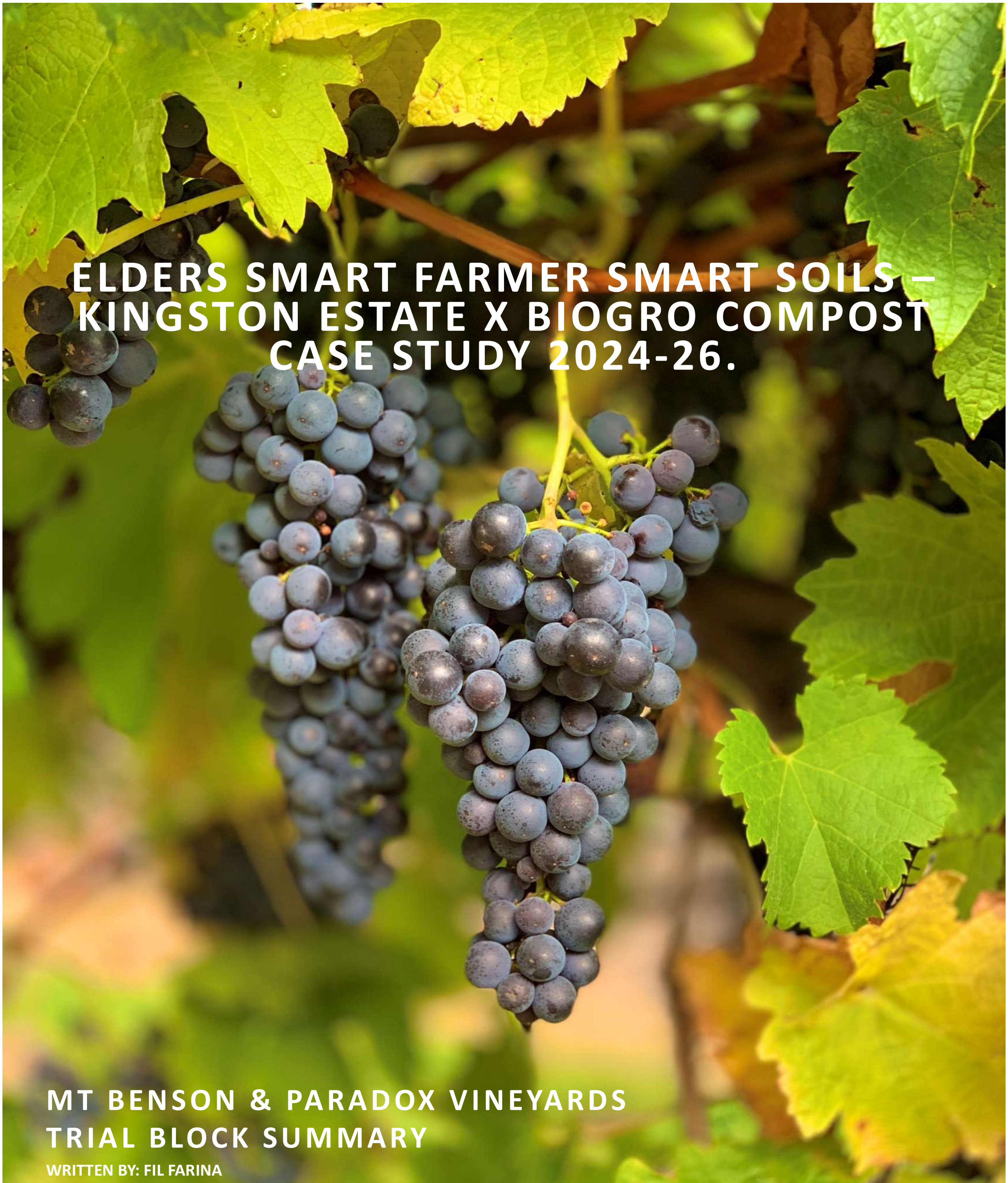

ELDERS SMART FARMER SMART SOILS – KINGSTON ESTATE X BIOGRO COMPOST CASE STUDY 2024-26.

