Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND
New Zealand's specialist land-based university

MASSEY UNIVERSITY

Research and Education Field Trip (4)

Sponsored by Lincoln and Massey Universities

Tuesday 22nd March 2011

Field Trip Leaders: Nick Pyke, Stuart Ford

Focus for the Day: Small selection of research and education facilities in the Lincoln area.

Programme:

8.10 am Bus departs Methven

9.20 am Arrive Plant & Food Research, Millennium Trial
Dr Mike Beare, Dr Trish Fraser, Richard Gillespie)
This is a long term tillage trial established in 2000. Discuss the trial results in relation to crop performance and soil quality changes.

10.40 am Field Service Centre, Lincoln University
Morning tea and Overview Lincoln University, Professor Keith Cameron

11.00 am View lysimeter trials and discuss nutrient leaching research. Discuss education in relation to soils and nutrients. Professor Keith Cameron and Professor Di

11.50 am depart for PGG Wrightson Seeds Kimihia Research Centre

12.10 pm Overview of PGGW and Kimihia Research Centre –Dr Derek Woodfield

12.30 pm lunch

1.10 pm View trials etc at Kimihia
Forage Breeding –Michael Norriss
Forage Brassicas –Andrew Dumbleton
Animal systems –Glenn Judson
Grass trials – covered by a member of the product development team
Other seed research at Kimihia – Murray Kelly
(including a discussion of other AgResearch and FAR herbage seed research)

2.50 pm Landcare Research – afternoon tea and Overview of Landcare Research Dr Phil Hart.
discussion of Biodiversity Research
discussion of Biocontrol Research

4.15 pm Bus departs to Methven.

Tuesday – 5.30 pm arrive Methven Resort

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Research and Education Field Day Overview

The Lincoln area is an important hub for Agricultural Research, Extension and Education in New Zealand. The area boasts the historic Lincoln University, a number of Crown Research Institutes and a host of commercial research and trial sites. One day is definitely not long enough for us to share our research and education activities with you thus you will only see and hear about a very small amount of the research in the area. We have included visits that give you an overview of the organizations involved in research in the area and some of the research that occurs. There are over ten organizations actively involved in research in the Lincoln Area and we will only visit four of them. The visits are planned to cover some of the issues you will not see on other field trips (little on sheep or dairy cows) but there are numerous researchers working on animals at the Lincoln Campuses. Some of the research we cover will be from a production perspective but the impact on the environment of farming will also be addressed.

Visits for the day will include the Millennium Trial, Plant & Food Research (Cultivation, soil quality and soil carbon), Lysimeters, Lincoln University (Nutrient leaching and links to teaching), Kimihia Research Centre (PGG Wrightson Seeds and AgResearch commercial forage and herbage seed research facility), Landcare Research (biodiversity and biocontrol).

Millennium Tillage Trial (Lincoln, NZ)

Introduction: Soil organic matter (SOM) and soil structure can decline rapidly when pasture soils are cultivated to grow crops. Management of SOM is crucial to sustaining long-term arable cropping following improvements under pasture. The aim of this trial is to identify tillage and crop management practices that maintain SOM and soil structure, mitigate N losses and maintain high levels of crop production following soil improvement under pasture.

Background: Site history: >10 years improved pasture (Wakanui silt loam soil)

Tillage treatments: Combinations of spring and autumn tillage practices including:

***Intensive tillage (IT)*:** Mouldboard plough (0-20 cm), grub & crumble x 2 (0-10 cm), then harrow and roll x 2

***Minimum tillage (MT)*:** Disc, harrow and roll x 2 (0-10 cm)

***No-tillage (NT)*:** None

Cropping treatments:

2001 – 2008 (Continuous arable cropping)

Summer main crops: wheat, barley and peas (spring sown).
Winter cover crops: forage rape (main plots split, +/- cover crops)

2008 – 2009 (Ryegrass restorative phase)

Ryegrass seed crop (autumn sown) followed by sheep grazed pasture

2009 – 2011 (spring vs autumn sown rotations)

Spring sown peas followed by:
Forage rape then spring sown wheat (+CC)
Autumn sown wheat (replaces – CC)

Control Treatments:

Permanent sheep grazed pasture (PP)
Permanent uncultivated chemical fallow (PF)

Common management practices:

All crops set up as medium to high yield potential crops.
All crop treatments sown with a Great Plains Direct Drill.
All treatments received the same rate of fertilizer, pesticide, irrigation.
All straw residues returned, except following 2007 & 2008 Barley (baled).
Brassica cover crops and pasture plots grazed by sheep.

Key findings:

Crop performance

- Average-to-high yield crops of barley, wheat and peas achieved (Table 1).
- 2000-2005: no consistent yield differences between tillage treatments.
- 2005-2008: barley crop yields followed the order NT>MT>IT.
- Winter crops: overall IT=MT>NT (varied year-to-year). Low dry matter production attributed to slug damage and poor crop establishment.

