Biological Systems Engineering
UNIVERSITY OF WISCONSIN–MADISON

UW Extension
University of Wisconsin–Extension

# Manure Irrigation: Benefits and Drawbacks

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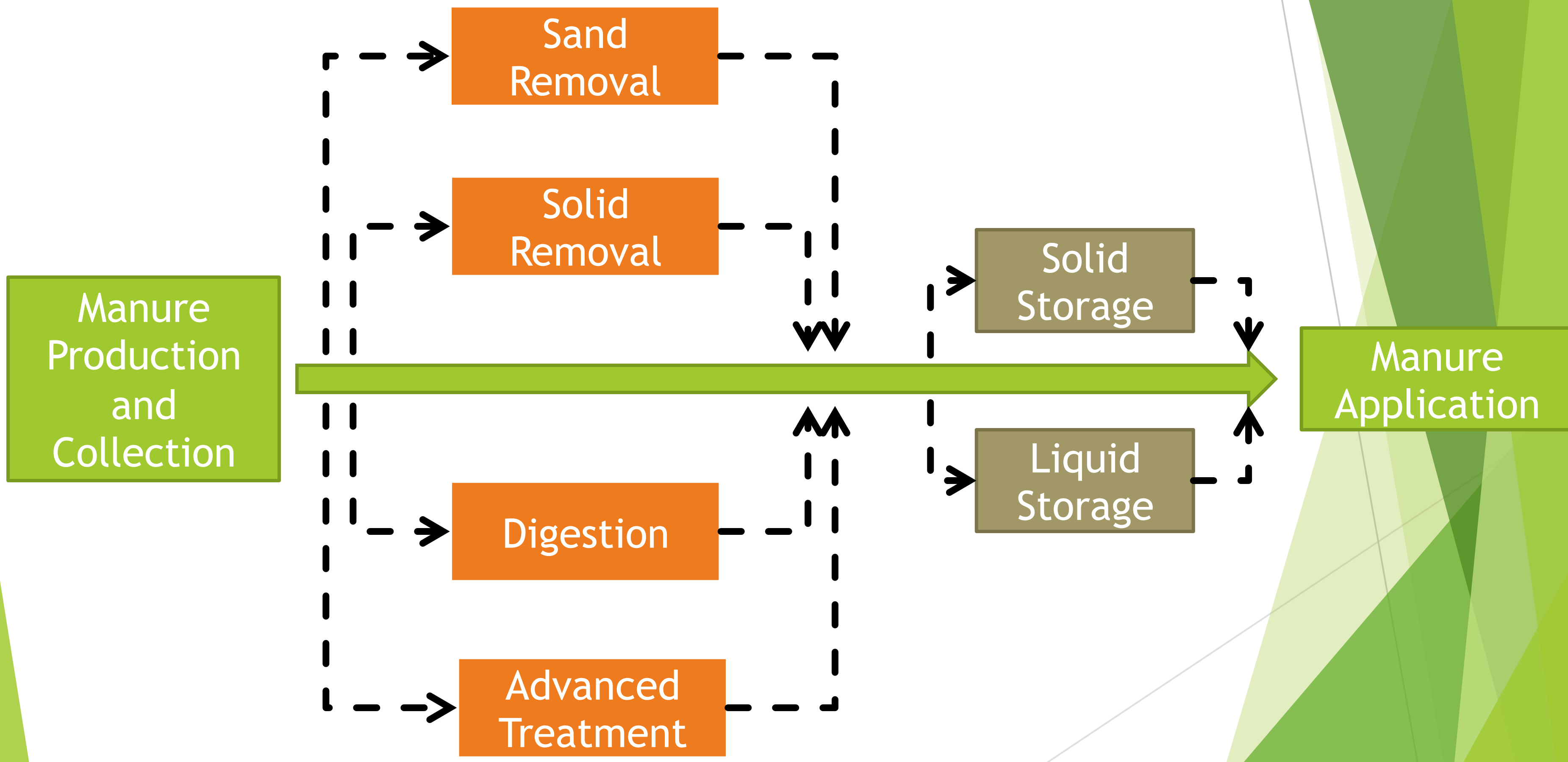
BALZER 3350
MAGNUM

# Sustainability & Manure Cycling

# Manure System



# Workgroup Outline

- Led by Dr. Ken Genskow, University of Wisconsin-Madison
- Workgroup consists of many different stakeholders – 18 members
- Assess application benefits and concerns in comparison to other practices
- Examine impacts related to human health, water quality, air quality, drift, etc.
- http://fyi.uwex.edu/manureirrigation/
- Workgroup report to be completed by March 2015


