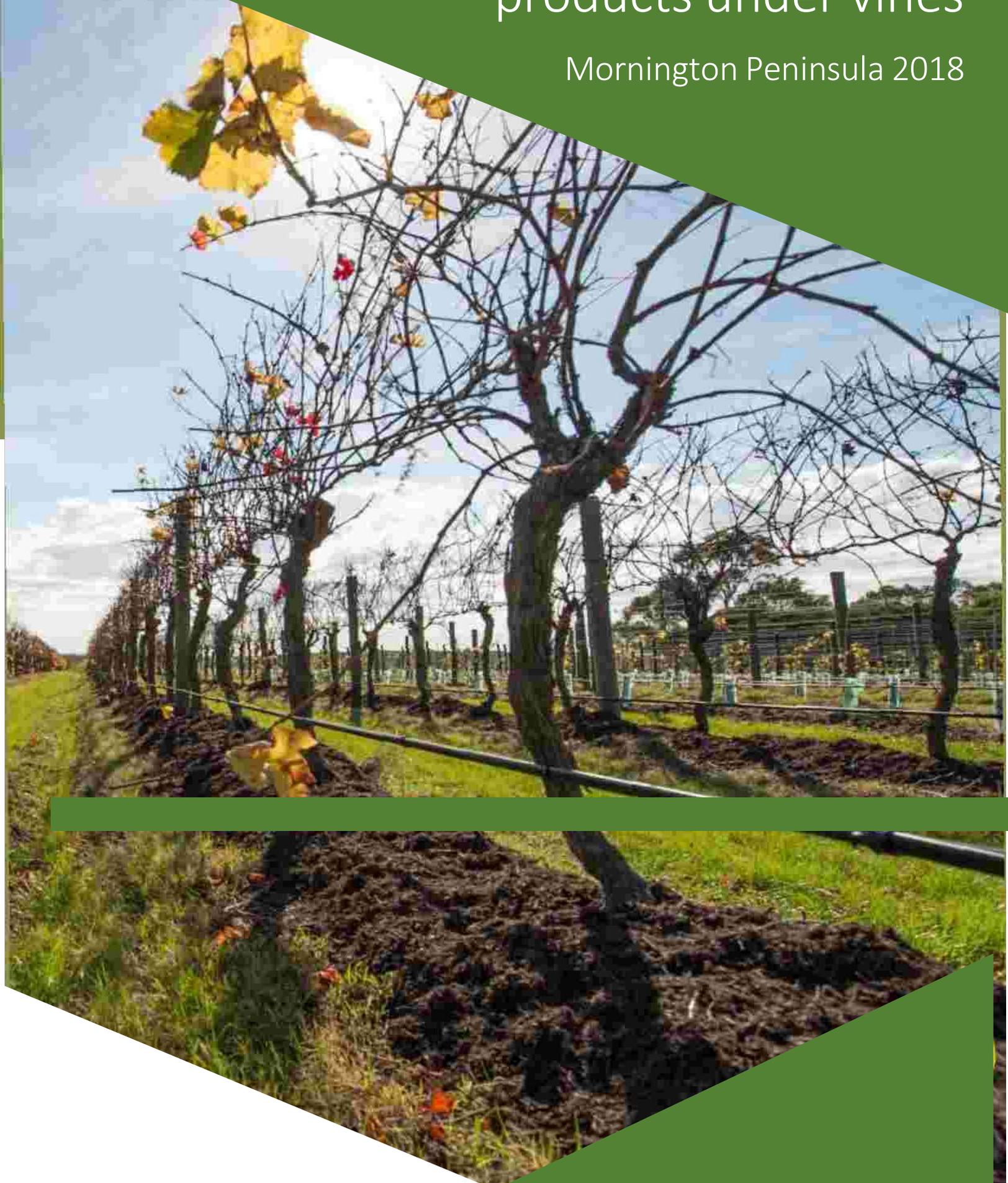


Effects of spreading composted products under vines

Mornington Peninsula 2018



Effects of spreading composted products under vines

Background

There is a large amount of research showing the benefits of compost. This four-year trial (2014 – 2018) investigated the effects of applying a compost mulch layer under grapevines to determine how the system responded on 4 vineyards on the Mornington Peninsula.



Figure 1: Inspecting the compost applied under the grape vines

Method

Compost mulch from Enviromix, Melbourne (produced by chipping urban garden waste, zeolite blending and composting according to AS 4454 standard) was spread under vines each spring at a rate of $25\text{m}^3/\text{acre}$ (or $61\text{m}^3/\text{ha}$) to result in a 7.5cm deep and 100cm wide strip. (This equates to 1m^3 of compost spread every 56m of row length). Two composts were trialled initially with different particle sizes (coarse av. 16mm and fine - av. 6mm). The coarse compost (or composted mulch) provided a longer lasting cover and was preferred by the vignerons. A trailable compost spreader was used to place the products in bands under the vines. A control row was also monitored that had no compost applied, and this received early season herbicide applications (as per standard vineyard management practice).



Figure 2: Compost applied under the grape vines at $61\text{m}^3/\text{ha}$

Monitoring

The following parameters were measured:

- Soil moisture (30cm depth) and soil temperature (15cm depth) at 10 minute intervals using electronic Carta-sense M-Sensors and cloud technology
- Soil chemistry, and bulk density by SESL methods
- Soil biology analysed by Microbiology Labs
- Irrigation savings
- Phenology (the timing of the biological events in plants such as flowering, veraison, and harvest)
- Canopy health and vine balance according to GrapeLinks (years 3 & 4)
- Bunch zone temperatures with Tinytag Gemini electronic monitors (years 3 & 4)
- Soil temperature at 15 cm depth using Tinytag Plus 2 dataloggers
- Wine grape quality; Berry weight, sugar ripeness

(Brix), pH, titratable acidity (TA), yeast assimilable nitrogen (YAN), potassium, phenolics, tannins and colour were assessed by Vintessential (Years 3 & 4)



Figure 3: The Carta sense soil moisture and temperature monitoring device



Figure 4: Coarse mulch under the grape vines

Soil temperature results

Soil temperature at 15 cm depth in vineyard HP (red=mulch, black=control)

