



Tree and Vine Newsletter

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Potassium Nutrition in Vineyards

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Potassium in Vines

Potassium (K) is required by plants in large amounts. It has a major role in many plant processes, such as promoting root growth, increasing fruit size, and providing key features in metabolism that include the formation of starch, translocation of sugars, stomata regulation, and the formation of xylem vessels. The K concentration in grapevines can range from 1 to 4% on a dry weight basis, depending on the tissues and time of sampling. Harvest removes about 5 lbs. K/ton of grapes, although this varies, based upon the rootstock and cultivar being grown. Varieties with high K demand, such as Cabernet Sauvignon, Merlot, Cinsaut, or Syrah, should not be grafted to rootstocks prone to K deficiency if soil levels are low. UC research has shown that vines on rootstocks with *Vitis berlandieri* genetic background, such as 420A, 110R, 5BB, 5C, and 1103P are sensitive to K deficiency. Freedom, 1616C, SO4, and 039-16 are examples of rootstocks that provide high K to the scion vines.

Annual soil analyses are of relatively little value in determining vine K needs since there are so many other factors that affect uptake and utilization, including soil type, texture and depth; amount of soil compaction; root pest damage; variety; rootstock; irrigation practice; and crop size. Petiole analysis has been the main tool for assessing K status and the need for K applications to vines. Petioles are usually collected at bloom from leaves opposite the cluster position on the shoot. Vines are generally sufficient at 1.5 to 2.0%, and deficiency may occur at 1.0% or less. Though it is not a completely reliable tool for making K management decisions, petiole analysis is the most consistent guideline currently available.

Potassium Deficiency

Grapevines tend to show K deficiency when they are heavily cropped and maintenance applications of K have not been made in the vineyard. Deficiency can be more likely to occur under these conditions:

- Soil cut areas
- Areas where the K-rich surface soil was removed during land leveling
- On sandy soils that have low native K fertility
- On clay soils of certain geologic origin
- Shallow soil areas
- Poorly drained soils
- Where soil pests have caused root problems
- Water stress can also increase this deficiency by reducing vine uptake of K – keep this in mind when using deficit irrigation on red grapes.

Deficiency symptoms can appear in early spring in cool, wet years, into June, but mild deficiencies will not be seen until just before harvest. The first symptom is a fading of green color at the leaf edges and between the main veins, while leaf margins tend to curl upward. The leaves may turn chlorotic and begin to turn brown on the margins, and some leaves may die as the deficiency becomes more severe. Severe K deficiency also reduces vine vigor and crop yield, and can result in defoliation.



K deficiency

Oftentimes petioles can remain attached as blades defoliate. Vines also tend to have fewer and smaller clusters that are tight, with unevenly colored, small berries.

Local Soil Composition and K Fixation in Soil

Soil composition plays a large role in which areas of a vineyard are K deficient. K ions are strongly adsorbed on clay; without this adsorbing ability, the soluble K in sandy soils is easily leached from surface soil. Therefore, sandy soils or sand streaks often have less plant-

available K.

Soils high in clay or silt content may also need added K because of their K fixing capacity. In K fixation, clay minerals remove K from solution by trapping it on sorption sites within the mineral layers. Many soils in the San Joaquin Valley have high K fixing capacity and can tie up 50% or more of added K fertilizer. This K is not lost, but rather stored between layers of clay and slowly released in soil solution as exchangeable K. However, most will not become available fast enough during times of high K demand, especially following veraison. The actual K available for plant uptake represents a very small fraction of the total K in soils – it is found in the soil solution and on the cation exchange sites of both clay particles and humus. This is why soil K levels have generally not been reliable criteria for indicating the actual K status of grapevines.

The major clay minerals responsible for K fixation are illite, weathered mica, smectite, and vermiculite. Soils high in vermiculite are found on the east side of the Central Valley of California including in the Lodi wine grape district, especially on landscapes with soils deriving from granitic parent material and that are weakly to moderately weathered. Vermiculite is a clay mineral, but actually it can be found in the silt and fine sand size fractions, which explains why coarse-textured soils are often found to fix K. In recent years, graduate students and staff in the UC Davis laboratories of Drs. Randy Southard, Toby O’Geen, and Stu Pettygrove have examined the K fixing capacities of soils in Sacramento and San

Joaquin counties and have developed a map of five general regions with similar “soilscape” characteristics. These regions help predict the likelihood of soil's K fixing capacity. Soils with a high K fixation potential may need greater K applications to reverse any deficiencies. We are currently comparing fertilizer applications in vineyards having high and low soil K fixation in both Sacramento and San Joaquin counties.

