Department of Horticulture and Extension Service – Umatilla County

SUNSCREEN FOR GRAPEVINES: KAOLIN CLAY USE IN PACIFIC NORTHWEST VINEYARDS

Cody R. Copp[1*], Aidan Wiggins[2], and Melinda Cramp[2]

[1]Assistant Professor of Practice, [2]Student Research Assistant, Department of Horticulture and Extension Service – Umatilla County, Oregon State University, 418 N Main Street, Milton-Freewater, OR 97862, *Corresponding author: cody.copp@oregonstate.edu

Short term climate change risks like extreme heat threaten wine grape production in the Pacific Northwest. Extreme temperatures inhibit photosynthesis, reduce yield, delay ripening, and promote fruit sunburn. Kaolin clay is used in other regional crops (e.g., apple) to reduce heat stress and sunburn. Other labelled (e.g., insect suppression) and experimental (wildfire smoke exposure) uses distinguish kaolin as a potential viticultural tool to mitigate climate change related risks.

Multiple field trials, described here, were established in 2022 and 2023 to optimize application (i.e., rate, surfactant), observe fruit sunburn, and measure effects to leafhopper populations.

PILOT STUDY

In 2022, a pilot study was conducted in a block of Syrah. Kaolin (Surround WP, NovaSource) was applied at maximum label rate (45 kg ha^{-1}) starting at pea-sized berry stage (KLN) and compared to an untreated control (CON). KLN was reapplied twice at three-week intervals. Leaf water potential (Ψ_{leaf}) and stomatal conductance (g_s) were monitored weekly. Yield was measured and fruit analyses were conducted at harvest.

Across the season, there were no Ψ_{leaf} differences. However, g_s was higher for KLN at Ψ_{leaf} above -1.4 MPa (Figure 1). This is likely attributable to lower leaf temperature for KLN, which was 2.3°C lower than CON across the season. There were few fruit differences at harvest (Table 1). Malic acid concentration was 4% higher (p = 0.035) in KLN fruit than CON. Vine yield trended higher for KLN and was 5% greater than CON.

APPLICATION RATE

In 2023, a trial was established in a block of Syrah to evaluate varying rates (0, 11, 22, 45 kg ha^{-1}) of kaolin application. Similar to the pilot study, kaolin was applied starting at pea-sized berry and reapplied at three-week intervals to maintain coverage. Measurements were largely the same as in the pilot study.

2023 was climatically milder than 2022. Across the season, there were few differences in Ψ_{leaf} amongst treatments. Leaf temperature was, on average, 0.7, 0.9, and 1.8°C lower for the 11, 22, and 45 kg ha^{-1} treatments, respectively, but average g_s was no more than 10% higher than the control. Tannin and anthocyanin concentrations increased with kaolin rate (Table 1). Berry pH trended lower with the highest kaolin rate.

Table 1. Fruit analysis results for the pilot study (2022) and kaolin rate trial (2023). Kaolin rate treatments at 11, 22, and 45 kg ha^{-1} are indicated by K-11, K-22, and K-45, respectively. Data are means (n = 4).

Year	Treatment	TSS (°Brix)	pH	TA (g L^{-1})	Tannin (mg L^{-1})	Anthocyanin (mg L^{-1})
2022	CON	22.9	3.64	4.5	481	1173
	KLN	22.7	3.61	4.5	444	1199
2023	CON	24.5	3.71	4.3	609	1264
	K-11	24.6	3.70	4.3	653	1325
	K-22	24.4	3.68	4.4	658	1362
	K-45	24.3	3.62	4.4	724	1359