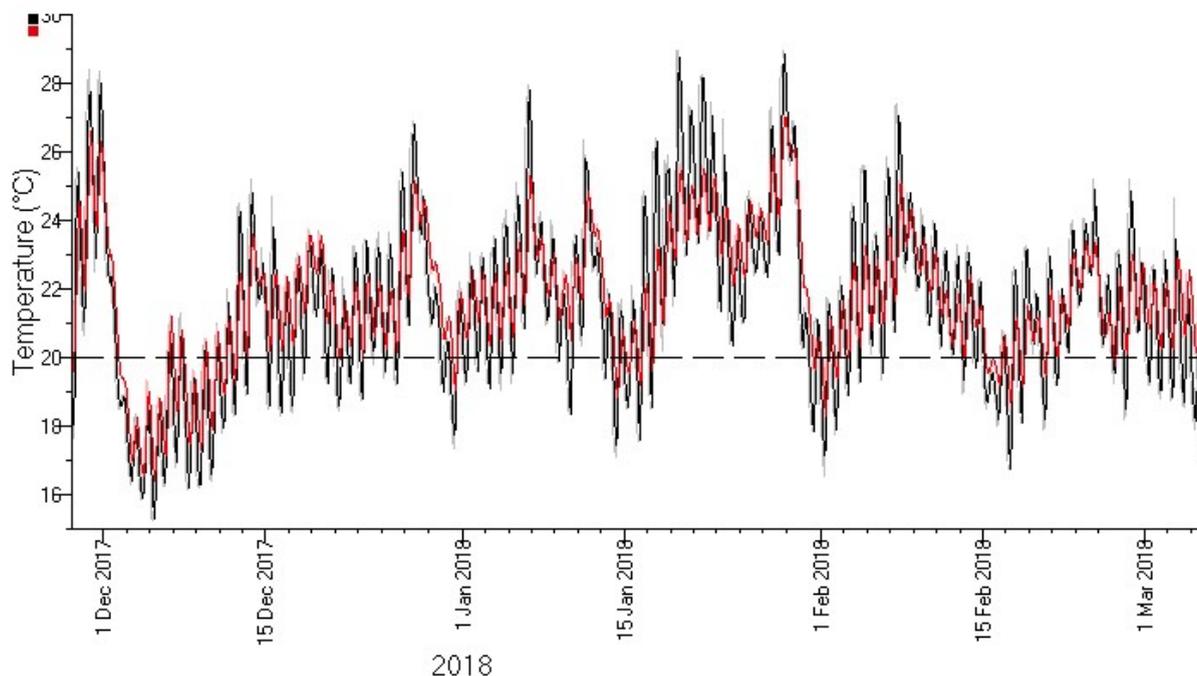


Figure 5: Hourly measurement of soil temperatures by Tinytag loggers in Pinot noir at Handpicked Wines

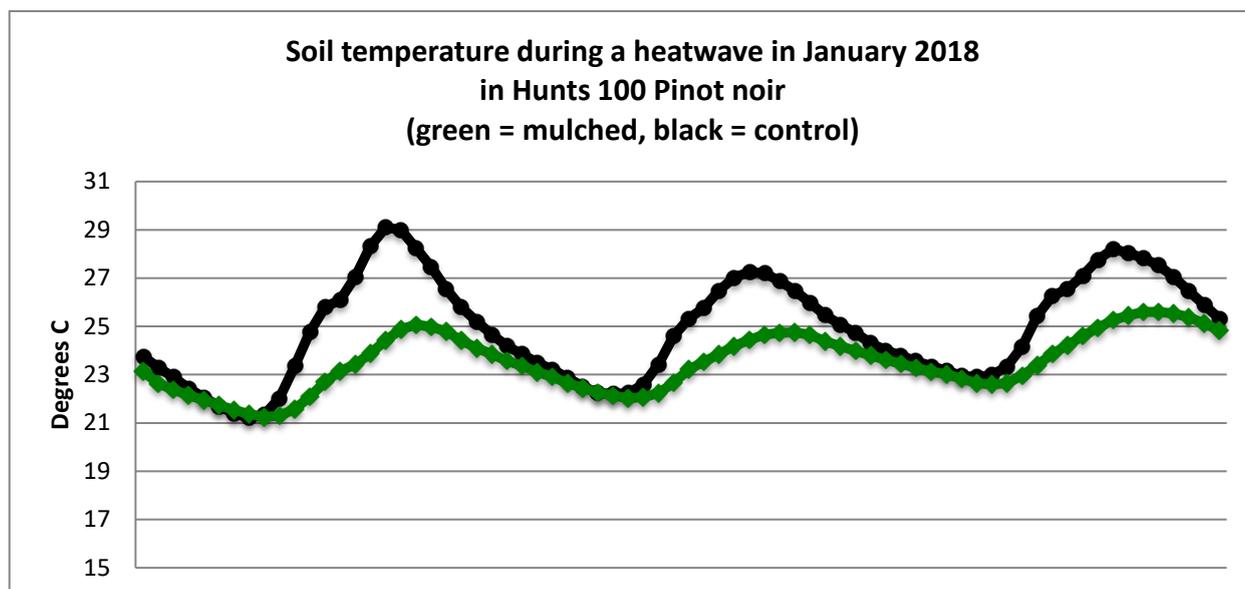


Figure 6: Soil temperatures at 15cm during a heatwave using Carta sense technology

In all years and using both technologies, when soils were covered by either the fine compost or the coarse mulch, temperatures at 15 cm depth were warmer at night and cooler during the day compared to the temperatures under bare ground of the controls. In particular during a heatwave in January 2018 large differences in temperature were recorded (Figure 6). More stable temperatures in the root zone reduce stress on vines, promote soil biological activity, and reduce water use.

Soil moisture results

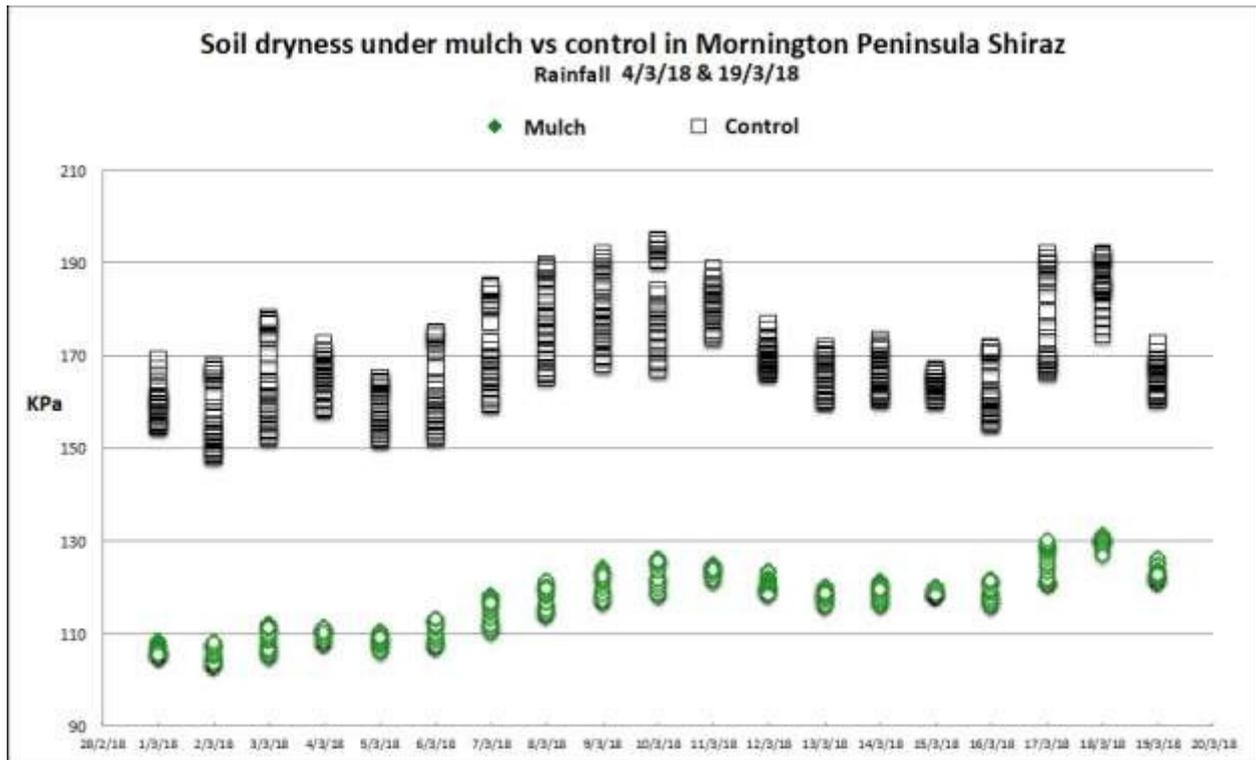


Figure 7: Soil moisture tension each day in March 2018 under coarse mulch vs control in Hunts 100 vineyard

