

# Evaluation of Thinning Agents for 'Kinnow' Mandarins<sup>1</sup>

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## Abstract

*An experiment was designed to determine the effectiveness of foliar prebloom boron (B) sprays for thinning 'Kinnow' mandarins (Citrus reticulata). Treatments consisted of a control and foliar B applied at 1000, 1500, 2000, 2500 and 3000 ppm. Leaf tissue B levels were not significant between treatments. Likewise, fruit quality was similar for all treatments. Fruit weight and number were significantly greater for the control compared to the 1500, 2000, 2500 and 3000 ppm B treatments for the undersize fruit. There was a clear reduction in yield as the rate of B applied increased, however, the reduction was not statistically significant.*

## Introduction

Chemical thinning of citrus trees has been practiced since the 1960's to reduce crop load for heavy or alternate bearing citrus cultivars. Naphthalene acetic acid (NAA) has been the most consistent chemical thinning agent and is currently used in Arizona predominantly for thinning mandarins. Spray applications of NAA applied about 'June drop' have been effective in reducing crop load, reducing biennial bearing and improve fruit size and quality (Hilgeman et al., 1964). The effectiveness of NAA for fruit thinning is dependant on factors such as timing of application, concentration, environmental and tree conditions as well as cultivar (Wheaton, 1981). In addition, NAA is relatively costly and the development of a cost effective thinning agent is desirable.

Chemical thinning agents tend to be erratic and consistent thinning is often difficult to achieve. In an initial study, the use of boron (B) as a prebloom spray has shown to be effective as a thinning agent which resulted in larger fruit depending on the level of thinning (Karim *et al.*, 1996). However, there is no information about the consistency of B as a thinning agent or the effects of temperature. In addition, there are other thinning agents currently being used in other fruit crops industries, which are effective at thinning fruit. The objective of this experiment is to evaluate prebloom B sprays as a thinning agent for 'Kinnow' mandarins.

## Materials and Methods

A field study was initiated on a block of six-year-old 'Kinnow' mandarins trees on Macrophylla rootstock located at the University of Arizona, Citrus Agricultural Center, Waddell, AZ. Treatments were arrange in a randomized complete block design with 10 single tree replicates. Treatments consisted of sodium borate (Solubor) applied at concentrations of 0, 1000, 1500, 2000, 2500 and 3000 ppm B. Applications were applied prebloom (13 March,

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<sup>1</sup> The authors wish to thank the Arizona Citrus Research Council for supporting this research. This is the final report for project 98-05 - Evaluation of thinning agents for 'Kinnow' mandarins.

1998) with a handgun sprayer calibrated to deliver 200 gpa. All treatments were applied with Activator 90 non-ionic surfactant at 0.1% v/v.

Leaf tissue samples collected 28 October 1998 were analyzed by a commercial laboratory for leaf B levels. Fruit weight, juice weight, percent juice, peel thickness, total soluble solids (TSS), titratable acidity (TA), and ratio (TSS:TA) were measured prior to harvest. 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 determined with a handheld temperature-compensating refractometer and TA by titration of a 25 ml aliquot of juice using 0.3125 N NaOH to an endpoint of pH 8 on an auto-titrator. Yield was determined by harvesting fruit from each tree and processed on a Greefa fruit sizer. Fruit were then counted and weighed in each size category. Sizes were > 1.75, 1.75-2.00, 2.00-2.25, 2.25-2.50, 2.50-2.75, 2.75-3.00, and 3.00-3.25 inches which represent fruit sizes of undersized fruit, small, medium, large, jumbo, mammoth and colossal fruit, respectively.

## Results and Discussion

Leaf B levels were 258, 268, 298, 328, 333 and 415 ppm B for the control, 1000, 1500, 2000, 2500 and 3000 ppm B foliar spray treatments, respectively. Although, there is a trend of increased leaf B levels with the increase B application rates there were no significant differences between treatments. Leaf B levels for all treatments were >200 ppm which is in the excess range for citrus leaves (Tucker, et.al, 1995). However, there were no visual symptoms of phytotoxicity on any of the treatments throughout the growing season.

