



Enterprise Budget for Cucumbers

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Cooperators:

- Ann Franzenburg - Van Horne
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Funding By:

CERES

Web Link:

http://bit.ly/pfi_horticulture

In a Nutshell

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

Key Findings

- Labor was the largest expense for all farms, ranging from 56% of enterprise expenses to 93%.
- Trellising and pruning were the biggest labor task for Ann, while harvesting and packing was the largest portion of labor for Emma and Jan.
- Production in the heated greenhouse at Ann's provided highest yield (lb fruit/ft²) and number of fruit per ft², and also the highest net income per ft² and per fruit.
- Among the three farms, outdoor production at Jan's had the highest net income per pound.

Project Timeline:

March 2015 - November 2015

Background

In past years, Practical Farmers' research cooperators have done enterprise budgets 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



Cucumbers growing up the trellis netting at Buffalo Ridge Orchard on June 23, 2015

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. Jan Libbey, from One Step at

a Time Gardens said, "I want to get a good handle on cost of production for our cucumber crop. I also want to participate in the insights gained among the other cooperators on this project." Ann Franzenburg from Pheasant Run Farm and Emma Johnson from Buffalo Ridge Orchard echoed this comment, hoping to find places to improve efficiencies, re-evaluate profit margins, and learn a trick or two from the others.

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.

Table 1

Production Practices for Cucumbers

Farm	Structure and protection (heat?)	Production Area (ft ²)	Transplant date and stage	Within row spacing	Irrigation	Variety	Trellis	Harvest window
Ann (Pheasant Run Farm)	Greenhouse (heated pex in soil)	712.5	Seeded transplants Mar. 31; transplanted to greenhouse Apr. 28	Staggered double row, 12 in. btwn row, 24 in. in-row	Drip	Tyria	Plastic vine clips on string from purlins.	June 25 – Nov. 19
Emma (Buffalo Ridge Orchard)	Moveable high tunnel, landscape fabric (unheated)	1,800	Seeded peat pods Apr. 26; transplanted to HT May 25	22 in.	Drip	Taurus, Taste Jade	Hung netting from purlins	June 21 – Oct. 16
Jan (One Step at a Time)	Outdoors, ground cloth, half with row covers over hoops (unheated)	300	Direct seeded, June 4	Hills spaced 24 in.; 4 plants per hill	Drip	Marketmore	none	Aug. 3 – Sept. 10

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, Ann and Emma, 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 trellised cucumbers in her heated greenhouse with orange twine and plastic vine clips (about nine clips per plant). She grows Tyria cucumbers, which are a very long, large, and expensive greenhouse variety from Johnny's; seeds cost about \$1 each. For Ann, 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 22 weeks she harvests. Ann sells primarily to grocery stores and restaurants.

Emma at Buffalo Ridge Orchard near Central City in Linn County grows two varieties of long Japanese cucumber, Taurus and Taste Jade, in an unheated, moveable high tunnel. She trellised using plastic netting, and her cucumbers average 0.75 lb each. Emma's cucumbers are sold at farmers market, to institutional buyers, and distributed in her CSA boxes. Due to high production this year, Emma donated about 18% of her harvest to food pantries. This amount was not included in her harvest reports for this project (she only reported sales).

Jan Libbey at One Step at a Time Gardens near Kanawha in Hancock County grows cucumbers outdoors without cover, except half of the cucumbers trialed were under a row cover for part of the season this year. Jan direct seeds Marketmore, a popular slicing cucumber. Jan's cucumbers averaged 0.46 lb each. Jan's cucumbers are primarily used in CSA boxes, but sold 13% as wholesale.

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

farmer 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.

