

# Liquid Manure Application Techniques to Minimize Odours

By

Ying Chen

Biosystems Engineering Department  
University of Manitoba

# Why injection?

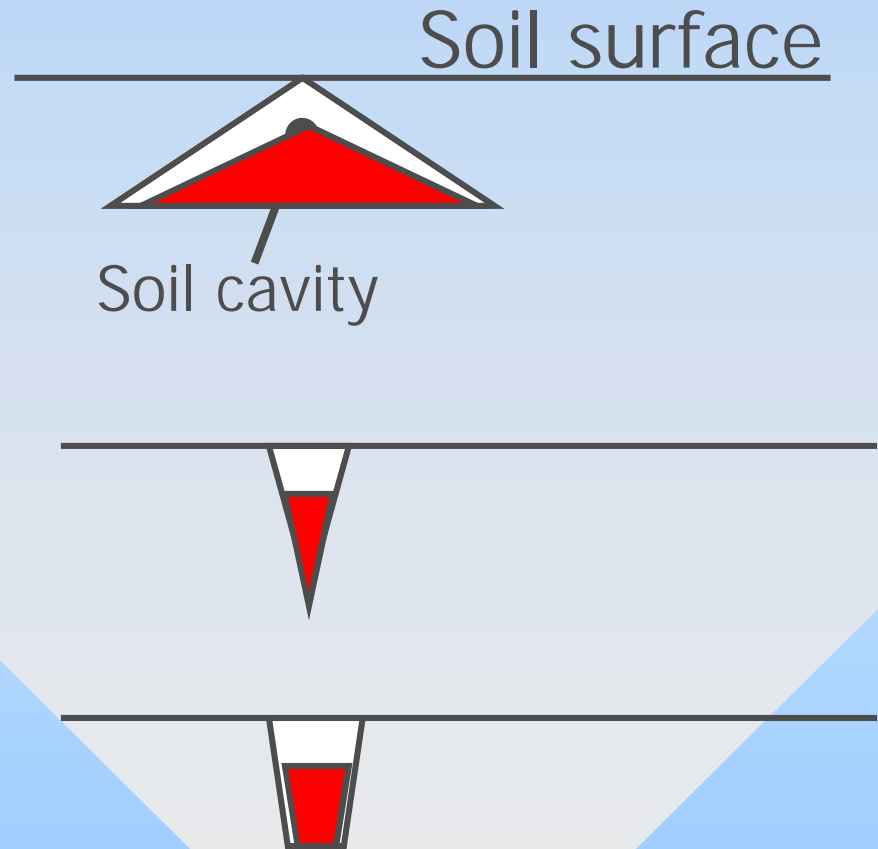
- reduce odour emissions
- reduce nutrient losses

# Problems associated with injection

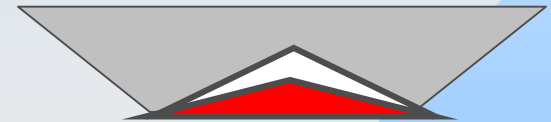
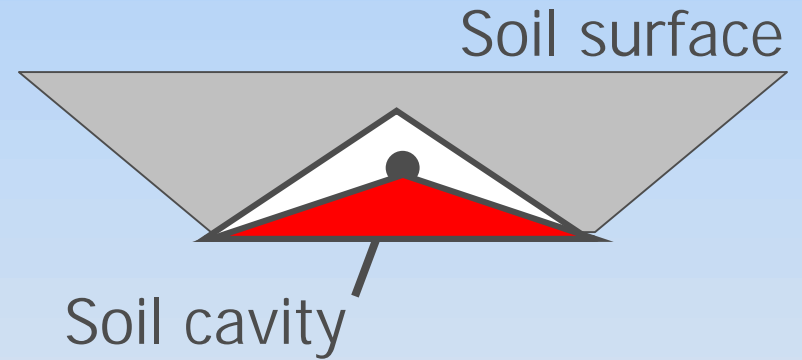
- High power requirement
- Striped crop response
- High surface soil disturbance
- Crop root damage

