Farm level impacts of Albrecht-Kinsey soil nutrient management

Mid-season field day

Friday 13th December 2019

Agenda

- Introduction and acknowledgements
- Overview of the project
- Physical and financial results
- Soil results
  - Plant and food annual measurements - Richard Gillespie
  - Urine patch experiment – Racheal Bryant
- Farmer reflections

- DairyNZ partner farms update

- BBQ lunch

Acknowledgements

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- **Steering group**
  - Tony Zwart
  - Glen Greer
  - Racheal Bryant
  - Ina Pinxterhuis
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  - Richard Gillespie
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- **Contributors**
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- **Supporters**
  - Farmers
  - Fonterra
  - Topsoils
  - Balance agri-nutrients

Introduction – why we're doing this

- Leaching of nutrients = environmental and economic cost
- Fertiliser regimes influence livestock intensity and nutrient surpluses
- Conventional fertiliser regime in NZ is 'sufficiency' approach = max rate below which crops respond to added fertiliser
- Claim alternative fertiliser regimes may be able to improve nutrient retention and recycling
- In 2012 decided to compare the impact of conventional or Albrecht-Kinsey fertiliser regime on production and profit

Key findings
Compared with conventional, the Albrecht-Kinsey farm:

- required greater fertiliser inputs and reached higher levels of Mg, K, S and Na but lower P in the soil.

- did not alter soil physical characteristics but invertebrate numbers, especially earthworms, were higher.

- had higher clover content due to lower N fertiliser but no significant difference in pasture yield or quality

- had similar milk yield but frequently better animal health during spring and reproductive performance was often better

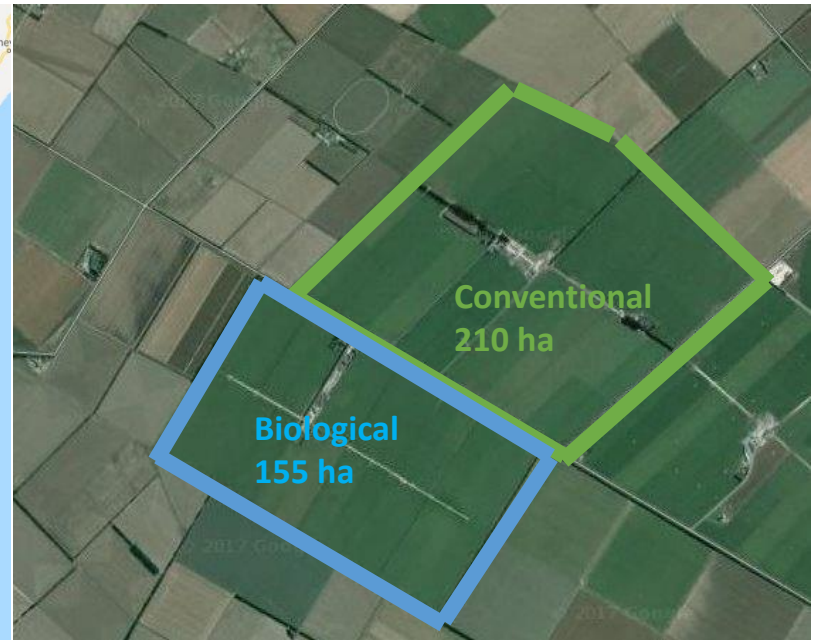
- did not have any financial or environmental advantage

- may, in future, experience problems maintaining high clover content due to high clover root weevil and low Olsen P

The Albrecht-Kinsey fertiliser approach

- Maintaining a base saturation of 80% as Ca (~68%) and Mg (~12%) is thought to improve:
  - crop yield and quality
  - animal health
  - soil structure
  - biological activity
  - soil nutrient retention
- Controversial as has been dismissed by most soil scientists as providing no more benefits then conventional practise of meeting plant requirements

The two irrigated farms are situated near Methven in Canterbury on Lyndhurst silt loam soil



- Note that the fertiliser treatments are neighbouring sites and are not replicated

Methodology and soils

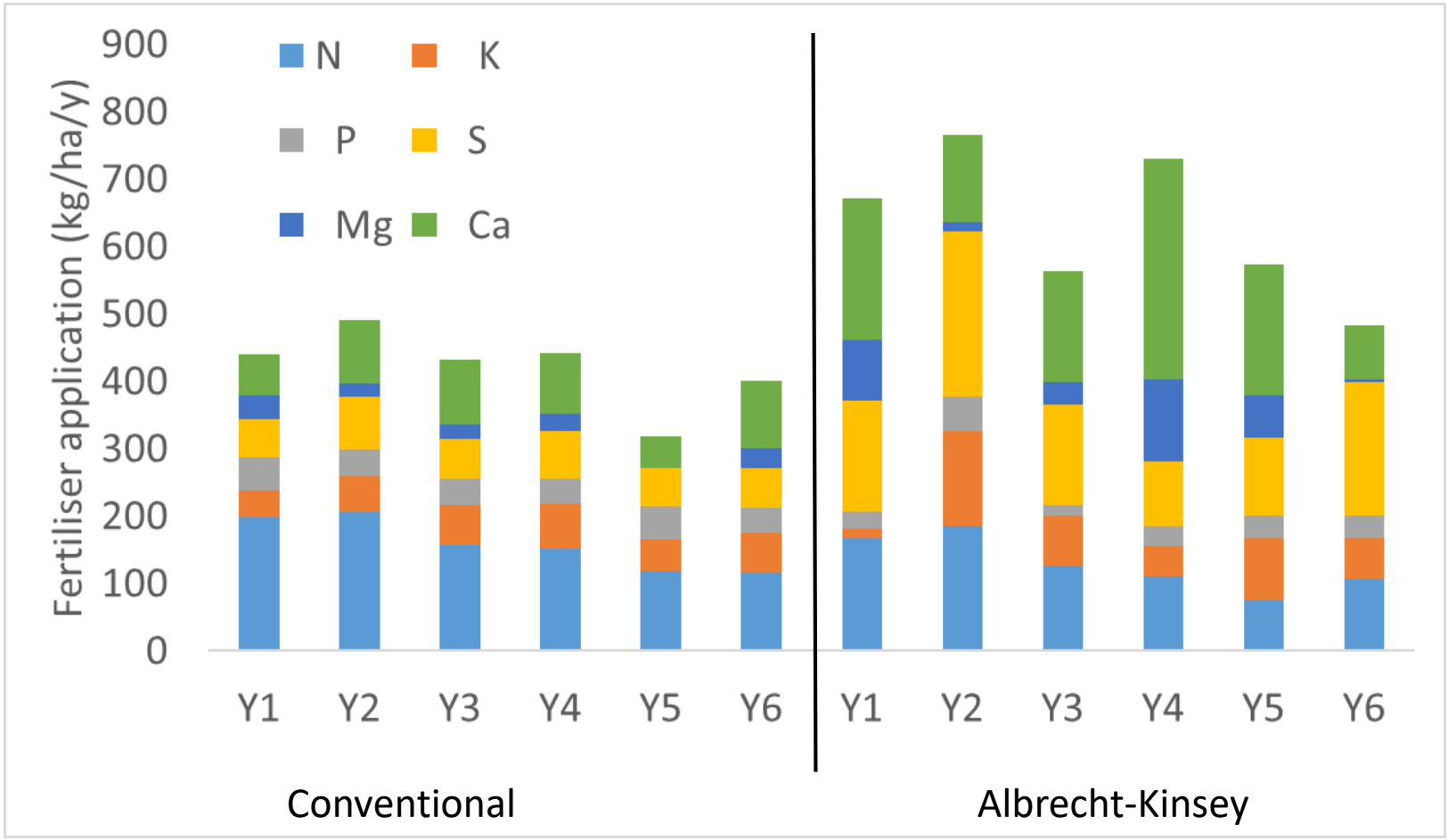
- Two ex-cropping farms with similar management history and soil fertility were converted to dairy
- From 2012/13 one farm was assigned an Albrecht-Kinsey fertiliser regime and the other a conventional fertiliser regime
- In 2013/2014 a steering committee of farmers, industry representatives and scientists was appointed
- 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

