

Introductory Chapter: Worldwide Fruit Crops Production and Research

Mateus Pereira Gonzatto and Júlia Scherer Santos

1. Introduction

All over the world, a large number of fruits are produced despite a fairly limited number of fruit species having significant economic importance. Although there is not a standard definition of cultivated fruit crops, they are horticultural plants, including woody trees or herbaceous perennials, shrubs, or lianas with an edible portion [1]. Also, they are identified as “edible fruit-bearing plants” [2], in which the edible portion can be true fruits, pseudofruits, or having structures parts close to the fruits [1, 2]. In turn, nuts are generally grouped as fruit crops or as “fruit and nut crops,” mainly because they are woody perennial trees, and they are approached within the area named as “fruticulture” in some countries [3]. On the other hand, short-cycle plants with vegetative growth, including strawberry, watermelon, and melon, which are annually cultivated, can also be understood as fruit crops [1]. Nevertheless, these plants are generally approached in olericulture, another horticulture area.

Fruit crops can be classified according to their preferred cultivation climate as tropical, subtropical, and temperate climates [4]. Among the main fruit crops of tropical climates, there are bananas and plantains (*Musa* spp.), mangoes (*Mangifera indica*), pineapples (*Ananas comosus*), papayas (*Carica papaya*), guavas (*Psidium guajava*), passion fruit (*Passiflora* spp.), and dragon fruits (*Selenicereus* spp.). Regarding subtropical climate fruits, we can mention citrus fruits (mainly *Citrus* spp.), avocado (*Persea* spp.), persimmons (*Diospyros kaki*), figs (*Ficus carica*), loquat (*Eriobotrya japonica*), litchi (*Litchi chinensis*), and several plants of the Myrtaceae family, including jaboticaba (*Plinia trunciflora*). Apples (*Malus domestica*), pears (*Pyrus* spp.), grapes (*Vitis* spp.), stone fruits (*Prunus* spp.), strawberries (*Fragaria × ananassa*), other berries (such as blueberry, blackberry, raspberry), kiwifruits (*Actinidia* spp.), olive (*Olea europaea*), and pistachio (*Pistacia vera*) can be classified as temperate fruits.

2. World fruit production and research

The global production of primary crops in 2022 reached 9.6 billion tons which is equivalent to USD 2.9 trillion. Fruit production is 10% of the world’s production of primary crops in volume. This production represents 17% of production value, ranking just behind cereals (29%) and vegetables (19%) [5].

World fruit production has grown linearly in the last 10 years, as shown in **Figure 1** [6]. The most recent data from the year 2023 show that the annual world

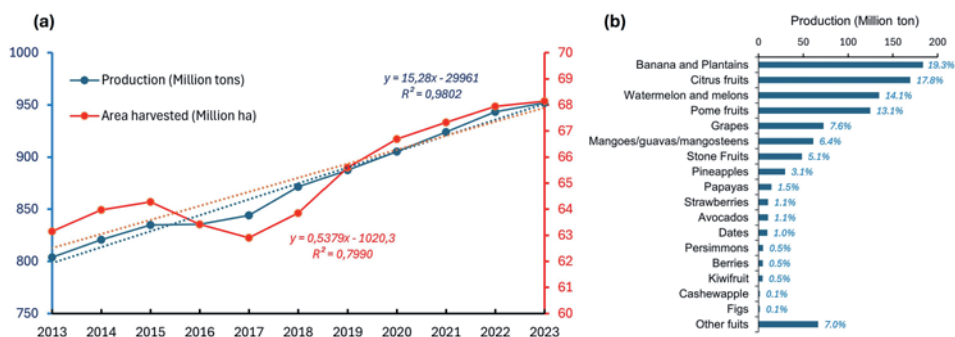


Figure 1.

(a) World production of fruit crops between 2013 and 2023, and (b) the production of different fruit crops in 2023. Data were retrieved from searching aggregate item “fruit primary” in Food and Agriculture Organization of the United Nations [6].

fruit production is 951.51 million tons in about 68.10 million hectares, with an average fruit yield of 13.97 tons ha⁻¹. The production increase is around 15 million tons year⁻¹. The harvested area remained between 63 and 64 million hectares between 2013 and 2018, with subsequent growth to 68 million hectares in the following years, denoting an increased production of around 500 thousand ha year⁻¹ in the 10-year period analyzed (**Figure 1a**).

