

Uncorking spatial variability in Canadian vineyards: An innovative way of detecting differences in growing conditions

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Background

- Vineyard 'terroir' is the interactions of a cultivated systems within a given place, which includes its climate, soil, topography & management traditions
- Terroir determines the suitability for growing different grape varieties, and influences distinct wine sensory attributes for a vine, defining its success
- Vineyard spatial variability caused by terroir controls can lead to difficulty managing crops successfully
- New TreeTalker-Wine (TT-W) sensors aim to reduce uncertainty in spatial differences, leading to better management, yield and quality

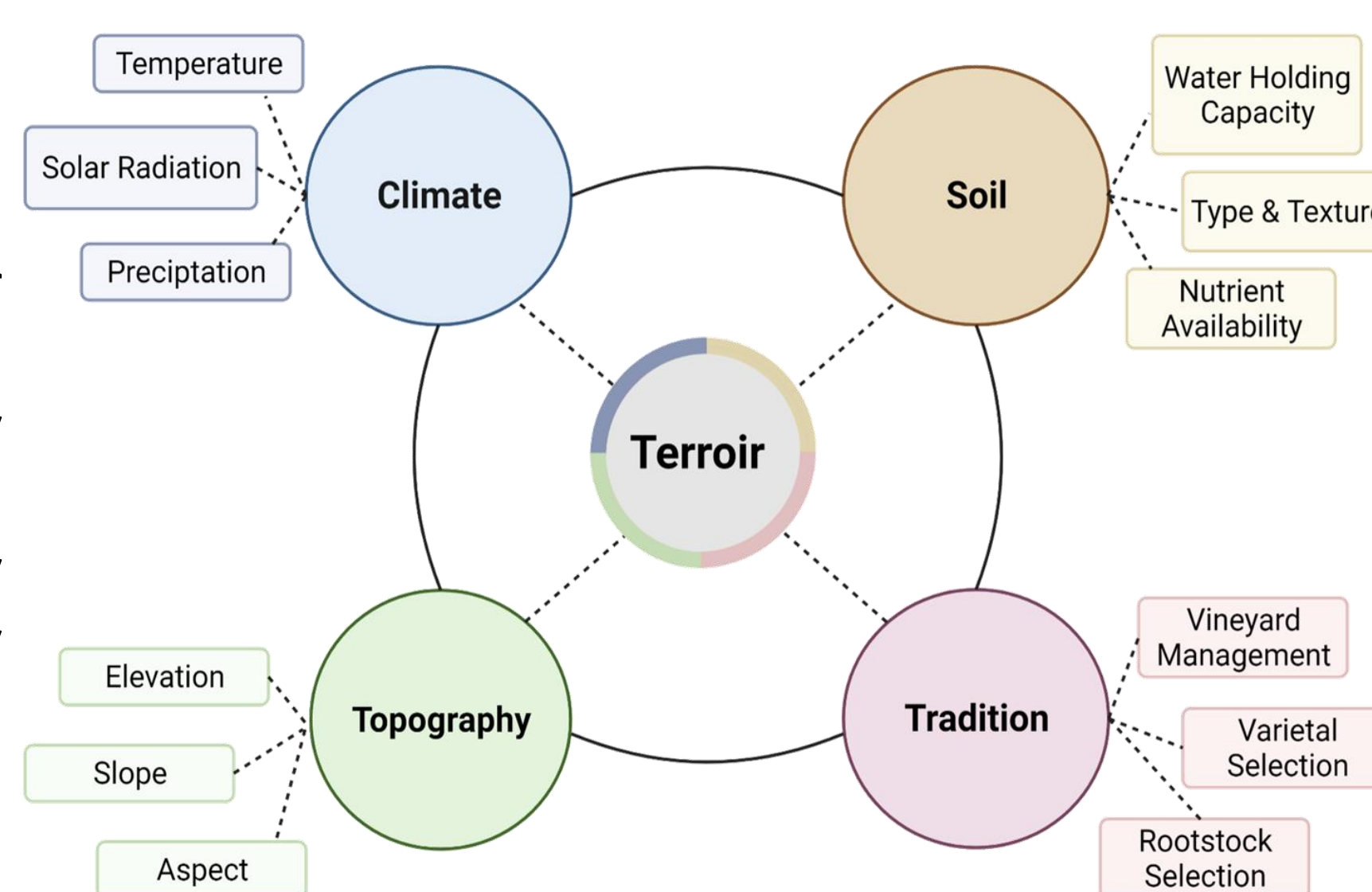
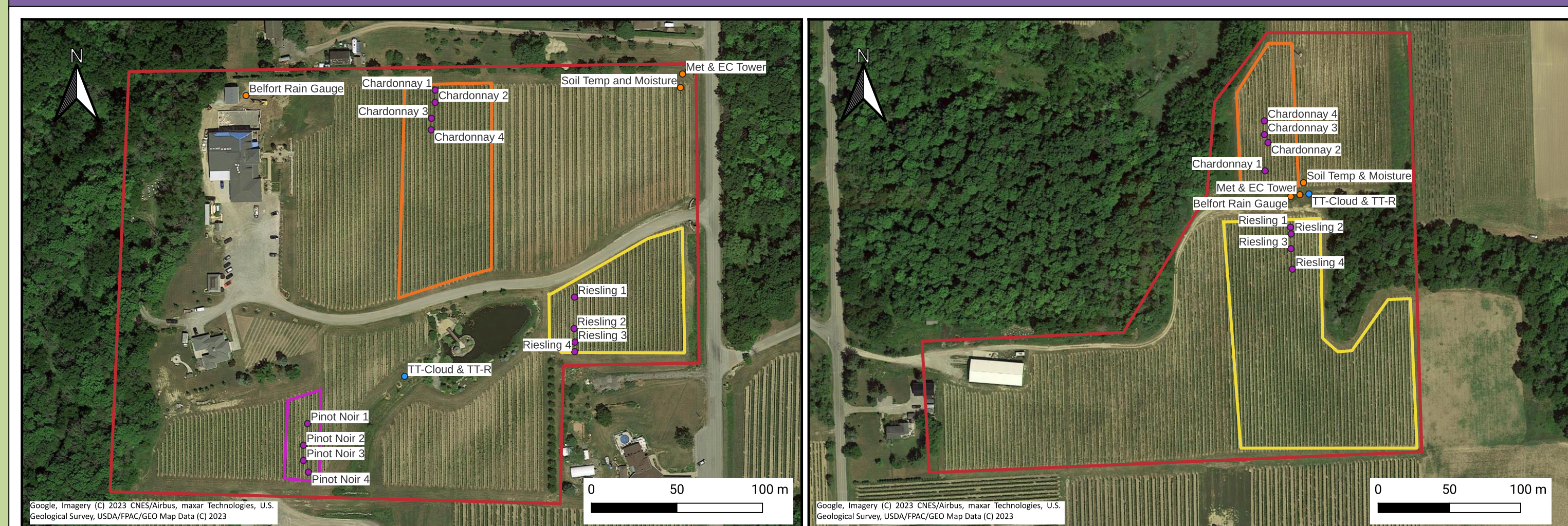


Figure 1. Terroir components and controls in vineyards

Objectives

1. Assess the spatial variability in meteorological controls on vineyard success including air temperature, relative humidity, as well as soil moisture and temperature across two vineyards in the Niagara growing region using TT-W sensors;
2. Analyze crop water use across each vineyard, between rows and blocks, using TT-W sapflow data to compute evapotranspiration rates;
3. Compare the above findings to grape chemistry and yield data in order to understand spatial variability in grape yield and quality across each vineyard.

Study Sites



Check out our live site data!

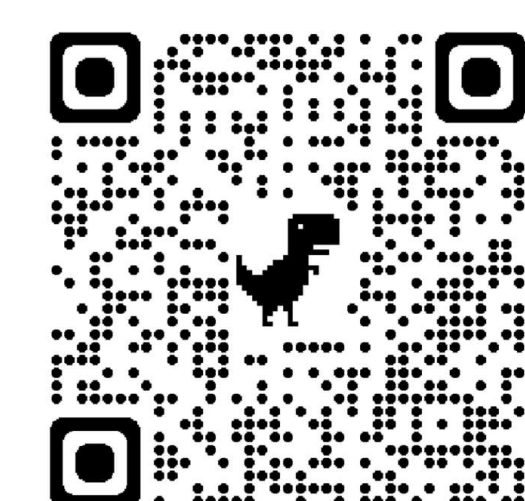


Figure 2. Annual patterns of vine phenology in Northern-Hemisphere vineyards

Methods

TT-W Sensors

TT-W Sensors are compact instruments developed to analyze grapevine micro-meteorology, growth and water use. The following table lists the important features of TT-W sensors:

| Component | Description |
|---------------------------------------|--|
| Sap Flow | Internal transpiration, reference heated temperature probe |
| Canopy Light Transmission | Growth, 12 NIR and visible light spectrum bands |
| Air Temperature and Relative Humidity | Thermohygrometer, below canopy |
| Soil Temperature and Moisture | Soil probe, approximately 15 cm depth |
| Flash memory for data storage | 16Mbyte |
| LoRa module for data transmission | Transmission 600 m (urban), >3 km in case of sight |

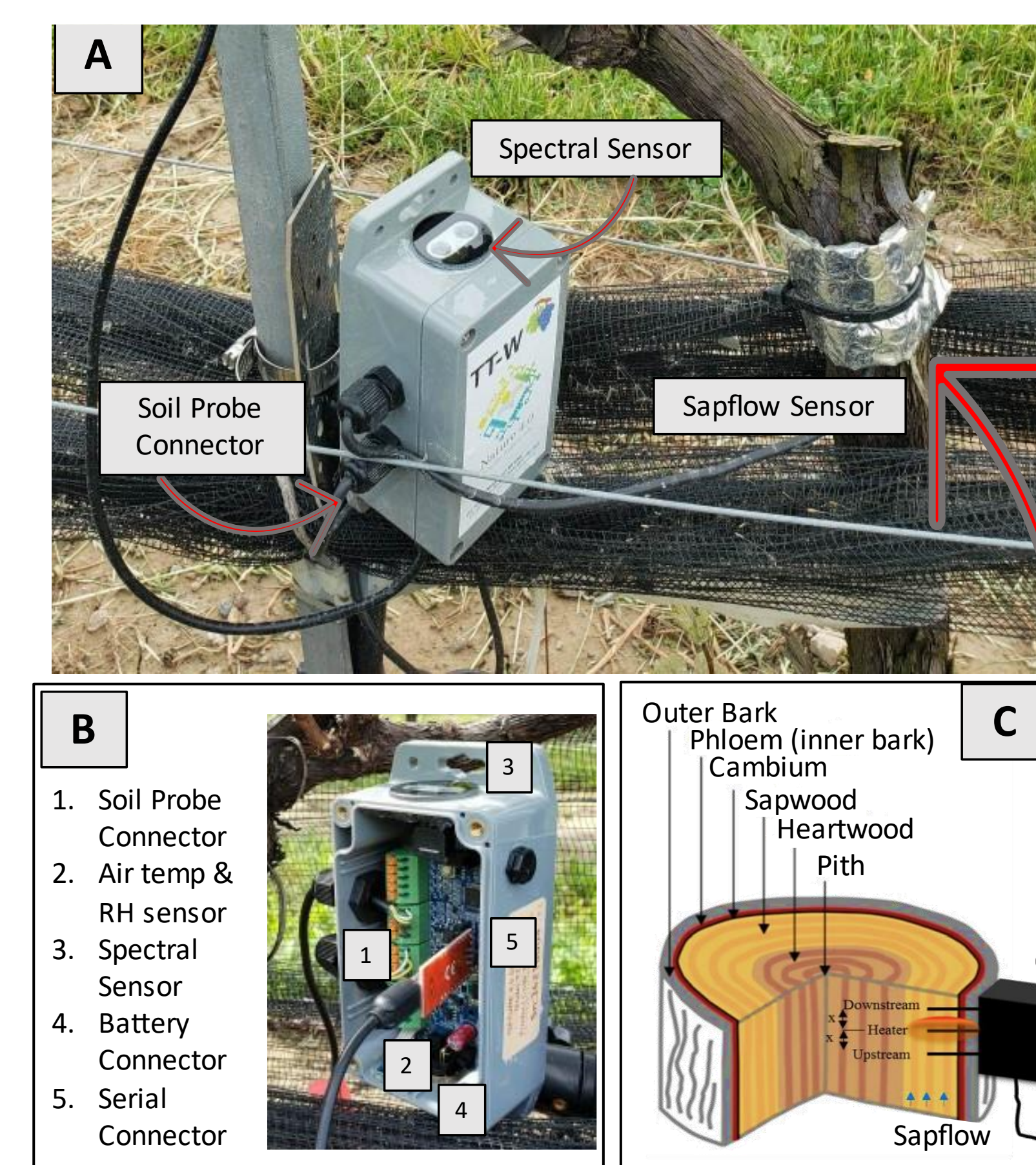


Figure 3. (A) Exterior reference for TT-W sensors and probes. (B) Interior schematic of TT-W parts. (C) Sapflow set-up within vine.

Additional Measurements

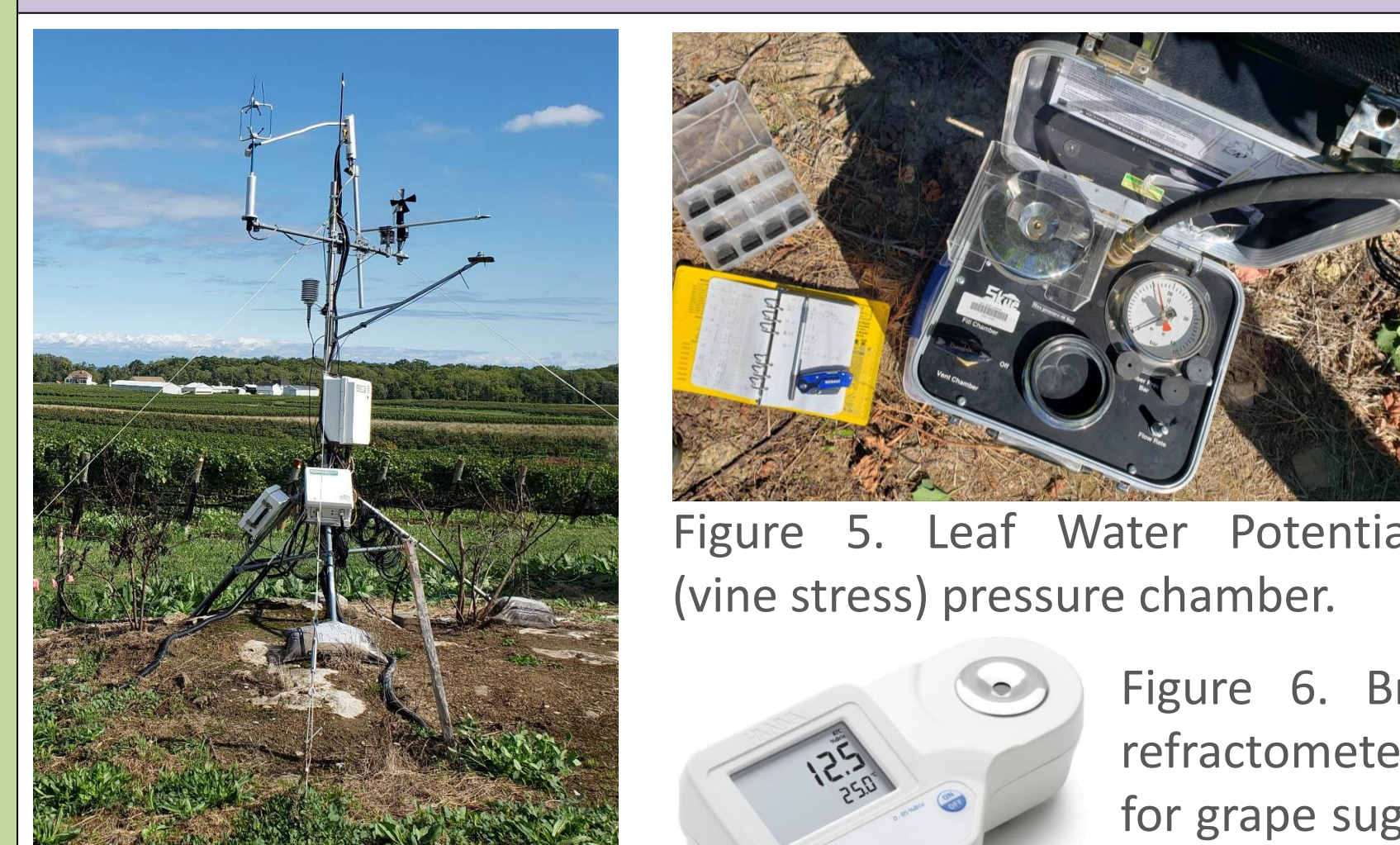


Figure 4. Vineyard 2 Meteorological and Eddy Covariance system.

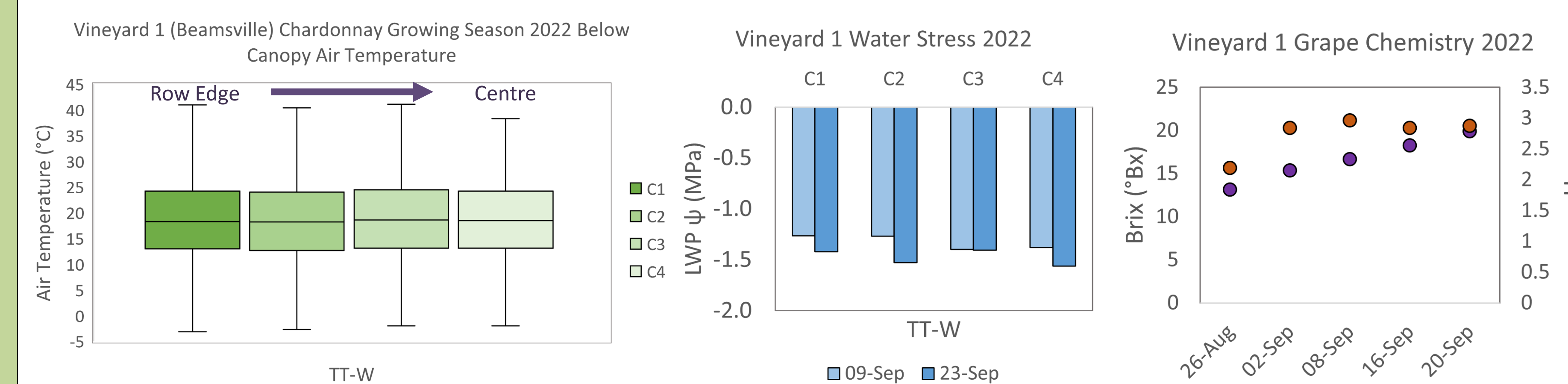


Figure 5. Leaf Water Potential (vine stress) pressure chamber.