Physical and financial performance

Addresses questions for crop/pasture yield and animal health

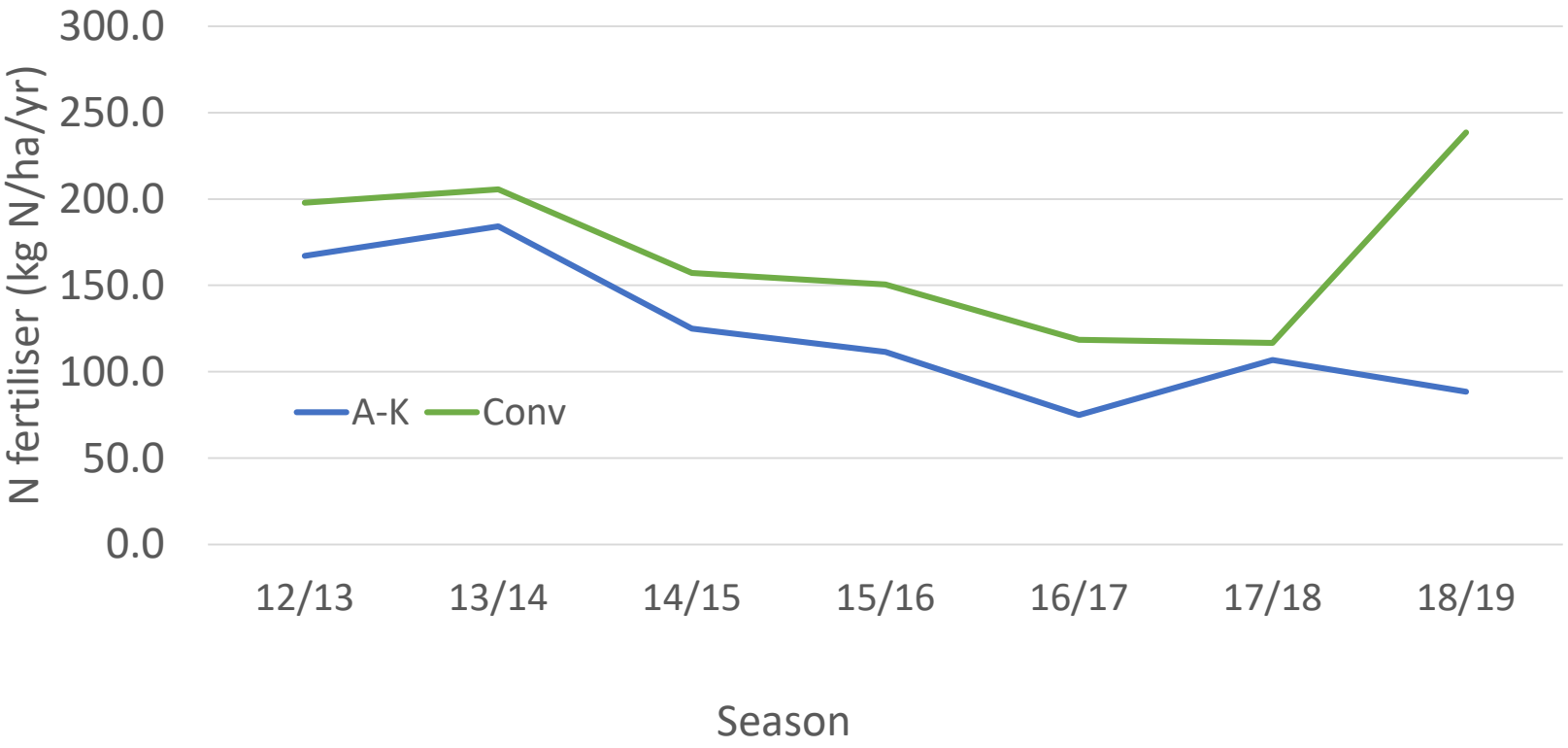
Photo from newshub.co.nz

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

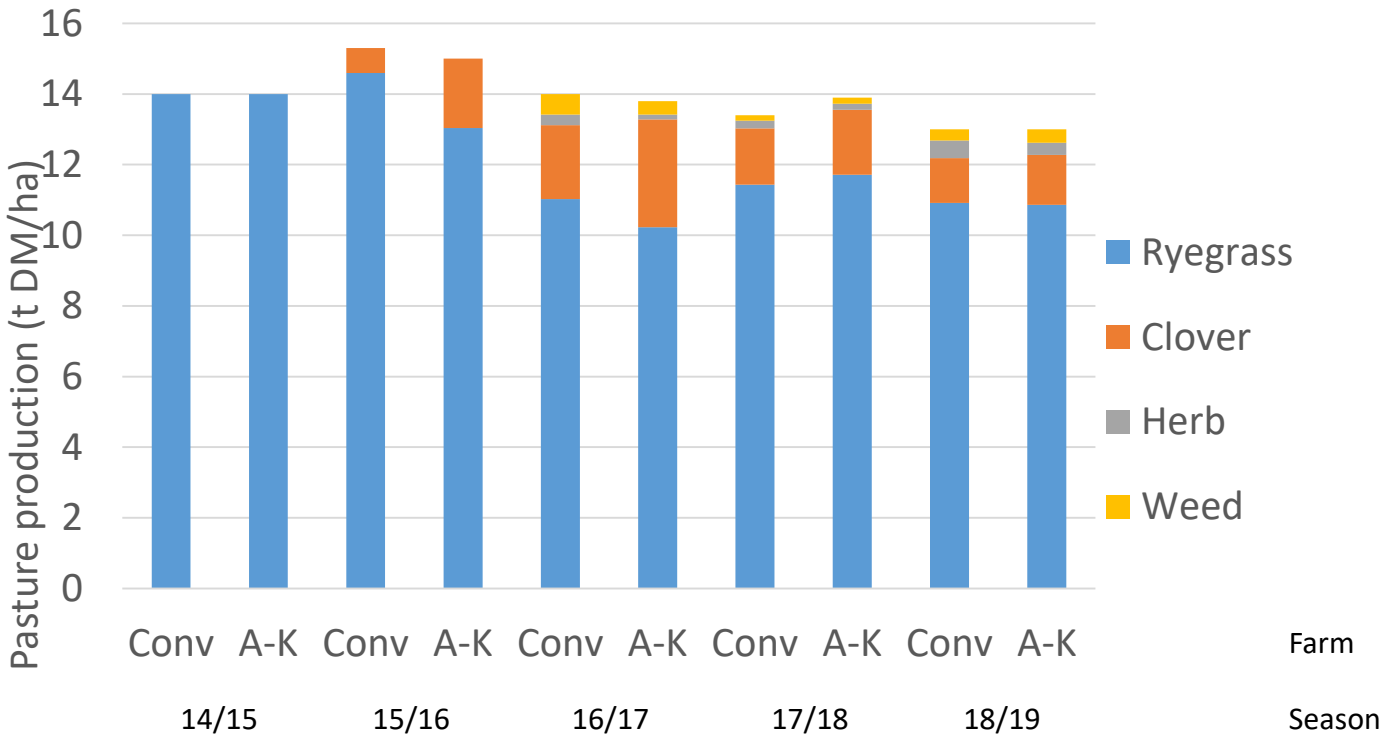


Where year 1 is the 2012/13 season