Among the main groups of fruits, the most produced ones are bananas and plantains, with 183.67 million tons produced, accounting for 19.3% of world production. The second most important fruit category is citrus (which includes oranges, tangerines, limes, and lemons), with 169.39 million tons, and represents 17.8% of world production. Watermelons and melons account for 14.1% of world production. Diversely, pome fruits (apples, pears, quinces, among others) account for 13.1% of world production. Moreover, grapes and stone fruits are responsible for 7.6% and 5.1% of world production, respectively. On the other hand, mangoes, guavas, and mangoosteens production of 6.4%, while pineapples have 3.1%.

Papayas, strawberries, avocados, and dates have production ranging from 1.0% to a maximum of 1.5%. Last, less representative fruits (< 1%) are persimmons, berries, kiwifruit, cashew apples, and figs (**Figure 1b**) [6].

Besides, fruits were produced all over the world. In 2023, Asia countries are the most important producers, accounting for 58.7% of production and 52.5% of the harvested area. The American countries are the second largest fruit producers, producing 17.8% of world production in 14.1% of the harvested area. Subsequently, with 14.4% of world production and 22.3% of the harvested area, is the African continent. The European continent is responsible for 8.2% of fruit production and 10.2% of the harvested area. The least relevant continent is Oceania, where 0.9% of fruit production occurred in 0.9% of the harvested area [6].

Further, the main fruit-producing country in the world is China, which alone is responsible for 28.3% of world fruit production (269.33 million tons) and 23.3% of the harvested area (15.81 million hectares). India appears as the second largest fruit producer, representing 12% of world fruit production and 11.1% of the harvested area. Brazil is the third-largest producer, responsible for 4.5% of world production and 3.5% of the harvested area. Turkey, Mexico, Indonesia, the United States of America (USA), the Philippines, Spain, Iran, Egypt, Nigeria, Italy, Vietnam, and Colombia are smaller producers, with production between 1.2 and 2.9% (**Figure 2a**) [6].

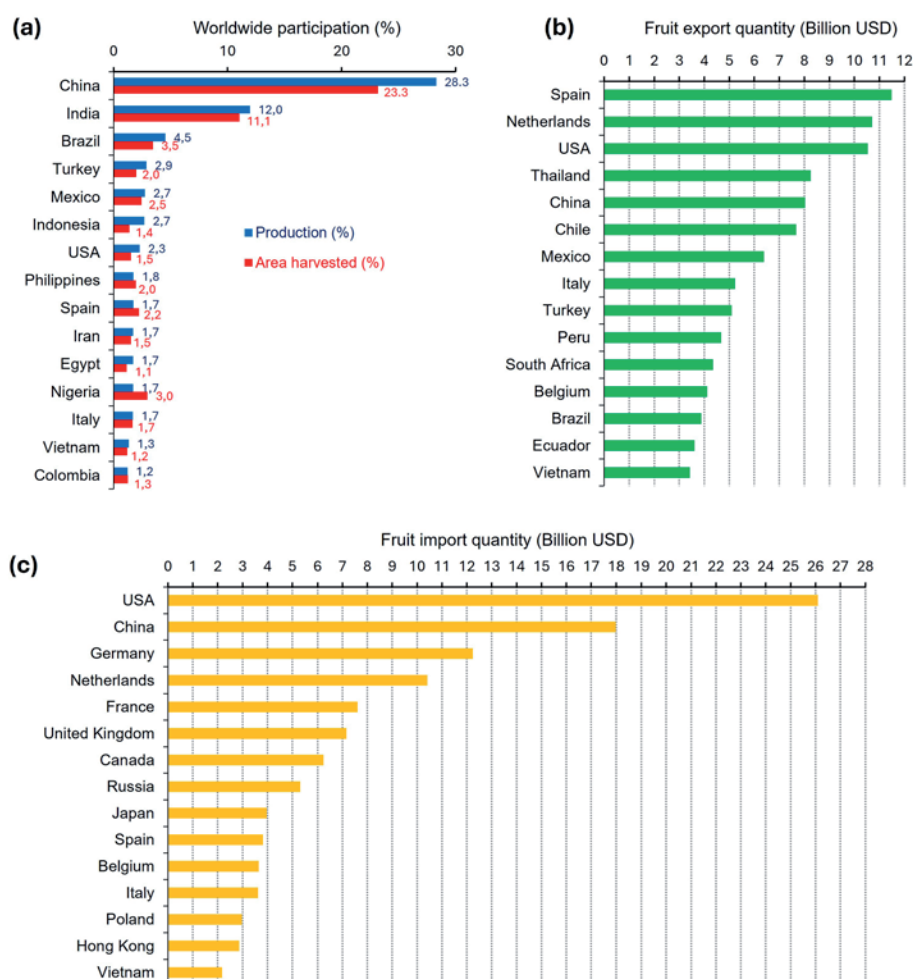


Figure 2. Fifteen main fruit-producing countries (a) in percentage of area and quantity produced were retrieved by searching the aggregate item “fruit primary” (b) in fruit exports and (c) in fruit imports in 2023 obtained when the item “fruit” was searched in Food and Agriculture Organization of the United Nations [6].

