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Boron Boosts Pistachio Yields

California researchers find foliar applications are most effective after three-year trials. Timing of application is critical.

***Summary**: Boron supplementation applied on pistachio trees in the late dormant stage increases germination, reduces blanking as well as non-splits, and, consequently, increases yield.*

Soil applications of boron are effective in raising leaf boron levels, but are not as effective as foliar sprays at increasing yield.

Recommended rates of boron application most effective in raising yields are between 2 and 5 lbs Solubor/100 gals.

Timing of foliar applications of boron is critical. Late dormant sprays (just prior to bud swell through to 20 percent bud break) are the most effective. Enhanced yield response to boron sprays may decrease yield in the following off-year effectively enhancing alternate bearing. At the site used here, boron sprays produced a net yield increase of approximately 20 percent over two veers.

Based on the results of this work, it is suggested that pistachio growers provide supplemental boron sprays at the rate of 2 to 5 lbs Solubor/100 gals during the late dormant or early bud break stage. These recommendations are based on research in two soil types in plants with average tissue summer boron levels of 150 to 190 ppm. The validity of these recommendations in different soils and environmental conditions is being assessed.

Boron deficiency occurs widely in the fruit growing regions of California. It is a limiting element in many pistachio growing regions of the central valleys. Boron deficiency results in characteristic leaf symptoms that can be alleviated with the additions of boron fertilizer.

Boron long has been recognized as an essential element for plant growth.

However, its role and mode of action are unknown. Boron has been reported to be involved in such diverse processes as nucleic acid metabolism, cell division, sugar biosynthesis and translocation. and membrane functions. The role boron plays in the flowering and fruiting process, however, is unclear.

There is an immediate need, therefore, to understand how boron moves through the soil and plant, and

Table 1. Effect of application date of foliar boron (5 pounds of Solubor/100 gals) on pistachio yield and leaf boron, Brown et al., University of California.

Application Date	Growth Stage	Yield lbs	Leaf Boron (July) micro-g
February 28	Late dormant	64	188
March 19	Early bud break	52	188
April 3	Flowering	54	187
April 17	Leafing out	51	256
May 8	Fully leafed out	52	468

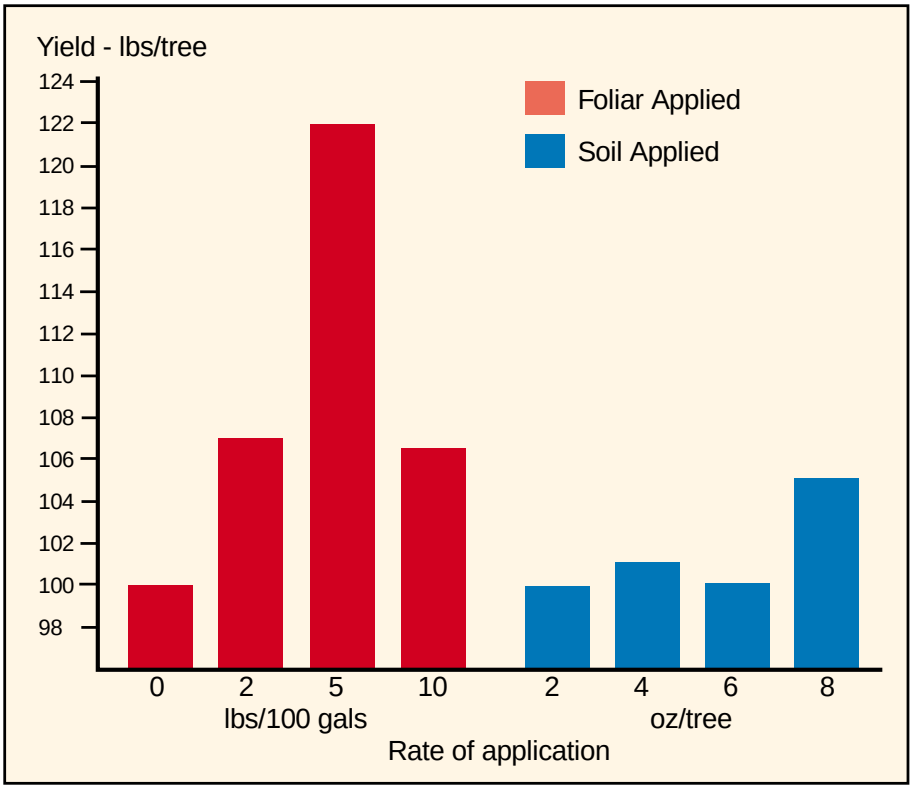

Figure 1. Influence of boron (soil or foliar) on pistachio yield, three-year average, Brown, et al., University of California.

the role it plays in the flowering process. To accomplish this and better assess the behavior of boron in plants, experiments were designed and conducted on pistachio trees by our research team from 1990 through 1992. Site of the study was the central valley of California. The results of our work, as reported in this article, are helping us to better under-stand the role of boron in plants.

