Journal of Applied Horticulture, 23(2): 106-110, 2021
https://doi.org/10.37855/jah.2021.v23i02.20
Journal of Applied Horticulture
ISSN: 0972-1045

Production cost analysis of organic and conventional vegetable seedlings

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Abstract

This study examined the economic differences between organic and conventional vegetable seedling production in Louisiana (US) in 2018. Organic and conventional broccoli, cabbage and cauliflower seeds were used for seedling production. Organic and conventional seedling production costs were compared, including trays, containers (100 count flats), seeds, substrate, fertilisers, water for fertiliser treatment and irrigation, labour and greenhouse space. The calculations were based on the total production cost and net returns for one flat, 100 flats, one hundred flats produced in three repetitions and one hundred m^2 of greenhouse space. After the seedlings had grown sufficiently to be transplanted, a survey was carried out to estimate the potential demand for the production of organic and conventional vegetable seeds for home gardeners. The overall production cost of one plant/repetition was $0.31 for organic broccoli, $0.26 for organic cabbage and $0.30 for organic cauliflower, whereas conventional seedlings cost $0.15 for broccoli, $0.11 for cabbage and $0.16 for cauliflower. The net returns in conventional seedling production for 100 flats 3 times per year for broccoli ($2,808.1), cabbage ($3,498.1) and cauliflower ($2,760.7) were higher than the net returns in organic seedling production. Net returns were 57.2, 39 and 43 percent lower than conventional for broccoli, cabbage and cauliflower, respectively. Net returns for conventional seedlings were nearly doubled when compared to organic seedlings in terms of seedling production per 100 m^2. Despite the requirement to recoup greater expenditures for organic vegetable transplants, more Louisiana consumers (65%) opt to spend a premium price for organic vegetable seedlings over conventional vegetable seedlings.

Key words: Cabbage, broccoli, cauliflower, production economics

Introduction

Organic and conventional farming are two different types of farming with different farm management practises and output prices (Shrestha et al., 2014). The vegetable industry offers producers and consumers alike an excellent opportunity to diversify their businesses and tastes (Singh, 2005). In the world, conventional farming is the most common method of producing vegetables. An estimated 69.8 million hectares were managed organically around the world. In 2017, an estimated 3.2 million hectares of land in North America were managed organically, accounting for less than 1% of all agricultural production (Willer and Lernoud, 2019). Despite low organic farm representation around the world, organic product production and processing has grown in popularity and economic importance. According to Maggie McNeal of the Organic Trade Association (2017), organic food sales in the United States increased by 8.4% from 2015 to 2016.

Organic fruit and vegetables accounted for 40% of all organic food sales in the US. The current market premiums for many organic crops are enticing conventional growers to consider organic practises (Conner and Rangarajan, 2009). Before making this decision, farmers should know production costs and market demand. Many vegetable crops are grown in nurseries or greenhouses before being transplanted in the field to ensure healthy seedlings. A good commercial vegetable transplant should be stocky, green, pest-free and have a strong root system (McAvoy and Ozores-Hampton, 2018). Other factors that influence producers' decisions about organic production include food safety and environmental protection (Prodanovi and Babovi, 2014). Reliable organic and conventional vegetable seedling production cost data is lacking. Therefore, the aim of this investigation was to study the cost analysis of producing organic seedlings compared to traditional vegetable transplants.

Material and methods

Organic and conventional seeds were purchased from Johnny's Select Seeds, US. Seeds from three different vegetables cultivars: cabbage (*Brassica olerace* var. capitata) 'Capture F1, Early green', broccoli (*Brassica olerace* var. *italic*) 'Santee F1', cauliflower (*Brassica olerace* var. *botrytis*), 'Veronica F1, Specialty', (organic) and 'Veronica F1, Romanesco', (conventional) were sown on 5 Oct, 2018.

Study area: The experiment took place in the Louisiana State University greenhouse (30°24'32.1012''N, 91°6'21.0132''W). The total size of the greenhouse was 279 m^2, while the total size for 100 containers was 14.3 m^2. The size of one container was 53 x 27 cm and every container had 50 holes for filling substrate and for sowing. The containers were purchased from BWI Industries out of Nash Texas. The substrate used was Sungro Horticulture from the company Sun Gro Horticulture Canada Ltd. Containers