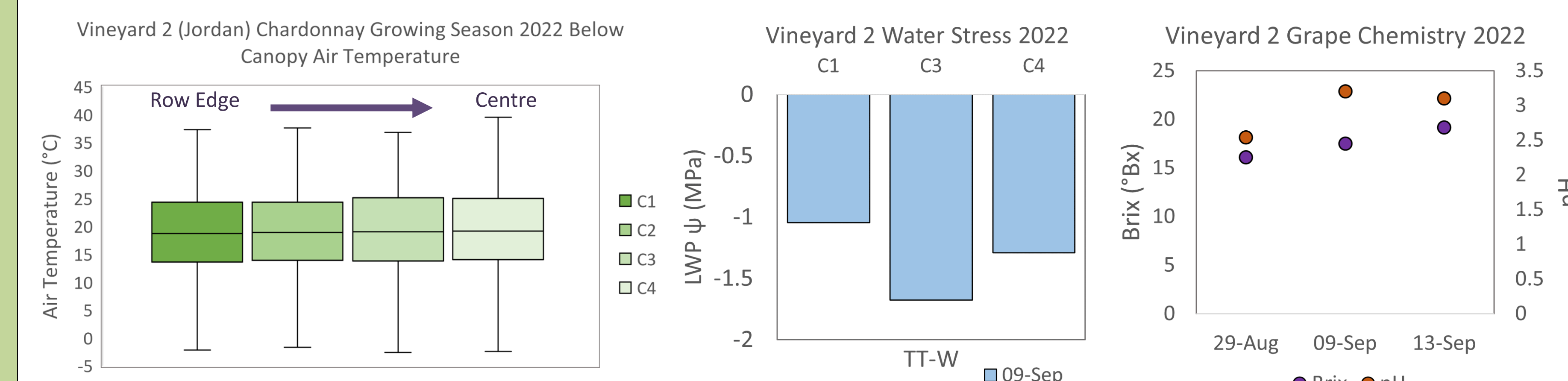


Figure 6. Brix refractometer for grape sugar levels (Hanna Instruments)

Preliminary Results



Figures 7 - 9. 2022 Vineyard 1 growing season blow canopy air temperature (left), Leaf Water Potential (LWP, stress) during harvest (centre) and, sugar (Brix) and acid (pH) accumulation during harvest (right). See Chardonnay 1 (C1), 2 (C2), 3 (C3), and 4 (C4) locations on Vineyard 1- Beamsville map.



Figures 10 - 12. 2022 Vineyard 2 growing season blow canopy air temperature (left), Leaf Water Potential (stress) during harvest (centre) and, sugar (Brix) and acid (pH) accumulation during harvest (right). See Chardonnay 1 (C1), 2 (C2), 3 (C3), and 4 (C4) locations on Vineyard 2- Jordan map.

Takeaways

Conclusions

- Below canopy air temperature is relatively consistent, with some fluctuations towards the centre of the row
- Water stress increased during harvest at Vineyard 1, showing higher stress typically closer to the centre
- Sugar levels steadily increase, while pH peaks and descends towards harvest

Relevance to Industry

- TreeTalker sensors are currently being tested on grapevines and trees, advancing local-scale information in both the agriculture and forestry sectors
- Understanding spatial variability within vineyards with TT-W sensors could allow growers to assess differences in row, block and varietal performance, allowing the application of selective management techniques, increasing grape quality and yield

Future Direction

- TT-W sensors are being modified to streamline data access, allowing growers to make management decisions quickly and efficiently
- TT-W technology can be used to test other crops, such as tender fruits in orchards, and other prominent vegetables
- Increased research on spatial and temporal changes across vineyards, orchards and farms could reduce management challenges from climate change

Acknowledgements

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