

CONTROL OF *CRYPTOSPORIDIUM* AND ROTAVIRUS CONTAMINATION IN AGRICULTURAL WATERSHEDS

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Objectives

1. To determine mechanisms of microbial (*Cryptosporidium* and Rotavirus) surface and near-surface overland transport and fate under various soil conditions
2. To characterize critical environmental factors affecting microbial transport and control in surface and near-surface runoff
3. To develop a predictive model for microbial transport in surface and near-surface runoff that can be used for designing agricultural BMPs that will prevent transport of microbial pathogens to the water supply.

Central Hypothesis: *properly designed vegetative filter strips can reduce the risk of microbial contamination of watersheds by runoff from animal production facilities.*

Approach

Laboratory

(large and small scale rain simulators)

effects of various environmental factors; vegetation, slope, soil type, rain intensity on microbial transport kinetics, retention (soil particle adhesion) and fate in VFS



Field

effects of environmental factors, such as duration and intensity of precipitation, snowmelt, vegetation, land-use condition, field topography, and field management practices on pathogen loads from dairy/cattle farms to the water supply at selected field sites



Watershed

representative watersheds containing croplands with livestock manure application, presence of vegetative buffers of different widths and grass types that drain into grass waterways - runoff samples entering each vegetative buffer, leaving the buffer, and at the watershed outlet drained by the grass waterways will be monitored for microbial concentration.

Large Scale Soil Chamber

- Horizontal Tilting Soil Chamber
 - 1.5m wide, 3.6m long, 0.3m deep
 - 10-gauge sheet metal
 - Hydraulic cylinder for slope adjustment
- Two compartments: Bare vs. **Vegetation**
 - Steel plate divider to prevent cross contamination
 - Smooth Brome vegetation
 - Two soil types: Catlin silt-loam and Newberry silt-loam



Large Scale Rainfall Simulator

- Micro-computer controlled laboratory rainfall simulator
 - 2 modules 1.3-m apart
 - 10-m above the test floor
 - Each module contains 5 spraying Veejet 80100 nozzles
 - Passes per minute (PPM) determines intensity
- Calibration
 - Linear relationship between PPM and intensity
 - Based on these 20 trials, an equation was developed.



