

# THE GOOD, THE BAD, AND THE UGLY:

## Optimizing OTC injections

By Ute Albrecht, Caroline Tardivo, Larissa Nunes, Gabriel Pugina,  
Gerardo Moreno and Jasmine de Freitas

**A**s growers are well into the second year of oxytetracycline (OTC) injections since approval for commercial use, more and more data are accumulating. The good news is that in all University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) trials, trees have been responding with significant improvements in yield and juice quality. The not so good news is that phytotoxic effects may occur. Researchers are still trying to figure out how to administer the injections without harming the trees in the process.

### THE GOOD

Let's begin with the good news. Numerous field trials are in progress in commercial citrus groves. In all trials, yield increases of 25% to more than 100% have been measured consistently, along with significant improvements in fruit size and juice quality. While yield increases vary from trial to trial, the increase in Brix or total soluble solids appears to be more consistent, ranging from 10% to 20%.

In rootstock trials, all rootstocks responded positively to the injections but, perhaps not surprisingly, there were

Rootstock	Pounds solids/acre		
	Non-injected	Injected	Increase
<b>Trial 1 (Highlands County)</b>			
US-812	389	704	81%
US-942	267	440	65%
UFR-4	135	311	130%
UFR-2	203	297	46%
Sour orange	147	266	81%
<i>Rootstock effect: p&lt;0.001</i>			
<i>OTC effect: p&lt;0.001</i>			
<b>Trial 2 (Polk County)</b>			
US-942	472	704	49%
Carrizo	514	673	31%
US-812	525	668	27%
US-897	356	516	45%
UFR-4	349	515	48%
UFR-2	372	443	19%
<i>Rootstock effect: p&lt;0.001</i>			
<i>OTC effect: p&lt;0.001</i>			

**Table 1.** Results from two rootstock trials. Trees (Valencia) were planted in 2015 and injected in May 2023.

significant differences among them (Table 1). Although differences among rootstocks seem to be mostly a reflection of their general relative performance, OTC injections may help uncover their true potential, especially in trials where new rootstocks are included.

A comparison of rootstock versus scion injection did not produce any significant differences for yield and juice quality thus far. However, longer bark cracks are being observed when injecting into the scion. This year, OTC was taken up faster when injections were administered into the scion instead of the rootstock. This was not the case last year. In some cases, the uptake rate also varied by rootstock.

In some UF/IFAS trials, trees have been injected for two consecutive years. One of these trials is in a commercial grove near Fort Pierce. The trees in that trial are Valencia on sour orange rootstock. They were nine years old at the time of the first injection in 2022.

In the first year, a yield increase of 32% was measured when OTC was applied at the low rate (0.55 g/tree) and an increase of 67% when applied at the high rate (1.1 g/tree). The pounds solids per box were increased by 15% and 19%, respectively.

Greater increases were measured after two consecutive years of injection. Although yields were higher in 2024 compared to 2023 regardless of injection, compared to non-injected trees, OTC injected at the low rate increased

# Good-Looking Groves

By Rick Dantzer, CRDF chief operating officer



I occasionally devote a column to what industry leaders are doing in their production practices. Such is this column, written after spending time riding groves with Riley McKenna of McKenna & Associates, a fifth-generation citrus grower.

McKenna is a young grower who is energetic, hard-working and cautiously bullish on the future of the citrus industry. He does not look at industry problems through rose-colored glasses but sees opportunity for those able to make it through the next two years.

We started our tour at a 60-acre block west of Sebring. The section that most knocked my socks off contained 3-year-old Parson Brown trees on Swingle and Carrizo rootstocks. All had been covered with bags when they were planted, a practice McKenna strongly endorses. “All our trees from here on out will get bags,” he said. And when does he take them off? “As soon as they fill them up, which usually takes about a year and a half.”

McKenna is a big proponent of injecting oxytetracycline (OTC) four to six months after the covers are removed, which is after reinfection has occurred. He doesn’t do it sooner, using this metaphor: “You wouldn’t take chemo six months before you knew you were going to get cancer.” This reinforces what University of Florida researcher Ozgur Batuman has said, that OTC can’t be used as a prophylactic.

There were tissue-cultured trees leaning at a 45-degree angle that had been pushed over by Hurricane Ian. This supports something I’ve heard from other growers, that trees created by tissue culture don’t seem as sturdy as those grown from seed.

Nearly as impressive as the Parson Browns were 6-year-old OLL-4 trees on a variety of rootstocks, followed closely by Valquarius. There were also a few rows of trees which had been treated with molecules being tested as part of the Grove-First Initiative™. It’s great how growers are always willing to assist in testing new therapies and germplasm.

Next up were several blocks east of Sebring where mature Valencia trees on X-639 rootstock were responding well to OTC treatment coupled with aggressive nutrition and fertilizer applications.

“We push the trees as hard as we can, especially younger trees. The bare minimum won’t cut it,” McKenna said. He again used an excellent metaphor: “Being stuck in traffic on I-4 is no different than being out of gas on I-4; either way, you aren’t moving.” His point, of course, was that even if OTC cleans CLAs out of the phloem, the tree still needs energy to produce.

