Book of Abstracts

ASSSI-ASPAC-ACMS National Soils Conference

Soil Science Solving Problems

The University of Adelaide
December 2006

Jointly convened by Australian Society of Soil Science Inc. and Australasian Soil & Plant Analysis Council Inc., in association with the Australian Clay Minerals Society.

ASSSI Australian Society of Soil Science Inc

ASPAC

AUSTRALIAN CLAY MINERALS SOCIETY

O7 : Across the Spectrum of Soil Science

Oral Session, Margaret Murray Room
10:50–12:30, Wednesday 6 December 2006

Chair: Associate Prof. David Chittleborough, University of Adelaide, Australia

Persistent Improvements in Structure and Permeability of a Ferrosol Due to Liming

James M. Kirkham[1], *Barry A. Rowe*[2], *Richard B. Doyle*[1]; [1]*University of Tasmania, Australia;* [2]*Tasmanian Institute of Agricultural Research, Australia*

Changes in the soil structure and permeability of a Ferrosol were measured in a long-term (1968–2003) fertiliser experiment on pasture in North West Tasmania, Australia. Studies were initiated following observations of both softer soil surface and cracking on plots that had received 15t of agricultural limestone. Liming reduced penetration resistance and increased water permeability. These structural improvements were associated with increased mean aggregate size, similar aggregate strength, higher exchange-able calcium levels and increased plant growth but soil organic matter was reduced in at the soil surface. The reduction in soil organic matter due to liming was not associated with deterioration in soil structure, as may have been anticipated. This is probably because at the surface the soil is naturally high in organic matter and iron oxides and the reduction in organic matter was relatively small. The reductions in soil penetration resistance due to liming increased the likelihood of pugging from livestock but may improve tillage operations. This research demonstrates that liming can improve the structure of an already well-structured ferrosol as well as its previously reported effects of improving soil pH and pasture and barley yields.

TASMANIAN INSTITUTE AGRICULTURAL RESEAR

Tasmania

Persistent improvements in structure and hydraulic conductivity of a Ferrosol due to liming

James Kirkham

Barry Rowe

Richard Doyle

Introduction

- Red Ferrosol in North West Tasmania
- Fertiliser and liming experiment on perennial pasture
- 1968 to present (38 years)
- Lime application 1968-1975 (15 t/ha)
- Lime surface applied (never cultivated)

Previous Publications

- Previously published data
  - Increased yields of pasture and barley
  - Increased pH
  - Reduced exchangeable aluminium

Rowe (1982), Rowe and Johnson (1989;1999,1995)

Physical changes

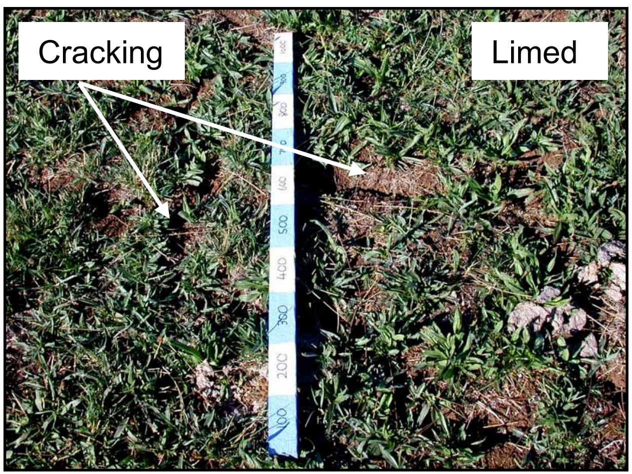
- Cracking of plots
- Reduced penetration resistance
- Reduction in organic carbon
- Coarser aggregation
- Increased hydraulic conductivity

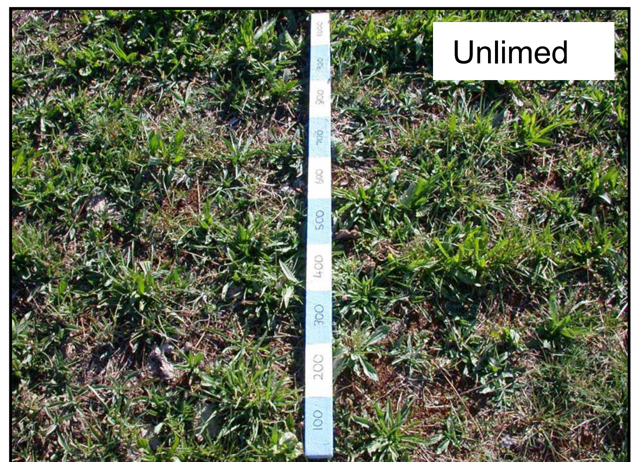
Physical Changes

- Cracking of plots

Physical Changes

- Cracking of plots
  - $Al(OH)_3$ polymers binding smectite clay platelets replaced by Ca^{2+}
  - Platelets compact resulting in shrinkage and cracking

