1994.94-PBB-Boron Deficiency in Almond - Combined Proceedings and Final Report

Project No. 94-PBB - Boron Deficiency in Almond

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Objectives:

1. To investigate the effect of the rate of boron application and time of spraying on almond nut set and yield from boron "deficient" orchards.

2. To assess whether there is any relationship between plant tissue B concentration and almond nut set or yield.

Results:

I. Effect of B rate on tissue B concentration, nut set and yield.

Influence of fall Boron application on tissue Boron content.

Fall foliar B sprays significantly increased B concentration in the various tissues sampled as indicated in Table 1 for 1993/94 season. Dormant flower buds, hulls, flowers and young fruits sampled at pit hardening stage accumulated the the greatest concentration of B. At higher levels of B application, 'Butte' accumulated significantly more B than 'Mono' in flower buds and flowers.'Mono' had significantly higher B concentration in the mid-summer leaves than 'Butte'. These data suggest that the two cultivars accumulate B differently.
The trend for 1993/1994 season results were comparable to those obtained during 1992/1993 season however, the concentration values were relatively higher in each tissue during 1993/1994 than during 1992/93 season. The possibility of residual effect was not very evident.
The results of this investigation did not show a significant relationship between increased tissue B concentration and fruit set or yield as a result of foliar application of B. However, there was a significant effect of B application on yield (see following).

Fruit set

During 1992/93 season (results not shown), foliar B treatment resulted in a significant increase in fruit set of the open pollinated 'Butte' and 'Mono' cultivars of almomd. A rate of 1.67, for 'Mono', and 0.8 Kg B/ha for 'Butte' gave the highest percentage fruit set (28 and 36%, respectively) while 2.5kg B/ha resulted in only a small percentage fruit set (20 and 26%, respectively).

Likewise, during 1993/94 season, B application gave a significant increase in fruit set . For both cultivars, the initial set recorded 4 weeks after pollination scored about 75% when trees were treated with 0.8-1.6 Kg B/ha. Trees which received high levels of B (2.50 kg B/ha) gave similar results to untreated trees (fruit set less than 60%) signifying the possible toxic effect of excess B on fruit set (Figure 1 Top).

The second set recorded 8 weeks after pollination was about 30% for 'Butte' and 20% for 'Mono' in trees sprayed with 0.8Kg B/ha. 1.7-2.5Kg/ha appeared to be depressive Figure 1 Bottom). There was an overall improvement in fruit set when flowers were hand pollinated as opposed to open pollination.

Moderate levels (1.67 kg B/ha) of B in 'Mono' trees increased the fruit set to over 50% indicating an increased B requirement by the pistil donor trees. The highest fruit set however, was found in trees receiving the 2.5Kg of B in 'Mono' and 1.67Kg/ha in 'Butte' as well as those trees receiving 1.67Kg/ha in 'Mono' and 0.8Kg/ha in 'Butte'.

The 1993/94 season results from hand pollinated trees were similar to those of 1992/93 season. Generally, fruit set was greater in the hand pollinated flowers (60-90%) in comparison to open pollinated flowers (45-75%) for the initial fruit set and 30-60 vs 5-30% respectively for the second set. The highest set was found in trees receiving any combination of either 0.8 or 1.67Kg B/ha in both 'Mono' and 'Butte'. The response of the second set to different levels of B was similar to the first set with the highest set of over 60% in trees receiving 0.8 or 1.67Kg B/ha applied to the pollinizer and style.

