

The Economic Viability of Expanding Fresh and Processed Fruit and Vegetable Production in Missouri – Interview Summaries, Marketing, Outlook, and Next Steps

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This report is the first of a three-part series on the economic viability of expanding fresh and processed fruit and vegetable production in Missouri. The other related parts include:

Part 2: The Economic Viability of Expanding Fresh and Processed Fruit and Vegetable Production in Missouri – Fruit and Vegetable Processing

Part 3: Missouri Specialty Crop Marketing and Costs & Returns Budgets: A Commercial Growers Guide

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The Economic Viability of Expanding Fresh and Processed Fruit and Vegetable Production in Missouri – Interview Summaries, Marketing, Outlook, and Next Steps

At the inception of this project, the primary goal was to evaluate the economic feasibility of expanding fruit and vegetable production within Missouri. Across much of 2014 through 2020, falling commodity prices had made Missouri's traditional crops (corn and soybeans) less profitable, increasing financial stress on Missouri farms. Although there has been a brief respite with higher commodity prices from September 2020 into early 2021, it is unlikely these higher prices will persist for an extended period of time. This study looks closely at the economics of Missouri fruit and vegetable production in the context of profitability, competitiveness with other states, barriers to expanding fruit and vegetable production, the needed knowledge and infrastructure to progress from low to high volume markets, and opportunities for processing and/or value-added products. Specialty crops are generally high margin, labor intensive crops that can be produced both in low and high capital investment environments. Subsequently, fruit and vegetable production also offer an attractive economic opportunity for beginning farmers.

This project also involved a significant number of interviews with participants all along the fruit and vegetable supply chain. The bulk of these interviews focused on growers in order to establish possible roadblocks to expanding production. We also interviewed auction markets, grocery stores, and participants in the processing industry from equipment makers to Missouri processors to large multi-national processors. We had many informal conversations with other players in the supply chain such as large-scale greenhouse operators, input suppliers, and food company buyers. In addition, we reviewed the trade magazines for industry insights into how the industry is changing and what trends are changing in the future.

An important part of this project was to establish a benchmark set of specialty crop enterprise budgets for different types of production systems relevant for Missouri. Although this information was intended to be gathered through the grower interviews and organized by region, only a few growers could associate costs by specific specialty crop. After consulting with the Extension horticulturalists, specialty crop budgets from surrounding states were updated with current input prices and output prices experienced by Missouri growers. Albeit not an ideal solution, these budgets provide a benchmark that can be improved upon in the future.

This study concludes by outlining a set of next steps that will need to be tackled by various market players in order to assist Missouri's fruit and vegetable growers in expanding production. In studying the history of Missouri's fruit and vegetable, Tom Dicke described the momentum gained when "an

infrastructure of equipment makers, suppliers, and brokers,...” as well as “local bankers and businessmen” comfortable with financing the business were available (Dicke, 2005). Fruit and vegetable production is starting a resurgence and much of its potential success hinges on developing the infrastructure to support it. The term infrastructure is used in its broadest sense to include:

- identifying and developing produce markets,
- ongoing benchmarking of costs of production,
- maintaining fruit and vegetable production and industry data,
- developing specialty crop production knowledge (both in growers and bankers),
- assisting growers to overcome capital hurdles related to production such as storage, cooling, and cleaning,
- helping growers establish cooperatives that can serve as produce aggregators in order to reach larger markets,
- helping growers establish cooperatives that can also provide inputs and serve as community builders providing a forum for growers to exchange ideas and experiences,
- reducing production risk through adjusting policy to encourage fruit and vegetable production,
- helping growers navigate food safety and compliance issues under federal, state, and county rules, and
- developing manufacturing test kitchens that demonstrate proof of concept to investors.

Overview of the Missouri fruit and vegetable industry

The US fruit and vegetable supply chain is quite different from commodity row crops and merits some explanation. Figure 1 provides an overview of the basic activities and participants in the market (Congressional Research Service, 2020). Fruit and vegetable growers should have arrangements to market their production before they begin the production process. Based on their arrangements, they should know which crops to produce, when to produce them, and when to deliver their production. Unlike commodity row crops, harvesting the crop may be done over several weeks depending on the type of crop. Specialty crops are also more fragile than row crops and require more attention to control pests. In Missouri, specialty crops follow two predominant pathways to market. In the first pathway, the fruits or vegetables are not cooled and move directly to a Farmers’ market, roadside stand, produce auction market, and/or possibly a Community Supported Agriculture (CSA) market (direct markets). Some especially fragile specialty crops may still be cooled or sold packed in ice. Many Missouri growers harvest their produce the morning of the day in which they sell it to ensure freshness. Some growers also deliver produce directly to restaurants several times per week.

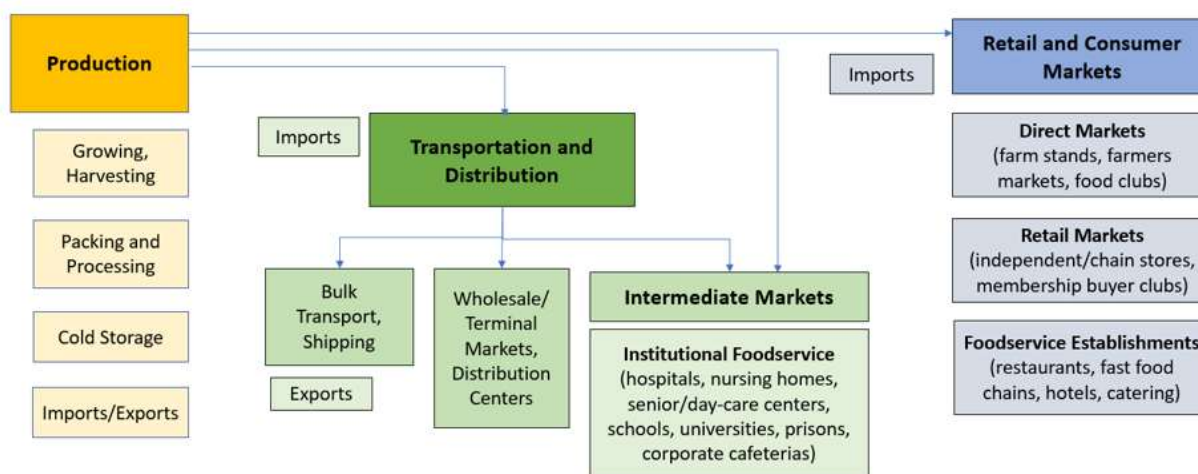
The second pathway is to immediately cool the fruits or vegetables initializing the cold chain. Each fruit or vegetable has a recommended temperature to be cooled to in order to slow deterioration. Many grocery stores that purchase directly from auction markets send refrigerated trucks to immediately begin the cooling process upon purchase.

For retail markets and some foodservice establishments, the cold chain usually begins upon packing for shipping. Some growers are large enough to have their own packing or aggregation and ship directly to distribution centers, wholesale markets, and/or retail grocery stores. Some growers take their produce to an aggregator/packing house to be combined with produce from other farms so they can participate with buyers who demand larger quantities than they can produce.

Many fruits and vegetables headed for the institutional market first go through a fresh cut processor. This processor performs the tasks of washing, chopping, packing, and labeling the fruit or vegetable for the institutional market. Products leaving the fresh cut processor are transported in refrigerated trucks.

The US Fruit and Vegetable Supply Chain

Figure 1. US fruit and vegetable value chain and marketing channels



Source: "COVID-19: Supply Chain Disruptions in the U.S. Fruit and Vegetable Industry: In Brief", Congressional Research Service, May 8, 2020

Historical Missouri fruit and vegetable production

Figure 2 provides a listing of the top vegetable, berry, and fruit crops grown in Missouri based on area harvested. This data is drawn from the various Censuses of Agriculture since 1997 that is reported by NASS in their Quick Stats database (United States Department of Agriculture, National Agricultural

Statistics Service, 2021). A full listing of all fruit and vegetable specialty crops can be found in Appendix A.

Over the past 20 years, Missouri's vegetable production has declined for all crops except potatoes and squash. The largest declines occurred in green beans and cucumbers that were being produced for processors, as well as watermelons for fresh consumption. Sweet corn acres have also declined from 1997 levels but were significantly higher in 2007.

In contrast, Missouri berry crop area continues to expand with the exception of strawberries which has been steady. Elderberry crop area was first reported in the 2017 census and Missouri is currently the largest producing state. Blackberry and blueberry crop area continues to expand supported by strong growth in consumer demand. Driven by the growing wine industry, Missouri's grape area continues to grow although some of the momentum has slowed since 2012. Both apple and peach area continue to decline.

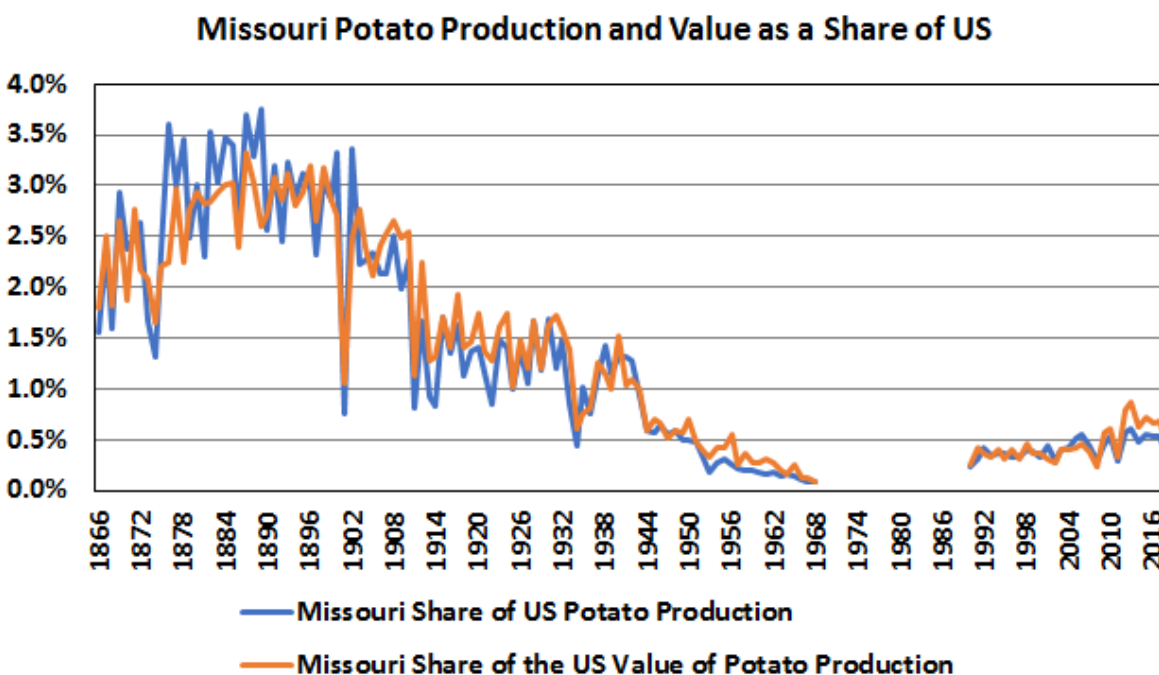
Figure 2. Primary fruit and vegetable crops in Missouri

Crop	1997	2002	2007	2012	2017
Acres					
Top Vegetable Crops by Acres					
Potatoes	5,982	5,256	6,127	9,056	8,553
Watermelons	4,778	4,993	3,479	2,744	2,919
Sweet Corn	1,870	1,633	3,065	2,325	1,138
Green Beans	2,753	3,962	7,636	1,479	692
Tomatoes	646	401	551	492	504
Squash	137	205	168	269	441
Cantaloupes	549	367	431	467	389
Cucumbers	5,195	11,325	6,814	612	215
Top Berry Crops by Acres					
Elderberries	NR	NR	NR	NR	369
Blackberries	NR	NR	275	259	307
Blueberries	NR	NR	217	194	247
Strawberries	NR	NR	172	196	171
Top Other Fruit Crops by Acres					
Grapes	970	1,453	1,773	1,828	1,854
Peaches	1,910	2,196	2,314	NR	1,305
Apples	NR	2,920	1,819	1,161	1,123

Source: USDA Census of Agriculture, Quickstats

Missouri Production in Perspective

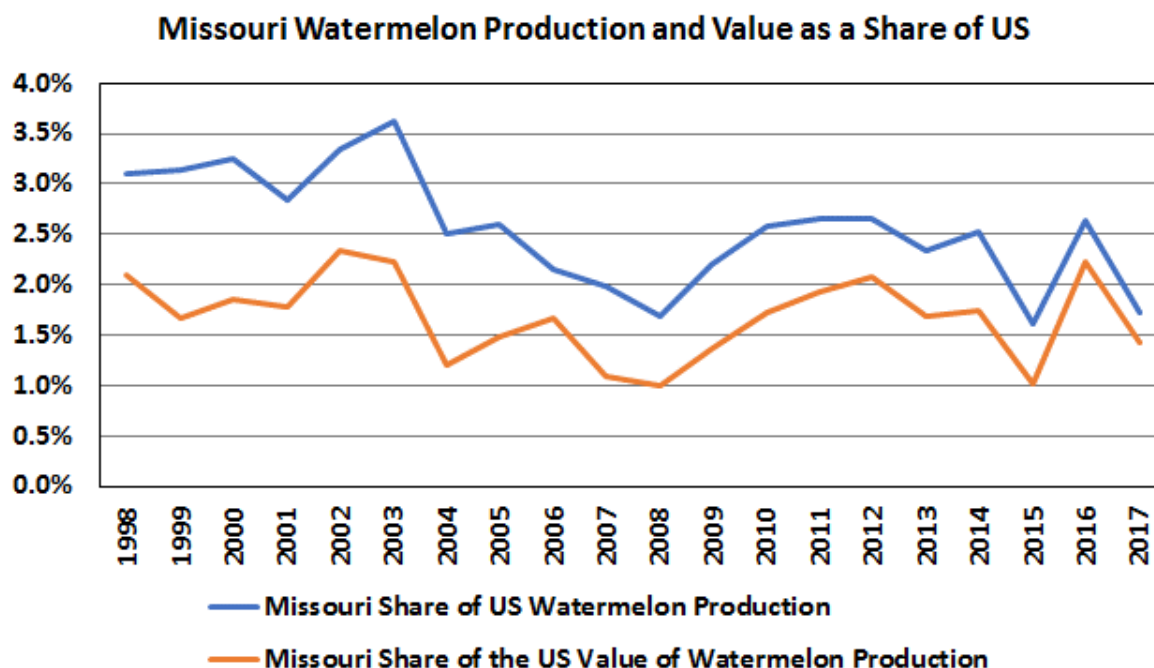
Historical data on Missouri fruit and vegetable production is a bit patchy. USDA's NASS Quick Stats database carried data back to 1866 for potatoes in Missouri. Some of the early decadal censuses have sporadic data on a few fruits and vegetables. As one might expect, the data suggest significantly more



acres in production for fruits and vegetables reflect weaker yields but also Missouri's stronger presence in fruit and vegetable production.

Missouri's importance in potato production has waned from 3.5% in the late 1800's to about 0.5% in recent years. Missouri produced its largest potato crop in 1902 with a crop size of 5.98 million hundredweight. In 2017, Missouri produced 2.81 million hundredweight, 47% of the 1902 crop size. Census data from the 1900 Census of Agriculture indicates that Missouri planted 93,915 acres of potatoes in 1899.

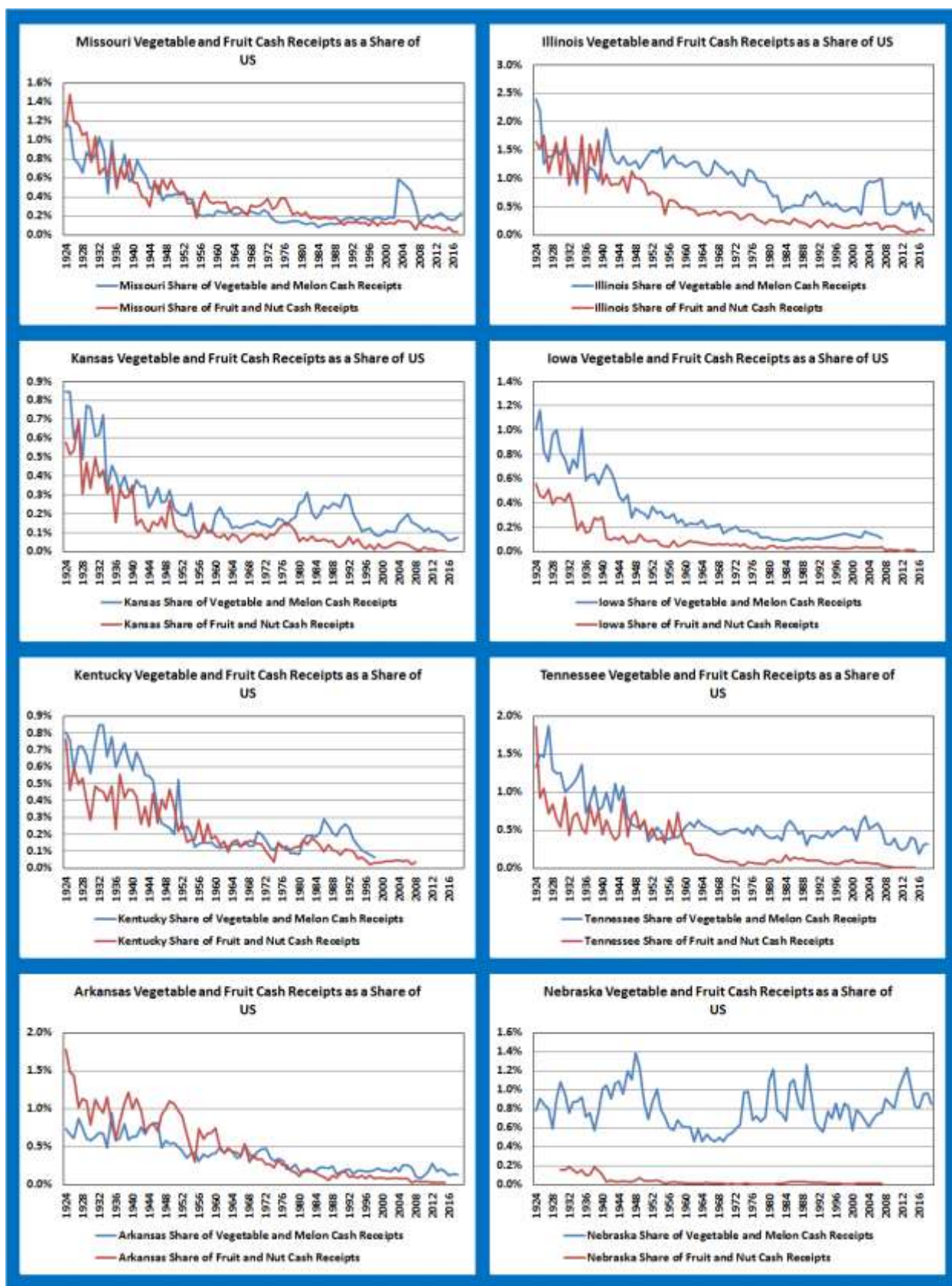
USDA- NASS data for watermelons begins in 1998 with Missouri at 3 percent of US production. Since 1998, Missouri's share of national watermelon production has declined to 1.6 percent in 2017. USDA- NASS no longer breaks out details on Missouri's watermelon production.

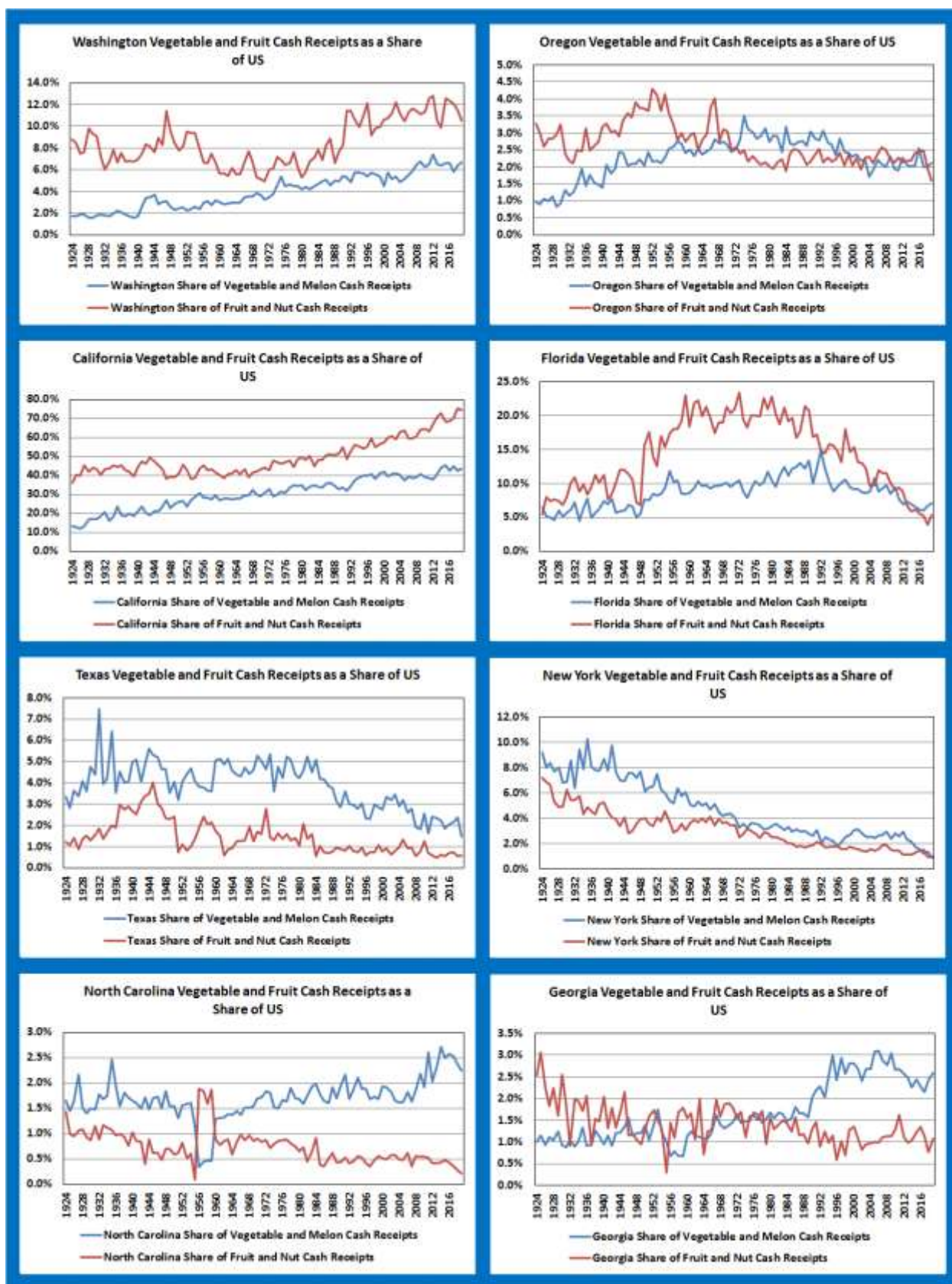


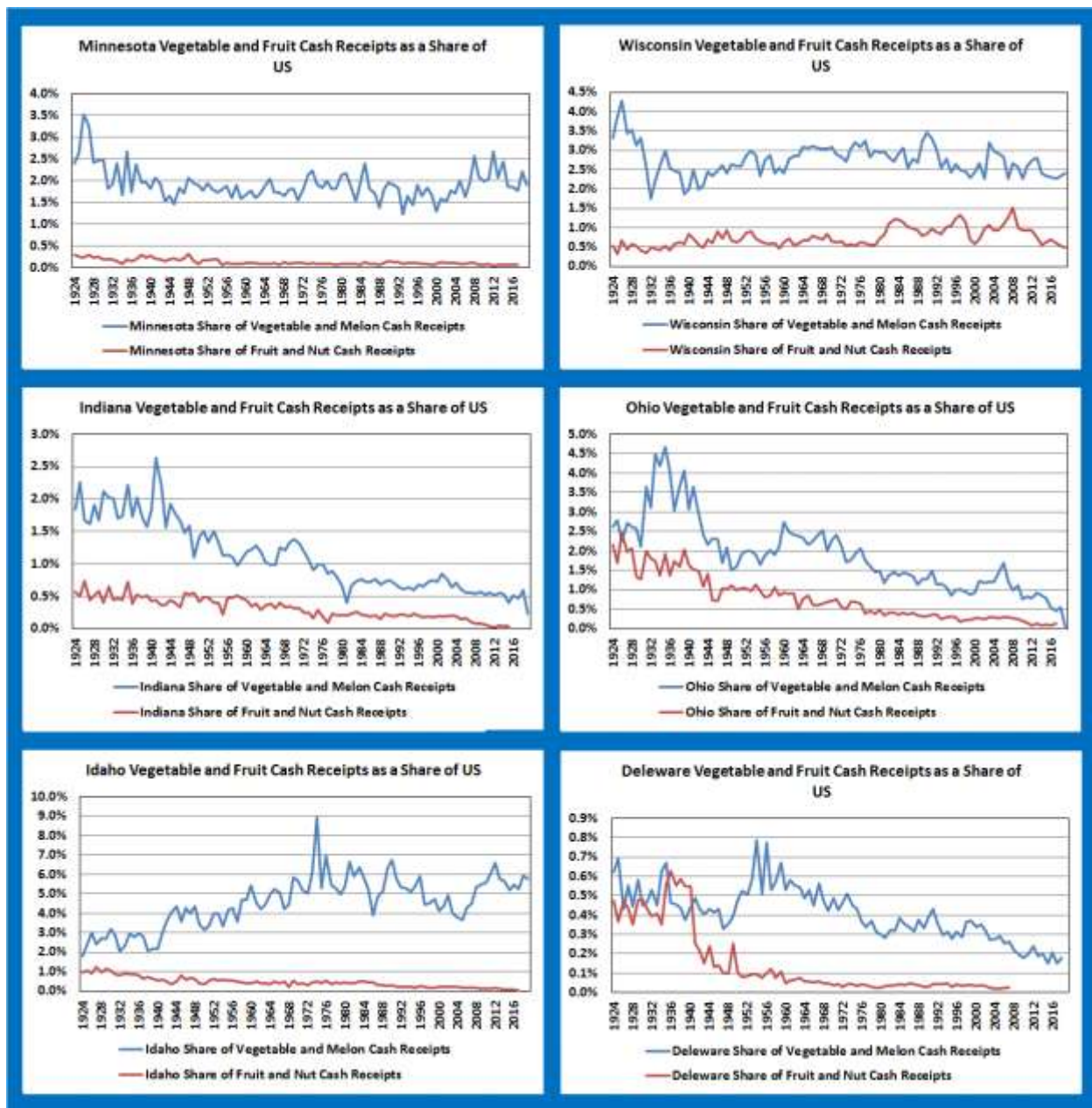
Missouri Fruit, Vegetable, and Tree Nut Cash Receipts in Perspective

Comparing the pattern of state fruit and vegetable cash receipts as a share of US fruit and vegetable cash receipts provides insight into which states are growing their fruit and vegetable industries and which are declining. USDA's Economic Research Service reports total cash receipts for vegetable and melons as well as fruit and tree nuts back to 1924 (United States Department of Agriculture, Economic Research Service, 2021). Missouri and its surrounding states (pictured on the following page) generally reflect declining shares of US fruit and vegetable cash receipts. Nebraska vegetable and melon receipts appear to be an exception with receipts holding steady. Missouri, unlike many of the surrounding states, has managed to keep its share of vegetable and melon receipts relatively steady since 2008 possibly reflecting the effectiveness of high tunnels in combination with the auction markets.

