

Does Growing Specialty Apples for the Hard Cider Industry Present a Viable Prospect for Colorado Orchardists?

A Preliminary Investigation

INTRODUCTION

Hard Cider, the alcoholic beverage made from fermenting apple juice, came to the United States with the colonists and was an important part of life for these early settlers.

Various factors including the arrival of German and Irish immigrants from beer producing cultures, the settlement of the grain producing rejoin of this new land, the temperance movement, and trends towards increased mass production coalesced to result in beer taking ciders place as the most popular drink.ⁱ

Recently there has been what many refer to as a cider revival. Cider sales in the U.S. were estimated to be less than \$50 million in 2009 and have climbed to over \$1 billion in 2019 showing exponential sales growth and growth of small independent cideries across the nation. For context, total alcohol sales in the United States in 2019 were \$250 Billion. Peak sales for cider were in 2015 and have recently declined with the changes in the market due to the pandemic. The most recent data from the 2nd quarter of 2021 show on-premise sales (bars and restaurants) have declined by 35.5% and off premise sales (liquor and grocery sales) have declined by 14.9% (Nielsen data)

In the past few years, ciders growth has slowed as hard seltzers, kombuchas, and ready to drink beverages compete for shelf space at the liquor stores. The cider industry is looking for ways to retain current cider drinkers and attract more. In 2017-2020 the number one goal of the Cider Association was to “grow demand for all styles of cider in the U.S. market”.ⁱⁱ Part of the Cider Association’s goals were to “Establish a nationally-recognized consumer-focused cider lexicon with the explicit goal of helping consumers of differing cider knowledge identify cider styles and products they are most likely to enjoy”.ⁱⁱⁱ

As the industry works to increase consumer cider literacy and consumption, individual brands work to differentiate themselves in an increasingly competitive market. Many cider makers look to the apples as a way to do this. While there are thousands of varieties of apples, the vast majority of cider is produced using the juice of apple varieties selected and grown for eating. This is in part due to the availability and price of such juice. However, this widely available juice lacks some of the characteristics that have been identified as contributing to quality ciders. Some cider makers have shown a preference for apples traditionally used in hard cider and apples that contribute unique and beneficial sensory elements. In particular, cider makers have shown interest in apples categorized as bittersweets and bittersharps due to their levels of tannins, sugars, and acids. As their name might imply, these apples are not suitable for eating. They are referred to as cider specific because their end use will be specifically for cider.

Does growing these desirable, cider specific apples present a viable opportunity for Colorado growers? A small number of orchardists are beginning to experiment with this possibility but there are many questions surrounding the larger scale adoption of this enterprise.

The aim of this study is to articulate these questions and inform them where possible. To this end the Colorado Cider Guild has reviewed the literature concerning this prospect, interviewed Colorado orchardists and cidermakers, and collated this information to illustrate some of the driving factors that may affect the adoption of this agricultural venture.

Following, we will present a picture of the apple and cider industries in Colorado and a discussion of the potential for these specialty apples to be a competitive crop within these contexts.

A LOOK AT THE DEVELOPMENT OF THE COLORADO APPLE INDUSTRY THROUGH TIME

Like in other parts of the country, apples were planted in Colorado along with the first European settlers. Without knowledge of the agricultural potential of these arid and unfamiliar lands, early orchardists planted trees where they saw fit. The first orchards were planted on the more physically and legally accessible lands that lay east of the Rocky Mountains. It was apparent that these trees would need more water than fell as rain so these orchards were planted along major waterways and watered by irrigation. In their *History of Agriculture in Colorado* published by The State Agricultural College in 1926, Alvin T. Steinel and D.W. Working describe the development of fruit growing and the early orchards in Colorado. The first orchards were planted along the Arkansas River near the towns of Canon City, Florence and Rocky Ford, CO and along other river valleys such as the South Platte and Clear Creek near Wheatridge and Golden, CO and in Northern Colorado within the Cache La Poudre watershed.^{iv} Notable in their descriptions of these early orchards are the diversity of varieties planted, the losses incurred, and the resulting value that these initial experiments had to the selection of varieties that would be deemed suitable for continued planting. This phase of experimentation continued as areas west of the Rocky Mountains, commonly referred to as the Western Slope, were opened for settlement.

Following a series of events that culminated in the Meeker massacre, the Ute Indians were forced off the Western Slope and onto reservations in the fall of 1881. The following spring, settlers moved in staking their claims. Apples were planted in the potentially fertile river valleys including the North Fork of the Gunnison River Valley near the townsites of Hotchkiss and Paonia and farther West in the Grand River Valley near Grand Junction where the Gunnison River joins the river now called the Colorado. Apple orchards were also set out in other areas with access to water including the Uncompahgre Valley in Montrose County and the far Southwestern region of the state in Montezuma and La Plata Counties near Cortez and Durango. Again, many different fruits were set out in many different locations and many of them failed to thrive.