Figure 7 displays the soil moisture tension levels at Hunts 100 vineyard in March with the control row (black) and the mulched row (green). The lower the kPa number on the left of the graph, the lower is the water stress. Results clearly demonstrate increased soil moisture levels under the compost and coarse mulch rows. This is due to reduced evaporation from the soil surface, greatly improved infiltration of irrigation and rainfall into the soil, and a corresponding reduction in runoff. The improved water holding capacity in the soil of all the compost rows in the vineyards being monitored resulted in a reduction in irrigation requirements. Detailed records of water use were maintained on 1 vineyard which showed improved irrigation and water use efficiency. Between November 2015 and March 2016 (a dry summer) the control block used 2MI/ha and the fine compost block used 1.6MI/ha. This amounted to savings of 20% or over 400,000l/ha under compost. Similar savings were achieved on another vineyard in the Yarra Valley. That vineyard has a capped water allocation and the savings in irrigation allowed the owners to extend their acreage under vine.



Figure 8: Joe from Hunts 100 vineyard inspecting vines pre harvest

There were some interesting differences between the control, coarse mulch and fine compost (Figures 9, 10 and 11, respectively) sensor readings in Hunts 100 Shiraz in 2015. The trial rows were irrigated on the same dates and with the same quantities. The monitoring showed that the compost rows improved water infiltration and water holding capacity and had better recovery after flooding rain.

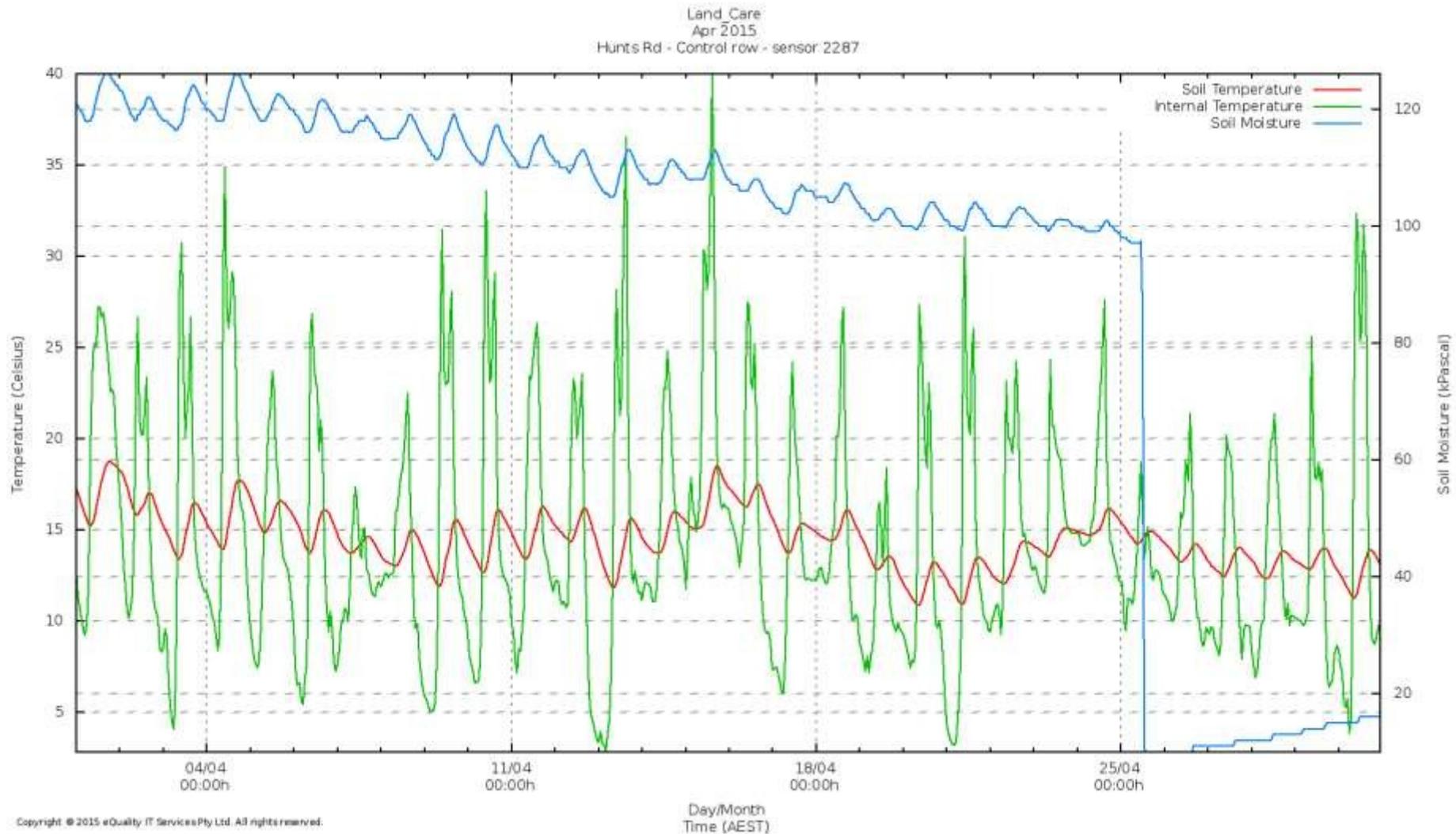


Figure 9: Control row showing water stress (blue line) and waterlogging after rain on 25/04/2015. The irrigation of 7/4/15 and 19/4/15 did not penetrate the soil to the 30cm depth in contrast to under the composted rows.

