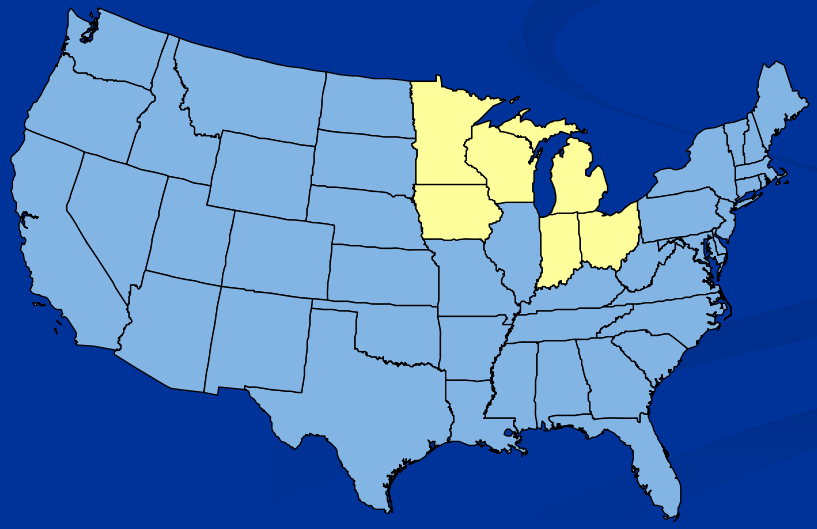
Volunteer Monitoring of *E. coli* in Upper Midwest Streams: A Comparison of Methods and Preferences



Citizens Monitoring Bacteria

Project Partners

UW Extension

Water Resources Center

THE OHIO STATE UNIVERSITY EXTENSION

HOOSIER RIVERWATCH

DNR

University of Minnesota Extension SERVICE

IOWATER Volunteer Water Quality Monitoring

WISCONSIN DEPT. OF NATURAL RESOURCES

PURDUE UNIVERSITY

MICHIGAN STATE UNIVERSITY EXTENSION

DNR INDIANA DEPARTMENT OF NATURAL RESOURCES

VOLUNTEER WATER QUALITY MONITORING National Facilitation Project

Water Action Volunteers

CSREES Cooperative State Research, Education, and Extension Service

CSREES Great Lakes Regional Water Quality Program

Project Goals

- Build the capacity of volunteer monitoring programs to monitor *E. coli* using the most effective and "volunteer-friendly" home lab testing methods
- Develop a comprehensive training program for volunteers to monitor *E. coli* in surface waters across six states
- Develop & disseminate educational materials about *E. coli* and its associated health risks, sources and reasons for monitoring

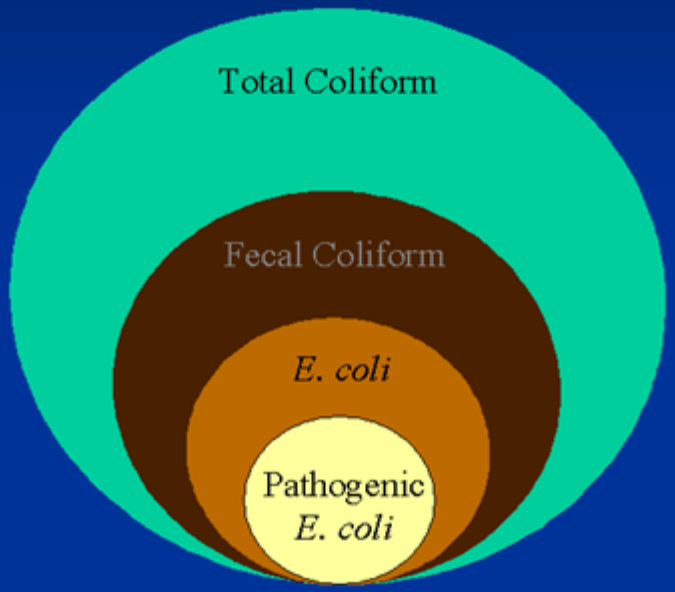
Projects Goals

- Increase awareness and acceptance of the use of volunteer collected data
- Share results with other volunteer monitoring programs
  http://www.usawaterquality.org/volunteer/Ecoli

Project Overview

- Year 1
  - Pilot test 5 home lab methods in 2 states (IA and IN) → recommendation
  - Develop training materials
- Year 2
  - Four states monitor using home lab methods selected from Iowa & Indiana year 1 results
  - Iowa and Indiana continue to test 5 (plus 1) home lab methods
  - Evaluate data and training methods
- Year 3
  - Adapt monitoring plan based on year 1 and 2 results
  - Continue monitoring with existing and new volunteers
  - Share results and materials

Why research *E. coli*?

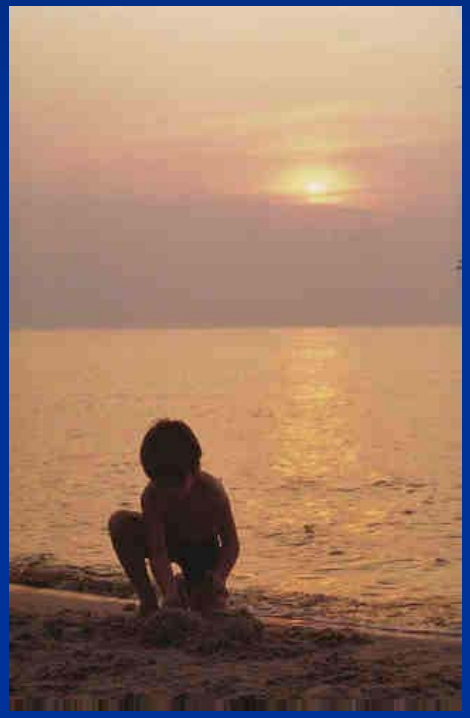


- Many U.S. surface waters impaired by bacteria
- Fecal bacteria can be used as an indicator of pathogens in water
  - Are easy to culture
  - Are generally harmless
- Current EPA standards use *E. coli* as indicator bacteria for beach closings

Why research *E. coli* home lab methods?

