

CHANGES IN TROPICAL FRUIT PRODUCTION IN FLORIDA AND THE WORLD THROUGH TIME

ROBERT J. KNIGHT, JR.*
University of Florida, IFAS
Tropical Research & Education Center
18905 S.W. 280th Street
Homestead, FL 33031-3314

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Abstract. The marketing picture for tropical fruit crops has changed through time thanks to economic and climatic factors and to crop diseases and pests. As an example, mangos marketed in the U.S. in the past were produced for the most part in Florida. The picture changed with increased entry of mangos from Haiti and Mexico, and later from producers in Central and South America. One consequence has been transformation of the mango from a fruit available in summer to one sold for much of the year in metropolitan supermarkets. Production of limes was largely eliminated from south Florida by Hurricane Andrew (in 1992) followed by bacterial citrus canker disease, and transferred to Mexico. Hurricane Andrew also severely reduced avocado and mango acreage in Florida, and the implementation of the NAFTA treaty from January 1, 1994 discouraged replanting efforts. Subsequent real estate development of agricultural land in south Florida forced fruit production to move to the Dominican Republic and elsewhere. Culture of other fruit crops has also changed, in some cases dramatically, in Florida and elsewhere. Forces that influence change continue to act.

Florida has been a producer of tropical and other fruit crops for as long as it has been occupied by people of European origin, and members of this Society have been directly involved in the development of the fruit industry (Knight, 1987). Florida pineapples were an important product from 1860 until wartime shortages curtailed production in 1917 and postwar competition from Puerto Rico and Hawaii prevented revival of the industry (Knight, 1980). Commercial production of avocados originated in Florida with the development of propagation of cultivars by grafting in the early 1900s, and Florida contributed to the development of cultivars adapted to lowland warm parts of the world (Knight and Campbell, 1999; Rouse and Knight, 1991). Mango culture was initiated in Florida after the Civil War, and cultivars developed in Florida from spontaneous crosses of improved Indian and rugged West Indian landraces have contributed to commercial mango development throughout much of the world (Knight, 1997). Papaya has been cultivated from time to time in Florida, but problems associated for the most part with virus disease have hampered development of a prosperous industry. Work with genetic modification currently in progress at the University of Florida's Tropical Research and Education Center, Homestead, has produced improved selections with virus tolerance that hold promise once approval of their marketing is obtained from three U.S. Government agencies: EPA, FDA and USDA (M. J. Davis, personal communication). Bananas have

always received too much competition from established industries in Central America to develop commercially in Florida, but they are grown in dooryards by the thousands here, and in other warm parts of the U.S. (Knight, 1975).

Materials and Methods

Since 1961 the Food and Agricultural Organization of the United Nations (FAO) has annually published data reporting the production of food and commodities throughout the world. This information is now available on the Internet as the FAOSTAT Database. The database provides information on production of a given foodstuff in the world as a whole and in countries where production is sufficient to be recognized. Viewed through time the database gives a picture of world and regional production, and changes in production by countries and regions. This information was tapped to present the world production (in metric tons) of avocados, bananas, mangos, papayas and pineapples at five-year intervals from 1961 through 2005, a total of 12 values for each fruit. Then the percentage of world production contributed by each of a series of representative countries was presented (Tables 1-6). This made it possible to compare the production of each of the countries with others being observed, and changes in production over the years.

Results and Discussion

World production figures between 1961-2005 increased from a low of 2.6-fold for mangos to a high of 5.12-fold for papaya, with increases for banana, avocado, lemon and lime and pineapple of 3.41, 4.52, 4.8 and 4.7-fold respectively. U.S. (Hawaiian) pineapple production in 1961 began with a total of 23% of the world production (Table 6), and declined steadily until, in 2005, it represented only 1.4% of world production. During this same period, Thailand's pineapple production started at 13.3%, reached a maximum of 26.5% in 1977 and had declined to 12.9% in 2005. Each country presents its own array of statistics, but Costa Rica presents a remarkable advance from 0.1% in 1961, staying in the same vicinity until 1985 when it rose to 0.3%, then by 1989 reached 3.9%, rising to 6.4% in 2001. The rise in availability in U.S. supermarkets of fresh pineapples from Costa Rica, as well as the decline in Hawaiian production (and wide availability of canned Thai pineapple) in recent years, suggests economic forces at work.