# Injecting process

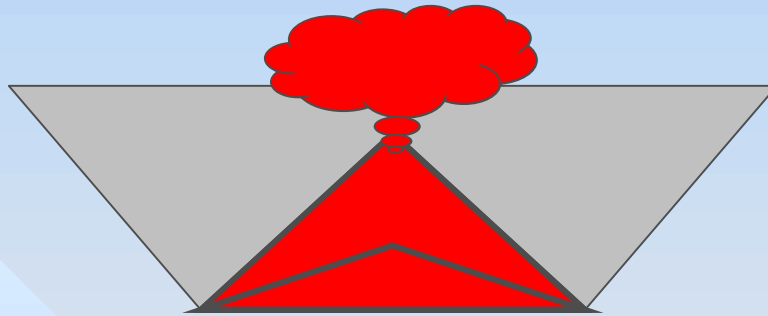
- Sweep-type
- knife or disc
- chisel



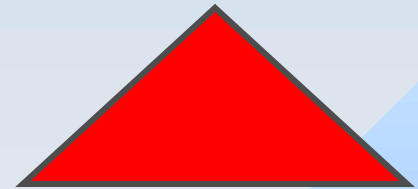
# Soil cavity- sweep-type injectors



# Manure holding capacity



Max. amount of manure =



# Ag Waste injector

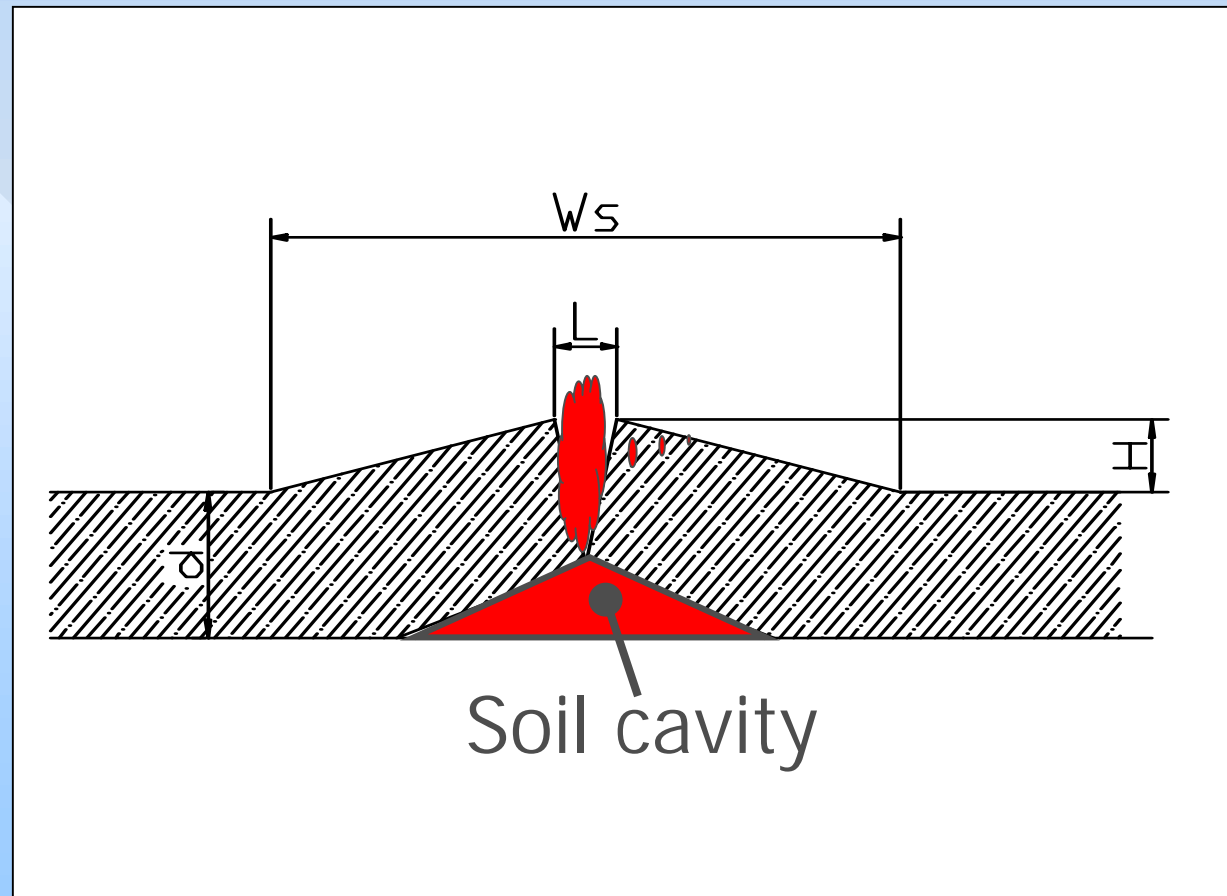


# Sweep - Ag. Waste injector

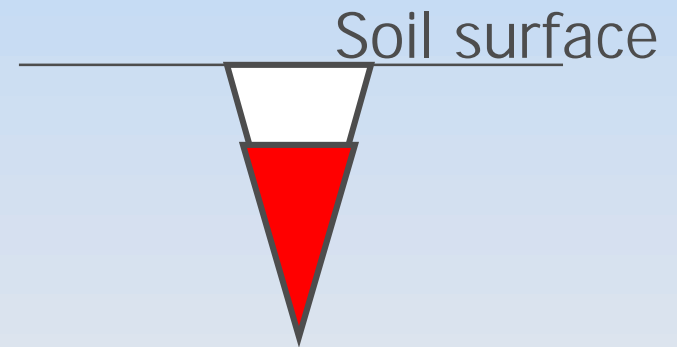




# Soil cross-section vs. manure covering



# Soil cavity- disc-type injectors



# Greentrack injector

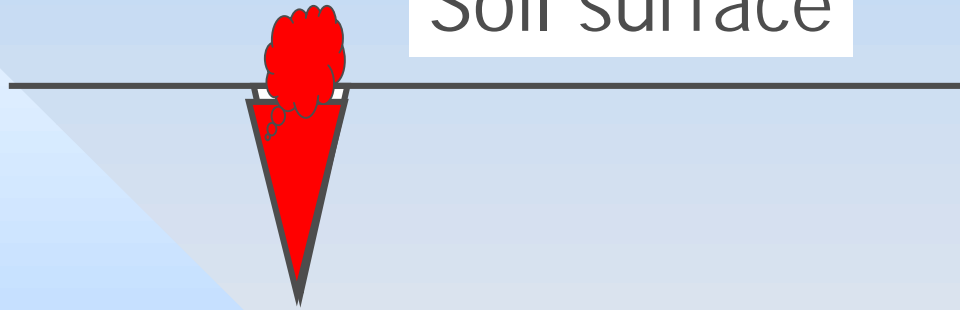


# Knife - Greentrack injector



# Soil cross section

Soil surface

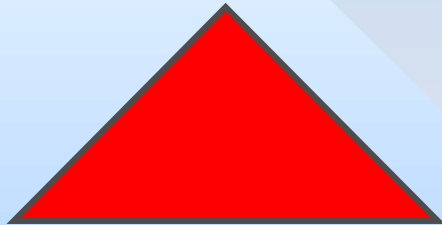


# Manure covering

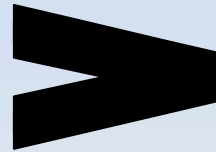


# Manure holding capacity vs. injector type

Sweep-type



Disc-, knife-type, chisel



# Design of sweep-type injection tool - Hypotheses

- Holding capacity - soil cavity
- $V_{\text{manure}}$  = soil cavity
- Soil cavity = tool opening
- tool opening =  $\frac{1}{2} w h$



