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DETERMINATION OF CHILLING INJURY IN MAIN MANGO VARIETIES GROWN IN MEXICO

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SUMMARY

Sea refrigerated mango shipments from Guatemala, Haiti, Ecuador, Peru and Brazil take up to three weeks to reach the US market. Most of the time because of inadequate cold chain, CI is observed in a high degree lowering fruit quality, especially poor flavor and color development. Consequently, that situation may be compromising mango marketing in the US causing great economic losses to the industry members. The objectives of this study were to determine the critical combinations of time and temperature and the associated chilling threshold temperature(s), as well as, to quantify the effect of ripening degree on CI for the most important mango varieties grown in Mexico. The study was done in fruit of 'Ataulfo', 'Tommy Atkins', 'Kent' and 'Keitt'. The following factors were evaluated: a) Ripening degree (Partially ripe and ripe); b) Storage temperatures (45.5, 50.0, and 54.5°F) (7.5, 10.0 and 12.5°C) and c) Storage time (1, 2, or 3 weeks). A Factorial design was used with 20 replications for weight loss and five for all the other variables. The analysis of variance was done independently for each variety. Significant differences for CI were found among varieties. 'Ataulfo' and 'Kent' were more susceptible than 'Tommy Atkins' and 'Keitt'. External damage was higher than internal damage. The most important factors were storage temperature and storage time. The lower the temperature, the higher the damage; as well as, the longer the storage time, the higher the damage. 'Ataulfo' and 'Kent' showed external injury as soon as one week storage at 45.5 and 50.0°F (7.5 and 10.0°C) while 'Tommy Atkins' and 'Keitt' showed moderate to severe damage only at 45.5°F (7.5°C), even after three weeks of shipment simulation. The internal CI damage was very low and it was reflected mainly on the pulp color. The lower the temperature, the lower the pulp color intensity; as well as, the longer the storage time, the lower the pulp color intensity. A very clear effect of temperature and storage time was also observed for firmness in all varieties. The lower the temperature, the higher the pulp firmness; whereas, the longer the storage time, the lower the pulp firmness. Thus, for practical purposes, 'Ataulfo' and 'Kent' should be shipped only at 54.5°F (12.5°C) while 'Tommy Atkins' and 'Keitt' can tolerate up 50°F (10°C). None of the varieties must be shipped at 45.5°F (7.5°C).

BACKGROUND

Mango is one of the favorite fruits in the US market, where consumption has doubled in the past 10 years. During the last three years (2009-2011) on average 71.7 million 10-pound boxes have been imported; mainly from Mexico (65.1 %), Peru (9.7 %), Ecuador (9.4 %), Brazil (7.4 %), Guatemala (4.6 %), and Haiti (2.5 %) [USDA-FAS, 2012]. However, most of the time the quality of mango fruit at the consumer level is compromised, since exporter countries face several challenges in delivering high quality fruit (Brecht *et al*., 2009). One of the big challenges is because shipping takes up to four weeks, leading to over ripe fruit as well as problems for distribution at retail level. To overcome those problems, sea shipments normally involve refrigeration. The principle behind cold storage is to delay the period of ripening of a product by slowing down its physiological activity. However, many commodities like mango are sensitive to chilling injury (CI) when stored at low temperature. Mango fruit undergo CI when stored at temperatures below 50°F (10°C) showing uneven ripening, poor color and flavor, surface pitting, grayish scald-like skin discoloration, increased susceptibility to decay, and, in severe cases, flesh browning (Medlicott *et al.,*1990; Kader, 1997). Symptoms are not apparent while stored at low temperature but they are visible later when fruit is brought to warmer temperature for ripening or displayed for sale. It is stated that the optimum storage temperature for mango fruit is around 54-55°F (12-13°C) (Medlicott *et al.,* 1990; Kader, 1992). The severity of CI of mango fruit stored below 50°F (10°C) depends on cultivar, ripeness stage, and the duration and exposure temperature. Regarding the differences in cultivars against CI, Phakawatmonkol *et al*. (2004) evaluated the sensitivity of five Thailand cultivars to temperatures of 39, 46 and 54°F (4, 8 and 12°C). CI was present in all cultivars at 39 and 46°F (4 and 8°C) but 'Rad' and 'Okrong' could be stored at 54°F (12°C) for 15 and 25 days, respectively. Siriphanich and Kunyamee (2010) found differences in CI sensitivity among three cultivars stored at 41 and 55°F (5 and 13°C). 'Nam Dok Mai' mango developed CI in both the peel and the pulp. 'Chok Anan' developed CI only on the peel. No CI was found in 'Hongsawadee'.

With respect to mango cultivars grown in Mexico, Farooqui *et al*. (1985) stated that 'Haden' and 'Keitt' were very susceptible to CI while Brecht *et al*., (2012) found that 'Ataulfo' was the one with most sensitivity, followed by 'Kent' and 'Keitt'. 'Tommy Atkins' showed more tolerance to low temperatures without major CI symptoms during the first two weeks of storage. On the other hand, the ripeness stage has a great influence on mango CI. In general, unripe fruit are more susceptible than more mature fruit (Medlicott *et al*. 1990; Kader, 1997; Mohammed and Brecht, 2002). As exposed above, the duration and exposure time to low temperatures influences greatly the susceptibility of mango fruit to CI. Fruit exposure to temperatures lower than 46°F (8°C) showed CI symptoms in the first week of storage while those stored at recommended temperature (54-55°F) (12-13°C), depending on the cultivar, did not express any or slight CI symptoms up to 21 days of storage (Chaplin, 1991; Phakawatmonkol *et al*., 2004; Luna *et al*., 2010; Miguel *et al*., 2011; Brecht *et al*., 2012). According to my experience, refrigeration at 55 ± 1.0°F (12.5 ± 1.0°C) should maintain fruit with good quality without any CI symptoms. However, as stated by Brecht *et al*. (2012) the critical information that must be found in order to avoid CI is the time temperature combinations that cause CI, along with the specific time temperature combinations involving the highest temperature at which CI can develop and the lowest temperature at which CI will not develop. It should be done for the same mango varieties ('Ataulfo', 'Tommy Atkins' 'Kent' and 'Keitt') grown in other regions, in different seasons and harvesting conditions. In fact, according to the National Mango Board, CI is one of the most important disorders affecting mango fruit quality, which may compromise their marketing in the US and causing great economic losses to the mango industry members (NMB, 2012).

