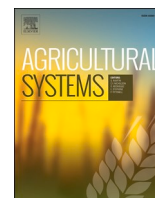




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# Impact of the COVID-19 pandemic on apple orchards in Europe

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## ABSTRACT

**CONTEXT:** The COVID-19 pandemic, caused by the SARS-CoV-2 virus, has affected global agricultural chains and intensified the issue of food insecurity worldwide.

**OBJECTIVE:** We propose a short retrospective of the reported effects of the COVID-19 pandemic from its beginning in March 2020 in Europe, on orchard management and harvest, sales and agricultural chains, monitoring and research in orchards, and we expose some of the solutions undertaken to tackle down these issues.

**RESULTS AND CONCLUSION:** In Europe, the fruit and vegetable sector has been affected by the pandemic in terms of production, distribution, and disturbance in market performance. Concerning apple, the most harvested and exported fruit in Europe, national governments, European institutions, the industry and producers have undertaken actions to ensure production and supply demand. Yet, stakeholders have faced several difficulties and additional costs for growth and harvest, sales, but also monitoring and research. However, European Union demand for fresh apples has increased during the pandemic. In addition, apple harvest has started a couple of months after the end of the first lockdown in most countries, and European apple orchards are usually in more flexible smallholder or family farms. Finally, the fruit itself has relatively long shelf-life comparatively to other fruits. For these main reasons, we argue that the apple sector might be more resilient than other fruit sectors or other cultures, despite the negative effects of seasonal workforce shortage and unstable market. The apple sector may suffer more from side-effects such as increasing labor, distribution, and packaging costs, than from actual stock and production issues.

**SIGNIFICANCE:** The pandemic could be an opportunity to reconsider production modes and to innovate for the future of food production in different crop systems in Europe, including apple orchards.

## 1. Introduction

The COVID-19 (SARS-CoV-2) pandemic has significantly affected – and will still affect in the foreseeable future – the world economy. Agricultural production systems, in the broadest sense, have not been spared, although some sectors and countries have been more affected than others (Brewin 2020; FAO 2020; Hart et al. 2020; OECD 2020; Stephens et al. 2020). No major food shortages have been reported yet, as most countries have taken actions to ensure continuous and as efficient as possible functioning agricultural production and supply chains in the short-term (Cullen 2020; Gray 2020; Laborde et al. 2020). However, the pandemic is threatening both mid-term and long-term food security, mainly because of disruption of international and national trade chains, inequitable access to the food that is produced, and logistics issues regarding worker flows (Laborde et al. 2020; Larue 2020; Pu and Zhong 2020; Toffolutti et al. 2020; Darnhofer 2021). As all actors

are getting organized for the food production to continue, questions arise on how resilient the system is, how it is responding to the different challenges imposed by the pandemic, and what will be the economic and social outcomes of the crisis on agricultural and food systems.

In particular, fruit and vegetable production and distribution in Europe have been affected by the COVID-19 pandemic in numerous ways; in terms of workforce availability and protection, logistics of the supply chain, and disturbance in market performance (European Commission 2020a; Freshfel Europe 2020; OECD 2020; Richards and Rickard 2020). Fruit production represents around 7% of total agricultural production of the European Union (EU-28), and apple orchards stand for an important part of the areas under selected fruit trees, with no less than 473,500 ha covered in 2017 (Eurostat 2017). Apple is the most harvested and exported fruit in Europe, with around 12.5 million tons collected annually, among which Poland, Italy, and France are top producers (Eurostat 2017). Although the average farm size has been

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increasing in recent years, apple production is historically concentrated in smallholder and family farms of 0.5–10 ha, depending on the country (Blommers 1994; Boshnakova 2015; Grappadelli 2011). The European Commission has announced on July 6, 2020, a financial support to the fruit and vegetable sector, recognized as ‘essential goods’, through an increase of the EU’s contribution, mainly to reduce crisis-related fluctuations in producers’ income, to improve the supply chain, and to encourage consumption of fruits in the EU (European Commission 2020b). The apple sector has globally managed to cope with the crisis and to supply fruits to retailers and markets, but has been facing significant difficulties both before and during the 2020 harvest season, and may face upcoming additional challenges in the times to come, as the virus and its new variants keep spreading (Freshfel Europe 2020; OECD 2020).

