VINEYARD FERTILIZATION

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Chemical Elements Essential to Plant Growth

There are 16 elements known to be absolutely necessary for normal growth and fruiting of green plants. They are:

Major Elements (used in relatively large amounts)	Minor or Trace Elements (required in very small amounts)
carbon	boron
hydrogen	manganese
oxygen	copper
nitrogen	zinc
phosphorus	molybdenum
potassium	chlorine
sulfur	
iron	
calcium	
magnesium	

The carbon used by green plants comes from the carbon dioxide in the air. Hydrogen and oxygen come from water which is absorbed from the soil. All the other elements are dissolved and enter the roots with the absorption of the water.

Elements Found Deficient in San Joaquin County Vineyards

Nitrogen - Essential element for building material in the plant. It promotes rapid vegetative growth and gives plants a healthy green color. It is essential for the quality and quantity of leaves. Nitrogen is the most likely element to be deficient.

Symptoms of a nitrogen-starved grape vine:

1. Short shoot growth
2. Small petioles and leaves
3. Pale yellow leaf color

Note: Vineyards may be deficient in nitrogen without expressing the above symptoms. Also yields could be reduced if nitrogen is lacking.

The best method to determine the nitrogen level in your vineyard is the petiole tissue analysis at bloomtime. (For details of petiole sampling, etc., see: Tissue Analysis--A Guide to Vineyard Fertilization.)

Form of nitrogen (N) to use? The form or type of N applied makes no measurable difference in the effect on the vines. Therefore, apply the cheapest form available. Grapevines use nitrate-nitrogen. This form of N should be in the root zone when spring growth begins because conversion of nitrogen in organic matter and ammonia compounds to nitrate must be carried out by microorganisms (soil bacteria). "Nitrosomonas" bacteria convert ammonia to nitrite nitrogen. Then nitrite nitrogen is converted to nitrate nitrogen by "nitrobacter" bacteria.

When should nitrogen be applied? The grapevine is similar to most tree fruits in its seasonal demands for nitrogen, the greatest amounts being needed during early spring growth and through the period of blooming. After the crop has set, the nitrogen supply should be only great enough to provide for an adequate, but diminishing, shoot growth and a healthy leaf surface. Excess nitrogen during ripening tends to divert the sugar produced by the leaves to continued shoot growth. In such cases, especially when excess nitrogen is combined with abundant water supply, vegetative growth may continue so late into the fall that the vine does not have time to mature its shoots before frost occurs and a serious die-back of canes may result. Also, since the grape's root system is deep and widespread, controlling nitrogen availability is more difficult with vines than with shallow-rooted annual plants. Thus, late spring or early summer applications should usually be avoided.

Nitrogen should be in the root zone when spring growth begins. The time of application will be influenced by soil texture, rainfall, and the practicality of getting into the vineyard with equipment.

In the San Joaquin Valley all forms of nitrogen may be applied in January and February. Where a midwinter irrigation is the rule, it is best to apply the nitrogen one or two weeks before irrigation. This allows the soil microorganisms time to convert all forms to nitrate, which will then move downward with the water.

Midwinter applications may use the cheapest form of nitrogen available. If for some reason application is delayed until bud-break, ammonium sulfate or ammonia forms should be avoided, since movement of this material into the root zone may be delayed. Urea, if irrigated within one or two days, and nitrate forms will move downward as soon as water is applied, whereas ammonium forms and ammonia gas are not free to move downward with water until they are wet enough to stick to the soil particles and have undergone microorganism oxidation to nitrates, which requires one to two weeks.

How do you figure out the cheapest form of N?

Example: Compare ammonium sulfate at $84 per ton with urea at $170 per ton. Ammonium sulfate is 21% N; urea is 45% N.