Potassium Fertilization

Response to a K fertilizer strategy may be influenced by several factors, including soil type and depth, variety, rootstock, cropping pattern, time of year and irrigation system or general growing conditions, especially if in a drought or a heavy rainfall year.

The particular form of K fertilizer chosen offers no inherent advantage as grapevines don’t care how their needed K becomes available, only that it is available. However, particular formulations of K do offer advantages to growers, such as cost and convenience of application vs. possible soil effects (e.g., acidification of soil, salinity, etc.). Foliar sprays for K are not without benefit, but at best they reduce foliar symptoms, at great cost.

K can be applied in the fall as long as field access is possible. Early spring applications in bulk or through drip systems can be as effective, depending on formulation and timing.

For a comparison of some general formulations of K fertilizer see the table below:

| Potassium Product | % K ₂ O* | % K | Advantages and Disadvantages |
|--|------------------------|-----------|--|
| DRY FORMS | | | |
| Potassium sulfate K ₂ SO ₄ | 53 | 43 | Most popular due to safety to plants and high K content; contains 18% sulfur. Low solubility limits liquid formulation; readily applied with gypsum solution applicators for drip. |
| Potassium chloride KCl | 62 | 51 | Highest K analysis and lowest cost; high solubility for liquid formulations. Chloride can cause salt injury. |
| Potassium nitrate KNO ₃ | 46 | 38 | Contains 14% N. Most expensive dry form. |
| Potassium-magnesium sulfate, K ₂ SO ₄ · 2MgSO ₄ | 22 | 18 | Contains 10% magnesium (Mg) to offset potential Mg deficiency. High cost for K content; Mg may interfere with K uptake. |
| LIQUID FORMS | | | |
| Potassium thiosulfate K ₂ S ₂ O ₃ | 25 | 21 | Contains 17% sulfur; acid-forming for alkaline soils. |
| Potassium carbonate K ₂ CO ₃ | 30 | 25 | High pH is suitable for acid soils; high solubility for liquid formulation and drip irrigation. |
| Potassium sulfate K ₂ SO ₄ | 8 | 7 | N (as ammonia) is commonly included in the formulation to assist K ₂ SO ₄ solubility. |
| Potassium chloride KCl | 8 or 10 | 7 or 8 | Most economical liquid formulation. Often sold with 2% N content. |

*Multiply K₂O (called *potash* by the fertilizer industry) by 0.83 to determine actual K content.

Source: Raisin Production Manual. 2000. Pub. #3393;

Generally, K use by grape vines can be as much or more than annual N demand, but the need for K applications is often not as critical as N. This is because K doesn't leach from the soil profile as readily as N and certain soil types provide enough K for fairly long periods under moderate crop demands.

Because of the strong fixing capacity of some soils and the relatively slower movement of K, a single heavy application (a "slug") of fertilizer is needed to quickly mitigate K deficiency and show a vine response.

The method of application and formulation of K will be determined by how fast a response is needed and how long it has been since any K was applied, or whether a more maintenance type strategy is being used.

Talk with your PCA or fertilizer company about what you want to accomplish and how fast, and try to keep your winery in "the loop". Some important considerations are:

- What is the soil type?
- Are there some soil concerns, such as pH, salinity, or drainage?
- How long has it been since K was applied, if ever?
- Are symptoms present in just the leaves, in the fruit, or in certain sections of the vineyard?

- What have the yields been in recent years?
- What is the comparative cost per unit of K_2O ?
- How can the formulation of choice be applied, and at what cost?
- When do you want to apply the fertilizer?

Whether you choose a dry formulation in the fall, or dry in early spring, or liquid in late spring/summer, or a combination depends more on your operation and schedule than on critical periods of the vines' ability to use K. Do talk with your winery about your strategy as some wineries have concerns about amount or timings of K. Generally, there is no hard or fast rule on K application, amount or timing, but too much K just before or just after veraison can affect K uptake by fruit and pH. However, the interaction of available nutrients, soil type, crop load, irrigation management, variety and rootstock make it complicated to predict. All the more reason to stay in communication with your winery or grape buyer.

