

Modelling – a support tool for getting those nutrient balances ‘just right’

Samantha Mullender, Organic Research Centre

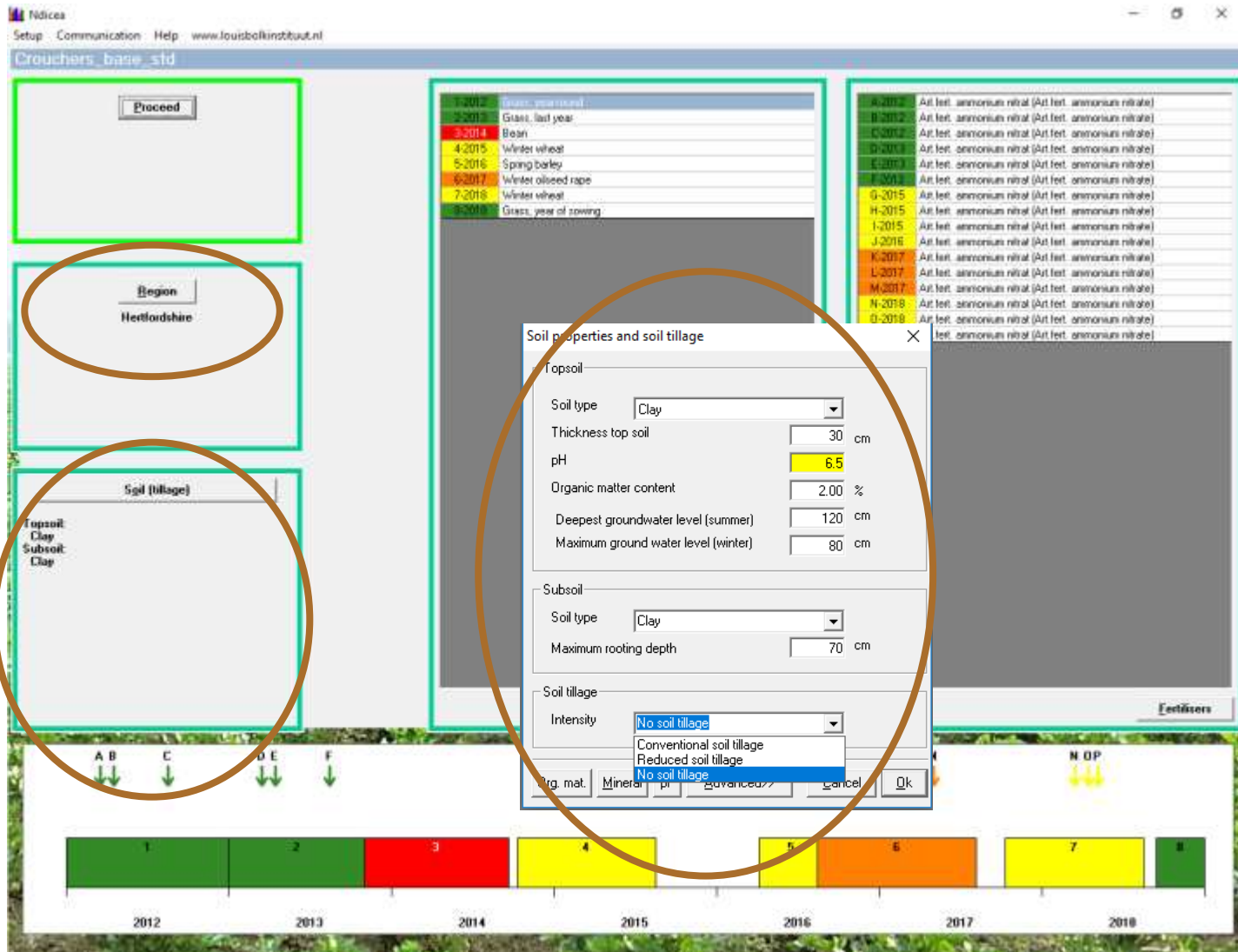
The Organic Research Centre



Nitrogen Dynamics In Crop rotations in Ecological Agriculture

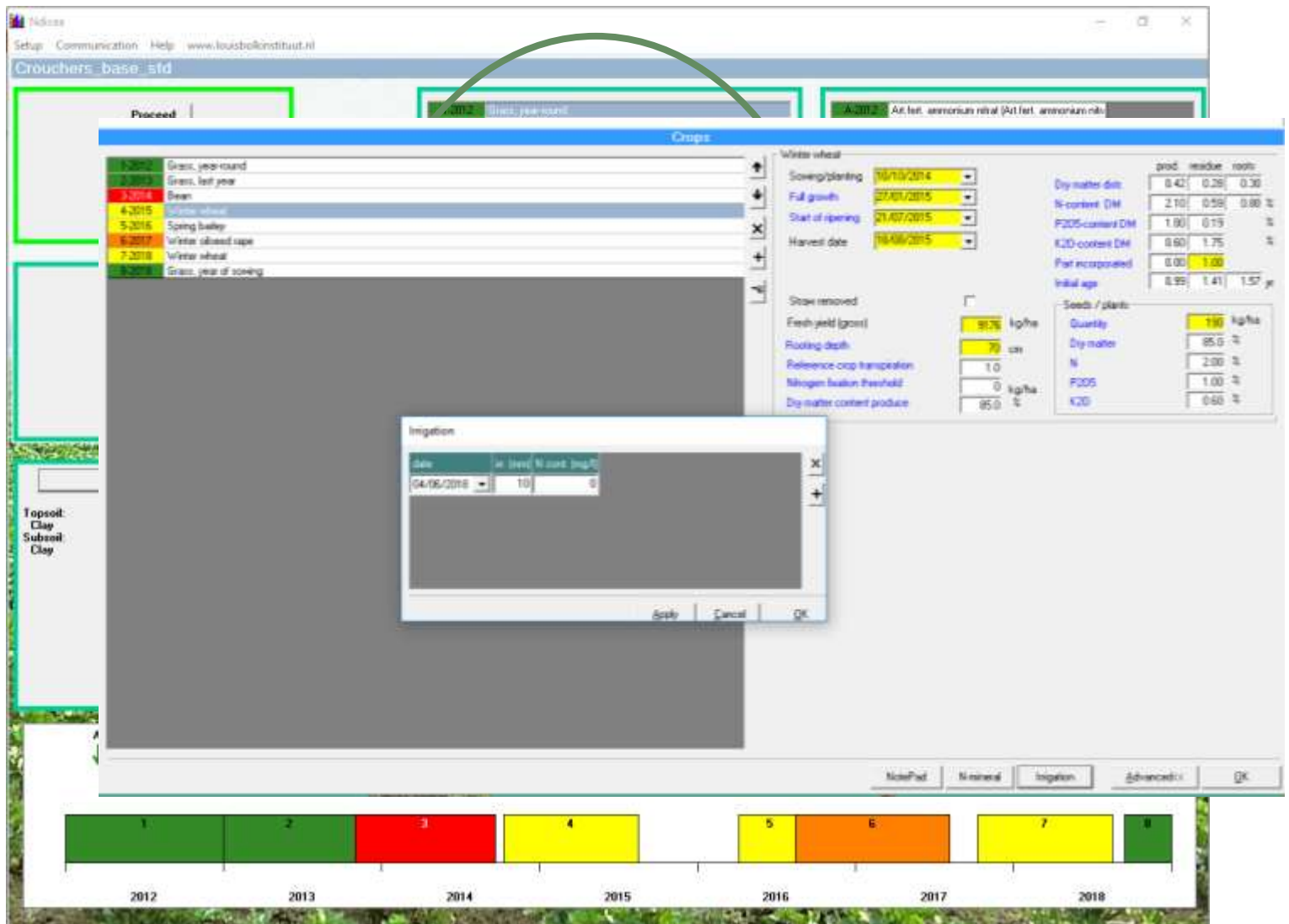


The Organic Research Centre

