perature, concentration and exposure time to acetylene on initiation of banana ripening. J. Sci. Food Agr. 40:43-50.
18. Subramanyam, H., N.V.N. Moorthy, S. Lakshminarayana, and S. Krishnamurthy. 1972. Studies on harvesting, transport and storage of mango. Intl. Soc. Hort. Sci. 24:260-264.
19. Thompson, A.K. and G.B. Seymour. 1982. Comparative effects of acetylene and ethylene gas on initiation of banana ripening. Ann. Applied Biol. 101:407-410.
20. Wang, C.Y. and W.M. Mellenthin. 1972. Internal ethylene levels during ripening and climacteric in Anjou pears. Plant Physiol. 50:311-312.

J. AMER. SOC. HORT. SCI. 115(3):430-434. 1990.

# Ripening of Mangos Following Low-temperature Storage

**A.P. Medlicott**[1]
*Overseas Development and Natural Resources Institute, 56-62 Gray's Inn Road, London, WX1X 8LU, England*

**J.M.M. Sigrist**
*Instituto de Tecnologia de Alimentos, Av. Brasil 2880, Campinas SP 13100, Brazil*

**O. Sy**
*Institut de Technologie Alimentaire, Route des Pères Maristes, Hann, Dakar BP 2765, Senegal*

*Additional index words.* *Mangifera indica*, harvest maturity, postharvest physiology; quality control

***Abstract.*** **The effects of harvest maturity of mangos (Mangifera indica L.) on storage tinder various low-temperature regimes and the influence of storage on quality development during subsequent ripening at higher temperatures were investigated. The capacity for storage of mango fruit depended on harvest maturity, storage temperature, and the time of harvest within the season. Development of peel and pulp color, soluble solids concentration, pH, and softening in 'Amelie', 'Tommy Atkins', and 'Keitt' mangos occurred progressively during storage for up to 21 days at 12C. Based on the level of ripening change that occurred during 12C storage, immature fruit showed superior storage capacity than fruit harvested at more-advanced stages of physiological maturity. On transfer to ripening temperatures (25C); however, immature fruit failed to develop full ripeness characteristics. Mature and half-mature fruit underwent limited ripening during storage at 12C, the extent of which increased with progressive harvests during the season. Ripening changes during storage for 21 days were less at 8 and 10C than at 12C. Chilling injury, as indicated by inhibition of ripening, was found at all harvest stored at 8C, and in early season harvests stored at 10C. Fruit from mid- and late-season harvests stored better at 10 than at 12C, with no apparent signs of chilling injury. Flavor of mangos ripened after low-temperature storage was less acceptable than of those ripened immediately after harvest. Suggestions are made for maximizing storage potential by controlling harvest maturity and storage temperature for progressive harvests throughout the season.**

Mangos are judged as luxury items on the markets of most industrialized countries, although a reduction in price, together with improved and consistent quality, likely could result in increased consumption. The high cost of mangos in importing countries is due primarily to airfreight charges, but air transport does have the advantage of speed over sea transport. Sea transport is less expensive and enables transport of larger volumes, and thus would aid in the expansion of mango export industries. At the present stage of technical development, however, sea shipment does not guarantee good-quality fruit on arrival nor sufficiently long shelf life for successful marketing.

Sea transport generally involves the use of low-temperature storage in an attempt to prolong storage life. In practice, the minimum temperature for storage of most tropical fruits is determined by their susceptibility to chilling injury (CI). Between 12 and 13C generally is considered as optimum for mango storage (4, 10, 13), although suitable temperatures have been given as 10C (12) and SC (1, 14). The variation in reported optimum temperatures may be a cultivar effect, and may also be related to, the stage of harvest maturity and ripeness of the mangos when placed in storage.

Harvest in the fully mature, firm, green, pre-climacteric stage and transport in this condition has been recommended (2, 16). However, in commercial situations where transport over long distances is involved, mangos are generally harvested before full maturity, which may result in fruit of reduced quality (8). In commercial conditions, fruit are harvested at several stages of maturity and are shipped together, which results in a lack of uniformity of ripening among fruits. In addition, quality of ripened mango fruit has been found to be temperature-dependent, with the range of 21 to 24C being optimum for the Florida cultivars (3). Varying ripening rates have been reported on mangos harvested at different times after fruit set (4), while immature mangos undergo only limited ripening changes (8).