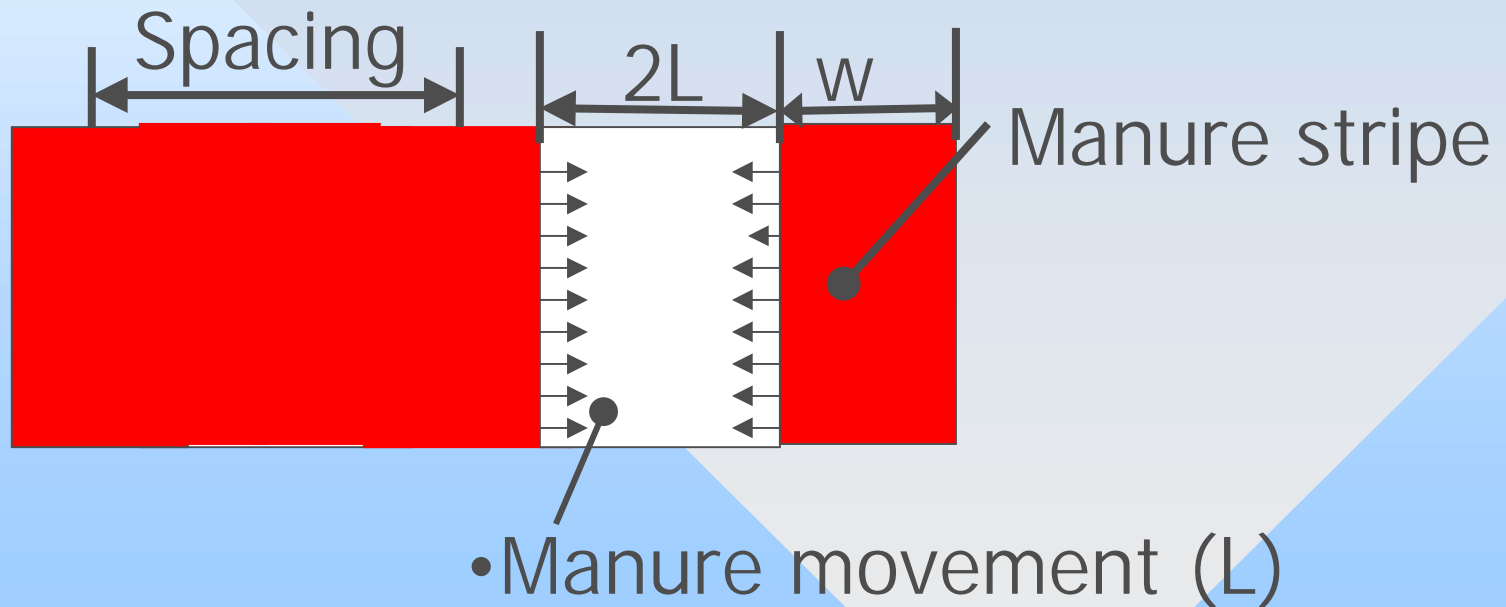
# Tool spacing vs. striped crop response