MT BENSON & PARADOX VINEYARDS TRIAL BLOCK SUMMARY

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ELDERS SMART FARMER SMART SOILS

RSP REGISTERED SOIL PRACTITIONER

Organisation FERTCARE®

Compost Case Study – BioGro x Kingston Estate (Mt Benson & Paradox Vineyards)

To be run over a minimum two seasons 2024/25-2025/26.

Compost use is one of the most important factors, which contribute to increased productivity and sustainable agriculture. In addition, compost can solve the problem faced on farmers with decreasing fertility of their soil. Due to soil fertility problems, crops return often decrease and the crops are more susceptible to pest and disease because they are in bad condition. Water holding capacity and it use is also of importance.

The experiment was conducted in two commercial vineyards in south-eastern south Australia, the Limestone Coast GI and over consecutive years and vintages (2024 - 2026). The vineyard design carries approx. 19 00 vines per hectare of chardonnay, shiraz and cabernet sauvignon, plus other varieties, mechanically hedge pruned, with no hand pruning and running both a bi-lateral cordon and single cordon across sites. The vineyard is managed for integrated pest management (IPM), with the application of herbicides under-vine to avoid weed presence and is irrigated via drip water irrigation.

Soil management treatments (compost) were applied in August 2024.

The compost was applied to a strip under vine that was up to 35 cm wide and in parts up to 5cm in depth. Due to the nature of both sites (shallow limestone/calcrete, to soil surface) some areas of soil under vine received no compost directly to the soil surface.

Conventional soil management practices were completed under vine; Paradox had herbicide use of Sprayseed (135 g/L Paraquat & 115 g/L Diquat) along with Spotlight (60 g/L carfentrazone-ethyl) used in both treatment and control blocks. Mt Benson had one season application of Basta (200g/L glufosinate-ammonium) at 4L/HA. Herbicide application water rates being as such at 400L / HA. A high rate such as this due to the large vegetative weed growth seen in such managed vineyards.

Dry fertiliser applied and broadcast was a blend of Mono-Ammonium Phosphate (MAP) 60kg/HA and Sulphate of Potash (SOP) 75kg/HA , again this was applied across both treatment and control.

Before the establishment of the soil treatments in September 2024, soil texture and nutritional composition were analysed in single soil samples (0-30 cm) distributed throughout the control and treatment blocks.

Each soil sample was a single drill sample, the location of which recorded via GPS data for future history use and data that this will provide.

Combined soil samples, mixed and sent to a laboratory for analysis, show analysis that can be best described as ‘average’, i.e. mixing areas of low nutrient availability, with those of high nutrient availability, clouding data and ensuring soil remediation or improvements is sub-optimal.

The experimental design followed a complete block (size being between 2ha – 10ha) being used as either treatment or control. The treatment had applied 20T of Bio-Gro compost to the HA.

The study region is characterised by a maritime climate with warm and dry summers.

In addition, soil temperature (°C) and volumetric soil water content (%) were recorded in each plot (n = 3) every 30 min at five soil depths (20, 40, 60, 80cm and 100cm) with Sentek equipment.

Soil Nutritional Components – Control versus Treatment

Soil samples and analysis were carried out in August 2024 and then again in April 2025. It must be noted that weather conditions and climate over this period, were conclusive with the driest recorded rainfall on record, therefore leading to irrigation being in use for an extended period. Nutrient uptake during this period would have also been suboptimal, again, due to such conditions.

Data shown below will be separated into Control (shown first) and Treatment (shown second).

Across most blocks, slightly alkaline, sandy loam soils with low organic matter was found.

Cation Exchange Capacity (CEC) ranged from 12.4 c.mol/kg to 19.3 c.mol/kg. Cation exchange capacity (CEC) is the total capacity of a soil to hold exchangeable cations. It influences soil structure stability, nutrient availability, soil pH and the soils' reaction to fertiliser and ameliorants. Soils with a high CEC have a much lower percentage of cations in soil water, so are less susceptible to losses of nutrients via leaching. The lower the CEC of a soil, the faster the soil pH will decrease with time.

The Organic Carbon % is low (1.59% - 1.79%) and should look to be maintained and improved where required, as it is a key component to aid nutrient & water retention and availability. Organic carbon is also key to developing and sustaining microbial populations and to aid in improving the soil structure and aggregate stability especially in irrigated systems, along with also aiding CEC. Please be aware that the above OC % is Organic Matter converted to Organic Carbon, so therefore not a true OC analysis.

