Recommended Methods for Manure Analysis:

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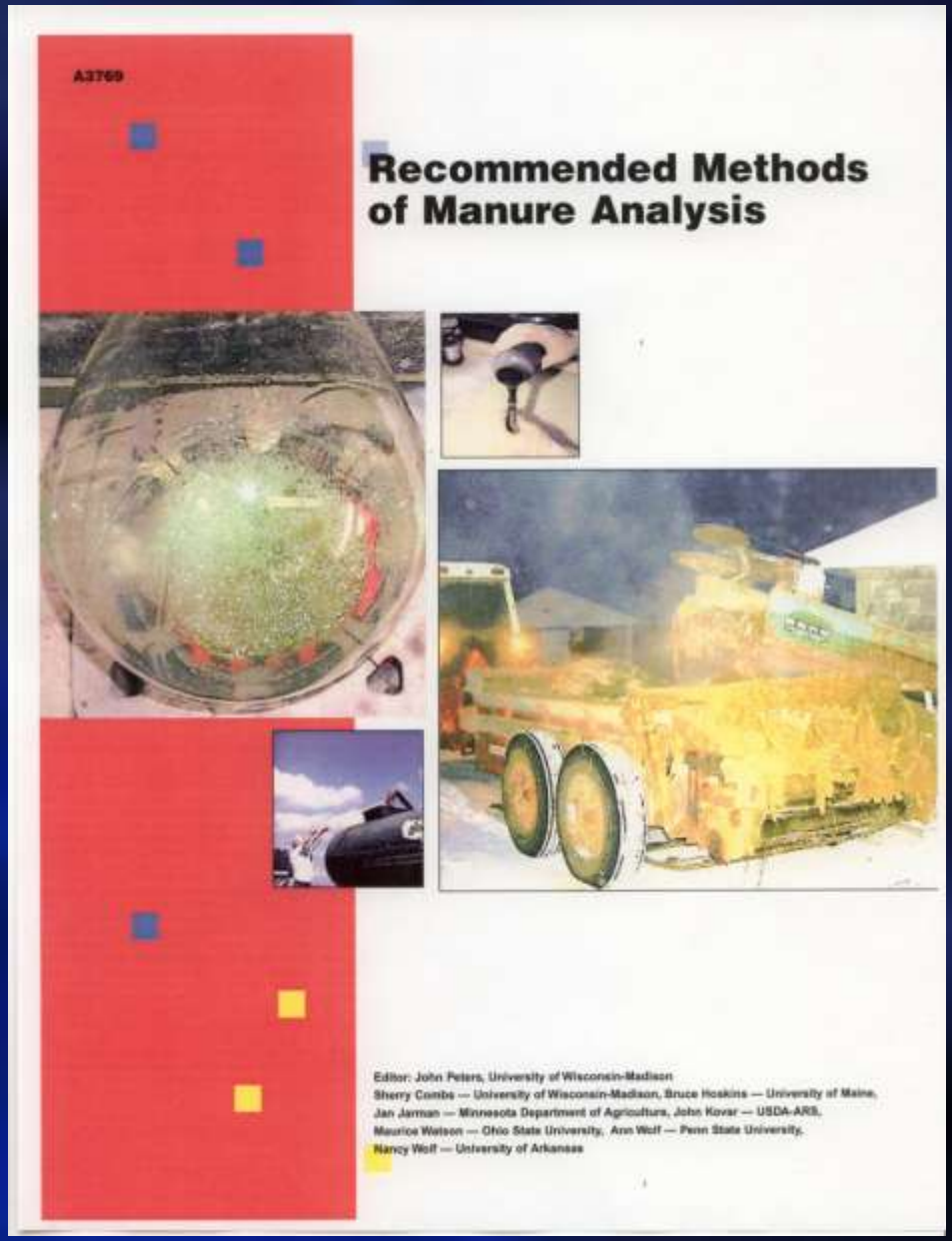
Background

