Lime Sources trial at Kendenup

INTRODUCTION

The lime sources trial at Kendenup, was established in 2015 to address the lack of long-term lime trials in the southern High Rainfall Zone (HRZ). John Blake (SCF) set-up the original trial with funding from South Coast Natural Resource Management (SCNRM). The aim was to evaluate five different sources of lime, from the south west, to determine if there were differences in soil pH change over time and/or grain yields. SCF has continued to monitor the trial past the original project timeframe.

NB: All soil pH levels quoted in this report were measured in $CaCl_2$ solution.

METHODOLOGY

A two-replicate broad-scale trial was set up in 2015 with plot dimensions of 130m by 30m. The five lime sources were:

1. Bornholm
2. Denmark
3. Lancelin
4. Redgate
5. WALCO
6. Nil control

Each lime source had the product rate (t/ha) adjusted to ensure each plot received the same amount of neutralising value (NV). For example, the reference liming rate was 2t/ha with a NV of 80%. A lime with a slightly lower NV, say 74%, had a higher rate of lime applied to make the NV's even between treatments.

A comprehensive soil testing regime was carried out by soil-sampling contractors to determine the base-line levels of soil acidity in each plot from three separate soil depths; 0-10cm, 10-20cm and 20-30cm in 2015. The locations of the soil sampling were geo-referenced so re-testing years later can be carried out from the exact same position within the plot.

Accurate grain yields were determined from the 2017 canola crop and the 2018 barley crop using the SCF weigh trailer to weigh individual plots after they were harvested with Mackie's header.

In 2019, SCF have employed a soil sampling contractor to re-test the 40 different locations in the trial so we can compare the potential changes in soil pH over the three different soils depths mentioned above.

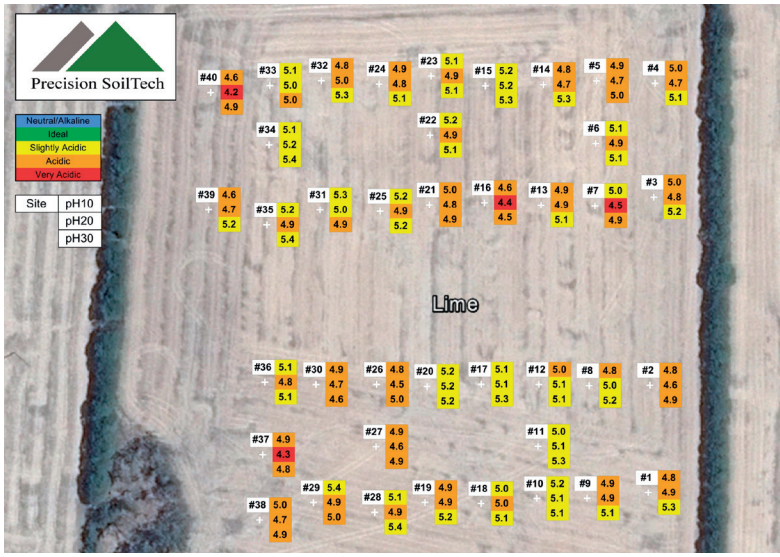

Figure 1: *Summary of the soil pH's ($CaCl_2$) recorded at the Mackie lime sources trial in 2015 at the beginning of the trial. There were 40 sample points tested in total, with three soil depths tested at each; 0.10cm, 10-20cm and 20-30cm.*

SCF plan to continue monitoring this trial site for many years to come to continue monitoring the long-term affects of each different lime source in comparison to each other as well the untreated control plots.

RESULTS

Grain yield data was collected in 2017-18 and no significant differences were recorded between any treatments, including the control treatment (See Figure 2). The lack of yield differences could be due to many factors. Firstly, the baseline soil pH levels in 2015 were 4.99 and 4.84 in the 0-10cm and 10-20cm layers respectively. These soil pH levels are close the recommended guidelines of 5.2 in the topsoil and 4.8 in the subsoil which means nutrient availability was likely not restricted.

Secondly, 2017 and 2018 were high rainfall years, particularly in the second half of the growing season (Figure 3), which translated to excellent grain yields in the respective canola and barley crops. High yields indicate the crops were not lacking access to soil moisture or nutrition late in the season or during the critical grain-filling period.

