



# Understanding mandarin blooming and fruit set requirements

By Fernando Alferez, Fred Gmitter and Jude Grosser

**C**itrus trees bloom profusely. It is estimated that a healthy adult tree can produce more than 200,000 flowers every year. This figure is much higher than the number of fruits the tree can maintain and develop. Normally, only 1% to 5% of flowers set fruit that develops, matures and can ultimately be harvested.

Blooming and fruit set are highly coordinated processes, with unique characteristics and patterns depending on the citrus variety. Understanding them is important for better grove management decisions that will maximize fruit yield and quality. This article reviews some of the basic concepts regarding blooming and fruit set and presents some classic examples. It also discusses challenges and new information regarding blooming and fruit set behavior of a few increasingly planted mandarin varieties in Florida, including Sugar Belle®, Bingo and Tango.

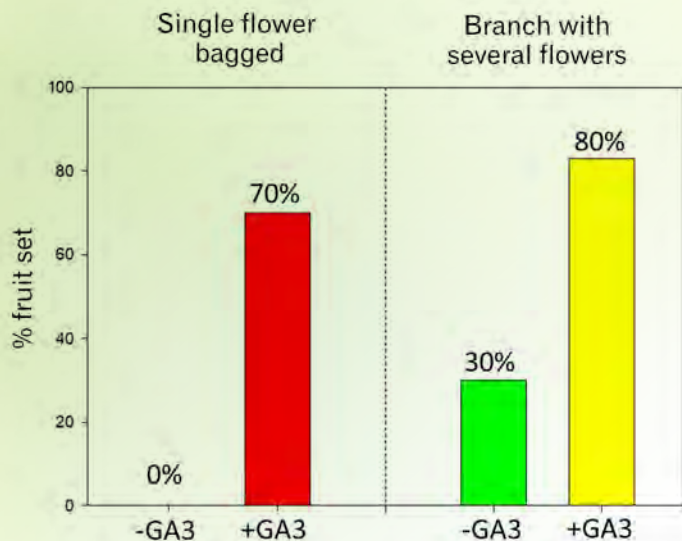
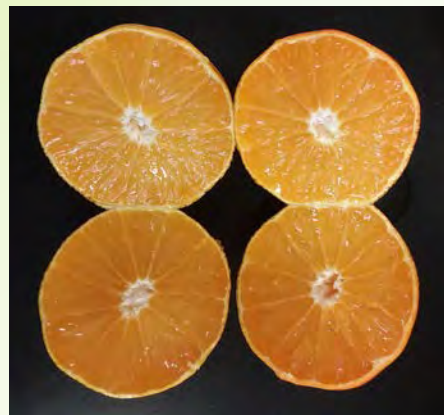
Low temperature (accumulation of chilling hours) and water stress are key promoters of flower induction. In tropical and subtropical areas, such as Florida, water stress should be the most important factor. However, given its longitudinal shape oriented south to north, Florida has several climatic areas. Whereas in the south, subtropical and even tropical conditions prevail with almost non-existent chill temperatures, more continental conditions may be present in central and northern regions, and chilling hours can accumulate during winter, inducing bloom in early

spring. In the south of the peninsula, water stress is more important in inducing flowering.

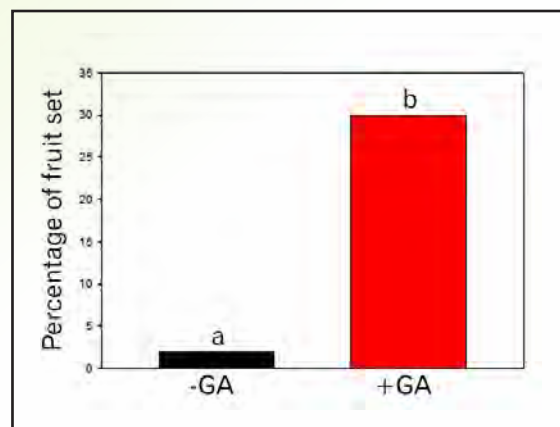
## WITHHOLDING WATER

In general, the longer the water stress period lasts, the greater the bloom after irrigation is resumed. Under controlled conditions, withdrawing irrigation for four to 10 weeks (typically six weeks) and rewatering only when the soil is totally dry will produce significantly more flowers once normal irrigation is resumed than normally irrigated trees.

