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producing acres, 882 non-bearing acres, a yield of 1,408,000 bushels (55 pounds), or a per acre yield of 383.5 bushels. This increase over the production of the 1945-55 era is substantial. It is partially due to close planting with improved land preparation along with improved virus free trees. However, if the use of the registered clones were 100% this production increase would be boosted again.

The lime growers hope for progress is more encouraging than it was in 1955, but more investigative work is needed to develop the lime growing industry to withstand the economy of the present mechanical methods of growing, producing and harvesting the crop.

ACKNOWLEDGMENTS

MANGO PRODUCTION AND MARKETING PRACTICES?
FLORIDA. 1971

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The mango business which we now operate is a family operation, with four generations currently involved in all aspects of the growing, harvesting, and marketing. It began to assume commercial status after 1950. Prior to this, from 1904 to 1950, our main agricultural pursuits were growing vegetables; mainly tomatoes, but we also grew okra, peppers, eggplant, and squash. Fruit growing this period was somewhat of a back-yard operation, even though my grandfather sold fruit for about 35 years from a 15 acre grove of mixed tropical fruit. My great grandmother had mangos on her place in 1896 in the Cutler area. These were the common varieties of the day; Sandershaw, Turpentine, Number 11 (sometimes called “Fiberless”), peach, and were mostly for home use. None had any commercial potential.

In 1941 the only commercial mango we grew was the Haden variety. Production was low and disease control was difficult on this popular variety. Mango growing was an unprofitable business. Newer seedling varieties began to be available in the period from 1941-1950. These were named and exhibited in the Florida Mango Forum for many years. Varieties which were the most well known during this period were Palmer, Keitt, Kent, Smith, Davis, Haden, Zill, Lippens, and Irwin. Sensation, developed by the Carmichael family, was also planted to a considerable extent. Florigon and Glenn were exhibited and planted to a lesser degree. Many of these varieties were found to have various problems in the market place. Many proved to be suitable only for local sales due to the fact that when they reached the northern markets, appearance and quality had broken down so as to have poor sales appeal. We can't get away from the fact that people buy with their eyes. They look for a highly colored fruit with a red blush and that is firm when fully ripe.

There were many persons growing mangos commercially before we got into production and packing as a full time business. The Carmichaels operated a nursery and were growers and packers for many years before the 1950 period. Lawrence Zill, James Miners from Palm Beach County; J. Francis Williams, Frank Smathers, Leith Kent, were active in the promotion and growing of mangos. Some of these people are still engaged in growing and packing mangos. Growers, research and extension personnel, as well as the mango enthusiast with only a few trees were active in the Florida Mango Forum. This organization has helped to create interest in the search for better varieties. It is still an active organization. The Krome family produced mango trees in their Coral Reef Nursery at the very start of tropical fruit interest in Dade County. They still operate considerable mango acreage in Dade County.

In 1950, when I decided that commercial mango growing might be better for me and my family than to attempt to get into limes and avocado growing, I talked to various people to try to find out what kind of mango the market would accept. I went to the Cooperative in Goulds, “Florida Tropical Fruit Growers Association,” now no longer
operating, and talked with Don Lins, the sales manager, about what kind of mango the market wanted. His suggestions were that first we needed a mango with a good shape and size; a mango that will remain firm and keep well, or, in other words, shelf-life. It should have a red cheek, preferably red all over, because if you don't have at least a red cheek you do not have a commercial mango. You should also have a mango that does not have an objectionable amount of fibers, but it would not have to be fiberless. He stressed this, that some fiber would give it more keeping quality and as long as they were not too tough a fiber to be sliced, or chewed, then this would be acceptable. The variety would have to have a wide picking tolerance and, by this, I mean that it can be picked two weeks before full maturity and still ripen with good color and not lose its flavor to any appreciable extent.

Another thing I found out in talking to dealers was that they were not interested in only a three weeks shipping season, which had been the situation in past years. They wanted a 2 to 3 months supply of mangos. This meant that we had to have varieties that would extend the season from June through August. We now have a lot longer shipping period in 1971, starting May 15 through September 1. We now start shipping Tommy Atkins May 15 to July 4. Van Dyk June 25 to July 31, Jubilee about the same period as Van Dyk. The season of Kent is from July 7 through August 1. Our last maturing mango, the Keitt, can be shipped from an early bloom as early as July 10, but our normal picking period is July 20 through September 1.