were kept in the greenhouse under optimal temperatures (18 °C) and using an automated overhead irrigation system for germination and growth. After first true leaves emerged, seedlings were fertilized on a weekly basis. For the organic seedlings, the fertilizer choice was hydrolyzed fish fertilizers from the company Neptunes Harvest US with the content of NPK 2-4-1. Fertilizer was applied to the soil with a concentration of 14.8 mL in 3.7 L of water. After the first month, a phosphorous deficiency appeared on the organic vegetable seedlings. Therefore, Trubone fertilizer 6-20-0 from the company Safer Brand US, with concentration 8 mL in 3.7 L of water was applied twice a week. For conventional seedlings, the fertilizer choice was Peter's fertilizer from the company Everris US with NPK content of 15-5-15. Concentration for foliar application of Peter's was 5 g in 3.7 L of water. The first application of fertilizer was applied on 16 Oct, 2018. After that, fertilizers were applied every 7 days using the same concentration. Irrigation occurred 3x a day with duration of 1 min at each application. The quantity of water applied at each irrigation application was 400 mL per container.

Total production cost: The economic evaluation of the relevant costs included the calculations of gross returns value, total direct cost (variable cost), total indirect cost, production cost and net returns. The gross returns of the selected crops are the product of the average selling price per container and the prevailing market prices of the products. Total direct cost or variable cost, (which included cost of trays, containers (flats), seed (organic and conventional), substrate, fertilizers (organic and conventional), water use to irrigate crops and water used to fertilize the crops, as well as labor for work) was calculated as a total cost of the mentioned items. Total indirect cost was calculated according to total investment for the greenhouse ($80,000 for 30 years), size of 100 containers (14.3 m^2) and the time needed for the seedlings production (6 months). Calculations were also projected for production cost (total variable cost + total indirect cost) and net returns (gross returns - production cost). The production season of the selected crops for producing seedlings was 2 months. Calculations were completed for 1 flat, 100 flats, for the production of 100 flats 3 times per year and for the production of seedlings per 100 m^2 in the greenhouse (Table 1, 2 and 3). The labor cost in LA is $10.73 per hour. Labor costs were calculated according to the time which is needed to sow and maintain the flats of vegetable seedlings. Filling containers with substrate and sowing seeds were completed by machine with the duration 30 sec per flat.

The survey of consumers: When seedlings were ready for transplanting, a survey was completed to determine consumer preference. The objective of the survey was to determine if home gardeners prefer to purchase organic seedlings at a higher price ($20 per container) compared to conventional ($17 per container). Price points were projected after speaking to local managers and plant nursery owners. The survey was conducted at Clegg's Nursery in Baton Rouge, Louisiana and with students and faculty members at Louisiana State University, in Baton Rouge, Louisiana. Survey participants were asked "If you were to purchase vegetable transplants today, would you prefer organic or conventionally produced seedlings?" Survey participants had the opportunity to view both conventional and organically produced seedlings at the time of the survey. Survey participants were also able to ask questions about the production practices used in this experiment. Each participant's response was counted as either preferring conventional or organic seedlings.

Results and discussion

In this research, calculations were made for 1 flat, 100 flats, for 100 flats 3 times per year and for 100 m^2 in the greenhouse (Table 1, 2 and 3). Both organic and conventional vegetable seedlings were grown to a mature transplant size within two months. Both methods of production (organic and conventional) produced high quality seedlings. Overall, conventional vegetables were less expensive to produce.

Production cost: The total production cost for producing organic broccoli (100 flats 3x per year) was $4,798.9 while for producing conventional broccoli it was $2,291.9. Cabbage cost for the production of 100 flats 3x per year, was almost three times more expensive when produced organically ($3,881.9) as compared to conventionally produced ($1,601.9) plants. Similar results were obtained when calculations were projected to produce 100 flats 3x per year. Organic cauliflower costs were $4,427.9 as compared to conventional production costs estimated at $2,339.3. Cauliflower and broccoli prices per container were at least doubled when producing them organically as compared to conventionally. Price differences were expected as organic producers are often required to pay additional costs for organic certification, additional costs for separate facilities to produce organic transplants in a controlled environment and the higher costs related to seeds, fertilizer and production itself (Slattery *et al.*, 2011). Additionally, to produce vegetables seedlings, organic producers need more seed (which is more expensive) than conventional. According to Naik (2010) organic tomato seedlings raised in the nursery and then transplanted to the field required 107.53 g seeds for organic seedlings per acre as compared to 73.77 g of seeds needed to transplant an acre of conventionally produced tomato seedlings. In this research, total production cost of one plant/repetition was for organic broccoli ($0.31), organic cabbage ($0.26) and organic cauliflower ($0.15) while for conventional seedlings it was 0.15, 0.11 and $ 0.15 for broccoli, organic cabbage and cauliflower, respectively. Results presented in the Table 1, 2 and 3, net returns were higher in the production of the conventional seedlings. The net returns for the production of conventional seedlings for 100 flats 3x per year were $2,808.1, $3,498.1 and $2,760.7 for broccoli, cabbage and cauliflower, respectively. The conventional net returns were higher compared to organic seedlings. However, better estimates of net returns can be determined after harvest of the organic vegetables. Calculation was also done to determine the production cost for the size of 100 m^2 in the greenhouse. Results indicated the highest net returns for the 100 m^2 of the production for organic seedlings was found $4,935.22 for cabbage followed by cauliflower ($3,663.04) and broccoli ($2,796.3). For the production of conventional seedlings, the highest net returns was found for cabbage followed by broccoli and cauliflower. These results indicated that in the production of seedlings in the greenhouse at the size of the 100 m^2 (one repetition) the

