Correct Project Number: 95-PB2

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Objectives:

1- To optimise the rate of B application in almonds.

2 -To investigate the best time of B application in almond orchards.

3 -To ascertain the organ and sampling time for boron diagnostic surveys.

4- To assess differences (if any) among rootstocks and cultivars in boron accumulation, tolerance and or resistance to boron deficiency and excess.

Results:

Objective 1:. To optimise the rate of B application in almonds.

Investigations conducted in Modesto, Fresno and Orland indicate 2lb solubor (20.5% B)/100 gal to be the most effective. The results reported here were obtained in a dilute (400 gal/acre) handgun sprayer. It is unclear how these rates can be adopted for use by the majority of growers who utilize low volume (100 gal/acre) applications. Given the critical importance of B concentration, it is essential that these results are verified using commercial spray application techniques. A pleriminary trial was initiated at the University Orchard in February 1996 using back pack motorised sprayer at an application rate of 2lb solubor (20.5% B)/100 gal delivering 1 and 2gallon/tree to simulates the rate and droplet size of commercial fan jet application. The results are yet to be reported. The main trial will be conducted post harvest at Straus Ravel in Arbucle

Objective 2: To investigate the best time of B application.

Earlier, this experiment was conducted over one season in Fresno during 1993-94 (refer to 1994 report). During this time, fall application was more effective than winter and spring application in that order. The experiment was repeated in Orland, Glen County where it is still ongoing and results for the dormant spray only are reported here. There was a considerable non-linear increase in B concentration (up to 80 ppm at the highest application rate of 2.5lb/100gal equivalent to 600 ppm) of buds sampled in March due to foliar B application to swelling buds in February (Figure 1). It is evident that B uptake was relatively low in comparison to the amount applied i.e. only 10% of the applied B. Previously we demonstrated a 60% yield increase in experiments conducted in Fresno (Figure 2). Replicated experiments in Glen County also demonstrated a significant effect of B application on fruit set and yield which indicated that sprayed trees

performed better than non sprayed trees (Figure 3). The results this year were compromised by the heavy rains that occured throughout the flowering season during February and March.

Objective 3:

Leaf, bark, bud, flower, fruit and hull samples were collected from B treated and non treated trees in existing experiments. Also, similar samples were collected from low and high B areas followed by analysis and comparison of their B concentration. The relationship between tissue B and the expression of B toxicity was demonstrated in Yolo County. Boron accumulation in the hulls of some cultivars related well with the observed symptoms of B excess whereas there was no clear pattern of B accumulation in leaves or bark (Table 1). So far, hull sampling appears to be the best indicator of B status.

Objective 4: To assess differences (if any) among rootstocks and cultivars in boron accumulation, tolerance and/ or resistance to boron deficiency and excess.

Preliminary results show that there is differential accumulation of B by different rootstocks and cultivars. Almond grown on peach- almond hybrid rootstocks accumulated significantly less B than those grown on peach rootstocks 'Nemaguard' and'Marianna'(Table 2). The effect also appeared to be most significant in locations with high soil and water B. In the absence of any other practical remedy for B toxicity, this phenomenon can be very helpful in management of orchards found in high B areas. Since peach almond hybrids accumulates less B, they could be the most appropriate rootstocks to use in areas where B content in the soil or irrigation water is high. On the other hand, high B accumulation power of rootstocks such as 'Marianna' 'Lovell' and 'Nemaguard' could be efficiently used in B deficient areas possibly in conjuction with B fertilization program. These speculations could only work if the differential accumulation observed were a result of differences in uptake and not just an altered distribution between roots and shoots. Experiments are required to verify this statement.

Conclusion

It is evident that B application significantly promotes fruit set and almond yield. Our research showed that spraying B at a rate of 1-2 lb Solubor/100 gal on B deficient almond trees increased fruit set by over 20% and yields by 15 lb/tree or 1200-1500 lb/acre or 900-1125 kernel lb/acre (at a total hulling and shelling percentage of 75). The current price of solubor is 61 cents/lb and that of kernel nuts is $1.32/lb (5 year average farm price - Almond Board statistics,1995). Even a 10% increase in fruit set translates into big profits. However, the dynamic nature of tissue B concentration due to high mobility of B in tree crops and growth related influences, as well as inappropriate spraying technique used so far complicates research efforts to establish sampling protocol, critical levels and optimization of rates and time of application. More research is required. Future research is geared at optimising the rates and time of application on a commerical scale so that solubor which is compatible with most insecticide and fungicides can be combined in spray tanks to cut down on spraying costs.