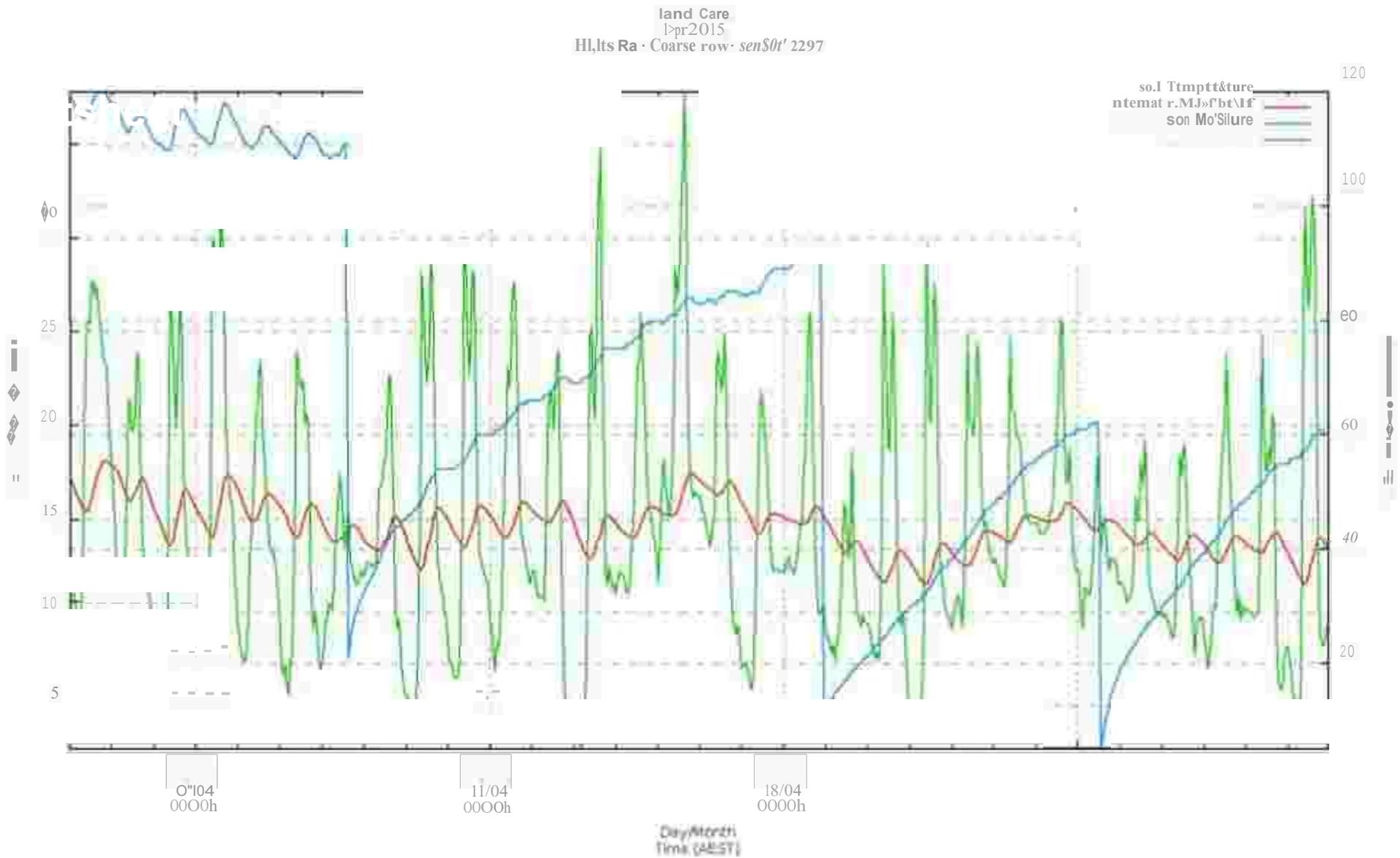
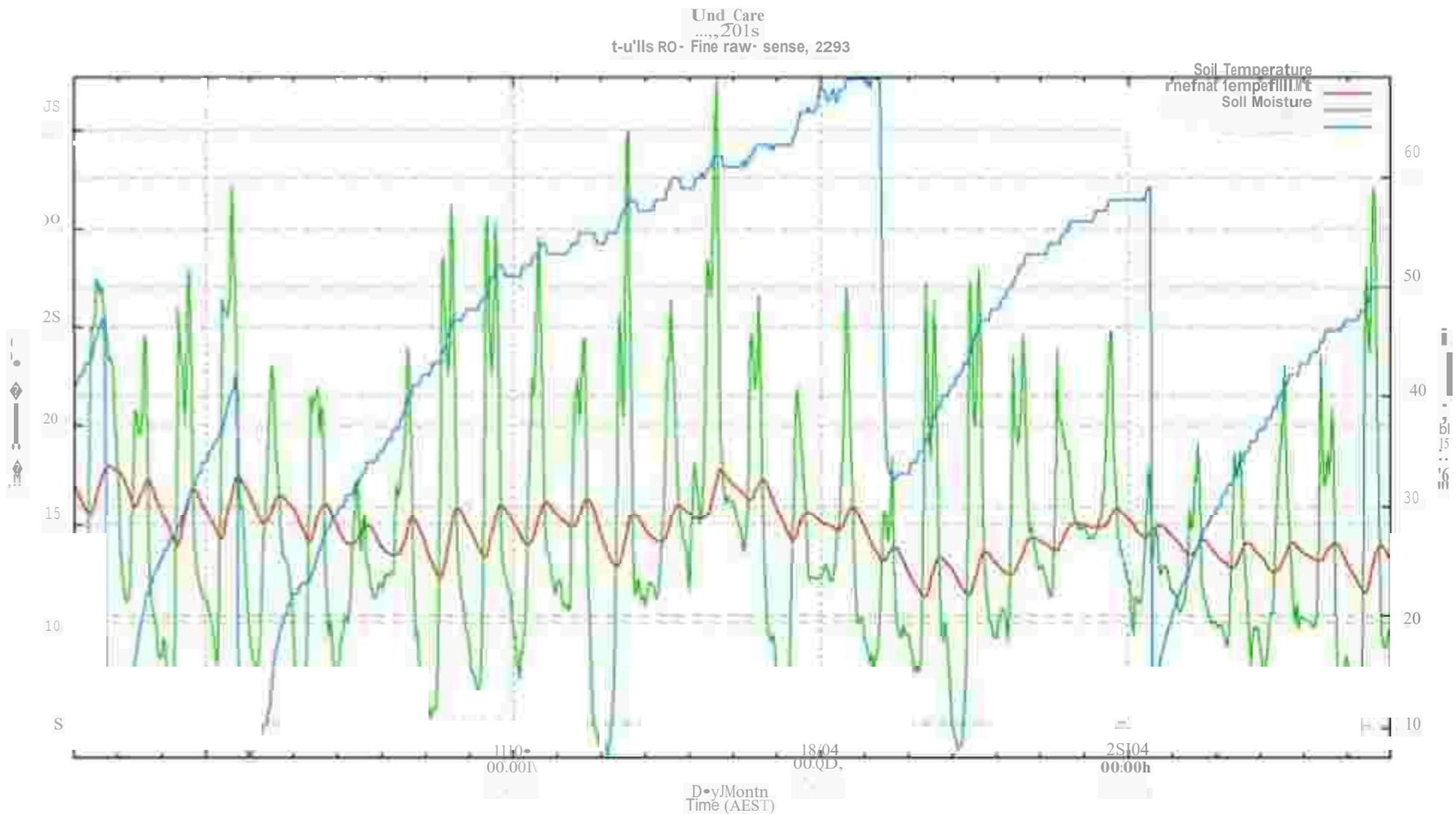


Figure 10: Coarse mulch row showing the release of water tension upon irrigation and a rapid improvement in drainage following the rain event on

25/04/2015 as compared to the control (Figure 9).