# How to select tool spacing?

to avoid striped crop response

- Spacing  $< 2L + w$



# Surface disturbance - Greentrack injector

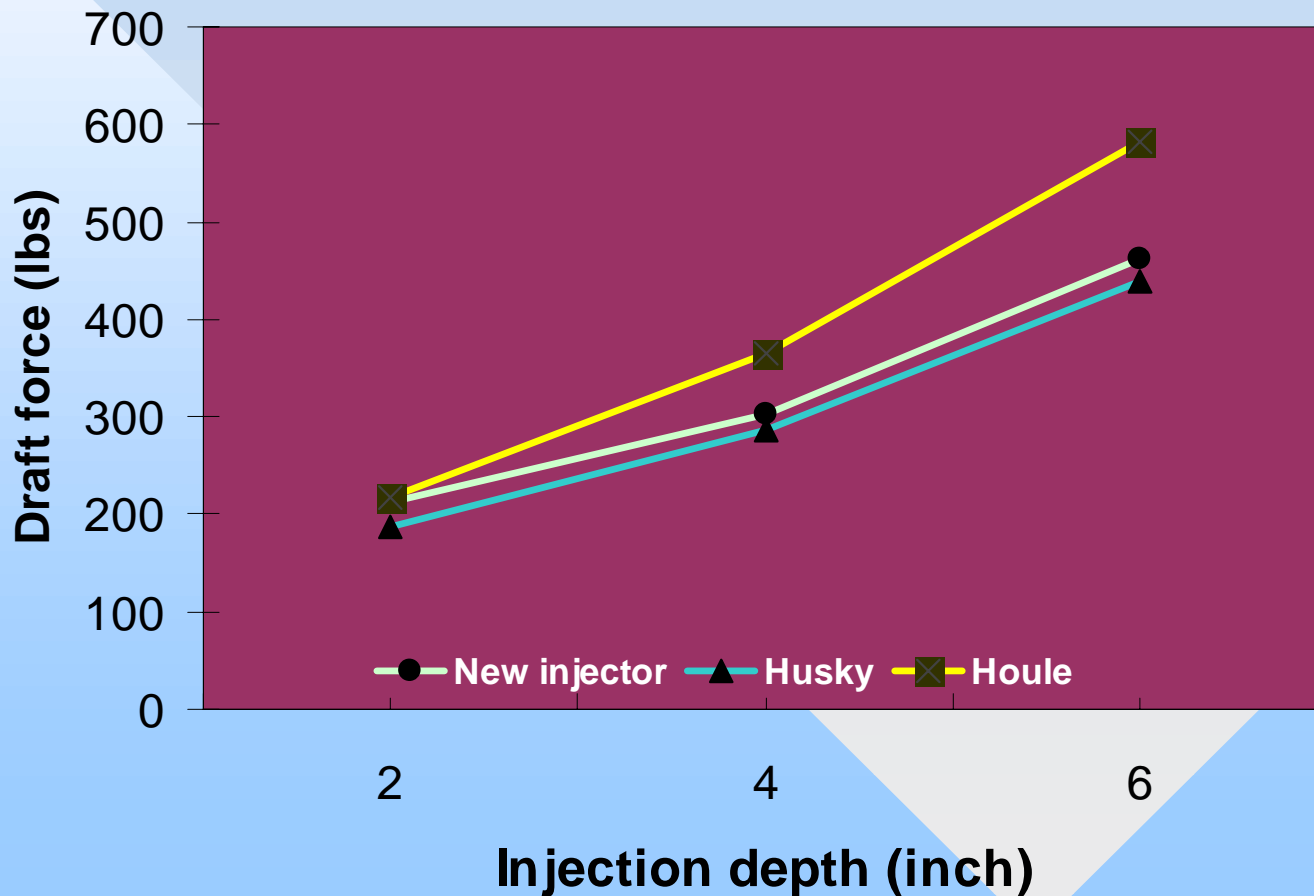


# Soil surface disturbance - AgWaste injector



# Injection depth vs. power requirement

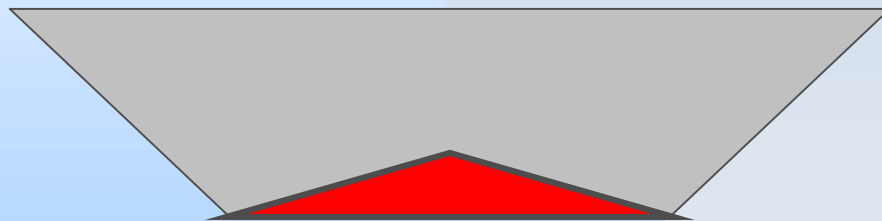
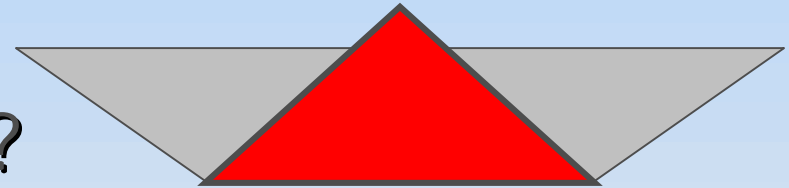
Draft forces of the three injectors tested in field



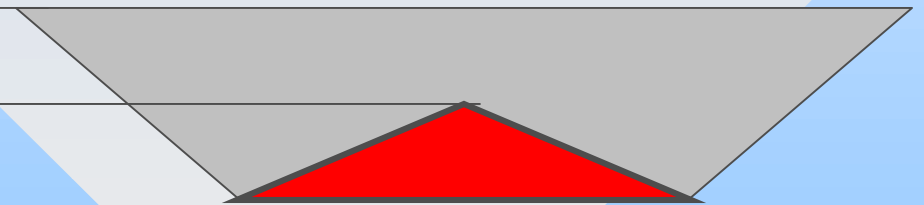
# Injection depth vs. manure covering

Shallow injection

How shallow is not deep?



50 mm



4 inch- good depth

# Conclusions

- Sweep-type injector
  - much higher manure application rate
  - can be used at shallow depth to minimize draft
  - higher soil surface disturbance
  - work well for crop field

# Conclusions -

- Disc or knife type injectors
  - lower soil surface disturbance
  - low draft force
  - lower manure holding capacity



# Conclusions -

- shallow injection depths can reduce draft
- Sufficient depth - to ensure manure being covered
- Tool spacing affects crop response
- Minimum soil disturbance is required