West Kendenup annual rainfall in the last two years:

- 2017 - 514mm
- 2018 - 481.8mm

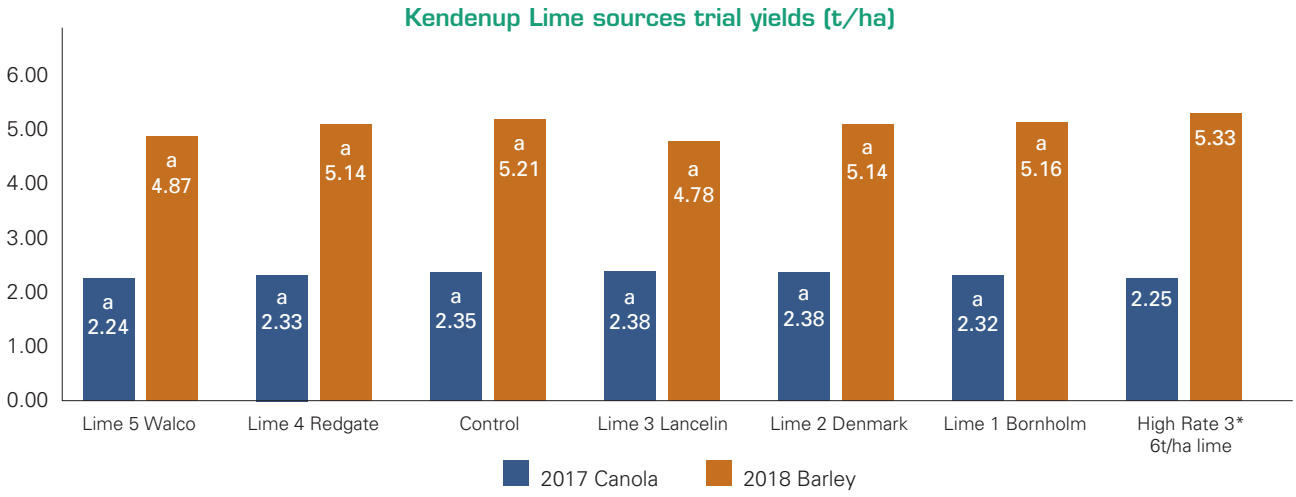

Figure 2: *Grain yields (t/ha) from the Kendenup Lime sources trial in 2017 (canola) and 2018 (barley). The trial was hosted by the Mackie family. Means followed by same letter or symbol do not significantly differ (P=.05, LSD).*

NB: *There is only one replicate of the high rate (6t/ha lime treatment) which means we are unable to complete statistical analysis on this treatment.*

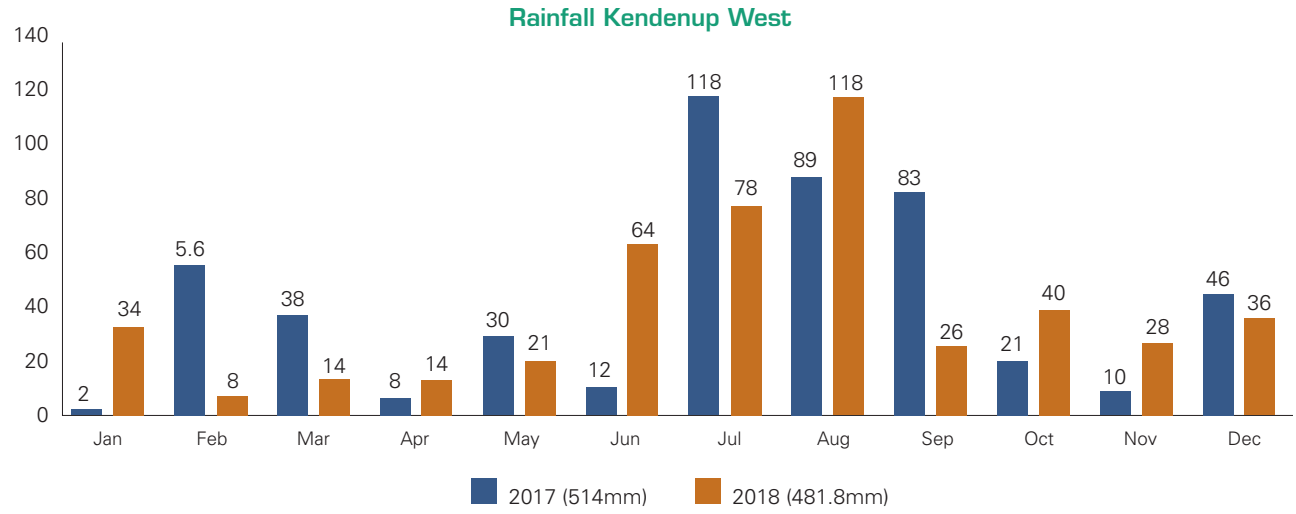

Figure 3: *Summarises the month by month rainfall (mm) for 2017 and 2018 at the Kendenup lime sources trial. Rainfall figures were recorded from the DPIRD Kendenup West weather station.*

Soil pH changes from 2015 to 2019

In April this year SCF employed *Map IQ* to re-sample the 40 sampling sites with the same methods as described above. This allows for direct comparisons of soil pH levels for each lime treatment over the four-year period.

Soil pH measurements are higher overall in 2019 compared to the 2015 data set. This is true of the nil lime (control) treatments and the limed plots. It was expected that the control treatments would be similar or lower in pH as they were not limed in 2015. Two different soil-sampling contractors were used in 2015 and 2019 who may have had subtle differences in their sampling techniques and/or the method for testing soil pH in $CaCl_2$. Therefore, the soil pH differences need to be assessed relative to the control treatments measured in the same year rather than comparing the two year's data.

