

Phase III for GA₃ and Phase II for 2,4-D and AVG for Commercial Use on 'Hass' Avocado

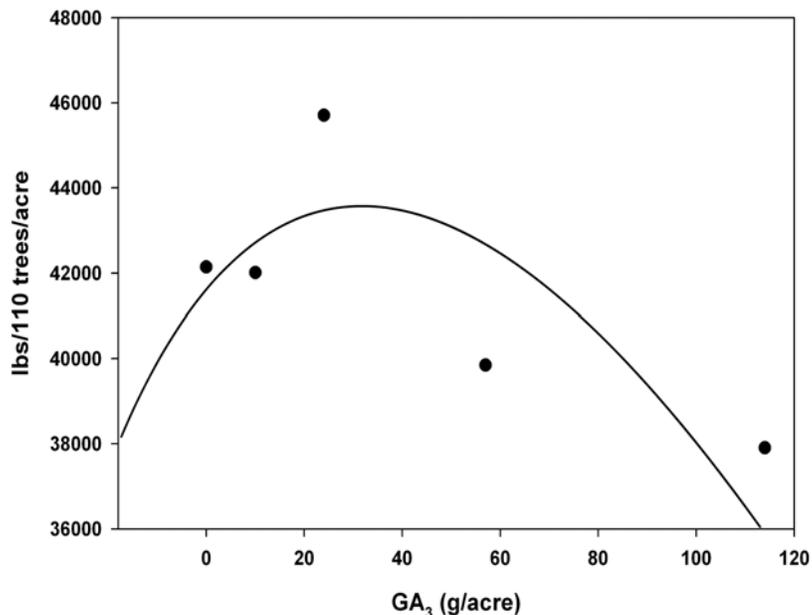
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Growers in Somis and Santa Paula

The increasing costs of inputs necessary for avocado production dictate that growers of the 'Hass' avocado in California increase profitability per acre. The goal of this research is to increase net income per acre by developing plant growth regulator (PGR) strategies that increase yield of commercially valuable fruit.

Results

'Hass' Avocado Orchards – Somis and Santa Paula 2. GA₃ (Pro-Gibb[®] Valent BioSciences) was applied at 10, 24, 57 and 114 g/acre at the cauliflower stage of inflorescence development. Untreated control trees produced 40,983 lbs/110trees/acre in Somis and 12,670 lbs/110 trees/acre in Santa Paula 2. For the 2009-2010 crop in both orchards, trees treated with GA₃ (24 g/acre, 25 mg/L) retained the greatest number of fruit per tree and produced the greatest number of commercially valuable large size fruit (178-325 g/fruit, packing carton sizes 60+48+40), but the effect was not significantly different from the untreated control trees in both orchards at the 5% confidence level. When trees were treated with GA₃ ≥ 57 g/acre, negative effects on total yield and yield of large size fruit occurred, establishing the upper concentration limit. However, there was no carry over effect from the high concentrations. In 2010-2011, these trees treated with 114 g GA₃ per acre produced higher yields and more commercially valuable large size fruit than untreated control trees and trees treated with only 10 or 24 g per acre. Because the 2009-2010 ON-crop at Somis was nearly 40 times greater than the OFF-crop yield, a dose response on 2-year cumulative yield was observed at Somis. However, the effect of GA₃ (24 g/acre, 25 mg/L) was not significantly different from the control due to the large degree in variation in yield (Fig. 1). Percent fruit set in October for the current crop in Somis decreased with increasing GA₃ concentration. There was no effect on fruit size.



Due to consistently low the fact that it rained unexpectedly within 24 hrs after the Spring 2011 PGRs were applied in the Santa Paula 2 orchard, we added another orchard in Santa Paula, designated as "Santa Paula 4", in which we applied the Spring 2011 treatments.

Hass' Avocado Orchards –Santa Paula 4. Foliar-application of GA₃ (24 g/acre, 25 mg/L) at the cauliflower stage of inflorescence development in Spring 2011 had a positive effect on the yield of the mature fruit (2010-2011 crop). GA₃ increased yield by 4,365 lbs/110 trees/acre above that of untreated control trees and trees receiving lower or higher GA₃ concentrations, except trees receiving 57 g/acre ($P = 0.0373$), which had an equal yield, but the results were statistically significant only for trees producing more than 60 lbs/tree. The increase in yield was due to a significant increase in both pounds and number of fruit of packing carton size 60. Percent fruit set in October for the current 2011-2012 crop was significantly greater for trees treated with GA₃ (24 g/acre, 25 mg/L) than trees treated with all other GA₃ concentrations but equal to the untreated control trees ($P = 0.0117$). There were no effects due to GA₃ concentrations on average fruit diameter.

No GA₃ concentration had a negative effect on any fruit quality parameter in any orchard in any year of the study.

It is clear that to obtain good dose response data for a PGR, a new orchard should be selected each year to avoid the carryover effects resulting from the high PGR concentrations.

