

The economics of citrus undercover production systems and whole tree thermotherapy

By Arnold Schumann and Ariel Singerman

In the October 2015 issue of *Citrus Industry*, an update of University of Florida/Institute of Food and Agricultural Sciences (UF/IFAS) research on the citrus undercover production system (CUPS) was provided. Also in that issue, whole tree thermotherapy (WTT) was introduced as a possible second alternative fresh fruit production system that could also produce huanglongbing (HLB)-free fruit, but without the high investment cost of a screen house. Both technologies are being explored as interim solutions to provide immediate, viable options for fresh fruit growers to produce disease-free, high-quality fresh fruit, even in the presence of HLB in surrounding groves.

The CUPS and WTT research at the UF/IFAS Citrus Research and Education Center (CREC) is now over a year old, with the trees having been planted from August to September of 2014. The first yield assessments, using fruit counts and diameters measured 13 months later (Figure 1) in October 2015, estimated W. Murcott and Ray Ruby grapefruit yields of 85 and 203 boxes per acre, respectively, from 871 trees per acre. The grapefruit sizes averaged 36, the Murcotts 120 fruits per carton, and the grapefruit maturity (Brix/acid ratio) was passing the packinghouse standards.

These results confirmed our original expectations and yield predictions for fresh fruit production under intensive management using high planting densities and advanced fertigation. As a result, we were able to conduct the first economic analysis of both CUPS and WTT production systems, which we will describe in this article. Readers are reminded that these economic analyses are based on a number of assumptions, particularly regarding yields, prices and, therefore, revenue. Thus, we utilized a combination of likely production scenarios in order to generate a range of possible outcomes to provide growers with useful information for them to make decisions about future CUPS or WTT investments.

ANALYSIS ASSUMPTIONS

The assumptions used for the economic analysis presented in this article include the following.

- 1) The land is already owned.
- 2) Tree spacing is 5 feet by 10 feet, so the tree density is 871 trees per acre.
- 3) We consider two investment alternatives: CUPS and WTT. For CUPS, trees are assumed to be planted in the soil. For WTT, the trees are grown in 10-gallon pots.
- 4) The WTT alternative is subject to a 3 percent annual recurring

incidence of HLB.

- 5) The time horizon for the analysis is 10 years.
- 6) Yields in boxes per acre by year are assumed to be:

Year:	1	2	3	4	5	6	7	8	9	10
WTT	131	323	684	866	866	866	866	866	866	866
CUPS	135	333	706	893	893	893	893	893	893	893

- 7) The assumed packout for CUPS and WTT are 95 percent and 85 percent, respectively.
- 8) Production costs are assumed to be constant for years two through 10.



Figure 1. One year-old Ray Ruby grapefruit tree on sour orange rootstock grown with a 10-gallon pot and drip fertigation in the Citrus Research and Education Center screen house.

- 9) For calculating the investment and fixed costs of most machinery and irrigation used, we assumed the size of the operation is 20 acres.

There are also a few caveats that are worth noting. First, production and input data are available for the first year only. Thus, the figures we used represent projections only.

Second, the quotes for chemicals in our calculations are based on retail prices. But growers — depending on the size of their operation — can get up to a 20 percent discount for volume. Third, the actual investment in machinery and irrigation by each grower will depend on whether he starts a new operation or some of the equipment is already available to him.

ESTIMATED COSTS

The estimated costs for the WTT alternative are as follows: The investment per acre is composed of \$8,500 for the trellis, \$8,473 for the dual (drip + microjet) irrigation system and \$3,888 for machinery. Under the WTT alternative, the first year variable and fixed costs per acre are \$19,777 and \$3,831, respectively. Note the variable cost includes the costs for the pots, media and tiles placed beneath the pots. From years two through 10, the variable and fixed costs per acre are estimated at \$2,951 and \$2,168, respectively.

The costs associated with the CUPS alternative are quite different than that of WTT. The actual cost for the structure and screens located at CREC is \$43,000 per acre. Note the screens need to be replaced every seven years. The investment per acre required for microjet irrigation is \$6,873 and \$3,888 for machinery. Under CUPS, the variable and fixed costs per acre during the first year are estimated at \$11,752 and \$8,529, respectively, whereas for years two through 10, the variable and fixed costs are instead \$2,147 and \$9,144, respectively.

