Predicting the fate of nitrogen in a dairy pasture system

S.R. Green[1], B E. Clothier[1], J.P.Watt[2], I. McIndoe[3], N, Selvarajah[4]

[1]Hort Research, Private Bag 11-030, Palmerston North Greens@hort.cri.nz

[2]47 Chambers St, Havelock North

[3]Lincoln Environment, Lincoln Ventures, PO Box 84, Lincoln University

[4]Environment Waikato, PO Box 4010 Hamilton East

In the Waikato region, and in other parts of the country, where intensive forms of agriculture are practised, nitrate levels in ground water have been gradually rising. The use of mineral-nitrogen fertiliser, plus inputs of organic nitrogen in the form of animal returns, are likely contributors to the problem. The fate of any surface-applied nitrogen depends on the soils ability to hold 'nutrients' within the root zone, relative to the plants ability to extract them. Any nitrogen that quits the root zone will travel on downwards with the percolating water in the root zone, and eventually end up as a contaminant in the ground water.

We carried out a desk-top study using a mechanistic simulation model to examine the nitrogen dynamics of a dairy pasture in the Waikato. The model was used to assess the potential risk of ground water contamination from dairy pastures that are both irrigated and fertilised. We used a simple 'lumped parameter' model (LPM) to link the mechanisms of water transport through the root zone, with the complex of nitrogen transformations that result from both natural processes, and those consequent upon the application of fertiliser or animal returns of dung and urine.

In this paper we describe the model and present some calculations to compare the leaching potential of an irrigated pasture with a dry-land dairy system. Because of the power of computers, even given the complexity of our LPM model, we have run long-term simulations of 25 years to assess the risk of groundwater contamination.

Green, S.R., Clothier, B.E., Watt, J.P., McIndoe, I. and Selvarajah, N. 1999. Predicting the fate of nitrogen in a dairy pasture system. ***In*** *Proceedings of the New Zealand Institute of Agricultural Science and the New Zealand Society for Horticultural Science Annual Convention 1999, Albany Campus, Massey University, New Zealand.*

Predicting the Fate of Nitrogen in a Dairy Pasture System

Steve Green & Brent Clothier
HortResearch, Palmerston North

Jim Watt, Landcare
Ian McIndoe Lincoln Environment
N. Selvarajah Environment Waikato

Environment & Risk Management Group
Hort+Research, PB 11-030
Palmerston North
Ph: (06) 356-8080

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I: Irrigation Requirements for Pasture

A modelling study commissioned by Environment Waikato
- guidelines for water right allocations to users

The BIG question ?
- 'how much' and 'how often' to irrigate pasture

Modelling approach

- Set up a simple water balance model
- Calculated pasture water use from 25 years of met data
- Determined soil hydraulic properties to estimate drainage
- Applied irrigation when available soil water was depleted

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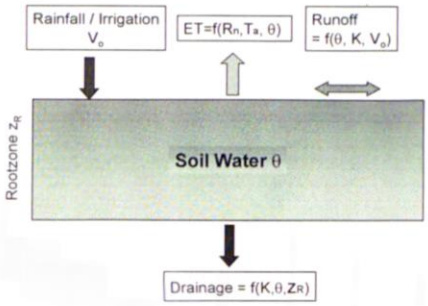
The soil water balance



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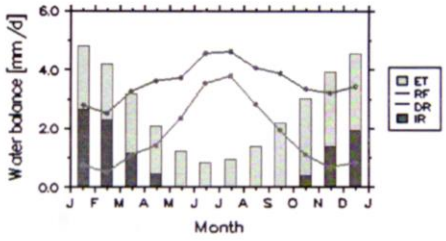
The soil water balance



- A water deficit develops in the root zone
- Irrigation is required to maintain productivity
- Require 250 mm per year, on average

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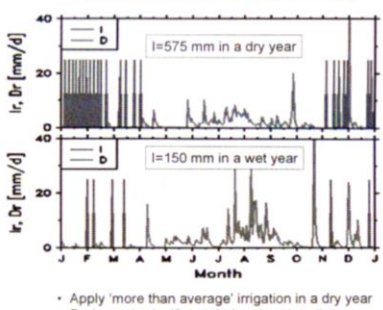
The soil water balance



- Apply 'more than average' irrigation in a dry year
- Drainage is significant during the wintertime

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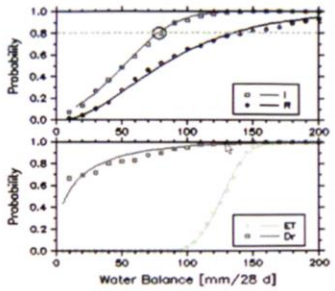
Statistical analysis of pasture irrigation

