



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



Importation of Fresh Mango Fruit (*Mangifera indica* L.) from Pakistan into the Continental United States

Risk Management Document

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A. Introduction

The Government of Pakistan (GOP) requested permission to import mango fruit (*Mangifera indica* L.) into the continental United States. Mangoes have not been imported from Pakistan before, so a Pathway-initiated Risk Assessment was conducted. A list of mango pests in Pakistan was prepared based on (1) documents submitted by the GOP, (2) the U. S. Department of Agriculture's (USDA's) Animal and Plant Health Inspection Service (APHIS) records of intercepted pests, and (3) scientific literature. The pest risk assessment (PRA) , *Importation of Fresh Mango Fruit (Mangifera indica L.) from Pakistan into the Continental United States, A Qualitative Pathway-Initiated Pest Risk Assessment* (USDA 2006a) identified **ten** insect pests and **two** pathogens likely to follow the pathway on fresh mango fruit from Pakistan.

The PRA further determined that the risk is high for four fruit flies, *Bactrocera correcta*, *B. cucurbitae*, *B. dorsalis* and *B. zonata*; medium for six scale insects, *Coccus discrepans*, *C. viridis*, *Aulacaspis tubercularis*, *Parlatoria blanchardi*, *P. crypta*, *Pseudaonidia trilobitiformis*, and one bacterium, *Xanthomonas campestris* pv. *mangiferaeindicae*; and low for the fungus, *Phomopsis mangiferae*.

As one of the options under review to mitigate identified pest risks, Pakistan proposes to treat mangoes with an APHIS-approved generic irradiation treatment that would mitigate pathway risks from most of the pests. All fruit flies will be effectively neutralized (killed, rendered sterile or prevented from developing into an adult) with the irradiation generic dose of 150 Gy and all insect pests excluding adults and pupae of the order Lepidoptera with the generic dose of 400 Gy (USDA, 2006b). Although the 150 Gy dose has also been shown to be effective against many other pests including certain weevils and borers, the dose has not been approved or determined effective against any of the six scale insects mentioned above. Neither of the two generic doses are considered efficacious to neutralize the two pathogens involved. The pests not mitigated by the irradiation dose applied will require additional measures.

Standard Industry Practices

In Pakistan, mangoes are subjected to the following standard post harvest practices essentially for desapping (removal of sap from) the fruit (Miller 2007, Pers. Comm.)

1. Washing in a clear water bath with brushing using bristle rollers,
2. Immersion in hot water bath for 4-5 minutes at 48 to 55 degree C.,
3. Drying using forced hot air,
4. Grading and sorting by size, and
5. Packing by hand into cartons.

B. Quarantine Pests Expected to Follow the Mango Pathway

The pest list completed by the Center for Plant Health Science and Technology (CPHST) for mangoes from Pakistan identified **twelve** potential quarantine pests that could follow the pathway on *Mangifera indica* fruit (USDA, 2006a, Table 3). These include ten insect pests, one fungus and one bacterium as follows:

Insects:

Bactrocera correcta (Bezzi) (DIPTERA:Tephritidae)
Bactrocera cucurbitae Coquillett (DIPTERA:Tephritidae)
Bactrocera dorsalis Hendel (DIPTERA:Tephritidae)
Bactrocera zonata (Saunders) (DIPTERA:Tephritidae)
Aulacaspis tubercularis Newstead (HOMOPTERA: Diaspididae)
Parlatoria blanchardi (Targioni-Tozzetti) (HOMOPTERA: Diaspididae)
Parlatoria crypta Mckenzie (HOMOPTERA: Diaspididae)
Pseudaonidia trilobitiformis (HOMOPTERA: Diaspididae)
Coccus discrepans (Green) (HOMOPTERA: Coccidae)
Coccus viridis (HOMOPTERA: Coccidae)

Fungi:

Phomopsis mangiferae Ahmad apud Petr. & Ahmad

Bacteria:

Xanthomonas campestris pv. *mangiferaeindicae* (Patel *et al.* 1948) Robbs *et al.* 1974

The proposed importation of mango fruit from Pakistan, if approved, would be regulated under the existing fruits and vegetables regulations [7 CFR § 319.56]. This document outlines the phytosanitary measures that APHIS will require if the proposed importation of mango from Pakistan is approved and documents the evidence used by APHIS to conclude that these measures will effectively prevent the introduction of quarantine pests.