International trade in fruit crops generates a large amount of money due to a worldwide distribution flow of fruits despite their production being limited to certain climates. The export of fruit crop products, which include fresh and dried fruits and fruit juices, is around USD 149.85 billion. Spain is the main exporter country, accounting for 11.5 billion USD, with 32.46% of this export due to the export of fresh citrus fruits. The Netherlands is the second main exporter, with USD 10.72 billion in exports, with emphasis on fruit juices, bananas, and grapes. The USA is the third-largest exporter, with USD 10.54 billion in exports, with 22.59% of this value referring to pistachios in shell (**Figure 2b**) [6].

Yet, the following countries export less than 10 billion USD: Thailand, China, Mexico, Italy, Turkey, Peru, South Africa, Belgium, and Brazil (**Figure 2b**). Thailand exports mainly tropical fruits, while China exports fruit prepared¹, apples,

¹ FAO item “Fruit prepared n.e.c.”. Refers to prepared or preserved fruits not specified in other categories [6].

mandarins, and grapes. Chile exports cherries and grapes, and Mexico exports fruit prepared, berries, and limes. Turkey and South Africa export fresh citrus fruits. Brazil mainly exports orange juice, mangoes, and melons [3]. Belgium exports fruit prepared, bananas, and kiwifruits, and Ecuador exports bananas and plantains. In turn, Vietnam is highlighted by the exportation of tropical fruits [6].

Moreover, import of fresh, dried, and processed fruits is estimated to be around USD 163 billion [6]. The main importer is the USA with a value of USD 26.1 billion imported in 2023, whose main products (60%) are fruit prepared, bananas, grapes, raspberries, blueberries, and strawberries. China is the second most importer country with an import value of USD 17.98 billion, mainly related to the following tropical fruits: cherries, fruit prepared, and bananas. The third-largest importer is Germany, mainly related to fruit prepared, citrus fruits, bananas, and grapes. The Netherlands is the fourth largest importer of mainly bananas, grapes, fruit prepared, oranges, and cranberries (**Figure 2c**).

As also shown in **Figure 2c**, France, the United Kingdom, Canada, Russia, Japan, Spain, Belgium, and Italy are the ones that import less than USD 10 billion. Citrus fruits are imported mostly by Russia, Canada, the United Kingdom, Spain, Italy, Poland, Hong Kong, Vietnam, and Russia. Differently, bananas are mostly imported by the United Kingdom, Canada, Japan, Spain, Belgium, and Italy. Fruit prepared is mostly imported by Canada, Japan, Spain, Belgium, and Poland. Grapes are the most imported fruits by the United Kingdom, Canada, and Vietnam.

Scientific research is essential to enable and optimize the production and commercialization of fruits and plays an important role in the development of technological innovations which enable a globalized fruit distribution chain. Scopus database search on fruit crops shows that there is a number of publications ranging from 30,000 to 35,000 from 2020 to 2024 (**Figure 3a**). The most important countries in terms of publication on fruit crops are China, India, the USA, Brazil, Italy, Spain, Indonesia, Iran, the United Kingdom, Turkey, Germany, Malaysia, Australia, South Korea, and Japan (**Figure 3b**). Among these, nine are among the largest fruit producers in the world: China, India, Brazil, Turkey, Indonesia, the USA, Spain, Iran, and Italy (**Figure 2a**). The largest publishing country is China, with over 46,000 publications, representing 25.7% of the total publications. India had almost 20,000 publications, representing 11.1% of the total, while the USA was responsible for around 18,500 publications. Next is the fourth most publisher, Brazil, which had over 10,000 publications. It is also worth mentioning Italy, Spain, Indonesia, Iran, and the United Kingdom, with more than 5000 publications each. Meanwhile, Turkey, Germany, Malaysia, Australia, South Korea, and Japan had between 4000 and 5000 publications (**Figure 3b**) [7].

