REPORT

Virtual Meeting
17 February 2015

Technical Panel on Phytosanitary Treatments
February, 2015

Food and Agriculture Organization of the United Nations

CONTENTS

1. Opening of the meeting

[1] The IPPC Secretariat (hereafter Secretariat) welcomed the participants to the meeting. The following persons participated in the meeting:

Mr Patrick GOMES (TPPT Member, USA)

Mr Guy HALLMAN (TPPT Member, USA)

Mr Michael ORMSBY (TPPT Member, New Zealand)

Mr Matthew SMYTH (TPPT Member, Australia)

Mr Daojian YU (TPPT Member, China)

Mr Andrew PARKER (TPPT Invited Expert, International Atomic Energy Agency (IAEA))

Mr Nuri NIYAZI (IPPC Secretariat)

Ms Adriana MOREIRA (IPPC Secretariat)

[2] The Secretariat especially welcomed two of the three new members to the Technical Panel on Phytosanitary Treatments (TPPT), Mr Matthew SMYTH (Australia) and Mr Daojian YU (China) and wished them best of success in their work on the Panel. The third new member, Mr Glenn BOWMAN (Australia), was unable to participate in the meeting.

[3] The participants introduced themselves briefly. The full list of TPPT members and their contact details can be found on the International Phytosanitary Portal (IPP)[1].

[4] The Secretariat gave a brief explanation of the use of the Adobe Connect tool.

[5] The Secretariat introduced the agenda and it was adopted as presented in Appendix 1 of this report.

Election of rapporteur

[6] Mr Matthew SMYTH was elected as the rapporteur.

2. IPPC Secretariat Updates

Update from Standards Committee 2014 November meeting

[7] The Secretariat provided an update from the Standards Committee (SC) 2014 November meeting. The SC recommended, for adoption, four draft International Standards for Phytosanitary Measures (ISPMs) and three draft phytosanitary treatments (PTs) to the Tenth Session of the Commission of Phytosanitary Measures (CPM-10) (2015). It was pointed out that one draft ISPM on Determination of host status of fruit to fruit flies (Tephritidae) (2006-031) and the three PTs—Cold treatment (CT) for *Bactrocera tryoni* on *Citrus sinensis* (2007-206E), CT for *B. tryoni* on *C. reticulata* x *C. sinensis* (2007-206F) and CT for *B. tryoni* on *C. limon* (2007-206G)—had previously received formal objections and the SC decided to forward them to CPM for adoption by vote, without option for formal objections according to the IPPC standard setting procedure.

[8] For the draft PT on CT for *B. tryoni* on *C. sinensis*, it was mentioned that the SC decided to change the title from CT for *B. tryoni* on *C. sinensis* "Navel" and "Valencia" (2007-206E) to CT for *B. tryoni* on *C. sinensis* (2007-206E), thus removing the cultivar names in response to a suggestion as part of the previous formal objections raised when presented to CPM-9 (2014). By the same token, in the text of the draft PT the information on pre-cooling was removed and a small adjustment to the references was made.

[1] TPPT membership list: https://www.ippc.int/en/core-activities/standards-setting/expert-drafting-groups/technical-panels/technical-panel-phytosanitary-treatments/#secretariat

[9] The Secretariat also updated the participants on relevant items relating to the work of the Technical Panel on Forest Quarantine (TPFQ) as discussed by the SC at its last meeting. The points were as follows:

- ❖ Moisture content and methyl bromide penetration into wood

[10] The Secretariat informed the participants that the SC had noted the TPFQ paper on "Moisture content and methyl bromide penetration into wood", which had been drafted with input from the International Forest Quarantine Research Group (TPFQ) and the TPPT. In the paper the TPFQ considered that, while moisture does affect the ability of methyl bromide to penetrate wood, most wood in service does not contain high levels of moisture. Therefore, this is not considered the major issue with the effectiveness of ISPM 15 (*Regulation of wood packaging material in international trade*), but rather, the main concern is the operationalization and implementation of the ISPM.

- ❖ Amendment of dielectric heating schedule in Annex 1 of ISPM 15

[11] Further, the Secretariat briefed the participants that the TPFQ had proposed an amendment to Annex 1 of ISPM 15 to remove restrictions on wood dimensions and heat-up time and that the SC agreed to propose this topic be added to the List of Topics (LOT) and this request will be forwarded to the CPM-10 (2015) for consideration.