Foliar feeding superior

It is clear from our trials that foliar applications of boron on pistachio trees are the most effective method to ensure adequate boron for the flowers and increase yields (Figure 1). Trees that received foliar applications through the three years of trial continue to respond to supplemental sprays.

Note in Figure 1 that the three-year cumulative yield per tree increased with foliar boron concentrations up to 5 lbs/I 00 gals, but decreased at the higher rate. It is significant that 5 lbs was shown to be the optimum rate in two of the three years. This was true even in trees growing in different soils with inherently different boron levels in their tissues.

The three-year cumulative yield for pistachio demonstrates that treatment with 5 lbs Solubor/100 gals resulted in an approximate overall 20 percent increase in yield for this period. Soil treatments did not significantly increase yield, though July boron levels should not be reduced below 120 ppm. The 20 percent yield increase is a significant economic benefit. Notably, these results were obtained in soils that were not particularly boron deficient. Greater yield response in boron-deficient regions would be expected.

Foliar sprays of boron also resulted in a decrease in the number of blanks and non-split nuts (Figure 2), which may account for part of the yield increase. Preliminary calculations suggest that the reduced number of blank nuts in the 5-lb foliar treatment may account for 65 percent of the observed yield difference. This finding clearly suggests that foliar boron increases crop yield through its effect on pollination or fertilization of the pistachio flower.

It is also evident at all times and in all treatments that the yield of trees using the Atlantica root stock was from 10 to 25 percent less than PGI (Figure 3).

Carryover

Soil. Two years after soil boron appli-cation, July leaf analysis showed a small residual effect of the earlier application. In sites with heavier soils, this carryover was even more evident. Soil applications of boron did not increase bud boron levels until one year or (in the case of heavier soils) two years after application. This indicates that soil applications of boron may not be effective in increasing bud boron concentrations in the following season.

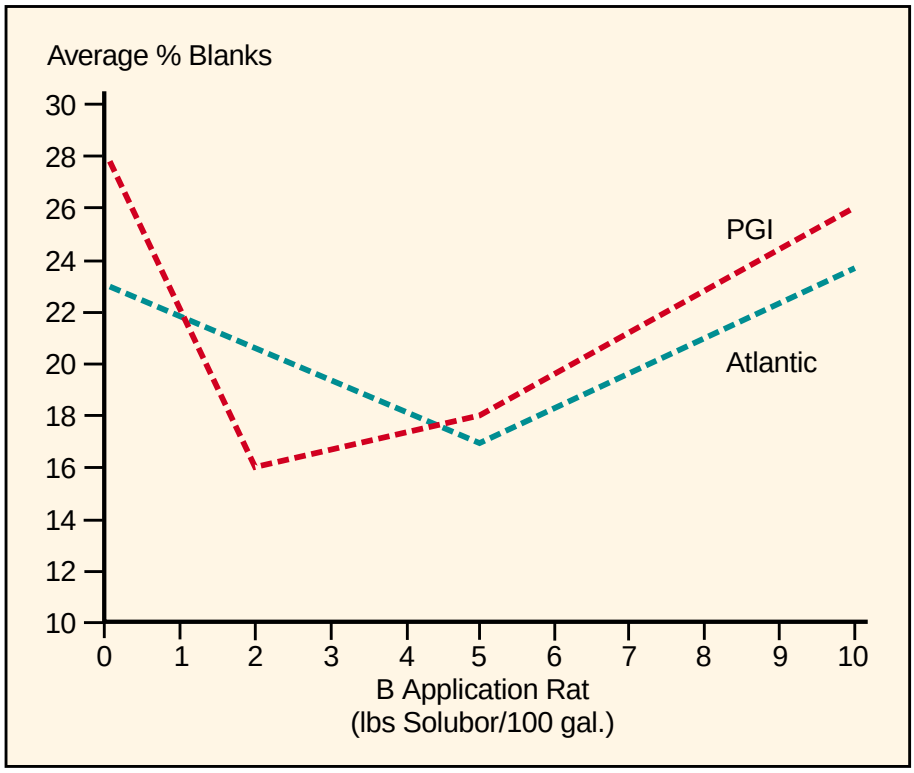

Figure 2. Effect of boron foliar treatment on percent of blanks in pistachio, Brown, et al., University of California.

