

IMPROVING FRUIT SET AND YIELD OF 'HASS' AVOCADO WITH A SPRING APPLICATION OF BORON AND/OR UREA TO THE BLOOM

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Temperatures prevailing during bloom are known to influence the effective pollination period of a fruit tree crop, such as avocado, and thus influence fruit set. The effective pollination period is the finite period of time during which fertilization (fusion of egg and sperm) can successfully take place. Conceptually and mathematically, the effective pollination period of a crop is the longevity of the ovule minus the length of time required for the pollen tube to reach the ovule to deliver the sperm to the egg so that fertilization can take place. The longer the effective pollination period, the better. Cool temperatures which prevail during the flowering period decrease the viability of the ovule and increase the length of time it takes for the pollen tube to grow from the stigma to the ovule. Thus, the duration of the effective pollination period is significantly shortened and fruit set is reduced. Warm temperatures during flowering increase both ovule longevity and the growth rate of the pollen tube. This correspondingly increases the effective pollination period and thereby fruit set and yield.

The objective of this project is to field test the efficacy of mid-bloom (April) trunk injections or canopy sprays of boron (to increase the number of pollen tubes that grow to the ovule) and/or nitrogen (to increase ovule viability) to improve fruit set and yield.

This is the second year of a three-year field study. The first year was funded by the California Avocado Development Organization. Based on the results of the first year, we reduced the number of treatments to those that proved most efficacious and increased the number of replicates of each treatment to 16 to help insure that observed yield differences will be significant at the 5% level.

During year one, voucher specimens were collected to insure that trees are treated at the same stage of flower development in each subsequent year. Thus, in year two of the study, at mid-bloom, trees were injected with 20 g Solubor® in 100 ml H₂O per tree, 100 ml of Unocal PLUS® low-biuret urea per tree (35.8 g N per tree), or 20 g Solubor® in 100 ml of Unocal PLUS® per tree or received a canopy spray of 30 g Solubor® in 4 gallons H₂O per tree (all 4 gallons were applied to the bloom and foliage to thoroughly cover the tree), 475 ml Unocal PLUS® (170 g N per tree) in 4 gallons H₂O per tree or 30 g Solubor® plus 475 ml Unocal PLUS® in 4 gallons of H₂O Per tree. Last year's results strongly indicated that more than one spray during bloom had a negative effect on yield. Control trees receiving two sprays of

H₂O at early and mid-bloom had lower yields than control trees receiving one or no sprays (trunk injection controls). The worst yields were obtained on trees receiving four canopy sprays, i.e., boron and nitrogen as separate sprays 24 h apart in early bloom and again in mid-bloom. So this year, after we determined that there were no negative effects of mixing boron and Unocal PLUS®, we applied the combination treatment as one spray.

Flower samples were again collected at intervals after the treatments to determine the effect of boron, nitrogen, and boron plus nitrogen on pollen tube growth and ovule longevity. Leaf samples were collected in September to determine which treatments are improving the boron and nitrogen status of the trees. The analyses are performed by Albion Laboratories; the results are not available yet. These analyses are essential in interpreting the results of trunk injection versus canopy sprays, i.e., is fruit set and yield increased by improving the boron and/or nitrogen status of the tree or do you have to spray boron and/or nitrogen onto the developing ovary? Harvest will be in March 1993. Yield will be determined including pounds of fruit per tree, packout, and fruit quality (pulp disorders). A cost/benefit analysis of applying boron and/or nitrogen will be done.

Anatomical studies have been conducted for two years employing: (i) flowers collected from the field trial, and (ii) flowers collected from trees two and three years from the bud, induced to flower by low-temperature treatment, and then transferred to warm temperature conditions optimal for pollen tube growth, ovule viability, fertilization, and fruit set, and treated with boron and/or nitrogen at mid-bloom at the same rates used in the field trials.

The results of both the field and controlled environment studies provided evidence that all treatments improved pollen tube growth. One boron spray at mid-bloom resulted in the greatest number of pollen tubes at the entrance to the ovule (>2). The second boron spray at mid-bloom was of no additional benefit at $P < 0.05$. A single spray of Unocal PLUS® at early bloom increased the number of pollen tubes reaching the ovule to more than one. Untreated control trees averaged less than one pollen tube at the entrance to the ovule.

The arrival of one pollen tube per ovule is all that is needed for successful fertilization of the egg. Logically, it would seem that the greater the number of pollen tubes that reach the ovule, the greater the probability of successful fertilization and, hence, fruit set. However, this may not be the case. The arrival of a greater number of pollen tubes at the entrance to the ovule may mean that the stylar barrier that prevents the growth of weaker pollen tubes and prevents their arrival at the ovule has broken down. This may actually have a negative impact on fruit set by either (i) permitting the egg to be fertilized by a weaker sperm resulting in a weak embryo that is aborted and causing drop of the fruit during early fruit development, or (ii) competition between the numerous pollen tubes for resources available in the base of the pistil (ovary), thereby reducing those available to the ovule, and subsequently to the developing embryo, resulting in early fruit abscission. Yield data for two consecutive years are essential to determine if increasing the number of pollen tubes reaching the ovule from less than one (untreated control trees) to more than one, but less than two (nitrogen treatment) or greater than two (boron treatment) is the better strategy to increase avocado production.

A single spray of boron or nitrogen increased ovule longevity for both years of the field

study and only in one year of the controlled environment study. While not statistically significant at $P < 0.05$, yield data from the first year of the study are consistent with the results of the anatomical studies. Trees receiving a single canopy spray of Unocal PLUS® had more fruit and pounds of fruit per tree. Two boron canopy sprays or two nitrogen canopy sprays were the second best treatments in terms of fruit number and pounds of fruit per tree.

One result that was very clear was that the combination of boron and nitrogen canopy sprays, especially at early bloom and again at mid-bloom, had a negative impact on yield due to the increased occurrence of double stigmas and double pistals. This is a good example of where more is not better.