C. Proposed Risk Mitigation Measures for Mangoes

We propose that mango fruit from Pakistan may be imported into the United States only under the following conditions:

- (a) The fruit must be commercially produced and part of a commercial consignment.
- (b) The fruit must be treated by irradiation by receiving a minimum absorbed dose (MAD) of 400 Gy and meet all other relevant requirements in 7 CFR 305.9 including monitoring of the treatment by APHIS inspectors.
- (c) If irradiation is applied outside the United States, each consignment of fruit must be inspected jointly by APHIS and GOP inspectors and accompanied by a Phytosanitary Certificate (PC) issued by the national plant protection organization (NPPO) of Pakistan certifying that the fruit received the required irradiation

- treatment. The PC must also include an Additional Declaration (AD) stating that "This consignment was treated with 400 Gy irradiation dose, inspected during pre-clearance activities and found free of *Xanthomonas campestris* pv. *mangiferaeindicae*." If irradiation is to be applied upon arrival in the United States, each consignment of fruit must be inspected by GOP inspectors prior to departure and accompanied by a PC issued by the NPPO of Pakistan with an AD stating that "This consignment was inspected by the GOP inspectors and found free of *Xanthomonas campestris* pv. *mangiferaeindicae*."
- (d) Fruits imported into the United States would also be subject to inspection at the port of entry.

D. Historical Performance of Importing Irradiated Mangoes

Current regulations 7CFR 305.9 allow the use of irradiation to treat fruit for importation into the United States. Starting April 2007, India began shipping mangoes irradiated with 400 Gy to the United States and continued shipping irradiated mangoes each year since. This was followed by Thailand which started shipping mangoes and longans both treated with 400 Gy irradiation dose to the United States as of November 1, 2007. Thereafter commodities irradiated with 400 Gy have also been received from Vietnam (dragon fruit) and Mexico (guava). No pests of quarantine significance have been reported from the irradiated fruit imported from all these countries. Regulations 7CFR318.13-4f allow interstate movement of fifteen different fruit, including mango, from Hawaii using a minimum absorbed dose of 150 Gy to 400 Gy. There are four fruit flies and one seed weevil associated with mango fruit from Hawaii: *Bactrocera cucurbitae* (melon fruit fly), *B. dorsalis* (oriental fruit fly), *B. latifrons* (Malasian fruit fly), *Ceratitis capitata* (Mediterranean fruit fly) and *Sternochetus mangiferae* (mango seed weevil). The 300 Gy dose is considered adequate to mitigate risk from mango seed weevil while oriental fruit fly, Mediterranean fruit fly, melon fruit fly and Malasian fruit fly, all require a lesser dose of 150 Gy (USDA, 2006b). No live pests of quarantine significance have been intercepted from fruits and vegetables treated with irradiation in Hawaii and moved to the mainland United States (Uyeda, 2005). Since 2004, there have been no records of pest interceptions on Australian mangoes irradiated with 150 Gy dose and imported into New Zealand (Edwards, 2005).

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

The following paragraph summarizes key mitigation measures for mango fruit from Pakistan and provides a general discussion of their efficacy. The evidence APHIS uses to determine that the measures described above in Section C effectively remove pests of concern from the pathway are also discussed. The International Plant Protection Convention (IPPC, 2007) defines "pathway" as "Any means that allows the entry or spread of a pest."

As part of the U.S. requirements (7CFR305.9) governing the use of irradiation as a phytosanitary treatment, APHIS and the NPPO of Pakistan will jointly develop an operational work plan. The work plan shall incorporate details of treatment and other activities including inspection of articles that APHIS may perform before or after the treatment. Inspection of the mango fruit for the presence of pests not targeted by irradiation will further ensure that the pests of concern are removed from the pathway.

Fruit Flies:

Four of the ten insect pests of concern are fruit flies, *Bactrocera correcta*, *Bactrocera cucurbitae*, *Bactrocera dorsalis* and *Bactrocera zonata*. All of the four fruit flies have been identified in the PRA as having high risk potentials to follow the mango pathway.