Traveling Gun


Center Pivot

# Benefits

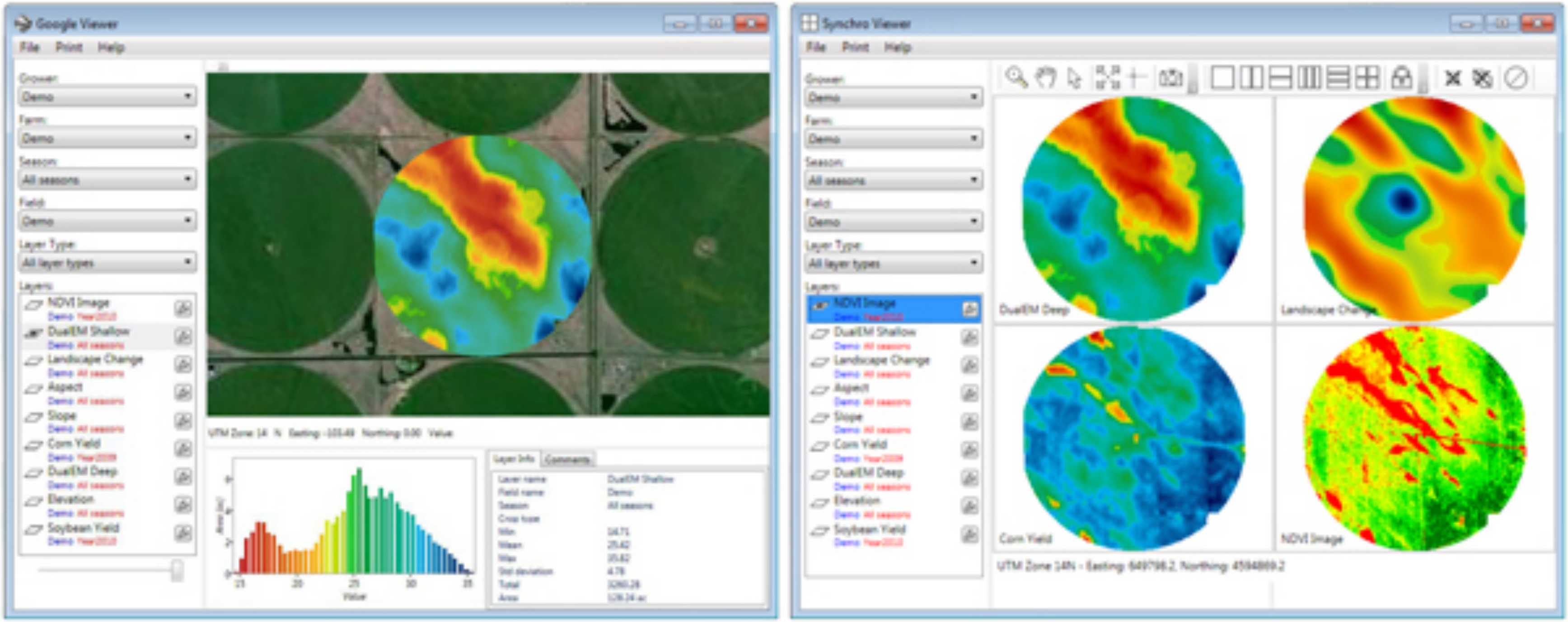
- Reduced hauling costs
- Reduced road traffic and the issues associated (if pumping)
- Multiple crop applications
- Potential to reduce irrigation water demand
- Reduced soil compaction
- Use when storage may overtop
- Water quality