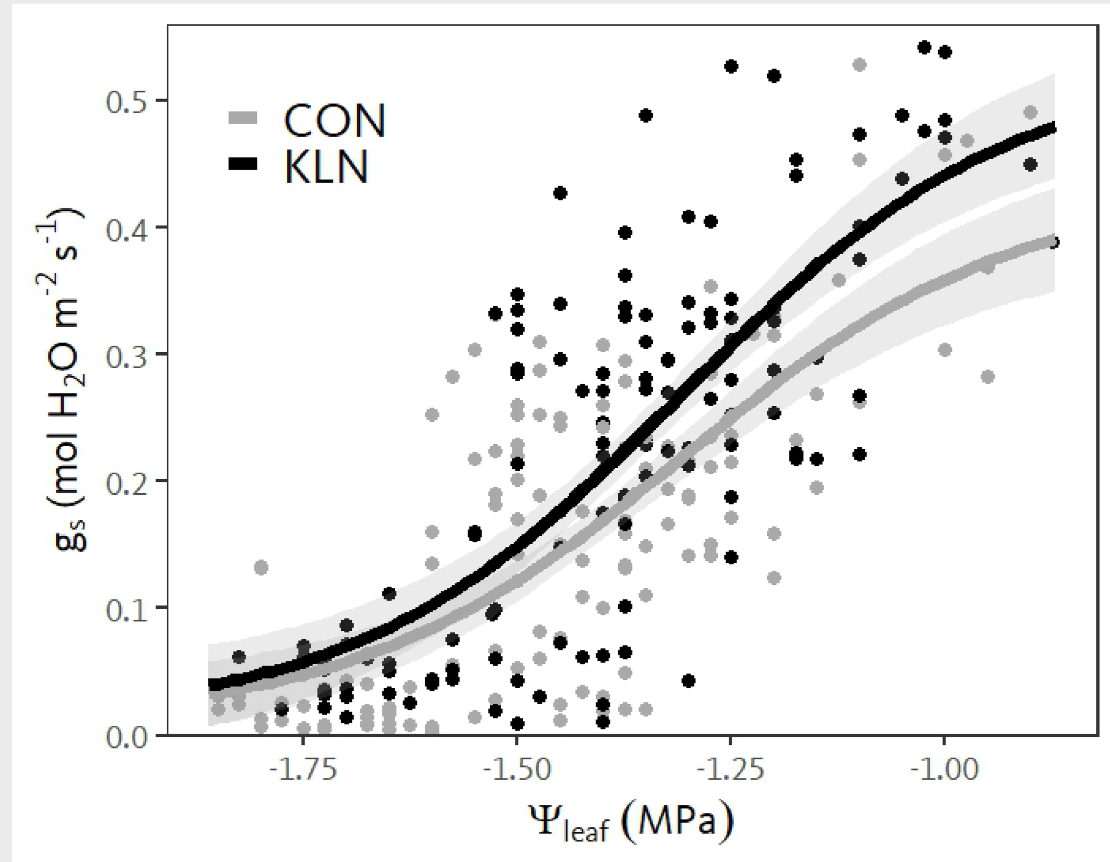

Figure 1. Relationship between leaf water potential (Ψ_{leaf}) and stomatal conductance (g_s) in kaolin-treated (KLN) and control (CON) vines from June to September 2022. Each data point is one paired measurement (n = 1). The light gray band is the 95% confidence interval.

LEAFHOPPER CONTROL

In 2023, kaolin was applied to half of vines in a block of organic Cabernet Sauvignon starting at fruit set and compared to a control. Populations of western grape leafhopper (*Erythroneura elegantula*) nymphs and adults were monitored weekly with leaf counts and yellow sticky cards, respectively.

Kaolin application reduced the peak population of second generation leafhopper nymphs by 54% (Figure 2). Notably, the average number of leafhopper nymphs remained below the regionally recommended treatment threshold of 20 per leaf.

SURFACTANT TEST

In 2023, a replicated surfactant test was conducted on Syrah clusters by applying kaolin and kaolin mixed with each of four commercially available non-ionic surfactants at label rate. The surfactants included 80/20 Surfactant (Farm General), Hi-Wett (Loveland Products), Silcote 2000 (Columbia River), and Sylgard 309 (Wilbur-Ellis). Clusters were visually rated for coverage on a scale of 0 to 100%.

The four surfactants all significantly improved cluster coverage by 50 to 66% compared to kaolin applied without a surfactant ($p < 0.001$), but the surfactants did not significantly differ from each other. Figure 3 exhibits the difference in coverage between kaolin and kaolin mixed with a surfactant (Hi-Wett).

