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

Carol Lovatt
UC Riverside

Growers in Fillmore, Somis, and Santa Paula

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.

Results

'Hass' Avocado Orchard – Fillmore. In this orchard we are testing the efficacy of 6-benzyladenine (6-BA, 25 mg/L, MaxCel[®] Valent BioSciences) applied (1) at full bloom; (2) when fruit were 17-20 mm in diameter; and (3) at full bloom and again when fruit were 17-20 mm in diameter and 2,4-D (38 g acid equivalents/acre, CitrusFix[®] AMVAC) applied when fruit were 17-20 mm in diameter.

Yield in this orchard was greater in Year 2 of this research (2010-2011 crop year) than in Year 1 (2009-2010 crop year). Control trees produced 128 fruit per tree (8,274 lbs/110 trees/acre) in Year 2 compared to only 47 fruit per tree (2,938 lbs/110 trees/acre) in Year 1. Due to alternate bearing there were no significant treatment effects on yield in Year 2. In Year 1 6-BA applied when fruit were 17-20 mm in diameter increased total yield, resulting in a net increase in yield of 1,360 lbs/110 trees/acre over that of the untreated control, and increased the yield of large size fruit, resulting in a net increase of 1,048 lbs/110 trees/acre of fruit of packing carton sizes 48+40+32 over the untreated control at the 10% confidence level. However, in Year 2, trees in this treatment had yields equal to that of the untreated control. Similarly, in Year 1 trees treated with 6-BA applied at both full bloom and when fruit were 17-20 mm in diameter produced less total yield and yield of a large size fruit than untreated control trees at the 10% confidence level last year, but in Year 2 produced a greater number of fruit and more commercially valuable large size fruit (packing carton size 60+48+40) per tree than the untreated control. Application of 2,4-dichlorophenoxyacetic acid (2,4-D, 38 g a.e./acre, CitrusFix[®] AMVAC) when fruit were 17-20 mm in diameter also produced a numerical but non-significant increase in total number and lbs of fruit per tree compared to the untreated control trees in Year 1, resulting in lower yields than the control trees in Year 2. Thus, there were no significant increases in total cumulative yield or cumulative yield of commercially valuable large size fruit in this orchard.

For the 2009-2010 and 2010-2011 crop years, no PGR treatment had a negative effect on any fruit quality parameter measured – peel color, number of days to ripen, fruit length, fruit diameter, mesocarp diameter, seed diameter, seed germination, vascularization (growth of vascular tissue into the mesocarp), mesocarp discoloration, or mesocarp decay.

For the current crop year (Spring bloom 2011, harvest 2012), percent fruit set and average fruit diameter quantified in October 2011 also reflected the effects of alternate bearing in this orchard. Trees receiving a foliar application of 6-BA when fruit were 17-20 mm in diameter had the highest percent fruit

set, but percent set was half the value obtained in October 2010, the ON-crop year in this orchard. Average fruit diameter was inversely related to percent fruit set; trees treated with 6-BA when fruit were 17-20 mm in diameter had smallest fruit diameter. However, the diameter of the setting fruit across all treatments is 10% larger than at this time last year.

The effect of 6-benzyladenine and 2,4-D on yield in additional orchards is presented in the report for CAC project #65306.

'Hass' Avocado Orchard – Somis. In the Somis orchard and two Santa Paula orchards below, we are testing the effects of (i) GA₃ (25 mg/L, ProGibb[®] Valent BioSciences) applied at the cauliflower stage of inflorescence development and again when fruit were 17-20 mm in diameter, (ii) GA₃ (25 mg/L) applied when fruit were 17-20 mm in diameter; and (iii) GA₃ (25 mg/L) applied when fruit were 17-20 mm in diameter followed by prohexadione-Ca (125 mg/L, Apogee[®] BASF) 30 days later (mid-August).

In Somis, 2009-2010 was the ON-crop year. Untreated control trees produced 40,983 lbs/110 trees/acre. GA₃ applied when fruit were 17-20 mm in diameter followed by prohexadione-Ca 30 days later (mid-August) significantly increased total yield, resulting in a net increase of 5,871 lbs/110 trees/acre over the untreated control ($P = 0.0357$). In addition, GA₃ (25 mg/L) applied when fruit were 17-20 mm in diameter followed by prohexadione-Ca 30 days later (mid-August) significantly increased the yield of commercially valuable large size fruit (packing carton sizes 60+48+ 40), resulting in a net increase of 6,691 lbs/110 trees/acre more large size fruit than the untreated control ($P = 0.0220$). This treatment also resulted in a net increase in fruit of packing carton size 48 of 4,920 lbs/110 trees/acre above the yield of untreated control trees ($P = 0.0165$).