Application of Oocysts



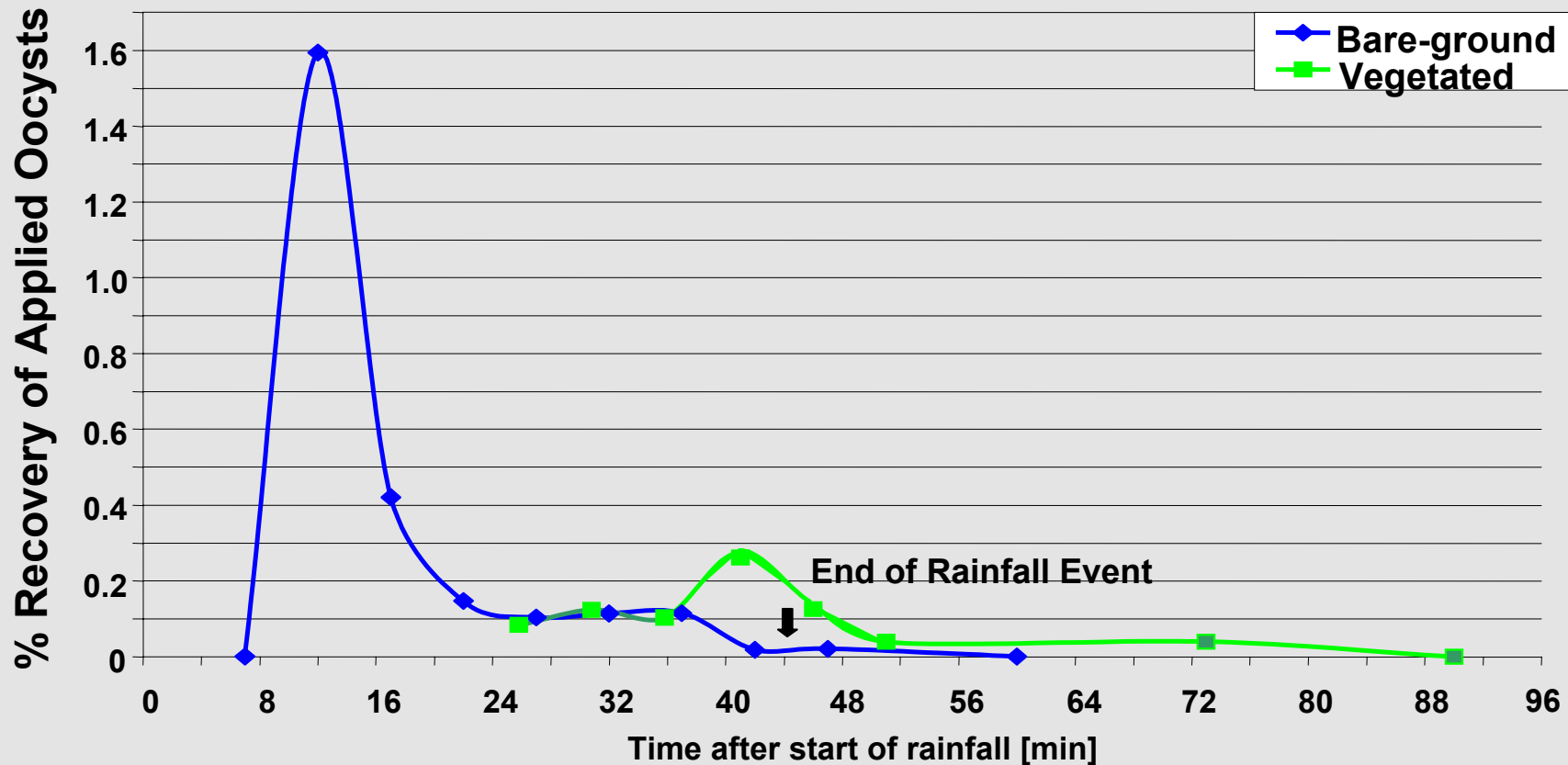
Large Scale Collection Systems

■ Near-surface Collection System

- Steel tray underneath each compartment
- 12, 9.5mm diameter holes in the bottom of each compartment
- 2 sheets of wire mesh over the subsurface collection holes
- 6-gallon glass bottles placed under steel tray for collection