Yield

Yield was recorded only in 1994. Yield, both in numbers (Figure 2 Top) and weight per tree (Figure 2 Bottom), was significantly enhanced by B fertilization. On average, 'Butte' gave the highest yield (32 kg/tree) compared to 'Mono' (21 kg/tree) as well as having a higher number of nuts/tree. The highest number of nuts in 'Butte' (12287 nuts/tree) was found in plots which had been fertilized with 0.8 Kg B/ha, while in 'Mono', the highest numbers (6543 nuts/tree) were obtained in trees treated with 1.6 kg B/ha. Yields from the two B rates (0.8 and 1.67 kg B/ha) were significantly higher than at the 0 and 2.5 kg B/ha rates.
Yield efficiency, taken as kilograms of yield per square centimeter trunk cross section area was 0.041and 0.028 kg per square centimeter for 'Butte' and 'Mono' respectively.
Regardless of the B rate, 'Mono' had the heaviest nuts (3.5 gm/nut) compared to 'Butte' (3.0 gm/nut). The heaviest nuts in 'Butte' were obtained from untreated trees. This may not necessarly reflect treatment effect, rather, the negative correlation between size and number i.e. Since treated trees had higher numbers, the size of the individual nuts would likely be smaller due to competiton for resources.
B application also seemed to influence significantly the proportion of the hull content of the nuts. On average, hulls constituted about 47% of the nut weight in 'Mono' and 49% in 'Butte' and in both cultivars, the highest proportion of hulls were found in nuts from untreated trees as well as trees that received the highest B rate of 2.5kg B/ha. On the other hand, B seemed not to affect to any significant extent the shelling percentage which averaged between 25 and 28%, however, a cultivar difference was noted. 'Mono' had significantly more shells (30%) than 'Butte'(25%). Likewise, the kernels which was only 23-25% of the total in-shell-nut-weight. Proportionate to the hull and shell content, there was a tendency for more kernel recovery in 'Butte' than in 'Mono'.

Hand pollination

Yield as number and weight of nuts /tree was not affected by B applied either to the pollinizer or pistil donor. Neither was the individual nut weight which averaged 3.6 gm, similar to the nut weight observed in the previous experiment. Shedding from the pollination bags which were not removed after pollination is implicated as the contributing artifact.

II. Effect of spraying time on the tissue B concentration, nut set and yield.

Leaf B concentration

The rate and time of B application had a significant effect on the B concentration of the leaves sampled in mid-September.'Butte' trees sprayed with B during September had significantly higher leaf B concentration (34 $\mu g \cdot g^{-1}$ dry matter) than those sprayed in December (23 $\mu g \cdot g^{-1}$ dry matter) or trees treated in February (30 $\mu g \cdot g^{-1}$ dry matter)(Figure 3 Top).

Fruit B concentration

The trend for immature fruit B concentration response to the time of B application was comparable to mid summer leaf B concentration. The B concentration of the immature fruit was highest (38 and 32$\mu g \cdot g$-1 dry matter respectively for 'Mono' and 'Butte') from trees receiving B treatment in September at a rate of 1.67 Kg B/ha and lowest in trees of February applied B (Figure 3 Bottom). In mature nuts, the hull B concentration increased with the advancement in the time of B application irrespective of the cultivar and 1.67 Kg B/ha resulted in significantly higher B concentration than 0.8 Kg B/ha. Shell B content in 'Mono' was not affected by the time of B application, while September and February applied B increased the B content in 'Butte' significantly more than December applied B. As for hull B content, 1.67 Kg B/ha resulted in significantly higher B concentration than 0.8 Kg B/ha. The kernel B content as the hull B content, increased with the advancement in the time of B application, but unlike it, 'Mono' showed higher response than 'Butte'. As in the first experiment the hull B content was higher than kernel and shells in that order.

Fruit set

Generally there was a positive and significant response of the initial set to the time of B application. However, the two cultivars responded differently. While fruit set in 'Butte' increased with advancement in the time of spraying from fall (63%) to spring (77%), no such significant differences in the initial set due to the time of B application were observed in 'Mono'.
Second set also responded to the time of spraying, 'Butte' more so than 'Mono'. No significant differences were found in fruit set of trees sprayed in September or February (24%) while trees sprayed in December had the lowest fruit set (9%).

Yield.

Cultivar, time of B application as well as the time of application and cultivar interaction significantly influenced yield as numbers (Figure 4 Top) and weight (Figure 4 Bottom) of nuts per tree. September application was more effective than February and December application. Only 'Butte' responded most to the time of B application. Boron influenced yield mainly through increasing the number of nuts. The rate of application was not as effective.

The single nut weight, averaging 3.4 gm/nut for 'Mono' and 3.1 gm/nut for 'Butte', was not significantly affected by either the B rate or the time at which it was applied, rather it appeared to be a function of the cultivar.

The proportion of hulls (43 and 40%), shells (30 and 26%) and nutmeat (24 and 27% respectively for 'Mono' and 'Butte') followed the same trend as single nut weight. There was a tendency for 'Mono' to have heavier in- shell-nuts especially in trees which had received B application during September (3.6gm/nut). However, proportionately 'Butte' had higher nutmeat than 'Mono'. Similar observations on hulls, shells and nutmeat were also made in the first experiment.