THE PROBLEM

Sea refrigerated mango shipments from Guatemala, Haiti, Ecuador, Peru and Brazil take up to three weeks to reach the US market. Most of the time because of inadequate cold chain, CI is observed in a high degree lowering fruit quality, especially poor flavor and color development. Consequently, that situation may be compromising mango marketing in the US and causing great economic losses to the industry members.

OBJECTIVES

- To determine the critical combinations of time and temperature and the associated chilling threshold temperature(s) for the most important mango varieties grown in Mexico.
- To quantify the effect of ripening degree on CI of main mango varieties grown in Mexico.

METHODOLOGY

FACTORS UNDER STUDY

a. **RIPENING DEGREE:** Partially Ripe and Ripe.
b. **STORAGE TEMPERATURE:** 45.5±1.5ºF, 50.0±1.5ºF and 54.5±1.5ºF (7.5±1.0ºC, 10.0±1.0ºC y 12.5±1.0ºC) in commercial cooling rooms.
c. **STORAGE TIME:** 1, 2 and 3 weeks + Market simulation (71±2°F (22±2°C); 75±10 % RH) until ready to eat stage.
d. **VARIETIES:** Ataulfo, Tommy Atkins, Kent and Keitt.

e. TREATMENTS

Number	Ripening Degree	Storage temperature (ºF)	Storage time (weeks)
1	Partially Ripe	45.5±1.5º	1
2	Partially Ripe	45.5±1.5º	2
3	Partially Ripe	45.5±1.5º	3
4	Partially Ripe	50.0±1.5	1
5	Partially Ripe	50.0±1.5	2
6	Partially Ripe	50.0±1.5	3
7	Partially Ripe	54.5±1.5	1
8	Partially Ripe	54.5±1.5	2
9	Partially Ripe	54.5±1.5	3
10	Ripe	45.5±1.5ºF	1
11	Ripe	45.5±1.5ºF	2
12	Ripe	45.5±1.5ºF	3
13	Ripe	50.0±1.5	1
14	Ripe	50.0±1.5	2
15	Ripe	50.0±1.5	3
16	Ripe	54.5±1.5	1
17	Ripe	54.5±1.5	2
18	Ripe	54.5±1.5	3

f. SAMPLING: Initial, at the end of the cold storage and until fruit reached ready to eat stage.

g. VARIABLES TO BE MEASURED: Chilling injury (Lenticel spots, peel discoloration, darkening of the pulp, and aroma); weight loss, peel color, firmness, pulp color, and TSS.

Detailed description of the methodology

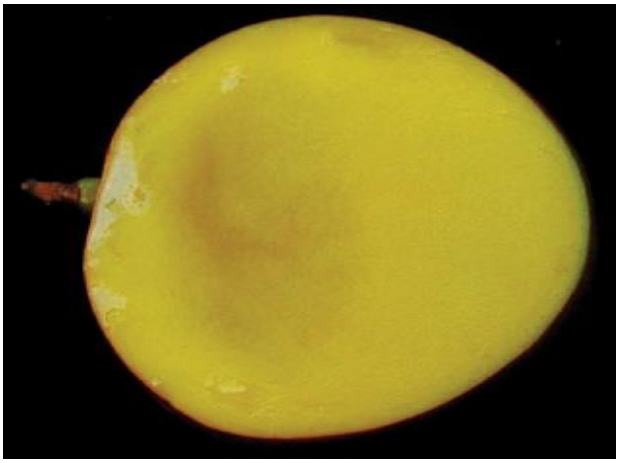
For each variety in a determined packinghouse 62 fruit per treatment were gotten (2 boxes with 31 fruit each). Fruit were collected just after washing and already classified for quarantine hot water treatment for 75 or 90 min. Then, they were separated according to ripening stage considering partially ripe fruit (flat shape without full cheeks and shoulders below the pedicel insertion; pulp color values between 1 and 2 and total soluble solids content of < 7.3 °Bx in Tommy, Kent and Keitt as well as < 6.0 °Bx in Ataulfo) and ripe fruit (round shape with full cheeks and shoulders above the pedicel insertion; pulp color values between 2 and 3 and total soluble solids content of > 7.3 °Bx in Tommy, Kent and Keitt as well as > 6.0 °Bx in Ataulfo). Fruit were with excellent external appearance, free of mechanical damage, pests, and diseases**.** Immediately quarantine hot water treatment for each variety and size was applied according to USDA-APHIS protocol. Then, fruit were stored at different temperatures (45.5±1.5ºF, 50.0±1.5ºF and 54.5±1.5ºF) in commercial cold rooms up to three weeks with weekly transfers to marketing simulation (71.6±3 °F; 75±10 % RH) until ready to eat stage. Sampling was done at the beginning, at the end of refrigerated period and then at consumption stage.

Note: The Technological University of Nayarit Coast and the Technological University of Nayarit facilitated their cooling rooms for managing temperatures of 45.5±1.5ºF and 50.0±1.5ºF, respectively.

Variables

Chilling injury (CI). The visual CI symptoms (lenticel darkening, skin pitting, scalding, uneven ripening) in mango were assessed during the whole storage period using a rating scale in which 1 = severe, >50% of the fruit's surface showing damage; 2 = moderate, 25–50% chilling damage; 3 = slight, up to 25% pitting and/or scalding; 4 = trace (small pits), 2–5% of the total fruit surface damaged; 5 = no visible symptoms of injury.