C. parvum Overland Transport Kinetics (1.5% slope)



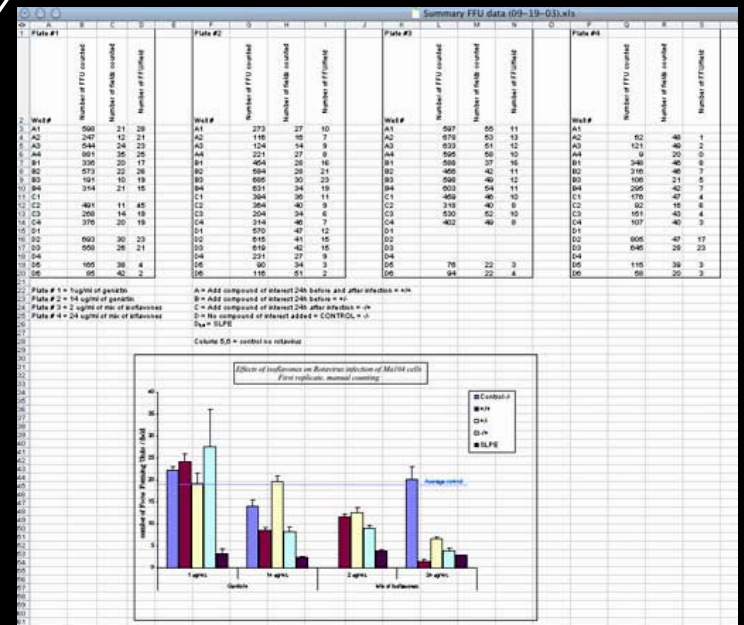
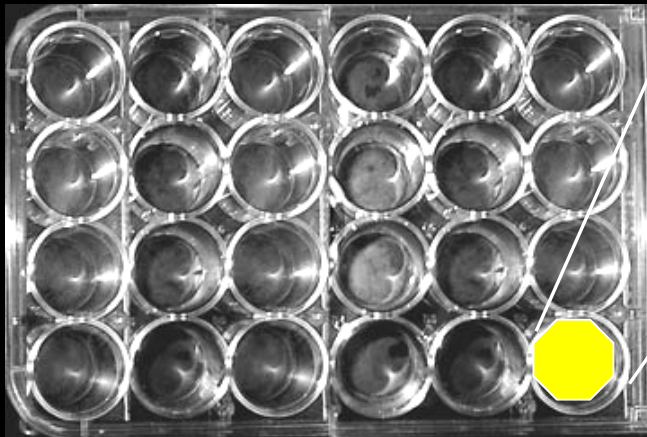
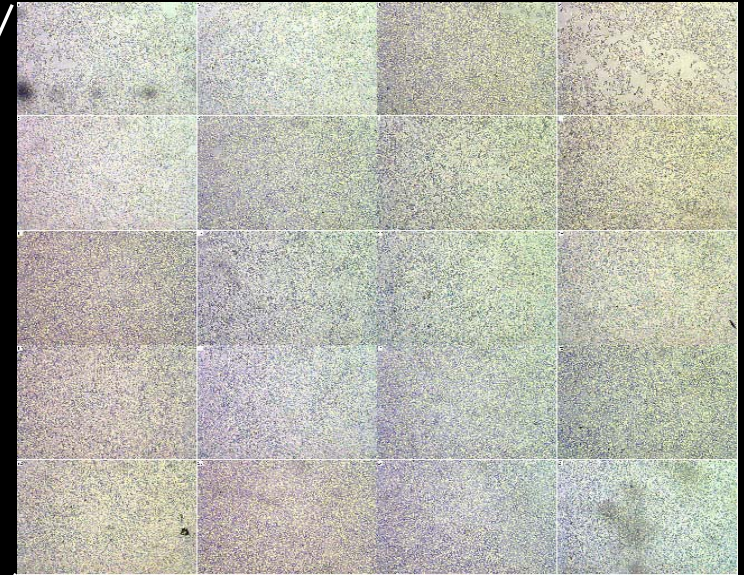
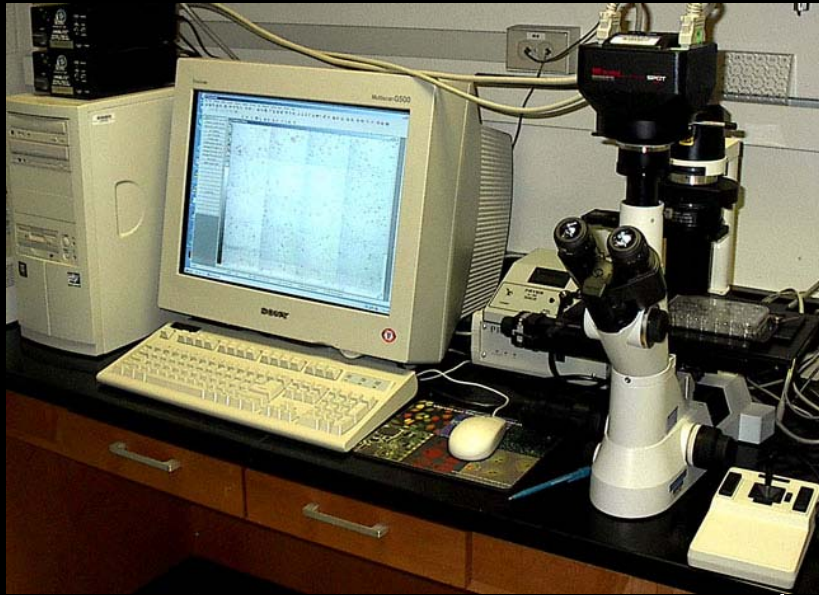
- **Bare-ground**