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Figure 11: Soil under the fine compost row showed a lower water deficit early April and throughout compared to the control (Figure 9). The finer compost may have improved soil structure allowing the irrigation water to remain in the soil at night (distinct daytime tension peaks mid-April).

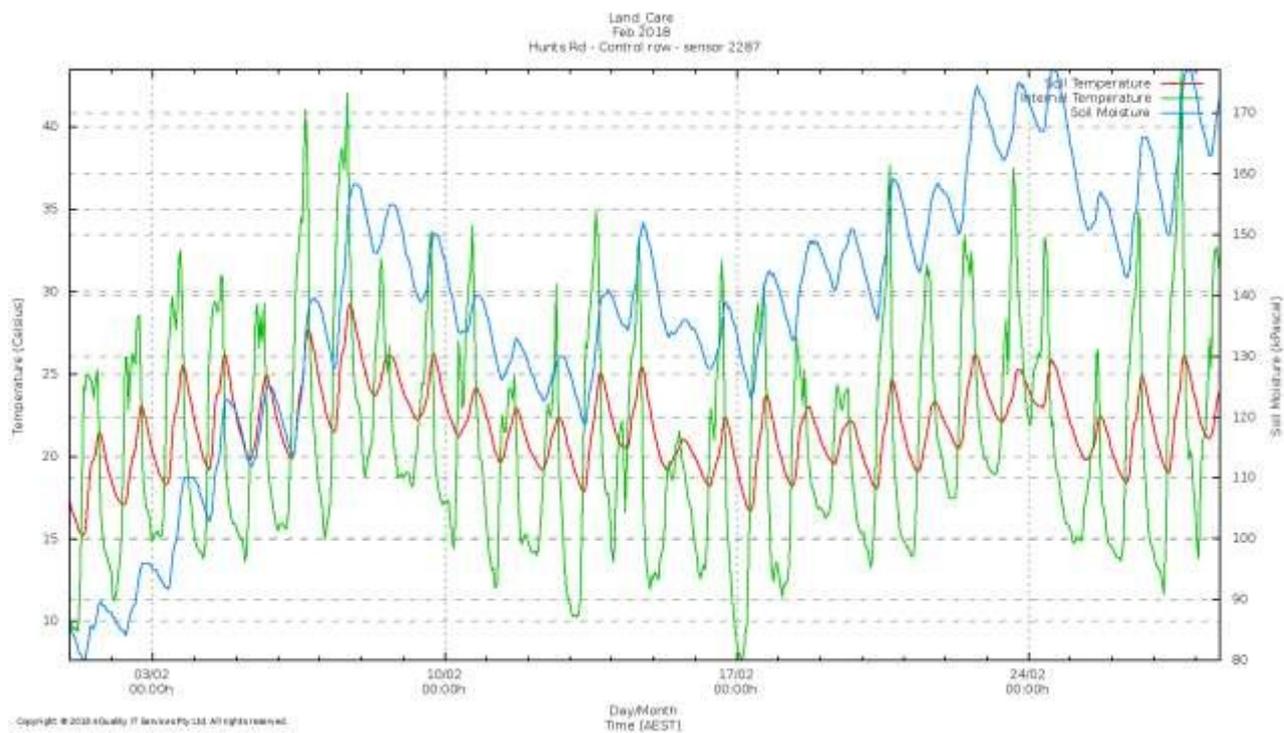


Figure 12: In February 2018 at Hunts 100 Vineyard the soil under the control rows of Shiraz did not take up much of the rain of 16/2 and 24/2 and dried out to 170 kPascal with strong diurnal transpiration cycles from a large canopy.

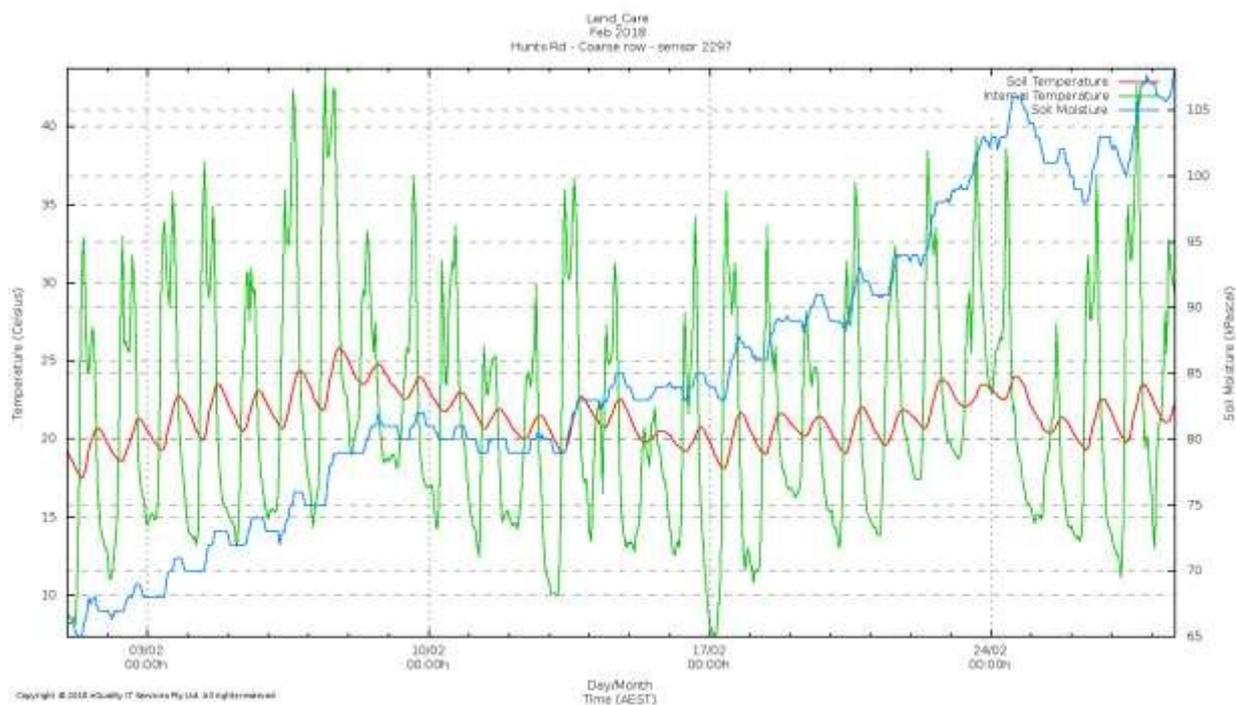


Figure 13: Under the coarse mulch soil water tension stayed lower and soil temperatures fluctuated less. Vines were much less stressed after veraison (8/2/18) with wetter soil only gradually drying out.

Weeds

Applications of compost can assist with weed suppression for at least 6 months, depending on application rate and seasonal conditions. At Hunts 100 vineyard the manager kept detailed records of herbicide application. This showed that in an average season, herbicide applications were reduced by 1-2 sprays. This equated to cost savings of about \$160/ha for each herbicide application.