More N fertiliser has been applied to the conventional farm compared with the A-K farm. Last season saw a large divergence in N fertiliser

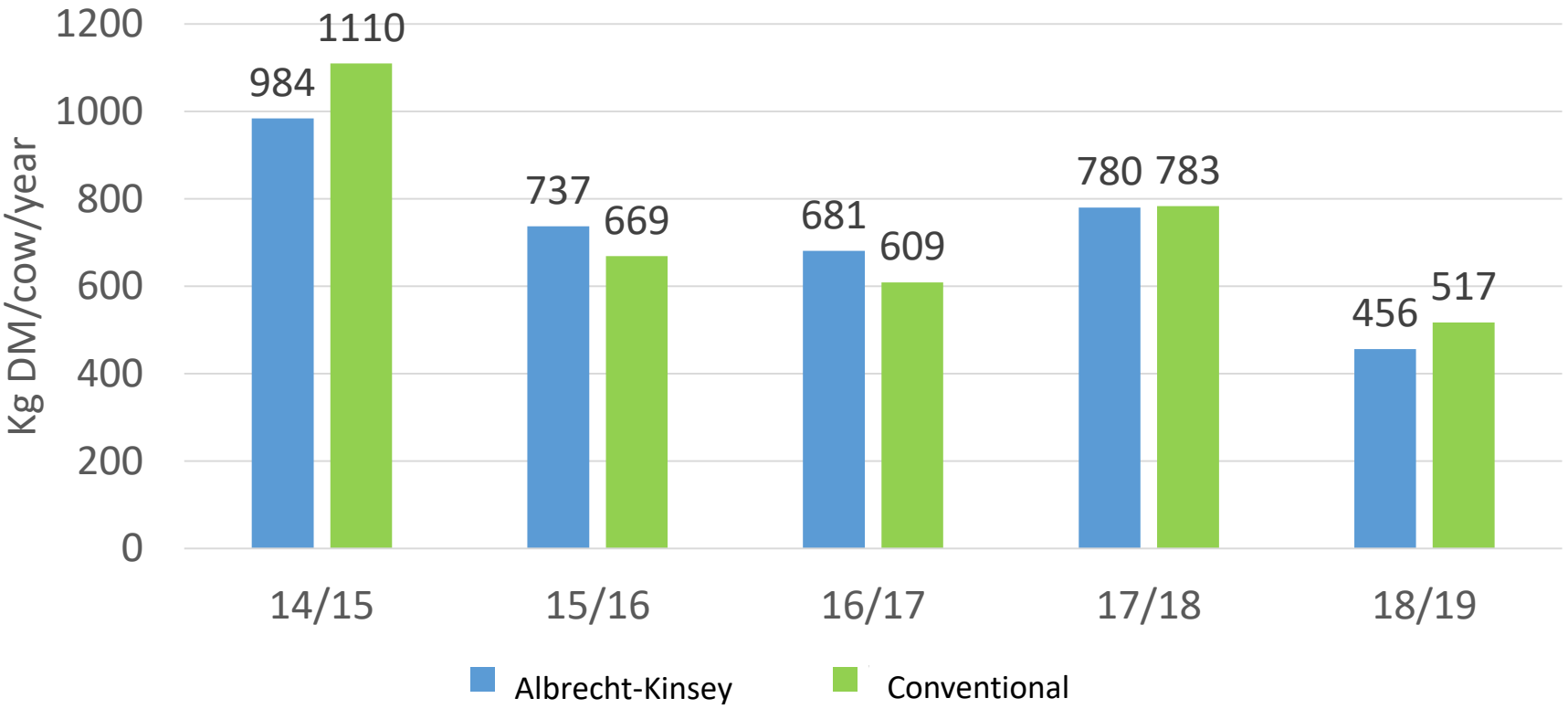


Both farms have grown the same amount of pasture, though lower N fertiliser on the A-K farm has resulted in more clover growth compared with Conventional