- **Peak Time: 12-15 min.**

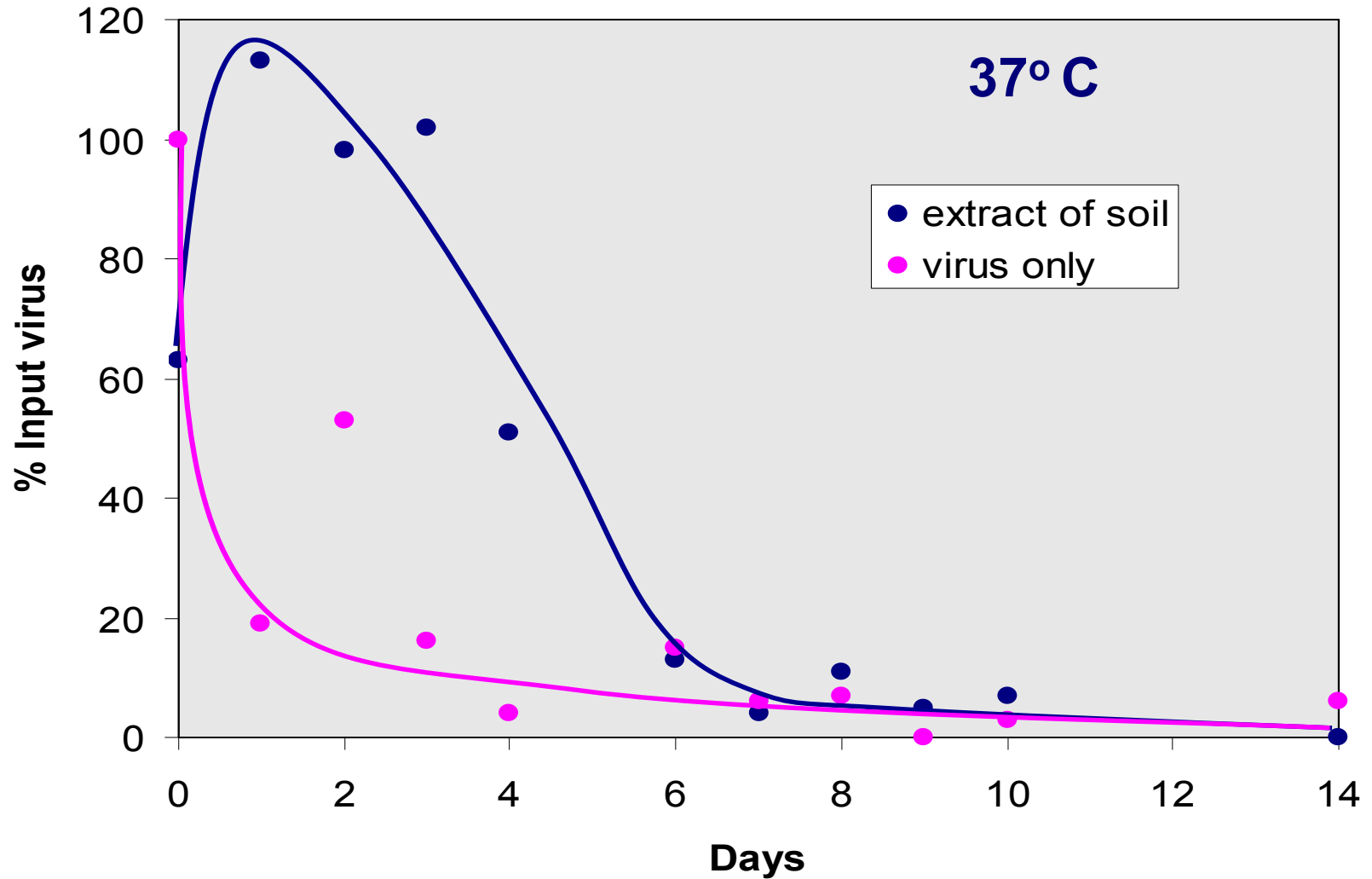
- **Vegetated**

- **Peak Time: 36-41 min.**

Automated Virus Focus Forming Assay



Soil is Thermal-Protective for Rotavirus



Field Study of a VFS- Overview



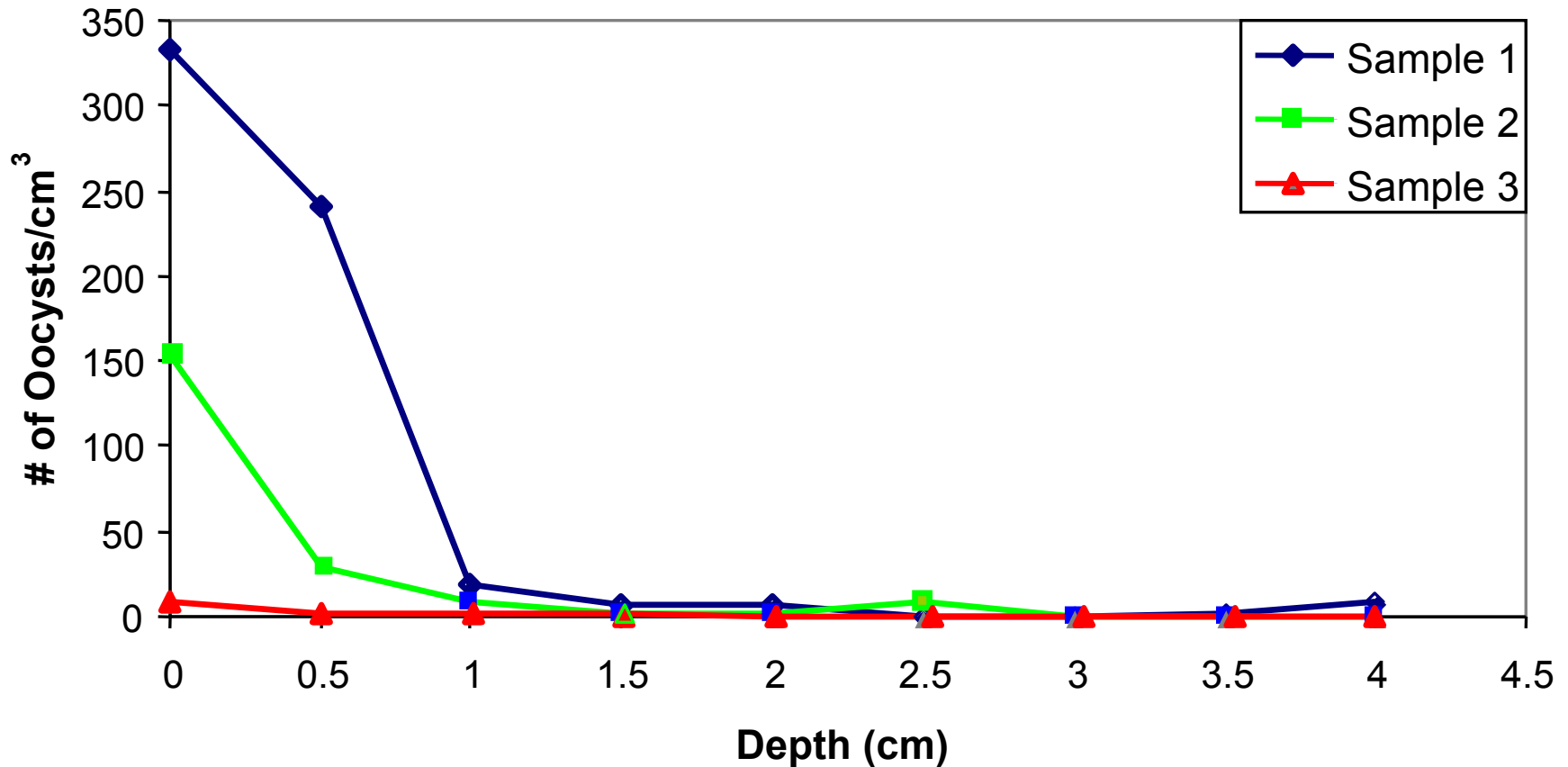
Overland Transport - Small Scale

■ Soil Beds

- ❖ 0.9 m long, 0.3 m wide, 4.5 cm deep
- ❖ Lined with Isotope Paper
- ❖ Shallow Subsurface Drainage
- ❖ Surface Drainage
- ❖ Catlin Soil
- ❖ Bare Soil, Vegetated (Tall Fescue), and Split Chamber Beds
- ❖ Plexiglass Sidewalls
- ❖ 3.0% Slope