Conclusion and Future Studies:

B application significantly improved fruit set and final yield in two cultivars of almond. Time of application, cultivar and pollination technique all influence the response of almond to supplemental B sprays. Further work is required to identify key indices of B deficiency and to identify the optimal rates and timing of B sprays. Excessive B application can negatively impact upon yield and care should be taken in any widespread application program.

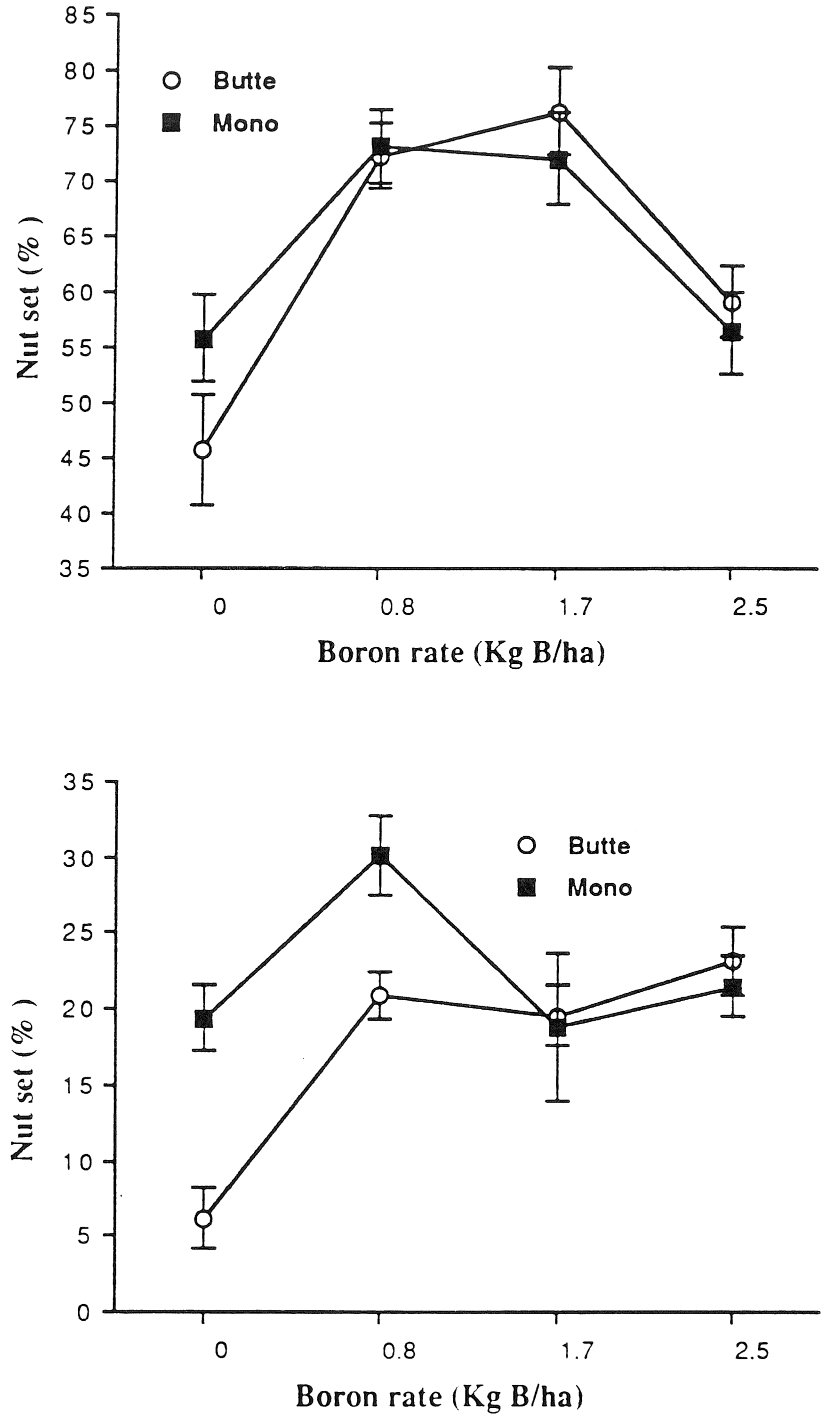


Figure 1: Effect of fall foliar applied B on fruit set (1993/94 season)(open pollination). Top - initial set, Bottom- Second set. Each value and respective standard error is a mean set of five replicates.