[12] The Secretariat also updated the participants on a relevant change to the LOT, namely that the SC agreed to split the topic "Sulfuryl fluoride [SF] fumigation of wood packaging material" (2007-101) into two separate topics targeted to specific pests groups, as follows: "SF fumigation of insects in debarked wood" (2007-101A) and "SF fumigation of nematodes and insects in debarked wood" (2007-101B). This had been recommended by the TPPT in its 2014 face-to-face meeting[2], so as to separate the treatment into one for insects (with a less severe schedule) and one for pine wood nematode (PWN) and insects (with a more severe schedule) because this would make the treatments more targeted and prevent unnecessarily high dosing of timber not infested with PWN.

[13] Regarding the 2014-08 "Call for experts for expert drafting groups", the Secretariat reiterated that the SC agreed to offer the following three nominated experts a five-year term as members of the TPPT, effective from 2014-11:

- Mr Glenn John BOWMAN (AUSTRALIA)
- Mr Matthew SMYTH (AUSTRALIA)
- Mr Daojian YU (CHINA)

[14] It was also mentioned that the SC noted the resignation of Mr Andrew JESSUP (Australia) and that an SC e-discussion was underway regarding an additional nomination received from Japan (which had been submitted to the Secretariat by the NPPO in a timely manner but for unknown reasons was not received. TPPT membership composition will be placed on the agenda of the at SC 2015-05 meeting, as three members' terms are expiring at the end of the present year.

Update on the 10th Session of the Commission on Phytosanitary Measures (CPM-10)

[15] The Secretariat informed the participants that a side-session on the "Expert consultation on phytosanitary treatments for *Bactrocera dorsalis* complex" will be held by the Secretariat during CPM-10. Further it was noted that a special topics session will be conducted which will include the topic of "New methods for pest control". This will be presented by Mr Ron SEQUEIRA of the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) and will address: (i) alternatives to methyl bromide, organophosphates and carbamates; (ii) new fumigants, broadcast products, radiofrequency, modified atmospheres and irradiation treatments; and (iii) integrated phytosanitary measures, including "next generation systems approaches".

[2] 2014 TPPT Meeting Report: https://www.ippc.int/en/work-area-publications/2545/

Update on the Expert Consultation on Phytosanitary Treatments for *Bactrocera dorsalis* complex

[16] The Secretariat updated the participants on the "Expert consultation on phytosanitary treatments for *Bactrocera dorsalis* complex", which was held from 1 to 5 December 2014 in Okinawa, Japan, hosted by the Japanese National Plant Protection Organisation (NPPO). The meeting was attended by 24 phytosanitary researchers from twelve countries and the agenda included the following points:

- Discussion of implications of synonymization of four *Bactrocera* fruit fly pests;
- Presentation of phytosanitary treatment research for species in the *B. dorsalis* complex;
- Discussion of issues in the design, conduct, operationalization, evaluation and presentation of the data of PTs.

[17] More detailed information can be obtained in the full meeting report[3].

[18] It was pointed out that the main outputs were as follows:

- Development of a list of NPPO or RPPO-approved treatments for *B. dorsalis* complex species;
- Publication of a joint-reviewed paper that is to provide a "phytosanitary treatment toolbox" (listing available PTs against *B. dorsalis* complex, describing the market access obtained, problems encountered with treatment efficacy, possible effects on fruit quality, and identifying future research needs);
- Continued collaboration will be achieved via the Phytosanitary Temperature Treatment Expert Group (PTTEG)[4], which was formed as an outcome of the Expert Consultation on Cold Treatments in December 2013[5], and which plans to hold its first meeting from 17-20 August 2015 in Nelspruit, South Africa.

3. TPPT Work Programme

Overview of status of TPPT treatment *portfolio*

[19] The Secretariat provided an overview of the TPPT portfolio of draft phytosanitary treatments, currently totaling 20 draft phytosanitary treatments (PTs) at various stages of development along the standard setting process:

- 4 PTs (three cold treatments and one irradiation treatment) were submitted to CPM-10 for adoption,
- 6 PTs that underwent member consultation in 2014 were under review by the TPPT,
- 4 PTs were approved by the SC for the 2015 member consultation period,
- 5 PTs were on hold pending further analysis of the supporting data and complementary studies, and
- 1 PT was being reviewed further and continues to await receipt of supplementary data requested from the submitter.