DETERMINING PROFITABILITY

To analyze the profitability of the two investments, we computed their net present value (NPV), which consists of summing the discounted cash flows for each year. When the NPV is positive, the investment is profitable and, therefore, should be accepted. Conversely, when the NPV is negative, the investment is not profitable and should not be accepted. Given that

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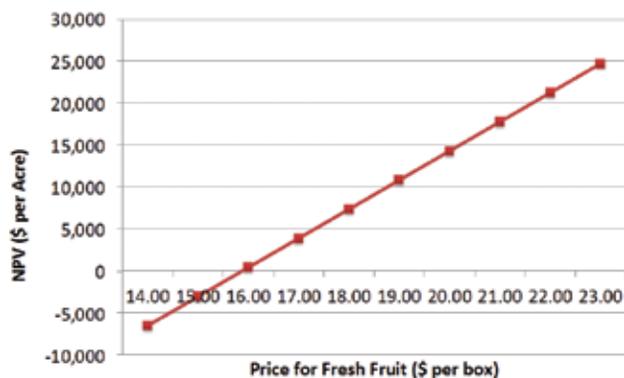


Figure 2. Whole tree thermotherapy: net present value (NPV) for different levels of fresh fruit prices (price per box for eliminations: \$3.02; interest rate: 10 percent; time: 10 years).

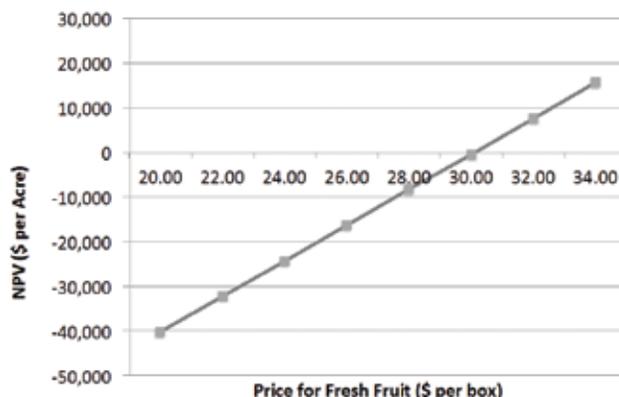


Figure 3. Citrus undercover production system: net present value (NPV) for different levels of fresh fruit prices (price per box for eliminations: \$3.02; interest rate: 10 percent; time: 10 years).

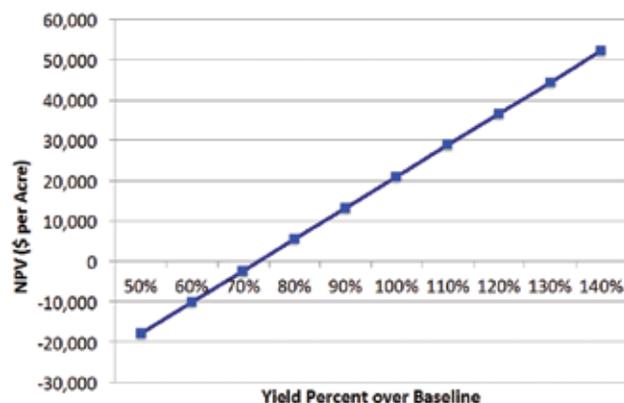


Figure 4. Whole tree thermotherapy: net present value (NPV) for different levels of yields (price per box: fresh \$21.95, eliminations \$3.02; interest rate: 10 percent; time: 10 years).

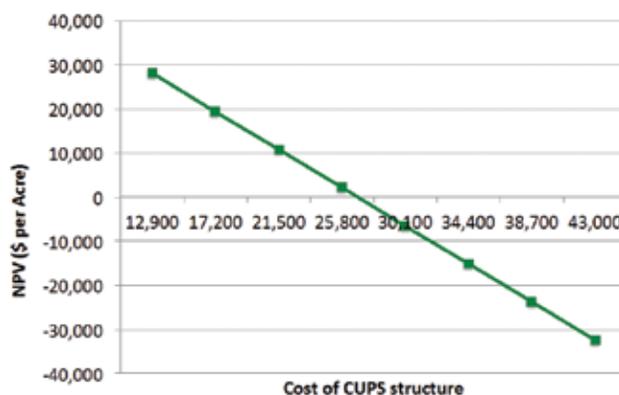


Figure 5. Citrus undercover production system (CUPS): net present value (NPV) for different levels of cost of structure (price per box: fresh \$21.95, eliminations \$3.02; interest rate: 10 percent; time: 10 years).

the budget we are working with is an economic budget — because we incorporated opportunity costs (e.g., foregone interest in the bank) — an NPV equal to zero implies that the investment is yielding a normal return while covering all costs.

