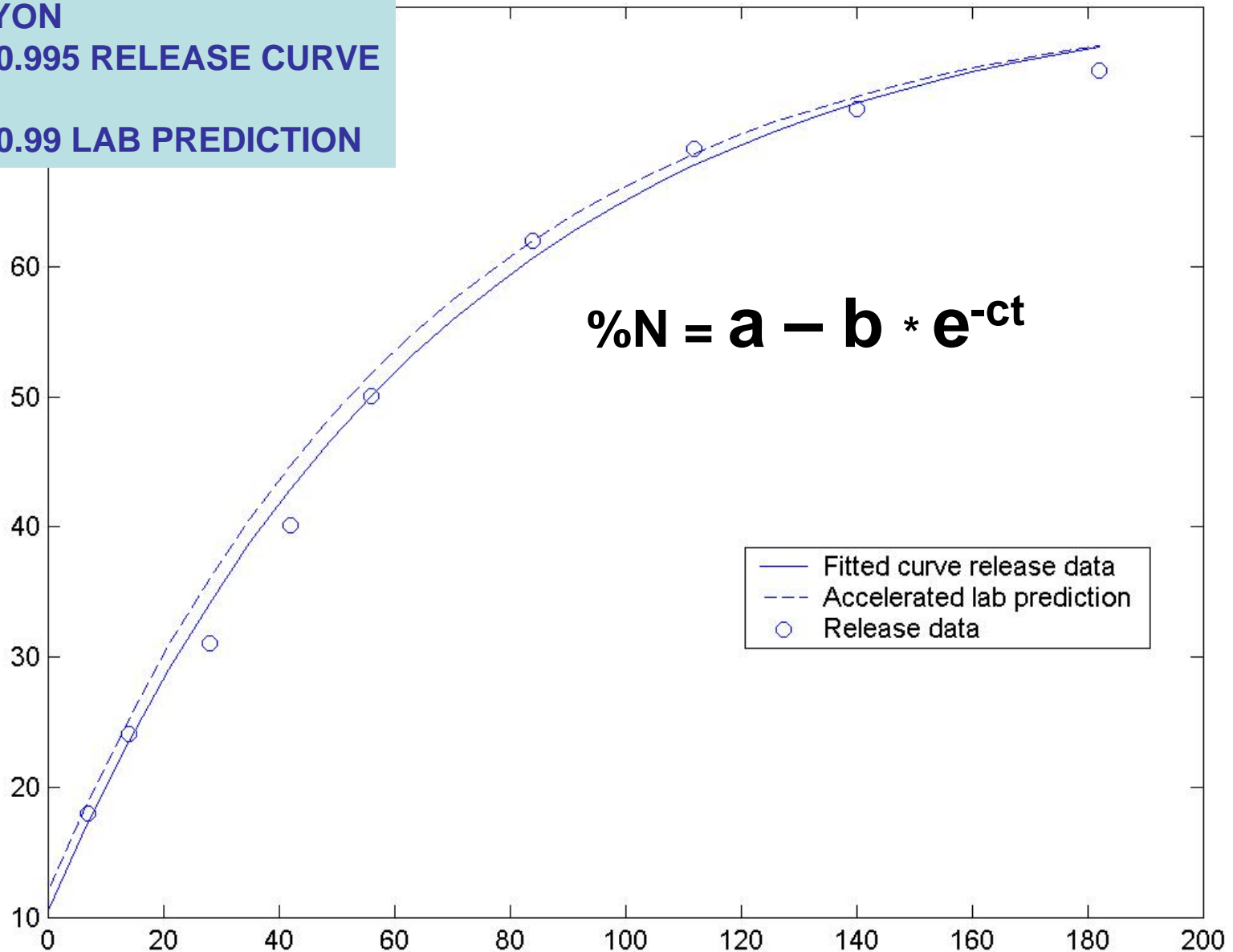
POLYON
$R^2 = 0.992$ RELEASE CURVE
$R^2 = 0.984$ LAB PREDICTION

$$\%N = a - b * e^{-ct}$$

— Fitted curve release data
-- Accelerated lab prediction
○ Release data
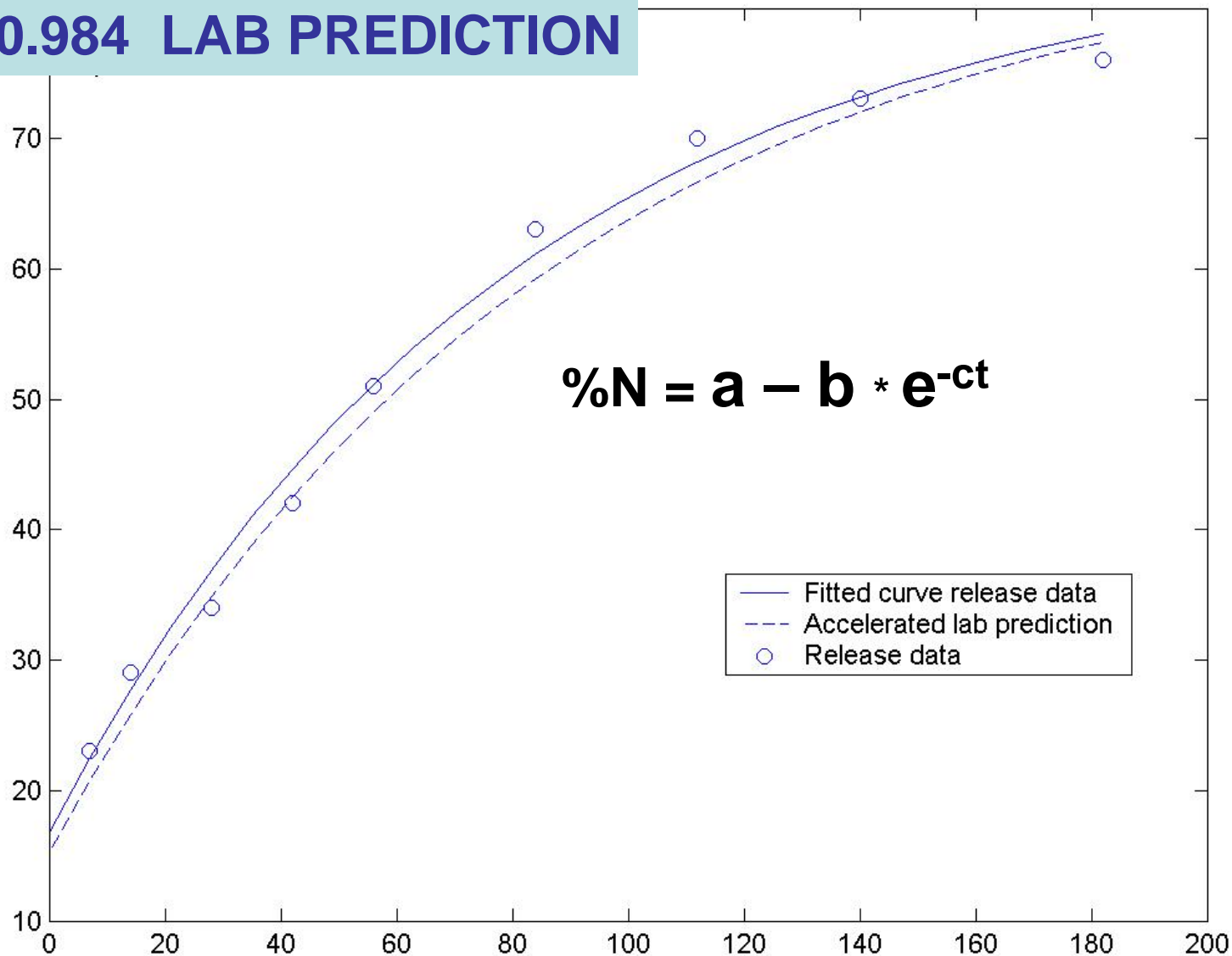
POLYON
$R^2 = 0.993$ RELEASE CURVE
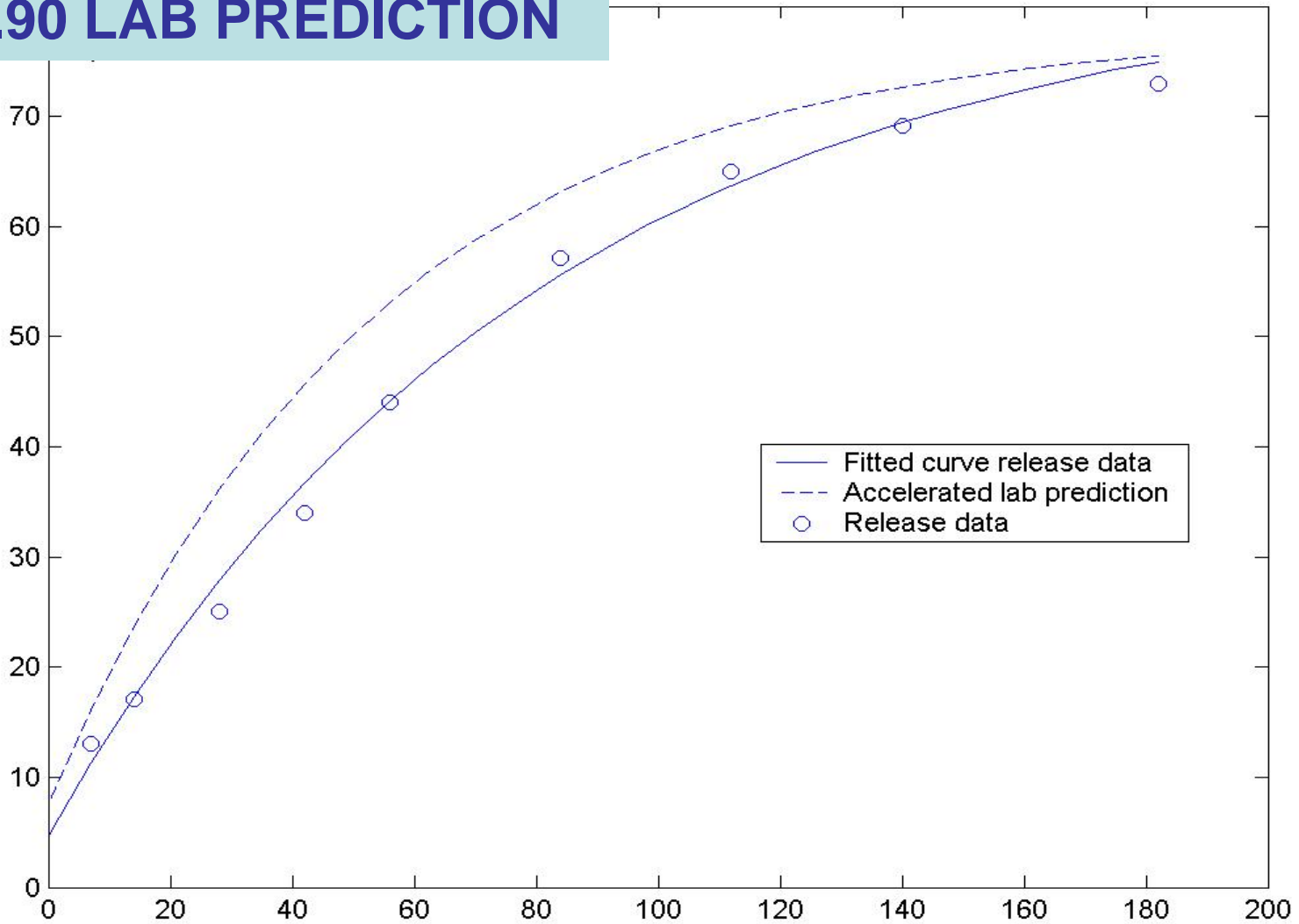$R^2 = 0.90$ LAB PREDICTION