- Cost of lab analyses high
- Many economical home lab methods available
- No comparative, independent study of how well these methods work vs. traditional lab methods – nor how well they work for use by volunteers

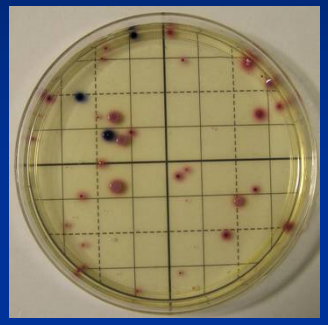
Body contact standard

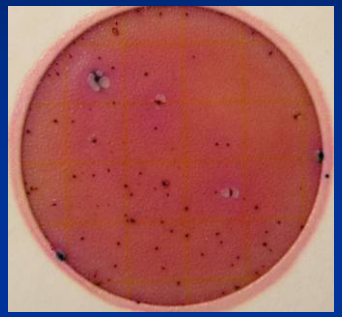


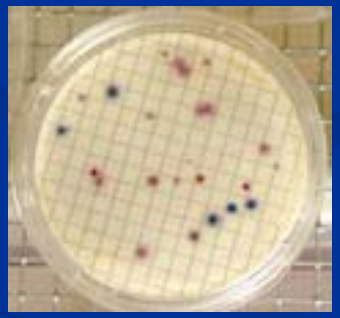
- Indicator of potential health risks from primary contact (swimming, kayaking, water skiing) or partial contact (boating, fishing)
- Used for recreational waters, TMDLs, beach closings
- 235 cfu per 100ml (primary contact 1 sample)

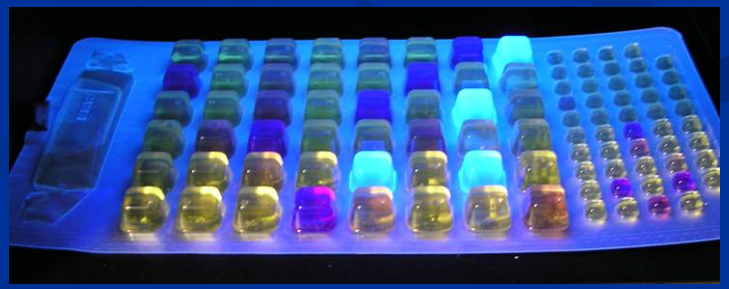
2004 Testing – Iowa & Indiana

- Home lab methods:
  - Coliscan® Easygel (incubated)
  - Coliscan® Easygel (not incubated)
  - 3M™ Petrifilm™
  - Coliscan® MF Method Kit *(IN only)*
  - Colisure® Method with IDEXX Quanti-Tray/2000™ *(IA only)*









2004 Testing – Iowa & Indiana

- Testing spring, summer and fall 2004
- Water samples sent to lab for analysis
- Recommended the 'best' method for volunteers

Identifying Impairments After 2004

- Four methods were statistically significant for predicting above or below regulatory cutoffs
  - Only Coliscan® MF was insignificant

- Methods with best results (1-4)
  - IDEXX Colisure®
  - 3M™ Petrifilm™
  - Coliscan® Easygel – Incubated
  - Coliscan® Easygel – Non Incubated

Results:
Cost of Kits

Method	Cost/Sample	Cost Includes
Coliscan® Easygel	$1.85	Incubator (varies)
3M™ Petrifilm™	$1.06	Incubator (varies)
Coliscan® Membrane Filtration Method	$1.70	Incubator (varies) Filter apparatus ($7.00) Syringe & hose ($2.50)
Colisure™ Method with the IDEXX Quanti-Tray®/2000	$5.45*	Incubator ($400) Sealer ($3,000) UV light & box ($240)

*Value would be much lower if ordered in greater bulk.

2005 Testing

- All states
  - Coliscan® Easygel (incubated)
  - 3M™ Petrifilm™
  - Water samples sent to lab for analysis
- Indiana & Iowa
  - Continued to test all other methods (and one more) too

2005 Data- What did it show?

- Evaluation of
  - Ability to make distinctions on impaired waters (235 cfu/100ml)
  - Regression models
  - Cost of kits
  - User friendliness (volunteer preferences)

Indiana and Iowa
2005 Results

Ranking of the % of time the home lab & laboratory values were both either above or below the 235 cfu/100 mL value