'Hass' avocado Orchards – Santa Paula 1 and Santa Paula 3. PGR strategies tested in these two orchards include: (i) aminoethoxyvinylglycine (AVG, 250 mg/L, ReTain[®] Valent BioSciences) applied at full bloom; (ii) AVG (250 mg/L) applied when fruit were 17-20 mm in diameter, just prior to exponential increase in fruit size; (iii) 2,4-dichlorophenoxyacetic acid (2,4-D, 38 g acid equivalents/acre, CitrusFix[®] AMVAC) applied when fruit were 17-20 mm in diameter; (iv) 6-benzyladenine (6-BA, 25 mg/L, MaxCel[®] Valent BioSciences) applied at full bloom; (v) 6-BA (25 mg/L) applied when fruit were 17-20 mm in diameter; and (vi) 6-BA (25 mg/L) applied at full blooms and again when fruit were 17-20 mm in diameter.

For 2009-2010, an ON-crop year (28,262 lbs/110/trees/acre) at Santa Paula 1, only 6-BA applied at full bloom and again when fruit were 17-20 mm in diameter significantly increased the yield of fruit of packing carton size 60 as both number and lbs of fruit per tree compared to the untreated control trees. However, this treatment also significantly reduced the number and lbs of fruit of packing carton size 48 per tree compared to the untreated control trees. Due to the significant increase in yield of fruit of packing carton size 60, the yield of fruit of packing carton sizes 60+48+40 was not significantly different from the untreated control. All PGR-treated trees produced numerically, but not significantly, more fruit per tree (number and lbs) than the untreated control trees. Yield was only 5,990 lbs/110 trees/acre in 2010-2011. No yield benefit was obtained from any PGR treatment in the OFF-crop year or as 2-year cumulative yield.

Percent fruit set in October for the 2011-2012 crop was significantly greater for trees treated with 2,4-D and numerically greater for trees in all other PGR treatments relative to untreated control trees. As a result average fruit diameter was smaller than the untreated control trees, with exception of trees treated with 6-BA and AVG when fruit were 17-20 mm in diameter. These results are consistent with data obtained for the setting ON-crop in October 2009. It is of interest that average fruit diameters were significantly larger in October 2009 and 2011 than in 2010, the OFF-crop year.

In 2009-2010, the Santa Paula 3 orchard produced approximately 50% fewer fruit at harvest than Santa Paula 1 (13,275 lbs/110 trees/acre). In Santa Paula 3, no treatment had a significant effect on total yield or yield of commercially valuable large fruit. All PGR-treated trees produced numerically, but not significantly, more fruit per tree (number and lbs) than the untreated control. Yield in 2010-2011 (7,833 lbs/110 trees/acre) was 40% lower than in 2009-2010. There were no significant PGR effects on yield or fruit size, with the exception that 2,4-D significantly reduced total yield and yield of fruit of packing carton sizes 60 and 48 as both lbs and number per tree for low yielding trees (30 lbs/tree). Percent fruit

set in October for the 2011-2012 crop was significantly greater for trees treated with AVG at full bloom or when fruit were 17-20 mm in diameter with no effect on fruit size, which was larger in October 2011 than in October 2010. AVG applied when fruit were 17-20 mm in diameter increased fruit set in October 2010.

There were no PGR effects of economic consequence on fruit quality in either orchard in either year of the research. At Santa Paula 3, AVG, an inhibitor of ethylene biosynthesis, increased the length of time for fruit to ripen by 1.5 days if applied when fruit were 17-20 mm in diameter, but not when applied at full bloom.

Benefits of the research to the industry

Results with AVG in both orchards demonstrated that the full bloom application increases yield by retaining many fruit of packing carton sizes 84 and 70 in an ON-crop year. Delaying the application of AVG until fruit were 17-20 mm in diameter increased the yield of larger size fruit. AVG applications should be at full bloom in OFF-crop years and delayed until fruit are 17-20 mm in diameter in ON-crop years. 2,4-D should not be used in OFF-crop years or applied in low yielding orchards (~3,650 lbs/110 trees/acre). It is clear that to be able to demonstrate a PGR dose response over multiple years, a new orchard will have to be used each year due to fruit loss in response to high PGR concentrations resulting in higher yields the following year. Note: that the yield increase the following year are not sufficient to warrant investigation of GA₃ as a fruit thinning agent.

The extremes in alternate bearing these past years have highlighted the interaction between crop load and the effect PGR treatments on yield. The results presented are consistent with the results of our prior research documenting that PGRs numerically, but not significantly, increased yield and fruit size in an OFF-crop year and had a statistically significant beneficial effect on yield and /or fruit size only in the ON-crop year (Garner et al., 2011). However, it now appears that there may be an upper limit in crop load above which some PGRs are not effective. We are working out the details in order to be able to guide growers in the cost-effective use of PGRs.

GA₃ and AVG yield data have been provided to Valent BioSciences for review.

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Literature Cited.

Garner, L., G. Klein, Y. Zheng, T. Khuong, and C.J. Lovatt. 2011. Response of evergreen perennial tree crops to gibberellic acid is crop load-dependent: II. *GA₃ increases yield and fruit size of 'Hass' avocado only in the on-crop year of an alternate bearing orchard.* Sci. Hortic. 130: 753-761.