PGR 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. 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. The objectives are to satisfy the requirements of the California Department of Pesticide Regulation (DPR) necessary to add a plant growth regulator to an existing label so that the PGR can be legally used in avocado production in California.

Results
Objective 1.
Background. To meet Objective 1, *(i)* 6-benzyladenine (25 mg/L) was applied at anthesis; *(ii)* GA_3 (25 mg/L) was applied in mid-July followed by prohexadione-Ca (125 mg/L) 30 days later (mid-August); and *(iii)* GA_3 (25 mg/L) was applied end of June – beginning of July. This is the first experiment in which the treatment of GA_3 (25 mg/L) applied end of June – beginning of July and the treatment of GA_3 (25 mg/L) applied in mid-July followed by prohexadione-Ca (125 mg/L) 30 days later (mid-August) are being tested in the same orchard for comparison. It is important to determine if GA_3 (25 mg/L) applied end of June – beginning of July is equally effective as GA_3 (25 mg/L) applied in mid-July followed by prohexadione-Ca (125 mg/L) 30 days later (mid-August), since a strategy requiring a single PGR would be more cost-effective than one requiring a separate application of two PGRs. In addition, we are also test the efficacy of applying *(iv)* 6-benzyladenine (25 mg/L) at anthesis and again at the end of July – beginning of August. Treatment *(v)* is the untreated control.

Results. Research to meet Objective 1 was initiated in spring 2007. All treatments were applied according to tree phenology (see the poster on the phenology of the 'Hass' avocado tree below). Due to the freeze, the first harvest produced an average total yield of only 819 lbs/110 trees /acre and no statistically significant results were obtained. The year-2 crop was totally lost due to the high temperatures in early June. To avoid further delays caused by adverse climate, this coming year, the experiments will be replicated in two orchards located in different avocado-growing areas of the state.

Take Home Message. The cost per acre for each PGR (excluding the cost of application) is: 6-benzyladenine (BA) as MaxCel®, $26; GA_3 as ProGibb®, $16; and prohexadione-calcium as Apogee®, $86. This research tests the reproducibility of these PRGs in a different orchard in a different avocado-growing area of the state. In the earlier experiment, 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, an average of more than 2,000 lbs/acre/year, more than control trees. GA_3 (25 mg/L) applied in mid-July followed by the application Prohexadione-Ca (125 mg/L) 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, an average of approximately 2,000 lbs/acre/year, more than control trees. GA_3 (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, an average of more than 2,700 lbs/acre/year, more than control trees. This treatment also resulted in a significant net increase in 2-year cumulative total yield of 6,579 lbs/acre, an average of more than 3,000 lbs/ acre/year, above the yield of control trees. These data are presented in detail in the poster appearing at the end of the annual report entitled "PGR Strategies to Increase Yield of 'Hass' Avocado".

Objectives 2.
Background. To meet Objective 2, the more successful, cost-effective strategies for increasing fruit size will be included in a new experiment to demonstrate the dose response. These strategies will be selected after the completion of the second harvest for Objective 1.

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, an average of more than 2,000 lbs/acre/year, more than control trees.
- GA_3 (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, an average of approximately 2,000 lbs/acre/year, more than control trees.
- GA_3 (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, an average of more than 2, 700 lbs/acre/year, more than control trees. This treatment also resulted in a significant net increase in 2-year cumulative total yield of 6,579 lbs/110 trees/acre, an average of more than 3,000 lbs/110 trees/acre/year, above the yield of control trees.

Per CA DPR requirements, these treatments must now be tested in a second orchard in a different avocado-growing area of the state. To avoid further delays caused by adverse climate, this coming year, the experiments will be replicated concurrently in two orchards located in different avocado-growing areas of the state. If we have sufficient funding to run multiple sites a year, the data for these PGRs should be ready to go to CA DPR in three crop years (four calendar years).

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'Hass' Avocado Tree Phenology