Soil chemistry and biology

Changes in soil condition were measured using bulk density, soil chemistry and soil microbial biomass. Longer term studies are required however visual assessment showed that control soils tended to crack and have moss cover which did not occur under the mulch. In well-functioning soils, the top 50mm are the most fertile with the highest levels of biological activity and nutrient cycling. Applications of herbicides remove plant matter and expose the soil and rob the soil of organic inputs from plant tops and roots. The soil surface is then vulnerable to rain drop impacts. Once the soil is exposed the surfaces become solarised (i.e. sterilised by the sun) with a reduction in soil biology.

Covering the soil with the composted mulch allows the topsoil layer to become productive, greatly enhancing the efficacy and efficiency of irrigation and fertigation. The supply of compost mulch also enhanced soil structure and soil nutrient cycling, while reducing vine stress.

Soil microorganisms are the driving force for

nutrient cycling, soil structural integrity, and ultimately, vine health. Soil organisms such as mycorrhizal fungi form mutualistic associations whereby both parties benefit from the symbiosis – the vine provides soluble carbohydrate to the fungus, and the fungus delivers essential nutrients to the vine. In this trial, mycorrhizal fungi responded very strongly to the presence of coarse mulch displaying 17mg of fungi per kg of soil compared to only 7.8mg per kg in the soil of the control treatment. The coarse compost treatment performed best in terms of total microbial biomass, total bacteria, and total fungi.



Figure 14: Soils from the control sites displayed cracking, moss and poor soil structure and aggregation



Figure 15: Mycorrhizal fungi colonising root hairs

Bunch zone temperatures

Grapes produce best quality traits when daytime bunch zone temperatures are as many hours between 15 °C and 35 °C as possible. In cold nights grapes will take longer to get to 15 °C over cold or moisture evaporating surfaces like grass or weeds. Mulch layers can alter bunch zone temperatures through their colour and thermal qualities. Minimum nightly bunch zone temperatures were higher over mulch compared to control, most obviously in cooler nights, less so in nights with minima above 19 °C. This is beneficial for cool climate vines.

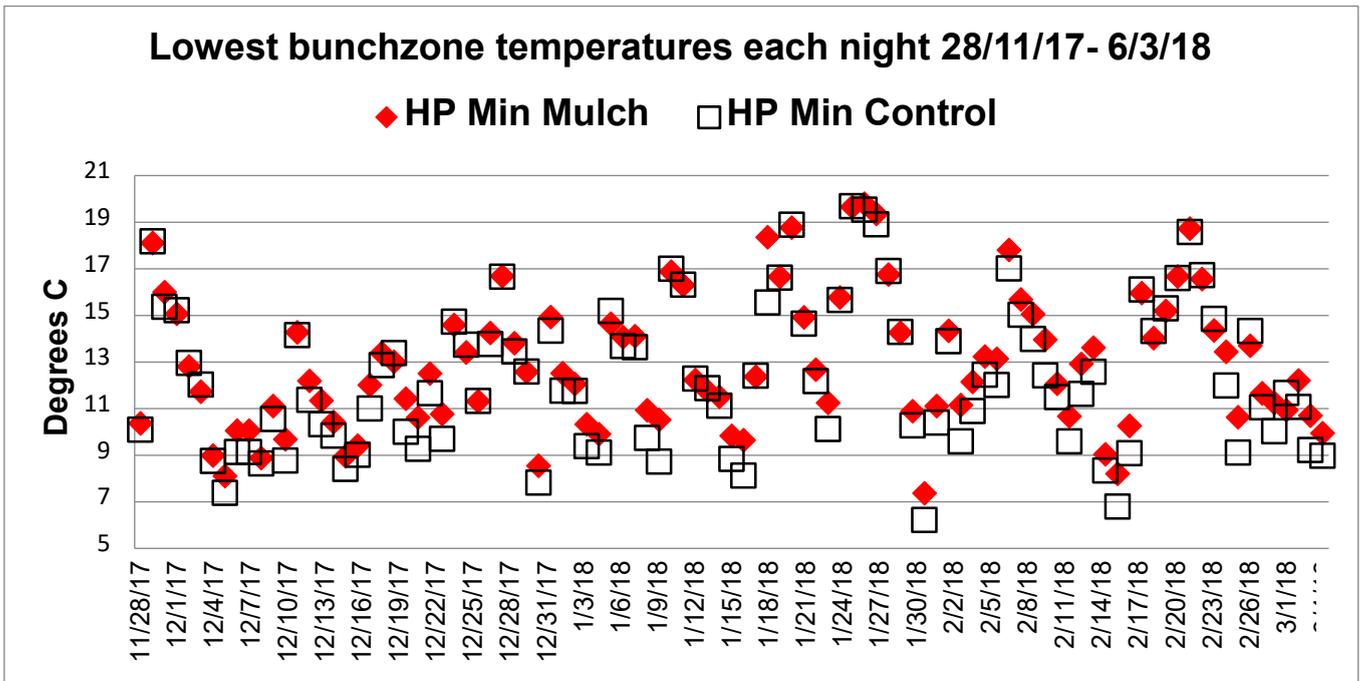


Figure 16: Night time bunch zone minima in Pinot noir, Handpicked vineyard (control = black, mulch = red)

At the end of the season, nights were warmer over coarse mulch and days not considerably hotter.

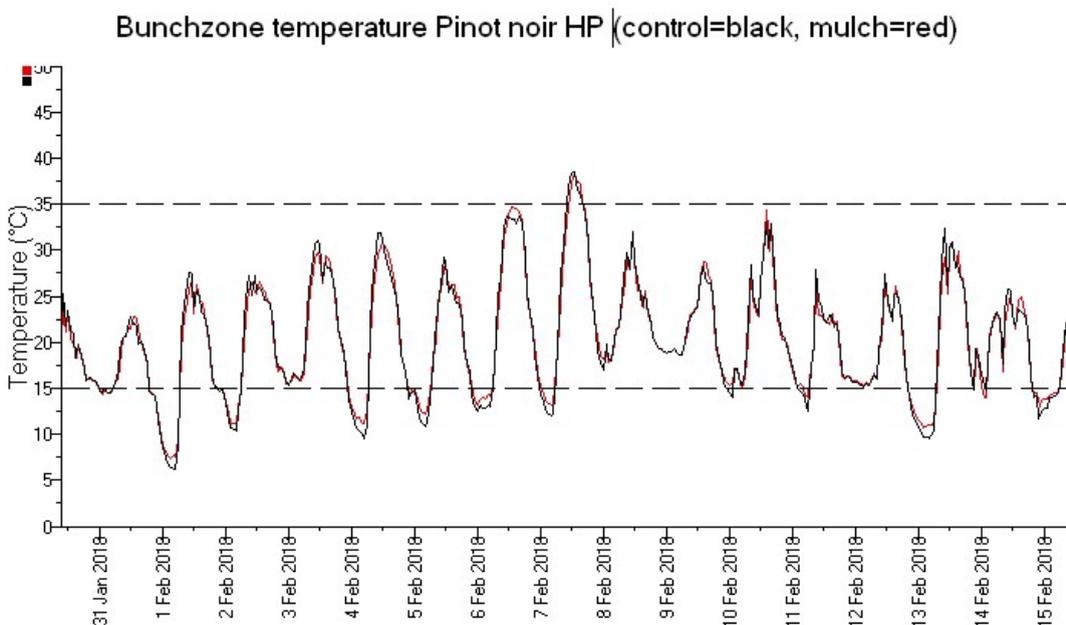


Figure 17: End of season hourly measurements of bunch zone temperatures in Handpicked vineyard

