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RESEARCH

Impact of COVID-19 on USDA-certified organic producers: exploring the role of sociodemographic and contextual factors

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Abstract The demand of local and organic products increased during the first years of the COVID-19 pandemic, and farmers' risk for transmission and infection also increased. A comprehensive picture on the effects of the pandemic on the organic farmer is not available. This was a cross-sectional survey study on the impact of COVID-19 on United States (US) certified organic producers, specifically on the challenges the pandemic imposed on the farm and the farming community. Data were collected in 2020–2021 through an electronic and paper survey. Participants included organic producers listed in the USDA Organic Integrity Database. Respondents represented producers from 40 states. The most frequently reported farm impacts were market availability (45.6%) and contact with the customer base (34.9%). The most frequently cited farming community impacts were economic hardship (44.2%), customer interaction and access (33.4%), and market availability (32.6%). Female respondents reported slightly more impacts than did male respondents (1.8 vs 1.3, $p < .001$). Hispanic reported more impacts on average than did non-Hispanic respondents (2.1 vs 1.4, $p = .002$). Differences by age and education were also found. Only a small percentage applied for and received emergency financial assistance. Results indicate that the pandemic had a multilevel impact on the workforce and on access to the market and costumers. They highlight the role of personal and contextual factors on how the producer experienced the pandemic. Also of relevance is that a high majority of participants did not pursue pandemic-specific assistance. The results of this study may inform research and policy, and interventions to protect and support organic producers in future emergencies.

Keywords Organic · Certified producer · COVID-19 pandemic · Impact on farm

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Introduction

The vulnerability of farmers and food systems to adversity and crises is well-known. Food producers

and distribution chains are being constantly challenged; uncertainty is the nature of agriculture, from weather insecurity and economic quandary to growing pressure to address climate change and environmental degradation (FAO 2021a, 2021b). However, COVID-19 is proving to be different from any other crisis we have experienced and has evidenced the susceptibility of agriculture to disturbance. Literature on the impact of the pandemic on the farm and food is rapidly emerging. International agencies and research groups are exploring the disruption COVID-19 is causing on farming systems, livelihoods, and food production and supply all over the world (Aday and Aday 2020; Barman et al. 2021; FAO 2020; FAO 2021a; Galanakis 2020; Haqiqi and Bahalou Horeh 2021; Lioutas and Charatsari 2021; Meuwissen et al. 2021; OECD 2020; Siche 2020; Stephens et al. 2020; Weersink et al. 2021).

In the United States (US), population data on the health effect of the pandemic is staggering. As of late November 2022, the Centers for Disease Control and Prevention (CDC) reported more than 98 million cases and over 1 million deaths (CDC 2022). The coronavirus has also affected agricultural production (ERS 2022; Weersink et al. 2021), and according to the Agriculture Secretary, the pandemic *exposed a food system that was rigid, consolidated, and fragile […], a system that rewards size over all else* (USDA 2021).

Agricultural producers are considered essential workers, as they are critical to food availability and access (US Department of Homeland Security 2021). Studies have shown that as COVID-19 spread in 2020 and 2021, people ate more at home and demand for agricultural produce increased (Goldy et al. 2020; Shearing 2020). To attend to the increased demand, farmworkers were called back to work and exposure to the virus also increased. How US agricultural producers and farmworkers were affected by the first few waves of the COVID-19 pandemic is still being assessed, but there are preliminary data on infection prevalence, barriers to healthcare access, and difficulties following prevention and testing mandates and recommendations (Chicas et al. 2022; Gupta and Fawcett 2020; Lewnard et al. 2021; Lusk and Chandra 2021; Rosero et al. 2021; Soto Mas et al. 2022; The Counter 2020). A 2020 small study estimated that agricultural workers were more likely to test positive for COVID-19 compared to the general population (Fielding-Miller, et al. 2020). Results from a recent study suggest that it is challenging for agricultural workers to comply with social distancing recommendations while harvesting and packing produce and that transportation arrangements to get to the fields increase the risk of transmission of the coronavirus (Chicas et al. 2022).

