Growing apples for the cider industry in the U.S. Northern Climate of Vermont: Does the math add up?

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ABSTRACT

Sales of fermented apple cider have tripled in the U.S. since 2007, with increases in both the quantity of cider sold by existing cideries and of new entrants in the cidery market. The cider market is differentiated between large national, mid-size regional, and small local producers. Industry characteristics in Vermont are similar to those of the national cider market and production is dominated by one large international cidery, followed by seventeen smaller regional or local cideries. In total, over 1.9 million liters of cider was produced by Vermont cideries from local or regionally-grown apples in 2015. Present levels of cider production and trends for future growth raise questions about apple growers' abilities to meet market demand. At the same time, new and expanding cideries are concerned about availability of apples. The Vermont apple industry is primarily oriented toward fresh fruit production, and prices received for marketable fresh fruit are several times greater than for cider fruit though recently the price received from the fresh market has decreased. Nevertheless, apple growers have expressed a guarded interest in growing apples for cideries but there are unknown variables such as the yield of cider-specific cultivars, availability of cider cultivars from nurseries, management practices unique to cider cultivars, and orchard establishment cost. In the immediate future, growers are more interested in diverting apples sold for the fresh market to the cider market. To inform management decisions, we used data from four Vermont orchards who currently grow for the fresh market to calculate current cost of production and to model cost of production under varying management scenarios such as reduced use of chemicals and harvesting labor. We then conducted a net present value analysis to analyze the profitability potential of various management scenarios and various apple markets.

Keywords: Malus x domestica, cost of production, apple prices, hard cider, net present value, profitability

INTRODUCTION

Fermented cider (hereafter referred to as 'cider') is a traditional value-added product produced by both orchardists and independent cider makers in the U.S. from the juice of pressed apples (*Malus x domestica*). In recent years, U.S. cider production has increased at an average rate of over 50% annually, with total revenue over US\$290 million in 2014 (Petrillo, 2014). Growth in the cider industry represents increased market opportunities for fruit producers, but competition for limited supplies of fruit may present barriers for future growth of the cider industry. U.S. cideries use several types of apple cultivars for cider making, including dessert cultivars culled from fresh market production channels, 'dual purpose' cultivars grown for both fresh market and cider markets, and specific cider apple cultivars with unique juice chemistry suited for cider making but not suited for traditional fresh market outlets (Merwin et al., 2008).

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However, the quantity of domestic specific cider cultivar apples is extremely limited and industry leaders estimate that about 200-300 bearing acres of specialty cider apples are in production out of approximately 380,000 total acres of apples in the U.S. (Milkovich, 2014; USDA, 2012). Industry trade and popular press articles highlight cidery concerns about potential shortages available for cider making, especially for specialty cultivars that may improve cider quality and facilitate increased product price (Bland, 2014; Frochtzwajg, 2014; Milkovich, 2014; Nassauer, 2014; Park, 2014).

A survey of apple producers and cider makers in Vermont highlighted the opportunities and challenges of growing apples for the cider market in that state (Becot et al., 2016). Cidery demographics are typical of a bifurcated market where a small number of large producers dominate the market and a larger number of smaller producers compete by offering potentially unique ciders that may have higher price points. These higher price points reflect diversity in style and increased production costs from reduced economies of scale or increased costs for unique fruit cultivars. While Vermont apple growers have expressed interest in selling to the cider industry, their interest has been guarded as the horticultural characteristics, including crop yield, biennial tendency, cold hardiness, and disease susceptibility, of many cider apple cultivars when grown in the state is little-known. Furthermore, since cider apple cultivars are not suitable for sales to the fresh market, growers would need the assurance that there will be a market for these apples once the trees start bearing fruit. In the immediate future, growers are more interested in diverting apples sold for the fresh market to the cider market as prices on the fresh market have recently decreased. Therefore, the goal of this research project is to inform growers' management decisions, in particular the diversion of orchard run dessert cultivar fruit from the fresh market to the cider market, by estimating profitability under various management and price scenarios.

