



Gibberellic Acid to Enhance Juice Yield and Late-Season Quality of Processing Oranges¹

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Introduction

Experiments have demonstrated that application of gibberellic acid (GA) in the fall often increases juice extraction weight from oranges during processing. Even a slight increase in juice extraction efficiency can be economically beneficial (Figures 1 and 2). In addition, processors report that GA-treated fruit often provide superior handling and juice quality late in the season. This is particularly valuable for production of Not-From-Concentrate (NFC) juice, and because of this benefit, some processors have provided incentives for growers to use GA and delay harvest.

GA has the potential to be an important part of the spray program for processing oranges, and many details concerning this use are still under investigation.

However, because this practice has already gained wide-spread industry adoption, this document was prepared to provide information to growers on the advantages and potential disadvantages of fall GA applications and delayed harvest.

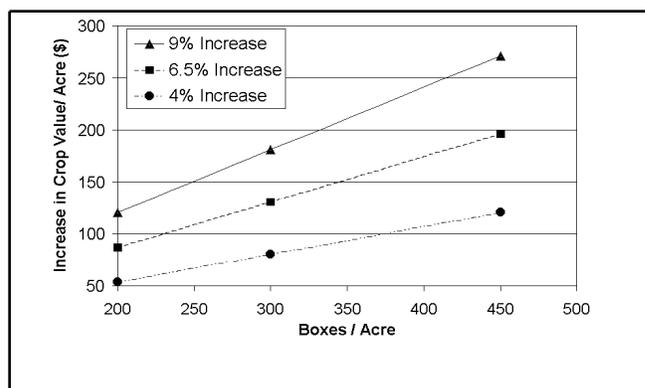


Figure 1. Effect of Increased Juice Extraction Efficiency on Crop Value at \$1/ Pound Solid - Values for Valencia at 6.7 Pounds Solids / Box State Average Yield is ~300 boxes/acre for 1994-99

How does this work?

GA (also known as GA₃ or gibberellic acid) is a naturally occurring plant growth regulator that has a number of effects on tree and fruit development. GA application to citrus fruits approaching maturity enhances peel firmness and generally delays peel senescence. It is likely that GA enhances juice extraction efficiency because increased peel firmness provides better mechanical support for fruit within

1. This document is HS-794, one of a series of the Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Publication Date: January 2001. Please visit the EDIS Web site at [HYPERLINK "http://edis.ifas.ufl.edu" http://edis.ifas.ufl.edu](http://edis.ifas.ufl.edu).

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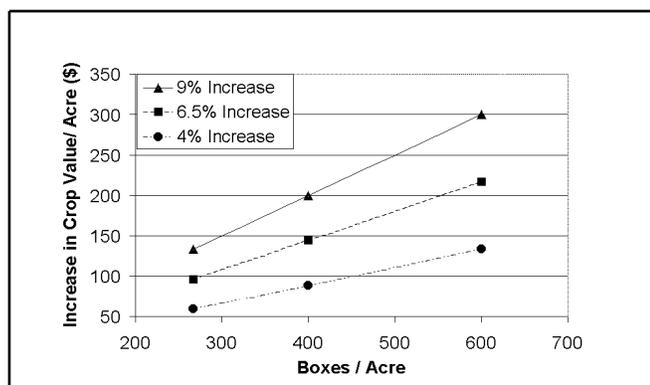


Figure 2. Effect of Increased Juice Extraction Efficiency on Crop Value at \$1/ Pound Solid - Values for Early-Mids at 5.5 PS / Box State Average Yield is ~400 boxes/acre for 1994-99

extractor cups. Similarly, firmer rinds may reduce damage to fruits at the bottom of trailer loads as fruit approach over-maturity. There are some industry reports that juice vesicle tissue also has greater integrity in GA-treated fruit, which reduces clogging of filters during processing.

Effect of GA on peel color.

When GA is applied around color break it delays loss of green color from the peel, providing a good visual cue that GA has been applied. This delay in peel color development could delay harvesting of fresh fruit early in the season and interfere with degreening but is of little consequence for processing fruit. The pull force needed for harvest of greener fruit may be slightly increased but has not resulted in reported problems.

How much increase in juice yield should I expect?

In most cases, proper GA application results in a 4 to 9% increase in juice weight. For example, an increase in juice weight for Valencia oranges from 60 to 63 % represents a juice weight increase of 5%. This is within the normal variability observed from year-to-year and among different groves, so the effects may not be readily apparent. As with all plant growth regulators, there may be some years where there is no response due to environmental or tree factors.

However, most University of Florida and industry trials have shown a positive response to GA application over the past 5 years.

What varieties respond?

Hamlin, Pineapple, and Valencia oranges have all shown increases in juice extraction weight with GA application but results have varied with season, grove location, and harvest date.

When should GA be applied to enhance juice extraction efficiency or provide higher late season quality?