This article is not intended to providing a full synthesis of the pandemic effects on the apple production chain, as it is too early to do so and consolidated information is still presently lacking. Forthcoming scientific articles, industrial reports or analytic documents from institutions and governments will handle this task in a close future. Here, we aim at proposing a retrospective overview of the situation regarding already reported effects of the COVID-19 pandemic from its beginning in March 2020 in Europe, on (1) orchard management and harvest, (2) apple sales and agricultural chains, (3) monitoring and research in apple orchards, and we expose some of the solutions undertaken to tackle down these issues, and what it says about current food production systems.

## 2. Orchard management and harvest

In developed countries, non-staple crops such as fruits rely on more workers for planting, monitoring and harvesting than staple crops such as cereals, which are easier to mechanize (Laborde et al. 2020). Fruit production is therefore extremely dependent upon workforce availability from the local labor pool, but mainly from seasonal and migrant workers who undertake highly skilled and difficult work (Palumbo and Corrado 2020). Despite workers from the agri-food sector being recognized as essential, labor shortages have happened due to foreign seasonal workers (from both EU and non-EU countries, such as Morocco or Ukraine) being stuck at the border or affected by exceptional paperwork delays and mobility restrictions (Alderman et al. 2020; Durinck 2020; Larue 2020). This is one of the reasons why, in Europe in particular, fruit producers have been struggling in spring because of the seasonal labor shortage (Dawson 2020; Petetin 2020). Without low-cost labor from Eastern Europe, some countries of Western Europe were at risk of not completing their fruit harvest (Crețan and Light 2020). For example, as of April 2020, Britain struggled to find people to pick raspberries, and Italy lacked workers to harvest a significant part of strawberry crops (Alderman et al. 2020). In some apple producing stations in France, only one third of employees were still working in April (Chambre d’Agriculture 2020; Harzig 2020) and most EU producers had number of difficulties to securing the workforce during the summer, which could have had an impact on apple picking (Durinck 2020). As of late June, the United-Kingdom (UK) estimated that workforce costs for apple production increased by 10.5% because of the COVID-19 pandemic, mainly due to recruitment, training of unexperienced workers, accommodation and operation expenses (Pelham 2020). Of course, not all European countries have been affected the same way, depending on national policies and local workforce availability (OECD 2020; Palumbo and Corrado 2020).

In countries such as the UK or France, where the majority of fruit pickers are migrant workers, the problem of labor shortage was emphasized when national workers were reluctant to take on agricultural work (Crețan and Light 2020). National appeals have called for city people, who were then confined to fight the pandemic, to come and work in the orchards, for example in France (Alderman et al. 2020; Laurensen 2020). In many countries, online platforms have been created

to link farmer demands with available workers and people interested in helping. Rapidly, government measures have been taken to try to fix the workforce issue, so the apple sector, with harvest starting in August, was not too heavily affected by labor shortage, although resurgent outbreaks of COVID-19 in parts of Europe did not help reducing the pressure on workforce (Gallotti 2020; Trompiz et al. 2020). Some concerns persisted however for the following months, because it was then hard to recruit locally, as many workers had returned to their previous jobs or activities outside farming after summer (Chambre d’Agriculture 2020; Trompiz et al. 2020). Belgium authorities have extended the period that seasonal workers can work on a farm (from 60 days to 200 days), in the hope that people still present in the country would decide to stay until the orchard harvest season is completed (OECD 2020). Temporarily unemployed people in Belgium have also been allowed to work in farms while keeping unemployment benefits (OECD 2020). Apple producers estimate that they incurred approximately 1 billion euros in additional costs during first months of the pandemic to readapting production and logistics, and due to increased labor costs (Eurofresh 2020; Freshfel Europe 2020). Additional production costs have also aroused from the disrupted supply chain as some operations could not be performed at time (e.g., weed removal) and essential materials such as seeds, machinery or agrochemicals might have been punctually missing (OECD 2020). Finally, limiting apple tree planting capacities, thinning and pruning of fruit trees is affecting the sustainability of activities for the upcoming years (Freshfel Europe 2020).