MATERIALS AND METHODS

We first evaluated the cost of production to produce dessert apples for processing into cider using cost data collected from apple growers. We then conducted a net present value (NPV) analysis under various scenarios of management, fruit price, and proportions of production going to fresh fruit and cider markets to evaluate the long-term economic performance of orchards selling dessert apples to the cider industry.

Data collection

We collected cost of production data for the 2015 growing season from four growers located in Vermont, U.S. in the winter of 2016. These growers were included in our study because at that time they were either selling apples to cideries or had expressed interest in selling to cideries. Additionally, these growers had expressed interest in modifying management practices in some orchard blocks that they would dedicate to the cider market. Orchards represented were typical for the state, including cultivar composition (e.g., 'McIntosh', 'Cortland', 'Empire', 'Macoun', etc.), rootstock (e.g., M.7, M.26, M. 9), and medium tree density (typically 500-1500 trees/ha) (VTFGA, 2011). Changes in management practices for dessert cultivars dedicated to the cider market may include reduced spraying, pruning, and harvesting labor (Becot et al., 2016; Williams, 1988). We used an instrument developed by Galinato et al. (2014) to estimate the cost of establishing a cider apple orchard which includes costs related to the establishment of the orchards as all of the orchards in our sample are in full production and growers did not have accurate establishment cost data for new orchards. We collected data related to orchard activities

including cost information for labor, materials, and supplies related to pruning and training, chemicals, fertilization, beehives, harvest activities, maintenance and repairs and other (taxes, insurance, overhead, depreciation). No cost data on irrigation were collected as none of the orchards were irrigated. Last, our data collection was limited to field operations and we intent to collect cost data related to storing and transport in the future.

Price data from apple growers and cider makers were collected through a paper survey distributed during a cider industry stakeholder meeting in June 2016. Growers and cider makers were asked to provide their target price, their average price, and their dignity price which is the price that can be paid or received without losing money. Nine growers and five cider makers provided price data. The University of Vermont Institutional Review Board reviewed and approved all research protocols.

Data analysis

Cost of production data were entered and analyzed using Microsoft Windows Excel 2016. Costs for each orchard were aggregated into main categories based on the enterprise budget template including pruning and tree training, chemicals, pollination, equipment maintenance and repairs, harvest, and other. After calculating the total production cost for each orchard, we calculated the production cost per hectare and the production cost per metric ton. We sent the results of the calculations to each growers to ensure accuracy of the data. Price data was entered and analyzed in IBM SPSS Statistics version 23.0.

NPV analysis is used to assess long-term profitability of orchards under various management, price, and market channels scenarios compared to a standard rate of return (Khera et al., 1980; Robinson et al., 2007). To conduct the NPV analysis and to preserve confidentiality of individual growers we grouped the orchards into two groups. In the first group, hereafter referred to as small scale orchard, the mean size of the orchard is 4.6 productive hectares (standard deviation 5.4) and the average yield in 2015 was 15.3 metric tons per hectare. In the second group, hereafter referred to as large scale orchard the mean size is 67.9 productive hectares (standard deviation 24.3) and the average yield in 2015 was 29.2 metric tons per hectare. Our NPV calculations are based on an instrument used for a previous study on profitability of organic orchard systems in Vermont (Bradshaw et al., 2016). We used the cost, price, and yield data from the four orchards and a discount rate of 5% to conduct the analysis based on the formula: [NPV = \sum (Net Period Cash Flow/(1+R)^T) - Initial Investment] where R is the rate of return and T is the number of time periods.