Results and Discussion

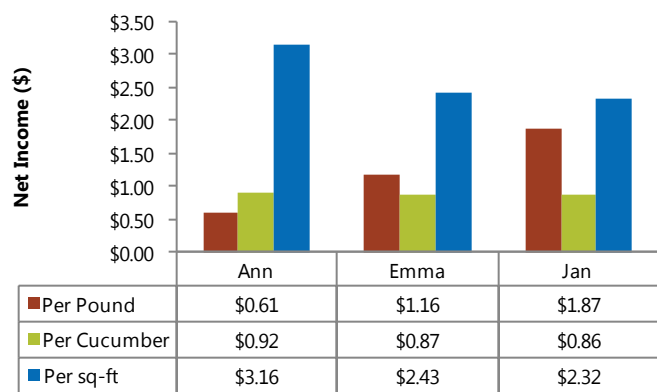
Weather at the three farms in 2015 was favorable for cucumber production in 2015. Because Emma and Ann grew under structures (Ann's heated), each farm's sensitivity to weather is different. Additionally, all farms had drip irrigation, so dry weather was not a factor. Jan, the only outdoor cucumber producer, had lower than average growing degree days in 2015 until September, and then enjoyed a warm fall. May, Aug. and Sept. also had higher than average rainfall. Emma and Ann benefitted from more growing degree days in May, September and November. Weather information is shown in **Table 2**.

Table 2

Total Monthly Rainfall and Growing Degree Days (GDD) (Base 50°F) for 2015 and Long-term Averages*

Month	Emma and Ann				Jan			
	GDD		Rainfall (in.)		GDD		Rainfall (in.)	
	2015	Avg.	2015	Avg.	2015	Avg.	2015	Avg.
May	441	426	4.4	4.7	316	356	4.9	4.3
June	553	619	7.7	5.4	550	565	4.6	5.1
July	658	735	3.4	4.3	639	677	3.8	4.2
Aug.	572	679	2.6	4.6	552	609	6.1	4.0
Sept.	543	476	4.5	3.6	550	430	3.3	2.9
Oct.	213	239	2.8	2.7	211	191	1.2	2.1
Nov.	86	58	4.4	2.3	75	38	3.2	1.6

*Rainfall and growing degree day data accessed from weather stations nearest farm locations (Iowa Environmental Mesonet, 2015). Ann and Emma: CEDAR RAPIDS1; Jan: Iowa – North Central Climate Division.

Figure 1**Net Income by Unit**Figure 1. Net income (gross revenue – total costs) calculated per pound, per cucumber and per ft².**Table 3****Cucumber Enterprise Budget**

	Ann	Emma	Jan
Marketable Harvest (lb)	3,693	3,755*	372
Marketable Harvest (count)	2,462	5,007	808
Marketable lb/ft ²	5.18	2.09	1.24
Marketable count/ft ²	3.46	2.78	2.69
Cull count	-**	725	106
GROSS REVENUE	\$4,534.95	\$6,221.00	\$922.75
Revenue per lb	\$1.23	\$1.66	\$2.48
Revenue per cucumber	\$1.84	\$1.24	\$1.14
Revenue per ft ²	\$6.36	\$3.46	\$3.08
Transplant Supply Costs	\$270.75	\$16.75	\$0.00
In-field Supply Costs	\$266.00	\$208.30	\$6.31
Irrigation system Cost	\$8.87	\$48.56	\$5.66
Machinery Cost	\$2.17	\$19.00	\$1.98
Building/Structure Cost	\$448.88	\$104.50	\$0.06
Land Cost	\$4.09	\$12.00	\$1.62
Total Labor Cost	\$1,280.00	\$1,440.00	\$210.50
TOTAL COSTS (ANNUAL)	\$2,280.75	\$1,849.11	\$226.12
Per lb cost	\$0.62	\$0.49	\$0.61
Per fruit cost	\$0.93	\$0.37	\$0.28
Per ft ² cost	\$3.20	\$1.03	\$0.75
NET INCOME	\$2,254.20	\$4,371.89	\$696.63
Per lb net income	\$0.61	\$1.16	\$1.87
Per fruit net income	\$0.92	\$0.87	\$0.86
Per ft ² net income	\$3.16	\$2.43	\$2.32
Net income ratio (net / gross)	0.50	0.70	0.75

* Though not included in the harvest data, about 17% of Emma's total harvest went to the food pantry this year.

** Ann has a strong market outlet for seconds, so no culls were reported.

Enterprise Budgets for Cucumber Production*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**, Jan earned the most net income per pound at \$1.87, followed by Emma and then Ann. Net income per cucumber was very similar by farm, ranging from \$0.86/cucumber for Jan to Ann's \$0.92/cucumber. Per ft², however, Ann earned highest, netting \$3.16/ ft², followed by Emma and then Jan. This was likely driven by a longer harvest window (22 weeks for Ann, 18 weeks for Emma and six weeks for Jan) and trellising at Ann's (heated greenhouse) and Emma's (high tunnel).