Average fruit weight, juice weight, percent juice, peel thickness, TSS, TA and ratio (TSS:TA) were similar for all treatments (Table 1). Harvested fruit weight (Table 2) and fruit number (Table 3) were significant only for the undersize category with significantly more fruit for the control compared to the 1500, 2000, 2500 and 3000 ppm B treatments. There were no significant differences in the total fruit weight and number harvested between treatments (Table 2 and 3). The lack of statistical difference between treatments can be attributed to the variation between trees within a treatment. The trend is evident by the total fruit weight and fruit number reduced by approximately 50% at the 3000 ppm B concentration compared to the control (Table 2 and 3). The results of this initial experiment indicate that B may be an effective thinning agent for thinning 'Kinnow' mandarins. The initial data indicate that a foliar prebloom application at a rate of 2000 to 2500 ppm B will decrease fruit set therefore increasing fruit size.

## Literature Cited

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**Table 1. Prebloom boron spray application effects on fruit weight, juice weight, percent juice, peel thickness, total soluble solids (TSS), titratable acidity (TA) and ratio of ‘Kinnow’ mandarins, 1998<sup>Z</sup>.**

Treatment	Fruit weight (g)	Juice weight (g)	Percent juice (%)	Peel thickness (mm)	TSS (%)	TA (%)	Ratio (TSS:TA)
Control	818	394	48	2.7	19.3	1.94	10.2
1000	968	472	49	2.7	13.2	1.72	11.2
1500	959	459	48	2.9	19.0	1.78	10.8
2000	1028	501	49	2.8	18.4	1.58	11.7
2500	951	459	48	2.7	19.0	1.68	11.6
3000	992	465	46	2.7	18.0	1.54	11.9

<sup>Z</sup>Ten fruit samples were collected from four single tree replicates per treatment. Fruit sample were collected 22 February 1999.

**Table 2. Prebloom boron spray applications effect on fruit weight of ‘Kinnow’ mandarins.**

Treatment	Undersize	Small	Medium	Large (lb.)	Jumbo	Mammoth	Colossal	Total
Control	22.8	132.5	40.7	14.8	4.5	0	0	215.3
1000	12.1	126.1	47.4	14.2	4.7	0	0	204.5
1500	6.4	96.7	43.3	17.7	8.4	1.0	0	173.6
2000	5.2	99.9	55.0	20.8	9.9	0.7	0.1	191.6
2500	6.3	71.7	37.5	21.1	14.4	1.1	0	152.1
3000	4.3	78.9	26.7	5.1	5.1	0	0	120.2
Significance	+	NS	NS	NS	NS	NS	NS	NS

Undersize = <1.75, Small = 1.75-2.00, Medium = 2.00-2.25, Large = 2.25-2.50, Jumbo = 2.50-2.75, Mammoth = 2.75-3.00, and Colossal = 3.00-3.25 inches in diameter.

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

**Table 3. Prebloom boron spray applications effect on fruit number of ‘Kinnow’ mandarins.**

Treatment	Undersize	Small	Medium	Large (no.)	Jumbo	Mammoth	Colossal	Total
Control	228	545	178	57	14	0	0	1314
1000	114	779	205	54	15	0	0	1166
1500	68	598	193	63	26	3	0	952
2000	48	596	243	72	30	2	0.2	991
2500	61	435	160	77	36	3	0	772
3000	43	475	120	18	18	0	0	673
Significance	+	NS	NS	NS	NS	NS	NS	NS

Undersize = <1.75, small = 1.75-2.00, medium = 2.00-2.25, large = 2.25-2.50, jumbo = 2.50-2.75, mammoth = 2.75-3.00, and colossal = 3.00-3.25 inches in diameter.

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