

Enterprise Budget for Cucumbers, Year 2

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Cooperators:

- Ann Franzenburg - Van Horne
- Emma Johnson - Central City
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In a Nutshell

- Three farmers provided enterprise budgets for cucumber production in 2016.
- Cucumbers were grown in a heated greenhouse (Ann Franzenburg), an unheated high tunnel (Emma Johnson), and an open field (Jan Libbey).
- Franzenburg, Johnson, and Libbey also provided enterprise budgets for year one of this study in 2015.

Key Findings

- Labor was the largest expense for Johnson and Libbey, accounting for 74% and 94% of their total expenses, respectively. Labor was only 40% of Franzenburg's costs.
- Labor breakdown by task differed at each farm. The largest tasks on each farm, measured in hours, were: pruning and trellising at Franzenburg, field maintenance at Johnson, and harvesting and packing at Libbey.
- Production in the greenhouse at Franzenburg's provided highest yield (lb fruit/ft²) and number of fruit per ft².
- Among the three farms, outdoor production at Libbey's had the highest net income per pound.

Project Timeline:

March 2016 - November 2016

Background

In 2015, Franzenburg, Johnson, and Libbey kept enterprise budgets for the cucumbers as Year 1 of this project with Practical Farmers (Kolbe et al., 2015). In past years, Practical Farmers' research cooperators have done enterprise budgets



The moveable high tunnel at Johnson's, prepped for cucumber planting in 2015.

in high tunnels that have included, in part, production information about cucumbers (Worley et al., 2011, 2012). Many university extension programs also offer enterprise budgets examples for cucumbers. Perhaps the best example for high tunnels comes from Iowa State University: Chase and Naeve (2013) provide a high tunnel budget example with cucumbers, breaking down expenses and labor, showing a net income of \$0.38/ft². Penn State researchers have a production budget example for cucumbers that shows net income of \$2,064 per acre (Orzolek et al., 2014). At the University of Nebraska, a 2006-2007 farm example of high tunnel cucumbers showed net losses of \$1.02 per ft² (2006) and \$0.05 per ft² (Fullerton and Wilson, 2011). Rutgers University provides only cost of production

estimates per acre, calculating \$3,038 per acre (Rutgers Extension, 1997).

While these studies are valuable, producers in the present study still had questions about the differences in their variety choices and management decisions, and how those variations by farm impacted the bottom line. The breakdown of labor by task in this study – for field, high tunnel, and greenhouse, is of particular interest.

Year 1 (2015)

In Year 1 of this study (2015), Franzenburg had the highest yields (lb/ft²), but also the highest costs and lowest (but still excellent) net income ratio (0.50). For 2016, Franzenburg was specifically looking for places to make labor more efficient.

Table 1

Production Practices for Cucumbers, 2016

Farm	Structure and protection	Production Area (ft ²)	Transplant date and stage	Within row spacing	Irrigation	Variety	Trellis
Franzenburg (Pheasant Run Farm)	Greenhouse (no heat for cucumbers in 2016)	405	Seeded trays April 15, transplanted to greenhouse Apr. 28 & May 20. Direct Seeded May 30 & Aug. 18	Staggered double row, 12 in. btwn row, 24 in. in-row	Drip	Tyria	Plastic vine clips on string from purlins.
Johnson (Buffalo Ridge Orchard)	Moveable high tunnel, landscape fabric (unheated)	1,200	Seeded peat pods Apr. 20; transplanted to HT May 11	22 in.	Drip	Taurus	Hung netting from purlins
Libbey (One Step at a Time)	Outdoors, ground cloth	550	Direct seeded, June 17	Hills spaced 24 in.; 4 plants per hill	Drip	Marketmore	none

In 2015, Franzenburg spent a lot of time, particularly, trellising and pruning, which makes harvest more efficient. Johnson used less labor to grow about the same volume of cucumbers as Franzenburg in 2015, but used more space. She was considering changing away from trellising with netting, but after seeing the difference in labor with Franzenburg's string method, she will use the net another year. Libbey did not do any trellising outdoors, but used more labor to harvest. She had the highest net income per pound, but the lowest net income per fruit and per area.

All three farmers chose to repeat the project, with some improvements to recordkeeping, to compare their own results over two years.

Objective:

1. Determine differences in enterprise budgets for cucumbers at three farms (two in structures, one outside)
2. Determine differences in labor efficiency for various tasks.