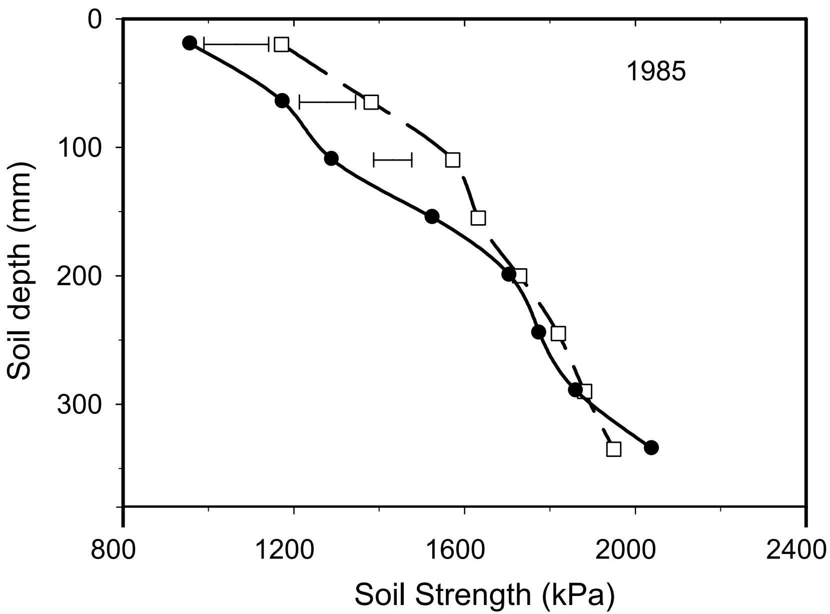




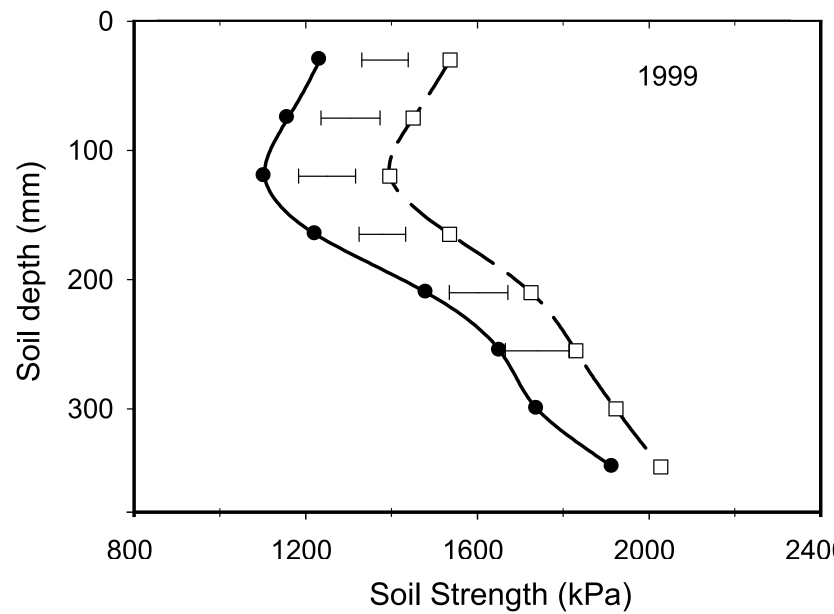
ixon and Jackson (1962)

