



United States Department of Agriculture
Animal and Plant Health Inspection Service
Plant Protection and Quarantine



Risk Management Document

Movement of the Fresh Fruit of *Garcinia mangostana* L. (mangosteen), Species of *Hylocereus*, *Selenicereus* (Dragonfruit), *Cucumis melo* L. (Melon), *Vigna* *unquiculata* (L.) Walp, (Cowpea and its relatives), *Artocarpus altilis* (Breadfruit), *Artocarpus heterophyllus* (Jackfruit), and *Moringa oleifera* Pods, from Hawaii into the Continental United States

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**Plant Health Programs (PHP)
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I. Executive Summary:

Responding to a request to allow movement of certain commodities from Hawaii into the continental United States, the Center for Plant Health Science and Technology (CPHST) of the United States Department of Agriculture's Animal Plant Health Inspection Service (APHIS) prepared pest risk assessments for mangosteen (*Garcinia mangostana*), dragonfruit (species of *Hylocereus*, *Selenicereus*), melon (*Cucumis melo* L.), cowpeas and their relatives, breadfruit (*Artocarpus altilis*), jackfruit (*Artocarpus heterophyllus*) and Moringa (*Moringa oleifera*) pods. These commodities have not been allowed movement from Hawaii before, so a detailed information on pests associated with these commodities was gathered and analysed. The information was based on (1) search of both print and electronic sources of scientific publications and (2) pest interception records of the United States Department of Agriculture (PIN309, 2005). Subsequent discussions with APHIS staff have revealed that shippers and producers in Hawaii would like to treat each fruit with an APHIS approved irradiation treatment that would mitigate the pathway risks from susceptible insect pests.

Analysis of the pest risks from each commodity indicated that all but one pest likely to follow the pathway are insect pests. While all insect pests could be effectively neutralized¹ with the irradiation generic dose of 400 Gy (USDA 2006g), treatment with a 150 Gy will only be effective against certain pests e.g., the fruit flies, leaving a number of other insects that would require additional measures to prevent their introduction into the United States. Additionally, one pathogen, *Phytophthora tropicalis*, which is likely to follow the breadfruit or jackfruit pathway, will not be effectively neutralized by either dose of irradiation and would require additional measures to prevent its introduction into the United States.

A commodity by commodity analysis of the associated pest risks and mitigations are further discussed. However, since the pest risk assessments only evaluated the movement of commodities from Hawaii to the continental United States, this document only addresses the risks associated with the commodities moving into the continental United States and not the U.S. territories.

¹ A pest is considered neutralized when it is killed, rendered sterile or its further development into an adult is stopped.

II. Mangosteen (*Garcinia mangostana*)

A. Introduction

The Animal & Plant Health Inspection Service (APHIS), Center for Plant Health Science & Technology (CPHST) prepared a pathway-initiated pest risk assessment (PRA) in which CPHST examined the risks associated with the movement of fresh fruit of mangosteen (*Garcinia mangostana*) from Hawaii into the continental United States. The PRA identified six quarantine significant pests which could potentially follow the pathway (USDA 2006a).

The quarantine significant pests that are likely to follow the pathway are as follows:

- Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae)
- Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)
- Dysmicoccus neobrevipes* (Beardsley) (Hemiptera/Homoptera: Pseudococcidae)
- Maconellicoccus hirsutus* (Green) (Hemiptera/Homoptera: Pseudococcidae)
- Pseudococcus cryptus* (Green) (Hemiptera/Homoptera: Pseudococcidae)
- Thrips florum Schmutz* (Thysanoptera: Thripidae)

Bactrocera dorsalis and *Ceratitis capitata* are rated as high risks, and the remaining four are rated as medium.

The proposed movement of mangosteen fruit from Hawaii into the continental United States would be regulated by an amendment to the existing fruits and vegetables regulations in Title 7, *Code of Federal Regulations* (7 CFR), 318.13, if approved. This document outlines the phytosanitary measures that APHIS will require if the proposed movement of mangosteen from Hawaii into the continental United States is approved and documents the evidence used by APHIS to conclude that these measures will effectively prevent the introduction of quarantine pests to the continental United States.

B. Proposed Risk Mitigation Measures for Mangosteen

We propose that mangosteen fruit from Hawaii may be moved into the continental United States only under the following conditions:

- (a) Only commercial shipments of mangosteen are allowed from Hawaii;
- (b) Mangosteen must be treated with irradiation in accordance with 7 CFR305.34 and 318.13-4(f) in an APHIS approved facility either in Hawaii or on the mainland United States;
- (c) The treatment is monitored by an APHIS inspector to ensure that the fruit received a minimum absorbed dose of either 400 Gy (Option 1) or 150 Gy (Option 2). The fruit receiving 150 Gy as the minimum dose (Option 2) must either receive a post-harvest dip with T102-c (warm soapy water and brushing) or originate from an orchard that was previously treated with a broad spectrum insecticide during the

growing season and a pre-harvest inspection of the orchard found the fruit free of any surface pests;

- (d) If fruit is to be treated using a 150 Gy minimum absorbed dose, the fruit after harvest must be inspected in Hawaii by an APHIS inspector for pests and found free of *Dysmicoccus neobrevipes*, *Maconellicoccus hirsutus*, *Pseudococcus cryptus*, and *Thrips florum Schmutz*. Sepals, if present on the sampled fruit, must be removed during the pre-departure inspection targeted for treatment with the 150 Gy minimum absorbed dose;
- (e) The fruit is packaged, labeled, and safeguarded from reinfestation by pests as per requirements of 7 CFR 305.34(b)(4) and 318.13-4f(b)(4);
- (f) Each shipment containing fruit treated in Hawaii must be accompanied by a certificate of irradiation treatment. Shipments containing fruit not treated in Hawaii and to be treated on the mainland United States may instead be issued a limited permit by an officer or official authorized by APHIS. If the fruit is to be treated on the mainland, a 400 Gy minimum absorbed dose must be used; and
- (g) Fruit is to be free from leaves and stems.

Fruits moved into the continental United States would also be subject to inspection at the port of entry, as provided in section 318.13-3, should inspectors determine that such inspection is necessary.

