University of California Cooperative Extension • Tulare County

# Grape Notes

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## Meeting Announcement

**SAN JOAQUIN VALLEY TABLE GRAPE SEMINAR**

**Wednesday, February 18, 2004**
**Visalia Convention Center**
**303 E Acequia Ave, Visalia, CA**

***See enclosed program and registration form***

## Research on Drip and Foliar Applied Boron

Bill Peacock, Pete Christensen, & Bob Beede*

Boron (B) is unique among the micronutrients because of the narrow "acceptable" range of soil B levels that fall between deficiency and excess (toxicity). For example, the B needs of the grapevine are satisfied when the soils saturated extract contains only 0.15 ppm B; whereas, toxicity can occur when concentration reaches 1 ppm B. In grapevine leaf tissue, deficiency can occur when concentrations are below 30 ppm while 80 ppm or more suggest toxicity. The goal of B fertilization is too keep soil and tissue levels within this narrow range.

Boron deficiencies occur on the east side of the southern San Joaquin Valley on alluvial and colluvial soils with igneous parent material (mostly granite) from the Sierra Nevada Mountains. In igneous rocks boron content is low and bound in borosilicate minerals, which are resistant to weathering and release B slowly. Boron is never found in its pure form in nature but is combined with oxygen, sodium, silicon, calcium, and water to form minerals. In soil, available B is held by the organic and clay fraction through complexion and anion adsorption, thus B levels are lowest in sandy, low organic matter soils.

Boron deficiency is not common on the east side of the San Joaquin Valley. When symptoms of deficiency occur, it is usually found on sandy soils, in low spots, or near irrigation valves where excessive leaching with irrigation water occurs. Vineyards are subject to deficiency when primarily irrigated with canal water originating in the Sierra Nevada or well water low in B content or during high rainfall years. Deficiency levels that do not result in symptoms expressed in the foliage affect fruit set and yield. Therefore, fertilizing the vineyard is warranted when tissue analysis suggests than B levels are approaching deficiency or when symptoms of deficiency are noted, even in a few vines. The cost of treatment is relatively low and B deficiency can drastically affect yield.

Boron toxicity on the east side is rare and almost always associated with over fertilization with B. Boron toxicity, however, can be a

serious problem on the west side of the San Joaquin Valley and in coastal districts. Soils in these districts have parent material associated with the marine sedimentary rocks of the coast range that have a high B content. Boron minerals such as borax, kernite, ulexite, and colemanite can be plentiful in dry lake and seas bottoms and associated sedimentary and metamorphic rocks. Boron in the form of borax and kernite has been mined in Kern, San Bernardino, and Lake Counties from shale and dry lakebeds.

**Deficiency Symptoms:**

Boron deficiency occurs when uptake from soil is inadequate to support new growth. The most serious and common effects are on berry set and growth. In severely affected vines, a poor fruit set at bloom can result in almost no crop. More moderately affected vines will have many clusters that set numerous "shot berries" that are distinctive in size and shape. Shot berries are uniform in size and round to somewhat flattened on the ends, "pumpkin" shaped, and they ripen uniformly. Mildly deficient vines may only show fruit symptoms, demonstrating that fruit set is the vine function that is most sensitive to low B. Foliar symptoms will appear as the severity of deficiency increases. Affected leaves show irregular, yellowish mottling between the veins. Some shoot tips stop growing and die. After a few weeks, vines resume normal growth, which hides the symptomatic leaves.

**Toxicity Symptoms:**

Toxicity on the east side of the San Joaquin Valley is associated with excessive B fertilization. Leaf symptoms associated with toxicity are quite distinctive. In the spring, young leaves will show downward cupping and puckering becoming contracted and wrinkled. These symptoms are most commonly observed when foliar B is applied in amounts greater than ½-pound B per acre in a single application (2 ½ -pounds 20.5% B soluble product per acre). Boron uptake by the sprayed tissues is rapid. However, vines quickly outgrow symptoms resulting from foliar application of B, and within a few weeks affected leaves are obscured by new, healthy, vine growth. Fruit set and berry development do not appear to be negatively affected. However, foliar symptoms can be much more protracted when B is applied in excess to the soil and production can be negatively affected.

Midsummer or late summer symptoms of boron toxicity are a brown speckling pattern adjacent to the leaf margin of mature leaves. Mature leaves show little cupping but the necrotic specks near the leaf margin can become so numerous that they seem to be continuous from the edge inward. Midsummer and late summer symptoms indicate excessive soil B. Correction requires additional irrigation to leach the excess B from the root zone.

**Research on drip applied boron:**

Studies were conducted during the 1998 and 1999 season in a mature Thompson Seedless vineyard on Cajon sandy loam in Tulare County. The soluble B product (20.5% B) was applied to an excavation beneath drippers simulating fertigation. Boron was applied at different rates three weeks prior to bloom on May 18, 1998. This was repeated the following year, again about three weeks prior to bloom on May 3, 1999. The experiment was designed as a randomized complete block with five treatments, five blocks, and five vine plots.

Boron drip irrigation treatments were as follows:

Pounds boron applied per acre over 2-year treatment period, 1998 and 1999.

| TREATMENT | 1998 | 1999 | TOTAL |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 1/3 | 1/3 | 2/3 |
| 3 | 2/3 | 2/3 | 1 1/3 |
| 4 | 1 | 1 | 2 |
| 5 | 1/6 | 2 [1] | 2 1/6 |

1. The 2-pound rate was applied to evaluate potential toxicity.

Tissue samples were collected at bloom and veraison in 1998 and 1999 to evaluate rate of B uptake and the accumulation of B in tissue with

consecutive years of fertilization. Samples were again collected two years later in 2001 to evaluate carryover.