Yield and Revenue

Looking at the enterprise budgets in **Table 3**, differences in production scale and expense categories begin to emerge. Ann and Emma harvested and sold thousands of cucumbers; amounting to more than 3,500 lb each. Jan harvested and sold only 10% of that by weight. The difference in volume produced and the associated marketing strategies changes the revenue per unit. Ann produced the highest yield and number of cucumbers per ft², followed by Emma, then Jan. This carried through to revenue per ft² and revenue per cucumber, but Jan had the highest revenue per pound produced, at \$2.48/lb, followed by Emma at \$1.66/lb and Ann at \$1.23/lb.

Production Costs

Labor cost (at \$10/hour) was the largest contributor to production costs at every farm. For Jan, labor cost accounted for 93% of total costs; for Emma and Ann labor cost was 78% and 56% 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 Jan, the remaining costs fall mostly into irrigation supplies and field supplies, but those costs in represent only 7% of her total costs (**Figure 2**). Reflecting her high tunnel use, Emma's cost breakdown falls largely into field supplies and building/structure. Field supplies for her include the trellis netting, landscape fabric, organic pesticide, and

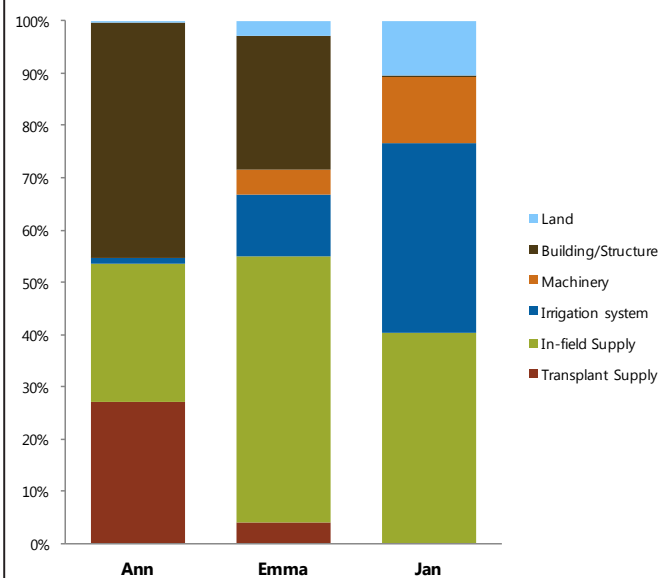
Figure 2**Cost Breakdown, Except Labor**

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

tomato clips. For Ann, 44% of her costs are non-labor, and 45% of non-labor cost is building/structure. The remainder is split mostly into in-field supplies and transplant supplies, which include the expensive Tyria seed.

Overall, Ann had the highest costs per lb, per fruit, and per ft², as seen in **Table 3**. Jan had the next highest cost per pound, but Emma had the next highest per fruit and per ft², which makes sense with Emma’s trellised production and larger Japanese fruit (Tastee Jade and Taurus vs. Marketmore).

All three farms showed strong net income ratios (**Table 2**) for their cucumber enterprise budgets. Jan’s outdoor production was highest (0.75) followed by Emma’s at 0.70 and Ann’s at 0.50. Though net income can vary widely, 0.35 and higher would be considered excellent. These enterprise budgets may be a slightly high estimate because some expense data was not captured (see *Conclusion and Next Steps*).

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 ranges from \$35.43 for Ann to \$43.84 for Jan, while net income ranges from \$17.61 per labor-hour for Ann to \$33.09 for Jan.

By percent of total labor-hours at each farm, trellising and pruning, and harvesting and packing accounted for the largest percentage of labor (**Figure 4**). On Ann’s farm, trellising and pruning accounted for 55% of total labor-hours. The next largest portion at Ann’s was marketing and sales (16%), which included wiping the cucumbers, putting “organic” stickers on each one, packaging for stores, and sales calls.

For Emma, though all her cucumbers were trellised using netting hung from the high tunnel purlins, trellising and pruning accounted for only 10% of her farm’s cucumber labor-hours. Harvesting and packing took the most labor, with 56% of their labor-hours dedicated to the task.