The US organic farmer and COVID-19

Organic food products are available in practically every US conventional grocery store (ERS 2021), and 40% of US adults said that most or some of the food they eat is organic (Funk et al. 2018). The US Department of Agriculture (USDA) database of certified organic operations lists more than 45,000 certified organic operations worldwide, with approximately 62% of them located in the USA (USDA, n.d.a). The USDA describes organic agriculture *as the application of a set of cultural, biological, and mechanical practices that support the cycling of on-farm resources, promote ecological balance, and conserve biodiversity. These include maintaining or enhancing soil and water quality; conserving wetlands, woodlands, and wildlife; and avoiding use of synthetic fertilizers, sewage sludge, irradiation, and genetic engineering* (AMS 2015).

While food production and consumption suffered with the first wave of infections, later data showed an increase in demand of local and organic products. Sales of organic and fresh produce experienced significant growth in 2020 and 2021 (Askew 2020; Ewing-Chow 2020; Organic Produce Network and Category Partners 2021). With consumers' increasing reliance on local products, it is important to understand how the pandemic has affected food systems and producers. There is strong evidence that the impact of COVID-19 has been different across the food production system, and it is important to identify which subgroups of agricultural workers are more susceptible to the negative effects of current and future pandemics and risks (Haqiqi and Bahalou Horeh 2021; Weersink et al. 2021). This paper presents data on the impact of the COVID-19 pandemic on the US organic farmer, specifically on the challenges the pandemic imposed on the farm and the farming community.

Material and methods

This was a cross-sectional survey of US-certified organic producers. The data presented here were

collected by the National COVID-19 organic farmer study, an ongoing project funded by the National Institute for Occupational Safety and Health (NIOSH) and the Southwest Center for Agricultural Health, Injury Prevention, and Education at the University of Texas Health Sciences Center at Tyler. The study was approved by the Institutional Review Board at the University of New Mexico. All participants were provided with an informed consent form and voluntarily consented to participate.

Participants included organic producers listed in the USDA Organic Integrity Database (OID). The USDA defines the farm producer as *the person who runs the farm, making day-to-day management decisions for the farm operation. She/he may be the owner, a member of the owner's household, a hired manager, a tenant, a renter, or a sharecropper* (USDA, n.d.b) (note that the "producer" may also be referred as the "operator"). Inclusion criteria consisted of (a) 18 years of age or older; (b) currently operating an organic farm in the US; and (c) listing a valid postal address or email address in the OID. Excluded were operations that solely engaged in processing organic consumer products. The OID is a publicly available electronic database with a variety of fields, such as operation (e.g., crop, handling, livestock, and wild crops) and certification status (e.g., certified, surrendered, suspended, revoked, and other). Contact information consists of a name (operator), phone, mailing address, and an optional entry for the email address.

Recruitment began in the fall of 2020 and extended through the spring of 2021. An advanced search of the OID database returned over 27,000 operations in the US. Of those, only 3559 listed an email or physical address. Operators with an email address were sent an introductory message on the study and survey and a link providing a copy of the informed consent and access to the electronic survey. Due to limited resources, only a portion of those without an email address or who had not completed the electronic survey (approximately 10% of the total sample) were reached by postal mail through a packet containing IRB documents, the paper survey and a stamped self-addressed return envelope. Recruitment efforts also included dissemination through websites, social media outlets, and through partners such as extension agents and farmer organizations. Reminder emails, phone calls, and postcards were systematically sent to non-responders throughout the recruitment period. Participation incentives included merchandize cards from a national hardware and home improvement store.