It is still early to provide exhaustive feedback on the pandemic effect on yields in apple orchards, because apple harvest usually runs until November in some countries, which also depends on the varieties. One thing to keep in mind for the apple sector is that the quality of the 2020 harvest will determine availability of apples on the market for 2021, so any effect of the pandemic might have long-lasting consequences. The 2020 apple harvest has been ahead of time, because of warm conditions, and yield will likely be roughly the same as the 2019 campaign for most countries (Fresh Plaza 2020a; Freshfruit 2020a; Peters 2020). Estimates are of 10.7 million tons produced over 21 European countries (including the UK) (Durinck 2020). Major determinant of the result of the 2020 apple harvest will remain weather conditions that have occurred during the few months preceding harvest, and not the COVID-19 pandemic (Durinck 2020; Fresh Plaza 2020b; Peters 2020; Trompiz et al. 2020). In any case, if the apple sector has been affected in numerous ways from the beginning of the pandemic, the harvest season was less impacted than for other fruits (e.g., raspberries, strawberries, apricots, etc.) (European Commission 2020a). Indeed, the production chain has had time to get organized since March 2020, and lockdown rules have been alleviated by the end of the summer in most countries, allowing harvesting orchards in relatively good conditions with local workforce, although at significantly increased costs. For the upcoming years, the apple production in EU-27 is projected to remain stable, with an increase in domestic consumption and a decrease in extra-European exports (European Commission 2021).

## 3. Apple sales and agricultural chains

With the lock down, food sales usually made through the foodservice channel (schools, restaurants) have been dramatically impacted because of the total closure of this sector and no access by customers (Richards and Rickard 2020). However, since the start of the COVID-19 crisis, customer demand for fruits at retail level has been increasing, leading to a growth in at-home consumption (Freshfel Europe 2020). Therefore, fresh apple consumption in Europe was quite good during the 2020 pandemic, and is expected to be 9% above average for 2020 (European Commission 2020a; Moret 2020; Sas 2020), although consumption habits have changed. During the first weeks of the pandemic, apple customers have mostly bought bagged apples in large volumes, because people have suddenly privileged “safe” consumption over usual quality, origin or sustainability considerations (Eurofresh 2020). This first

reaction likely came from a buying frenzy due to images of empty shelves in retail. After a few weeks however, customers realized that there were no risks of apple stocks running out and they have turned back to demanding unpacked and local apple production (Buhr 2020; Eurofresh 2020; Freshfruit 2020b; Trompiz et al. 2020). Apple has also benefited from its image of a fruit being good for the health (“*an apple a day keeps the doctor away*”) (Karst 2020; Trubek 2020). The decrease in tropical fruit imports during the COVID-19 pandemic may also have boosted demand for EU fruits, including apples (European Commission 2020a). Last but not least, apple has the advantage over many other fruits of being a long-conservation product, which has attracted customers. In March 2020 in France, 40% of the 2019 apple harvest were still in stock, but as apple sales have increased considerably during the pandemic, harvest began on summer 2020 with low stock from the previous season in most producing countries (Fresh Plaza 2020c).

Of course, apple has not been as impacted by the closure of the foodservice channel as other products, such as potatoes, because retail has taken over sales (Freshfel Europe 2020). However, there are reported labor and logistical constraints in making the change from selling apples locally through the foodservice channel and small markets to selling them to retailers and to the processing industry. The change in eating patterns in many countries has required the food-production system to adapt, which has led to additional costs, for example through increased packaging activities (OECD 2020). One of the results is that prices have increased at the beginning of the pandemic (March and April 2020) before returning to close to normal. For example, as of April 2020, the price for ‘Golden’ apples had increased by 9% in France, not because of stock issues, but mostly because of rising transport and packaging costs (Plichon 2020). The shortage of workers, as exposed above, may also have contributed to an increase in prices (Palumbo and Corrado 2020).