Despite their losses, the results of these experimentations led experts such as Alexander Shaw, Secretary of the Colorado State Horticultural Society to look positively toward the future of Western slope fruit growing.^v

In 1891, less than a decade after the first trees were planted on the western side of the mountains, Charles S. Crandall, horticulturalist for the Colorado State Experiment Station published a report of his formal survey of Colorado's fruit industry. This report touts the rapid development of Delta, Mesa, and Montrose Counties, collectively defined as the western district and foreshadows their booming future:

“So universally successful is the growing of fruit that the industry bids fair to surpass all other industries of the county.”^{vi}

Indeed, the fruit industry of the western district would greatly expand in the next decades to come. The environmental conditions of Colorado's fruit growing regions produce exceptionally high-quality fruit. Gaining attention and awards at the Chicago World's Fair in 1893 as well as several other national and local exhibitions thereafter, Colorado apples created a name for themselves. The resultant demand greatly exceeded the supply. Pests had not yet found our fertile fruit producing valleys and so the costs of production were low, the value of the fruit high, and the profits substantial. Colorado's apple industry was booming! Thousands of additional acres were planted at the turn of the century.^{vii} Great efforts were put towards canal and reservoir building to support these orchards and bring new land into production. Wilson Rockwell in his 1936 *New Frontier* describes these "gala years" years in the North Fork Valley:

"From 1904-1907 nearly everyone was planting fruit, and the mesas as well as the bottom-lands soon became one continuous garden of blooming orchards. Paonia grew swiftly, developing in population form about 250 at the beginning of the boom period to over four times that size by 1909, surpassing its rival town, Hotchkiss, which had grown from about 300 to 650 inhabitants."^{viii}

The nation at large was in a state of rapid change and this boom would not last for long. As the "great fruit districts of the Northwest" came into maturity, large quantities of fruit were put onto the market, decreasing the demand for Colorado fruit.^{ix} Meanwhile, Colorado's fruit producers were coming up against local challenges as well. Severe and unseasonable freezes had decimated orchards. Pests too, had become an increasing problem bringing additional costs of control. In many areas, apple growing didn't look to be such a sunny prospect anymore.

This was especially true for apple orchards in parts of the Grand Valley, enthusiastically planted in difficult soils. Having already lost apple acreage due to poor soil water management and the buildup of alkalinity, this area experienced a severe codling moth infestation in 1923 that resulted in much of its apple acreage being torn out. ^{x xi}

Where apples persisted, adaptations and inventions limited the ill effects of nature. Coal and oil fueled heaters called smudge pots were invented to combat the early and late freezes. Orchardists, with the help of experiment stations, developed safe and effective ways of managing pests such as the codling moth.

By the later part of the 1920's, suitable areas for apple production had been discovered, limited mostly by topography and its associated climate. Steinel's assessment of the fruit growing industry in his 1926 publication identifies major areas of fruit production as being confined mainly to the upper Arkansas Valley and to Mesa, Delta, and Montrose Counties, with considerable area of land in Montezuma County. He mentions Northern Colorado Orchards as being confined to the foothills and valleys close to the mountains and proposes that this limitation may keep this area from becoming important to commercial production. He notes the orchards of Montrose County as being at more risk of freeze due to their higher elevation. The Southwestern district, was noted as having suitable climate and the potential for commercial production if and when transportation to greater markets was achieved.^{xii}

Fruit growing in the Grand Valley shifted towards peaches as areas such as the North Fork, with its cooler winter temperatures capable of controlling the codling moth to a certain degree, revealed themselves as more suitable to apple production.^{xiii} Delta County (and the North Fork Valley (NFV)

which it encompasses) establishes itself as the most productive region for commercial apple growing in the State, a trend that would continue into the future.

In addition to the suitability of environmental conditions, the apple industry would continue to evolve; being shaped by changing political and economic conditions, technological advancements, and cultural values. Like other industries, the apple industry struggled and prospered through larger economic cycles of depression and prosperity.

Nationally, the apple industry continued to develop within the context of increasing industrialization and consolidation of supply chains and continuing technological advancements. The 1960's saw great expansion of controlled atmosphere storage facilities in the larger apple producing regions such as Washington state.^{xiv} This, along with other advantages of economies of scale, facilitated the ability to provide large and steady supplies of fruit to the increasingly conglomerated grocery supply chains that were coming to characterize the industry.

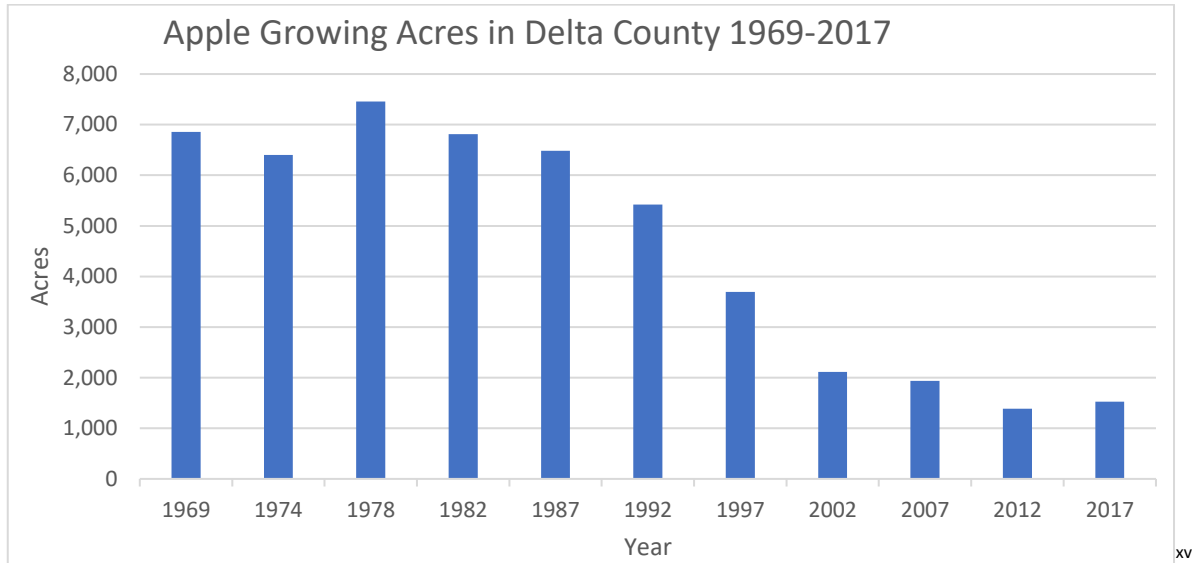
Colorado, with its smaller production base was not as readily competitive within this environment. In response, growers worked to develop their own niches. Some would build their own packing houses, amass larger quantities of apples and proactively forge relationships with grocery stores and institutions within Colorado and other western states. Others would shift towards organic production. Direct marketing; skipping the packing houses and fruit broker part of the traditional supply chain, was another tactic that allowed growers to sell their fruit at a profit.

