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Impacts of COVID-19 on the Horticultural Industry

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Abstract: The COVID-19 pandemic has forced businesses to alter the way they operate. This includes, but may not be limited to, changing hours of operation, working with limited staff, and restricting customer access indoors. This could result in several challenges for businesses. In this study, we evaluate the impacts of COVID-19 on the horticultural industry and identify the challenges for businesses. Based on our research findings, the major challenges faced by businesses were not having enough employees and inventory to keep up with consumer demand during COVID-19. We also evaluate the effect of the pandemic on the sales of different plants, gardening products/services, and the overall revenues of businesses. For different types of plants included in the survey, landscape herbaceous flowers, landscape shrubs, and landscape trees showed the most significant increase in sales. In addition, for different gardening products/services, container plants, small plants, and soil & compost showed the most significant increase in sales. 64% of the businesses indicated higher overall sales compared to same season previous year. Over 46% of the businesses reported increased sales in 2020 under COVID-19. These findings imply a greater demand potential for plants and gardening products/services from consumers, in light of this pandemic.

Keywords: COVID-19, Gardening Industry, COVID-19, gardening industry, horticulture, nursery and landscape, business survey

1. Introduction

The COVID-19 pandemic is a health tragedy on a global scale. It has changed the world in numerous ways- quality of life, political, environmental, and economic sustainable development [1]. Businesses worldwide, as well as the United States economy, have been impacted. It is estimated that the United States real GDP suffered a year-on-year contraction of almost 11% in 2020 [2]. Gardening industry is an important part of United States economy. According to the 2019 USDA NASS Census of Horticultural Specialties, the value of all horticultural crops sold was over \$13.7 billion [3]. Therefore, understanding the effect of this pandemic on the industry, for plants and gardening products/services, is important.

In this study, we evaluated the influence of COVID-19 on the gardening industry. COVID-19 has affected the agricultural industry in several ways. The pandemic has had an effect on the consumers, making it imperative for businesses to adapt to the new normal. As the pandemic forced people into isolation, they have been facing periods of stress [4]. Therefore, the potential benefits of being in contact with nature are gaining more importance [5]. In fact, extant literature suggests that leisure activities are being associated with tending to flowers and ornamental plants [4]. Moreover, gardening has been reported to be effective in alleviating the undesirable effects of isolation caused by the pandemic [6]. This might suggest a potentially higher demand for horticultural products. In addition, foreign countries' export of horticultural products saw a sharp decline in 2020 [7]. This might imply a lower supply of horticultural products in the U.S market.

The pandemic has also forced businesses to alter the way they operate. This includes, but may not be limited to, changing hours of operation, working with limited staff, and restricting customer access indoors. This could result in several challenges for businesses. We were able to shortlist the major challenges faced by businesses due to the pandemic.

We also evaluate the effect of the pandemic on the sales of different plants, gardening products/services, and the overall revenues of businesses. An important objective of this study is to investigate the extent of these impacts on different businesses based on their size (number of employees), business type (family or individual operation, incorporated), type of operation (retail, wholesale, etc.), and revenue.

2. Materials and Methods

2.1. Producer survey

We used the data from a Texas Nursery & Landscape Association (TNLA) survey conducted in September 2020. 67 TNLA members responded to the survey regarding the impact that the pandemic has had on the different components of their businesses, such as availability of employees, market access, and inventory management. The participants were asked to rate each issue on a scale of 1 to 5 (1=not challenging at all, 2=slightly challenging, 3=challenging but manageable, 4=definitely challenging, 5=very challenging). The relative index (RI) can be employed to compare the ranking of all the challenges faced by the businesses, based on their relative severity [8]. Relative index has been used in horticulture, engineering research, and project management (e.g., [9-14]). The following formula is used to calculate the relative index [15]:

$$RI = \sum_{H \times N} \frac{I}{H \times N} \quad (1)$$

Here, I is the “importance” assigned by the survey respondents. In this study it refers to the severity of the challenge, on a scale of one to five (1=not challenging at all, 2=slightly challenging, 3=challenging but manageable, 4=definitely challenging, 5=very challenging), H is the value for highest severity and N is the total number of survey participants [9,15].

The survey participants were also asked about the changes in their business operations that they had to incorporate in light of the pandemic, such as changing hours of operation, working with limited staff, and restricting customer access indoors. We also asked the participants to choose the main factor affecting their sales (increase in sales, decrease in sales, and no effect) in 2020, from the following- COVID-19, weather, and general economy prior to COVID-19. Additionally, the survey also collected data on the size (number of employees), type of operation (landscaper, grower, retail, supplier, arborist, re-wholesaler), business type (partnership, individual or family, incorporated), and revenue for the businesses, in order to study the effect that the pandemic has had on different types of businesses. The plants included in the survey were- vegetables, fruits, florist type plants, landscape herbaceous flowers, landscape shrubs, and landscape trees. In addition, the gardening products/services included in the survey were- landscaping, seeds, small plants, container plants, bareroot plants, soil & compost, fertilizer & chemicals, and gardening accessories.