Table 1. Production cost of conventional and organic seedlings of broccoli ($)

Production Type		Number of Applications	Cost per application	Total cost for 1 flat	Total Cost for 100 flats	Cost for 100 flats 3x per year	Cost for 100 m^2 (1 repetition)
Conventional	Gross returns			17	1,700	5,100	11,883
	Direct cost (Variable cost)						
	Trays	1	0.34	0.34	34	102	237.66
	Containers (flats)	1	1.01	1.01	101	303	705.99
	Conventional Broccoli seed (100 seeds)	1	2.93	2.93	293	879	2,048.07
	Conventional fertilizer Peters 15-5-15	7	0.03	0.21	21	63	146.79
	Substrate	1	1.17	1.17	117	351	817.83
	Water used at each fertilizer treatment	7	0.005	0.035	3.5	10.5	24.46
	Water used to irrigate crop	156	0.0012	0.187	18.7	56.1	130.71
	Labor cost for filling substrate in containers by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for sowing by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for fertilizing [30 sec/tray]	16	0.085	1.36	136	408	950.64
	Total Variable cost		5.74	7.412	741.2	2,223.6	5,180.97
	Indirect cost						
	Description	Greenhouse			22.76	68.3	159.1
	Total Indirect cost				22.76	68.3	159.1
	Production Cost				763.96	2,291.9	5,340.07
	Net returns				936.04	2,808.1	6,542.9
Organic	Gross returns			20	2,000	6,000	13,980
	Direct cost (Variable cost)						
	Trays	1	0.34	0.34	34	102	237.66
	Containers (flats)	1	1.01	1.01	101	303	705.99
	Organic Broccoli seed (100 seeds)	1	5.66	5.66	566	1,698	3,956.34
	Organic fertilizer Neptunes harvest	10	0.5	5	500	1,500	3,495
	Organic fertilizer TruBone+	5	0.16	0.8	80	240	559.2
	Substrate	1	1.17	1.17	117	351	817.83
	Water used at each fertilizer treatment	15	0.005	0.075	7.5	22.5	52.42
	Water used to irrigate crop	156	0.0012	0.187	18.7	56.1	130.71
	Labor cost for filling substrate in containers by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for sowing by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for fertilizing [30 sec/tray]	16	0.085	1.36	136	408	950.64
	Total Variable cost		9.1	15.772	1,577.2	4,731.6	11,024.6
	Indirect cost						
	Description	Greenhouse			22.76	68.3	159.1
	Total Indirect cost				22.76	68.3	159.1
	Production Cost				1,599.96	4,798.9	11,183.7
	Net returns				400.04	1,201.01	2,796.3

net returns was almost twice as high for conventional seedlings compared to organic seedlings.

To determine if there is a market for organically grown vegetable transplants, a consumer survey was conducted. According to the report presented by Willer *et al.*, (2013), organic fruits and vegetables in USA make up 40% of the total organic product market. The survey results from over 230 people indicate that 65 percent of respondents said they would pay more for organically grown cabbage, cauliflower and broccoli seedlings. These findings imply that organic transplant production is viable in Louisiana. Organic food has exploded in popularity due to rising public concerns about the safety and quality of conventional products (USDA, 2017). The majority of customers believe organic food is better for them and are prepared to pay a premium for it (Magkos et al., 2006). Many people believe organic vegetables are better tasting, healthier and safer than conventionally cultivated vegetables (Khanal et al., 2008). The organic market is predicted to grow due to this strong belief.