For the local market, we still sell a lot of Lippens and Irwin. The season for Irwin is May 15 to July 1 and Lippens ripen from June 7 to as late as the beginning of August.

Getting back to the search for a suitable mango, after I had found out what kind of fruit the market might accept, I thought that the Irwin would fill the bill. I was mistaken. While having most of the qualities described, we found that it had a narrow picking tolerance and when picked before full maturity it ripened with a mottled appearance and just would not bring the price of better commercial varieties. It is now one of our better varieties for local consumption, if picked at color break.

Our mango business started as a roadside operation and was quite a good source of income to pay the taxes, particularly when the vegetables did not pay off as expected. We thought that perhaps our business would stay “roadside” sales unless we could find the suitable varieties for shipping.

In 1950, we planted the first Tommy Atkins on our place. It was purchased from Jim Carmichael who had propagated some of this seedling variety. It had been first exhibited in the 1941 Florida Mango Forum, but was not too well accepted by the panel. They, of course, made no field observations or shipping trials to learn of its disease resistance or keeping quality, and its yield ability. Color, if I recall, was rated high by the panel. The fiber content proved to be not objectionable, having fiber similar to the Haden. This seedling was named after the man who had grown the tree in his backyard in Ft. Lauderdale. For several years we were the only grower and packer who propagated this variety to any extent, but we believed it was the best variety for the market that had appeared on the scene. It had most of the qualities previously described. It had the important quality of wide picking tolerance and a long picking season. Also it had the good color and shelf-life with acceptable eating quality. For these reasons, the dealers had confidence that it could be handled well in the markets. This has proved to be true. We market much of our fruit directly to the chain stores as well as through the other outlets.

By 1960, we had top-worked large numbers of the unsuitable varieties to Tommy Atkins. We shipped about 1,000 lugs in that year and increased each year until we were shipping about 8,000 lugs and began to wonder what the saturation point was. We still cannot answer what the market can handle after shipping some 60,000 lugs of Tommy Atkins in 1971. Including other varieties, our own out of state shipments totaled 180,000 lugs. The 1971 mango crop is reported to be the largest on record, at over 415,000 lugs.

Production Practices

Years ago we started using the standard fertilizer of that period, a 4-7-5 with some magnesium in it. Today we use about 4 times the potash to that of nitrogen. Until research or observations can show us an improvement in our N, P, K, ratios and the amount to apply, we will continue our present program. We know we have succeeded in getting good yields consistently. The appearance and internal fruit quality have been good to this date.

Our mango acreage now totals about 300 grove acres owned, leased or by share crop arrangements.
We also are planting new groves. We planted in excess of 40 acres in 1970.

We have changed our production and management programs from one of low fertility and infrequent spraying to a program that is intensive in nutritional applications and disease control. We maintain nutritional levels with fertilizers that are much higher in potassium than phosphorus or nitrogen and, we will in the future, lower the phosphorus levels considerably. We use foliar applications of liquid nutrients. We use over-tree irrigation with a permanent system that also gives us frost and freeze protection. For weed control we apply paraquat in the tree rows and mow the middles. In addition to cold protection by irrigation, we use some form of wind circulating equipment, such as airboats mounted on trucks where there is no protection from irrigation.

Our costs for our programs are:

- Ground applications of fertilizer .... $100 per acre
- Foliar applications of liquid fertilizers ................... $ 25 per acre
- Disease control (anthracnose and powdery mildew) Average of 25 applications to the bloom and fruit per season .... $300 per acre
- Weed control - 3 applications of herbicide and mowing 8 times a year .......... $ 50 per acre
- Total ......... $475 per acre

Our permanent irrigation systems are designed for about one half of an acre inch per hour. We use 18 #70 7/32” x 3/8” Rainbirds per five acre block. We have found that in addition to the liquid fertilizers used as foliar applications, we need to increase the rate of zinc application to the foliage because trees in our groves, and in many other groves we have observed, are showing various degrees of zinc deficiency. We have also profited from the use of chelated iron formulated for alkaline soils as soil applications and will probably expand the program using this iron material.