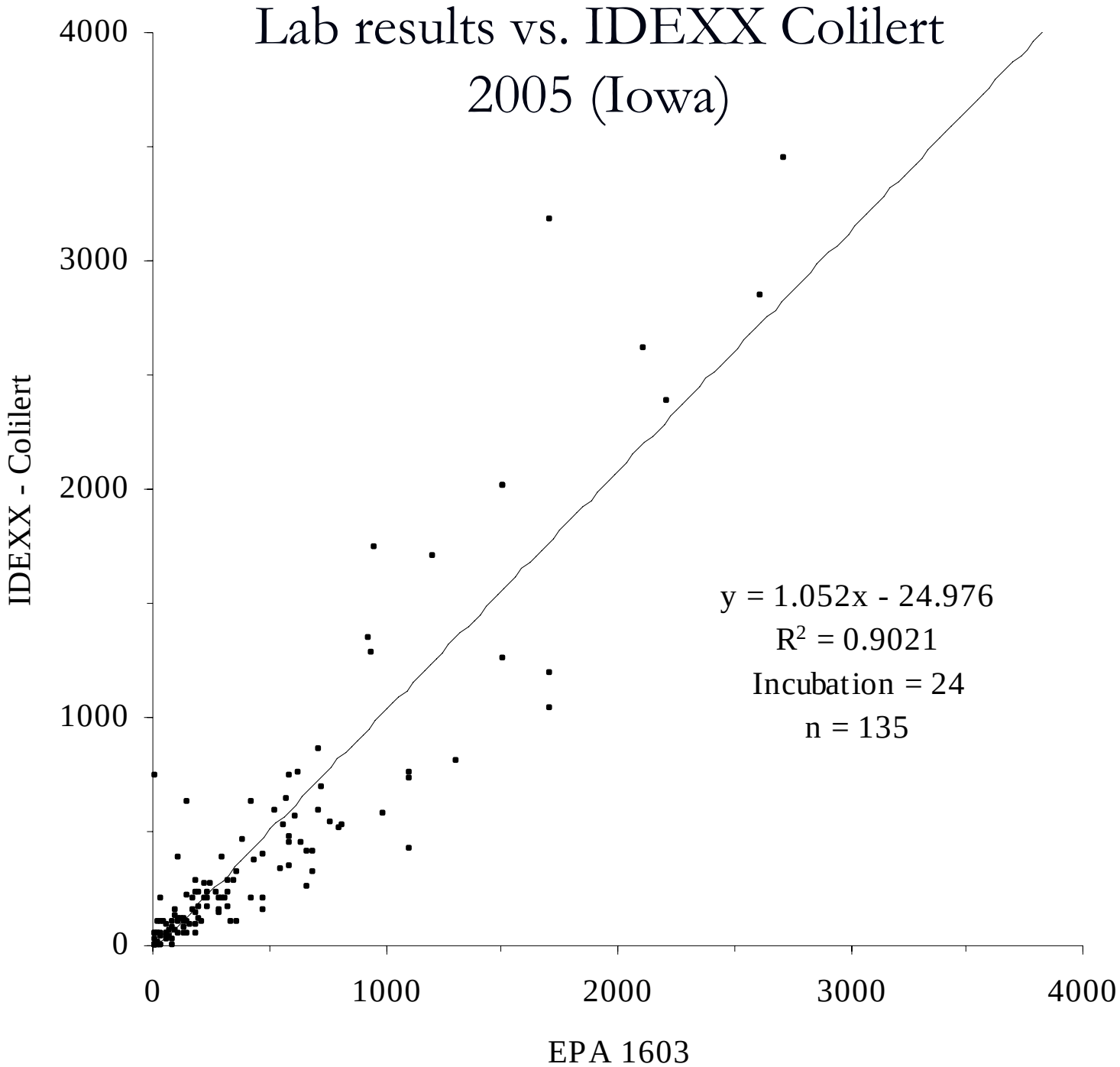
Test	Incubation Time (h)	n	Agree	Disagree	% Agreement
Colisure (IDEXX)	24	171	151	20	88.3%
Petrifilm (3M)	24	268	229	39	85.4%
Colilert (IDEXX)	24	161	136	25	84.5%
Easygel - 35°C	24	245	196	49	80.0%
Coliscan MF	24	94	75	19	79.8%
Easygel - Room Temp	24	241	143	98	59.3%