[3] "Expert consultation on phytosanitary treatments for *Bactrocera dorsalis* complex" meeting report: https://www.ippc.int/en/publications/2702/

[4] Phytosanitary Temperature Treatment Expert Group: https://www.ippc.int/en/liason/organizations/phytosanitarytemperaturetreatmentsexpertgroup/

[5] Expert Consultation on Cold Treatments: https://www.ippc.int/en/core-activities/standards-setting/expert-consultation-on-cold-treatments/

[20] With regard to the three cold treatments submitted to CPM-10 for adoption, the Secretariat reminded the panel that these had previously received formal objections, responses to which were drafted by the TPPT at its 2014 face-to-face meeting and endorsed by the SC at its 2014 November meeting. The Secretariat further explained that, in response to a subsequent informal query by a contracting party regarding the treatment schedules presented in the three draft cold treatments, the TPPT in consultation with the Steward provided an explanatory document entitled "Influence of Treatment Efficacy on Selecting Phytosanitary Treatments" via the Secretariat. This document was agreed to by the TPPT and is appended to the present report (see Appendix 2).

Review of 2014 member consultation comments on six phytosanitary treatments

[21] The Secretariat explained that comments received during the member consultation (1 July to 30 November 2014) on six draft phytosanitary treatments were already under review by TPPT members but that treatment leads still needed to be formally assigned by the TPPT for four of these treatments. For the benefit of the new TPPT members a brief discussion followed outlining the requirements for the review of comments.

[22] The Secretariat highlighted the importance of meeting review and submission deadlines, as well as the availability of other panel members to assist the treatment leads in their review of comments or other tasks associated with advancing the draft PTs. By way of email exchange the deadline for the initial review of the comments had been set for 30 March 2015 and this was reaffirmed by the meeting participants; next steps would be discussed after the initial review was completed.

[23] The TPPT:

(1) *agreed* to assign the following TPPT members as treatment leads for the following four draft phytosanitary treatments:

a. High temperature forced air treatment for *Bactrocera melanotus* and *B. xanthodes* on papaya (2009-105): Mr Daojian YU

b. Cold treatment for *Ceratitis capitata* on *Citrus clementina* var. Clemenules (2010-102): Mr Eduardo WILLINK

c. Cold treatment for *Ceratitis capitata* on *Citrus sinensis* var. Navel and Valencia (2010-103): Mr Glenn BOWMAN

d. Irradiation treatment for *Ostrinia nubilalis* (2012-009): Mr Matthew SMYTH

TPPT recommendations for future research on high temperature forced air treatment

[24] The lead TPPT member for the development of a paper on "High temperature forced air treatment" introduced the paper, explaining it was being developed in an effort to provide recommendations to the treatment submitter. The original title of this paper: "High temperature forced air treatment for selected fruit fly species (Diptera: Tephritidae) in fruit" was reconsidered when the TPPT, at its 2013 meeting, considered the submitted data and noted these supported recommendations of HTFA treatment for only two tephritid fruit fly species, namely *Bactrocera melanotus* and *B. xanthodes*, on one fruit crop, *Carica papaya*. The TPPT changed the title to: "High temperature forced air treatment for *Bactrocera melanotus* and *B. xanthodes* on papaya" (2009-105)" as a result. The work underpinning this draft treatment was intended to provide support for a generic high temperature forced air (HTFA) treatment which would cover all fruit fly pests of quarantine concern, thus facilitating export of fruit.

[25] It was agreed that the panel would provide guidance to the treatment submitter on the research required to extend the treatment to other fruit fly species and hosts of interest to them in international trade. The paper thus intends to encourage the submitter, or indeed other interested parties, to consider submitting additional data in the future to add other fruit fly species or fruit commodities to a given treatment.

[26] The Secretariat provided a brief history of the document, noting that it had been drafted by the assigned lead and reviewed at the TPPT 2014 meeting. In consideration of the discussions at that meeting and subsequent comments provided by several TPPT members the lead revised the document and it was reviewed again in a TPPT e-forum discussion in January 2015. The accordingly revised draft was presented to the TPPT for discussion at the present meeting.

[27] It was further explained by the Secretariat that the procedure for making the document "TPPT recommendations for future research on high temperature forced air treatment" publically available would be to forward it to the SC, as part of the TPPT update at the next SC meeting (2015 May), for noting the document and requesting the Secretariat to append it to the report of the present meeting. The panel members indicated their agreement with the present version of the document and that it should therefore be submitted to the SC. Several comments were provided to the lead who will revise the document further, the revisions will be verified by the Rapporteur, and the document will be submitted to the SC May 2015 meeting. Once approved by the SC, it will be appended to the report of this meeting.