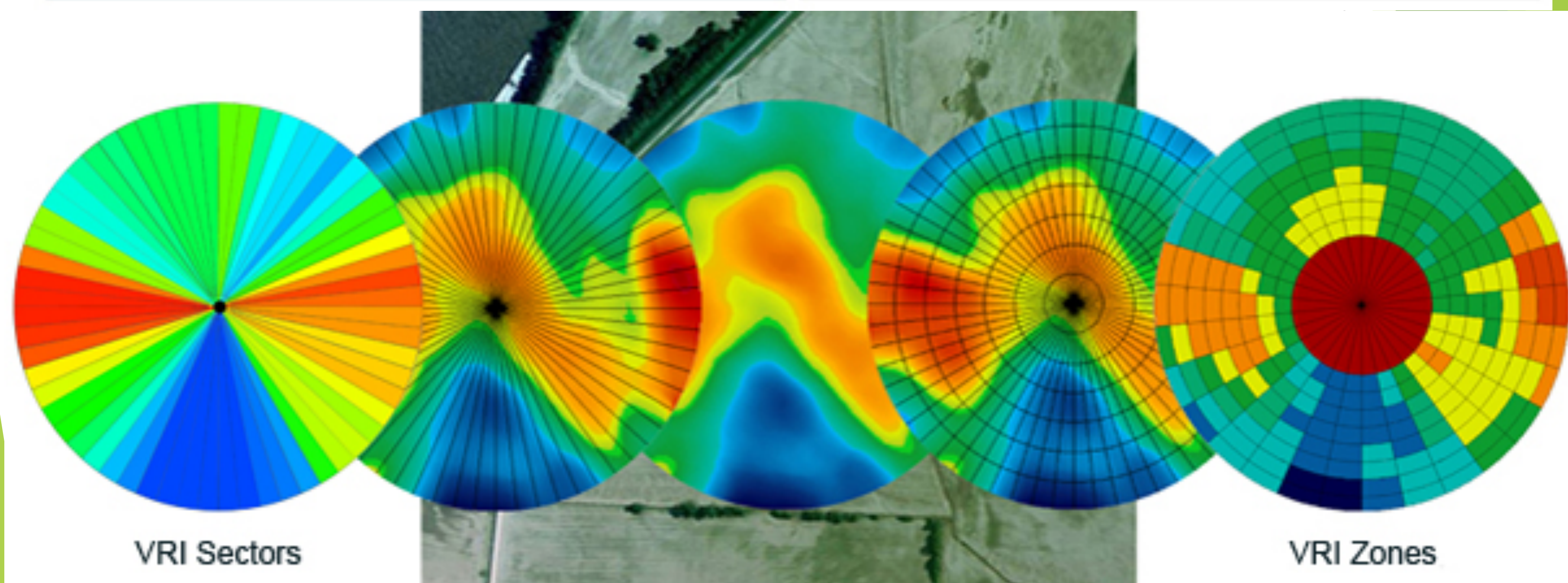
# Example

- 8,000 gallons/acre @ 1.5¢ per gallon = $120/acre
  - Saving of $60 per acre with traveling gun
- For a 130 acre parcel with an application rate of 10,000 gallons per acre @ 1.5¢ per gallon = $19,500
  - Using an 8,000 gallon tanker requires ~163 tanker loads
  - With a center pivot @ 0.5¢ per gallon = $6,500

# Challenges

- Odor
- Drift
- Water quality
- Air quality
- Operational issues
- Human health concerns from pathogens and other additives