Avocado production in the United States remained more or less steadily in the vicinity of 6-7% of world production throughout the observation period (Table 1) except for the years from 1981-1985, when it clustered near 10%. Australian avocado production presents a more or less steady growth from 1961-2005, starting with 0.05% of world production and in 2005 reaching 1.3%. Chile, like Australia, presents a steady growth from 1.12% in 1961 to 5.0% in 2005, and Mexico, with a much larger share of the world market, rises from 15.1% in 1961 to 32.3% in 2005. Cuba in contrast shows a long period of decline, starting at 4.9% of world production in 1961, and

Author's e-mail: rjknight@ufl.edu

Table 1. World avocado production and percent from various countries, 1961-2005.

Year	Metric tons	Australia %	Brazil %	Chile %	Costa Rica %	Cuba %	Dominican Republic %	Mexico %	USA %
1961	713,369	0.05	11.6	1.12	1.50	4.90	14.9	15.1	7.2
1965	854,705	0.07	13.0	1.30	1.50	3.70	13.6	18.9	6.5
1969	1,002,631	0.08	14.3	1.10	1.60	1.60	12.0	20.1	6.7
1973	1,167,153	0.06	10.7	1.10	2.00	1.60	10.8	24.5	7.0
1977	1,344,211	0.04	10.4	1.30	1.90	1.50	9.9	24.8	7.9
1981	1,539,363	0.16	8.8	1.60	1.80	0.06	8.7	29.9	10.8
1985	1,746,417	0.40	7.2	1.70	1.30	0.49	7.3	32.4	9.8
1989	1,663,416	0.69	6.9	2.30	1.30	0.53	8.2	28.4	7.6
1993	2,048,827	0.63	5.2	2.00	1.10	0.41	7.3	34.6	6.4
1997	2,223,306	0.90	3.8	2.50	1.10	0.34	4.0	34.3	7.3
2001	2,821,271	1.06	5.5	3.90	0.85	0.00	2.9	33.3	7.3
2005	3,222,069	1.30	5.4	5.00	0.77	0.00	4.3	32.3	6.6

Source: FAOSTAT data, 2006.

ending with no production reported after 2001. The Dominican Republic started with avocado production comparable to that of Mexico in 1961 but continued on a downward spiral until in 2001 its production was 2.9% of world totals, rising then to 4.3% in 2005.

Bananas are a food crop of enormous importance, and are a dietary staple in some parts of the world. This may be why they show relatively less fluctuation in a steadily rising production from year to year (Table 2), although China's rise from 1993 to 2005 contrasts with Brazil's slight decline during the same period. Increased world production obviously responded to rising world demand over a 44-year period.

Statistics for lemons and limes are reported together by FAO (Table 3), which makes assessment of Florida's contribution to the total U.S. production difficult. FAOSTAT's picture of world production is further complicated by the fact that sweet limes, popular in the Middle East, are included and the data for acid limes cover both Tahiti (Persian) and Mexican (Key) types. United States production of lemons and limes descended from a high of 19.2% in 1961 to 5.9%, the lowest figure in 40 years, in 2005. The role of Hurricane Andrew in this downturn is difficult to determine because U.S. lemon and lime production for 1993 (10.6%), the year after Andrew eliminated Florida's lime production, does not differ significantly from 1989's 10.3%. Since 1993, Florida's contribution to national lime production has been essentially nil thanks to

hurricane damage and to efforts to control citrus canker (*Xanthomonas campestris* pv. *citri*) in the area of production.

India led world mango production in 1961 (Table 4) with 64.1% of the world's production of nearly 11 million metric tons (mt) and continued to lead, but with a smaller percentage (38.6%) of 27,966,749 mt produced in 2005. Mango production in the U.S. was not reported by FAO until 1970, when it reached 3,690 mt (FAOSTAT, 2006), continuing with a minuscule percentage of world production through 2005. Haiti maintained a production between 1.7 and 2.2% of the world's total from 1961 through 1993, falling since into the vicinity of 1.0%. Brazil began the reporting period with a production of 6% in 1961, and by 1973 had begun a descent that reached 2.2% in 1997, rising to 3.0% of the world total by 2005. China in contrast started low (1.8% in 1961) and stayed in this vicinity until 1989 when it reached 3.9%, then continued rising until by 2001 it was at 13.1% of the world total. Mexico produced 1.6% of the world's mango total in 1961 and by 1981 had reached 13.5%, but dropped by 1985 to 6.7%, staying in that vicinity until 2005. Many locally-produced mangos formerly were sold in Florida stores; now many come from Mexico and other foreign producers.

Nigeria is one of the world's major producers of papayas (Table 5). How much of this quantity goes for the fresh market is not reported by FAO. India also produces large amounts of papayas, but fewer now (10.4%) than when FAO's

Table 2. World banana production and percent from various countries, 1961-2005.

