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Boron Deficiency in Grapes

Information summarized from "Grapevine nutrition and fertilization in the San Joaquin Valley"-Pete Christensen, Amand Kasimatis, and Fred Jensen. UC ANR pub. 4087 (the "black book")-now out of print.

Why boron (B) is important in plants: functions in the differentiation of new cells-with B deficiency, structural parts of cells are not properly formed. Regulates the carbohydrate metabolism in plants. B deficiency in grapes can drastically affect vine growth and fruit set by limiting pollen germination and normal pollen tube growth.

B in soil: Native B is mostly in the form of borosilicate minerals, which resist weathering and release B slowly. This is especially true of foothill soils formed from igneous rocks of the Sierra Nevada which is low in total B. Much of the available B is held by the organic and clay fraction of soil-through "complexing" and anion adsorption. Therefore, B is less leachable than are other neutral or negatively charged plant nutrients. B deficiency also occurs on sandy soils, in low spots or near irrigation valves where excessive leaching with irrigation water occurs. Vineyards irrigated with canal water originating in the Sierra Nevada are subject to B deficiency, as are those receiving well water with low B.

Root effect: any condition which limits the roots ability to pick up B can induce deficiency. Nematodes, phylloxera, and drought stress are sometimes associated with B deficiency symptoms.

Petiole analysis:
Deficient at < 25 ppm
Questionable at 26-30 ppm
Adequate at > 40 ppm
Possibly toxic at 100-150 and above (confirmed with blade analysis, presence of symptoms, and/or soil analysis)
Toxic at > 300 in leaf blades
B levels don't vary much along shoot or during the growing season, except in soils with excess B, then petioles increase during the season. B does accumulate in blades, so it is higher in older leaves in high B soils.

Symptoms: B deficiency is easily confused with other disorders (petiole analysis helps determine). Two types of deficiency: 1.) temporary, early spring and 2.) early to mid-summer deficiency.
1.) Temporary, early spring deficiency: stunted, distorted shoot growth, zig-zagged, appears after bud-break, numerous lateral shoots from stunted shoots, then shoots elongate normally by late spring. More common after low rainfall winters or in shallow soils (think caused by drought induced deficiency). Lower leaves can be misshapen, symptoms differ among varieties: Grenache-fan shaped leaves with internveinal chlorosis; Chenin blanc-leaves have wide fan-shaped appearance and prominent veins; Barbera-leaves are more rounded but misshapen appearance.

2.) Early to mid-summer deficiency: Occurs more consistently year to year than early spring deficiency. Symptoms appear in around June -severely affected vines have no crop. Clusters appear to burn off or dry around bloom time. Poor set-clusters can have normal sized as well as shot berries. Berries are very round to somewhat flattened, instead of the oval or elongated normal berries in most varieties. Can be confused with Zn deficiency-Zn deficiency caused shot berries of normal shape, and most remain hard and green. Leaf symptoms include a mottled yellow color between veins that may develop into a "burned" look. Can be confused with Esca-but B deficiency shows primarily on younger leaves. Shoot tips may stop growing and die, resulting in excess lateral shoot growth.

Correcting B deficiency: (Note higher than recommended rates can cause toxicity). Because B deficiency can drastically affect fruit set and vine growth, and the cost of treatment is relatively low, B fertilizer application is recommended over entire vineyard blocks that have a deficient spot or as "insurance" against deficiency if you know you are generally low on B. Petiole analysis can help confirm B deficiency and your need for a B fertilizer program.

Boron Fertilizers: Industry used to express B as percent of boron trioxide ($B_2 0_3$) but now it is common for labels to state the amount of *actual* B, i.e. Solubor (U.S. Borax) contains 20.5% actual B, the label states that 4.9 lbs of Solubor provides 1 lb. of boron. Solubor D.F. (formulated for foliar spray solutions) contains 17.5% B, so 5.7 lbs. of Solubor DF provides 1 lb. of actual boron.

The basic recommendation is 1lb. actual Boron/acre/year for soil application(equivalent to 5 lbs. of 20% formulated B fertilizer) with amounts adjusted to frequency of application, local experience, rainfall amounts, irrigation practices, and results monitored through tissue testing. Soil applications can be made during the fall or winter to allow winter rains to carry in the fertilizer.

Boron can be successfully applied through the drip using fertigation at a rate of 1/3 lb per acre annually for two years to correct a mild deficiency, depending on the leaching potential a higher rate may be needed.

Foliar sprays can also be used to correct B deficiency, either as an emergency treatment or as a method of vineyard maintenance. Work done by Christensen, Beede and Peacock showed that B can be applied safely to foliage in the fall, postharvest (but while a good canopy remains), at a rate of 1 lb. actual B per acre. Alternatively, spring and summer sprays can be applied but the rate should be reduced to ½ lb. per acre per application because young foliage is more sensitive to phytotoxicity, not to exceed 1 lb. per acre for the season.