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Immigration Reform and Implications for the US Fruit Industry

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Abstract
Stricter immigration policies could drastically reduce US fruit production. Rising farm wages have increased mechanization efforts, but many tasks are still done by hand. This paper reviews recent literature on the current farm labor market conditions and the outlook for automation.

1 Introduction

Secretary of Agriculture Brooke L. Rollins declared that there would be "no amnesty under any circumstances" for the agricultural sector and set a priority to transition the agricultural sector towards increased automation and a 100 percent American workforce through mass deportation.[1] This directive, if followed, poses severe challenges for the US fruit and nut industry, where labor accounts for about 38 percent of production costs (Castillo et al. 2021).[2] Fresh fruit is delicate and is typically picked by hand. As technologies advance, the potential to automate tasks for some fruit varieties improves. Nevertheless, if the removal of unauthorized immigrants from the farm workforce were achieved, we should expect US fruit production to decline, imports of fresh fruits to increase, and food prices to rise. This article reviews the literature on the US fruit industry's dependence on unauthorized immigrant workers and assesses the industry's potential for quick adjustment to a smaller, fully authorized workforce.

2 The US Fruit Industry's Dependence on Unauthorized Migration

US fruit and nut sales were $34.2 billion in 2022, accounting for 6.3 percent of total US agricultural sales (USDA-NASS 2024). Yet despite its small share of total sales, the fruit and nut sector accounts for almost a quarter of total agricultural labor expenditures (Castillo et al. 2021). Nearly all fresh fruits are picked by hand since they are fragile, often ripen at different rates, and require dexterity and precision to reach. Currently, about half the hired workers in the fruit and nut sector are unauthorized immigrants.[3]

Unauthorized immigrants play an important role in US fruit production because labor demand is seasonal, and the timing and size of peak demand vary from one year to the next (Taylor and Charlton 2019). However, access to a steady supply of Mexican farm workers has become more tenuous in recent years. The rural Mexican workforce is becoming more educated and less agricultural (Charlton and Taylor 2016). Meanwhile, the population of Mexicans living in the US without legal authorization fell by

[1] See press conference on July 8, 2025. Video is available at Market to Market (July 12, 2025) "Rollins: No Amnesty for Undocumented Farm Workers." https://www.youtube.com/watch?v=i1MATv729jI [Accessed August 5, 2025].
[2] Labor's share of production costs was 38.5 percent in 2017. This is second only to greenhouse, nursery, and floriculture production, where the labor share of production expenses was 43 percent. The third industry was vegetable and melon farming with 28.8 percent (Castillo et al. 2021).
[3] According to the National Agricultural Workers Survey (NAWS), a nationally representative survey of crop workers, excluding H-2A guest workers, 61.35 percent of fruit and nut workers were unauthorized in 2022. It is estimated that 15 percent of crop workers have H-2A visas (Castillo et al. 2024), which, if applied to fruit workers, would make the resulting unauthorized share 52 percent.

28 percent from 2007 to 2017 (Passel and Cohn 2019). Given a 10 percent decline in farm labor supply, Rutledge and Mérel (2022) calculate a decline in production of up to 4.2 percent from the top 10 fruit and vegetable producing counties in California.

The effects of deportation on fruit production might be offset by increased H-2A guest worker employment (Devadoss and Luckstead 2018). However, H-2A is costly, especially for smaller employers and those with less experience. Castillo et al. (2024) estimate that employers must pay a minimum of $10,000 per H-2A worker for nonwage expenses. Efforts to streamline the program have failed, but better solutions will likely become necessary as H-2A demand grows.

Figure 1 shows the number of private sector workers per crop group in the 2024 Quarterly Census of Employment and Wages (QCEW). The QCEW collects employment data for workers covered by state unemployment insurance laws, but it undercounts farm employment for several reasons: (i) small farms are sometimes excluded from the QCEW; (ii) fruit employment is typically seasonal, but these numbers are annual averages; (iii) H-2A workers are included in the QCEW in some, but not all, states; (iv) Figure 1 does not allocate employees of farm labor contractors (FLCs) across crops,[4] and (v) unauthorized workers are included only when they provide a social security number (SSN), but many unauthorized workers do provide an SSN and pay taxes to avoid detection.