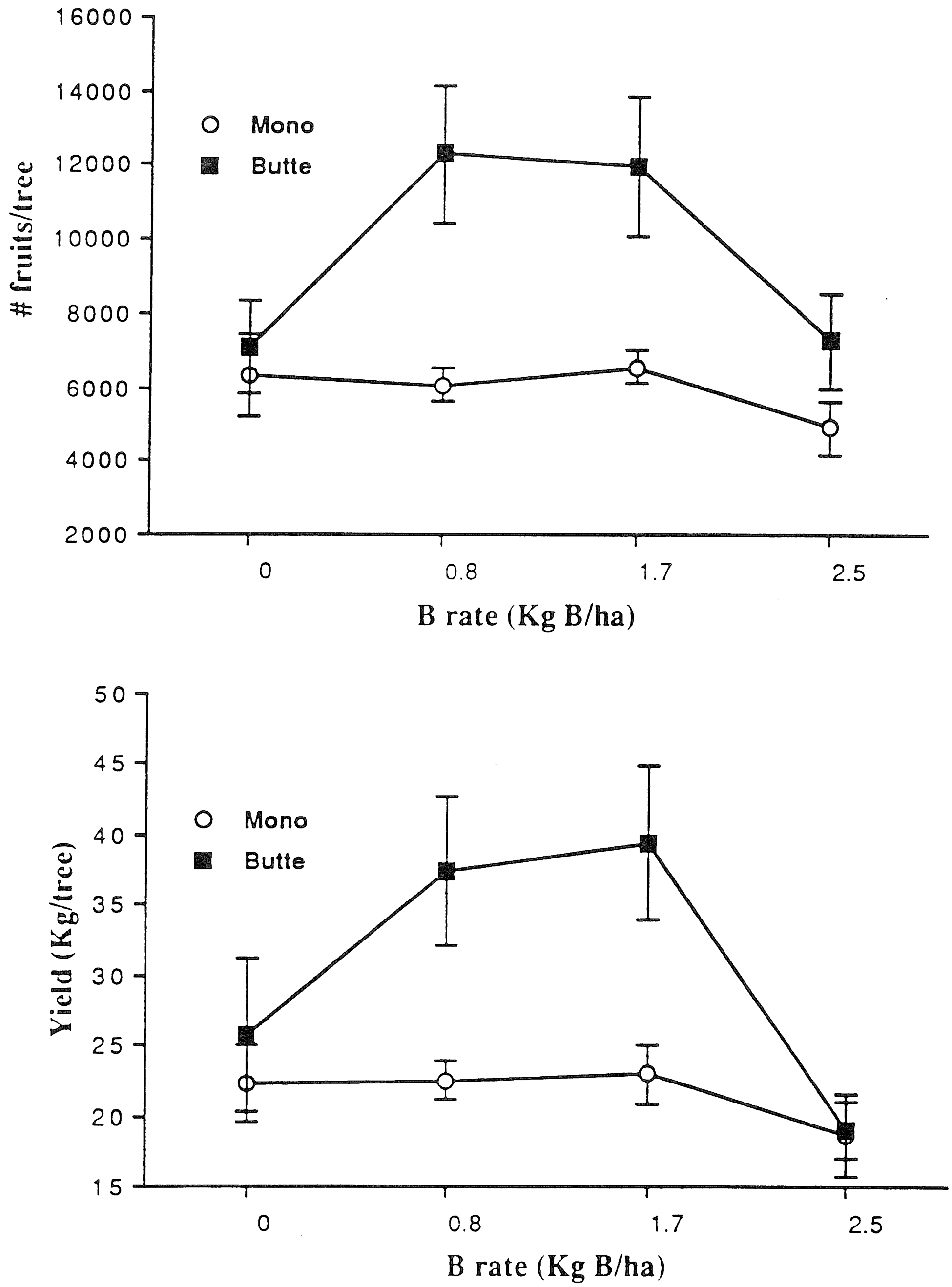
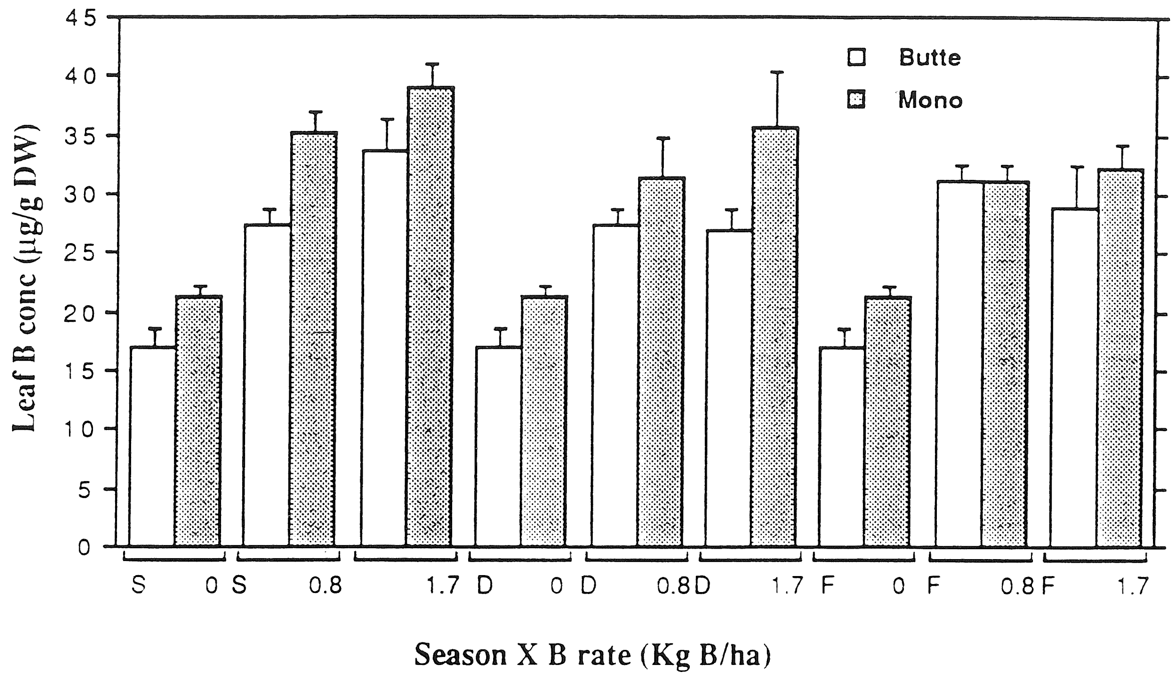


