



Farm level impacts of 'biological' soil nutrient management

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Background

-  Farmers recognise the need to be environmentally proactive
-  Uncertainty over current practices
-  Can changing fertiliser policy improve on the status quo
-  Theories offered but evidence mostly anecdotal
-  Two dairy farmers decided to test the impact of a biological fertiliser regime on production and profit



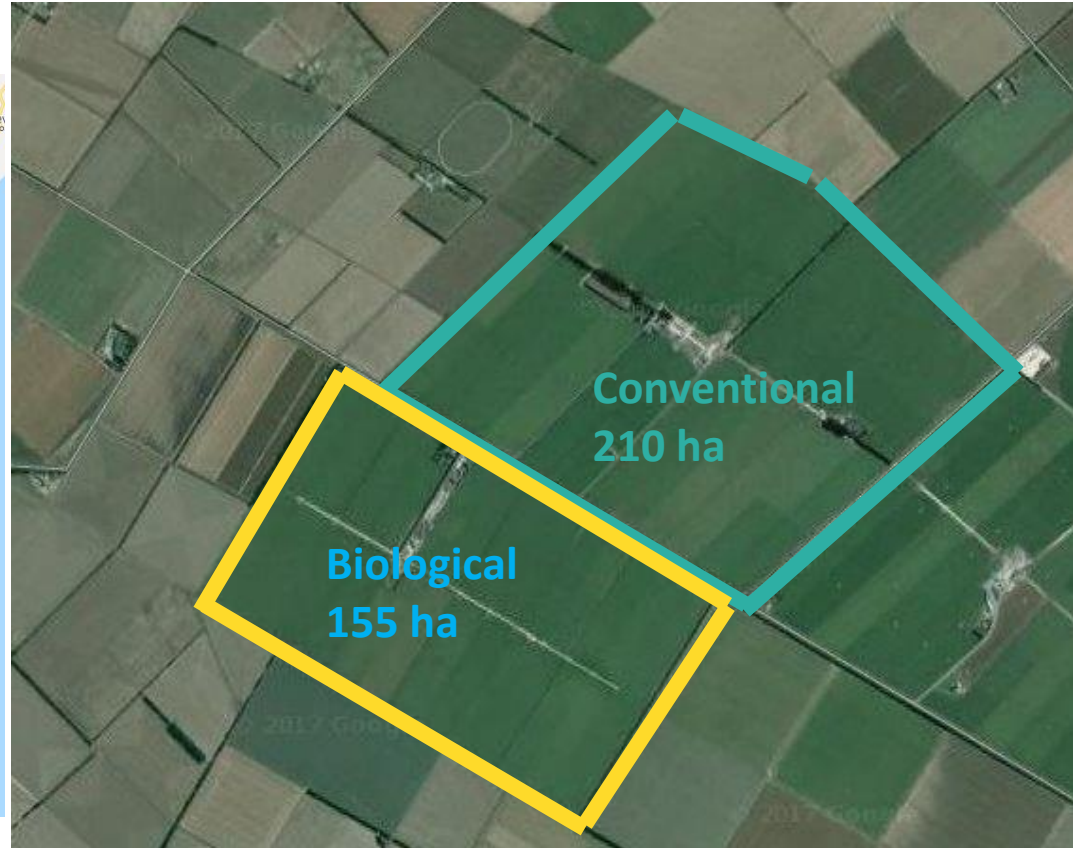
Left to right: Jeremy Casey (farmer), Neal Kinsey, Kim Solly (farmer)
Photo courtesy of Dairy Exporter

The biological fertiliser regime



- Referred to here as the Albrecht-Kinsey approach
- Maintaining a base saturation of 80% as Ca (68%) and Mg (12%) is thought to improve soil structure, biological activity, crop yield and animal health
- Controversial as has been dismissed by most soil scientists as providing no more benefits than conventional practise of meeting plant requirements
- Most of the published science from pot trials, no farm scale comparison exists for pastoral situation

Farms are situated near Methven in Canterbury



Methodology and soils



Two ex-cropping farms with similar management history and soil fertility were converted to dairy



One farm was assigned a biological fertiliser regime and the other a conventional fertiliser regime