http://cropmetrics.com/features/variable-rate-irriga

# Pathogens

**Data Collection**

**Model Development**

**QMRA**

# Sampling

Field air flow calibration

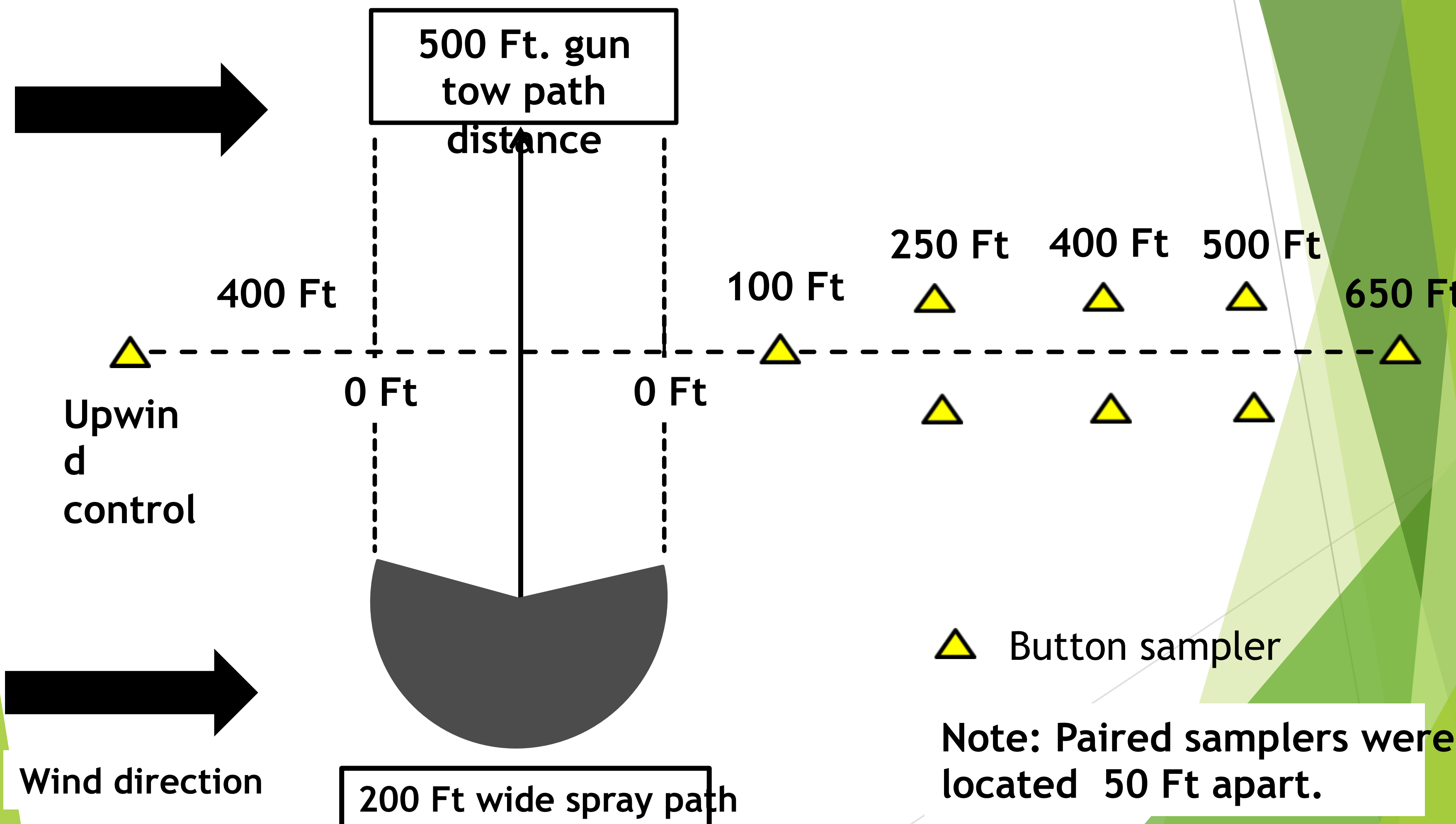
Removable filters

# Pathogens Measured

- *Campylobacter* (bacteria)
