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Cost and Profitability Estimates for Producing Lychee (Litchi chinensis) in South and Central Florida[1]

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Figure 1. 'Mauritius' lychee at harvest and 'Brewster' lychee. Credit: Ian Maguire, UF/IFAS TREC

Introduction

Florida growers are increasingly interested in diversifying their production with minor fruit crops. To assist current and future lychee growers, wholesalers, and processors, this publication provides an estimate of the costs and returns associated with operating an established lychee grove in south and central Florida. The information presented was obtained from field interviews with growers and industry experts; it is representative of small lychee operations (2–12 acres). The information provided here is intended only as a guide to estimate the financial requirements of operating a full production lychee grove. Readers interested in cultural practices may want to consult Lychee Growing in the Florida Home Landscape (Crane et al. 2020).

Lychee (*Litchi chinensis*), a member of the Sapindaceae, is a large evergreen tree originating from Asia. Lychee is cultivated in tropical and subtropical areas and requires a cold (but nonfreezing) winter period, a warm spring, and a hot summer. The top global producers include China, India, Taiwan, Thailand, Australia, Brazil, South Africa, Mexico, and Vietnam (Crane, Balerdi, and Maguire 2016). Mexico, China, and South Africa are the leading lychee exporters to the US market (USDA AMS 2018). Imports of lychee to the United States follow a seasonal pattern. South Africa supplies the fruit from December to January, while fruit from China and Mexico arrives in the US market from June to August. Because of climatic requirements, US lychee production is restricted to Florida, Hawaii, and California.

Florida leads US domestic lychee production with about 700 acres (Crane 2018). The lychee industry expanded notably in south Florida after hurricane Andrew in 1992.

Demand for lychees grown in the United States is rising along with populations of Asian and Hispanic people, who like the fruit. Lychee is considered to be economically important for many Asian countries and Mexico. Because lychee fruit is so delicate, it is difficult to transport the fresh fruit long distances. Therefore, demand for Florida lychee is projected to increase (Rafie and Balerdi 2002).

The three primary lychee cultivars grown in Florida include 'Mauritius', 'Sweet Heart', and 'Brewster'. 'Mauritius' and 'Sweet Heart' have more reliable bearing volumes than 'Brewster' (Crane et al. 2020). Unfortunately, lychee production in many areas in south Florida (e.g., Miami-Dade County and some southern areas along the SE and SW coasts) has been unreliable. Production is reduced approximately every five years because trees grow vegetatively during warmer winters, which reduces flowering and fruiting. Plantings inland and along the coastal areas of central Florida counties may have more reliable bearing, although frost or freeze events pose a constant threat. About 57% of south Florida's lychee acreage is in Miami-Dade County, with the remaining acreage located in coastal areas of central Florida (Crane 2018).

Assuming a year when trees flower and set fruit and an average planting density of 75 trees per acre with average yield from a mature tree (6 years or older) of 70 pounds, after accounting for an average 84% fruit pack-out rate, marketable yield averages about 5,250 pounds/acre. At an average F.O.B. Homestead price (i.e. the price at the packinghouse) of $2.55/pound, the crop is worth about $13,388/acre. Thus, the industry is estimated to be worth $9.37 million in a good year. However, in off-years the crop yields and worth are substantially less.

In 2018, the lychee erinose mite was discovered in Lee County and since has spread to thirteen other counties in Florida (Brevard, Broward, Charlotte, Collier, Hendry,

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Highlands, Lee, Martin, Miami-Dade, Palm Beach, Pinellas, Polk, and Sarasota) threatening the viability of lychee production in the state (Carrillo et al. 2020; Revynthi et al. 2020; FDACS 2021).

Main Assumptions

The budget and annual production costs are calculated per acre from interviews conducted with growers in August and September 2021. Given the diversity of managerial styles and production practices growers employ in south and central Florida, average costs and prices are reported. This information is representative of small lychee operations (2–12 acres) in south and central Florida. Since most of the growers own the land, we used a rental cost of $500/acre/year to account for the opportunity cost of not being able to use the land for other purposes.

Orchard Layout—Lychee tree planting densities range from 50 to 100 trees per acre. A planting distance of 24 x 24 ft. (8 x 8 m) between rows and within rows is recommended in commercial plantings if annual pruning is practiced controlling for tree size and shape. For this analysis, we consider a planting density of 75 trees per acre.

Yields—Assuming a planting density of 75 trees per acre and an average yield of 70 pounds/tree, after accounting for a fruit pack-out rate of 84%, the average marketable yield would be 5,250 pounds/acre in an average year. Substantially less can be expected in an off-year (low-yielding year).

