The economics of mesh bags for protecting young citrus trees

By Ariel Singerman

The use of mesh bags has been proposed as a strategy for excluding Asian citrus psyllids to protect young citrus trees. The expected benefit of using mesh bags is increased yield by delaying HLB infection.

A scientific experiment to evaluate the effectiveness of mesh bags started in February 2018. There are still many unknowns regarding yield, use of chemicals, incidence of other pests and diseases, etc. However, some growers are already experimenting with mesh bags in their groves in different ways. In some groves, every other tree within a row is covered. In other groves, every other row is covered. Some growers choose to cover the entire new planting.

In this article, I evaluate the economic feasibility of using mesh bags for protecting young citrus trees based on a number of assumptions. Growers can follow the methodology to make the calculations relevant for their own operation and, therefore, improve their decision-making process to decide whether to use the bags.

YIELD AND PRICE ASSUMPTIONS

Two key variables for the calculations are yield and prices (in years 3, 4, 5 and 6). Therefore, to deal with the uncertainty regarding yield, I make assumptions based on historical data available. To take into account the uncertainty in prices, I create scenarios that represent different potential values. Other key variables for the calculations are the cost of the bag and the associated labor to put them on and take them off, the useful life of the bags, and the savings in caretaking programs that can be achieved by using the bags. The latter variables, unlike yield and prices, are either known or can be reasonably estimated.

Table 1. Detailed calculations for reset scenario: two-use bag, $2.00/pound solids and high savings

Year	Item	Cost Cash Flow	Revenue Cash Flow	Undiscounted Profit	Net Present Value 10%
		Dollars per Tree			
0	Bag + labor on	-4.80		-4.80	-4.80
1	Savings		2.77	2.77	2.52
2	Labor off + savings	-1.25	2.77	1.52	1.26
3	Differential yield and revenue		1.00	1.00	0.75
4	Differential yield and revenue		0.77	0.77	0.52
5	Differential yield and revenue		0.54	0.54	0.33
6	Differential yield and revenue		0.00	0.00	0.00
			Total	**1.79**	**0.58**
			Internal Rate of Return =		**16.43%**

The analysis provided here is for Valencia oranges and is based on the following assumptions. I assume that the bags will be put on young trees for two years. During those two years, trees will be HLB-free, and the grower will incur additional costs and savings due to the use of bags. At the end of the two years, the bags will be removed. Trees will eventually become HLB-infected but will attain a differential yield (relative to unbagged trees) because of the delayed infection.

The average reduction in yield relative to a healthy tree due to HLB is 40 percent. Thus, after taking the bag off a reset, I assume the progression of the reduction in yield is 20, 30, 37 and 40 percent in years 3, 4, 5 and 6, respectively. In other words, the differential yield benefit vanishes four years after taking the bag off. Also, the underlying assumption for the level of yield is that the tree density is 220 trees per acre.

Regarding prices, I assume that they are constant throughout the investment period, but I assume three different price levels (on a delivered-in basis) to denote possible market conditions. Given the recent decrease in prices in the cash market, I assume $1.75, $2.00 and $2.25 per pound solids for the low, medium and high price scenarios, respectively. In terms of costs, I assume that the cost of a 5-foot bag and PVC stake is $7.10, and the associated labor cost to put the bag on and off is $1.25. I assume two scenarios regarding the bag lifetime: one-use (two years) and two-use (four years).

CARETAKING SAVINGS

With respect to caretaking savings, I use the annual cost of production data as a basis for the calculations and assume two different scenarios: low and high savings. The low-savings scenario achieves savings of $0.88 per tree in years 1 and 2 by avoiding the expense of two drench applications for a total of $0.72 per tree, foliar insecticide savings of 50 percent at $0.12 per tree, and foliar nutritional savings of 20 percent

Table 2. Reset model profitability analysis for different scenarios

Bag Use	Price ($)		Savings	Internal Rate of Return
	Delivered-In			
One use	Low	9.63/box	Low	-30.53%
		1.75/pound solids	High	-12.71%
	Medium	11.00/box	Low	-27.00%
		2.00/pound solids	High	-9.79%
	High	12.38/box	Low	-23.90%
		2.25/pound solids	High	-7.16%
Two use	Low	9.63/box	Low	-19.11%
		1.75/pound solids	High	13.41%
	Medium	11.00/box	Low	-14.92%
		2.00/pound solids	High	16.43%
	High	12.38/box	Low	-11.24%
		2.25/pound solids	High	19.18%

at $0.03 per tree. The high-savings scenario achieves savings of $2.77 per tree in years 1 and 2 by avoiding the expense of seven drench applications for a total of $2.53 per tree, foliar insecticide savings of 75 percent at $0.18 per tree, and foliar nutritional savings of 33 percent at $0.06 per tree.