2.2. Econometric Model

We investigated the impact of COVID-19 on sales of horticultural businesses controlling for important factors such as business size (no. of employees), revenue, operation type (grower, retailer, landscaper, etc.), business type (partnership, family or individual, incorporated), and changes in business operations (open with modified procedures or with no access for customers). We employed an ordered logit model for our analysis as described in Equation 1 [16,17]:

$$\text{logit}(Y) = \alpha_0 + \alpha_1(\text{operation}) + \alpha_2(\text{size}) + \alpha_3(\text{revenue}) + \alpha_4(\text{operation type}) + \alpha_5(\text{business type}) + \varepsilon \quad (2)$$

The dependent variable Y in our analysis is the change in sales for the businesses. Y ranged from -2 to 2 (-2=significantly decreased, -1=moderately decreased, 0=no change, 1=moderately increased, 2=significantly increased).

α_0 represents an intercept, while the effects of changes in operation (open with modifications/no customer access), business size (employees), revenue, operation type (grower, retailer, landscaper, etc.), and business type (partnership/individual/incorporated) are reflected by parameters α_1 , α_2 , α_3 , α_4 , and α_5 respectively [16].

3. Results

3.1. Producer sales

For all types of plants as well as gardening products and services included in our study, with the exception of bare root plants, the percentage of businesses reporting higher sales outweighed the percentage of businesses reporting decreased sales (Figures 1 and 2). In the survey, over 46% of the businesses reported increased sales in 2020 under COVID-19. For different types of plants included in the survey, landscape herbaceous flowers, landscape shrubs, and landscape trees showed the most significant increase in sales. In addition, for different gardening products/services, container plants, small plants, and soil & compost showed the most significant increase in sales.

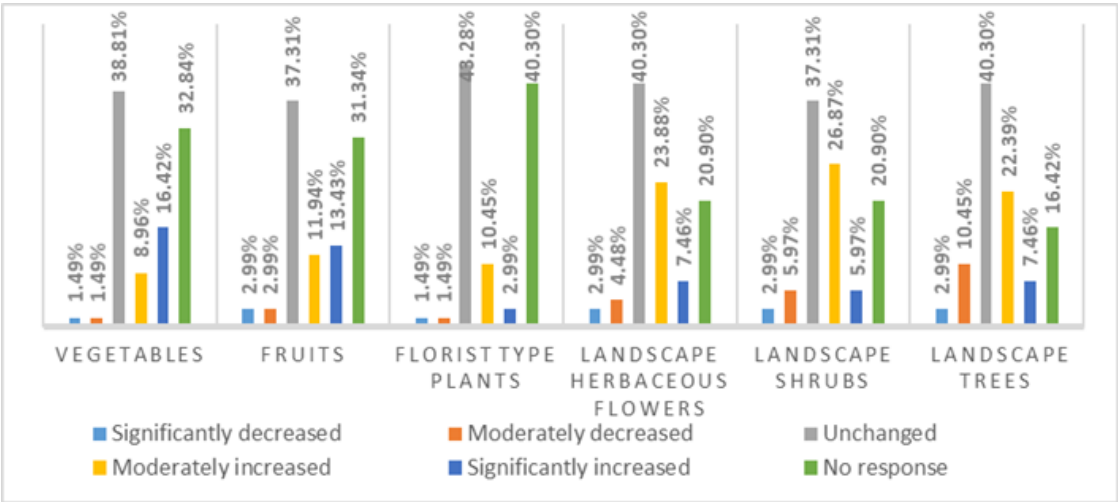


Figure 1. Change in purchases of plants during the pandemic, based on producer surveys