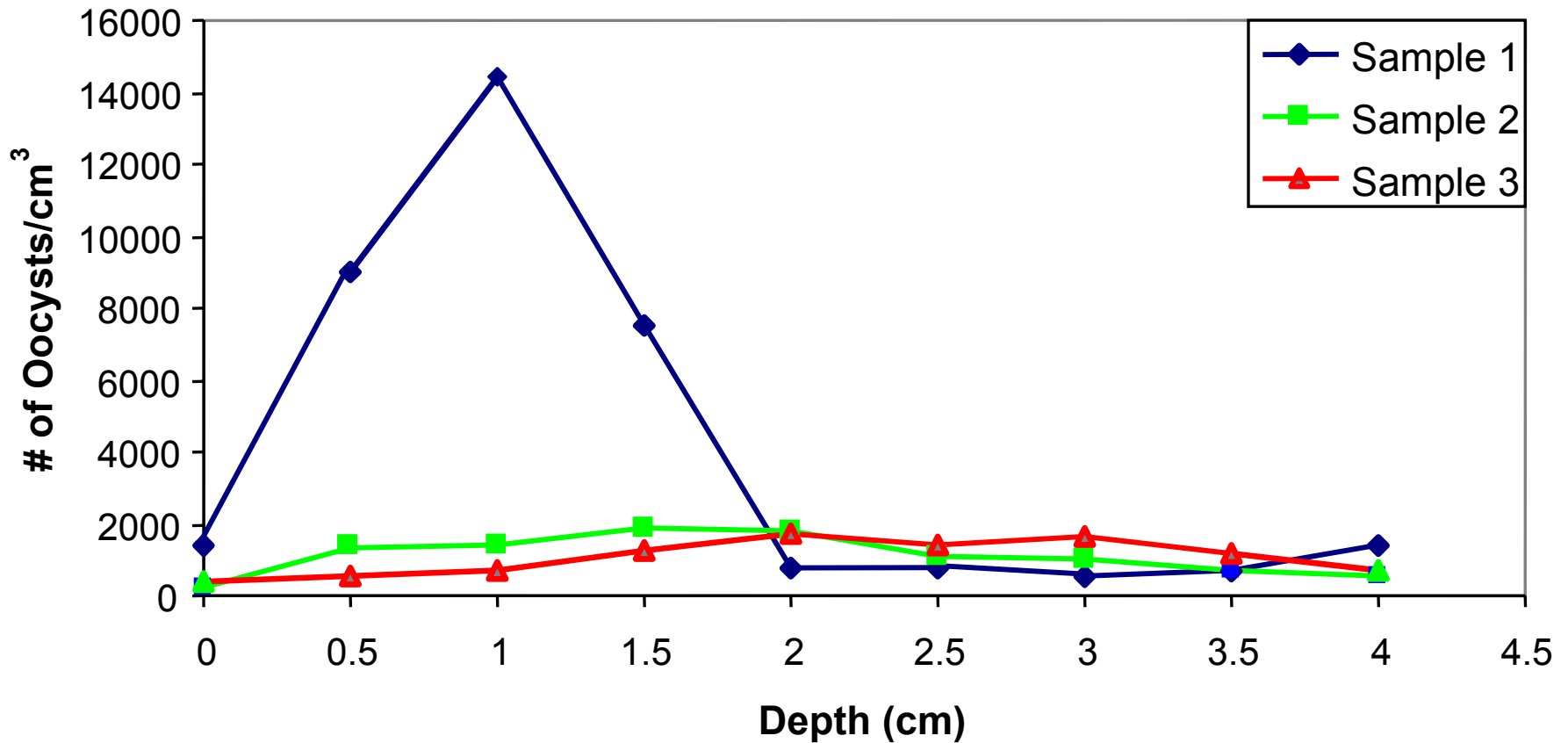


Oocyst Infiltration Depth - Bare Soil



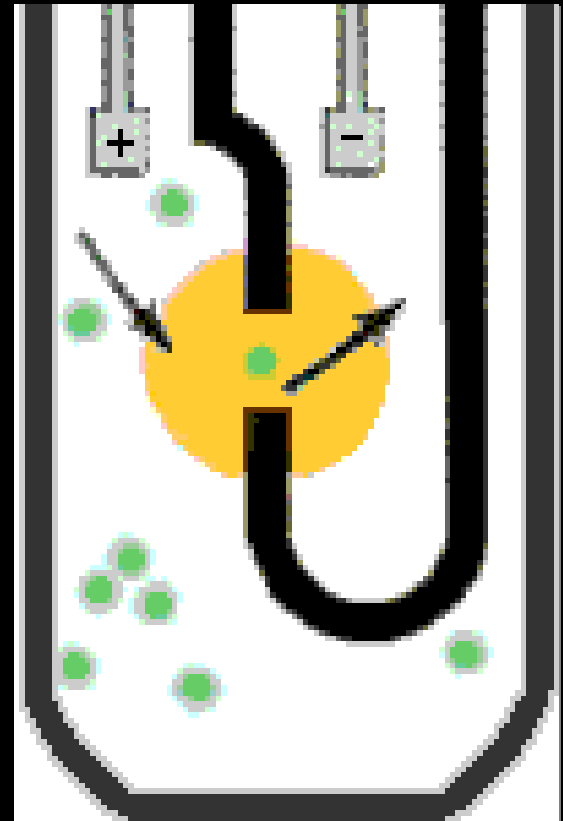
The movement of *C. parvum* oocysts into the soil profile on a bare soil. (Sample 1 was located closest to the point of application and Sample 3 was the furthest from the application point.)

