ADVANCED NUTRIENTS®

CASE STUDY

www.advancednutrients.com.au

Summary of Observations Using AquaMate®

By: S. Kaan Kurtural UC Davis

Summary

AquaMate® has been used as an irrigation aide at the UC Davis Oakville Station since 2019. Our work has looked at using the conventional product as well as the organic product in wine grape vineyards. Both forms have performed equally well in cleaning irrigation lines. As the rate of application increased, the amount of water delivered cumulatively through the season increased as a result of emitters not being clogged; and we have seen a linear increase in yield. When the conventional AquaMate® rate was increased from 10 ppm to 40 ppm, the berry composition values were adversely affected. However, berry composition values were unchanged in the organic AquaMate® when the application rate changed from 20 ppm to 40 ppm constant dosing. The distribution uniformity and application rate has also improved using AquaMate® resulting in savings of 0.75 mega litres of water savings and potential energy savings of 66kWH/hectare. The cost savings in energy was equivalent to $21.77/Ha.

Evaluation of AquaMate® Application Rate in a Young Vineyard.

The rate of AquaMate® application was evaluated in a young Cabernet Sauvignon vineyard. An untreated control, 20 ppm and 40 ppm of AquaMate® was evaluated during the 2021 growing season. Components of yield and berry composition was measured.

Factor	Berry w (g)	Cluster wt (g)	Yield (kg/vine)
Control	1.96 b	103.34	1.13 b
20 ppm	1.99 ab	110.93	1.57 b
40 ppm	2.12 a	112.98	2.89 a
Pr>F	0.0367	0.8088	0.0117

As indicated in the above table, yield of grapevine was beneficially affected. The berry mass increased with the inclusion of the organic AquaMate® in the weekly irrigation, although there was no effect on the cluster weight.

The berry composition of Cabernet Sauvignon was also measured. We measured total soluble solids, juice pH and titratable acidity as well as anthocyanin content per berry as these grapes were destined for wine making. Although increasing the amount of AquaMate® to 40 ppm reduced total soluble solids compared to no AquaMate® application, this reduction was not statistically significant. Likewise, we did not see any differences in juice pH or titratable acidity. The anthocyanin content per berry was also not adversely affected as indicated in the table below.

Factor	TSS (%)	Juice pH	TA	Anthocyanin (mg/berry)
Control	24.2	3.61	0.72	0.93
20 ppm	22.0	3.55	0.74	1.17
40 ppm	22.6	3.56	0.74	0.97

Distribution Uniformity and Energy Savings using AquaMate®.

A 0.93 hectare (2.3 acre) Cabernet Sauvignon vineyard at the UC Davis Oakville Station was used. In this vineyard the vines were spaced 9' x 6' and equipped with 2 pressure compensating emitters capable of delivering 0.53 gph. There was a difference of 8 metre in elevation between the pump outlet and water level. The ump set-point was fixed: 75 gpm @ 64 psi . Water traveled from the pump outlet to the study vineyard through 3-in PVC pipe for 292 metres. Linear head losses due to friction along the water conveyance were calculated based on the flow rate of 75 gpm (0.167 cfs) as HLF = 1.4 metre.

Initial irrigation line cleaning:

Vineyard was irrigated for one hour. Emitter output was collected from 24 emitters that were equi-distantly spaced in the vineyard after one hour. Pressure at the manifold was also measured. Into the irrigation stream, 2.5 litres of organic AquaMate® was injected in 2000 litres of water and let sit overnight. The following day, the irrigation system was switched on and emitters were flushed. The results of pressure and distribution uniformity are presented in the below table.

Factor	Pressure	Distribution Uniformity
Pre cleaning *	22 b	0.70 b
Post cleaning	28 a	0.95 a
t-test	0.0001	0.0001

The baseline conditions for water and energy savings are described below.

Baseline conditions ($_B$) refer to the pre-cleaning of the micro-irrigation system

Average measured low-quarter baseline distribution uniformity: $DU_B = 0.70$

Average measured emitters' application rate: $AR_B = 0.494$ gph (1.87 l/h)

Average measured pressure head available at the inlet of the manifold: $H_B = 22$ psi

Enhanced conditions ($_E$) refer to the post-cleaning of the micro-irrigation system with AquaMate®

Average measured low-quarter baseline distribution uniformity: $DU_E = 0.95$

Average measured emitters' application rate: $AR_E = 0.515$ gph (1.95 l/h)

Average measured pressure head available at the inlet of the manifold: $H_E = 28$ psi

Methods and Assumptions

The actual consumptive vine water use (ETa) was measured with a commercial surface renewal energy flux station (Tule Technologies, Inc.) along the grapevine growing season of 2021.

The required gross irrigation depth (GID) was determined from the measured ETa, and the resulting water depletion in the effective rooting zone, and the measured system DU values to optimize the application efficiency (EQ). EQ is the water application efficiency of the low quarter and represents the percentage of gross water applied that is beneficially utilized for actual vine evapotranspiration.