Cucumbers reaching the top of the trellis netting in July at Buffalo Ridge Orchard. July 21.

Figure 3

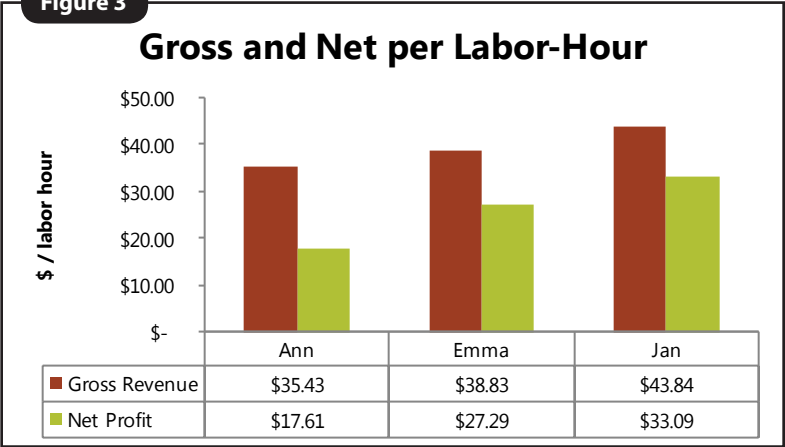


Figure 3. Gross revenue and net profit per labor-hour for each farm.



Tyria cucumbers trellised in the greenhouse at Pheasant Run Farm on Aug. 2.

Figure 4

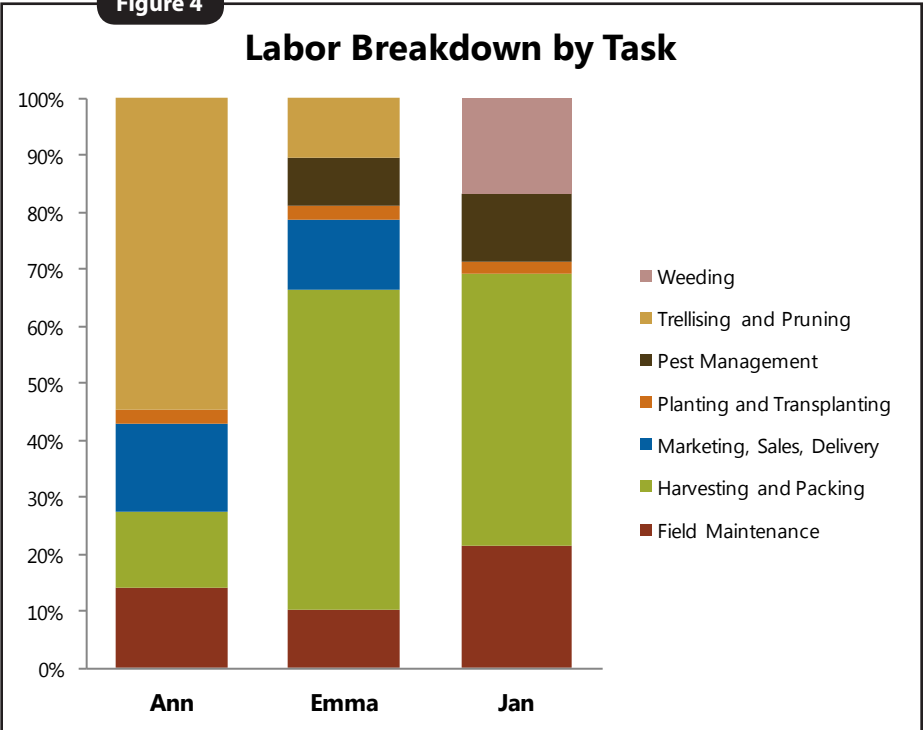


Figure 4. Cucumber labor-hours broken down by task on each farm.

Table 4

Labor-hours and cost by category, averaged by pounds sold, fruit sold and production area

Farm	Category	Hours	Annual Cost	% of Total Labor	Min./lb	Min./cuke	Min./ft ²	\$/lb	\$/cuke	\$/ft ²
Ann	Field Maintenance	18.0	\$180	0.14	0.29	0.44	1.52	\$0.05	\$0.07	\$0.25
	Harvesting	17.0	\$170	0.13	0.28	0.41	1.43	\$0.05	\$0.07	\$0.24
	Marketing	20.0	\$200	0.16	0.32	0.49	1.68	\$0.05	\$0.08	\$0.28
	Planting	3.0	\$30	0.02	0.05	0.07	0.25	\$0.01	\$0.01	\$0.04
	Pruning and Trellising	70.0	\$700	0.55	1.14	1.71	5.89	\$0.19	\$0.28	\$0.98
	Total	128.0	\$1,280	1.00	2.08	3.12	10.78	\$0.35	\$0.52	\$1.80
Emma	Field Maintenance	16.2	\$182	0.10	0.26	0.19	0.54	\$0.05	\$0.04	\$0.10
	Harvest and Packing	90.0	\$900	0.56	1.44	1.08	3.00	\$0.24	\$0.18	\$0.50
	Marketing and Delivery	20.0	\$200	0.12	0.32	0.24	0.67	\$0.05	\$0.04	\$0.11
	Pest Management	13.5	\$135	0.08	0.22	0.16	0.45	\$0.04	\$0.03	\$0.08
	Planting and Transplanting	4.0	\$40	0.02	0.06	0.05	0.13	\$0.01	\$0.01	\$0.02
	Trellising	16.5	\$165	0.10	0.26	0.20	0.55	\$0.04	\$0.03	\$0.09
	Total	160.2	\$1,622	1.00	2.56	1.92	5.34	\$0.43	\$0.32	\$0.90
Jan	Field Maintenance	4.5	\$45	0.21	0.73	0.33	0.90	\$0.12	\$0.06	\$0.15
	Harvest and Packing	10.1	\$101	0.48	1.62	0.75	2.01	\$0.27	\$0.12	\$0.34
	Pest Management	2.5	\$25	0.12	0.40	0.19	0.50	\$0.07	\$0.03	\$0.08
	Planting and Transplanting	0.5	\$5	0.02	0.08	0.04	0.10	\$0.01	\$0.01	\$0.02
	Weeding	3.5	\$35	0.17	0.56	0.26	0.70	\$0.09	\$0.04	\$0.12
	Total	21.1	\$211	1.00	3.40	1.56	4.21	\$0.57	\$0.26	\$0.70

Figure 5

Labor Time per Unit

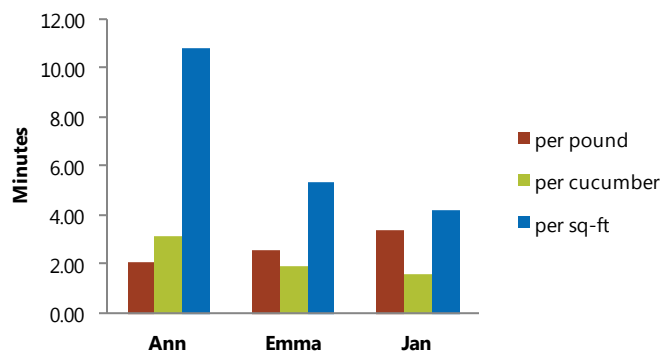


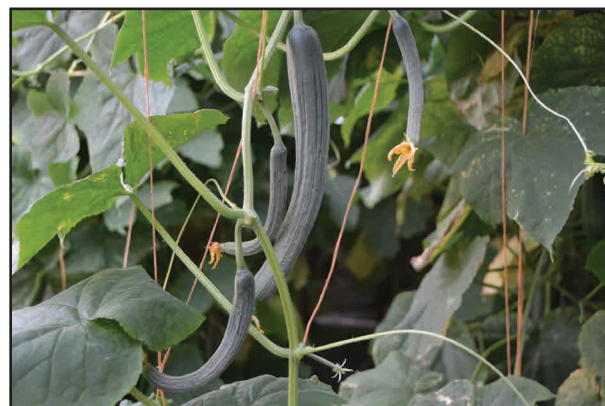
Figure 5. Labor-hours converted to minutes, averaged by pound sold, number of fruit sold, and production area in square feet.