Bloom induction under controlled irrigation conditions is being studied in citrus under protective screen (CUPS). Treatments began around Jan. 10 in the last two seasons. Deficit irrigation was performed by watering only once every 15 days to field capacity for two months, as compared with normal irrigation



**Figure 1.** Single Sugar Belle® flowers were covered with a mesh bag. GA3 treatment (10 parts per million) was applied at petal fall in some flowers, inducing 70% set of seedless fruit. In the absence of pollination and/or external GA, there was no fruit set. In contrast, when several flowers were covered together, self-pollination effectively induced a modest amount of fruit set, which was dramatically increased with GA application at petal fall.



**Figure 2.** In this case, isolated blocks of 2-year-old Tango trees were used. Treatment with GA induced some modest increase in fruit set. These experiments will continue until the trees enter a commercially productive age to clearly assess the need for fruit set aids.

(watering every other day). Data shows that withholding irrigation for 60 days can induce 30% more bloom in both Sugar Belle® and Tango. The effect on Bingo is milder (around 10% more flower induction). This strategy can be adopted in Florida in the absence of

other stresses (disease) in CUPS or possibly even in trees grown in IPCs, although the latter still needs to be proved.

### GIBBERELLINS FOR FRUIT SET

In some cases, cross-pollination carried out by bees is required at

anthesis for successful ovule fertilization. However, this produces fruit with seeds. In contrast, many citrus varieties can naturally set fruits without seeds. This phenomenon is called parthenocarpy and is the ability to produce fruits without fertilization of the ovules and, therefore, without developing seeds. Parthenocarpy is genetically regulated and determined by high levels of gibberellins (GA) in the ovule.

Varieties with lower levels of GA may be induced to set seedless fruit by applying exogenous GA, a well-known horticultural practice. A classical case study of this is known as the Satsuma/Clementine system.

Satsuma and Clementine are two species of seedless mandarins that differ in their parthenocarpy. On one hand, Satsuma is a male-sterile cultivar that shows a high degree of natural parthenocarpy and a high fruit set. On the

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other hand, Clementine varieties are self-incompatible, and in the absence of cross-pollination set very few fruits. Treatment with GA can improve fruit set in Clementine but does not influence Satsuma. Clementine fruits do not have adequate GA levels for fruit set, so treatment is effective. Satsumas already have high levels of GA, so this treatment is not as effective.

## WHAT THIS MEANS FOR GROWERS

Preliminary data indicate that Sugar Belle® will benefit from an external source of pollen to set fruit, but this will result in increased numbers of seeds per fruit. However, it has been shown that GA application in bagged flowers at petal fall increases the fruit set rate to 80%. In addition, the fruit is seedless as no cross pollination occurs (Figure 1, page 22). This shows that growing Sugar Belle® in a closed environment like CUPS or in solid blocks can produce a harvestable crop that can be improved with hormonal treatment.

In the case of Tango mandarin, which is the result of mutations induced by irradiating budwood from W. Murcott mandarin, there is not yet any published information addressing these questions. However, reports on W. Murcott mandarin suggest a high degree of self-incompatibility but also high parthenocarpic ability. Hence, for Tango, no additional aid (GA) should be necessary. However, in trials, some improvement has been seen in the percentage of fruit set (20% more fruit set) after the hormonal treatment (Figure 2, page 23).

Bingo seems a little more complicated, and there are still some conflicting data. In closed environment conditions (CUPS) with no air circulation and presumably no pollination, no fruit set was seen. In contrast, hand pollination induced fruit set. A very modest increase (5%) in fruit set after GA application was seen. Experiments continue with this variety. 🍊

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