Table 1: Tissue Boron concentration of three almond cultivars sampled from normal and trees showing boron excess symptoms

Cultivar	Tissue	Tree condition	Bconcentration (ppm)
Carmel	Leaves	Normal	42.1
Carmel	Leaves	B excess	37.9
Nonpareil	Leaves	Normal	47.4
Nonpareil	Leaves	B excess	47.1
Butte	Leaves	Normal	47.2
Butte	Leaves	B excess	56.0
Carmel	Bark	Normal	60.8
Carmel	Bark	B excess	56.8
Nonpareil	Bark	Normal	98.5
Nonpareil	Bark	B excess	74.2
Butte	Bark	Normal	71.3
Butte	Bark	B excess	106.5
Carmel	Hull	Normal	150.0
Carmel	Hull	B excess	204.0
Nonpareil	Hull	Normal	106.0
Nonpareil	Hull	B excess	164.2
Butte	Hull	Normal	208.3
Butte	Hull	B excess	275.2

Table 2: Effect rootstocks and cultivars on boron accumulation in almond hulls (Arbucle)

Rootstocks	Cultivars			
	Mission	**Neplus**	**Nonpareil**	**Mean**
Lovell	73± 3	90± 6	65± 3	77± 5
Nemaguard	96±10	115±7	79± 4	97± 6
Mission	63± 3	79± 8	89± 5	77± 5
Bright hyd	73± 6	-1	54± 5	64± 6
Hansen 536	81± 6	82±7	65± 6	76± 4
I-82	82± 6	97±9	69± 7	83± 5
Mariana(F)	84± 4	118±4	103±2	101±6

-1 Data not available

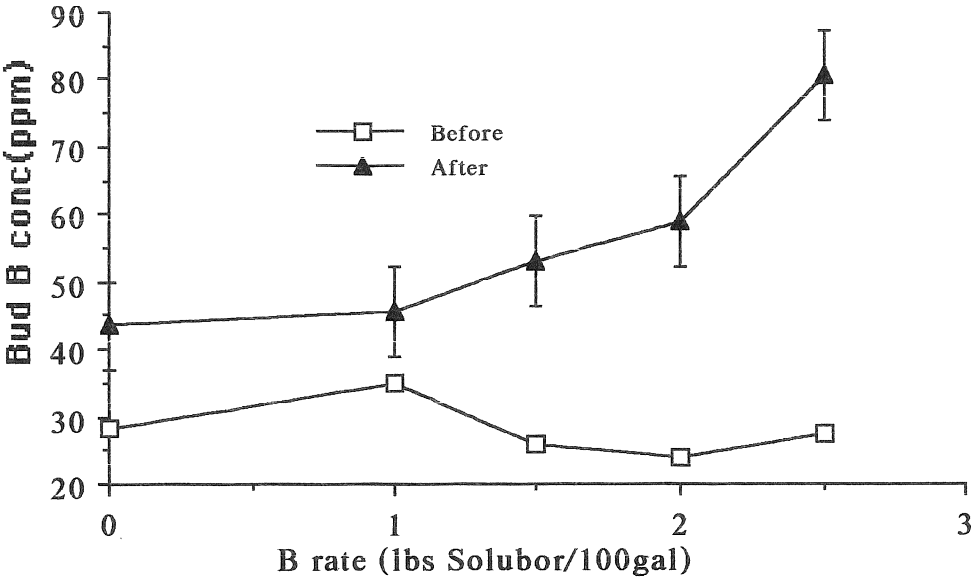
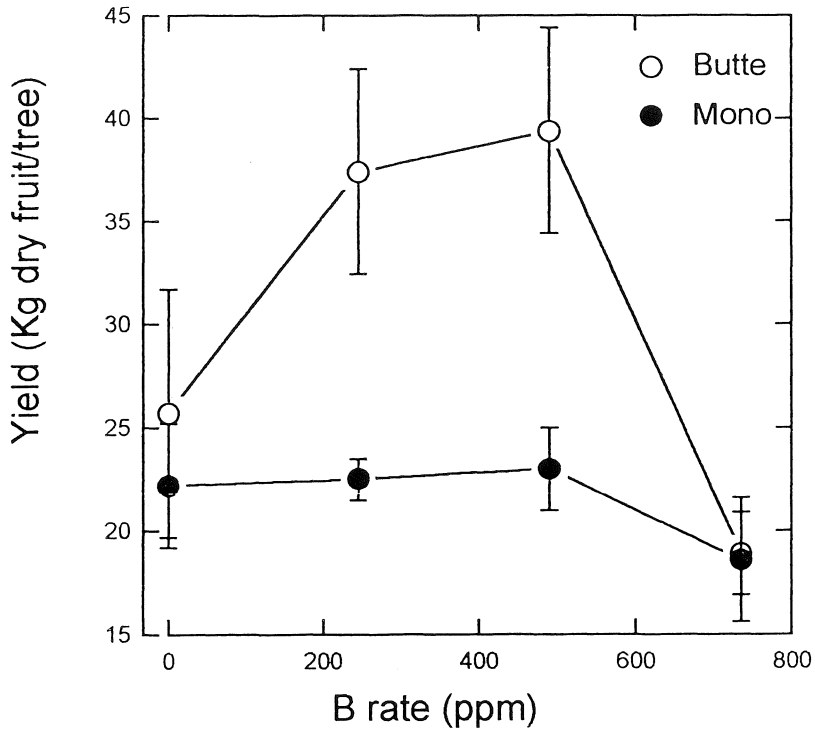