Year	Metric tons	Australia %	Brazil %	China %	Costa Rica %	Cuba %	Dominican Republic %	Mexico %	USA %
1961	21,269,119	0.60	13.3	0.8	1.9	0.20	1.8	3.0	0.02
1965	26,371,730	0.50	13.7	2.3	2.0	0.14	1.0	3.9	0.01
1969	30,099,343	0.40	16.0	2.2	3.2	0.10	0.8	2.4	0.01
1973	30,930,039	0.34	11.9	1.9	4.2	0.25	0.9	3.4	0.01
1977	34,098,428	0.34	13.0	0.9	3.3	0.40	0.9	3.7	0.01
1981	37,157,856	0.33	12.5	0.8	3.1	0.50	0.9	3.6	0.01
1985	39,697,877	0.36	12.6	2.1	2.5	0.50	0.8	5.0	0.01
1989	44,422,546	0.44	12.9	3.6	3.4	0.40	0.9	4.1	0.01
1993	53,220,884	0.40	10.9	5.5	3.8	0.36	0.8	4.1	0.01
1997	60,824,708	0.30	8.9	5.1	3.8	0.27	0.6	2.8	0.01
2001	66,148,554	0.50	9.3	8.3	3.2	0.48	0.7	3.1	0.02
2005	72,624,562	0.30	9.2	8.8	3.4	0.60	0.7	2.8	0.01

Source: FAOSTAT data, 2006.

Table 3. World lemon and lime production, percent from various countries, 1961-2005.

Year	Metric tons	Argentina %	Brazil %	Chile %	China %	India %	Mexico %	Thailand %	USA %
1961	2,625,865	3.3	2.2	0.8	0.20	15.8	4.7	0.95	19.2
1965	2,978,501	2.4	2.6	0.9	0.24	15.1	7.0	0.80	17.1
1969	3,466,533	5.6	2.7	1.1	0.29	11.5	6.4	0.90	16.5
1973	4,365,725	5.3	2.6	1.4	0.23	10.3	11.1	0.80	18.4
1977	4,988,764	6.4	3.3	1.4	0.33	8.0	9.7	0.80	18.7
1981	5,955,735	6.9	3.3	1.2	0.53	8.4	10.9	0.80	18.8
1985	6,335,820	7.3	4.7	1.0	0.82	7.1	14.0	0.70	14.9
1989	7,156,864	4.2	6.0	1.0	1.60	9.6	11.2	0.90	10.3
1993	8,456,678	7.2	6.0	1.1	1.90	11.0	9.0	0.80	10.6
1997	9,790,517	10.0	5.2	1.3	2.40	11.6	11.5	0.80	9.0
2001	11,956,523	10.2	8.1	1.1	3.30	11.0	13.3	0.67	7.6
2005	12,530,565	10.4	8.0	1.3	5.10	11.3	14.6	0.65	5.9

Source: FAOSTAT data, 2006.

reporting started in 1961 (17.3%). Brazil has shown an increase, rising from 5.1% in 1977 to 10.5% in 1981, and continuing steadily upward since. The popularity of small, Solo-type fruit may be related to this production. China's papaya production rose from 0.8% in 1977 to 3.1% in 1981, and has remained in this general area since. In contrast to its performance with avocados, Cuba has been more or less consistent with papaya production except for 1993 and 1997 when the figure fell to 0.4 and 0.6%. Indonesia has been a major pro-

ducer of papayas since 1961, but from 1997 its production has been below 10% of the world total. Papaya production in Mexico grew, starting in 1965 at 7.7%, and continued upward until 1985 when it reached 21% of world production. After dropping, in the early 2000s it has remained in the vicinity of 14%. Peru has had a steady papaya production near 2 to 3% since 1961, possibly reflecting a steady local demand. For a while Hawaii did well exporting fresh papayas to the U.S. mainland, using virus-tolerant lines they had developed.

Table 4. World mango production and percent from various countries, 1961-2005.

