
PGR II - Strategies to Increase Fruit Size of 'Hass' Avocado

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Competition from Mexico, Chile and other countries requires that the California avocado industry not only increase production per acre, but also increase fruit size to remain profitable. The goal of this research is to increase net income per acre for growers of the 'Hass' avocado in California by developing plant growth regulator (PGR) strategies that increase yield of commercially valuable large size fruit. To achieve this goal, the specific objectives of this research are: (1) to demonstrate that the ability of three strategies to increase fruit size is reproducible in a second avocado orchard representing a different avocado-growing area of California and (2) to demonstrate that the yield of large size fruit responds incrementally to increases in PGR dose.

To meet objective 1 we are testing the following treatments: (i) 6-benzyladenine (25 mg/L) at anthesis; (ii) GA₃ (25 mg/L) mid-July followed by prohexadione-Ca (125 mg/L) 30 days later (mid-August); (iii) GA₃ (25 mg/L) end of June – beginning of July and (iv) when fruit are 17-20 mm in diameter; (v) 6-benzyladenine (25 mg/L) anthesis and again at the end of July – beginning of August; and (vi) the untreated control. To meet objective 2, strategies that successfully (significant at the 5% level) increase the yield of large size fruit in this second orchard for two consecutive harvests or as the 2-year average or 2-year cumulative yield compared to the untreated control will be included in a new experiment to demonstrate dose response.

Results

This was year 1 of this research. All PGR treatments were applied to 20 individual trees (replications) in a randomized complete block design that included 20 untreated control trees. All PGR treatments were included in a minimum of two orchards. The research is on schedule. All PGR applications were made according avocado tree phenology. To facilitate the use and reliability of GA₃ treatment that is applied prior to the period of exponential increase in fruit growth, we are testing whether fruit transverse diameter between 17 and 20 mm can serve as a biological marker for timing this application. To do this we are determining how close in time the two phenological events occur each year in the different orchards and also comparing the efficacy of GA₃ applied just prior to the period of exponential increase in fruit growth on one set of trees with the efficacy of GA₃ applied when fruit are 17 to 20 mm in transverse diameter on another set of trees in the same orchard. Data collected on fruit set and fruit size in September suggest that the application times are comparable, but yield results from the harvests in 2010 and 2011 will be required before making a final decision. Analysis of fruit set and fruit size data for 6-benzyladenine will be completed in November.

Take home message.

This research includes PGRs that have proven efficacious in at least one avocado-growing area of the state for increasing yield of large size fruit, i.e. packout peaked on packing carton size 40, or the yield of commercially valuable fruit of packing carton sizes 60 + 48 + 40. The goal of the current project is to reproduce these results in a second orchard in a different avocado-growing area.

Benefits of the research to the industry (includes accomplishments and future prospects)

Previous research identified three PGR strategies that significantly increased yield of commercially valuable large size fruit without reducing total yield and, in one case, significantly increased total yield compared to untreated control trees.

BA (25 mg/L) (Accel Valent BioSciences) applied at full bloom resulted in a net increase in 3-year cumulative yield of commercially valuable large size fruit (packing carton sizes 40 + 36 + 32) of 6,511 lbs/110 trees/acre/3 years, an average of more than 2,000 lbs/acre/year, more than the control trees.

GA₃ (25 mg/L) (ProGibb Valent BioSciences) applied in mid-July followed by the application Prohexadione-Ca (125 mg/L) (Apogee BASF) approximately 30 days later (mid-August) resulted in a net increase in 3-year cumulative yield of commercially valuable large size fruit (packing carton sizes 40 + 36 + 32) of 6,070 lbs/110 trees/acre/3 years, an average of approximately 2,000 lbs/acre/year, more than the control trees.

GA₃ (25/mg/L) applied at the end of June-beginning of July resulted in a net increase in 2-year cumulative yield of commercially valuable large size fruit (packing carton sizes 60 + 48 + 40) of 5,665 lbs/110 trees/acre/2 years, an average of more than 2, 700 lbs/acre/year, more than the control trees. This treatment also resulted in a significant net increase in 2-year cumulative total yield of 6,579 lbs/110 trees/acre/2 years, an average of more than 3,000 lbs/110 trees/acre/year, above the yield of the control trees.

These treatments are now being tested in a second orchard in a different avocado-growing area of the state. To avoid delays caused by adverse climate events, the treatments have all been replicated in two orchards located in different avocado-growing areas.

To enhance my ability to conduct research on behalf of the avocado growers of California, I wrote and submitted, with an Israeli colleague, a BARD grant in September 2008. We were asked to collect additional preliminary data and resubmit the proposal. We are in the process of doing this and will resubmit in 2010. I wrote and submitted an IR-4 proposal in October 2008 and again in October 2009 to continue research with GA₃, and a CDFA Specialty Crops grant in April 2009. We plan to resubmit this proposal. To date I personally have obtained \$257,218 in funding from the CDFA-FREP program to conduct research optimizing fertilization of the 'Hass' avocado and an additional \$245,000 from the CDFA-FREP in collaboration with Dr. Richard Rosecrance, CSU-Chico, and Dr. Ben Faber, UCCE-Ventura and Santa Barbara, for the avocado tree dissection research to determine up-take and partitioning of soil nutrients in response to crop load and for the development of a demand driven web-based fertilization program. Further, Dr. Rosecrance was awarded partial matching funds from CSU for the two collaborative projects. Thus, I have played a key role in bringing over half a million dollars from outside CAC to avocado research for improving fertilization and, hence, productivity and grower profitability.