This paper reports a study aimed at determining the effects. of harvest maturity, storage period, and temperature, and the time of harvest within the season, on storage potential and quality development during subsequent ripening on transfer to higher temperatures.

## Materials and Methods

Studies were carried out over two successive mango seasons in Brazil (Nov.-Feb. 1985-86 and 1986-87) and Senegal (June-

Received for publication 28 Dec. 1987. Research supported by the Overseas Development Administration, England, commissioned project "Tropical and subtropical fruit storage and ripening". The technical assistance of J.R. Coutinho, A.P. Cury (ITAL, Brazil), Mayé N'Diaye. and S. N'Diaye (ITA, Senegal) is gratefully acknowledged.

[1]Current address: Fintrac Consulting Ltd., Hythe, Welches, Christchurch, Barbados, West Indies.

July 1986 and June-Aug. 1987). Mango cultivars Tommy Atkins and Keitt (harvested from Taquaritinga, São Paulo) and Amelie (harvested from Sangalkam, Dakar) were used in the Brazil and Senegal experiments, respectively. After harvest, undamaged fruit free from apparent pathogen infection were selected and taken immediately to the laboratory, where they were placed under experimental conditions within 24 hr.

Fruit were categorized into three stages of harvest maturity based on their morphological characteristics (8). A fully mature fruit was defined as having outgrown shoulders, formation of a depression at the stem end, but remaining firm and green. Half-mature fruit had shoulders in line with the stem, while immature fruit had shoulders below the pedicel insertion. In both countries, tagging of individual fruitlets when 1 cm long indicated that the immature, half-mature, and mature stages were harvested 83, 90, and 97 days after fruit set, respectively. Variation of 2 to 3 days was found between orchard sites.

Fruit were stored in temperaturecontrolled rooms at 8, 10, or 12 ± 0.5C, 85% to 95% RH for up to 21 days. In Brazil, the fruit were transferred after storage to a temperature-controlled ripening room at 25 ± 1C, 85% to 95% RH and in Senegal to ambient conditions of 27.5 to 30.5C, 65% to 83% RH. Fruit were placed in 200- and 78-liter airtight containers in Brazil and Senegal, respectively, and exposed to ethylene at 1.0 $ml \cdot liter^{-1}$ for 24 hr, then removed and placed in ventilated fiberboard boxes. Experiments were replicated between three and six times, with eight fruit per treatment.

Physico-chemical analyses to determine the levels of ripeness were carried out at harvest, after storage, and at intervals during ripening. Measurements were made of the pulp rupture force, soluble solids content (SSC), pH, and the visual assessment of the peel and pulp color, as described by Medlicott et al. (7).

Sea shipment trials were carried out in collaboration with commercial exporters. Experimental fruit were included in commercial consignments and outturns analyses made on arrival in England on the stage of ripeness (based on firmness and peel color).

Experiments were carried out as randomized complete-block design and data subjected to analyses of variance.

## Results

*Effects of storage period at 12C on ripening.* Ripening of 'Amelie' mangos occurred progressively during prolonged storage at 12C (Table 1). In mature fruits stored for 7 days, SSC and pH increased when compared to values at harvest. After 14 days, significant changes were found in each of the characteristics measured. Ripening was almost complete after 21 days at 12C. Similar trends were apparent for half-mature fruit, although the rate of change and the extent of development were reduced for some characteristics. Based on the degree of ripening changes that occurred under the storage conditions, immature fruit appeared to show extended storage capacity compared to fruit harvested at a more advanced stage of physiological maturity. Some ripening occurred in immature fruit during storage; fruit retained their firmness, and showed only slight SSC and peel and pulp color development. However, upon transfer of fruit from 12C to ambient conditions for completion of ripening, immature fruit showed only limited ripening compared to those of mature and half-mature fruit, as shown by the peel color development (Table 2). This effect was more pronounced as the storage period at 12C was increased; after 21 days at 12C, immature fruits showed only slight increases in SSC, peel and pulp color development, and acidity loss on subsequent transfer to ambient conditions (data presented only for peel color). No differences were observed in the physico-chemical characteristics of ripe mature and half-mature fruits.

*Effects of harvest date and storage temperature on storage potential.* Storage potential was found to decrease with pro-

Table 1. Ripening changes during storage for varying periods at 12C in 'Amelie' mangos harvested at three stages of maturity.

| Initial fruit maturity | Storage period (days) | Pulp rupture force (kgf) | Soluble solids concn (%) | pH | Peel color score[z] | Pulp color score[y] |
|---|---|---|---|---|---|---|
| Mature | 0 | 3.70 | 6.0 | 3.21 | 1.0 | 2.9 |
| | 7 | 3.51 | 8.4 | 3.52 | 1.8 | 2.7 |
| | 14 | 1.72 | 9.5 | 3.68 | 1.3 | 3.9 |
| | 21 | 0.25 | 11.9 | 5.17 | 3.7 | 4.9 |
| Half-mature | 0 | 4.42 | 5.2 | 3.18 | 1.0 | 2.4 |
| | 7 | 4.09 | 7.7 | 3.40 | 1.6 | 2.1 |
| | 14 | 2.86 | 9.0 | 3.38 | 1.3 | 2.6 |
| | 21 | 0.25 | 12.4 | 5.14 | 3.4 | 4.8 |
| Immature | 0 | 6.67 | 5.1 | 3.11 | 1.0 | 1.7 |
| | 7 | 5.62 | 6.0 | 3.22 | 1.5 | 1.3 |
| | 14 | 3.99 | 8.0 | 3.33 | 1.2 | 1.9 |
| | 21 | 2.63 | 8.7 | 3.43 | 1.3 | 2.6 |
| Source | df | MS | MS | MS | MS | MS |
| Reps | 7 | 2.27 | 1.87 | 0.09 | 0.02 | 0.29 |
| Maturity (A) | 2 | 50.97** | 36.57** | 3.54** | 4.53** | 24.81** |
| Error (A) | 14 | 1.11 | 0.33 | 0.04 | 0.05 | 0.16 |
| Time (B) | 3 | 72.99** | 131.93** | 9.66** | 14.9** | 19.35** |
| Interaction (AB) | 6 | 0.93[NS] | 4.98** | 1.64** | 3.14** | 1.43** |
| Error | 63 | 1.45 | 0.83 | 0.05 | 0.10 | 0.31 |

[z]1 = green, 5 = yellow.
[y]1 = white, 5 = orange.
**Significant at $P = 0.01$.

Table 2. Peel color of 'Amelie' mangos harvested at three stages of maturity after seven days at 25C and varying periods at 12C.

| Initial fruit maturity | Storage time at 12C before ripening (wk) | | | |
|---|---|---|---|---|
| | 0 | 1 | 2 | 3 |
| | *Color rating*[z] | | | |
| Mature | 4.1 | 3.5 | 2.9 | 4.5 |
| Half-mature | 3.9 | 3.6 | 2.9 | 4.5 |
| Immature | 3.4 | 3.3 | 2.5 | 1.8 |
| Source | df | MS | | |
| Reps | 7 | 0.53 | | |
| Maturity (A) | 2 | 10.84** | | |
| Error (A) | 14 | 0.33 | | |
| Storage time (B) | 3 | 4.38** | | |
| Interaction (AB) | 6 | 3.68** | | |
| Error | 63 | 0.17 | | |

[z]1 = green, 5 = yellow.
**Significant at $P = 0.01$.

gressive harvests throughout the season. Storage of mature 'Keitt' mangos for 21 days at 12C restricted ripening in the first harvest of the season, as indicated by limited changes in texture, acidity, and peel and pulp color (Table 3). When harvested 3 weeks later, fruit underwent substantial softening, increases in SSC, and peel color during storage. Increased ripening changes during 21 days storage at 12C with successive harvests were also found with 'Tommy Atkins' (Brazil) and 'Muska' mangos (Senegal) (data not shown).

Outturns of commercial sea shipments of mangos from Brazil to Europe in the 1985-86 and 1986-87 seasons indicated that early season-harvested 'Tommy Atkins' arrived in Europe in the unripe preclimacteric condition, while middle- and late-season shipments contained fruit at varying stages of ripeness, as indicated by softening and peel color development (data not shown). Transit times ranged from 19 to 25 days with containers at 12 ± 1C.

Reduction of the ripening changes in 'Amelie' mango observed during storage at 12C for 21 days was also observed for 'Tommy Atkins' stored at 8, 10, and 12C. Ripening of both mature and half-mature fruit, expressed as loss of firmness, was retarded under these conditions, although the fruit softened relative to the values at harvest (Table 4). Fruit stored for 21 days at 12C were consistently softer than those at 8 or 10C. Softening under each of the storage conditions advanced further with progressive harvests, although the effect was smaller at 12C. No differences were found between mature and half-mature fruit.