Oocyst Infiltration Depth - Vegetated Soil

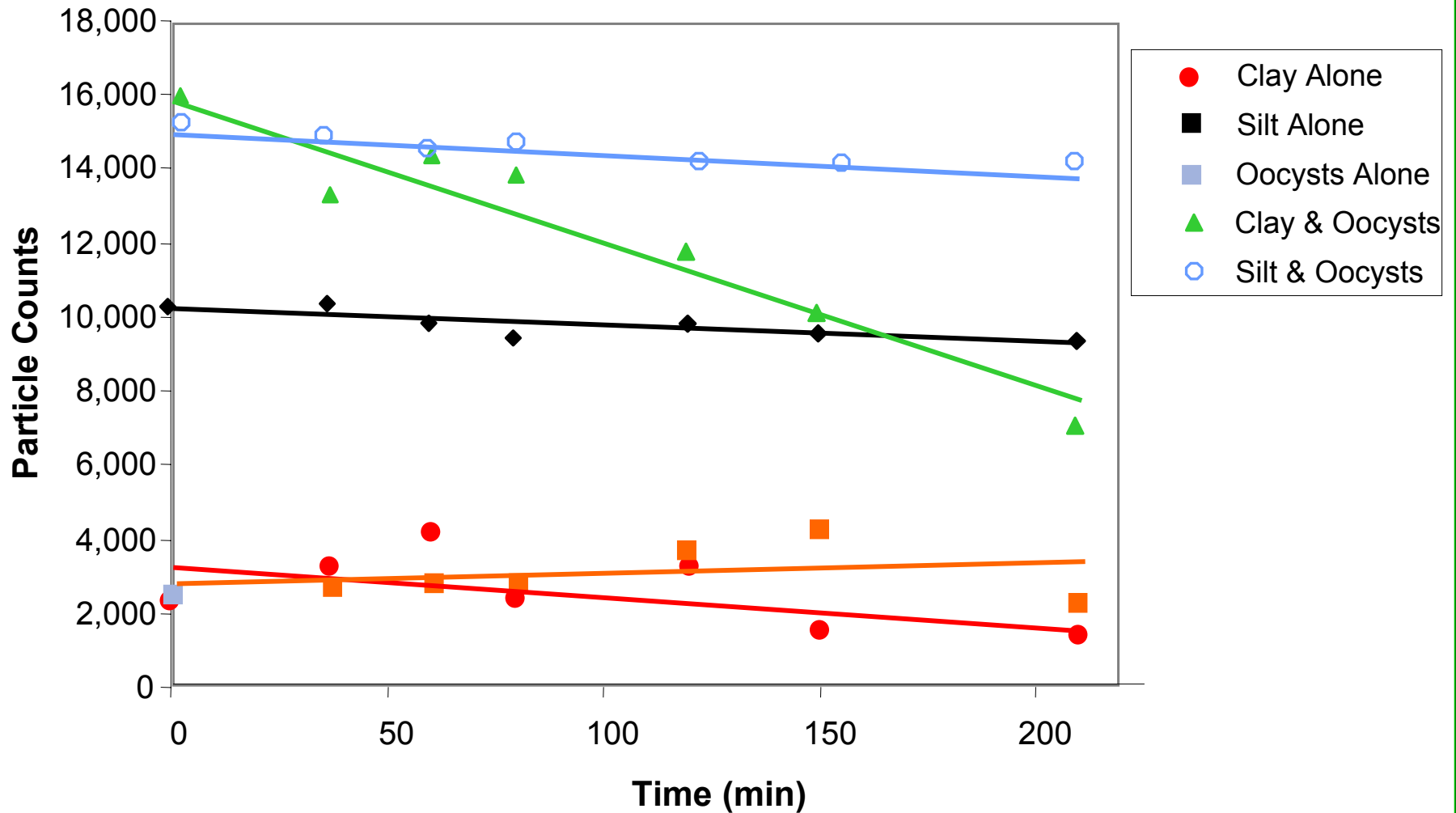


The movement of *C. parvum* oocysts into the soil profile on a vegetated soil. (Sample 1 was located closest to the point of application and Sample 3 was the furthest from the application point.)

