Precision Ag Variable Rate Fertilizer Application Trial

Precision Agriculture Pty Ltd (Precision Ag) approached the MDF to be one of six commercial dairy farms in Gippsland to undertake a trial to demonstrate the benefits of variable rate application of fertiliser as a tool for improved soil management. The project is funded by DELWP through the Virtual Centre for Climate Change Innovation (VCCCI) as a Climate Change Innovation Grant, with project activities delivered by December 2019.

Improved fertiliser management and the removal of soil nutrient constraints can deliver economic benefits to farmers through greater fertiliser (and other input) efficiency and improved productivity, with the additional benefit of improved environmental outcomes by reducing nitrogen losses from the soil, in particular a reduction in Nitrous Oxide (N_2O) emissions, a significant greenhouse gas.

Pasture growth is determined by the most limiting factor in the soil and in a high input system the capacity of pasture to utilize applied nitrogen may be limited where other nutrient deficiencies or constraints to growth are present. Research suggests a high level of variability in soil characteristics within and between Gippsland dairy paddocks. Consequently, limited data on soil fertility and the traditional uniform application of fertiliser may not adequately match pasture requirements. There is scope to improve nitrogen use efficiency of pastures by both directly varying nitrogen fertiliser application rates to reflect underlying soil nitrogen levels, and/or applying appropriate nutrients to alleviate other limiting factors and improve nitrogen use efficiency. This project will enable an assessment of potential economic benefits and help identify the appropriate methods of variable fertilizer application on a commercial scale in the Gippsland region.

In consultation with Precision Ag, the MDF has identified two areas of the farm that are suitable for a demonstration trial:

- Paddocks 6 & 7 – Located on the Tinamba red soil under fixed spray irrigation;
- Paddocks 16 & 17 – Located on the Nambrok clay-based soil under flood irrigation.

Both paddocks have a history of soil tests, the most recent being as part of a Fert$mart program with the following soil test results:

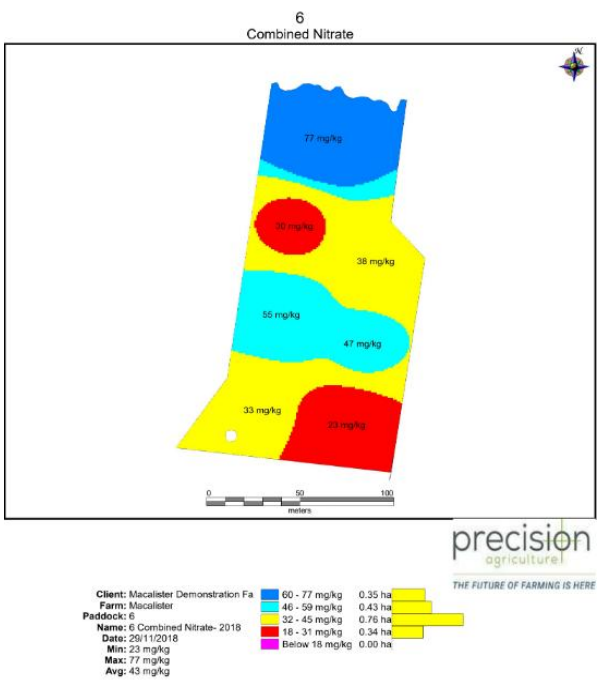
Macalister Research Farm Soil Test Summary - 2017/2018					
Analysis			**Desirable Result**	**Paddock 16**	**Paddock 7**
Phosphorus	(Olsen P)	mg/kg	25.00	24.30	25.10
Potassium	(Cowell)	mg/kg	250.00	194.00	218.00
Sulphur	(KCL-40)	mg/kg	18.00	14.60	14.80
pH	(CaC12)		6.00	4.90	4.90
pH	(1:5 Water)		6.80	5.80	5.90
Phosphorus Buffer Index (PBI)			100.00	116.20	134.80
Salinity (EC)	(1:5 Water)	dS/m	1.00	0.04	0.07
Chloride	(1:5 Water)	mg/kg	50.00	0.00	0.00
Organic Carbon	%		4.00	3.98	4.21
Nitrate Nitrogen	(KCl)	mg/kg	25.00	25.00	15.00
Copper	(DTPA)	mg/kg	8.00	3.13	1.74
Zinc	(DTPA)	mg/kg	15.00	19.07	13.69
Boron	(HWS)	mg/kg	2.00	0.00	0.00
Manganese	(DTPA)	mg/kg	40.00	45.55	21.35
Iron	(DTPA)	mg/kg	200.00	435.00	546.00