Data collection

Data were collected through a multidimensional survey developed by the research team. The process consisted of (a) a search of the literature to identify domains of potential interest; (b) reiterated draft versions of the survey; and (c) a review by experts in public health, social and behavioral sciences, epidemiology, occupational health, and agricultural research. This process contributed to the face and content validity of the instrument. The final version of the survey consisted of 28 items, including standard sociodemographic questions and COVID-specific items. Results on other dimensions, specifically COVID-19 prevalence, prevention behaviors, and healthcare delays, have been reported previously (Rosero et al. 2021; Soto Mas et al. 2022). The present analysis explored the impact of COVID-19 on the farm and the farming community by asking *What has been the impact of COVID-19 on your farm?* and *"What do you currently consider to be the most pressing issue(s) in the farming community related to the COVID-19 pandemic*? Response scales consisted of multiple choice and an open-ended option (see Table 3).

Data management and analysis

REDCap (Research Electronic Data Capture), a secure web application, was used for data collection and management. Participants were assigned a unique ID number. Paper survey data were manually entered into the application by trained project staff. Of the 3559 operators invited to participate, 387 responded to the survey. The estimated response rate was 11%. Respondents who did not meet qualifying requirements or who did not answer demographic questions were classified as "incomplete" and excluded, leaving 344 valid cases for analysis. SPSS 25.0 (IBM SPSS Statistics, Armonk, NY: IBM Corp.) was used to analyze the data. Continuous and categorical independent variables were dichotomized to allow for comparisons by key demographic and farm characteristics. For example, age, which was collected as a

categorical variable with response options ranging from 18 to 65 years of age and over, was dichotomized as 55 years of age and older or under 55 years of age as roughly half of the respondents fell into each of these categories. Similarly, while both sex at birth and gender identity were collected, nearly all respondents identified as female or male. Thus, for comparison purposes, the variables were combined into a dichotomous gender identity variable representing female or not. The same approach was followed on all variables for which respondents could select one or more categories, including race, ethnicity, education level, annual household income, household size, marital status, and number of years in organic farming (see Table 1). The number of organic acres in production was collected as a continuous variable, allowing respondents to enter a numeric response. These responses were dichotomized as fewer than 50 acres and 50 or more acres. Health insurance status was collected as a dichotomous variable asking respondents whether or not they have health insurance coverage.

Descriptive statistics were used for sociodemographic variables, the prevalence of COVID-19 in respondents' households, and receipt of COVID-19-specific assistance (see Tables 1 and 2). Descriptive and bivariate statistics were used to analyze the impacts of the COVID-19 pandemic on respondents' farms and the perceived impacts of the pandemic on the farming community. Pearson chi-square tests were used to assess the statistical significance of differences between reported individual impacts by sociodemographic categories, and ANOVA was used to assess the statistical significance of differences in the number of different types of impacts reported by sociodemographic categories. Fisher's exact test was used when cell sizes were small (a count of five or less in a response category).

Results

Table 1 shows the sociodemographic characteristics of the sample. Respondents represented producers from 40 states. Half were 55 years old or older (49.7%), most were US born (96.8%) and Non-Hispanic White (89.7%), and one-third identified as female (34.4%). A majority had a college degree or greater (67.8%). About half of the respondents were new or beginning organic farmers, had a farm size of at least 50 acres, and lived in a household with two or more people. A high majority were married or cohabitating (83.9%), and about 26% had a yearly household income under $50,000. Most had some form of health insurance (91%).

A very low percentage reported COVID-19 infection for themselves or household members. Less than a quarter of respondents.reported that they or someone in their household had applied for or received COVID-19 assistance (Table 2).

Table 3 shows the self-reported impacts of the COVID-19 pandemic on respondents' farms and perceived impacts on the farming community. The most frequently reported impacts on respondents' farms were market availability (45.6%) and contact with the customer base (34.9%). Limited farmworker availability and providing worker protection (including masks, gloves, washing stations and hand sanitizer, and social distancing) were also selected by many participants. Regarding the perceived impact of the pandemic on the farming community, the most frequently cited issues were economic hardship (44.2%), customer interaction and access (33.4%), and market availability (32.6%).