Lychee Prices—The F.O.B. Homestead price (price at the packinghouse) for lychee averaged $2.55 per pound during the 2016–2018 seasons. Growers are billed separately for the harvesting and marketing expenses (which will be discussed later in this publication).

Irrigation—Full bearing trees (6 years or older) should be irrigated regularly from flowering through harvest. Average irrigation expenses comprised of fuel or electricity costs are estimated to be $178/acre/year.

Fertilization—For a full production grove, the fertilization plan includes granular mixes containing minimal nitrogen, phosphate, potash, and magnesium (N-P-K-Mg), soil drench applications of iron sulfate, and foliar sprays of micro-nutrients (manganese, zinc, and iron). Average annual fertilization expenses (materials only) are estimated to be $275/acre/year.

Pest, Disease and Weed Management—Pests of importance to lychee include the lychee webworm (*Crocidosema litchivora*), which causes necrosis to new stems and panicles (Brown et al., 2002), plumose scales (*Morganela longispina, Philephedra tuberculosa*), which attack stems and may cause stem dieback, and erionse mites (*Eryophyes litchi*), which feed on leaf epidural cells and cause significantly decreased yields and increased production costs (Revynthi et al. 2020). Unfortunately, the erinose mite has been introduced into Florida and poses a severe threat to lychee production in Florida (Peña 1994; Bermudez 2018; Revynthi et al. 2020). The Florida Department of Agriculture and Consumer Services, Division of Plant Industry is currently conducting a lychee erinose mite eradication program.

Anthracnose (*Colletotrichum gloeosporioides*) is the major disease of the fruit. Some cultivars such as 'Mauritius' are more susceptible than 'Brewster'.

Weed management focuses on controlling grasses, sedges, and pigweeds. The average annual agrochemical costs for fungicides (materials only) are estimated to be $166/acre/year; insecticides are estimated to be $127/acre/year; and herbicides are estimated to be $48/acre/year.

Labor Costs—Labor costs include agricultural input application costs for fertilizers and other agrochemicals and other cultural practices such as irrigation, pruning, mowing, vine removal,harvest, and other activities. Labor costs are estimated to average $572/acre/year.

Interest on Operating Capital—This is the cost of borrowing money or the opportunity cost for using equity. A rate of 5 percent was used in the present analysis, as it reflects the borrowing cost in commercial banks in south and central Florida. Interest on operating capital is estimated at $68/acre/year.

Fixed Costs—Fixed costs are the expenses that the growers incur operating their businesses independent of the production levels. They include cash overhead, non-cash overhead, and other overhead costs. Cash overhead costs were $200/acre/year, consisting of taxes and insurance. Non-cash overhead costs include land rental or opportunity cost for land use, and are estimated to be $500/acre/year. Other overhead costs (e.g., depreciation of machinery, telephone, computer, and other office expenses) are estimated to be, on average, $389/acre/year.

Harvesting and Marketing Costs—The lychee harvesting season starts in mid-May and continues until early July, depending on the cultivar. The annual cost for picking, packing, marketing, and transportation to the packing house was $2,956/acre/year.

Production Costs—Production costs, or variable costs, amounted to $1,434/acre/year (about $0.27 per pound), representing 25% of the total cost. The major components of the pre-harvest variable costs were hired labor (40%), fertilizers (19%), irrigation (12%), fungicides (12%), and insecticide (9%).

Fixed Costs—These include cash, non-cash, and other overhead expenses. Although most growers own the land, a land rental charge of $500/acre/year was considered to account for the opportunity cost of the land. Total fixed costs were $1,089/acre/year ($0.21/pound), representing 20% of the total cost.

Harvesting and Marketing Costs—Harvesting and marketing costs were $2,956/acre/year ($0.56/pound), representing 54% of the total cost. Harvesting and marketing costs included the costs associated with picking, packing, and marketing the fruit.

The cost structure for lychee production in south and central Florida and the respective share of its components is shown in Figure 2. Harvest and marketing costs accounted for 54% of total costs. Cultural costs (variable costs for hired labor, irrigation, fertilization, and pest control) constituted 25% of the total cost. Fixed or overhead costs were 20% of the total cost. Interest on capital represented 1% of total costs.