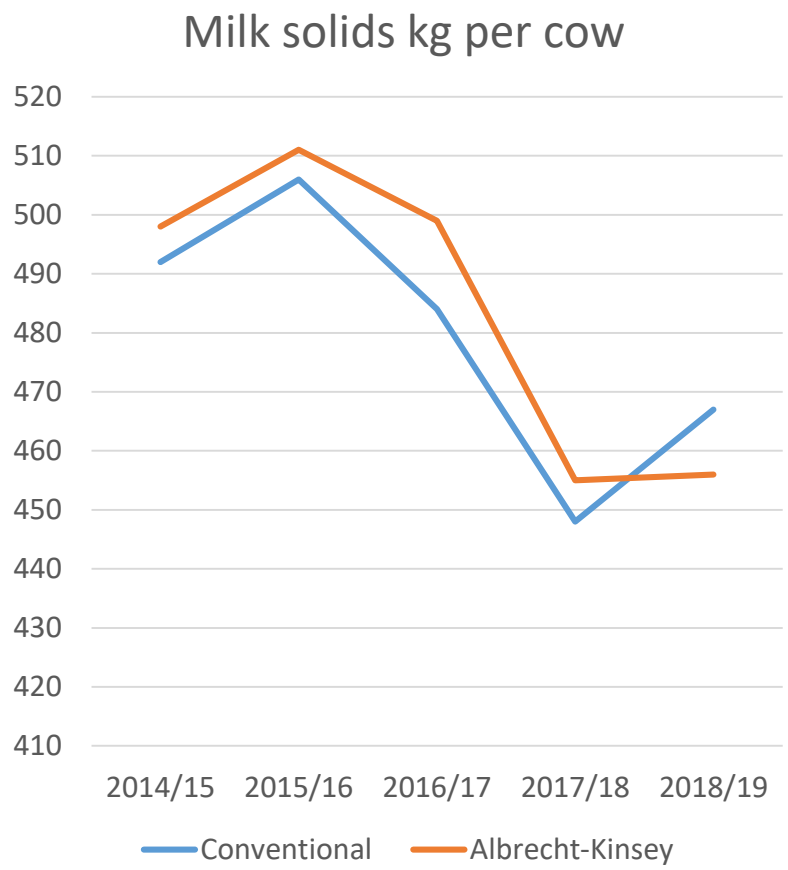


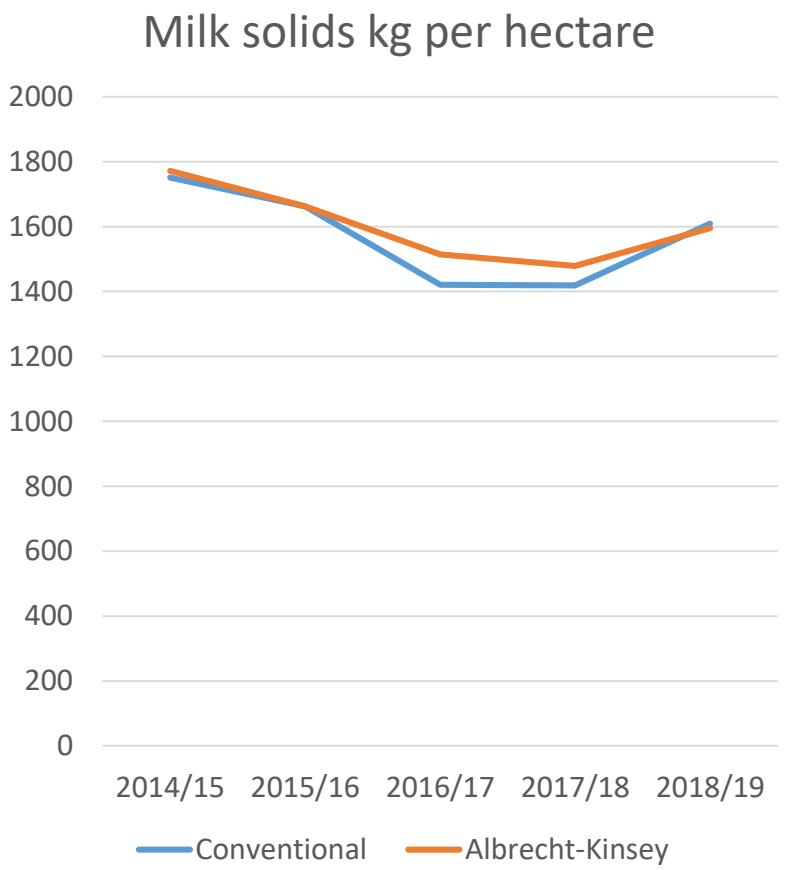
NB: Weekly botanicals commenced in 2015 season

Supplement use has also been similar for both farms

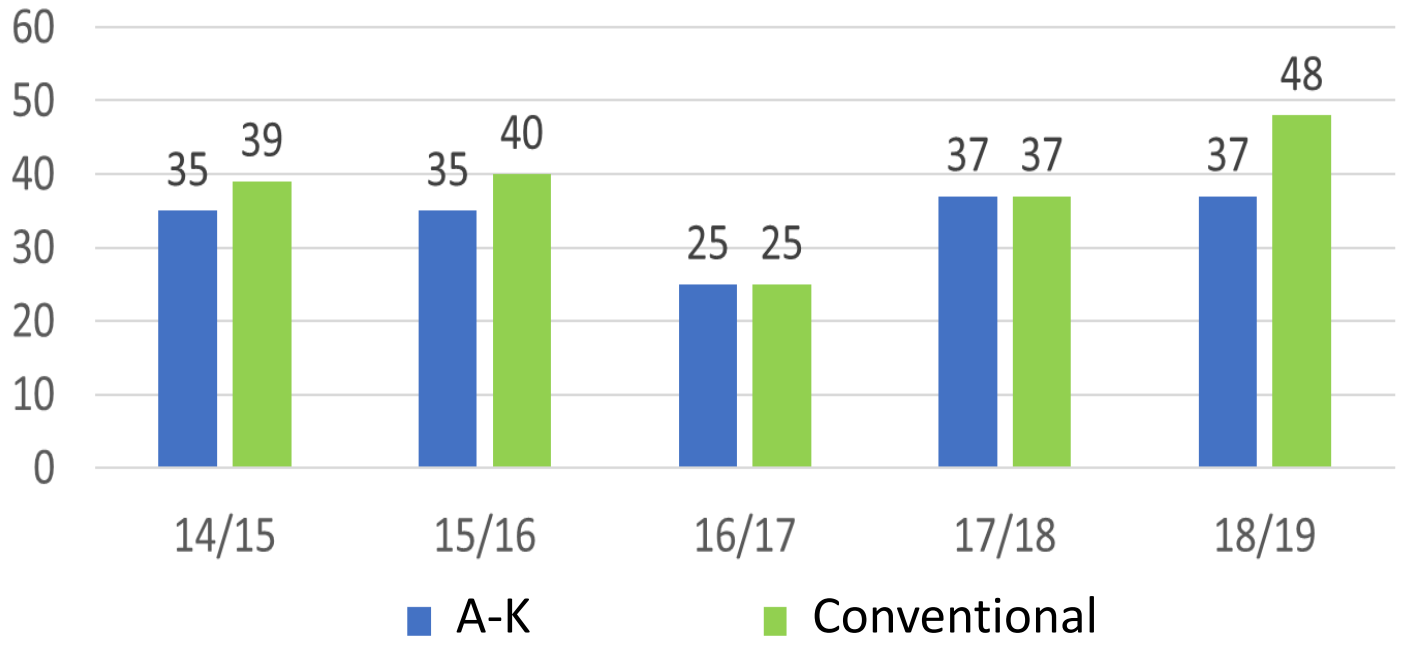


There is no statistical difference in milk yield between farms. Reductions in average yield was due to reduction in supplementation, lower N fertiliser and subsequent reduction in stocking rate