Our production with 100 trees per acre averages 400 bushels per acre annually for most of our varieties. We are now following a tree management program which includes topping the trees at 14 feet in order to maintain low headed, more easily sprayed and more easily harvested trees. Our topping is selective pruning with power tools. At the first topping of large trees our costs have been as high as $60 per acre. Thereafter our costs for topping decreased to $20 per acre. The work involved for top working older trees to more suitable varieties, which includes hat-racking or buck-horning the tree, grafting the stumps, post grafting care, removal of sprouts, training and supporting the new grafts, costs approximately $20 per tree.

LABOR

The harvesting, packing, and marketing of mangos requires full attention to all details and we put in long hours during the season. In addition, the sight of a heavy laden tree with highly colored fruit creates a great theft problem which has to be guarded against. The county agricultural patrol and grower cooperation has reduced this to a considerable extent. There are some advantages to growing mangos over limes or avocados, at least for us. We are almost through before the hurricane season arrives.

The harvesting of our mango crop occurs at a period when labor is plentiful. The regular labor force who harvest fruit and vegetables during the fall and winter season are available for this off-season work. High school and college students are also seeking work. We have a peak labor force of 100 people at harvest time.

The question has been put to me as to how to get good labor every year? My answer is that you have to provide good supervision, and give them an incentive.

It is essential that our labor be competitive and responsible. We maintain a supervisory program using year-round employees who, during the normal fruiting season, handle tree-topping, top working, spraying, and fertilizing. During the harvest season these permanent personnel become supervisors and direct the picking crews who are mainly residents of the area. Mango harvesting requires special skills for recognition of optimum maturity. This varies considerably with each variety.
Hopefully, we have the same harvesting crews returning every year. In an attempt to insure ourselves we have an incentive program for our full-time personnel which includes two weeks vacation with pay, Christmas bonuses and a hospitalization insurance which we pay on a 50-50 basis with the permanent employees. Our harvesting crews are paid an end-of-the-season bonus. Included in the harvesting crews are out of school older teenagers.

Since harvesting and post-harvest handling of mangos controls to a great extent the condition of the fruit and the prices received for that fruit when it reaches the terminal market, we use picking poles for selective picking. After the fruit have been picked from the tree and removed from the picking bag at the end of the pole, it is put into large tubs of water on the pickup trucks that we find to be more suitable than large trucks in maneuvering in the grove. When the tubs are full, the pickup truck goes directly to our packing house where the fruit are taken out of the water-filled tubs and unloaded into bins. During the time the fruit is in the water the washing action removes the unsightly sap that comes from the stem end after the fruit has been picked. The fruit at the packing house are graded and sized visually and place-packed in telescoping cardboard lugs which we make by machine at the packing house. Each lug contains 14 lbs. net of fruit and sizes will vary from 8 to 20, depending on size of the variety and period of the season. The filled lugs are put on pallets and fork lifted into the refrigerated truck.

The packing house is cleared of all harvested fruit daily. We check with the trucker to make certain that the information printed on our lugs that fruit be refrigerated at not less than 55° be scrupulously observed. Fifty to 60% of our crop is shipped f.o.b. as of this past season. We ship to all major distribution terminals in the United States and Canada. The mango industry is unique in that there are no U.S. Grades nor Standards for mango fruits. However, through a self-policing system we have continued to improve quality and appearance of our fruit with resultant expanding sales. We feel that quality is paramount and that our label should be as reliable as we can make it. It is of the utmost importance to us that our label need never be questioned.

Although we need to reduce the number of varieties produced and sold industry wide, we have limited our varieties to those mentioned because we feel that these varieties, until new and better varieties come along, give us a wider production and marketing program and a great deal of latitude in harvesting tolerances.