In the first set of scenarios we analyzed, we assumed that the average prices per box were those reported by U.S. Department of Agriculture-National Agricultural Statistics Service in 2013–2014. Thus, the average price per box for fresh fruit during the 10-year period was assumed to be \$21.95, while the average price per box for eliminations was assumed to be \$3.02. Under the current assumptions for

prices, yields, packout and costs, the resulting NPV when using a 10 percent discount rate is \$20,995 for WTT and -\$32,445 for CUPS.

However, for both alternatives, we also computed the NPVs using a range of different fresh fruit prices. The results are shown in figures 2 and 3. Figure 2 shows how the NPV (values derived on the vertical axis) for WTT changes for different price levels of fresh fruit (values derived on the horizontal axis). Thus, Figure 2 shows that for WTT, the NPV is zero for a fresh fruit price of \$15.88. The positive relationship between price and NPV can be quantified as: for every \$1 increase (decrease) in the price of fresh fruit, NPV increases (decreases)

by \$3,458. Figure 3 shows that for CUPS, the NPV of zero is attained when the price of fresh fruit is \$30.09 per box. Hence, everything else constant, any higher (lower) price yields a positive (negative) NPV. In this case, the positive relationship between price and NPV can be summarized as: a \$1 increase (decrease) in the price of fresh fruit increases (decreases) the NPV by \$3,984. Note the larger effect of price on NPV for CUPS is the result of a higher assumed packout relative to WTT.

Another set of relevant scenarios we analyzed for WTT involved uncertainty or variability of the yield, regardless of the cause. Figure 4 depicts the change in NPV (in the

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Higher revenue from higher fruit prices or yields, or a lower cost for the structure, or a combination of those factors, is needed to make CUPS profitable.

vertical axis) as yield (denoted in the horizontal axis in percent with respect to the baseline yield) changes. It can be seen from Figure 4 that a yield level of 73 percent, or, equivalently, a 27 percent reduction in the yield baseline, would make the NPV be zero; higher (lower) yield levels would make the NPV be positive (negative).

For CUPS, we computed the change in NPV for different cost levels of the screen house. The results are depicted in Figure 5 (page 16), which shows that the NPV is zero for a cost of the structure of \$26,832; a higher cost for the structure makes the NPV negative, and any lower cost makes the NPV positive. In fact, under the current assumptions, we found that for every \$1,000 decrease (increase) in the cost of the structure, the NPV increases (decreases) by \$2,000.

SUMMARY/CONCLUSIONS

WTT and CUPS could be considered as alternatives to traditional fresh citrus production methods in the era of HLB. However, an economic analysis of the costs and benefits involved in any such project is key to establishing the profitability of the investment.

In this article, we provided a number of scenarios for growing W. Murcott tangerines in both WTT and CUPS based on a number of assumptions, projections and the data collected during the first year of CUPS and WTT research at the UF/IFAS CREC. We found that WTT was profitable under our hypothesized baseline scenario, while CUPS was not, primarily because it requires a

larger investment compared to that of WTT. Therefore, higher revenue from higher fruit prices or yields, or a lower cost for the structure, or a combination of those factors, is needed to make CUPS profitable.

CUPS or WTT profitability should also be compared with the profitability of conventional fresh fruit production methods in HLB-endemic conditions. According to CREC Director Michael Rogers, recent new citrus plantings in Florida have shown average HLB incidences of 18 percent after two years under conditions of medium psyllid pressure. Assuming HLB incidence can roughly double every year, those young conventional groves will reach 100 percent HLB incidence by five years of age. At that point in time, a young grove should be reaching full production capacity. Thus, profitable fresh fruit production with most HLB-susceptible commercial varieties in conventional groves is very challenging, mainly due to high production costs, excessive pre-harvest fruit drop, low packout (small fruit size and poor internal quality), stunted tree growth and low fruit set. 🍊

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