e-GRO Edible Alert

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Grafting Cucumbers for High Tunnel Production: Is It Worth It?

This study provides a baseline reference for growers interested in grafting seedless cucumber and for high tunnel production.

Cucumber (Cucumis sativus) is one of the most important vegetables produced and consumed in the United States. In the midwestern United States, a major obstacle to spring cucumber production is low soil temperatures during plant establishment, and high tunnels have become a popular tool for season extension of vegetable production. Grafting is a cultural practice known to help control soilborne diseases and improve plants' tolerance to abiotic stresses. Recent studies found that using grafted cucumber plants with cold-tolerant rootstocks greatly benefited early season seedless cucumber production in high tunnels.

The objective of this study was to analyze the economic feasibility of growing grafted cucumber in high tunnels.

We conducted a comparison of partial costs and returns between growing grafted and nongrafted cucumbers in a high tunnel in Vincennes, IN. Data were used to develop a partial budget analysis and sensitivity tests Results indicated that grafting can help farmers increase net returns through the increasing yield of grafted plants. Results from the sensitivity analysis illustrate how the increased yield of grafted cucumbers offsets the extra cost incurred in the technique while providing a higher revenue. While actual production costs for individual farmers may vary, our findings suggest that grafting can be an economically feasible tool for high tunnel seedless cucumber production.

Transplant and Grafting Production

The experiments included nongrafted cucumber and cucumber grafted on hybrid squash (*Cucurbita maxima* × *Cucurbita moschata*) rootstock 'Cobalt' (Rijk Zwaan, Fijnaart, Netherlands). Cucumber cultivar Socrates was used as the scion and nongrafted controls for all 3 years. Nongrafted plants and rootstock seeds were planted in 50-cell trays, while scion seeds for the grafted plants were sowed in 128-cell trays 1-2 d later than the rootstock seeds.

Grafting was performed a week later after scion seeds were planted using the one-cotyledon method. The graft healing was conducted in a plant growth chamber and both grafted and nongrafted plants were moved back to greenhouse 7 d after grafting. For more details about transplant and grafting see Rodriguez et al. (2021).

High Tunnel Cucumber Production

Cucumber plants were grown in 30-ft-wide and 96 ft-long high tunnels located at SWPAC, Vincennes, IN from 2017-19. Grafted and nongrafted cucumbers were planted in black plastic mulch covered beds for all 3 years in this study. All plants survived in 2017, but 91.2% and 77.7% of nongrafted plants died in 2018 and 2019 after transplanting due to low soil temperature stress. Nongrafted plants were replanted on 10 Apr. 2018 and 27 Mar. 2019. For more information about cucumber production in high tunnels see Guan et al. (2020).

Economic Analyses

A partial budget analysis was used to assess the cost effectiveness comparison between grafted and nongrafted cucumbers. We focused only on the changes in revenues and costs that result from implementing the grafting technique, while omitting production, harvest, and packing costs (e.g., land preparation, irrigation, fertilizer, pest control, etc.) that remained equal between grafted and nongrafted experiments.

We used 2018 prices of two market channels commonly used by cucumber growers (i.e., farmers' market and retail stores) to provide a gross revenue comparison between markets. Price variation across markets can help us understand how a change in markets may impact the partial revenue of grafted vs. nongrafted cucumbers. Annual median farmers' market price ($1.70/lb) came from a price database published by Purdue Horticulture Business Extension Program. Annual median retail price ($1.10/lb) came from United States Department of Agriculture-National Agricultural Statistics Service (USDA-NASS) pricing reports. Gross revenue per plant was computed by multiplying the marketable yield per plant times the cucumber price for each market channel. Partial profit per plant was computed as the gross revenue per plant minus partial transplant cost and partial harvesting/pruning cost. For more details about economic analyses see Rodriguez et al. (2021).