P_{80} = Irrigation to meet pasture demand 80% of time



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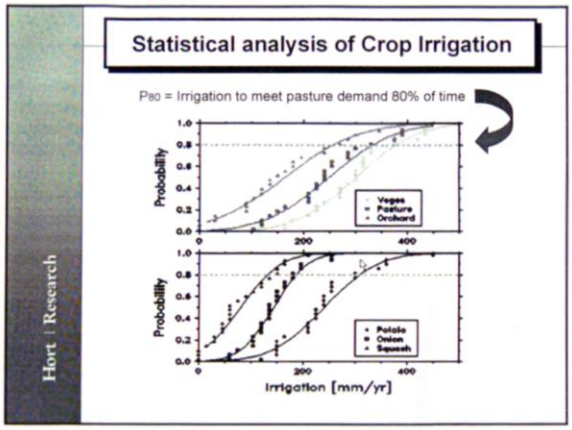

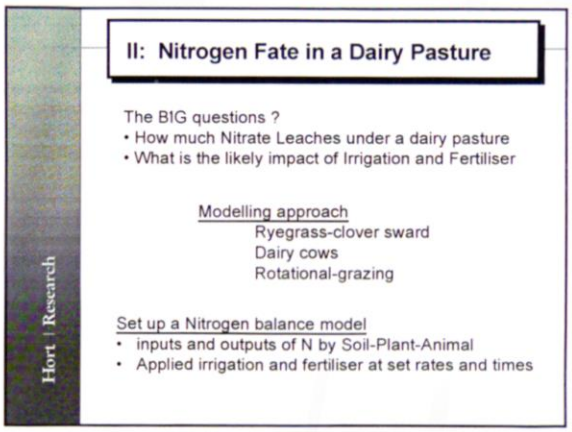

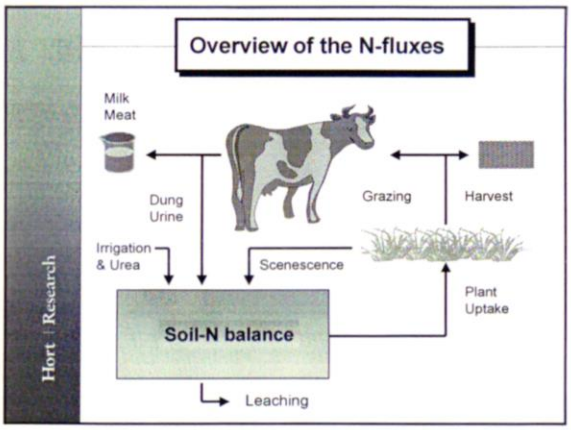

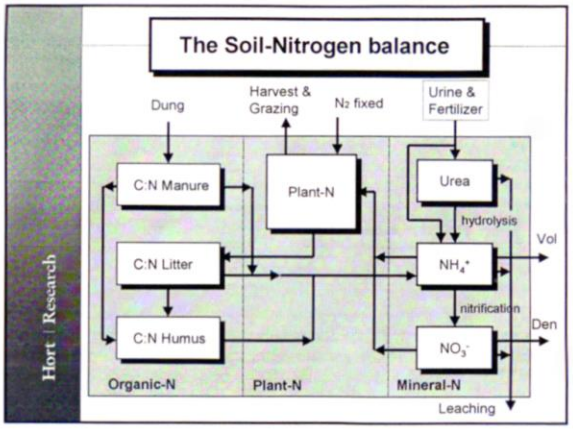

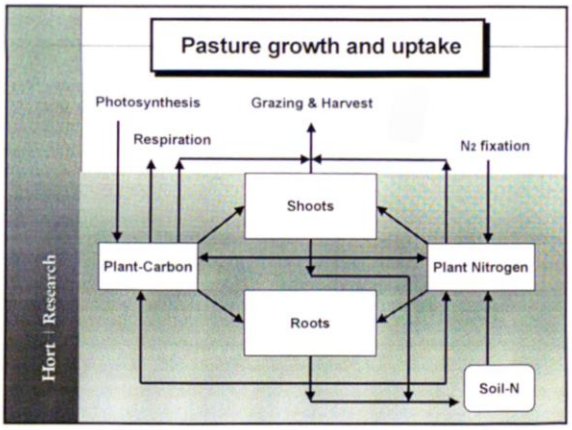

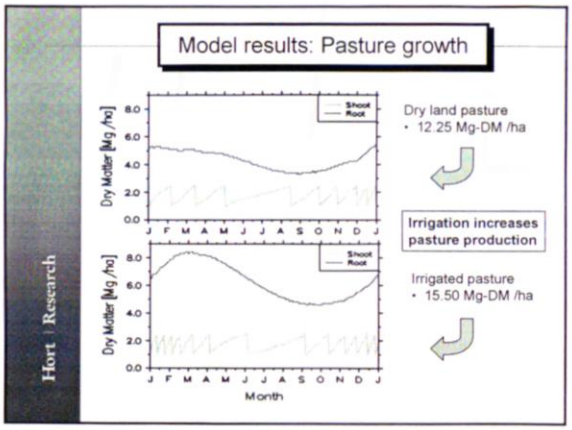

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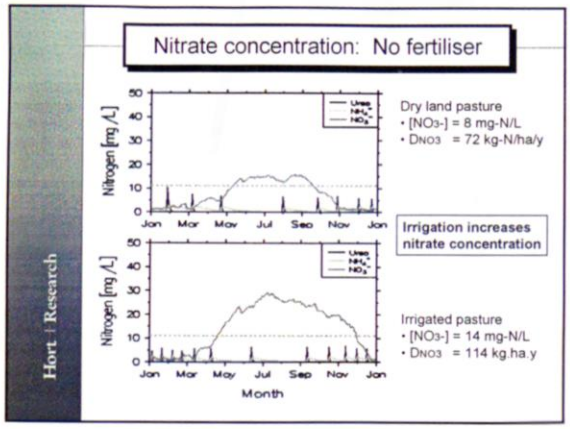