For 2010-2011, the OFF-crop year, untreated controls produced 1,164 lbs/110 trees/acre. No treatment significantly increased yield in Year 2.

Two-year cumulative yield was significantly increased by foliar-application of GA₃ when fruit were 17-20 mm in diameter followed by prohexadione-Ca (125 mg/L) 30 days later (mid-August) above that of all other treatments, resulting in a net increase of 5,820 lbs/110 trees/acre/2 years more fruit than the untreated control ($P = 0.0401$). More than 90% of the increased yield was of commercially valuable size fruit. This treatment significantly increased the 2-year cumulative yield of fruit of packing carton sizes 60+48+40 as both pounds ($P = 0.0105$) and number of fruit ($P = 0.0171$) per tree compared to untreated control trees ($P = 0.0054$).

For both the 2009-2010 and 2010-2011 crop years, no PGR treatment had a negative effect on any fruit quality parameters measured – peel color, number of days to ripen, fruit length, fruit diameter, mesocarp diameter, seed diameter, seed germination, vascularization (growth of vascular tissue into the mesocarp), mesocarp discoloration, or mesocarp decay.

For the current crop (spring 2011, harvest 2012), percent fruit set in October 2011 is 2.7-fold greater than in 2010 but half the value of 2009. Average fruit diameter is not significantly different among years. For the current crop, trees treated with GA₃ when fruit were 17-20 mm in diameter are 40% larger than fruit on untreated control trees ($P = 0.0001$).

'Hass' avocado Orchard – Santa Paula (2). In contrast to Somis, GA₃ treatments had no effect on the yield of the 2009-2010 crop in this orchard, in which untreated control trees produced 12,635 lbs/110 trees/acre. In 2010-2011, untreated control trees averaged only 97 lbs/110 trees/acre. There were no significant treatment effects on yield in Year 2 or 2-year cumulative yield in this orchard. The lack of PGR effect in low yield years is not unanticipated. In Spring 2011, it rained unexpectedly 24 hrs after the PGR treatments were applied in this orchard. To compensate, we added an additional orchard, designated as "Santa Paula (4)", in which we applied the Spring 2011 treatments.

'Hass' avocado Orchard – Santa Paula (4). The PGRs being tested in this orchard were all applied when fruit were 17-20 mm in diameter in July 2011, after the orchard was harvested. Thus, the effect of the PGR treatments in this orchard must await harvest in 2012. We are optimistic that we initiated the research at this site in an ON-crop year; 2010-2011 was the OFF-crop year in this area of Santa Paula. The 2010-2011 yield was 12,707 lbs/110 trees/acre. For the current (2011-2012) crop, fruit set determined in October 2011 was significantly greater for trees receiving a foliar application of GA₃ when fruit were 17-20 mm in diameter followed by prohexadione-Ca 30 days later (mid-August). There were no significant treatment effects on average fruit diameter.

Benefits to the Industry

It is becoming increasingly clear that the yield potential (crop load) in a specific orchard or in a given year and, thus, alternate bearing, have a significant effect on the results obtained with PGRs. Too few flowers or setting fruit limits the potential of a PGR to increase yield and size, which is already large (Fig. 1). Too many flowers or fruit such that all fruiting points are saturated and the tree lacks sufficient reserves to support an increase fruit size in response to a PGR-derived signal would also compromise PGR efficacy. PGRs being tested in this research continue to show promise for increasing total yield and yield of commercially valuable large size fruit in orchards that are producing well and in ON-crop years in an alternate bearing orchard. When complete, results of this research will be used to advise growers whether they should apply a treatment only in ON-crop years and whether it is better to initiate the use of a PGR in the ON- or OFF-crop year. We are pleased that 6-BA has moved into the IR-4 program for determination of maximum residue levels, a required step towards making 6-BA available to avocado growers taken by CAC with the support of Valent BioSciences, manufacturer of MaxCel®.

Acknowledgement. The PI thanks the following individuals for the use of their orchards, assistance with harvest each year, and the financial sacrifices they make in order for this research to be conducted in their orchards: Darrell Nelson, Charles and David Vanoni, Gus Gunderson, and Craig Colton.

