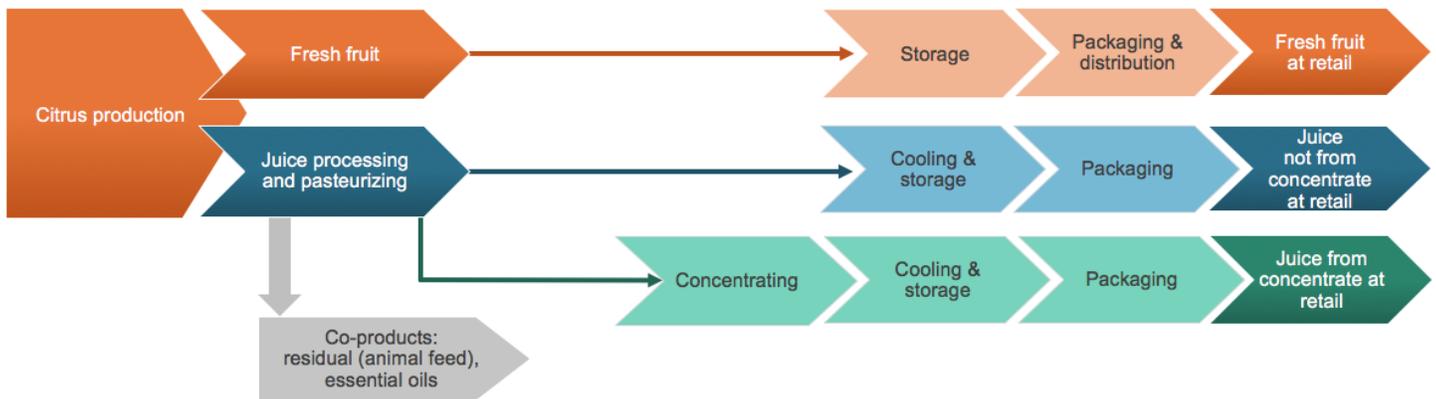


Citrus

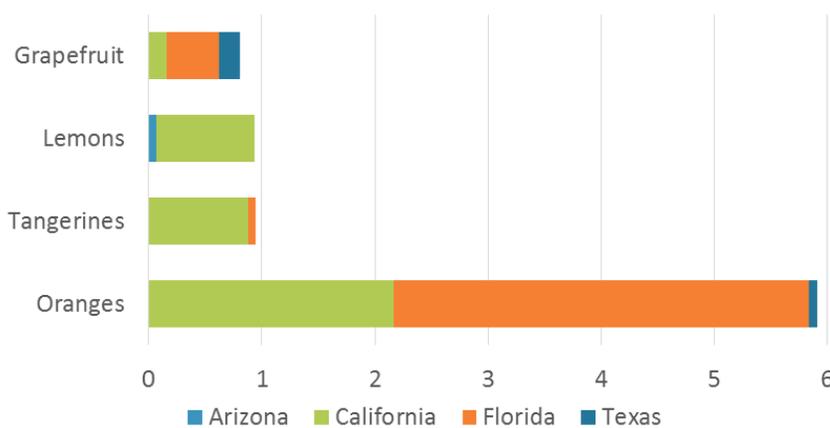


Citrus represents about 12% of the fresh fruit consumed by Americans. Citrus juices, 90% of which are orange juice, make up 63% of U.S. juice consumption. The purpose of this summary is to highlight what is known about the environmental impacts of citrus production, processing, distribution and consumption based on a review of publically available life cycle assessment (LCA) studies. Even though citrus is not grown in Oregon, the information here may be useful to distributors, retailers, institutional buyers and consumers in making sound environmental decisions. The generic life cycle of citrus production in the U.S. is depicted below.



California and Florida dominate U.S. citrus production as shown in the graph below. However, while 80% of California’s crop is marketed as fresh fruit, 90% of Florida’s crop is processed. On top of this domestic production, half of the orange juice consumed in the U.S. is imported (likely from Brazil and Mexico), as are half of the lemons and limes (likely from Mexico), and about a quarter of the tangerines and mandarins.