Risk Mitigation Options:

Per U.S. requirements, a minimum absorbed dose of 150 Gy is considered adequate to mitigate risks from all fruit flies. This is also the dose being used effectively to mitigate risks from fruit flies in Australian mangoes shipped to New Zealand since 2004.

Scale Insects:

Out of the the six remaining insect pests of concern, two are soft scale insects, *Coccus discrepans* and *Coccus viridis* and four armored scales, *Aulacaspis tubercularis*, *Parlatoria blanchardi*, *Parlatoria crypta*, *Pseudaonidia trilobitiformis*. In the PRA, all of these scales are rated to have medium pest risk potential and therefore require measures beyond port of entry inspections.

Risk Mitigation Options:

Besides fruit flies, the generic dose of 150 Gy is also effective and approved by APHIS against other insect pests including certain weevils and borers. However, this dose has not been approved against any of the six scale pests mentioned above. The U.S. regulations 7CFR305.9 support the use of a generic 400 Gy dose to neutralize all insect pests including the scale pests but excluding adults and pupae in the order Lepidoptera. None of the ten insect pests likely to follow the pathway belong to the order Lepidoptera, therefore the generic irradiation treatment with 400 Gy is a valid treatment for all of the insect pests.

Fungal Pathogen:

The PRA determined that the fungus *Phomopsis mangiferae* has a low pest risk potential. According to the *Guidelines for Pathway-Initiated Pest Risk Assessments*

Version 5.02 (USDA, 2000), pests rated with low risk potential do not require mitigation measures beyond port of entry or preclearance inspection.

Bacteria:

Bacterial black spot or black canker caused by *Xanthomonas campestris* pv. *mangiferaeindica* occurs in Australia, Brazil, China, India, Japan, Pakistan, Réunion, South Africa, Sudan, and Taiwan (CABI, 2005). Since the pathogen moves only short distances in wind-blown aerosols (usually within orchards), the long-distance spread of the pathogen depends almost entirely upon the movement of diseased propagation material. True seed transmission has not been demonstrated (Manicom and Pruvost, 1994, Gagnevin and Pruvost, 2001).

Symptoms of *Xanthomonas campestris* pv. *mangiferaeindica* on mango fruit consist of fruit lesions that develop into water-soaked halos, become raised, blacken and crack open (Ploetz *et al.*, 1994). These conspicuous lesions usually produce gummy exudates and are discernible with the naked eye (Johnson *et al.*, 1989). Fruit susceptibility increases over time and is highest during the month preceding harvest (Gagnevin and Pruvost, 2001). Visual inspection of the fruit at the packinghouse would most likely detect this pathogen. This pest is rated as medium risk in the PRA. According to our 5.02 guidelines pests rated as medium risk may require specific mitigation measures beyond port of entry inspection.

This bacterial pathogen is not generally considered as a post harvest disease (Johnson, 1994; Singh, 2000). The pathogen is an epiphytic colonist of leaves (Manicom, 1986; Pruvost *et al.*, 1990), buds (Pruvost *et al.*, 1993) and fruit (Pruvost and Luisetti, 1991). Infection usually occurs through wounds and less often through stomata (Ploetz *et al.*, 1994).

Risk Mitigation Option:

Inspection of the fruit for evidence of *Xanthomonas campestris* pv. *mangiferaeindica*.

Additional Declaration:

All consignments require the following AD on the PC:

"This consignment was inspected and found free of *Xanthomonas campestris* pv. *Mangiferaeindicae*."

F. Conclusion

The phytosanitary requirements described above include treatment of mango fruit with irradiation using a minimum absorbed dose of 400 Gy and certification of pest freedom by the NPPO of Pakistan based on inspections for pests not targeted by the irradiation

treatment. Based on the evaluation of effectiveness of these measures directed against the pests of concern, APHIS finds that the safeguards of 7 CFR § 319.56 and the additional mitigations described here will result in the effective removal of the pests of concern identified by the pest risk analysis from the pathway of the importation of fresh mango fruit from Pakistan.

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