Ohio, Michigan, Wisconsin & Minnesota

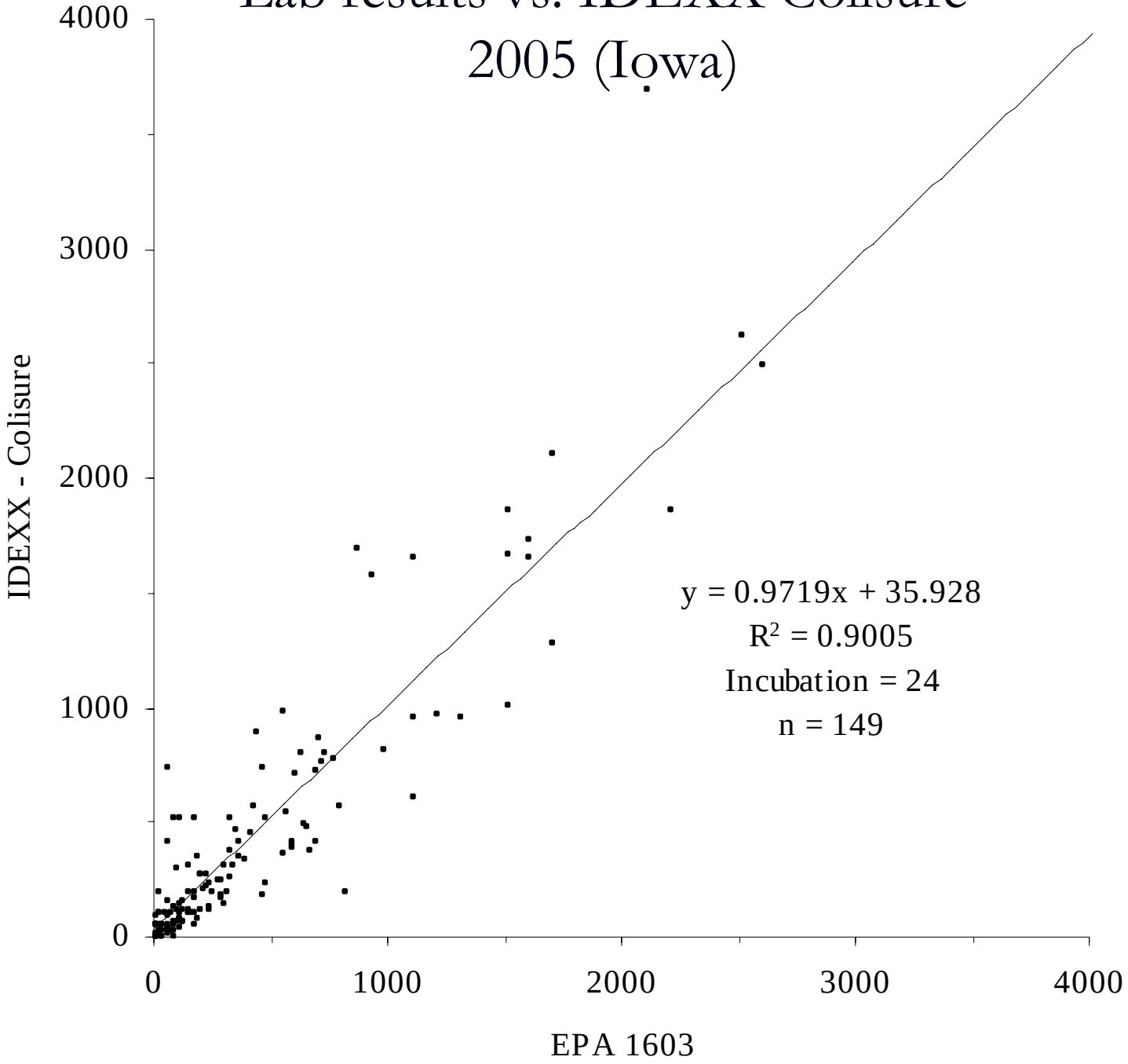
2005 Results

Ranking of the % of time the home lab & laboratory values were both either above or below the 235 cfu/100 mL value

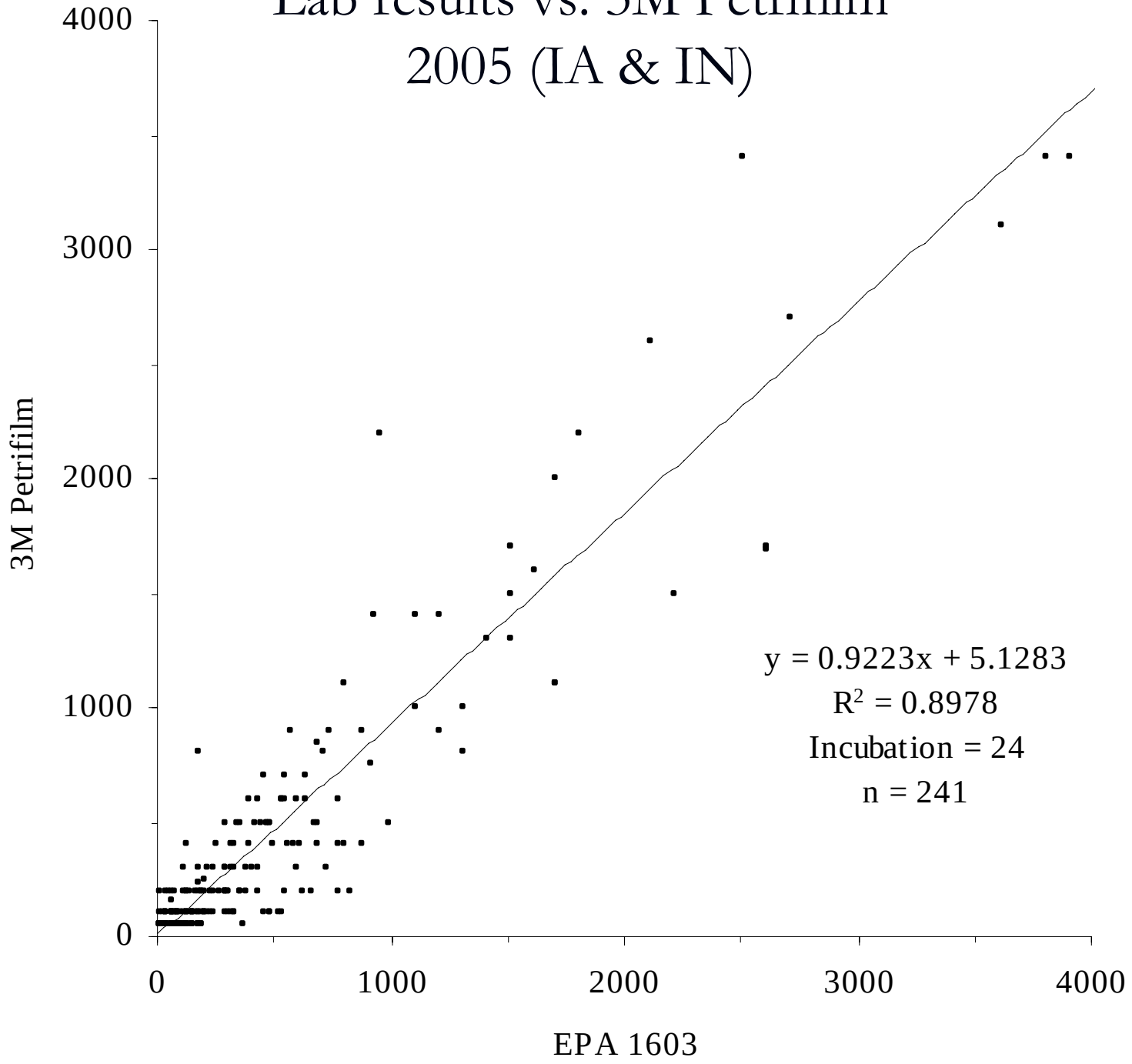
Test	Incubation Time (h)	n	Agree	Disagree	% Agreement
Petrifilm (3M)	24	291	254	37	87.29
Easygel-35 °C	24	289	240	49	83.04