1. Determine lbs. of N/ton
   Ammonium sulfate - 2000 x .21 = 420
   Urea - 2000 x .45 = 900

2. Determine price per lb. of N

$$\frac{\text{Price/Ton}}{\text{Lbs. N/Ton}} = \text{Price/lb. of N}$$

Ammonium sulfate $\frac{\$84.00}{420} = 20$ cents/lb. of N

Urea $\frac{\$170.00}{900} = 18.9$ cents /lb. of N

Urea is the cheapest form in this example.

How much actual N to apply? Normal amounts for vine maintenance:

Wine grapes - 40 to 60 lbs/A

Tokay table grapes - 30 to 40 lbs/A

Excess N will result in delay of flame red color.

Zinc - Zinc is a micronutrient which vines need only a small amount of--one-half pound of actual zinc per acre. However, zinc deficiency ranks second to nitrogen deficiency in number of acres affected in California vineyards. Zinc problems are found in vineyards on sandy soils; old corrals and barnyard areas; on vines grafted onto the rootstocks Salt Creek and Dogridge. Symptoms usually appear in early summer.

Deficiency symptoms are

- --Small size leaves (called "Little leaf")
- --Chlorotic pattern in leaves: veins green, inter veinal areas are yellow
- --Petiolar sinus is widened (the leaf indentation where the petiole is attached)
- --Leaf symptoms are first found on primary and secondary shoot tips
- --Straggly clusters; many shot berries

Correcting Zinc Deficiency

Daubing - On spur-pruned varieties, the common treatment is to daub pruning cuts with a zinc sulfate solution (1 lb. of 36 per cent metallic zinc in 1 gal water). Pruning must be timed when little or no bleeding occurs. Avoid applications during freezing weather if the vines are dry. This could result in excess absorption and killing of terminal buds. Daub cuts as soon as possible--at least within 3 hours after pruning.

Foliar Sprays - Foliar zinc sprays can be used for cane pruned varieties, or for young vines that have few pruning cuts. Zinc foliar sprays are usually only moderately successful in correcting the deficiency. To improve set, apply the zinc spray three weeks before bloom. Wet the under surface of the leaves. Zinc stunted vines will require additional applications during the growing season. For amounts applied, follow label directions on these prepared zinc spray compounds.

Zinc Injection - Severe zinc deficiency may require injection of a zinc sulfate solution.

Where is it beneficial?

- --Chronic zinc deficiency problems found
  - --in sand pockets
  - --in old corral spots
  - --where daubing and zinc foliar spraying fails

How does it compare with trenching or furrow-placement techniques?

- --More immediate response
- --Uses half the rate of zinc sulfate per vine as used in furrow-placement
- --Deeper placement of the zinc

What depth of application?

- --18-30 inches, depending on root distribution and soil depth

What type of applicator?

- --Injections are made with a hand-held gun attached to a high-pressure orchard-type sprayer operated at 5 gpm at 250 psi. The gun consists of 3/4-inch galvanized steel pipe connected to form a "T"-shape, with a

pressure-type quick-shutoff valve attached to one end of the handle. On the tip of the gun is a 24-inch section of 3/8-inch pipe. An 8-inch diameter back-splash plate is attached to the pipe 18 inches from the tip.

How to apply?

--Dissolve 1 pound of zinc sulfate (36%) per gallon of water in the spray tank.
--Calibrate to determine number of seconds it takes to apply one gallon (1 pound of zinc sulfate).
--Apply needed gallonage per vine to achieve the desired zinc rate.
--Make injections 12 to 24 inches from vine. Normally 3 to 6 injections are made per vine, spacing these injections around the vine.

What rate?

--1- or 2-year-old vines use 1/2 gallon (1/2 lb. zinc/vine)
--3- or 4-year-old vines use 1 gallon per vine (1 lb. zinc/vine)
--Old vines use 2 to 3 gallons per vine (2-3 lbs. zinc/vine)

Maximum response from these treatments is in 2 to 4 years. However in tests, vines have been free of symptoms for 6 years. Once the deficiency is corrected, the vines show a degree of permanent improvement.

When to apply?

--Dormant season is safest.