Internal flesh browning and decay should be scored on the basis of the area affected using a scale of 0 to 3: 0 = no damage or decay (no visible damage); 1 = slight damage or decay (Any damage or decay affecting an area up to ¾ inch in diameter); 2 = moderate damage or decay (Damage or decay affecting an area more than ¾ inch up to 1 ½ inches in diameter); 3 = severe damage or decay (Damage or decay affecting an area more than 1 ½ inches in diameter).



Weight loss. By using an analytical digital balance (Acculab VI-4800) with accuracy of 0.1 g (Ohaus Corp. Florham Park, NJ). Twenty fruit were weighed periodically throughout the evaluation period. The difference in weight with respect to initial weight was expressed as percentage weight loss.

Firmness. Firmness was measured using a DFE-050 Chatillon penetrometer (Ametek Instruments, Largo, FL) with a 10 mm diameter head. A portion of the skin of approximately 5 mm was removed to expose the pulp and the probe inserted about 4 mm depth at a speed of 180 mm·min-[1]. Measurements were taken at two opposite sites. Data were expressed in Pounds.

Pulp color. By a portable colorimeter CR-10 (Konica Minolta), reporting as Hue values.

Total soluble solids (TSS). By a digital refractometer with temperature compensator, ATAGO model PAL-1 calibrated with distilled water (AOAC, 1984).

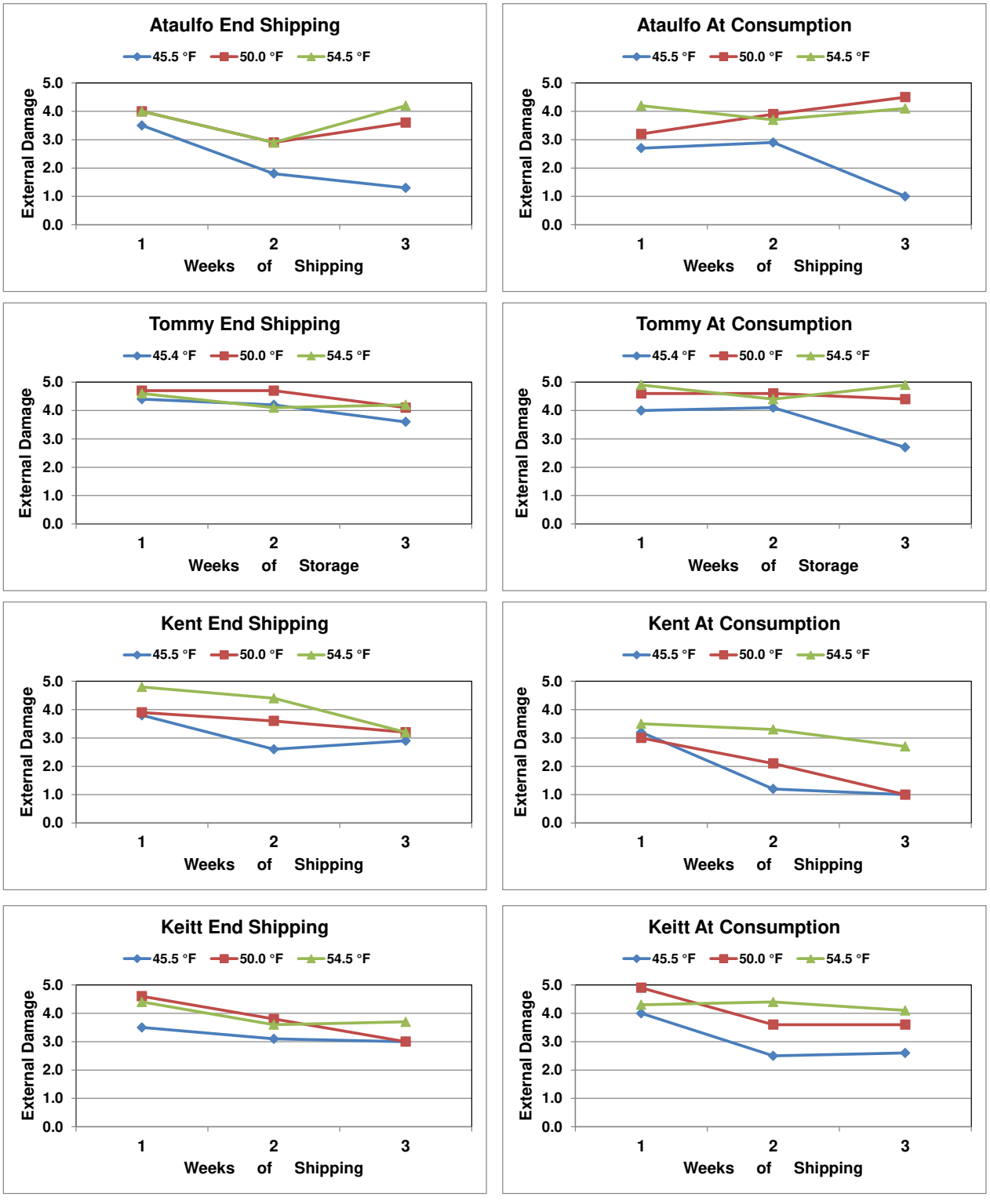
A factorial design (ripening stage, storage temperatures and times of storage) was used with 20 replications for weight loss and five replications for all other variables. Analysis was done independently for each variety.

RESULTS AND DISCUSSION

It was observed the ripening degree did not have a significant influence on CI but the most important factors were the temperature and length of storage. At lower temperature, higher CI, as well as, the longer the storage time, the higher the CI (Figure 1). 'Ataulfo' and 'Kent' were the most susceptible varieties to CI since they showed slight damage at the end of the first week of storage, especially at 45.5 °F, and the damage increased to slight and moderate damage at the end of the second and third week of shipping simulation. In contrast, 'Keitt' showed only slight symptoms at the end of one week of shipping simulation. In addition, 'Tommy Atkins' was the most tolerant variety to CI since at 45.5 °F showed only traces of damage.

At the end of the second week of shipping simulation, the most evident CI symptoms at 45.5 °F were present in 'Ataulfo' and 'Kent' with moderate values, while they were slight for 'Keitt' and only traces for 'Tommy Atkins'.