The industry would see further competition in the 1990's as China's agricultural policy changed allowing peasants to produce fruits and vegetables. A Colorado grower describes these far-reaching effects:

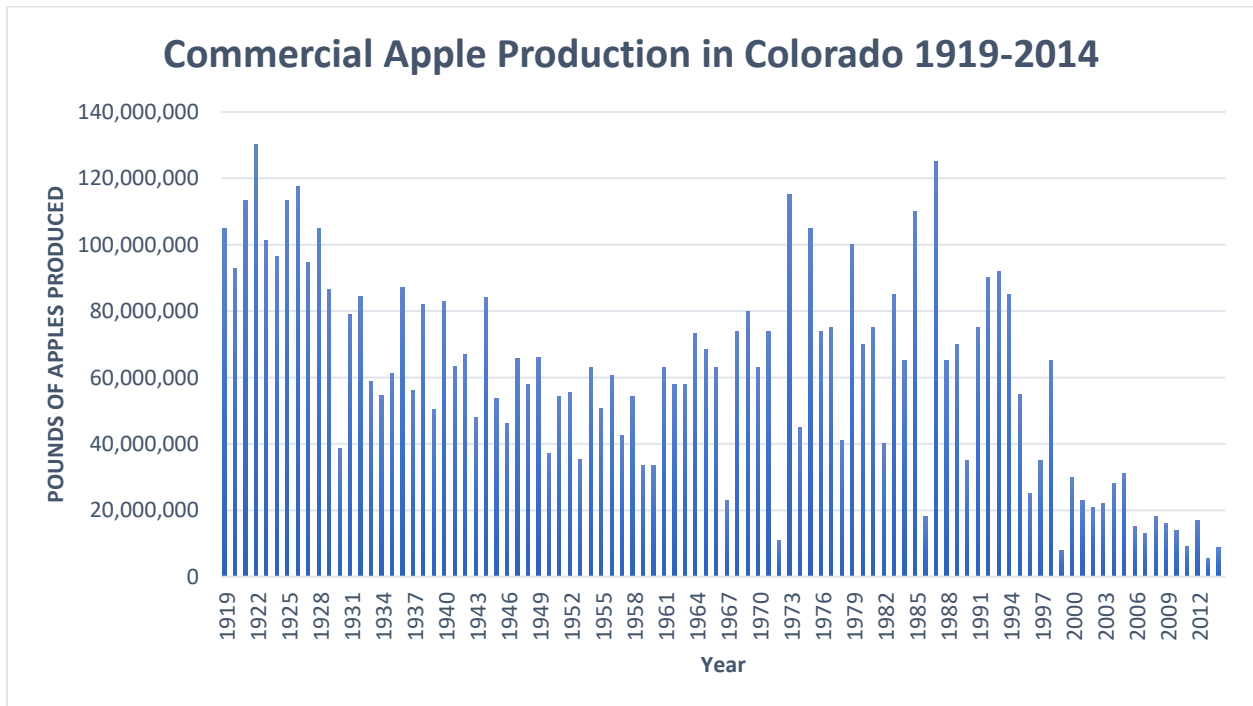
“My memory is that we (the U.S.) were #1 with 12% of world production in 1992 with China being #2 at 12%. By 1998 they had trees in the ground to produce 4 times US production and by 2005 they had production capacity to be 8 times US production. They quickly become the biggest apple producer in the world as well as the largest consumer. The Germans produce some of the best food processing equipment in the world and have had a strong working relationship with China for a long time. They built and financed some of the best apple juice processing and concentration plants in China which were turnkey. China ended up setting the world price for apple juice concentrate to the point that they put alternate fructose producers such as Niagara and Concord grape producers out of business and effectively pulled the price floor out from under process apples in the US. My last crop of Red and Golden Delicious in 1999 had a return to grower value of about \$20/ton with the packing shed running at cost. It cost \$50/ton to harvest the fruit which you would never do except that you don't know those numbers until 4 or 5 months later. We had no choice but to remove that production even if we left the ground fallow. This was the type of economic pressure that caused a rapid drop in the CO production base. By 2005 we had even removed our Galas, Fujis and other higher value apples. We went from 90% of our own production being apples in 1985 when we took over from my grandfather to 0% by 2006.”