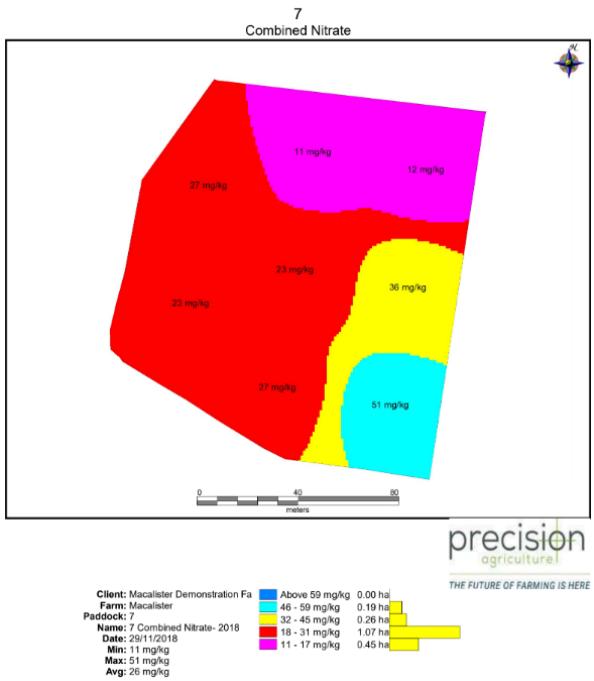
Macalister Research Farm Soil Test Summary - 2017/2018			
Analysis	**Desirable Result**	**Paddock 16**	**Paddock 7**
Soil Structure	**(% of CEC)**	**(% of CEC)**	**(% of CEC)**
Calcium	71%	55%	52%
Magnesium	13%	24%	26%
Sodium	1%	1%	3%
Potassium	5%	3%	3%
Aluminium	0%	2%	2%
Hydrogen	10%	15%	14%
Calculations			
Total Exchange Capacity (TEC) meq/100g	15.00	13.68	13.51

In Spring of 2018, Precision Ag undertook grid soil sampling at a frequency of four samples per hectare to map the variability in elevation, soil EC, pH, and a range of other characteristics and nutrients across these paddocks.

The maps generated were studied and two different approaches were identified:

- Paddocks 6 & 7 – Paddock 7 will have traditional uniform application of nitrogen in the form of Urea applied at the same rate as the rest of the farm; Paddock 6 will have a variable rate of Urea applied to match the needs of each identified zone. Both paddocks will receive an application of P, K and S at the same rate in autumn.