- *Salmonella* (bacteria)
- *E. coli* O157:H7 (bacteria)
- *Giardia* (protozoa)
- *Cryptosporidium* (protozoa)
- *Eimeria* (protozoa)
- Bovine polyomavirus

# Traveling Gun

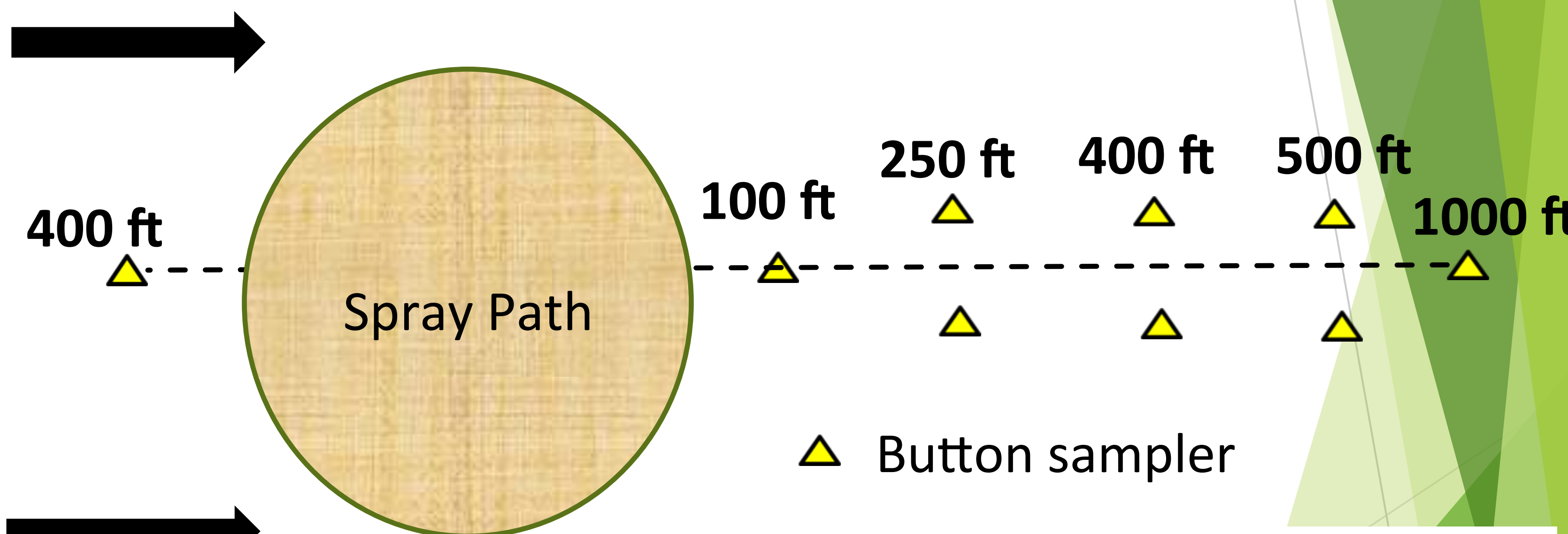
*Typical full scale spray / sampler configuration*