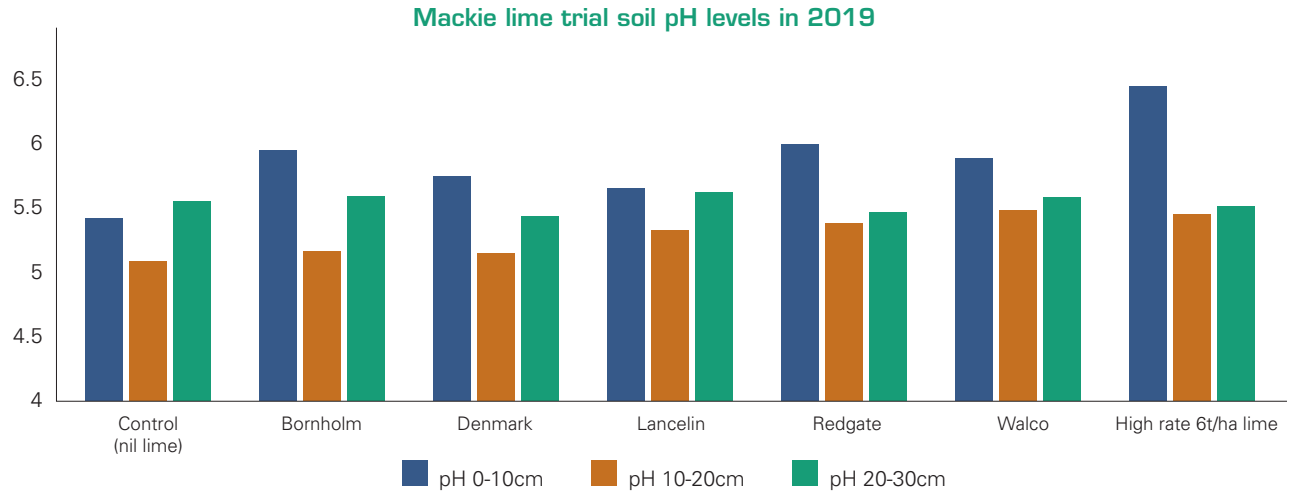

Figure 4: *Summarises the soil pH levels (in $CaCl_2$), measured in April 2019, for the Mackie lime sources trial in Kendenup.*
NB: *The soil pH starts at 4.0 on the y-axis.*

Table 1: Summarises the soil pH levels ($CaCl_2$) measured in April 2019 for the Mackie lime sources trial in Kendenup.

Treatment	pH 0-10cm	pH 10-20cm	pH 20-30cm
Control	***5.43***	***5.09***	***5.58***
Bornholm	5.94	5.18	5.60
Denmark	5.77	5.14	5.44
Lancelin	5.64	5.34	5.63
Redgate	5.99	5.40	5.46
Walco	5.89	5.49	5.60
High rate 6t/ha lime	6.44	5.47	5.53

SUMMARY

- There were no significant yield differences between any treatments in the 2017 canola and the 2018 barley crops.
- All lime treatments measured in 2019, had higher soil pH levels than the control in the 0-10cm and 10-20cm layer.
- Soil pH levels in the 20-30cm layer are very similar to the control and this is expected since lime is unlikely to have moved that deep in the soil profile after only four years.
- Each of the 2t/ha lime (equivalent NV) treatments improved soil pH levels in the topsoil by similar amounts.
- The stand-out liming treatment in the trial was the 6t/ha lime treatment which was tested in only one plot. This treatment has clearly improved soil pH levels at a faster rate than any of the 2t/ha lime treatments. This is reassuring for farmers that have been investing in lime in recent years.
- It is interesting to note that 6t/ha of lime has not led to a soil pH increase in the 10-20cm and certainly not the 20-30cm layer compared to the 2t/ha liming treatments.

FINAL COMMENT

The lack of grain yield differences in 2017 and 2018 is reflective of the adequate starting soil pH levels and the 'soft' seasonal finishes which tends to mask the effects of soil constraints. Despite no yield difference, 2t/ha of lime has lifted the soil pH levels and the un-replicated 6t/ha lime treatment lifted soil pH by even more (>1 pH unit).

After four years, the lack of soil pH changes deeper than 0-10cm shows how slowly lime moves in the profile. For those with subsoil pH levels greater than 4.8, it is easier to maintain pH through regular surface lime applications than to try and fix the problem once it is causing yield losses. Cultivation and incorporation of lime is an option on some soils to ameliorate subsoil acidity, but not all soil types are suitable to deep tillage and the forest gravel in this trial is probably one of them.

The interaction with seasonal conditions and the amount of time it takes for lime to work means that monitoring this trial over multiple seasons is very important. Comprehensive soil testing is not required every year, but it is worthwhile to measure yields annually to see which seasonal conditions give the greatest response to maintaining recommended soil pH levels.