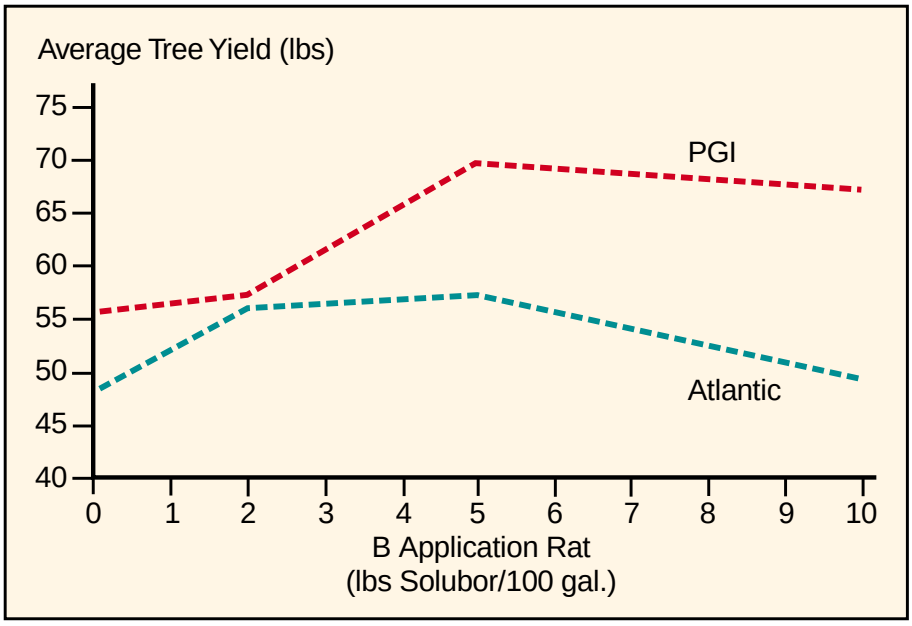

Figure 3. Effect of boron foliar treatment on yield of pistachio, comparing Atlantica and PGI rootstocks, Brown, et al., University of California.

Foliar. Foliar application of boron effectively increases July leaf boron only in the year of application. Only at very high rates does it carry over into subsequent years.

Timing critical

Timing of foliar boron spraying is critical, as is readily apparent in Table 1. Late dormant sprays (just prior to bud swell) through to 20 percent bud break are the most effective. Later sprays effectively increase boron levels in the tissue but may not enhance current year fruit yield and quality. Enhanced yield in response to boron sprays may decrease yield in the following off-year, effectively enhancing alternate bearing. At the site used here, boron sprays produced a net yield increase of approximately 20 percent over the two-year period. The effectiveness of early, but not late, boron sprays is further evidence that boron is critical for pollination or fertilization of pistachio flowers.

Procedure

The experimental site was established in 1989-1990 in boron-deficient sites near Arbuckle, CA. Four fields were used (two for soil applications; two for foliar applications). The experiment was designed as a randomized complete block with 50 replicate trees per block. Over 1,000 pistachio trees were used, divided into four groups.

In 1989-90, soil treatments were made in November at rates of 0, 2, 4, 6, and 8 ounces Solubor per tree. Foliar treatments were made in January and again in July at rates of 0, 2, 5, and 10 lbs Solubor/l 00 gals.

In the second year of this experiment, one site receiving foliar sprays and two sites receiving soil boron treatments were given no additional applications. This was done to investigate the effectiveness of fertilizer carryover on productivity. The remaining foliar site was sprayed at the late dormant stage, and again in mid-July.

In the third year, only one site received foliar treatments in March. In addition, a subset of trees was used for a spray timing trial. In this site, trees were sprayed with 5 lbs Solubor/l 00 gals at either of five dates—from late dormant through full leaf emergence.

Total yield was determined on each of 800 trees and related to boron application, pollen growth, and nut quality. Harvested nuts were sorted and the percent of blanks, non-splits, and average kernel weights were determined.

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