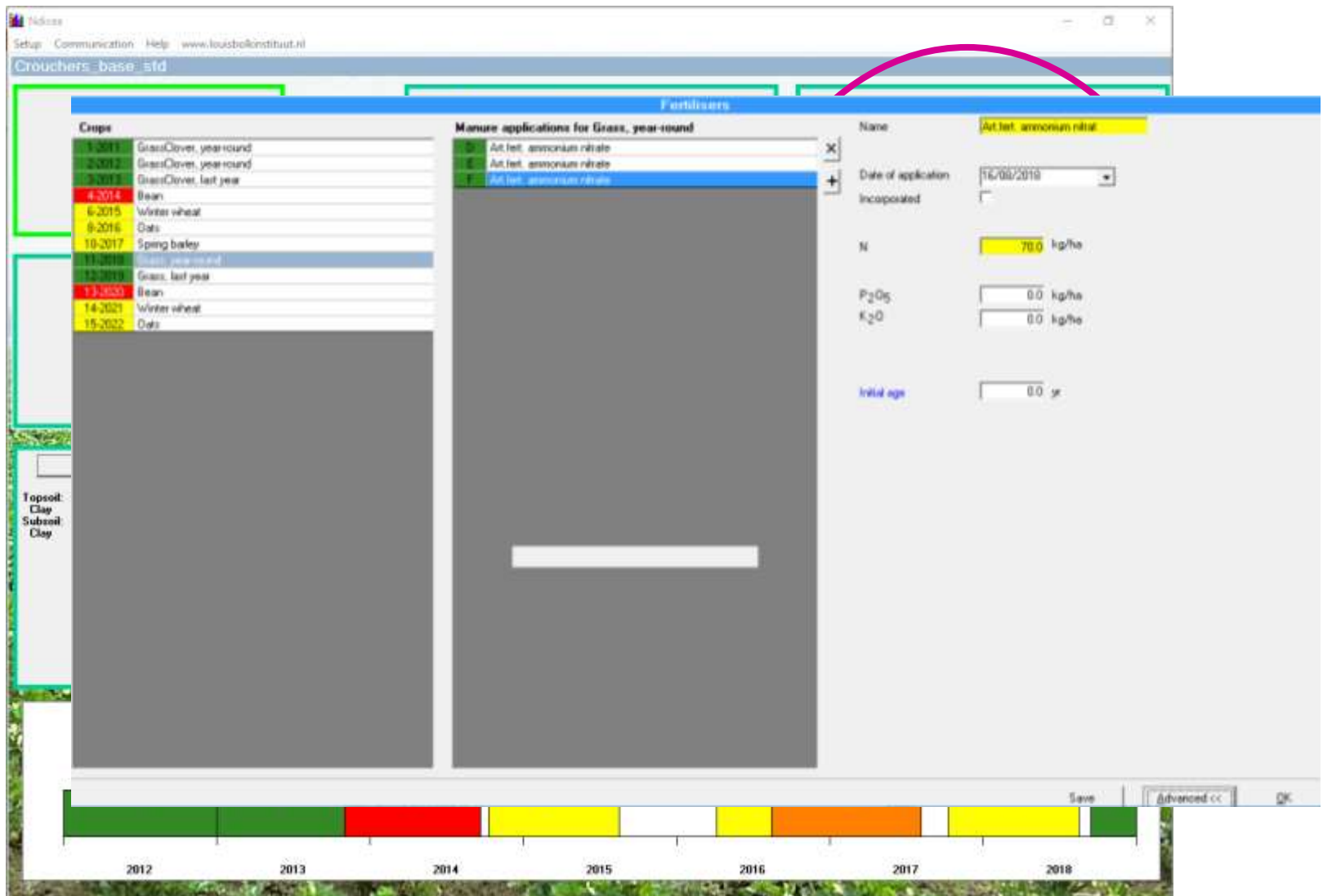


- **County**
- **Soil type (topsoil and subsoil)**
- Thickness top soil
- pH
- Maximum rooting depth
- Deepest groundwater level in summer
- Maximum ground water level in winter
- Organic matter content at start of rotation
- **Tillage (conventional, reduced, none)**

The Organic Research Centre



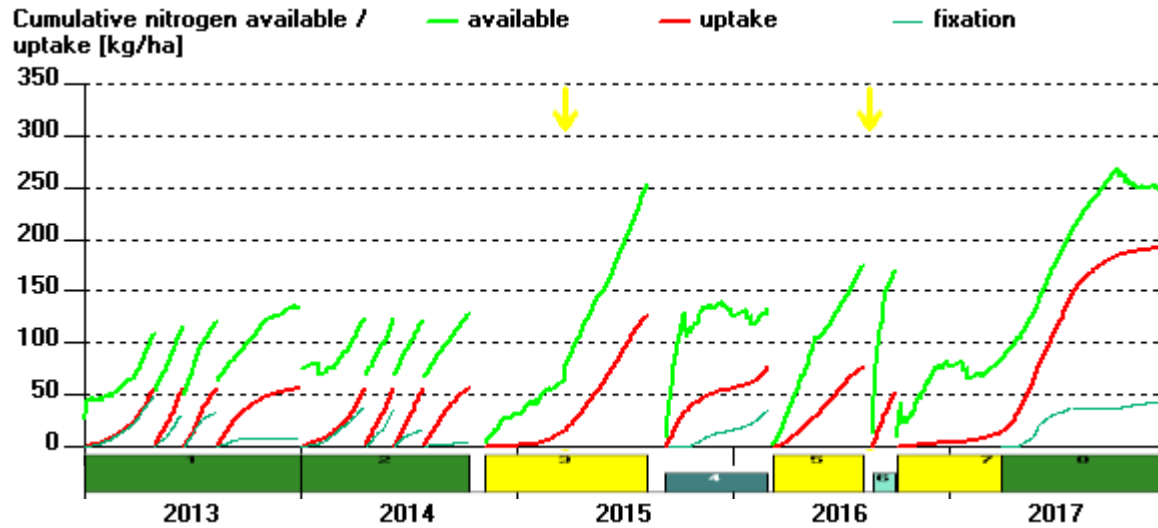
- **Dates of sowing/planting**, full growth, start of ripening and **harvest**
- Yield and **whether straw is removed**
- Rooting depth
- DM content of produce
- DM and nutrient distribution between product, residue and roots
- Seed/plant quantity and nutrient balances
- **Irrigation events: dates, volumes and N-content of water**



- **Date of application**
- **Quantity** (t/ha organic, kg/ha of N, P2O5 and K2O if mineral)
- Initial age of fertiliser
- **Incorporation** (yes or no; mineral fertilisers only)

Organic fertilisers only:

- **Ammonium emission reduction** (strongly/moderately/not reduced)
- N, N-mineral, P2O5, K2O, dry matter and organic matter contents



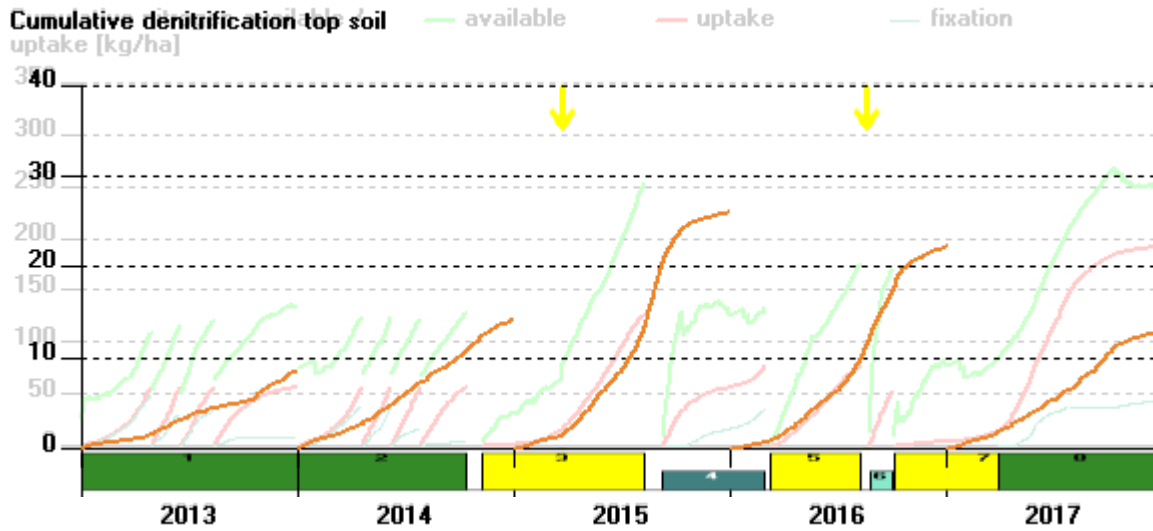
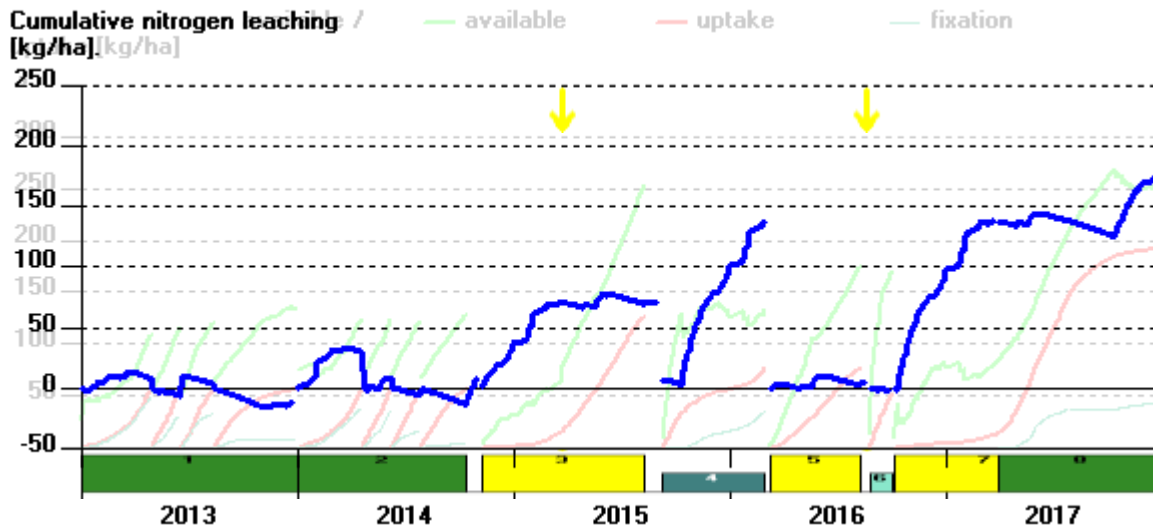
Crops

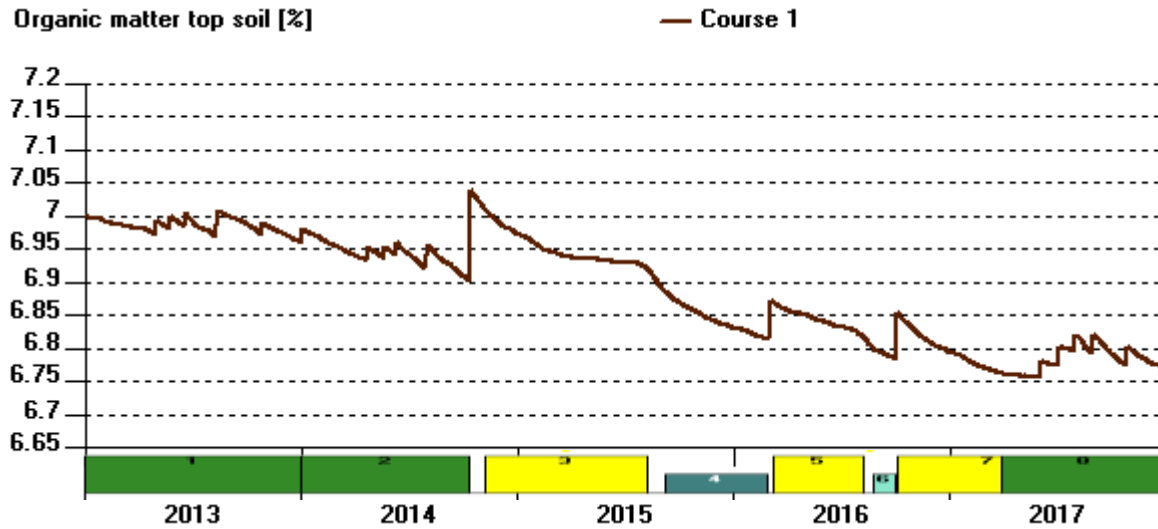
- 1 Grass clover, year-round
- 2 Grass, last year
- 3 Winter wheat
- 4 Fodder rye/vetch
- 6 Spring barley
- 7 Yellow mustard
- 8 Grass, year of sowing

Fertiliser

- All chicken manure
- First application at 8t/ha, second at 5t/ha

The Organic Research Centre



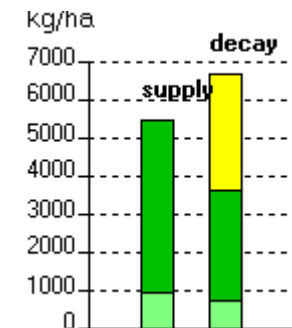


Supply and decay of organic

In kg/ha/jaar, average of crop rotation. L decay.

- Crop residues
- Green manures
- Manure
- Soil organic matter (decay only)

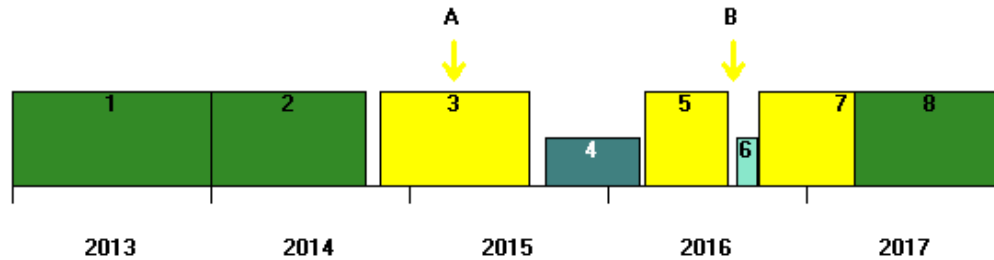
	N	P2O5	K2O
Supply with fertilisers	83	44	53
Nitrogen fixation	60		
Deposition	10	3	8
Total supply	153	47	61
Removal with produce	81	33	73
Calculated remains	72	14	-11
Emission	10		
Denitrification	17		
Leaching	89		
Calculated remains after losses	-44		
Accumulation org. matter	-55.3		



Modelling can be used to assess and improve

- **Assess current rotation**
- **Experiment with alternative crops/practices**
- **Decide where to invest – best options; whether benefits outweigh costs**
- **Explore and optimise nutrient applications (amount, type, timings)**
- **Investigate alternative weather**

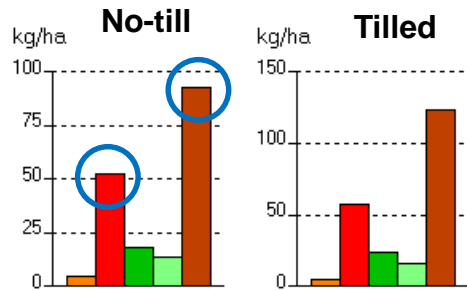
Tillage



Nitrogen mineralisation

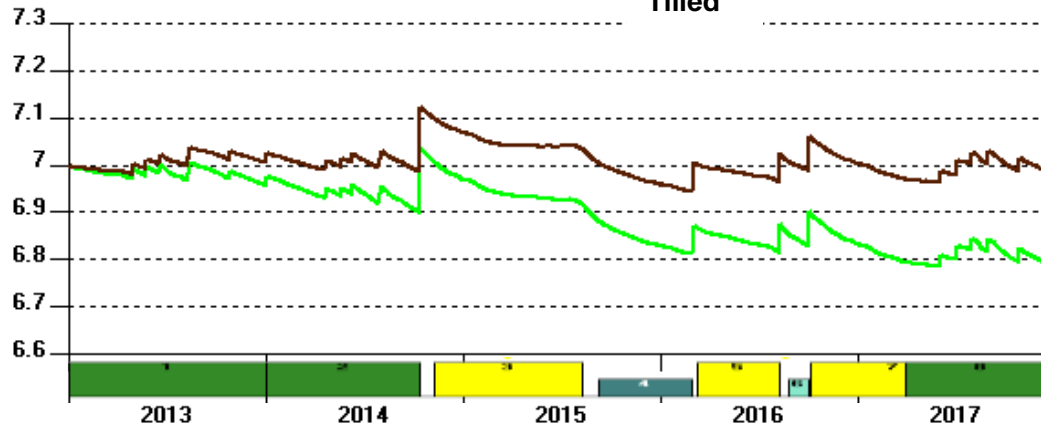
kg/ha/year, average of crop rotation

- N as mineral N in fertiliser/manure
- N mineralised out of organic part of manure
- N mineralised out of crop residues
- N mineralised out of green manures
- N mineralised out of soil (humus)



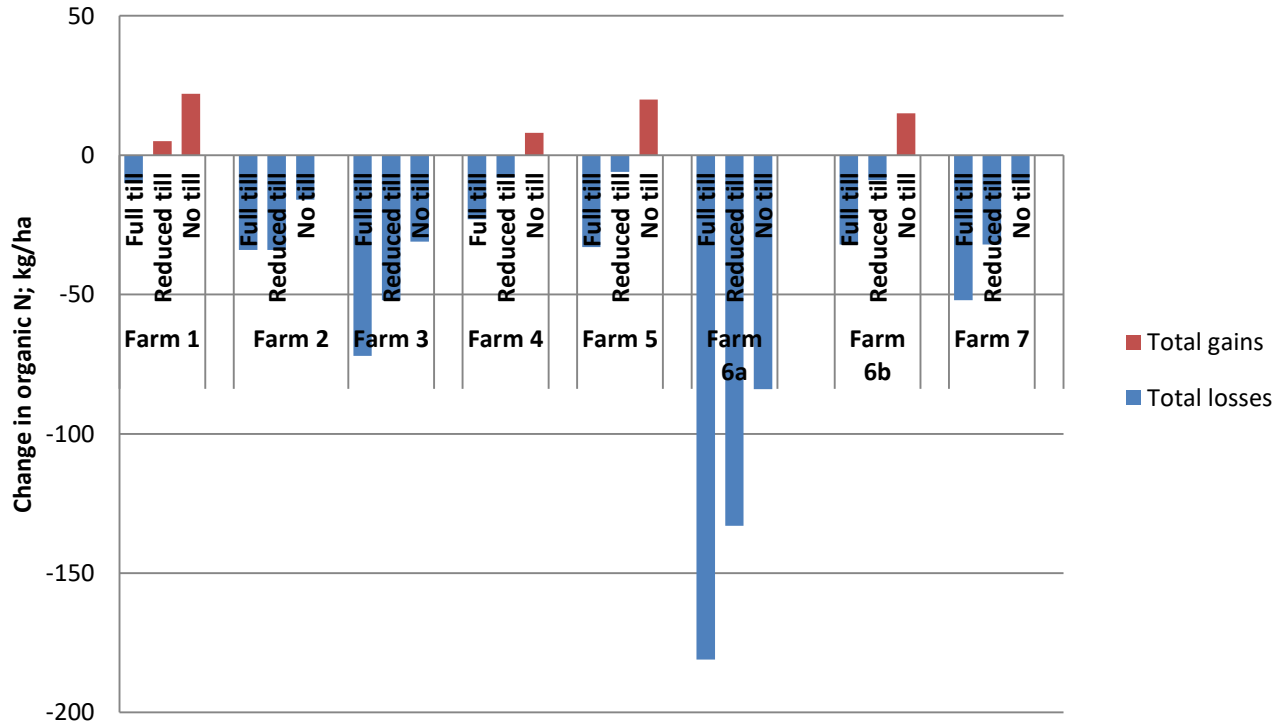
Organic matter top soil [%]

- No-till
- Tilled

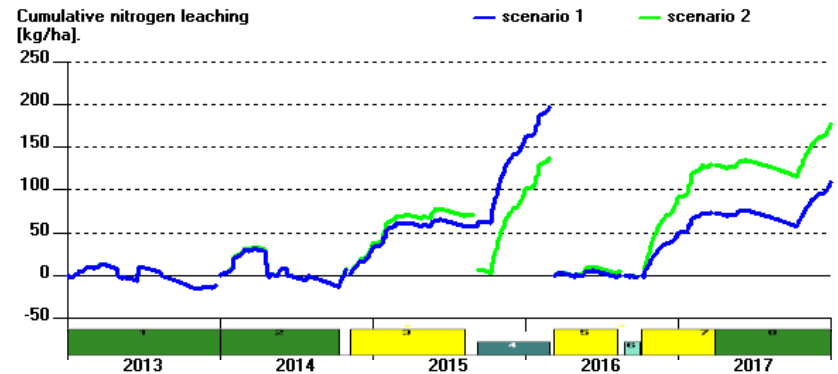
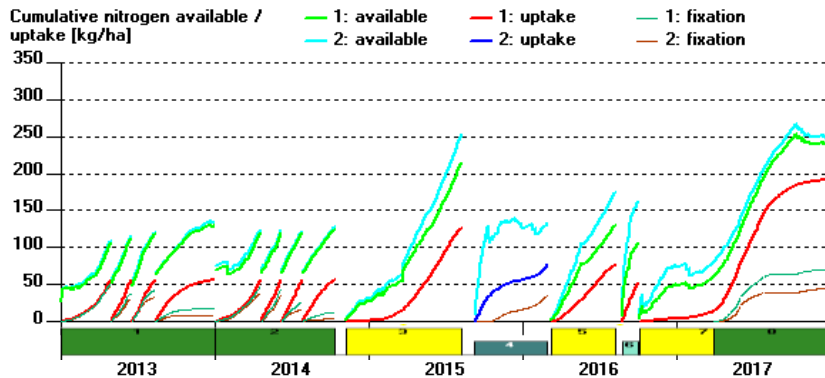
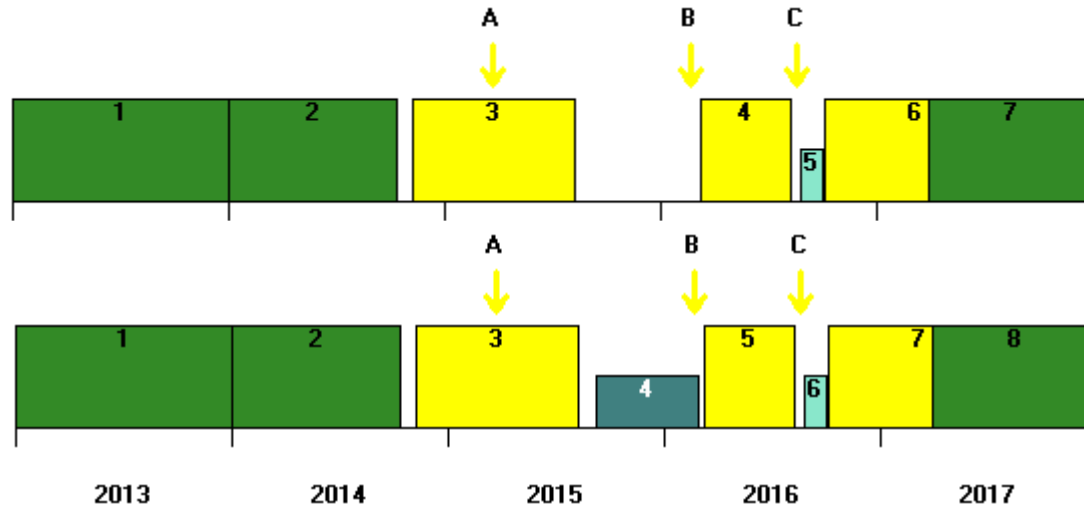


Tillage

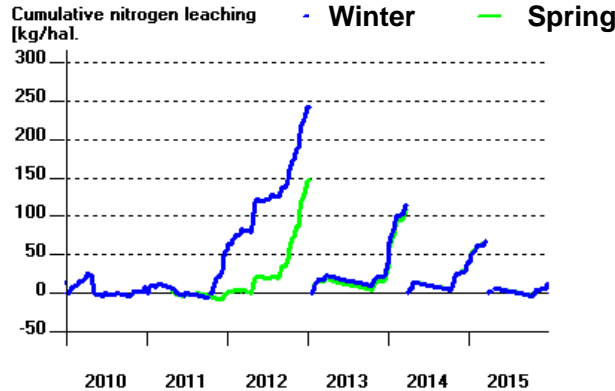
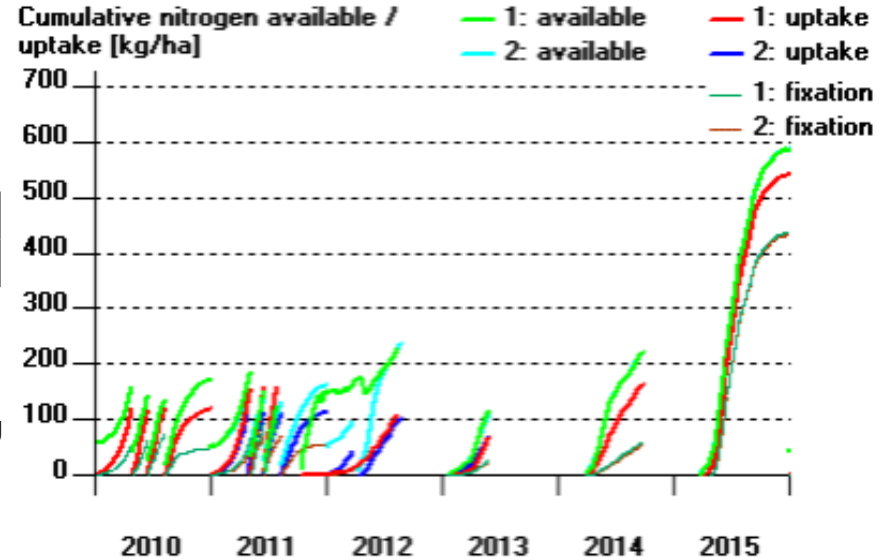
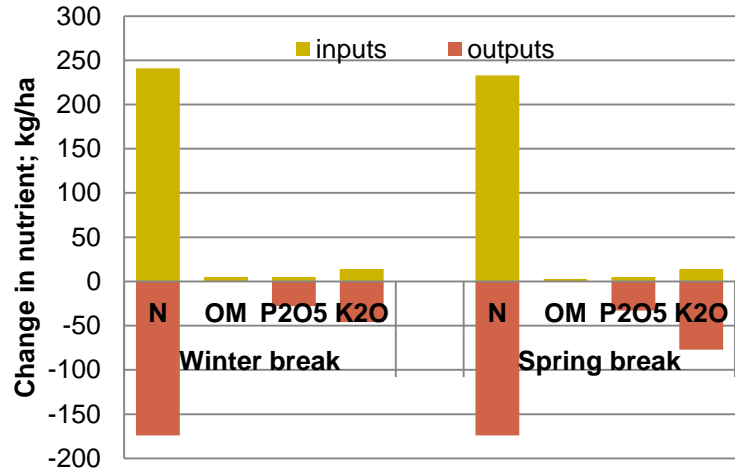
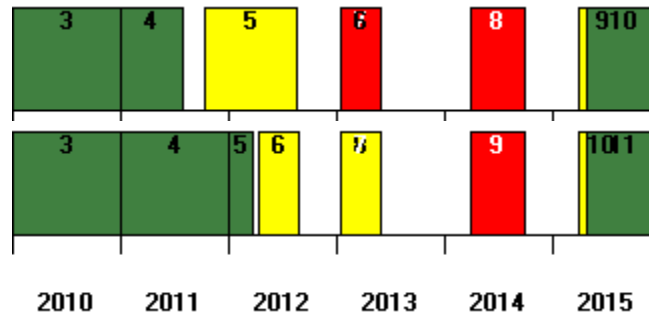
Organic nitrogen balance under alternative tillage



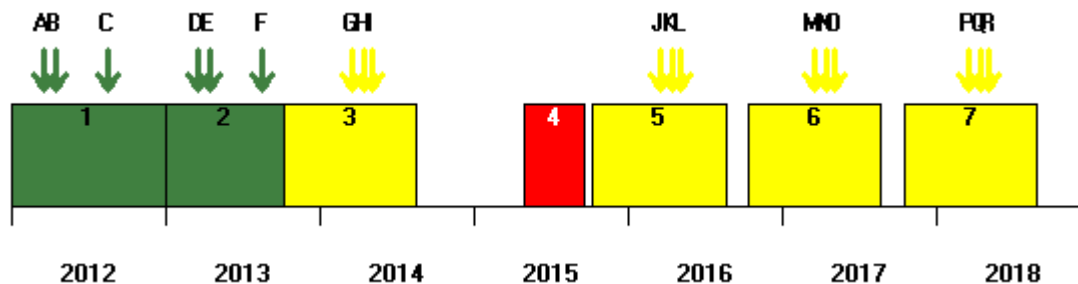
Ground cover



Spring or winter break?



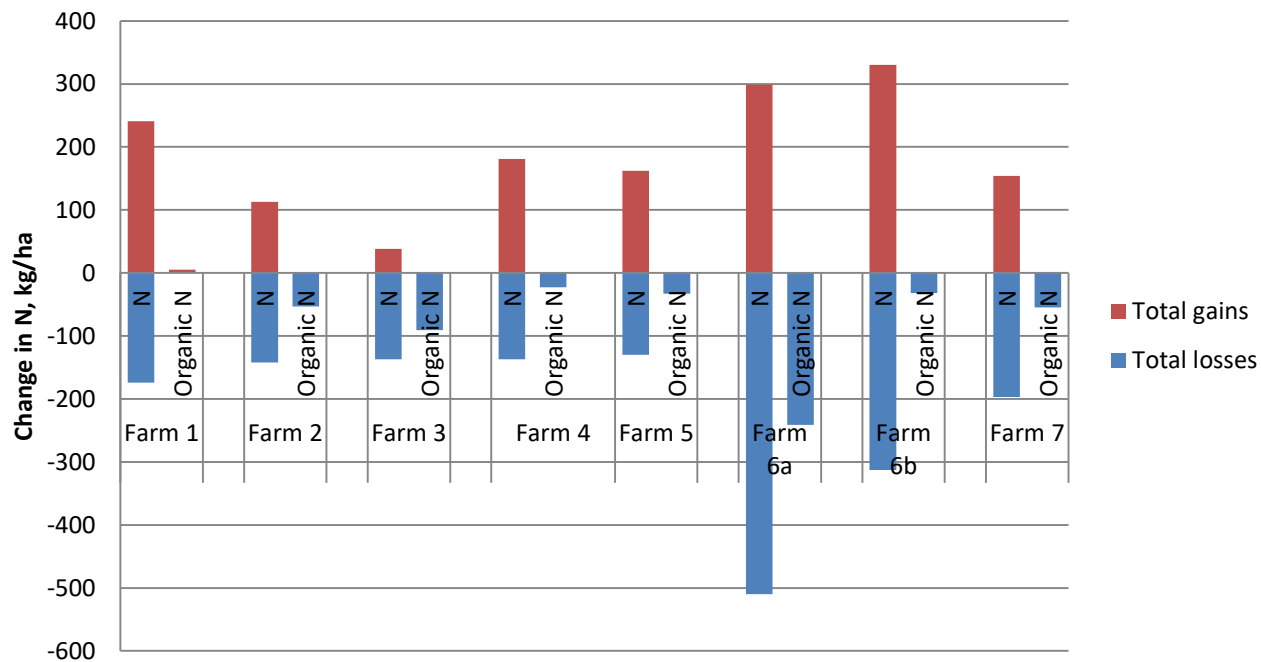
What to grow?



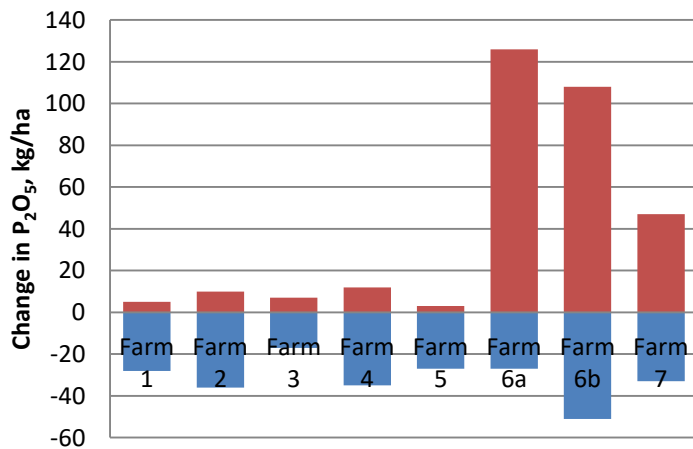
	Ryegrass - cut			Ryegrass-clover – cut			Ryegrass-clover – grazed		
	N	P2O5	K2O	N	P2O5	K2O	N	P2O5	K2O
Supply with fertilisers	146	0	0	92	0	0	92	0	0
Nitrogen fixation	12			70			76		
Deposition	15	3	8	15	3	8	15	3	8
Total supply	173	3	8	177	3	8	183	3	8
Removal with produce	135	49	133	132	53	88	99	44	35
Calculated remains	38	-46	-125	46	-50	-80	84	-41	-27
Emission	8			5			5		
Denitrification	14			14			18		
Leaching	12			15			18		
Calculated remains after losses	4			12			43		
Accumulation org. matter	13.4			13.6			31		



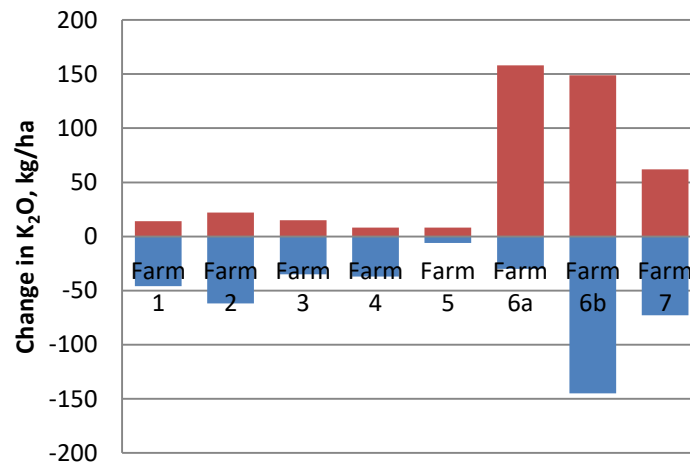
Nitrogen balance

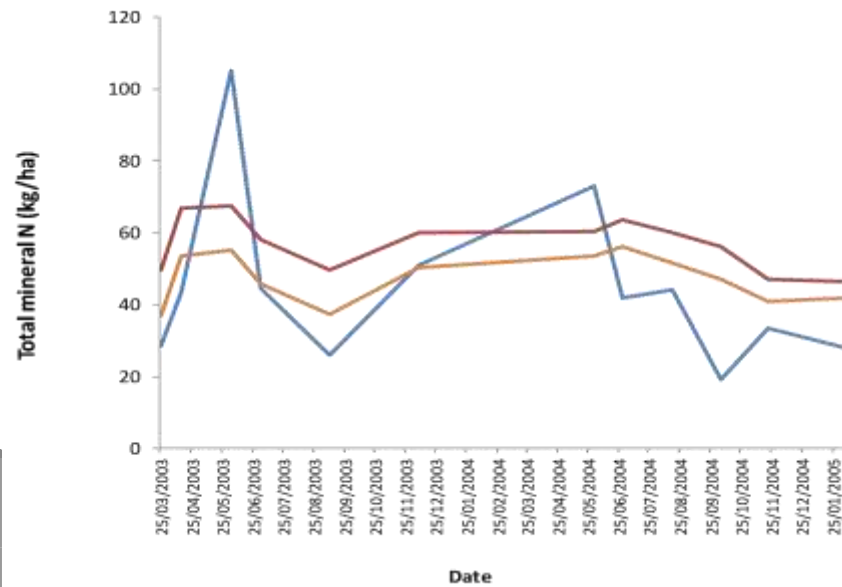
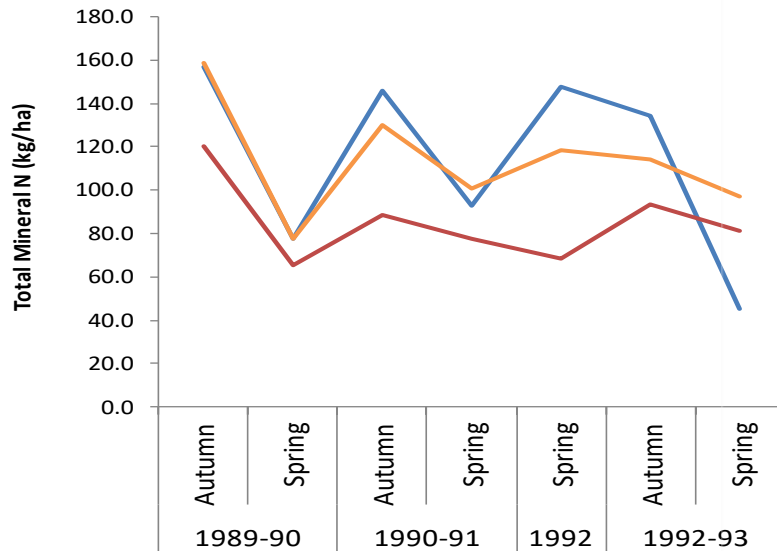


P₂O₅ balance

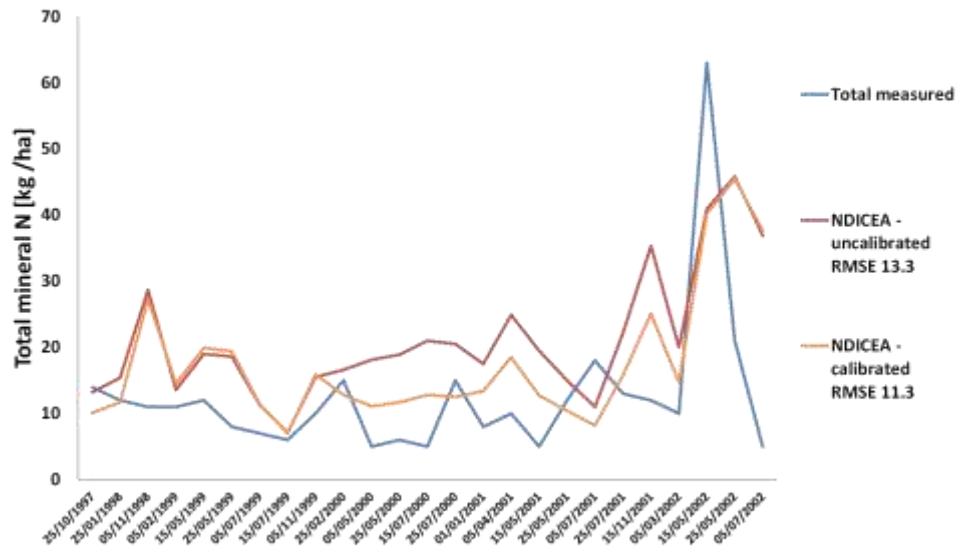


K₂O balance





WoodSide plot Woodside (SRUC)



**“All models are wrong, but some
are useful”**

Whittaker et al. 2013 (Box 1976?)

Thank you

The Organic Research Centre

samantha.m@organicresearchcentre.com

01488 658298 (ext. 522)