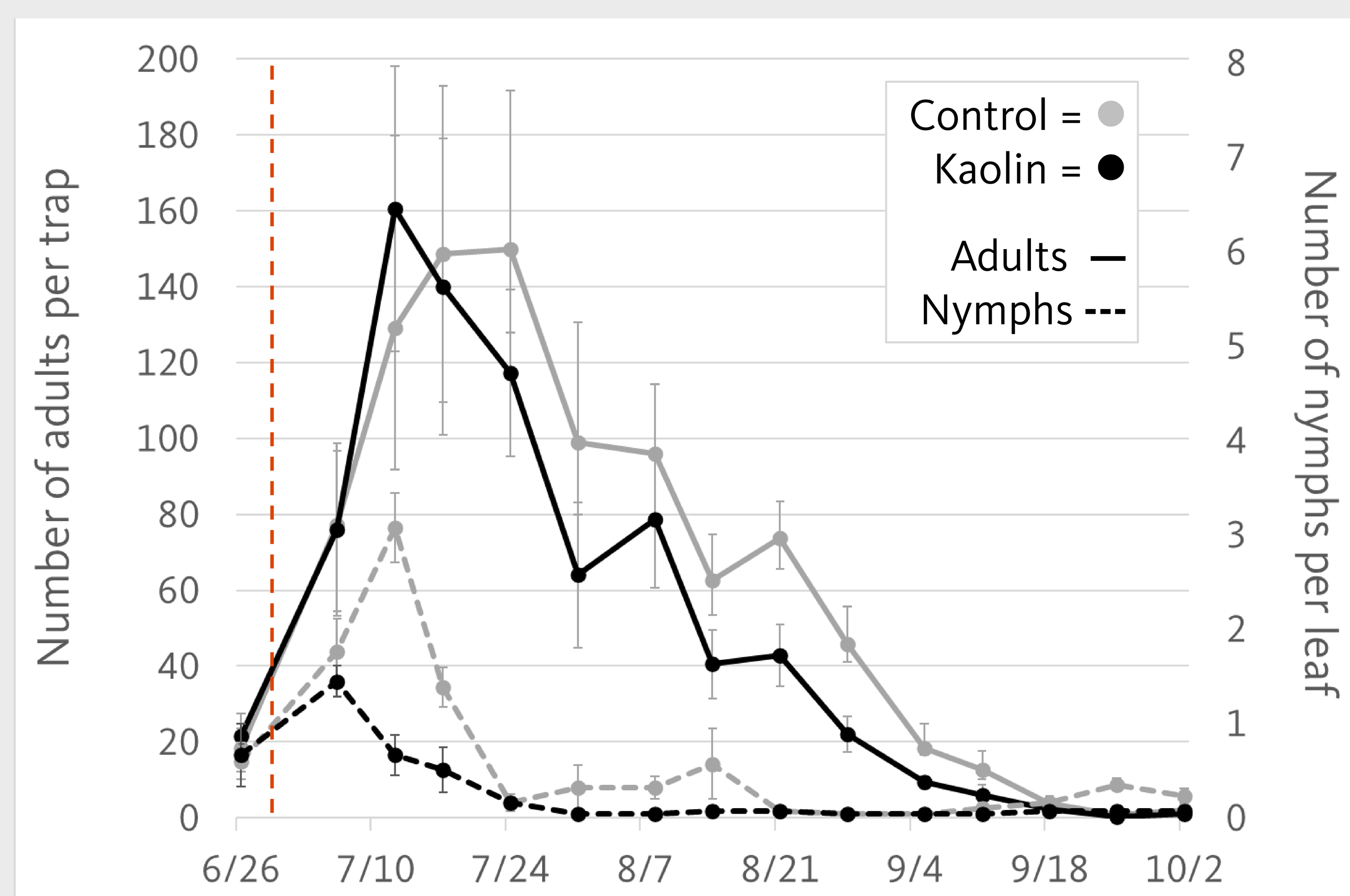

Figure 2. Abundance of *E. elegantula* adults and nymphs in an organic Cabernet Sauvignon vineyard in 2023. Data are means (n = 4) ± one standard error. The date of first kaolin application is indicated by the vertical dashed line.