The areas of knowledge covering fruits are shown in **Figure 3c**, of which 52.6% are associated with the Agricultural and Biological Sciences area, 18.1% are associated with Biochemistry, Genetics, and Molecular Biology, while 14.2% are associated with Environmental Science. Also, there were a significant number of publications addressing fruit crops in other areas: Medicine; Chemistry; Engineering Chemical Engineering; Computer Science; Material Science; Pharmacology, Toxicology and Pharmaceuticals; and Physics and Astronomy [7]. The wide range of fruit applications in different areas of knowledge denotes the relevance of research on fruits.

The consumption of fresh fruits is encouraged due to their health benefits, and strategies to ensure the post-harvest quality of fruits allow them to reach non-producing countries of these fruits. These fruits processing to obtain juice, or byproducts show applications in the food, pharmaceutical, cosmetic, and materials

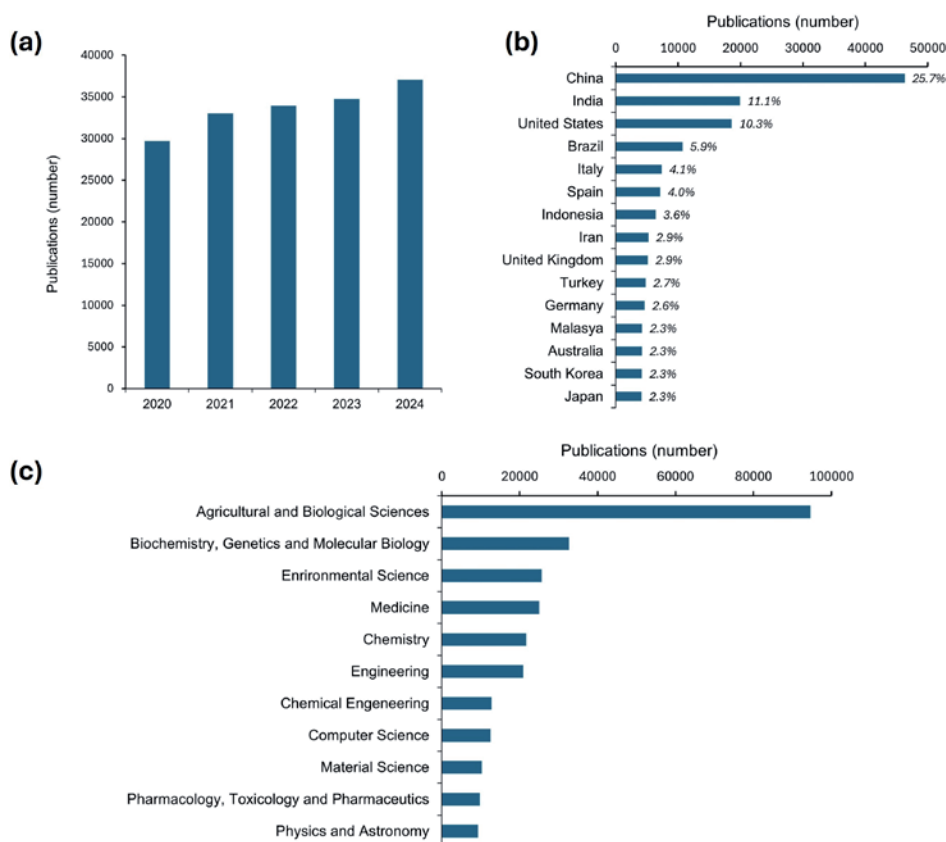


Figure 3.
 (a) Number of publications, (b) countries with the highest number of publications, and (c) main areas of knowledge retrieved by the search of the terms “fruit” or “fruits” in the title, abstract, or keywords in the Scopus database from year 2020 until April 20, 2025.

science industries. A suitable quality of fresh fruits and their derivatives is achieved by well-conducted scientific research which ultimately allows to obtain better commercial products. The data on import, export, and production of fruits presented in this chapter show their impact on the global economic aspect, therefore denoting their commercial importance. Likewise, the significant number of publications shows current research interest in fruit crops.

Author details

Mateus Pereira Gonzatto^{1*} and Júlia Scherer Santos²

1 Department of Agronomy, Federal University of Viçosa, Viçosa, Brazil

2 Institute of Biological Sciences, Department of Pharmacology, Federal University of Juiz de Fora, Juiz de Fora, Brazil

*Address all correspondence to: mateus.gonzatto@ufv.br

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