In addition to competition from apple producers from faraway lands, Colorado orchardists were experiencing economic challenges at home. While it became increasingly difficult to turn a profit by growing apples, real estate values were increasing. Labor costs and availability were a significant challenge too. Suffering these circumstances some orchardists would convert their land to other uses.

The following chart shows Colorado’s decline in apple acreage since 1969, when the USDA Census started tracking the acreage planted in apples.



Before Colorado acreage was recorded, commercial apple production for the state was estimated in the Colorado Department of Agriculture’s yearly Agricultural Statistics Bulletins. Although production varies according to weather and horticultural factors, together the charts above and below give a picture of our declining industry.



Concurrent with these large and powerful trends and challenges, the apple industry exists on a much-reduced scale and is small part of Colorado's rural economies. Surviving orchardists are growing apples commercially and organically, selling individual apples at local and regional markets. The newly emerging cider industry represents a potential new market for apple producers. The state has also seen a renewed interest in Colorado's apple heritage. Several non-profits dedicated to preserving the valuable genetic and historic resources held in the dwindling remnants of trees and landscapes from times past have formed. Such interesting organizations include: The Montezuma Orchard Restoration Project in southwestern Colorado, The Apple Core Project based out of Norwood, CO, the Boulder Apple Tree Project in Boulder, Colorado and the Ark Valley Fruit Tree Network in Colorado's Upper Arkansas River Valley.

NORTH FORK VALLEY ORCHARDISTS WERE INTERVIEWED TO GET A PICTURE OF WHERE THE INDUSTRY STANDS NOW

Due to the high concentration of orchards and suitable climate of Delta County and the NFV, the CCG chose to interview orchardists from this area to get a direct picture of the apple industry in Colorado and its receptivity to the potential of producing cider specific apples for the hard cider industry.

9 Orchardists were interviewed with regards to their individual operations and their thoughts about growing cider apples. Collectively, this sample represents 343 Apple growing acres within the NFV. Of this acreage 49.6 acres were devoted to cider specific varieties. All of the 49.6 cider specific acres were cultivated by growers who also produced their own cider.

Orchardists ranged from younger to older. Some were tending ground that had been in their families for generations, while others were first generation orchardists just beginning to see their planted trees come to bear fruit. Some were looking to get out of the fruit growing industry while others were just getting into it. Orchardists were asked about the characteristics of their operations and their considerations concerning the prospect of planting cider apples. The characteristics of their orchards and associated business models varied as much as the people tending them, yet their concerns with regard to planting cider apples were often shared.

Conducting interviews in the winter/spring of 2020/2019, I found orchardist reeling from a bout of bad weather. Hit by an unseasonable hard freeze last fall, orchardists were cutting into limbs and examining buds, waiting to see how bad the damage may be. A long-time orchardist expresses:

“...generations [of fruit growing] and we haven't had a freeze like this. 0-degree temp in October.” “I don't think there is anybody in the nation that's had a 0-degree temperature, in a fruit growing area, on peaches or apples, I don't...ever...it just hasn't happened.”

Mother nature, enabling farmers to do what they do, remains a constant challenge. When asked what the greatest challenges to the success of their apple production ventures were, every interviewed orchardist mentioned the weather. Late spring and early fall frosts present an ever-present risk. I spoke with a man who had been in the orchard industry in the North Fork Valley his entire life. He said orchardists planned on having a complete failure due to weather one out of every six years. Growers talked of “weird weather” and our “tenuous and changing climate”. Colorado's western and southwestern fruit growing districts are in the midst of a significant and concerning drought.^{xvii} Hail is

not uncommon here and can wreak havoc on trees in addition to damaging that particular year's harvest.

Pests and diseases, likely a challenge for all growers, were mentioned in response to the greatest challenges to orchard operations by 3 and 4 growers respectively. Mildew, fire blight, and the codling moth were specifically mentioned. Other mentioned challenges that would fall into the category of environmental include the selection of varieties and rootstocks that are suitable to our area and compatible with one another.

Economic challenges were also on the forefront of orchardist's minds. The majority of orchardists listed this as one of their greatest challenges. The cost of controlling environmental factors such as pests, diseases, and frosts was a great challenge reported by 2 growers. Packing and storage costs were specifically mentioned by 3. The increasing cost of labor and difficulties finding available and competent workers was a concern for several growers.

Competition from other places was reported as a greatest challenge by 3 growers. It's hard for growers to compete with large production areas like Washington. They have economies of scale on their side. One grower explains that although our apples may be higher quality, "Everyone is looking at the bottom dollar".

Somewhat related to this is our shrinking production base and lack of storage facilities (listed by two growers as one of their greatest challenges).

Market trends are a big challenge for Colorado growers. It can take several years for planted trees to come into bearing and less than a year for people to decide they don't want red delicious anymore but want Honeycrisp.

Orchardists are generally aware of the challenges and risks inherent within the Colorado apple industry. They have all had to adapt to changing circumstances. The industry that persists is diverse in its adaptations to common challenges.

ORCHARD CHARACTERISTICS

All of the interviewed orchardists were growing apples alongside at least one other type of fruit; often peaches, apricots, cherries, plums, grapes or pears. They were also diversified in the varieties of apples grown. Different varieties of apples, bloom and ripen at different times. Diversity in varieties thus provides a bit of insurance against the forces of nature.