C. Historical Performance of Irradiated Fruit Moved Interstate

Current regulations in 7 CFR 305.34 allow the use of irradiation to treat fruit for interstate movement within the United States. Regulations in 7 CFR 318.13-4f allow interstate movement of fifteen different fruits (mangosteens are not one of them) and vegetables from Hawaii using a minimum absorbed dose of 150 Gy to 400 Gy. Among the pests associated with many fruits from Hawaii, four fruit flies, *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (oriental fruit fly), *B. cucurbitae* (melon fruit fly), and *B. latifrons* (Malasian fruit fly) are the primary pests of concern for which fruit is irradiated. Other pests for which fruits and vegetables from Hawaii are irradiated using a dose of 150 Gy or 400 Gy include West Indian sweetpotato weevil (*Euscepes postfasciatus*), sweetpotato vine borer (*Omphisa anastomosalis*), green scale (*Coccus viridis*), and the banana moth (*Opogona sacchari*). The 150 Gy is considered adequate to mitigate risk from all these fruit flies and certain other pests e.g., the sweetpotato vine borer and the two sweetpotato weevils and the 400 Gy is considered adequate to mitigate risk from all insect pests excluding adults and pupae of the order Lepidoptera (USDA 2006g). Fruits and vegetables treated with irradiation in Hawaii and moved to other parts of the United States (the mainland) have had no pests of quarantine significance intercepted (Uyeda 2005). On very rare occasions when wigglers were detected in irradiated shipments, they were always found to be moribund and never resulted in further development or completing life cycles (Uyeda 2005).

D. Evidence for the Effective Removal of Pests of Concern from the Pathway

The following paragraph summarizes key mitigation measures for mangosteen fruit from Hawaii and provides a general discussion of their efficacy. The evidence APHIS uses to determine that the measures described above in Section **B** effectively remove pests of concern from the pathway are also discussed. The FAO (2006) defines “pathway” as “Any means that allows the entry or spread of a pest.”

(i) Insect Pests

The six pests likely to follow the pathway are all insect pests, and none of these belong to the order Lepidoptera. In accordance with the regulations in 7 CFR 305.31, a minimum absorbed dose of 150 Gy will neutralize all fruit flies, and a minimum absorbed dose of 400 Gy has been determined by APHIS to be adequate to neutralize all insect pests, excluding adults and pupae of the order Lepidoptera (USDA 2006g). Therefore, the generic irradiation treatment of 400 Gy is a valid treatment for these six pests (considering that none of these belong to the order Lepidoptera), whereas, an application of 150 Gy will mitigate risks from fruit flies only and additional measures would be needed for the remaining four pests. Since these remaining pests are external in nature, macroscopic in size and visible to the naked eye, visual inspection of the fruit prior to shipment from Hawaii is considered adequate to mitigate risks from these pests. Likewise, the treatment T102-c is an APHIS approved treatment and determined adequate to mitigate risk from external pests. In Hawaii, it is a common practice to treat the orchard during the growing season with a broad spectrum insecticide to control ants and surface pests that are of concern to the destination States in the United States. Application of a broad spectrum insecticide in the field along with pre-harvest inspection of fruit is therefore an effective substitute for the T102-c treatment.

There is no record of importation or movement interstate of irradiated mangosteen from Hawaii or other areas. Therefore, there is no record of interception of any quarantine pests from irradiated mangosteen.

III. Dragonfruit (species of *Hylocereus*, *Selenicereus*)

A. Introduction

In response to a request from Hawaii, the Animal & Plant Health Inspection Service (APHIS), Center for Plant Health Science & Technology (CPHST) prepared a pathway-initiated pest risk assessment (PRA) in which CPHST examined the risks associated with the movement of fresh fruit of dragonfruit (species of *Hylocereus*, *Selenicereus*) from Hawaii into the continental United States and identified five quarantine significant pests which could potentially follow the pathway (USDA 2006b).

The quarantine significant pests that are likely to follow the pathway are as follows:

- Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae)
- Ceratitis capitata* (Wiedemann) (Diptera: Tephritidae)
- Dysmicoccus neobrevipes* (Beardsley) (Hemiptera/Homoptera: Pseudococcidae)
- Maconellicoccus hirsutus* (Green) (Hemiptera/Homoptera: Pseudococcidae)
- Pseudococcus cryptus* (Green) (Hemiptera/Homoptera: Pseudococcidae)

Bactrocera dorsalis and *Ceratitis capitata* are rated as high risks, and the remaining four are rated as medium.

The proposed movement of dragonfruit from Hawaii into the continental United States would be regulated by an amendment to the existing fruits and vegetables regulations in Title 7, *Code of Federal Regulations* (7 CFR), 7 CFR 318.13, if approved. This document outlines the phytosanitary measures that APHIS will require if the proposed movement of dragonfruit from Hawaii into the continental United States is approved and documents the evidence used by APHIS to conclude that these measures will effectively prevent the introduction of quarantine pests to the continental United States.

B. Proposed Risk Mitigation Measures for Dragonfruit

We propose that dragonfruit from Hawaii may be moved into the continental United States only under the following conditions:

- (a) Only commercial shipments of dragonfruit are allowed from Hawaii;
- (b) Dragonfruit must be treated with irradiation in accordance with 7 CFR 305.34 and 318.13-4(f) in an APHIS approved facility either in Hawaii or on the mainland United States;
- (c) The treatment is monitored by an APHIS inspector to ensure that the fruit received a minimum absorbed dose of 400 Gy (Option 1) or 150 Gy (Option 2). The fruit receiving 150 Gy as the minimum dose (Option 2) must either receive a post-harvest dip with T102-c (warm soapy water and brushing) or originate from an orchard that was previously treated with a broad spectrum insecticide during the growing season and a pre-harvest inspection of the orchard found the fruit free of any surface pests;

- (d) If the fruit is to be treated using a 150 Gy minimum absorbed dose, the fruit after harvest must be inspected in Hawaii by an APHIS inspector for pests and found free of *Dysmicoccus neobrevipes*, *Maconellicoccus hirsutus*, and *Pseudococcus cryptus*. Sepals, if present on the sampled fruit, must be removed during the pre-departure inspection targeted for treatment with the 150 Gy minimum absorbed dose;
- (e) The fruit is packaged, labeled, and safeguarded from reinfestation by pests as per requirements of 7 CFR 305.34(b)(4) and 318.13-4f(b)(4);
- (f) Each shipment containing fruit treated in Hawaii must be accompanied by a certificate of treatment. Shipments containing fruit not treated in Hawaii and to be treated on the mainland United States may instead be issued a limited permit by an officer or official authorized by APHIS. If the fruit is to be treated on the mainland, a 400 Gy minimum absorbed dose must be used; and
- (g) Fruit is to be free from leaves and stems.