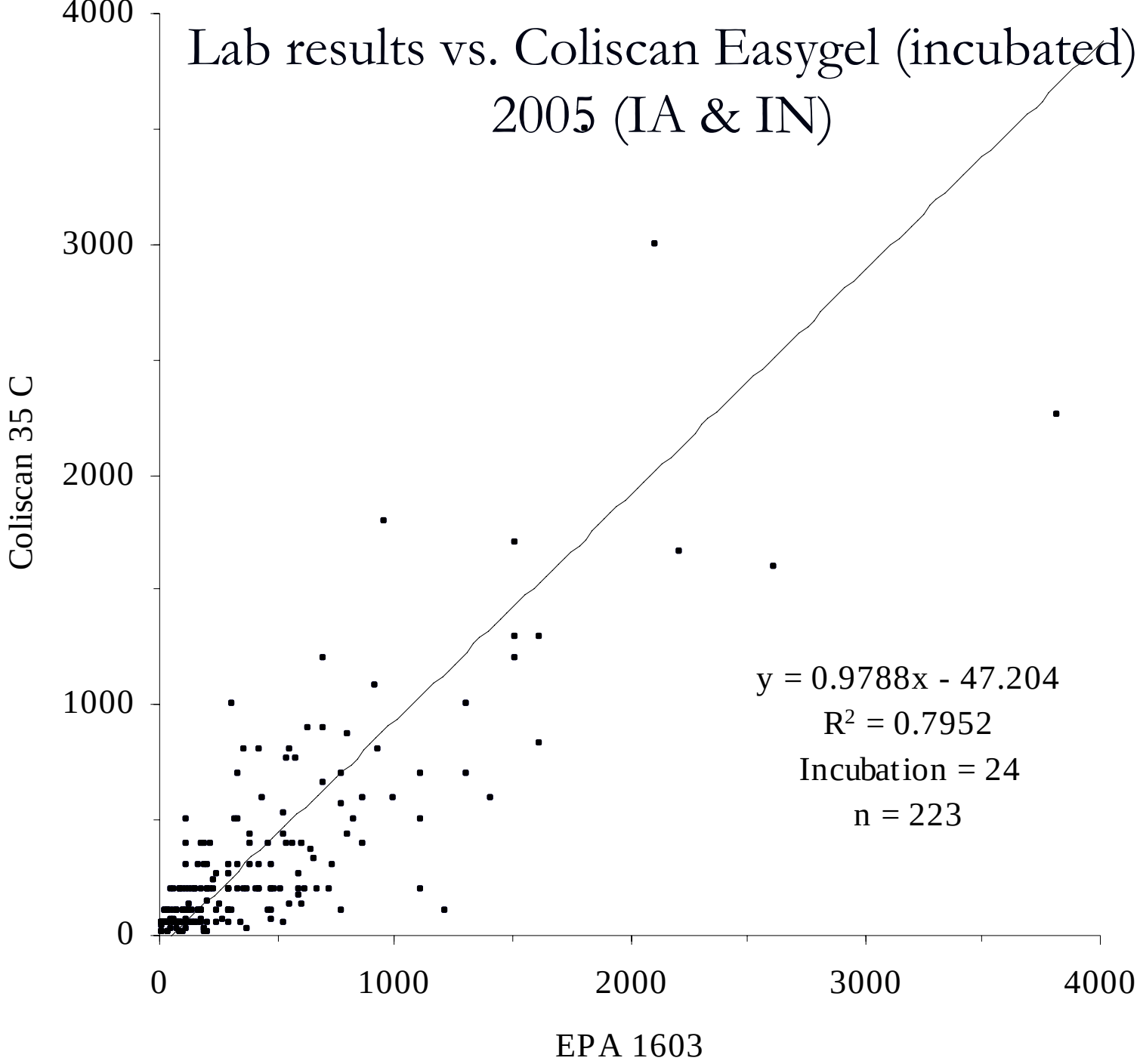

Lab results vs. IDEXX Colilert
2005 (Iowa)
IDEXX - Colilert
EPA 1603
0
1000
2000
3000
4000
y = 1.052x - 24.976
R² = 0.9021
Incubation = 24
n = 135

Lab results vs. IDEXX Colisure 2005 (Iowa)