The pH levels within the range of blocks tested are generally slightly alkaline (7.89 – 7.59). This will mean the availability of certain nutrients will be affected by nutrient lock up.

Nitrate levels are very low given the type of soil. Due to the inherent nature of nitrate, being an anion, it could be expected to see high levels as the soil is mostly negatively charged, resulting in leaching during rainfall and irrigation. Soil ammonium nitrogen levels are low, giving the nature of the soil (1mg/kg-1.5mg/kg).

The Phosphate levels are moderate (66mg/kg - 150mg/kg) in these soils; pH and the influence of positively charged nutrients will influence its availability. The PBI (Phosphorus Buffer Index) is at moderate levels. PBI measures the ability of a soil type to remove P when applied as a solution, soils with a high PBI quickly and tightly bind P. Root growth, inflorescence development, berry set and carbohydrate storage amongst other things can be affected by P levels, so a strategy needs be implemented for further improvement across all blocks as soon as practicable.

On the cation exchange sites that are available in these soils there are high levels of Calcium, with low levels of Magnesium (Mg) and Potassium (K). Confirming this as a calcareous soil.

Low levels of K (120mg/kg – 120mg/kg) may influence the acidity and fruit pH. It should be noted the soil K levels can vary wildly through the growing season, and plant tissue testing should be used to correlate any possible issues. High soil levels of K can be mined via plant uptake, as only a very small percentage is available at any one time to the vine.

Soil Nutritional Components – Control versus Treatment *(cont).*

Sodium (Na) levels are high to extremely high (144mg/kg to 28mg/kg) in these soil's and should look to be improved rapidly.

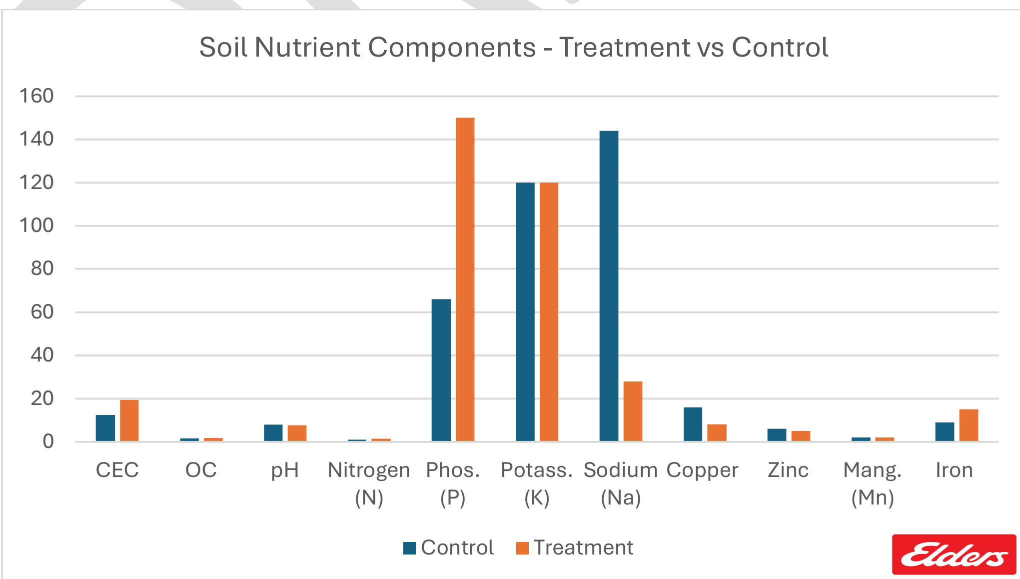
Sodium is weakly bound to soil particles so the exchangeable sodium level can be deceptive in its impact on plant interaction due to the nature of how sodium acts upon irrigation/rainfall and may also impact soil microbial populations. A dry autumn and winter period with below average rainfall leading into these samples being taken, may have increased these levels, with a follow up testing recommended leading into spring and irrigation season, if rainfall is suffice.

The Electrical Conductivity (EC) level of soils across the testing range are desirable so no direct osmotic influence is being caused by salts in this soil affecting plant growth. However, it is recommended that attention be paid to these levels to minimise any possible future issues.