[28] The TPPT:

(2) *invited* the SC to note the document "TPPT recommendations for future research on high temperature forced air treatment", to be appended to the 2015 February TPPT virtual meeting report.

Characterization of heated air treatments

[29] The lead TPPT member introduced the paper and, by way of background, mentioned that concerns regarding the complexity of HTFA treatments had been raised during a TPPT e-forum discussion in August 2013. The issue of the characterization of heated air treatments was thus added to the TPPT work program in April 2014, with the objective of providing the following in the document:

- explanations of:
  - what type of information should be provided in heated air treatment proposal submissions;
  - the differences between vapour heat treatments (VHT) and HTFA treatments;
  - how temperatures should be recorded during experiments (e.g. highest temperature recorded during the confirmatory tests should be considered as a minimum requirement, minimum core temperature for the entire load and minimum time at that core temperature, heat-up time);
- describe what factors can affect efficacy of heat treatments and factors which may not be significant for commercial application;
- describe what type of information a treatment schedule should contain, giving examples of VHT and HTFA treatment schedules (e.g. hydro cooling is not part of a schedule).

[30] It was explained that this document outlined these issues and that the panel was requested to approve it for submission to the SC for noting and inclusion to the "Working TPPT criteria for treatment evaluation", which are published in the IPPC Standard Setting Procedure Manual[6].

[31] Two members considered that some of the information provided in the draft document "Characterization of heated air treatments" could be included in the paper on guidelines for the evaluation of treatment efficacy and the lead for the latter document invited members to provide him with comments and suggestions.

[6] IPPC Standard Setting Procedure Manual: https://www.ippc.int/en/core-activities/ippc-standard-setting-procedure-manual/

[32] One member requested clarification of a mention regarding heating rates with reference to work of Thomas and Shellie (2011). The treatment lead explained that the way it was written was correct, as it suggested that heat shock protein development can occur under commercial treatment scenarios where heating rates are slow. It was agreed that this document needed some slight adjustments to the text for better clarity.

[33] The panel members agreed to open an e-forum discussion to submit further comments and suggestions on the document to the lead. The Secretariat mentioned that an e-forum would be opened with urgency in order to have final agreement from the TPPT before presenting the document to the SC at its 2015 May meeting.

[34] The TPPT:

(3) *agreed* for the lead TPPT member to finalize the document "Characterization of heated air treatments" subsequent to an e-forum discussion soliciting final comments by TPPT members;

(4) *invited* the SC to note the document "Characterization of heated air treatments" for inclusion in the "Working TPPT criteria for treatment evaluation".

Extrapolation to estimate efficacy

[35] The lead TPPT member introduced the paper "Extrapolation to estimate efficacy", mentioning that he was tasked with producing a first draft at the 2014 TPPT meeting. It was explained that this document, once finalized, is to be submitted to the SC for inclusion in the "Working TPPT criteria for treatment evaluation".

[36] One member indicated that he had many comments to provide on the draft document and suggested an e-forum discussion be opened for comments to be submitted and views exchanged on the document. He highlighted that, as a starting point for discussion, it will need to be clarified if extrapolation was used to estimate efficacy or if it was rather a means of placing bounds on efficacy. The lead concurred that further consideration of these concepts in the context of high treatment levels was needed and emphasized the importance of confirmatory testing particularly in regard of phytosanitary treatments for fresh commodities where treatment levels hover on the edge of damaging the commodity whenkilling the target insects.

[37] It was agreed that this issue needs further discussion and that an e-forum will be opened in March 2015.

[38] The TPPT:

(5) *agreed* to hold an e-forum discussion on the document "Extrapolation to estimate efficacy" to provide comments and exchange views.

Technical support document for definition of effective dose

[39] The lead TPPT member introduced the paper "Technical support document for definition of effective dose", which has been produced in response to a request received by the SC after its 2014 May meeting for the TPPT to discuss the term *effective dose* (2013-017), taking into account the options proposed by the Technical Panel on Glossary.

[40] A suggestion was put forward to add a section at the end of the document to note the specific recommendations made by the TPPT to the SC, namely to invite the SC to consider the use of the recommended text to describe the level of efficacy achieved by a treatment schedule and to consider amending existing treatment schedules in accordance with the revised text.

[41] One panel member suggested to condense the text in the draft document to summarise more succinctly the various deliberations by the TPPT on the use of different options for stating treatment efficacy levels.