Table 4 shows the reported impact of COVID-19 on the respondent's farm and frequency of specific farm impacts and the total number of impacts by sociodemographic characteristics, COVID-19 prevalence, and receipt of COVID-19-specific assistance. Several demographic characteristics were associated with the report of farm impacts. Female respondents reported slightly more impacts on average than did male respondents (1.8 vs 1.3, $p < 0.001$) and were more likely to report worker protection (33.1% vs 15.1%, $p < 0.001$) and contact with the customer base (50.0% vs 26.7%, $p < 0.001$) as specific issues impacting their farm. Respondents who were married or cohabitating reported fewer impacts on average than those who were not (1.4. vs 1.7 $p = 0.008$). Similarly, those who identified ethnically as Hispanic reported more impacts on average than did non-Hispanic respondents (2.1 vs 1.4, $p = 0.002$); they also selected worker protection as the main issue impacting their farm, which was significantly different from non-Hispanic respondents (50.0% vs 20.8%, $p = 0.006$).

Foreign-born respondents were more likely to report limited farmworker availability as impacting their farm compared to those born in the USA

Table 1 Social demographic and selected characteristics of respondents

	Count	Percent	Valid N
Age			
Under 55 years of age	173	50.3%	344
55 years of age or older	171	49.7%	
Sex at birth			
Female	116	33.9%	342
Male	220	64.3%	342
Prefer not to disclose	6	1.8%	342
Gender identity			
Female	118	34.4%	343
Male	217	63.3%	343
Transgender	0	0.0%	343
Other	1	0.3%	343
Prefer not to disclose	7	2.0%	343
Race/ethnicity			
Hispanic or Latino	16	5.0%	321
Non-Hispanic White	288	89.7%	
Non-Hispanic Asian, African American/Black, Native American or Alaska Native, or Multi-Racial	17	5.3%	
Place of birth			
USA	330	96.8%	341
Outside of USA	11	3.2	
Education level			
Less than 4-year degree	110	32.2%	342
4-year degree or more	232	67.8%	
Annual household income			
Under $50,000	87	26.2%	332
$50,000 or More	245	73.8%	
Household size			
Lives alone or with 1 other person	163	49.1%	342
2 or more other people	174	50.9%	
Marital status			
Not Married or cohabitating	55	16.1%	342
Married or cohabitating	287	83.9%	
Years in organic Ag			
Fewer than 10 years	180	52.5%	343
More than 10 years	163	47.5%	
Acreage			
Fewer than 50 Acres	172	50.9%	338
At Least 50 Acres	166	49.1%	
Health insurance status			
No health insurance	29	8.5%	341
Any type of health insurance	312	91.5%	

(54.5% vs 23.9%, $p=0.021$). Statistically significant differences by age group were also found. Those under 55 years of age reported slightly more impacts on average than did older respondents (1.5 vs 1.3, $p=0.038$), but there were no differences by age in the reporting of specific farm impacts. Respondents with

Table 2 Reported receipt of COVID-19 assistance

COVID-19 assistance	Count	Percent	Valid N
Respondent or someone in household applied for COVID-19-specific assistance	69	20.2%	342
Respondent or someone in household received COVID-19 specific assistance	82	24.0%	342
Neither I nor anyone in my household applied or Received COVID-19 specific assistance	191	55.8	342

Table 3 Impact of COVID-19 on respondent's farm and farming community

	Count	Percent	Valid N
Impact of COVID-19 on respondent's farm			
Market availability	157	45.6%	344
Contact with the customer base	120	34.9%	344
Limited farm worker availability	87	25.3%	344
Worker Protection (providing masks, gloves, wash stations, hand sanitizer, and social distancing)	73	21.2%	344
Other	55	16.0%	344
Most pressing issues in the farming community related to COVID-19			
Economic hardship	152	44.2%	344
Customer interaction and access	115	33.4%	344
Market availability	112	32.6%	344
Adherence to protective practices (masks, gloves, social distancing, sanitation practices)	63	18.3%	344
Other	22	6.4%	344