Boron levels are low; Boron is negatively charged and is subject to leaching through the soil, care must be taken with the form of any Boron applied to the soil. A targeted foliar strategy is recommended for the maintenance of Boron to maintain fruit set and cane maturity.

Copper (16mg/kg to 8mg/kg) & Zinc (6mg/kg to 5mg/kg) levels are high to excessive across all blocks. Excess Copper & Zinc will have an antagonistic effect on Manganese and Iron. Manganese levels are low (2mg/kg-2mg/kg) with very Iron levels (9mg/kg-15mg/kg) also present. It is recommended that a targeted strategy is used to improve Iron along with manganese; a major contributor to various biological systems including photosynthesis, respiration, and nitrogen assimilation. Although compost may add high levels of Iron, its uptake is poorly available due to soil pH and excess copper & zinc in this instance.

The exchangeable cation % shows some fascinating numbers. This reflects the influence the cations have on the soils structure and what is contributing to it not necessarily how plant available the individual cations are. This soil is dominated by Calcium on exchange sites in relation to Potassium and Magnesium.



Soil chart showing improvements across multiple facets. pH and Na being most important in this instance.

Plant Nutritional Components – Control versus Treatment

Plant petiole analysis was carried out in January 2025, just prior to the onset of veraison. Veraison being a key time for nutrient analysis in grape varieties, as nutrient levels are most stable within the vine, therefore showing the most accurate nutrient reading. Testing at other times can show large daily changes within these levels.

Again, and as previously mentioned, weather conditions were conclusive with the driest recorded rainfall on record. Nutrient uptake during this period would have also been suboptimal, again, due to such conditions.

Data shown below will be separated into Control (shown first) and Treatment (shown second).

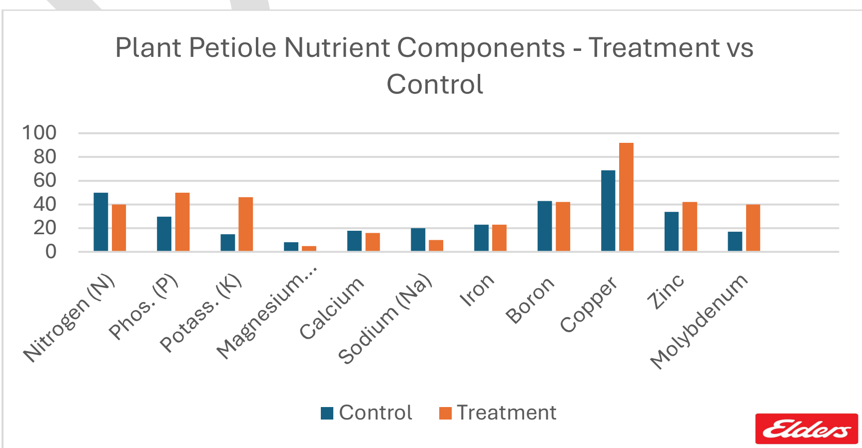
Nitrogen (total) was shown to be low (0.53%-0.44%), which given the time of year is to be expected to be somewhat higher, around 1.0% considered acceptable. Low total nitrogen can lead to issues within the fermentation process, leading to impacts on yeast growth, fermentation vigour, and the formation of various flavour and aroma compounds (more so in white varieties), making nitrogen management in both the vineyard and winery essential for optimal wine production.

Phosphate levels have increased (0.26%-0.53%),) as this would have been driven by fertiliser application along with compost use and the more readily available nature of organic P, versus that of inorganic P. This is a key driver in fruit set, yield and quality.

Levels of potassium have increased substantially (K) (0.26%-4.49%) and this will influence the acidity and fruit pH, as grape berries are large sinks for K. Veraison again being a critical timing for testing of plant K, as berries store it from then onwards.

Sodium (Na) levels have improved considerably (0.22%-0.09%); a key driver of fruit quality. High sodium in fruit and the resultant wine, can impact sweetness, acidity and other flavours. Compost use has long been shown to improve levels of sodium within soil and plant mass, with a great example shown here.

