Adoption of Plastic Field Crates to Reduce Mechanical Injuries in Postharvest Handling of Haitian Mango

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Consumers are generally motivated by the appearance of a product, and the final objective of any producer is to satisfy the consumer. In Haiti, since the 1980s, new technologies have been introduced by mango packers to meet the requirements of the export market. However, growers are still using traditional methods to produce, harvest, and handle fruit. As a consequence, the rejection rate is dramatically high. In fact, the common traditional method is to load and transport fruits from the field to a field collection center by animal, where a truck picks them up for transport to the packing facility. Mangos are transported to the collection center in a handcrafted woven bag that does not permit air circulation and results in fruit damage from mechanical injuries and heat produced by accelerated respiration rate. The USAID–WINNER Project supported this research project, and one outcome was to provide 1,500 crates to Haitian grower associations. This research aimed to compare losses for mangos carried in plastic field crates or traditional woven bags from the field to the collection center. The results showed that the crates reduced losses due to mechanical injuries from 8.25% to 3.10%, over a distance varying from 2 to 4 km.

Mango (Mangifera indica) is a very perishable fruit originating from Southeast Asia. Many factors can cause losses in mango from the harvest step until the final consumer. Packaging and transport conditions are two major factors that challenge postharvest scientists. Around the world, many research projects are aimed at improving postharvest materials and methods used in order to reduce losses to an acceptable level, even though it is very difficult to estimate loss because it is a culture-dependent decision (NAS, 1978). Haiti mango production in 2010 was estimated at 218,400 tons of all varieties (FAO, 2010). The most important variety, ‘Madame Francique’, accounted for more than 40,000 tons; of this amount only 20,000 tons reached the packinghouses, which exported 10,000 tons yearly (ANEM, 2011). In Haiti, mangos are generally grown on small farms where access to roads can be difficult. The fruit harvested in the field is typically transported by donkeys or mules to a collection center where vehicles have access to transport the packinghouse. Commonly, the fruits are loaded into a two-sided woven bag, plus a sack of fruits on the top of each side. This method causes losses due to fresh mechanical injuries, such as bruising, cuts, and punctures. In Haiti, the total rejection for mangos is estimated at 55% from the field to the packinghouses, but divided into different segments; it has been reported at 15% at the collection centers (Medlicott, 2001).

The USAID–WINNER Project worked with growers in the Cul de Sac and Mirebalais regions of the country. It is aimed at improving the life conditions of the growers by providing new techniques, methods, and materials of production. In the mango sector, the project trained people in grafting and helped in re-inforcement of growers’ associations. Last year, the WINNER Project provided 1,500 plastic crates and several mobile collection centers or packing sheds to different associations involved in mango for the improvement of the handling and transport conditions, to name a few.

This research study introduced plastic field crates in this segment (field-collection center) and compared the results to that usually found by using the traditional woven bags.

MATERIALS AND METHODS

This research was conducted in the region of Matheux (Cabaret) of Haiti. This region is located about 40 km to the north of Port-au-Prince, capital of the country.

BIOLoGICAL MATERIALS. ‘Madame Francique’ mangoes were used (Fig. 1A–B). ‘Madame Francique’ mango was discovered in Haiti, and is grown throughout the country.

TRANSPORT. In Haiti donkey and mule are the two most popular animals used in the rural transport system (Fig. 2A–B). In some regions the donkey is more popular; in others, the mule is more popular. In Cabaret, the mule is the dominant animal. Since it was very difficult to find a donkey in this region, a mule was used for transport.

PHYSICAL MATERIALS. The physical materials were:

The traditional handcrafted woven bag used in Haiti is made of palm strips, and is a regular container in the animal transport system (Fig. 3A–B). It can transport 60 to 90 fruits per bag, depending on fruit size.

The plastic field crates that this research project aims to introduce in the segment from field to collection center (Fig. 4). Each crate can transport 13 to 15 kg, but in terms of mangos, it works well with 50 to 80 fruits per crate, depending on fruit size.