[42] The panel agreed that the treatment lead will adjust the draft document, considering the participants' comments and circulate the final version to panel members via e-mail for approval. Once approved it

will be submitted to the SC at its 2015 May meeting, inviting the SC to agree to the following text to describe the level of efficacy achieved by a treatment schedule, as outlined in the document "Technical support document for definition of effective dose":

> There is 95% confidence that the treatment according to this schedule [kills|inactivates|removes|renders infertile|devitalizes] not less than 99.9963% of [the treated pests].

[43] The TPPT:

(6) *invited the SC to agree* to the use of the following text to describe the level of efficacy achieved by a treatment schedule, as outlined in the document "Technical support document for definition of effective dose":

> There is 95% confidence that the treatment according to this schedule [kills|inactivates|removes|renders infertile|devitalizes] not less than 99.9963% of [the treated pests].

(7) *invited the SC to consider* whether the existing schedules included as annexes to ISPM 28 (*Phytosanitary Treatments for Regulated Pests*) should be amended to conform with the new format for describing the treatment efficacy.

4. Other business

Work programme

[44] The Secretariat mentioned that an e-forum discussion will be opened up soon for the review of the document "Instructions to assist NPPOs and RPPOs in proper and complete submissions".

Next virtual meeting/face-to-face meeting dates

[45] The next TPPT virtual meeting was agreed to be held on 26 May 2015.

[46] The Secretariat informed that the next face-to-face meeting will be held in Fukushima, Japan from 31 August to 4 September 2015.

Other business

[47] The Secretariat mentioned that one TPPT member enquired about the available documentation of the rationale for selecting the final dose for the treatment schedule in Annex 12 of ISPM 28. The member was informed that the Secretariat could not retrieve this information. A panel member offered to obtain this information from his notes and share it with the TPPT.

[48] The Secretariat informed the TPPT about the IPPC Photo Contest named "Pests without Borders!". It was mentioned that there were three thematic areas: pests, their impact on food security and the environment, and management of pests. Participants were encouraged to submit their photos by the deadline for submissions (28 February 2015). Winners of the contest will be announced at CPM-10 (2015).

5. Close of the meeting and feedback

[49] The Secretariat thanked all members for their participation and closed the meeting.

Appendix 1 - Agenda

2015 February TPPT Virtual Meeting

Meeting Schedule
17 February 2015

12:00 noon to 01:30 pm (Rome, Italy)

AGENDA

AGENDA ITEM	DOCUMENT NO.	PRESENTER
1. Opening of the meeting		NIYAZI
• Welcome by the IPPC Secretariat • Virtual meeting information for Adobe Connect • Adoption of the agenda and election of rapporteur	 02_TPPT_2015_Feb 01_TPPT_2015_Feb	
2. IPPC Secretariat Updates		NIYAZI
• Update from SC 2014 Nov • Update on CPM-10 • Status of draft PTs • Update on Expert Consultation on PTs for *Bactrocera dorsalis* complex		
3. TPPT Work Programme		
3.1 Review of member consultation (MC) comments on 6 draft PTs *(discussion to guide new TPPT members)* 3.2 TPPT recommendations for future research on HTFA treatment 3.3 Characterization of heated air treatments 3.4 Extrapolation to estimate efficacy 3.5 Technical support document for glossary definition of effective dose	 03_TPPT_2015_Feb 04_TPPT_2015_Feb 05_TPPT_2015_Feb 06_TPPT_2015_Feb	 ORMSBY HALLMAN HALLMAN ORMSBY
4. Other business		NIYAZI
• Work programme • Next virtual meeting/face-to-face meeting dates • Any other business		
5. Close of the meeting and feedback		

Appendix 2

Influence of Treatment Efficacy on Selecting Phytosanitary Treatments

(prepared by the TPPT)

[1] The Technical Panel for Phytosanitary Treatments (TPPT) evaluates submitted phytosanitary treatments to ensure they meet the requirements of ISPM 28 (*Phytosanitary Treatments for Regulated Pests*). ISPM 28 states that "..adopted treatments provide the minimum requirements necessary to control a regulated pest at a stated efficacy." This stated efficacy is required to enable member countries to select treatments that provide a level of protection equivalent to that country's acceptable level of protection (ALOP). TPPT calculates the level of efficacy of a submitted treatment from the information provided and publically available to the 95% level of confidence.