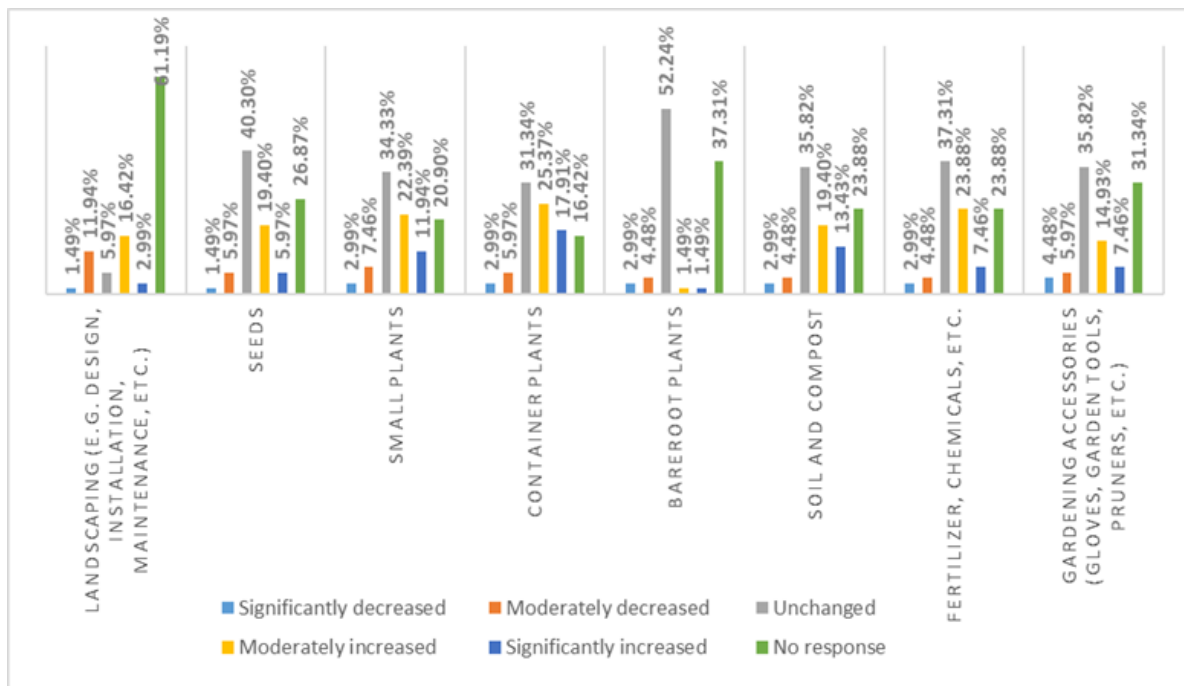


Figure 2. Change in purchasing of gardening products/services during the pandemic, based on producer surveys

3.2. Effects of business size and total revenue

The summary statistics for the survey are described in Table 1. Different operation types included landscaper, grower, retail, supplier, arborist, and re-wholesaler. The main business types included incorporated under state law, partnerships, and family or individual operation. 58.21% of businesses were open as before COVID-19, while others reported modified operations. 64% of the businesses indicated higher overall sales (compared to same season previous year), while less than 24% of the businesses reported decreased sales.

Table 1. Characteristics of survey respondents

Category	Percentage
Operation Type	
Landscaper	31.34%
Grower	29.85%
Retail	17.91%
Supplier	14.93%
Arborist	4.48%
Re-wholesaler	1.49%
Change in Operation due to COVID	
Open, as before COVID-19	58.21%
Open -with modified procedures (remote staff, limited staff, limited hours)	34.33%
Open -No Customer Access (phone or online ordering, pick-up or delivery only)	5.97%

Closed -Management decision	1.49%
Change in Sales during COVID	
significantly decreased	14.93%
moderately decreased	8.96%
no change	11.94%
moderately increased	40.30%
significantly increased	23.88%
Business Type	
Incorporated under state law	70.15%
Partnership – Include family partnerships	17.91%
Family or Individual operation – Exclude partnerships and corporations	10.45%
Other, such as estate or trust, prison farm, grazing association, American Indian Reservation, etc. Please specify	1.49%
Number of Employees	
Less than 10	23.88%
10 to 49	46.27%
50 to 99	10.45%
100 to 499	14.93%
more than 500	4.48%
Total Revenue	
\$0 to \$9,999	1.49%
\$100,000 to \$249,999	5.97%
\$250,000 to \$349,999	5.97%
\$350,000 to \$500,000	5.97%
\$500,000 to \$749,999	2.99%
\$750,000 to \$999,999	8.96%
\$1,000,000 to \$1,099,999	4.48%
\$1,100,000 to \$4,999,999	34.33%
\$5,000,000 to \$7,999,999	1.49%
over \$8,000,000	28.36%

The estimates from our ordered logit model for change in businesses' sales are shown in Table 2. Based on the type of operation, the retail operations were associated with 16 times higher probability of increased sales, compared to the growers (base). The results were not statistically significant for other business types. In terms of change in daily operations, the difference was not statistically significant as businesses shift from "open – as before COVID" to "open – with modifications" or "open – with no customer access". We also found that the effects of number of employees and revenue on overall sales during the pandemic were not statistically significant.