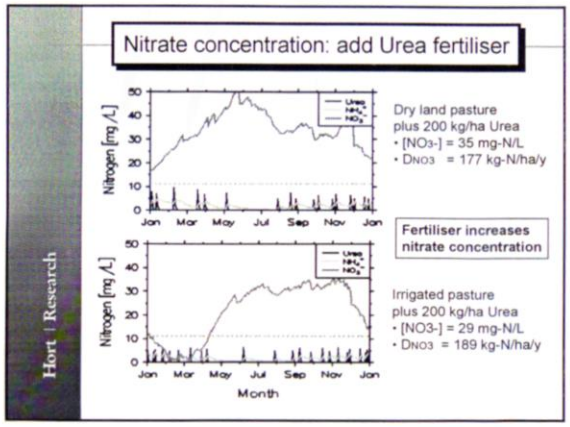

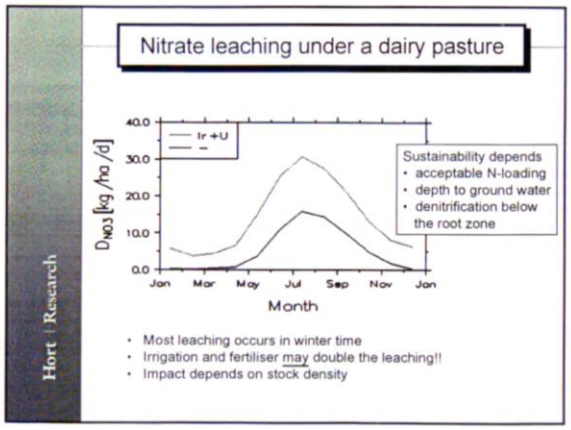

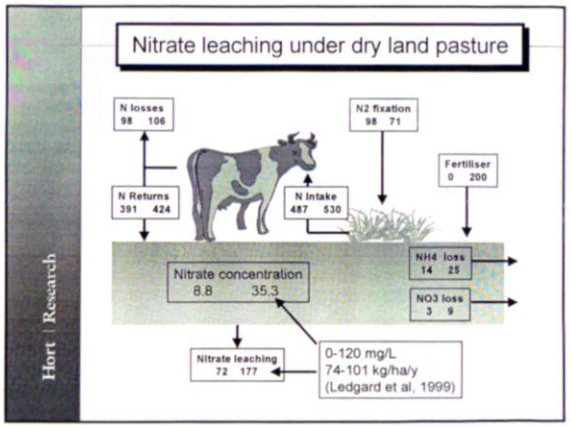

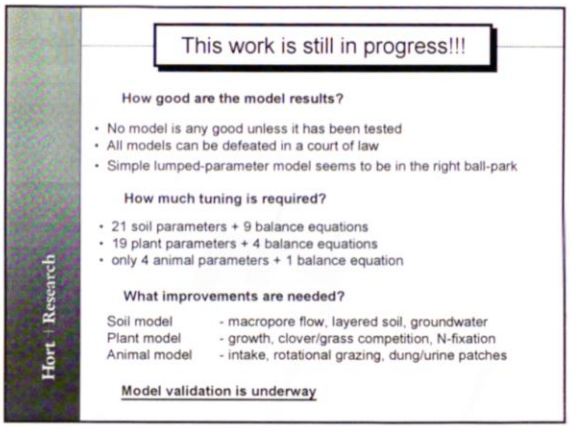

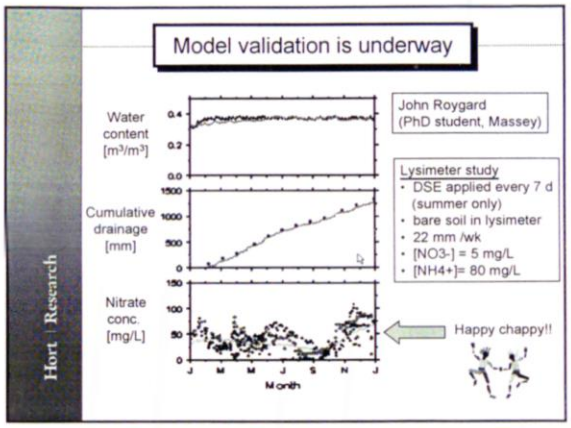

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