What one would like to see for Missouri is an increase in the share of US fruit and vegetable cash receipts suggesting a strongly growing industry. Expanding the graphs to cover additional states brings out a few states where exactly that pattern emerges. As may be expected, the most pronounced patterns are in Washington and California with growth in the share of both fruit and vegetable receipts. Georgia and North Carolina also show strong growth in vegetable and melon cash receipts share. Florida Extension personnel indicated that some large grower companies in California were relocating to Georgia because of water constraints and land prices in California. Florida growers have also been teaming with North Carolina growers to extend the supply season. Greening disease has decimated Florida's orange returns resulting in a dramatic decline in their share of fruit cash receipts.







Historical Tomato Processing in Missouri

Tom Dicke wrote an article on the history of the canning industry documenting the rise and fall of tomato canning in the Missouri and Arkansas Ozarks (Dicke, 2005). His article points out some critical issues that are very relevant today both for growing and processing tomatoes. A brief summary of his article is included below.

Dicke reports that in 1900 the Ozarks accounted for 20 percent of all tomatoes canned in the US. The logical question is how the Ozarks went from such a dominant position to essentially no processors today? As with many new industries, the canning business was initially very profitable with very low capital demands and few regulations. In the Ozark area both commercial and family cannery operations produced canned tomatoes with significantly more family cannery operations than commercial operations. Quality was highly variable but initially quality was highly variable everywhere in the US. The structure of the small Ozarks farms also complimented production and processing of tomatoes because other farm work and timber harvesting often occurred during other times of the year than tomato production and processing. The interest in production of tomatoes led to full infrastructure of equipment makers, suppliers, brokers, bankers and investors that provide support to make the industry thrive. Commercial canneries even supplied seed or seedlings, fertilizer, and insecticide in some situations.

The demise of the Ozark canning industry was rooted in quality control of the canned tomatoes. With all of the small growers there was limited quality control and Ozark tomatoes became known for having quality issues. Commercial canning companies in California and other states began to deliver more consistent quality and products were more traceable through one large commercial canner versus trying to trace Ozark tomatoes through brokers back to small canneries that were often only open seasonally and transient. Commercial canning companies began to use national brands (Del Monte and Libby) to define consistent quality. After World War II consumers shifted their demand preferences to the national brands sometimes leaving the brand name products sold out while unbranded products went unsold.

Simultaneously, changes in lifestyle lead to less complementarity between tomato production and processing and the jobs families wanted to do. Farmers became more specialized focusing on specific livestock or crop production with little time for tomatoes. Off farm employment also became more attractive with higher wages and more consistent work. Some workers were attracted to urban and other areas where there were higher wages. Dicke describes the decline of the Ozark canning industry not in the context that canners went bankrupt, but that they simply chose not to reopen the next season.

Profitability of fruits and vegetables

The 2017 Census of Agriculture reports farm receipts and net cash income by the North American Industry Classification System (NAICS) business code. Farms are classified based on their predominant business. In 2017, vegetable and melon farming had the second highest rate of return with a net cash income to total receipts ratio of 38 percent. Greenhouse, nursery, and floriculture had the highest return at 40 percent. Both of these rates of return exceeded the rate of return from oilseed, grain, and rice farming of 31 percent. Fruit and tree nut farming had a lower rate of return at 19 percent, which was an improvement from 6 percent in 2012.

Despite higher reported profitability in 2017, overall sales of fresh vegetables in Missouri were down 11 percent from 2012 levels.

Figure 3. Missouri Farm Receipts and Net Cash Income by NAICS Farm Type

	Receipts*			Net Cash Income			Net Cash Income as a % of Receipts	
	2012	2017	% Chg**	2012	2017	% Chg**	2012	2017
<i>million dollars</i>								
Oilseed, Grain, & Rice Farming	4,185	5,136	23%	1,333	1,570	18%	32%	31%
Vegetable and Melon Farming	57	61	7%	14	23	72%	24%	38%
Fruit and Tree Nut Farming	25	28	11%	2	5	260%	6%	19%
Greenhouse Nursery and Floriculture	87	121	39%	22	48	123%	25%	40%
Other Crop Farming	505	461	-9%	144	171	18%	29%	37%
Cattle Ranching and Farming	2,159	1,971	-9%	96	206	114%	4%	10%
Hog and Pig Farming	913	1,317	44%	166	365	120%	18%	28%
Poultry and Egg Production	1,469	1,657	13%	280	474	69%	19%	29%
Sheep and Goat Farming	12	16	31%	-9	-13	-38%	-76%	-80%
Aquaculture & Other Animals	76	80	6%	-59	-39	34%	-78%	-49%
Total	9,489	10,850	14%	1,989	2,810	41%	21%	26%

Source: USDA-NASS, Census of Agriculture, Quickstats Database, NAICS Classifications.

* Market value of agricultural products sold including government payments

** Percentage change from 2012 levels.

Figure 4. Total sales of fresh vegetables in Missouri for selected counties and the state (1000 dollars)

Counties	2007			2012			2017			% increase in sales over 2012	% increase in sales over 2007
	Field	Covered	Total	Field	Covered	Total	Field	Covered	Total		
Audrain	138	109	247	222	179	401	572	546	1,118	179%	352%
Barton	301	56	357	606	173	779	304	605	909	-17%	155%
Dallas	314	48	362	398	287	685	447	236	683	0%	89%
Davies	204	124	328	499	405	904	219	494	713	-21%	117%
4 County Auction (Benton & Johnson only)	427	248	675	689	247	936	626	247	873	-7%	29%
Central Auction	884	1,053	1,937	1,030	1,088	2,118	1,638	3,013	4,651	120%	140%
Rich Hill Produce Businesses	552	229	781	3,864	537	4,401	2,256	323	2,579	-41%	230%
Above	2,820	1,867	4,687	7,308	2,916	10,224	6,062	5,463	11,525	13%	146%
Statewide	32,832	3,706	36,538	43,215	5,719	48,934	32,083	11,517	43,600	-11%	19%

Several values are estimates, including field statewide value(s). A statewide average sales per acre had to be calculated for fresh vegetables (as the average with the census includes processing vegetables, which tend to be lower value). It was calculated by averaging all the counties for a given year where sales for a given county was available, and processing acreage was 0 to 10. For 2007 this was 26 counties, 29 in 2012, and 39 in 2017. This estimated that average sales per acre was \$2985 in 2007, \$4374 in 2012, and \$3811 in 2017.

Drivers of change in Missouri fruit and vegetable production

Fruit and vegetable production is often broken down into two types based on the method of production: open field production and protected production. Open field production was historically the most common type and included both production for the fresh market and production for the processed market.

Protected production is almost entirely for the fresh market. Beginning with open field production, the census data suggests the number of Missouri acres used to produce fruits and vegetables (in the open) declined from 9,880 to 8,418 acres from 2012 to 2017, sales revenues have increased from \$63.1 million to \$65.6 million from 2012 to 2017. By contrast, protected production sales revenues have increased from \$5.7 million in 2012 to \$11.5 million in 2017 with area under cover growing from 962,238 square feet to 1,125,527 square feet. The growth in protected production has occurred largely due to the investment in high tunnel systems some of which can be cost shared under the USDA Environmental Quality Incentives Program (EQIP) program (United



Winter Production of "Salad Mix"
Vegetables, Granby, MO (Newton County).
Photo taken Jan 28, 2019.

States Department of Agriculture, Natural Resources Conservation Service, 2021). Auction markets have also facilitated growth giving growers access to higher volume markets than farmers' markets but with lower prices than farmers' markets. The fresh market for fruits and vegetables is where much of the growth in the past decade has occurred. In August 2015, Robert Garino (MO State Statistician) and James Quinn (MU Extension Horticulturalist) produced the tables below for 2007 and 2012 using Missouri Census of Agriculture data. These tables have been updated to include 2017 data. The table shows the sales revenues of fresh vegetables produced in Missouri based on the past three censuses of agriculture. Columns labeled field are based on open field sales and columns labeled covered are based on sales from protected culture production. The detailed data is organized around key counties that produce for auction markets. Audrain, Barton, Dallas, and Davies each support their own auction market. 4-county auction, central auction, and Rich Hill Produce Businesses are auctions supported by multiple counties. The growth in overall auction sales has been strong over the ten-year period reaching 146%. In the past 5 years, Audrain, Barton, and Central auctions have continued to experience strong growth. On a statewide basis, sales of fresh fruits and vegetable under protected cultures grew from \$5.7 million to \$11.5 million from 2012 to 2017.

Figure 5. Greenhouse or high tunnel vegetables and herbs for selected counties in Missouri (sales in \$1,000)

Counties	2007			2012			2017			% increase in sales over 2012	% increase in sales over 2007
	farms	sq ft	sales	farms	sq ft	sales	farms	sq ft	sales		
Audrain	5	14,552	109	13	35,281	179	15	80,999	546	206%	400%
Barton	3	7,488	56	10	36,980	173	11	83,672	605	249%	977%
Dallas	3	6,360	48	13	81,244	287	14	112,375	236	-18%	391%
Daviess	5	20,360	124	20	134,444	405	11	95,616	494	22%	297%
Benton	4	38,700	220	4	28,500	86	5	10,080	63	-27%	-71%
Johnson	4	3,850	28	12	46,200	161	7	37,836	184	14%	568%
4 County Auction	8	42,550	248	16	74,700	247	12	47,916	247	0%	0%
Moniteau	11	50,400	378	14	260,020	644	16	390,672	1,312	104%	247%
Morgan	15	89,740	675	17	97,553	444	20	262,517	1,701	283%	152%
Central Auction	26	140,140	1,053	31	357,573	1,088	36	653,189	3,013	177%	186%
Vernon	5	23,815	186	19	213,516	451	9	46,584	298	-34%	60%
Bates	3	6,000	43	4	28,500	86	1	5,176	25	-71%	-41%
Rich Hill Produce Businesses	8	29,815	229	23	242,016	537	10	51,760	323	-40%	41%
Total	58	261,265	1,867	126	962,238	2,916	109	1,125,527	5,463		
% increase from previous census				117%	268%	56%	-13%	17%	87%		

Yellow highlighted box for sales are adjusted as follows: square footage was multiplied by average sales per sq ft for that year. Average sales per sq ft was calculated by summing sales from counties without a yellow highlight, of that given year, and then divided by the corresponding square footage.

The square foot for the operation in Bates County in 2017 is based on the average size of an operation in Vernon County in 2017.

Figure 6. Open field vegetable (fresh) farms, acres, and sales (\$1,000) for selected counties in Missouri

Counties	2007			2012			2017			% increase in sales over 2012	% increase in sales over 2007
	farms	acres	sales	farms	acres	sales	farms	acres	sales		
Audrain	29	42	138	23	63	222	28	103	572	158%	314%
Barton	7	87	301	25	151	606	20	89	304	-50%	1%
Dallas	29	68	314	40	121	398	27	98	447	12%	42%
Daviess	11	64	204	30	134	499	16	39	219	-56%	7%
Benton	7	57	197	8	30	120	3	11	63	-27%	-68%
Henry	11	42	215	9	47	171	2	10	58	-32%	-73%
Johnson	42	84	230	26	74	368	37	84	422	15%	83%
Pettis	14	76	187	4	6	30	7	15	83	-3%	-55%
4 County Auction	74	259	829	47	157	689	49	121	626	-9%	-24%
Moniteau	29	106	465	45	162	697	41	138	1,099	58%	136%
Morgan	45	121	419	34	83	333	30	97	539	62%	29%
Central Auction	74	227	884	79	245	1,030	71	235	1,638	59%	85%
Vernon	9	96	244	50	879	3,527	38	316	1,757	-50%	620%
Bates	14	88	308	12	84	337	9	61	499	48%	62%
Rich Hill Produce Businesses	23	184	552	62	963	3,864	47	377	2,256	-42%	309%
Webster	24	45	156	32	57	229	41	95	372	62%	138%
Total	271	976	3,378	338	1,891	7,537	299	1,157	6,434		
% increase from previous census				25%	94%	123%	-12%	-39%	-15%		

Yellow highlighted box for sales are adjusted as follows: acres were multiplied by average sales per acre for that year. Average sales per acre was calculated by summing sales from counties without a yellow highlight, of that given year, and then divided by the corresponding acres. Orange highlighted boxes were calculated using average farm size from the 2012 census. Light green boxes were calculated by dividing total sales by the average sales per acre.

High tunnels: A game changer for Missouri fruit and vegetable production

The rapid adoption of high tunnels in Missouri has been driven both by the significant benefits of high tunnels as well as the cost share assistance available through USDA's EQIP program. The benefits of high tunnels include:

- Extended growing season
- Improved plant and soil quality
- Reduced nutrient use
- Reduced pollen drift
- Reduced energy use and improve air quality by providing consumers with a local produce

High tunnel cost share assistance through USDA's EQIP program can cover a significant portion of the cost of the high tunnel. Growers often add additional funds to upgrade beyond the minimum requirements and minimize fixed costs per square foot. A good step-by-step guide for the EQIP program can be found at:

<https://www.tunnelvisionhoops.com/blogwhat-is-the-nrcs-high-tunnel-initiative-grants-for-high-tunnels/>

While the cost of constructing a high tunnel can vary considerably, the budget below is adapted from a Kansas budget. There are several companies that manufacture the construction materials.

Construction Costs of High Tunnels, \$/2000 square feet

Component	Labor	Machinery	Materials	Total Cost	Useful Life	10 year Cost
Site evaluation and soil preparation	\$312.88	\$69.85		\$382.73	10	\$382.73
Trenching and laying water pipes	\$14.20		\$100.00	\$114.20	10	\$114.20
Inserting poles and setting posts	\$283.92	\$159.24	\$211.20	\$654.36	10	\$654.36
Assembling the frame	\$283.92		\$7,048.80	\$7,332.72	10	\$7,332.72
Treating and setting baseboards	\$94.64		\$119.64	\$214.28	10	\$214.28
End and sidewall installation	\$473.20		\$337.00	\$810.20	10	\$810.20
Pulling plastic	\$94.64		\$656.00	\$750.64	3	\$2,502.13
Channel lock installation	\$23.66			\$23.66	10	\$23.66
Shutter vents	\$0.00		\$612.00	\$612.00	10	\$612.00
Trellis purlin installation	\$141.96		\$221.30	\$363.26	10	\$363.26
Electrical	\$116.56			\$116.56	10	\$116.56
Miscellaneous hardware and tools			\$100.00	\$100.00	10	\$100.00
Total Cost	\$1,839.58	\$229.09	\$9,405.94	\$11,474.61		\$13,226.10

Cost Per Month **\$110.22**

Adapted from Kansas high tunnel budgets developed by Tom Buller, Dr. Cary Rivard, and Kimberly Oxley.

Limitations of identifying Missouri costs of production

Growers in the southeast region of the state were best able to comment on their specific costs of production in part due to the larger scale of their operations. In other regions, the small-scale growers could talk about total costs for their entire operation, but not crop specific costs because they don't break their costs down by crop.

A starting point for Missouri fruit and vegetable enterprise budgets

On the recommendation of Missouri's Extension horticulturalists for specialty crops where no previous enterprise budget specific to Missouri existed, a nearby state's budget was utilized as a starting point. These budgets from other states were updated with the latest input costs and 2020 Missouri output prices. By reviewing these budgets over time with Extension horticulturalists the goal is to further customize these budgets to Missouri conditions. Missouri enterprise budgets are available for the following crops:

Fruit

- Apples
- Blackberries
- Blueberries

- Elderberries
- Peaches
- Strawberries

Vegetables

- Bell Peppers
- Broccoli
- Cantaloupe
- Carrots
- Cucumbers
- Eggplant
- Garlic
- Green Beans
- Leafy Greens
- Okra
- Onions
- Potatoes
- Pumpkins
- Squash (Summer)
- Squash (Winter)
- Sweet Corn
- Sweet Potatoes
- Tomatoes
- Watermelon
- Watermelon (Seedless)

High Tunnel Crops

- Bell Peppers
- Cucumbers
- Head Lettuce
- Leafy Greens
- Radishes, Beets, & Carrots
- Spinach

- Strawberries
- Tomatoes

The budgets are posted on the FAPRI website under Farmer's Corner, Specialty Crops at the URL:

<https://www.fapri.missouri.edu/farmers-corner/specialty-crops/>

The reference section of this report also provides a listing of the sources for other state budgets.

Summary of Missouri fruit and vegetable grower interviews

In order to determine the economic viability of expanding Missouri fruit and vegetable production, it was important to develop a representative understanding of the current Missouri grower including their desire to expand production, current difficulties in production, yields and costs of production, and any barriers to expansion. The set of interview questions used is reported in Appendix B at the end of this report. Each interview was approximately 1.5 to 2.5 hours long and often included a farm tour providing further insight into the inputs and production processes used. Fifty interviews of fruit and vegetable growers were conducted across Missouri in 2019 including growers in the following counties: Adair, Audrain, Barton, Boone, Cape Girardeau, Cooper, Daviess, Greene, Howell, Jasper, Jefferson, Johnson, Lafayette, Lawrence, McDonald, Mississippi, Moniteau, Morgan, Newton, Ozark, Polk, Ralls, Saint Genevieve, Saline, Scott, and Shelby. The local Extension agents set up each interview with their local growers and were often present during the interviews.

Grower desire to expand fruit and vegetable production

With the exception of 2 growers in retirement, all of the other 48 growers interviewed indicated a willingness to expand production if markets were available. Many were already in the process of expanding.

Barriers to growing fruit and vegetable production in Missouri

Herbicide Drift

After interviewing growers across Missouri, the largest herbicide drift damages are primarily focused in southeast and central Missouri. Many of the fruit and vegetable growers interviewed in these areas had experienced damage or knew another grower that had. Several growers reported that the level of damage was not reduced with having a high tunnel because the drift comes in through the ventilation and there is no filtering system available to control herbicide drift.

The southeast region of Missouri is perhaps the best suited area for large scale fruit and vegetable production in Missouri due to the soils, abundance of water, and milder temperatures. Historically, it has

been the largest fruit and vegetable producing area of the state. However, it is also the area with the most serious herbicide drift issues.

When asked which herbicide was causing the damages, all growers pointed to Dicamba arguing that they had not experienced herbicide drift problems before Dicamba was released. Growers indicate that fruits and vegetables have low or no tolerance to Dicamba. Extension horticulturalists suggested that temperature inversion in southeast Missouri contributes to the problem and spraying in the afternoon to early evening seems to contribute to volatility. The topography in southeast Missouri is also very flat and wide open so it is very easy for drift to occur. Growers report a higher incidence of damages to fruits and vegetables when Dicamba is sprayed later in the growing season. Some fruit and vegetable growers suggested that wider buffer zones would be helpful. However, other growers mentioned that Dicamba drift has been documented to move or “jump” over five miles. Some growers noted that no damage may occur in fields immediately adjoining the field that is being treated but fields that are five miles away are damaged. Finally, some growers mentioned losing markets for their fruits and vegetables because they couldn’t guarantee their clients that their produce was free of herbicide drift.

Growers indicate that herbicide drift is a serious barrier to fruit and vegetable production expansion in Missouri. Fruit and vegetable growers emphasize the difference in the level of investment at risk between fruits and vegetables versus row crops. For example, a watermelon producer may have \$2000 per acre invested relative to a soybean producer who has \$250 per acre invested or a corn producer who may have \$500 per acre invested.

Fruit and vegetable growers in the southeast were asked if they had attempted to coordinate with row crop producers to apply Dicamba when it would be less volatile. Growers noted that producers applying Dicamba in full compliance with all regulations might still have unintended impacts on specialty crops and drift was very difficult to control citing some of the same issues mentioned by Extension horticulturalists. In southeast Missouri, growers noted that Dicamba is primarily used on very large cotton and soybean farms that operated “tens of thousands of acres”, huge by comparison to many of the fruit and vegetable growers. They commented that the large cotton and soybean producers use Dicamba due to the weed resistance that has developed in other herbicides.

Herbicide risk was not a major factor on the western and northern parts of Missouri, at least in the farms visited, but this may be due to the topography. Most of the farms were relatively small and often sheltered by rolling hills, pasture, or wooded areas that helped protect the specialty crops. Most growers had a combination of hoop buildings and open field production. Growers in these areas were uncertain about the ability of hoop buildings to protect crops from herbicide drift. Some growers suggested that

they coordinated with neighboring farms to know when spraying would be done so they can close up the ventilation.