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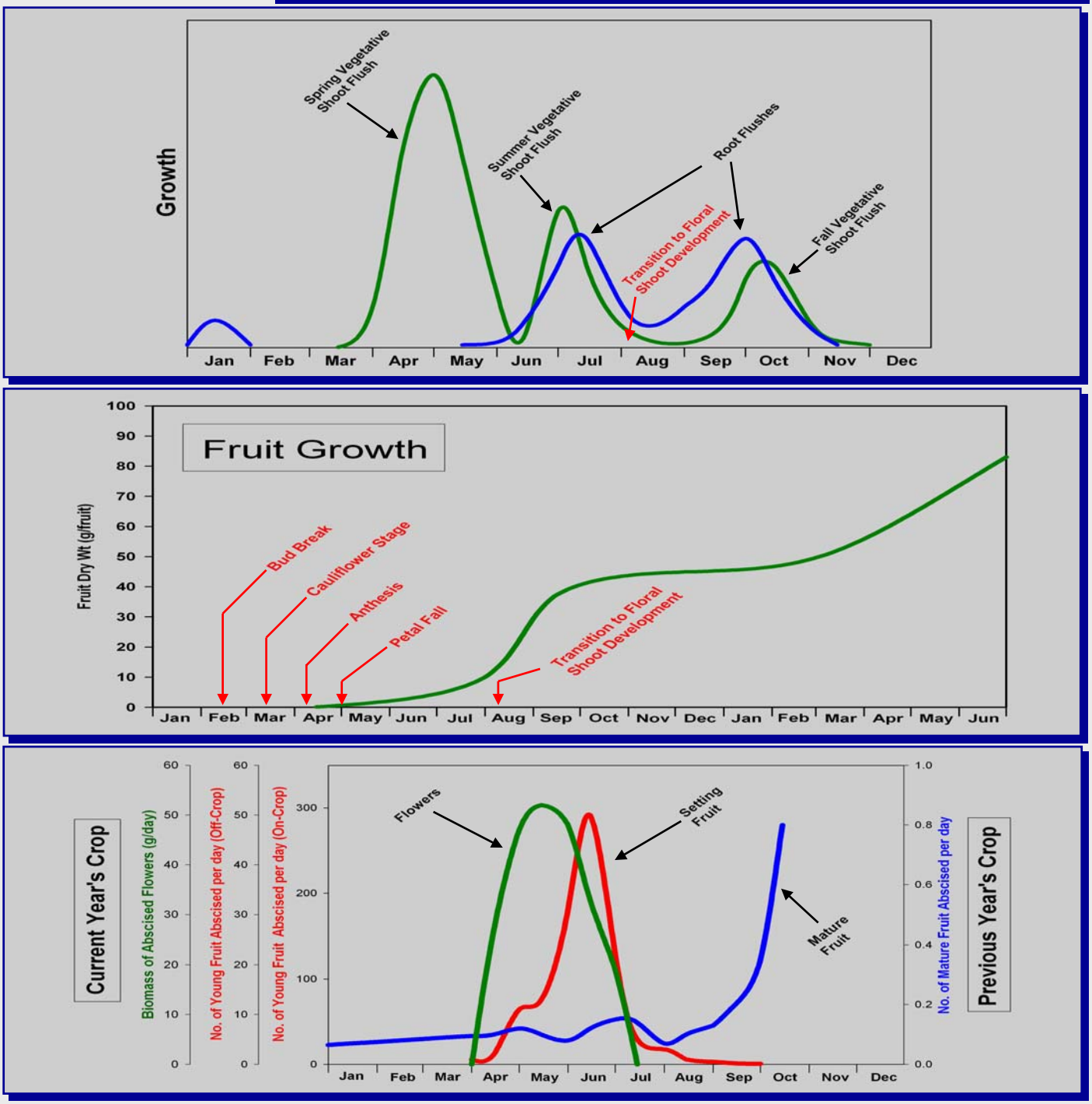

Figures – ***TOP - Vegetative shoot and root growth of the 'Hass' avocado.*** The January root flush does not occur in all years. The magnitude of summer and fall shoot flushes is greatly diminished when the tree sets of a heavy on-crop. The 'Hass' avocado transitions from vegetative shoot growth to floral (reproductive) shoot development at the end of July through August in California. ***MIDDLE - Reproductive development of the 'Hass' avocado.*** Key stages of inflorescence development preceding fruit growth are indicated. ***BOTTOM - Abscission of reproductive structures.*** The rate of flower abscission per day is similar for spring blooms producing on or off crops, but flower abscission starts approximately 2 weeks earlier and last approximately 2 weeks longer during the on bloom. Peak fruit abscission for the current (setting) crop is approximately 4 weeks after peak flower abscission (mid-June ± 1 week), making it earlier than previously thought. Note the significantly greater number of setting (young) fruit that abscise per day in an on-crop year versus an off-crop year. Preharvest abscission of mature fruit from the previous spring starts after the end of June drop of the setting crop. Neither period of fruit abscission was related to adverse climatic factors, though such factors can increase the rate of fruit abscission. The rate of mature fruit abscission per day is similar in on- and off-crop years, increasing from August through harvest. Cumulative loss of mature fruit from August to a late harvest in October can be significant. The data represent southern California inland and coastal conditions.

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