Physical Changes

- Reduced penetration resistance



10 years FAL



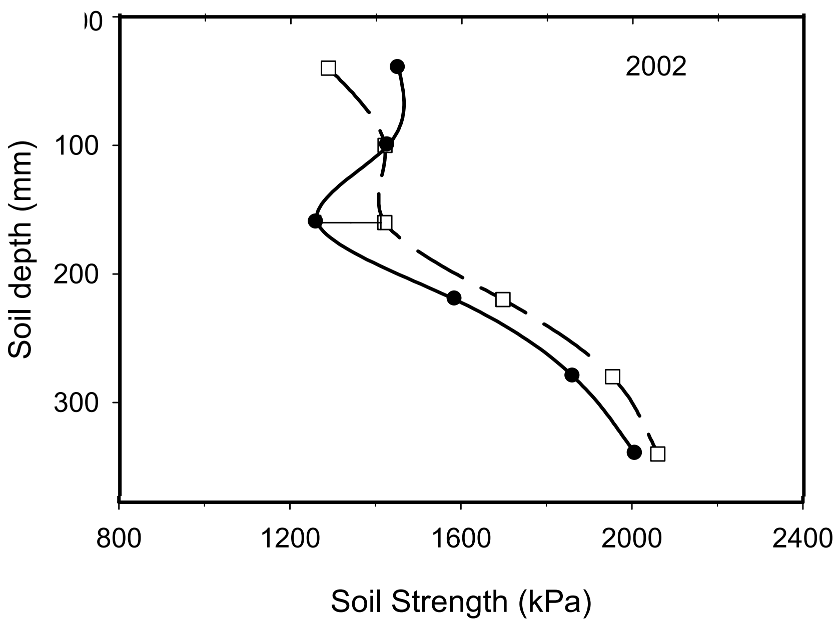
24 years FAL

limed (●), unlimed (□)

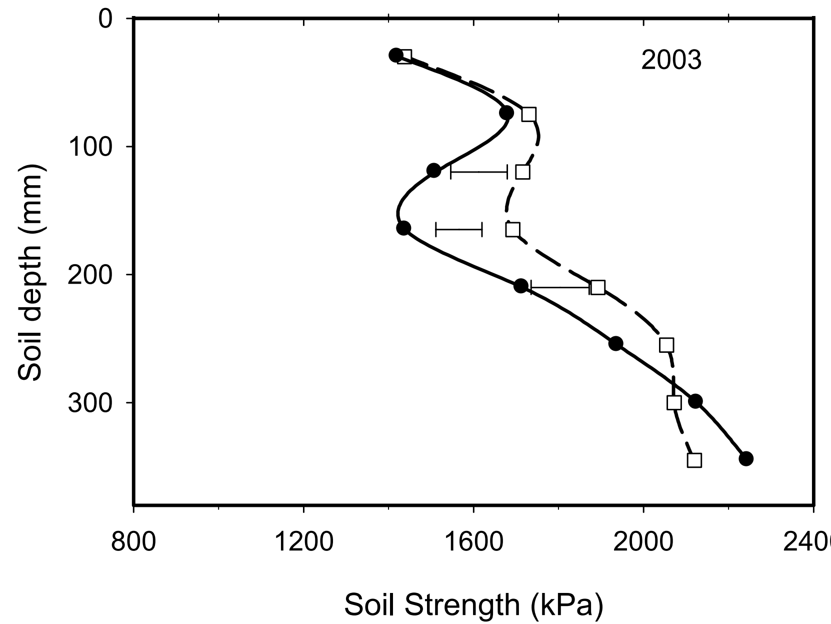
Gardner and Garner (1953)

Physical Changes

- Reduced penetration resistance



27 years FAL



28 years FAL

limed (●), unlimed (□)

Physical Changes

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Organic carbon (0-50mm)

- 1989 (14 years FAL): Organic carbon reduction of **5.5%** due to liming

- 2003 (28 years FAL): Organic carbon reduction of **9.2%** due to liming

- Carbon loss by 2003: 4.5 t/ha

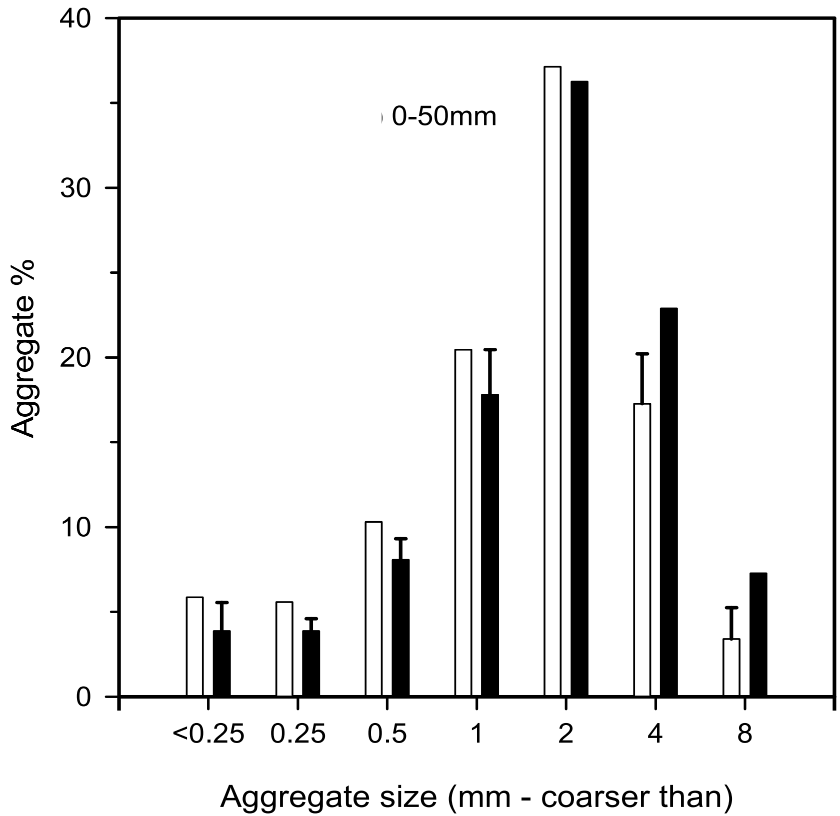
Chan and Heenan (1998), Haynes and Naidu (1998)