Table 2. Ordered logit model estimates for change in overall sales due to modified operations, business size, business type, operation type, and revenue

Change in sales	Odds Ratio	SE	P> z
Change in operation (Base=Open- as before COVID)			
Open- with modifications	0.795	0.487	0.708
Open- no customer access	0.680	0.669	0.695
Operation Type (Base= Grower)			
Arborist	0.292	0.366	0.326
Landscaper	0.393	0.287	0.201
Retail	16.515***	14.564	0.001
Supplier	1.685	1.361	0.518
Business Type (Base=Family or Individual operation)			
Incorporated under state law	0.479	0.439	0.422
Partnership – Include family partnerships	0.539	0.561	0.553
Size (per 10 employees)	1.032	0.029	0.255
Revenue (in \$100,000)	1.005	0.012	0.667

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

The estimates from our ordered logit model for change in sales of different plants and gardening products are shown in Table 3. An important result from our analysis was difference in change of sales of different plants and gardening products based on type of operation. Retail operations were associated with higher probability of increased sales for seeds, small plants, container plants, soil & compost, fertilizer & chemicals, gardening accessories, and florist type plants. Supplier operations were associated with higher probability of increased sales for small plants, container plants, vegetables, and fruits.

Table 3. Ordered logit model estimates for change in sales of plants and gardening products

Change in sales	Odds Ratio	P> z	Odds Ratio	P> z	Odds Ratio	P> z
	Landscaping		Seeds		Small Plants	
Change in operation (Base=Open- as before COVID)						
Open- with modifications	1.35	0.80	2.75	0.21	1.63	0.52
Open- no customer access	-	-	0.00**	0.01	0.20	0.25
Operation Type (Base= Grower)						
Arborist	-	-	0.22	0.35	0.18	0.19
Landscaper	0.53	0.66	0.50	0.50	0.12**	0.02
Retail	3.63	0.42	46.02***	0.00	16.92***	0.01
Supplier	3.97	0.43	0.99	1.00	0.14**	0.04
Business Type (Base=Family or Individual operation)						
Incorporated under state law	1.37	0.82	0.44	0.56	0.60	0.64
Partnership – Include family partnerships	2.99	0.55	0.50	0.68	0.48	0.57

Size (per 10 employees)	0.99	0.77	0.99	0.86	1.02	0.55
Revenue (in \$100,000)	1.00	0.97	0.98	0.31	1.00	0.99
	Container Plants		Soil and Compost		Fertilizer and Chemicals	
Change in operation (Base=Open- as before COVID)						
Open- with modifications	1.64	0.51	2.38	0.24	1.70	0.47
Open- no customer access	3.12	0.40	0.06*	0.06	0.12	0.15
Operation Type (Base= Grower)						
Arborist	0.12	0.11	0.21	0.28	0.41	0.54
Landscaper	0.09**	0.01	0.51	0.47	0.48	0.43
Retail	28.31***	0.00	11.44**	0.01	8.68**	0.02
Supplier	0.07***	0.01	0.80	0.83	0.99	0.99
Business Type (Base=Family or Individual operation)						
Incorporated under state law	0.60	0.65	1.63	0.65	1.63	0.70
Partnership – Include family partnerships	0.50	0.60	1.16	0.91	1.16	0.92
Size (per 10 employees)	1.03	0.35	0.98	0.60	1.03	0.42
Revenue (in \$100,000)	1.00	0.92	0.99	0.42	0.99	0.59
	Gardening Accessories		Vegetables		Fruits	
Change in operation (Base=Open- as before COVID)						
Open- with modifications	2.07	0.34	6.59	0.10	1.30	0.75
Open- no customer access	1.5E+07	0.99	0.00	0.20	0.99	1.00
Operation Type (Base= Grower)						
Arborist	0.70	0.83	0.02	0.14	0.04*	0.08
Landscaper	0.13*	0.08	0.03**	0.02	0.01***	0.00
Retail	21.18**	0.01	7.67*	0.06	3.78	0.14
Supplier	2.63	0.42	0.04**	0.03	0.03**	0.02
Business Type (Base=Family or Individual operation)						
Incorporated under state law	0.18	0.22	0.39	0.51	0.24	0.25
Partnership – Include family partnerships	0.14	0.24	0.03*	0.06	0.33	0.47
Size (per 10 employees)	1.00	0.97	0.94	0.16	1.03	0.49
Revenue (in \$100,000)	1.02	0.47	1.02	0.29	1.00	0.85
	Florist Type Plants		Landscape Herbaceous Plants		Landscape Shrubs	
Change in operation (Base=Open- as before COVID)						
Open- with modifications	12.08*	0.07	2.43	0.24	1.13	0.86
Open- no customer access	0.00	1.00	0.20	0.22	1.25	0.87
Operation Type						