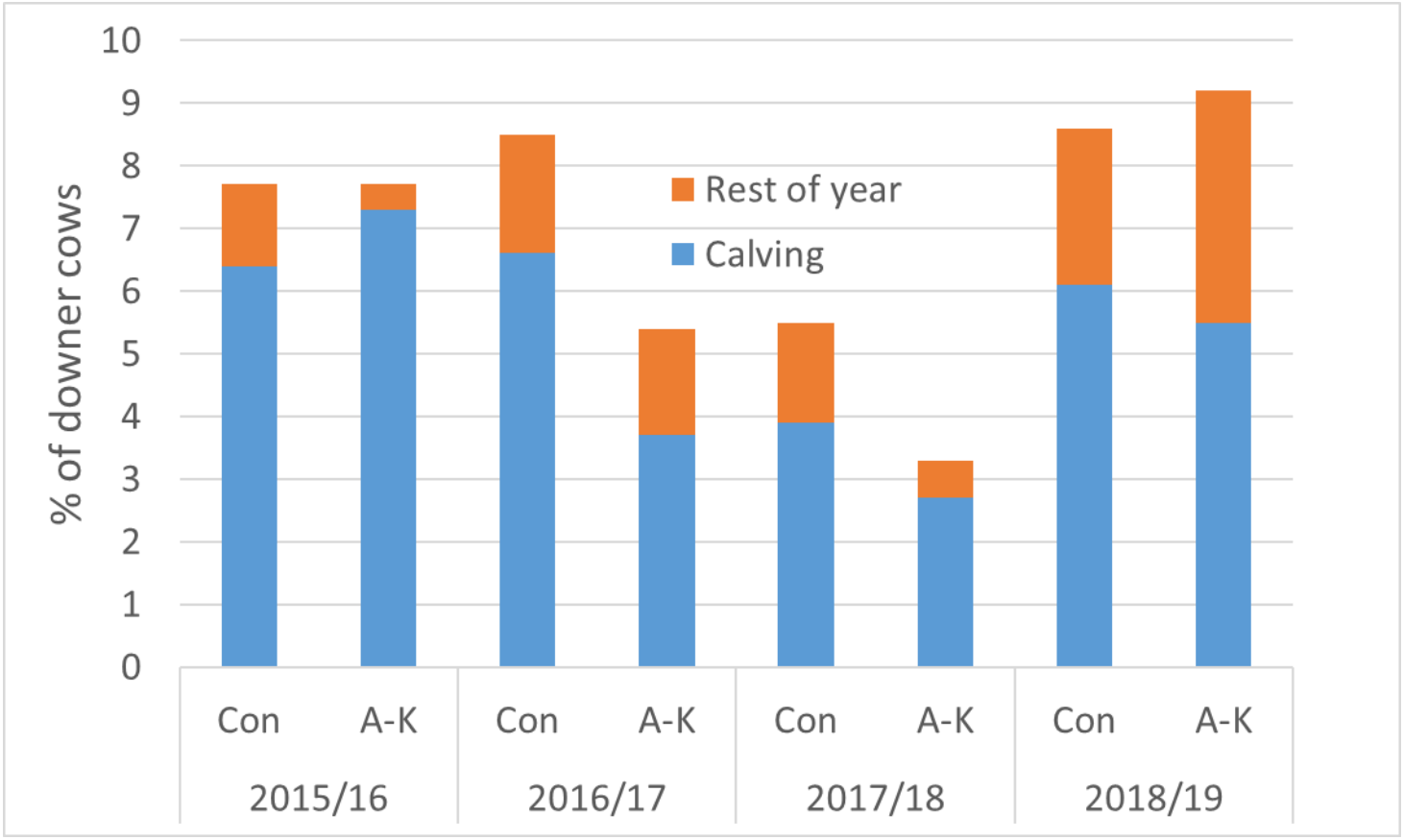




Little difference in N leaching apart from last year when difference in N fertiliser input was large



Generally, more preventative measurements were required on the conventional farm to manage metabolic problems at calving. Across years, no significant effect of fertiliser regime on overall animal health.



Reproductive performance has tended to be better for the A-K farm in terms of 3 week SR and non-cyclers, though there has been no significant difference in empty rate

	2014/15	2015/16	2016/17	2017/18	2018/19	Average
Conventional						
3 wk Submission Rate %	89	88	87	86	87	**87.4**
Non Cyclers %	11	12	13	14	13	**12.6**
MT Rate %	10	15	15	13	11.5	**12.9**
Albrecht-Kinsey						
3 wk Submission Rate %	92	91	91	85	91	**90.0**
Non Cyclers %	8	9	9	15	9	**10.0**
MT Rate %	8	14	15	11	9.5	**11.5**

Over recent years, the farms have been very similar in typical benchmark physical attributes.

	Comparison - Average 2015 to 2019		
	A-K	Con	Units
Stocking Rate	3.33	3.2	cows/ha
Nitrogen Use	100	139	kg N/ha
Peak Cows Milked	514	672	
Milk Solids per ha	1562	1506	kg/ha
Milk Solids per cow	472	471	kg/cow
Pasture Eaten	3960	4002	Kg DM/cow
Total Feed Eaten	4716	4670	t DM/cow
Silage Harvested	235	407	Kg DM/Ha
Total Feed Utilised	13.3	13.1	t DM/Ha

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

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	Y 1	Y 2	Y 3	Y 4	Y 5	Y 6	Y 7	ave last 3
Season	12/13	13/14	14/15	15/16	16/17	17/18	18/19	**yrs**
Cost per Hectare ($)								
Albrecht-Kinsey	1,151	1,522	980	739	602	655	672	**643**
Conventional	806	804	629	665	408	455	591	**485**
FARMAX Gross margin/ha								
Albrecht-Kinsey					7,451	7,620	7,974	**7,682**
Conventional					7,568	7,569	7,700	**7,612**

Soil measurements – Richard Gillespie

Addresses questions for soil structure and biological communities

- Annually from 3 focus paddocks end of winter
- Physical measurements
  - Penetration resistance
  - Macro porosity
  - Aggregate stability
- Chemical measurements
  - Anaerobically mineralisable N
  - Carbon and nitrogen
  - Basic soil and sulphate S
- Biological measurements
  - Earthworms
  - Other critters inc
    - Porina
    - Grass grub
    - Clover root weevil
    - Slugs

In July 2019, the A-K soils have higher Mg, S, and lower P (based on Hill Lab tests)

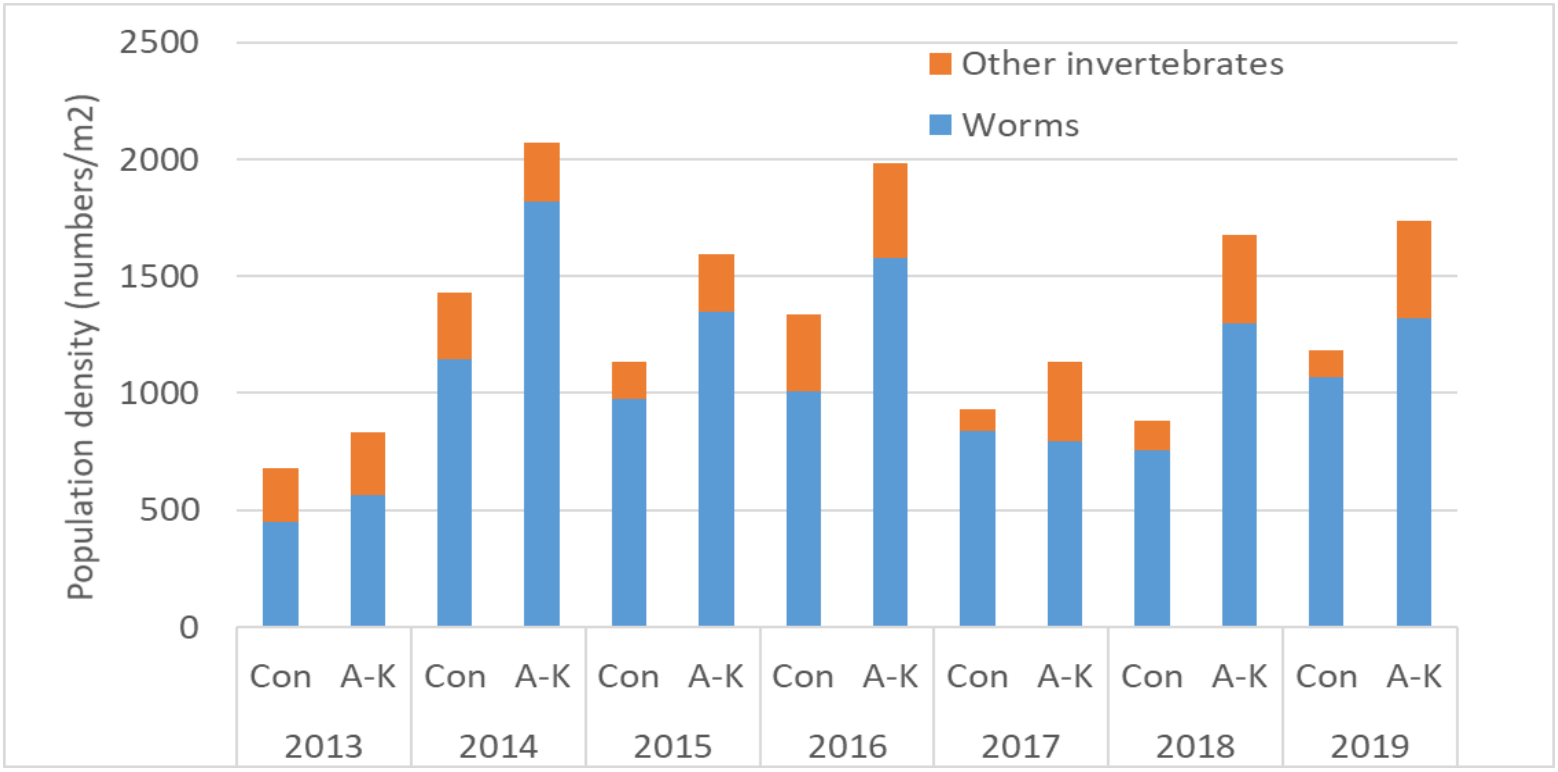
Soil chemistry parameters	Conventional	A-K
Carbon (%)	3.1	3.1
pH	6.3	6.4
Cation exchange capacity (me/100g)	13.7	14.0
Sulphate S (mg/kg)	**6.5**	**9.3**
MAF Calcium (Kinsey Base %)	9.0 (63%)	9.0 (63%)
MAF Magnesium (Kinsey Base%)	**19.7 (9%)**	**27.3 (12%)**
MAF Potassium (Kinsey Base %)	7.3 (4%)	5.7(3%)
Olsen P	**18.7**	**11.7**
AMN (µg/g)	**117**	**106**