In relation to the CI observed at the end of the third week of shipping simulation, again it was observed that the lowest temperature (45.5 °F) caused severe damage in 'Ataulfo' and 'Kent' fruit whereas 'Keitt' and 'Tommy Atkins' showed only slight to moderate damage. The storage temperature of 50.0 °F showed moderate to severe CI only in fruit of the 'Kent' variety.

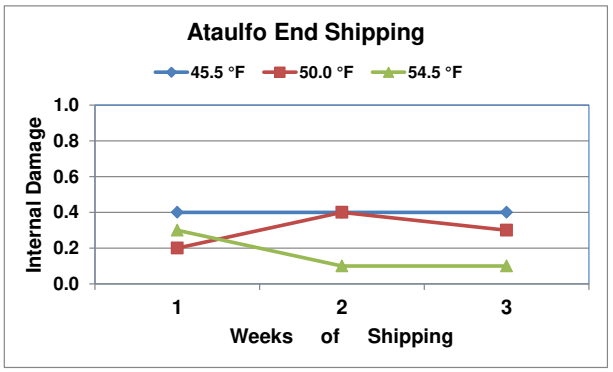


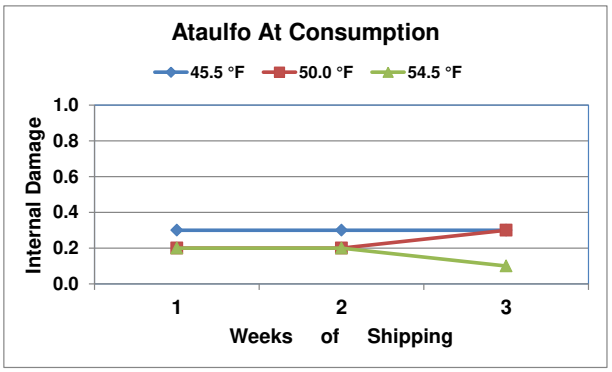
Scale values: 1 = Severe 2 = Moderate 3 = Slight 4 = Traces 5 = No Damage

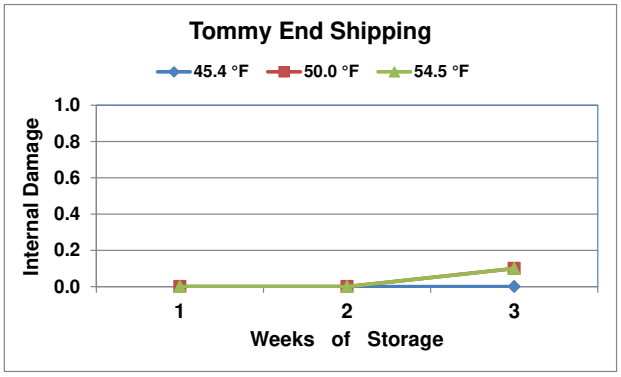
Figure 1. Effect of Temperature and Storage time on the External Damage of mango fruit from Ataulfo, Tommy Atkins, Kent, and Keitt varieties at the end of shipping simulation or ready to eat stage.

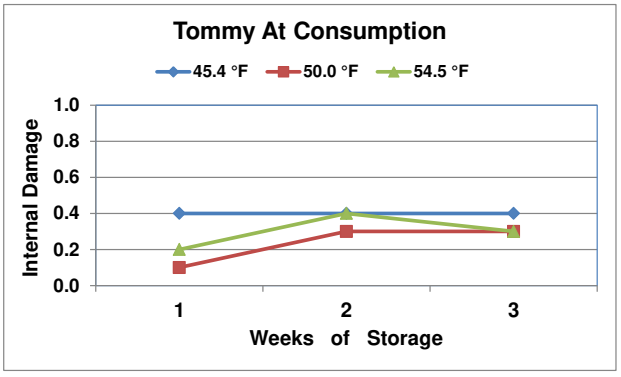
In contrast, the external chilling injury (Figure 2), was practically unobserved being statistically equal for ripening degree, storage temperature, or time temperature. At the end of three weeks of shipping simulation at 45.5 °F only slight damage was observed in fruit of 'Keitt' variety. In general, as will be observed ahead, the internal damage was displayed as a decrease in the intensity of the pulp color in all varieties and factors under study.

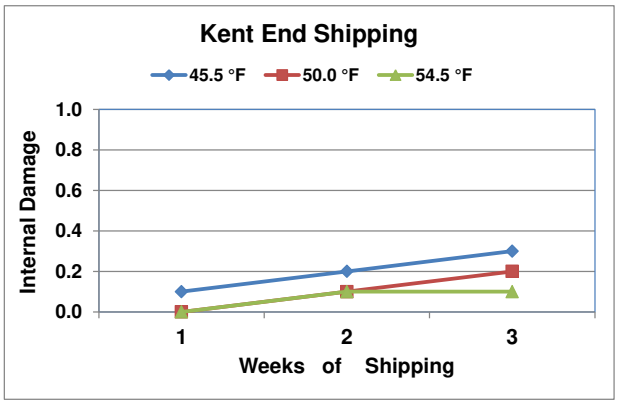
The pulp firmnes (Figure 3) showed a similar trend for the four varieties. No significant differences were detected among varieties at the end of shipping simulation. However, at the end of the second week of shipping simulation the recommended temperature (50.0 °F) was unable to maintain the pulp firmness in 'Ataulfo' and 'Tommy Atkins' but it kept pulp firmness for 'Kent' and 'Keitt'. After three weeks of shipping simulation the effect of the coldest temperature was more evident. The lower the temperature, the higher the pulp firmness. However, it was observed that temperatures of 45.5 and 50.0 °F caused external damage to mango fruit. In addition, it is important to menction that the longer the storage time, the lower the pulp firmness. Moreover, it was observed that depending on the length of storage time the ready to eat stage (1 to 3 pouns) was reached at different times. After one week of shipping simulation, the fruit needed 12 to reach the ready to eat stage; after two weeks, they needed nine days; and after three weeks, they only required seven days at market simulation (71.6±3 °F; 75±10 % RH) to reach the consumption stage.