Methods

Each farm planted and managed cucumbers according to their own timing, markets, and preferred practices. Data collected from each farm was standardized to provide insight into cost and labor efficiency at each farm. Planting and management details can be found in **Table 1**. Two of the farmers, Franzenburg and Johnson, tracked data on cucumbers raised in structures, which are trellised to maximize space and lengthen the harvest window. All growers used drip irrigation.

At Pheasant Run Farm near Van Horne in Benton County, Ann Franzenburg trellised cucumbers in her greenhouse (unheated in 2016) with orange twine and plastic vine clips. She grows Tyria cucumbers, which are a very long, large, and expensive greenhouse variety from Johnny's; seeds cost about \$1 each. For Franzenburg, the extra expense of seed is worth it, her cucumbers average about 1.5 lb each, and she typically gets two cucumbers per vine per week for the 20 weeks she harvests. Ann sells primarily to grocery stores and restaurants.

Emma Johnson at Buffalo Ridge Orchard near Marion in Linn County grows a long, Japanese cucumber, Taurus, in an unheated, moveable high tunnel. She trellised using plastic netting, and her cucumbers average 0.60 lb each. Emma's cucumbers are sold at farmers market, to institutional buyers, and distributed in the farm's CSA boxes. Johnson reduced her production for 2016; in 2015 they over-produced for their markets.

Jan Libbey at One Step at a Time Gardens near Kanawha in Hancock County grows cucumbers outdoors without cover. Libbey direct seeds Marketmore, a popular slicing cucumber. Libbey's cucumbers averaged 0.43 lb each. Her cucumbers are primarily used in the farm's CSA boxes, but in 2016 she sold 18 percent as wholesale through North Iowa Fresh.

For data collection on the enterprise budget, an Excel workbook was provided to each farmer (modified from a Healthy Harvest of North Iowa workbook [Libbey, unpublished]). The workbook contained multiple worksheets, including a labor log distributed by task and cost calculations for land, labor, machinery, buildings, and transplant, field, and irrigation supplies. The farmers completed the workbooks throughout the growing season and emailed the completed workbooks to PFI for analysis.

Enterprise data were analyzed to discern differences in revenue, costs, net income, and labor hours by task. These data were not analyzed as replicated trials, only compared as enterprises by farm.



Tyria cucumbers producing well in Franzenburg's greenhouse.

Results and Discussion

Weather at the three farms in 2016 was acceptable for cucumber production, though Franzenburg noted the hot June might have stressed the cucumbers in the unheated greenhouse. Because Johnson and Franzenburg grow under structures, each farm's sensitivity to weather was different. All farms had drip irrigation, so dry weather was not a factor. July, August and September had higher than average rainfall at Libbey's. Extreme weather played a surprising role in Johnson's cucumber season. A high wind blew the cover off the high tunnel, which allowed some insect and bacterial pests to get in before the tunnel was re-covered. Weather information is shown in **Table 2**.

Enterprise Budgets for Cucumber Production

For each table and figure that follow, results for 2015 (Year 1 of the study) and 2016 (Year 2) are provided, but this report will mainly discuss the 2016 data (discussion of 2015 data can be found in Kolbe, et al., 2015).

Net Income

Revenue, costs, and net income were analyzed three ways: per pound sold, per cucumber sold, and per square-foot in production. As seen in **Figure 1**, Libbey earned the most net income per pound at \$1.73, followed by Johnson (\$1.19/lb) and then Franzenburg (\$0.32/lb). Net income per cucumber was more similar by farm, ranging from \$0.72/cucumber for Johnson to Franzenburg's \$0.48/cucumber. Per square-foot, Johnson again earned highest, netting \$2.37/ft², followed by Libbey (\$1.21/ft²) and then Franzenburg (\$1.14/ft²). Franzenburg and Johnson both noted they had a difficult year with pests (Johnson) and poor establishment (Franzenburg), though all farms saw less net income per unit in 2016.

Yield and Revenue

Looking at the enterprise budgets in **Table 3**, differences in production scale and expense categories begin to emerge. The vertical growing in the greenhouse and high tunnel allow Franzenburg and Johnson to have higher yields, and to produce larger-variety cucumbers (Tyria and Taurus). The role of variety stands out starkly between Franzenburg and Libbey; Franzenburg harvested only 13 more cucumbers than Libbey, but Franzenburg's cucumber harvest weighed over 1,000 lb more than Libbey's.