Despite the data limitations, Figure 1 provides suggestive evidence of what fruits might be most vulnerable to the removal of up to half the fruit workforce. Apples and strawberries lead the employment counts, each with over 30,000 workers. Tree nuts, though mechanically harvested, employed nearly 20,000 workers, likely to help with planting and pruning, which are also labor-intensive (Castillo et al. 2021). The omission of H-2A workers from the QCEW likely explains why employment is much lower for oranges and citrus. Florida, which employs the most H-2A workers in the US and ranks second in citrus production, does not include H-2A in QCEW counts (Simnitt and Castillo 2025).

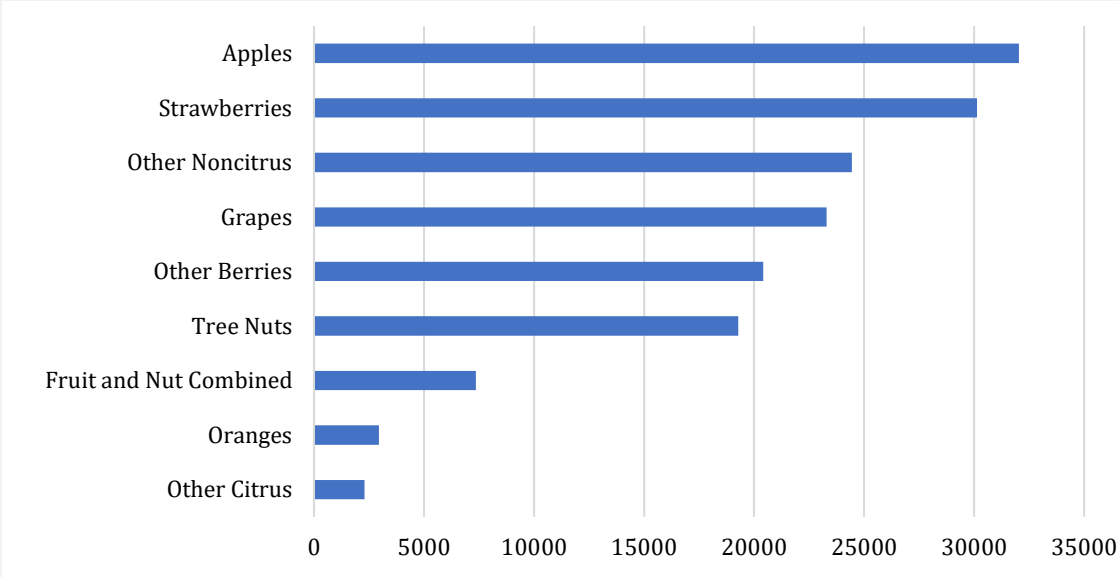

Figure 1. Employment by fruit and nut crop groups reported in the QCEW

Note: The QCEW undercounts farm workers, so these are lower bounds. Notably, some states do not report H-2A workers in the QCEW. Florida, which leads in H-2A employment and ranks second in citrus production, does not report H-2A in the QCEW (Simnitt and Castillo 2025).
Data Source: 2024 Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW).

[4] 186,976 workers were employed by FLCs in 2024 according to the QCEW.

3 Advances in Automated Technologies for Fruit Production

In response to diminishing farm labor supply, fruit growers are increasing investments in robots and worker aids that improve worker efficiency. Worker aids include innovations like hydraulic platforms that replace ladders in orchards or autonomous carts that move harvested fruit to the ends of rows (Calvin et al. 2022). Profitability of new technologies is essential. For successful adoption of robotic technologies, robot designs must become faster, more accurate, lower cost, and more streamlined for use in a wider variety of orchards and crops (Vougioukas et al. 2025).

Most research for the development of automated technologies is currently focused on harvest activities since harvest is labor-intensive and even a short harvest delay can severely reduce the quality and value of the fruit that goes to market (Vougioukas et al. 2025). Both academic and private sectors are investing in the development of mechanical fruit harvesting systems (Gallardo and Sauer 2018). Yet, by the 2010s, only tree nuts and five fruit crops could be commercially harvested using automated systems, and all were destined for processing (Gallardo and Sauer 2018).[5] Tree shakers, which are used to harvest nuts, are not effective for fresh fruits since the fruit is too fragile to tolerate the impact (Gallardo and Sauer 2018). Robots that pick fruit and place it in a container require a high degree of technological sophistication and possibly different crop architecture (Karkee et al. 2017; Vougioukas et al. 2025).