[2] In developing phytosanitary treatments internationally, researchers may create data on the same treatment type over a number of different treatment conditions e.g. irradiation doses at different temperatures, temperature treatments over different durations etc. Where these efficacy data can be justifiably combined the TPPT will do so to provide a higher efficacy level for a particular treatment schedule. However the efficacy data often cannot justifiably be combined and different but closely related treatment schedules result.

[3] These separate schedules will (more than likely) have differing levels of demonstrated efficacy. In these cases the TPPT considers the least stringent treatment schedule (e.g. warmer cold treatment or cooler heat treatment etc) will be recommended to the SC for their consideration if that treatment has the highest level of demonstrated efficacy. Where more stringent treatments have a higher level of efficacy, both the less stringent treatment schedule and the more stringent treatment schedule with the higher level of efficacy will be recommended. The latter case will allow contracting parties the option of selecting the more stringent treatment for use if the efficacy of the less stringent treatment does not meet their ALOP.

[4] In the current situation of the cold treatment schedules for Queensland fruit fly (*Bactrocera tryoni*):

- Treatments 2007-206 E and F: the 2°C schedules were not specifically stated, as the **less stringent 3°C schedules showed higher efficacy**, and the 2°C schedules would be covered by stating that the treatment had to be **at 3°C or below**, rendering the more stringent 2°C schedule redundant.
- Treatment 2007-206 G: Both schedules (2 and 3°C) were retained separately as the **less stringent 3°C treatment has a lower efficacy** than the more stringent 2°C treatment.

[5] **Table 1: Decision analysis for schedule selection of cold treatments for Queensland fruit fly**

Treatment Label	Treatment Schedule	Level of Efficacy (at 95% level of confidence)	Decision
2007-206E - Navel Oranges	2°C for 16 days	99.9973%	**Not proposed (lower efficacy)**
	3°C **or below** for 16 days	99.9981%	**Proposed (less stringent)**
2007-206E - Valencia Oranges	2°C for 16 days	99.9960%	**Not proposed (lower efficacy)**
	3°C **or below for**	99.9973%	**Proposed (less stringent)**

	16 days		
2007-206F - Tangor	2°C for 16 days	99.9968%	**Not proposed (lower efficacy)**
	3°C **or below** for 16 days	99.9986%	**Proposed (less stringent)**
2007-206G - Lemons	2°C for 14 days	99.99%	**Proposed (highest efficacy)**
	3°C for 14 days	99.9872%	**Proposed (less stringent)**

Appendix 3

TPPT Recommendations for Future Research on High Temperature Forced Air Treatment

(TOWARDS A POSTHARVEST HEAT TREATMENT AGAINST FRUIT FLIES OF ECONOMIC IMPORTANCE IN THE PACIFIC REGION)

Name of treatment	**High temperature forced air treatment for selected fruit fly species (Diptera: Tephritidae) in fruit.**
Treatment type	Heat
Target pests	*Anastrepha ludens* (Loew), *Anastrepha suspensa* (Loew), *Bactrocera cucurbitae* (Coquillett), *Bactrocera dorsalis* (Hendel), *Bactrocera facialis* (Coquillett), *Bactrocera kirki* (Froggatt), *Bactrocera melanotus* (Coquillett), *Bactrocera passiflorae* (Froggatt), *Bactrocera psidii* (Froggatt), *Bactrocera tryoni* (Froggatt), *Bactrocera xanthodes* (Broun), *Ceratitis capitata* (Wiedemann), (Diptera: Tephritidae)
Target regulated articles	Fruit hosts of tephritid fruit flies (Diptera: Tephritidae).
Treatment schedule	Exposure in a forced air chamber: • at a minimum of 60% relative humidity; • to air temperatures increasing from room temperature to 48.5°C; • for at least 3 hours or until core temperature reaches 47.5°C; • followed by 20 minutes in a forced air chamber at 60% relative humidity and an air temperature of 48°C and fruit pulp temperature at a minimum of 47.5°C; • after which fruit are hydro-cooled in a shower of water at 24-26°C for 70 minutes.

