Poster Title: Annual Update - Fumigation and Rootstocks: Managing Plant-Parasitic Nematodes in Vineyard Replant Scenarios

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Management of plant parasitic nematodes in Washington State vineyards has been dominated by preplant soil fumigation. Our past work shows the effects of fumigation are not long-lasting. This poster is presenting the additional, annually-collected data from a long-term rootstock and fumigation trial for nematode management. The trial was established in 2015, in a commercial vineyard undergoing replanting after 20+ years of production. The rootstocks (101-14 MGT, 1103P, Harmony, Teleki 5C, and own-rooted controls) were planted in plots of fumigated (metam sodium), nonfumigated, and nonfumigated + inoculated with *Meloidogyne hapla* (northern root knot nematode) soil. By the second year of establishment, the fumigation effect was gone. By 2019, all evaluated "resistant" rootstocks supported the same number of nematodes as own-rooted vines. In the first three years of establishment, no differences were seen in yield and vigor, but by year 4 own-rooted vines had significantly lower pruning weights than vines on rootstock. By summer 2019, own-rooted vines in grown under initially-high-nematode pressure plots (non-fumigated + inoculated) had lower yields than own-rooted vines grown in lower nematode pressure plots. While "resistant" rootstocks do support some level of nematode development, they maintain scion productivity, and are a long-term solution for avoiding nematode-induced vine decline.

Poster Title: Digging into the effects and implications of soil health management practices in a long-term research vineyard in Washington State

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In 2023, a long-term research and extension vineyard was established in Prosser, WA as part of the Washington State Soil Health Initiative. The goal of this site is to evaluate and identify the influence of vineyard management practices on soil health and its impact on grape and wine quality. The vineyard is 4.1 acres and separated into 5 treatments that are replicated 4 times. Each treatment replicate contains planted Vitis vinifera scions 'Cabernet Sauvignon' and 'Chardonnay' grafted to 1103P rootstock, alternating every 3 rows. The vineyard is drip-irrigated. The site includes 5 primary treatments: i) WA 2021 Industry Standard (herbicide and synthetic nutrient application), ii) Managed Resident Vegetation (mowing for weed control, synthetic nutrient application), iii) Under-vine Cover Crop (under-vine cover crop, synthetic nutrient application), iv) Organic Matter Additions (compost) and v) Integrated Management (under-vine and alleyway cover crop and compost). Soil samples were collected prior to planting, in the fall immediately after plating, one year post vineyard establishment, and then will be collected 5 years post establishment. Soils are analyzed for an array of soil health measurements. This poster will introduce the overall program, vineyard metrics the project will evaluate based on stakeholder input, and initial results.

Poster Title: The WSU Cold Hardiness Program.

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Eastern Washington experiences cold winter temperatures, which help grapevines to fulfill their dormancy requirements. However, if temperatures drop too low before grapevines have had the chance to acclimate, or if the temperature drops below the vines' acclimation limit, the damage inflicted on the vines can result in significant growth and production challenges, potentially even threatening their survival.

To assist grape growers in managing cold weather events, the viticulture team of Washington State University has established a cold hardiness program. This program consists of real time cold hardiness monitoring, which evaluates the critical temperatures for grape cultivars throughout the dormant season, and provides cold hardiness models, based on historical data and AI technologies, that predict potential damage.

We are continuously working on improving these models and actively researching cold hardiness and damage from various perspectives, such as investigating the effects of chronic cold stress on grape buds.

Despite the existence of the program, it is important to conduct your own cold damage assessment and take appropriate measures, for example, to make appropriate pruning decisions. Information about how to assess and manage cold damage can be found on Grapevine Cold Hardiness | WSU Viticulture and Enology | Washington State University.

Poster Title: Vineyard Management

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A two-year study (2023–2024) at Roza irrigation vineyard assessed reference lines for irrigation scheduling based on various soil and plant water status indicators in fully irrigated (FI) vines. FI blocks were irrigated above full crop water requirements to ensure non-limiting soil conditions. Indicators investigated included relative soil water content (RSWC), soil water potential (SWP), stem water potential (SSWP), maximum daily shrinkage (MDS), tree growth rate (TGR), and tree water deficit (TWD). TWD was the most reliable indicator for assessing the water status of vines, whereas MDS correlated better with meteorological variables after veraison. SWP and SSWP were reliable only pre-veraison, while RSWC was consistent throughout. Solar radiation best correlated with TWD (pre-veraison) and MDS (post-veraison). The use of TWD and MDS signal intensity around the unity was the best criteria for irrigation scheduling in well-irrigated vines, during pre- and post-veraison periods, respectively.

