

Economic Feasibility of Caterpillar Tunnels on Urban & Small-scale Farms



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Project Summary

To meet the growing demand for locally produced food year-round, many farmers have turned to protected agriculture for season extension. Growers have numerous options ranging from high tunnels to low tunnels, greenhouses, and caterpillar tunnels; all of which vary in price, labor to construct, stability, and return on investment. In 2020, Groundwork Market Garden, an urban farm in Buffalo, NY was funded through a Northeast SARE Farmer Grant, to determine the economic feasibility of caterpillar tunnel production in small-scale urban farming in the Northeast. The project sought to explore this under-researched season extension option, as caterpillar tunnels have been touted as having “the fastest possible payback period per initial investment of any growing structure”, despite there being no empirical evidence to support this claim. More specifically, the study sought to answer the question:

Is the use of caterpillar tunnels economically beneficial for small-scale urban farmers?

The following questions were also intended to be answered throughout the course of the project:

- How quickly might there be a return on investment? (Break-even point).
- How do profits per square foot compare in caterpillar tunnels v field production?
- Does caterpillar production result in higher yields and/or better quality of crops compared to in-field production?
- How, if at all, can profits be increased during shoulder seasons?

Methods:

Two different observations were recorded over a two-year period. One was a measure of all time, labor, and resources (inputs) as compared to all yield, harvests, and profits (outputs) to determine the economic benefit and break-even point of caterpillar tunnels. The second was a side-by-side comparison of bell peppers and cucumbers when grown in the caterpillar tunnels vs. in-field controls.

Findings:

Inputs v Outputs

All inputs (labor for time spent on construction, bed prep seeding, planting, crop maintenance, harvesting) and outputs (number of units/lbs of marketable produce

harvested and avg. prices per unit sold) were recorded over the two-year project period.

2020 CAT Income Totals			
Crop	Yield	Avg Price Per	Profit
Cucumber	254 un	\$1.50/un	\$381
Eggplant	398 un	\$2/un	\$796
Pepper	790 un	\$2/un	\$1,580
Lettuce	160 hd	\$2/hd	\$320
Kale	130 bu	\$3/bu	\$390
Swiss Chard	95 bu	\$3/bu	\$285
Gross Profit			
2 Tunnels			\$3,752
Per Sq Ft			\$2.68
Total Costs			
labor			\$4,336
hard costs			\$2,890
Net Profit			
2 Tunnels			-\$3,474
Per Sq Ft			-\$2.48

2021 CAT Income Totals			
Crop	Yield	Avg Price Per	Profit
Mizuna	45#	\$8/lb	\$360
Spinach	12#	\$8/lb	\$96
Tatsoi	45#	\$8/lb	\$360
Cucumber	884 un	\$1.5/un	\$1,326
Bell Pepper	465 un	\$2/un	\$930
Eggplant	258 un	\$2/un	\$516
Bok Choy	300 un	\$1/un	\$300
Carrots	200# (est)	\$3/lb	\$600
Gross Profit			
2 Tunnels			\$4,488
Per Sq Ft			\$3.20
Total Costs			
Labor			\$2,320
Hard Costs			\$100
Net Profit			
2 Tunnels			\$2,420
Per Sq Ft			\$1.48

Considerations for Profits Break-Down

- CAT tunnels were built over a new field, requiring more initial labor for bed/field prep
- Some plantings had poor germination or pest issues and were not re-planted due to time constraints (ex. cukes 2020, spinach 2021)
- Looking at data when yields are better gives an idea of a potential for increased profit
- High yielding greens with a high price-point greatly increases profit in the shoulder seasons
- A newer, slower hire in 2021 may have led to heightened labor hours & associated costs

Considerations for Overall Economic Feasibility

- When considering the net loss in profit from 2020, and factoring it into the 2021 net profit, the project has still not reached a break-even point
- The stipulations of the grant dictated that the project not start until late Feb 2020. Had there been the ability to build in fall 2019 and plant early season greens in 2020, the numbers would look very different.
- One bad year due to pest/disease pressure (like 2020) can make or break the overall economic feasibility of the structures.
- Given these numbers, it is fair to assume there will be a break-even point and substantial profits in year 3.