at least a 4-year college degree were more likely than those without a 4-year college degree to report market availability (50.0% vs 37.3%, $p=0.027$), worker protection (24.6% vs 14.5%, $p=0.035$), and contact with customer base (39.2% vs 26.4%, $p=0.02$) as specifically impacting their farms. They also reported slightly more impacts on average compared to less educated respondents (1.5 vs 1.2, $p<0.001$). Regarding farm size, smaller farm producers (less than 50 acres) reported slightly more impacts on average (1.6 vs 1.3, $p<0.001$) than those with larger farms, and they were more likely to report worker protection (26.7% vs 15.7%, $p=0.013$) and contact with customer base (47.1% vs 22.3%, $p<0.001$) as impacting their farms. Finally, respondents who reported that they or someone in their household had had COVID-19 were less likely to report worker protection as an impact (3.0% vs 23.2%, $p=0.007$); they also reported fewer impacts on average (1.0 vs 1.5, $p=0.005$) than did respondents with no cases of COVID-19 in their households. There were no statistically significant differences by household size or years in organic farming for any impacts reported.

Fewer associations were found when looking at the perceived impact of COVID-19 on the farming community. Table 5 presents the reported types of impacts and the average number of impacts by sociodemographic characteristics and COVID-19 prevalence. By gender, female respondents were more likely to report interaction with and access to customers as issues in the farming community compared to non-female (44.1% vs 27.6%, $p=0.002$), and they reported slightly more impacts on average (1.5 vs 1.3, $p=0.010$). Respondents with at least a 4-year college degree were more likely than less educated respondents to report customer interaction and access to customers as impacting the farming community (39.7% vs 20.9%, $p<0.001$), but there were no significant differences on the average number of impacts reported. Respondents with smaller farms (fewer than 50 acres) were more likely than those with larger farms to report adherence to protective practices (22.1% vs 13.9%, $p=0.049$) and customer interaction (45.3% vs 21.7%, $p<0.001$) as impacting the farming community and reported slightly more impacts on average (1.5 vs 1.2, $p=0.005$). Those who reported that they or someone in their household had COVID-19 were more likely than respondents with no COVID-19 in their households to report market availability as impacting the farming community (48.5% vs 30.9%, $p=0.040$), but they did not report more impacts on average. Finally, respondents who had applied for or received COVID-19-specific assistance reported slightly more impacts on the farming community on average than did those who had not applied for or received COVID-19 assistance (1.5 vs 1.3, $p=0.035$), but there were no significant differences in

Table 4 Reported impact of COVID-19 on respondent's farm by sociodemographic characteristics, COVID-19 prevalence, and receipt of COVID-19 specific assistance

	Market availability		Worker protection		Contact with customer base		Limited farm worker availability		Number of types of impacts selected	
	%*	Sig.**	%*	Sig.**	%*	Sig.**	%*	Sig.**	Mean	Sig.**
Gender identity										
Not female	44.4%	.495	15.1%	**<.001**	26.7%	**<.001**	22.7%	.113	1.3	**<.001**
Female	48.3%		33.1%		50.0%		30.5%		1.8	
Ethnicity										
Not Hispanic	46.9%	.465	20.8%	**.006**	35.5%	.237	24.0%	.221	1.4	**.002**
Hispanic	56.3%		50.0%		50.0%		37.5%		2.1	
Race										
Not Non-Hispanic White	54.5%	.342	33.3%	.113	48.5%	.069	36.4%	.160	1.9	**.006**
Non-Hispanic White	45.8%		21.2%		32.6%		25.0%		1.4	
Birthplace										
Born outside of the USA	27.3%	.204	36.4%	.219	27.3%	.576	54.5%	**.021**	1.5	.936
Born in the USA	46.7%		20.9%		35.5%		23.9%		1.4	
Age										
Under 55 years	48.0%	.381	23.7%	.258	38.2%	.201	24.9%	.852	1.5	**.038**
55 years or over	45.3%		18.7%		31.6%		25.7%		1.3	
Education level										
< 4-year college degree	37.3%	**.027**	14.5%	**.035**	26.4%	**0.02**	23.6%	.598	1.2	**<.001**
4-year college degree or more	50.0%		24.6%		39.2%		26.3%		1.5	
Marital status										
Not married or cohabitating	56.4%	.081	32.7%	**.020**	41.8%	.254	27.3%	.692	1.7	.008
Married or cohabitating	43.6%		18.8%		33.8%		24.7%		1.4	
Household size										
Alone or with 1 other person	42.9%	.315	22.0%	.665	31.5%	.178	27.4%	.349	1.4	.332
Two or more other people	48.3%		20.1%		38.5%		23.0%		1.5	
Annual household income										
Under $50,000	54.0%	.084	20.7%	.916	42.5%	.084	28.7%	.483	1.6	**.042**
$50,000 or More	43.3%		21.2%		32.2%		24.9%		1.4	
Years of organic farming										
10 years or less	45.0%	.763	21.7%	.855	35.0%	.995	25.0%	.871	1.4	.835
More than 10 YEARS	46.6%		20.9%		35.0%		25.8%		1.4	
Organic acres										
Less than 50 acres	43.0%	.399	26.7%	**.013**	47.1%	**<.001**	29.7%	.071	1.6	**<.001**
50 or more acres	47.6%		15.7%		22.3%		21.1%		1.3	
COVID-19 prevalence										
No COVID-19 in household	45.0%	.476	23.2%	**.007**	35.7%	.335	26.4%	.159	1.5	**.005**
Any COVID-19 in household	51.5%		3.0%		27.3%		15.4%		1.0	
COVID-19 assistance										
No assistance received	38.7%	**.004**	19.4%	.317	33.5%	.491	23.0%	.251	1.3	**.003**
Applied or received assistance	54.3%		23.8%		37.1%		28.5%		1.6	