**Note: Paired samplers were located 50 Ft apart.**

# Center Pivot

*Typical full scale spray / sampler configuration*




**Wind direction**

Note: Paired samplers are located 50 feet apart. Additional Bio Samplers will be added to assess viable pathogens.

# Traveling Gun Conditions

## *Weather conditions during testing – Fall 2012*

| Date of Spray | Spray No. | Avg. Wind Speed (mph) (± St D) | Avg. Wind Gust (mph) (± St D) | Avg. Solar Intensity (W/m^2) (± St D) |
|---|---|---|---|---|
| Sep 26 | 1 | 2.7 (± 1.5) | 4.2 (± 1.8) | 172(± 57.1) |
| Sep 27 | 2 | 2.3 (± 1.6) | 4.5 (± 2.2) | 637 (± 8.40) |
| Oct 10 | 3 | *12.9 (± 2.5) | *16.3 (± 2.9) | 403 (± 212) |
| Oct 11 | 4 | 11.2 (± 2.0) | 14.1 (± 2.6) | 447 (± 159) |

**Note: (*) Indicates the highest recorded value within category**

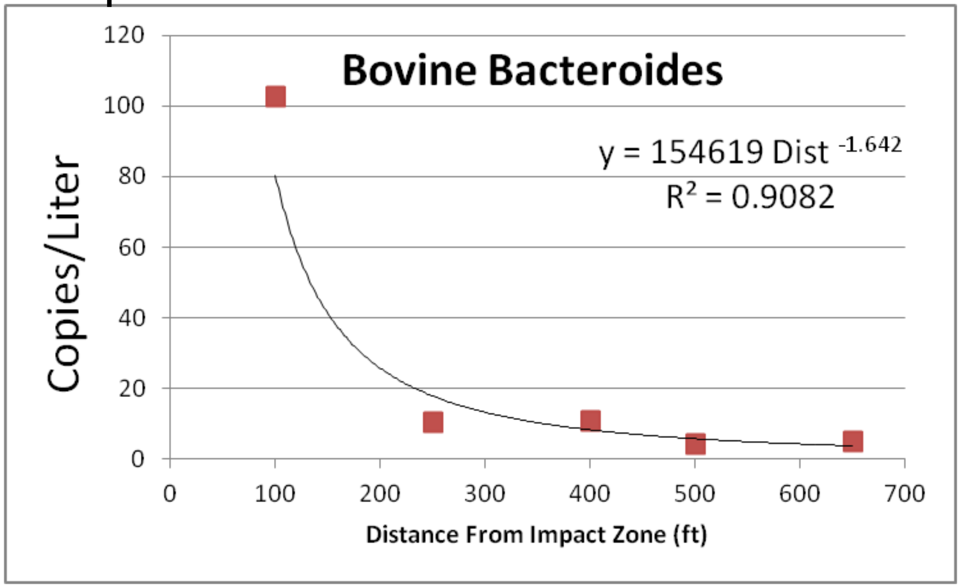
# Center Pivot Conditions

*Weather conditions during testing – Fall 2012*

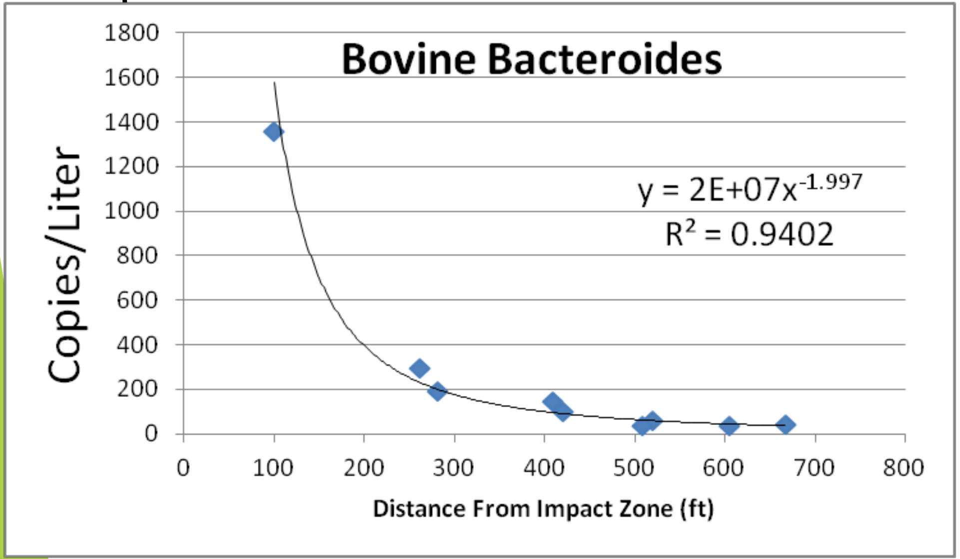
| Date of Spray | Spray # | Avg Temp (F) | Avg Wind Speed (mph) (+-StD) | Avg Wind Gust (mph) (+-StD) | Avg Solar Intensity (W/m^2) (+-StD) |
|---|---|---|---|---|---|
| 6.7.2013 | 1 | 64.5 | 6.2 (+-1.2) | 8.0 (+-1.3) | *916.3 (+-108.7) |
| 6.11.2013 | 2 | 78.4 | 5.7 (+-2.0) | 7.4 (+-2.1) | 510.5 (+-191.6) |
| 6.20.2013 | 3 | *79.6 | 6.8 (+-1.5) | 8.6 (+-1.8) | 432.6 (+-206.7) |
| 6.28.2013 | 4 | 72.6 | *8.7 (+-2.0) | *12.0 (+-2.8) | 617.7 (+-263.5) |