RESULTS AND DISCUSSION

The costs of production for the small and large scale operations are shown in Table 1. The production cost per hectare was lower for the small scale orchards (US\$7,308.30) than for the large scale orchards (US\$11,410.90). The cost per metric ton was higher for the small scale orchards (US\$472.80) than for the large scale orchards (US\$391.20) indicating higher efficiency of the large scale orchards. Harvest represented the largest share of variable expenses with potential to reduce for cider apple production for both small and large operations (20.0% and 24.9% respectively) followed by chemicals (18.7% and 15.9% respectively). The largest expenses in the other category (not shown in the table) included miscellaneous supplies and overhead for the two scales of operation.

Table 1. Cost of production by main categories on small and large orchards.

Material and labor	Production Costs (US\$)	Production costs * ha ⁻¹ (US\$)	Production costs * t ⁻¹ (US\$)	Percent expenses
	Small orchard			
Pruning and training	1,904.00	413.90	26.80	5.7
Chemicals	6,303.00	1,370.20	88.60	18.7
Beehive	130.00	28.30	1.80	0.4
Maintenance & Repairs	3,417.00	742.80	48.10	10.2
Harvest	6,727.50	1,462.50	94.60	20.0
Other ^z	15,136.50	3,290.50	212.90	45.0
Total costs	33,618.00	7,308.30	472.80	100.0
	Large orchard			
Pruning and training	64,365.40	949.30	32.50	8.3
Chemicals	123,230.30	1,817.60	62.30	15.9
Beehive	8,720.00	128.60	4.40	1.1
Maintenance & Repairs	35,954.60	530.30	18.20	4.6
Harvest	192,291.20	2,836.10	97.20	24.9
Other ^z	349,098.10	5,148.90	176.50	45.1
Total costs	773,659.60	11,410.90	391.20	100.0

^zOther includes: miscellaneous supplies and labor, overhead expenses, taxes, insurance, and depreciation.

Prices reported by growers and cider makers varied greatly based on the type of apple cultivar and marketing niche (figure 1). Growers of dessert cultivar apples typically harvest, store, and





pack apples in multiple grades which may be offered separately to cideries based on market prices or storage and packing needs (Watkins, 2003). Fruit may be sold as 'orchard run' when not sorted in the field or packing house to segregate higher-value US#1 grade fruit; as 'culls' from packing houses which are discarded after segregating US#1 fruit and may be small, poorly colored, or have cosmetic blemishes; or as 'drops' which are harvested from the ground and generally are not saleable to fresh markets (including non-fermented sweet cider) because of food safety concerns, but which may be acceptable to cideries because fermentation is an effective processing step to remove pathogens and mycotoxins from cider (U.S. FDA, 2001; USDA, 2002). Because specialty cider cultivar apples are not sold to the fresh market, those fruit are typically all sold as orchard-run. The prices that cider makers are currently paying or able to pay for specialty cider/bittersweet is higher than what growers are asking or receiving. For instance, cider makers reported a target price of US\$1.32 per kg while apple growers reported a target price of US\$1.10 per kg. The supply of specialty cider/bittersweet apples is extremely limited in the U.S. explaining cider makers' willingness to pay a premium for these apples. We find an opposite discrepancy for dessert cultivar orchard run and packing culls where the price that growers are receiving or desire to receive is higher than what cider makers are willing to pay or currently paying. For instance, for dessert orchard run, growers report receiving US\$0.85 per kg while cider makers report paying US\$0.44 per kg. The higher price received by apple growers is likely due to the fact that they sold these apples on the fresh market regionally. The lower price paid by cider makers is likely due to the fact that they purchased these apples on the national commodity market at lower prices. For dessert cultivar orchard run and desert cultivar packing culls, the dignity price needed by growers is higher than the dignity price that cider makers can pay. There is little to no discrepancy for dessert cultivar drops as apple growers and cider makers are reporting the same going and dignity price (US\$0.28 per kg for price received, US\$0.29 for price paid and US\$0.33 per kg for dignity price).