Iron (Fe) levels have remained constant (23mg/kg-23mg/kg) which although low within plant (50mg target) are quite common in all varieties across the Limestone Coast. Given the Fe levels within the supplied compost, you'd expect this to be somewhat higher. Several factors would influence this, the 'flushing phase' of Fe from the compost, was at such a time for limited/no root uptake. Once this phase is over, Fe uptake from soil into the vine is extremely slow. It would be expected to see higher levels in the second season of compost application.



Plant petiole chart showing improvements. Here K important due to ripening of crop loads. Again, Na showing great improvement leading to grape quality increases predominately in red varieties.

Summary

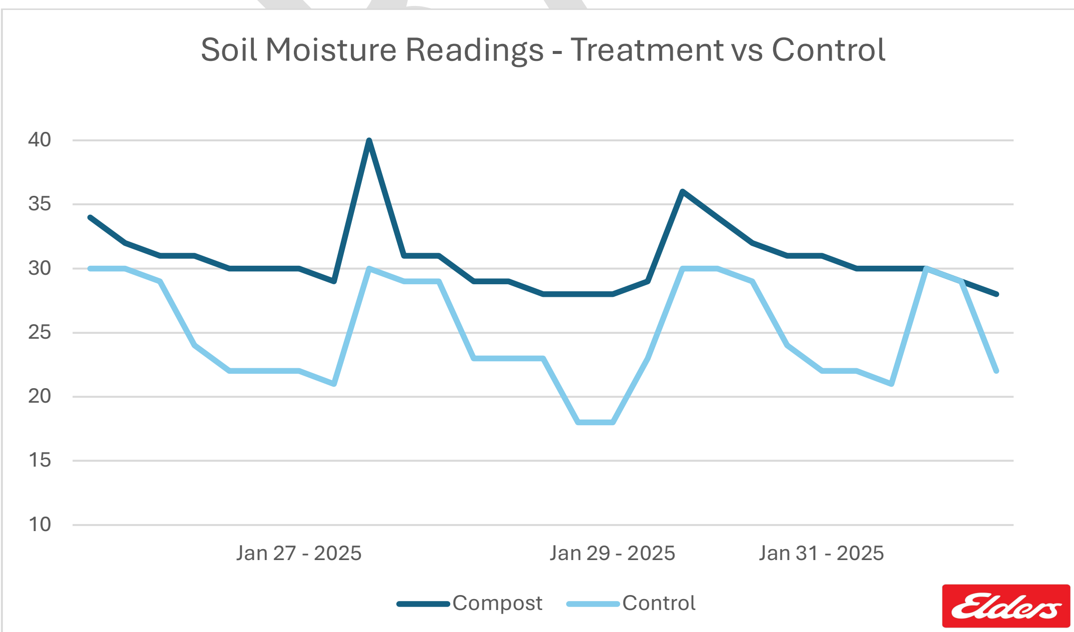
Year one of the ongoing compost trial has found that compost additions have increased soil nutrient levels, their availability (predominately P & K) and overall soil fertility. Organic matter and soil organic carbon, along with water retention has also been improved, albeit marginally, data suggests <5% which from calculations is in the order of an extra 10,000L of water being held within the soil per hectare.

A reduction in sodium levels via compost use lowers the risk to soil and plant health due to sodium being quite mobile and its impact on soil microbes, more so after such dry conditions.

From a yield, fruit quality and return on investment (ROI) point of view, yields have increased marginally in the treatment compared to the control, although more year-on-year data is required for this to be conclusive.

Irrigation water use, small savings have been made, and it can be seen via soil moisture probes, that soil moisture is being maintained at a higher sustained level for a longer period post irrigation. Both treatment and control blocks being watered for 3 hrs every 3 days. Infiltration rate increases are also being seen, thereby increasing efficacy from each irrigation and in times of high or extreme hourly rainfall, runoff will be reduced.

Early results from year one of the compost trial are quite promising, with improvements in soil fertility, nutrient availability, water retention and perhaps marginal yield gains and improved fruit quality. Continued monitoring and measurement are essential to confirm the long-term benefits of compost use and overall return on investment.



Soil moisture levels show compost block with higher infiltration rates and holding a higher amount of moisture. Mt Benson data. Blocks CAS 4 vs SHI 2.