Figure 2: Effect of boron application on almond yield (1994 season).Top- number of fruits/tree, Bottom- weight (Kg/tree). Each data point with respective standard errors is a mean of 15 trees.



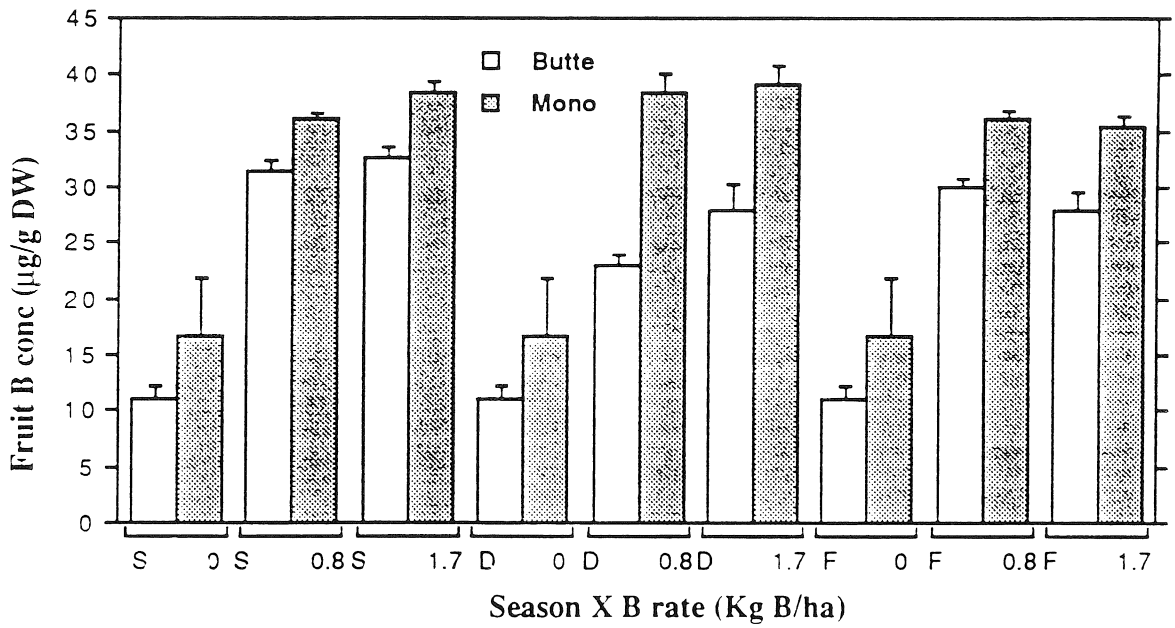


Figure 3: Effect of the time and rate of boron application on plant tissue boron concentration.Top- Summer leaf, Bottom-immature fruit. Leaf (25) and immature fruits (10) were randomly sampled, air dried for 48 hours at 95^{0}C, weighed (0.5g) dry ashed at 932^{0}C for 8 hours,digested using 1NHNO_3, made up to 50ml and analysedfor B using ICP-AES. S- September, D- December and F-February application. Each value is a mean of 5 replicate trees.