*Percentage of responses for selecting the types of impacts, they do not necessarily add up to 100%.

**Bolded items had p-values < 0.05

Table 5 Most pressing issues on the farming community associated with COVID-19 by sociodemographic characteristics, COVID-19 prevalence, and receipt of COVID-19-specific assistance

	Economic hardship		Adherence to protective practices		Market availability		Customer interaction and access		Number of types of impacts selected	
	%*	Sig.**	%*	Sig.**	%*	Sig.**	%*	Sig.**	Mean	Sig.**
Gender identity										
Not female	44.0%	.871	17.3%	.495	32.4%	.909	27.6%	**.002**	1.3	**.010**
Female	44.9%		20.3%		33.1%		44.1%		1.5	
Ethnicity										
Not Hispanic	46.2%	.849	18.1%	.944	29.9%	.241	33.0%	.507	1.3	.809
Hispanic	43.8%		18.8%		43.8%		25.0%		1.4	
Race										
Not Non-Hispanic White	48.5%	.604	21.2%	.695	39.4%	.342	27.8%	.392	1.5	.297
Non-Hispanic White	43.5%		18.4%		31.3%		34.7%		1.3	
Birthplace										
Born outside of USA	45.5%	.937	18.2%	1.000	36.4%	.801	36.4%	.851	1.5	.649
Born in USA	44.2%		18.2%		32.7%		33.6%		1.3	
Age										
Under 55 years	48.0%	.154	17.3%	.639	29.5%	.220	33.5%	.970	1.4	.814
55 years or over	40.4%		19.3%		35.7%		33.3%		1.3	
Education level										
< 4-year college degree	50.9%	.098	18.2%	.937	31.8%	.801	20.9%	**<.001**	1.3	.128
4-year college degree or more	41.4%		18.5%		33.2%		39.7%		1.4	
Marital status										
Not married or cohabitating	49.1%	.449	18.2%	.991	36.4%	.533	40.0%	.231	1.5	.078
Married or cohabitating	43.6%		18.1%		32.1%		31.7%		1.3	
Household size										
Alone or with 1 other person	39.9%	.095	20.2%	.320	35.7%	.251	33.9%	.732	1.4	.663
Two or more other people	48.9%		16.1%		29.9%		32.2%		1.3	
Annual household income										
Under $50,000	49.4%	.260	14.9%	.336	35.6%	.429	40.2%	.156	1.4	.163
$50,000 or More	42.4%		19.6%		31.0%		31.8%		1.3	
Years of organic farming										
10 years or less	47.2%	.255	19.4%	.588	28.3%	.073	32.2%	.590	1.3	.778
More than 10 years	41.1%		17.2%		37.4%		35.0%		1.4	
Organic acres										
Less than 50 acres	39.5%	.086	22.1%	**.049**	32.6%	.901	45.3%	**<.001**	1.5	**.005**
50 or more acres	48.8%		13.9%		31.9%		21.7%		1.2	
COVID-19 prevalence										
No COVID-19 in household	45.0%	.341	18.6%	.621	30.9%	**.040**	34.4%	.239	1.4	.715
Any COVID-19 in household	36.4%		15.2%		48.5%		24.2%		1.3	
COVID-19 assistance										
No assistance received	44.0%	.942	16.2%	.240	31.9%	.719	29.8%	.096	1.3	**.035**
Applied or received assistance	44.4%		21.2%		33.8%		38.4%		1.5	