RESULTS FOR DIFFERENT SCENARIOS

Table 1 (see page 24) illustrates the cost and revenue cash flows each year for the scenario that combines medium prices, two-use bags and high savings. Using a 10 percent rate to discount the cash flows at different years, the net present value (NPV) is $0.58. As a rule of thumb, investments with a positive NPV should be accepted, and those with a negative NPV should be rejected. The rationale for accepting investments with positive NPVs is that they yield higher returns than the discount rate (i.e., cost of capital).

However, it is impossible to estimate a discount rate that would be representative of the cost of capital of all growers because each individual grower has a different opportunity cost of capital. Therefore, I show the results of the investment analysis using the internal rate of return (IRR) methodology. The IRR is the actual rate of return on the investment, which for the example in Table 1 is 16.43 percent.

Table 2 (see page 25) shows the results for different scenarios I analyzed using the reset model. The only scenarios in which using bags for protecting resets that turn out to be profitable are those that combine a two-use bag with high savings (for all three price levels). As illustrated by the results, much of the benefits of using bags depends on how much caretaking savings a grower can achieve. This finding is, not surprisingly, also key in the solid set model.

Using mesh bags for protecting solid sets is profitable when the grower can achieve high savings in terms of caretaking.

The solid set analysis is more complex because it requires the creation of a spreadsheet to track the tree inventory each year. That is, the number of infected and healthy trees along with their yield, and the differential cost and revenue relative to a solid set with no bags.

The solid set model requires a few additional assumptions. First, I assume tree mortality to be 1 percent in year 0 through 2 and 4 percent in year 3 and beyond. Second, I assume that there are additional savings on two ground applications and on aerial applications (in the high savings scenario). Third, I also need to make a key assumption regarding the progression of the HLB infection throughout the grove because trees in a solid set do not get immediately infected after the bag is taken off. Thus, I assume that at the end of years 3, 4, 5, and 6, the infection throughout the grove is 30, 60, 90 and 100 percent, respectively.

Table 3 (see page 27) shows the results for the different scenarios analyzed using the solid set model. I

Table 3. Solid set model profitability analysis for different scenarios

Bag Use	Price ($) Delivered-In		Savings	Internal Rate of Return
One use	Low	9.6/box	Low	-18.66%
		1.7/pound solids	High	-1.14%
	Medium	11.0/box	Low	-14.63%
		2.0/pound solids	High	2.43%
	High	12.3/box	Low	-11.10%
		2.2/pound solids	High	5.60%
Two use	Low	9.6/box	Low	-4.86%
		1.7/pound solids	High	28.63%
	Medium	11.0/box	Low	-0.02%
		2.0/pound solids	High	32.28%
	High	12.3/box	Low	4.23%
		2.2/pound solids	High	35.60%

found the use of bags to be profitable for all scenarios with high savings except that of low prices and one-use bags. Of course, profitability improves significantly when the bags can be reused for two more years. However, again, the results denote that much of the benefits of using bags depends on how much caretaking savings a grower can achieve.

SUMMARY

I showed the calculations and procedure for evaluating the economic feasibility of using mesh bags for protecting young citrus trees based on assumptions that allowed us to overcome the many unknowns regarding their use. Growers can follow the methodology I applied to make the calculations relevant for their operations and, therefore, improve their decision-making process to decide whether to use the bags.

I found that using mesh bags for protecting resets is profitable when the bag can be reused (halving its cost), and the grower can achieve high savings in terms of caretaking. In addition, using mesh bags for protecting solid sets is profitable when the grower can achieve high savings in terms of caretaking, even in some scenarios in which the bag has a single use. The reason for finding the use of (relatively) more expensive bags to be profitable in solid sets is because trees in a solid set do not get infected at the time, so the impact of HLB on yield is slower (relative to that of a reset).

Ariel Singerman is an assistant professor at the University of Florida Institute of Food and Agricultural Sciences Citrus Research and Education Center in Lake Alfred.