- Multi-regional committee was established in September 1996 to work on the development of a manual for manure sampling, analysis and reporting.
- Committee members from NCR-13, SERA-6, NEC-67, and MN Dept. of Agriculture
- Publication is available on the web

http://uwlab.soils.wisc.edu/pubs/A3769.pdf

Available Now



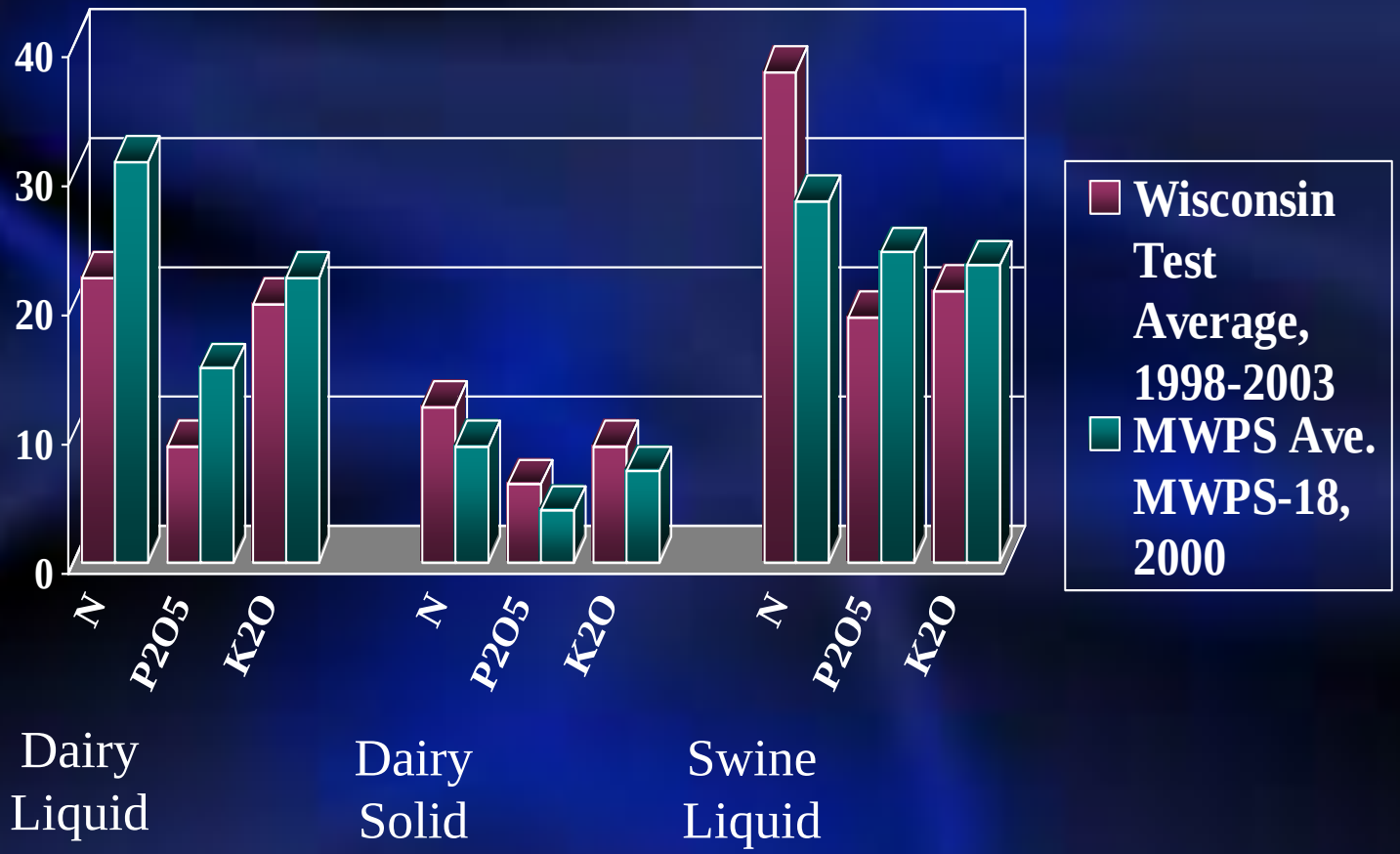
http://uwlab.soils.wisc.edu/pubs/A3769.pdf