Labor

As in all fruit and vegetable growing areas in the United States, both labor availability and labor cost is a significant concern for growers. In Missouri, smaller farms largely rely on family and operator labor. Some Amish and Mennonite farms reported no labor concerns with extended family and the community willing to help at harvest time. All large growers mentioned access to affordable, efficient labor as a concern but they didn't consider it their most limiting factor. Larger farms use an informal system where informal "regional labor coordinators" secure labor for both construction and farming operations. Growers use contacts in the construction industry to identify the "regional labor coordinators". Large growers stay in close contact with "regional labor coordinators" making them aware of how much labor they need and approximately when they will need it. Growers mentioned that they don't typically use the H-2A program because they don't need labor for the extended time period that must be committed to under the H-2A program. They also commented that the program is expensive because of all the extra benefits that must be provided including housing, guaranteed working time, covering the cost of transportation to and from the US border, etc. In interviews with Extension personnel in the state of Florida, Extension experts noted the high cost of migrant labor noting their farmers were paying \$12 to \$15 per hour to migrant labor for maintaining and harvesting tomatoes and concurred with Missouri growers on the extra benefits that must be provided.

Most of the labor is composed of migrant workers. Although many migrant workers were historically from Mexico, increasingly growers are sourcing labor from other countries including Haiti, Ireland, and South Africa. Some innovative Missouri growers are using non-violent prisoner labor through work release programs as well as troubled teens programs such as Teen Challenge. The prison labor is trained via classes held in the prison. Some of these prisoners go on to work at the fruit and vegetable production facility when they are released.

The labor problem becomes more complicated when specialty crop specific skills are needed. For example, in one instance a grower reported hiring local labor to pick strawberries. Although, the crew worked all day, they were only able to harvest approximately one-half of the strawberries that would have been picked by experienced migrant workers resulting in the local labor costing twice as much as migrant workers. Knowledge of harvesting techniques is also important for some specialty crops. For example, in the case of apples, improper harvesting of this year's crop could damage next year's crop.

The growers indicate that access to labor is not always timely and that this has caused some crops such as watermelons to be left unharvested because they were overripe before they could get labor for harvesting.

Growers report that sourcing labor is becoming more difficult as indicated by their personal experience and based on what they have been advised by the regional labor coordinators.

Missouri growers are not alone in the challenges to source labor. Many growers are looking for mechanical solutions to maintaining and harvesting crops because manual labor has become difficult to find as well as more expensive. New automation technologies are expected to radically change the fruit and vegetable industry over the next two decades. Crops such as green beans, sweet corn, wine/jelly grapes, and processing tomatoes are already predominantly mechanically harvested in the major producing states.

Crop Insurance

Growers were skeptical of crop insurance for fruits and vegetables for a variety of reasons. First, they felt it was expensive for the limited amount of coverage it provided. Growers commented that crop insurance did a reasonable job covering weather events such as a late spring frost or drought, but coverage was uncertain when it came to pests and diseases. This may be due to the fact that USDA's Risk Management Agency (RMA) may not pay an indemnity if the crop loss is caused by insufficient or improper applications of pest or disease control measures (Congressional Research Service, 2019). According to the USDA RMA, crop insurance does not cover damage from pesticide/herbicide drift. Importantly, not all specialty crops have coverage directed specifically at the crop but can be more generically covered under a blanket crop insurance policy. Participation rates in crop insurance by specialty crop for 2019 are given in the tables below. The participation rates are reported as market penetration rates based on the number of insured acres versus reported NASS acres.

Providing crop insurance to specialty crop growers is significantly more complex than the insurance provided to row crop producers. Specialty crop reference yields are often not well established in areas with minimal production and small growers may not have access to all of the same tools, equipment, and pest control practices available to large growers. In order for crop insurance to be a more usable tool for small specialty crop growers to encourage growth, it needs to include herbicide drift damage as well as pest damage and have larger premium subsidies. These changes could apply only to small growers with less than \$1,000,000 in gross sales.

Market Penetration of Fruit & Nuts			
Crop	2019 Insured Acres	NASS Acres	Market Penetration
Almonds	836,600	1,180,000	71%
Apples	226,006	338,980	67%
Apricots	4,520	9,720	47%
Avocados	33,418	52,920	63%
Blueberries	69,890	104,610	67%
Cherries	86,319	129,880	66%
Citrus Fruit	591,508	686,200	86%
Cranberries	30,919	40,000	77%
Figs	4,908	6,700	73%
Grapes	772,005	1,033,000	75%
Mac Nuts	11,117	16,900	66%
Nectarines	14,085	16,500	85%
Olives	23,223	37,500	62%
Peaches	64,058	102,550	62%
Pears	32,893	47,840	69%
Pecans	169,052	419,900	40%
Pistachios	142,254	289,000	49%
Plums/Prunes	48,123	59,000	82%
Strawberries	66	48,400	0%
Tropical Fruit	4,695	8,390	56%
Walnuts	179,668	365,000	49%
TOTAL	3,345,327	4,992,990	67%

Market Penetration of Vegetables			
Crop	2019 Insured Acres	NASS Acres	Market Penetration
Beans, Fresh Snap	5,197	160,600	3%
Cabbage	11,835	72,900	16%
Chile Peppers	1,056	13,800	8%
Cucumbers	24,659	87,460	28%
Dry Beans	1,193,921	1,287,400	93%
Dry Peas	1,843,306	2,040,400	90%
Green Peas	120,380	141,200	85%
Onions	86,007	160,100	54%
Peppers, Bell	4,041	43,500	9%
Potatoes	755,031	1,035,000	73%
Processing Beans	88,912	194,650	46%
Pumpkins	7,697	83,200	9%
Sweet Corn, Fresh	45,402	242,090	19%
Sweet Corn, Process	200,349	299,380	67%
Sweet Potatoes	8,860	299,380	3%
Tomatoes, Fresh	25,640	95,200	27%
Tomatoes, Process	228,212	241,000	95%
TOTAL	4,650,505	6,497,260	72%

Source: Specialty Crops Report, Delivered by the Federal Crop Insurance Corporation, June 2020
(Federal Crop Insurance Corporation, 2020)

Access to Markets

Nearly all growers mentioned access to markets as a major obstacle to growth. These comments will be discussed in detail under the “marketing aspects of expanding Missouri’s fruit and vegetable production” section of this report.

Access to Production Inputs

Most, but not all, of the growers interviewed mentioned accessing inputs for fruit and vegetable production from out-of-state sources. Growers describe purchasing vegetable seeds from out-of-state and then sending the seeds to Kansas or Georgia to have them grown into seedlings. A number of growers commented that they had difficulty sourcing parts locally, especially irrigation supplies. There seemed to be more comments about difficulty sourcing inputs in southwestern Missouri than other regions.

Food Safety Regulations

Food safety regulations were raised as a concern by growers who were unsure about how to comply with the Food Safety Modernization Act (FSMA). The farmer interviews were completed over the first half of 2019 and for many growers the January 27, 2020 compliance date for small growers was quickly approaching. A brief summary of FSMA is included next in order to provide context for the farmer comments.

Food Safety Modernization Act (FSMA)

On January 26, 2016, the U.S. Food and Drug Administration began implementation of science based minimum standards for produce, covering the production, harvesting, packing, and holding of fruits and vegetables grown for human consumption (U.S. Food and Drug Administration, 2021). Implementation of FSMA occurred over a three-year period based on the previous three-year average of farm sales. Farms with sales revenue averages greater than \$500,000 were required to comply with the new rule by January 26, 2018. Farms with sales revenue averages between \$250,000 and \$500,000 were required to comply with the new rule by January 28, 2019. Farms with sales revenue averages between \$25,000 and \$500,000 were required to comply with the new rule by January 27, 2020. A very brief summary of FSMA requirements includes:

- Testing of water used in growing produce as well as water used for hand washing, food contact surfaces, ice produce for packing or preserving fruits and vegetables after harvest, as well as other sources.
- Ensuring that produce does not come into contact with raw manure or stabilized compost.
- Requiring all growers to take “all measures reasonably necessary” to identify and not harvest produce contaminated by domesticated or wild animals.
- Requiring growers to prevent contamination of produce and food-contact surfaces by ill or infected persons. Requiring washing and drying hands thoroughly after using the restroom.

Making toilet and hand-washing facilities accessible to visitors. Training all workers on the importance of health and hygiene

- Requiring appropriate maintenance and cleaning of equipment and tools

Details on FSMA can be found at: <https://www.fda.gov/food/food-safety-modernization-act-fsma/fsma-final-rule-produce-safety>

Along with the FSMA regulations, growers were told that it would cost most farms about \$3,000 to comply which was not well received with growers.

Growers emphasized three areas of the FSMA regulations they were concerned about. The first issue was the required water testing. Growers that produce plants hydroponically and used surface water were concerned that testing could result in them having to switch to a different water source even though they had no issues with produce in the past. The second issue was related to the subjectivity with which they felt the requirement that growers must take “all measures reasonably necessary” to identify and not harvest produce contaminated by domesticated or wild animals. They felt they had no control over wild animals and did not want to be cited if a bird flew overhead or a wild animal defecated in an open field of tomatoes. The growers were uncertain as to how much produce might be excluded due to fecal contamination by wild animals. Would it be limited only to the affected produce, the entire plant, or some or all of the field or hoop building? Finally, growers were very upset about the additional paperwork load the new FSMA regulations would require. Daily logs, standard operating procedures and other forms were mentioned as burdensome when growers felt they were already running behind.

Water availability and access

None of interviewed growers identified water availability and access as a problem at this time. Some growers who were using surface water for hydroponic irrigation were concerned about the required water testing under FSMA. Some growers were concerned about the cost of potentially switching to rural



Winter Hydroponic Vegetable Production, Oronogo, Missouri (Jasper County). Photo taken Jan 29, 2019.

water sources and/or if they would be able to get access to rural water. Of the over 50 growers interviewed only two specifically mentioned this as a significant problem. Unlike large fruit and vegetable producing states such as California, Oregon, and Washington, access to water was not a significant problem for Missouri growers.

Climate variation issues

For the most part Missouri growers did not notice a great deal of change in climate variation. One peach grower noted that they were moving some of their production across the Mississippi River into Illinois because they thought there was less susceptibility to frost and there was less risk of herbicide drift. A few growers commented on rainfall intensity and the quantity of rain that occurred in a single rainfall event, but they were unconvinced that there had been a wholesale shift in weather conditions. No growers indicated that pest or disease infestations were any worse than the past due to climate conditions.

Access to capital

Several growers specifically mentioned access to capital for investing in facilities as a significant problem. They noted that local bankers are often unfamiliar with the biological production lags, economics, and risks associated with fruit and vegetable production. As a result, even fruit and vegetable growers with a detailed business plan may not be able to access capital because they cannot find a lending institution with enough experience with fruit and vegetable production to loan them the funds.

In working with lenders under the University of Missouri Extension Ag Lenders Program held each fall, lenders value an objective perspective on the costs and returns by commodity. Historically, included in the ag lender's books were budgets for row crop and livestock operations but there were no budgets on specialty crops. By helping ag lenders understand specialty crop profitability through enterprise budgets it may increase their willingness to loan money to specialty crop growers. The budgets created in the project set the first benchmark for ag lenders.

Refrigeration and transportation

All fruit and vegetable growers ideally need access to refrigeration especially if their goal is to market large volumes of fruit and vegetable products. In fresh food systems this is referred to as "maintaining the cold chain" (Watson, Treadwell, Sargent, Brecht, & Pelletier, 2018). The science is very clear on the inverse relationship between temperature and storage life of fruit or vegetables. Climacteric fruits and vegetables such as tomatoes, potatoes, peaches, and muskmelons generally have a longer window of storage life without having to be cooled. However, non-climacteric fruits and vegetables such as blueberries, blackberries, cherries, cucumbers, eggplants, grapes, strawberries, peppers, summer squash, and watermelon ideally need to be cooled as quickly as possible after they are harvested.

For growers without access to cool and/or refrigeration there are some handling methods that will help reduce degradation including avoiding injury to the produce, harvesting crops during cooler times of the day such as early morning, removing the produce from field heat immediately upon harvesting, and placing the produce out of direct sunlight. Several of the growers we interviewed mentioned they were using these techniques.

At least 20 percent of the growers we interviewed were Amish or Mennonite. Although it varied by location, a number of communities noted that they had limited options on transportation and no refrigeration. All expressed an interest in expanding production of fruits and vegetables, but were limited particularly by the lack of refrigeration for perishable commodities and their ability to transport long distances. Strawberries are a good example of how the lack of access to refrigeration limits production. Strawberries are highly perishable and require refrigeration to be stored for any length of time beyond a few hours.

Other growers mentioned the significant cost of investing in refrigeration in order to be able to support the production of more perishable products. Some growers mentioned cost sharing programs with the Missouri Department of Agriculture as well as some nuances regarding the ability to use funds only on new equipment that made the cost share programs less attractive.

Interest in large scale greenhouse production

The growers we interviewed were predominantly either small growers, open field growers, or high tunnel growers. There was only one group that was actively pursuing large scale greenhouse production. The capital intensity of the investment was certainly an obstacle for many growers. Given that many of the interviews were with small growers, this report is unable to draw any conclusions regarding the interest in large scale greenhouse production.

Competitiveness of Missouri fruit and vegetable production

Comparing the competitiveness of Missouri fruit and vegetables with other states turned out to be a bit more difficult than initially expected. While we were aware that all budgets were largely based on the expertise of extension personnel and growers across the United States, many of the budgets reported were more than 10 years old. Georgia's budgets were updated to 2020 and subsequently may be the best comparison. In order to make the other budgets comparable, the costs were inflated to 2020 levels using a 1.5% inflation rate per year. Certainly, more advanced methods could be used but these were beyond the scope of this study.

Another challenge was selecting the yield to use for each specialty crop. For a few specialty crops in Missouri, USDA NASS reports an average yield that can be used as guideline. Strip trial yields also provide some insight but are often significantly higher than average realized production. In selecting the yields to use we considered yields in surrounding states, NASS data if available, and consulted strip trial yields if a yield looked too high. We think we have been conservative in selecting the yields and that growers may be able to reach significantly higher yields resulting in lower production costs per unit.

Since many states have very different yield levels than Missouri for their specialty crops the costs were converted from dollars per acre to dollars per pound of production with the exception of sweet corn which was converted to dollars per dozen. Fortunately, nearly all state budgets also include a yield associated with the costs or production so that costs should be consistent with the yield level attained.

Importantly, not all state Extension services report specialty crop budgets and they often only report a few crops most relevant to the region. In developing the comparisons with other states, the specialty crops with the largest crop areas in Missouri were selected. The large fruit and vegetable producing states (California, Florida, Washington) were included whenever possible depending on whether data for the state was available. Nearby states were also included to add context to the Missouri estimates. Although these estimates are based on reported data, the user should still view them with a strong sense of skepticism as they are not survey based and subsequently may not reflect an actual average.

In judging the competitiveness of specialty crops in Missouri, cost of production estimates offer insights in two primary ways. First it is important to understand that these costs do not suggest whether Missouri should be producing a particular specialty crop, but rather how vulnerable are Missouri growers relative to other states if specialty crop prices begin to fall. If Missouri growers are the high-cost producer relative to other states, they would be under financial pressure more quickly if the price of the specialty crop declined.

The table below compares the specialty crop costs across states. When comparing Missouri costs of production to surrounding states, Missouri appears competitive and Missouri is fairly competitive with most Florida crops. For some specialty crops such as blueberries, sweet corn, and peaches, Missouri is a higher cost producer than Washington, California, and Oregon. But when these costs are compared with the prices actually paid for these crops, large margins still exist providing a buffer should prices decline. Although not all of the details are present, Missouri has definite cost of production advantages in land costs and water access.

Figure 7. Specialty crop cost of production comparison in 2020, Missouri versus other states

	Missouri	California	Washington	Oregon	Idaho	Florida	North Carolina	South Carolina	Arkansas	Kentucky	New York	Georgia
\$ Per Pound												
Vegetables												
Cucumbers	0.27		0.16			0.22	0.15	0.18	0.31	0.17		0.26
Peppers, Bell	0.33											0.34
Potatoes	0.11	0.07	0.09		0.07	0.16						
Tomatoes	0.59	0.27				0.56						0.30
Tomatoes - High Tunnel	1.02		1.96								0.83	
Watermelons	0.20	0.15		0.19		0.16		0.24	0.08	0.16		0.15
\$ Per Dozen												
Sweet Corn	1.50		0.33	0.42		3.62		1.91		1.29		1.99
\$ Per Pound												
Fruits and Berries												
Apples	0.15	0.13	0.72									
Blackberries	1.05	3.75		1.09			2.21					2.64
Blueberries	1.68		1.10	1.32								2.51
Peaches	0.38	0.25	0.34									0.35
Strawberries	1.03	1.05		0.87		1.39						1.37

Source: Based on extension budgets gathered from each state and author calculations.

The second set of insights is related to competition with Missouri crops and relates to the initial concern about declining returns for row crops. When we compare Missouri returns across crops the opportunity of specialty crops emerges. Appreciating the nuances of prices, yields, and costs, the comparison of specialty crops with row crops clearly suggests significantly higher profitability in specialty crops. As expected, tomatoes stand out as the most profitable crop with returns of \$11,679 per acre. Bell peppers and cucumbers follow closely with returns of \$9,342 and \$9,047 per acre, respectively. An important caveat is that a representative average yield for Missouri is not available for bell peppers. The yields included in the bell pepper budget are conservative, well below strip trial yields, and prices are below those observed at the produce auctions.

For high tunnel crops, tomatoes are nearly double the next closest competing returns from cucumbers, followed by bell peppers in a distant third. High tunnel returns clearly are driving the popularity and growth in Missouri's high tunnel production. Throughout the interviews, most growers indicated a strong preference for production in high tunnels. The relatively low capital investment in combination with strong returns suggests opportunities even for beginning farmers.

An excellent opportunity for young and beginning farmers

Affordable entry point for beginning farmers

With one exception, every grower, regardless of size, felt that fruit and vegetable production was an excellent way for beginning farmers to get started. The one exception was concern that the production techniques might be too complicated for beginning growers. Several growers indicated that they were

using fruit and vegetable production to keep their families on the farm because it provided the income stream needed to support a family.

Not only can fruit and vegetable production be a great resource for getting beginning farmers started, it also offers the opportunity for them to be very successful because direct consumer sales result in larger profit margins than row crop production and the capital requirement can be significantly less intensive.

Fruit and vegetable production can be started without capital intensity leveraging the surplus time beginning growers may have available while being flexible enough to allow off farm employment.

Starting small and mastering the production practices for specialty crops allow beginning growers to build on their experience and expand their future production.

Figure 8. Missouri crop returns over total costs in 2020

Missouri Crop Returns Over Total Costs in 2020		
Row Crops	\$ per acre	
Corn	\$11.62	
Soybeans	58.64	
Wheat	-53.44	
Sorghum	-40.55	
Specialty Crops (Open field)	\$ per acre	
Asparagus	815	
Apples	1,603	
Bell Peppers	9,342	
Blackberries	2,294	
Blueberries	4,946	
Broccoli	6,194	
Cantaloupe	5,754	
Carrots	1,993	
Cucumbers	9,047	
Eggplants	1,301	
Elderberries	3,228	
Garlic	98	
Green Beans	703	
Leafy Greens	4,788	
Okra	1,280	
Onions	1,519	
Peaches	1,060	
Potatoes	268	
Pumpkins	1,402	
Squash, Summer	6,932	
Squash, Winter	2,177	
Strawberries	5,036	
Sweet Corn	1,594	
Sweet Potato	2,862	
Tomatoes	11,679	
Watermelons, Seeded	3,614	
Watermelons, Seedless	3,469	
High Tunnel Crops	\$ per acre	\$ per 2000 square feet
Bell Peppers	10,994	1,010
Cucumbers	23,266	2,136
Head Lettuce	8,511	782
Leafy Greens	8,679	797
Spinach	2,997	275
Strawberries	18,109	1,663
Tomatoes	45,023	4,134

Marketing aspects of expanding Missouri's fruit and vegetable production

One of the most important and critical activities in getting into fruit and vegetable production is determining which markets the grower intends to sell to, what types of produce is wanted in that market, and when the market wants the produce delivered (Trinklein, Hendrickson, & Jett, Marketing Vegetables in Missouri, 2015) (Rowell, Woods, & Mansfield, 1999). This activity applies regardless of the market the grower intends to sell in. For example, a beginning grower may want to sell in the local Farmers' Market, but before buying the first seed, that grower should contact the Farmers' Market manager and determine availability for a stall at the market and what they can sell at the market. The market manager may also provide insights into the types and varieties of produce that is selling well. They may also be able to guide the producer on the quantity of product to bring as well as provide pricing guidelines. With this information, the grower is equipped to determine the type and variety of specialty crops they will produce and have an idea of how much they want to produce.

Each potential fruit and vegetable market will have specific produce needs, regulations, labeling, packaging, grading, etc., information growers need to know before they start producing. Growers may need to adjust which markets they intend to sell in based on the market requirements. Figure 9 shows how some of the market characteristics vary by sales volume potential. Low volume markets tend to have fewer rules, less insurance, lower capital requirements, less shelf life needed, and typically pay retail prices. However, they also require that the grower interact directly with the end consumer which takes more marketing time and the grower is unlikely to sell everything they produce. At the other extreme, high volume markets tend to have more regulations, food safety inspection requirements, more insurance, high capital demands, require longer shelf life, require full traceability, and typically pay only wholesale prices. The figure also includes black, red, and gray dividing lines between the sales volume levels. Most Missouri growers fall below the red line producing low or moderate production levels.

Figure 10 is more direct than Figure 9, illustrating the marketing steps in expanding fruit and vegetable production. The grower may not choose to market to all steps but the diagram attempts to convey potential markets for each volume level. Level 1 markets have the lowest volume levels and are typically the simplest to operate in while level 4 markets tend to be able to handle the largest volumes but are also the most complex to manage. The green arrow shows the types of things that increase as one moves from level 1 production to level 4 production. The purple arrow pointing down shows that prices received and produce flavor tend to fall as production volumes increase.

