



## “Fertigating drip-irrigated vineyards with macro- and micronutrients”

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This is a brief review covering some useful tips on nitrogen, potassium, and boron fertilization through drip systems, mainly from a table grape perspective.

- The first California drip systems were installed in San Diego County –for citrus and avocados- in the 1960s. In 1971, the first drip system in grapes was installed in San Joaquin Valley and, within 10 years, most new plantings of grapes were drip irrigated. Drip irrigation is particularly suitable for the application of fertilizers (fertigation) because it distributes the fertilizer uniformly and where the roots are concentrated.
- **Water flux in the drip zone** . In an old study with Ugni blanc in the San Joaquin Valley (California), the author studied the dynamics of water depletion throughout the season by placing tensiometers at increasing depths from the surface (all the way to 150 cm, or 5 ft) and at increasing distances into the interrow (up to 150 cm). He found the highest water potential to be nearest the drip line, and the lowest water potential in the interrow. Therefore, water flux was *downward* beneath the drip line, *upward* in the middle of the interrow, and *laterally* from the drip line into the interrow. (Kay, I changed things a bit to avoid confusion. “Row middle” here means “middle of the interrow”, I think.) The author also found that the whole profile remained wet until May, started declining in June, and reached a steady level of 20% wetness due to the drip irrigation from late July on. The soil was a fine sandy loam, and drip irrigation had been applied daily, starting in June.
- **Salt distribution in the drip zone**. In the same study, the author measured salt concentration throughout the soil profile in spring and fall. Salts concentrated near the soil surface and between 50 to 100 cm away from the drip line. This correlated with the water flux movements. No negative effects resulted, as winter rain was adequate to leach these salts.
- **Nitrogen**. The timing of N application is critical. N is best applied after budbreak through fruit set, or postharvest. Growers in the San Joaquin Valley tend to split applications between late spring and postharvest. When dealing with young vines, multiple applications of small amounts are particularly recommended to reduce the risk of salt injury. Another problem when fertigating with N fertilizers that contain ammonia is soil acidification (it is not uncommon to find a pH of 4 or 5 beneath the emitters). Adding calcium through the emitters can help alleviate this problem. Calcium acetate, calcium nitrate, calcium chloride, and potassium carbonate (if K is also needed) all worked better than lime (calcium carbonate) which is rather insoluble.
- **Potassium**. K diffusion into the roots is limited to the soil solution in intimate contact with the roots (a few millimeters), so high root density is important for K uptake. Typically, in the San Joaquin Valley, K is applied weekly at a rate of 10-15 kg/ha for 5-10 weeks, and discontinued at veraison. Potassium sulfate is the most commonly used K fertilizer. Other alternatives are potassium chloride (if soils have no salinity

problems), potassium nitrate (if N is needed), and potassium carbonate (if the soil is acidic). Because K, Ca, and Mg compete for soil cation exchange sites, the author cautions that applying K through the drip can result in a Mg deficiency in some situations.

- **Boron (B)** is unique because of the narrow range between deficiency and toxicity (0.15 mg/l satisfies the vine's needs, but 1 mg/l starts causing toxicity). Research in Thompson Seedless showed that an annual maintenance application of B at 1 kg/ha caused toxicity by the 4<sup>th</sup> or 5<sup>th</sup> year. So boron applications need to be closely monitored, and might need to be "switched on and off". In this study, applying 1/3 kg/ha elevated tissue levels to the adequate range within two years. Even though plant tissue analysis routinely uses petioles, B concentrated more in blades than in petioles, indicating that the blades are the best choice for monitoring the vine nutrient status.

- **Water infiltration.** When infiltration is inadequate, surface sealing and puddling under the emitters takes place, and vines show water stress even when water is supplied in adequate amounts. One major cause of low infiltration is the use of low salinity water. (We are more familiar with high salt water problems, but as the author points out, too low – less than 0.2 dS/m-, is also problematic) ("S" stands for "siemen", a unit of electrical conductivity. Because this is quite large, a decisiemen, dS, is often used). Calcium, regardless of the carrier, added continuously to the irrigation water, can double or triple the infiltration rate. A common practice in the San Joaquin Valley is the application of finely-ground gypsum (calcium sulfate) at rates of 2-4 meq/l with specially designed equipment. Alternatively, calcium acetate, which is useful to improve infiltration and to increase acidity, can be used. And finally, an important warning from the author: fertigation with K tends to decrease infiltration rates.

Even though the research presented in this review was conducted several years ago and is not, therefore, intended as a recipe, we think the general tips offered here could be instructive and helpful. William Peacock is the U C Davis Cooperative Extension Viticulture Farm Advisor for Tulare County, California, has many years of experience with grapes and is considered one of the leading experts in raisin-, table- and wine-grape production. For another of the author's publications on nitrogen sources in the vineyard, see: [http://cetulare.ucdavis.edu/newsletterfiles/Grape\\_Notes10882.pdf](http://cetulare.ucdavis.edu/newsletterfiles/Grape_Notes10882.pdf) or visit his website: <http://cetulare.ucdavis.edu/Viticulture/>

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