Cider specific varieties were grown by 3 orchardists who were also producing their own cider. The orchardists not producing cider were growing eating apples, also called desert varieties, for the fresh market. Damaged apples and apples of sub-standard quality were often juiced but the return on this juice from desert apples was far less profitable than selling into the fresh market. The juice market was seen as a channel for loss recovery and their goal was to sell as much as possible into the fresh market.

Growers appreciated the importance of the market. Several orchardists had shifted away from varieties such as red and golden delicious due to market factors. Many growers were growing Honeycrisp: a big, beautiful, highly desired, hard to grow apple developed at the University of Minnesota. Although this

fussy apple can take longer to come into bearing, the increased profits due to market demand make this an enticing apple to grow. Honeycrisps, however do not store well. Every apple has its advantages and disadvantages and growers are wise to diversify in an attempt to have some apples to sell if others are affected by circumstances that particular varieties are susceptible to. Regardless, the market and salability of an apple affects them all. One grower states: "the market is king". Another simply: "Why grow them if you can't sell them". One explains his early mistake of trying to approach the apple business from the supply side: he went broke that way and now grows what the people want and finds they will pay him what he wants for it.

All of the orchardists I interviewed actively managed their orchards. Some were commercial, some certified organic, and several falling somewhere in between. All of them paying great attention to their orchards and investing significant inputs in labor, materials, and capital. This should not leave one to believe that all orchards in Delta County are actively managed. There are several orchards that have been abandoned due to challenges already mentioned. These orchards are seen as a nuisance as they provide a safe haven for the dreaded codling moth.

Orchard design ran the gamut from wide spaced free-standing trees planted on old standard rootstocks at 220 trees per acre to modern high-density orchards planted on dwarfing rootstocks and supported by trellis systems planted at over 2000 trees per acre. The average density reported being 1092 trees per acre. The median value was 1111 trees per acre. These average and median values being higher than a statement by a long-time grower that many people around here have orchard densities of 600-700 trees per acre.

Many of the orchards had frost protection infrastructure in place, but some did not. Wind machines, costing close to \$30,000 per machine and ideally placed every 5-7 acres were a common method to mitigate damaging cold air inversions. Burning was also common. Some growers used propane and gas burners and some burnt piles of wood. Frost protection costs varied year to year based on the costs of fuel and the weather to be mitigated. Frost protection costs varied greatly from operation to operation as fuel source and the level at which frost protection was employed were widespread. It was common for yearly costs of burning to be higher than the maintenance and fuel costs for using wind machines.

Average or typical yields for the individual operations ranged from just over 10 800lb bins per acre to 80 800lb bins per acre. The mean reported figure for average or typical yields was just over 25 800 Lb. bins. The median value was 27.5 800lb bins.

The mean value of reported yield for a season considered a good year was 40 800 Lb. bins per acre and the median value for a good year was 46.25 800 Lb. bins per acre.

Prices received varied greatly depending on marketing channel and to a lesser degree the variety of apple.

As previously mentioned, apple growers not producing their own cider were unanimously trying to maximize the quantity of fruit sold into the fresh markets. Fruit diverted away from the fresh market was juiced at Big B's, Roger's Mesa Fruit Shed, or by Mobil juicing out of Fort Collins. One producer mentioned diverting a small amount to the processing market.

Fruit was sold directly to consumers (retail) as well as to distributors or other intermediaries (wholesale). Larger operations tended to sell more of their fruit through wholesale outlets where

smaller operations maximized profit by selling a higher percentage of their fruit directly to consumers. Conglomerated and adjusted by acreage, 93% of fruit was sold to wholesale outlets or other intermediaries and 7% directly to consumers. One grower illustrates the difference in inputs and outputs of these two ways of selling fruit when he explains that farmers markets are “a lot of work” and although he sells only 5% of his fruit here, he probably makes 20-30% of his profit from this market channel.

Top quality apples are sold direct to consumers at prices close to \$3/Lb. at a farmers’ market or for a tenth of that price if sold in 800lb bins on the commodity market.

After asking growers about their current operations, they were asked about cider specific apples; their interest, concerns and what they would need to see it as a venture they would be willing to embark on.

GROWERS ON GROWING CIDER SPECIFIC APPLES

To open the conversation, orchardists were asked what they thought about planting cider specific varieties. (If growers were already growing cider specifics they were asked if they would plant additional acreage.) Those growing cider specifics for use in their own cider were more confident in their ability to make profitable use of the apples and were thus more interested in planting additional cider specifics. The majority of apple growers who were not currently growing cider specifics were interested in this new market and said they would consider planting these apples with some mention of the necessity of a long-term buying plan or confidence in the market.

Open-ended questions on their thoughts concerning this prospect revealed further concerns that can be loosely classified as horticultural, economic, and logistical.

Horticulturally, these apples are far less known than popular desert varieties. Desert varieties go through virus trials where these cider apples do not. 3 growers specifically mentioned this as a concern. Orchardists are concerned about the susceptibility of cider varieties to disease and the risks that this may present to other trees they are growing. The biennial bearing nature of cider apples was mentioned by 2 growers as a concern. Another grower mentioned biennial bearing but was less concerned and more interested in the ability of hormones and the use of different rootstocks to mitigate this potentially negative effect. A grower cultivating Kingston Blacks, a popular cider specific variety, reported that these trees are now 7.5 years old and barely beginning to produce. This illustrates the challenges that unknown varieties can present to a grower. This concern: the horticultural unknowns of cider specific varieties was explicitly mentioned by 2 orchardists.