Greatest effects on juice extraction weight have typically been observed when applications are made near color break for each variety. However, significant increases in juice extraction have also been observed with application earlier and later than colorbreak. In most cases, the increase in juice yield is greatest for Hamlin with December harvests but increases are usually observed throughout the commercial harvest period for all varieties tested.

Generally, effects on late-season quality are greatest when GA application is made after color-break. For example, Valencia has responded well to application as late as the first of December. However, the possibility of affecting bloom is much greater with late applications.

How should GA be applied?

All Florida trials have been conducted with 18 ounces of ProGibb (4%) per acre. Lower rates and other GA₃ formulations may also be effective, but they have not been subjected to scientific trials. Most studies have been conducted using organosilicone surfactants (such as Silwet L-77, Silken, Breakthru and Kinetic) at 0.05% (v/v, 1 quart of surfactant per 500 gallons). However, recent studies suggest that surfactants do not increase GA effectiveness if applied under ideal temperature and drying conditions. Although, these surfactants are relatively expensive, it may be wise to continue including them in the GA tank mix until further information becomes available.

Thorough spray coverage is important, but spray volumes as low as 125 gallons / acre have been

shown to be effective. It is probably beneficial to make applications during slow drying conditions. Remember that PGRs such as GA actually have to enter plant tissues to be effective. Ideal conditions include high humidity, little wind, moderate temperatures (70-80 F) and no rainfall or overhead irrigation for at least 4 to 12 hours after application.

In a few trials it appears that tank mixing some materials with GA can greatly reduce GA effectiveness. Tank-mixing GA with other materials reduces application costs but care should be taken before mixing GA with other materials such as miticides, fungicides, nutritionals, or oil. Tank-mixing may reduce the efficacy of GA or in some cases cause phytotoxicity. Check label instructions for details.

Can GA influence cold-hardiness?

Earlier flushing has been observed in many blocks treated with GA as early as late November, suggesting that GA-treated trees may be more sensitive to cold during at least part of the winter following treatment. However, at present there are no data or observations indicating that GA affects cold hardiness.

Can GA influence cropping or tree health?

Flower induction in Florida citrus typically occurs from November through February. Application of GA during this period is likely to reduce numbers of flowers produced the following spring and may alter bloom timing. Applications during November or December to increase juice extraction weight often delay bloom compared to untreated trees.

Reduced flowering may actually increase cropping or have negligible effects for trees that tend to flower excessively, with high numbers of “bouquet” blooms (flower clusters not associated with newly formed leaves). However, trees that usually have more moderate flowering may have reduced fruit set following GA application in the flower induction period. Knowledge of a block's flowering history and / or suitable economic

incentives for GA use may be advisable before using GA during this period.

GA has been applied to citrus trees for over 40 years and there are periodic reports of fruit or leaf damage. A superficial marking, similar to copper burn, is frequently seen in grapefruit treated with GA combined with strong surfactants. However, we are unaware of such damage in oranges, and such damage would have little significance in processed fruit. Some increase in leaf drop is sometimes observed after GA application, but is not sufficient for concern when applied according to label directions. As described above, care should be taken in tank-mixing GA with other materials to avoid potential phytotoxicity problems.

Delayed harvest is known to reduce subsequent cropping!

While use of GA to improve late-season fruit quality is desirable for NFC production, it is well established that delaying harvest can significantly reduce fruit retention and growth for the following season's crop. The only published report on oranges comes from a study on Valencia in Arizona. This study found that harvest from early March through late April produced little difference in the following season's yield. However, subsequent cropping was reduced by 25% when harvested in late May, 37% when harvested in mid- June, and 53% when harvested in mid- July. When delaying harvest, some increase in fruit weight does occur, but since some drop also occurs there is little increase in total yield after mid-April for the current season's crop. Please note that the magnitude of crop reduction from delayed harvest may be quite different in Florida, but grower observations suggest that the same general trend is likely to be observed here.

There is also emerging evidence that fall GA treatments may reduce Brix in the subsequent season's crop. This could result from more prolonged competition between the maturing crop and the fruit which will be harvested the following season. It is also possible that GA applied in October or November may delay bloom and subsequent fruit set, effectively reducing the age of fruit harvested on a given date. In addition, Brix may also be decreased in the current season's crop if fruit are harvested soon after GA

application when the peel is still green. For example, Hamlin oranges sprayed with GA in October at color break had lower Brix levels than non-sprayed fruit when harvested in December. However, practically this should not be a problem because the major reason for applying GA in the fall is to improve juice content and peel integrity for late-harvested fruit.

Conclusion

All these factors should be considered when weighing the economic merits of delaying harvest. However, GA has proven to be safe and effective for increasing juice yield for processing oranges in 5 years of testing. Growers do need to be aware of possible undesirable side effects when considering application of GA.