Boron application in vineyards

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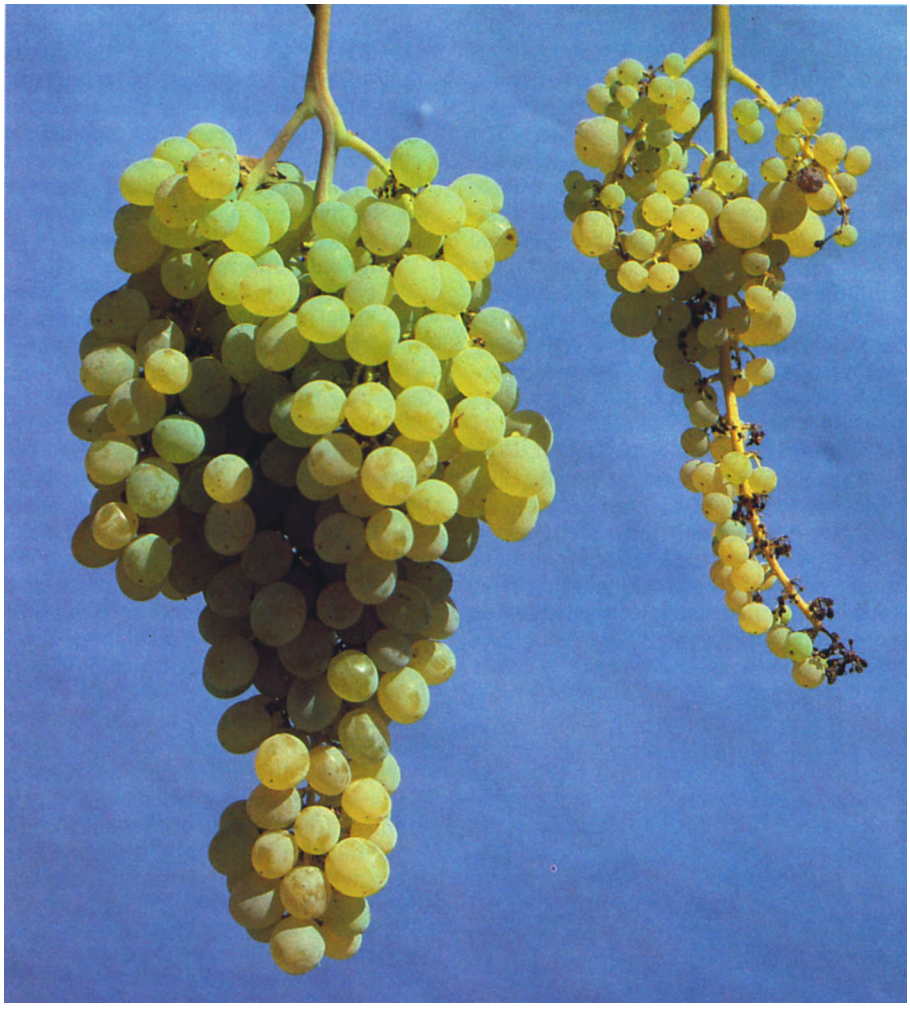
Berm sprays or hand applications are favored for small amounts needed



Boron deficiency can drastically reduce fruit set on Thompson Seedless grapes. Relatively small applications of the mineral to soil or foliage will correct the problem.

Boron deficiency is a geographically restricted nutritional problem in California. Affected vineyards in the San Joaquin Valley are primarily on soils of granitic origin on the east side of the Valley extending from northern Tulare to San Joaquin counties. The deficiency is particularly common on soils associated with the original flood plains or alluvial fans of the Kings, Merced, and Stanislaus rivers. Even in these areas, the problem is not extensive, occurring mostly on sandy or shallow soils and in low spots or near irrigation valves where excessive leaching with irrigation water occurs.

Because the deficiency can drastically affect fruit set and the cost of treatment is relatively low, however, boron fertilizer application is warranted over entire vineyard blocks that have a deficient spot or as insurance against problems in areas known to be low in boron. Relatively small amounts of boron are needed for correction, and so conventional fertilizer application equipment is not used. Hand application and spraying a boron solution on the soil surface have been the most common methods. Others include foliar spraying, aircraft application, and application with a sulfur dusting machine.

The variety of methods and lack of comparative information about them led to this four-year trial of boron fertilizer application methods, rates, and frequencies. The trial was conducted in a mature Thompson Seedless vineyard near Fresno.

Vineyard experiment

Three application methods (hand broadcast, vine-row berm spray, and foliar spray) were compared for efficiency of boron uptake on two soil types (Hanford fine sandy loam and Delhi loamy sand) during 1979-82. Thirteen-vine plots were used in a split plot design with four randomized complete blocks in each of the two soil types. The hand-broadcast treatments were only applied once in the first year, while the berm sprays were compared annually and biannually over four years. The folar sprays were applied annually.