Growing apples requires a relatively high initial investment and they take several years to begin producing fruit. Together these facts represent a lot of risk. Growers expressed concern in the ability to recover these initial costs and make up for income lost in the years before the trees come in to bearing.

Furthering this concern is a lack of confidence in the market demand for cider specific apples and its stability and longevity. Agriculturalist in the North Fork Valley have witnessed boom and bust cycles come and go.

Growers are also concerned about market competition in various realms. How will the cider apple compete with desert apples as an ingredient for cider? Is there really a market demand for these

inedible, more difficult to grow apples. And is it sustainable; are cider makers and cider drinkers going to continue to show preference for a higher cost beverage? If they are in fact competitive, will Colorado grown cider apples be competitive against cider apples from other regions that have a competitive advantage in the desert apple industry?

Finally, there were questions and concerns about the logistics of getting cider makers what they would need. Growers want to know the details of what cider makers want. What varieties and flavor profiles are they willing to pay what prices for, how much do they want, what standards of quality will they have for the apples, who will be in control of what parts of the harvest and storage of the apples etc.

SO, WHAT WOULD GROWERS NEED TO BE INTERESTED IN PLANTING CIDER SPECIFIC VARIETIES?

- Confidence in the Market!!! And Information on what the end user is looking for
- Profitability
- Horticultural Information

Not all of the orchardist I interviewed were currently running profitable businesses, yet profitability was a primary concern. The initial investment in establishing an apple orchard is high. So is the labor and maintenance and land requirement. Growers want to see a return on this investment that would be comparable to other desired or competitive uses for their land. When asked if they had an idea of the kind of returns per acre that would be necessary for cider apple growing to be economically feasible, orchardists reported needing returns ranging from \$6000-\$12000 per acre per year. Both the average and median values of grower responses to this question fell between \$9,000 and \$10,000 dollars per acre per year.

Growers need confidence in the market! Growers unanimously needed some kind of investment or risk sharing from cider makers. Contracts were perceived as a way to get this by some. Some cautioned that growers, valuing their independence, may not be interested in having an outside stakeholder having a say on their farm. One grower brought up the possibility of cider makers sharing in the initial investment costs by purchasing the trees.

Growers also wanted to know what cidermakers were looking for. What varieties and or flavor profiles are they looking for? Are they looking to buy juice or apples? How much? Do they have a preference for juice grown in Colorado? What quality standards are they looking for? Would mechanical harvesting be an option. Who will make the decisions as to when the apples will be harvested? How will the apples be processed, stored, and transported after harvest? And who would be responsible logistically and financially for which parts of the process?

Horticultural information on cider specific varieties would greatly support grower's decisions. Which varieties do well in our climate and soil? What is their susceptibility to disease? How much yield can be expected from these varieties? When do they start bearing fruit? What are the best rootstocks for producing cider apples? What sources are available for obtaining cider specific trees or scion wood?

In conclusion, orchardists are generally amenable to the idea of planting cider specific varieties. Some are already doing it. There are many unknowns concerning this prospect. At this point in time,

orchardists top concern is the profitability and marketability of these specialty apples over time. They need more information about the demand for cider specific apples and what cider makers were willing to do to provide some degree of market assurance. Eventually, interested growers would want to know the details of arrangements that would be made with cider makers including quality standards and the logistics and control over aspect of production including harvest, storage, and transportation. While many growers expressed horticultural concerns, there was also an air of positivity surrounding their ability to deal with these issues. They would need this information, but it was not seen as a barrier by most growers at this point in time.

These concerns will be discussed accordingly.

The Colorado Cider Guild, interviewed cider makers to more clearly define the market for this specialty crop.

THE CIDER INDUSTRY: A MARKET ASSESSMENT

We asked nine people who are currently making cider in Colorado where they got their apples/juice from now, and why. 7 producers questioned got apples from Colorado; but only one stated that they didn't import any apples or juice. The others stated that their apples and/or juice came from Washington, Oregon and Michigan, due to the steady supply, reliability and price points.

- Colorado – including both sides of the Rockies
- Washington
- Michigan
- Oregon

When asked if the Colorado Cidermakers would pay \$6 - \$9 per gallon for juice using cider-specific varieties of apples, four out of nine said yes. The others ranged from a hard “no; not in my business model”, to one who said they would, but it would depend on where and when the apples were harvested, how they were grown, the quality of the fruit.

We asked the Cidermakers if they thought that Colorado cider drinkers would be willing to pay a higher price for cider made from locally grown apples, and why or why not. Only three said yes; three said no; and the other three were on the fence, with answers ranging from “A very small percentage, because they wouldn't see the value from a flavor standpoint”, to “Yes and no – there are some cider drinkers who care about the price and location and some who don't.” “Depends on the cider drinker – knowing where your food and drink comes from is important to some, others are more concerned with the cost”. One mentioned that they felt it would take a huge marketing push to get the word out and that he thought younger, newer drinkers were more concerned with consuming beverages that are exciting and new; rather than locally produced.

The Colorado Cidermakers were united in their answers regarding barriers to locally grown apples. The number one barrier was the climate. Number two was price – the cidermakers felt that farmers can make more money by growing and selling dessert apples. There was also the cost of land – which is prohibitive if you don't already own an orchard. The time it takes for apple trees to produce was brought up, as well as transportation and on the front range, finding laborers to work in the orchard and pick the fruit at harvest time was a concern. Finally, the costs of transporting, pressing and not having a guaranteed buyer.