Tasmania

UTA

Physical Changes

- Coarser aggregation

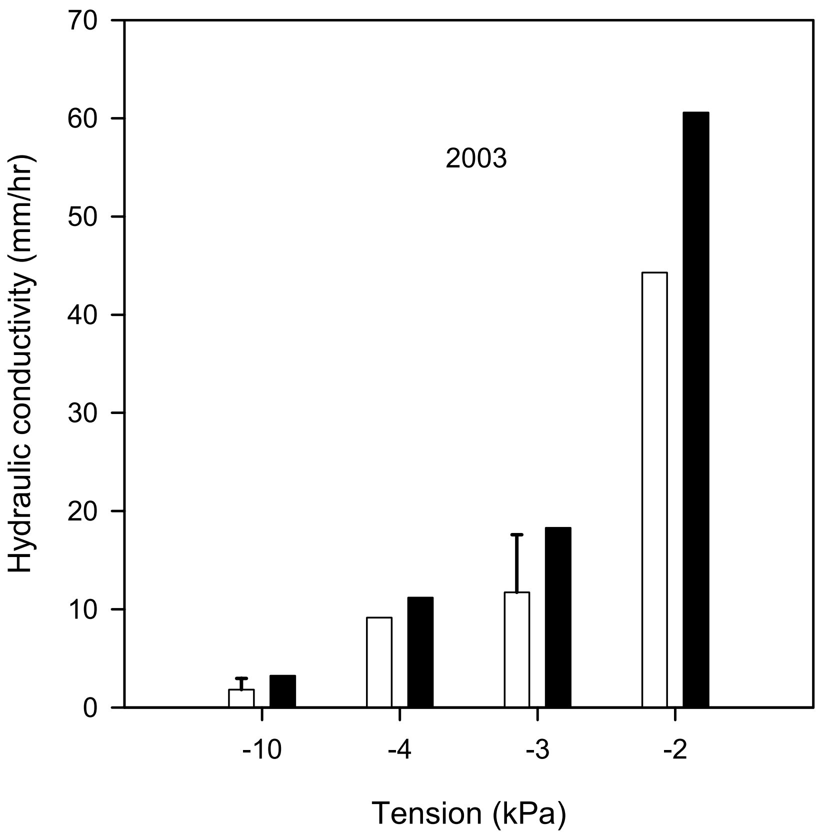


- Ca^{2+} Bridging
  - Humic particles to clay
  - Clay platelets
- $Al(OH)_2^+$ Bridging
  - Humic particles to clay

limed (■), unlimed (□)

Physical Changes

- Increased hydraulic conductivity



- Saturated (1995)
  - Limed: 520 mm/h
  - Unlimed: 260 mm/h

limed (■), unlimed (□)

Summary

- Up to 28 years after liming, effects on structure still observable through
  - Cracking
  - Penetration resistance
  - Coarser aggregation
  - Increased hydraulic conductivity
- Despite a reduction in Organic Carbon

Acknowledgements

- Co-Authors
  - Mr Barry Rowe
  - Dr Richard Doyle
- Elliot Research Station Managers
  - Mr D. E. Johnson
  - Mr D. Butler
- Tasmanian Institute of Agricultural Research
  - Mr R. Baker
  - Dr R. Rawnsley
  - Mr M. Robinson

Summary

- Up to 28 years after liming, effects on structure still observable through
  - Cracking
  - Penetration resistance
  - Coarser aggregation
  - Increased hydraulic conductivity
- Despite a reduction in Organic Carbon