*Percentage of responses for selecting the types of impacts, they do not necessarily add up to 100%.

**Bolded items had p-values < 0.05

the report of specific types of impacts on the farming community.

Discussion

To our knowledge, this is the first national study reporting on the impact of COVID-19 on US certified organic producers and the farming community. Results highlight the role that sociodemographic and contextual factors on how the farmer experienced and navigated the pandemic.

The study collected valuable sociodemographic data. Approximately half of the respondents were younger than 55 years of age and had less than 10 years of experience in organic agriculture (Table 1). These are not the typical demographics of the US farm producer, which according to the 2017 Census of Agriculture, is older (57.5 average age) and had more farming experience (21 + years). On the contrary, the distribution of female (sex at birth) (34%) and Hispanic/Latino (5%) respondents was only slightly different from that estimated by the 2017 Census (35% and 4%, respectively) (NASS, n.d.). Also noticeable is that nearly 70% had an education level beyond high school, and 91% had some kind of health insurance. Thus, this study adds to the limited data currently available for this population. Despite increased interest by the USDA in organic agriculture, little is known about the actual farmer, and more resources should be dedicated to characterize and typify the US organic producer and farmworker. Also important would be to explore how individual and intrapersonal characteristics may contribute to job security, occupational safety, and health status in this population.

Similar to previously reported data on COVID-19 prevalence, prevention behaviors, and healthcare delays (Rosero et al. 2021; Soto Mas et al. 2022), the present analysis yielded interesting results. For instance, less than one-fourth reported applying for or receiving COVID-19 assistance (Table 2). This is surprising considering the initial impact of the pandemic on all jobs and sectors, including agriculture, and the financial resources made available to alleviate the negative economic effects of COVID-19. Multiple appropriation acts passed by the US Congress provided funds to assist farmers. According to the USDA Economic Research Service, $35.1B in total financial assistance was provided to farm operations and households in the calendar year 2020. These funds were made available through programs such as the Coronavirus Food Assistance Program (CFAP), which specifically targeted small farm operations (Giri et al. 2021). In March 2021, the USDA announced the allocation of $6B to the Pandemic Assistance to Producers, a new initiative to provide financial assistance to "a broader set of producers than in previous COVID-19 relief programs" (ERS 2022). It seems that the certified organic producer did not largely pursue COVID-19 assistance. Perhaps communication on the availability of funds did not reach these farmers, and it would be interesting to find out how they compare to the conventional farmer in terms of requesting and receiving financial assistance.

Results on the actual impact of the COVID-19 pandemic at the personal and community levels illustrate the numerous issues confronted by producers, such as disruption of market dynamics and customer relations, workforce availability, and safety and protection (Table 3). These findings are consistent with regional COVID studies with US farmers (all farmers) that found loss of income, labor shortages, and difficulty following safety precautions and providing safety equipment to employees (Ceryes et al. 2021; Chicas et al. 2022).