From this market assessment, we can say that cidermakers are concerned with the reliability and cost of juice. 7/9 obtain some juice from Colorado. There is some interest in paying \$6-\$9 per gallon for cider specific juice.

Cidermakers had differing impressions on the potential value of local cider apples.

In lieu of a solid history of market demand or quantitative data on the demand for Colorado grown cider apples, contracts or other forms of commitment and investment negotiated between cider makers and growers may suffice. Without such commitment growers will be unlikely to risk planting the apples.

In addition to offering growers some economic assurance, these arrangements could be used to define the terms of the relationship including all aspects of cultivation, harvest, and post-harvest.

OUT OF STATE CIDERMAKERS

We surveyed a range of cidermaker from different regions of the country about their experiences in obtaining cider apples from existing growers or partnering with growers to grow apple on their behalf. We talked to prominent cidermakers in Washington, Michigan, Vermont, Oregon, Virginia and New York and they universally expressed the difficulty in convincing growers to take the risk of growing on their behalf's and, more importantly, selling the product in an immature market on a large scale. The consensus seems to be that there needs to be a direct relationship with the grower either as a partner or growing apples as an extension of the cidermaking business.

PROFITABILITY

Profitability defined by the returns minus the costs of a venture or enterprise will be affected by many variables. However, preliminary information on the returns necessary to interest Colorado growers and prices some cider makers would be willing to pay can begin to illustrate how negotiations between cider makers and growers would begin to be framed. Following is a chart that presents different returns per acre as affected by yields and prices received. Cider makers around the country have reported paying between 30 and 75 cents per Lb. for cider specific apples. The Colorado Cider Guild survey found that 4/9 would pay \$6-\$9 per gallon which, depending on the press efficiency, would roughly translate to the above quoted prices.

Returns Per Acre by Price Paid and Sellable Yield

	Sellable Yield (40Lb. Bushels/acre)											
Price Paid (\$/Lb.)	160	200	240	280	320	360	400	440	480	520	560	600
0.15	960	1200	1440	1680	1920	2160	2400	2640	2880	3120	3360	3600
0.2	1280	1600	1920	2240	2560	2880	3200	3520	3840	4160	4480	4800
0.25	1600	2000	2400	2800	3200	3600	4000	4400	4800	5200	5600	6000
0.3	1920	2400	2880	3360	3840	4320	4800	5280	5760	6240	6720	7200
0.35	2240	2800	3360	3920	4480	5040	5600	6160	6720	7280	7840	8400
0.4	2560	3200	3840	4480	5120	5760	6400	7040	7680	8320	8960	9600
0.45	2880	3600	4320	5040	5760	6480	7200	7920	8640	9360	10080	10800
0.5	3200	4000	4800	5600	6400	7200	8000	8800	9600	10400	11200	12000
0.55	3520	4400	5280	6160	7040	7920	8800	9680	10560	11440	12320	13200
0.6	3840	4800	5760	6720	7680	8640	9600	10560	11520	12480	13440	14400
0.65	4160	5200	6240	7280	8320	9360	10400	11440	12480	13520	14560	15600
0.7	4480	5600	6720	7840	8960	10080	11200	12320	13440	14560	15680	16800
0.75	4800	6000	7200	8400	9600	10800	12000	13200	14400	15600	16800	18000
0.8	5120	6400	7680	8960	10240	11520	12800	14080	15360	16640	17920	19200
0.85	5440	6800	8160	9520	10880	12240	13600	14960	16320	17680	19040	20400
0.9	5760	7200	8640	10080	11520	12960	14400	15840	17280	18720	20160	21600
0.95	6080	7600	9120	10640	12160	13680	15200	16720	18240	19760	21280	22800
1	6400	8000	9600	11200	12800	14400	16000	17600	19200	20800	22400	24000
	8	10	12	14	16	18	20	22	24	26	28	30
	Sellable Yield (800Lb. Bins)											

The costs of production will vary greatly based on a multitude of factors and decisions. Factors such as the variety planted, quality standards and harvest methods may depend in part on the cidemakers preference. Orchard design and the initial costs of establishment could range from close to \$20,000/ac for a high-density trellised system to far less if a grower was to top-graft cider apples onto already established rootstock. Furthermore, these decisions would have an effect on the yields and the time required before the trees came into bearing fruit and the grower into earning profits. Variable costs, including labor and farm inputs such as sprays to mitigate pests are significant and would again vary by design and orchard decisions. While planting cider specific apples has many unknowns and many variables, private experimentations and organized research groups and institutions are working to help inform this prospect.