Figure1: Effect of dormant (February) foliar Boron spray on almond bud Boron concentration



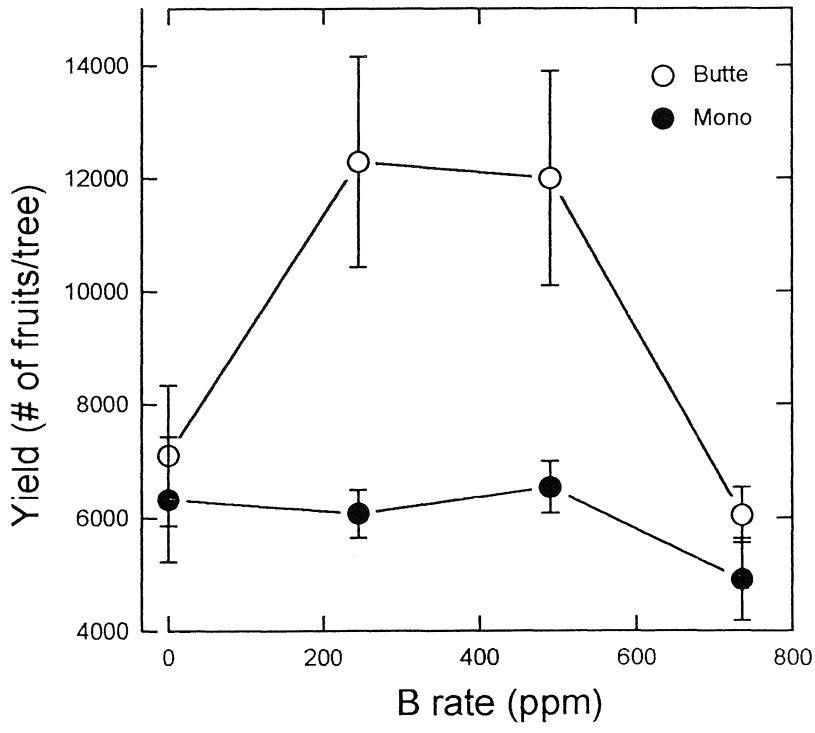


Figure 2: Effect of boron application on almond yield (1994 season). Top-fruit dry weight /tree, Bottom- number of fruits/tree.

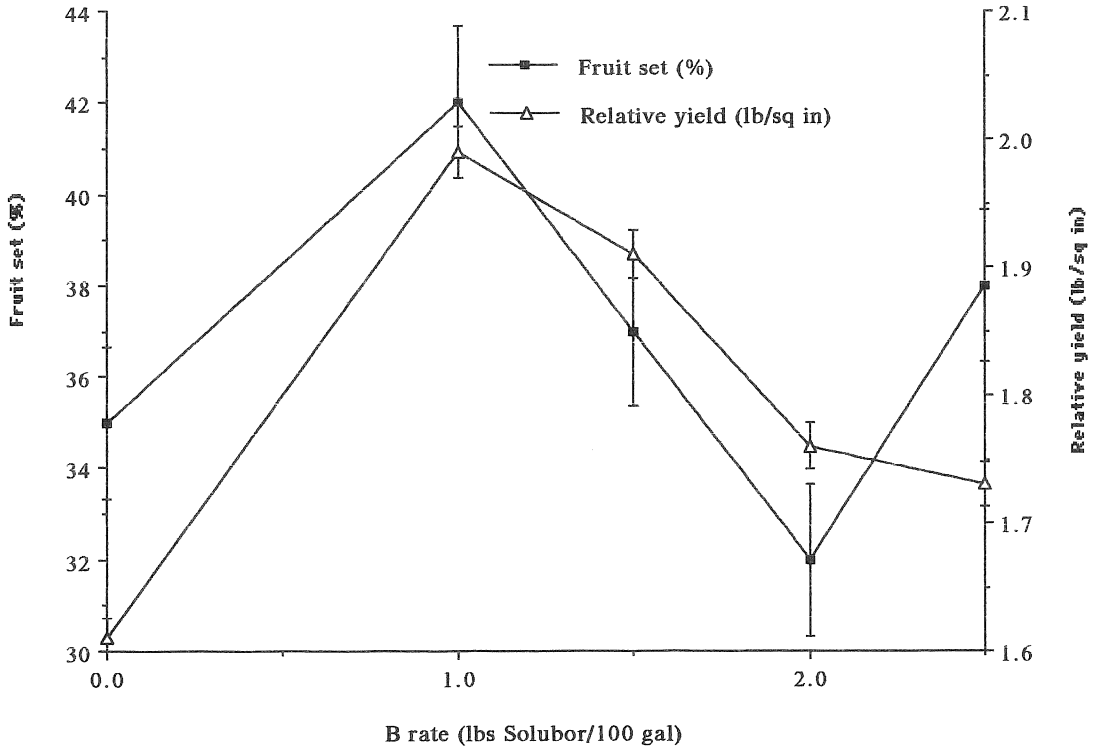


Figure 3: Effect of foliar applied boron (February) on fruit set and yield of almond (cv Butte)