Fruits moved into the continental United States would also be subject to inspection at the port of entry, as provided in section 318.13-3, should inspectors determine that such inspection is necessary.

C. Historical Performance of Irradiated Fruit Moved Interstate

Current regulations in 7 CFR 305.34 allow the use of irradiation to treat fruit for interstate movement within the United States. Regulations in 7 CFR 318.13-4f allow interstate movement of fifteen different fruits and vegetables (dragonfruit are not one of them) from Hawaii using a minimum absorbed dose of 150 Gy to 400 Gy. Among pests associated with many fruits from Hawaii, four fruit flies, *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (oriental fruit fly), *B. cucurbitae* (melon fruit fly), and *B. latifrons* (Malasian fruit fly) are the primary pests of concern for which fruit is irradiated. Other pests for which fruits and vegetables from Hawaii are irradiated using a dose of 150 Gy or 400 Gy include West Indian sweetpotato weevil (*Euscepes postfasciatus*), sweetpotato vine borer (*Omphisa anastomosalis*), green scale (*Coccus viridis*), and the banana moth (*Opogona sacchari*). The 150 Gy is considered adequate to mitigate risk from all these fruit flies and certain other pests e.g., the sweetpotato vine borer and the two sweetpotato weevils and the 400 Gy is considered adequate to mitigate risk from all insect pests excluding adults and pupae of the order Lepidoptera (USDA 2006g). Fruits and vegetables treated with irradiation in Hawaii and moved to other parts of the United States (the mainland) have had no pests of quarantine significance intercepted (Uyeda 2005). On very rare occasions when wigglers were detected in irradiated shipments, they were always found to be moribund and never resulted in further development or completing life cycles (Uyeda 2005).

D. Evidence for the Effective Removal of Pests of Concern from the Pathway

The following paragraph summarizes key mitigation measures for dragonfruit from Hawaii and provides a general discussion of their efficacy. The evidence APHIS uses to determine that the measures described above in Section **B** effectively remove pests of

concern from the pathway are also discussed. The FAO (2006) defines “pathway” as “Any means that allows the entry or spread of a pest.”

(i) Insect Pests

The five pests likely to follow the pathway are all insect pests, and none of these belong to the order Lepidoptera. In accordance with the regulations in 7 CFR 305.31, a minimum absorbed dose of 150 Gy will neutralize all fruit flies, and a minimum absorbed dose of 400 Gy has been determined by APHIS to be adequate to neutralize all insect pests, excluding adults and pupae of the order Lepidoptera (USDA 2006g). Therefore, the generic irradiation treatment of 400 Gy is a valid treatment for these five pests (considering that none of these belong to the order Lepidoptera), whereas, an application of 150 Gy will mitigate risks from fruit flies only and additional measures would be needed for the remaining three pests. Since all these remaining pests are external in nature, macroscopic in size and visible to the naked eye, visual inspection of the fruit prior to shipment from Hawaii is considered adequate to mitigate risks from these pests. Likewise, the treatment T102-c is an APHIS approved treatment and determined adequate to mitigate risk from external pests. In Hawaii, it is a common practice to treat the orchard during the growing season with a broad spectrum insecticide to control ants and surface pests that are of concern to the destination States in the United States. Application of a broad spectrum insecticide in the field along with pre-harvest inspection of fruit is therefore an effective substitute for the T102-c treatment.

There is no record of importation or movement interstate of irradiated dragonfruit from Hawaii or other areas. Therefore, there is no record of interception of any quarantine pests from irradiated dragonfruit.

IV. Melon (*Cucumis melo L.*)

A. Introduction

Based on a request from Hawaii, the Animal & Plant Health Inspection Service (APHIS), Center for Plant Health Science & Technology (CPHST) prepared a pathway-initiated pest risk assessment (PRA) in which CPHST examined the risks associated with the movement of fresh fruit of melon (*Cucumis melo L.*) from Hawaii into the continental United States. The PRA identified four quarantine significant pests which could potentially follow the melon pathway (USDA 2006c).

The quarantine significant pests that are likely to follow the pathway are as follows:

Bactrocera cucurbitae (Hendel) (Diptera: Tephritidae)

Bactrocera dorsalis (Hendel) (Diptera: Tephritidae)

Ceratitis capitata (Wiedemann) (Diptera: Tephritidae)

Aleurodicus dispersus (Russell) (Hemiptera/Homoptera: Aleyrodidae)

Bactrocera cucurbitae, *Bactrocera dorsalis*, and *Ceratitis capitata* are rated as high risks, and *Aleurodicus dispersus* is rated as medium. *Aleurodicus dispersus* is mainly a pest of leaves but could hitchhike on fruit as an external pest in the form of adult, nymph, or eggs.

The proposed movement of melon fruit from Hawaii into the continental United States would be regulated by an amendment to the existing fruits and vegetables regulations in Title 7, *Code of Federal Regulations* (7 CFR), 318.13, if approved. This document outlines the phytosanitary measures that APHIS will require if the proposed movement of melon from Hawaii into the continental United States is approved and documents the evidence used by APHIS to conclude that these measures will effectively prevent the introduction of quarantine pests to other part of the United States.