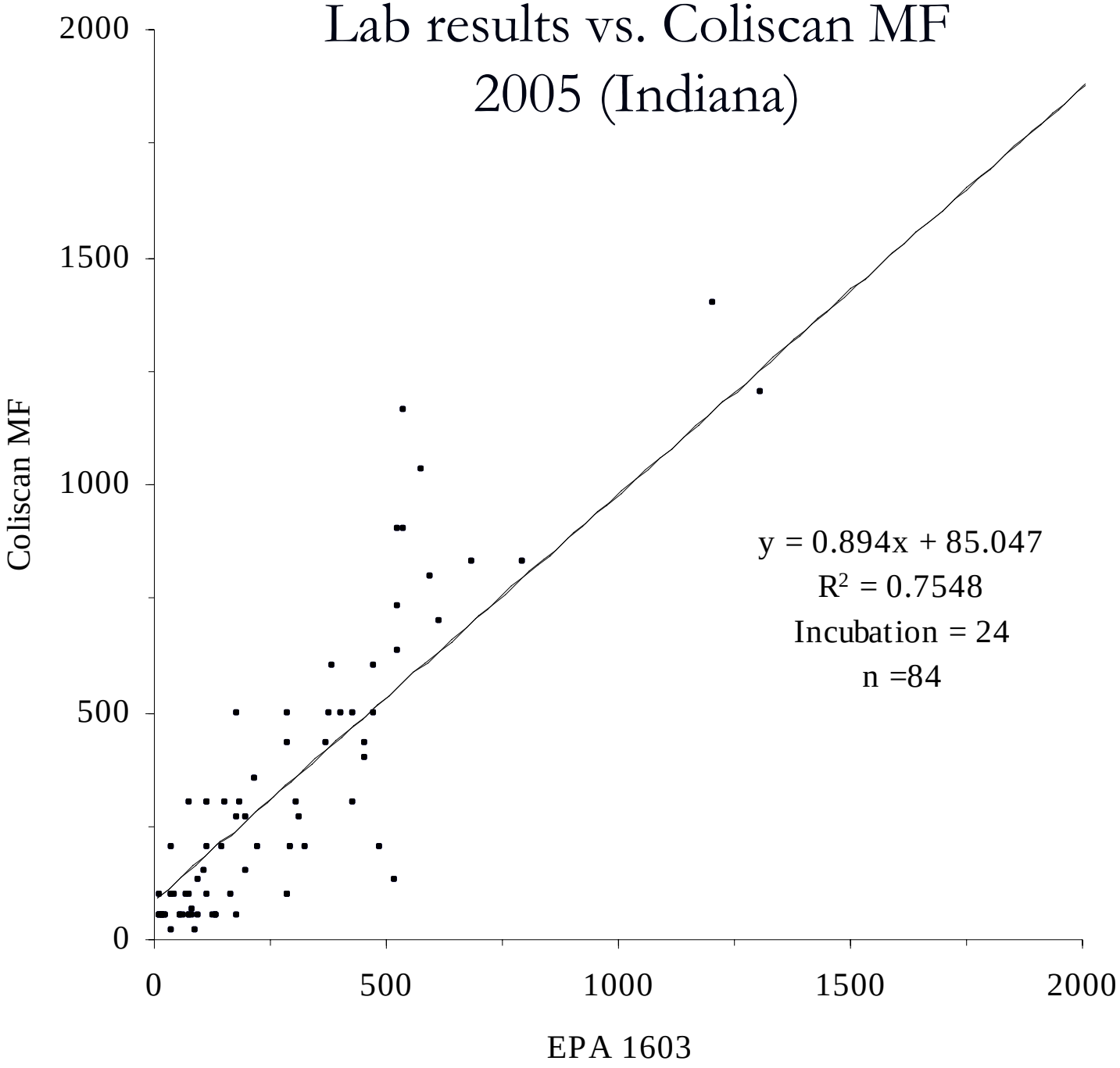


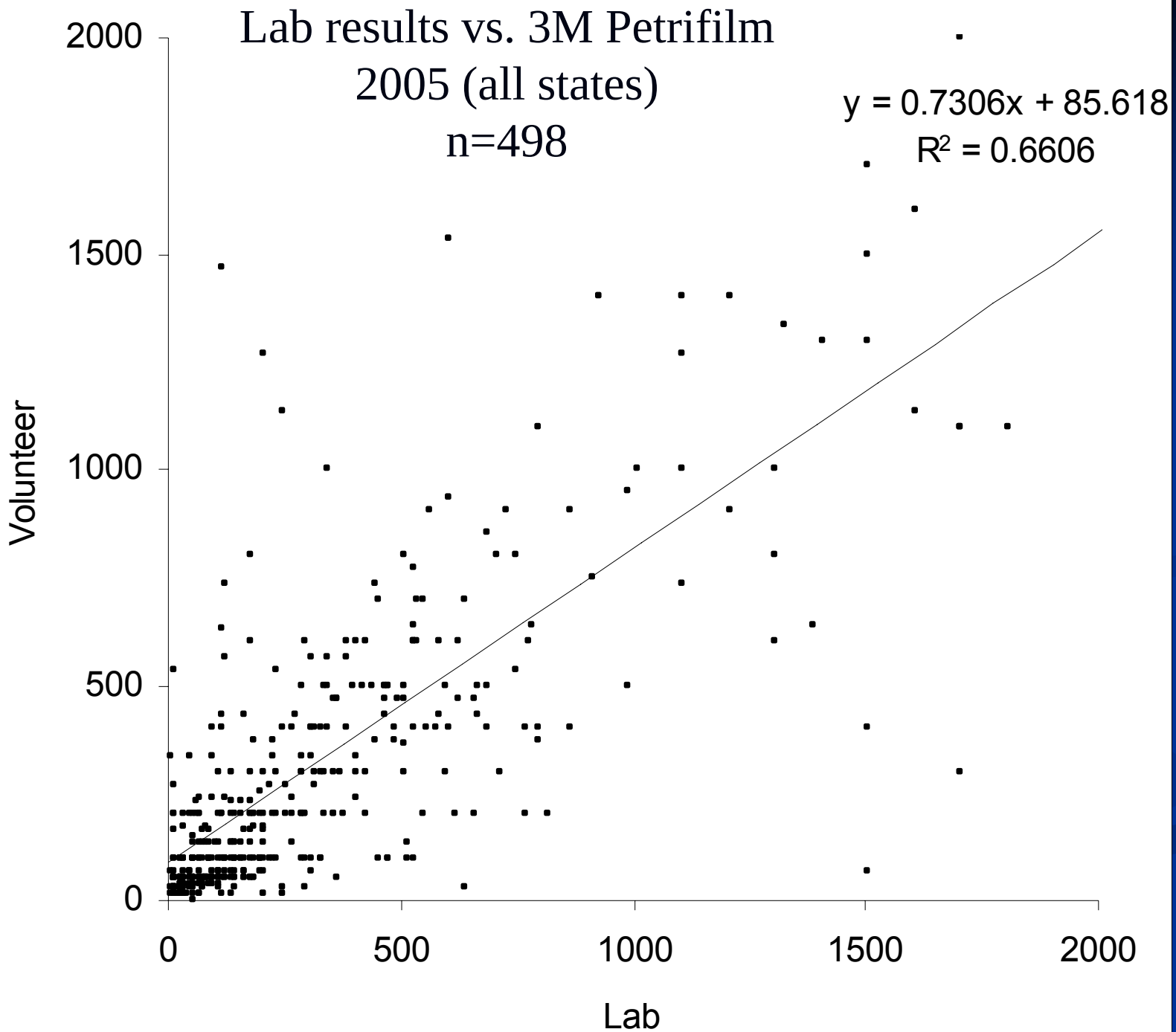
Lab results vs. 3M Petrifilm 2005 (IA & IN)