Figure 9. Fruit and vegetable market characteristics by sales volume

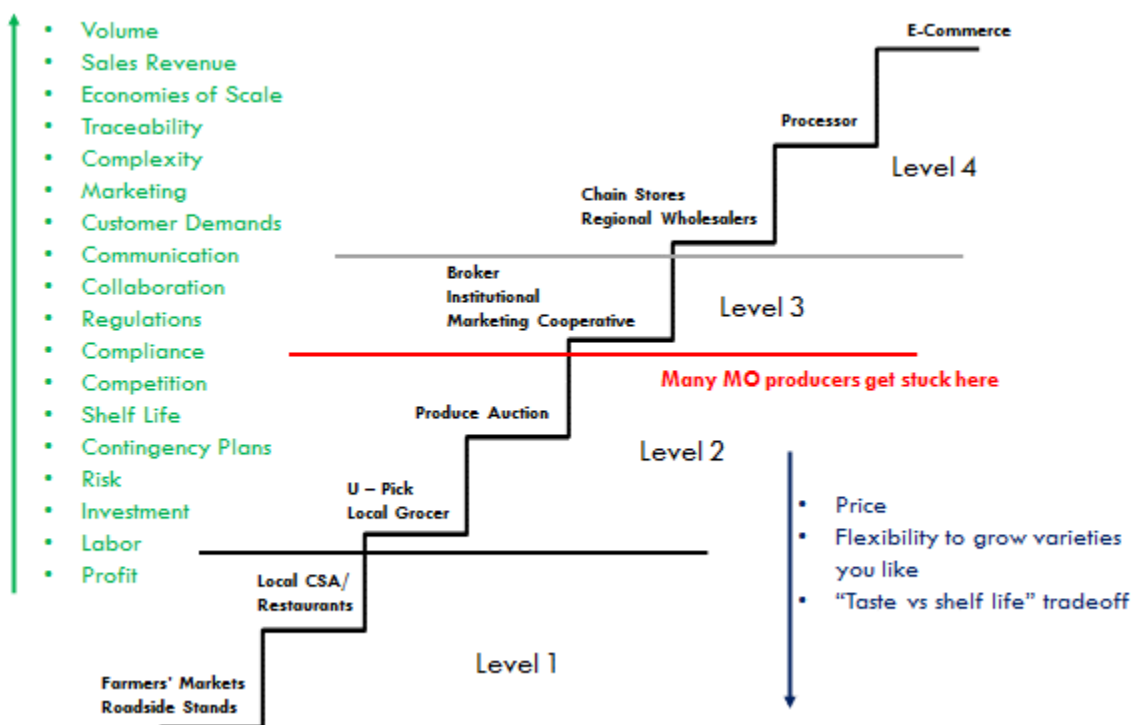
Market Characteristic	Sales Volume Potential														
	low				moderate			high			very high				
	Farmers Markets	Roadside Stand	Local CSA	Resturants	U-Pick	Local Grocer	Produce Auction	Broker	Institutional	Marketing Cooperative	Processing	Chain Store Distribution	Regional Wholesalers	Terminal Markets	E-commerce
Difficulty getting into the market	L	L	M	L	L	M	L	H	M	M	H	H	H	H	M
Direct consumer contact & service	H	H	H	L	H	L	L	L	L	L	L	L	L	L	M
Compatibility with off farm employment	H	H	M	H	H	M	H	L	L	M	H	L	L	L	M
Marketing time	H	H	H	M	H	M	L	L	L	L	L	M	L	M	H
Electronic, computer, internet complexity required	N	N	M	L	M	M	L	M	M	M	L	M	M	M	H
Transport/Shipping cost	L	L	H	M	N	M	L	M	M	M	M	M	M	M	H
Initial capital required	L	L	L	L	L	H	L	H	H	H	V	H	H	H	V
Investment in post harvest equipment and facilities	L	L	L	M	L	M	L	H	H	H	V	H	H	H	V
Likelihood of production contract	N	N	N	M	N	M	N	H	H	M	H	H	H	H	N
Likelihood of product tracability	N	N	L	M	N	H	L	H	H	H	H	H	H	H	H
Likelihood of requiring GAP certification	N	N	L	M	N	H	M	H	H	H	H	H	H	H	H
Likelihood of requiring liability insurance	L	L	L	L	H	M	L	H	H	H	H	H	H	H	H
Ability to set prices	H	H	H	H	H	M	L	L	L	L	L	L	L	L	H
Price level to expect	R	R	R	W	W	W	W	W	W	W	F	W	W	W	R
Price variance week-to-week	M	M	L	M	M	M	H	L	L	L	L	L	L	L	H
Importance of shelf life versus taste	L	L	L	L	L	M	L	H	H	M	L	H	H	H	V

* H - high, M - medium, L - low, N - nil, R - retail, V - variable, W - wholesale, F- farmgate

Note that processing is included as one of the level 4 steps in Figure 10. Processors require very high volumes of throughput in order to attain the economies of scale needed to be competitive. Literally, California scale processing is not necessarily the “lowest hanging fruit” for Missouri produce growers. There is still much that can be done to increase fresh fruit and vegetable markets. In addition, it’s important for growers to remember that processing markets almost always have lower prices and smaller margins than fresh markets. However, an aspect of processing markets that bears monitoring is that many processed vegetables can be harvested mechanically. With increasing difficulties accessing labor, processing could become more important.

What does merit some attention is small scale value-added processing. In the European market model, there are many small localities that have established a worldwide reputation for specific value-added products, some of which are not-so-small scale anymore. Missouri has the potential to do the same making small scale value-added products from base fruits such as elderberries, strawberries, wines, etc. and vegetables such as summer squash, butternut squash, beets, potatoes, and turnips.

Figure 10. Supply chain steps in expanding fruit and vegetable production



In order to significantly expand fruit and vegetable production, grower's must be able to push through into levels 3 and 4. In order to understand how to push through these obstacles, the next section discusses each of the levels. Levels 1 and 2 set the context for the where the market stands today and how these markets might grow in the future. The most critical step for the next five years is helping growers get to level 3.

Level 1: low volume markets

The majority of Missouri fruit and vegetable growers are very small, often less than 4 acres. The small growers sell nearly all of their produce through farmers' markets, produce auctions, U-pick markets, local grocers, and local CSA's. One of their primary interests is in accessing new markets and several mentioned they would like to have help accessing larger markets that could enable them to produce more. Several growers who have marketed primarily at farmers' markets for five or more years felt that the markets were saturated in their local areas and they have branched out to marketing at multiple farmers' markets with limited success.

Small growers indicated that they preferred the farmers' markets because they could get retail prices for their products but noted that it was time consuming and they didn't always sell out of everything. Several

mentioned taking surplus production to the auction markets but felt they were taking a significant price discount. Compared with the farmers' market, auction market prices should run lower because the buyers attending the auctions are expecting to pay wholesale prices. The auction markets can also vary significantly from week-to-week. However, an important advantage of auction market is that generally all of the grower's production brought to the auction is sold. One of the hurdles that growers must face as they move towards commercial production volumes is that most of their buyers will be paying wholesale, not retail prices.

Farmers' Markets and roadside stands

Beginning and small growers usually target the local farmer's markets as their initial marketing outlet. Some growers have roadside or farm stands but some noted that the volumes sold have declined in the past few years.

Growers prefer farmer's markets because the prices they receive may be the same or higher than retail grocery stores. The growers commented that they appreciate good farmers' market managers. They indicated that it was helpful when the farmers' market managers do not allow "dumping" of products at low prices and keep things organized in a way that eases the logistics for growers such as assigned locations rather than first come, first serve.

Some growers in this stage do not have a good awareness of prices and are just looking for another source of revenue perhaps without understanding their costs fully. Competing growers get frustrated when these growers dump fruits and vegetables on the market at low prices lowering revenues for everyone.

Some of the more successful growers who marketed all of their produce through farmer's markets indicated that it was very important to provide customers with a back story about how the produce was grown, its health benefits, its country of origin, and/or how they became interested in growing it. The backstory is what builds a relationship with customers and foreshadows agritourism.



March 21, 2019. High Tunnel for Tomato Production (dormant phase), Caulfield, MO (Howell County)

Marketing through Farmers' Markets

Advantages	Disadvantages
Grower is able to get retail prices	Growers can only sell limited quantities and often cannot sell completely out of product. Growers may have to sell in multiple Farmers' Markets
One of the least complex ways to market fruit and vegetables, but still requires coordination with the Farmers' Market manager	Some Farmers' Markets are more strictly managed including strong suggestions on the types of produce you can supply
Direct access to customer to learn consumer preferences and market trends	Some competitors at Farmers' Markets will "dump" products at below the cost of production
Minimal paperwork and limited regulations to comply with	Requires the ability to manage many small monetary transactions and may require the ability to take electronic payment forms
Depending on the Farmers' Market, may have more flexibility to try different produce types	Requires significant grower labor to attend farmers' markets to sell products and does require an annual fee for the space
Grower is able to invent their own marketing materials and displays and provide a sense of agrotourism by providing a backstory on how their produce was produced.	Depending on how the market is managed, the grower may have to arrive extremely early to get the prime spot

Marketing through Roadside Stands

Advantages	Disadvantages
Grower is able to get retail prices	Unlikely to sell the same volume as Farmers' Market because it's difficult to get as many customers at a roadside stand
Flexibility to sell any produce within state rules	May need additional liability insurance
Grower has complete control of location and hours of operation	Current Missouri growers selling through roadside stands suggest declining customers at Farmers' Markets
Not necessary to have electronic communication to customers but it can be helpful	

Community supported agriculture (CSA)

CSA's can be a very successful market outlet for fruit and vegetable growers. However, all successful CSA operators specifically mentioned the importance of maintaining direct customer relationships and accommodating customer preferences. Several growers suggested that new growers focus on producing their produce for a few years and sell at the Farmers' Market before trying to market through a CSA. It is important to get to know how to manage each crop, automate where possible, and correctly apply hired

labor resources to free up time to manage the operation. CSA's require a significant amount of online work to set up websites, a Facebook page, and/or utilize an app that customers can customize their weekly orders. Part of the art of marketing a CSA is to make the customer feel a part of the grower operation filling in as much backstory about the history of the operation and the production methods used. All CSA managers interviewed indicated that they provided direct delivery to customers and often had 2 to 3 employees focused on deliveries. Growers who have successfully managed CSA's are usually located next to large metropolitan areas and may support approximately 75 – 125 consumers. CSA managers also indicated that it was best to specialize in a few items rather than trying to supply everything customers wanted. Several CSA managers found that by working with other small growers, they could each specialize in the production of certain fruits and vegetables (as well as specialty meats) and this actually ensured they could produce more reliable supplies and increase customer retention.

Marketing through Community Supported Agriculture (CSA)

Advantages	Disadvantages
Grower is able to maintain retail prices	Customer service intensive (time consuming)
Upfront “subscriptions” help provide cash flow even before planting	Requires online marketing
Direct access to customers to learn consumer preferences and market trends	Often requires product delivery
Customer feels they are a part of the local food production process	Can be very challenging to manage to specific consumer demands but web tools and apps are improving.
Customer feels good about supporting local farmers	Beginning growers may want to perfect growing methods before jumping straight into marketing through a CSA

Restaurants

Many of the grower's interviewed had experience with selling to restaurants and a few had worked with hotels. There were a range of positive and negative experiences. On the positive side, many growers were able to expand their production to service the restaurant and balance their marketing portfolio by having a new customer. Selling to local restaurants is also usually a fairly easy step from selling at Farmers' markets. Restaurants typically pay wholesale price but may pay a little more if you have high quality products that their customers like. Restaurants are usually not able to vary their prices because their menus are printed so most will not want to vary the price they are paying. It is also important to remember that restaurants are sensitive to delivery times and adhering to their preferred delivery schedule will help build rapport. Restaurants may also want to be able to jump online and adjust orders on a daily

basis to reflect customer demands so it is important for the grower to have an electronic method of contacting them.

On the negative side, some growers have had difficulty getting paid especially if the restaurant was having financial difficulty. One grower relayed that he had provided 3 weeks of vegetable deliveries without payment only to arrive the fourth week and find the restaurant out of business. Some growers reported that they had been delivering products on a regular basis only to be told there would be no more orders because a competitor had offered a lower price.

Marketing to Restaurants

Advantages	Disadvantages
Relatively easy way to expand produce sales	Restaurants usually want to pay closer to wholesale prices rather than retail prices
Generally, a regular, predictable buying pattern	Restaurants have specific delivery times that must be met.
Restaurants may be willing to pay above wholesale prices for products customers really like	Often requires product delivery
Less time consuming to market to higher volumes to restaurants	Restaurants operate with a printed menu and don't have flexibility to adjust prices within the season
Less stringent labeling requirements	Restaurants will likely require an electronic ordering system

Level 2: moderate volume markets

In order for growers to move from low volume markets to higher volume markets there are some significant changes in the way they have been doing business that must occur. The first big change is that growers must change their expectations about the prices they receive. Generally, this means that higher volume markets will largely be paying wholesale market prices and/or even farmgate prices depending who transports the produce. It's important to remember that when growers move to the wholesale markets, they generally spend less time on marketing and dealing with individual customers. In addition, higher volume markets such as produce auctions usually sell everything brought (provided it is of acceptable quality) whereas growers that sell at Farmers' Markets may frequently find that they do not completely sell out of their produce. Growers that have moved from level 1 to level 2 markets note that the increase in volume sold more than offsets what is lost in accepting lower wholesale prices. Some innovative growers have been able to use CSA's to sell higher volumes but still retain retail price levels. Instances of this are rare and volumes are still limited.

Many of the varieties of fruits and vegetable used by small scale growers are selected for taste preferences. But many varieties that taste good don't have a long shelf life. For example, tomatoes harvested from large farms in California or Mexico are often picked green, ripened in a truck on the way to market, and have a shelf life of 6 weeks where as many varieties produced by local farmers for the farmers' market may have a shelf life of 4 to 6 days. Geneticists are experimenting with how to get longer shelf lives and it would appear that there may be opportunities for plant breeders to develop tomatoes that taste good and have a longer shelf life. However, currently there is a trade-off between taste and shelf life and growers must acknowledge that when producing larger volumes, the produce must have a longer shelf life. In most cases, growers must select different varieties with a longer shelf life.

U-pick markets

U-pick markets can be a stepping stone to selling larger volumes of produce and growing farm revenues. Many U-pick growers are focused on fruits particularly apples, peaches, pears, blueberries, blackberries, and strawberries. The main advantages of u-pick marketing are that the grower does not have to harvest, transport, and market a significant portion of the production and there are opportunities for agritourism that could be an additional source of revenue for the farm. Innovative growers offer "wagon rides" around the farm discussing the farm history, crop production aspects, fun facts about the fruit or vegetables, sometimes discussing production struggles, and providing a general storyline that is engaging to (predominantly) urban families. Some researchers have indicated that u-pick markets are on a declining trend, but recent evidence suggests this may be changing based on the interviews we conducted. Growers used Facebook as a medium to advertise and develop a backstory (history) for both U-pick and CSA enterprises.

U-pick marketing is not without its challenges. Rarely does the general public pick a patch thoroughly and the grower will likely have to do a final clean picking. In addition, the general public may need some instruction on picking for crops where incorrect harvesting could damage next year's crops. Growers will also need to have access to handwashing and drying stations, restrooms, additional supervision to ensure they stay in the assigned picking area and behaving in a safe manner, and the grower will need additional liability insurance.

Marketing through U-Pick Programs

Advantages	Disadvantages
Grower does not have to harvest, transport, and market a significant portion of the production	Customer service intensive (time consuming) and marketing intensive (i.e., Facebook, etc.)
Grower can charge above wholesale prices and maybe close to retail prices	Customers may need some instruction on harvesting techniques
Direct access to customers to learn consumer preferences and market trends	Customers will not cleanly pick fruits and growers should plan on performing a clean picking
Grower has the opportunity for a new agrotourism revenue stream. Many growers provide tours of their operations	Growers need to provide restrooms and handwashing stations
Customer feels good about supporting local farmers and takes some ownership in the production process	Growers will need additional liability insurance due to having customers on their farming operation and may need to restrict access to certain markets

Auction markets

For many of Missouri's growers, produce auction markets represent a relatively easy method for marketing additional production. As the census data shows, the auction markets brought expansion to Missouri's protected culture production. Two different auction managers were interviewed about their impression of how the auction markets were doing. The managers recognized that there were obvious periods where supply exceed demand contributing to the price variability week-to-week. One auction manager indicated that in anticipation of excess supply periods, he had contracted supplies through brokers and/or wholesale buyers to deliver to urban markets such as the Kansas City metro market. In interviewing the auction managers, it was clear that they were quite innovative and had strong relationships with their customers. The success of auction markets is tied to high tunnel production. In Figure 6 (reported earlier), revenues from vegetables produced in protected culture growing from \$1.9 million to \$5.5 million over the 2007 to 2017 period.

Marketing through Produce Auctions

Advantages	Disadvantages
Provides growers access to a much larger volume market and is an easy step from Farmers' Markets without a lot of addition paperwork	Produce auctions do experience more price variability sale to sale than observed in terminal markets.
All produce that the grower brings to the produce auction is sold – no leftovers	Produce auctions do not have cooling facilities available and typically do not handle highly perishable products
Produce auction prices are generally consistent with and occasionally modestly higher than terminal market prices, even with higher price variability	Produce auctions have specific packing requirements that generally mimic industry standards. Growers will have additional costs for packing containers.
Produce auction markets generally operate over most of the year. For example, the Central Missouri Produce Auction operates March to early November	Buyer and seller attendance vary week-to-week which contributes to the price variability experienced in auction markets.
Growers have excellent pricing opportunities for specialty crops marketed early in the season	Growers will pay marketing fees to produce auctions typically 9-12% higher.

Auction market price versus other market prices

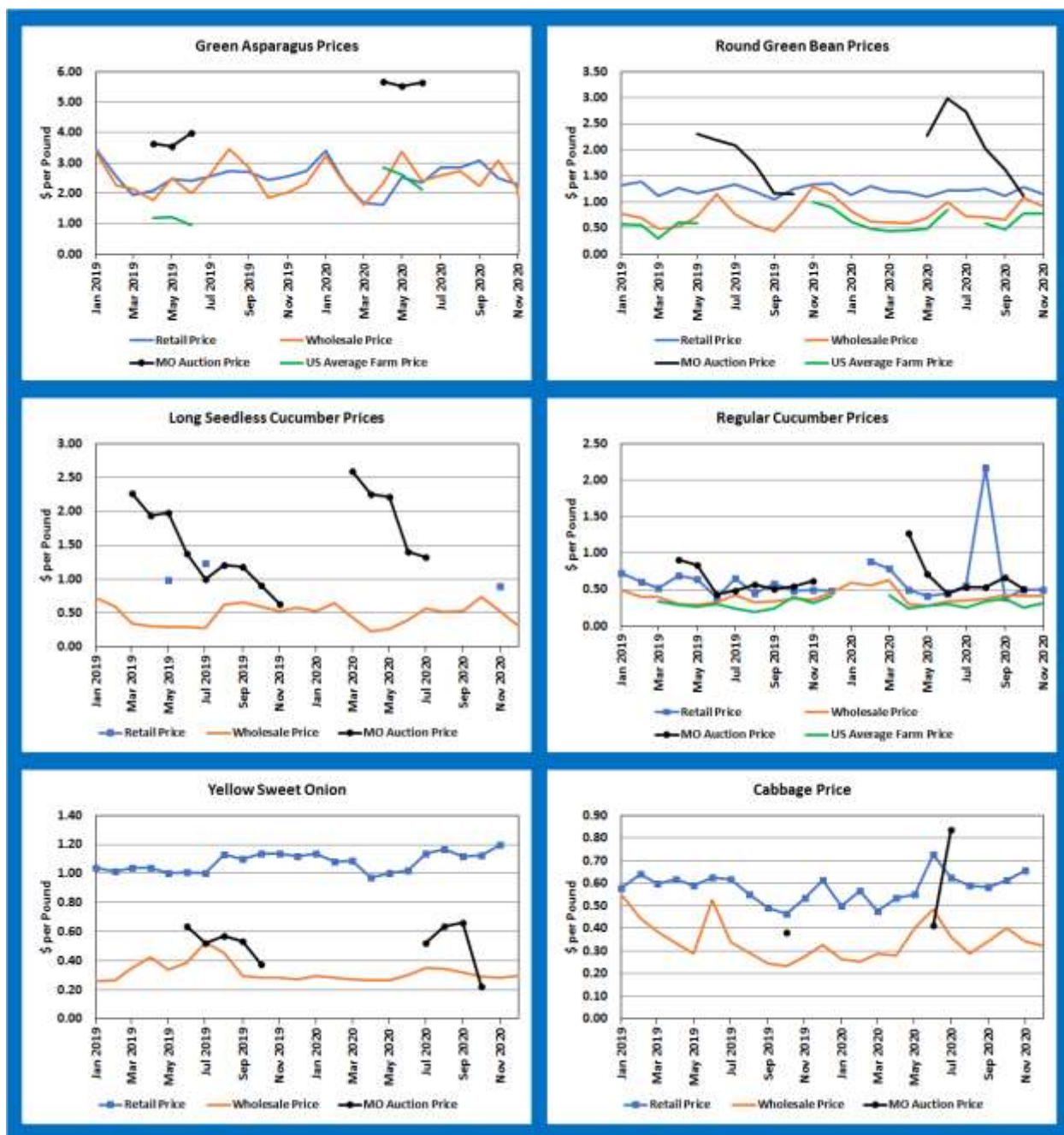
One of the biggest innovations in Missouri fruit and vegetable marketing has been the addition of the produce auction markets that enabled growers to sell larger volumes while reducing their marketing time. One of the concerns often stated in the interviews was that auction markets have lower prices than selling at the Farmers' Market. However, this is to be expected because auction markets are effectively a wholesale market. Their prices should resemble terminal market prices. For example, many of the

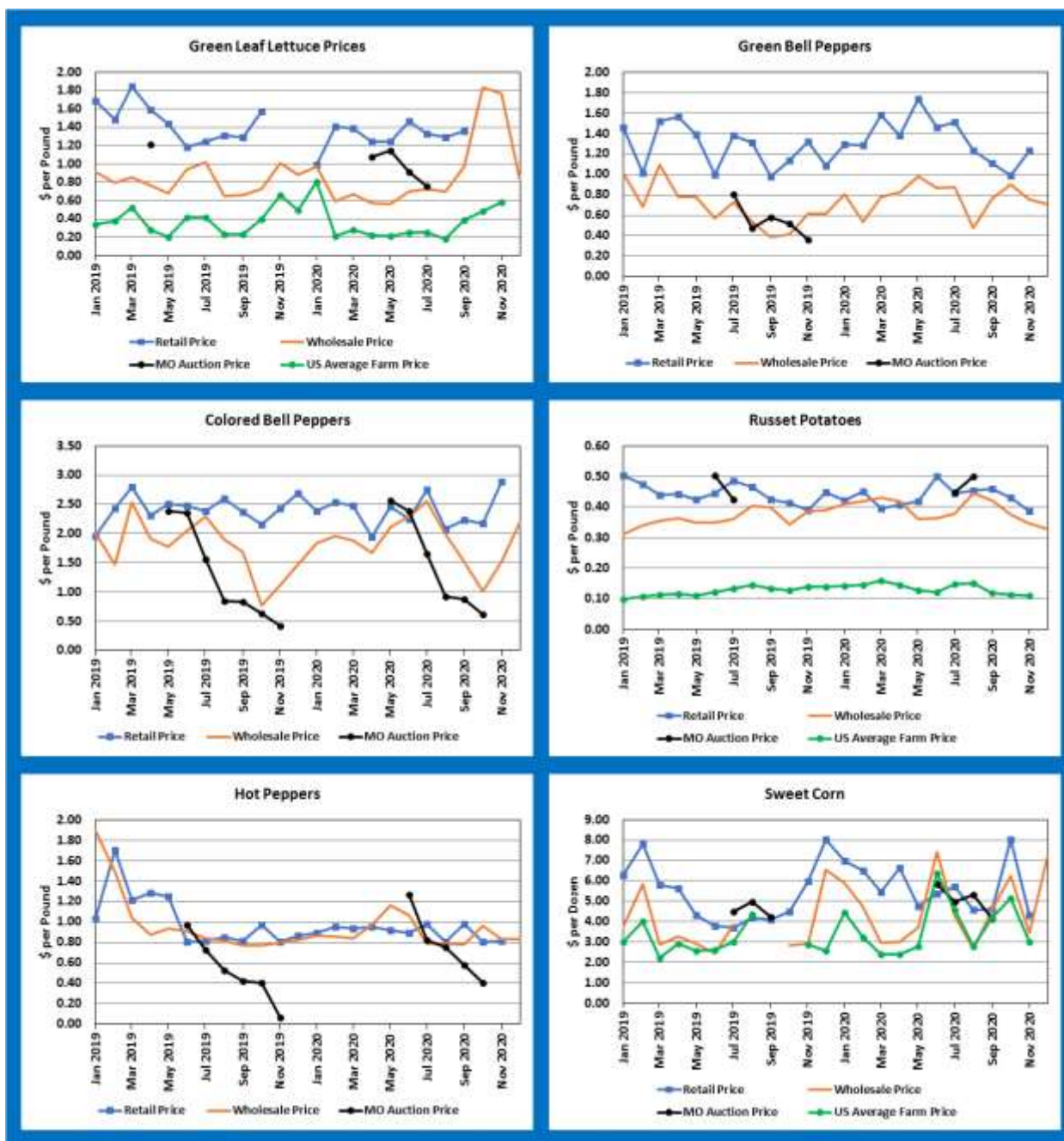
customers of auction markets are grocery stores and they can buy from terminal markets just as easily as produce auctions.

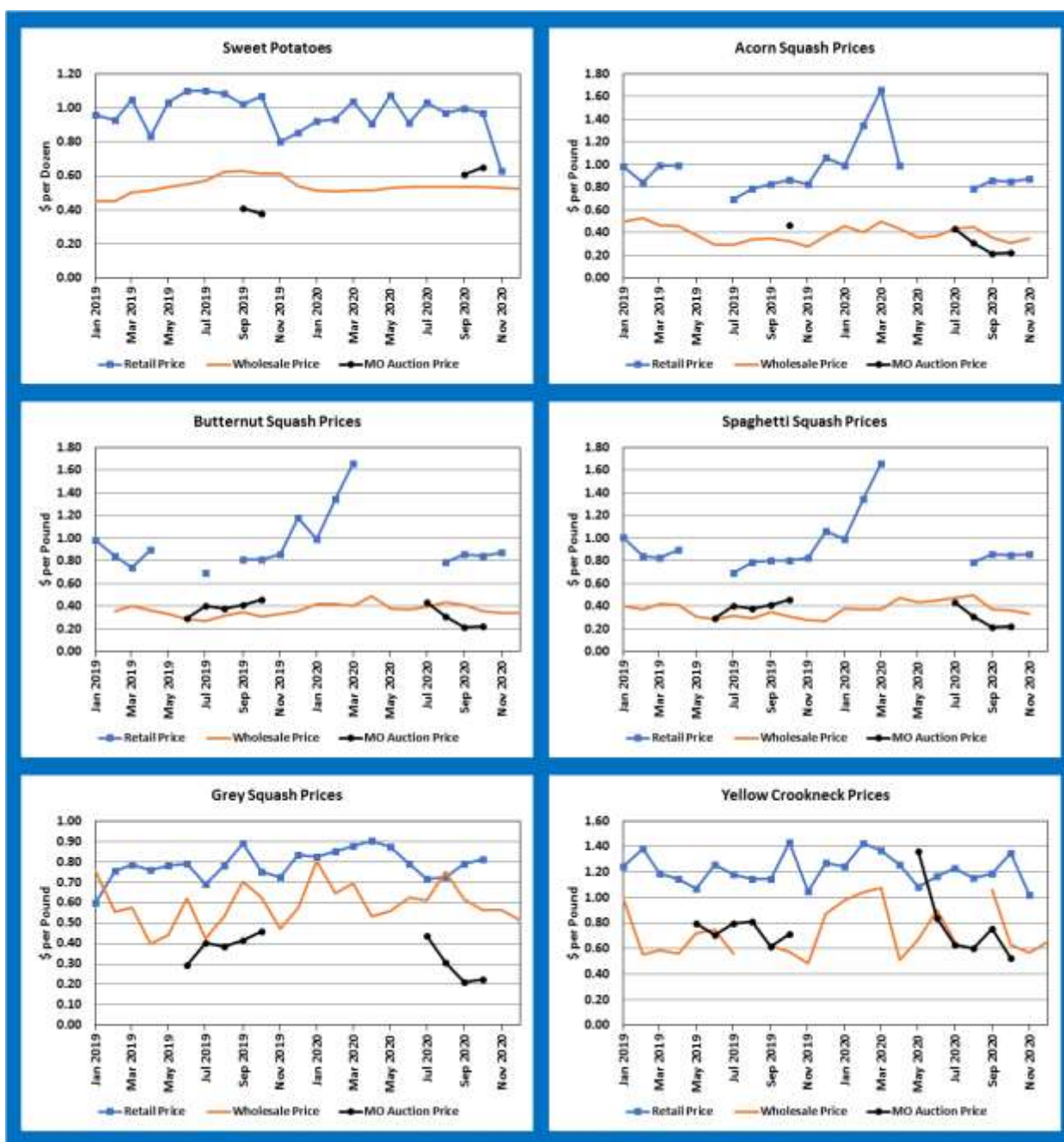
In order to determine if the auction market prices were significantly lower than terminal prices daily sales data were collected for 2019 and 2020 from the Central Missouri Produce Auction (CMPA). The data was then averaged to generate monthly prices for comparison with monthly Midwest U.S. retail prices and Chicago terminal market prices as reported by USDA-AMS as well as the US average farm price as reported by USDA-NASS. Importantly, many of the prices were reported in different units of measure. All prices, with the exception of sweet corn, were converted to a dollar per pound basis to allow for consistent comparison. Importantly, the Midwest US region is broader than the Chicago terminal price so the retail and wholesale (terminal) prices are not perfectly comparable. One would expect the retail price to be higher than the wholesale price and the wholesale price to higher than the farm price. One would also expect the CMPA price to be similar to the wholesale (terminal) prices although possibly slightly lower because Chicago is a major urban city. CMPA prices would also be affected by local supply and demand conditions although some of this variance would be removed by taking a monthly average.

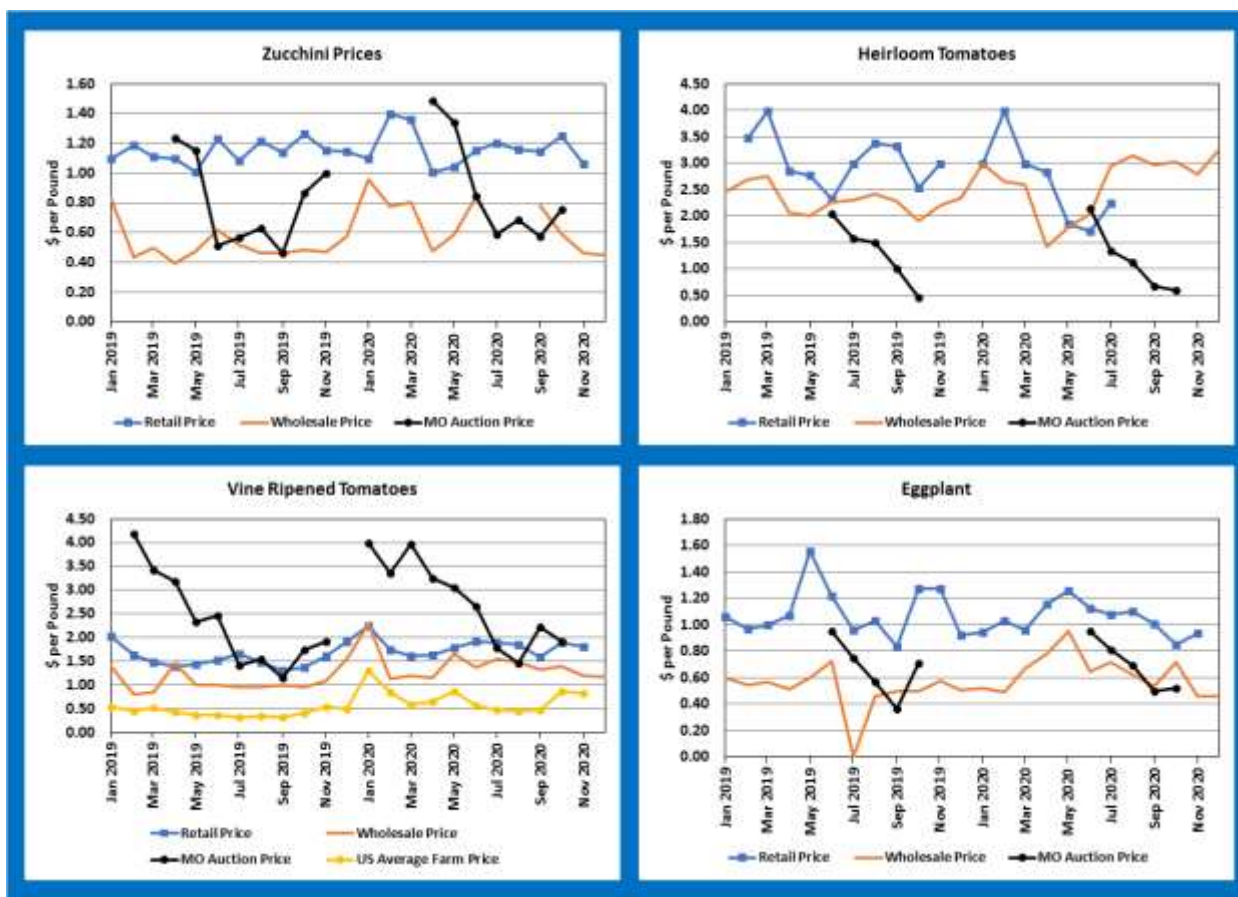
The graphs presented on the following pages include the data for various vegetable crops important to Missouri. In each graph the blue line is the retail price, the red line is the wholesale price, the black line is the CMPA price and when relevant, the green line is the US average farm price. While there are some exceptions, the majority of the auction prices are slightly below to significantly above the wholesale price. Some auction prices such as asparagus, round green beans, and long seedless cucumbers are significantly above the wholesale prices for portions of 2019 and 2020. Colored bell peppers and heirloom tomatoes seem to fall consistently below the wholesale prices for portions of 2019 and 2020. Winter squash prices are difficult to compare because CMPA does not report specific prices for the different types but they do not seem to be too far off with the possible exception of grey squash.

This rough comparison of historical CMPA prices does not suggest the prices are grossly inconsistent with wholesale price as reported for terminal markets and in fact there the auction market prices appear to run above the terminal market prices for some crops. Growers should be aware that auction markets do charge a 9 to 12 percent sales commission on what they sell. As indicated through the grower interviews, this commission likely contributes to some growers' perceptions that they get lower prices at auction markets versus Farmers' Markets.





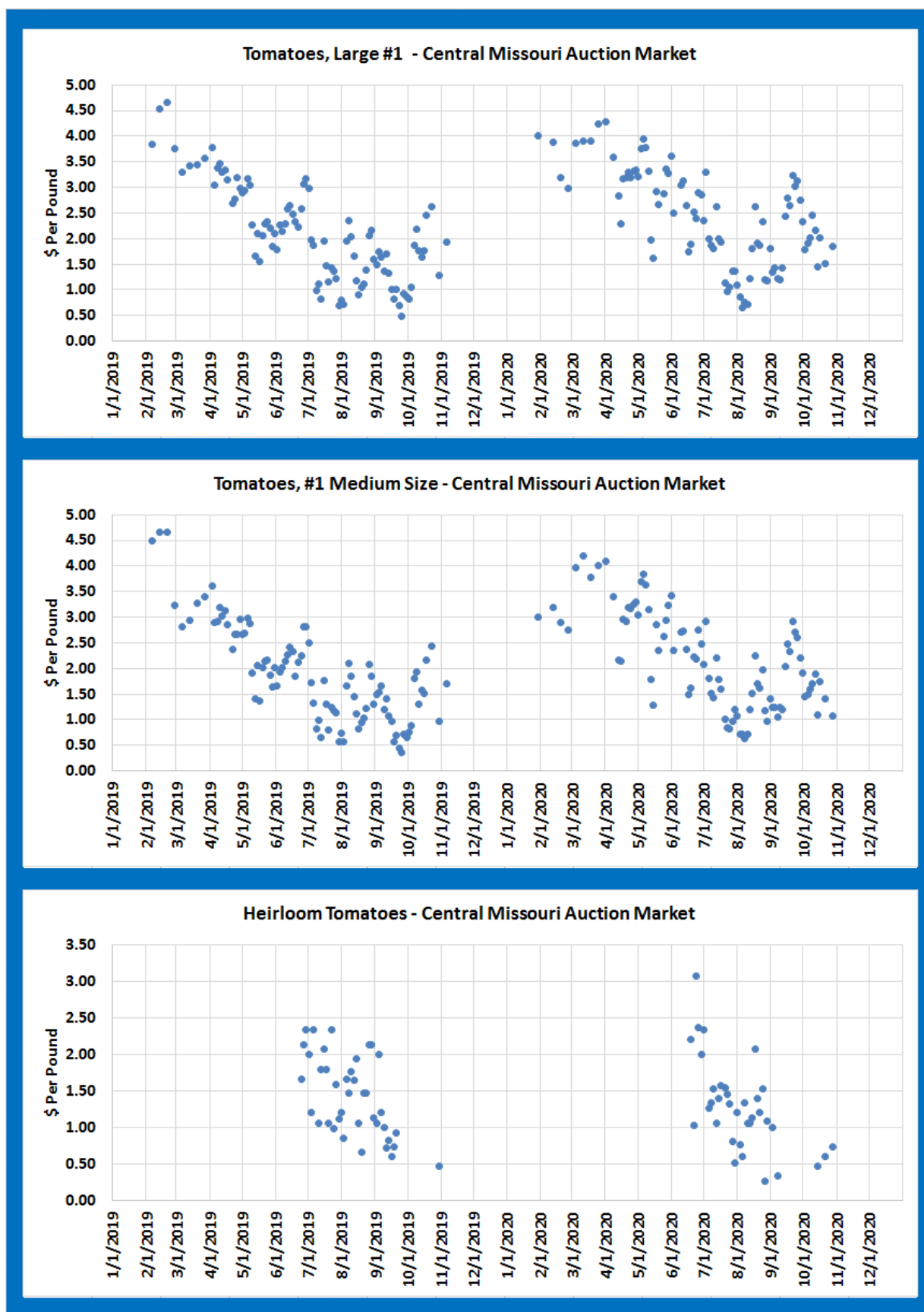


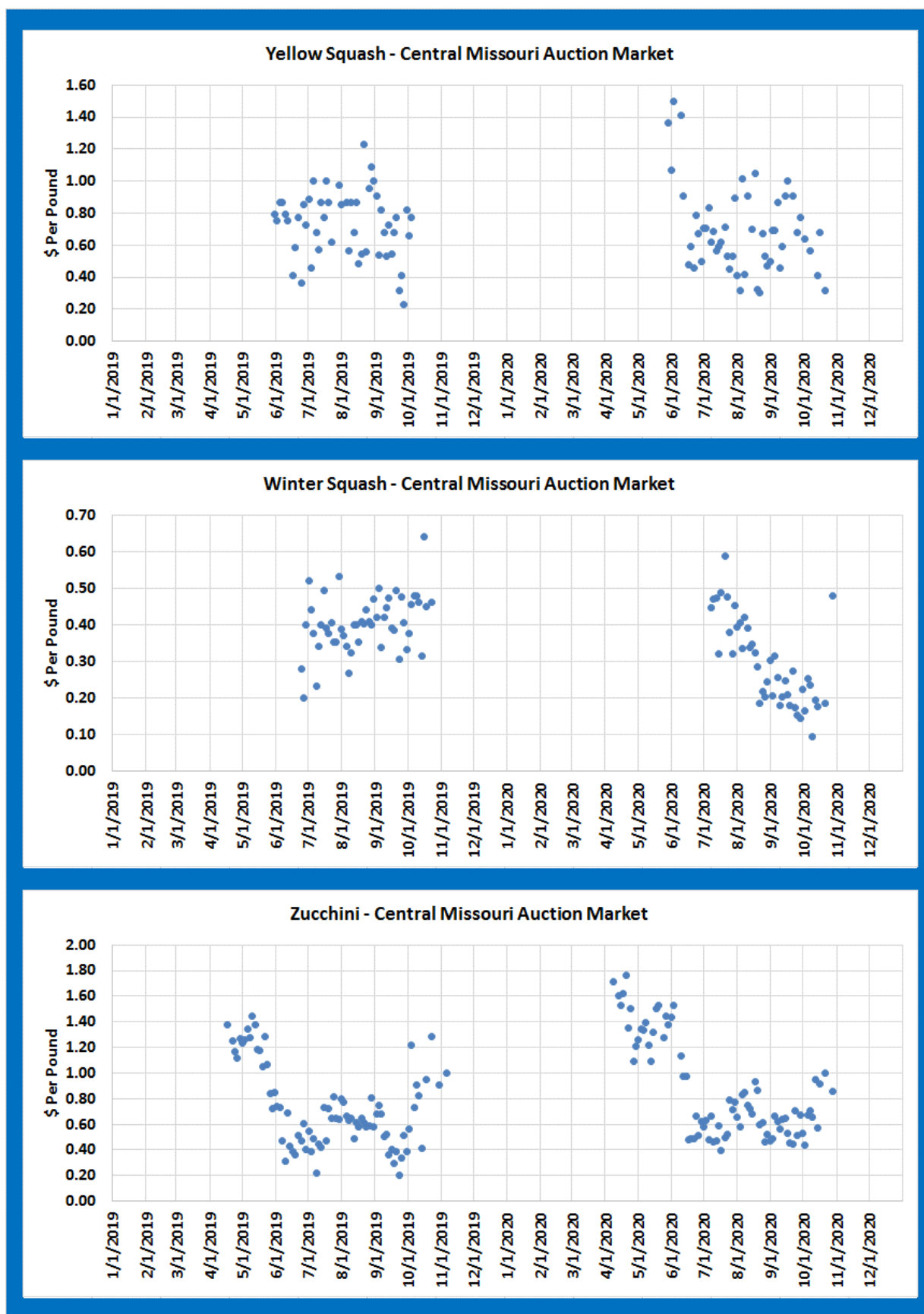


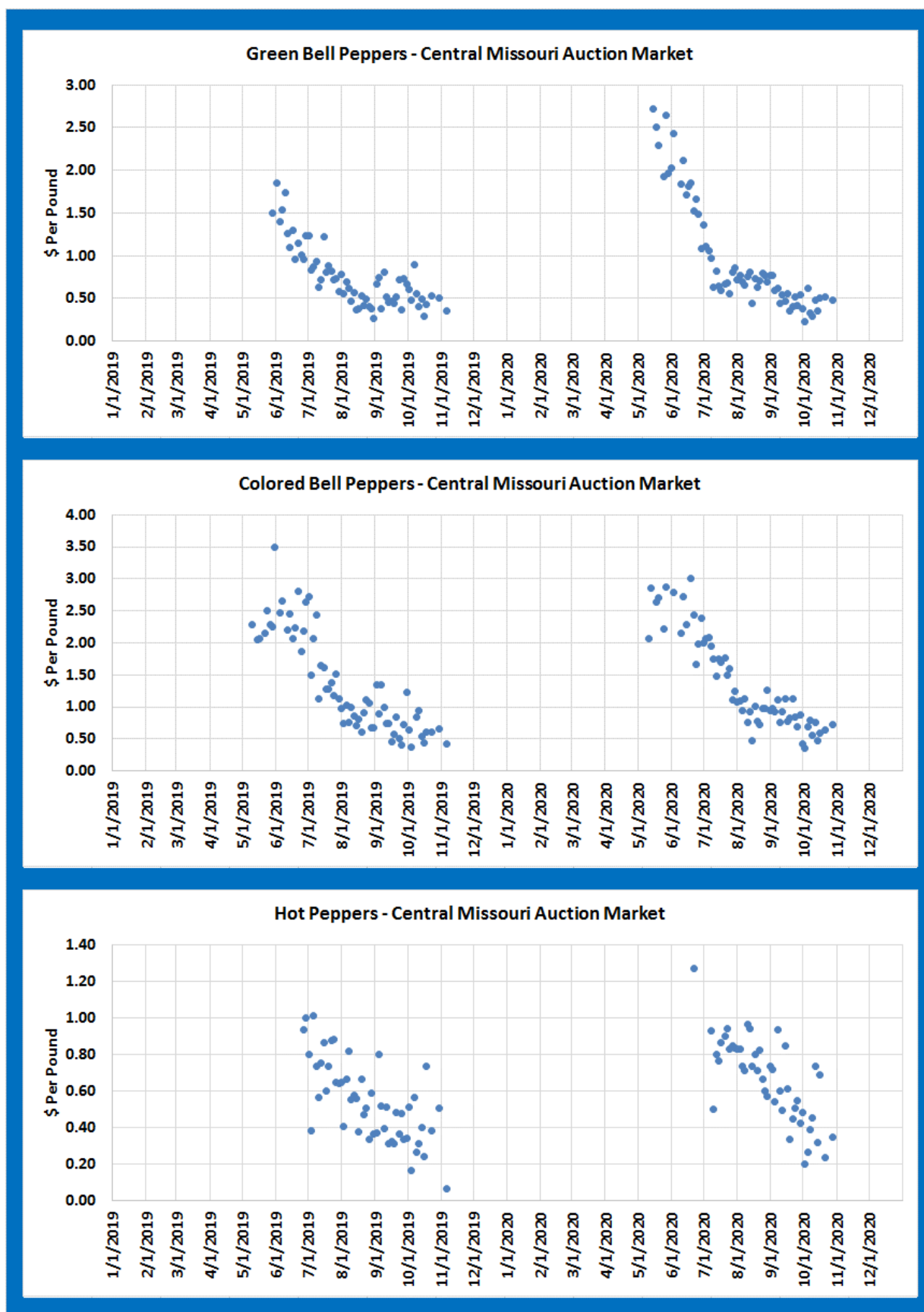
Price variance at the produce auction markets

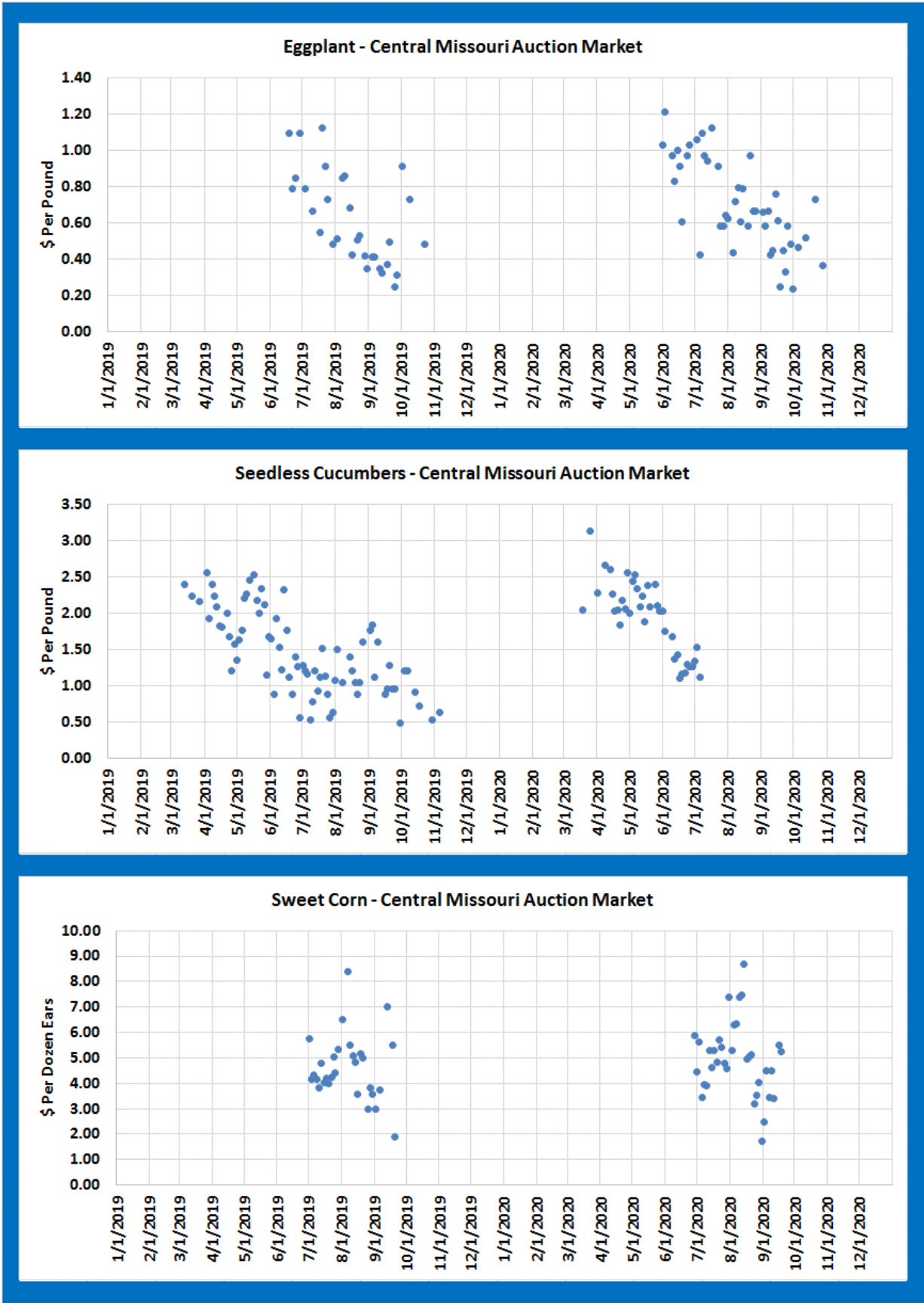
Growers' primary concern with the produce auction markets was the price variance they experienced week to week. In order to look at this issue, the prices observed in 2019 and 2020 from the Central Missouri Produce Auction (CMPA) were graphed choosing commodities with frequent sales across the season. The time period was kept the same in each graph so that you can see generally when the various specialty crops are marketed and that some crops have very narrow marketing periods. The CMPA is somewhat seasonal with the number of auctions increasing to three per week during the high production season (April to October). Tomatoes are one of the most popular products with growers because they are one of the most profitable products to sell. As the graphs below indicate, one can see the variability in the prices from auction to auction. The auction managers and participants indicated that this was due to variance in supply and demand conditions. At some auctions there might be an unusually large supply of a particular type of produce and sometimes there is variance in buyer attendance at the auction.

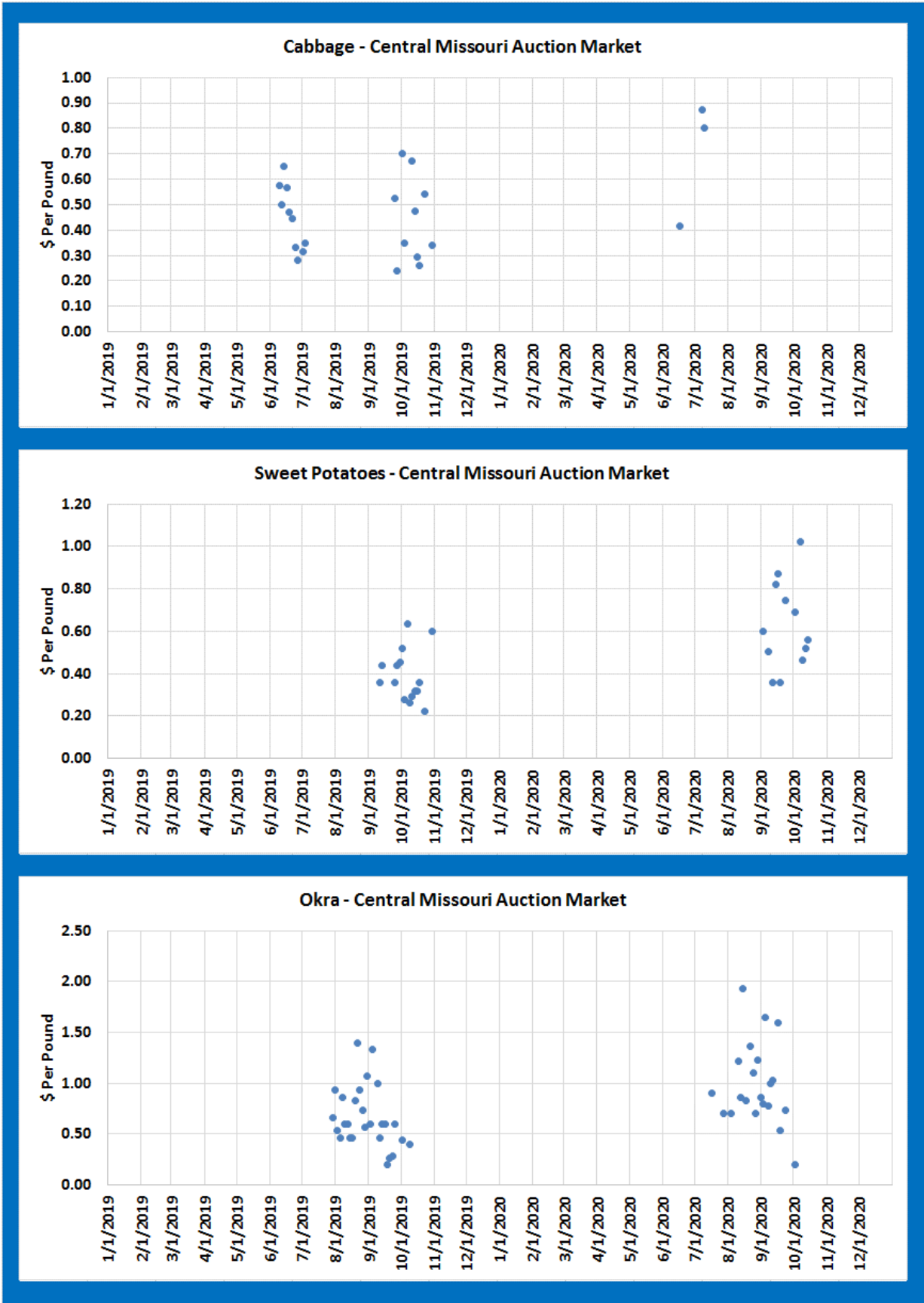
Careful examination of the graphs suggests that some products such as colored peppers, cucumbers, and zucchinis have less price variance than tomatoes, yellow squash, green beans, and sweet corn. The graphs also indicate a pervasive downward trend in produce prices from early in the season to late in the season. One of the key marketing opportunities for growers is to target marketing earlier in the season. Tomatoes and squash also appear to have a resurgence in prices in late September and early October, at least in the data presented.

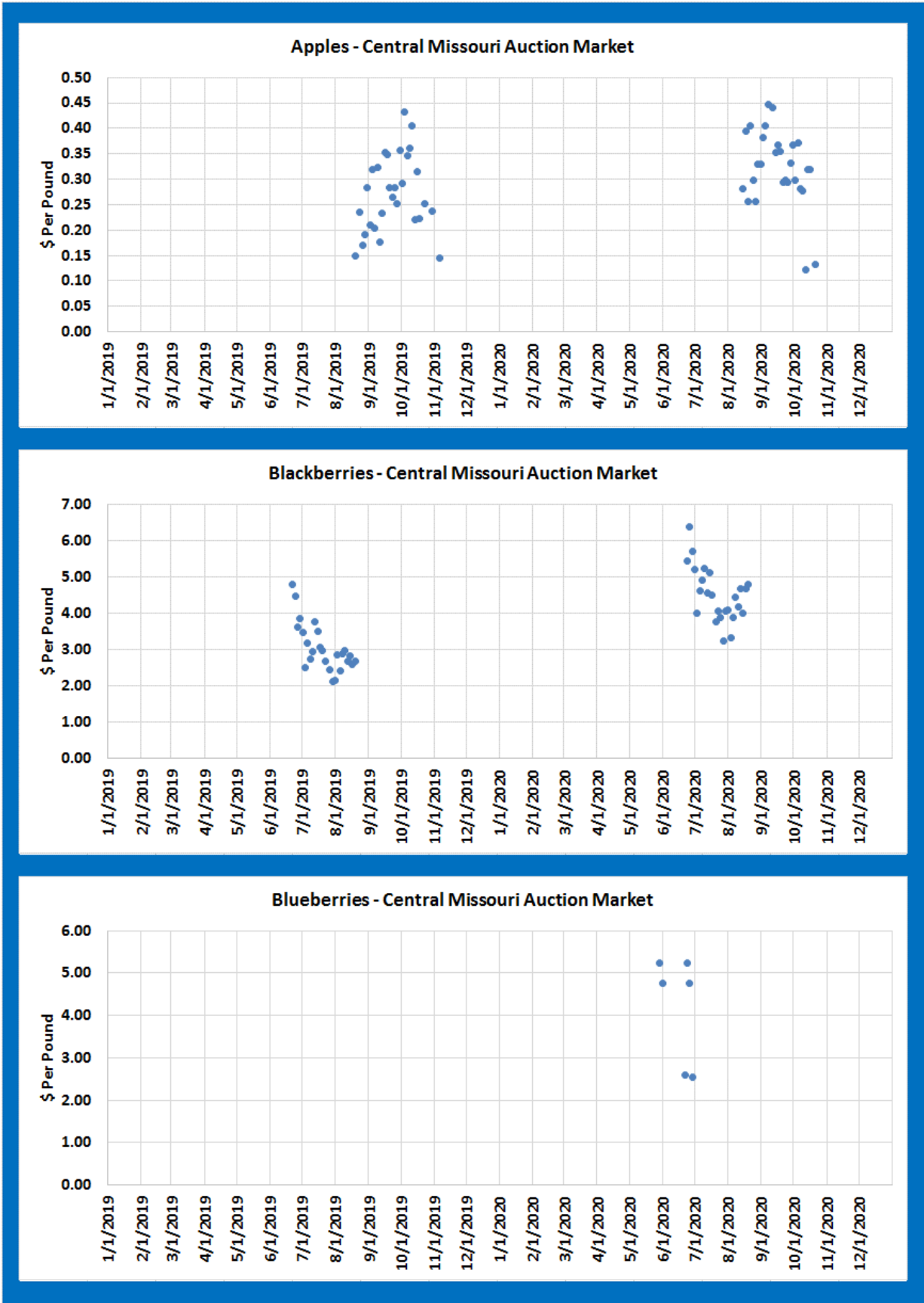


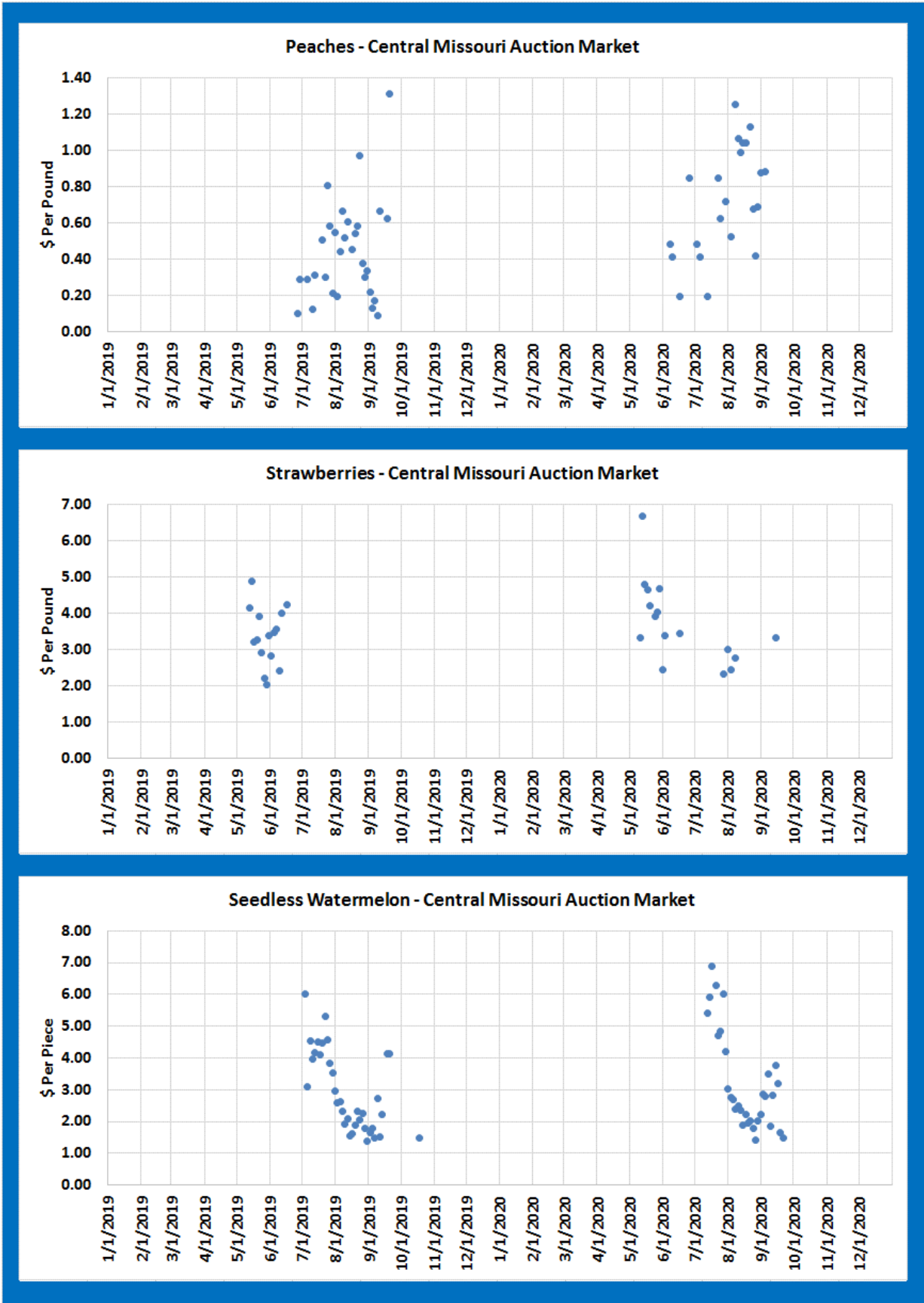












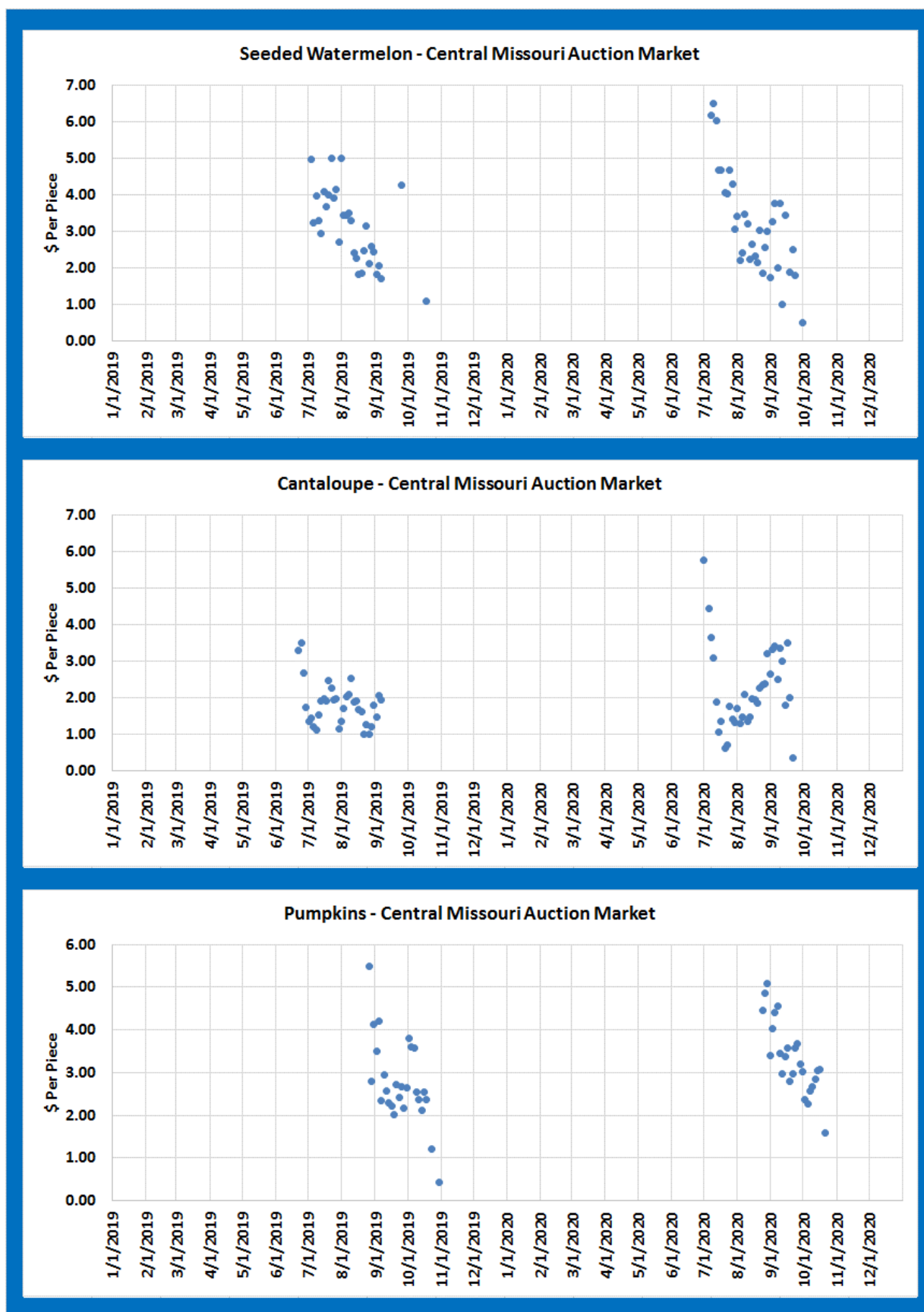


Figure 11. Fruit and Vegetable Price Statistics at the Central Missouri Produce Auction

Specialty Crop	Units	2019					2020				
		Average	Median	Standard Deviation	Skewness	# of Obs	Average	Median	Standard Deviation	Skewness	# of Obs
Apples	\$/lb	0.27	0.26	0.08	0.23	29	0.32	0.32	0.08	-0.91	28
Asparagus	\$/lb	3.72	3.82	0.64	-0.40	33	5.61	5.76	0.80	-0.38	29
Beans, Green (Snap)	\$/lb	1.81	1.89	0.60	-0.32	69	2.15	2.13	0.82	0.11	58
Beets	\$/lb	0.38	0.38	0.10	-0.04	27	0.37	0.38	0.08	-0.15	17
Blackberries	\$/lb	3.04	2.88	0.66	1.11	25	4.50	4.49	0.74	0.55	25
Blueberries	\$/lb						4.19	4.75	1.27	-0.84	6
Cabbage	\$/lb	0.44	0.46	0.14	0.28	20	0.70	0.80	0.25	-1.55	3
Cantaloupe	\$/piece	1.82	1.85	0.59	1.05	34	2.24	1.97	1.13	0.96	35
Corn, Sweet	\$/dozen	4.61	4.32	1.28	0.79	29	4.95	4.95	1.45	0.35	35
Cucumbers, Regular	\$/lb	0.58	0.57	0.20	0.47	80	0.61	0.55	0.25	1.81	77
Cucumbers, Seedless	\$/lb	1.44	1.28	0.57	0.27	77	1.94	2.04	0.51	-0.05	38
Eggplant	\$/lb	0.62	0.53	0.25	0.50	31	0.70	0.66	0.25	0.15	46
Lettuce, Green Leaf	\$/lb	1.21	1.21			1	1.05	1.00	0.30	0.30	26
Okra	\$/lb	0.66	0.60	0.30	0.89	27	0.99	0.87	0.40	0.64	21
Onions, Sweet	\$/lb	0.54	0.58	0.16	-0.27	46	0.53	0.56	0.21	-0.24	45
Peaches	\$/lb	0.44	0.41	0.27	1.20	30	0.72	0.70	0.30	-0.08	22
Peppers, Colored Bell	\$/lb	1.36	1.12	0.77	0.70	68	1.39	1.12	0.74	0.68	64
Peppers, Green Bell	\$/lb	0.75	0.67	0.36	1.14	64	0.98	0.72	0.66	1.23	66
Peppers, Hot	\$/lb	0.54	0.51	0.22	0.30	53	0.66	0.71	0.23	-0.08	47
Potatoes	\$/lb	0.47	0.50	0.14	-0.19	5	0.45	0.45	0.11	0.41	15
Potatoes, Sweet	\$/lb	0.39	0.36	0.12	0.73	15	0.63	0.58	0.21	0.49	12
Pumpkins	\$/piece	2.76	2.56	1.00	0.47	26	3.35	3.21	0.84	0.32	25
Squash, Winter	\$/lb	0.40	0.40	0.08	0.03	52	0.30	0.27	0.12	0.51	45
Squash, Yellow	\$/lb	0.73	0.77	0.21	-0.24	51	0.69	0.67	0.27	1.11	52
Strawberries	\$/lb	3.36	3.37	0.80	0.02	15	3.71	3.42	1.13	1.11	16
Tomatoes, Heirloom	\$/lb	1.43	1.47	0.54	0.12	39	1.28	1.21	0.62	0.79	35
Tomatoes, Large #1	\$/lb	2.11	2.04	0.94	0.43	96	2.43	2.45	0.94	0.02	90
Tomatoes, Medium #1	\$/lb	1.90	1.84	0.94	0.69	96	2.17	2.15	0.93	0.29	90
Watermelon, Seeded	\$/piece	3.12	3.22	1.04	0.13	31	3.18	3.05	1.40	0.62	34
Watermelon, Seedless	\$/piece	2.93	2.59	1.28	0.61	35	3.21	2.77	1.56	1.03	31
Zucchini	\$/lb	0.73	0.65	0.32	0.61	81	0.87	0.70	0.39	0.77	81

Since auction markets have become a very critical market for Missouri specialty crop growers, the table above is included in order to document some of the statistics from the Central Missouri Produce Auction for 2019 and 2020. The “average” columns are the simple average of all prices reported across the marketing seasons for 2019 and 2020. The median is the middle value of price with half of the observed prices above that value and half of the observed prices below that value.

The standard deviation measures how spread out the prices are from the average. The larger the standard deviation the greater the spread of the data. For example, in the case of apples, the standard deviation is \$0.08 per lb with an average price of \$0.27 per lb. If the data are distributed normally, this would mean that approximately 68.2% of the observed prices would fall within \$0.19 and \$0.35 per lb. When data are distributed normally, they generally follow a bell curve pattern that looks like Figure 12 below.

Figure 12. Probability of observations occurring within 1, 2, and 3 standard deviations of the average price in the Normal distribution



It also means that 15.9% of the observed prices fell below \$0.19 per lb. while 15.9% of the observed prices were above \$0.35 per lb. The standard deviation helps growers understand the price risks associated with each specialty crop. Keep in mind that the standard deviation should also be considered relative to the average price. For example, winter squash prices in 2019 have the same variance as apple prices in 2019 at \$0.08 per pound, but winter squash prices average \$0.40 per pound versus \$0.27 per pound for apples. So relative to overall value per pound, winter squash is less risky from a price perspective than apples.

As the term implies, skewness measures how the price data is spread out around the average. If the skewness is negative it means there are more price observations below the average than above the average. The more negative the skewness the further those price observations are from the average. Likewise, if the skewness is positive it means there are more observations above the average than below the average. A skewness of 0 means that there are roughly the same number of price observations above and below the average with roughly the same spread from the average price. A large negative skewness tells you that there is a significant chance that observed prices will be below the average. A large positive skewness suggests that there is a significant chance the observed prices will be above the average. When the skewness is either strongly negative or strongly positive it also means that the data is probably not normally distributed.

Finally, the number of observations tells you how many days average price observations were reported. For example, in the case of apples in 2019, there were 29 days on which average prices were reported while in 2020, there were 28 days on which average prices were reported. Generally, the larger the number observations the more reliable the data is at measuring the statistics for the specialty crop. Statisticians generally prefer to have 30 observations and the statistics from any specialty crops with less than 20 observations should be considered potentially unreliable.

Price seasonality at the produce auction markets

Specialty Crop Price Seasonality at the Central Missouri Produce Auction

	Years Included	Price Index (First Marketing Month = 100)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beans, Green (Snap)	2019					100	95	90	75	51	50		
Blackberries	2019 & 2020						100	72	69				
Corn, Sweet	2020						100	84	91	71			
Cucumbers, Regular	2019 & 2020				100	74	41	47	52	54	49		
Cucumbers, Seedless	2019 & 2020			100	86	86	58	48					
Eggplant	2019 & 2020						100	82	66	45	64		
Onions, Sweet	2019						100	81	90	83	59		
Peppers, Colored Bell	2019 & 2020					100	96	65	36	34	25		
Peppers, Green Bell	2019 & 2020					100	81	45	31	30	26		
Peppers, Hot	2019 & 2020						100	70	57	45	37		
Pumpkins	2019 & 2020								100	72	58		
Squash, Yellow	2019 & 2020					100	75	73	73	66	64		
Strawberries	2020					100	68	59	58	74			
Tomatoes, Heirloom	2019 & 2020						100	70	63	40	25		
Tomatoes, Large #1	2019		100	82	76	55	59	34	37	28	42	46	
Tomatoes, Medium #1	2019		100	73	69	50	52	28	32	23	36	40	
Watermelon, Seeded	2019 & 2020							100	61	57			
Watermelon, Seedless	2019 & 2020							100	45	54			
Zucchini	2019 & 2020				100	92	49	43	49	38	60		

The table above shows the seasonality in fruit and vegetable prices at the Central Missouri Produce Auction based on reported data for 2019 and 2020. In this table, actual prices are converted into a price index for each specialty crop comparing each month with the first month where sales occurred. For example, in the case of green beans, the first month with sales was May so the May prices was set as the basis for comparison. For green beans the May index is set at 100. The June price is then measured against the May price. With a value of 95, it indicates that June prices were 95% of the level of May prices. By the end of the season in October, green bean prices have fallen to 50% of the May price level. Note that the first month of sales varies by commodity. In the case of blackberries, June is the first month of sales, so the June index is set at 100 and the other months compared to June for blackberries.

Growers should take away three things from the table:

1. It's best to market the largest portion of your produce early in the season so that you get the highest prices.
2. Some crops experience an increase in prices towards the end of the year because supplies get tighter as you move away from the primary growing period.
3. Many specialty crops can be produced over a long production window in Missouri.