B. Proposed Risk Mitigation Measures for Melons

We propose that melon fruit from Hawaii may be moved into the continental United States only under the following conditions:

- (a) Only commercial shipments of melon fruit are allowed from Hawaii;
- (b) After harvest, the fruit must be washed to remove soil and inspected in Hawaii by an APHIS inspector and found free of *Aleurodicus dispersus*.
- (c) Melon fruit must be treated with irradiation in accordance with 7 CFR 305.34 and 318.13-4(f) in an APHIS approved facility either in Hawaii or on the mainland United States;
- (d) The treatment is monitored by an APHIS inspector to ensure that the fruit received a minimum absorbed dose of 400 Gy (Option 1) or 150 Gy (Option 2). The fruit receiving 150 Gy as the minimum dose (Option 2) must either receive a post-harvest dip with T102-c (warm soapy water and brushing) or originate from an

orchard that was previously treated with a broad spectrum insecticide during the growing season and a pre-harvest inspection of the growing area found the fruit free of any surface pests;

- (e) If the fruit is to be treated using a 150 Gy minimum absorbed dose, the fruit after harvest must be inspected in Hawaii by an APHIS inspector for pests and found free of *Aleurodicus dispersus* before or after undergoing irradiation treatment in Hawaii;
- (f) The fruit is packaged, labeled, and safeguarded from reinfestation by pests as per requirements of 7 CFR 305.34(b)(4) and 318.13-4f(b)(4);
- (g) Each shipment containing fruit treated in Hawaii must be accompanied by a certificate of treatment. Shipments containing fruit not treated in Hawaii and to be treated on the mainland United States may instead be issued a limited permit by an officer or official authorized by APHIS. If the fruit is to be treated on the mainland, a 400 Gy minimum absorbed dose must be used and certificate of treatment issued; and
- (h) Fruit is to be free from leaves and stems.

Fruits moved into the continental United States would also be subject to inspection at the port of entry, as provided in section 318.13-3, should inspectors determine that such inspection is necessary.

C. Historical Performance of Irradiated Fruit Moved Interstate

Current regulations in 7 CFR 305.34 allow the use of irradiation to treat fruit for interstate movement within the United States. Regulations in 7 CFR 318.13-4f allow interstate movement of fifteen different fruits and vegetables (melon is not one of them) from Hawaii using a minimum absorbed dose of 150 Gy to 400 Gy. Among pests associated with many fruits from Hawaii, four fruit flies, *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (oriental fruit fly), *B. cucurbitae* (melon fruit fly), and *B. latifrons* (Malasian fruit fly) are the primary pests of concern for which fruit is irradiated. Other pests for which fruits and vegetables from Hawaii are irradiated using a dose of 150 Gy or 400 Gy include West Indian sweetpotato weevil (*Euscepes postfasciatus*), sweetpotato vine borer (*Omphisa anastomosalis*), green scale (*Coccus viridis*), and the banana moth (*Opogona sacchari*). The 150 Gy is considered adequate to mitigate risk from all fruit flies and certain other pests e.g., the sweetpotato vine borer and the two sweetpotato weevils and the 400 Gy is considered adequate to mitigate risk from all insect pests excluding adults and pupae of the order Lepidoptera (USDA 2006g). Fruits and vegetables treated with irradiation in Hawaii and moved to other parts of the United States (the mainland) have had no pests of quarantine significance intercepted (Uyeda 2005). On very rare occasions when wigglers were detected in irradiated shipments, they were always found to be moribund and never resulted in further development or completing life cycles (Uyeda 2005).

D. Evidence for the Effective Removal of Pests of Concern from the Pathway

The following paragraph summarizes key mitigation measures for melon fruit from Hawaii and provides a general discussion of their efficacy. The evidence APHIS uses to determine that the measures described above in Section **B** effectively remove pests of concern from the pathway are also discussed. The FAO (2006) defines “pathway” as “Any means that allows the entry or spread of a pest.”

(i) Insect Pests

The four pests likely to follow the pathway are all insect pests, and none of these belong to the order Lepidoptera. In accordance with the regulations in 7 CFR 305.31, a minimum absorbed dose of 150 Gy will neutralize all fruit flies, and a minimum absorbed dose of 400 Gy has been determined to effectively neutralize all insect pests, excluding adults and pupae of the order Lepidoptera (USDA 2006g). Therefore, the generic irradiation treatment of 400 Gy is a valid treatment for these four pests (considering that none of these belong to the order Lepidoptera), whereas, a dose of 150 Gy will mitigate risks from fruit flies only and additional measures would be needed for the remaining pest. The pest not treated by irradiation is a whitefly (*A. dispersus*) which is an external feeder that can be controlled by post-harvest treatment or can be easily identified and the infested fruit culled in the field during harvesting or in the packinghouse during sorting and packing. A pre-departure inspection or a post-harvest treatment with warm soapy water (T102-c) is considered adequate to mitigate risk from the whitefly.

There is no record of importation or movement interstate of irradiated melon from Hawaii or other areas. Therefore, there is no record of interception of any quarantine pests from irradiated melon.

V. Cowpea and its relatives (*Vigna unguiculata* (L.) Walp)

A. Introduction

The Animal & Plant Health Inspection Service (APHIS), Center for Plant Health Science & Technology (CPHST) prepared a pathway-initiated pest risk assessment (PRA) in which CPHST examined the risks associated with the movement of fresh pods of cowpea and its relatives (*Vigna unguiculata* (L.) Walp) from Hawaii into the continental United States. The PRA identified 11 quarantine significant pests which could potentially follow the pathway (USDA 2006d).

The quarantine significant pests that are likely to follow the pathway are as follows:

Bactrocera cucurbitae (Diptera: Tephritidae)
Frankliniella schultzei (Thysanoptera: Thripidae)
Lampides boeticus (Lepidoptera: Lycaenidae)
Maruca vitrata (Lepidoptera: Pyralidae)
Spodoptera litura (Lepidoptera: Noctuidae)
Thrips palmi (Thysanoptera: Thripidae)
Aleurodicus dispersus (Hemiptera: Aleyrodidae)
Cryptophlebia ombrodelta (Lepidoptera: Tortricidae)
Dysmicoccus neobrevipes (Hemiptera/Homoptera: Pseudococcidae)
Maconellicoccus hirsutus (Hemiptera/Homoptera: Pseudococcidae)
Oligonychus biharensis (Acari: Tetranychidae)

Bactrocera cucurbitae, *Frankliniella schultzei*, *Lampides boeticus*, *Maruca vitrata*, *Thrips palmi*, and *Spodoptera litura* are rated as high risks, and the remaining five are rated as medium.