At Jan's, the only farm reporting on outdoor cucumber production, harvesting and packing took the most time (48%) followed by field maintenance (21%) and weeding (17%). Neither Ann nor Emma, who both used structures, recorded labor hours for weeding. 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 (Ann, who grows Tyria) has the least labor-hours per pound sold, followed by Emma (second largest cucumbers), and lastly Jan, 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). Ann had the most labor-hours per ft² (10.78 min.); double the next highest, which was Emma at 5.34 min./ft².



Row covers were used over a 30-foot section at Jan's as part of a project with Iowa State University. Covers were removed in August.



Tyria cucumbers getting started at Pheasant Run Farm. Each cucumber reaches about 14 in. long and weighs about 1.5 lb.

Conclusions and Next Steps

For this project, three farmers provided enterprise budgets for their cucumber production. Cucumbers in the greenhouse (Ann Franzenburg at Pheasant Run Farm) had the highest yields (lb fruit/ft²), but also the highest costs and lowest (but still excellent) net income ratio (0.50). Ann knows her revenue could have been higher. In early August they ripped out a bed of cucumbers that was beginning to show signs of disease. Ann: "For approximately one-third to one-half of the growing season, we were only harvesting off of one bed. The replanted bed never achieved the production levels of the other beds. It was a good experiment to try – we found out that cucumbers don't really like to be planted later in the season—or maybe we didn't have the time to pamper them like we did the early plugs." This mid-season 'experiment' also cost Ann additional time trellising cucumbers that never achieved full production. Ann also discounted her cucumbers in mid-July when the harvest was at its peak. Without that discount, she says, some cucumbers might have gone to the compost.

Ann intends to look for places where they can make their labor more efficient, and confirmed they spend a lot of time trellising and pruning. "The better the cucumbers are trellised, the less space they take up in the greenhouse and the easier they are to harvest," said Ann. This also spreads out the labor during the year by front-loading the work for an organized growing space. "No matter what the crop, no matter what we're doing, it's labor," she said, to Jan's agreement. Ann's trellising method is two strings of orange twine per plant. She prunes two leaders and trains them up the strings, using Johnny's tomato clips as needed.

Emma Johnson, who grew cucumbers in the high tunnel at Buffalo Ridge Orchard, grew and sold the most cucumbers in number and pounds, without counting the 18% of harvest that was not sold this year. Her cucumber yields of 2.09 lb/ft² and 2.78 lb/ft² were still in the middle of the pack. Of the three farms, Emma's was intermediate for net income per lb, per fruit, and per ft². Emma's labor-hours proved more efficient than Ann's, especially for pruning and trellising, but she did use more space to grow a similar volume of cucumbers as Ann.

Emma was a little surprised by the difference in trellising labor-hours between her and Ann. "We've considered switching to string because we do get a few culls when the cucumbers get wrapped in the netting," said Emma. "But seeing how long it takes

Ann... maybe not! We use string to trellis our tomatoes, and we know it takes a long time. The netting is definitely faster, but we haven't timed ourselves between the two styles." Emma trains the cucumbers to the netting a couple times during the early weeks, but when the cucumbers are a couple feet tall, they train themselves and only require occasional pruning.

Emma continued, "One reason we don't grow English cucumbers is that they flop all over the place – the Tyria just takes forever to trellis, even on the netting. The Japanese cucumbers (Taurus and Taste Jade) grow very upright, they take less time to trellis for us, and we feel we had fewer culls."

Jan Libbey from One Step at a Time Gardens was the only farmer who grew cucumbers outside a structure, and direct-seeded. 93% of Jan's costs went toward labor, which may be reflective of her smaller production scale. Jan had the highest net income per pound, but the lowest net income per fruit and per ft². Jan was curious about the time Ann and Emma spent trellising, pruning, harvesting. In her outdoor production, there is no trellising or pruning, but it does take longer to hunt for fruits to harvest.

The three farmers in this study did a good job of including expenses related to cucumber production, but categories could have been tightened up and more inclusive. Of note, no farms included the cost of cooler use, and reporting of packing house supplies, marketing, office and software expenses, etc. varied by farm. Jan commented that she needed to think further about how to account for cucumber portion of CSA marketing and management, which is a significant task.

Each farmer expressed interest in continuing the project with cucumbers for a second year and possibly expanding the work to other crops, also.



Carrie Zahradnik harvesting cucumbers at Buffalo Ridge Orchard. Their cucumbers average 0.75 lb/fruit.

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