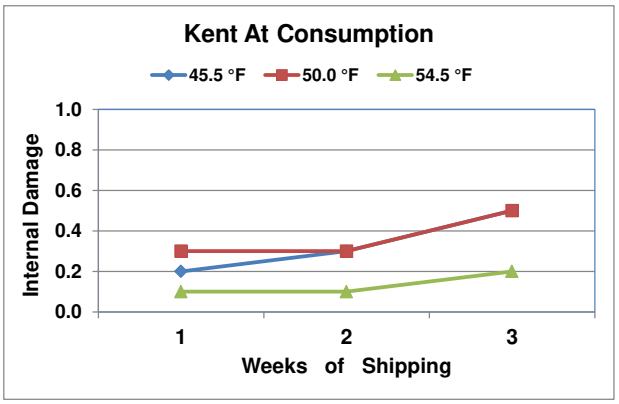


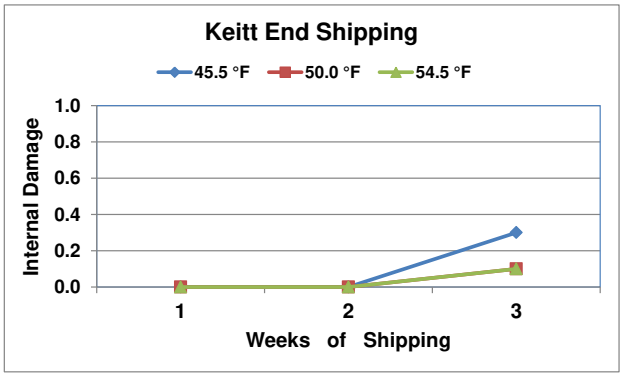


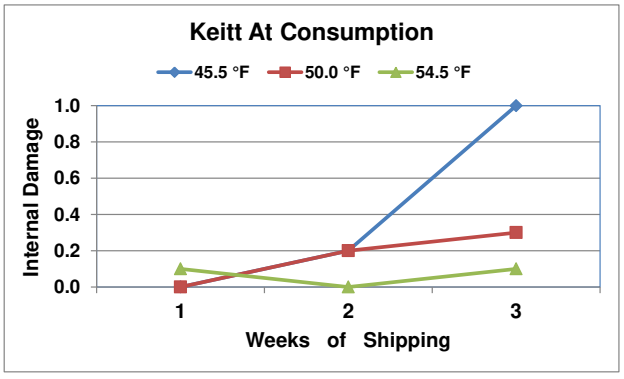






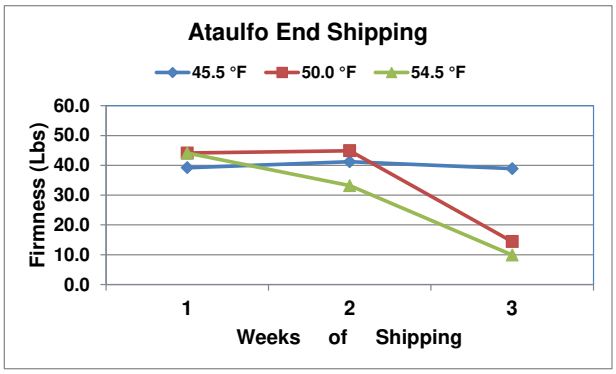


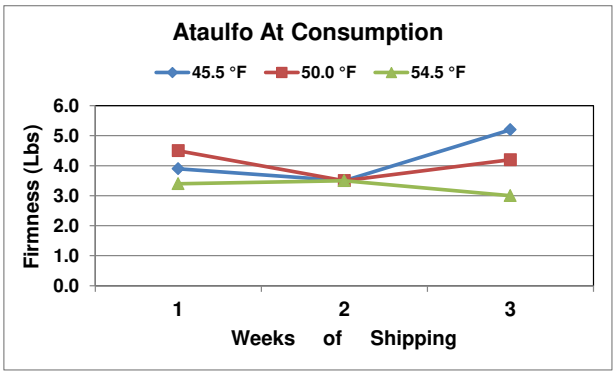


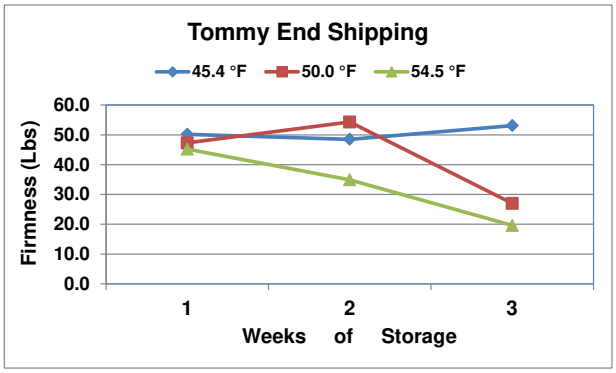


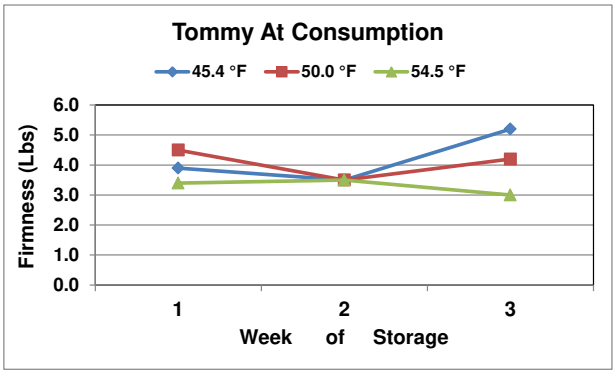
Scale values: 0 = No Damage 1 = Slight 2 = Moderate 3 = Severe

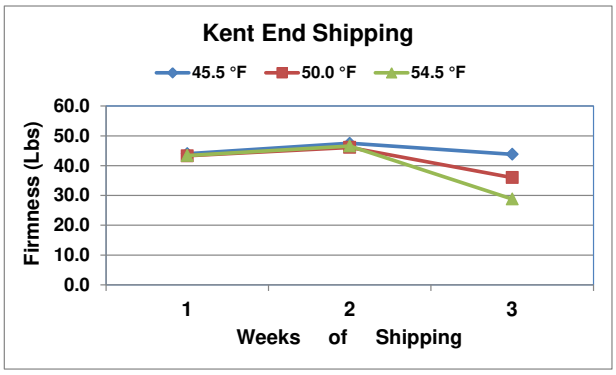
Figure 2. Effect of Temperature and Storage time on the Internal Damage of mango fruit from Ataulfo, Tommy Atkins, Kent, and Keitt varieties at the end of shipping simulation or ready to eat stage.