Background

[1] The IPPC Technical Panel on Phytosanitary Treatments (TPPT) reviewed additional information submitted in support of the original proposal entitled: *High temperature forced air treatment for selected fruit fly species (Diptera: Tephritidae) in fruit (2009-105).*

[2] In evaluating this treatment the TPPT considered the technical justification for including other pest tephritid fruit flies (*Anastrepha ludens* (Loew), *Anastrepha suspensa* (Loew), *Bactrocera cucurbitae* (Coquillett), *Bactrocera dorsalis* (Hendel), *Bactrocera facialis* (Coquillett), *Bactrocera kirki* (Froggatt), *Bactrocera melanotus* (Coquillett), *Bactrocera passiflorae* (Froggatt), *Bactrocera psidii* (Froggatt), *Bactrocera tryoni* (Froggatt), *Bactrocera xanthodes* (Broun) and *Ceratitis capitata* (Wiedemann) and other fruit crops (all fruit hosts of tephritid fruit flies) in the treatment description as originally submitted.

TPPT recommendations

[3] The TPPT is recommending including only the two pest tephritid fruit flies, *B. melanotus* and *B. xanthodes* for only one fruit crop, *Carica papaya*, based on the work presented, in this treatment.

[4] The proposed treatment is based on:

- Exposure in a forced air chamber;
- At a minimum of 60% relative humidity;

- To air temperatures increasing from room temperature to 48.5°C;
- For at least 3 hours or until core temperature reaches 47.5°C;
- Followed by 20 minutes in a forced air chamber at 60% relative humidity and an air temperature of 48°C and fruit pulp temperature at a minimum of 47.5°C
- After which fruit are hydro-cooled in a shower of water at 24-26°C for 70 minutes
- With an Effective Dose $(ED)_{99.9914}$ at a confidence level of 95%.

Reasons for TPPT recommendations

[5] The original submission included twelve tephritid species, mostly of importance to exports of host fruit from the Pacific region. A subsequent re-submission deleted two Anastrepha species and Ceratitis capitata from the original list. That left nine Bactrocera species of direct economic importance to Oceania.

[6] The panel had concerns with the quality of data provided and whether it was possible to compare thermotolerance of different species using data from different laboratories. It was also noted that there may be difficulties with approval of this treatment as importing countries may not accept a generic treatment for all fruit fly species on all fruit fly host fruits from the Pacific region based on the publications and unpublished data mentioned in the re-submission.

[7] It is understood that there is much historical evidence for the success of this high temperature forced air (HTFA) schedule in international trade on a number of pest tephritids in a range of exported commodities and from a number of Pacific island nations. However, these data have not been made available in the submission.

[8] Studies reported here on determining the most thermotolerant life stages of the insects were completed in hot water baths. It is not known if insects treated in a hot water dip (HWD) respond the same way to those treated with vapour heat (VHT) or with HTFA. It may also be unlikely that naked insect life stages dipped in hot water respond to heat in the same manner as insects in fruit dipped in hot water. Research comparing naked insect reactions with insects in fruit and also on naked insects dipped in water compared with insects in fruit in VHT or HTFA should be done before using naked stages to develop treatments. The panel considers that the use of the HWD method to determine the most tolerant life stage for a species may not be consistent with in-fruit tests, and this has indeed been suggested from the results of comparative trials between HWD and VHT (Merino et al., 1985) and HWD and HTFA (Waddell et al., 1993). Therefore, the panel considered that, although HWD testing would show differences in heat tolerances between species, life-stage differences to the treatment schedule within a species could be determined only by treatment of the different stages infesting fruit in a way that closely mimics nature. This is in part because the fruit fly life stages occur in different areas of the fruit (e.g. eggs at the surface and third instar larvae towards the centre), thus, receive different total exposures to temperature during the treatment.

[9] Species tolerances to treatments are compared between different Pacific islands over varying periods of time and under different laboratory conditions, making comparisons among studies precarious. Conflicting data (e.g. which species is the more heat tolerant and different LD99 values given for the same species but from different laboratories) are evident from comparisons of heat tolerance between species when carried out at different laboratories over differing time periods. However, the panel considered that the comparative species tolerance testing between B. melanotus and B. xanthodes by Waddell et al. (1993) was carried out adequately and confirmed that B. melanotus is the more heat tolerant of the two species.

[10] Much of the submitted supporting data do not describe the actual treatment sufficiently well. For example, no mention is made of heat ramping up time or of the need for hydrocooling after treatment.

[11] Temperature treatments for determination of most tolerant life stage were applied in two different ways by:

- Increasing temperature; or
- Increasing exposure times to a single temperature.

[12] Often no statistical analysis of the research data was provided to showif differences in life-stage responses were significant.

[13] Most of the tests shown in supporting documents relate only to 99% mortality (LD_{99}) for evidence of treatment efficacy. This may be insufficient for international acceptance. The TPPT considered it unlikely that there would be international (e.g. IPPC) acceptance of LT99 as the criterion for treatment efficacy.

