In accordance with the APHIS regulations 7 CFR §319.56, importation of mangoes, Mangifera indica L., into the United States are allowed subject to satisfying specific entry requirements. Preceding shipment to the United States, mangoes from Mexico, certain Caribbean islands, and countries in South and Central America must be treated with an appropriate Probit 9-based T102-a hot-water immersion treatment to mitigate the infestations of several species of fruit flies. The T102-a quarantine treatment (http://manuals.cphst.usda.gov/Tindex/index.cfm) requires immersion of mangoes in hot-water bath with constant temperature of 46.1°C for a specified duration (minutes). Based solely on fruit weight, the T102-a has four published treatment schedules, which were proposed in late 2014 and are presently amended and harmonizing the T102-a treatment schedules, countries in South America had no USDA-approved hot-water immersion treatment for “oversized” fruits (>650 grams); furthermore, the duration of treatment was dependent on the variety or shape of the fruit. The previously published T102-a quarantine treatment had 14 treatment schedules based on three variables: fruit weight, fruit variety or shape (“round,” “flat,” or elongated), and origin (country) of the fruit. Amendment and harmonization of T102-a from 14 to four treatment schedules were accomplished by removing restriction based on country of origin, eliminating restriction based on the variety or shape of the fruit, and harmonizing the treatment duration based on the weight of the fruit. The scientific evidence used in amending and harmonizing the T102-a treatment schedules are efficacy and validation data of T102-a hot-water immersion treatment to the following fruit flies in mangoes: Inga fruit fly, Anastrepha ludens (Loew); West Indian fruit fly, Anastrepha obliqua (Macquart); sapote fruit fly, Anastrepha serpentina (Wiedemann); and Mediterranean fruit fly, Ceratitis capitata (Wiedemann).

### Study 1. Fruit Fly Life History Parameters

To review and summarize the supporting information and justification for the currently amended hot-water immersion treatment T102-a (http://www.aphis.usda.gov/import_export/plants/manuals/parts/downloa ds/treatment.pdf/). The amendment to the treatment schedule was necessary to allow importation into the United States of mangoes, Mangifera indica L., weighing more than 650g (also known as “oversized”) mangoes from countries that had prohibition and to remove shape and country restrictions associated with the treatment.

### Background

In accordance with the APHIS regulations 7 CFR §319.56, importation of mangoes from different countries are currently allowed subject to satisfying specific entry requirements. Mangoes from Mexico, certain Caribbean islands, and countries in South and Central America must be treated with an appropriate T102-a hot-water immersion treatment schedule, prior to importation into the United States, to mitigate infestations of several species of fruit flies. The T102-a hot-water immersion treatment has approved schedules for Ceratitis capitata (Mediterranean fruit fly) and Anastrepha spp., including Anastrepha ludens (Mexican fruit fly) for mango. Prior to the current amendment, the maximum allowable size (weight) of rounded mango varieties that can be treated with hot-water immersion and imported into the United States from Panama, countries in South America and the West Indies islands of Aruba, Bonaire, Curacao, Margarita, Tortuga, and Trinidad and Tobago was 650 grams (Figure 1). However, T102-a had treatment schedules allowing importation of rounded mango varieties weighing up to 900g from Mexico, Central America (north of and including Costa Rica), Puerto Rico, the U.S. Virgin Islands, and the West Indies excluding islands of Aruba, Bonaire, Curacao, Margarita, Tortuga, and Trinidad and Tobago.

### Efficacy Data Supporting Amendment of T102-a Quarantine Treatment

**Study 2: Heat Tolerance of Developmental Stages by Diagnostic Bioassay Method**

Study 2 determined the most heat tolerant species and stage of development among A. distincta, A. fraterculus, A. obliqua, A. serpentina, and C. capitata by immersing 800 ± 25 g, fruit-fly infested ‘Kent’ mangoes in 46.1°C hot-water bath for 60-, 75- and 90-minute durations. Eggs, first-instar larvae of A. distincta, A. fraterculus, A. obliqua, A. serpentina and C. capitata had 100% mortality after fruit immersion in 46.1°C hot-water bath for 75 and 90 minutes. Based on these results, third-instar larvae of C. capitata appear to be the most heat tolerant and that the efficacy of the hot-water immersion quarantine treatment should be validated using third-instar larvae of C. capitata (Figure 4).

**Study 3: Hot-water Immersion Quarantine Treatment Validation Test**

A total of 112,178 third-instar larvae of C. capitata infesting ‘Kent’ mangoes were subjected to 110-minute immersion in 46.1°C hot-water bath; all (100%) third-instar larvae in treated fruits died (Figure 5).

**Study 4: Quality of Hot-Water Immersion Annealed Fruit**

Quality evaluation tests showed no difference in quality of treated and control fruits following hot-water immersion.

### Conclusion and Regulatory Decision

The APHIS-PPQ-Center for Plant Health Science and Technology (CPHST) reviewed the research findings and agreed with the above conclusions. Therefore, CPHST recommended revising the hot-water immersion treatment T102-a by adding a fruit immersion duration of 110 minutes for all mango varieties weighing 651-900 grams and originating in any country where T102-a is currently required (Table 2). CPHST also recommended removing shape and country associations with the treatment and maintaining the option to delay hydro-cooling (up to 30 minutes following completion of the treatment duration or add 10 minutes to the treatment duration to allow hydro-cooling: The amendment allows importation of all varieties of mangoes weighing 651-900 grams from countries currently approved for entry into the U.S.

### Table 2. T102-a Treatment schedules for fruit flies in mangoes

<table>
<thead>
<tr>
<th>If the weight is (grams):</th>
<th>Then the dip time (minutes) is:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 375</td>
<td>65</td>
</tr>
<tr>
<td>376 to 500</td>
<td>75</td>
</tr>
<tr>
<td>501-700</td>
<td>90</td>
</tr>
<tr>
<td>701 to 900</td>
<td>110</td>
</tr>
</tbody>
</table>