Table 2 Monthly Rainfall (in.) and Growing Degree Days (GDD) (base 50°F) at the Three Farms^a

Month	Franzenburg and Johnson				Libbey			
	GDD		Rainfall (in.)		GDD		Rainfall (in.)	
	2016	Avg.	2016	Avg.	2016	Avg.	2016	Avg.
April	223	198	3.4	3.2	166	163	2.1	3.0
May	442	406	2.3	4.1	341	365	4.5	4.0
June	641	601	8.0	4.8	607	564	4.1	4.7
July	681	729	3.8	4.0	664	695	6.3	3.9
Aug.	652	675	6.0	3.9	638	637	5.7	3.8
Sept.	475	421	6.5	3.9	418	427	8.4	3.4
Oct.	249	249	1.7	2.5	226	219	2.5	2.2
Nov.	121	- ^b	1.9	1.57	114	- ^b	1.1	1.97

^aRainfall and growing degree day data accessed from weather stations nearest farm locations (Iowa Environmental Mesonet, 2015). Franzenburg and Johnson: CEDAR RAPIDS1; Libbey: Iowa – North Central Climate Division.

^bNo historical data was available for November growing degree days.

Figure 1

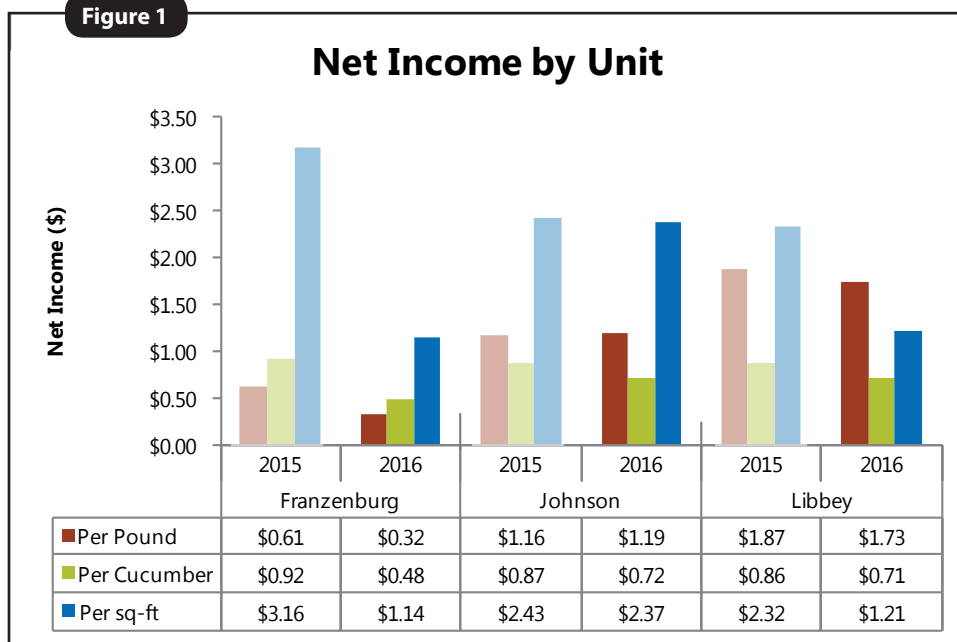


Figure 1. Net income (gross revenue – total costs) calculated per pound, per cucumber and per ft².



Cucumbers in the high tunnel at Johnson's in June, 2015.

Table 3

Cucumber Enterprise Budget

	Franzenburg		Johnson		Libbey	
	2015	2016	2015	2016	2015	2016
Marketable Harvest (lb)	3,693	1,448	3,755 ^a	2,380	372	386
Marketable Harvest (count)	2,462	965	5,007	3,951	808	942
Marketable lb/ft ²	5.18	3.57	2.09	1.37	1.24	0.70
Marketable count/ft ²	3.46	2.38	2.78	3.29	2.69	1.71
Cull count	- ^b	- ^b	725	488	106	175
GROSS REVENUE	\$4,534.95	\$1,755.00	\$6,221.00	\$4,100.00	\$922.75	\$950.52
Revenue per lb	\$1.23	\$1.21	\$1.66	\$1.72	\$2.48	\$2.46
Revenue per cucumber	\$1.84	\$1.82	\$1.24	\$1.04	\$1.14	\$1.01
Revenue per ft ²	\$6.36	\$4.33	\$3.46	\$3.42	\$3.08	\$1.73
<i>Transplant Supply Costs</i>	\$270.75	\$363.70	\$16.75	\$14.35	\$0.00	\$0.00
<i>In-field Supply Costs</i>	\$266.00	\$57.60	\$208.30	\$156.74	\$6.31	\$6.81
<i>Irrigation system Cost</i>	\$8.87	\$90.15	\$48.56	\$46.94	\$5.66	\$3.89
<i>Machinery Cost</i>	\$2.17	\$2.17	\$19.00	\$14.00	\$1.98	\$1.98
<i>Building/Structure Cost</i>	\$448.88	\$258.45	\$104.50	\$79.17	\$0.06	\$0.40
<i>Land Cost</i>	\$4.09	\$2.30	\$12.00	\$8.26	\$1.62	\$2.97
<i>Total Labor Cost</i>	\$1,280.00	\$520.00	\$1,440.00	\$937.50	\$210.50	\$268.30
TOTAL COSTS (ANNUAL)	\$2,280.75	\$1,294.37	\$1,849.11	\$1,256.95	\$226.12	\$284.35
Per lb cost	\$0.62	\$0.89	\$0.49	\$0.53	\$0.61	\$0.70
Per fruit cost	\$0.93	\$1.34	\$0.37	\$0.32	\$0.28	\$0.28
Per ft ² cost	\$3.20	\$3.20	\$1.03	\$1.05	\$0.75	\$0.52
Efficiency Ratio (Costs / Revenue)	0.50	0.74	0.30	0.31	0.25	0.30
NET INCOME	\$2,254.20	\$460.63	\$4,371.89	\$2,843.05	\$696.63	\$666.17
Per lb net income	\$0.61	\$0.32	\$1.16	\$1.19	\$1.87	\$1.73
Per fruit net income	\$0.92	\$0.48	\$0.87	\$0.72	\$0.86	\$0.71
Per ft ² net income	\$3.16	\$1.14	\$2.43	\$2.37	\$2.32	\$1.21
Net income ratio (net / gross)	0.50	0.26	0.70	0.69	0.75	0.70

^a (2015) Though not included in the harvest data, about 18% of Johnson's total harvest went to the food pantry in 2015.

^b Franzenburg has a strong market outlet for seconds, so no culls were reported.

Production Costs

Labor cost (Labor cost (at \$10-15/hour) was the largest contributor to production costs at every farm. For Libbey, labor cost accounted for 94 percent of total costs; for Johnson and Franzenburg labor cost was 75 percent and 40 percent of total cost, respectively. Looking beyond labor, the breakdown of cost categories varied by farm. This breakdown can be seen in actual dollar amounts in **Table 3**, and by percent in **Figure 2**. For Libbey, the remaining costs fall mostly into field and irrigation supplies, but those costs represent only 6 percent of her total costs (**Figure 2**). Reflecting her high tunnel use, Johnson's cost breakdown falls largely into field supplies and building/structure. Field supplies for her include the trellis netting, landscape fabric, and organic pesticides. For Franzenburg, 60 percent of her costs are non-labor. The bulk of those non-labor expenses are transplant supplies – namely the Tyria seed and the annualized cost of the greenhouse space.

Overall, Franzenburg had the highest costs per pound, per fruit,

and per square-foot, as seen in **Table 3**. Libbey had the next highest cost per pound, but Johnson had the next highest per fruit and per square-foot, which makes sense with Johnson's trellised production and larger Japanese fruit (Taurus).

All three farms showed adequate net income ratios (**Table 3**) for their cucumber enterprise budgets. Libbey's outdoor production was highest (0.70) followed closely by Johnson's at 0.69 and then Franzenburg's at 0.26. Though net income can vary widely, 0.35 and higher would be considered excellent (Chase, 2012).

Labor for Cucumber Production

As discussed in the enterprise budget section, labor is the primary cost for each farm's cucumber production. Are these hours well spent? **Figure 3** provides the gross revenue and net income per labor-hour by farm. Gross revenue per labor-hour, shown in red, ranges from \$33.80 for Franzenburg to \$53.90 for Libbey, while net income ranges from \$8.90 per labor-hour for Franzenburg to \$38.70 for Libbey.

By percent of total labor-hours at each farm, trellising and pruning, harvesting and packing, and field maintenance accounted for the largest proportion of labor (**Figure 4**). On Franzenburg's farm, trellising and pruning accounted for 37 percent of total labor-hours; in 2015 the same task was 55 percent of the total. According to Franzenburg, credit for the large gain in efficiency is due to Jill Beebout of Blue Gate Farm, who provided Franzenburg with a new trellising method after the presentation of this report at the 2015 Practical Farmers Cooperators' Meeting, where Franzenburg had voiced her dissatisfaction with her current method. The next largest proportions at Franzenburg were marketing and sales, and harvesting and packing, both with 23 percent of the total.

For Johnson, though all her cucumbers were trellised using netting hung from the high tunnel purlins, trellising and pruning accounted for only 12 percent of her farm's cucumber labor-hours. Field maintenance, including bed-making, irrigation, fertilizer, and pest management accounted for 30 percent of the labor. Harvesting and packing was the second-most time-consuming task, at 26 percent of the total cucumber labor.

At Libbey, the only farm reporting on outdoor cucumber production, harvesting and packing took the most time (61 percent of labor) followed by field maintenance and marketing and delivery (both 17 percent). Libbey's 2015 data included significant weeding time, which was not separated out in 2016. A detailed breakdown of labor-hours can be found in **Table 4**.

Averaging labor-hours over yield, fruit number and production area, a logical trend emerges in **Figure 5**. The farm with the largest fruit (Franzenburg, who grows Tyria) has the least labor-hours per pound sold, followed by Johnson (2nd largest cucumbers), and lastly Libbey, who had the smallest cucumber variety. This trend was reversed when labor-hours were averaged by number of fruit (bigger fruit equated to more labor/fruit). Franzenburg had the most labor-hours per square-foot (7.7 min.); followed by Johnson at 4.69 min./ft² and Libbey at 1.93 min./ft². Overall, the three farms were more efficient with their labor in 2016 than in 2015.

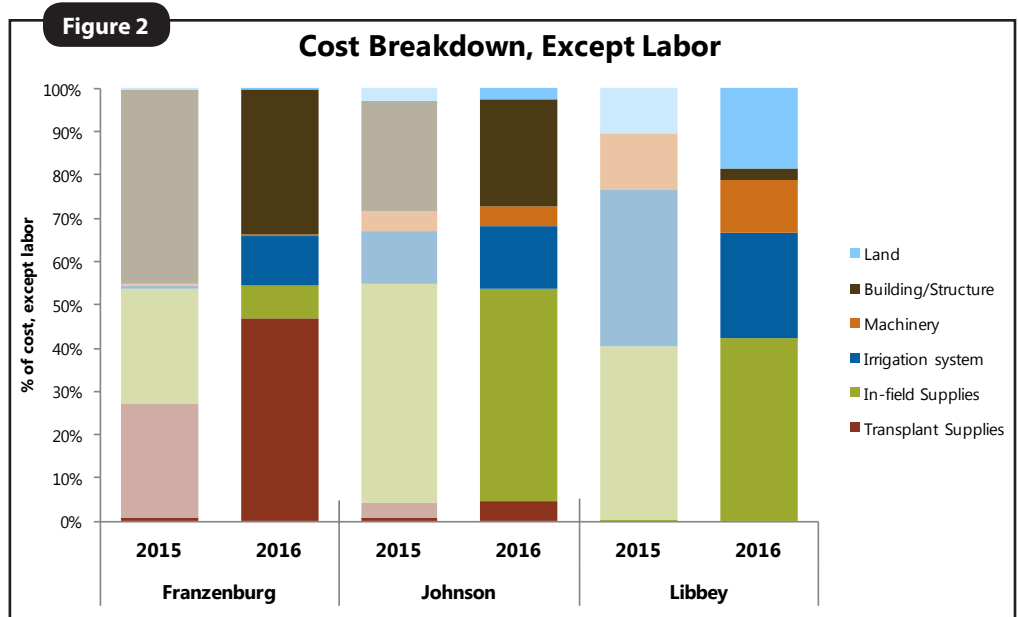


Figure 2. Breakdown of non-labor costs by category.