Same decision rules on pasture management on both farms

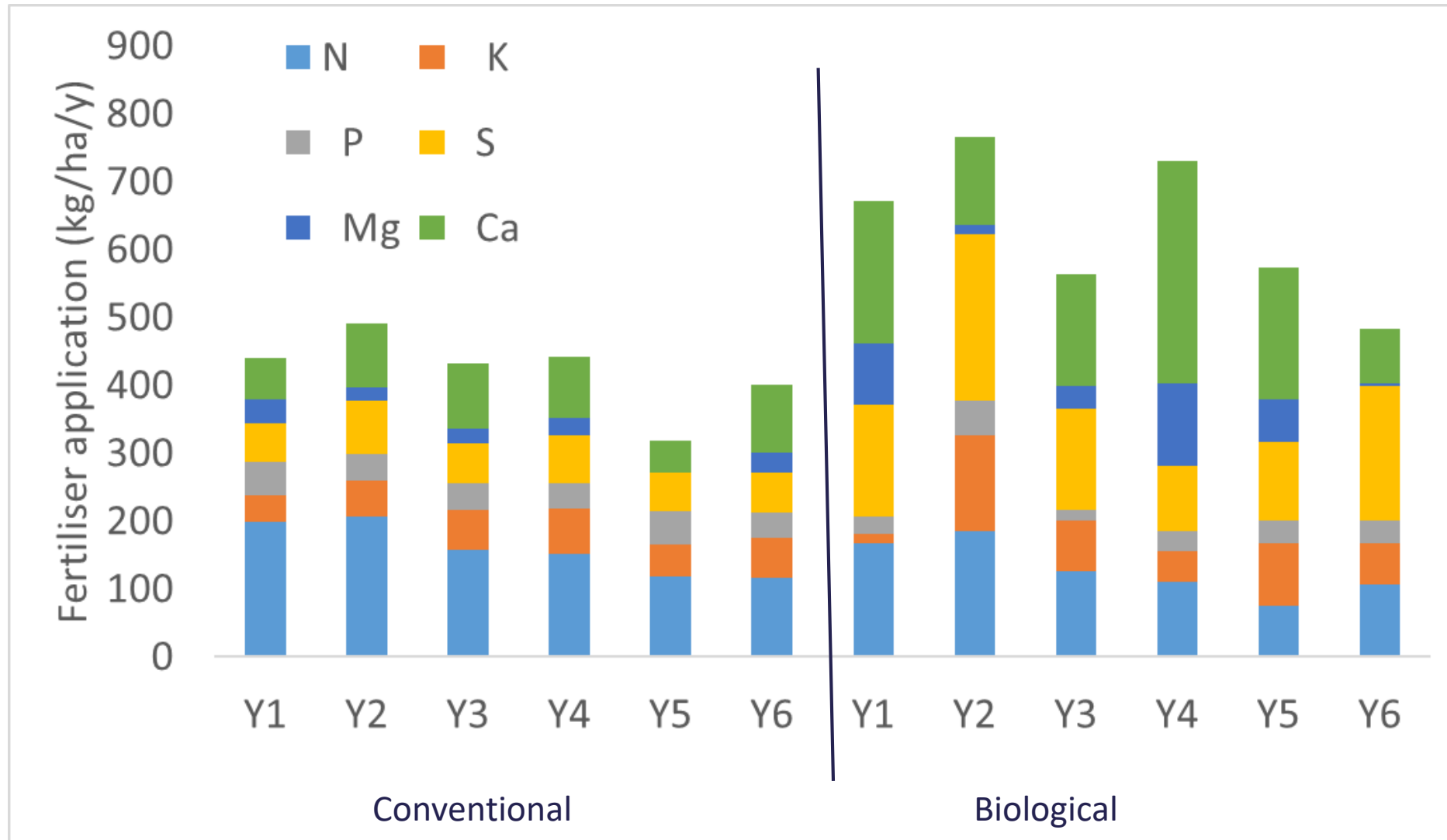


Farm managers alternated between farms to keep consistence in practises



Regular measurements of soils, plants and animals

Annually, more fertiliser has been applied to the biological farm, especially Ca, S and Mg, but less N and P



Based on conventional testing methods (Hills), means for the last four years show soils are similar with exception of magnesium and sulphur levels

Soil chemistry parameters	Conventional	Biological
Organic matter (Carbon %)	2.9	3.0
Nitrogen (N%)	0.27	0.27
pH	6.3	6.2
Cation exchange capacity (me/100g)	14.4	14.7
Avail. Mineralisable N ($\mu\text{g/g}$)	91.8	93.8
MAF Calcium (Base %)	9.1 (56)	8.2 (58)
MAF Magnesium (Base%)	14.8 (6.7)	26.9 (9.1)
MAF Potassium (Base %)	5.2 (3.1)	5.4 (2.8)
Olsen P	14.9	12.6
Sulphur (mg/kg)	9.9	17.2

Soil characteristics from 15cm deep soil cores on three monitor paddocks. Bold = $P < 0.05$. (From Bryant et al. 2019)

Annual soil physical tests show soils have very similar physical properties with exception of earthworms and total insects which are greater on the biological farm

Soil physical parameters	Conventional	Biological
Compaction (Mpa 0-10 cm)	1.50	1.40
Compaction (Mpa 10-20 cm)	1.98	1.75
Soil moisture at field capacity	43.6	43.8
Macro porosity	12.1	11.9
Aggregate stability	76.0	76.1
Earthworms (/m2)	945	1365
Other insects	197	323
Total insects	1442	1691

On average, over the last four years, the farms have been very similar in typical benchmark physical attributes.