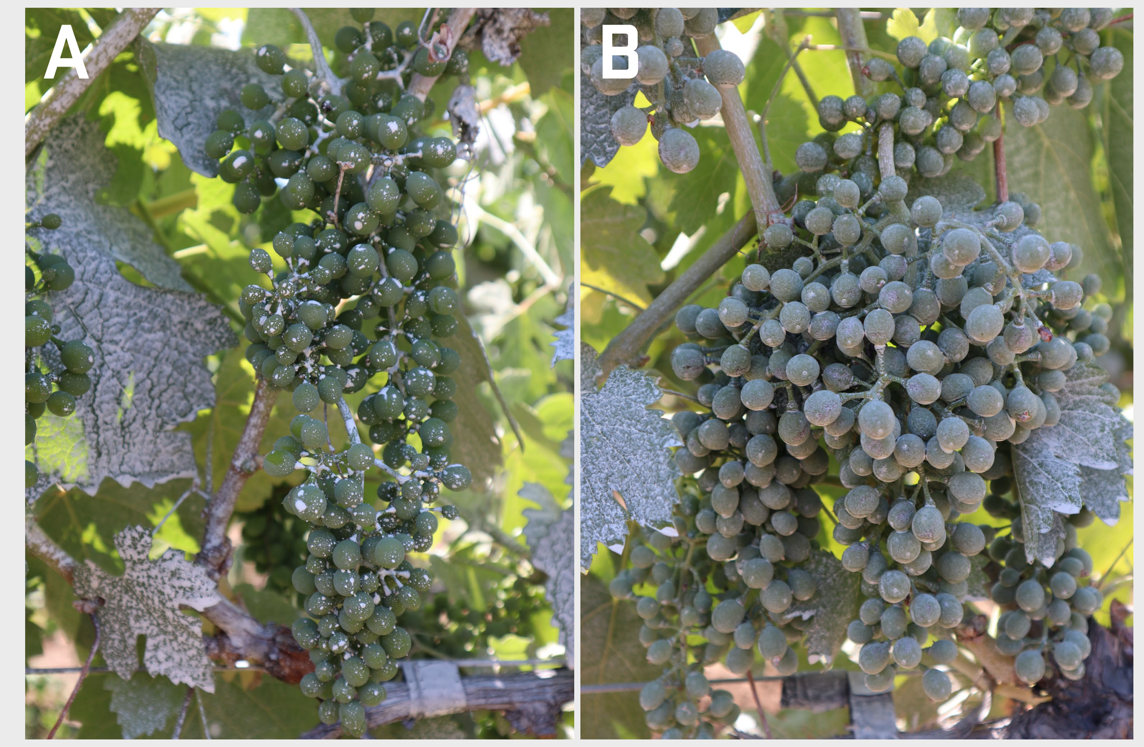

Figure 3. Syrah clusters treated with kaolin (A) and kaolin plus a non-ionic surfactant (B). The surfactant improved kaolin deposition to unripe berries.

SUNBURN PREVENTION

Prior to a forecast heat event post-véraison in 2023, leaves were removed in the fruit zone on the western side of the canopy in blocks of Syrah and Tempranillo. Half of the clusters were treated with kaolin (KLN) and half were left untreated (CON). After the heat event, clusters were observed for berry shrivel. At harvest, clusters were sampled for chemical analysis.

Maximum air temperature was above 41°C (106°F) for three days following leaf removal and kaolin application. For Syrah, there was not a significant difference in the number of shriveled berries per cluster between the treatments. For Tempranillo, KLN had 85% fewer shriveled berries than CON (p = 0.029). There was no difference in anthocyanin concentration for Syrah and no differences in primary fruit chemistry (i.e., sugar, pH, acid) for either variety. Tempranillo treated with KLN had 25% higher anthocyanin concentration than CON (p = 0.068).

KEY RESULTS

- Kaolin has a **greater impact** on water stress, yield, and berry composition **in hot years**.
- Kaolin **alters water stress** by reducing leaf temperature and increasing gas exchange.
- Kaolin can **reduce leafhopper populations** in organic systems.
- Kaolin can **reduce sunburn damage** to sensitive varieties in extreme climatic conditions.
- A non-ionic **surfactant improves deposition** of kaolin applied pre- and post-véraison.

ACKNOWLEDGEMENTS

Cooperators: Chad Johnson (Dusted Valley), Tim Donahue (Horse Thief Wine Consulting), Matt Austin (Grosgrain Vineyards), Banek Winegrower Management, Results Partners

Funding: ETS Labs, Agricultural Research Foundation, Oregon Wine Research Institute

Oregon State University