Introduction

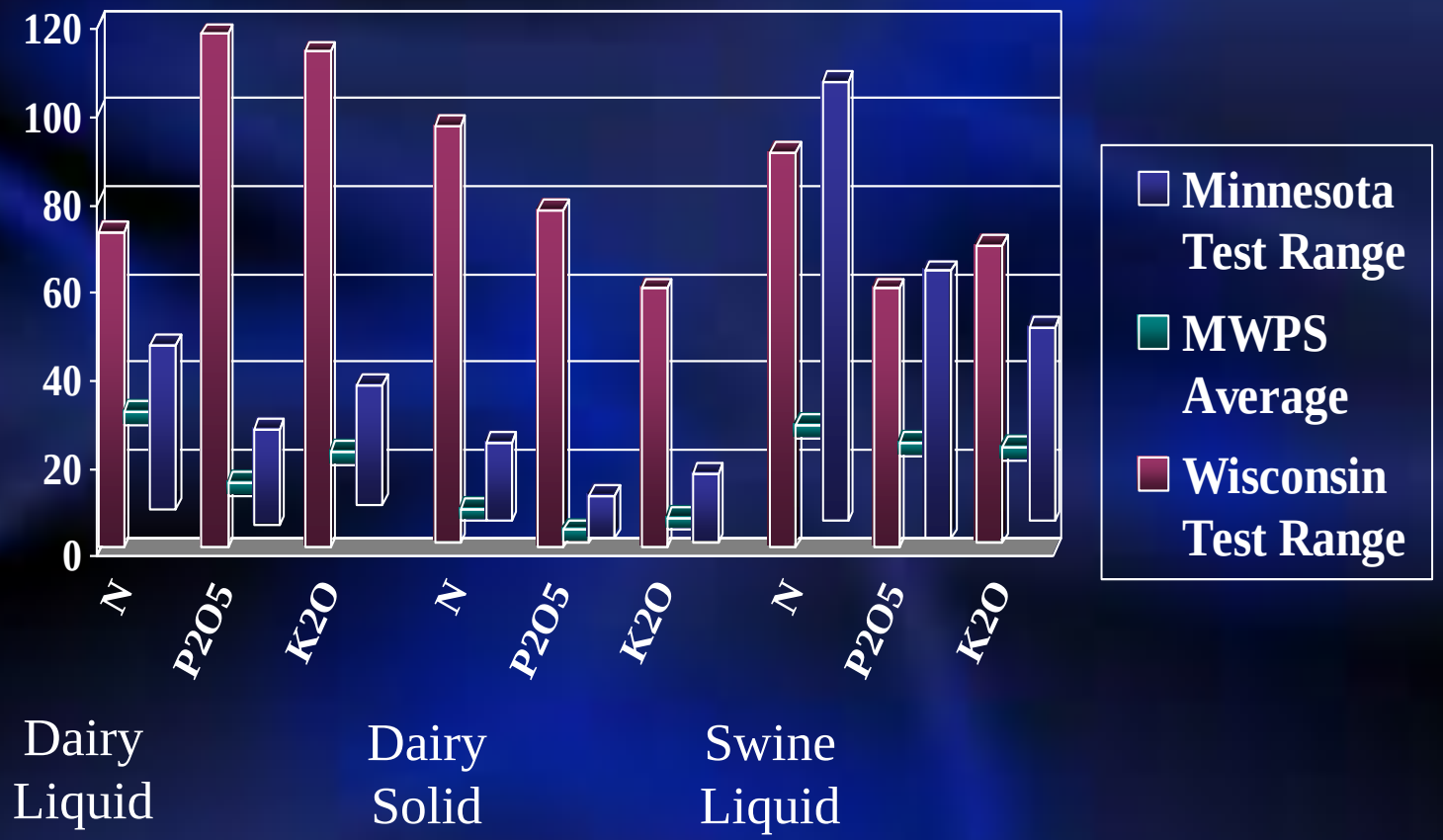
- Nutrient concentrations can be estimated using “book” values for available N, P2O5, and K2O
- Manure testing takes management practices into account and delivers more accurate values
- Sampling technique greatly influences test results
- Sample handling and testing methods also affect analytical results

Table of Contents - 1

Comparison of analyzed and "typical" manure nutrient content



Range of analyzed manure nutrient content



Effect of In-Lab Variability on Total Nutrient Content of Manure

Material	No. of Analysis		DM	Nutrient* N	P	K
			---------- % ----------			
Liquid Dairy Manure #3	4	Mean	7.13	4.25	1.04	3.63
		SD	0.08	0.09	0.03	0.04
Liquid Dairy Manure #4	4	Mean	6.05	4.65	1.28	4.07
		SD	0.09	0.05	0.05	0.04