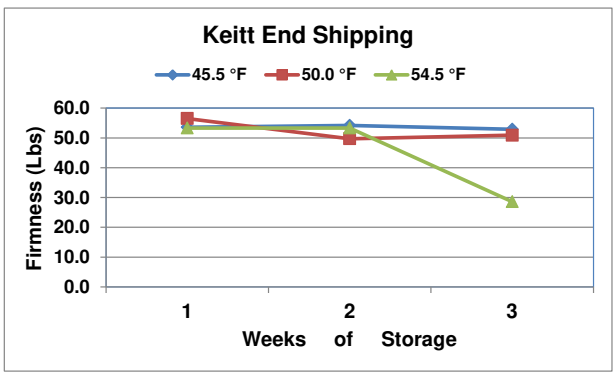












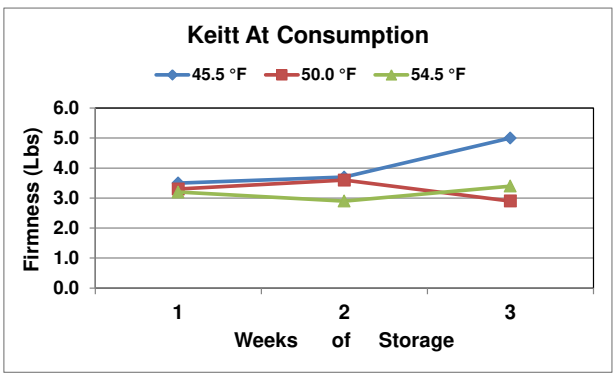


Figure 3. Effect of Temperature and Storage time on Pulp Firmness (Pounds) from mango fruit of Ataulfo, Tommy Atkins, Kent, and Keitt varieties at the end of shipping simulation or ready to eat stage.

With respect to Pulp Color (Figure 4), a similar trend for pulp firmness was observed. The lower the temperature or the longer the storage time, the intensity of pulp color was delayed or inhibited. After one week of shipping simulation only significant differences for storage temperature were detected in fruit of 'Keitt' variety. At the end of two weeks of shipping simulation, all varieties except 'Tommy Atkins' showed significant differences for storage temperature. At the end of three weeks of shipping simulation a similar trend was observed. Only 'Tommy Atkins' did not show any significant difference among the storage temperatures. In general, the development of pulp color was delayed for the lower temperatures. The recommended temperature (54.5 °F) showed the higher intensity of the pulp color, indicating that this temperature did not delay the ripening process in any of the varieties.

For the content of Total Soluble Solids (Figure 5) the differences among storage temperatures was observed since the first week of shipping simulation in all the varieties except 'Ataulfo'. The lower the temperature, the lower the Total Soluble Solid Content (TSS). After two weeks of shipping simulation, the recommended temperature (54.5 °F) showed the highest content of TSS indicating a faster ripening process. After three weeks of shipping simulation, only the storage temperature at 45.5 °F showed a delay in the ripening process, but remember, this temperature caused the greatest CI in fruit of all varieties.