For micro-irrigation, EQ is calculated as the mean low-quarter volume of irrigation water per unit area infiltrated and stored in the root zone. According to Keller and Bliesner (2000), EQ is primarily a function of DU, but it also depends on minor losses (runoff, leaks, filters and line flushing, and drainage), unavoidable losses to deep percolation (through cracks or water percolation beyond the root zone), and avoidable losses resulting from poor irrigation scheduling.

For well-watered crops grown with adequately maintained and properly operated micro-irrigation systems and accurately scheduled irrigation, EQ approximates the system DU.

For this specific study, given the well-watered conditions, the adequate irrigation system maintenance and advanced irrigation scheduling, we assumed that EQ ~ DU.

As such, dividing the ETa by DU (instead of by EQ) provides an estimate of the water depth that will infiltrate into the low quarter of the irrigated vineyard block (in well-drained soil). In this way, the low-quarter of the vineyard will receive sufficient water to return to field capacity and maintain good vine growth and production, while the remainder of the vineyard will receive more than sufficient water to refill the soil to field capacity.

Water Usage and Water Saving Calculation (from Baseline to Enhanced Conditions)

ETa (May 1 – Sept 15) = 19.30 ac-in/ac

Gross Irrigation Depth, (GID_B = Baseline; GID_E = Enhanced)

GID_B = 19.30/0.70 = 27.60 ac-in/ac = 2.3 ac-ft/ac

GID_E = 19.30/0.95 = 20.30 ac-in/ac = 1.7 ac-ft/ac

Potential Water Saving (GID_B – GID_E) = 2.3 – 1.7 = 0.61 ac-ft/ac

Potential cost saving for reduced water usage, assuming an average water cost of $405/meg ($1,000/ac-ft) in Napa Valley:

Cost Saving Water: 0.75 megalitre /ha x $405/meg = $303/ha (0.61 ac-ft/ac x $1,000/ac-ft = $610/ac)

Energy Usage and Energy Saving Calculation (from Baseline to Enhanced Conditions)

Total Dynamic Head, TDH = 27 ft + (64 psi x 2.31 ft/psi) = 175 ft

Estimated Energy Usage (EU_B = Baseline; EU_E = Enhanced)

For electric motor-powered pumps it takes on average 1.55 kWh per ac-ft of water per foot of lift (Nebraska Pumping Plant Performance Criteria, NPPPC).

EU_B = 2.30 ac-ft/ac x 175 ft x 1.55 kWh/ac-ft = 624 kWh/ac

EU_E = 1.70 ac-ft/ac x 175 ft x 1.55 kWh/ac-ft = 461 kWh/ac

Potential Energy Usage Saving (EU_B – EU_E) = 624 - 461 = 163 kWh/ac

Potential cost saving for reduced energy usage, assuming an average energy cost of $0.33/kWh in Napa Valley:

Cost Saving Energy = 66 kWh/ha x $0.33/kWh = $21.77/ha (163 kWh/ac x $0.33/kWh = $53.8/ac)

Estimated reduction in GHG emissions was calculated assuming the CO_2 emission factors obtained from the US Environmental Protection Agency (https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf). For Electricity, we assumed the CO_2 emission factor of 0.000379 Ton-eq. CO2 per kWh.

GHG Reduction = 163 kWh/ac x 0.000379 Ton-eq. CO_2/kWh = 0.061 Ton-eq. CO_2/ac.

ESTIMATED REDUCTION OF PUMPING HOURS (from Baseline to Enhanced conditions)

Net irrigation volume to apply per vine, NIV = 19.30 ac-in/ac x 54 ft^2 x 0.623 = 649 gal/vine

Gross irrigation volume to apply per vine (GIV_B = Baseline; GIV_E = Enhanced)

GIV_B = 649/0.7 = 928 gal/vine

GIV_E = 649/0.95 = 682 gal/vine

Total estimated pump operation hours (PO_B = Baseline; PO_E = Enhanced)

PO_B = 928 gal/vine / (2 x 0.494 gph) = 939 hrs.

PO_E = 682 gal/vine / (2 x 0.515 gph) = 662 hrs.

Saving in pump operation hours (PO_B - PO_E) = 939 – 662 = 275 hrs.

Observations with the Application Rate of AquaMate® in Mature, Producing vineyards.

We ran trials in 2019 and 2020 looking at the dose response of mature and fruiting Cabernet Sauvignon grapevines. The range of application rates were 10 ppm, 20 ppm and 40 ppm. In both years of the experiment there was a linear response of yield to application rate. Conversely, the fruit composition values responded differently where the highest application rate (40 ppm) resulted in the lowest anthocyanin content per berry. Meanwhile, applied fertilizer uptake (Nitrogen, Potassium, Calcium and Magnesium) increased linearly with the increase in AquaMate® application. Year-over-year, repeatable results were seen with the 20 ppm application rate without detrimental effects on fruit composition with this AquaMate®.