Much of this formal research on planting cider specific orchards comes from agricultural colleges in apple producing regions. In 2020 prominent cider apple researchers from Washington State University, Cornell University, and Michigan State University published an article reviewing the current state of research on the production of these specialty apples. Growing Apples for Hard Cider Production in the United States-Trends and Research Opportunities distinguishes 6 categories of inquiry on the subject:^{xviii}

1. Economic considerations in cider apple production
2. Production systems
3. Preharvest and postharvest factors that affect cider quality
4. Mechanization
5. Identification and evaluation of apple cultivars for hard cider use
6. Genetics and cultivar improvement

Studies looking into the economic feasibility of growing cider apples in other parts of the country have developed enterprise budgets and analyses that can be adjusted to an individual operation's circumstances and conditions. These customizable excel spreadsheets can be downloaded and adjusted to reflect various conditions and decisions made on individual orchards:

Virginia Cooperative Extension's publication Assessing the Economic Feasibility of Growing Specialized Apple Cultivars for Sale to Commercial Hard Cider Producers hosts a link to a downloadable excel file containing a customizable budget. This publication can be found by searching by title here: <https://resources.ext.vt.edu/>

Washington State University Extension has also developed customizable downloadable enterprise budgets to assist in assessing the economic feasibility of growing cider apples. These budgets and their studies are available by searching for cider apples here: http://ses.wsu.edu/enterprise_budgets/

All of these studies recognize the multitude of variables involved in these assessments. From the variety of apple and design of the orchard to the climate and marketing channel, individual circumstances are diverse. There are many unknowns and so, these assessments are based on assumptions that should be recognized and evaluated as such. Inputs into these budgets should also be carefully evaluated. The cider apple yields for Virginia, Central Washington, and Western Washington are 37,200, 45,000 and 41,400 Lbs. per acre respectively. Growers interviewed in the North Fork Valley report yields for desert apples that only approach or reach these yields on good years for some operations. Reported yields fell between 9,600 and 64,000 Lbs. per acre on a good year with mean and median values of 31,973 and

37,000 Lbs. per acre respectively. Average year yields for North Fork Valley growers were lower. The average yield reported for an average year being 20,060 Lbs. per acre. The median yield reported for an average yield being 22,000 Lbs. per acre. Reported yields for cider apples were much lower. Many of the cider apple yields were low because they were new orchards that had not yet obtained full bearing nature. However, an orchardist with 7–9-year-old cider specific trees reported best case scenario yields to be 20-30 bins per acre (16,000-24,000 Lbs. per acre), a figure that represents about one third of the quantity of fruit harvested from this operation’s desert apple harvests.

As Colorado growers know, the assumed prices that will be paid for these apples are not guaranteed and are susceptible to the fluid nature of supply and demand.

Researchers from Cornell University looked at the economics of cider operations that had a diversity of production practices, marketing strategies, and growing conditions. They modified the enterprise budgets developed by Virginia Cooperative Extension and present an interesting study that shows how sensitive the economic bottom line is to different operational inputs and outputs as well as assumptions of yields and prices received.

HORTICULTURAL INFORMATION

In addition to their local networks and formal resources on growing desert apple varieties such as the Intermountain Commercial Tree Fruit Production Guide ^{xix} and our local extension offices and research stations, orchardists considering growing cider apples can find some horticultural information from research institutions with dedicated cider apple programs including Cornell University, Washington State University Extension, Michigan State University, Virginia Cooperative Extension, Pennsylvania State Extension, and the University of Vermont. Several of these institutions have established trial orchards to test cider apples in their various climates.

While valuable, much of this information will have less relevance to growers in the high and dry areas of the Intermountain West. Montana State University’s Western Agricultural Research Center planted 6 cultivars of bitter apples in 2017 and is researching the performance of these and other cultivars grown in the Intermountain West. Their March 2020 report *Performance of Cider Apple Cultivars in the Intermountain West A Survey of Cider Apple Growers* can be found here:

https://agresearch.montana.edu/warc/research_current/apples/cider_cultivar_research.html Having planted their cider apples in both high density and free standing orchard systems, this research station will be evaluating both to compare “production, harvest efficiency, fruit quality and flavor as well as weed competition.”^{xx}

In addition to their amazing extension program and research centers across the state, many of which are conducting research on fruit trees and orchard systems, Colorado State University’s Southwestern Colorado Research Center in Yellow Jacket, CO has partnered with the Montezuma Orchard Restoration Project (MORP) to develop the High-Altitude Fruit Tree Project. They planted 26 varieties of heritage fruit trees in 2017. According to their website, “The focus for this planting is on the newly emerging cider market in the Four Corners Region.” While many of these varieties may represent heritage apples that are also suitable for eating, this group is working with local cider producers and may be a valuable source of information.

CONCLUSION

Colorado is a unique place, with unique opportunities and challenges. Our apple industry has been diminished as large trends toward conglomeration and commodification have dominated the food supply chains. The industry that remains is generally interested in the new market that the hard cider industry may provide. The high quality of our fruit and enduring nature of the orchardists here, coupled with a consumer desire for local, craft, and artisanal products may represent an opportunity for cider makers to develop a desirable and profitable specialty product.

However, there are a multitude of risks and unknowns surrounding this prospect. Consumer demand for ciders made from cider specific apples and local, Colorado grown apples has not been adequately defined or quantified. Growing cider specific apples on trees that take years to begin bearing fruit for an unsubstantiated market represents great risk. As artisans, cider makers will likely have preference in the varieties and perhaps the growing and harvest processes of these apples. These characteristics of this newly revived faction of the craft beverage industry warrant relationships between orchardists and cidermakers that go beyond your typical market-based relationships of buying and selling on the commodity market. Indeed, strategic partnerships, based on mutual investment and risk sharing are likely to be a necessary incentive for growers to begin planting these trees.

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ⁱⁱⁱ Nicolas Fabien-Ouellet and David Scott Conner, "The Identity Crisis of Hard Cider," *Journal of Food Research* 7, no. 2 (2018): 54.

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