The pandemic has undermined food security both directly, by disrupting food systems, and indirectly, through impairing physical access to food (Devereux et al. 2020). As a lot of local producer’s markets had to close during the pandemic, people get organized to continue accessing products and try maintaining the social functions served by farmers’ and small markets, while minimizing physical interactions (Trubek 2020). Smaller farms were especially affected by closure of outdoor and small markets, because they depend a lot on this channel, and they sometimes struggle transferring their products to the retail market (OECD 2020). Farms that were used to sell an important part of their apple production in orchards through direct apple picking from the customers have been facing difficulties because of sanitary rules such as capping attendance, physical distancing, or people having to wear masks and gloves to pick fruits from the trees (Croke and Clark 2020). However, one positive aspect of the pandemic might be that customers are now looking to buy apples closer to their homes, and are in search for higher quality products such as those with sustainable or organic labels.

The complex networks of modern supply chains make them difficult to regulate and manage during crises (Garnett et al. 2020; Mussell et al. 2020; Song et al. 2021). Therefore, the importance of protecting domestic agricultural production and local supply chain such as farmer markets and direct sales at the orchard have been recently put to light (Pu and Zhong 2020). Boosting domestic sales is particularly important for farmers producing apple-derived artisanal products that are not easily sold in retail, such as ciders and other alcohols. They have been heavily affected by the crisis because sales are usually destined to restaurants, cafés, delicatessens or small retailers, and typically rely on tourism (Kokabi 2020). Cider factories in France report losses of around 20% from the retail sector, and an almost complete stop of sales through other channels, including export (French Senate 2020). In the fall, another difficulty has come from the harvest surplus that is difficult to absorb in an already saturated market of apple-derived products.

Extra-European apple exports have been slowed down in some countries during the first months of the pandemic (Wheat 2020), and have fallen by the end of the year 2020 (−34% estimation, compared to the last 5-year average) due to increased domestic demand and the

struggle to reach some export markets in Asia (European Commission 2020a). Packaging issues have for instance prevented some apple producer from starting exports, despite very good harvests (EastFruit 2021). In addition, the fruit industry has pushed for retailers to sell more domestically grown apples than imports (Camier 2020; Fresh Plaza 2020b), and a number of EU countries have supported ‘eat local’ incentives during the pandemic (European Commission 2020a). However, this consumption mode is not accessible to all social classes, especially to the urban-poor who mostly visit large markets where access to fresh fruits is complicated (Devereux et al. 2020).

#### 4. Monitoring and research

We briefly expose how the COVID-19 pandemic has also affected monitoring and research programs in orchards. Monitoring and controlling pest outbreaks such as weeds, phytoviruses, or phytophagous insects in a timely manner are an important component of apple production in orchards. However, such actions may require a certain level of expertise that is not necessarily available during a crisis, and are often time and labor consuming. For example, Italy has been missing workforces to take measures against the spread of the brown marmorated stink bug (*Halyomorpha halys*) in apple and pear orchards, which has likely affected in some measure the outcome of the harvest, and may also affect the availability of apple on the market for next year (Freshfel Europe 2020; Wax 2020). Beyond production issues, the pandemic has also threatened monitoring of farmer’s well-being. Indeed, reduced access to medical care and psychological monitoring during the pandemic, combined with overwork, stress, and social isolation, have challenged health and wellbeing of food producers and farm families (Recchi et al. 2020; Timilsina et al. 2020). In Ireland for example, Meredith et al. (2020) have determined that single person farm households from rural areas were at particular risk of social isolation, whilst families with children were exposed to increased risks of stress, in addition to being exposed to higher risks of contracting the virus.