Harvest date was also found to influence the susceptibility to CI; no external symptoms were observed after 21 days at any of the storage temperatures, although a "corky layer" developed 5 to 7 mm below the peel in fruit from the first three harvests stored at 8C and from the first harvest at 10C. A similar incidence of CI was noted in both mature and half-mature fruit (data not shown).

Inhibition of ripening, which is a symptom of CI, was apparent in fruit from all harvests ripened at 25C after 8C storage, and in fruit from the first two harvests stored at 10C.

Quality development of 'Tommy Atkins' mango during rip-, ening after low-temperature storage depended on harvest maturity and the storage temperature (Table 5). Comparison of the physico-chemical characteristics of ripe fruit with and without low-temperature storage showed no inhibitory effects of 10 and 12C storage. After 8C storage, fruit underwent limited ripening, including some SSC development, but retained firmness and lacked peel and pulp coloration. Similar characteristics were found in mature and half-mature fruit ripened immediately after harvest, while half-mature fruit ripened after low-temperature storage were less-advanced than mature fruit under the same conditions.

Sensory evaluation of stored and nonstored fruit after ripening carried out by a trained panel indicated that nonstored fruit were preferred, although fruit ripened after 12C storage attained comparable acceptability levels (data not shown). Poor sensory ratings were obtained for fruits after the 8 and 10C storage treatments, which indicated impaired ripening or off-flavor development.

## Discussion

The storage capacity of mango fruit depended on harvest maturity, the time of harvest within the season, and the storage temperature. Storage capacity of mature-fruit was lower than for immature fruit. 'Dashehari' mangos harvested immature (85

Table 3. Effect of harvest date on the ripening changes of mature 'Keitt' mangos during 21 days storage at 12C.

| Harvest date (1987) | Time of examination | Pulp rupture force (kgf) | Soluble solids concn (%) | pH | Peel color score[z] | Pulp color score[y] |
|---|---|---|---|---|---|---|
| 12 Jan. | At harvest | 9.48 | 6.1 | 3.34 | 1.0 | 3.3 |
| | After storage | 8.77 | 11.0 | 3.41 | 1.3 | 3.1 |
| 26 Jan. | At harvest | 9.62 | 5.8 | 3.49 | 1.0 | 3.1 |
| | After storage | 4.37 | 11.4 | 3.53 | 1.1 | 3.4 |
| 2 Feb. | At harvest | 9.30 | 5.6 | 3.47 | 1.0 | 3.0 |
| | After storage | 1.68 | 13.0 | 3.68 | 1.8 | 3.4 |
| Source | df | MS | MS | MS | MS | MS |
| Reps | 7 | 5.15 | 0.27 | 0.01 | 0.02 | 0.24 |
| Date (A) | 2 | 54.91** | 2.53** | 0.17[NS] | 0.51* | 0.11[NS] |
| Error (A) | 14 | 4.85 | 0.66 | 0.08 | 0.04 | 0.16 |
| Time (B) | 1 | 247.98** | 430.80** | 0.14[NS] | 2.08** | 1.51** |
| Interaction (AB) | 2 | 48.05** | 6.87** | 0.03[NS] | 0.51* | 0.04[NS] |
| Error | 21 | 4.51 | 0.51 | 0.01 | 0.03 | 0.18 |

[z]1 = green, 5 = yellow.
[y]1 = white, 5 = orange.
[NS,*,**]Not significant or significant at $P = 0.05$ or 0.01, respectively.

Table 4. Effect of storage temperature on pulp rupture force (kgf) during storage for 21 days in 'Tommy Atkins' mangos harvested at two stages of maturity throughout the season.

| Storage temp (C) | Initial fruit maturity | Harvest date | | | |
|---|---|---|---|---|---|
| | | 12 Nov. 86 | 11 Dec. 86 | 23 Dec. 86 | 5 Jan. 87 |
| | | | *kgf* | | |
| At harvest | Mature | 10.20 | 8.21 | 8.06 | 8.28 |
| | Half-mature | 10.44 | 10.45 | 7.62 | 7.45 |
| 8 | Mature | 8.42 | 7.73 | 7.44 | 5.75 |
| | Half-mature | 8.32 | 8.63 | 8.12 | 4.00 |
| 10 | Mature | 7.93 | 8.21 | 5.35 | 5.06 |
| | Half-mature | 7.53 | 8.43 | 4.88 | 3.46 |
| 12 | Mature | 1.56 | 1.00 | 1.61 | 0.91 |
| | Half-mature | 0.81 | 0.88 | 1.49 | 0.87 |