Not all crops exhibit strong seasonality patterns and/or do not have enough observations to establish a pattern in the Central Missouri Produce Auction market. Seasonality patterns could not be established for

apples, asparagus, beets, blueberries, cabbage, cantaloupe, lettuce, okra, potatoes, sweet potatoes, and winter squash. It is likely that seasonal patterns vary somewhat across produce auction markets and from year to year, but the underlying pattern of experiencing the highest prices in the early part of the season is pervasive across years and most specialty crops.

Note that COVID-19 appeared to distort the seasonality in some specialty crops in 2020 and 2020 is excluded for those crops. In addition, for some specialty crops, only 2020 included data across a period of months.

Local grocery stores

The producer perspective:

Growers reported good success in working with grocery store chains. Local chains such as Schnucks and HyVee are positively discussed by growers but they caution that it is important to work with the produce manager, not just the store manager. Some large growers sell significant volumes to local grocery stores with good success. Several small growers indicated they also sold produce directly to grocery stores. They indicated that local grocery stores were more approachable and mentioned Schnucks, Associated Wholesale Growers, Hy-Vee, and others as amenable to working with small growers.

The produce manager perspective:

In order to get the grocery store perspective on buying produce from local growers, a few local chain grocery stores were also interviewed. Both chain grocery stores indicated that they would buy local produce including lettuce, tomatoes, cucumbers, green bell peppers, sweet corn, zucchini squash, yellow squash, jalapeno peppers, Gala and Jonathan apples, peaches, pumpkins, and assorted fall gourds. They usually make local purchases from May through early October although they are open to year-round purchases. In purchasing directly from farmers, they prefer prearranged consistent delivery times and do not want to work with growers that show up at random times with deliveries.

Produce managers indicated that they often made purchases from local produce auctions and wanted produce that was packed in industry standard packaging and weights as well as compliant with food safety guidelines. Some produce managers indicated that their corporate office requires that growers fill out forms related to food safety and other regulations. They also indicated that they could source “local” produce through their regular vendors although the prices were higher. Some grocers commented that they preferred to purchase from the auction markets because it gave them more flexibility in aligning the quantity they purchased with the amount consumers were purchasing.

Marketing to Grocery Stores

Advantages	Disadvantages
Relatively easy way to expand produce sales	Grocery stores pay closer to wholesale prices rather than retail prices
They will take a variety of produce, but demands can be unpredictable	Local grocery stores have specific delivery times that must be met
Less time consuming to market to higher volumes	Requires product delivery
Growers should “sell” the idea of local produce with local grocery stores	Growers must focus on higher volume markets

“Easy” value-added products

Many growers in level 2 were also engaged in the beginning stages of developing “value-added” products. These growers were involved in producing jams, jellies, apple cider, vinegar, elderberry products, and many others. Some growers commented that improvement in food safety regulations that allowed small farmers to open small kitchens could be quite beneficial. Others commented that it might be helpful to have two sets of regulations – one that applied to washing, chopping, and freezing and another set that applied to anything associated with cooking and canning.

Many growers have tried to go to institutional markets such as schools, hospitals, senior living facilities, and prisons. Supplying schools is difficult because it really requires year-round production and often the heaviest season of production are when schools are not in session. Heated high tunnels offer some possibilities for year-round supplies and several growers were able to produce tomatoes through as long as March with production only absent in April and May. Various types of leaf lettuce, swiss chard, kale, etc. are produced year-round by growers with hoop houses. Over half of that production utilizes hydroponics within hoop buildings.

Another significant issue with supplying institutions is that many items need to be lightly processed. This might include washing, slicing, packaging, labeling, and possibly freezing. Growers indicate this requires meeting additional food safety regulations and a certified kitchen. There are some efforts being coordinated by Extension to get some pilot kitchens started.

Level 3: high volume markets

Helping growers move to level 3 markets is critical for the fruit and vegetable industry to grow in Missouri. Characteristics of high-volume markets:

- more complex to manage with more clients,
- require on-farm cooling facilities,

- have more food safety regulations,
- require more paperwork,
- include more stringent production schedule and delivery deadlines,
- will likely require the grower to switch their day-to-day activities to managing the business rather than producing the specialty crop,
- will likely require full traceability with implications for labeling, and
- may possibly require fresh cut processing.

Of all the barriers discussed, the most common issue was uncertainty regarding food safety regulations. Missouri's small growers are aware that additional regulations and paperwork apply as they expand their production. Many are very excited about learning new production techniques but view regulations, particularly paperwork and record keeping, as particularly burdensome. They also note that some regulations seem outside their control (such as avoiding contamination from wild animals) putting a random element of risk in their operations. In particular, growers do not like to be told, "it's your choice, you decide how much risk to take" when they are unsure if the action they take could cause them to be out of compliance. Growers are looking for transparent and realistic regulations with straight forward procedures for compliance. Complying with additional regulations can be a large hurdle for small commercial growers that want to be significantly larger.

In contrast, large commercial operations in California and Florida often have one or more full time "compliance officers" dedicated to ensuring compliance with the variety rules and regulations as well as demands from grocery store chains. Large volume buyers such as Walmart often require food safety audits of their growers that even large operations struggle to stay in compliance with. These audits would make it difficult for small growers to participate with these large buyers.

The changes mentioned above can be significant hurdles for growers. These hurdles can be overcome by developing and aggressively promoting the support systems (infrastructure) to make it easy for growers to jump through these hurdles. One extension agent described the need for "turn-key" grower training where growers go through a 12-week class covering all of these aspects and in fact, a commercial fruit production series of class was held by MU Extension over the spring and summer of 2020.

To speed up interest in expanding production, growers need:

- direct examples of points of contact for new markets and/or how to develop these contacts,
- step-by-step instructions on what to expect at different markets,
- detailed knowledge of their costs of production
- step-by-step detailed instructions on how to comply with various food safety regulations,

- boilerplate templates for the forms, standard operating growers, and compliance logs,
- how to get help if their operation is found to not be in compliance,
- information on how to access more labor with the skills they need,
- information and demonstration of labor-saving equipment,
- knowledge of what traceability is, what it means, and how they can cost effectively achieve it,
- training for food handling as well as training on how to access and use an approved commercial kitchen
- detailed information on how a cooperative might be used as a tool to give them more access to institutional markets and/or fresh markets, and
- access to credit.

There were a few Missouri growers who had pushed through to level 3 markets and their insights are reported below.

Selling through brokers

Several large Missouri growers discussed how they market their fruits and vegetable through brokers and many of these farms have been in business in excess of 100 years. Large grocery store chains such as Walmart, Kroger, Save-a-lot, etc. often buy their produce through brokers instead of dealing directly with lots of individual growers. The broker's job is to connect the buyers and growers making sure the grower is a reliable source of quality produce. In most cases the broker never even sees the actual produce nor do they assume ownership of the produce. They rely entirely on the grower to deliver a quality product. Brokers quickly lose interest in growers that produce inferior products or insufficient volumes. Brokers may also facilitate transportation of produce from the farm to the retail destination. Brokers are often skeptical of new growers that haven't been producing long and are reluctant to take them on as clients.

Produce marketed through brokers is inspected before it leaves the farm and when it gets to the final destination and the buyers can reject the entire semi-load at either time. Missouri growers indicated that in their experience, loads were typically rejected less than 5% of time, but if they are, the grower is responsible for finding a new customer for their produce. This can be difficult if the rejected load is 500 miles from the grower. Food banks are often a logical delivery point for rejected loads. In these situations, the grower then bears not only the cost of producing and harvesting the crop, but also the delivery cost.

Marketing through Brokers

Advantages	Disadvantages
Access to large volume market without producing everything yourself	Brokers charge a commission fee
Gives the grower access to markets they may otherwise not be able to get into	Difficult for new growers to get started with a broker
Brokers may be able to secure higher prices with their more detailed knowledge of buyers	Grower must deliver both high volume and high quality
Grower can focus on producing the crop and let the broker worry about marketing the crop	Risk of having produce rejected either at the farmgate or at the destination with the grower bearing all the costs

Institutional markets

Missouri growers expressed a strong interest in supplying institutional markets, such as schools and hospitals. Most felt that an intermediary entity would be needed to handle some minor processing such as chopping, washing, packaging, etc. because of the regulatory requirements on food safety. Missouri Extension personnel are already working on some special projects to help growers connect to commercial kitchens fully compliant with food processor requirements in Missouri. Small growers often felt they didn't have the resources to support a commercial kitchen. However, this is an opportunity to develop a food processing cooperative that could purchase from small growers, process their products, and deliver to institutional markets. The institutions get the advantage of having a reliable supplier as well as dealing with a significantly larger supplier than one grower.

One of the largest Missouri produce grower commented that once you get large enough to begin competing in wholesale type markets the competition becomes much more intense. In institutional markets such as large school districts other suppliers from the coasts will reduce their prices to undercut local production. In addition, other suppliers may have access to a variety of suppliers enabling them to deliver products year-round rather than only being able to supply when the product is in season. Suppliers leverage this capability by suggesting they will drop the buyer for the entire year if they are not able to supply them all year long. Some large Missouri growers have often found that using a combination of marketing outlets is usually the most reliable. They mentioned using a combination of grocery store chains, high end restaurants, and wholesalers to ensure they had adequate markets. They also indicated they were always making new contacts and exploring new potential markets.

Marketing to Institutions (schools, hospitals, prisons, etc.)

Advantages	Disadvantages
Access to large volume markets	Grower must deliver both high volume and high quality
Fewer customers to service	Grower's individual volume may not be high enough to supply the institution
Regular, consistent demand makes it easier for the grower to plan production expansion	Grower production cycle may not sync well with institutional demand (i.e., school demands often follow cycles opposite of grower production.)
Grower can capture economies of scale reducing variable and fixed costs of production	Institutions often require at least "fresh-cut" processing and the grower may not have access to a certified kitchen to do this processing.
	Requires more food safety paperwork
	Some institutions require one vendor to supply produce all year long

Marketing cooperatives

Missouri has a long history of developing successful cooperatives for other agricultural enterprises. States accounting for the largest share of fruit and vegetable production (California, Florida, Washington) have demonstrated the importance of utilizing cooperatives in fruit and vegetable production. In the case of Missouri, produce auctions are already a form of a marketing cooperative. They serve the function of providing a method for aggregating graded produce for buyers to access higher volumes.

There are a few private packing houses in Missouri, one of which is Proffer Produce in Park Hills (60 miles south of St. Louis). This packing house has growing and marketing arrangements in Missouri, Arkansas, Illinois, Louisiana, Mississippi, Wisconsin, Michigan, Minnesota, South Carolina, Florida, Tennessee, and Texas. They also import produce from Mexico, the Dominican Republic, and Costa Rica. Establishing a network of cooperatives that would serve as aggregators for produce from Missouri's small fruit and vegetable farms could provide additional markets and allow for significant production expansion.

Given the relatively small size of Missouri fruit and vegetable growers, it would likely be most economical to leverage existing cooperatives such as MFA and Coops to help carry inputs for fruit and vegetable growers. Some growers mention that this was occurring to some extent but others noted that many did not carry items needed for irrigation. Whether the cooperatives could afford to carry the inventory of inputs needed is a good question but with a strong network of growers buying the supplies, it could be beneficial to have parts available locally.

Marketing through Cooperatives

Advantages	Disadvantages
Access to large volume markets	Grower must deliver both high volume and high quality
Cooperative manages quality and volume requirements	Grower may not agree with cooperative's grading of their products
Cooperative can negotiate better delivery terms since they are managing production from several growers	The success of the cooperative depends on the grower members delivering the volume and quality of products
Grower can capture economies of scale reducing variable and fixed costs of production	Growers must give up some of their independence and work collaboratively
Cooperative can access produce from other regions/countries to ensure year-round supply to customers	

Wholesalers

Wholesalers typically require very large volumes of produce and primarily work through brokers or large packing houses. There are a few Missouri growers that have attempted to work directly with wholesalers. Wholesalers also typically want year-round supplied and have very exacting standards regarding packing, product quality, and delivery standards. Missouri producers may have a window into these markets by emphasizing “locally produced” in their marketing but they will still have to deliver significant volumes. In addition, some wholesalers have sought to diversify their supplies to limit exposure if there is a recall on one supplier's produce. But this also means that suppliers must have full traceability of their products back to the grower and the grower may need to be able to determine which set of production was affected.

Marketing directly to Wholesalers

Advantages	Disadvantages
Access to large volume markets	Growers must deliver both high volume and high quality
No middleman to take a marketing fee	Wholesalers have exacting standards regarding product packaging, labeling, uniformity, cooling, transportation and delivery and they will reject produce that does not meet their specifications
Grower can capture economies of scale reducing variable and fixed costs of production	May require superior quality when supplies are plentiful
Grower can capture economies of scale reducing variable and fixed costs of production	Likely require traceability
Fewer customers to service	Requires more food safety paperwork

Level 4: very high-volume markets

In level 4, growers are now large enough that they must move beyond local markets to regional markets, national markets, and sometimes international buyers. There aren't many growers in this stage in Missouri and, in fact, Missouri has lost more commercial growers than we have gained especially in open field vegetable production.

Processing markets

Many Missouri growers expressed an interest in being able to sell to processing markets. Many perceive that they could take excess production unsold in the fresh market to a processor and at least capture some value on the residual production. For around 80 percent of the fruits and vegetables grown, unfortunately this perception is incorrect. In order to produce optimal products in a highly competitive consumer market, processors demand very specific varieties of produce that generate these optimal products. In addition, in order to stay in business, processors must have adequate volumes of produce to keep their facility running. In order to ensure adequate volumes, most processors contract over 90 percent of the production that they need in a given season.

Given the small and scattered nature of Missouri fruit and vegetable growers, commercial scale processing such as the often-discussed tomato processing plant is not a viable option. Commercial scale processors require dense clusters of production that are capable of providing huge volume over the entire season. Interviews with large processors in California suggest that a plant with competitive economies of scale would require 20,000 acres of processing tomato production within a 20-mile radius of the plant. In

total, the 2017 census indicated that Missouri had 543 acres of fresh and processing types. In addition, the price of processing tomatoes is considerably lower than fresh tomatoes. California data suggest processing tomato prices around \$0.04 per pound and California growers struggle to cover all costs at those prices.

What is more likely to be successful in Missouri are smaller processing facilities directed at specific markets (or consumer segments). For example, a simple fresh cut processing facility that served several institutional markets could be successful if they could find enough growers to supply products. Although clusters of growers do exist, the sparse data on fruits and vegetable growers even from the Census of Agriculture makes it difficult to identify the best location to locate a facility. By working with the produce auction markets and Farmers' markets it could be possible to put together the critical volume of products needed. The fresh cut processing facility may have to locate "packing sheds" close to growers so that they can provide cooling and refrigeration. The "packing sheds" could then ship produce to the fresh cut processing facility. The processing facility could be designed to also handle specialty crops with a longer shelf life to allow the facility to operate year-round.

Another option is the production of value-added products. Flash frozen fruits and vegetables have declined in popularity in recent years, but finding niche markets in jellies, jams, and a variety of other possible products could be economically feasible. Under the umbrella of Missouri's Food, Beverage, and Forestry Manufacturing Initiative, small scale food processing centers with store fronts are envisioned to allow growers interested in pursuing value-added concepts to test their concept before investing in large scale facilities. This approach would help growers limit risk and be more willing to test value-added concepts.

More details on the processing sector can be found in a second report produced in the study entitled, "The Economic Viability of Expanding Fresh and Processed Fruit and Vegetable Production in Missouri – Fruit and Vegetable Processing".

Missouri Potatoes

Less perishable products such as potatoes can move long distances to processing markets, even as far as Canada or Mexico. Potatoes are not stored in Missouri due to the hot climate where they are produced. Nearly all of Missouri's commercial potatoes go to chipping plants. Buyers often directly supply the seed potatoes they want the producer to use. The farms in the Charleston area of Missouri are as large as growers in Washington, Oregon, or Idaho.

Marketing to Processors

Advantages	Disadvantages
Access to large volume markets	Growers must deliver high volumes and often specific varieties produced are dictated by the processor
No middleman to take a marketing fee	Processors still have quality standards to meet and will reject loads of produce if quality is impaired
Processors will often contract with growers for specific volumes at a set price helping limit grower price risk	Growers have to be located close to the processing facility in order limit any degradation in produce quality before it reaches the processor
Grower can capture economies of scale reducing variable and fixed costs of production	Consumer demand for processed fruits and vegetables has been flat to declining
Fewer customers to service	Small growers may not be able to access a processor if they have small volumes

Chain Store Distribution

Large chain stores often will not buy directly from growers but there are exceptions. These stores often want the quality control services their regional distribution centers provide. Increasingly these large chains not only demand large volumes on a regular basis, but they also want a supplier that can deliver products reliably year-round.

By comparison, Florida Extension personnel note that there is a lot of consolidation occurring in the vegetable sector with fewer and larger vegetable growers. One of the drivers of this consolidation is that big grocery store chains are demanding that growers deliver year-round supplies. The only way that Florida growers have been able to accommodate this request is by having suppliers across multiple states.

Direct sales to larger chains such as Walmart, Kroger, and Save-a-lot are generally handled through a broker. Produce quality, packaging, and labeling are critical when working with chain stores. Many chain stores will also require traceability and may even do their own food safety and handling inspections at the grower's farm.



April 12, 2019. Romaine lettuce in hydroponic production, Sikeston, MO (Scott County)

Marketing directly to Large Chain Stores

Advantages	Disadvantages
Access to very large volume markets	Growers must deliver both high volume and high quality
Fewer customers to service	Chains have exacting standards regarding product packaging, labeling, uniformity, cooling, transportation and delivery and they will reject produce that does not meet their specifications
No middleman to take a marketing fee	Difficult to gain access to this market
Grower can capture economies of scale reducing variable and fixed costs of production	Usually require year-round supply capability
Can simplify delivery by channeling all deliveries through a regional distribution center	Require traceability
	Requires stringent food safety paperwork

Terminal Markets

Historically terminal markets were centrally located hubs where wholesalers, distributors, and brokers were clustered together usually around key transportation hubs including rail and truck. These markets were very important three decades ago and were often the outlet for growers with large volumes of produce. Over the past three decades terminal markets have declined significantly in importance. The USDA's Agricultural Marketing Service (AMS) stopped collecting prices from the Saint Louis terminal

market on December 30, 2017 making Chicago the closest terminal market for which AMS still reports prices. As with all produce markets, effective participation required building strong relations with buyers.

Value Added Opportunities

Many growers mentioned wanting to pursue value-added opportunities. Their ideas included apple cider, vinegar, jellies, jams, alcohol, cough syrup, infused drinks, etc. Some weren't sure exactly how to start the process and were concerned about the food safety regulations. Many mentioned reaching out to extension as the first step.

Marketing Value Added Products

Advantages	Disadvantages
Increased shelf life	Products must comply with food safety standards often requiring a specialized kitchen and/or processing facility.
Product is less bulky and fragile to handle	In some cases, products must pass food safety tests
Can help utilize unsold produce	Requires a marketing plan for how you will distribute and sell your products and an understanding of competitive products
May allow labor to be used outside the growing season	Requires more interaction with customers
Adds another profit stream to the business	

Missouri Elderberries

One of the examples with a lot of potential came from a Missouri elderberry producer. She had coordinated with a local small processor to sell her excess elderberries (those not sold on the fresh market) for manufacture into cough syrup and drinks. With help from the research community, it may be possible that scientific research could verify the potential health benefits of elderberries opening the path for explosive demand growth.

"Found" brand elderflower infused sparkling water a "value-added" product of elderberry production.



March 21, 2019. Elderberry field in winter dormancy. Springfield, MO (Greene County)

Missouri is the largest producer of elderberries in the United States and production is growing. Improved varieties of elderberries have led to significantly higher yields boosting profitability. The demand for elderberries has also continued to grow especially with the perceived health benefits as an antioxidant, possible antiviral properties, and potential to boost the immune system. The body of scientific evidence supporting the health benefits of elderberries is still small with only a handful of studies on relatively small groups of people. In these small studies, elderberries were found to help people recover more quickly from flu-like symptoms. Larger studies are needed to determine more conclusive results. Elderberries certainly represent a unique Missouri opportunity for a “value-added” product.

E-commerce & online marketing

One of the many side effects of COVID-19 on the fruit and vegetable sector is the growth in direct-to-consumer marketing. Fruit and vegetable growers as well as processors are looking at direct-to-consumer marketing as an opportunity to diversify their customer base. Having multiple ways to reach consumers via retail, foodservice, and direct-to-consumer allows them to manipulate the supply when disruptions such as COVID-19 arise. Cathy Burns, CEO of the Produce Marketing Association, (Newark, Delaware) believes that COVID-19 has accelerated the growth of e-commerce with 10 years of growth occurring in just 3 months. In addition, internet technology platforms have now been developed to deliver cost-effective store front solutions directly to the consumer and advanced packaging solutions make shipping fresh produce directly to the consumer possible.

The rapid growth in e-commerce and online marketing was a developing trend prior to COVID-19, but since COVID-19 this trend has rapidly accelerated. According to the trade magazine, “The Packer” 72% of produce industry leaders agree that direct-to-consumer (DTC) sales will continue to expand rapidly.

Future Trends in the Fruits and Vegetable Industry

In the fruit and vegetable industry one of the most popular and widely read trade magazines is “The Packer”. The Packer includes discussions of policies, technologies, varieties, trends in consumer demands, etc. that are shaping the fruit and vegetable supply chain. In the sections below, some of their insights are outlined. These comments are not specific to Missouri but instead apply to the fruit and vegetable industry as a whole.

Trends

Craig Carlson with the trade magazine “The Packer” offered the following insights from his interviews of fruit and vegetable supply chain participants on the future of consumer purchases of fruits and vegetables (Carlson, 2020):

- Reduction in the size of produce departments in grocery stores because more produce will be sold directly to consumers
- Fewer units will be stocked in grocery stores
- Shelf life will be extended and quality enhanced
- Fruit and vegetable yields will continue to increase
- Fruit and vegetable production will become more sustainable, affordable, and local
- Brands will lose share to private label offerings

Vertical farming is starting to play in major urban areas and is becoming more economically competitive. It could possibly be a disruptive technology for the fruit and vegetable industries, primarily. Vertical farming is primarily focused on tomatoes, spinach, and strawberries at this time. A good example of a vertical farm is AeroFarm in the New York City area which has 36 levels all of which are hydroponic.

Key drivers of vertical farming include:

- Consumer preferences for local production
- Lower transportation costs
- Reliable supplies
- Improved pest and disease control
- Some facilities do not use any chemicals
- Facilities can control light to affect yields and produce quality
- Vertical spinach production systems are already competitive with open-field systems for certain crops.

Increased automation

- Fruit and vegetable production automation is still in the infancy stages, but is rapidly changing due to labor costs
- Historically, most automation has focused on thinning and weeding
- Automated harvesting is a research focus
- Automated harvesting already occurring for arugula and baby spinach
- Automated strawberry harvesting is 3-5 years from effective commercial deployment.
- Breeding varieties of fruits and vegetables to be more consistent with machine harvesting, for example, California broccoli
- Florida chipping potato demand has declined because a new genetically engineered variety for North Dakota allows their potatoes to be stored longer
- Berry growers focused on automation but can rely on it to substitute for labor

Rapid expansion in protected production systems

- More conducive to automation
- Helps limit pest and disease problems
- Growers trying to capture premium prices available earlier in the season

US industry insights on challenges and opportunities

Most pressing challenges

- Regulatory pressures causing some companies to shift production and processing to Mexico.
- Regulatory burden becoming very costly for companies operating in the US.
- Labor costs and access to labor through H-2A program is getting more difficult. Minimum wage, health care, and benefit increases are also escalating costs.
- Finding growth markets can be challenging, lots of competition from China
- California – cost of land is very expensive and irrigation water is limited
- Climate change is affecting the pattern in chill hours available for Florida fruit production. Results in small fruits and lower yields.
- Access to plant health materials (pesticides, herbicides, and fungicides)

Key advantages and opportunities

- Climate and infrastructure still excellent in most parts of the United States
- Potential for carbon markets as a new revenue stream.

These trends will create opportunities for Missouri fruit and vegetable growers. The most important trend is the shift in consumer preferences to local foods. Missouri growers need to capitalize on this change in preference and provide consumers with the backstory on the history of their farm, their production techniques, and how buying local helps local farmers as well as improve the environment. The second most important trend is automation. With many growers mentioning struggles with finding labor, the pros and cons of automation need to be evaluated and growers will need to blend automation increasingly into their operations. The third most important trend is more direct consumer purchases. Missouri growers need to think long term about which states and which countries they want to be able to sell their products and make sure the Missouri has in place the regulatory structure to support sales to these markets. The ability to sell food through e-commerce could expose Missouri growers to much large markets and Missouri producers could ride the next wave in consumer purchases.



High tunnel raspberries in Michigan.

Could Missouri growers do the same thing? Some are trying...

Next Steps

With the input of many players in the fruit and vegetable food supply chain, there are several actions that need to be taken to help Missouri fruit and vegetable growers grow their business. Some of these actions have been organized into stages on a timeline reflecting how quickly the complexity of the activity can be accomplished. Some of these activities are already occurring. These suggestions are directed at establishing the critical mass of infrastructure to support Missouri's fruit and vegetable growers with knowledge and connections to be successful.

Reducing grower risks

- Reduce herbicide drift particularly from Dicamba
 - Help growers learn methods to minimize risks
- Work with horticulturalists to develop seasonal regulations to minimize risks

- Improve specialty crop insurance for beginning farmers
 - Directly provide subsidies for small growers (< \$1 million in sales) in first 5 years of production
 - Eliminate exclusions for pest and disease for small growers (< \$1 million in sales) in first 5 years of production
 - Cover herbicide drift – no exceptions or delays

Improve market transparency via data collection

NASS has stopped collecting Missouri specialty crop data which means that only the 5-year census data will be available to monitor progress of Missouri specialty crops.

- Growers need regularly updated data for market transparency and to make informed production decisions.
- Potential marketing cooperatives, packing houses, and or fresh cut processors need to understand where Missouri producer are located and how much production they might have available for sale
- Missouri Department of Agriculture and MU Extension need to be able to monitor the progress of its programs
- Data collection by crop is needed for the following:
 - Area harvested; area planted by county/CRD
 - Yields
 - Production by county/CRD
 - Market prices and volume sold
 - Auction markets
 - Farmers' markets

Educating and training growers

- Provide Missouri growers with annual updated specialty crop budgets customized to Missouri practices
- Provide situation and outlook information via the website and meetings around the state to keep growers informed of market conditions, developing trends, and consumer preferences.
- Promote fruit and vegetable farming with beginning farmers and target new growers with specific training programs and assistance
- MU Extension continues to train growers in production techniques, labor saving technologies, and has field days dedicated to specialty crop production
- Connecting growers to new markets
 - Directly help growers through the process of moving from level 2 to level 3 markets to market more production
 - Identify various market channels and connect growers

- Institutional markets via food processing kitchens/fresh cut processors
- Establish and/or assist in expanding a statewide fruit, vegetable, and tree nut growers' association capable of lobbying the state legislature on issues specific to Missouri fruit and vegetable production.

Special programs to facilitate cooling and refrigerated storage

- Educating growers on cooling equipment and techniques
- Helping producers connect with input suppliers and select appropriately sized equipment for their operation

Ensuring access to inputs

- Educating and connecting growers with input suppliers
- Educating agricultural lenders about fruit and vegetable production
- Helping growers develop or work with existing cooperatives to ensure timely access to the inputs for fruit and vegetable production

Regulatory Compliance

- Establishing a compliance strategist position within Missouri Department of Agriculture or MU to directly help specialty crop growers with regulations and provide boiler plate templates of the various paperwork, manuals, and forms.

Food Processing

- Establish a processing authority in Missouri
- Establish a fruit and vegetable food processing/manufacturing concept facility
- Develop a simple food processing and packing concept facility (fresh cut processor)

This list of next steps will involve multiple players. As this report came together, it became apparent that there is a strong role for Extension, the College of Agriculture, Food, and Natural Resources, and the Missouri Department of Agriculture. A two- page proposal is in the process of being reviewed by Agriculture Extension Associate Dean Rob Kallenbach that would target organizing clusters of Missouri's growers to formulate enough volume to support a "fresh-cut" processing facility that would service institutional markets. This overlays well with Dean Daubert's Food, Beverage, and Forestry Product Manufacturing Initiative that seeks to build food processing/manufacturing concept facilities. A wealth of institution knowledge and supply chain contacts exists at the Missouri Department of Agriculture which would facilitate the identification of the clusters of producers where aggregation facilities might be placed, avoid duplication with existing efforts, and provide contacts across the supply chain. The

Missouri Department of Agriculture would also continue to be instrumental in guiding producers through state and federal food safety regulations.

One of the key features of this work is that it must be sustained on an ongoing basis and real progress in providing and connecting growers with expanded market options will take several years. In addition, the work will involve multiple disciplines to be successful. Funding this work will be challenging but developing this opportunity is critical for providing profitable business options to Missouri's farmers and providing economically viable opportunities for beginning farmers.

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Appendix A – Census Data on Missouri Fruits and Vegetables

Missouri Vegetable Area Data from the Census of Agriculture

Crop	1997	2002	2007	2012	2017
<i>Acres</i>					
Artichokes Area Harvested, Fresh Market	NR	NR	NR	NR	1
Asparagus Area Harvested					
Area Harvested	61	46	39	NR	30
Fresh Market	NR	NR	NR	31	24
Processing Market	NR	NR	NR	NR	6
Beans, Green (Snap)					
Area Harvested	2,753	3,962	7,636	1,479	692
Fresh	NR	NR	836	NR	NR
Processed	NR	NR	6,801	NR	NR
Beans, Lima Area Harvested, Fresh Market	NR	NR	NR	2	1
Beets Area Harvested					
Area Harvested	20	12	12	13	25
Fresh Market	NR	NR	7	NR	24
Processing Market	NR	NR	6	NR	1
Broccoli					
Area Harvested	NR	6	9	12	30
Fresh Market	NR	NR	NR	11	27
Processing Market	NR	NR	NR	1	3
Brussel Sprouts Area Harvested	NR	NR	NR	NR	5
Cabbage, Chinese					
Area Harvested	NR	NR	NR	NR	64
Fresh Market	NR	NR	NR	NR	64
Processing Market	NR	NR	NR	NR	1
Cabbage, Head					
Area Harvested	176	114	88	74	84
Fresh Market	NR	NR	88	NR	82
Processing Market	NR	NR	0	NR	2
Cabbage, Mustard					
Area Harvested	NR	NR	NR	NR	5
Fresh Market	NR	NR	NR	NR	5
Carrots					
Area Harvested	1	3	3	4	23
Fresh Market	NR	NR	3	4	NR
Cauliflower					
Area Harvested	NR	1	7	4	21
Fresh Market	NR	NR	7	4	21
Processing Market	NR	NR	NR	NR	1
Celery					
Area Harvested	NR	NR	NR	NR	2
Fresh Market	NR	NR	NR	NR	2
Cucumbers					
Area Harvested	5,195	11,325	6,814	612	215
Fresh Market	NR	NR	149	207	200
Processing Pickles	NR	11,295	6,665	405	15
Daikon Area Harvested	NR	NR	NR	NR	2
Eggplant					
Area Harvested	43	10	14	14	32
Fresh Market	NR	NR	14	14	32
Processing Market	NR	NR	NR	NR	1
Escarole & Endive					
Area Harvested	NR	NR	NR	NR	1
Fresh Market	NR	NR	NR	NR	1
Garlic					
Area Harvested	NR	6	6	12	41
Fresh Market	NR	NR	6	11	40
Processing Market	NR	NR	NR	1	2

Missouri Vegetable Area Data from the Census of Agriculture (continued)

Crop	1997	2002	2007	2012	2017
<i>Acres</i>					
Ginger Root					
Area Harvested	NR	NR	NR	NR	1
Fresh Market	NR	NR	NR	NR	1
Greens, Collard					
Area Harvested	12	0	5	7	6
Fresh Market	NR	NR	5	7	NR
Greens, Kale					
Area Harvested	NR	NR	NR	7	18
Fresh Market	NR	NR	NR	7	17
Processing Market	NR	NR	NR	NR	1
Greens, Mustard					
Area Harvested	19	25	1	7	9
Fresh Market	NR	NR	1	7	8
Processing Market	NR	NR	NR	NR	1
Greens, Turnip					
Area Harvested	9	14	1	1	10
Fresh Market	NR	NR	1	1	NR
Herbs, Fresh Cut Area Harvested, Fresh Market	10	NR	21	7	20
Horseradish Area Harvested, Fresh Market	NR	NR	NR	NR	1
Lettuce, Head Area Harvested	NR	1	3	4	17
Lettuce, Leaf Area Harvested	NR	14	10	22	33
Lettuce, Romaine	NR	5	5	NR	16
Melons, Cantaloupe					
Area Harvested	549	367	431	467	389
Fresh Market	NR	NR	431	NR	387
Processing Market	NR	NR	0	NR	2
Melons, Honeydew					
Area Harvested	NR	NR	NR	5	16
Fresh Market	NR	NR	NR	5	16
Melons, Watermelons					
Area Harvested	4,778	4,993	3,479	2,744	2,919
Fresh	NR	NR	3,479	NR	2,883
Processed	NR	NR	0	NR	35
Mushrooms (protected production)	0	3	0	1	3
Okra					
Area Harvested	20	14	24	13	30
Fresh	NR	NR	24	NR	28
Processed	NR	NR	0	NR	2
Onions, Dry					
Area Harvested	12	65	16	22	70
Fresh	NR	NR	16	NR	69
Processed	NR	NR	0	NR	1
Onions, Green					
Area Harvested	8	3	8	8	26
Fresh	NR	NR	8	NR	21
Processed	NR	NR	0	NR	5
Parsley					
Area Harvested	NR	NR	NR	1	7
Fresh	NR	NR	NR	1	6
Peas, Chinese (Sugar & Snowpeas)					
Area Harvested	NR	NR	NR	1	8
Fresh	NR	NR	NR	1	8
Peas, Green					
Area Harvested	1,203	3	0	1	12
Fresh	NR	NR	0	1	11
Processed	NR	NR	NR	NR	1

Missouri Vegetable Area Data from the Census of Agriculture (continued)

Crop	1997	2002	2007	2012	2017
<i>Acres</i>					
Green Southern Peas (Cowpeas)					
Area Harvested	1,925	2,216	2,211	623	NR
Fresh	NR	NR	24	135	4
Processed	NR	1,803	2,187	488	NR
Peppers, Bell					
Area Harvested	NR	59	98	129	174
Fresh	NR	NR	98	0	170
Processed	NR	NR	NR	0	4
Peppers, Chile					
Area Harvested	NR	26	28	21	69
Fresh	NR	NR	0	0	59
Processed	NR	NR	0	0	9
Potatoes					
Area Harvested	5,982	5,256	6,127	9,056	8,553
Fresh	NR	NR	290	1,410	545
Processed	NR	NR	5,837	7,646	8,008
Pumpkins Area Harvested					
	1,700	1,697	1,430	1,043	1,257
Radishes					
Area Harvested	NR	0	1	9	30
Fresh	NR	NR	1	9	29
Processed	NR	NR	NR	NR	1
Rhubarb					
Area Harvested	NR	NR	2	2	7
Fresh	NR	NR	2	2	NR
Spinach					
Area Harvested	40	9	5	3	23
Fresh	NR	NR	5	3	21
Processed	NR	NR	NR	NR	3
Squash					
Area Harvested	137	205	168	269	441
Summer	NR	NR	60	143	264
Winter	NR	NR	108	126	177
Fresh	NR	NR	168	242	434
Summer	NR	NR	60	118	261
Winter	NR	NR	108	124	173
Processed	NR	NR	NR	27	7
Summer	NR	NR	NR	25	4
Winter	NR	NR	NR	2	3
Sweet Corn					
Area Harvested	1,870	1,633	3,065	2,325	1,138
Fresh	NR	NR	3,035	2,266	1,117
Processed	NR	NR	30	59	21
Sweet Potatoes					
Area Harvested	39	73	54	NR	NR
Fresh	NR	NR	NR	15	33
Processed	NR	NR	NR	NR	NR
Tomatoes, Open Field					
Area Harvested	646	401	551	492	504
Fresh	NR	NR	505	472	471
Processed	NR	50	46	20	33
Tomatoes, Under Cover					
Area Harvested	NR	NR	9	31	39
Turnips					
Area Harvested	76	53	53	14	22
Fresh	NR	NR	53	14	21
Processed	NR	NR	NR	NR	1
Watercress					
Area Harvested	NR	NR	NR	2	NR
Fresh	NR	NR	NR	2	NR
Mixed Vegetables Area Harvested					
	57	11	NR	NR	NR
Other Vegetables					
Area Harvested	347	85	393	112	220
Fresh	NR	NR	308	107	186
Processed	NR	NR	85	5	34
Vegetable Total, Open Field Production					
Area Harvested	21,804	27,404	32,837	20,213	18,487
Fresh	NR	NR	10,999	9,880	8,418
Processed	NR	17,401	21,838	10,333	10,069

Missouri Berry Area Data from the Census of Agriculture

Crop	1997	2002	2007	2012	2017
<i>Acres</i>					
Aronia Berries					
Acres Grown	NR	NR	NR	NR	67
Acres Harvested/Bearing	NR	NR	NR	NR	37
Acres Not Harvested/Non-Bearing	NR	NR	NR	NR	30
Blackberries					
Acres Grown	NR	NR	275	259	307
Acres Harvested/Bearing	119	294	119	169	238
Acres Not Harvested/Non-Bearing	NR	NR	156	90	68
Blueberries (Wild)					
Acres Grown	NR	NR	NR	NR	1
Acres Harvested	NR	NR	NR	NR	NR
Acres Not Harvested	NR	NR	NR	6	1
Blueberries (Tame)					
Acres Grown	NR	NR	217	194	247
Acres Harvested/Bearing	136	294	53	138	206
Acres Not Harvested/Non-Bearing	NR	NR	164	57	41
Elderberries					
Acres Grown	NR	NR	NR	NR	369
Acres Bearing	NR	NR	NR	NR	236
Acres Non-Bearing	NR	NR	NR	NR	133
Raspberries					
Acres Grown	NR	NR	38	31	29
Acres Harvested/Bearing	27	30	23	20	21
Acres Not Harvested/Non-Bearing	NR	NR	15	11	8
Strawberries					
Acres Grown	NR	NR	172	196	171
Bearing Area	196	151	99	183	152
Non-Bearing Area	NR	NR	74	13	18
Other Berries					
Acres Grown	NR	NR	10	110	14
Acres Harvested/Bearing	NR	5	0	33	1
Acres Not Harvested/Non-Bearing	NR	NR	10	77	13
Total Berries					
Acres Grown	NR	NR	716	799	1,205
Acres Harvested	NR	774	NR	NR	NR
Acres Not Harvested	NR	NR	NR	NR	NR

Missouri Tree Fruit Area Data from the Census of Agriculture

Crop	1997	2002	2007	2012	2017
<i>Acres</i>					
Apples					
Acres Bearing and Non-Bearing					
Bearing Area	NR	2920	1,819	1,161	1123
Non-Bearing Area	NR	901	360	275	258
Cherries, Sweet					
Acres Bearing and Non-Bearing	NR	29	12	17	36
Acres Bearing	NR	13	7	7	17
Acres Non-Bearing	NR	17	5	10	19
Cherries, Tart					
Acres Bearing and Non-Bearing	NR	8	6	4	19
Acres Bearing	NR	NR	4	2	7
Acres Non-Bearing	NR	NR	2	2	12
Figs					
Acres Bearing and Non-Bearing	NR	NR	NR	NR	6
Acres Bearing	NR	NR	NR	NR	1
Acres Non-Bearing	NR	NR	NR	NR	5
Grapes					
Bearing and Non-Bearing Area	970	1453	1,773	1,828	1,854
Bearing Area	NR	1046	1,342	1,397	1,589
Non-Bearing Area	NR	407	430	431	182
Kiwifruit Bearing and Non-Bearing Area	NR	NR	NR	NR	1
Nectarines					
Bearing and Non-Bearing Area	NR	40	5	3	3
Bearing Area	NR	38	4	2	2
Non-Bearing Area	NR	3	1	1	1
Peaches					
Bearing and Non-Bearing Area	1910	2196	2314	NR	1305
Bearing Area	NR	1781	1677	1273	934
Clingstone	NR	NR	NR	NR	66
Freestone	NR	NR	NR	NR	868
Non-Bearing Area	NR	415	637	NR	372
Clingstone	NR	NR	NR	NR	36
Freestone	NR	NR	NR	NR	335
Pears					
Bearing and Non-Bearing Area	80	106	82	93	97
Bearing Area	NR	70	61	49	52
Non-Bartlett	NR	NR	NR	NR	27
Bartlett	NR	NR	NR	NR	25
Non-Bearing Area	NR	36	21	43	45
Non-Bartlett	NR	NR	NR	NR	26
Bartlett	NR	NR	NR	NR	19
Persimmons					
Bearing and Non-Bearing Area	NR	15	11	8	35
Bearing Area	NR	8	6	6	27
Non-Bearing Area	NR	8	5	2	8
Plums and Prunes					
Bearing and Non-Bearing Area	13	45	31	16	41
Bearing Area	NR	21	22	6	18
Non-Bearing Area	NR	23	10	10	23

Appendix B – Fruit, Vegetable, and Tree Nut Growers Interview Questions

Question Set 1 (Historical Experiences with Specialty Crop Production)

Please tell us a little about the history of your farm and your past experiences with specialty crop production.

Question Set 2 (Crops Produced):

What types of fruit, vegetables, and tree nuts do you produce on your farm(s) and how much (acres, sq. ft.), what methods do you use (open field, high tunnel, hydroponic, what is the bearing period, and what is the yield (specify units per square foot, per acre, etc.)? Are there any you are interested in producing?

Question Set 3 (Budget Review)

For the crops you produce, we would like to review budgets we have to see if they are consistent with your experience with input use and, if possible, costs. These production budgets were developed from past budgets for Missouri and surrounding states so they may not be correct. They may also need to be adjusted to fit the production method you are using or for your region.

Question Set 4 (Input acquisition)

Where do you currently source your various inputs from?

Seed, fertilizer, pesticides, herbicides, fungicides, labor, water for irrigation, building materials, irrigation equipment, specialized production machinery, other items.

Special Labor Questions:

Where do you currently source your labor?

Have you ever tried to hire more labor and were you successful?

If you wanted to double the size of your operation would labor be a major concern?

Question Set 5 (Obstacles to Production)

What obstacles have you encountered in producing your specialty crops? For example, are there any particular pests such as insects, fungi, etc. that have caused problems, are there any herbicides, pesticides, fungicides used to treat other crops that have created problems for your crops, are there any problems accessing the quantity of labor you need, are their irrigation constraints, are their climate issues, do you have access to credit, internet access, any other obstacles?

Question Set 6 (Marketing Pathways)

How do you market your harvested crops? For example, do you sell them at a farmer's market, take them to an auction market, sell them directly to local grocery stores, market them online, sell them to wholesaler, sell them to a processor, etc.?

In the case of roadside stands and farmers' markets, relative to pricing in retail markets such as grocery stores, how do you price your specialty crops (10% higher, the same, 10% lower, etc.)?

Are there any specific characteristics that you notice your buyers are looking for in your crops?

Question Set 7 (Market expansion)

Do you have any interest in expanding your production of fruit and vegetables if there was demand for your production (similar price levels or higher price levels)? If so, how much is the most you would be willing to expand?

Would you be interested in producing fresh fruit and vegetables for institutional markets such as schools, hospitals, prisons, etc. if it was necessary for these products to flow through a cooperative or packing house to lightly process or package the products in usable forms for these entities?

If you could obtain a higher price and continuous demand for your products, would you be willing to work through a cooperative/packing house, etc. with other growers to produce enough volume to obtain a contract of this nature?

Would you consider producing for the fresh or processed markets under contract if the contracts offer a premium over your current marketing path?

Would you consider producing products for a processor in addition to, or instead of, the fresh market? If so, which fruits and/or vegetables would you be most interested in producing?

Question Set 8 (Greenhouse/Protected Culture Production)

If not already doing so, would you consider any type of protected culture production? If so, what types?

If a capital-intensive option for producing vegetables and fruits in a greenhouse environment that allowed more production with less labor would you be interested in considering the option?

Next Steps:

If we need to clarify or follow up with a question, how is it best to contact you? Is there any time we could come back and visit you during the summer or is it too busy?

We would like to come back and share with you a summary of the results from our discussions with other farmers, our analysis of the competitive position of Missouri fruit, vegetable, and tree nut growers relative

to other states, and what we learned in our investigation of alternative marketing pathways visiting with institutional buyers, local markets, wholesalers, retailers, and e-commerce companies. Would you be available to meet again in late October or early November?

Appendix C – Local Grocery Store Interview Questions

The following survey is part of a study to evaluate the economic viability of expanding fruit and vegetable production in Missouri. The first phase of the project focused on interviewing commercial fruit and vegetable growers across the state to establish challenges to expanding production and their desire to expand production. We have learned that there is a strong desire to expand production but many growers feel challenged in accessing markets for their production. With this portion of the survey, we are trying to help growers understand if there is interest in their products from grocery stores and, if so, what are the best ways for them to do that. The results of these interviews will be included in a guide to marketing for growers designed to help them be prepared and understand what is necessary when they talk to you.

Do you currently purchase locally sourced fruits or vegetables? Yes/No

If you do not, would you be interested in talking to local farmers about purchasing their products?

Yes/No

If so:

What types and quantities of fruits and vegetables do you purchase?

How often do you purchase it? Is it seasonal (if so, please indicate months purchased) or year around?

Would you be interested in purchasing more locally sourced fruits or vegetables and if so what types and how much more?

What types of arrangements do you have with local farmers to supply fruits and/or vegetables?

What do farmers need to do to gain access to your store for their locally sourced fruits and vegetables? (volume requirements, regular delivery schedule, food safety regs, etc.)

What do you see as the biggest obstacle to buying local produce from farmers?

How do your year-round food service vendors react to your sourcing local produce?

What types of arrangements that you have with local growers are the most successful and why?

What types of arrangements that you have with local growers have not been successful and why?

Would you like us to provide a copy of the final study report to you? Yes/No

Appendix D – Fruit and Vegetable Processor Interview Questions

Question Set 1 (Historical Experiences with Specialty Crop Production)

Please tell us a little about the history of your business and your past experiences with processing.

Question Set 2 (Crops Produced):

Why types of fruit, vegetables, or tree nuts do you currently process, (volumes if you can share those)?

Question Set 3 (Processing)

What are the major steps the commodities go through in your process? For example, please describe how you procure your products, the stages of processing such as unloading, washing, cutting, cooking, packaging, distributing, etc.

Question Set 4 (Processing costs)

We appreciate that costs may be sensitive and confidential information. Can you give us a sense of the share of costs attributed to raw inputs, energy, labor, overhead, and capital investment?

We know from other studies that processing costs can vary by scale of the operation. As we look at Missouri fruit, vegetable, and tree nut growers, we know that attaining a critical mass of production for scale processing could be an issue. We want to understand how processing scale affects your cost so that we can tell growers they need X volume in order for a processor to be interested in building a facility in their area. Can you tell us how those costs would change with the scale of your operation? Or, can you refer us to a source of this information?

Question Set 5 (Fruit, vegetable, and tree nut inputs)

How do you source your inputs? Are there any specific criteria they need to meet? Can production for the fresh market be used in the processed market? Are there specific varieties that you require?

What quantity of your inputs do you purchase or have grown under contracts?

Do you require growers to meet certain compliance standards and how do you enforce those (i.e., on-farm inspections, etc.)?

Question Set 5 (Obstacles to Production)

What obstacles have you encountered as a processor? For example, having sufficient supplies, supply quality, labor, sanitary regulations, community regulations, capital, water availability, demand for your products, being competitively priced, distribution?

Question Set 6 (Marketing Pathways)

How do you sell your products? Roughly what shares flow through wholesale markets, grocery stores, consumers, etc.

Are there any specific characteristics that you notice your buyers are looking for?

Are there any specific characteristics of your products that your premium price for?

Question Set 7 (Market expansion)

Do you have any interest in expanding your processing capacity?

What would be signals for you to expand?

Are there any new markets you would like to participate in?