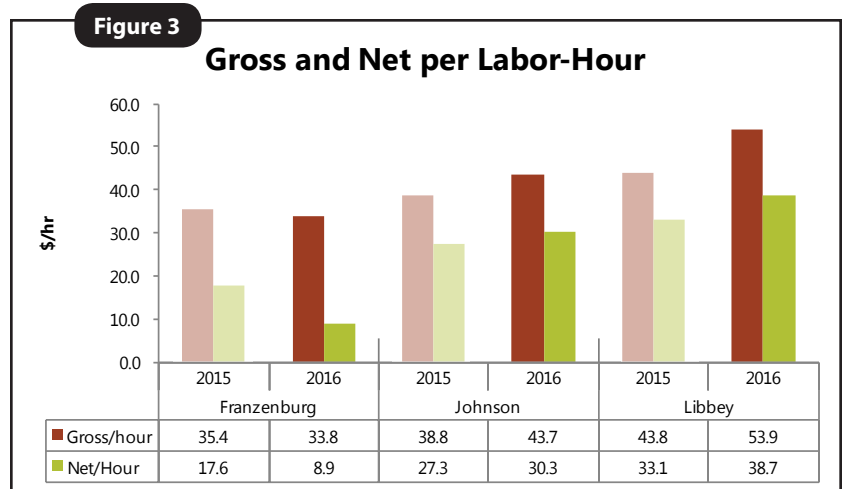


Figure 3. Gross revenue and net profit per labor-hour for each farm.

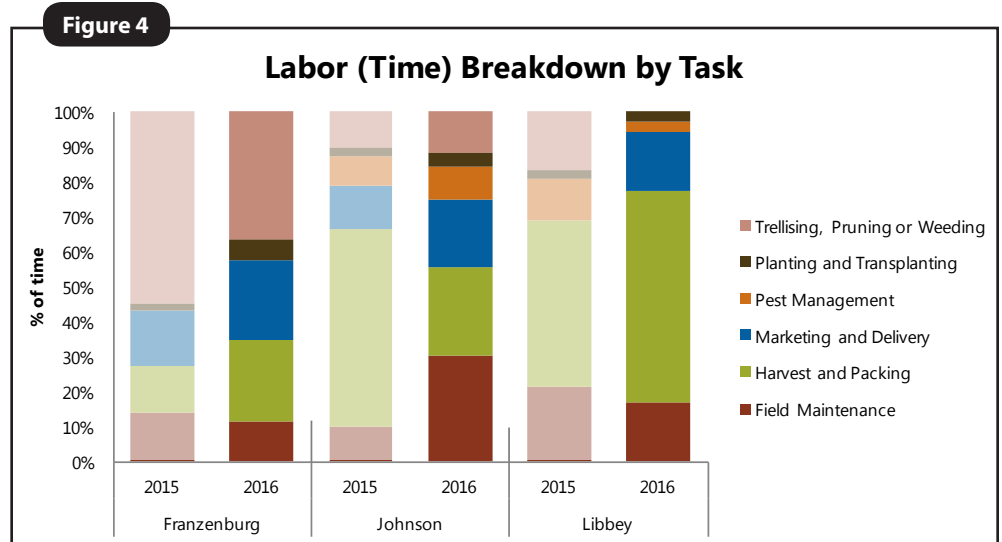


Figure 4. Cucumber labor-hours broken down by task on each farm.

Table 4

**Labor-hours and cost broken down by category
and averaged over lb sold, number of fruit sold, and production area in square feet.**