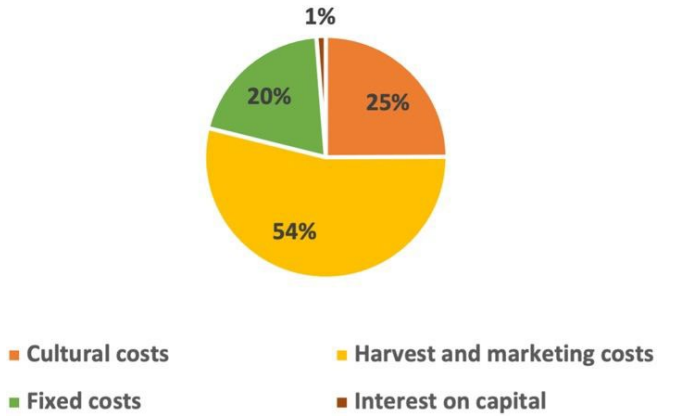

Figure 2. Cost structure to produce lychee in south and central Florida.
Credit: undefined

Returns and Profitability Analysis

The information provided in Table 1 shows that the total cost to produce and market one acre of lychee is estimated at $5,479 or about $1.04 per pound. Assuming a marketable yield of 5,250 pounds/acre, and an average F.O.B Homestead price (price received from the packinghouse) of $2.55 per pound, the **total receipts or gross revenue** would be $13,388/acre. Subtracting total operating and harvesting cost from total receipts results in a **gross margin** of $8,998/acre ($13,388–$4,390). The gross margin provides a useful indicator of short-run profitability. A positive gross margin implies that all variable costs have been covered by the income generated and there are additional funds remaining to cover some or all of the fixed costs. A negative gross profit implies that a business is not viable in the short run, so changes are needed to make it viable.

Net return is obtained by subtracting the fixed cost from the gross margin. It provides an insight into the long-term profitability of the farm operation. The data in Table 1 show a net return of $7,909/acre/year, or $1.51/pound.

Sensitivity Analysis

A sensitivity analysis based on gross margin (gross profit) that considers the short-term economic viability of a lychee grove operation is shown in Table 2. Because lychee exhibits alternate bearing and is very sensitive to the weather—it needs several cool nights in the winter to encourage flowering and fruiting—the sensitivity analysis considers a 20% yield above and a 60% yield below the base yield of 5,250 pounds/acre/year. Growers should consider that yields can fall by 60% every three to five years. It appears that planting north of Miami Dade County into lower central Florida in areas that do not freeze would result in a more reliable cropping. The price range for the sensitivity analysis covers a range of 10% higher and lower than the base price of $2.55/pound. The F.O.B. Homestead price (price at the packinghouse) for lychee averaged $2.55 per pound during the 2016–2018 seasons.

Under the best-case scenario, if price increases 10% and yield increases by 20% from the base level, gross margin rises from $8,998/acre to $13,313/acre. Under the worst-case scenario, where price decreases by 10% and yield decreases by 60%, gross margin drops from $8,998/acre to $440/acre. Price fluctuations have a larger impact on gross margin than production variations. A 10% increase in price with base yield unchanged at 5,250 pounds has a slightly larger impact on gross margins than a 10% increase in the base yield with base price unchanged at $2.55/pound. A 10% increase in price would lead to an increase in gross margins of $1,365; a 10% increase in yield would lead to an increase of $1,339 in gross margins.

Table 3 shows a similar sensitivity analysis for net returns. Under the best-case scenario, where price increases by 10% and yield increases by 20%, net return rises from $7,919/acre to $12,234/acre. Under the worst-case scenario, where price falls by 10% and yield decreases by 60%, net return drops from $7,909/acre to a loss of $639/acre. Table 3 can be interpreted in a similar way to Table 2.

Conclusion

The average net return of a lychee farm operation in south and central Florida is $7,909/acre, or $1.51/lb if cropping is reliable. Many growers only consider the gross margin when making production decisions, which we estimated to be $8,998/acre. The gross margin does not include the fixed costs and, hence, is not a good indicator of the long-term profitability of the business. So, we suggest that growers pay close attention to the net return instead of the gross margin when making planting decisions; they should consider the fixed costs.

The costs and prices presented in this publication are for an established grove. We have not considered grove establishment costs, which include land acquisition, development, planting costs, and amortized capital costs. Once these establishment costs are factored in, net return estimates will change considerably. Thus, caution is needed when using this analysis to make decisions on establishing a new orchard. Another important consideration is that a significant increase in yield is likely to affect all groves in south and central Florida, simultaneously leading to an increased supply, market saturation, and downward pressure on prices. So, a yield increase is likely to be complemented by a fall in prices, which is a consideration to keep in mind when interpreting the sensitivity analysis.