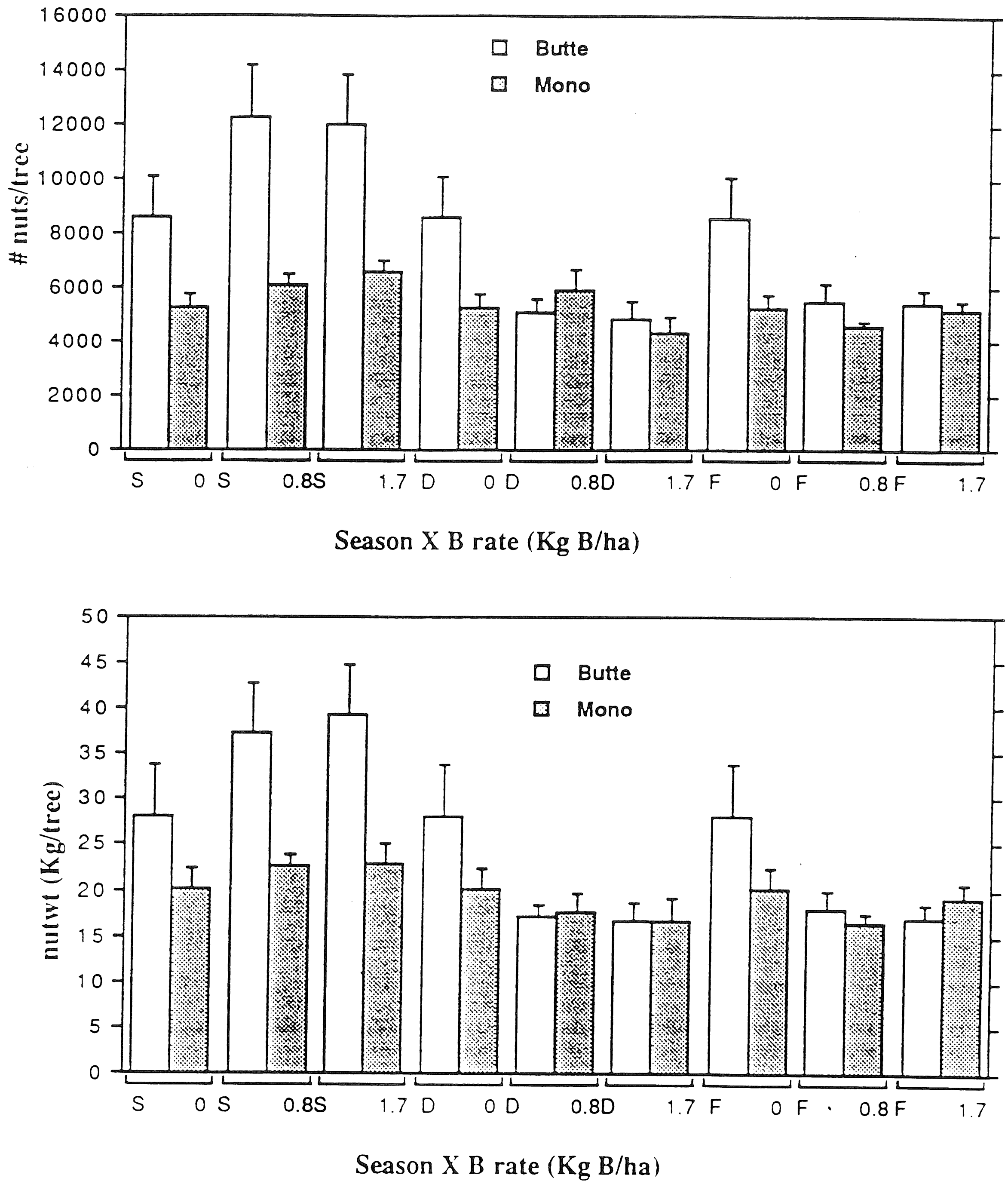


Figure 4: Effect of the time of boron application on almond yield. Top- numbers, Bottom- weight. Mature nuts were shaken and left to dry on the ground for 2 week before being picked and weighed. S- September, D- December, F- February application. Each data point with respective standard error is a mean of 5 trees.

Project No. 94-C17 - Insect & Mite Research

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Cooperating Personnel: Various Farm Advisors in at least 9 counties for Objective 1, P. Verdegaal, W. Bentley & C. Pickel for Objective 2, J. Connell and C. Pickel for Objective 3.

Objectives:

1. Purchase pheromone traps and lures, and other monitoring supplies for Farm Advisors as part of their ongoing monitoring efforts.

2. Conduct field trials in both the San Joaquin Valley and the Sacramento Valley to further develop and validate early season exclusion as a control for spider mites. Development of thresholds, treatment timing and control materials to be applied will be of highest priority.

3. Train growers and pest control advisors in use of bloomtime *Bt* sprays and monitoring for pests in demonstration orchards.

Results:

As in prior years, pheromone traps, lures, and other monitoring supplies were purchased for Cooperative Extension Farm Advisors in eight counties who request them as part of their ongoing monitoring efforts. The data from these plots are collected at the end of each season and assembled at Davis, where they become part of an ongoing database of trapping information.

Results of experiments with tree banding and winter soil sampling conducted in Kern County indicate that a significant number of mated, diapausing female Pacific spider mites overwinter in the soil near the base of almond trees and on the trunks

94-PBB.Final Report

1994

~~1995~~ Progress Report to the Almond Board of California.

Boron Deficiency studies in almond orchards.

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Abstract:

A very significant portion of Californian almond orchards in the upper Sacramento valley (around Yuba City and Chico) as well as many of the eastern regions of the San Joaquin valley (from Modesto to Fresno) occupy soils in which B is in low supply. However, the extent and impact of B deficiency in almond is not very well known. Some observations show that almond trees respond positively to supplimental B sprays without showing visible B deficiency symptoms. B application (0 to 2.0 Kg B/ha) significantly improved fruit set and the final yield of almond (see report for December,1994) On the other hand, the highest rate of B application (2.5 Kg B/ha) had a negative impact on yield during 1992-94 seasons. Time of application, cultivar and pollination technique also influenced the response of almond to supplimental B sprays. To this effect, it is necessary to identify key indices of B deficiency in addition to identification of the optimal rates and timing of B sprays, as well as investigating on the possible mechanisms by which B influences the reproductive processes.

Objectives of the study:

1. To confirm the effect of boron application on fruit set and yield of almond in B deficient orchards.

2. To monitor changes in plant tissue B concentration in response to foliar B application.

3. To establish the time of spraying B for optimal almond set and yield.

4. To study the influence of B deficiency on flower maturity especially pollen development.

Current Research:

Objective 1 and 3

An orchard with low B (less than bud B concentration of 25ppm) in Glen County is currently being used for the B deficiency studies.
B as Solubor (20.5% B) was applied to the trees at rates of 0, 0.8, 1.2, 1.67 and 2.0 Kg $B \cdot ha^{-1}$ during the dormant season (The rates are a follow up to earlier results. It was not possible to apply the fall treatment). The B concentration in various tissues are being analysed and so is the initial fruit set. Treatment effects might be adversely affected by the bad weather this year.

Objective 2

A site in Colusa County (Nickleson's Farm) is currently being used for this objective. B^{10} in the form of boric acid was applied to 5 almond trees and the B concentration in monitored thereafter in various organs at bloom, fertilization, fruit setting, pit hardening, maturity and in fruit parts.

Objective 4

Buds will be harvested, processed and viewed for developmental changes from the month of May when initiation supposedly starts up to the next bloom in Feb,1996. Glen county site will be used. Scanning Electron Microscopy (SEM) technique will be utilized mostly.