| Source | df | MS |
|---|---|---|
| Replicates | 7 | 0.14 |
| Harvest date (A) | 3 | 8.04* |
| Error (A) | 21 | 0.27 |
| Temp (B) | 3 | 214.48* |
| Interaction (AB) | 9 | 14.69$^{NS}$ |
| Error (B) | 84 | 14.93 |
| Maturity (C) | 1 | 0.12$^{NS}$ |
| Interaction (AC) | 3 | 2.80$^{NS}$ |
| Interaction (BC) | 3 | 0.68$^{NS}$ |
| Interaction (ABC) | 9 | 1.93$^{NS}$ |
| Error | 112 | 22.70 |

$^{NS,*}$Not significant or significant at $P = 0.01$, respectively.

Table 5. Comparison of the ripeness characteristics of 'Tommy Atkins' mangos ripened 11 days at 25C immediately after harvest with those stored for 21 days at low temperature and subsequently ripened for 5 days at 25C.

| Storage temp (°C) | Initial fruit maturity | Pulp rupture force (kgf) | Soluble solids concn (%) | pH | Peel color score[z] | Pulp color score[y] |
|---|---|---|---|---|---|---|
| Not stored | Mature | 0.54 | 10.3 | 4.00 | 4.5 | 4.6 |
| | Half-mature | 0.43 | 9.6 | 3.64 | 4.6 | 4.6 |
| 8 | Mature | 2.29 | 10.0 | 3.59 | 2.9 | 3.3 |
| | Half-mature | 1.52 | 8.9 | 3.35 | 2.9 | 2.8 |
| 10 | Mature | 0.44 | 10.5 | 3.81 | 4.3 | 4.3 |
| | Half-mature | 0.63 | 10.4 | 3.77 | 4.6 | 4.1 |
| 12 | Mature | 0.46 | 11.3 | 4.48 | 4.4 | 4.3 |
| | Half-mature | 0.53 | 9.7 | 4.46 | 4.8 | 3.9 |

| Source | df | MS | MS | MS | MS | MS |
|---|---|---|---|---|---|---|
| Reps | 7 | 0.08 | 0.43 | 0.09 | 0.32 | 0.13 |
| Temp (A) | 3 | 7.92** | 3.08** | 2.78** | 10.59** | 7.07** |
| Error (A) | 21 | 0.08 | 0.25 | 0.04 | 0.18 | 0.09 |
| Maturity (B) | 1 | 0.38$^{NS}$ | 11.82** | 0.44** | 0.77$^{NS}$ | 1.00** |
| Interaction (AB) | 3 | 0.72** | 1.55* | 0.11$^{NS}$ | 0.09$^{NS}$ | 0.14$^{NS}$ |
| Error | 28 | 0.16 | 0.52 | 0.09 | 0.26 | 0.09 |

[z]1 = green, 5 = yellow.
[y]1 = white, 5 = orange.
$^{NS,*,**}$Not significant or significant at $P = 0.05$ or 0.01, respectively.

days after fruit set) were also shown to store better than fruit harvested more mature (90 and 95 days after fruit set) (4). In this study, however, while immature fruit stored well, it failed to develop full quality characteristics upon ripening. Ripening after storage indicated that low-temperature conditions inhibited the development of some of the ripening processes. This was particularly apparent with acidity loss, notably after 8C storage. Higher acidity and lower sugar levels were shown in low-temperature-ripened 'Totapuri' (6) and 'Kent' (15) mangos. The reduction in the capacity to undergo acid loss may have resulted from disruption of acid metabolism during storage. It should be noted, however, that acid changes arc one of the slower processes that occur during ripening in mangos (9). Pulp color development and, therefore, carotenoid content, was impaired during ripening after storage, particularly after 8C. This result may, in turn, be related to production of volatiles, as sensory evaluation

indicated that the overall flavor of the nonstored fruit was generally preferred to stored fruit, even when no differences were present in individual taste characteristics. Thomas (12) has reported that 'Alphonso' mangos held continuously at 7 and 15C were sweet, but bland and atypical in terms of aroma and taste.