Expected net returns are comparable for organic and conventional seedling production with the notable exception of lower expected output for organic broccoli, cabbage and cauliflower. According to this research, the profitability of these crops is highly dependent on price premiums for organic products. The production cost of organic seedlings is quite expensive compared to production costs related to conventional production. However, consumers are willing to pay higher prices for organic vegetable seedlings. In Louisiana according to this research, the price premium for organic produce over the conventional ones still exists in most markets and there are a higher number of consumers who would purchase organic vegetable seedlings.

Table 2. Production cost of conventional and organic seedlings of cabbage ($)

Production Type		Number of Applications	Cost per application	Total cost for 1 flat	Total Cost for 100 flats	Cost for 100 flats 3x per year	Cost for 100 m^2 (1 repetition)
Conventional	Gross returns			17	1,700	5,100	11,883
	Direct cost (Variable cost)						
	Trays	1	0.34	0.34	34	102	237.66
	Containers	1	1.01	1.01	101	303	705.99
	Conventional Cabbage seed (100 seeds)	1	0.63	0.63	63	189	440.37
	Conventional fertilizer Peters 15-5-15	7	0.03	0.21	21	63	146.79
	Substrate	1	1.17	1.17	117	351	817.83
	Water used at each fertilizer treatment	7	0.005	0.035	3.5	10.5	24.465
	Water used to irrigate crop	156	0.0012	0.187	18.7	56.1	130.71
	Labor cost for filling substrate in containers by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for sowing by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for fertilizing [30 sec/tray]	16	0.085	1.36	136	408	950.64
	Total Variable cost		3.44	5.11	511	1,533.6	3,573.28
	Indirect cost						
	Description	Greenhouse			22.76	68.3	159.1
	Total Indirect cost				22.76	68.3	159.1
	Production Cost				533.96	1,601.9	3,732.38
	Net returns				1,166.04	3,498.1	8,150.61
Organic	Gross returns			20	2,000	6,000	13,980
	Direct cost (Variable cost)						
	Trays	1	0.34	0.34	34	102	237.66
	Containers	1	1.01	1.01	101	303	705.99
	Organic Cabbage seed (100 seeds)	1	2.6	2.6	260	780	1,817.4
	Organic fertilizer Neptunes harvest	10	0.5	5	500	1,500	3495
	Organic fertilizer TruBone+	5	0.16	0.8	80	240	559.2
	Substrate	1	1.17	1.17	117	351	817.83
	Water used at each fertilizer treatment	15	0.005	0.075	7.5	22.5	52.425
	Water used to irrigate crop	156	0.0012	0.187	18.7	56.1	130.713
	Labor cost for filling substrate in containers by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for sowing by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for fertilizing [30 sec/tray]	16	0.085	1.36	136	408	950.64
	Total Variable cost		6.04	12.71	1,271	3,813.66	8,885.68
	Indirect cost						
	Description	Greenhouse			22.76	68.3	159.1
	Total Indirect cost				22.76	68.3	159.1
	Production Cost				1,293.76	3,881.9	9,044.78
	Net returns				706.1	2,118.1	4,935.22

Acknowledgements

Dr. Jeff Kuehny's assistance in providing greenhouse space for expriments is gratefully acknowledged. Mr. Johnny Naylor of Cleggs Nursery in Baton Rouge is also thanked for allowing us to conduct the survey at his nursery and for assisting us in determining reasonable prices for conventional and organic vegetable seedlings.

References

Conner, D. and A. Rangarajan, 2009. Production Costs of organic vegetable farms: Two case studies from Pennsylvania. *HortTechnology,* 19(1): 193-199.

Khanal, K., S.R. Henneberry, M. Taylor, R.J. Schatzer, M. Epplin, B.W. Roberts, J. Edelson and J. Shrefler, 2008. Organic and conventional vegetable production in Oklahoma. Selected Paper prepared for presentation at the *Southern Agr. Econ. Assn Annu. Meeting*, Dallas, TX, February 2-6.

Magkos, F., F. Arvaniti and A. Zampelas, 2006. Organic food: buying more safety or just peace of mind? A critical review of the literature. *Fd. Sci. Nutr.,* 46(1): 23-56.