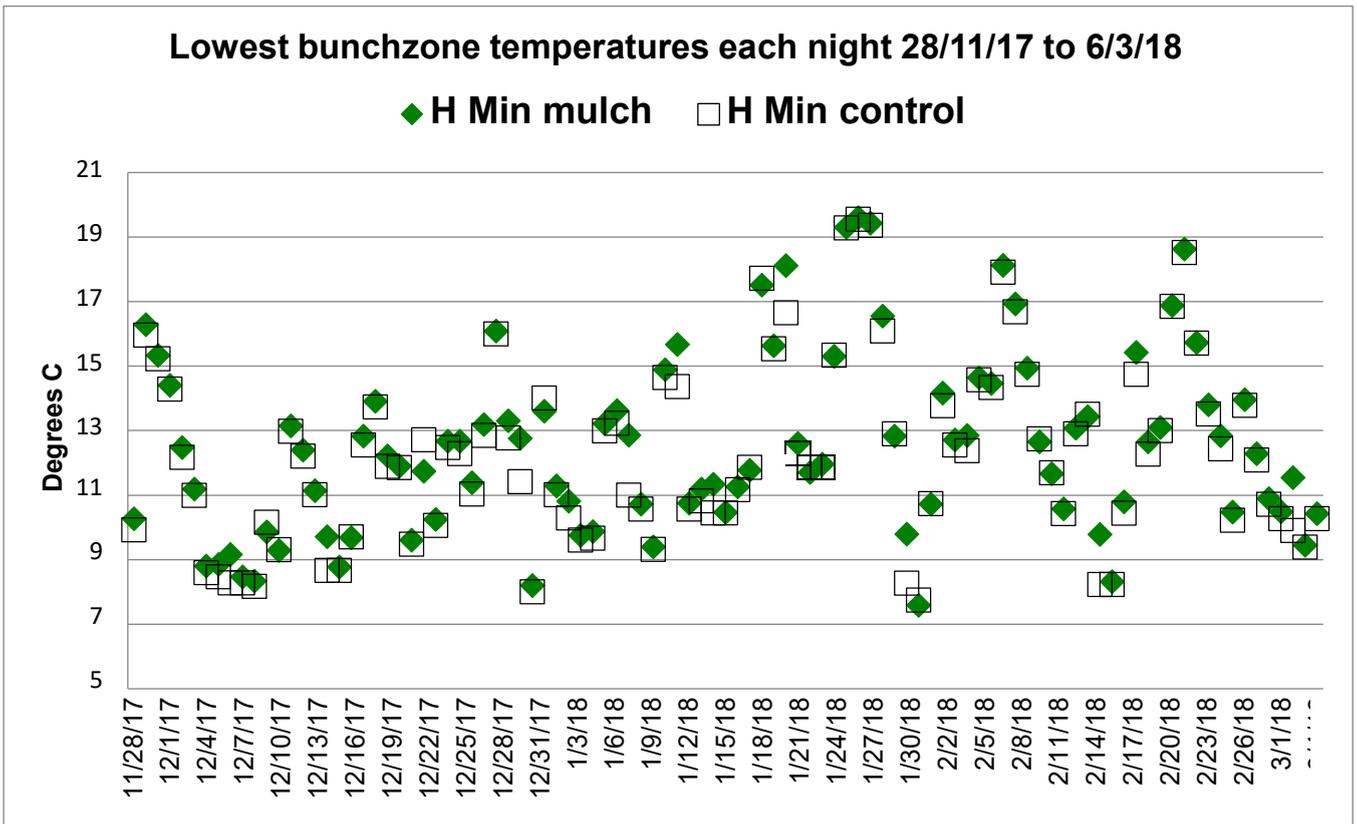


Figure 18: Night time warmth over mulch is reconfirmed in the Hunts 100 vineyard

Daytime temperatures depend on exposure of logger by wind or leaf loss. The end of season graph from the Hunts 100 vineyard shows eastern (early morning) exposure in the mulch row and western exposure of the logger in the control.

Bunchzone temp. Pinot vineyard H (black=control, green=mulch)

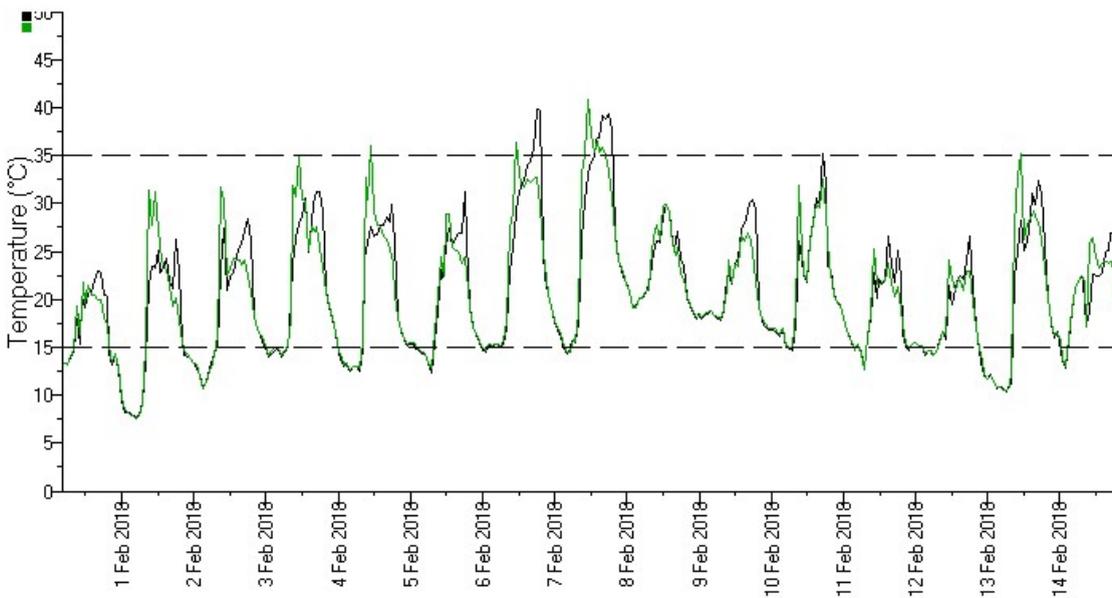


Figure 19: Diurnal bunchzone temperature curves in February 2018 in Hunts 100 vineyard

Vine balance

In viticulture, veraison is the onset of ripening. The official definition of veraison is "change of colour of the grape berries", and represents the transition from berry growth to berry ripening. Many changes in berry development occur at veraison.