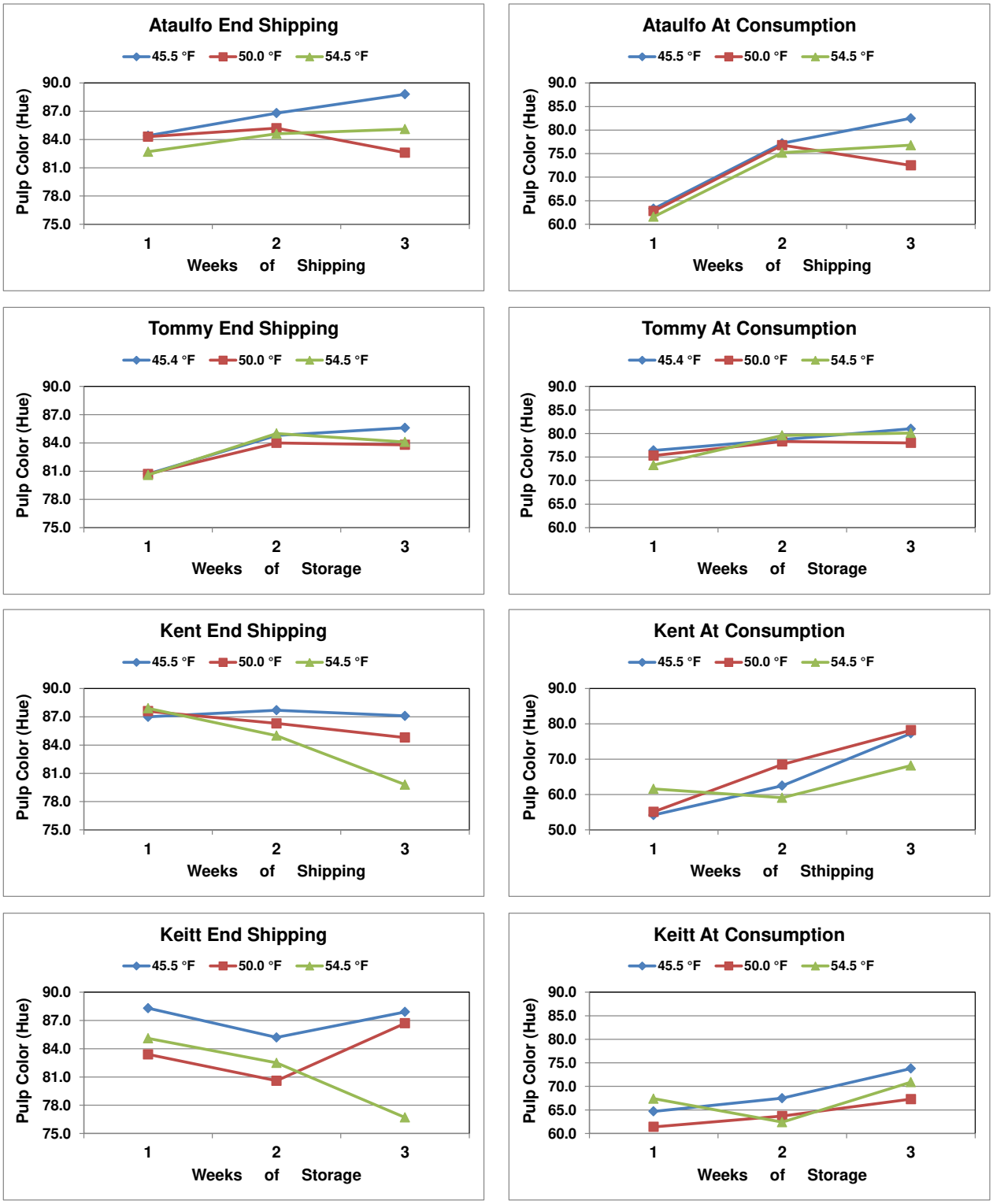


Figure 4. Effect of Temperature and Storage time on Pulp Color (Hue) of mango fruit from Ataulfo, Tommy Atkins, Kent, and Keitt varieties at the end of shipping simulation or ready to eat stage.

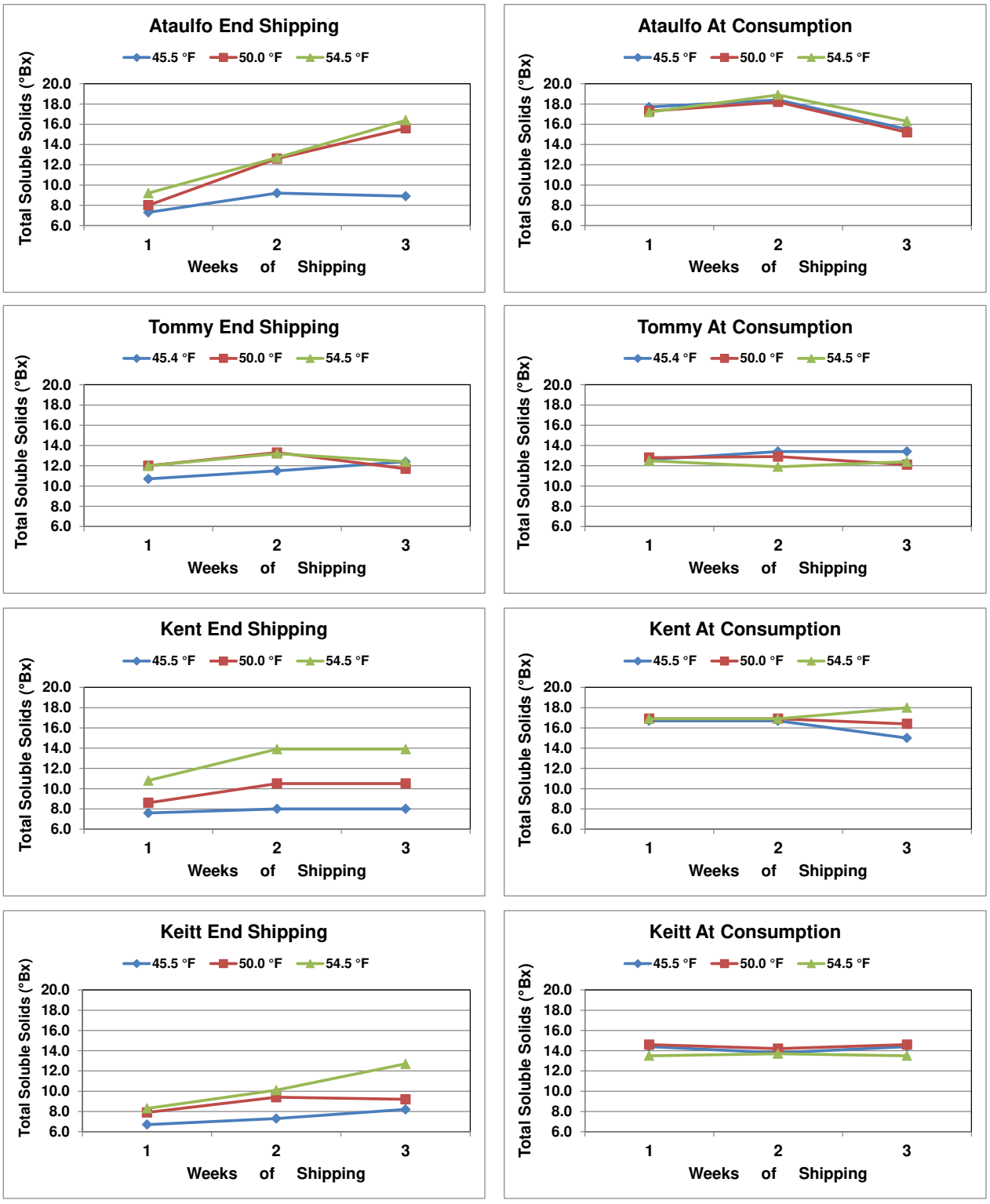


Figure 5. Effect of Temperature and Storage time on content of Total Soluble Solids (°Bx) of mango fruit from Ataulfo, Tommy Atkins, Kent, and Keitt varieties at the end of shipping simulation or ready to eat stage.