Arborist	0.41	0.76	0.12	0.16	0.24	0.32
Landscaper	0.08	0.20	0.06***	0.00	0.25	0.14
Retail	28.84**	0.04	2.79	0.23	4.15	0.14
Supplier	0.09	0.33	0.11**	0.03	0.13**	0.05
Business Type						
Incorporated under state law	6.0E+11	1.00	2.28	0.51	0.74	0.81
Partnership – Include family partnerships	2.0E+10	1.00	4.46	0.31	0.68	0.78
Size (per 10 employees)	0.83	0.14	1.00	0.91	1.05	0.14
Revenue (in \$100,000)	1.05	0.21	1.00	0.84	1.00	0.92
	Landscape Trees					
Change in operation (Base=Open- as before COVID)						
Open- with modifications	1.20	0.79				
Open- no customer access	1.86	0.58				
Operation Type (Base= Grower)						
Arborist	0.34	0.39				
Landscaper	0.56	0.47				
Retail	1.46	0.65				
Supplier	0.31	0.18				
Business Type (Base=Family or Individual operation)						
Incorporated under state law	0.43	0.43				
Partnership – Include family partnerships	0.60	0.68				
Size (per 10 employees)	1.05*	0.08				
Revenue (in \$100,000)	0.99	0.34				

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

3.3. Challenges faced by businesses due to COVID-19

Table 4 shows the weighted average rating on a scale of 1 to 5 (1=not challenging at all, 2=slightly challenging, 3=challenging but manageable, 4=definitely challenging, 5=very challenging), as well as the relative index, for several issues faced by businesses due to the pandemic. Our findings indicated that the major challenges faced by the businesses were not having enough employees to keep up with demand during COVID-19, not having enough inventory to meet customer demand, and social distancing for employees.

Table 4. Severity of challenges faced by businesses due to the pandemic on a scale of 1 to 5 (1=not challenging at all, 2=slightly challenging, 3=challenging but manageable, 4=definitely challenging, 5=very challenging)

Challenge	Rating	Relative Index
Not enough employees to keep up with demand	2.86	0.571
Not enough inventory to meet customer demand	2.81	0.563
Social distancing for employees	2.54	0.507
Social distancing for customers	2.48	0.495
Compliance with government covid-19 mandates	2.47	0.494
Covering work hours with available employee	2.45	0.490
Increase in operation costs due to covid-19	2.38	0.477
Access to government relief programs	2.29	0.458
Market access	2.26	0.452
Training workers	2.23	0.445
Delivering to other state	1.93	0.386
Keeping staff employed	1.90	0.379
Taxes	1.87	0.375
Cash flow obligations	1.84	0.369
Billing and collections	1.81	0.363

4. Discussion

In general, businesses reported higher overall sales for all plants and gardening supplies during COVID-19, with the exception of bare root plants. 64% of the businesses indicated higher overall sales compared to same season previous year. Over 46% of the businesses reported increased sales in 2020 under COVID-19. These are interesting findings, which imply a greater demand potential for plants and gardening products/services from consumers, in light of this pandemic. It is very important for businesses to match this potential demand in order to move towards economic recovery in the aftermath of the pandemic.

The major challenges that all businesses faced were lack of enough employees to cover hours of operation, not enough inventory to keep up with the consumer demand, and social distancing for employees. Based on the type of operation, the retail type businesses were associated with 16 times higher probability of increased sales, compared to the growers (base). The results were not statistically significant for other business types. In terms of change in daily operations, the difference was not statistically significant as businesses shift from “open – as before COVID” to “open – with modifications” or “open – with no customer access”. We also found that the effects of number of employees and revenue on overall sales during the pandemic were not statistically significant. This suggests that in general, the pandemic has affected diverse businesses in a similar manner. For different plants and gardening products, we were able to analyze the effect on change in sales due to modified operations, type of operations, business type, size, and revenue. We found that retailers and suppliers were associated with a higher probability of increased sales for several plants and products.

Awareness regarding the major challenges, and the impact of the pandemic on change in sales of businesses in general, as well as different products, would provide insight to governmental agencies while planning aid, relief programs, and assistance. The results from our producer surveys indicate that the pandemic has had a huge impact on the gardening industry. Results of this study provide important information for supply

chain management, general operations, and marketing practices for businesses in the gardening industry; it is useful to guide the nursery owners and the green industry to drive towards the economic recovery from COVID-19.

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