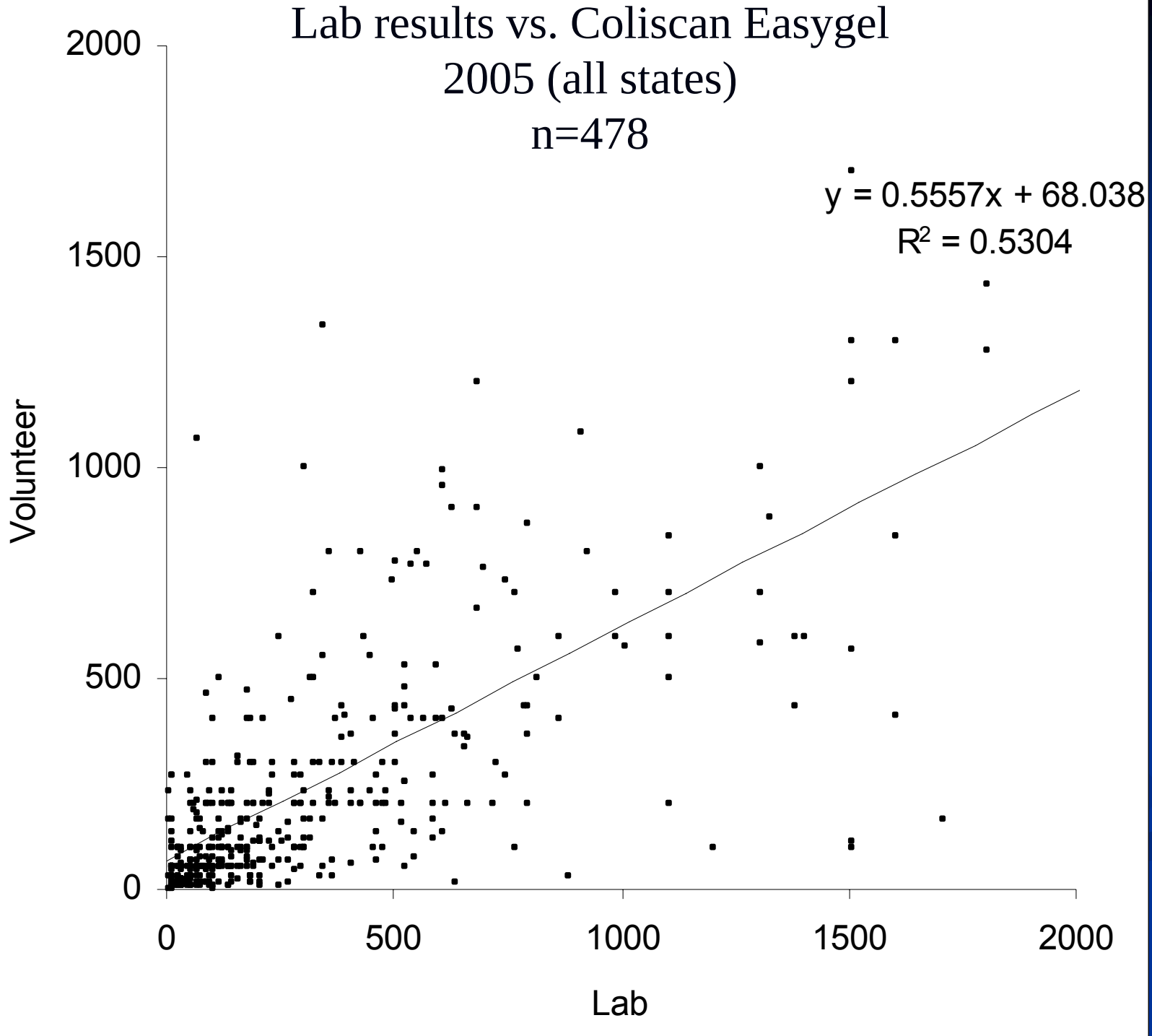



Lab results vs. Coliscan Easygel (incubated)
2005 (IA & IN)
Coliscan 35 C
EPA 1603
0
1000
2000
3000
4000
y = 0.9788x - 47.204
R2 = 0.7952
Incubation = 24
n = 223

Lab results vs. Coliscan MF 2005 (Indiana)




Lab results vs. 3M Petrifilm
2005 (all states)
n=498
y = 0.7306x + 85.618
R2 = 0.6606
Volunteer
Lab
0
500
1000
1500
2000


Lab results vs. Coliscan Easygel
2005 (all states)
n=478
y = 0.5557x + 68.038
R2 = 0.5304
Volunteer
Lab
0
500
1000
1500
2000
0
500
1000
1500
2000

Volunteer Perceptions

- Indiana and Iowa volunteers ranked their <u>confidence</u> in methods used in 2005
- Indiana volunteers chose (*Used Coliscan Easygel, 3M Petrifilm, Coliscan MF, but did not use IDEXX methods*)
  (1) Coliscan Easygel ® - Incubated
  (2) 3M™ Petrifilm™
- Iowa volunteers chose *(Used Coliscan Easygel, 3M Petrifilm, two IDEXX methods)*
  (1) Colisure® with IDEXX Quanti-Tray /2000
  (2) 3M™ Petrifilm™
  (3) Colilert® with IDEXX Quanti-Tray /2000

Volunteer Perceptions (cont.)