The proposed movement of pods of cowpea and its relatives from Hawaii into the continental United States would be regulated by an amendment to the existing fruits and vegetables regulations in Title 7, *Code of Federal Regulations* (7 CFR), 318.13, if approved. This document outlines the phytosanitary measures that APHIS will require if the proposed movement of pods of cowpea and its relatives from Hawaii into the continental United States is approved and documents the evidence used by APHIS to conclude that these measures will effectively prevent the introduction of quarantine pests to the continental United States.

B. Proposed Risk Mitigation Measures for Cowpea Pods

We propose that pods of cowpea and its relatives from Hawaii may be moved into the continental United States only under the following conditions:

- (a) Only commercial shipments of pods of cowpea and its relatives are allowed from Hawaii;

- (b) Pods of cowpea and its relatives must be treated with irradiation in accordance with 7 CFR 305.34 and 318.13-4(f) in an APHIS approved facility either in Hawaii or on the mainland United States;
- (c) The treatment is monitored by an APHIS inspector to ensure that the fruit received a minimum absorbed dose of 400 Gy. (A minimum absorbed dose of 400 Gy is the only treatment option for cowpea and its relatives.);
- (d) After harvest, the shipment must be inspected in Hawaii by an APHIS inspector and found free of mite (*Oligonychus bharensis*) and adults and pupae of the order Lepidoptera;
- (e) The pods are packaged, labeled, and safeguarded from reinfestation by pests as per requirements of 7 CFR 305.34(b)(4) and 318.13-4f(b)(4);
- (f) Each shipment of cowpeas treated in Hawaii must be accompanied by a certificate of treatment. Shipments of cowpeas not treated in Hawaii and to be treated on the mainland United States may instead be issued a limited permit by an officer or official authorized by APHIS; and
- (g) Fruit is to be free from leaves and stems.

Fruits moved into the continental United States would also be subject to inspection at the port of entry, as provided in section 318.13-3, should inspectors determine that such inspection is necessary.

C. Historical Performance of Irradiated Fruit Moved Interstate

Current regulations in 7 CFR 305.34 allow the use of irradiation to treat fruit for interstate movement within the United States. Regulations in 7 CFR 318.13-4f allow interstate movement of fifteen different fruits and vegetables (cowpea and its relatives are not among them) from Hawaii using a minimum absorbed dose of 150 Gy to 400 Gy. Among pests associated with many fruits from Hawaii, four fruit flies, *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (oriental fruit fly), *B. cucurbitae* (melon fruit fly), and *B. latifrons* (Malasian fruit fly) are the primary pests of concern for which fruit is irradiated. Other pests for which fruits and vegetables from Hawaii are irradiated using a dose of 150 Gy or 400 Gy include West Indian sweetpotato weevil (*Euscepes postfasciatus*), sweetpotato vine borer (*Omphisa anastomosalis*), green scale (*Coccus viridis*), and the banana moth (*Opogona sacchari*). The 150 Gy is considered adequate to mitigate risk from all these fruit flies including *Bactrocera cucurbitae*, and certain other pests e.g., the sweetpotato vine borer and the two sweetpotato weevils and the 400 Gy is considered adequate to mitigate risk from all insect pests, excluding adults and pupae of the order Lepidoptera (USDA 2006g). Fruits and vegetables treated with irradiation in Hawaii and moved to other parts of the United States (the mainland) have had no pests of quarantine significance intercepted (Uyeda 2005). On very rare occasions when wigglers were detected in irradiated shipments, they were always found to be moribund and never resulted in further development or completing life cycles (Uyeda 2005).

D. Evidence for the Effective Removal of Pests of Concern from the Pathway

The following paragraph summarizes key mitigation measures for pods of cowpea and its relatives fruit from Hawaii and provides a general discussion of their efficacy. The evidence APHIS uses to determine that the measures described above in Section **B** effectively remove pests of concern from the pathway are also discussed. The FAO (2006) defines “pathway” as “Any means that allows the entry or spread of a pest.”

(i) Insect Pests

Of the 11 pests likely to follow the pathway, 10 are insect pests. In accordance with the regulations in 7 CFR 305.31, a minimum absorbed dose of 150 Gy has been determined to neutralize all fruit flies, and a minimum absorbed dose of 400 Gy has been determined to effectively neutralize all insect pests, excluding adults and pupae of the order Lepidoptera (USDA 2006g). Although 4 of the 11 pests belong to the order Lepidoptera, the stages of concern of these 4 Lepidoptera pests are eggs and larvae. Therefore, the generic irradiation treatment of 400 Gy is a valid treatment for all 10 insect pests. The eleventh pest, *Oligonychus biharensis* (a mite), is not an insect pest, and therefore, it may not be neutralized by the 400 Gy dose. However, inspection for the mite and adults and pupae of Lepidoptera before departure is considered adequate measure to mitigate these external pests because of their size and characteristics.

There is no record of importation or movement interstate of irradiated pods of cowpea and its relatives from Hawaii or other areas. Therefore, there is no record of interception of any quarantine pests from irradiated pods of cowpea and its relatives.

VI. *Artocarpus altilis* (Breadfruit), *Artocarpus heterophyllus* (Jackfruit),

A. Introduction

Based on a request from Hawaii, the Animal & Plant Health Inspection Service (APHIS)' Center for Plant Health Science & Technology (CPHST), prepared a pathway-initiated pest risk assessment (PRA) in which CPHST examined the risks associated with the movement of fresh fruit of breadfruit (*Artocarpus altilis*) and jackfruit (*Artocarpus heterophyllus*) from Hawaii into the continental United States and identified 13 quarantine significant pests which could potentially follow the pathway (USDA 2006e).