At veraison in 2017 and 2018, in 3 vineyards the leaf areas per shoot of mid-sized productive leaves were higher on vines that had received the coarse mulch treatment compared to those from control rows. These leaves will grow and supply nutrients to the grapes later in the season. Leaf areas of larger leaves may show less of a treatment effect due to summer abscission and younger leaves due to canopy trimming. The effect was particularly strong in 2018 with more rainfall in December and January than in 2017.

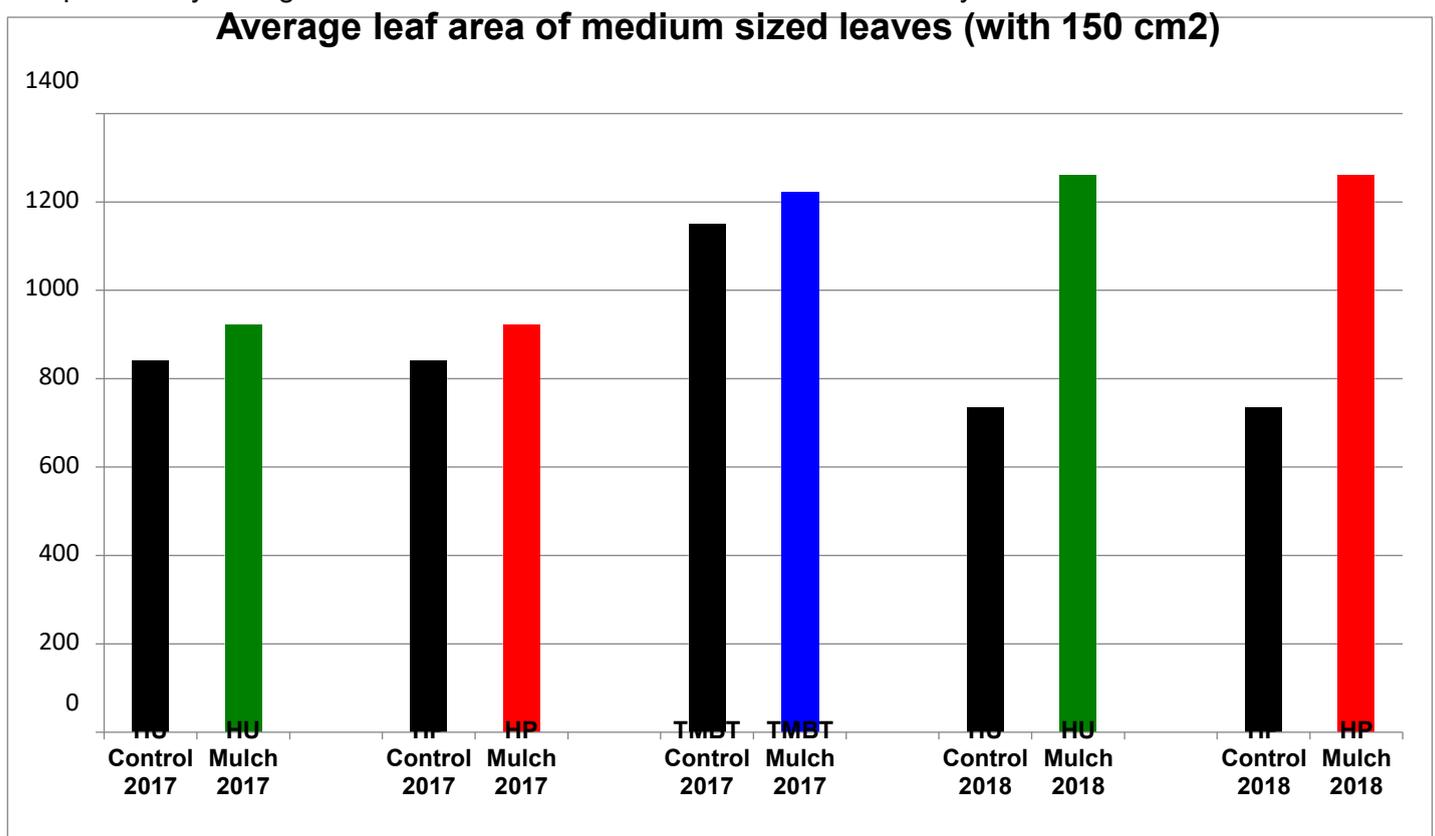


Figure 20: Leaf area per shoot of mid-sized leaves on 20 shoots (randomly chosen)



Figure 21: Measuring leaf area distribution on 20 randomly selected shoots at veraison

Grape quality

Grapes in all vineyards were harvested according to winemaker's recommendations at 22 to 24 Brix. Anthocyanins were higher in grapes from mulched rows except in 2018 in the Hunts 100 vineyard and in 2017 from the Lynstead vineyard, where grapes from control rows were sugar riper and had lower acid than those from the mulched site. However tannins were lower in the grapes from mulched rows except in Lynstead in 2017. This could be explained by either cooler grape conditions or lower water availability to control roots pre-veraison, which has been shown to increase tannin formation.

In 5 out of 7 sites titratable acidity (TA) was lower at harvest in grapes from mulched vines compared to controls. This may be due to warmer night time conditions. The decline of TA or in particular malic acid happens in conjunction with flavour ripening.

Earlier ripening berries were observed in the rows with mulch applied in 3 out of 4 vineyards monitored (photos below courtesy of J. Vaughan). In general mulched grapes veraised 5-7 days faster than control grapes.



Figure 22: Berry ripening comparison on the same day (left = control, right = compost mulch)

Autumn rains pose an issue through increased disease pressure so early ripening is desirable in the cooler climate of the Mornington Peninsula.

The mulch used herein did not (like grape mark containing mulches) - enhance Potassium (K). Noteworthy is the high K concentration in one vineyard together with a very low YAN in both treatments with very leafy canopies. Lack of nitrogen can lead to photosynthetic malfunction; then leaves send K into the berries instead of sugar. Compost mulch does not fertilise soils thus petiole nitrogen testing and grape YAN control are important also in vineyards receiving recycled garden waste mulch.

Summary of outcomes

The following observations were noted in the compost mulch treatments:

- Lower daytime and warmer night time soil temperatures in the main root zone
- Less soil water tension and water stress during summer with similar leaf canopy
- Better rain or irrigation infiltration and water preservation
- Lower irrigation requirements
- Less moss and soil cracking
- Less herbicides needed
- More fibrous roots in the top 300mm of the soil profile
- More beneficial fungi and bacterial life
- Increased leaf area of the medium sized leaves, which are the most productive
- Bunch zones were considerably warmer in cold nights
- Daytime bunch zone temperatures depended on leaf exposures
- Grapes from mulched rows veraised and flavour ripened 5-7 days faster
- Beneficial effect on colour in 5 out of 7 sites
- Lower grape tannins in 6 out of 7 sites due to wetter soils
- Following harvest, the vine leaves held on longer
- No negative effect on grape nutrition

Adoption

Since the trials began, over 34 vineyards have reported trialling or adoption of compost mulch under vine, resulting in over 160 hectares under this improved practice.

Video

A video from the trial site has been created to provide more information. The video complements the information in this case study and associated documents. Visit www.wpcln.org.au to view the video.

Acknowledgements

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