Table 1. Effects of tillage on grain yield (t/ha @ 14% moisture) of spring-sown crops.

Tillage Treatment	Barley (2000-01)	Wheat (2001-02)	Peas (2002-03)	Barley (2003-04)	Peas (2004-05)	Barley (2005-06)	Barley (2006-07)	Barley (2007-08)
IT	10.8	7.9	6.2	9.5	6.5	8.1	8.9	9.3
MT	10.3	8.1	6.4	9.6	6.4	8.5	9.5	10.1
NT	10.3	7.5	6.1	9.4	5.8	10.4	11.3	10.9
LSD (5%)	ns	ns	ns	ns	1.0	1.2	1.3	1.1

Soil organic matter and soil carbon

- Relative to baseline C stocks, losses of C from PF, IT and MT were much higher than losses from NT in the first year of cropping (Table 2).
- After 7 yrs continuous cropping, C stocks under the tillage treatments had converged, owing to differences in the rate of C loss.
- Total C loss under NT was only slightly less than that of MT and IT.
- C loss from uncultivated chemical fallow (PF) was very high, confirming that continuous inputs of plant matter are important to maintaining SOM.

Table 2 Soil C stocks after one year and seven years of continuous management.

	Baseline	2001 (1 Year Cropping)		2007 (7 Years Cropping)	
Tillage Treatment	Content Mg C/ha	Content Mg C/ha	Loss Mg C/ha	Content Mg C/ha	Loss Mg C/ha
Intensive Till (IT)	79.2	74.6	4.6	69.3	9.9
Minimum Till (MT)	80.6	77.5	3.1	72.0	8.6
No-Till (NT)	78.2	77.4	0.8	71.0	7.2
Fallow (PF)	82.3	77.2	5.1	66.1	16.8
Pasture (PP)	82.3	81.8		83.0	
LSD (5%)		2.8		2.7	

Soil structure

- Soil aggregate stability (0-7.5 cm) has remained high under pasture and declined with cropping. Pasture>NT=MT>Fallow>IT.
- Soil structural condition scores (SCS) have remained high under pasture and declined with cropping. Pasture>NT>MT>Fallow=IT (Fig 1).
- Rapid decline in SCS under IT and slower decline under MT and NT to reach new near-equilibrium levels.
- SCS in IT fell below critical limit of 5 after five years continuous cropping when barley crop yields where 1-2 t/h lower than MT and NT crops.
- The yield of barley crops harvested between 2006 and 2008 was strongly and positively related to soil structural condition scores (Fig 2).