The quarantine significant pests that are likely to follow the pathway are as follows:

Bactrocera cucurbitae Coquillett (Diptera: Tephritidae)
Bactrocera dorsalis (Hendel) (Diptera: Tephritidae)
Ceratitis capitata Wiedemann (Diptera: Tephritidae)
Aleurodicus dispersus (Hemiptera: Aleyrodidae)
Ceroplastes rubens Maskell (Hemiptera: Coccidae)
Coccus viridis (Green) (Hemiptera: Coccidae)
Aonidiella inornata McKenzie (Hemiptera: Diaspididae)
Dysmicoccus neobrevipes (Hemiptera: Pseudococcidae)
Maconellicoccus hirsutus (Green) (Hemiptera: Pseudococcidae)
Nipaecoccus viridis (Newstead) (Hemiptera: Pseudococcidae)
Pseudococcus cryptus Hempel (Hemiptera: Pseudococcidae)
Phytophthora tropicalis Aragaki & J.Y. Uchida (Oomycetes: Pythiales)
Thrips palmi Karny (Thysanoptera: Thripidae)

Bactrocera cucurbitae, *Bactrocera dorsalis*, *Ceratitis capitata*, *Thrips palmi*, and *Phytophthora tropicalis* are rated as high risks, and the remaining eight are rated as medium.

The proposed movement of breadfruit and jackfruit from Hawaii into the continental United States would be regulated by an amendment to the existing fruits and vegetables regulations in Title 7, *Code of Federal Regulations* (7 CFR), 318.13, if approved. This document outlines the phytosanitary measures that APHIS will require if the proposed movement of breadfruit and jackfruit from Hawaii into the continental United States is approved and documents the evidence used by APHIS to conclude that these measures will effectively prevent the introduction of quarantine pests to the continental United States.

B. Proposed Risk Mitigation Measures for Breadfruit and jackfruit

We propose that breadfruit and jackfruit from Hawaii may be moved into the continental United States only under the following conditions:

- (a) Only commercial shipments of breadfruit and jackfruit are allowed from Hawaii;
- (b) Breadfruit and jackfruit must be treated with irradiation in accordance with 7 CFR 305.34 and 318.13-4(f) in an APHIS approved facility either in Hawaii or on the mainland United States;
- (c) The treatment is monitored by an APHIS inspector to ensure that the fruit received a minimum absorbed dose of 400 Gy (Option 1) or 150 Gy (Option 2);
- (d) The fruit receiving 150 Gy as the minimum dose (Option 2) must either receive a post-harvest dip with T102-c (warm soapy water and brushing) or originate from an orchard that was previously treated with a broad spectrum insecticide during the growing season and a pre-harvest inspection of the orchard found the fruit free of any surface pests;
- (e) Breadfruit and jackfruit must receive a post-harvest fungicidal dip appropriate for the fungus *Phytophthora tropicalis* or originate from an orchard that was previously treated with an appropriate fungicide during the growing season and a pre-harvest inspection of the orchard found the fruit free of the disease;
- (f) If the fruit is to be treated using a 150 Gy minimum absorbed dose, the fruit after harvest must be inspected in Hawaii by an APHIS inspector and found free of *Aleurodicus disperses*, *Dysmicoccus neobrevipes*, *Maconellicoccus hirsutus*, *Pseudococcus cryptus*, *Thrips palmi*, *Aonidiella inornata*, *Coccus viridis*, *Cerpoplastes rubens*, and *Nipaecoccus viridis*. The fruit must also be inspected for signs of damage caused by thrips.
- (g) The fruit is packaged, labeled, and safeguarded from reinfestation by pests as per requirements of 7 CFR 305.34(b)(4) and 318.13-4f(b)(4);
- (h) Each shipment containing fruit treated in Hawaii must be accompanied by a certificate of treatment. Shipments containing fruit not treated in Hawaii and to be treated on the mainland United States may instead be issued a limited permit by an officer or official authorized by APHIS. If the fruit is to be treated on the mainland, a 400 Gy minimum absorbed dose must be used and certificate of treatment issued; and
- (i) Fruit is to be free from stems and leaves.

Fruits moved into the continental United States would also be subject to inspection at the port of entry, as provided in section 318.13-3, should inspectors determine that such inspection is necessary.

C. Historical Performance of Irradiated Fruit Moved Interstate

Current regulations in 7 CFR 305.31 allow the use of irradiation to treat fruit for interstate movement within the United States. Regulations in 7 CFR 318.13-4f allow interstate movement of fifteen different fruits and vegetables (breadfruit and jackfruit are not among them) from Hawaii using a minimum absorbed dose of 150 Gy to 400 Gy. Among pests associated with many fruits from Hawaii, four fruit flies, *Ceratitidis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (oriental fruit fly), *B. cucurbitae* (melon fruit fly), and *B. latifrons* (Malasian fruit fly) are the primary pests of concern for which

fruit is irradiated. Other pests for which fruits and vegetables from Hawaii are irradiated using a dose of 150 Gy or 400 Gy include West Indian sweetpotato weevil (*Euscepes postfasciatus*), sweetpotato vine borer (*Omphisa anastomosalis*), green scale (*Coccus viridis*), and the banana moth (*Opogona sacchari*). The 150 Gy is considered adequate to mitigate risk from all these fruit flies and certain other pests e.g., the sweetpotato vine borer and the two sweetpotato weevils and the 400 Gy is considered adequate to mitigate risk from all insect pests, excluding adults and pupae of the order Lepidoptera (USDA 2006g). Fruits and vegetables treated with irradiation in Hawaii and moved to other parts of the United States (the mainland) have had no pests of quarantine significance intercepted (Uyeda 2005). On very rare occasions when wigglers were detected in irradiated shipments, they were always found to be moribund and never resulted in further development or completing life cycles (Uyeda 2005).

D. Evidence for the Effective Removal of Pests of Concern from the Pathway

The following paragraph summarizes key mitigation measures for breadfruit and jackfruit from Hawaii and provides a general discussion of their efficacy. The evidence APHIS uses to determine that the measures described above in Section **B** effectively remove pests of concern from the pathway are also discussed. The FAO (2006) defines “pathway” as “Any means that allows the entry or spread of a pest.”