*** Dry Weight Basis, University of Wisconsin Soil and Forage Analysis Lab - Marshfield**

Effect of In-Lab Variability on Total Nutrient Content of Manure

Material	No. of Analysis		Nutrient*			
			DM	N	P	K
			%			
Poultry (fresh)	8	Mean	28.14	6.31	1.76	3.08
		SD	0.15	1.12	0.04	0.05
Dairy semi-solid (fresh)	8	Mean	14.14	3.75	0.83	3.27
		SD	0.14	0.26	0.02	0.03

*** Dry Weight Basis, University of Wisconsin Soil and Forage Analysis Lab - Marshfield**

Nutrient Variability of Solid Dairy Manure.* Marshfield, 1997

Sampling Method	No. of Analysis		Nutrient**			
			DM	N	P	K
			%			
Barnyard - Hand	6	Mean	35.02	1.87	0.42	2.48
		SD	2.81	0.22	0.04	0.27
Barnyard - Shovel	7	Mean	31.37	2.10	0.50	3.45
		SD	4.50	0.40	0.09	1.16

*** Wisconsin Farm Training Instructions used in this study.**

**** Dry matter basis**

Nutrient Variability of Solid Dairy Manure.* Marshfield, 1997

Sampling Method	No. of Analysis		Nutrient**			
			DM	N	P	K
			%			
Spreader - Hand	6	Mean	34.35	1.98	0.42	2.60
		SD	1.41	0.17	0.03	0.39
Spreader - Shovel	6	Mean	34.60	1.98	0.41	2.30
		SD	4.82	0.31	0.04	0.31

*** Wisconsin Farm Training Instructions used in this study.**

**** Dry matter basis**

Effect of Agitation on Analysis of Liquid Manure

Minnesota

Animal System	Loads From Storage	DM	Nutrient		
			N	P_2O_5	K_2O
		%	------- lbs/1000 gal -------		
Dairy - Metal Tank	First	8.2	34	16	28
	Mid	8.6	33	18	28
	Last	8.0	30	14	27
Swine - Concrete Pit	First	6.9	45	50	15
	Mid	8.5	46	60	16
	Last	7.4	46	57	18

Effect of Agitation on Analysis of Liquid Manure

Animal System	Loads From Storage	DM	Nutrient		
			N	P_2O_5	K_2O
Minnesota		-- % --	---------- lbs/1000 gal ----------		
Dairy - Earthen Pit	First	4.4	24	10	23
	Mid	6.0	23	10	22
	Last	8.7	27	12	23
Wisconsin*					
Dairy - Earthen Pit	Early**	6.1	24	15	23
	Late**	7.1	25	14	25

*** Dairy milking herd, Marshfield Agricultural Research Station**

**** Average of four-subsample analysis**


Badger
11000L

Nutrient Variability of Liquid Dairy Manure.* Marshfield, 1997

Sampling Method	No. of Analysis		Nutrient**			
			DM	N	P	K
			---------- % ----------			
Pump - Direct	8	Mean	5.11	4.66	1.27	5.23
		SD	0.08	0.32	0.09	0.66
Pail - Subsample	4	Mean	5.2	4.8	1.30	5.15
		SD	0.06	0.10	0.03	0.23

*** Wisconsin Farm Training Instructions used in this study.**

**** Dry matter basis**


How do you sample this?

Sampling while loading is a better choice

Recommended Sampling Procedures: Solid Manure

- Sampling while loading
  - Take samples from several spreader loads
  - Combine samples to form one composite sample

Recommended Sampling Procedures: Solid Manure

- Sampling during spreading
  - Catch manure from one pass on a tarp in field
  - Sample from several locations to create a composite sample

Recommended Sampling Procedures: Solid Manure

- Sampling daily haul
  - Place five-gallon bucket under the barn cleaner 4-5 times while loading spreader
  - Repeat sampling 2-3 times and test separately

Recommended Sampling Procedures: Solid Manure

- Sampling stockpiled manure
  - Take ten subsamples from different locations around the pile at least 18 inches below surface
  - Mix thoroughly in a five-gallon pail