Poster Title: The Role of Canopy Management in UV-C-Control Grape Powdery Mildew

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The germicidal effects of UV-C light (254 nm) has been used as a method of grape powdery mildew (*Erysiphe necator*) suppression in multiple crops including grapevines (*Vitis vinifera*). The use of UV-C light in Washington vineyards may help mitigate fungicide resistance by introducing new methods to expand IPM strategies of grape diseases. However, since the application of UV-C cannot be adjusted like traditional sprays (i.e., changes in water or air volume), information is needed on how grapevine canopy management influences the effectiveness of UV-C light applications. In 2023 and 2024, we conducted a study that looked powdery mildew disease management using once and twice a week UV-C applications (200 J/m^2). Within these UV-C treatments, we also compared disease control on vines that had no canopy management, shoot thinning, and shoot thinning + early fruit zone leaf removal. In both years, canopy management did not help nor hinder the disease severity in an already effective mildew management strategy, including the UVC regimes. Canopy management had a significant effect in reducing mildew severity in the high disease pressure unsprayed controls. Yield and fruit quality differences were primarily due to differences in fungicide treatments, not canopy management. This information re-verifies the usefulness of UV-C light as a method of grape powdery mildew control and highlights the effectiveness of canopy management in high disease pressure situations.

Poster Title: Grapevine response to soil moisture and soil temperature differences caused by deficit irrigation strategies.

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The combined effect of soil moisture and temperature on grapevine physiology and water relations is gaining attention in the context of global warming. However, further research is still needed to fully understand the interaction between these factors. A field trial using soil probes that measured temperature and moisture hourly at a depth of 30 cm revealed that irrigation water reduced soil temperature by up to 5 °C at this depth in the field. Grapevines can adapt their water uptake capacity in response to changing environmental conditions by regulating aquaporins in the plasma membrane of root cells. Changes in soil temperature have been reported to modify root hydraulic conductance (the ability to transport water) and aquaporin gene expression (proteins involved in water transport). We studied the differential gene expression of four *Vitis vinifera* aquaporins in potted vines in response to soil moisture and soil temperature manipulation in a growth chamber under controlled conditions. The experiments revealed that lower soil moisture availability and cooler root zone temperatures significantly reduced plant hydraulic conductance and the differential gene expression of four targeted aquaporins in the roots.

Poster Title: Automated Evaporative Cooling Systems for Grapevine Heat Stress Management.

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This study explores the effectiveness of automated evaporative cooling system variants in grape (*cv. Chardonnay*) heat stress management. Two under-canopy fogging systems and a fixed spray system (FSS) were evaluated in the 2024 growing season. Fogging systems were installed under the canopy to cool berry clusters using either of a one-way fogger, i.e., Fogging1: Jain by Rivulis Inc. & Fogging2: DIG Corp. The FSS was originally designed for crop protection with emitters installed over (Modified StripNet, Netafim™) and under-canopy (Modified 90° modular, Jain by Rivulis Inc.) was also evaluated for heat stress mitigation. The cooling systems were automated using sensing and actuation hardware integrated via Long Range Wide Area Network (LoRaWAN). Berry temperature (T_b > 35 °C) and canopy wetness were measured continuously using thermistor (ST-200, Apogee Instruments Inc.) and leaf wetness sensor (Phytos 31, Meter Group Inc.) for automated ON/OFF. Air temperature (T_a) and relative humidity (ATMOS 14, Meter Group Inc.), soil moisture (TEROS 12, Meter Group Inc.), and canopy temperature (T_c, SI-1H1, Apogee Instruments) data were used to quantify the effectiveness of the cooling system. Ground truth measurements were also taken for T_b and T_c on nine hotter days of the season, at every 30-minute interval using a contact K-type thermocouple (Thermapen Blue, ThermoWorks Inc.) and thermal-infrared imager (Duo Pro R, FLIR Systems, Inc.), respectively. Subsequently, yield (kg/vine), berry mass (g), Brix (°Bx), pH, and Titratable Acidity (TA, g/L) were assessed post-harvest. Statistical ANOVA showed significantly higher T_b and T_c in no cooling and Fogging1, however it was comparable in Fogging2 and FSS treatments on hotter days. Moreover, significantly low T_a was recorded in the FSS compared to all other treatments. There were no significant differences in yield and pH; however, berry mass, Brix, and TA varied significantly among treatments at a 5% significance level.