*Soil characteristics from soil cores in July 2019 to 15 cm depth in three monitor paddocks on each farm. T-test for comparison of means Bold P<0.05, * P<0.10.*

Soil physical tests show Conv. and A-K soils have similar physical properties

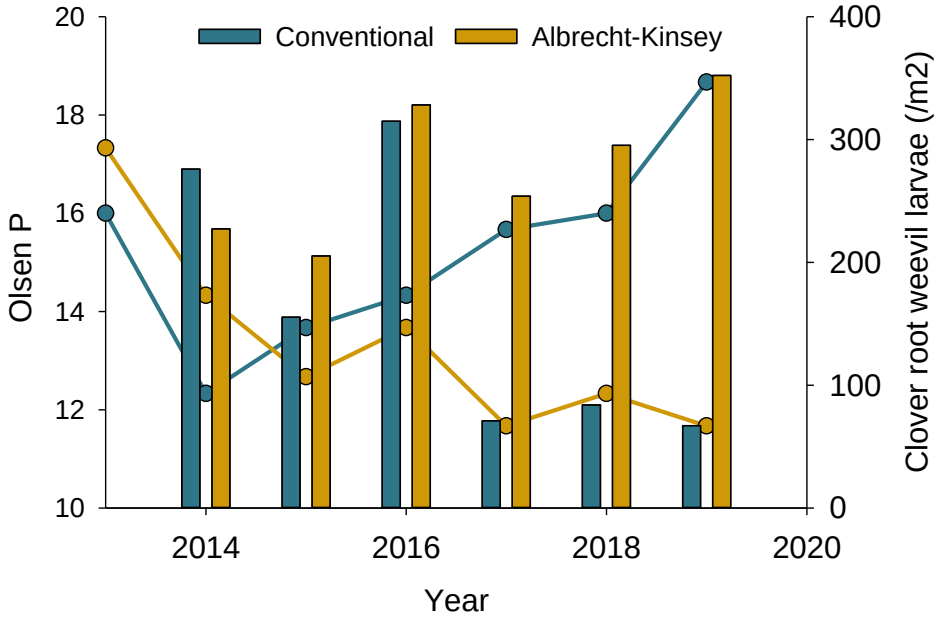
Soil physical parameters	Conventional	A-K
Penetration resistance (Mpa 0-10 cm)	1.54	1.45
Penetration resistance (Mpa 10-20 cm)	1.74	1.73
Aggregate stability (%>1mm)	88	89

Earthworms and total invertebrate populations have been greater on the A-K farm



Not all invertebrates are desirable as clover comes under threat from high CRW populations

- Clover root weevil populations remain high on the A-K farm
- Low phosphate applications on have resulted in low Olsen P
- Future difficulties for recovery of clover



Olsen P (line) and clover root weevil larvae density (bars) on the conventional and Albrecht-Kinsey farms. NB Olsen P values are to 15 cm depth

Soil Mg in the conventional farm has been gradually increasing so differences between the two farm are becoming less. Carbon content has increased to over 3% on both farms.

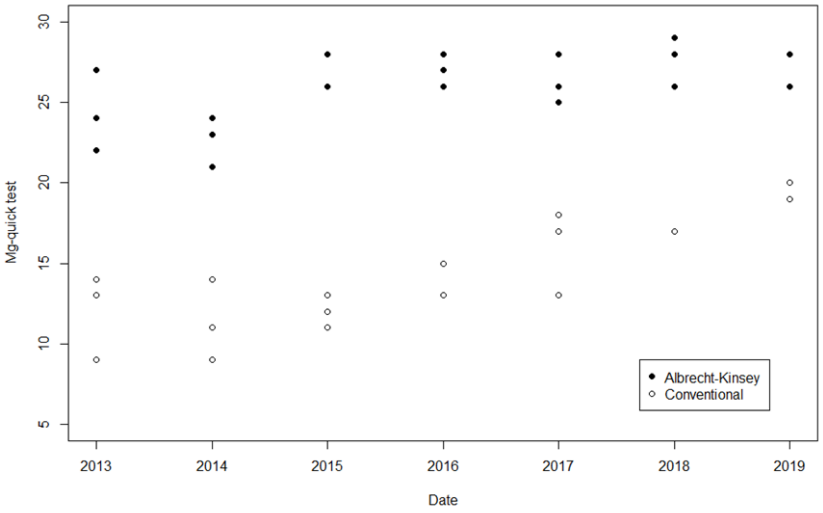


Figure 1. Quick test soil magnesium (Mg) for the conventional and Albrecht-Kinsey farms in 2013–19.