Our industry has progressed in spite of, or maybe because of, a number of things. Not long ago in Dade County, lime growing was a business, avocado growing a hobby, and mango growing a religion, according to some authorities. If this be true, we have converted a lot of people in both the avocado industry and especially in the mango industry. In those years mango production was of little significance to anyone other than mango lovers and backyard growers. Now, however, the demand for and consumer acceptance of mangos is increasing even more rapidly than the increasing production of each succeeding year.

There are still many needs and many obstacles to overcome in the mango industry. The mango industry is considered a minor industry and probably it is when compared by dollar values with most other agricultural industries in the county and in Florida. We are still limited in the use of agricultural chemicals because of the lack of label approvals for the newer and better disease and insect control materials. We cannot blame the manufacturers of these chemicals for their unwillingness to spend the hundreds of thousands of dollars to obtain label approvals for crops in which they may not sell enough material to get back 10% of their investment. Since many of the materials that we would like to use are approved for many other crops with thinner skins, or in which skin and all are consumed, those of us in this industry would like to see some state labels approved for this and other minor crops. I feel that the industry could do a better job of marketing with fewer but better handling varieties and, although we do not like to think of foreign competition, the movement of foreign mangos into this country under USDA

![Figure 2.—Loading pallet of mango lugs into refrigerated truck. Pallet contains 100 lugs.](image-url)
quarantine regulations should tend to eliminate some of our own marginal varieties. Thus far we have not felt many, if any, ill effects from the competition of foreign mango imports. Perhaps by expanding and exploiting market acceptance and introducing the mango to new markets, as must be done, our mango industry will continue with a bright future. My future in the mango industry is to continue to produce and market quality mango fruit as an expanding family business. I am not looking for alternative enterprises. We are a close knit family with four generations of Mitchells involved in our mango business.

To summarize, there have been some doubts by many people as to how we can survive in the mango business on such high priced land, high production costs and the increasing foreign competition.

The answer, as I see it, is to work toward the following:
1. Get higher production per acre.
2. Use high tree population and better nutrition.
3. Top-work poor market varieties to the best commercial varieties.
4. Plan your planting or top-working, so you have varieties which give you an extended season.
5. Do not pick when fruit is immature.
6. Grow clean fruit by following a rigid spray program.
7. Keep trees topped and hedged so spraying and picking can be done with more efficiency.
8. Keep in close touch with the market demand.

MANGO AND AVOCADO: EMERGING FRUITS IN WORLD HORTICULTURE AND TRADE

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INTRODUCTION

For centuries people of European ancestry have traditionally relished and consumed apples, pears, plums, peaches and other fruits grown successfully only in the temperate zones. Citrus fruits from the subtropical Mediterranean basin have also been known to westerners for a long time. Although most of these fruits are not actually native to Europe but were introduced from Asia long ago, their study and improvement constitute the foundation of western fruit horticulture, and have contributed almost our entire backlog of knowledge of fruit horticulture in general.

Tropical fruits, on the other hand, made their first appearance in the sixteenth century, following their discovery and introduction by early Portuguese and Spanish navigators. Today fruits such as the banana and the pineapple are readily available to consumers in North American and European countries. Both comprise industries of staggering proportions, to the extent that the entire economics of many small countries are based on their successful production and marketing. Very recently a new trend in fruit growing has originated in warm tropical and subtropical areas. Mango and avocado orchards are being planted at an increasing rate largely for the export market. The initial success in selling and transporting these fruits on a commercial scale to distant markets warrants more attention from horticulturists and governments around the world. In fact, this success suggests that an international mango and avocado industry will steadily increase in importance and perhaps even rival the far-flung banana business.

Present Status of production and exports

Many of the less developed countries have already launched a modest avocado and mango industry or are conducting research to determine whether it is feasible to grow these fruits on a commercial scale. Mango production in most of the highly populated countries of Southeast Asia is expanding but is mostly handled by small local businesses with only small, experimental quantities for the export market. The Philippines, however, has been exporting appreciable quantities of ‘Carabao’ mango and other fruits to Hong Kong, and Singapore (Table 1), and several studies are at present under way to increase production and to evaluate the possibilities of expanding exports to such potential large markets as Japan.1 The in-

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