Potassium is an essential element for vine growth, and all fruit crops have a heavy demand for potassium. However, most California soils have good supplies of potassium. Deficiency symptoms are found in a few vineyards in San Joaquin County.

Deficiency symptoms

--Begin to appear in early summer on leaves in the middle part of the cane
--Fading of leaf color, beginning at the leaf margin
--As it progresses, the fading continues into the areas between the veins
--Marginal burning and curling of leaves either upward or downward
--Leaf fall is premature
--Small tight clusters with small unevenly ripened berries
--True potassium deficiency usually occurs in areas that have been heavily scraped in land leveling

A soil may have adequate potassium supply but leaf and fruit deficiency can occur where root growth is seriously restricted because of severe overcropping, phylloxera, nematodes, hardpan, or poorly drained soils.

Correcting Potassium Deficiency

--Apply 3 or 4 pounds of potassium sulfate in a deep furrow next to the vine. (Apply half of this amount on each side of the vine.)
--Apply potassium sulfate in early winter. Leave the furrows open so rain can move this element into the soil. Apply first irrigation in these furrows.

Boron is a micro-nutrient. Vines need very little of this element.

Symptoms of boron deficiency

Leaf and shoot symptoms:
--Normal growth until near bloomtime

--Shoot tip leaves show a mottled or uneven fading of green color which soon develops into yellow streaks between the veins. These yellow areas become more striking in advanced stages and may turn red with some varieties.
--Leaf symptoms may resemble measles, but can be distinguished in two ways:
  --with boron deficiency the leaf pattern is found only on terminal leaves
  --with measles one can usually find some fruit spotting characteristic of that disease.
--Shoot tips cease to grow and are stunted, then numerous laterals may push out to give the vine a characteristic shape. The shoots become unusually brittle. In vineyards where deficiency exists, not all vines are equally affected, and affected vines can often be spotted from a distance because of their short, bushy appearance.
--The leaf pattern may tend to fade and become almost undistinguishable late in the year, and secondary growth may hide the more obvious symptoms.

Fruit symptoms:
--On severely infected vines there is no crop. It appears to burn off or dry up around blossom time.
--Sometimes only the dry, dead stems are left and sometimes stems with occasional berries or very ragged clusters are found.

Where to look for symptoms

--Symptoms may occur throughout a vineyard on many vines or only a few. The most likely place to see symptoms is either in a weak spot due to phylloxera or in young vines one or two years old. Hillside vineyards are particularly susceptible.
--In sandy soils where large heads of irrigation water are applied (at the beginning of the run).

What to apply

There are many materials containing boron on the market and they will vary in their actual boron content. The boron content is usually expressed in terms of per cent boron oxide, B_2O_3, or the strength relative to that of borax which is rated at 36% B_2O_3.

One ounce of borax per vine will correct the deficiency. Rates higher than this are likely to cause toxicity symptoms. Where a more concentrated material is used, the amount applied should be cut down proportionately. Small differences in concentration may be ignored. That is, the one-ounce-per-vine rate may be used with all materials varying from about 33 to 46 per cent B_2O_3. One-half-ounce-per-vine rates are advised when using materials as high as 55 to 65 per cent B_2O_3.

How to apply boron fertilizers

Actually weigh out the proper amount per vine and find a container if possible which will hold just that amount when level full. The boron may be surface broadcast. Do this by walking up to each vine and ringing it with the fertilizer at about 2 to 4 feet from the trunk.

OR, apply with a weed spray rig (properly calibrated).

When to apply

As soon as practical in the fall--usually as soon as the vines have lost their

leaves. There is no danger of this material being washed away; the winter rain will carry the material into the soil, but considerable rain is needed.

How often to apply

We have no experience under our conditions as to how long an interval there will be between applications. Trials are in progress. Applications should definitely not be made every year, as harmful amounts will build up in the soil.

CAUTION: Be careful in applying boron. Excess boron can cause a toxic condition which is most difficult to correct.