Engineers have designed robots capable of successfully harvesting apples and strawberries, but current prototypes are not yet economically viable. Delbridge (2021) calculates that strawberry harvesters must achieve 70–80 percent efficiency relative to manual harvest for adoption to be commercially profitable. His analysis shows that if a robot were used, it would still be profitable to hire a crew to pick the strawberries that the robot misses. Charlton et al. (2025) calculate that a Gala apple grower could spend no more than $248.42 per acre per year on a robotic harvester to obtain the same profits as manual harvest, and they also assume that the grower hires a clean-up crew to follow the robot. They assume the harvester successfully removes 60 percent of the fruit and has a cull rate 5 percent above that of hand-harvest. For higher-value apple varieties like Honeycrisp, robot-induced harvest losses make robots economically infeasible for any up-front purchase cost.

Both Delbridge (2021) and Charlton et al. (2025) conclude that robotic harvesters will become economically profitable if robot efficiency continues to improve and farm worker wages rise. However, their findings underscore the essential role of field workers, even as fruit production becomes more mechanized. Workers will still be needed to operate and assist the harvesting robots, make in-field repairs, and perform other in-field tasks like collecting and sorting fruit for the fresh market. Therefore, investing in the necessary skills of the farm workforce should be at the forefront of industry objectives.

Research and development efforts for the robotic strawberry and apple harvesters also highlight the fact that innovation is a long process. Harvest Croo, one of several firms developing robotic strawberry harvester designs, began work in 2013 (Crunchbase 2025; Harvest Croo 2025). Twelve years later, the design has improved, but robots are not yet commercially available. To facilitate innovation, growers' associations often partner with startup firms with private venture capital (Calvin et al. 2022). Nevertheless, since private sector returns on agricultural technology development are generally limited by relatively low output prices and the seasonality of economic returns in the agricultural sector (Gallardo and Sauer 2018), government investment might be required for more rapid technological advance.

Adoption can also be a long process. If a new robotic harvester requires orchards or vineyards to be retrofitted or producers to change plant varieties, adoption rates will be determined, in part, by the age of existing orchards and optimal timing to replace trees or vines. Factors like farm size, terrain, farm compatibility with technology design, and risk perception also play important roles. When there are

[5] These include oranges, apples, tart cherries, blueberries, and olives for canning.

economies of scale, well-functioning custom harvest markets can make technologies accessible to smaller growers. However, if rental markets do not emerge quickly, technological change will likely lead to farm consolidation. This might be efficient, but it also reduces competition, which could diminish product variety and consumer choice. As technologies evolve, careful analysis will be needed to monitor market power in up- and downstream markets.

4 Foreign Import Competition

Lacking technological solutions in the immediate term, rising labor costs make it increasingly difficult for US fruit producers to compete with imports. The US imported about 60 percent of its fresh fruits in 2021, up from 50 percent in 2007 (Khanal et al. 2024). This is largely driven by increased consumer demand for fresh fruits year-round, but the import share will continue to rise if the industry cannot innovate ways to produce more efficiently, given increasing wages.

Most fresh fruit imports come from Mexico and Central and South America (Calvin et al. 2022). However, imported fruit usually arrives in months when the US is not harvesting the crop, and imports can decrease the prices of US fresh fruit only if consumers substitute imports for domestically grown fruit. Muhammad and Countryman (2021) find negligible effects of blueberry imports on US prices. However, Khanal et al. (2024), focusing on fresh fruit prices in the months when fruits are imported as well as produced in the US, conclude that imports of blueberries, asparagus, bell peppers, and strawberries cause a substantial decrease in US farmgate prices and seasonal farm revenues. Anecdotal conversations with citrus growers in California also indicate that growers believe that import competition is shortening the season when it is profitable to harvest fruit.

5 Conclusions

Mass deportation of unauthorized farm workers while automated fruit harvest and production technologies are still in early stages of development will cause farm labor shortages in the short run, reduce fruit production, and increase consumer food prices. If fruit goes unharvested, some producers might be able to survive for a few seasons while markets adjust, but the authorized population of farm workers in the US is not large enough to support current domestic production of fresh fruits. As field tasks become automated, farm workers will remain essential to fruit production. They will be required to operate, maintain, and assist automated technologies. Therefore, farm managers should begin now to provide opportunities for workers—who might include native, immigrant, and guest workers—to learn more advanced technological skills.

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