# Airborne Transport – Bovine Bacteroides

Experiment 1



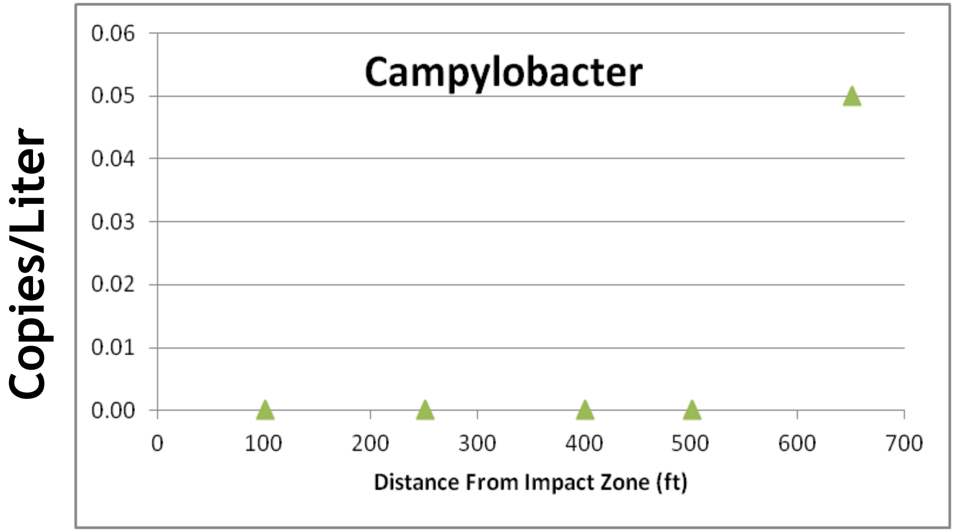

Experiment 4



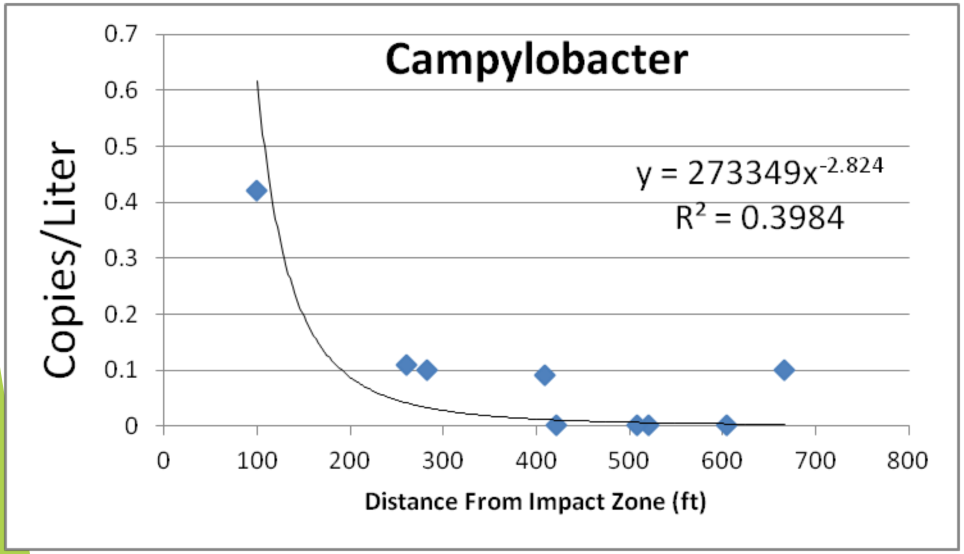

| | **Expt 1 9/26/12** | **Expt 4 10/11/12** |
|---|---|---|
| Bacteroides manure concentration (gc/L) | $4.8 \times 10^7$ | $3.3 \times 10^8$ |
| Average wind speed (mph) ± SD | 2.7 ± 1.5 | 11.2± 2.0 |
| % time samplers in target wind direction | 70% | 97% |
| Average solar intensity ($W/m^2$) | 172 | 447 |

# Airborne Transport – *Campylobacter jejuni*

Experiment 1



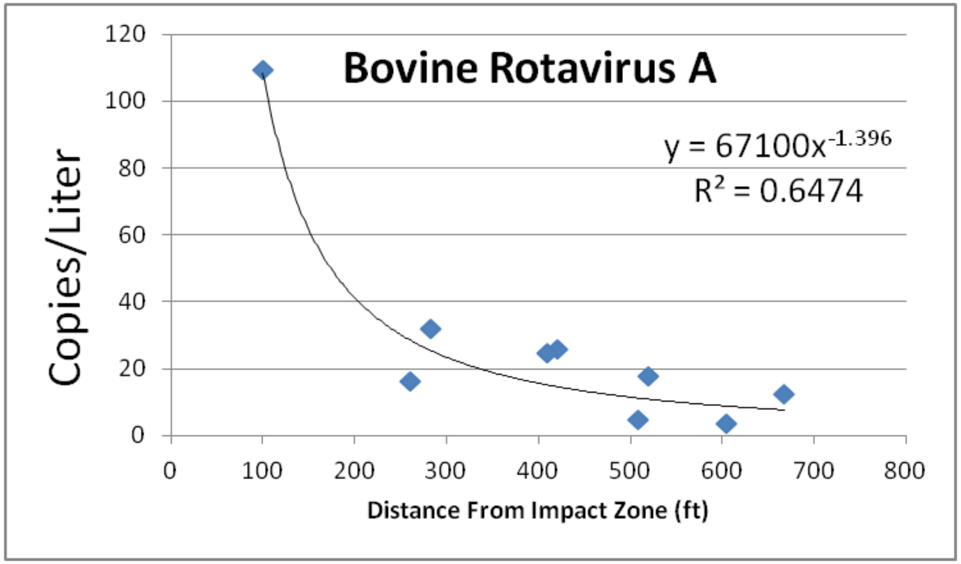

Experiment 4




| | Expt 1 9/26/12 | Expt 4 10/11/12 |
|---|---|---|
| *C. jejuni* manure concentration (gc/L) | $3.5 \times 10^3$ | $6.1 \times 10^4$ |
| Average wind speed (mph) ± SD | 2.7 ± 1.5 | 11.2± 2.0 |
| % time samplers in target wind direction | 70% | 97% |
| Average solar intensity (W/m²) | 172 | 447 |