Year	Metric tons	Brazil %	China %	Haiti %	India %	Indonesia %	Mexico %	Philippines %	Thailand %	USA %
1961	10,904,082	6.0	1.8	1.7	64.1	2.8	1.6	0.6	2.9	0
1965	11,491,395	6.1	1.7	1.8	60.9	2.7	3.1	1.1	3.3	0
1969	11,908,588	6.4	1.6	2.1	59.6	2.9	2.3	1.2	3.7	0
1973	12,355,335	5.3	2.2	2.2	58.3	2.7	2.4	1.5	4.0	0.05
1977	13,140,331	5.6	1.8	2.2	56.7	2.6	3.1	2.3	4.3	0.03
1981	15,155,526	4.0	2.1	2.2	56.2	2.0	13.5	2.4	4.5	0.04
1985	16,554,999	3.2	2.3	2.2	56.4	2.5	6.7	2.1	4.8	0.06
1989	16,428,146	3.3	3.9	2.1	51.8	2.7	6.8	2.3	5.2	0.06
1993	19,367,647	2.9	7.1	1.2	52.2	2.4	5.9	2.1	5.2	0.005
1997	23,594,902	2.2	10.2	0.9	46.6	4.6	6.4	4.3	5.1	0.01
2001	24,937,235	3.1	13.1	1.0	40.3	3.7	6.3	3.5	7.2	0.01
2005	27,966,749	3.0	13.1	0.9	38.6	5.3	5.4	3.4	6.4	0.01

Source: FAOSTAT data, 2006.

Table 5. World papaya production and percent from various countries, 1961-2005.

Year	Metric tons	Brazil %	China %	Cuba %	India %	Indonesia %	Mexico %	Nigeria %	Peru %	USA %
1961	1,317,877	3.8	0.8	2.3	17.3	15.2	2.7	19.0	1.9	0.54
1965	1,541,781	3.5	0.8	2.1	11.6	18.2	7.7	19.5	1.9	0.57
1969	1,704,868	3.5	1.1	2.1	13.0	21.1	7.0	17.6	3.1	0.51
1973	1,801,378	3.5	1.5	2.1	12.1	15.5	10.2	19.4	3.2	0.83
1977	2,277,399	5.1	0.8	2.9	19.8	10.7	12.4	16.7	2.8	1.30
1981	2,398,294	10.5	3.1	1.4	10.3	13.5	10.3	16.7	1.8	1.80
1985	3,142,263	19.1	3.0	1.2	7.6	8.1	21.0	12.7	1.5	0.90
1989	3,129,339	17.9	2.4	1.0	11.3	10.3	9.1	15.9	2.8	1.10
1993	3,998,944	23.0	3.9	0.4	12.1	10.6	6.8	15.5	2.8	0.70
1997	5,002,163	26.0	3.1	0.6	12.4	7.2	11.9	13.5	2.9	0.30
2001	6,239,727	23.9	2.6	2.2	11.2	8.0	14.0	12.0	2.5	0.40
2005	6,753,240	24.4	2.4	1.8	10.4	9.6	14.2	11.2	2.7	0.20

Source: FAOSTAT data, 2006.

Table 6. World pineapple production and percent from various countries, 1961-2005.

Year	Metric tons	Brazil %	China %	Costa Rica %	India %	Mexico %	Philippines %	Thailand %	USA %
1961	3,381,437	8.1	6.3	0.10	2.2	5.2	3.4	13.3	23.0
1965	4,476,921	6.5	6.3	0.10	6.3	6.0	3.9	6.7	19.0
1969	5,236,740	7.4	7.3	0.10	7.1	4.6	4.6	3.5	15.9
1973	5,816,261	8.4	6.7	0.14	6.9	4.6	5.0	5.5	12.6
1977	8,083,975	6.8	4.4	0.11	5.5	6.3	5.2	26.5	7.7
1981	9,017,372	6.9	3.0	0.12	6.6	5.2	10.8	22.1	6.4
1985	9,754,525	11.8	2.4	0.30	7.9	3.3	10.6	18.1	5.3
1989	11,564,722	10.7	6.4	3.90	6.8	3.8	10.2	17.3	4.6
1993	12,727,854	9.8	5.7	3.80	7.9	1.7	10.1	20.3	2.6
1997	12,805,184	8.4	6.5	5.00	9.8	3.0	5.0	16.3	2.3
2001	14,963,795	9.6	8.4	6.40	8.2	4.2	10.8	13.9	2.0
2005	15,889,649	8.9	9.2	4.60	8.2	4.5	11.3	12.9	1.4

Source: FAOSTAT data, 2006.

Papayas require relatively little land for production. When the genetically transformed material under test at Homestead can be released for commercial production, it promises to have positive economic impact on Florida agriculture.

Production figures for the six fruit crops discussed here indicate that Florida is not a major producer of them, nor has it been in the past. However, work done in Florida on production methods and varietal improvement, much of it documented in this journal, contributed significantly to tropical horticulture's development in many other countries during the 20th century.

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