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**ETHYLENE PRERIPENING OF MANGOS PRIOR TO SHIPMENT<sup>1</sup>**

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95% relative humidity (RH)) followed by shipment at 15.6°C (60°F).

External appearance and edible quality are major factors which determine the consumers' acceptance of most fruits. This is especially true for the marketing of mangos. Most mango cvs. of commercial importance produced in Florida develop very good color and edible quality when ripened or partially ripened on the trees. Unfortunately, these fruit are difficult to ship because of the short shelf-life due to the degree of softening when picked. In addition, some cvs. such as the 'Tommy Atkins' will develop an internal breakdown when ripened or partially ripened on the tree. Because of these limitations, most mangos are picked and shipped mature-green. Even though the edible quality of these fruit when stored and ripened at the recommended temperatures (5) is very good, external color development often does not attain that of tree ripened fruit.

An additional problem often encountered when marketing mature-green mangos is ripening time. Most mangos when displayed by the retailer still require several days to ripen, and the ripening times within a particular lot of fruit are often not uniform. This can create a backlog of fruit in the warehouse and requires the retailer to regrade for display purposes as the fruit ripen. It is the

*Abstract.* Successful commercial shipments of ethylene preripened mangos were made during the 1975 season to all major markets in the U. S. and parts of Canada. The slight softening upon arrival due to the ethylene treatment was not objectionable. The edible quality of the fruit was not affected. In one month in 1975, nearly twice as many Florida mangos were shipped as in any single month in any previous season. This was attributed to the effect of ethylene on color development, uniformity of ripening, and reduction in ripening time producing a fruit which is ready to eat or nearly so when purchased by the consumer. Recommended treatment conditions for mangos to be shipped are: 10 to 20 ppm ethylene at 21°C (70°F) for 12 to 24 hr under high humidity (92 to

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general consensus of most produce managers that the consumer wants a fruit that is ready to eat or nearly so, not one that still requires several days to ripen.

Use of ethylene for enhancing color development and ripening is a common practice in the tomato (6), banana (4), and citrus (5) industries. Ethylene is a normal metabolic product of many fruits and vegetables and is considered to be a ripening hormone (2,3). The possibility of using ethylene for enhancing color development and reducing the ripening time of mangos was suggested by Barmore (1). The treatment conditions then outlined were for mangos to be marketed locally and storage or shipment was not desired. Because of the market response of the few mangos pre-ripened with ethylene last year,<sup>2</sup> it was decided to examine the feasibility of using ethylene to pre-ripen mangos to be shipped.

The purpose of this paper is to report the conditions required for pre-ripening mangos with ethylene for shipping and the general market response to ethylene pre-ripened mangos.

#### Materials and Methods

Treatment conditions were established by experimenting with a commercial tomato ripening room.<sup>3</sup> Changes in the ethylene and ventilation systems of the room were made to maintain an ethylene concn of 10 to 20 ppm and an air exchange every 2 hr. Ethylene concn in the room was checked daily with a Kitigawa ethylene detector (7). Treatment temperature was maintained at 21°C. Treatment time ranged from 12 to 48 hr. All major Florida cvs. were tested. Market response to ethylene pre-ripened mangos was determined from sales records and reports from handlers. All market information was based on fruit treated and shipped by Mitchell Mango Company.

#### Results and Discussion

The technique of pre-ripening mangos with ethylene is intended to be used for mature fruit only. Immature fruit will respond to ethylene in a similar manner as mature fruit. However, color development is not always uniform and, most importantly, the poor eating quality of immature fruit is not improved with ethylene.

*Treatment conditions.* An ethylene concn of

10 to 20 ppm and a treatment temperature of 21°C were adequate for initiating both ripening and color development. There did not appear to be any difference in response by any of the cvs. tested. A temperature of 21°C was used to achieve a balance between the rate of color development and ripening. Development of the carotenoid pigments (yellow color) was favored at 21°C and immediately following the ethylene treatment the degree of softening was also minimal. Further color development following treatment was achieved by shipping the fruit at 15.6°C. This also helped control the rate of softening which was increased by the ethylene treatment.

Optimum treatment time ranged from 12 to 24 hr depending on the stage of maturity. At earliest maturity, a treatment time of 24 hr was sufficient. A treatment time of 48 hr was initially tried, but this resulted in fruit which were slightly too soft to handle following shipment. Treatment time was eventually reduced to 12 hr as the season progressed for a particular cv. This compensated for changes in maturity so that color development and stage of ripening were comparable to that of the earlier harvested fruit.

*Storage and ripening quality.* Ripening time of most of the cvs. was reduced 40 to 50% with the above treatments. In addition, uniformity of ripening was achieved. Similar findings were reported by Barmore (1). Even though ethylene treated fruit were slightly soft and required less ripening time, shipments were made to all major markets in the U.S. and parts of Canada with very good success. The slight softening upon arrival was not objectionable. Flavor of fruit ripened at 21° to 24°C (75°F) was not affected by the prior ethylene treatment. The incidence of internal breakdown in fruit such as the 'Tommy Atkins' was reduced with the use of ethylene. In addition, surface spotting due to anthracnose development was reported to be less on ethylene treated fruit.

*Marketing program and consumers' acceptance.* Before marketing ethylene treated mangos, the reasons for pre-ripening with ethylene and procedures for handling treated fruit were explained to the brokers and retailers to ensure acceptance. This played a major role in the development of the program. Skepticism was at first expressed because of the slight softness of the fruit upon arrival at the market. However, after comparing the good color and uniform ripening of ethylene treated fruit to nontreated fruit, the demand for these fruit steadily increased. The vol of fruit

<sup>2</sup>Information supplied by Mr. Erickson, Canal Point, FL.  
<sup>3</sup>Herman Walker Tomato Co., Perrine, FL.

marketed in many areas more than doubled as compared to the vol marketed in previous years. Prior to the 1975 season, the largest vol of fruit shipped during a weekly and monthly period by Mitchell Mangos was 37,000 and 100,000 lugs, respectively. During the 1975 season, vol shipped during 1 week reached 65,000 lugs with a total of 200,000 lugs for the month without a marked drop in price. Volume shipped to any broker on consignment was not greater than could be handled without reducing the price. It was estimated that without the use of ethylene 20 to 25% of the crop would not have been marketed because of the tremendous vol of fruit which matured in a 4 to 5-week period. Thus, acceptance by the various handlers and consumers was very good.

#### Conclusion

There were several reasons for the success of the ethylene program. The ethylene treatment enhanced color development and produced a fruit ready to eat or nearly so when purchased by the consumer. Thus, the consumer was offered an improved product and one that did not require additional storage time by either the retailer or consumer before it was acceptable for either display or consumption. At the New York market, ethylene treated fruit were being actively sought

even though a sufficient supply of mature-green fruit was present. Because of the exceptional market response to ethylene preripened fruit, 90% or more of the fruit shipped by Mitchell Mangos were ethylene treated.

The full potential of marketing ethylene preripened mangos has not been realized. This treatment can be used not only for increasing sales in established markets, but can be used as a means of competing with imported mangos and for developing new markets. Both the banana and tomato industries have capitalized very successfully on controlled ripening with ethylene. The success an individual packer has with this technique will depend on his acceptance of the program and control of the treatment conditions.

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