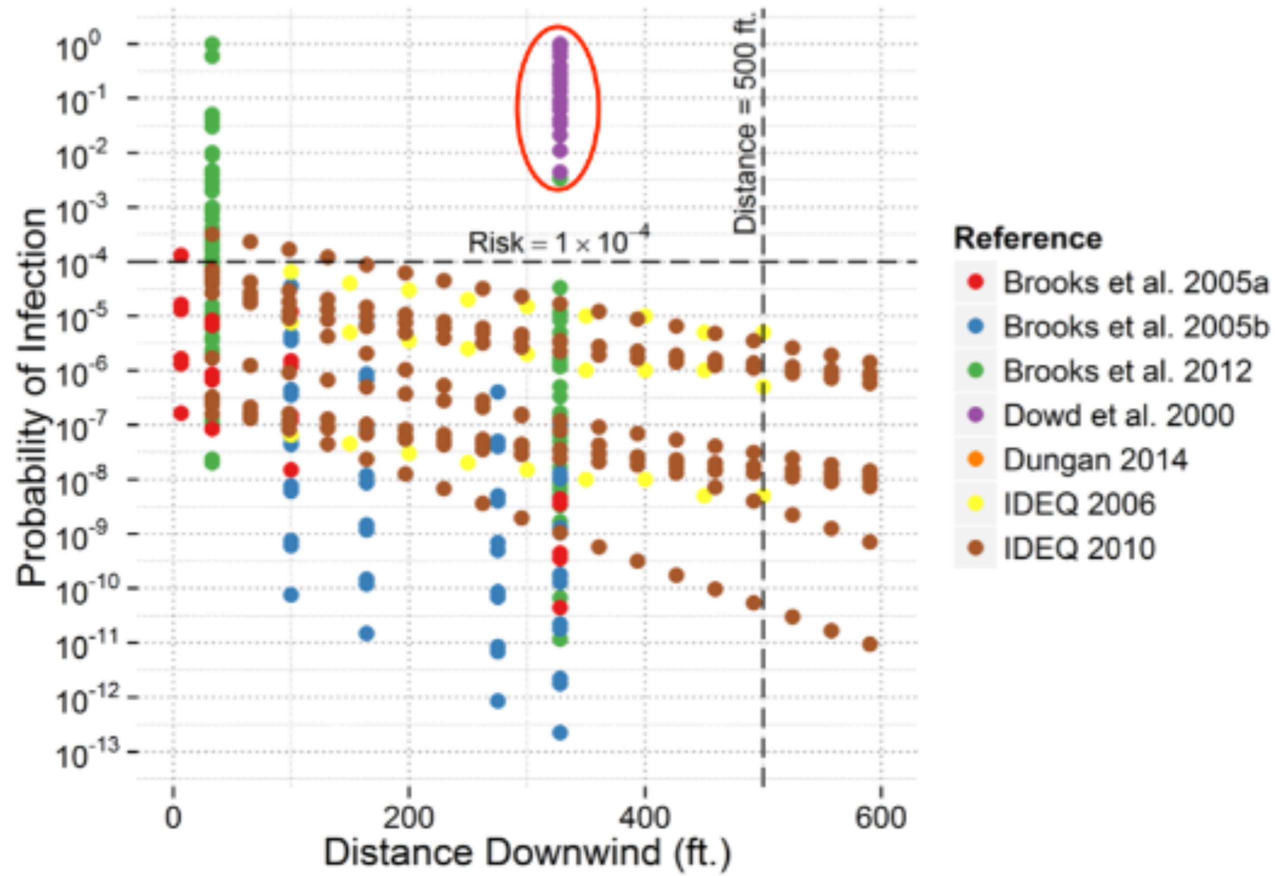
# Airborne Transport – Bovine Rotavirus A

Experiment 4




| | Expt 1 9/26/12 | Expt 4 10/11/12 |
|---|---|---|
| Rotavirus A manure concentration (gc/L) | Not detected | $5.9 \times 10^5$ |
| Average wind speed (mph) ± SD | 2.7 ± 1.5 | 11.2± 2.0 |
| % time samplers in target wind direction | 70% | 97% |
| Average solar intensity (W/m²) | 172 | 447 |

# Risk by Reference




T.R. Burch and M. Borchardt. 2014. Literature Review of Quantitative Microbial Risk Assessments Related to Aerosolization of Livestock Manure and Municipal Biosolids, U.S.G.S & USDA ARS, Marshfield, WI

# Conclusions

- Existing challenges remain
- Irrigation may be suitable for some fields as well as many which it is not
- Reduced application costs are attractive but can also require high capital costs (center pivots) and requires *significant* management
- Questions still remain
  - Water quality impacts
  - Risks aside from pathogens?

# Thank You!

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UWEX IRRIGATION WEBSITE

http://fyi.uwex.edu/manureirrigation/