(i) Pests

Of the 13 pests likely to follow the pathway, all but 1 are insect pests. The lone pest that is not an insect is a fungal pathogen, *Phytophthora tropicalis*. A minimum absorbed dose of 150 Gy has been determined by U.S. regulations 7CFR305.31 to neutralize all fruit flies and a minimum absorbed dose of 400 Gy has been determined to neutralize all insect pests excluding adults and pupae of the order Lepidoptera (USDA 2006g). Of the 12 insect pests likely to follow the pathway, none belongs to the order Lepidoptera. Therefore, the generic irradiation treatment of 400 Gy is a valid treatment for all the insect pests. The pest not targeted by the 400 Gy dose is the pathogen, *Phytophthora tropicalis*. Application of a fungicide during the growing season coupled with finding of the fruit as free of disease symptoms during pre-harvest orchard inspection or application of a post-harvest fungicidal dip treatment followed by a pre-departure inspection is considered sufficient to mitigate the risk from *Phytophthora tropicalis*. Alternatively, an application of 150 Gy will mitigate risks from the three fruit flies and additional measures would be needed for the remaining ten pests. Since nine of the remaining ten are insect pests and external in nature, macroscopic in size and visible to the naked eye, visual inspection of the fruit prior to shipment from Hawaii is considered adequate to mitigate risks from these insect pests. In addition, inspectors should inspect fruit for signs of insect damage due to thrips. Since the fungal pathogen, *Phytophthora tropicalis*, is not targeted by the 150 GY dose, application of a fungicide during the growing season coupled with finding of the fruit as free of disease symptoms during preharvest orchard inspection or application of a post-harvest fungicidal dip treatment followed by a pre-departure inspection is considered sufficient to mitigate the risk.

There is no record of importation or movement interstate of irradiated breadfruit and jackfruit from Hawaii or other areas, and hence there is no record of interception of any quarantine pests from irradiated breadfruit and jackfruit.

VII. *Moringa oleifera* pods

A. Introduction

Based on a request from Hawaii, the Animal & Plant Health Inspection Service (APHIS), Center for Plant Health Science & Technology (CPHST) prepared a pathway-initiated pest risk assessment (PRA) in which CPHST examined the risks associated with the movement of fresh fruit of *Moringa oleifera* pods from Hawaii into the continental United States. The PRA identified seven quarantine significant pests which could potentially follow the pathway (USDA 2006f).

The quarantine significant pests that are likely to follow the pathway are as follows:

Aleurodicus dispersus Russell (Hemiptera: Aleyrodidae)
Aonidiella inornata (McKenzie) (Hemiptera: Diaspididae)
Bactrocera cucurbitae (Coquillett) (Diptera: Tephritidae)
Bactrocera dorsalis (Hendel) (Diptera: Tephritidae)
Ceratitis capitata (Wiedemann) (Diptera: Tephritidae)
Coccus viridis (Green) (Hemiptera: Pseudococcidae)
Pseudococcus cryptus Hempel (Hemiptera: Pseudococcidae)

Bactrocera cucurbitae, *Bactrocera dorsalis*, and *Ceratitis capitata* are rated as high risks, and the remaining four are rated as medium.

The proposed movement of moringa pods from Hawaii into the continental United States would be regulated by an amendment to the existing fruits and vegetables regulations in Title 7, *Code of Federal Regulations*, (7 CFR), 318.13, if approved. This document outlines the phytosanitary measures that APHIS will require if the proposed movement of moringa pods from Hawaii into the continental United States is approved and documents the evidence used by APHIS to conclude that these measures will effectively prevent the introduction of quarantine pests to other part of the United States.

B. Proposed Risk Mitigation Measures for *Moringa* Pods

We propose that moringa pods from Hawaii may be moved into the continental United States only under the following conditions:

- (a) Only commercial shipments of moringa pods are allowed from Hawaii;
- (b) Moringa pods must be treated with irradiation in accordance with 7 CFR 305.34 and 318.13-4(f) in an APHIS approved facility either in Hawaii or on the mainland United States;
- (c) The treatment is monitored by an APHIS inspector to ensure that the fruit received a minimum absorbed dose of 400 Gy (Option 1) or 150 Gy (Option 2);
- (d) The pods receiving 150 Gy as the minimum dose (Option 2) must either receive a post-harvest dip with T102-c (warm soapy water and brushing) or originate from an orchard that was previously treated with a broad spectrum insecticide during the

growing season and a pre-harvest inspection of the orchard found the pods free of any surface pests;

- (e) If the pods are to be treated using a 150 Gy minimum absorbed dose, the pods after harvest must be inspected in Hawaii by an APHIS inspector for pests and found free of *Aleurodicus dispersus*, *Aonidiella inornata*, *Coccus viridis*, and *Pseudococcus cryptus*;
- (f) The pods are packaged, labeled, and safeguarded from reinfestation by pests as per requirements of 7 CFR 305.34(b)(4) and 318.13-4f(b)(4); and
- (g) Each shipment containing pods treated in Hawaii must be accompanied by a certificate of treatment. Shipments containing pods not treated in Hawaii and to be treated on the mainland United States may instead be issued a limited permit by an officer or official authorized by APHIS. If the pods are to be treated on the mainland, a 400 Gy minimum absorbed dose must be used and treatment certificate issued.

Moringa pods moved into the continental United States would also be subject to inspection at the port of entry, as provided in section 318.13-3, should inspectors determine that such inspection is necessary.