[14] The IPPC generally requires that at least 95% Confidence Intervals be given for all data on LT values. Many of the supporting documents do not provide these.

[15] All of the tests were applied to *Carica papaya* only. No results for other fruit types could be found in the literature, so the panel considered the schedule should be recommended only for papaya.

Discussion on future research

[16] There is an obvious benefit for creating a single heat disinfestation treatment schedule for a range of fruit commodities against a range of pest fruit flies found in the southern Pacific. The strategy was to use published literature and unpublished documents resulting from a large number of similar experiments which were not originally designed to work together. However, for the reasons given above, the TPPT could not recommend this approach due to major differences and inconsistencies between these results.

[17] A single regional treatment schedule could be developed in a number of ways.

[18] The most scientifically valid way would be to carry out standard heat disinfestation trials for each target fruit fly species in each target fruit within each nation:

- Determination of the life history of eggs and larvae,
- Determination of the most treatment tolerant life stage and
- Determination of the efficacy of the treatment through large scale confirmatory trials.

[19] This pathway would be time consuming and costly and would most likely end up with a whole series of different treatment schedules for different fruit fly species, different fruit and even the same fruit fly species but in different countries. This latter problem has occurred over the long history of cold treatment research and development.

[20] An alternative to the above method would be for each country to determine which fruit in which each of their endemic/ established pest fruit fly species is most heat tolerant. Ideally each fruit fly species would be assessed for their most heat tolerant immature life stage prior to carrying out tests on different fruits. Determination of the most heat tolerant life stage would need to be done in fruit (not *in vitro*). This would mean that several fruit types would need to be infested with the most heat tolerant immature life stage of each target pest fruit fly species. The fruit would then be heat treated and assessed to determine which fruit type had the most survivors after treatment. Then the fruit with most survivors would be infested with the most heat tolerant insect life stage of each pest species, heat treated and assessed for insect survival. Again, this pathway is long and costly.

[21] Another way would be for each country to determine the most heat tolerant combination of life stage, pest fruit fly, and host fruit. Confirmatory trials could then be completed on this most heat tolerant combination or set of combinations if they differ between countries.

Recommendations for future research

[22] None of the above methods address the desirability to create a generic approach that will be accessible for all countries in the region as it is difficult and likely to be costly to carry out tests against all target fruit fly species and host material in one location due to practical and quarantine reasons.

[23] However, the TPPT considers that there is potential to use the treatment schedule recommended above (see the box at the top of page 1 next to "Treatment schedule") as the basis for comparisons of different fruit and different fruit fly species in different countries. It would be scientifically valid to apply an agreed target temperature for varying durations (e.g. 47°C for 1, 5, 10 and 20 minutes) to identify the most heat tolerant combination of fruit fly life stage, species and host in each country.

[24] Unless there is ample justification given to do otherwise:

1. the determination of the most heat tolerant immature life stage will need to be done in HTFA treated infested fruit (not naked eggs and larvae in hot water). However, it may be acceptable to carry out this determination using infested fruit heat treated in a HWD if the response between the two treatment methods is demonstrated to be adequately similar.
2. juvenile life stages should develop in fruit rather than be grown on artificial diet and placed into cuts in the fruit unless evidence can be provided that artificial growth substrates and artificial infestation do not significantly affect fruit fly heat tolerances.

[25] Determination of the most heat tolerant immature life stage would be done for a representative number of fruit fly species and exportable fruit hosts present in the region. Large scale confirmatory trials would be done in the countries where the most tolerant combinations of fruit flies and hosts exist. Communication and research coordination among exporting and importing countries would guide the research and confirmatory process which would be flexible enough to change as the ongoing results and circumstances dictate.

Recommendation in brief

1. Participating countries agree to common experimental procedures to determine the most heat tolerant life stage of their own pest fruit fly species and their own host fruit.
2. Immature life stages are treated in fruit under HTFA following a discriminating treatment schedule patterned after the one recommended in this document. It is important that the schedule allow for a small amount of survivors in almost all cases to be able to identify most thermotolerant entities.
3. Data are analysed to determine the most heat tolerant life stage of each fruit fly species in each fruit.
4. One country or more will carry out large scale confirmatory tests against the most heat tolerant combination of fruit fly life stage, species and host.
5. Appropriate statistical techniques should then be used to estimate the likely effective dose at the 95% level of confidence.

References

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