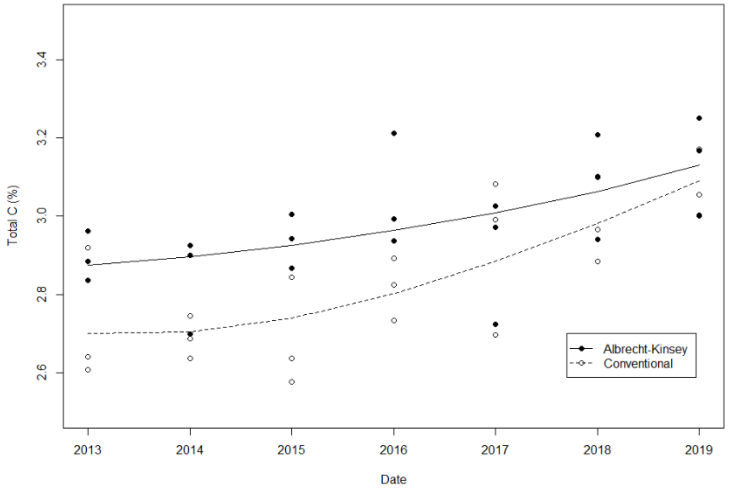
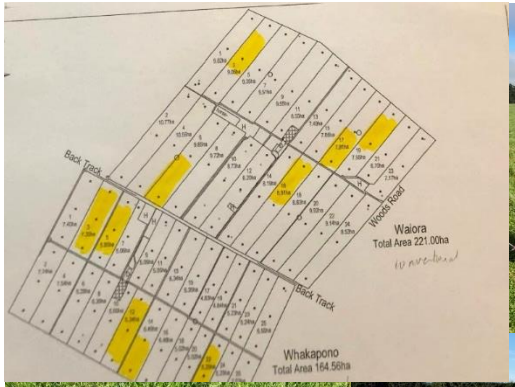


Figure 2. Total carbon (C %) (loess trend line fitted) for the conventional and Albrecht-Kinsey farms in 2013–19

Nutrient retention under a urine patch

Objective: to measure soil nitrate distribution under a simulated urine patch determine the effect of soil nutrient management on nitrate leaching risk

What we did

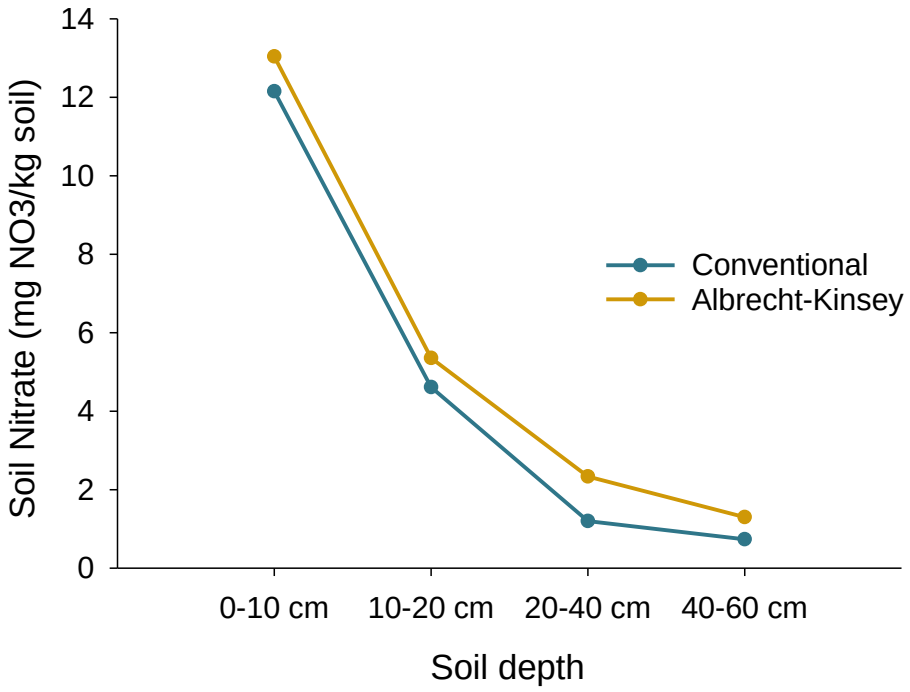


- Carried out between May and August 2019
- Five paddocks paired for grazing history
- Three sites within each paddock mown to 4 cm height and fenced
- Random locations in each site were marked and soil cores collected
- Soil depths of 0-10, 10-20, 20-40 and 40-60 cm
- Artificial urine applied at 600 kg N/ha

What we did

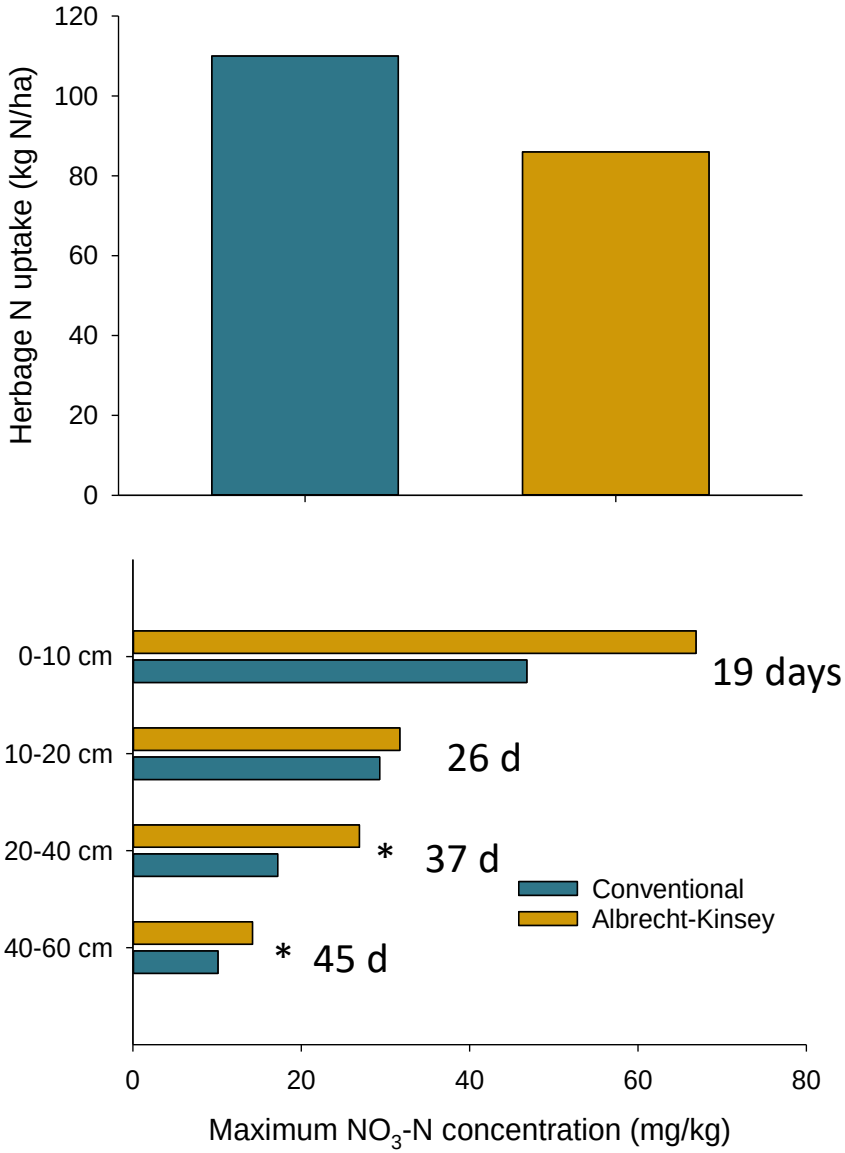
- Sampling soil again at 0, 10, 20, 50 and 70 days
- Concentration of nitrate and ammonium measured
- Harvested the herbage and measured yield and mineral content