Farm	Category	Hours	Annual Cost	% of Total Labor	Min./lb	Min./Cuke	Min./ft ²	\$/lb	\$/Cuke	\$/ft ²	
Franzenburg	2015	Field Maintenance	18	\$180	0.14	0.29	0.44	1.52	0.05	0.07	0.25
		Harvesting	17	\$170	0.13	0.28	0.41	1.43	0.05	0.07	0.24
		Marketing	20	\$200	0.16	0.32	0.49	1.68	0.05	0.08	0.28
		Planting	3	\$30	0.02	0.05	0.07	0.25	0.01	0.01	0.04
		Pruning and Trellising	70	\$700	0.55	1.14	1.71	5.89	0.19	0.28	0.98
		Total	128	\$1,280	1.00	2.08	3.12	10.78	0.35	0.52	1.80
	2016	Field Maintenance	6	\$60	0.12	0.25	0.37	0.89	0.04	0.06	0.15
		Harvesting	12	\$120	0.23	0.50	0.75	1.78	0.08	0.12	0.30
		Marketing	12	\$120	0.23	0.50	0.75	1.78	0.08	0.12	0.30
		Planting	3	\$30	0.06	0.12	0.19	0.44	0.02	0.03	0.07
		Pruning and Trellising	19	\$190	0.37	0.79	1.18	2.81	0.13	0.20	0.47
		Total	52	\$520	1.00	2.16	3.23	7.70	0.36	0.54	1.28
Johnson	2015	Field Maintenance	16	\$182	0.10	0.26	0.19	0.54	0.05	0.04	0.10
		Harvest and Packing	90	\$900	0.56	1.44	1.08	3.00	0.24	0.18	0.50
		Marketing and Delivery	20	\$200	0.12	0.32	0.24	0.67	0.05	0.04	0.11
		Pest Management	14	\$135	0.08	0.22	0.16	0.45	0.04	0.03	0.08
		Planting and Transplanting	4	\$40	0.02	0.06	0.05	0.13	0.01	0.01	0.02
		Trellising	17	\$165	0.10	0.26	0.20	0.55	0.04	0.03	0.09
	Total	160	\$1,622	1.00	2.56	1.92	5.34	0.43	0.32	0.90	
	2016	Field Maintenance	28	\$283	0.30	0.71	0.43	1.41	0.12	0.07	0.24
		Harvest and Packing	24	\$240	0.26	0.61	0.36	1.20	0.10	0.06	0.20
		Marketing and Delivery	18	\$180	0.19	0.45	0.27	0.90	0.08	0.05	0.15
		Pest Management	9	\$85	0.09	0.21	0.13	0.43	0.04	0.02	0.07
		Planting and Transplanting	4	\$40	0.04	0.10	0.06	0.20	0.02	0.01	0.03
Trellising		11	\$110	0.12	0.28	0.17	0.55	0.05	0.03	0.09	
Total	94	\$938	1.00	2.36	1.42	4.69	0.39	0.24	0.78		
Libbey	2015	Field Maintenance	5	\$45	0.21	0.73	0.33	0.90	0.12	0.06	0.15
		Harvest and Packing	10	\$101	0.48	1.62	0.75	2.01	0.27	0.12	0.34
		Pest Management	3	\$25	0.12	0.40	0.19	0.50	0.07	0.03	0.08
		Planting and Transplanting	1	\$5	0.02	0.08	0.04	0.10	0.01	0.01	0.02
		Weeding	4	\$35	0.17	0.56	0.26	0.70	0.09	0.04	0.12
		Total	21	\$211	1.00	3.40	1.56	4.21	0.57	0.26	0.70
	2016	Field Maintenance	3	\$54	0.17	0.46	0.19	0.32	0.14	0.06	0.10
		Harvest and Packing	11	\$138	0.61	1.66	0.68	1.17	0.36	0.15	0.25
		Pest Management	1	\$8	0.03	0.08	0.03	0.05	0.02	0.01	0.01
		Planting and Transplanting	1	\$8	0.03	0.08	0.03	0.05	0.02	0.01	0.01
		Marketing and Delivery	3	\$45	0.17	0.47	0.19	0.33	0.12	0.05	0.08
		Total	18	\$252	1.00	2.74	1.12	1.93	0.65	0.27	0.46

Conclusions and Next Steps

For this project, three farmers provided enterprise budgets for their 2016 cucumber production, building on Year 1 of the project from 2015. In 2015, Franzenburg had the highest net income per square-foot and per cucumber, but as for the 2016 data, she said, "This is what it looks like to have a bad year of cucumbers!"

Franzenburg still had the highest yields in pounds and count per square-foot and maintained an acceptable net income from her cucumbers, but struggled with some plant health issues. "We lost heat in the greenhouse in the early spring and then had some problems with our poly cover on the greenhouse," said Franzenburg. "Even though we planned to have two full beds, we probably harvested off only half that, due to loss of plants and/

or late production by re-plants. If we'd had better production, we would have made more money. We weren't meeting demand, especially early in the season. We're going to plant more next year, and are going to direct seed the beds as those plants seemed the most vigorous."

