# Use of Plant Growth Regulators to Increase Fruit Set, Fruit Size and Yield and to Manipulate Vegetative and Floral Shoot Growth

**New Project: Year 1 of 3**

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## Benefit to the Industry

This research addresses the research priority: "The role of endogenous and exogenous growth regulators in avocado and the evaluation of commercial growth regulators on flowering, fruit set, fruit size, yield and vegetative growth."

The results of this project will provide both practical and basic information to guide the avocado industry in the use of commercial plant growth regulators (PGRs) to: (1) prevent flower abscission; (2) to reduce fruit abscission during fruit set, June drop and preharvest drop for late hanging fruit; (3) to increase fruit size; and (4) to regulate growth of vegetative shoots and indeterminate floral shoots.

It has long been the goal of growers and researchers alike to be able to manipulate the vegetative and reproductive growth of crop plants. Avocado growers and researchers are no exception. At the present time, plant growth regulators are perhaps the most powerful tools available for achieving this goal. However, in the specific case of avocado production, the use of PGRs remains underdeveloped despite the enormous potential that PGRs offer for maximizing yield, optimizing fruit size and quality, and increasing net dollar return to the grower. In contrast, for a wide variety of tree crops, there are many examples of the successful use of PGRs to solve production problems. PGRs have been used successfully as foliar sprays to increase flowering, synchronize bloom, or change the time of flowering to avoid adverse climatic conditions or to shift harvest to a time when the market is more economically favorable. Foliar-applied PGRs are routinely used to improve fruit set, reduce June drop or to prevent pre-harvest drop to increase yield. PGRs sprays are applied to increase fruit size directly by stimulating cell division or to increase fruit size indirectly by decreasing fruit number through the application of PGRs that reduce the number of flowers formed or promote flower or fruit abscission. PGRs have been used as both pre- and post-harvest treatments to hasten or slow the ripening process, color development, and maturation of specific fruit tissues to improve the quality of the product sold in the market. More recently, success has been achieved using PGRs to even out alternate bearing and increase cumulative yield for multiple alternate bearing cycles. The emerging use of PGRs to overcome the adverse effects of abiotic stresses is increasingly successful. Surprisingly, these successes have been achieved with a modest number of commercial PGRs that are members of one of the five classic groups of plant growth regulators: auxins, cytokinins, gibberellins, abscisic acid and ethylene. Hence, the tools we need are already available.

If PGRs can be used successfully to solve production problems in other tree crops, they can be used to solve these same problems in avocado production.

Limited research has been conducted on the use of foliar-applied plant growth regulators in avocado production. This is especially true in California. The research will provide much needed information on the best PGR and time of application for increasing fruit set and/or size and how these treatments affect the growth of indeterminate floral and vegetative shoots. This research will provide the first information for whole trees on the effects of foliar-applied Accel and Apogee on fruit set, fruit size, yield, growth of vegetative shoots and indeterminate floral shoots, and on

return bloom the following spring. If treatments are successful, we will have the first efficacy data needed for adding avocado to commercial PGR labels.

## Objectives

The objectives are to screen three PGRs, Accel, ProGibb and Apogee, for their ability to increase fruit set, fruit size and yield without reducing quality or return bloom and to learn their effect on growth of vegetative and indeterminate floral shoots.

**Accel** (Valent BioSciences$_{TM}$ Corp.), contains the cytokinin 6-benzyladenine (1.8%) plus $GA_{4,7}$ (0.18%). Cytokinins stimulate cell division, increases sink activity to improve the ability of fruit to compete for resources (Bower and Cutting, 1988), prevents leaf abscission and aging, maintains leaves as sources of photosynthetic carbon, nitrogen and other nutrients and endogenous PGRs. This may be important during flowering and fruit set, both of which rely on resources provided by mature leaves. High levels of cytokinin during early fruit development are critical for obtaining large size fruit (Cutting, 1993; Cowan et al., 1997). Accel is registered in California for use on apples, necessitating only efficacy data to add avocado to the label.

**ProGibb** (Valent BioSciences$_{TM}$ Corp.,) contains 4% $GA_3$, which is known to stimulate cell enlargement. GAs are important in the early stages of fruit development and fruit set. Work by Salazar-Garcia and Lovatt (2000) demonstrated that $GA_3$ increases fruit set and size when applied in March. Other application times need to be tested with these goals in mind to complement our $GA_3$ research testing the use of $GA_3$ to even out alternate bearing and increase cumulative yield. With sufficient efficacy data, some of which must be collected in California, avocado could be added to the ProGibb label and used in commercial avocado production in California.

**Apogee** (BASF) contains 27% prohexadione calcium, a new GA biosynthesis inhibitor. Test results on apple show that prohexadione calcium at 250 mg ai/L inhibits vegetative shoot growth for approximately four weeks. We plan to use Apogee to inhibit the growth of the vegetative shoot of indeterminate inflorescences to reduce the competition that exists between setting fruit and the developing flush. Previous work using Paclobutrazol to inhibit vegetative shoot growth during the fruit set period was successful in increasing total yield and total number of fruit of export size (Kremer-Kohne and Kohne, 1998). Apogee offers a safe alternative to Pacobutrazol.

## Experimental Plan and Design

We are testing the efficacy of Accel, ProGibb and Apogee in the following treatments: (1) ProGibb (25 mg ai/L) applied at S-8, cauliflower stage; (2) Accel (25 mg ai/L) applied at S-11, full bloom; (3) Apogee (125 mg ai/L) applied at S-8 (cauliflower stage) and at S-11 (anthesis); (4) ProGibb (25 mg ai/L) applied in mid-July [prior to S-2 (transition from vegetative to reproductive growth)] followed by Apogee (125 mg ai/L) 30 days later (mid-August); and (5) control trees receiving no PGRs. I left two treatments available for testing the efficacy of CPPU, a cytokinin more powerful than Accel, to increase fruit set and size in anticipation of being given permission to test this product. We now have permission to test CPPU. CPPU will be applied at S-11 to increase set and at the end of June drop to increase size. Yield (kg/tree), fruit size distribution (pack out) and fruit quality of 100 randomly selected fruit, including seed size and fruit length to width ratio, will be determined at harvest. Leaves will be collected in September for nutrient analysis (Albion Laboratories). The experimental design is randomized complete block with 20 individual tree replicates per treatment. There are buffer trees between treated trees and buffer rows between treated rows. The research is being conducted in a commercial orchard owned by the Irvine Company. This orchard is maintained by regular pruning, so we will also be able to observe the interaction of Apogee with pruning in comparison to pruned trees not treated with Apogee.

## Summary

The project is on schedule; the harvest from year 1 will be in July 2002.

## Literature Cited

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