Cucumber variety evaluation in high tunnel

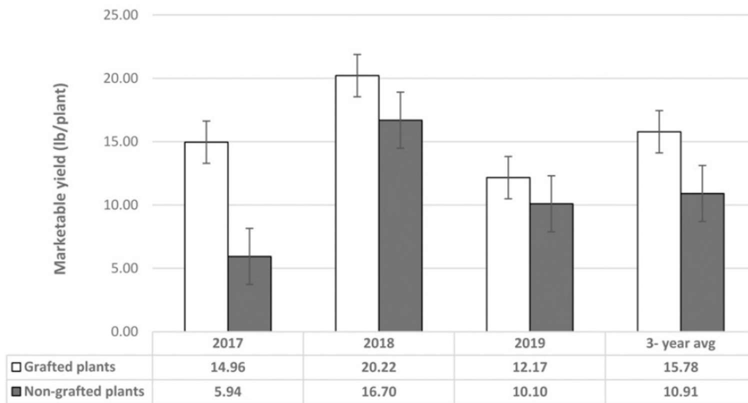
Growing grafted cucumbers for early season production in high tunnels

Cucumber growing in high tunnels

Item	Grafted plants Materials ($/1000 plants)	Grafted plants Labor ($/1000 plants)	Nongrafted plants Materials ($/1000 plants)	Nongrafted plants Labor ($/1000 plants)
Seeds				
Scion	466.62[z]		373.29	
Rootstock	150			
Seeding production				
Potting soil	40.23		23.16	
Trays	38.4		22.11	
Seed sowing and care	—	96.66[y]	—	65.75
Grafted transplant production				
Grafting labor	—	157.01[x]	—	
Grafting clips	336.11			
Miscellaneous supplies[w]	20			
Post-grafting care		23.88[v]		
Total cost	1328.92		484.31	
Cost/plant	1.33		0.48	

[z]Germination rate at 95% was used to calculate all the seeds. Graft successful rate at 80% was used in the calculation of seeds and materials for producing grafted plants.
[y]Labor required for sowing seeds and caring seedlings was estimated at 8.09 h for grafted plants production and 5.51 h for nongrafted plants production. $11.94/h pay wage for all labor based on Indiana State Occupational Employment and Wage Estimates, May 2018 (U.S. Department of Labor, 2019).
[x]Grafting speed was estimated at 100 plants per person per hour.
[w]Miscellaneous supplies for producing grafted plants include razor blade, sanitizer, paper towels, and clear plastic.
[v]A total of 2 h was estimated to take care of grafted plants for the 7d post-grafting care.

Partial costs of grafted and nongrafted cucumber plants



Marketable yield for grafted and nongrafted 'Socrates' cucumber grown in a high tunnel at the Southwest Purdue Agricultural Center, Vincennes, IN, in 2017–19. 1 lb = 0.4536 kg.

What did we find?

- Grafted cucumber plants had a partial cost of $1.33 each, while the cost of nongrafted plants was $0.48 each. In other words, grafting increased the production cost of cucumber by $0.85/plant.
- The higher cost of grafted plants can be attributed to scion and rootstock seed costs, which accounted for 46% of the partial cost. Grafting materials and labor represented 27% and 21% of the partial cost, respectively. The other 6% of partial cost was due to seedling production inputs (potting soil and trays).
- Grafted plants had higher annual marketable yield than nongrafted plants in 2017, 2018, and 2019 with 14.96 lb, 20.22 lb, and 12.17 lb, respectively.
- Grafted cucumber had a 3-year average yield of 15.78 lb/plant, whereas nongrafted plants had a 3-year average yield of 10.91 lb/plant.
- Partial profit for grafted plants was $13.89, $4.54, and $2.07 higher than nongrafted plants when sold at farmers markets for years 2017, 2018, and 2019, respectively.
- When selling cucumber through retail channels, partial profit for grafted plants was $8.48, $2.43, and $0.83 higher than nongrafted plants for years 2017, 2018, and 2019, respectively.
- Grafted cucumber had higher 3-year partial profit when sold at farmers markets ($24.61/plant) than nongrafted cucumber ($17.77/plant).
- Grafted cucumber plant had higher 3-year partial return when sold at retail market ($15.13/plant) than nongrafted plants ($11.22/plant).

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