A high incidence of postharvest diseases was noted in our tests in the low-temperature-stored fruit; stem end rot caused by *Botryodiplodia theobromae* and other fungi have been reported as a particular problem in low-temperature-stored mangos (5, 17).

For long-term storage of mangos, early season harvests of both mature and half-mature fruits should be stored at 12C when held for 21 days. In subsequent harvests, however, 12C-stored fruits exhibit substantial ripening changes during storage, which effectively reduces the available shelf life and marketing period of late-harvested fruit. In mid- and late-season harvest, half-mature fruits are preferred, and can be stored at 10C for 21 days. Immature fruit and 8C storage temperatures should be avoided under these conditions. In all of these cases, the fruit should be transferred to 20 to 25C to complete ripening and to achieve full potential quality development (3). If required, ethylene or acetylene treatment should be given to initiate and synchronise ripening (7, 11). The disadvantages of long-term low-temperature storage for sea shipment is the possibility of a reduction in fruit quality and flavor compared to nonstored air-freighted fruit.

## Literature Cited


1. Abou Aziz, A.B., S.M. El-Nabaway, F.K. Adel Wahab, and A.S. Abdel Kader. 1976. The effect of storage temperature on quality and decay percentage of "Pairi" and "Taimour" mango fruits. Scientia Hort. 5:65-72.
2. Cheema, G.S. and P.G. Dani. 1934. Report on export of mango to Europe in 1932-33. Bombay Dept. Agr. Bul. 170.
3. Hatton, T.T., W.F. Redder, and C.W. Campbell. 1965. Ripening and storage of Florida mangoes. USDA Mktg. Res. Rpt. 725.
4. Kalra, S.K. and D.K. Tandon. 1983. Ripening behaviour of-"Dashehari" mango in relation to harvest period. Scientia Hort. 19:263-269.
5. Kane, O., M. Boulet, and F. Castaigne. 1982. Effect of chilling injury on texture and fungal rot in mangos *(Mangifera indica* L.). J. Food Sci. 47:992-995.
6. Kapse, M.B., D.A. Rane, D.N. Kulkarni, and U.M. Ingle. 1975. Biochemical changes in "Totapuri" mangos during ripening and storage. S. Indian Hort. 25:119-120.
7. Medlicott, A.P., Maye N'Diaye, and J.M.M. Sigrist. 1988. Harvest maturity and concentration and exposure time to acetylene influence initiation of ripening in mangos. J. Amer. Soc. Hort. Sci. 115(3):426-430.
8. Medlicott, A.P, S.B. Reynolds, S.W. New, and A.K. Thompson. 1987. Harvest maturity effects on mango fruit ripening. Trop. Agr. 65(2):153-157.
9. Medlicott, A.P., S.B. Reynolds, and A.K. Thompson. 1986. Effect of temperature on the ripening of mango fruit *(Mangifera indica* L. var. Tommy Atkins). J. Sci. Food Agr. 37:469-474.
10. Medlicott, A.P., J.M.M. Sigrist, S.B. Reynolds, and A.K. Thompson. 1987. Effects of ethylene and acetylene on mango fruit ripening. Ann. Applied Biol. 111:439-444.
11. Musa, S.K. 1974. Preliminary investigations on the storage and ripening of "Totapuri" mangos in the Sudan. Trop. Sci. 16:65-72.
12. Thomas, P. 1975. Effect of post-harvest temperature on quality, carotenoids and ascorbic acid content of "Alphonso" mangos on ripening. J. Food Sci. 40:704-706.
13. Thomas, P. and M.S. Oke. 1983. Improvement in quality and storage of 'Alphonso' mangoes by cold adaptation. Scientia Hort. 19:257-262.
14. Thompson, P.K. 1977. The storage of mango fruits. Trop. Agr. (Trinidad) 48:63-70.
15. Veloz, C.S., F.E. Torres, and S. Lakshminarayana. 1977. Effect of refrigerated temperatures on the incidence of chilling injury and ripening quality of mango fruit. Proc. Fla. State Hort. Soc. 90:205-210.
16. Wardlaw, C.W. and E.R. Leonard. 1936. The storage of West Indian mangos. Low Temp. Res. Station, Imperial College Trop. Agr., Trinidad. P. 1-47.
17. Wehner, F.C., S. Bester, and J.M. Kotze. 1982. Fungi associated with post-harvest decay of mangos. S. African Mango Growers Assn. 2:12-15.