- Minnesota, Michigan, Ohio and Wisconsin volunteers' end of season confidence rankings showed a nearly equal split
  - 13 chose Coliscan Easygel ® - Incubated
  - 16 chose 3M™ Petrifilm™

Conclusions

- IDEXX, Coliscan Easygel ® (incubated) and 3M™ Petrifilm™ perform well in describing when bacteria counts are above and below 235 cfu/100 mL standard
- These also have strongest correlations with lab results
- Volunteers nearly equally split in their assessment of two methods
- Cost of IDEXX methods might be prohibitive for volunteer groups
- We need more data! Season 3 results will
  - Help clarify trends and reliability
  - Provide additional volunteer opinions about using the methods

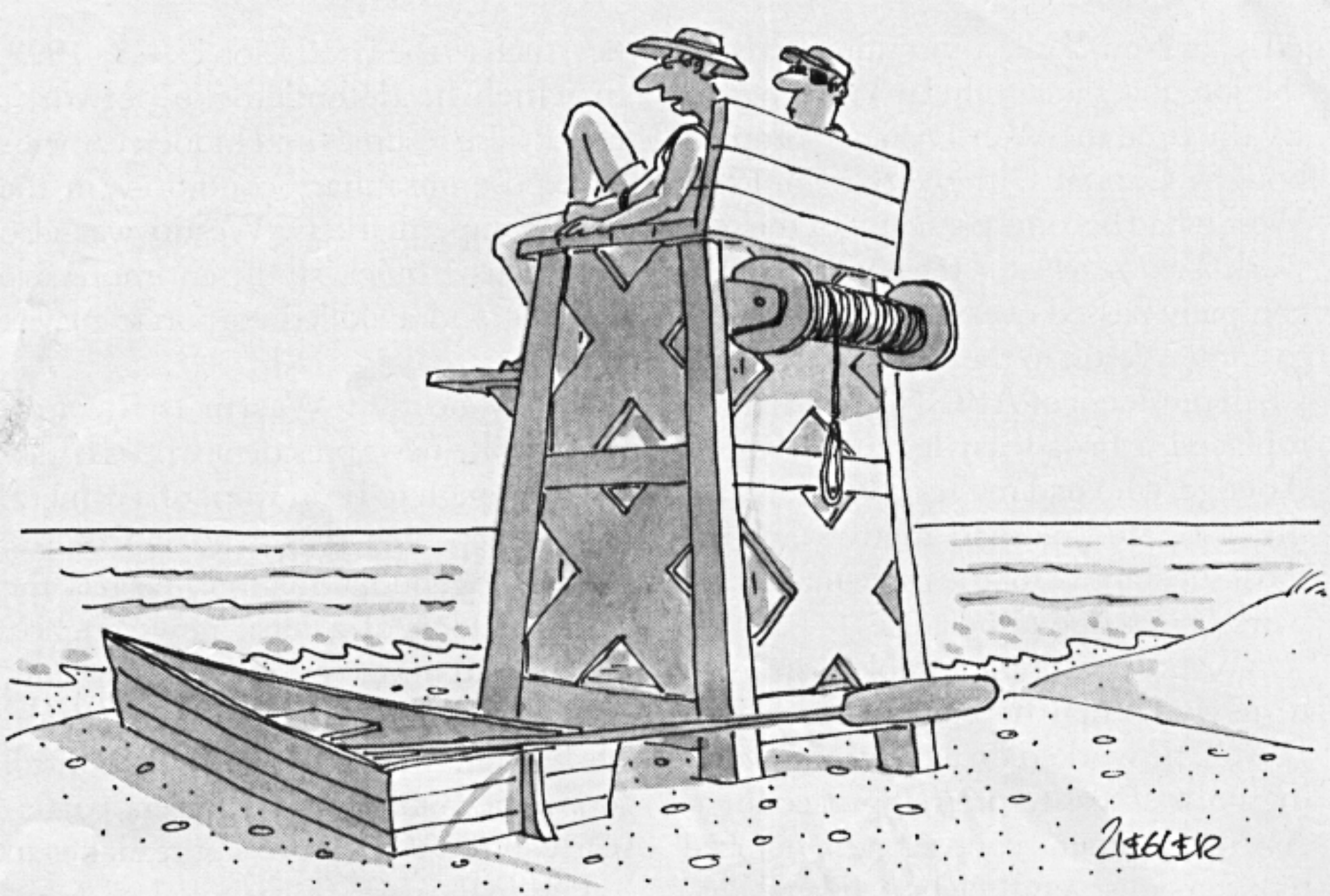
Acknowledgements

- USDA Cooperative State Research Education and Extension Service (CSREES)
- USDA CSREES Great Lakes Regional Water Quality Program
- Volunteers in IA, IN, MI, MN, OH, and WI

USDA

Cooperative State Research, Education, and Extension Service

CSREES Great Lakes Regional Water Quality Program



"I adore the beauty and tranquillity of these raw-sewage days."

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