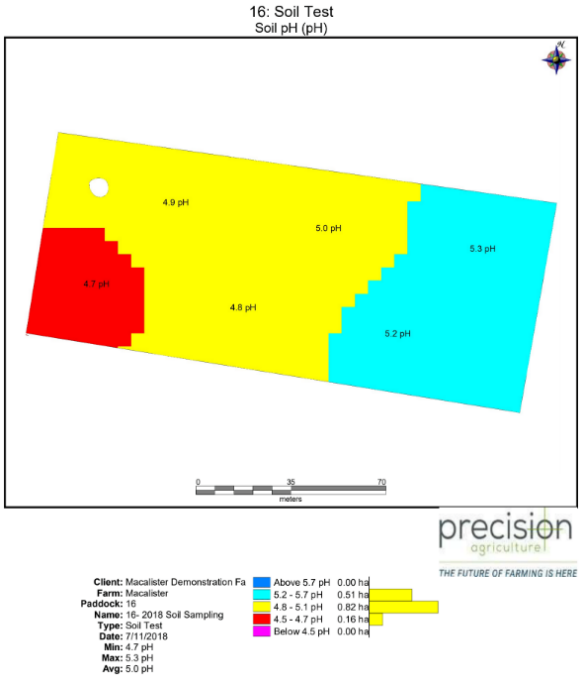


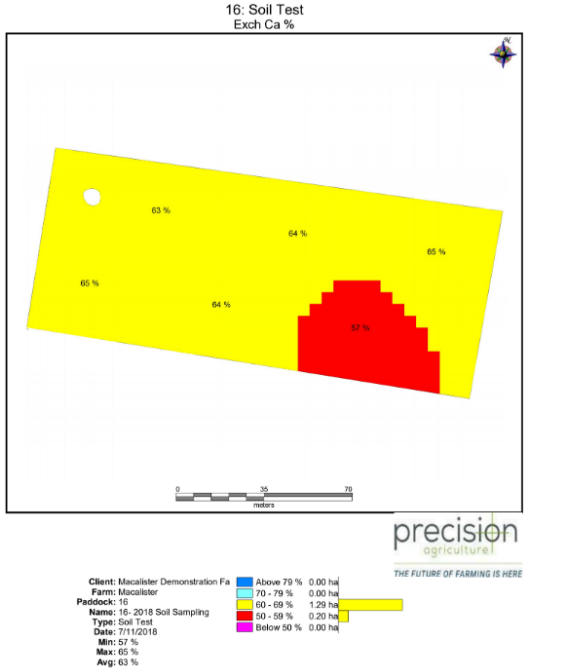


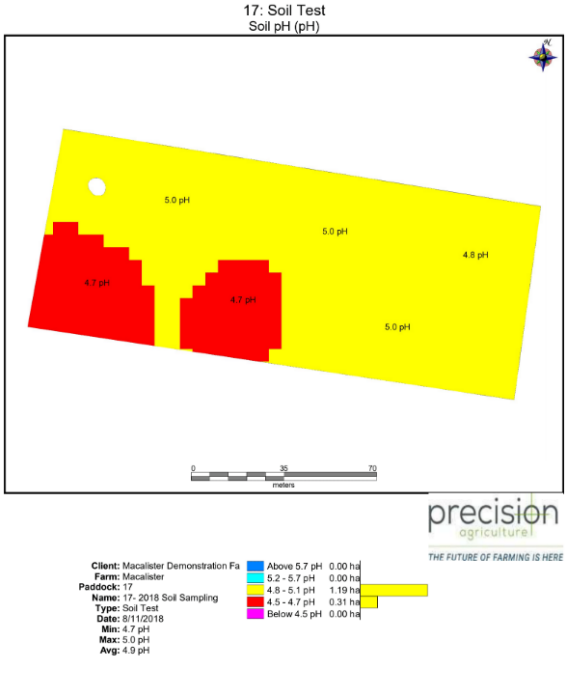
- Paddocks 16 & 17 – Paddock 16 will receive an application of Buchan lime at a variable rate to achieve a pH of 6.0 after two years; Paddock 17 will not receive lime. Both paddocks will receive an application of P, K and S at the same rate in autumn.
  From the Fert$mart report:
  "Fertility levels are in a good position and the soil seems to be in a healthy state. My only concern with these paddocks is the measurable level of Aluminium that is showing on the tests. Aluminium is a very

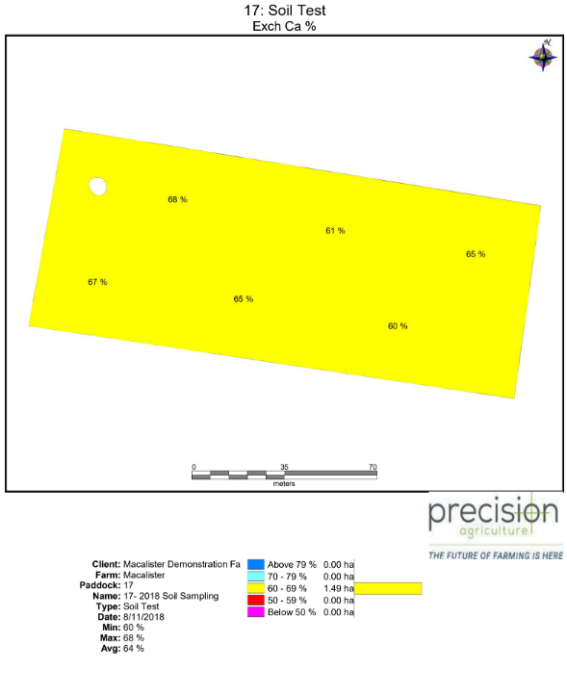
bad element to have in the soils as it dramatically effect Phosphorus plant availability and cause roots to become burnt and stunted. Aluminium becomes plant available once pH goes below 5.0. When magnesium levels are high, the soil particles join and make the soil tight and compacted. When this occurs, negative elements (sodium, aluminium) can't drain through the profile, which will dramatically affect dry matter production.

The only way to overcome this is to apply Lime to the soil so that pH is lifted and Aluminium is no longer plant available. The increase in soil pH will then bring about a release of 'locked-up' nutrients that are in the soil and, with a reduced level of Aluminium, root depth can increase. Lime also brings much need calcium which will start to remove the high levels of magnesium within the soil. Once magnesium is reduced, soil compaction decreases, and the friability becomes significantly better. This then allows for Sodium to drain through the profile and will increase the pastures tolerance to heat and summer conditions."









Each pair of paddocks will be grazed together in the rotation and each paddock will have dry matter production measured and mapped before and after each grazing using an Automatic Pasture Reader on a quad bike. Two measurements will be taken to create a baseline taken before any treatment is applied. Tissue samples will also be taken before and after treatments are applied in Spring 2019; return grid pattern soil sampling will also be conducted in Spring 2019 to assess any changes to underlying soil fertility, and an economic and environmental impact of the treatments will be calculated.

You can see the full set of maps for a range of nutrients for each paddock on our website – macalisterdemonstrationfarm.com. You will be amazed at the nutrient distribution variability across each paddock.

Watch out for regular reports in upcoming newsletters and for a field day later in the year to examine the results.