Recommended Sampling Procedures: Solid Manure

- Sampling poultry in-house
  - Collect ten samples from throughout the house to the depth litter will be removed
  - Sample near feeders and waterers proportionately to their space occupied in the whole house
  - Mix samples well in a five-gallon pail

Sampling Procedures: Liquid Manure

- Sampling from storage
  - Agitate storage facility thoroughly (2-4 hrs minimum)
  - Collect at least five samples from storage facility or during loading using a five gallon pail

Sampling Procedures: Liquid Manure

- Sampling during application
  - Place buckets around field to catch manure from spreader or irrigation equipment
  - Combine and mix samples

Effect of Sampling Time on Content of Laying Hen Manure

		Nutrient**		
Month*	DM	N	P_2O_5	K_2O
	%	---------- lbs/ton ----------		
March	28.1	36	23	20
August	20.0	25	7	14

*** Average of four-subsample analysis**

**** Laying hen barn, University of Wisconsin Arlington Agricultural Research Station**

Table of Contents – Lab QA/QC

Quality Assurance

- Ensures consistent quality of analytical results through the application and documentation of appropriate quality control and quality assessment procedures
- Serves to promote client confidence in analytical results and documenting analytical uncertainty.

Quality Control

- Comprised of laboratory practices undertaken specifically to achieve accurate and reliable analytical results.
- Quality assessment is comprised of the procedures undertaken to monitor and document the effectiveness of quality control practices.

Components of a Quality Control Program

- Documentation of SOP (standard operating procedure)
- Training
- Implementation of good laboratory practices and procedures

Components of a QA/QC Program

- Document precision
- Document accuracy
- Known vs. blind checks
- Control charts
  - X-charts – accuracy and precision
  - R-charts – replicate range

X - Charts

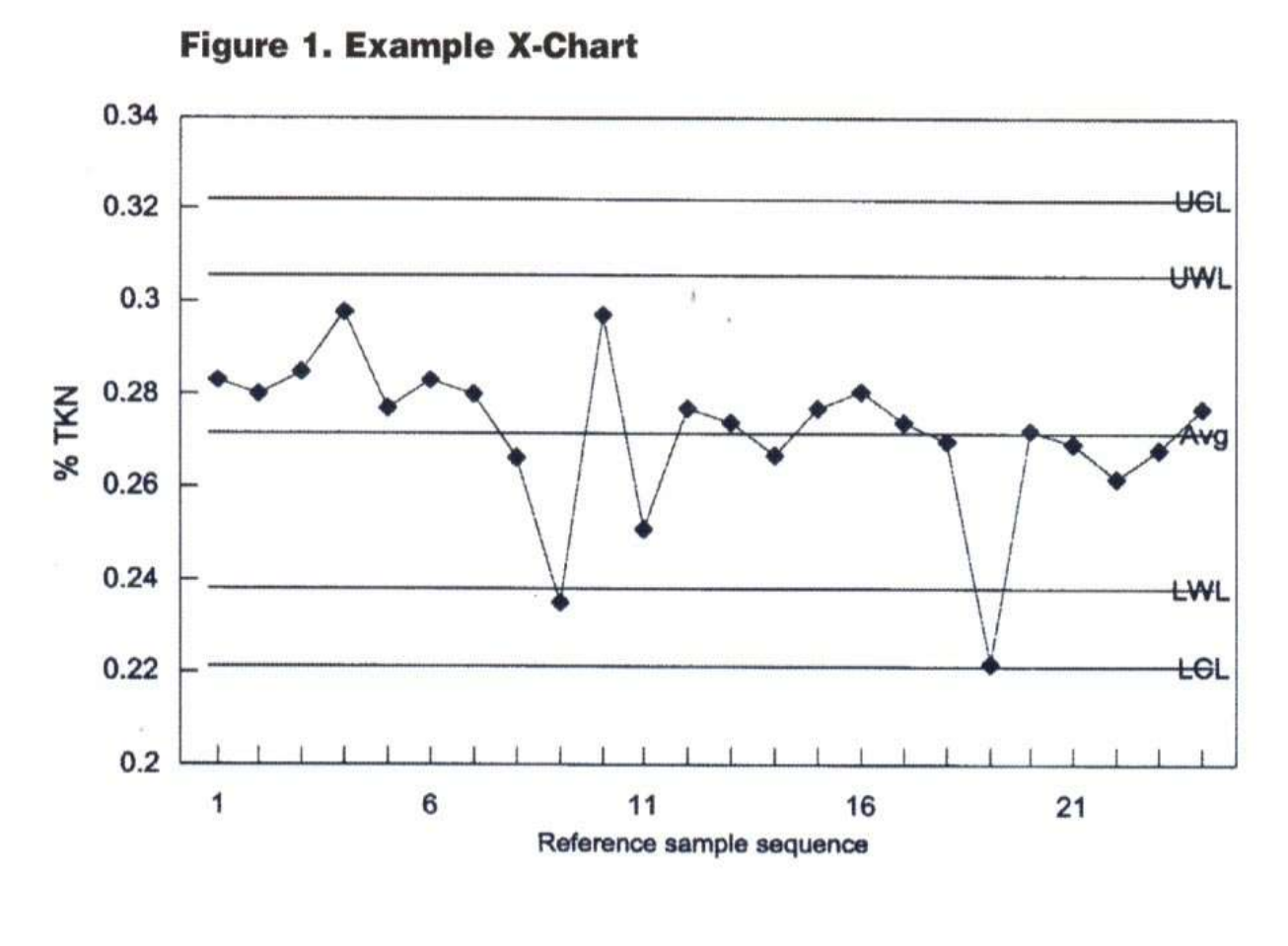


Figure 1. Example X-Chart
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
% TKN
UCL
UWL
Avg
LWL
LCL
1
6
11
16
21
Reference sample sequence

R - Chart

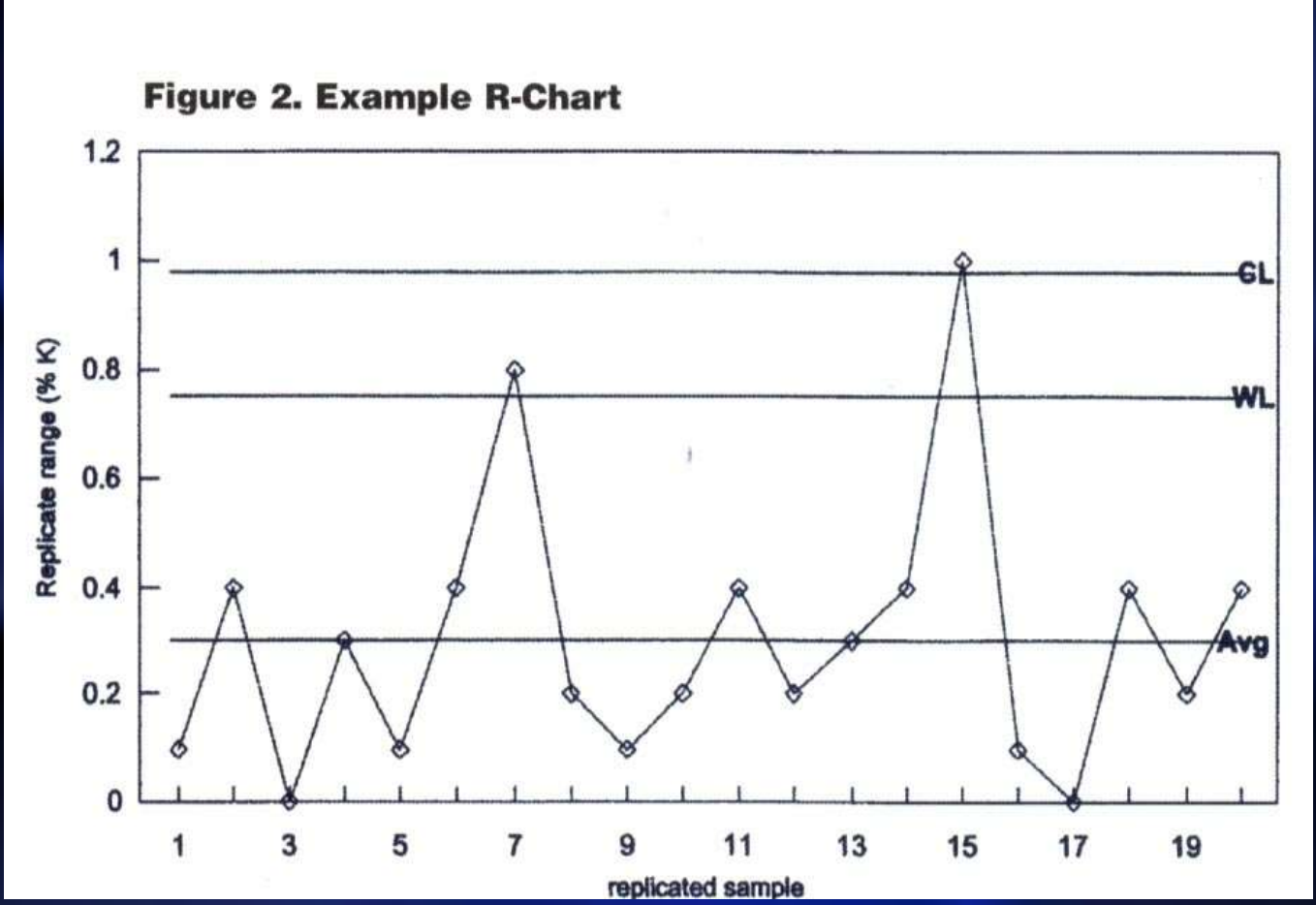


Figure 2. Example R-Chart
Replicate range (% K)
1.2
1
0.8
0.6
0.4
0.2
0
GL
WL
Avg
1
3
5
7
9
11
13
15
17
19
replicated sample

Table of Contents – Lab Procedures

Sample Handling

- Biohazards and laboratory safety
- Sample receiving, examination and transfer
- Sample stabilization and storage
- Sample holding times
- Homogenizing and subsampling
- Archiving and disposal

Sample Holding Times

Table 4. Maximum holding times for manure at 4° C before specific analyses.

pH	7 days
Dry matter/Total solids	7 days
Total nitrogen/Kjeldahl nitrogen	7 days
Ammonia nitrogen	7 days
Electrical conductivity	6 months
Minerals— Total P, K, Ca, Mg, Cu, Zn	6 months

Dry Matter Analysis

Sample size for DM analysis

Table 5. Maximum fresh sample size for dry matter determination in open vessels

	Drying temperature		
Drying Time	**50°C**	**70°C**	**110°C**
6 hr	Not recommended	5 g	10 g
16 hr	5 g	10 g	20 g
24 hr	10 g	20 g	20 g

Dry Matter Effect on Calculated Manure Nutrient Content

	Nutrient*		
DM%	N	P_2O_5	K_2O
	--------- lbs/wet ton ---------		
12	7.2	5.5	11.5
15	9.0	6.9	14.5
18	10.8	8.3	17.3

*** Based on dry matter analysis of 3.00% N, 1.00% P and 4.00% K**

Suggested Minimum Drying Times at Various Temperatures

	Temperature		
	50 C	70 C	110 C
	---------- hours ----------		
Solids (<85% H_2O)	24	16	6
Liquids (>85% H_2O)	48	48	16

Table of Contents – Total N

Laboratory Methods of Analysis

- Total Nitrogen determination
  - Kjeldahl
    - Advantages – low cost, large samples, wet or dry
    - Disadvantages – strong chemicals, labor intensive
  - Combustion
    - Advantages – fast and automated, no strong acids,etc.
    - Disadvantages – high cost of equipment and maintenance and small sample size requirement

Ammonium Nitrogen

Ammonium Nitrogen Methods

- Distillation
- Electrode
- Colorimetry using an autoAnalyzer

Table of Contents – Digestion and Dissolution

Digestion and Dissolution Methods

- P, K, Ca, Mg & trace minerals
  - Digestion
    - Dry Ashing
    - Microwave assisted acid digestion
    - Nitric and hydrochloric acid digestion with peroxide
    - Nitric and hydrochloric with block digester

Table of Contents – Mineral Analysis

Methods of Determination for P, K Ca, Mg and trace elements

- Atomic absorption spectrophotometer
- Inductively coupled plasma spectroscopy
- Colorimetric method for P

Table of Contents – pH and EC

Table of Contents - Reporting

First year availability assumptions – Use the values appropriate for your state

Example - Wisconsin

- N – Variable; Dependant on animal species and type of application
- P_2O_5 – 60%
- K_2O – 80%
- S – 60%

Samples Analyzed By:
UW Soil & Forage Analysis Lab
8396 Yellowstone Dr
Marshfield, WI 54449
(715) 387-2523

WASTE ANALYSIS REPORT

Cooperative Extension
UW - Extension
UW - Madison
Soils Dept, Madison, WI

Lab Number: 2 **Date received:** 8/25/02 **Account #:** 555901

County: Wood **Date processed:** 8/25/02 **Client:** UW Soil & Forage Analysis Laboratory

Send to:
UW Soil & Forage Analysis Laboratory
8396 Yellowstone Drive
Marshfield, WI 54449

Sample Information

Sample Name: #2

Material: Dairy **Type of Storage:** Lagoon

Storage System: Liquid **Type of Bedding:**

Comments:

Laboratory Analysis

Moisture: 95.20 %

Dry Matter: 4.80 %

	Total Nutrients lbs/1000 gal	Estimated Available Nutrient Credits for Manure: In 1st Year of Application lbs/1000 gal	If Applied 2 Consecutive Yrs lbs/1000 gal	If Applied 3 Consecutive Yrs lbs/1000 gal
Total Nitrogen (Injected)	27.09	10.84	13.55	14.90
Total Nitrogen (Surface Applied)	27.09	8.13	10.84	12.19
Total Phosphorus as P2O5	15.51	9.31	10.86	11.63
Total Potassium as K2O	28.68	22.94	25.81	27.25
Sulfur	1.27	0.70	0.83	0.89
Estimated Value of Available Nutrients in Surface Applied Manure[1]		$7.08	$8.43	$9.10

Additional Tests

NH4-N

Ash

Additional Information

1 Value based on commercial fertilizer costs as of 3/1/2002:

N (urea)	$0.21/lb
P_2O_5 (Triple Superphosphate)	$0.24/lb
K_2O (Potash)	$0.13/lb
S (Elemental Sulfur)	$0.23/lb

Samples Analyzed By:
UW Soil & Forage Analysis Lab
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Marshfield, WI 54449
(715) 387-2523

WASTE ANALYSIS REPORT

Cooperative Extension
UW - Extension
UW - Madison
Soils Dept, Madison, WI

Lab Number: 1 **Date received:** 9/25/02 **Account #:** 555901

County: Wood **Date processed:** 9/25/02 **Client:** UW Soil & Forage Analysis Laboratory

Send to:
UW Soil & Forage Analysis Laboratory
8396 Yellowstone Drive
Marshfield, WI 54449

Sample Information

Sample Name: #1

Material: Dairy **Type of Storage:** Stack

Storage System: Solid **Type of Bedding:** hay/straw

Comments:

Laboratory Analysis

Moisture: 81.50 %

Dry Matter: 18.50 %

	Total Nutrients lbs/ton	Estimated Available Nutrient Credits for Manure: In 1st Year of Application lbs/ton	If Applied 2 Consecutive Yrs lbs/ton	If Applied 3 Consecutive Yrs lbs/ton
Total Nitrogen (Injected)	11.50	4.60	5.75	6.33
Total Nitrogen (Surface Applied)	11.50	3.45	4.60	5.18
Total Phosphorus as P2O5	5.75	3.45	4.03	4.31
Total Potassium as K2O	11.32	9.06	10.19	10.75
Sulfur	0.51	0.29	0.33	0.36
Estimated Value of Available Nutrients in Surface Applied Manure[1]		$2.79	$3.33	$3.60

Additional Tests

NH4-N

pH

Ash

Additional Information

1 Value based on commercial fertilizer costs as of 3/1/2002:

N (urea)	$0.21/lb
P_2O_5 (Triple Superphosphate)	$0.24/lb
K_2O (Potash)	$0.13/lb
S (Elemental Sulfur)	$0.23/lb

Summary

- The value of manure testing is highly dependant on sampling technique
- Laboratory methods – a variety of methods seem to be acceptable for N, P and K
- Standardizing dry matter analysis methods is important for calculating proper nutrient credits of fresh (as applied) manure