No difference in soil nitrate concentrations at day 0 for the different sampling depths in the untreated areas



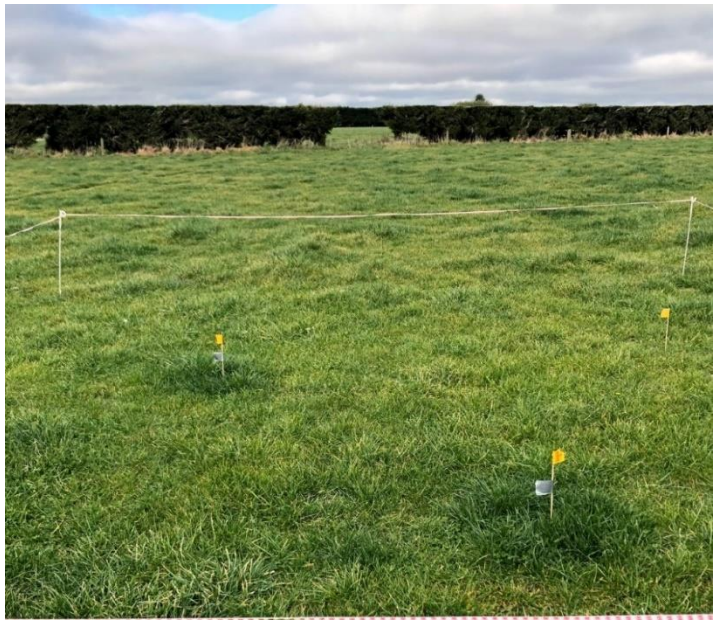
What we found

- Time taken to reach peak nitrate similar
- More nitrate in soils in A-K (P = 0.07), particularly below root zone at 20-60cm depth (P<0.05).
- Pasture growth less on A-K (P<0.05), leading to less plant N uptake
- At same urine N load greater nitrate leaching risk from a urine patch on A-K



Patch to paddock

- Higher leaching risk at the patch level not necessarily equivalent to paddock level
- Need to consider the N surplus over the whole farm
- Urine N load driven by N concentration in the diet. In autumn low N supplements can reduce N intake and lower urine N
- Results highlight value of cool season growth on soil N uptake



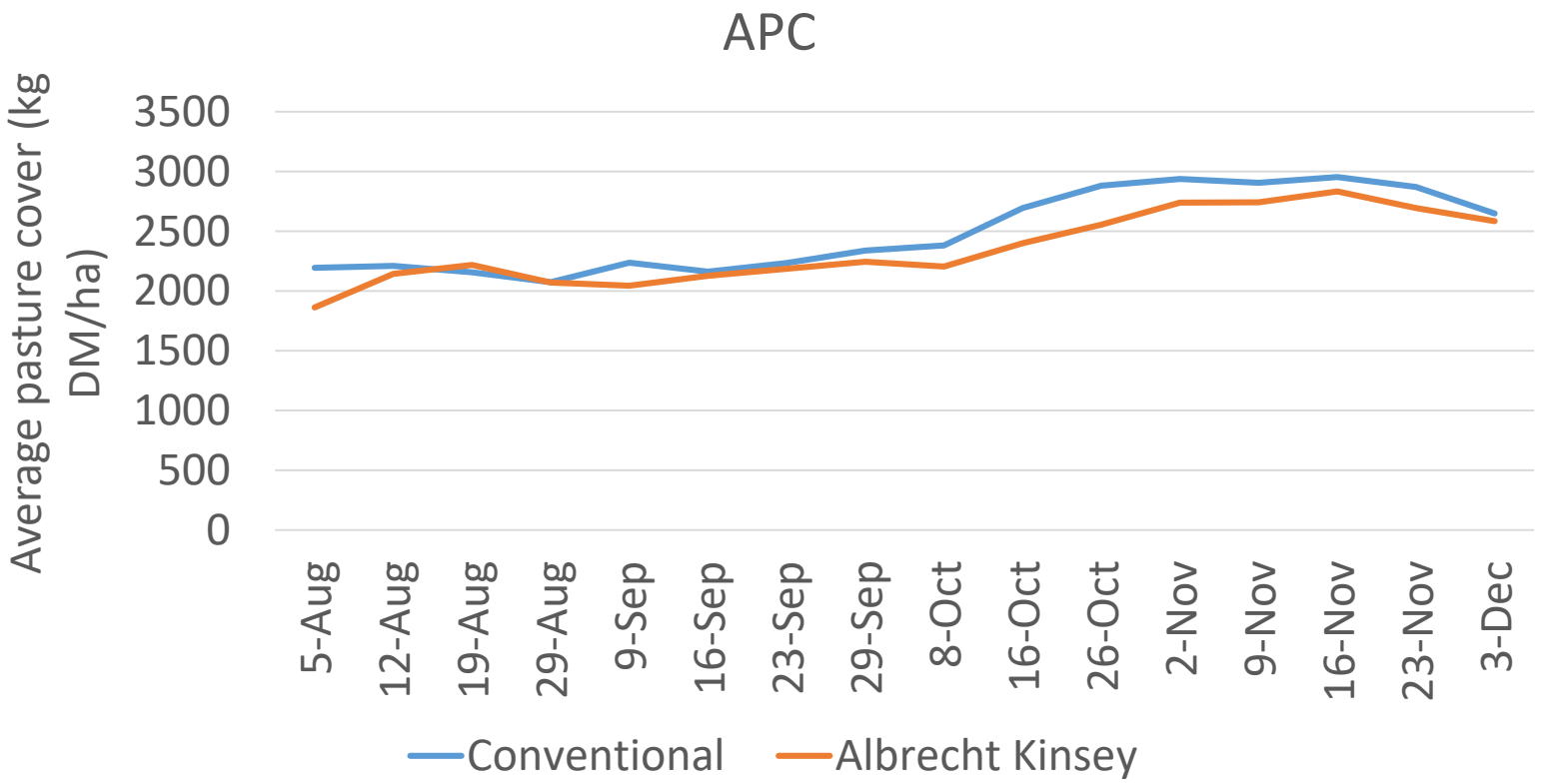
Season to date

Backtrack Dairies – 2019/2020 season to date

	Waiora (incl lease)	Whakapono
Effective Area (ha)	225	155
Stocking Rate (cows/ha)	3.55	3.70
Peak Cows	800	575
Treatment	Conventional (Con)	Albrecht-Kinsey (A-K)
Kg milk solid/ha	734	769
Kg milk solid/cow	206	207
N Applied (kg N/ha)	84	76
Supplements made (t DM)	13.8	0
Supplements Fed (kg DM/cow)	231	269
Pasture Grown (t DM/ha)	6.3	5.7

Data to 30 November

This season, pasture production has been similar for both farms, though pasture cover has been slightly higher on the conventional farm



Soil moisture report 9 December. Irrigation turned off between 6th and 13th Dec

Conventional (Waiora)

A-K (Whakapono)

Sponsored lunch thanks to: