Pit latrine additive studies

UNIVERSITY OF
KWAZULU-NATAL

Pollution Research Group

Overview

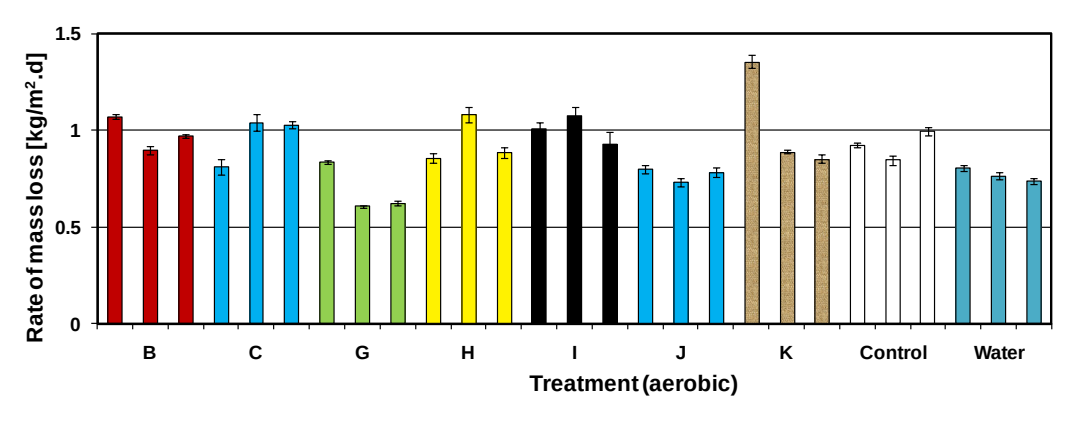
- Lab study
  - Controlled conditions
  - Easy measurements
  - Many replicates
  - Conditions differ from those in pit
- Field study
  - Uncontrolled conditions
  - Measurements difficult
  - Higher cost to replicates
  - *In situ* experimentation

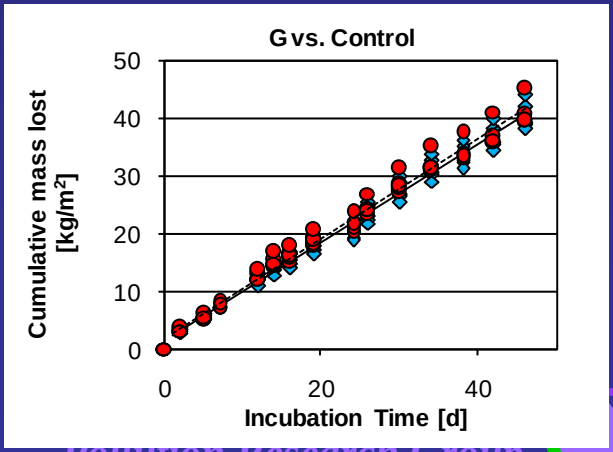
Laboratory studies

- 2007/8 study (published in Water SA in 2009)
  - Developed laboratory protocol
  - Measure rate of mass loss from samples of fresh (surface) pit latrine sludge
  - Control moisture content to reduce dehydration
  - Dose additive on a *per area* basis (same mass additive/m^2 surface area in pit and lab test)
  - Calculate differences in mass loss rate ($kg/m^2.d$) between different treatments
  - Use rigorous statistical methods to compare results between treatments

Laboratory studies

- Results of 2007/8 study
  - 9 different additives tested at supplier recommended dosage rates
  - Pit latrine additives had no statistically significant effect on the rate of mass loss from lab samples
  - Rate of mass loss in the absence of air (anaerobic) was much slower than when air circulated freely (aerobic)





Laboratory studies

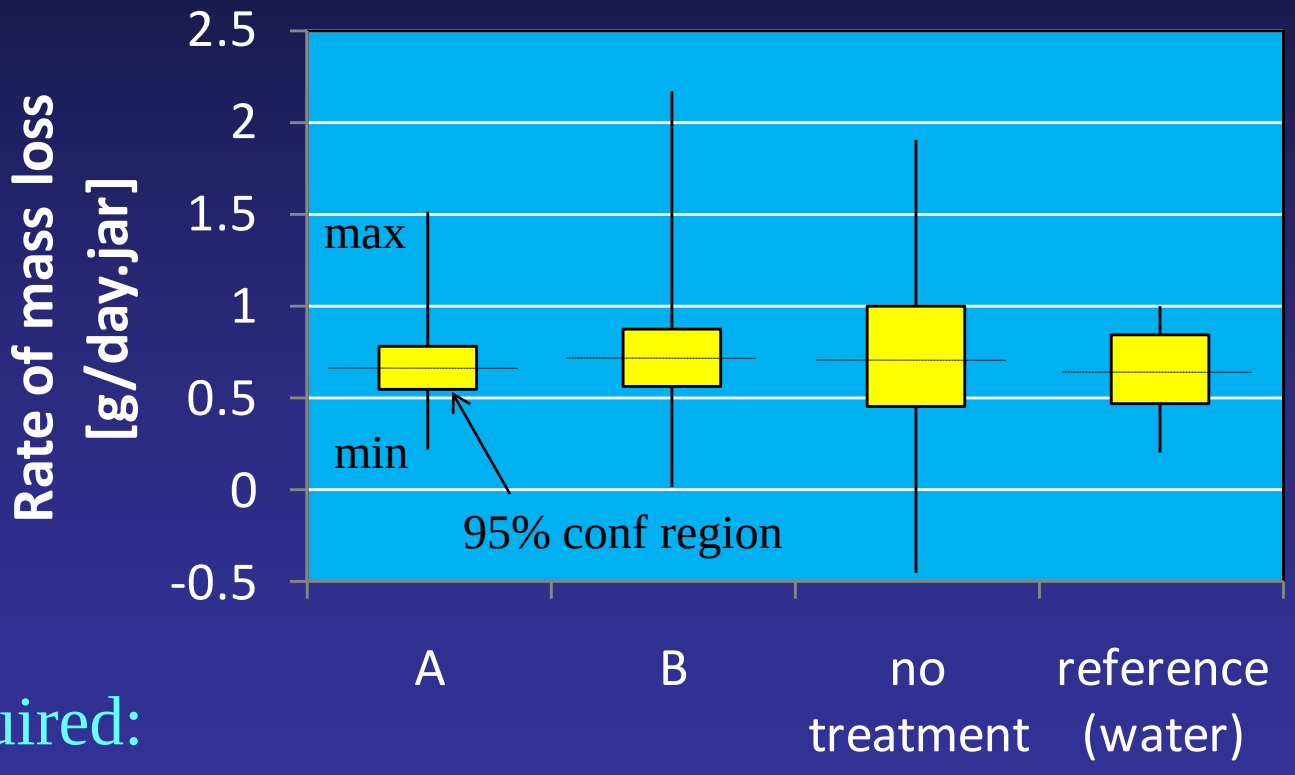
- Limitations of 2007/8 study
  - Suppliers not convinced
    - Questioned reliability of dosage rate and age of products
    - Inconclusive results on bacterial loads
- Proposed study 2009/2010
  - Redo laboratory trial with “fresh” additives
  - Redo bacto counts
  - Vary dosage rates to determine ranges of effectiveness

Laboratory Studies

- Lab study 2009
  - Objective: To find a defendable explanation why pit latrine additives do not appear to enhance mass reduction of pit latrine contents.
  - Hypothesis: Pit latrine additives do not significantly change the rate of mass loss (indication of biological breakdown of pit latrine contents) because the amount of active micro-organism added to the pit latrine in each dose of additive is insignificant compared to the micro-organism load naturally present in pit latrine sludge.
  - 2 additives tested using 2007/8 protocol

Laboratory Studies

- 2009 Study
  - Results



  - Still required:
    - Comparison between 2007/8 and 2009 data

Laboratory Studies

- 2009 Study
  - Results
    - Additives did not enhance mass loss rate above rate observed in controls and samples treated with water
    - Still working on results of plating
      - 1 additive grew moulds and fungi, but no bacterial colonies
      - 1 additive had fewer culturable colonies than VIP sludge (approx. half)
    - Hypothesis supported:
      - i.e. Pit latrine additives do not significantly change the rate of mass loss (indication of biological breakdown of pit latrine contents) because the amount of active micro-organism added to the pit latrine in each dose of additive is insignificant compared to the micro-organism load naturally present in pit latrine sludge.

Laboratory studies

- 2010 study
  - New study beginning March 2010
    - Investigate effect of different dosage rates
    - Repeat plating exercise to confirm 2009 results

Field Study

- WRC 1630 identified difficulties with reliable measurement of rate of pit filling for additive studies
- Developed equipment for stereoscopic imaging of pit latrine contents
- Field study significantly delayed for development of measurement method
- Measurement technique found to have low sensitivity (sensitivity does not justify effort!) and high time cost
- Measurement techniques still under review and development
- Equipment and measurement procedure being developed and tested under Gates Foundation funding

Field Study

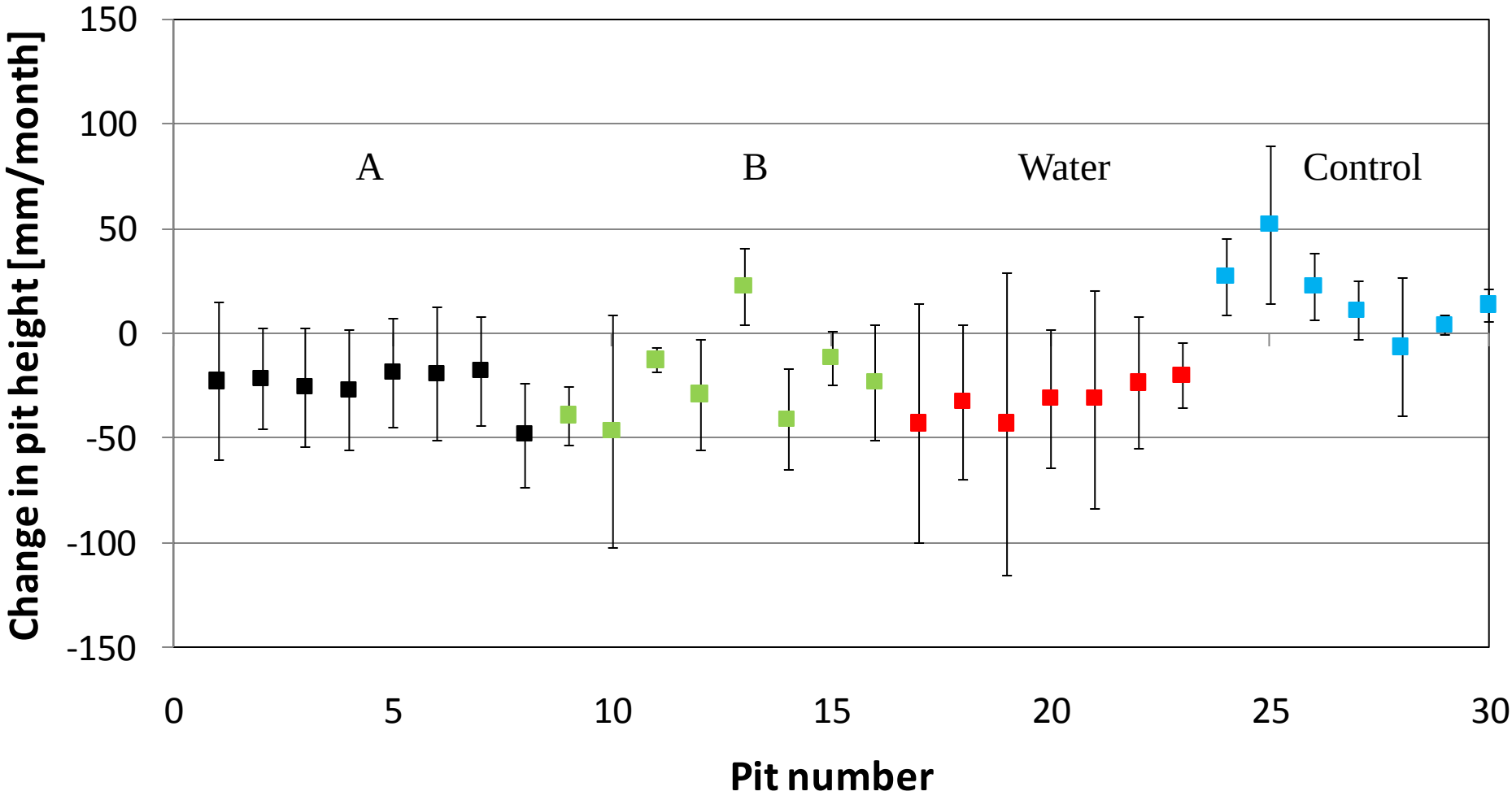
- Field study initiated before measurement technique finalised
- Two measurement techniques tested
  - Stereoscopic imaging
  - 3 measurements using laser tape down pedestal
- Stereoscopic images still under analysis
- Results presented for rough laser measurements only.

Field study

- Field study design
  - 30 pits
    - 8 x additive A
    - 8 x additive B
    - 7 x water
    - 7 x no treatment
  - Dosage according to manufacturer's instructions
- Pit content height measured initially, after 3 months and after 6 months
- Additive A:
  - Pour 10 ℓ of water into the pit before adding 200 g additive every second month.
- Additive B:
  - 2 tablespoons (about 30mℓ into 10 ℓ bucket of water and add on a weekly basis
- Water treatment
  - 10 ℓ water added on a weekly basis

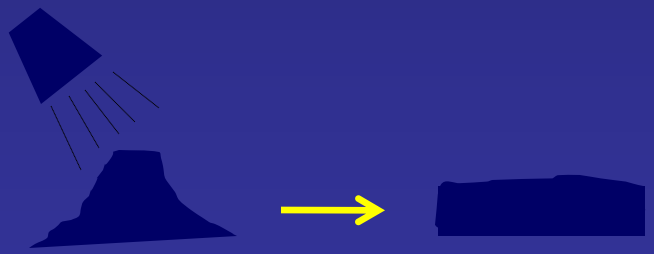
Field Study

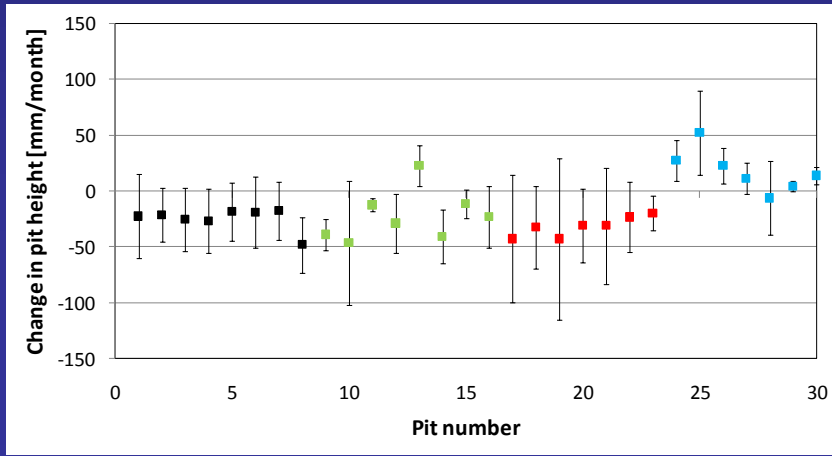
- Results: Change in pit height showing variation in measurement (calculations based on 3 measurements of height)



Field Study

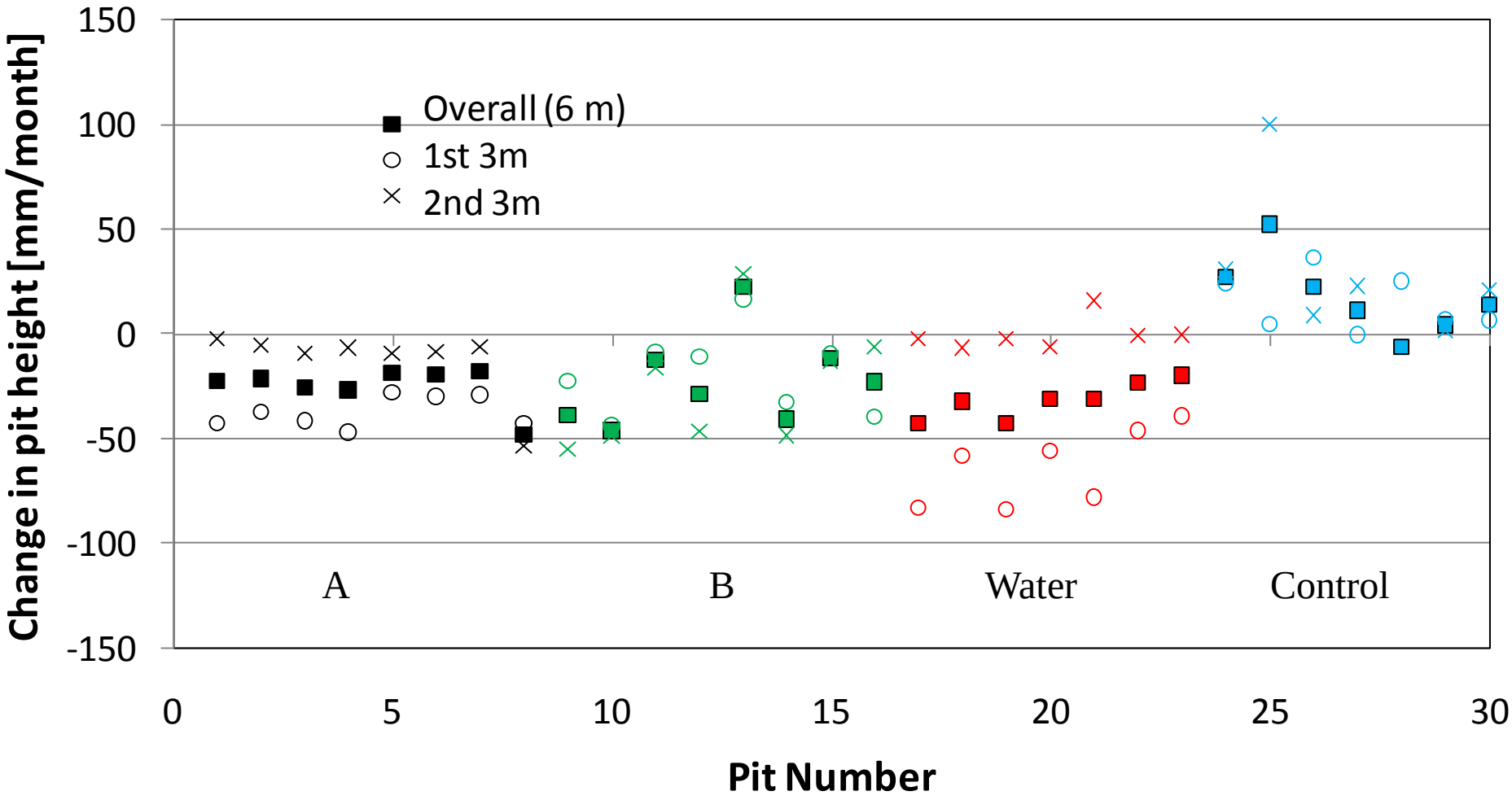
- No significant difference between additive treatments and water treatment
- Additives and water treatment showed a net decrease in height
- Control showed a net increase in height
- Since water treatment gives same results as additives, we conclude that the apparent reduction is not due to biological activity related to the additives
- Decrease probably due to pyramid flattening from liquid addition





Field Study

- Apparent rates calculated for overall, 1st half and 2nd half of study



Field Study

- User experience
  - Owners of the pits for all four treatments were regularly questioned about their experience of their pits during the trial.
  - Pit owners did not know what treatment had been applied to their pits.
  - Most pit owners reported that bad smells and fly problems were reduced as a result of the treatments
  - Similar results for additive treatments, water treatments and controls!
- Raises questions about the reliability of reports that flies or odours were reduced as a result of a certain product.

Field Study

- More accurate filling rates to be calculated
- Preliminary data analysis indicates that additives do not enhance biodegradation rates

Additive studies - Conclusions

- Neither field nor lab studies provide any support to claims that additives can control sludge accumulation rates
- Preliminary results support hypothesis that additives do not reduce VIP sludge because the number of micro-organisms in the additive is significantly less than already in the pit
- More work is being done on accurate VIP filling rate measurements for additive work
- Questions raised about reliability of user perception on smell and fly nuisance issues.