Soil applications (hand and berm spray) were made in early January to allow winter rains to carry in the fertilizer. In hand application, the desired amount of

TABLE 1. Vine leaf tissue boron levels resulting from various application methods and rates

Method, frequency	Actual boron Rate	Actual boron Total (4-yr)	Boron, dry weight* Bloom petioles 1979	Bloom petioles 1980	Bloom petioles 1981	Bloom petioles 1982	Midsummer (veraison) blades 1979	Midsummer (veraison) blades 1980	Midsummer (veraison) blades 1981	Midsummer (veraison) blades 1982
	lb/acre		*ppm*							
Untreated control	—	—	37 c	34 c	31 bc	35 bc	57 d	53 d	50 c	52 d
Hand broadcast:										
1st yr only	6	—	54 a	44 b	35 b	40 ab	114 b	92 bc	68 bc	66 c
1st yr only	3	—	49 ab	40 bc	32 bc	37 b	97 b	67 c	56 c	55 d
Berm spray:										
1st yr only	6	—	60 a	60 a	46 a	52 a	147 a	144 a	90 ab	100 b
1st yr only	3	—	48 ab	53 ab	41 ab	46 a	120 b	116 b	75 b	80 bc
Biannually	1.5	3	55 a	44 b	47 a	52 a	92 bc	87 c	110 a	95 b
Annually	1.5	6	45 b	64 a	49 a	53 a	90 c	119 b	120 a	152 a
Foliar spray:										
Annually	0.5	2	36 c	35 c	34 b	39 ab	59 d	62 cd	69 bc	66 c
Annually	1	4	38 c	36 c	37 b	44 a	77 cd	78 c	107 a	96 b

*Mean separation by Duncan's Multiple Range test. Like letters within a column are not significantly different at the 5 percent level.

fertilizer per vine was broadcast in a circle 2 to 3 feet from the trunks. The berm sprays were applied to a 4-foot band at 50 gallons per treated acre, as in typical herbicide spraying. The foliar sprays were applied at 250 gallons per acre in May shortly after bloom. This timing was to avoid boron spray deposit contamination on the bloom-time leaf samples. A soluble sodium borate fertilizer of 20 percent boron was used in all treatments.

Separate leaf petiole and blade samples for laboratory boron analysis were taken at bloom and again at the onset of grape ripening (veraison) each year to compare uptake differences. The purpose of the bloom sampling was to duplicate the technique most often used by growers to determine nutrient deficiencies. Veraison blade sampling is most commonly used to diagnose toxicity problems, because it allows for greater seasonal accumulation in the foliage. These two sampling methods were thus used to separate out those treatments best suited to correcting deficiencies while avoiding toxicity problems (table 1). The overall averages for both soil types are used, since there are only minor differences between the soil locations.

Results

Petiole boron levels in the untreated control plots show the vineyard to be in a moderately low but adequate range, typical of many vineyards irrigated with low-boron canal and well water in eastern Fresno County. None of the treatments increased boron to toxic levels or produced visible toxicity symptoms.

Hand broadcasting boron at 3 pounds per acre significantly increased leaf blade levels over those in the control for only two years, whereas the 6-pound rate increased the levels throughout the four-year trial period. Reapplication thus appears necessary every two to three years at the 3-pound rate, compared with four to five years at the 6-pound rate.

Berm sprays increased vine boron uptake more than hand broadcasting did at comparable rates. The berm sprays also provided the greatest ultimate boron uptake if they were applied annually over the four years as compared with a first-year-only spray.

Because foliar sprays were applied after the bloom petiole sample but before the veraison sample, the bloom petiole boron levels would show only carryover effects from the previous year's treatments; veraison blade levels would better reflect foliar spray effects within any year. The higher foliar rate of 1 pound per acre significantly increased veraison leaf-blade boron levels by the second year of treatment, whereas levels in the ½-pound treatment were not significantly higher until the fourth year. Foliar spraying thus can be expected to ultimately give some carryover in boron uptake in succeeding years as well as to provide immediate uptake.

Conclusions

The results demonstrate the versatility and effectiveness of the various methods of boron application. Berm spray treatments generally increased uptake the most, probably because the fertilizer spray was more uniformly distributed over the berm surface where roots were more concentrated. Also, the berm area receives no irrigation water, which would otherwise leach some of the boron below the root zone. Boron rates thus can be lighter when applied by berm sprays than by hand broadcasting.

It was also most efficient to apply lighter rates on berms annually than higher rates every two to four years, although all frequencies down to the single initial application gave significant increases in boron uptake over the four-year period. Berm spraying would be most convenient when vine-row herbicides are applied each winter; a soluble boron fertilizer could be merely added to the tank mix.

Foliar spraying is more often used as an emergency measure against boron deficiency. It may also be used, however, to maintain or increase soil and vine levels over time, because the boron would ultimately end up on the vineyard floor at leaf fall. A soluble boron fertilizer could be added to one or several normally scheduled foliar sprays each season.

Hand broadcast application was not as effective as berm sprays in this study. It may be useful, however, on small acreages and where berm herbicide spraying is not practiced. Boron at the 3-pound-per-acre rate should be reapplied every two to three years, and at the 6-pound rate every four to five years under the conditions reported here.

The only difference between the two soil types in this study (data not shown) was that, in the berm spray treatments, total boron uptake was significantly greater and longer lasting in the fine sandy loam soil than in the loamy sand soil throughout much of the trial period. This difference may have resulted from better root activity and less boron leaching with rainfall in the berms of finer textured soil. Soil type, as well as other vineyard and water conditions, may thus affect treatment longevity and rates of application. Leaf petiole or blade samples, or both, should be taken periodically for laboratory analysis to monitor boron fertilizer uptake and to schedule retreatment. This would also help to avoid any possible toxicity due to overapplication.

It should be emphasized that these results and recommendations can only be applied to soil, well water, and rainfall conditions approximating those of the trial vineyard. Rainfall during the trial years averaged 10.48 inches annually, slightly above the historical average of 10.24 inches.

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