Research programs that required to sample and/or monitor fruits, diseases, insects, or any other component of an apple orchard were heavily affected because of circulation restrictions during the first months of the pandemic, but also because of total lock down of universities, laboratory facilities, field stations and research centers. In addition, industry events and scientific meetings that were long-time planned were canceled, postponed, or held online, with deleterious consequences on knowledge sharing, and with difficulties to keep people updated about the pandemic and on recent advances in their business or research field. In applied scientific projects, for example focusing on biological control of orchard pests or innovative techniques to increase apple yields, land practitioners often expect a direct and quick sharing of information and fresh data from scientists, in order to take rapid measures. However, in the past months, both farmers and the general public have avoided such meetings resulting in lower attendance than expected, so less information has been transmitted and preserving interactions between scientists and apple producers has been tough.

To end on this section on a more general point, the question remains how, as scientists, we participate in enabling decision-making in a world in transition, facing crises and unpredictable socio-economic and environmental changes (see Darnhofer 2021, for more details). This is an important question to ask for the future of agricultural systems and food production, of course, but also for associated topics in global change ecology, biodiversity conservation, resource sustainability, and social sciences.

#### 5. Conclusion

The COVID-19 pandemic has challenged apple orchards in many ways, from production to trade chains, monitoring, and research. Reports, press releases and prospective documents written soon after the start of the pandemic (around March in Europe) were extremely

alarming and had questioned the fruit sector's ability to cope with the crisis, including production in orchards. However, as for now, the apple sector has not suffered from direct stock and production issues, and demand remains high. One could argue that solutions undertaken to address the challenges imposed by the pandemic may have been sufficient to ensure a good apple production in 2020, and to not put the apple sector at too high risks for next years, although this may have come at a significant cost. Additional and side-effect costs for the apple sector have aroused from increased insurance costs, intensified packaging activities, social distancing and safety measures or equipment for workers in orchards and packhouses, the need for logistics reconsideration for production and sales, transports and supply delays, and market pressure (European Commission 2020b; Freshfel Europe 2020; OECD 2020). Questions regarding international trade, global market, export and country-specific response to the crisis have been disregarded in this manuscript, but necessarily have to be considered to assess how the apple sector has been dealing with the pandemic (European Commission 2020a). The aftermaths are not done yet, and it is still early to provide final estimations of the costs that the pandemic represents for apple producers and for the industry, as the 2020 harvest has just ended (at the time this article was written). Additionally, the recent outbreak of variant strains of the virus is likely to affect the fruit sector in 2021 and beyond. Apple producers and the industry may now be better prepared than they were in 2020, but the major issues exposed in this article remain, including workforce shortage and limited access to trade chains.

We conclude that the pandemic could be an opportunity to change production modes, integrate more sustainable practices in different crop systems including orchards, and innovate for the future of food production and distribution (Lal et al. 2020; Mitaritonna and Ragot 2020; Petetin 2020; Lioutas and Charatsari 2021; Darnhofer 2021; Song et al. 2021). As also outlined in the Food and Agriculture Organization guideline for the future (FAO 2017), there is a need to revise agriculture policy making, strengthen food production systems and enhance their resistance and resilience to different kind of crises, in order to face challenges such as climate change, biodiversity collapse, population growth and natural disasters (Mishra et al. 2021; Lioutas and Charatsari 2021). The key question is whether the COVID-19 crisis would trigger a transition towards sustainable and agroecologically based food systems, with shorter distribution circuits as privileged by consumers during the crisis, lower dependence on international trade markets, adequate prices and quality standards, and social fairness and ethics (Altieri and Nicholls 2020; Pu and Zhong 2020). On this last point, the pandemic has brought to light how food production, and particularly fruit production, is heavily dependent on workforce availability, especially migrant and low-income workers. This may constitute an opportunity for the EU to enforce migrants' rights, ensuring fair labor and living conditions for farmworkers in apple orchards and other farming systems (Crețan and Light 2020; Mitaritonna and Ragot 2020; Palumbo and Corrado 2020; Toffolutti et al. 2020).

#### Author contribution statement

KT collected and synthesized information, and wrote the manuscript. TH revised the final draft.

#### Declaration of Competing Interest

The authors have no competing interest to declare.

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