CONCLUSIONS

- Significant differences for CI were found among varieties. ‘Ataulfo’ and ‘Kent’ were more susceptible than ‘Tommy Atkins’ and ‘Keitt’. External damage was higher than internal damage.

- The most important factors were storage temperature and storage time. The lower the temperature, the higher the damage; as well as, the longer the storage time, the higher the damage.

- ‘Ataulfo’ and ‘Kent’ showed external injury as soon as one week storage at 45.5 and 50.0 °F while ‘Tommy Atkins’ and ‘Keitt’ showed moderate to severe damage only at 45.5 °F, even after three weeks of shipment simulation.

- The internal CI damage was very low and it was reflected mainly on the pulp color. The lower the temperature, the lower the pulp color intensity; as well as, the longer the storage time, the lower the pulp color intensity.

- A very clear effect of temperature and storage time was also observed for firmness in all varieties. The lower the temperature, the higher the pulp firmness; whereas, the longer the storage time, the lower the pulp firmness.

- Thus, for practical purposes, ‘Ataulfo’ and ‘Kent’ should be shipped only at 54.5 °F while ‘Tommy Atkins’ and ‘Keitt’ can tolerate up 50.0 °F. None of the varieties must be shipped at 45.5 °F.

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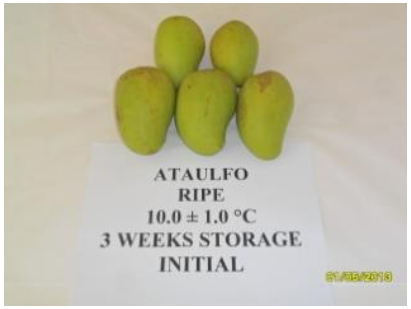
PHOTO GALLERY

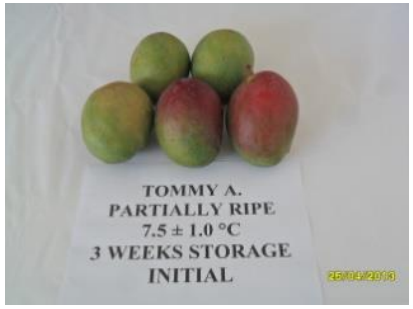
ATAULFO (45.5 °F)

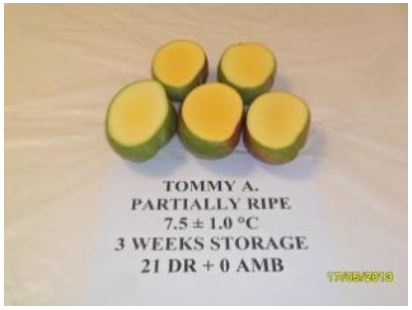
ATAULFO (50.0 °F)

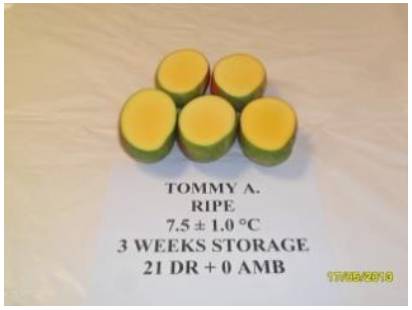


ATAULFO (54.5 °F)

TOMMY ATKINS (45.5 °F)

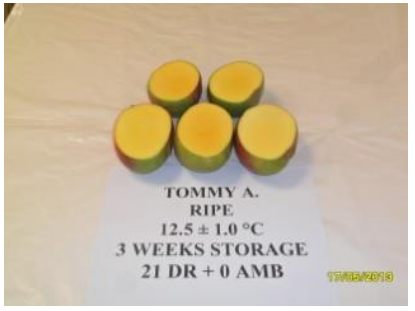






TOMMY ATKINS (50.0 °F)

TOMMY ATKINS (54.5 °F)



KENT (45.5 °F)


KENT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB

KENT (50.0 °F)


KENT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB

KENT (54.5 °F)


KENT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KENT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KENT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB


KENT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 5 AMB

KEITT (45.5 °F)


KEITT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB

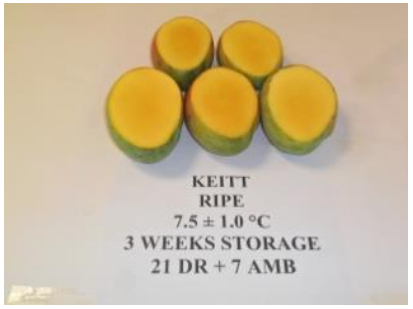

KEITT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
PARTIALLY RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
RIPE
7.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB

KEITT (50.0 °F)


KEITT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
KEITT


KEITT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
INITIAL

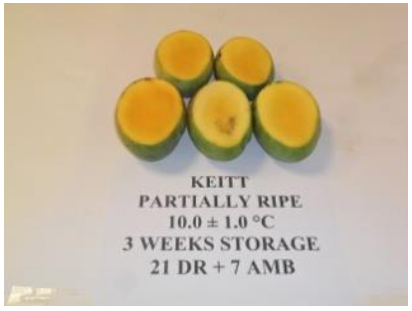

KEITT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
PARTIALLY RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
RIPE
10.0 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB

KEITT (54.5 °F)


KEITT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL


KEITT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
INITIAL

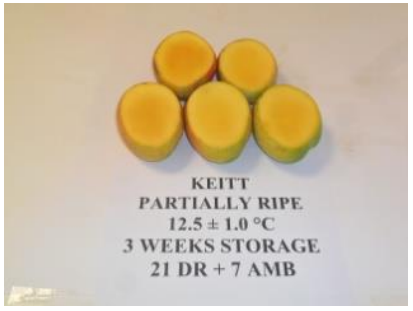

KEITT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 0 AMB


KEITT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
PARTIALLY RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB


KEITT
RIPE
12.5 ± 1.0 °C
3 WEEKS STORAGE
21 DR + 7 AMB