And the injection process itself? “Two-sided,” McKenna said. “Going forward, this is what we are going to do with all our trees. Distribution is much better.” He’s less enthusiastic about gibberellic acid but sees good potential with 2,4-D. He also observed that hurricane-affected trees are not responding as well to the treatments.

“We still have a lot to do, but things are getting better,” McKenna believes. And with young stars like him stepping up and assuming leadership roles, indeed they are.



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**Figure 1.** Top: Leaf yellowing shortly after OTC injection in June 2024. Injections were done in line with the crotch of the scaffold branches. Bottom: Severe phytotoxicity in one sector of the canopy, resulting in leaf and fruit drop.

OTC rate	Boxes/acre	Lbs. solids/box	Lbs. solids/acre
<b>Year 1</b>			
Non-injected	57 b	4.8 b	274 b
5,500 ppm	75 ab	5.5 a	408 a
11,000 ppm	95 a	5.7 a	543 a
	<i>p=0.056</i>	<i>p&lt;0.001</i>	<i>p&lt;0.001</i>
<b>Year 2</b>			
Non-injected	101 b	5.4 b	541 b
5,500 ppm	173 ab	6.2 a	1066 a
11,000 ppm	223 a	6.2 a	1385 a
	<i>p&lt;0.001</i>	<i>p&lt;0.001</i>	<i>p&lt;0.001</i>

**Table 2.** Results from a trial near Fort Pierce, Florida. Trees (Valencia/sour orange) were planted in 2013 and injected in June 2022 and 2023.

harm to the tree. Phytotoxic effects are not limited to OTC or the low pH of the injected solution. Similar or even worse phytotoxic effects with other injected chemicals, regardless of the pH, have been seen. Researchers have not observed any such effects when injecting water alone, even when it was acidified.

How can phytotoxic effects be avoided? Unfortunately, there is not a clear answer yet. This year, Florida had a long dry period followed by higher than usual temperatures. It is possible that the stress caused to the trees by these conditions rendered them more vulnerable to the additional stress from the injections.

Interestingly, a study initiated this year saw severe leaf yellowing in one grove location but not in another even though the trees were of similar age, and injections were performed at the same time using the same rate. This suggests that the local environment at the time of injection plays a role in the tree response. In one trial, leaf yellowing was observed even when the OTC was administered in two half doses on two opposite sides of the trunk. However, the leaf yellowing was more moderate than when administering a single injection of the full dose into one side of the trunk.

## MOVING FORWARD

For new tree plantings, managing the trees so they have a longer trunk rather than a short one should be considered. The longer the trunk, the more time (distance) the OTC has to disperse evenly before reaching the scaffold branches. In any case, it is better to inject in line with the crotch of

the yield by 71% and at the high rate by 121%.

Pounds solids were increased by 15% regardless of the rate. The total pounds solids/acre was 1,066 for trees that received 0.55 g OTC and 1,385 for trees that received 1.1 g OTC, compared to 541 for the non-injected control trees (Table 2). The tree density in that trial was 290 trees per acre.

## THE BAD AND THE UGLY

The bad (and sometimes ugly) news is that, especially in this year, phytotoxicity after injection seems to have been occurring with some regularity. This can manifest as moderate leaf yellowing in some parts of the canopy to severe yellowing and bronzing (Figure 1). In even more severe cases, leaf drop, twig dieback and fruit drop may occur.

However, such effects are usually

only observed in a small section of the canopy. In most cases, yellowing or bronzing are followed by the production of healthy new leaves during the next flush.

The location of phytotoxicity in the canopy is related to the proximity of a branch to the injection site. Branches emerging closely in line with the injection site will usually receive more OTC than branches emerging on the opposite side of the injection and experience the most severe phytotoxicity.

At harvest, the injected side of the canopy usually looks healthier and produces more and better quality fruits than the opposite side (see [citrusindustry.net/2024/05/14/address-sectoring-trunk-injected-trees](http://citrusindustry.net/2024/05/14/address-sectoring-trunk-injected-trees)). It must be noted that any xenobiotic (a chemical substance foreign to an organism) can potentially cause



**Figure 2.** Injecting smaller doses of OTC on different sides of the trunk promotes a more even distribution, prevents sectoring and reduces phytotoxicity.

the scaffold branches instead of directly in line with a main branch.

The best approach is to use two injectors (or more for very large trees) spaced evenly around the trunk, to split the OTC into multiple smaller doses, instead of one injector on one side of the trunk containing a high

dose (Figure 2). However, this may not be cost-effective and/or practical.

If deciding to split the injections, using a smaller injector tip may be considered. Using a smaller injection tip is especially important for injecting smaller trees, which are more prone to bark cracking and other trunk damage.

A recently completed UF/IFAS study suggested that the number of injection sites is more important than the OTC dose. Chemjet injectors were used in that study (which require a 11/64-inch drill bit), but smaller tips are also available for the FLExInject injectors.

Researchers are constantly learning as studies continue. OTC injections are effective. Learning how to optimize the process without increasing the costs is the goal moving forward.

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*Ute Albrecht (ualbrecht@ufl.edu) is an associate professor; Caroline Tardivo, Gabriel Pugina and Larissa Nunes are PhD candidates; and Jasmine Freitas and Gerardo Moreno are biological scientists — all at the UF/IFAS Southwest Florida Research and Education Center in Immokalee.*

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