Crypto Oocysts - Soil Adhesion Coulter Counter Particle Sizing Analyses

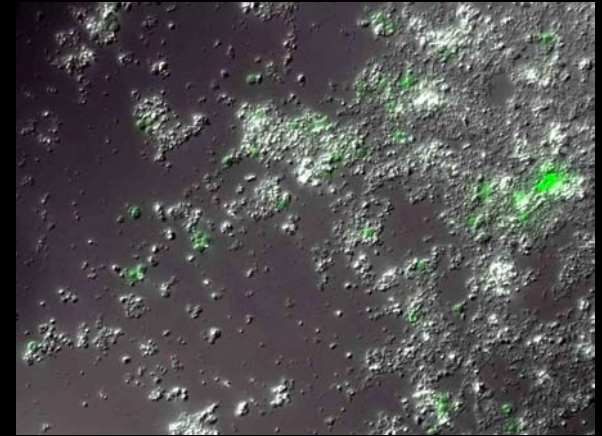
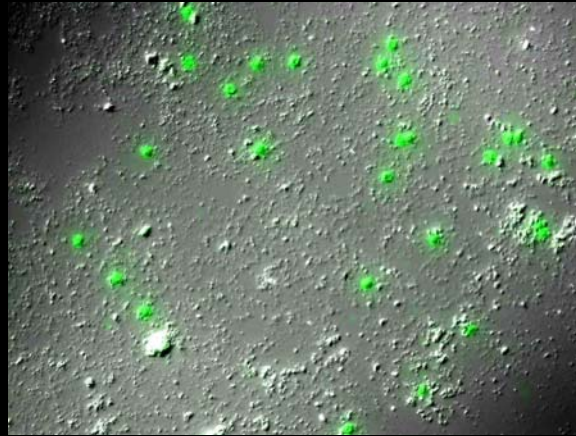
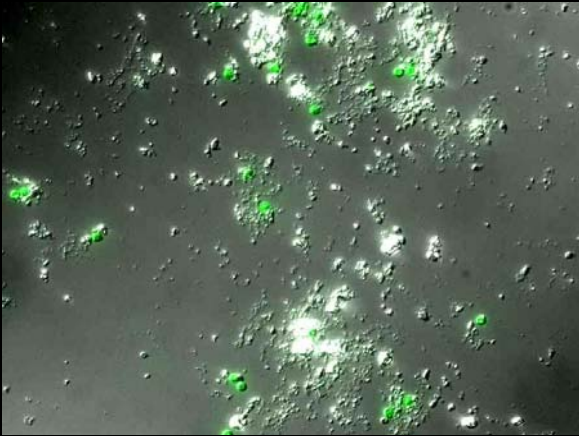


Oocysts Adhere Specifically to Clay

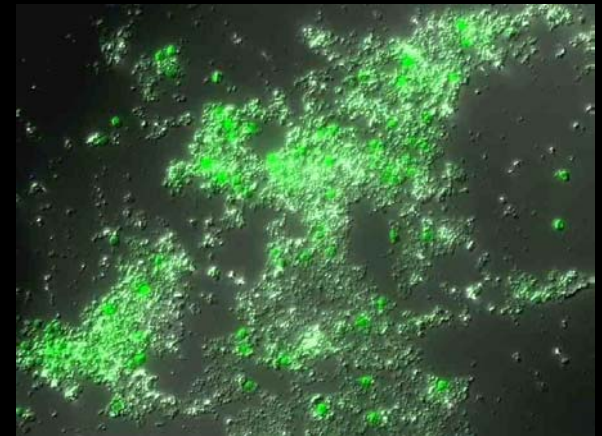
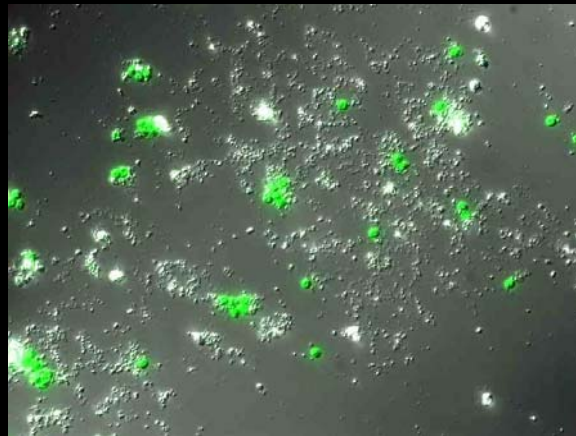


Summary of Oocysts Adhesion to Various Soil Particles

0 Time



210 Minutes



Sand

Silt

Clay