Finally, results also highlight significant differences by sociodemographic characteristics in how respondents experienced the COVID-19 pandemic (Table 4). Self-identified females, not married or cohabitating, and Hispanic respondents reported more impacts on average. Similarly, significant differences were found related to the place of birth, age, and education level. Data on the perceived impact of the pandemic in the farming community also showed significant differences by gender identity, education level, and farm size (Table 5). Other COVID-19 assessments and studies have also found differences by sociodemographic characteristics, such as a higher prevalence of COVID-19 among racial and ethnic minority groups compared to the general population (Acosta et al. 2021; Tai et al. 2022) and among Hispanic/Latino agricultural workers compared to non-Hispanic farmworkers (Waltenburg et al. 2021).

In summary, the results of this study indicate that personal and contextual factors played a role on how farmers confronted and navigated the many challenges presented by the first few waves of the

COVID-19 pandemic, both at the individual and community levels. These results may prove to be essential to plan for future emergencies and for the allocation of resources to support the organic food producer. Authors have already argued that the COVID-19 experience constitutes an opportunity to *create transformative public policies serving to build more sustainable food systems* (Hobbs 2020). This is important, as the food producer has shown to be essential to alleviate the effects of the pandemic on the food supply chain. Furthermore, since most organic farms are small and local, it has been suggested that they may be essential for communities to withstand, overcome, and recover from adversity (McDaniel et al. 2021). This study may inform targeted interventions for emergency preparedness, including a global pandemic, that contemplate specific measures to support the small-scale organic producer.

Conclusion

This study identified key challenges experienced by the certified organic producer during the COVID-19 pandemic, as a farmer and as a member of the farming community. Results indicate that the pandemic had a multilevel impact on the workforce and on access to the market and costumers. They highlight the role of personal and contextual factors on how the producer experienced the pandemic. Also of relevance is that a high majority of participants did not pursue or receive pandemic-specific assistance.

The results of this study may inform research and policy, and interventions to protect and support organic producers in future emergencies. Considering the popularity of local food systems and the essential role that farmers play on food availability and security, more resources should be dedicated to design audience-specific information and education on how to navigate public health emergencies, particularly among certain subgroups of organic producers. Resources to control the spread of worksite infections should be made available to protect farmworkers and minimize the impact of on day-to-day activities. Interventions may focus on those who may be more vulnerable to market disruption and access to customer. Additional efforts should also be dedicated to disseminating information among organic producers on how to identify and access emergency financial assistance. Despite the strong response from governments and federal agencies to provide financial support to businesses, many participants in this study were not benefitting from available COVID-19 assistance. Similarly, there is a pressing need for existing or new surveillance systems that collect data on the organic producer.

Regarding limitations, this was a cross-sectional study, and COVID-19 trends and impacts may change over time. The study may serve as a baseline for surveillance and a reference for future research. Although the sample was small and may not represent the entire US organic producer population, the response rate is typical for survey studies of this nature, and results on sociodemographic characteristics, COVID-19 prevalence, and other variables of interest were consistent with data reported by national surveillance systems, federal agencies, and research studies. On recruitment, while the primary method involved electronic outreach, the email address is not a required field in the OID. This significantly reduced the pool of participants. Finally, most participants completed the electronic version of the survey, and the data and results presented here largely reflect participants who had access to the Internet. However, data also show that a high majority of farmers, both conventional and organic, have access to electronic devices and the Internet.

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Author contribution Daisy V Rosero contributed to the design of the study as well as recruitment, data collection, management, and analysis. She contributed to the writing of the results section of the manuscript and edited the final version.

Francisco Soto Mas was a senior researcher and lead team member. He contributed to all phases of the study and was a major contributor in writing, editing, and finalizing the manuscript.

Laura Nervi provided valuable input into the development of the survey and the interpretation of data and results. She contributed to the introduction, discussion, and conclusion sections of the manuscript.

Rachel Sebastian conducted the statistical analysis and was a major contributor in writing and editing the data and results sections of the manuscript.

Vanessa Casanova contributed to the design of the study and interpretation of data and results. She edited the final version of the manuscript.

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Declarations

Conflict of interest The authors declare no competing interests.

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