The pack frame was constructed of reinforced steel bar designed by the Department of Agricultural and Biological-Engineering (ABE) of the University of Florida under the guidance of Dr. Arthur Teixeira (Fig. 5). This pack frame was designed to hold...
up to five plastic crates.

Methods. The methods were as follows:

Upon arrival in Haiti, a field assistant was recruited. He identified the sites of harvest, planned for rental animal, helped in the identification of the collection center and in the purchase of supplies.

After arrival in the Cabaret region, we selected a field-collection center that was located beside a road. At this center, fruit were received from many locations and vehicles could arrive there to load and transport the mangos to a packinghouse or any other destination. In this study we considered three harvesting sites located, respectively, at 2, 3, and 4 km from the collection center.
We moved to the field with our materials, selected growers, and started to harvest. After harvest, fruit were sorted in the field based on the following criteria: maturity, size, physical damage, shape, ripening, etc. We were looking for samples of wholesome, marketable fruit.

After sorting, the fruit was divided into samples of 210 fruits each, which is the equivalent of 15 dozens; the dozen is the unit of measurement of mango in Haiti. This amount varies from 13 to 20, depending on the location. At the collection center the dozen is generally 14 fruits, but in the field it is higher as the field is located far from a road, up to 20. For this study, we defined an amount of 14 fruit that may be considered as a dozen.

We were requested to use the value of 15 dozens, because we wanted to take into account the cost/benefit of the rental animal and test also the capacity of the pack frame to load five crates. We used the same animal to transport 210 mangos from the same site to the collection center, both in the traditional woven bag and in the plastic field crates loaded into the pack frame. The animal followed a pathway of a known distance (2, 3, and 4 km). Then, the fruit was unloaded at the collection center where each batch made a lot (n = 210 fruit).

Upon arrival at the collection center the test fruit were sorted. At this point the field assistant was very useful, because he used to work as an inspector for one of the local packinghouses. So, he had very good skills in terms of causes of rejection of fruits at the collection center. See Fig. 6A–C for some fruits rejected at the collection center.

**Results**

For the purpose of this research, the most attention was paid to the fruits rejected due to mechanical injuries. We recorded our preliminary results at the collection center. Rejection rate varied from 16% to 20% for woven bags, and from 11% to 15% for crates, with the lower percentage for the shorter distance (Fig. 7). Bruising was the major mechanical injury problem identified with the mango. With woven bags, total loss rates varied from 16% to 20%, with 6% to 10% due to mechanical injuries (Table 1). Total loss rates varied from 11% to 15%, with 3% to 5% due to mechanical injuries when the crates were used (Table 2).

**Discussion**

These preliminary results showed a percentage of loss at the collection center that varied from 16% to 20%, with 6% to 10% due to mechanical injuries when the fruits were transported in a handcrafted woven bag. These values were lower, 11% to 15% loss and 3% to 5% due to mechanical injuries when fruits were transported in plastic field crates. These results are similar in some cases to the results found by Medlicott in 2001, and they are
slightly different in some other cases. Furthermore, we observed certain differences that may be due to the distance. In fact, for fruit transported in woven bags, the percentage of loss at the collection center was 16% for a distance of 2 km; 18% when the distance was 3 km, and 20% for the distance of 4 km. In the case of the plastic field crates the rates of losses were 11%, 13%, and 15%, respectively, for 2, 3, and 4 km.

Conclusion

Based on the preliminary results, it seems that the adoption of plastic field crates could bring some reduction of loss in the segment from field to collection center. However, the investment in a pack frame could be a true challenge for individual growers, which would make the innovation unsustainable. Therefore, we would advise the grower organizations to purchase the crates and pack frames that they could loan to the individual growers when they will need them for specific needs. USAID–UF WINNER Project has funds for working with growers living in its regions of intervention, i.e., Matheux included Cabaret and Mirebalais regions. With a good coordination of its interventions, significant improvement may be observed in the living conditions of the growers, particularly the mango growers, who may learn how to produce mango in the best conditions. Finally, additional data collection is still necessary to confirm or reject this tendency.

Literature Cited