Citrus production in 2016 (million tons)



Citrus juices, predominantly orange juice, are available in a number of forms: fresh squeezed, not-from-concentrate, reconstituted from concentrate, or frozen concentrate. Packaging and branding in the marketplace is sometimes confusing to the general public; for example, not-from-concentrate does not necessarily mean freshly processed. Consumer preference for not-from-concentrate juice has all but eliminated the frozen concentrate market in the U.S. Disease pressure and successive hurricanes have significantly impacted Florida citrus growers and have resulted in increased imports from Brazil.

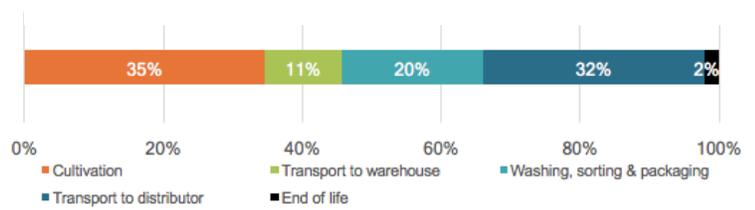
Key Findings

Citrus Agricultural Production

Citrus orchards are often very intensive systems with high inputs of irrigation water, fertilizers, pesticides and fungicides. Fertilizer manufacturing is nearly always a dominant contributor to the carbon footprint. The chart to the right depicts one study that carried the assessment of fresh citrus fruit beyond agricultural production to include sorting and packaging, transport to distributors, and even composting of inedible portions such as peels. Citrus orchards also tend to be high yielding in terms of

tons of fruit per hectare in comparison with other perennial tree fruits. Studies that compare conventional and organic orange production show that organic performs better in key impact categories (carbon footprint and others) on a per hectare basis, but yield gaps between conventional and organic may shrink these differences when expressed per kilogram of fruit.

Contribution of life cycle stage to carbon footprint of orange production in Italy

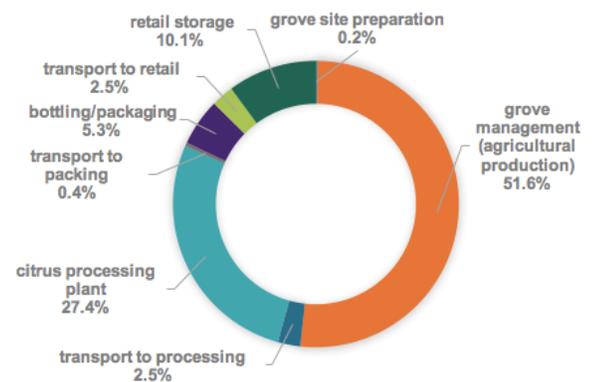


Citrus Juices

Differences in what is and isn't included in a study (system boundary) and final product make direct comparisons between the handful of studies that consider citrus juices unproductive. Lessons can be learned by considering studies independently, however. One study found that about half of the carbon footprint of a carton of not-from-concentrate orange juice occurs during management of the orange grove, which can be productive up to 30 years (see figure to the right). These agricultural impacts are fairly evenly distributed between energy use in tractors and equipment and material inputs such as fertilizer and pesticides. The juice processing stage, which includes juicing, pasteurization, and storage of not-from-concentrate juice, represents an additional 27%.

The results assume a transport distance to retail of 1,000 kilometers (621 miles). Estimating the transport of not-from-concentrate orange juice by truck from Orlando, FL to Portland, OR (3,037 miles) would cause the "transport to retail" stage to go from about 3% to 11% of the total impact and increase the overall carbon footprint of a liter of non-from-concentrate orange juice by nearly 10%.

Carbon footprint of Florida not-from-concentrate packaged 64 fl oz orange juice



Conclusions

Results from this review of the life cycle assessment literature on citrus and their juices suggest a few generally applicable conclusions:

- Agricultural production of citrus is an important stage in the product footprint regardless of whether the citrus are consumed fresh or processed into juices. Fertilizer production appears to be a major contributor to on-farm impacts.
- While not unanimously conclusive across the studies reviewed, it appears that organic production of citrus may have an environmental advantage over conventional production even on a product output basis.
- Results indicate that paperboard cartons are a less impactful packaging option for citrus juice than PET bottles.
- Existing evidence is inconclusive regarding whether juice from concentrate (reconstituted by the user) has a lower carbon footprint than not-from-concentrate juice.

The full report created by Center for Sustainable Systems - University of Michigan can be downloaded from <http://www.oregon.gov/deq/mm/food/Pages/Product-Category-Level-Footprints.aspx>.