Table b. Regression constants for percentage N released and coefficients of determination for goodness fit in predicting N release rates as determined by the soil incubation methodology by the laboratory extraction procedure for selected N sources over a 189 d soil incubation period .

N Source	asymtote a	asymotote-intercept b	rate c	R^2
Nitroform	52.3	38.6	0.006	95
Nutralene	58.5	32.3	0.017	86
Polyon	94.3	103.7	0.029	99
SCU	96.9	84.5	0.039	96
IBDU	78.1	73.6	0.008	99
Osmocote	105.5	95.3	0.012	99
20-2-20	47.1	29.4	0.008	64

CONCLUSIONS

1. N RELEASE METHODOLOGY

A. NO VOLATILE AMMONIA

B. 97% OF APPLIED SOLUBLE N RECOVERED

C. NITRIFICATION OCCURRING - MICROBES ACTIVE

D. CV = 9.07%

E. $\%N = a - b * e^{-ct}$ $\qquad$ $R^2 = 0.99$

2. EXTRACTION METHODOLOGY

A. EXTRACTION # 1 CV = 3.1%

B. EXTRACTION # 2 CV = 2.9%

C. EXTRACTION # 3 CV = 3.2%

D. EXTRACTION # 4 CV = 3.6%

CONCLUSIONS CONTINUED

3. USING PARAMETERS FROM RELEASE CURVE AND DATA FROM LAB EXTRACTION CAN PREDICT RATE OF N RELEASE - R^2 OF 0.90

4. CURRENT RELATIONSHIPS ARE SPECIFIC TO MATERIAL. NEED TO ACCUMULATE MORE DATA ON INDIVIDUAL MATERIALS AND MIXTURES FOR VERIFICATION OF N RELEASE CURVES

5. ULTIMATELY, OBTAIN APPROVAL BY AAPFCO FOR USE IN STATE FERTILIZER LABS FOR VERIFICATION OF CONTROLLED RELEASE CLAIMS IN LABELING