This study demonstrated that 1-pound actual B per acre (5 lbs. 20.5% B soluble product) can be safely applied to mature vines through drip irrigation, even in a single application. But, annual application of 1-pound B per acre applied for three or four consecutive years will probably result in toxicity. For maintenance, apply 1-pound through the drip system every three or four years or ¼ to ⅓-pound every year. Tissue sampling should be used to fine tune fertilizer amounts and avoid toxicity. Rates should be reduced when bloom petiole levels reach 50 ppm B or blade levels reach 80 ppm B. Toxicity is indicated when bloom petiole and blade B concentration exceed 80 and 120 ppm, see Table.

Vine uptake of drip-applied B is fairly rapid after application during the growing season: leaf tissues were significantly increased in three weeks with ⅔ and 1-pound B per acre rates applied pre-bloom in our studies. However, it may be advisable to apply some or all of the B in the fall in order to ensure that primordial shoot and inflorescence tissue in the buds is not affected by deficiency.

Apply no more than 1-pound B per acre per year for safety, and never apply the full rate to young, immature vines. One-year-old vines should not be fertilized with more than ⅓-pound of B per acre; two-and three-year-old vines should not be fertilized with more than ½ and ⅔-pound B per acre per year, respectively. These more conservative rates are because of the known efficiency of fertilizer delivery with drip irrigation and grower experience of B toxicity in new plantings.

**Research on foliar applied boron:**

Studies were conducted in 1998 and 1999 in an own-rooted, furrow irrigated, Thompson Seedless vineyard on Delhi loamy sand. The Kingsburg area vineyard was selected due to the observance of severe boron deficiency symptoms in 1997. Boron was applied to the foliage at different stages of vine development. Fall foliar sprays contribute to soil B levels once leaves fall and mineralization occurs. To differentiate foliar and soil contributions to vine uptake from the fall foliar treatment, a dormant soil application was included in the experiment. Boron treatments were all applied at 1 lb. B per acre as 20.5% B soluble product. Trial design was a randomized complete block, with five blocks and five treatments and using 5-vine plots. Boron foliar and soil treatments were as follows:

1. Control, untreated.
2. Fall foliar, Oct. 19, 1998.
3. Soil application as a berm spray, Feb. 8, 1999.
4. Prebloom foliar, May 4, 1999.
5. Bloom foliar (50% caps off), May 20, 1999.

Fruit response to treatment was determined by visually grading individual clusters for the presence of boron deficiency symptoms on August 15, 1999. This included as assessment of reduced fruit set and the presence of the characteristic, pumpkin-shaped shot berries. Fifty clusters per plot were individually scored as percent of the cluster showing the combined symptoms of fruit set and shot berries.

This study showed that correction of a deficiency might not be immediate due to restricted mobility within the plant and continued development of deficient tissues. Pre-bloom and bloom sprays were only partially effective in preventing deficiency at bloom and fruit set. Fall foliar sprays were more effective in eliminating cluster and berry symptoms the following year. This corresponded with an increase in the B content of dormant buds and suggests that low boron levels in primordial tissue in early spring can negatively affect flower cluster development.

Leaves are more tolerant of B applied at fall, and B can be applied to foliage at 1-pound B per acre in a single application with no consequence. Fall applications should be made soon after harvest for leaf and vine uptake.

Ultimately, all of the residual spray B is washed into the soil with winter rainfall, further supplying soil B for root uptake. After one or several years of treatment, there should be enough residual B in the soil to provide for a more constant uptake and long-term correction. Then, one can conveniently spray B at any time of the year to achieve maintenance.

Commercial B spray products include 10% B liquid, 17.5% B dry flowable and 20.5% B powder. All of the materials should be equally effective at the same rates of elemental B per acre. They also increase spray tank water pH and should not be combined with alkaline pH-sensitive products without pH adjustment with a recommended acidifier. Follow label instructions.

**Summary:**

Research was conducted with boron fertilization by drip irrigation and with foliar application from 1988 to 2001. New information developed by these studies follows:

- Vine uptake of drip-applied B is rapid. Boron concentration of leaf tissue is elevated within three weeks of application.

- 1-pound actual B per acre (5 lbs. 20.5% B soluble product) can be safely applied to mature vines through drip irrigation, even in a single application, but an annual drip application of 1-pound B per acre applied for three or four consecutive years can result in toxicity.

- For maintenance, apply 1-pound through the drip system every three or four years or ¼ to ⅓-pound every year.

- In severely B deficient vineyards, pre-bloom and bloom sprays are only partially effective in preventing fruit symptom. Fall foliar sprays increase B content of dormant bud tissue and are more effective in eliminating cluster and berry symptoms the following year.

- Leaves are more tolerant of B applied at fall, and B can be applied to foliage at 1-pound B per acre in a single application with no consequence.

- Monitor tissue levels to avoid B toxicity.

Potential Boron Toxicity Values for Petioles and Blades.

| Time of Sampling | Tissue | Boron (ppm) |
|---|---|---|
| Bloom Period: | Petioles | 80 |
| | Blades | 120 |
| Mid to late summer: | Petioles | 100 |
| | Blades | 300 |

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## San Joaquin Valley
## Table Grape Seminar
## Wednesday, February 18, 2004

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