Effect of Foliar Boron Sprays on Yield and Fruit Quality of Navel Oranges[1]

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Abstract

A field study was designed to determine if foliar boron (B) sprays could increase fruit set and yield of 'Parent Washington' navel oranges (Citrus sinensis). Treatments consisted of two application timings (prebloom and postbloom) and five application rates 0, 250, 500, 750 and 1000 ppm B as Solubor. Leaf B levels had a significant response to both application timing and rate. There were no significant difference in fruit quality or yield.

Introduction

Boron (B) is a micronutrient that is often thought to be toxic to many crops, even at low concentrations in leaves. However, deficiency of B is equally serious, and may be a problem in Arizona citrus. Certainly, many symptoms of B deficiency are apparent in Arizona citrus.

The effects of B deficiency on vegetative growth of citrus are well known, and occur when leaf B concentrations are less than 15 ppm. Some of these symptoms include translucent or water-soaked flecks on leaves and deformation of those leaves, yellowing and enlargement of the midrib of older leaves, death and abortion of new shoots, dieback of twigs, and gum formation in the internodes of stem, branches and trunk (Reuther *et al.*, 1968). Many of these symptoms are seen in Arizona.

Furthermore, the supply of B needed for reproductive growth in many crops is more than that needed for vegetative growth (Mengel and Kirkby, 1982, Marschner, 1986; Hanson, 1991), and the same may be true in citrus. Boron appears to accumulate in citrus peel to a much greater extent than in the leaves, ranging in lemon from 1600 to 3500 $ug \cdot g^{-1}$ (Sinclair, 1984). Concentrations of B also may be higher in flower parts as well. It is entirely possible that Arizona citrus appearing to have adequate B for vegetative growth may exhibit deficiency symptoms during flowering, fruit set, and fruit maturation. In citrus, B deficiency leads to low sugar content, granulation and excessive fruit abortion (Reuther *et al.*, 1968) as well as rind thickening; symptoms that are seen regularly in fruit grown here in Arizona. Increases in fruit set from B have been reported on 'Redblush' grapefruit (Maurer and Davies, 1993) and 'Hamlin' oranges, but no response on 'Lisbon' lemons (Karim *et al.*,1996).

Materials and Methods

A field study was initiated on a block of six-year-old 'Parent Washington' navel orange trees (Citrus sinensis) on a Carrizo citrange rootstock located at the Cactus Lane, Bard Ranch north of Sun City, AZ. Treatment were arranged as a 2 (spray timings) X 5 (application rates) factorial experiment with 10 single tree replicates in a

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randomized complete block design. Treatment included two application timings of prebloom and post bloom and five boron (B) concentrations of 0, 250, 500, 750 and 1000 ppm. Applications were applied prebloom (11 March 1998) and postbloom (28 May 1998) with a handgun sprayer calibrated to deliver 200 gpa. Sodium borate (Solubor) was applied at rates of 0, 250, 500, 750 and 1000 ppm B. All treatments were applied with Activator 90 non-ionic surfactant at 0.1% v/v.

Fruit weight, juice weight, percent juice, peel thickness, total soluble solids (TSS), titratable acidity (TA), and ratio(TSS:TA) were taken prior to harvest on 28 October 1998 and 11 November 1998. Fruit samples consisted of 10 fruit/tree from four trees per treatment. Fruit were sectioned equatorially so that the peel thickness could be measured with a hand caliper and the juice extracted by hand with a Sunkist motor driven extractor. TSS was determines with a handheld temperature-compensating refractometer and TA by titration of a 25ml aliquot of juice using 0.3125 N NaOH to a endpoint of pH 8 on an auto-titrator. Leaf tissue samples collected 28 October 1998 were analyzed by a commercial laboratory for leaf B levels. Yield was determined by harvesting fruit from each tree and then weighing and counting the number of fruit.

Results and Discussion

Leaf B levels were significantly different between timing of application and rate of application (Table 1). Leaf B levels were significantly higher for postbloom applications (140 ppm B) compared to the prebloom applications (130 ppm B). In addition, there was a significant rate effect with the 750 and 1000 ppm B rates significantly higher than the other treatments. However, there was no interaction between application timing and rate. All leaf B levels were in the high range (100-200 ppm) Figure 2. Residual mortality of second instar citrus thrips on lemon foliage treated on 2 June, 1.0 inch diameter fruit for citrus (Tucker et.al., 1995). The difference between application timings can be attributed to leaf development stage at the prebloom application.

Fruit weight, fruit number and average fruit size at harvest were similar for treatments (Table 1). Likewise, fruit weight, juice weight, percent juice, peel thickness, total soluble solids, titratable acidity and ratio were similar for all treatments (Table 2).

The initial results of this experiment indicate that foliar prebloom and postbloom applications had no impact on navel oranges. However, the cooler than normal temperatures in the spring of 1998 may have contributed to an optimum fruit set and therefore the impact of foliar B sprays eliminated. The grower, where this experiment was conducted, indicated that yields were high for this particular block. In addition, another grower applied foliar B to a block of navel orange trees and felt that yields were increased. This experiment will be repeated in 1999 in an effort to determine the effectiveness of foliar B sprays for navel oranges.

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Table 1. Prebloom and postbloom boron spray applications effects on leaf B levels, fruit weight, number and size of navel oranges.

Treatment Timing	Rate	Leaf B level (ppm dry wt.)	Fruit weight (lb.)	Fruit number (no.)	Fruit size (lb.)
Prebloom	0	123	186	505	0.377
Prebloom	250	125	159	426	0.383
Prebloom	500	130	139	374	0.378
Prebloom	750	135	204	564	0.372
Prebloom	1000	140	168	502	0.352
Postbloom	0	128	133	344	0.396
Postbloom	250	133	162	455	0.373
Postbloom	500	140	156	441	0.371
Postbloom	750	140	124	342	0.375
Postbloom	1000	163	150	406	0.383
Significance					
Timing		+	NS	NS	NS
Rate		*	NS	NS	NS
Timing*Rate		NS	NS	NS	NS

NS, +, * Nonsignificant or significant at P 0.10 or 0.05, respectively.

Table 2. Prebloom and postbloom boron spray applications effects on fruit weight, juice, percent juice, peel thickness, total soluble solids (TSS), titratable acid (TA) and ratio of navel oranges.

Treatment Timing	Rate	Fruit weight (g)	Juice weight (g)	Percent juice (%)	Peel thickness (mm)	TSS (%)	Acid (%)	Ratio (TSS:TA)
Prebloom	0	1735	766	44	5.5	9.9	0.77	12.8
Prebloom	250	2010	921	46	5.8	9.7	0.75	13.1
Prebloom	500	1792	823	46	5.4	9.7	0.83	11.8
Prebloom	750	1815	821	45	5.8	9.8	0.76	12.9
Prebloom	1000	1644	742	45	5.2	9.8	0.74	13.4
Postbloom	0	1917	882	46	5.5	9.2	0.83	11.1
Postbloom	250	1875	868	46	5.3	9.6	0.79	12.2
Postbloom	500	1718	788	46	5.3	9.8	0.85	11.6
Postbloom	750	1802	816	45	5.6	9.4	0.78	12.4
Postbloom	1000	1927	890	46	5.5	9.7	0.75	13.0
Significance		NS	NS	NS	NS	NS	NS	NS

NS = Nonsignificant.