C. Historical Performance of Irradiated Fruit Moved Interstate

Current regulations in 7 CFR 305.34 allow the use of irradiation to treat fruit for interstate movement within the United States. Regulations in 7 CFR 318.13-4f allow interstate movement of fifteen different fruits and vegetables (moringa pods is not one of them) from Hawaii using a minimum absorbed dose of 150 Gy to 400 Gy. Among pests associated with many of these fruits from Hawaii, four fruit flies, *Ceratitis capitata* (Mediterranean fruit fly), *Bactrocera dorsalis* (oriental fruit fly), *B. cucurbitae* (melon fruit fly), and *B. latifrons* (Malasian fruit fly) are the primary pests of concern for which fruit is irradiated. Other pests for which fruits and vegetables from Hawaii are irradiated using a dose of 150 Gy or 400 Gy include West Indian sweetpotato weevil (*Euscepes postfasciatus*), sweetpotato vine borer (*Omphisa anastomosalis*), green scale (*Coccus viridis*), and the banana moth (*Opogona sacchari*). The 150 Gy is considered adequate to mitigate risk from all these fruit flies and certain other pests e.g., the sweetpotato vine borer and the two sweetpotato weevils, and the 400 Gy is considered adequate to mitigate risk from all insect pests, excluding adults and pupae of the order Lepidoptera (USDA 2006g). Fruits and vegetables treated with irradiation in Hawaii and moved to other parts of the United States (the mainland) have had no pests of quarantine significance intercepted (Uyeda 2005). On very rare occasions when wigglers were detected in irradiated shipments, they were always found to be moribund and never resulted in further development or completing life cycles (Uyeda 2005).

D. Evidence for the Effective Removal of Pests of Concern from the Pathway

The following paragraph summarizes key mitigation measures for moringa pods from Hawaii and provides a general discussion of their efficacy. The evidence APHIS uses to

determine that the measures described above in Section **B** effectively remove pests of concern from the pathway are also discussed. The FAO (2006) defines “pathway” as “Any means that allows the entry or spread of a pest.”

(i) Insect Pests

Seven pests likely to follow the pathway are all insect pests, and none of these belong to the order Lepidoptera. In accordance with the regulations in 7 CFR 305.31, a minimum absorbed dose of 150 Gy will neutralize all fruit flies, green scale, and certain other pests, and a minimum absorbed dose of 400 Gy has been determined by APHIS to be adequate to neutralize all insect pests, excluding adults and pupae of the order Lepidoptera (USDA 2006g). Therefore, the generic irradiation treatment of 400 Gy is a valid treatment for these seven pests (considering that none of these belong to the order Lepidoptera), whereas, an application of 150 Gy will mitigate risks from fruit flies and additional measures would be needed for the remaining four pests. Since the remaining four pests are all external in nature, macroscopic in size and visible to the naked eye, visual inspection of the fruit prior to shipment from Hawaii is considered adequate to mitigate risks from these pests.

There is no record of importation or movement interstate of irradiated moringa pods from Hawaii or other areas. Therefore, there is no record of interception of any quarantine pests from irradiated moringa pods.

VIII. Conclusion

The phytosanitary requirements described above include treatment of mangosteen, dragonfruit, melon, cowpeas pods, breadfruit, jackfruit, and moringa pods with irradiation using a minimum absorbed dose of 150 Gy or 400 Gy. While the 400 Gy dose is effective against all insect pests excluding adults and pupae of the order Lepidoptera – the stages that generally do not feed on fruit or pods, the dose is not effective against pathogens and mites for which additional measures have been recommended. Likewise while the dose of 150 Gy is effective against all fruit flies, green scale, and certain other pests, the dose is not effective against many other pests for which additional measures have been recommended. Depending upon the pests involved and the dose used, the additional measures may include a post-harvest treatment with a warm soapy water (T102-c), a pre-harvest treatment of orchard with a broad spectrum insecticide and inspection of commodity in the field, a post-harvest fungicidal dip or a pre-departure inspection for pests not targeted by the irradiation treatment. The risk management document concludes that based on the evaluation of effectiveness of these measures directed against the pests of concern, APHIS finds that the safeguards of 7 CFR 318.13-4f and the additional mitigations described here will result in the effective removal of the pests of concern identified by the PRA to allow movement of these commodities from Hawaii (USDA 2006a).

IX. Author(s):

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X. References Cited:

- FAO. 2006. International Standards for Phytosanitary Measures: Guidelines for Pest Risk Analysis. Publication No. 2. Rome: Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations.
- USDA 2005. Guidelines for pathway-initiated pest risk assessments (version 5.02), US Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine, Center for Plant Health Science & Technology, NC , March 2005.
- USDA 2006a. Movement of Mangosteen, *Garcinia mangostana*, from Hawaii into the Continental United States. A Pathway-initiated Risk Assessment. Published by US Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine, Center for Plant Health Science & Technology, NC , 2004, edited 2006.
- USDA 2006b. Movement of Dragon Fruit (*Hylocereus*, *Selenicereus*) from Hawaii into the Continental United States. A Qualitative Pathway-initiated Risk Assessment. Published by US Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine, Center for Plant Health Science & Technology, NC , 2005, edited 2006.
- USDA 2006c. Qualitative Pathway-Initiated Risk Assessment of the Movement of Melon, *Cucumis melo* L., from Hawaii into the Continental United States. Published by US Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine, Center for Plant Health Science & Technology, NC , 2006.
- USDA 2006d. Movement of Cowpea, and its relatives (*Vigna unguiculata* (L.) Walp), as Fresh Immature Fruit Pods from Hawaii into the Continental United States. A Pathway-initiated Risk Assessment. Published by US Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine, Center for Plant Health Science & Technology, NC , 2005, edited 2006.
- USDA 2006e. Movement of Breadfruit, (*Artocarpus altilis*), and Jackfruit, (*Artocarpus heterophyllus*), from Hawaii into the Continental United States. A Pathway-initiated Risk Assessment. Published by US Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine, Center for Plant Health Science & Technology, NC , 2006.
- USDA 2006f. Movement of *Moringa oleifera* Pods from Hawaii into the Continental United States. A Pathway-initiated Risk Assessment. Published by US Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine, Center for Plant Health Science & Technology, NC , 2006.

- USDA 2006g. Treatment of fruits and vegetables. Federal Register 71 (18): 4451-4464, published January 27, 2006.
- Uyeda E. 2005. Personal communication from E. Uyeda, Port Director, US Department of Agriculture, Animal & Plant Health Inspection Service, Plant Protection & Quarantine, Hilo, HI.