McAvoy, G. and Ozores-Hampton M, 2018. Commercial transplant production in Florida. *IFAS Extension, University of Florida* <https://edis.ifas.ufl.edu/pdffiles/CV/CV10400.pdf >

Mcneil, M. 2017. Robust organic sector stays on upward climb, posts new records in U.S. Sales. *Organic Trade Association Press Release*. <https://ota.com/news/press-releases/19681>

Table 3. Production cost of conventional and organic seedlings of cauliflower ($)

Production type		Number of Applications	Cost per application	Total cost for 1 flat	Total Cost for 100 flats	Cost for 100 flats 3x per year	Cost for 100 m^2 (1 repetition)
Conventional	Gross returns			17	1,700	5,100	11,883
	Direct cost (Variable cost)						
	Trays	1	0.34	0.34	34	102	237.66
	Containers (flats)	1	1.01	1.01	101	303	705.99
	Conventional Cauliflower seed (100 seeds)	1	3.09	3.09	309	927	2,159.91
	Conventional fertilizer Peters 15-5-15	7	0.03	0.21	21	63	146.8
	Substrate	1	1.17	1.17	117	351	817.83
	Water used at each fertilizer treatment	7	0.005	0.035	3.5	10.5	24.47
	Water used to irrigate crop	156	0.0012	0.187	18.7	56.1	130.71
	Labor cost for filling substrate in containers by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for sowing by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for fertilizing [30 sec/tray]	16	0.085	1.36	136	408	950.64
	Total Variable cost		5.9	7.57	757	2,271	5,292.83
	Indirect cost						
	Description	Greenhouse			22.76	68.3	159.1
	Total Indirect cost				22.76	68.3	159.1
	Production Cost				779.76	2,339.3	5,451.93
	Net returns				920	2760.7	6431
Organic	Gross returns			20	2,000	6,000	13,980
	Direct cost (Variable cost)						
	Trays	1	0.34	0.34	34	102	237.66
	Containers (flats)	1	1.01	1.01	101	303	705.99
	Organic Cauliflower seed (100 seeds)	1	4.42	4.42	442	1,326	3,089.58
	Organic fertilizer Neptunes harvest	10	0.5	5	500	1,500	3495
	Organic fertilizer TruBone+	5	0.16	0.8	80	240	559.2
	Substrate	1	1.17	1.17	117	351	817.83
	Water used at each fertilizer treatment	15	0.005	0.075	7.5	22.5	52.42
	Water used to irrigate crop	156	0.0012	0.187	18.7	56.1	130.71
	Labor cost for filling substrate in containers [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for sowing by using machine [30 sec]	1	0.085	0.085	8.5	25.5	59.41
	Labor cost for fertilizing [30 sec/tray]	16	0.085	1.36	136	408	950.64
	Total Variable cost		7.86	14.53	1,453.2	4,359.6	10,157.86
	Indirect cost						
	Description	Greenhouse			22.76	68.3	159.1
	Total Indirect cost				22.76	68.3	159.1
	Production Cost				1,475.96	4,427.9	10,316.96
	Net returns				524.04	1,572.1	3,663.04

Naik, V.R. 2010. *Comparative economics of vegetable production under organic and inorganic farming in Belgaum district.* Master thesis. Department of Agricultural Economics College of Agriculture, Dharwad, 2010.

Prodanović, R. and J. Babović, 2014. Ekonomski pokazatelji u proizvodnji organskog voća. *Economics*: *Theory and Practice*, 7(4): 21-35.

Shrestha, K., G. Shrestha and R.P. Pradyumna, 2014. Economic analysis of commercial organic and conventional vegetable farming in Kathmandu Valley. *J. Agr. Environ*., 15: 58-71.

Singh, M.K. 2005. Economics of production and marketing of vegetables in Madhya Pradesh, India. *Agr. Econ. Res. Rev*., 9(1): 101-113.

Slattery, E., M. Livingston and C. Greene. and K. Klonsky, 2011. Characteristics of conventional and organic apple production in the United States. A Report from the *Econ. Res. Service*/USDA.

USDA Economic Research Service 2017. Organic Market Overview.

Willer, H., L. Julia and H. Beaute, 2013. *The world of organic agriculture-statistics and emerging trends 2013*. Research Institute of Organic Agriculture (FiBL); Bonn (Germany): International Federation of Organic Agriculture Movements (IFOAM). <https://orgprints.org/26322/1/1606-organic-world-2013.pdf >

Willer, H. and J. Lernoud, 2019. The world of organic agriculture. *Statistics and Emerging Trends* 2019. Research Institute of Organic Agriculture (FiBL), Frick and IFOAM – Oragnics Interntaional, Bonn. <https://shop.fibl.org/CHen/mwdownloads/download/link/id/1202/?ref=1>

Received: October, 2020; Revised: December, 2020; Accepted: December, 2020