	Conventional	Biological	P value
Animal production			
Total milk solids (kg MS/ha)	1563	1609	0.691
Total MS/Cow (incl. calf milk)	483	491	0.653
Animal health			
Empty Rate %	13.3	11.5	0.362
Downer cows %	7.2	5.5	0.319
Crop Yield			
Total Pasture Grown (T DM/ha)	14.3	14.2	0.834
Clover (% DM)	10.1	16.3	0.004
Supplements offered (kg DM/cow)	774	766	0.952
Environment			
Total N Applied (kg/ha)	151	115	0.126
N Leaching (kg/ha)	35	33	0.628

Cost of nutrients has been higher on the biological farm, though in recent years the differences have been less

	year 1	year 2	year 3	year 4	year 5	year 6	TOTAL	average
Season	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18		last 2 yrs
Cost per Hectare								
Biological	\$1,151	\$1,522	\$980	\$739	\$ 602	\$ 655	\$5,649	\$ 629
Conventional	\$ 806	\$ 804	\$629	\$665	\$ 408	\$ 455	\$3,767	\$ 432
FARMAX Gross margin/ha								
Biological					\$7,451	\$7,620		\$7,536
Conventional					\$7,568	\$7,569		\$7,569

Summary



No difference between biological or conventional fertiliser regime on pasture production or milk yield. Same crop yield with less N fert.



Fertiliser recommendations for the biological farm often seem complicated.



Increased insect activity on biological farm: indirectly associated with N fertiliser and increased clover?



The biological farm has lower costs associated with better animal health and reproductive performance



Biological fertilisers can be more expensive, but once the soils meet their goal chemistry, profitability is similar for both fertiliser regimes

Acknowledgements

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- Dairy Condition Monitoring



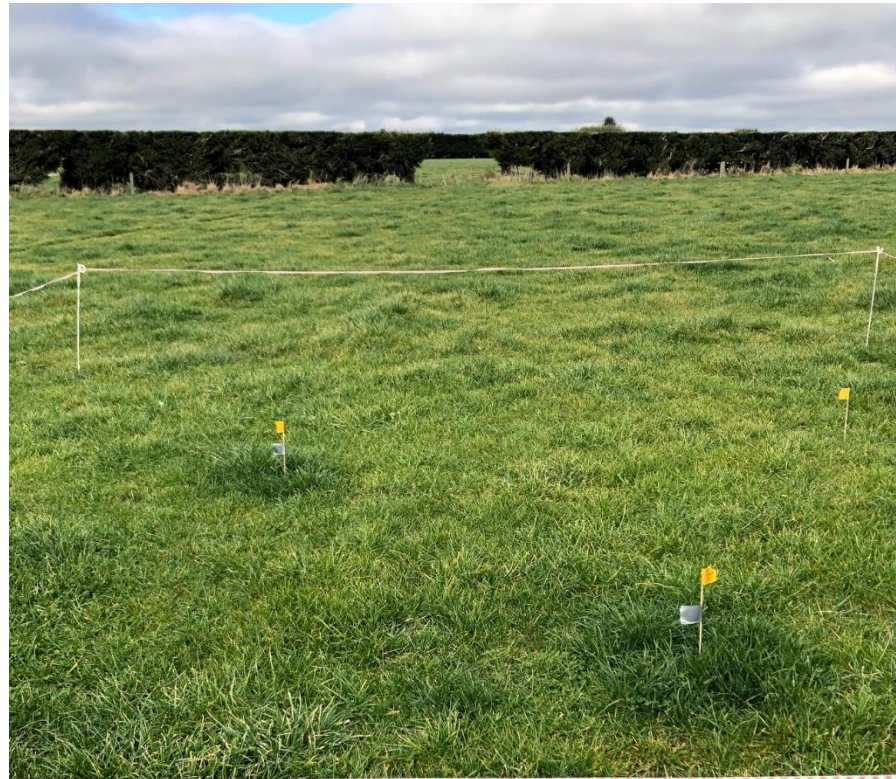
•Funders

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- DairyNZ
- Farmer stakeholders
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This winter we are measuring distribution of nutrients in the soil under 'urine' and non-urine patches to compare nutrient retention during drainage



Soil cores: 0-10, 10-20, 20-40 and 40-60 cm deep



Simulated urine patches where cores are collected



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