We conducted several NPV analyses to assess long-term profitability of orchards selling to cideries under various management, price, and market channels scenarios (Figures 2 and 3). Small scale orchards selling 25% to the dessert cultivar orchard run to cideries would incur an opportunity cost ranging from US\$668 to US\$40,628 at the end of 10 years. The lower opportunity cost occurs when the use of chemicals and harvest labor are lowered by 25% and growers receive their dignity price of US\$0.85 per kg. The larger opportunity cost occurs if growers receive the price paid by cideries of US\$0.26 per kg. Large scale orchards selling 25% of their dessert cultivar orchard would incur an opportunity cost occurs if growers were to sell 25% of their production to cideries at the dignity price of US\$0.85 per kg. Similarly, to small scale orchards, the larger opportunity cost occurs if growers were to receive the price paid by cider of US\$0.26 per kg. Similarly, to small scale orchards, the larger opportunity cost occurs if growers were to receive the price paid by cider and opportunity scale orchards would receive an opportunity gain for US\$3,100 at the end of 10 years if they were to lower their use of chemicals and use of harvest labor by 25% and receive the growers' dignity price of US\$0.85 per kg.



Figure 2. Net present value for small scale orchard selling 25% of the dessert cultivar orchard run production to cider under various price and management scenarios.



Figure 3. Net present value for large scale orchard selling 25% of the dessert cultivar orchard run production to cider under various price and management scenarios.

The goal of this research project was to evaluate the cost of production to grow dessert apples for processing into hard cider and evaluate the long-term economic performance under varying management practices, prices received, and proportions of production going to fresh fruit and cider markets. Chemicals and harvest activities, including material and labor, represent large expenses on apple orchards but selling to the cider market represents opportunities to cut these cost of production as appearance of the fruit is not important in cider production. We find that considering the prices that growers are currently receiving on the fresh market and the minimum price they need to receive to not incur a loss, diverting 25% of the dessert cultivar orchard run apples from the fresh to cider market represents an opportunity cost under almost all of the scenarios. The lowest opportunity loss for small scale orchards and the opportunity gain for large scale orchards occur when chemical and labor costs are reduced and when growers receive their dignity price. However, considering the prices that cideries are currently paying or willing to pay for dessert cultivar orchard run, these scenarios are unlikely to occur. Nevertheless, none of the NPV analysis represent an economic loss for the growers in the 10-year time frame and a reduction of the management costs by more than 25% would likely reduce the opportunity cost or increase the opportunity gain. We did not assess the costs of establishing new orchards or packing costs which present a limitation that should be addressed in future research. Future research should also assess whether harvest mechanization provides an opportunity to reduce costs of production in the orchard systems used by Vermont growers. Beyond reduction of cost of production, mechanization could remove current difficulties that Vermont growers in procuring labor (Bradshaw, 2013). Most growers report difficulties in finding adequate domestic workers and hire migrant workers through the US agricultural temporary visa program. In recent years, the administrative and housing costs and the regulations have grown further increasing the cost of production and the difficulty to hire labor (MacVeigh-Fierro et al., 2014). However, farm work represents an important source of income for the migrant workers and their families and any study on mechanization should assess social costs for workers associated with mechanization. Last, the Vermont cider industry has grown rapidly in the last few years and is struggling to source cider apples cultivars (Becot et al., 2016; Bland, 2014; Park, 2014). While larger producers may import bittersweet apple concentrate from Europe, most Vermont cideries prefer to procure Vermont fruit as local fruit is an important component of their marketing increases ability to capture a price premium (Becot et al., 2016). The price survey data shows that cider makers are currently willing to pay prices well above apple growers' target prices and above prices for the fresh markets for cider specific apple cultivars. Yet, little is known on the management and yield of cider apple cultivars in the U.S. and further research is needed before growers will likely be willing to grow these varieties. Since cider apple cultivars are only suitable for the production of cider, assurance that the growth of the cider market is sustainable will also be crucial for growers. Technical support providers could play a role in providing information on contractual arrangements that would be mutually beneficial for the growers and cider makers to improve the sustainability of both industries.

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