Franzenburg also gave a nod to a couple benefits of the season, she said, "Two things helped us have a decent net price per cucumber: we realized significant labor savings using the Jill Beebout method of hanging trellising strings, and the fourth planting of fall cukes (Aug. 18) were supplied for free by Johnny's." Franzenburg also has a strong market for seconds, so even her "ugly" cucumbers were sold for wholesale price.

Emma Johnson, who grew cucumbers in the high tunnel at Buffalo Ridge Orchard, grew and sold the most cucumbers in number and pounds among the three farms, like they did in 2015. Though Johnson's crop had new issues with pests and diseases, the farm maintained their net income, perhaps by better meeting their market demand with reduced production (in 2015 they donated 18 percent of their harvest). Said Johnson, "Aphids were our biggest problem, but for the first time we also had cucumber beetle and powdery mildew. Normally the plants are protected in the high tunnel because we have insect barrier on the roll-down sides, but this year the cover of the hoop house was blown off, which allowed the plants to get rained on and cucumber beetle moved in before we got the hoop house re-covered. Because of this, we spent more time, and money, applying organic sprays than we would have liked." There was one highlight of the additional pest pressure. Said Johnson, "We ended up using sticky traps for the cucumber beetles, and they worked just as well as the spray – very good to know! Even though we grow cucumbers every year, there's still always something to learn."

Jan Libbey from One Step at a Time Gardens was the only farmer who grew cucumbers outside a structure, and direct-seeded. 94 percent of Libbey's costs went toward labor, which may be reflective of her smaller production scale, and low infrastructure costs. In her outdoor production, there is no trellising or pruning, but it does take longer to hunt for fruits to harvest. Like in 2015, Libbey had the highest net income per pound among the three

Figure 5

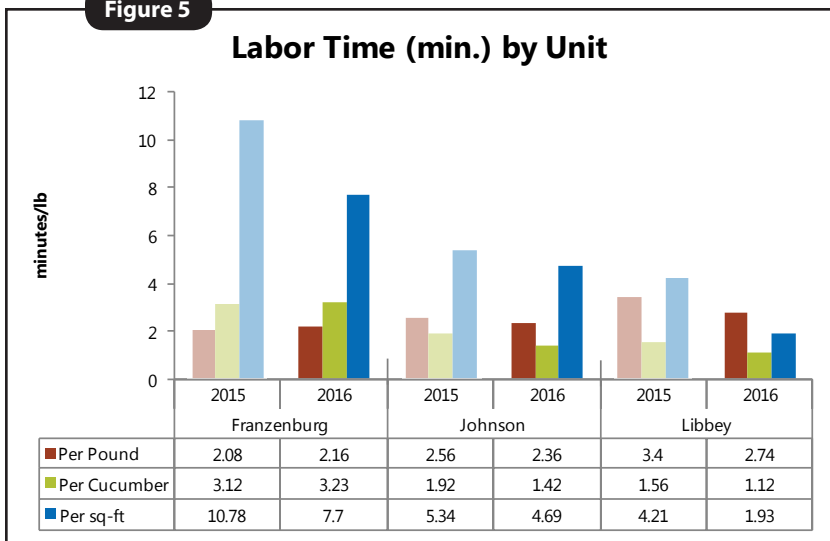


Figure 5. Labor-hours converted to minutes, averaged by pound sold, number of fruit sold, and production area in square feet.

farms. Libbey reported high yields, 21 lb/plant (better than their average since 2008), in the 25 cucumber hills they direct seeded. "We had very little pest pressure and the plants looked great until about half-way through the harvest when a leaf disease – anthracnose, perhaps – began to take hold." Libbey used a copper spray on the disease and was pleased with the production, overall.

The three farmers in this study did a good job of including expenses related to cucumber production – even better than in 2015 – but there is still room for improvement. Of note, cooler use, packhouse supplies, and CSA marketing and delivery time reported varied by farm.



Cucumbers in the field at Libbey's on Aug. 14.

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PFI Cooperators' Program

PFI's Cooperators' Program gives farmers practical answers to questions they have about on-farm challenges through research, record-keeping, and demonstration projects. The Cooperators' Program began in 1987 with farmers looking to save money through more judicious use of inputs. If you are interested in conducting an on-farm trial contact Stefan Gailans @ 515-232-5661 or stefan@practicalfarmers.org.