Several factors may constrain the expansion of lychee cultivation in south and central Florida. There is a lack of appropriate cultivars for south Florida's warm climate (Knight 2000). The inconsistent bearing pattern because of climate variability and the trend of warmer winters makes the estimation of future yields and, thus, profits very difficult (EPA 2016). Some growers have reported no fruit set for as many as three consecutive years followed by a bumper crop, which has the effect of depressing prices. 'Mauritius' is the only cultivar that may bear fruit semi-consistently under the prevailing climatic conditions (Knight 2000). Foreign competition may also limit the crop expansion, as cheaper imports with lower production costs, particularly labor costs, are a threat for domestic producers (Evans and Danger 2005).

Unless lychee erinose mite is eradicated or controlled, it may depress the production and trade of lychees. For instance, this mite was detected in Brazil in 2007 and has since spread to all lychee-producing areas, causing an estimated 70%–80% yield reduction and a 20% increase in production costs (Navia et al. 2013). The Florida Department of Agriculture Consumer Services (FDACS) implemented an eradication program that limits the ability of infested groves to market their product unless they are under a compliance agreement with FDACS. A quarantine is in place on Lee County, prohibiting the movement of lychee fruit or plant parts (trees, leaves, or stems) out of the county. In addition, orchards in other counties where the erinose mite is detected must sign a compliance agreement with FDACS, and can only sell lychee fruit outside of the state or use a phytosanitary postharvest treatment to disinfest fruit before moving fruit within Florida (Revinthi et al. 2020).

The reported economic return of a lychee operation is based on a grower selling the fruit to the packinghouse; however, to increase a farm's profitability, several growers have decided to bypass intermediaries and engage in direct marketing activities, receiving more per pound sold (Evans et al. 2004). On the brighter side, US demand for lychee fruit is strong, especially among certain ethnic groups. The fruit is popular among Asian consumers, so, given the rapid growth of the Asian population in the United States, the outlook for lychee demand seems favorable (Rafie and Balerdi 2002). Be that as it may, potential growers should exercise caution and limit expansion as the fruit is still not widely consumed and an oversupply in the market could send prices plummeting.

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Table 1. Annual costs for producing one acre of lychee in south and central Florida.

Item	Quantity (lbs.)	Value per acre ($/acre/year)	Value per pound ($/pound)
Revenue			
Marketable yield	5,250		
F.O.B. Homestead price			2.55
Total Revenue		13,388	
Production Costs			
Irrigation		178	
Fertilizer		275	
Herbicide		48	
Insecticide		127	
Fungicide		166	
Labor cost		572	
Interest on operating capital (5%)		68	
Total production cost		1,434	0.27
Fixed Costs			
Cash overhead:			
Insurance		100	
Taxes		100	
Non-cash overhead:			
Land rent		500	
Other overhead		389	
Total fixed cost		1,089	0.21
Total Pre-Harvest Cost		2,523	0.48
Harvest and Marketing Costs			
Picking, packing, transportation, and sales cost		2,956	0.56
Total harvest and marketing cost		2,956	0.56
Total Cost		5,479	1.04
Gross Margin		8,998	1.71
Estimated Net Return		7,909	1.51

Table 2. Sensitivity analysis, gross margin per acre ($/acre).

Yield (pounds/acre)		Wholesale Price ($/pound)				
		2.30	2.42	2.55	2.68	2.81
		(–10%)	(–5%)	(base)	(+5%)	(+10%)
2,100	–60%	440	692	965	1,238	1,511
3,150	–40%	2,855	3,233	3,643	4,052	4,462
4,200	–20%	5,270	5,774	6,320	6,866	7,412
5,250	(base)	7,685	8,315	8,998	9,680	10,363

Yield (pounds/acre)		Wholesale Price ($/pound)				
5,775	10%	8,893	9,586	10,336	11,087	11,838
6,300	20%	10,100	10,856	11,675	12,494	13,313

Table 3. Sensitivity analysis, net returns per acre ($/acre).

Yield (pounds/acre)		Wholesale Price ($/pound)				
		2.30	2.42	2.55	2.68	2.81
		(–10%)	(–5%)	(base)	(+5%)	(+10%)
2,100	–60%	–639	–387	–114	159	432
3,150	–40%	1,776	2,154	2,564	2,973	3,383
4,200	–20%	44,191	4,695	5,241	5,787	6,333
5,250	(base)	6,606	7,236	7,919	8,601	9,284
5,775	10%	7,814	8,507	9,257	10,008	10,759
6,300	20%	9,021	9,777	10,596	11,415	12,234

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