Field v. CAT Tunnel Production of Cucumbers & Bell Peppers

2020 Field v CAT Tunnel Comparison:			
Cukes			
	CAT	FIELD	NOTE
avg weight	.6#	-	
1st harvest date	7/13	-	field crops were never harvested.
last harvest date	7/30	-	
total harvest window	~2.5 wks	-	
*it was a bad year for cucurbit crops regionally, and plants succumbed to pressure quickly.			
Peppers			
	CAT	FIELD	NOTE
avg weight	.36#	.23#	
1st harvest date	8/11	9/3	
last harvest date	11/6	10/23	
total harvest window	~13 wks	~7 wks	CAT extended harvest by ~6 wks

2021 Field v CAT Tunnel Comparison:					
Cucumber			Bell Pepper		
	CAT Yield	Field Yield		CAT Yield	Field Yield
TOTAL	884un / 648#	332un / 172#	TOTAL	465un / 174#	285un / 100#
per 50 ft bed	221un / 162#	332un / 172#	per 50 ft bed	232.5un / 87#	285un / 100#
per plant	5.5un / 4#	8un / 4#	per plant	6 un / 2#	7 un / 2.5#
avg size fruit	.73#	.51#	avg fruit size	.37#	.35#

2021 Field v CAT Tunnel Comparison:			
Cukes			
	CAT	FIELD	NOTES
avg weight	.66#	.53#	
1st harvest date	6/22	7/12	*3 wks earlier, planted same date!
last harvest date	8/16	8/9	*1 wk later!
total harvest window	~8 wks	~4 wks	CAT extended harvest by 4 wks
Peppers			
	CAT	FIELD	NOTES
avg weight	.37#	0.35#	
1st harvest date	7/26	7/26	*planted same date, small field yield
last harvest date	11/2	10/7	
total harvest window	~15 wks	~11 wks	CAT extended harvest by 4 wks

Considerations for Field v. Cat Tunnel Production

- In both 2020 & 2021 trials, there were earlier and longer harvests in both cucumbers and peppers, extending the harvest season by 4-6 weeks, which is significant.
- The CAT tunnels allowed for some harvest of cukes before disease entered region with earlier planting in 2020.
- Bell peppers did significantly better in 2020 in CAT compared to field trials, which contrasts with 2021
- In 2021, a DMR cucumber was used, which may have helped overall yields and outcomes.
- Considering irrigation v rain, much more time is spent watering in CAT.
- The beds used for field production have been amended over several years, v. new beds in CAT tunnels, which meant better soil conditions in field.
- Observed difference in labor hours for trellising/pruning cukes in CAT v field

Other Anecdotal Observations for Farmers

- There is a definite learning curve with managing these structures and knowing how to maximize profits.
- Cat Tunnels are not suitable for use areas with high wind! We are fortunate to have natural breaks, and still suffered some wind damage. Our friends a few miles up the road who put up 2 CAT tunnels in 2021 lost both tunnels after one night of high winds.
- As with all structures, you'll need to consider the location/soil quality/drainage of your construction site. Due to lack of options and space on our small urban farm, we had to create a new field which didn't have the best soil or drainage, and our outcomes were affected.
- It would be interesting to do a similar study of cat tunnels when compared to low tunnels. It seems that the real benefit and profits of the cat tunnels on our farm were seen with greens in the shoulder seasons. Low tunnels might produce similar results and would save on hard costs and labor.
- Additional steps could be taken to mitigate issues such as temp/pest control, such as purchasing insect netting to put around the structure and shade cloth for summer heat, but that would also mean an increase in costs, inputs, & labor.
- You may be able to save on initial investment costs by applying for a NRCS EQIP grant which now allows for the use of caterpillar tunnels. Having volunteers help with construction, instead of paid employees, could greatly reduce labor-associated costs.

Summary

Considering the space constraints associated with urban and small-scale farms and given that many small farmers might lack access to capital necessary for larger investments such as a high tunnel, caterpillar tunnels may be a potential point-of-entry for farmers looking to extend their growing seasons, given their relatively low cost.

The break-even point for farmers will vary from farm to farm depending on several factors including site considerations, crops grown, pest/disease issues, farmer learning curve, and varying labor costs. On our farm, after two seasons, we have not seen a break-even point, but predict that we will break-even and see considerable profits in year three.

Although we did not record a significant difference in size/quality of crops in CAT tunnels v field production in this study, we were able to see larger yields over an extended harvest period for both cucumbers and bell peppers in the CAT tunnels v our in-field controls.

When you consider the potential for extending the shoulder seasons and lengthening harvest windows, as demonstrated through this study, the potential profits per square foot in caterpillar tunnels v. in-field production is significant.

The information presented in this article is intended to be beneficial for farmers who have not yet invested in this type of equipment, as well as new farmers who are budgeting for planned projects, and help them to make more informed decisions. For a more detailed break-down of the numbers, refer to this [data report](#).