For more information on K composition of local soils, see "Soil-landscape model helps predict potassium supply in vineyards", Calif. Agriculture, vol. 62, no. 4, p. 195-201 (Oct.-Dec. 2008).

Use of Kocide 3000 for Fire Blight Control

Spraying copper products for fire blight control may induce russetting on Bartlett pear fruit, but Kocide 3000 (copper hydroxide) has been used by several Sacramento district growers since 2007, with good blight control and little or no additional russetting. However, spring weather from 2007 through 2009 was relatively dry. In 2010 there was substantially more spring rain, so the potential for increased russetting may have increased where Kocide 3000 was sprayed when the fruit were wet.

In 2009 and 2010 we compared spray programs using Kocide 3000 + Manzate Pro Stick vs. Mycoshield (oxytetracycline) in large-scale trials. Kocide 3000 has a reduced metallic copper equivalent (30% MCE), and less product is needed than other copper formulations.

The 2009 program used Kocide 3000 + Manzate Pro Stick (K+MPS) season-long, which resulted in significantly fewer blight strikes per tree than Mycoshield alone season-long (0.6 vs. 1.5 strikes/tree) before the second cutting, and also fewer strikes than K+MPS through April 8 followed by Mycoshield until April 21. It is likely that the presence of copper on the tissues prior to the early May rains

provided better protection from shoot strikes than Mycoshield. There were no differences in russetting.

Because frequent use of Kocide has the potential to select for resistant bacteria populations, in 2010 we compared a season-long rotation of K+MPS / Mycoshield vs. the same products rotated at the opposite timings vs. Mycoshield alone. We found no differences in either the number of blight strikes or the amount of russetting (russetting was very low in both years).

Russetting from Kocide 3000 could occur with excessive application rate or where fruit are wet when applied. In our trials, leaves and fruit were dry when nearly all the Kocide 3000 applications were made, even during the wet April of 2010. Any applications made when fruit are wet or remain wet for extended periods of time could result in russetting. Caution is warranted in the need both to rotate bactericide products and to spray copper only when fruit are dry.

New Online Evapotranspiration Forecast Product

The University of California, the Calif. Dept. of Water Resources, and the National Weather Service (NWS) have developed a new reference evapotranspiration (ET_o) forecast tool with the NWS office in Sacramento. The ET_o forecast is now online at <http://www.wrh.noaa.gov/forecast/evap/FRET/FRET.php?wfo=sto>. The map is quite impressive. You can select the day of the week (starting with the current day), and it will show a color map indicating the ET_o rates for that day. The forecast is for

up to six days in addition to the current day (CIMIS only provides ET_o up to the previous day). The NWS has also developed a useful product for growers to obtain weather trends. From the ET_o map page, click on Forecast Weather Tables in the left-hand column. You can select hourly, 3-hourly, 6-hourly forecasts for several days in tabular format. There is a lot of information there that growers want and use. The FRET values are really ET_o. It stands for forecast ET.

New Publications

Effective Vineyard Spraying: A Practical Guide for Growers

This Cornell University publication shows growers and sprayer operators how to get the best from sprayers and spraying operations. It describes how to improve deposition throughout the canopy and reduce drift, and it details airflow adjustment and nozzle orientation, methods of quantifying deposition, and maintenance and sprayer adjustments. A compact disc with the book includes video clips on nozzle selection and sprayer calibration spreadsheet-based "What-if" programs allowing growers to assess the effect of changes in operating parameters (larger tanks, multi-row machines and rapid filling) on the overall system output. For more information, visit www.effectivespraying.com.

Establishing Hedgerows on Farms

This free 7-page UC publication is available for download online at <http://anrcatalog.ucdavis.edu> (enter Search word "hedgerows"). Hedgerows consist of trees, shrubs, grasses, forbs, rushes, and sedges. This publication discusses the benefits of hedgerows to habitat, soil, and water on farms. It details developing a farm plan; selecting, analyzing, designing, and preparing the site for planting; choosing appropriate plants; and weed and rodent control. You will see on the web site that a 2002 DVD on establishing hedgerows is also available.