Fig 1. Changes in soil structural condition under continuous management

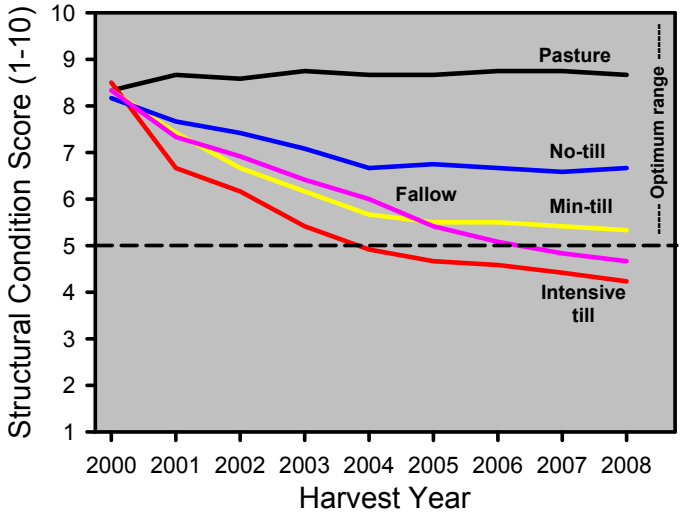
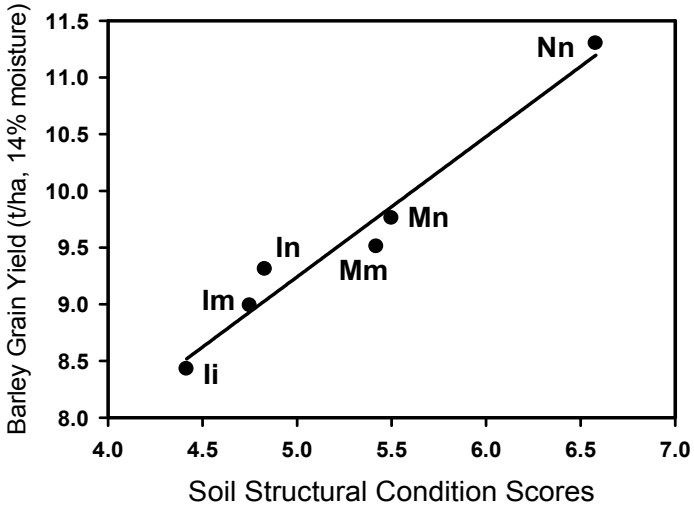
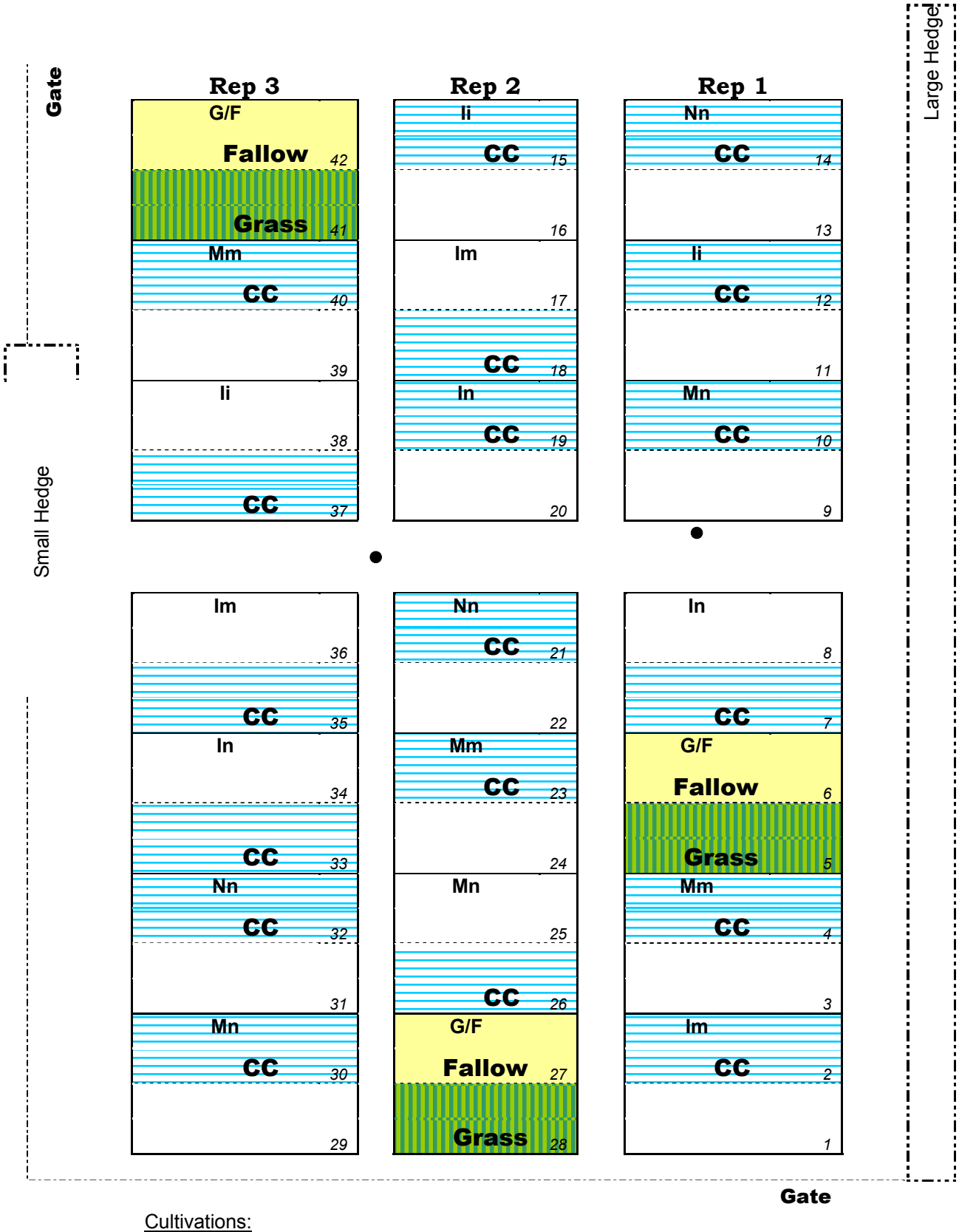


Fig 2. Relationship between SCS and barley crop yields



Millennium Tillage Trial

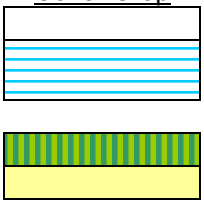


Cultivations:

First letter is Spring, Second letter is Autumn

Nn	No Tillage,No Tillage
Mm	Minimum,Minimum
Ii	Intensive, Intensive
Mn	Minimum, No Tillage
Im	Intensive, Minimum
In	Intensive, No Tillage
G/F	Grass or Fallow

Cover Crop



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Grass

Fallow

Design:

Split-plot.

3 replications of the treatments

Main plots are laid out in an incomplete Latin square (7 rows of 3 plots)

Mainplot treatment: cultivation

Split-plot treatment: cover crop

Notes: