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International Plant Protection Convention

REPORT

Technical Panel on Phytosanitary Treatments

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Shenzhen, China

25 – 29 June 2018

IPPC Secretariat

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1. Opening of the Meeting

Opening remarks by the Secretariat

[1] The International Plant Protection Convention (IPPC) Secretariat (hereafter referred to as the "Secretariat") thanked the Shenzhen Academy of Inspection and Quarantine for hosting the meeting and welcomed the members of the Technical Panel on Phytosanitary Treatments (TPPT). The representatives of the host agency opened the meeting.

[2] The Secretariat highlighted that the TPPT, since its establishment in 2004, has developed 32 phytosanitary treatments (PTs) and several International Standards for Phytosanitary Measures (ISPMs), one of which has already been adopted, the ISPM 42 (*Requirements for the use of temperature treatments as a phytosanitary measures*)[1]. The Secretariat also stressed the importance of these PTs to safe trade facilitation. The Secretariat reminded the TPPT of three key concepts to keep in mind during the meeting: transparency, technical justification, and safe trade facilitation. The Secretariat also reminded the participants how phytosanitary treatments contribute to the IPPC mission, the FAO strategic objectives and the United Nations sustainable development goals.

[3] The Secretariat thanked China for their continuing support to the IPPC Secretariat and their excellent organization of this meeting.

Opening remarks by the Host Agency

[4] The meeting was hosted by the Shenzhen Academy of Inspection and Quarantine (established by the Shenzhen Entry-Exit Quarantine and Inspection Bureau of the General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) and Shenzhen Municipal Science and Technology Innovation Committee). Mr Zhenshuan ZHAO (General Director, Shenzhen Customs District P.R. China), Mr Xiaodong FENG (on behalf of the Director of Plant Quarantine, IPPC official contact point of China), Ms Junwen LOU (Deputy General Director, Department of Supervision for Animal and Plant Quarantine, General Administration Customs of P.R. China), and Mr Shizhen SHI (Director of Standards Division, Market and Quality Supervision Commission of Shenzhen Municipality) warmly welcomed all the participants.

2. Meeting Arrangements

Election of the Chairperson

[5] The TPPT elected Mr Matthew SMYTH as Chairperson. He thanked Mr Daojian YU and the other organizers for hosting the TPPT meeting.

Election of the Rapporteur

[6] The TPPT elected Mr Michael ORMSBY as Rapporteur.

Adoption of the agenda

[7] The TPPT reviewed and adopted the agenda (Appendix 1).

3. Administrative Matters

Documents list

[8] The TPPT reviewed the documents list (Appendix 2).

Participants list

[9] The TPPT noted the passing of Mr Glenn BOWMANN, one of its members, and extended their condolences to his family and colleagues.

[1] Adopted ISPMs page: https://www.ippc.int/en/core-activities/standards-setting/ispms/

[10] The TPPT noted that Mr Andrew PARKER (TPPT member) and Mr David OPATOWSKI (TPPT Steward) were unable to attend the meeting. Mr Guoping ZHAN attended the meeting on behalf of the host agency. The Participants list is presented in Appendix 3.

[11] The TPPT members reviewed their contact information and noted to update it on the International Phytosanitary Portal (IPP)[2].

[12] The Secretariat was represented by Ms Adriana MOREIRA and Ms Janka KISS, who provided support to the panel and to meeting.

Local information

[13] Mr Daojian YU provided further information regarding the local arrangements and logistics[3].

4. Draft Phytosanitary Treatments (PTs) in the Work Programme

[14] The Secretariat provided an overview of the Standard setting process and introduced the list of treatments currently on the TPPT work programme[4] (see also *List of topics for IPPC standards*[5]).

[15] All references quoted in the main part of the report are listed in Appendix 4.

4.1 Cold treatment of *Ceratitis capitata* on table grapes (2017-023A) – priority 1

[16] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Toshiyuki DOHINO, introduced the draft PT and the summary[6].

[17] The Cold disinfestation of Australian table grapes against Mediterranean fruit fly and Queensland fruit fly (2017-023) was submitted by Australia. The TPPT discussed the submission at their 2017 July meeting (Vienna)[7] and recommended splitting the submitted treatments into two: "Cold treatment of *Ceratitis capitata* on table grapes" (2017-023A) and "Cold treatment of *Bactrocera tryoni* on table grapes" (2017-023B). The TPPT recommended the PTs to the Standards Committee (SC) for inclusion into the TPPT work programme, both with priority 1, and the SC have added the PTs to the *List of topics for IPPC standards*.

[18] **Supporting information.** At their July 2017 meeting, the TPPT strongly encouraged the submitter to make the confidential information supporting this submission (De Lima *et al.*, 2007) publicly available. The submitter has agreed to the release of the information.

[19] **Treatment end point.** At their 2017 July meeting, the TPPT also agreed that failure to pupariate was an appropriate measure of mortality and has already been approved in other PTs (PT 24, PT 25, PT 26 and PT 30).

[20] **Treatment schedule.** The draft PT has three schedules based on the work of De Lima *et al.* (2007) and De Lima *et al.* (2011).

[21] **Experimental conditions.** Larval developmental studies in table grapes (cultivars 'Red Globe', 'Crimson Seedless', 'Thompson Seedless') at 26 °C have been conducted with artificial inoculation of eggs.

[2] TPPT membership list: https://www.ippc.int/en/publications/81655/
[3] 04_TPPT_2018_Jun
[4] 05_TPPT_2018_Jun_Rev1
[5] *List of topics for IPPC standards*: https://www.ippc.int/en/core-activities/standards-setting/list-topics-ippc-standards/list
[6] 2017-023A, 06_TPPT_2018_Jun
[7] 2017-07 TPPT meeting report: https://www.ippc.int/en/publications/85139/

[22] Most tolerant life stage trials in each cultivar at 1 °C, 2 °C and 3 °C have indicated that the second instar is the most cold tolerant stage.

[23] Large-scale confirmatory trials have been conducted using the most tolerant life stage (second instar) in each cultivar. Fruit infested with first instar and second instar were used (6–7 days after egg inoculation). Treatments of 1.0±0.5 °C for 16 days, 2.0±0.5 °C for 18 days, and 3.0±0.5 °C for 20 days provided no survivors from three replications per cultivar per treatment condition.

[24] On the topic of artificial infestation, the TPPT concluded that as long as the larvae developed in the fruit and consumed it, the infestation method is not affecting the tolerance of the insect (as opposed to late instar larvae planted into the fruit, instead of the egg).

[25] **Most tolerant life stage.** One member queried how it was determined that the second stage is the most resistant stage, and the Treatment Lead explained that it was based on the assessment of one of the studies undertaken by De Lima *et al.* (2011).

[26] It was discussed that the TPPT have previously compiled studies to determine the most tolerant life stage of *Ceratitis capitata* and found that the third instar was the most cold tolerant, with the exception of one study that concluded that the second instar was slightly more tolerant.

[27] After discussing the available studies, the TPPT concluded that differences between the tolerance of second and third instars are minor, and at the 95% confidence level their confidence intervals overlap. Therefore, studies using either second or third instar conclude similarly and there are no concerns that the phytosanitary treatment would not be sufficiently effective against all eggs and larvae – which is consistent with the wording in the draft PT.

[28] Furthermore, one member stated that a study of De Lima *et al.* (2017) provides a data set from preliminary trials that would support a 14 day cold treatment, however these data were not included in the submission and need to be confirmed through further large-scale confirmatory trials. The TPPT decided to propose that the current PT proposal is 16 days, as this is supported by extensive studies.

[29] **Title.** The TPPT agreed to change the title to include the scientific name of the commodity as follows: Cold treatment for *Ceratitis capitata* on *Vitis vinifera* (2017-023A).

[30] **Scope.** One member suggested that “mortality” be replaced with “prevention of pupariation”. Although the TPPT considered that this is more technically precise, it is mentioned later in the text of the draft PT that this is the treatment endpoint. Moreover, it is not included in the scope of adopted cold treatments as it is considered too much detail for the scope. For this reason, the TPPT agreed to use “control” in the scope and included further details on the outcome of the treatment in the “Treatment schedule” and “Other relevant information” sections.

[31] **Treatment schedule.** The draft PT contains three schedules:

- Schedule 1: 1 °C or below for 16 continuous days
- Schedule 2: 2 °C or below for 18 continuous days
- Schedule 3: 3 °C or below for 20 continuous days.

[32] **Cultivars.** The TPPT agreed to combine the efficacy results of the three grape cultivars as there are no differences indicated between them. The Treatment Lead was asked to combine the three efficacy calculations for the three varieties and only indicate one efficacy number as the efficacy for all grape species.

[33] **Number of insects tested.** As the efficacy ultimately depends on the number of insects tested (e.g. the more tested, the more certain it is that none survives), one member suggested that this should be included in the draft to increase confidence and ease of understanding of the PT and what the efficacy means.

[34] It was also mentioned that the number of life stages at the time of the treatment is an estimation. The total number of treated insects given in the study is estimated based on counting the number of pupae

developing in the control. The TPPT agreed to include an additional sentence indicating the number of insects treated for each schedule in the “Other relevant information” section in each new draft PT.

[35] **Efficacy.** The TPPT had a general discussion on the importance of efficacy and how they help contracting parties choose the treatments that match or exceed their acceptable level of protection.

[36] Some members suggested that the efficacy be removed from the “Treatment schedule” section and included instead in the “Other relevant information”. Other members argued that the efficacy is an essential part of the PTs and should be included earlier rather than later as it is also used to distinguish between the schedules. The TPPT decided to keep it as it is.

[37] The Treatment Lead explained that the numbers used to calculate the efficacy originated from the report of De Lima *et al.* (2007) submitted by Australia along with the submission[8] based on which a paper was published in 2011 by Lima *et al*.

[38] The Treatment Lead also explained that he had calculated the efficacy based on the number of second instars and removed the other life stages. The TPPT noted that while the treatment was timed to optimize the number of the most tolerant life stage, other life stages would invariably be present. The TPPT discussed whether to use only one life stage (the most tolerant) when calculating efficacy, or all life stages that were in the treated fruit. Given that targeting the most tolerant life stage was creating a worst case scenario even if other life stages were present, the TPPT decided to use the total number of insects treated in the study, not only the most tolerant life stage.

[39] The efficacy was recalculated using the cumulative number of treated insects in each grape cultivar based on discussions within TPPT. The efficacy calculations for this PT can be found in Appendix 5.

[40] The TPPT:

(1) *recommended* the draft PT Cold treatment for *Ceratitis capitata* on *Vitis vinifera* (2017-023A) to the Standards Committee (SC) for approval for first consultation.

4.2 Cold treatment of *Bactrocera tryoni* on table grapes (2017-023B) – priority 1

[41] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Toshiyuki DOHINO, introduced the draft PT and the summary[9].

[42] The Cold disinfestation of Australian Table grapes against Mediterranean fruit fly and Queensland fruit fly (2017-023) was submitted by Australia. The TPPT discussed the submission at their 2017 July meeting (Vienna)[10] and recommended splitting the submitted treatments into two different subjects: “Cold treatment of *Ceratitis capitata* on table grapes” (2017-023A) and “Cold treatment of *Bactrocera tryoni* on table grapes” (2017-023B). The TPPT recommended the PTs to the SC for inclusion into the TPPT work programme, both with priority 1, and the SC have added the PTs to the *List of topics for IPPC standards*.

[43] **Supporting information.** At their July 2017 meeting, the TPPT strongly encouraged the submitter to make the confidential information supporting this submission publicly available (NSW DPI 2007). The submitter has agreed to the release of the information.

[44] **Treatment end point.** At their 2017 July meeting, the TPPT also agreed that failure to pupariate was an appropriate measure of mortality and has already been approved in other PTs (PT 24, PT 25, PT 26 and PT 30).

[45] **Title.** The TPPT agreed to change the title to include the scientific name of the commodity as follows: Cold treatment for *Bactrocera tryoni* on *Vitis vinifera* (2017-023B).

[8] Link to the supporting documentation: https://www.ippc.int/en/publications/84525/

[9] 2017-023B, 07_TPPT_2018_Jun

[10] 2017-07 TPPT meeting report: https://www.ippc.int/en/publications/85139/

[46] **Treatment schedule.** The original submission contained three different schedules, but one schedule (2 °C or below for 14 continuous days) was removed as it does not provide greater efficacy than the less stringent one. Therefore, the TPPT agreed to include the below two:

- Schedule 1: 1 °C or below for 12 continuous days
- Schedule 2: 3 °C or below for 14 continuous days.

[47] **Most tolerant life stage.** Trials at 1 °C (‘Ruby Seedless’, ‘Flame Seedless’, ‘Thompson Seedless’), 2 °C (cultivars ‘Red Globe’, ‘Crimson Seedless’, ‘Thompson Seedless’) and 3 °C (same cultivars as 2 °C) have indicated that the first instar is the most cold tolerant stage although eggs were numerically the most tolerant in ‘Thompson Seedless’ at 1 °C. The Probit analysis (LD_{99} with 95% Cl) showed that there was no statistical difference between ‘Thompson Seedless’ and the other two cultivars (‘Ruby Seedless’ and ‘Flame Seedless’ at 1 °C; ‘Red Globe’ and ‘Crimson Seedless’ at 2 °C and 3 °C).

[48] Large-scale confirmatory trials with the most tolerant life stage (i.e. first instar) in each cultivar at 1.0±0.5 °C for 12 days, 2.0±0.5 °C for 14 days, and 3.0±0.5 °C for 14 days resulted in no survivors.

[49] **Experimental conditions.** The number of insects in the control (and consequently the estimated treated numbers) varied considerably in the first trial conducted at 1 °C on the ‘Flame Seedless’ cultivar because of the natural infestation methods used (poor oviposition). This resulted in an error when calculating the efficacy. To manage this variation, artificial infestation methods were used for the rest of the varieties in the 1 °C trial and for the 2 °C and 3 °C trials. Therefore, the TPPT agreed to calculate the efficacy separately for the replicates using natural and artificial infestation and provided the efficacy calculations in Appendix 6.

[50] The artificial infestation consisted of the pricked fruit dipped in a slurry of eggs; after hatching, the larvae burrowed into the fruit without having to break through the barrier of the skin of the fruit.

[51] **Efficacy.** The Treatment Lead explained that the numbers used to calculate the efficacy originated from the report of NSW DPI (2007) submitted by Australia along with the submission[11] based on which a paper was published in 2011 by Lima *et al*. The Treatment Lead and another TPPT member recalculated the efficacy and the number of treated insects again based on the discussion of the TPPT (including all grape varieties and replicates but separating out the natural and artificial infestation) (Appendix 6).

[52] **Temperature.** The TPPT had a discussion referring to considerations reported under agenda item 11.1 Evaluation criteria for temperature treatment exposure parameters. They discussed whether to use the mean of the measured temperatures in the trials in the treatment schedule, or the lowest measured one, knowing that the commercial practice is to keep the commodity *below* the temperature determined in the treatment schedule (going above the set temperature is regarded as treatment failure). The TPPT decided to use the mean temperature, to not to be too trade restrictive, and as this trial used a lot of replicates (where many of the treatment temperatures were above the proposed schedule), there is a very high confidence of its efficiency.

[53] In line with the decision of the TPPT reported under agenda item 4.1 the estimated number of treated insects were included in the PT.

[54] It is noted, however, that the calculation of efficacy at 1 °C was not completed in the meeting. This will be rechecked by the Treatment Lead at a later point and if there are concerns the TPPT may decide to reopen the discussion on the efficacy.

[55] The TPPT:

(2) *recommended* the draft PT Cold treatment for *Bactrocera tryoni* on *Vitis vinifera* (2017-023B) to the Standards Committee (SC) for approval for first consultation.

[11] Link to the supporting documentation: https://www.ippc.int/en/publications/84525/

4.3 Cold treatment of *Ceratitis capitata* on stone fruit (2017-022A) – priority 1

[56] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Toshiyuki DOHINO, introduced the draft PT and the summary[12].

[57] Cold disinfestation of Australian stone fruit against Mediterranean fruit fly and Queensland fruit fly (2017-022) was submitted by Australia. The TPPT discussed the submission at their 2017 October virtual meeting[13]. The TPPT recommended splitting the submitted treatments into two different subjects: "Cold treatment of *Ceratitis capitata* on stone fruit" (2017-022A) and "Cold treatment of *Bactrocera tryoni* on stone fruit" (2017-022B). The TPPT recommended them to the SC for inclusion into the TPPT work programme, both with priority 1, and the SC have added the PTs to the *List of topics for IPPC standards*.

[58] **Supporting information.** At their July 2017 meeting, the TPPT strongly encouraged the submitter to make the confidential information supporting this submission publicly available (De Lima, 2011). The submitter has agreed to the release.

[59] **Target regulated articles.** The Treatment Lead clarified that "the term 'stone fruit' is used to cover fruits of the *Prunus* species, e.g. peaches, nectarines, plums, cherries and apricots". The TPPT agreed to include the specific stone fruits that the supporting study uses as target regulated articles: *Prunus avium* (cherry), *Prunus persica* var. *nectarina* (nectarine), *Prunus persica* (peach) and *Prunus domestica* (plum).

[60] One member queried whether to make a distinction between nectarines and peaches, as they are the same species (*Prunus persica*). The TPPT agreed that with regards to cold treatments, the differences between peaches and nectarines are negligible and the treatment developed on nectarines could be applied to peaches as well. It was discussed that the difference between peaches and nectarines is one gene mutation (Vendramin *et al.*, 2014) that results in the fuzziness in case of the peach. The TPPT agreed to combine nectarines and peaches into one schedule and to include an explanation on this in the "Other relevant information" section.

[61] **Efficacy.** The TPPT discussed whether to combine the efficacy of all treatments or to list them separately for each fruit species and decided to indicate separate efficacies for each species. The efficacy of the treatment for *Prunus persica* has been recalculated combining nectarines and peaches (Appendix 7).

[62] **Treatment schedule.** The submission contains the following two schedules:

- Schedule 1: 1 °C for 16 days
- Schedule 2: 3 °C for 20 days.

[63] **Title.** The TPPT decided to remove stone fruit from the title to avoid confusion and list the species included in the trial instead, using the scientific names as in the other PTs.

[64] **Treatment schedule.** The Treatment Lead calculated the efficacy for each variety of each fruit species, and also a combined efficacy for the species (disregarding the cultivars) based on the data provided in De Lima (2011).

[65] **Number of treated insects.** In line with the decision of the TPPT reported under agenda item 4.1, the estimated number of treated insects was included in the PT for all efficacy calculations.

[12] 2017-022A, 08_TPPT_2018_Jun

[13] 2017-10 TPPT Meeting report: https://www.ippc.int/en/publications/85545/

[66] The TPPT:

(3) *recommended* the draft PT Cold treatment for *Ceratitis capitata* on *Prunus avium*, *Prunus domestica* and *Prunus persica* (2017-022A) to the Standards Committee (SC) for approval for first consultation.

4.4 Cold treatment of *Bactrocera tryoni* on stone fruit (2017-022B) – priority 1

[67] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Toshiyuki DOHINO, introduced the draft PT and the summary[14].

[68] Cold disinfestation of Australian stone fruits against Mediterranean fruit fly and Queensland fruit fly (2017-022) was submitted by Australia. The TPPT discussed the submission at their 2017 October virtual meeting[15]. The TPPT recommended splitting the submitted treatments into two different subjects: "Cold treatment of *Ceratitis capitata* on stone fruit" (2017-022A) and "Cold treatment of *Bactrocera tryoni* on stone fruit" (2017-022B). The TPPT recommended them to the SC for inclusion into the TPPT work programme, both with priority 1, and the SC have added the PTs to the *List of topics for IPPC standards*.

[69] **Supporting information.** At their July 2017 meeting, the TPPT strongly encouraged the submitter to make the confidential information supporting this submission publicly available (NSW DPI, 2008; NSW DPI, 2012). The submitter has agreed to the release.

[70] **Target regulated articles.** See discussion reported under agenda item 4.3.

[71] **Treatment schedule.** The submission contains the following two schedules:

- Schedule 1: 1 °C or below for 14 continuous days (for *P. persica*)
- Schedule 2: 3 °C or below for 14 continuous days (for *P. persica*, *P. domestica* and *P. avium*).

[72] The TPPT decided to remove the original proposed schedule of 1 °C for *P. domestica* and *P. avium* because it was shown to have a lower efficacy than the less restrictive schedule of 3 °C.

[73] **Efficacy.** The efficacy of the treatment for *Prunus persica* was calculated using the data from the studies on nectarine.

[74] **Title.** The TPPT decided to remove stone fruit from the title to avoid confusion and list the species included in the trial instead, using the scientific names as in the other PTs.

[75] **Other relevant information.** The TPPT agreed to include the estimated number of treated insects for all fruit species.

[76] The TPPT:

(4) *recommended* the draft PT Cold treatment for *Bactrocera tryoni* on *Prunus avium*, *Prunus domestica* and *Prunus persica* (2017-022B) to the Standards Committee (SC) for approval for first consultation.

4.5 Irradiation treatment for the genus *Anastrepha* (2017-031) – priority 1

[77] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Guy HALLMAN, introduced the draft PT and the summary[16].

[78] The Irradiation treatment for the genus *Anastrepha* (2017-031) was submitted by Mexico. The TPPT discussed the submission at their 2017 November virtual meeting[17]. The TPPT recommended it to the

[14] 2017-022B, 09_TPPT_2018_Jun

[15] 2017-10 TPPT Meeting report: https://www.ippc.int/en/publications/85545/

[16] 2017-031, 65_TPPT_2018_Jun

[17] 2017-11 TPPT Meeting report: https://www.ippc.int/en/publications/85546/

SC for inclusion into the TPPT work programme with priority 1 and the SC have added the PT to the *List of topics for IPPC standards*.

[79] A 70 Gy schedule is proposed for all of the known species of economic importance in the genus *Anastrepha* (Diptera: Tephritidae). The Treatment Lead introduced the discussion paper[18] outlining the justification and references for this dose.

[80] **Approved PTs for *Anastrepha* species.** The TPPT noted that three irradiation treatments for *Anastrepha* species are already approved (PT 1, PT 2 and PT 3) along with a generic treatment for Tephritidae (Table 1).

Table 1. PTs that include irradiation of *Anastrepha*

Phytosanitary treatment	Target pest	Dose	Efficacy
PT 1	*Anastrepha ludens*	70 Gy	99.9968%
PT 2	*A. obliqua*	70 Gy	99.9968%
PT 3	*A. serpentina*	100 Gy	99.9972%
PT 7	Tephritidae	150 Gy	99.9968%

[81] The Treatment Lead explained that the large-scale confirmatory trial at a target dose of 60 Gy (absorbed dose measurements were as high as 69 Gy) with *A. ludens* supported a dose of 70 Gy, and two further studies indicated that *A. obliqua* was not more radio-tolerant than *A. ludens*; thus, a dose of 70 Gy for *A. obliqua* was justified.

[82] A large-scale confirmatory trial at 100 Gy with *A. serpentina* supported a dose of 100 Gy for that insect. One study showed that *A. serpentina* was no more radio-tolerant than *A. ludens*; thus, a dose of 70 Gy could be supported for the former, but the TPPT at that early time in the development of treatments (2004) decided in the interests of caution to go with 100 Gy.

[83] There are a few studies that do not agree that 70 Gy suffices for two of the *Anastrepha* species. However, the studies indicating that 70 Gy would be insufficient were examined in detail and found not to be scientifically robust. For example, one study indicated that an extreme dose of several kilograys would be required to control one species while in another study adults emerged at doses where the pupariation rate was very low, which is a very abnormal result for fruit flies.

[84] **Applicability.** The Treatment Lead also highlighted that this would be a treatment that could be quickly implemented, for example for mangoes that are hot water treated right now but could be treated with this schedule. Other commodities are currently treated with the generic fruit fly treatment of 150 Gy even when only *Anastrepha* species are of concern, and this would mean a significant dose reduction, and thus faster and more economic application.

[85] **Economically important species.** One member queried whether there are data on *A. fraterculus* (South American fruit fly), and whether there was evidence of efficacy against all *Anastrepha* species of economic importance. The Treatment Lead presented the available research on the seven economically important species of *Anastrepha* (Table 2) identified by DP 9 (Genus *Anastrepha* Schiner)[19]: *A. fraterculus* (Wiedemann), *A. grandis* (Macquart), *A. ludens* (Loew), *A. obliqua* (Macquart), *A. serpentina* (Wiedemann), *A. striata* Schiner and *A. suspensa* (Loew). These are the ones that are widely regarded as quarantine pests.

[18] CRP 01_TPPT_2018_Jun

[19] DP 9: https://www.ippc.int/en/publications/81502/

Table 2. Radiation doses for seven species of *Anastrepha* that prevented adult emergence when third instars were reared and irradiated in fruit

Species	Plant host	Gy*	#	Reference
A. fraterculus	*Eugenia uvalha*	50	48	Arthur *et al.* (1989)
A. fraterculus	*Mangifera indica*	50	100	Arthur *et al.* (1991)
A. fraterculus	*Malus domestica*	25	70	Arthur and Wiendl (1996)
A. grandis	*Cucurbita pepo*	36	170	FAO/IAEA (2017)
A. ludens	*Citrus paradisi*	69	94 400	Hallman and Martinez (2001)
A. ludens	*Mangifera indica*	60	5 513	Bustos *et al.* (1992, 2004)
A. ludens	*Citrus ×sinensis*	60	1 716	Toledo *et al.* (2001)
A. obliqua	*Psidium guajava*	50	176	Arthur *et al.* (1993)
A. obliqua	*Averrhoa carambola*	50	88	Arthur and Wiendl (1994)
A. obliqua	*Mangifera indica*	60	4 194	Bustos *et al.* (1992, 2004)
A. serpentina	*Mangifera indica*	60	4 025	Bustos *et al.* (1992, 2004)
A. suspensa	*Citrus paradisi*	25	2 421	Burditt *et al.* (1981)
A. suspensa	*Averrhoa carambola*	50	>100 000	Gould and von Windeguth (1991)
A. striata	*Psidium guajava*	40	1 834	Toledo *et al.* (2003)

* Lowest dose of those tested with no adult emergence.

Number of 3rd instars irradiated at that dose.

[86] The chair queried if there was any study that indicated survival of *Anastrepha* species at higher doses. The Treatment Lead explained that there were none, except the previously mentioned early studies for *A. ludens* and *A. suspensa* that recommended higher doses but there were inconsistencies in the data.

[87] **Efficacy.** The TPPT discussed how to establish the efficacy for a group of pests and decided to follow a similar method to that used for the generic PT 7 for all fruit fly species, calculating the efficacy based on data provided for the most tolerant species of the pest group.

[88] The Treatment Lead explained that *A. ludens* is regarded as the most radio-tolerant species of the group as there is no study available that would show that other economically important *Anastrepha* species were more tolerant. The efficacy was based on the large-scale study of Hallman and Martinez (2001) that treated an estimated 94 400 insects in *Citrus paradisi* with 69 Gy. The measure of efficacy is prevention of pupariation.

[89] **Experimental conditions.** The Treatment Lead explained that entomological techniques were adequate for the group; for example, infestation mimicked nature in that flies were allowed to oviposit into fruit, and the response of the controls was as expected.

[90] Considering the justification and supporting information presented above, the TPPT decided to recommend the draft PT for first consultation.

[91] The TPPT:

(5) *recommended* the draft PT Irradiation treatment for the genus *Anastrepha* (2017-031) to the Standards Committee (SC) for approval for first consultation.

5. Review of Evaluation of Treatments Submissions from the 2017 Call for Treatments

5.1 CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and western cherry fruit fly (*Rhagoletis indifferens*) in cherry (2017-037)

[92] The Lead for the submission, Mr Michael ORMSBY, introduced the Checklist for evaluating treatment submissions and Prioritization score sheet[20] for the Irradiation treatment for CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and western cherry fruit fly (*Rhagoletis indifferens*) in cherry (2017-037).

[93] The Lead observed that while the study for *Rhagoletis indifferens* was using naturally infested fruit, the study for *Cydia pomonella* was using artificially infested fruit, although both used cherries.

[94] The TPPT recalled that similar treatments were submitted in 2012 except for other commodities, but that some data were missing to support the treatment. The TPPT noted that this treatment is not used currently in international trade and is fairly hard to implement due to the complexity of the factors to be monitored. The TPPT considered that the draft ISPM on *Requirements for the use of modified atmosphere treatments as a phytosanitary measure* (2014-006) has recently been approved for first consultation and one of the issues is the lack of practical application, where the schedules are lacking too.

[95] The TPPT had a general discussion on the use of the treatment and agreed to proceed with the evaluation to explore the potential of this treatment. The TPPT decided to recommend the submission to be added to the work programme.

[96] The TPPT recommended assigning priority 3 to the submission as the treatment is currently not used in commercial practice. Further information might be requested, once the TPPT had a thorough evaluation.

[97] The TPPT:

(6) *recommended* the "CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and western cherry fruit fly (*Rhagoletis indifferens*) in cherry (2017-037)" to the Standards Committee (SC) for inclusion in the *List of topics for IPPC standards* (i.e. for inclusion in the TPPT work programme), with priority 3 and Mr Michael ORMSBY as the Treatment Lead, so that the TPPT can better assess the information from the submitter.

5.2 CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and oriental fruit moth (*Grapholita molesta*) in apple (2017-038)

[98] The Lead for the submission, Mr Michael ORMSBY, introduced the Checklist for evaluating treatment submissions and Prioritization score sheet[21] for the Irradiation treatment for CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and oriental fruit moth (*Grapholita molesta*) in apple (2017-038).

[99] The TPPT, after the considerations reported under agenda item 5.1, decided to recommend the submission to be added to the work programme. The TPPT recommended assigning priority 3 to the submission as the treatment is currently not used in commercial practice. Further information might be requested, once the TPPT had a thorough evaluation.

[100] The TPPT:

[20] 10_TPPT_2018_Jun

[21] 11_TPPT_2018_Jun

(7) *recommended* the CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and oriental fruit moth (*Grapholita molesta*) in apple (2017-038) to the Standards Committee (SC) for inclusion in the *List of topics for IPPC standards* (i.e. for inclusion in the TPPT work programme), with priority 3 and Mr Michael ORMSBY as the Treatment Lead, so that the TPPT can better assess the information from the submitter.

6. Review of Additional Supporting Information

6.1 Irradiation treatment for spotted wing drosophila *Drosophila suzukii* on all fresh commodities (2017-017) – priority 1

[101] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Matthew SMYTH, introduced the draft PT and the summary[22].

[102] The Irradiation treatment for spotted wing drosophila *Drosophila suzukii* on all fresh commodities (2017-017) was submitted by the United States of America. The TPPT discussed the submission at their 2017 July virtual meeting[23]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 1 and the SC have added the PT to the *List of topics for IPPC standards*. The TPPT also requested further information from the submitter to be able to fully evaluate the treatment.

[103] In response to the TPPT's queries, the submitter provided clarification on a range of issues requested by the TPPT[24]. These are discussed further below.

[104] **Dosimetry.** The submitter noted that the highest recorded dose is 78.2 Gy, with the measured dose ranging from 70–78 Gy for an overall dose uniformity ratio (DUR) of 1.1, which is very tight for a large-scale study.

[105] One member disagreed with the concept of rounding up doses to create a margin of safety when there are data to adequately support the target dose. The practice of the commercial application of the schedule is to exceed the *lowest* required dose. Also, the prevention of egg laying is "far away" from the establishment of a population. The panel therefore agreed to use the maximum measured dose in any subsequent schedule.

[106] **Treatment schedule.** The original dose proposed in the submission was 100 Gy. Other studies cited report sterility at lower doses, and the study of Follett *et al.* (2014) also used lower doses than the proposed 100 Gy.

[107] The TPPT agreed to use the 78 Gy dose, as the safety margin was not used in the case of the cold treatments either and the maximum dose in the experiment will be the minimum dose applied in commercial conditions. The TPPT reduced the dose to 78 Gy as the experimental data support this dose and the efficacy is high.

[108] The following treatment schedule was agreed by the TPPT: minimum absorbed dose of 78 Gy to prevent oviposition in adults from irradiated late puparial stages of *Drosophila suzukii*.

[109] **Detection of live but non-viable adults.** The panel considered whether the detection of sterile but live insects post-border may result in regulatory issues for the importing country. The submitter noted that adult emergence only occurs from pupae. Completion of development to pupae would result in damage to the fruit and the fruit would therefore not meet commercial requirements and be culled. Therefore, fruit infested with pupae are unlikely to be associated with export quality fruit.

[110] The Treatment Lead explained that the submitter provided additional papers supporting irradiation for *D. suzukii*. Kruger *et al.* (2018) found that ovaries of *D. suzukii* do not develop (ovarian atrophy) when pupae are exposed to a dose of 75 Gy. Irradiation has also been shown to increase sterility in male flies

[22] 2017-017, 25_TPPT_2018_Jun

[23] 2017-07 TPPT Meeting report (Vienna, Austria): https://www.ippc.int/en/publications/85139/

[24] 14_TPPT_2018_Jun

by over 90% when exposed to doses of 50 Gy or greater (Lanouette *et al.*, 2017). It is likely that similar morphological effects observed in the ovaries of *D. suzukii*, as observed in the testes of other insects (Hassan *et al.*, 2017; Salwa and Al Khalaf, 2011), would be observed in the testes of *D. suzukii*. Kim *et al.* (2016) also report that 70% of *D. suzukii* that emerged from pupae irradiated at 150 Gy were deformed.

[111] Therefore, in the unlikely event that an irradiated adult was detected in the importing country, it is likely that it would be sterile, and a simple dissection may be sufficient to identify the irradiated adult females (for males the effect is not described properly). The detection of a sterile fly would therefore not result in regulatory action against, or within, the importing country.

[112] One member suggested that even though the females dissected in the paper by Kruger *et al.* (2018) did not have developed ovaries, it cannot be affirmed that none of the irradiated females have developed ovaries. The TPPT agreed to include that dissection may be an option to identify irradiated adults.

[113] **Treatment end point.** The submitter agreed that the desired outcome of this treatment is the prevention of F1 adults. However, the submitter noted that no eggs or larvae were detected from the parental generation (adults emerged from irradiated pupae). Therefore, the desired outcome was prevention of F1 adults but a more stringent outcome of adult sterility was achieved (no oviposition).

[114] Lanouette *et al.* (2017) found a very low number of eggs in the offspring of pupae irradiated at 50 Gy. The Treatment Lead explained that the submitter clarified in his response that the eggs are easy to detect as they have breathing tubes that protrude from the diet (white tubes on black diet), and there were none detected in the study supporting the efficacy of this schedule (78 Gy). The TPPT agreed to specify the outcome as “prevention of oviposition”.

[115] **Estimation of the number of insects treated.** According to the submitter, the number of treated cherries was estimated by weight: 3 000 g of cherries being equal to 550 cherries. Cherries were exposed to flies each day for four days, for a total of >8 000 cherries exposed per week for four weeks. A subset of infested cherries (10%) was held from each treatment and control replicate to estimate the treated population, but the submitter has not been able to locate the calculations.

[116] As discussed at the TPPT meeting in July 2017, the sampling of insects is likely to underestimate the number of insects treated. The number of pupae treated is listed in Table 3 of Follett *et al.* (2014). Approximately 4 100 control pupae (replicates = 19) where used to estimate that 33 000 pupae had been treated in the confirmatory trials.

[117] The TPPT discussed the fact that about 30% of the sample was used as a control, but the submitter was unable to produce the calculation of how the number of treated insects was estimated. The TPPT considered this as a problem, and as the pest is cryptic and very fast to reproduce, a high efficacy would be needed (possibly more than for fruit flies).

[118] The TPPT agreed to again request from the submitter the calculations on how the number of treated insect and controls were estimated, as this is crucial to the calculation of efficacy.

[119] **Efficacy.** Efficacy will be established later, once the submitter has provided the requested data.

[120] The TPPT agreed to the draft but pending the information requested from the submitter on the calculation of the number of treated insects.

[121] The TPPT:

(8) *asked* the submitter to provide further information on how the number of treated insects and number of insects in the control were estimated for the Irradiation treatment for *Drosophila suzukii* (2017-017).

6.2 Generic irradiation treatment for Curculionidae (Coleoptera) (2017-016) – priority 2

[122] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Daojian YU, introduced the draft PT and the summary[25].

[123] The Generic irradiation treatment for Curculionidae (Coleoptera) (2017-016) was submitted by the United States of America and had been evaluated by the TPPT at their virtual meeting in October 2017[26]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 2 and the SC have added the PT to the *List of topics for IPPC standards*. The TPPT also requested further information from the submitter to be able to fully evaluate the treatment.

[124] In response to the TPPT's queries, the submitter provided clarification[27] on the issues requested by the TPPT. These are discussed below.

[125] **Scope of the treatment.** It was proposed to expand the generic treatment to include the superfamily Curculionoidea, which includes the Curculionidae and closely related families based on a new paper (Follett, 2018).

[126] The TPPT considered that the Curculionidae, the family of the "true" weevils, is one of the largest animal families, with 5 489 genera and 82 741 species described worldwide. They include the bark beetles as subfamily Scolytinae, which are modified in shape in accordance with their wood-boring lifestyle. They do not much resemble other weevils, so they were traditionally considered a distinct family, Scolytidae. The Curculionidae family also includes the ambrosia beetles, of which the present-day subfamily Platypodinae was formerly considered the distinct family Platypodidae.

[127] Only one Scolytinae beetle, *Hypothenemus hampei*, is discussed in the paper by Follett (2018). The list of radiation doses reported to sterilize adult curculionid weevils in Table 3 of Follett (2018) includes 15 species from 12 genera. The research supporting the proposed schedule is mainly focused on fresh and stored products. If a generic dose is expanded for the superfamily Curculionoidea, further research on Scolytinae bark beetles in wood packaging material and timber would be required to support a generic dose. One member also voiced concern that, because the taxonomic classification of the superfamily may change, to approve a generic treatment would pose some challenges in the future.

[128] As there are many economically important species in the Curculionoidea superfamily and the Scolitinae has a lot of important species that were not tested, the TPPT decided to not recommend this treatment for the Curculionoidea superfamily.

[129] The TPPT considered whether to narrow the treatment only to the Curculionidae family, but faced similar issues about whether enough research had been presented to support a generic treatment. There are subfamilies where there are no data at all. It was suggested that an attempt be made to identify subfamilies, narrowing the scope of the treatment even further to identify a sufficiently narrow group with enough supporting data. It was clarified that there are at least 19 subfamilies in the Curculionidae and there are numerous untested species. Furthermore, many important species already have established treatment schedules.

[130] After a more thorough look at the treatment, the TPPT decided to not pursue this treatment any further as the available information does not support such a big group of pests.

[25] 2017-016, 30_TPPT_2018_Jun

[26] 2017-10 TPPT Meeting report: https://www.ippc.int/en/publications/85545/

[27] 20_TPPT_2018_Jun

[131] The TPPT:

(9) *recommended* to the Standards Committee (SC) that the draft PT Generic irradiation treatment for Curculionidae (Coleoptera) (2017-016) be removed from the TPPT work programme and the *List of topics for IPPC standards*.

6.3 Irradiation treatment for light brown apple moth *Epiphyas postvittana* on all fresh commodities (2017-018) – priority 2

[132] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Daojian YU, introduced the draft PT and the summary[28].

[133] The Irradiation treatment for light brown apple moth *Epiphyas postvittana* on all fresh commodities (2017-018) was submitted by the United States of America and had been evaluated by the TPPT at their virtual meeting in October 2017[29]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 2 and the SC have added the PT to the *List of topics for IPPC standards*. The TPPT also requested further information from the submitter to be able to fully evaluate the treatment.

[134] In response to the TPPT's queries, the submitter provided clarification[30] on the issues requested by the TPPT. These are discussed below.

[135] **Experimental conditions.** The number of fifth instar larvae used in the confirmatory trials was 34 997 in artificial diet, 2 650 in apple fruit and 300 in pepper fruit, respectively (Follett and Snook, 2012). The radiation dose of 150 Gy was applied in tests, but a dose of 200 Gy is accepted by the United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) for the treatment protocol for *E. postvittana* in the APHIS Treatment Manual. The submitter has recommended the 200 Gy dose to control the eggs and larvae of *E. postvittana* in this submission.

[136] The submitter explained that the trial used artificial diet, as many natural hosts are poor hosts only and typically in nature only one larva is found per infested fruit. Most of the temperate hosts of *E. postvittana* are difficult to find in Hawaii, where the studies were conducted.

[137] The submitter conducted a comparison trial between natural and artificial diet. The TPPT noted that the number of insects emerging from the natural host were highly variable.

[138] The TPPT discussed the fact that this moth is a leaf roller, feeding normally on foliage and is usually of concern in the case of nursery stocks, or when leaves are left on the fruit. The TPPT discussed whether host foliage would be a more suitable substrate for comparison of larval development in a natural diet to the artificial diet then the fruits used in this work.

[139] The TPPT decided to ask the submitter for more justification on why the infestation methods and the use of artificial diet in the confirmatory trial were sufficient, including whether there is any evidence on artificial diet making it easier or harder to kill the pest.

[140] **Presence of pupae in traded commodities.** The submitter provided information explaining that, according to interception data, pupae are often found in grape bunches. The hosts for light brown apple moth (*E. postvittana*) include apples, apricots, citrus, grapes, nectarines, peaches, plums, pears, and sweet cherries, as well as forestry, vegetable and nursery crops (Follett and Snook, 2012).

[141] The TPPT considered whether grapes should be excluded from the treatment but decided instead to include a warning in the "Other relevant information" section of the PT to explain that grapes often

[28] 2017-018, 35_TPPT_2018_Jun

[29] 2017-10 TPPT Meeting report: https://www.ippc.int/en/publications/85545/

[30] 21_TPPT_2018_Jun

contain pupae that are not sterilized by 154 Gy. Grapes were described as *Vitis* spp. to include the fruit of both *Vitis vinifera* and *Vitis labrusca*.

[142] The TPPT decided to clarify that if pupae are found *at the time of the treatment* then the proposed treatment is not effective in managing *E. postvittana*, but if they are found later (pupae that have developed from irradiated larvae) then that is not an indication of treatment failure. However, the TPPT acknowledged that this would be difficult to ascertain by the importing country.

[143] **Most resistant life stage.** The paper of Dentener *et al.* (1990) suggests that the sixth instar larvae are the most radio-tolerant. The TPPT questioned why the study used fifth instar, and whether the sixth instar was taken into consideration when the most tolerant stage was identified.

[144] **Data analysis.** The submitter had explained that linear regression was used because only four doses (60, 90, 120 and 150 Gy) had been tested in the research. Some other useful details for LD90 and LD99.9968 estimation in different methods were also provided. 150 Gy was the dose considered to prevent adult emergence.

[145] **Estimated number of insects treated.** Efficacy numbers were estimated from controls, but no information was provided on the actual number of insects treated. The submitter will be asked to provide the control data to allow the panel to provide adequate confidence in the treated estimates.

[146] **Dose.** Information to develop the dose was based on the following three papers: Batchelor *et al.* (1984), Dentener *et al.* (1990), and Follett and Snook (2012).

[147] One member highlighted that the highest measured dose in the research supporting the treatment (Table 3 in the paper by Follett and Snook (2012)) was 149 Gy. Therefore, it may be possible to further reduce the treatment dose. However, the Treatment Lead informed the TPPT that the study of Bachelor *et al.* (1984)[31] recorded that in a small-scale test (200 insects) a 154 Gy dose was insufficient to prevent emergence (1 adult survived, Table 6 of Bachelor *et al.* (1984)).

[148] **Treatment end point**. One member highlighted that Dentener *et al.* (1990) reported no difference in sixth and fifth instar, but the aim of that study wass to kill the larvae, not to prevent oviposition of the adults developing from their irradiated eggs and larvae of *Epiphyas postvittana.*

[149] The TPPT decided to determine the treatment end point as “no oviposition of any adult emerging from the irradiated eggs and larvae” – allowing for adult emergence (in the Bachelor study the emerging ones were sterile and deformed) using the dose 154 Gy.

[150] **Efficacy.** The efficacy will be added once it is clarified how the number of treated insects were calculated.

[151] The TPPT:

(10) *asked* the submitter to provide further information on:

- infestation methods and the artificial diet (considering the discussion of the TPPT)
- the reasoning why the sixth instar was not considered in establishing the most tolerant life stage
- how the number of treated insects was calculated.

6.4 Sulfuryl fluoride fumigation treatment for *Chlorophorus annularis* on bamboo articles (2017-028) – priority 2

[152] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Eduardo WILLINK, introduced the draft PT and the summary[32].

[31] 23_TPPT_2018_Jun

[32] 2017-028, 64_TPPT_2018_Jun

[153] The Sulfuryl fluoride fumigation treatment for *Chlorophorus annularis* on bamboo articles (2017-028) was submitted by China and had been evaluated by the TPPT at their face-to-face meeting in July 2017[33]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 2 and the SC have added the PT to the *List of topics for IPPC standards*. The TPPT also requested further information from the submitter to be able to fully evaluate the treatment.

[154] In response to the TPPT's queries, the submitter provided clarification[34] on the issues requested by the TPPT. These are discussed below.

[155] **Low number of treated pests.** The low numbers of individuals treated is reflected in the low efficacy value, as there is 95% confidence that the treatment according to this schedule kills not less than 99.8820% of larvae, pupae and adults of *Chlorophorus annularis.*

[156] The TPPT noted that for cerambycid species, it is difficult to achieve large sample sizes due to the lifestyle of the pest.

[157] **Moisture content.** As the moisture content is an important factor in fumigant penetration, the TPPT queried what the moisture content of the bamboo was in the confirmatory trials, and what should be the maximum acceptable. The submitter explained that the moisture content was determined by taking 24 crosscuts from the centres of randomly selected pieces of representative sizes, but the maximum acceptable moisture content was still not made clear to the TPPT. A maximum moisture content of 18% is recommended in the submission, and in the response of the submitter, moisture content values between 9.5% and 12.5% are mentioned.

[158] **Presence of eggs on the commodity.** The testing was conducted on larvae and adults, however eggs may be associated with harvested bamboo (at the time of the fumigation) and these eggs may develop to adults. As the sulphuryl fluoride (and other fumigants) work on organisms that respire and the respiration rate of eggs is low, eggs are usually more resistant to fumigation than other life stages. Clarification was needed if the eggs could be present on the bamboo, as the fumigant is known to have difficulty killing egg stages.

[159] The submitter replied that eggs are associated with living bamboo plants and can be laid on the surface of the bamboo. The eggs are more than 1 mm in diameter and are laid in clusters. They are easy to see and handling would destroy them. He also explained that normally after cutting, the bamboo is soaked in water for more than 1 week to prevent the spread of bamboo infesting insects. The bamboo is dried afterwards, cleaned (wiped) and cut into pieces.

[160] The TPPT considered that this is interesting as a systems approach, but if eggs can be present in commercial bamboo products, it is unlikely that sulphuryl fluoride would be effective and no efficacy data have been provided for eggs. One member highlighted that in another study, where bamboo is fumigated with methyl bromide, it is suggested that eggs are laid on dried bamboo as well (Barak *et al.*, 2009)[35].

[161] The panel discussed the feasibility and appropriateness of including a system within a treatment, and recalled that this has occurred with other PTs, for example heat treatment (hydro-cooling after treatment, etc.). To include a pest management system, more efficacy information (e.g. time to egg hatch, season of egg hatch) would be required.

[162] The panel concluded that eggs may be associated with the commodity at the time of fumigation (albeit in low numbers), and either efficacy data should be provided on eggs (as the most tolerant life stage), or proof provided that the tested life stage was the most tolerant, or an additional step (e.g. period in

[33] 2017-07 TPPT Meeting report (Vienna, Austria): https://www.ippc.int/en/publications/85139/

[34] 36_TPPT_2018_Jun

[35] 31_TPPT_2018_Jun

containment before fumigation to allow all eggs to hatch before treatment) could be included in the treatment.

[163] The panel agreed to request information from the submitter on how to manage the issues related to egg tolerance and association with the commodity at the time of fumigation.

[164] The TPPT:

(11) *asked* the submitter to provide additional information on:

- the most tolerant life stage – whether eggs are indeed the most tolerant life stage
- the containment period before fumigation to allow all eggs to hatch.

6.5 Irradiation treatment for eggs and larvae of the family Tortricidae (generic) (2017-011) – priority 2

[165] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Matthew SMYTH, introduced the draft PT and the summary[36].

[166] The Irradiation treatment for eggs and larvae of the family Tortricidae (generic) (2017-011) was submitted by the United States of America and had been evaluated by the TPPT at their meeting in Vienna, July 2017[37]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 2 and the SC have added the PT to the *List of topics for IPPC standards*.

[167] The TPPT asked the submitter to provide a list of major pests of economic importance within the Tortricidae family with information on the treatment end point, the tested life stage, the effective dose and the source of the information (reference) for each species.

[168] The submitter did not provide any further information on the range of tortricid pests covered by the proposed schedule. However, a publication was provided (Nadel *et al.*, 2018)[38] on another species of Tortricidae, *Lobesia botrana* (European grapevine moth), that also discusses a possible 250 Gy generic dose for eggs and larvae of tortricids. It highlights that that while the fifth instar is the most radio-tolerant life stage likely to occur within the commodity and a minimum radiation dose of 250 Gy will prevent adult emergence from this stage, some traded commodities such as table grapes may contain *L. botrana* pupae. A dose of 325 Gy applied to mature female pupae sterilized emerging adults and may provide quarantine security.

[169] **Generic treatment.** The TPPT considered whether there are enough data of suitable quality on a wide enough range of species tested to establish a generic dose. The Tortricidae family includes three subfamilies (Tortricinae, Olethreutinae and Chlidanotinae), with around 93% of the currently identified species belonging to the first two subfamilies. The range of pests for which irradiation data has been provided is summarized in the Treatment Lead's summary.

[170] One TPPT member was concerned that this generic treatment would include a very high number of economically important pest species. The Treatment Lead explained that the information supports the contention that a broad range of species are effectively managed by a dose of 250 Gy or less. Some key pests such as *Epiphyas postvittana*, *Cydia pomonella and Thaumatotibia leucotreta* were managed to a very high efficacy (>30 000 of the most tolerant life stage associated with the commodity were treated).

[171] The Treatment Lead explained that his preliminary review of Tortricidae (based on species assessed in the Tortricidae treatment submission to the IPPC and risk assessed by Australia) identified 124 species from 55 genera of potential pest status. Consequently, many of the genera have not been assessed for radio-tolerance. For example, genera such as *Adoxophyes*, *Archips* and *Homona* have many species in the genus with well-known pests. Within the Tortricinae subfamily, five genera have been tested for

[36] 2017-011, 47_TPPT_2018_Jun

[37] 2017-07 TPPT Meeting report (Vienna, Austria): https://www.ippc.int/en/publications/85139/

[38] 48_TPPT_2018_Jun

radio-tolerance while seven genera have been tested from the Olethreutinae. Importantly, these two sub families contain all the identified pest species within Tortricidae.

[172] The TPPT agreed that a thorough consideration of the diversity of species to determine the most resistant species and a compilation of the available research is required. The paper by Hallman *et al.* (2013) could provide a good basis for this.

[173] One member explained that effective doses for all Lepidoptera species (including the species in the Tortricidae family) were at 250 Gy (excluding pupae). This indicates a consistency across the order; there is no reason to assume that Tortricidae are the exception, having more tolerant species. Conversely, there are no data on many of the important economic species.

[174] The TPPT agreed that there is great value in a generic treatment, but that transparency is paramount and there should be a proper justification, written up by the submitter, including what species were tested and what percentage of all Tortricidae was covered (potentially for all Lepidoptera).

[175] The TPPT discussed that the physiological basis of tolerance of the Lepidoptera species is well understood. It was explained that the development of ovaries is a process that requires significant cell division and the irradiation through the destruction of DNA prevents or limits reproductive cell development. This could support the argument for how irradiation treatment is efficacious across the species of the family.

[176] The TPPT reviewed the PT and provided improvements.

[177] **Treatment end point.** A more conservative end point ("prevent the oviposition of the adults developing from irradiated eggs and larvae of Tortricidae at the stated efficacy") provides an extra margin of safety and would include a wider selection of studies.

[178] **Other relevant information section.** The TPPT decided to include some text on the unlikely event of the survival of adults that are "not normal looking", for example having deformed wings or shrivelled abdomens. The TPPT considered that the presence of deformed adults may not indicate treatment failure, as non-viable adults might develop but would not lay eggs. The TPPT included wording to indicate that some species pupate inside grape bunches.

[179] One member stated that it is extremely unlikely that any irradiated eggs would develop to deformed adults; it might happen from late stage larvae, but in any case the emerged adults would not be able to reproduce. The TPPT agreed, but left the wording in the draft PT to note that adults that develop from irradiated eggs are not viable.

[180] **References.** The PT was drafted based mainly on the publication of Hallman *et al.* (2013) but other references were included that provide extra information.

[181] **Efficacy for generic treatment.** One member was concerned about how to establish the efficacy of a treatment for such a broad range of species. He suggested that the submitter be asked to provide more justification and data on the different species and genera.

[182] To establish the efficacy of a generic treatment, the TPPT decided to apply the approach used before when establishing the efficacy of the generic fruit fly PT: to identify the most tolerant species of the group and indicate the efficacy of the treatment against that pest. Testing with sublethal doses may allow identification of the most tolerant species.

[183] The paper of Hallman *et al.* (2013) summarizes the radio-tolerance of Lepidoptera species and although in this comparison *Cryptophlebia illepida* at 289 Gy (Follett and Lower, 2000) was the highest dose tested, there were no doses tested between 220 Gy and 250 Gy, and the test with a target dose of 250 Gy actually measured 289 Gy.

[184] *Grapholita molesta* was suggested as the most radio-tolerant species because it is cryptic and high efficacy is needed for it; there are studies available with a high number of insects tested. The TPPT

agreed to a provisional efficacy of 99.9949% that was calculated based on the study of Hallman *et al.* (2013) treating 58 779 insects.

[185] The TPPT did not reach consensus on recommending this treatment for consultation and agreed to seek further information and a comprehensive analysis of the available data in order to justify the generic treatment to all genera of Tortricidae.

[186] The Treatment Lead agreed to work with the submitter to compile the information in a discussion paper for the next TPPT meeting.

[187] The TPPT:

(12) *asked* the submitter to compare the radio-tolerance of the economically important species of the Tortricidae family to support the effectiveness of a generic dose and justify how it can be assumed that the treatment is efficacious against the non-tested species as well.

6.6 Irradiation treatment for *Carposina sasakii* (2017-026) – priority 2

[188] **Treatment Lead summary.** As Mr Andrew PARKER, the Treatment Lead, could not attend the meeting, Mr Guy HALLMAN presented the draft PT and the summary[39] prepared by the Treatment Lead.

[189] The Irradiation treatment for *Carposina sasakii* (2017-026) was submitted by China and had been evaluated by the TPPT at their virtual meeting in November 2017[40]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 2 and the SC added the PT to the *List of topics for IPPC standards*. The TPPT also requested further information from the submitter to be able to fully evaluate the treatment.

[190] In response to the TPPT's queries, the submitter provided clarification[41] on the issues requested by the TPPT. These are discussed below.

[191] **Voucher specimens.** The submitter addressed the TPPT's questions on species identification satisfactorily. The voucher specimens of *Carposina sasakii* were kept in the laboratory of the Chinese Academy of Inspection and Quarantine.

[192] **Pesticide residue on the test fruits.** The panel discussed the issue of possible pesticides on the test fruit and considered that the reported control mortality rates were normal (the percentage of fifth instars that made it to adults was relatively high). While no information on the particular pesticide used was provided, the panel was confident that there were no residual insecticide impacts on the efficacy recorded as pesticide application was restricted to four months prior to harvest.

[193] **Diapausing larvae.** One member queried whether diapausing late-instar larvae have an increased (or lower) radio-tolerance. One member explained that according to studies by Hallman (2003) or Burditt (1986), diapausing may decrease tolerance to irradiation, probably due to the increased cell-multiplication activity when the insect emerges from diapause. The TPPT concluded that this should not influence the efficacy of the treatment.

[194] **Treatment end point.** A dose of 228 Gy is proposed for eggs and larvae to prevent the emergence of adults. The TPPT considered how to define the outcome of the treatment. The TPPT decided to change the end point of the treatment, as four (deformed) adults emerged after the treatment in the trials. In this case oviposition after the emergence was not measured, so the TPPT defined the end point as "prevent the emergence of *viable* adults" to indicate that the few adults that might emerge will still not be able to survive or reproduce.

[39] 2017-026, 55_TPPT_2018_Jun

[40] 2017-11 TPPT Meeting report: https://www.ippc.int/en/publications/85546/

[41] 49_TPPT_2018_Jun

[195] **Other relevant information.** In the "Other relevant information" section it was clarified that it does not indicate failure of the treatment if live eggs, larvae or deformed adults are found.

[196] **Efficacy.** The schedule is based on the publication of Zhan *et al.* (2014) that describes the large-scale confirmatory testing. The efficacy is based on a direct count of insects.

[197] As natural mortality occurs in the control (in this case about 10 %), the treated numbers have to be corrected to account for the effect of natural mortality (Abbott's formula (Abbott, 1925)[42]). The TPPT recalculated the efficacy based on the number of tested insects corrected by natural mortality (corrected number of treated insects is 27 950). The TPPT calculated the efficacy at 99.9893% based on this number (Appendix 9).

[198] The TPPT:

(13) *recommended* the draft PT Irradiation treatment for *Carposina sasakii* (2017-026) to the Standards Committee (SC) for approval for first consultation.

6.7 Irradiation treatment for *Bactrocera tau* (2017-025) – priority 3

[199] **Treatment Lead summary.** As Mr Andrew PARKER, the Treatment Lead, could not to attend the meeting, Mr Scott MYERS introduced the draft PT and the summary[43] prepared by the Treatment Lead.

[200] The Irradiation treatment for *Bactrocera tau* (2017-025) was submitted by China and had been evaluated by the TPPT at their virtual meeting in January 2018[44]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 3 and the SC have added the PT to the *List of topics for IPPC standards*. The TPPT also requested further information from the submitter to be able to fully evaluate the treatment.

[201] In response to the TPPT's queries, the submitter provided clarification[45] on the issues requested by the TPPT. These are discussed below.

[202] **Voucher specimens.** The submitter addressed the TPPT's questions on species identification satisfactorily. The voucher specimens of *Bactrocera tau* were kept in the laboratory of the Chinese Academy of Inspection and Quarantine.

[203] **Economic importance of the treatment.** The submitter explained that *Bactrocera tau* is an important agricultural pest in south-east Asia. It is capable of infesting more than 80 plant species. The production losses caused by *Bactrocera tau* in China are 21.3–31.8% in pumpkin, 10–30% in water melon, and 21–34% in *Sirairtia grosuenorii*. Fang *et al.* (2015) analysed and estimated the potential economic loss of

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[42] Abbott (1925) noted that it was common practice at the time to subtract the level of control morality from the treated mortality, as "*when a certain number of [the target pest], as for example 20 percent, is found to have died from natural causes, it logically follows that only 80 percent of the original infestation was living and could have been killed by the treatment applied*" (Abbott 1925).

Abbott (1925) notes that when the level of treatment mortality is very high (~100%), accounting for control mortality is quite simple, as you can "*subtract the percentage of dead in the [control] from the corresponding figure for the treated [.....] and call the remainder the effectiveness of the treatment*" (Abbott 1925).

The recommendation therefore is to apply the control mortality adjustments as follows, in line with Abbott (1925):;

1) Where treatment mortality is 100% or close to it: Treatment Mortality = Y − X; where 'X' is measured % control mortality and 'Y' is measured % treatment mortality
2) Where treatment mortality is significantly less than 100%: Treatment Mortality =100 – ((X − Y)/X)*100; where X is measured % surviving in the control and Y is measured % surviving in the treated cohort.

[43] 2017-025, 27_TPPT_2018_Jun

[44] 2018-01 TPPT meeting report: https://www.ippc.int/en/publications/85607/

[45] 28_TPPT_2018_Jun

pumpkin cause by *Bactrocera tau* in China, which is about CNY 2.25 billion (7.97% of the total value of production and processing) per year.

[204] This fruit fly has been regarded as a quarantine pest with potential high risk by importing countries, such as the United States of America, Australia, New Zealand and Japan (Biosecurity Australia, 2011; CABI, 2018; Hossain *et al*., 2011; Ohno *et al*., 2008). The proposed 85 Gy treatment might be a viable treatment against *Bactrocera tau* on avocado, which has low tolerance to fumigation and temperature treatment but tolerates about 100–200 Gy (Thomas, 2001).

[205] In view of the information regarding economic importance, the Treatment Lead recommended that the TPPT consider changing the treatment priority to 2. The TPPT agreed to recommend that the priority be changed from 3 to 2 as this treatment would have direct economic benefits.

[206] **Treatment end point.** More than 90% of the irradiated larvae pupated, but no adults emerged. The TPPT agreed to determine the treatment end point as prevention of adult emergence.

[207] **Second schedule.** Two large-scale studies were conducted (Zhan *et al.*, 2015). The TPPT agreed to establish a second schedule based on the research reported in the paper of Zhan *et al.* (2015) at 72 Gy with a slightly lower efficacy, in addition to the proposed 85 Gy schedule. Both schedules provide a very high efficacy even after the treated numbers are corrected by Abbott’s formula (Abbott, 1925). The TPPT included both schedules in the draft.

[208] **Target pest.** *Zeugodacus* has recently been recognized as a separate genus of *Bactrocera* and the species is often referred to as *Bactrocera* (*Zeugodacus) tau*. For this reason, the TPPT decided to keep *Bactrocera tau* in the title but mention *Zeugodacus* in the “Treatment description” section.

[209] **Efficacy and number of treated insects.** Late stage larvae were indicated to be the most tolerant life stage. The control mortality was low. The third instar larvae escaping from the fruit were counted and also the number of pupae and adults.

[210] The efficacy of the 85 Gy schedule was calculated combining the number of treated insects of both experiments (72 Gy and 85 Gy), and the efficacy of the 72 Gy schedule was calculated from the number of insects treated with 72 Gy.

[211] The number of treated insects was corrected based on Abbott’s formula. The TPPT considered whether to account for the difference between the number of insects surviving from pupae to adult or from third instar to adult. Both would result in very high efficacy, but the TPPT decided to go with the difference between the number of insects surviving from third instar to adult to correct the number of treated insects with the control mortality.

[212] The number of treated third instar insects was calculated as 44 994 and the 99 005, for 72 Gy and 85 Gy respectively (also taking into account the control mortality) (Appendix 10).

[213] The TPPT:

(14) *recommended* changing the priority of the draft PT Irradiation treatment for *Bactrocera tau* (2017-025) from 3 to 2 due to the demonstrated economic importance of the treatment

(15) *recommended* the draft PT Irradiation treatment for *Bactrocera tau* (2017-025) to the Standard Committee (SC) for approval for first consultation.

6.8 Irradiation treatment for oriental fruit fly *Bactrocera dorsalis* on all fresh commodities (2017-015) – priority 3

[214] **Treatment Lead summary.** As Mr Andrew PARKER, the Treatment Lead, could not to attend the meeting, Mr Eduardo WILLINK introduced the draft PT and the summary[46] prepared by the Treatment Lead.

[215] The Irradiation treatment for oriental fruit fly *Bactrocera dorsalis* on all fresh commodities (2017-015) was submitted by the United States of America and had been evaluated by TPPT at their virtual meeting in January 2018[47]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 3 and the SC added the PT to the *List of topics for IPPC standards*. The TPPT also requested further information from the submitter to be able to fully evaluate the treatment.

[216] In response to the TPPT's queries, the submitter provided clarification [48] on the issues requested by the TPPT. These are discussed below.

[217] **Economic importance of the treatment.** The TPPT was concerned with the small benefit of the slight dose reduction compared to the generic dose for fruit flies and requested justification, but the submitter did not supply any data on the trade involved, nor address product sensitivity to irradiation.

[218] **Lower dose.** As agreed in previous TPPT meetings, the TPPT accepts the highest recorded dose as the minimum treatment dose. The practicalities of commercial treatment mean that products are always over-dosed, providing the necessary safety margin.

[219] The highest recorded dose in the study of Follett and Armstrong (2004)[49] is 124 Gy so the proposed 150 Gy is overestimated. The study of Zhao *et al*. (2017)[50] used 116 Gy so the TPPT agreed to use this as the basis of a new schedule. This is a more significant reduction compared to the generic dose and warrants the establishment of a treatment schedule.

[220] **Equivalence of artificial and natural infestation.** The TPPT asked the submitter whether the equivalence of artificial to natural infestation was considered. The submitter provided some justification that insects raised in artificial diet were harder to kill. However, as the TPPT agreed to base the schedule on the study of Zhao *et al*. (2017), which used natural infestation that reflects the commercial conditions better, the issue of artificial infestation loses its relevance.

[221] **Most resistant life stage.** The most resistant life stage was identified as the third instar. The treatment at 116 Gy produced mortality in pupae as well.

[222] **Treatment end point.** The TPPT agreed that the outcome of the treatment is prevention of adult emergence.

[223] **Efficacy and the number of treated insects.** The efficacy is calculated based on the data in the paper by Zhao *at al.* (2017) and additional information is supplied by Follett and Armstrong (2004).

[224] The TPPT discussed whether to use Abbott's formula in this case as the number of insects emerging were counted, which results in a conservative estimate (compared to, for example, dissecting the fruit). One member suggested that the number of treated insects corrected by Abbott's should not be lower than the number of insects counted.

[225] The importance of using a healthy insect colony to conduct the study was discussed. If the control population is performing poorly, and the natural mortality is high, it could be an indication of poor

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[46] 2017-015, 53_TPPT_2018_Jun

[47] 2018-01 TPPT meeting report: https://www.ippc.int/en/publications/85607/

[48] 52_TPPT_2018_Jun

[49] 57_TPPT_2018_Jun

[50] 58_TPPT_2018_Jun

colony health, and treatment may be compromised – thus the TPPT decided to include into the draft the full number of insects treated (100 684, as in this study they were actually counted as they emerged). However, they decided to correct the number of treated insects with the control mortality for the efficacy calculation and include into the draft that control emergence was 81%. The efficacy calculation is attached as Appendix 11.

[226] **Correcting sample sizes.** The TPPT agreed that Mr Mike ORSMBY will draft a paper on how to account for the mortality in the control sample, outlining the considerations of the TPPT related to the use of Abbott's formula and its appropriate use in phytosanitary treatment evaluation.

[227] **Live but non-viable insects.** The TPPT established that inspectors may encounter live but non-viable insects and included the standard text into the "Other relevant information" section.

[228] The TPPT:

(16) *recommended* the draft PT Irradiation treatment for *Bactrocera dorsalis* (2017-015) to the Standards Committee (SC) for approval for first consultation.

6.9 Irradiation treatment for ants (Hymenoptera: Formicidae) hitch-hiking on fresh commodities (2017-014) – priority 3

[229] **Treatment Lead summary.** The Treatment Lead of the draft PT, Mr Scott MYERS, introduced the draft PT and the summary[51].

[230] The Irradiation treatment for ants (Hymenoptera: Formicidae) hitch-hiking on fresh commodities (2017-014) was submitted by the United States of America and had been evaluated by TPPT at their virtual meeting in January 2018[52]. The TPPT recommended it to the SC for inclusion into the TPPT work programme with priority 3 and the SC added the PT to the *List of topics for IPPC standards*. The TPPT also requested further information from the submitter to be able to fully evaluate the treatment.

[231] In response to the TPPT's queries, the submitter provided clarification[53] on the issues requested by the TPPT. These are discussed below.

[232] **Whether the ant colonies lose their reproductive capacity once the queen is sterilized.** The submitter informed the TPPT that the four studies listed in the submission are the only available studies on this topic. Reproductive systems in ants vary by species. Ants always have a way to replace reproductives (queens), as brood life stages (ant eggs and larvae) have the potential to develop into reproductive queens. The submitter informed the TPPT that they did not study this possibility because brood have not been found during inspection in imported commodities, only workers and occasionally queens. Irradiation does decrease the longevity and egg production of queens and probably devitalizes workers as well, making queen replacement unlikely.

[233] The TPPT acknowledged that brood are rarely found on the pathway.

[234] **Low number of insects tested.** The submitter explained that studies with ants are all low replication studies due to the difficulty of maintaining multiple colonies under artificial conditions.

[235] During dose response testing with *Pheidole megacephala*, *Wasmannia auropunctata*, *Linepithema humile* and *Solenopsis invicta*, a total of only 152 fertile queens in microcolonies were irradiated during a period of about five years. To compensate for the low numbers, the submitter proposed a 67% higher dose than the dose required to prevent reproduction in the most tolerant ant species tested to date, *Pheidole megacephala*, and more than twice the dose required to prevent reproduction in the other three species tested.

[51] 2017-014, 66_TPPT_2018_Jun

[52] 2018-01 TPPT meeting report: https://www.ippc.int/en/publications/85607/

[53] 62_TPPT_2018_Jun

[236] One TPPT member suggested that sometimes after rain or other special events, many reproductives come out and these could pose a quarantine threat if they infest commodities. They appear in larger masses and could be used in research. For this reason, the tested numbers are not sufficient to support a treatment.

[237] Another member remarked on how few eggs were laid in the trials, and that it is assumed that the study used new queens in the "microcolonies" referred to in the paper. The colony queens may be even more resistant.

[238] **Generic treatment.** It was discussed that as this is proposed as a generic treatment for all ants, it should be established how many economically important species there are in this group, and whether they were tested.

[239] It was considered that ants often arrive with containers or other non-agricultural material as contaminants.

[240] The TPPT concluded that the management of ants is a very good suggestion, but there are not enough data to consider such a generic treatment. It was proposed to consider reducing the scope to only the four tested species.

[241] The TPPT:

(17) *asked* the submitter to provide more data and justification on why the tested species are the economically important species, how they are representative of all ants (Hymenoptera: Formicidae) and either provide more data or consider reducing the scope.

7. Updates from IPPC Bodies

7.1 Follow-up actions from CPM-13 and Standards Committee

[242] The Secretariat updated the TPPT on recent decisions of the CPM-13 and informed the panel of the adoption of ISPM 42 (*Requirements for the use of temperature treatments as phytosanitary measures*) and PT 32 (Vapour heat treatment for *Bactrocera dorsalis* on *Carica papaya*).

[243] The Secretariat informed the TPPT that the SC was updated on their recent activities and that the SC agreed that the TPPT can communicate directly with the International Quarantine Forestry Research Group (IFQRG) in addressing the objection raised at CPM-12 to the Heat treatment of wood using dielectric heating (2007-114) and in providing references to support the phytosanitary treatment submission on the Heat treatment of wood chips (2017-024).

[244] The Secretariat invited the TPPT to reflect on the queries of the SC-7 on the definition and temperature range of "cool conditions" that is used in the draft ISPM on Requirements for the use of fumigation as a phytosanitary measure (2014-004) in relation to the use of a vaporizer. The TPPT recommended that the section be reworded to avoid the use of the term "cool condition", and explained that the use of a vaporizer in the introduction of the fumigant is rather dependent on the fumigant type than the temperature. For example, vaporizers are used almost all the time when fumigating with methyl bromide. The Secretariat will forward the recommendation of TPPT to the SC.

[245] **Review of Treatment Leads for PTs.** The TPPT made some adjustments in the Treatment Leads. The following arrangements were agreed:

- Irradiation treatment for the genus *Anastrepha* (2017-031) – Mr Matthew SMYTH
- Irradiation treatment for eggs and larvae of the family Tortricidae (generic) (2017-011) – Mr Matthew SMYTH
- Generic irradiation treatment against insects, except Lepidoptera larvae and pupae (2017-030) – Mr Scott MYERS
- Irradiation treatment for *Lobesia botrana* eggs and larvae on all fresh commodities (2017-021) – Mr Eduardo WILLINK.

[246] The TPPT:

(18) *noted* the update and *agreed* to the new Treatment Leads.

8. Liaison

8.1 Phytosanitary Measures Research Group (PMRG)

[247] Mr Guy HALLMAN, former PMRG chairperson, provided an update of the activities of the PMRG[54].There are currently 71 members from 21 countries. The PMRG is working on developing research guidelines on different types of phytosanitary treatments. The “Guidelines for vapour heat treatment research” and the “Guidelines for cold treatment research” have been developed and circulated to the group for comment. The “Guidelines for fumigation treatment research” and the “Guidelines for controlled atmosphere treatment research”, including controlled atmosphere heat treatments, are being developed.

[248] The former PMRG chairperson recalled the collaboration of the PMRG with the Joint FAO/International Atomic Energy Agency (IAEA) Division and the Japanese Ministry of Agriculture, Forestry and Fisheries (Research Center Yokohama) on the studies of how *Bactrocera dorsalis* populations from different geographical regions of the world respond to vapour heat treatments. They concluded that there is no evidence to support the contention that there are significant differences in vapour heat tolerance among populations of *Bactrocera dorsalis*. These results were presented to the TPPT and supported their work to move forward on the development of international phytosanitary treatments in 2017.

[249] The PMRG meets every two years. The next meeting of the PMRG will (tentatively) be held in Cairns, Australia in August 2019.

[250] For the next PMRG meeting, the group is developing working papers on research and operational issues covering generic cold treatments, modelling phytosanitary treatments, documenting existing phytosanitary systems, treatment of mixed loads, heat treatments and non-target organisms, as well as the use of systems approaches.

[251] The TPPT agreed that the issue of correcting sample sizes (reported under agenda item 6.8) and estimating number of insects treated could be good topics for the PMRG along with the temperature measurements (reported under agenda item 11.1))

[252] The TPPT:

(19) *noted* the update of the PMRG activities and acknowledged the importance of this group to the work of the TPPT

(20) *agreed* to recommend to PMRG the following topics for consideration: correcting sample sizes, evaluating treatment temperatures from trials, and estimating treated insect numbers.

8.2 Ozone Secretariat (Vienna Convention and Montreal Protocol / United Nations Environment Programme (UNEP))

[253] The Secretariat introduced the document[55] which was prepared by the Secretariat based on the report of the Ozone Secretariat and the Methyl Bromide Technical Options Committee (MBTOC) co-chairs to the CPM-13.

[254] The Secretariat informed the TPPT members that to strengthen collaboration, the MBTOC still seeks nomination from the TPPT members to become members of the MBTOC.

[255] The MBTOC invited the TPPT to provide a list of the top 10–20 key pests for which methyl bromide is used in quarantine and pre-shipment application, including possibly a list of key alternatives used in

[54] Phytosanitary Measures Research Group: https://www.ippc.int/en/external-cooperation/organizations-page-in-ipp/phytosanitarymeasuresresearchgroup/

[55] 63_TPPT_2018_Jun

various regions. The TPPT noted that this is outside of the remit of the TPPT and would need further guidance from the SC.

[256] The TPPT:

(21) *noted* the update of the recent meeting of the Methyl Bromide Technical Options Committee (MBTOC).

9. Overview of the TPPT Work Programme[56]

[257] The TPPT work programme currently contains 25 treatments (24 newly added topics and the Heat treatment of wood using dielectric heating (2007-114)) and 4 ISPMs (*Requirements for the use of chemical treatments as a phytosanitary measure* (2014-003) – priority 3, *Requirements for the use of fumigation as a phytosanitary measure* (2014-004) – priority 1, *Requirements for the use of modified atmosphere treatments as a phytosanitary measure* (2014-006) – priority 2, *Requirements for the use of irradiation as a phytosanitary measure* (revision to ISPM 18) (2014-007) – priority 3).

[258] **Dielectric heating.** The Treatment Lead of the draft PT Heat treatment of wood using dielectric heating (2007-114) provided a brief update on the progress in evaluating the objection. As already discussed at the November 2017 meeting of the TPPT, it is likely that problems around the application resulted in the failure of the schedule (loss on the surface, cold spots cannot be excluded). The IFQRG is currently reviewing the previously developed (IPPC) guidance on how to successfully apply dielectric heating treatments. Once the new guidance is available, the submitter may be able to repeat the experiment and potentially reconsider the objection. At the last IFQRG meeting, researchers conducting research on dielectric heating volunteered to provide advice on the application to the submitter.

[259] **Wood chips.** The Technical Panel on Forest Quarantine and IFQRG had a look at the submission for the Heat treatment of wood chips (2017-024) that was discussed at the July 2017 meeting of the TPPT and added to the work programme. As the treatment has the same treatment schedule proposed as in ISPM 15 (*Regulation of wood packaging material in international trade*) the TPPT was hoping to get data on supporting studies to develop the treatment. The TPPT was informed of major ongoing research in Canada to develop a concept of a generic heat dosage for all insects in different types of wood.

[260] The TPPT agreed to remove from the work programme the draft PT Heat treatment of wood chips (2017-024) as there is no information available to support the development of this PT.

[261] **Next meeting.** The Secretariat informed the TPPT that the next meeting is scheduled for July 2019 (see calendar on IPP: https://www.ippc.int/en/year/calendar/).

[262] The list of actions that arise from this meeting is presented in Appendix 12.

[263] The TPPT:

(22) *recommended* to the Standards Committee (SC) that the draft PT Heat treatment of wood chips (2017-024) be removed from the TPPT work programme.

(23) *recommended* to the Standards Committee (SC) to assign pending status to the draft PT on Heat treatment of wood using dielectric heating (2007-114) to allow for further guidance on the treatment application to be developed.

10. Recommendations to the SC

[264] The following summarizes the TPPT recommendations to the SC from this meeting.

[265] The TPPT invited the SC to:

- *remove* from the TPPT work programme the following draft phytosanitary treatments:

[56] List of Topics for IPPC standards: https://www.ippc.int/en/core-activities/standards-setting/list-topics-ippc-standards/list

· Heat treatment of wood chips (2017-024)

· Generic irradiation treatment for Curculionidae (Coleoptera) (2017-016)

- *change* the priority of the draft PT Irradiation treatment for *Bactrocera tau* (2017-025) from 3 to 2 due to the demonstrated economic importance of the treatment
- *assign* pending status to the draft PT on Heat treatment of wood using dielectric heating (2007-114) to allow for further guidance on the treatment application to be developed.

[266] The TPPT recommended to the SC for *inclusion* into the TPPT work programme the following treatments so that the TPPT can better assess the information from the submitter:

- CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth *(Cydia pomonella)* and western cherry fruit fly *(Rhagoletis indifferens)* in cherry (2017-037) with priority 3 and Mr Michael ORMSBY as the Treatment Lead
- CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and oriental fruit moth (*Grapholita molesta*) in apple (2017-038) with priority 3 and Mr Michael ORMSBY as the Treatment Lead.

[267] The TPPT recommended the following draft PTs to the Standard Committee (SC) for *approval for first consultation*:

- Cold treatment for *Ceratitis capitata* on *Vitis vinifera* (2017-023A)
- Cold treatment for *Bactrocera tryoni* on *Vitis vinifera* (2017-023B)
- Cold Treatment for *Ceratitis capitata* on *Prunus avium*, *Prunus domestica* and *Prunus persica* (2017-022A)
- Cold Treatment for *Bactrocera tryoni* on *Prunus avium*, *Prunus domestica* and *Prunus persica* (2017-022B)
- Irradiation treatment for the genus *Anastrepha* (2017-031)
- Irradiation treatment for *Carposina sasakii* (2017-026)
- Irradiation treatment for *Bactrocera tau* (2017-025)
- Irradiation treatment for *Bactrocera dorsalis* (2017-015).

11. Other Business

11.1 Evaluation criteria for temperature treatment exposure parameters

[268] Mr Mike ORMSBY submitted a discussion paper[57] on the issue of temperature measurements during heat treatment research and how these measurements should be used to derive the temperature schedule of treatments.

[269] The paper outlines that during temperature treatment trials or application in trade, the temperature measurements fluctuate slightly. The question is what deviation is allowed and whether to determine the treatment temperature as the mean or average of the measurements or use another computation method.

[270] The TPPT briefly discussed the issue. One member explained that in commercial application if a measurement is above the minimum temperature (e.g. in the case of cold treatments), it is considered a treatment failure. That results in more stringent temperature control than using the mean.

[271] One member noted that cold dips could potentially result in higher efficacy than just keeping the temperature constant (the mean would stay the same). It was suggested that the PMRG be asked how this could influence the efficacy of PTs.

[272] Another member informed the TPPT that in temperature treatment research there is normally a range of variation allowed (e.g. +/− 0.5 °C), and if the temperature spikes exceed that, the treatment results are

[57] 13_ TPPT_2018_Jun

discarded. Another member was concerned with how to determine the range. In the case of some specific treatments, there is guidance on the allowed temperature spikes.

[273] It was noted that the Standard setting procedure manual contains the following in relation to temperature measuring equipment: “Regarding temperatures sensitivities (e.g. 2 °C +/− 0.5 °C), these were not added to the treatment schedules. In some submissions the temperature limits were quoted, but the TPPT noted that experimental probes were often more sensitive than commercial probes. The TPPT therefore decided to include a sentence in the treatment descriptions indicating that ‘the stated temperatures should not be exceeded’. Commercial operators would need to take into account the normal working range of their equipment in order to meet this requirement.”

[274] Another member reminded the TPPT that the PMRG is developing Guidelines on temperature research.

[275] The TPPT felt that this topic warrants more consideration and would be suitable for the PMRG to discuss. The TPPT agreed to forward this issue to the PMRG.

12. Close of the Meeting

[276] The TPPT was asked to provide feedback on the meeting process. The Secretariat provided a link to the online survey to receive feedback and suggestions to improve the meeting.

[277] The host organization addressed the TPPT to wish them farewell.

[278] The Secretariat thanked China for hosting the meeting, thanked the TPPT members for a productive meeting and the Rapporteur for his support to the Secretariat. The Secretariat also expressed appreciation to the Chairperson for leading the discussions and seeking consensus.

[279] The Chairperson thanked the host and the TPPT members for the good discussion, highlighting the excellent coordination of the host agency.

[280] The meeting was closed.

Appendix 1: Agenda

2018 MEETING OF THE TECHNICAL PANEL ON PHYTOSANITARY TREATMENTS

25 – 29 June 2018

Shenzhen, China

AGENDA

	AGENDA ITEM	DOCUMENT NO.	PRESENTER
1.	**Opening of the meeting**		
	- Opening remarks by the IPPC Secretariat		MOREIRA
	- Opening remarks by the Host Agency		IPPC official contact point of China
2.	**Meeting Arrangements**		CHAIRPERSON
	- Election of the Chairperson		MOREIRA
	- Election of the Rapporteur		CHAIRPERSON
	- Adoption of the Agenda	01_TPPT_2018_Jun	CHAIRPERSON
3.	**Administrative Matters**		CHAIRPERSON
	- Documents List	02_TPPT_2018_Jun	KISS
	- Participants List	03_TPPT_2018_Jun	KISS
	- Local Information	04_TPPT_2018_Jun	YU
4.	**Draft phytosanitary treatments (PTs) in the work program**[58]	Link to Call for treatments page	KISS / MOREIRA
	- Overview of the standard setting procedure - List of treatments	05_TPPT_2018_Jun_Rev1	
4.1	Cold treatment of *Ceratitis capitata* on table grapes (2017-023A) – priority 1	Link to the submission 2017-023A	DOHINO
	- Draft PT: 2017-023A	2017-023A	
	- Treatment lead summary	06_TPPT_2018_Jun	
4.2	Cold treatment of *Bactrocera tryoni* on table grapes (2017-023B) – priority 1	Link to the submission 2017-023B	DOHINO
	- Draft PT: 2017-023B	2017-023B	
	- Treatment lead summary	07_TPPT_2018_Jun	
4.3	Cold treatment of *Ceratitis capitata* on stone fruit (2017-022A) – priority 1	Link to the submission 2017-022A	DOHINO
	- Draft PT: 2017-022A	2017-022A	

[58] Additional resources: IPPC procedure manual for standard setting: https://www.ippc.int/en/core-activities/ippc-standard-setting-procedure-manual/; IPPC style guide: https://www.ippc.int/en/publications/81329/; TPPT Specification TP3: https://www.ippc.int/en/publications/1308/

	AGENDA ITEM	DOCUMENT NO.	PRESENTER
	- Treatment lead summary	08_TPPT_2018_Jun	
4.4	Cold treatment of *Bactrocera tryoni* on stone fruit (2017-022B) – priority 1	Link to the submission 2017-022B	DOHINO
	- Draft PT: 2017-022B	2017-022B	
	- Treatment lead summary	09_TPPT_2018_Jun	
4.5	Irradiation treatment for the genus *Anastrepha* (2017-031) – priority 1	Link to the submission 2017-031	HALLMAN
	- Draft PT: 2017-031	2017-031	
	- Treatment lead summary	65_TPPT_2018_Jun	
	- Discussion paper (2017-031)	CRP 01_TPPT_2018_Jun	
5.	**Review of evaluation of treatments submissions from the 2017 call for treatments**		CHAIRPERSON / KISS
	Draft Phytosanitary Treatments and submissions	Link to Draft PTs and submissions	
5.1	CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and western cherry fruit fly (*Rhagoletis indifferens*) in cherry (2017-037)	Link to the submission 2017-037	ORMSBY
	- Checklist for evaluating treatment submissions and Prioritization score sheet	10_TPPT_2018_Jun	
	- Reference: Neven *et al* 2000	17_TPPT_2018_Jun	
	- Reference: Obenland *et al* 2005	18_TPPT_2018_Jun	
5.2	CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and oriental fruit moth (*Grapholita molesta*) in apple (2017-038)	Link to the submission 2017-038	ORMSBY
	- Checklist for evaluating treatment submissions and Prioritization score sheet	11_TPPT_2018_Jun	
	- Reference: Neven *et al* 2000	17_TPPT_2018_Jun	
	- Reference: Obenland *et al* 2005	18_TPPT_2018_Jun	
6.	**Review of additional supporting information**		CHAIRPERSON / KISS
6.1	Irradiation treatment for spotted wing drosophila *Drosophila suzukii* on all fresh commodities (2017-017) – priority 1	Link to the submission 2017-017	SMYTH
	- Draft PT: 2017-017	2017-017	
	- Additional supporting information (2017-017)	14_TPPT_2018_Jun	
	- Reference: Follett *et al* 2014	15_TPPT_2018_Jun	
	- Reference: Kruger *et al* 2018	16_TPPT_2018_Jun	
	- Treatment leads summary	25_TPPT_2018_Jun	
6.2	Generic irradiation treatment for Curculionidae (Coleoptera) (2017-016) – priority 2	Link to the submission 2017-016	YU

	AGENDA ITEM	DOCUMENT NO.	PRESENTER
	- Draft PT: 2017-016	2017-016	
	- Additional supporting information (2017-016)	20_TPPT_2018_Jun	
	- Reference: Follett 2018	19_TPPT_2018_Jun	
	- Treatment lead summary	30_TPPT_2018_Jun	
6.3	Irradiation treatment for *Epiphyas postvittana* on all fresh commodities (2017-018) – priority 2	Link to the submission 2017-018	YU
	- Draft PT: 2017-018	2017-018	
	- Additional supporting information (2017-018)	21_TPPT_2018_Jun	
	- Reference: Follett and Snook 2012	22_TPPT_2018_Jun	
	- Reference: Batchelor *et al* 1984	23_TPPT_2018_Jun	
	- Reference: Dentener *et al* 1990	24_TPPT_2018_Jun	
	- Reference: USDA Treatment evaluation Document	26_TPPT_2018_Jun	
	- Treatment lead summary	35_TPPT_2018_Jun	
6.4	Sulfuryl fluoride fumigation treatment for *Chlorophorus annularis* on bamboo articles (2017-028) – priority 2	Link to the submission 2017-028	WILLINK
	- Draft PT: 2017-028	2017-028	
	- Additional supporting information (2017-028)	36_TPPT_2018_Jun	
	- Reference: Barak *et al* 2009	31_TPPT_2018_Jun	
	- Reference: Barak et al 2006	32_TPPT_2018_Jun	
	- Reference: Yu *et al* 2010	33_TPPT_2018_Jun	
	- Reference: Barak *et al* 2010	34_TPPT_2018_Jun	
	- Treatment lead summary	64_TPPT_2018_Jun	
6.5	Irradiation treatment for eggs and larvae of the family Tortricidae (generic) (2017-011) – priority 2	Link to the submission 2017-011	SMYTH
	- Draft PT: 2017-011	2017-011	
	- Reference: Follett and Snook 2012	37_TPPT_2018_Jun	
	- Reference: Follett 2008	38_TPPT_2018_Jun	
	- Reference: Follett and Lower 2000	39_TPPT_2018_Jun	
	- Reference: Hallman 2004	40_TPPT_2018_Jun	
	- Reference: Hallman et al 2013	41_TPPT_2018_Jun	
	- Reference: Lester and Barrington 1997	42_TPPT_2018_Jun	
	- Reference: Lin *et al* 2003	43_TPPT_2018_Jun	
	- Reference: Mansour 2003	44_TPPT_2018_Jun	
	- Reference: Mansour 2014	45_TPPT_2018_Jun	
	- Reference: Wit and van de Vrie 1986	46_TPPT_2018_Jun	

	AGENDA ITEM	DOCUMENT NO.	PRESENTER
	- Reference Nadel *et al* 2018	48_TPPT_2018_Jun	
	- Treatment lead summary	47_TPPT_2018_Jun	
6.6	Irradiation treatment for *Carposina sasakii* (2017-026) – priority 2	Link to the submission 2017-026	HALLMAN (PARKER)
	- Draft PT: 2017-026	2017-026	
	- Additional supporting information (2017-026)	49_TPPT_2018_Jun	
	- Reference: Jihoon *et al* 2015	50_TPPT_2018_Jun	
	- Reference: Li *et al* 2016	51_TPPT_2018_Jun	
	- Reference: Zhan *et al* 2014b	54_TPPT_2018_Jun	
	- Treatment lead summary	55_TPPT_2018_Jun	
6.7	Irradiation treatment for *Bactrocera tau* (2017-025) – priority 3	Link to the submission 2017-025	MYERS (PARKER)
	- Draft PT: 2017-025	2017-025	
	- Additional supporting information (2017-025)	28_TPPT_2018_Jun	
	- Reference: Zhan *et al* 2015	29_TPPT_2018_Jun	
	- Treatment lead summary	27_TPPT_2018_Jun	
6.8	Irradiation treatment for oriental fruit fly *Bactrocera dorsalis* on all fresh commodities (2017-015) – priority 3	Link to the submission 2017-015	WILLINK (PARKER)
	- Draft PT: 2017-015	2017-015	
	- Additional supporting information (2017-015)	52_TPPT_2018_Jun	
	- Reference: Follett and Armstrong 2004	57_TPPT_2018_Jun	
	- Reference: Zhao *et al* 2016	58_TPPT_2018_Jun	
	- Treatment lead summary	53_TPPT_2018_Jun	
6.9	Irradiation treatment for ants (Hymenoptera: Formicidae) hitchhiking on fresh commodities (2017-014) – priority 3	Link to the submission 2017-014	MYERS
	- Draft PT: 2017-014	2017-014	
	- Additional supporting information (2017-014)	62_TPPT_2018_Jun	
	- Reference: Calcaterra *et al* 2012	56_TPPT_2018_Jun	
	- Reference: Coulin *et al* 2013	59_TPPT_2018_Jun	
	- Reference: Follett *et al* 2016	60_TPPT_2018_Jun	
	- Reference: Follett and Taniguchi 2007	61_TPPT_2018_Jun	
	- Treatment lead summary	66_TPPT_2018_Jun	
7.	**Updates from IPPC bodies**		CHAIRPERSON
	- SC November 2017	SC November 2017 report	
	- CPM-13 (2018)	CPM- 13 Final Report (2018)	

	AGENDA ITEM	DOCUMENT NO.	PRESENTER
	- SC May 2018	SC May 2018 report	
7.1	Follow-up actions from the thirteenth session of the Commission on Phytosanitary Measures (CPM-13) and Standards Committee (SC)	12_TPPT_2018_Jun	MOREIRA
7.2	Review of treatment leads for Phytosanitary Treatments (PTs)	05_TPPT_2018_Jun_Rev1	MOREIRA / KISS
8.	**Liaison**		CHAIRPERSON
8.1	Phytosanitary Measures Research Group (PMRG)	Link to PMRG page	MYERS/ HALLMAN
8.2	Ozone Secretariat (Vienna Convention and Montreal Protocol / United Nations Environment Programme (UNEP)) - Update from the Methyl Bromide Technical Options Committee	Link to Ozone Secretariat website MBTOC meeting report 63_TPPT_2018_Jun	MOREIRA
9.	**Overview of the TPPT work programme** - TPPT 2018-2019 work plan	Link to List of topics for IPPC standards Link to TPPT Specification TP3 05_TPPT_2018_Jun_Rev1	MOREIRA / KISS
10.	**Recommendations to the SC**		CHAIRPERSON
11.	**Other business**		CHAIRPERSON
11.1	Evaluation Criteria for Temperature Treatment Exposure Parameters	13_TPPT_2018_Jun	ORMSBY
12.	**Close of the meeting**		CHAIRPERSON
	- Evaluation of the meeting process - Close		MOREIRA / CHAIRPERSON

Appendix 2: Documents list

2018 MEETING OF THE TECHNICAL PANEL ON PHYTOSANITARY TREATMENTS

25 – 29 June 2018

Shenzhen, China

DOCUMENTS LIST

DOCUMENT NO.	AGENDA ITEM	DOCUMENT TITLE	DATE POSTED / DISTRIBUTED
DRAFT PHYTOSANITARY TREATMENTS (PTS)			
2017-023A	4.1	Draft PT: 2017-023A	2018-06-08
2017-023B	4.2	Draft PT: 2017-023B	2018-06-08
2017-022A	4.3	Draft PT: 2017-022A	2018-06-08
2017-022B	4.4	Draft PT: 2017-022B	2018-06-08
2017-031	4.5	Draft PT: 2017-031	2018-06-18
2017-017	6.1	Draft PT: 2017-017	2018-06-18
2017-016	6.2	Draft PT: 2017-016	2018-06-11
2017-018	6.3	Draft PT: 2017-018	2018-06-13
2017-028	6.4	Draft PT: 2017-028	2018-06-14
2017-011	6.5	Draft PT: 2017-011	2018-06-18
2017-026	6.6	Draft PT: 2017-026	2018-06-13
2017-025	6.7	Draft PT: 2017-025	2018-06-11
2017-015	6.8	Draft PT: 2017-015	2018-06-13
2017-014	6.9	Draft PT: 2017-014	2018-06-19
MEETING DOCUMENTS			
01_TPPT_2018_Jun	01.	Agenda	2018-05-28 2018-05-30 2018-06-14
02_TPPT_2018_Jun_Rev2	02	Document List	2018-06-20
03_TPPT_2018_Jun	02	Participants List	2018-06-14
04_TPPT_2018_Jun	02	Local Information	2018-05-07
05_TPPT_2018_Jun_Rev1	04, 7.2 and 09	List of treatments	2018-06-20
06_TPPT_2018_Jun	4.1	Treatment lead summary: 2017-023A	2018-06-07
07_TPPT_2018_Jun	4.2	Treatment lead summary: 2017-023B	2018-06-07
08_TPPT_2018_Jun	4.3	Treatment lead summary: 2017-022A	2018-06-07

DOCUMENT NO.	AGENDA ITEM	DOCUMENT TITLE	DATE POSTED / DISTRIBUTED
09_TPPT_2018_Jun	4.4	Treatment lead summary: 2017-022B	2018-06-07
10_TPPT_2018_Jun	5.1	Checklist for evaluating treatment submissions (2017-037)	2018-06-07
11_TPPT_2018_Jun	5.2	Checklist for evaluating treatment submissions (2017-038)	2018-06-07
12_TPPT_2018_Jun	7.1	Updates from CPM-13 and Standards Committee (SC)	2018-06-12
13_TPPT_2018_Jun	11.1	Evaluation Criteria for Temperature Treatment Exposure Parameters	2018-06-12
14_TPPT_2018_Jun	6.1	Additional supporting information (2017-017)	2018-06-11
15_TPPT_2018_Jun	6.1	Reference: Follett *et al.* 2014	2018-06-08
16_TPPT_2018_Jun	6.1	Reference: Kruger *et al.* 2018	2018-06-08
17_TPPT_2018_Jun	5.2	Reference: Neven *et al.* 2000	2018-06-08
18_TPPT_2018_Jun	5.2	Reference: Obenland *et al.* 2005	2018-06-08
19_TPPT_2018_Jun	6.2	Reference: Follett 2018	2018-06-08
20_TPPT_2018_Jun	6.2	Additional supporting information (2017-016)	2018-06-08
21_TPPT_2018_Jun	6.3	Additional supporting information (2017-018)	2018-06-08
22_TPPT_2018_Jun	6.3	Reference: Follett and Snook 2012	2018-06-08
23_TPPT_2018_Jun	6.3	Reference: Batchelor *et al.* 1984	2018-06-08
24_TPPT_2018_Jun	6.3	Reference: Dentener *et al.* 1990	2018-06-08
25_TPPT_2018_Jun	6.1	Treatment lead summary: 2017-017	2018-06-11
26_TPPT_2018_Jun	6.3	Reference: USDA Treatment evaluation Document	2018-06-11
27_TPPT_2018_Jun	6.7	Treatment lead summary: 2017-025	2018-06-11
28_TPPT_2018_Jun	6.7	Additional supporting information (2017-025)	2018-06-11
29_TPPT_2018_Jun	6.7	Reference: Zhan *et al.* 2015	2018-06-11
30_TPPT_2018_Jun	6.2	Treatment leads summary: 2017-016	2018-06-12
31_TPPT_2018_Jun	6.4	Reference: Barak *et al.* 2009	2018-06-12
32_TPPT_2018_Jun	6.4	Reference: Barak *et al.* 2006	2018-06-12
33_TPPT_2018_Jun	6.4	Reference: Yu *et al.* 2010	2018-06-12
34_TPPT_2018_Jun	6.4	Reference: Barak *et al.* 2010	2018-06-12
35_TPPT_2018_Jun	6.3	Treatment lead summary: 2017-018	2018-06-12
36_TPPT_2018_Jun	6.4	Additional supporting information: (2017-028)	2018-06-12
37_TPPT_2018_Jun	6.5	Reference: Follett and Snook 2012	2018-06-12
38_TPPT_2018_Jun	6.5	Reference: Follett 2008	2018-06-12
39_TPPT_2018_Jun	6.5	Reference: Follett and Lower 2000	2018-06-12

DOCUMENT NO.	AGENDA ITEM	DOCUMENT TITLE	DATE POSTED / DISTRIBUTED
40_TPPT_2018_Jun	6.5	Reference: Hallman 2004	2018-06-12
41_TPPT_2018_Jun	6.5	Reference: Hallman *et al.* 2013	2018-06-12
42_TPPT_2018_Jun	6.5	Reference: Lester and Barrington 1997	2018-06-12
43_TPPT_2018_Jun	6.5	Reference: Lin *et al.* 2003	2018-06-12
44_TPPT_2018_Jun	6.5	Reference: Mansour 2003	2018-06-12
45_TPPT_2018_Jun	6.5	Reference: Mansour 2014	2018-06-12
46_TPPT_2018_Jun	6.5	Reference: Wit and van de Vrie 1986	2018-06-12
47_TPPT_2018_Jun	6.5	Treatment lead summary: 2017-011	2018-06-13
48_TPPT_2018_Jun	6.5	Reference Nadel *et al.* 2018	2018-06-12
49_TPPT_2018_Jun	6.6	Additional Supporting Information: (2017-026)	2018-06-13
50_TPPT_2018_Jun	6.6	Reference: Jihoon *et al.* 2015	2018-06-13
51_TPPT_2018_Jun	6.6	Reference: Li *et al.* 2016	2018-06-13
52_TPPT_2018_Jun	6.8	Additional Supporting Information: (2017-015)	2018-06-13
53_TPPT_2018_Jun	6.8	Treatment Lead Summary: 2017-015)	2018-06-13
54_TPPT_2018_Jun	6.6	Reference: Zhan *et al.* 2014b	2018-06-13
55_TPPT_2018_Jun	6.6	Treatment lead summary: (2017-026)	2018-06-13
56_TPPT_2018_Jun	6.9	Reference: Calcaterra *et al.* 2012	2018-06-14
57_TPPT_2018_Jun	6.8	Reference: Follett and Armstrong 2004	2018-06-13
58_TPPT_2018_Jun	6.8	Reference: Zhao *et al.* 2016	2018-06-13
59_TPPT_2018_Jun	6.9	Reference: Coulin *et al.* 2013	2018-06-14
60_TPPT_2018_Jun	6.9	Reference: Follett *et al.* 2016	2018-06-14
61_TPPT_2018_Jun	6.9	Reference: Follett and Taniguchi 2007	2018-06-14
62_TPPT_2018_Jun	6.9	Additional supporting information: (2017-014)	2018-06-14
63_TPPT_2018_Jun	8.2	Update from the Methyl Bromide Technical Options Committee	2018-06-14
64_TPPT_2018_Jun	6.4	Treatment Lead Summary: 2017-028	2018-06-14
65_TPPT_2018_Jun	4.5	Treatment lead summary: 2017-031	2018-06-18
66_TPPT_2018_Jun	6.9	Treatment lead summary: 2017-014	2018-06-19
CRP 01_TPPT_2018_Jun	4.5	Discussion paper - (2017-031)	2018-06-28

Links:

CONTENT	AGENDA ITEM	LINKS:
Standard Setting Call for treatments page	4	Link to Call for treatments page

CONTENT	AGENDA ITEM	LINKS:
Treatments submissions Cold treatment of *Ceratitis capitata* on table grapes (2017-023A)	4.1	Link to the submission 2017-023A
Treatments submissions Cold treatment of *Bactrocera tryoni* on table grapes (2017-023B)	4.2	Link to the submission 2017-023B
Treatments submissions Cold treatment of *Ceratitis capitata* on stone fruit (2017-022A)	4.3	Link to the submission 2017-022A
Treatments submissions Cold treatment of *Bactrocera tryoni* on stone fruit (2017-022B)	4.4	Link to the submission 2017-022B
Treatments submissions Irradiation treatment for the genus *Anastrepha* (2017-031)	4.5	Link to the submission 2017-031
Draft Phytosanitary Treatments and submissions	5	Link to Draft PTs and submissions
Treatments submissions CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and western cherry fruit fly (*Rhagoletis indifferens*) in cherry (2017-037)	5.1	Link to the submission 2017-037
Treatments submissions CATTS (Controlled Atmosphere/Temperature Treatment System) treatments against codling moth (*Cydia pomonella*) and oriental fruit moth (*Grapholita molesta*) in apple (2017-038)	5.2	Link to the submission 2017-038
Treatments submissions Irradiation treatment for spotted wing drosophila *Drosophila suzukii* on all fresh commodities (2017-017)	6.1	Link to the submission 2017-017
Treatments submissions Generic irradiation treatment for Curculionidae (Coleoptera) (2017-016)	6.2	Link to the submission 2017-016
Treatments submissions Irradiation treatment for *Epiphyas postvittana* on all fresh commodities (2017-018)	6.3	Link to the submission 2017-018
Treatments submissions Sulfuryl fluoride fumigation treatment for *Chlorophorus annularis* on bamboo articles (2017-028)	6.4	Link to the submission 2017-028
Treatments submissions Irradiation treatment for eggs and larvae of the family Tortricidae (generic) (2017-011)	6.5	Link to the submission 2017-011
Treatments submissions Irradiation treatment for *Carposina sasakii* (2017-026)	6.6	Link to the submission 2017-026
Treatments submissions Irradiation treatment for *Bactrocera tau* (2017-025)	6.7	Link to the submission 2017-025
Treatments submissions Irradiation treatment for oriental fruit fly *Bactrocera dorsalis* on all fresh commodities (2017-015)	6.8	Link to the submission 2017-015
Treatments submissions Irradiation treatment for ants (Hymenoptera: Formicidae) hitchhiking on fresh commodities (2017-014)	6.9	Link to the submission 2017-014
SC November 2017	7	SC November 2017 report
CPM-13 (2018)	7	CPM-13 Final Report (2018)
SC May 2018	7	SC May 2018 report

CONTENT	AGENDA ITEM	LINKS:
Liaisons: Phytosanitary Measures Research Group (PMRG)	8.1	Link to PMRG page (see also report of the PTTEG: click here)
Liaisons: Ozone Secretariat (Vienna Convention and Montreal Protocol / United Nations Environment Programme (UNEP))	8.2	Link to Ozone Secretariat website (see also the report of the MBTOC: click here)
Overview of the TPPT work programme	09	Link to 2018-06 List of topics for IPPC standards Specification TP 3

Appendix 3: Participants list

2018 MEETING FOR THE TECHNICAL PANEL ON PHYTOSANITARY TREATMENTS

25-29 June 2018

Shenzhen, CHINA

PARTICIPANTS LIST

A check (✓) in column 1 indicates confirmed attendance at the meeting.

Confirmed	Participant role	Name, mailing, address, telephone	Email address	Term expires
	Steward	Mr David **OPATOWSKI** 1-3 avenue de la Paix 1202 Geneva, Switzerland **ISRAEL** Tel: (+41) 79945 7344	dopatowski@yahoo.com; agriculture@geneva.mfa.gov.il	N/A
✓	**Member**	Mr Michael **ORMSBY** Plant Risk Analysis New Zealand Ministry for Primary Industries P.O Box 2526, Wellington, **NEW ZEALAND** Tel: +64 4 8940486	Michael.Ormsby@mpi.govt.nz;	2020 – 3rd Term
✓	**Member**	Mr Eduardo **WILLINK** Estación Experimental Agroindustrial Obispo Colombres, P.O.Box 9, Las Talitas (4101) Tucumán **ARGENTINA** Tel: +54 381-4521010 +54-381 154692512	ewillink@eeaoc.org.ar ewillink@arnet.com.ar	2020 – 3rd Term
✓	**Member**	Mr Yuejin **WANG** Institute of Inspection Technology and Equipment Chinese Academy of Inspection and Quarantine No. 241 Huixinli, Chaoyang District, Beijing 100029 **CHINA** Tel: +86 10 64934647	wangyj@caiq.gov.cn wangyj1961@hotmail.com	2020 – 3rd Term
✓	**Member**	Mr Scott **MYERS** USDA APHIS 1398 W Truck Rd., Buzzards Bay, MA, **USA** Tel: 508-563-0959	scott.w.myers@aphis.usda.gov	2023– 2nd Term
✓	**Member**	Mr Matthew **SMYTH** Australian Department of Agriculture & Water Resources 7 London Circuit, Canberra ACT 2601 **AUSTRALIA** Tel: +61 2 6272 5662	matthew.smyth@agriculture.gov.au	2019– 1st Term

Confirmed	Participant role	Name, mailing, address, telephone	Email address	Term expires
✓	**Member**	Mr Daojian **YU** Shenzhen Entry-Exit Inspection and Quarantine Bureau, AQSIQ 1011, Fuqiang Road, Shenzhen, 518045,Guangdong, **CHINA** Tel: +86-755-82117990	yudj@szciq.gov.cn	2019– 1st Term
✓	**Member**	Mr Toshiyuki **DOHINO** Disinfestation Technology Section, Research Center Yokohama Plant Protection Station Ministry of Agriculture, Forestry and Fisheries (MAFF) 1-16-10, Shin-yamashita, Naka-ku, Yokohama 231-0801 **JAPAN** Tel: +81 45 622 8893 Fax: +81 45 621 7560	dohinot@pps.maff.go.jp	2020– 1st Term
	Member	Mr Andrew **PARKER** Insect Pest Control Laboratory FAO/IAEA Agriculture and Biotechnology Laboratories Agency's Laboratories Seibersdorf IAEA A-2444 Seibersdorf AUSTRIA Tel: +43 1 2600 28408	a.parker@iaea.org;	2020 – 1st term
✓	**IPPC Secretariat Lead (Standard Setting Officer)**	Ms Adriana **MOREIRA** International Plant Protection Convention Food and Agriculture Organization of the United Nations Viale delle Terme di Caracalla 00153 Rome ITALY Tel: + 39 06 570 55809	adriana.moreira@fao.org	N/A
✓	**IPPC Secretariat Support (Standard Setting Associate)**	Ms Janka **KISS** International Plant Protection Convention Food and Agriculture Organization of the United Nations Viale delle Terme di Caracalla 00153 Rome ITALY Tel: +39 06 570 52454	Janka.kiss@fao.org	N/A
✓	**Invited Expert**	Mr Guy **HALLMAN** Research Entomologist	N5551212@yahoo.com	N/A
✓	**Host representative**	Mr Yongyue **LU** Professor, Southern China Agriculture university	luyongyue@scau.edu.cn	N/A
✓	**Host representative**	Mr Guoping **ZHAN** Professor, Chinese academy of inspection and quarantine	zhgp136@126.com; zhangp@caiq.org.cn	N/A

Appendix 4: References

Abbott W.S. 1925. A method of computing the effectiveness of an Insecticide. *Journal of Economic Entomology*, 18: 265–267.

Arthur, V., Domarco, R.E., Walder, J.M.M. & Spoto, M.H.F. 1991. Desinfestação de mangas "Haden" infestadas por *Anastrepha fraterculus* (Wied., 1830) (Diptera, Tephritidae), através da radiação gama. In: Abstracts, 13th Brazilian Congress of Entomology, pp. 633. Socidade Entomológica do Brasil, Recife.

Arthur, V., Leme, M.H.A., Wiendl, F.M., Silva, A.C., Faria, J.T. & Wiendl, J.A. 1993. Desinfestação de frutos de goiaba infestados pela mosca-das-frutas *Anastrepha obliqua* (Mac., 1835) (Diptera, Tephritidae) através das radiações gama do cobalto-60. *Revista de Agricultura*, 68: 207–217.

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Appendix 5: Efficacy calculation for the draft PT Cold treatment for *Ceratitis capitata* on *Vitis vinifera* (2017-023A)[59]

Red Globe	1°C	16 Days	Confirmatory Controls - MedFly			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	16,462			16,462	16.46
2	1,000	12,762			12,762	12.76
3	1,000	12,436			12,436	12.44
Total	**3,000**	**41,660**	**0**	**0**	**41,660**	**13.8867**
Average (± SE x (SQR(1+1/r)) =				**13.8867 ±**	**2.582 =**	**11.3045**
Number Tested Fruit =						**6,000**
Estimated Number of Treated FF (Average) =						**67,827**

Red Globe	2°C	18 Days	Confirmatory Controls - MedFly			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	13,170			13,170	13.17
2	1,000	14,038			14,038	14.04
3	1,000	14,923			14,923	14.92
Total	**3,000**	**42,131**	**0**	**0**	**42,131**	**14.0437**
Average (± SE x (SQR(1+1/r)) =				**14.0437 ±**	**1.012 =**	**13.0316**
Number Tested Fruit =						**6,000**
Estimated Number of Treated FF (Average) =						**78,190**

Red Globe	3°C	20 Days	Confirmatory Controls - MedFly			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	12,821			12,821	12.82
2	1,000	13,284			13,284	13.28
3	1,000	13,903			13,903	13.90
Total	**3,000**	**40,008**	**0**	**0**	**40,008**	**13.3360**
Average (± SE x (SQR(1+1/r)) =				**13.3360 ±**	**0.627 =**	**12.7091**
Number Tested Fruit =						**6,000**
Estimated Number of Treated FF (Average) =						**76,255**

Crimson Seedless	1°C	16 Days	Confirmatory Controls - MedFly			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	12,932			12,932	12.93
2	1,000	13,791			13,791	13.79
3	1,000	13,780			13,780	13.78
Total	**3,000**	**40,503**	**0**	**0**	**40,503**	**13.5010**
Average (± SE x (SQR(1+1/r)) =				**13.5010 ±**	**0.569 =**	**12.9320**
Number Tested Fruit =						**6,000**
Estimated Number of Treated FF (Average) =						**77,592**
Crimson Seedless	**2°C**	**18 Days**	**Confirmatory Controls - MedFly**			

[59] Abbreviations: FF:fruit flies; Medfly: Mediterranean fruit fly (*Ceratitis capitata*); SQR: square root of a number

TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	12,932			12,932	12.93
2	1,000	15,630			15,630	15.63
3	1,000	13,780			13,780	13.78
Total	**3,000**	**42,342**	**0**	**0**	**42,342**	**14.1140**
			Average (± SE x (SQR(1+1/r)) =	**14.1140 ±**	**1.593 =**	**12.5209**
					Number Tested Fruit =	**6,000**
					Estimated Number of Treated FF (Average) =	**75,125**
Crimson Seedless	**3°C**	**20 Days**	**Confirmatory Controls - MedFly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	11,555			11,555	11.56
2	1,000	12,981			12,981	12.98
3	1,000	12,082			12,082	12.08
Total	**3,000**	**36,618**	**0**	**0**	**36,618**	**12.2060**
			Average (± SE x (SQR(1+1/r)) =	**12.2060 ±**	**0.833 =**	**11.3734**
					Number Tested Fruit =	**6,000**
					Estimated Number of Treated FF (Average) =	**68,240**

Thompson Seedless	**1°C**	**16 Days**	**Confirmatory Controls - MedFly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	14,524			14,524	14.52
2	1,000	14,732			14,732	14.73
3	1,000	13,024			13,024	13.02
Total	**3,000**	**42,280**	**0**	**0**	**42,280**	**14.0933**
			Average (± SE x (SQR(1+1/r)) =	**14.0933 ±**	**1.076 =**	**13.0173**
					Number Tested Fruit =	**6,000**
					Estimated Number of Treated FF (Average) =	**78,104**
Thompson Seedless	**2°C**	**18 Days**	**Confirmatory Controls - MedFly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	13,798			13,798	13.80
2	1,000	13,259			13,259	13.26
3	1,000	12,373			12,373	12.37
Total	**3,000**	**39,430**	**0**	**0**	**39,430**	**13.1433**
			Average (± SE x (SQR(1+1/r)) =	**13.1433 ±**	**0.831 =**	**12.3125**
					Number Tested Fruit =	**6,000**
					Estimated Number of Treated FF (Average) =	**73,875**
Thompson Seedless	**3°C**	**20 Days**	**Confirmatory Controls - MedFly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,000	13,010			13,010	13.01
2	1,000	12,643			12,643	12.64
3	1,000	12,289			12,289	12.29
Total	**3,000**	**37,942**	**0**	**0**	**37,942**	**12.6473**

Average (± SE x (SQR(1+1/r)) =	12.6473 ±	0.416 =	12.2310
Number Tested Fruit =			6,000
Estimated Number of Treated FF (Average) =			73,386

Combined	1°C	16 Days
Estimated Number of Treated FF (Average) =		223,523
	Efficacy =	99.9987

Combined	2°C	18 Days
Estimated Number of Treated FF (Average) =		227,190
	Efficacy =	99.9987

Combined	3°C	20 Days
Estimated Number of Treated FF (Average) =		217,881
	Efficacy =	99.9986

Appendix 6: Efficacy calculation for the draft PT Cold treatment for *Bactrocera tryoni* on *Vitis vinifera* (2017-023B)[60]

Table 1. Table grape 'Ruby Seedless' (1°C) & 'Red Globe' (2°C & 3°C) CT for QFly

Ruby Seedless	**1°C**	**12 Days**	**Confirmatory Controls - Qfly - Cage Infestation**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	1,493	209			209	0.14
2	1,613	161			161	0.10
3	1,474	147			147	0.10
4	1,792	251			251	0.14
5	1,498	315			315	0.21
Total	**7,870**	**1,083**	**0**	**0**	**1,083**	**0.1380**
			Average (± SE x (SQR(1+1/r)) =	**0.1380 ±**	**0.0492 =**	**0.0888**
					Number Tested Fruit =	**14,292**
					Estimated Number of Treated FF (Average) =	**1,269**
Ruby Seedless	**1°C**	**12 Days**	**Confirmatory Controls - Qfly - Artificial Infestation**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	747	3,145			3,145	4.21
2	807	2,090			2,090	2.59
3	928	3,731			3,731	4.02
4	585	2,960			2,960	5.06
Total	**3,067**	**11,926**	**0**	**0**	**11,926**	**3.9700**
			Average (± SE x (SQR(1+1/r)) =	**3.9700 ±**	**1.1461 =**	**2.8239**
					Number Tested Fruit =	**11,663**
					Estimated Number of Treated FF (Average) =	**32,935**
					Total combined Estimated Number =	**34,204**
Red Globe	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 1**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	150	546			546	3.64
2	150	1,026			1,026	6.84
3	150	859			859	5.73
Total	**450**	**2,431**	**0**	**0**	**2,431**	**5.4022**
			Average (± SE x (SQR(1+1/r)) =	**5.4022 ±**	**1.8758 =**	**3.5264**
					Number Tested Fruit =	**3,300**
					Estimated Number of Treated FF (Average) =	**11,637**
Red Globe	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 2**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	87	36			36	0.41
2	87	64			64	0.74
3	87	19			19	0.22
4	87	4			4	0.05
5	87	15			15	0.17
6	87	40			40	0.46

[60] Abbreviations: FF:fruit flies; QFly: Queensland fruit fly (*Bactrocera tryoni*); SQR: square root of a number

Total	**522**	**178**	**0**	**0**	**178**	**0.3410**
		Average (± SE x (SQR(1+1/r)) =		**0.3410 ±**	**0.2670 =**	**0.0739**
					Number Tested Fruit =	**2,096**
					Estimated Number of Treated FF (Average) =	**155**
Red Globe	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 3**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	847			847	3.39
2	250	586			586	2.34
3	250	540			540	2.16
4	250	557			557	2.23
Total	**1,000**	**2,530**	**0**	**0**	**2,530**	**2.5300**
		Average (± SE x (SQR(1+1/r)) =		**2.5300 ±**	**0.6451 =**	**1.8849**
					Number Tested Fruit =	**4,000**
					Estimated Number of Treated FF (Average) =	**7,539**
Red Globe	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 4**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	150	3,398			3,398	22.65
2	150	3,684			3,684	24.56
3	150	3,407			3,407	22.71
Total	**450**	**10,489**	**0**	**0**	**10,489**	**23.3089**
		Average (± SE x (SQR(1+1/r)) =		**23.3089 ±**	**1.2516 =**	**22.0573**
					Number Tested Fruit =	**1,050**
					Estimated Number of Treated FF (Average) =	**23,160**
					Total combined Estimated Number =	**42,491**
Red Globe	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 1**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	81	422			422	5.21
2	81	169			169	2.09
3	81	239			239	2.95
4	81	279			279	3.44
5	81	235			235	2.90
6	81	204			204	2.52
7	81	155			155	1.91
8	81	212			212	2.62
9	81	177			177	2.19
10	81	146			146	1.80
11	81	154			154	1.90
12	81	137			137	1.69
Total	**972**	**2,529**	**0**	**0**	**2,529**	**2.6019**
		Average (± SE x (SQR(1+1/r)) =		**2.6019 ±**	**1.0218 =**	**1.5800**
					Number Tested Fruit =	**3,028**
					Estimated Number of Treated FF (Average) =	**4,784**
Red Globe	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 2**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	1,653			1,653	6.61
2	250	1,438			1,438	5.75

3	250	1,825			1,825	7.30
4	250	1,806			1,806	7.22
Total	**1,000**	**6,722**	**0**	**0**	**6,722**	**6.7220**
			Average (± SE x (SQR(1+1/r)) =	**6.7220 ±**	**0.8008 =**	**5.9212**
					Number Tested Fruit =	**2,000**
					Estimated Number of Treated FF (Average) =	**11,842**
Red Globe	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 3**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	1,099			1,099	4.40
2	250	623			623	2.49
3	250	875			875	3.50
4	250	1,098			1,098	4.39
Total	**1,000**	**3,695**	**0**	**0**	**3,695**	**3.6950**
			Average (± SE x (SQR(1+1/r)) =	**3.6950 ±**	**1.0129 =**	**2.6821**
					Number Tested Fruit =	**4,000**
					Estimated Number of Treated FF (Average) =	**10,728**
Red Globe	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 4**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	597			597	2.39
2	250	768			768	3.07
3	250	515			515	2.06
Total	**750**	**1,880**	**0**	**0**	**1,880**	**2.5067**
			Average (± SE x (SQR(1+1/r)) =	**2.5067 ±**	**0.5962 =**	**1.9105**
					Number Tested Fruit =	**3,000**
					Estimated Number of Treated FF (Average) =	**5,731**
					Total combined Estimated Number =	**33,085**

Table 2. Table grape 'Flame Seedless' & 'Crimson Seedless' CT for QFly at 1°C, 2°C and 3°C

Flame Seedless	**1°C**	**12 Days**	**Confirmatory Controls - Qfly - Cage Infestation**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	500	415			415	0.83
2	500	225			225	0.45
3	500	410			410	0.82
4	1,985	119			119	0.06
5	1,674	201			201	0.12
6	1,516	167			167	0.11
7	2,005	201			201	0.10
Total	**8,680**	**1,737**	**0**	**0**	**1,737**	**0.3557**
			Average (± SE x (SQR(1+1/r)) =	**0.3557 ±**	**0.3699 =**	**-0.0141**
					Number Tested Fruit =	**38,279**
					Estimated Number of Treated FF (Average) =	**-541**
Flame Seedless	**1°C**	**12 Days**	**Confirmatory Controls - Qfly - Artificial Infestation**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	435	1,353			1,353	3.11
2	801	1,874			1,874	2.34

3	870	3,106			3,106	3.57
4	500	1,480			1,480	2.96
5	500	1,555			1,555	3.11
6	500	1,530			1,530	3.06
Total	**3,606**	**10,898**	**0**	**0**	**10,898**	**3.0250**
			Average (± SE x (SQR(1+1/r)) =	**3.0250 ±**	**0.4283 =**	**2.5967**
					Number Tested Fruit =	**18,473**
					Estimated Number of Treated FF (Average) =	**47,969**
					Total combined Estimated Number =	**47,969**
Crimson Seedless	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 1**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	207			207	0.83
2	250	160			160	0.64
3	250	97			97	0.39
Total	**750**	**464**	**0**	**0**	**464**	**0.6187**
			Average (± SE x (SQR(1+1/r)) =	**0.6187 ±**	**0.2549 =**	**0.3637**
					Number Tested Fruit =	**9,000**
					Estimated Number of Treated FF (Average) =	**3,274**
Crimson Seedless	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 2**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	150	689			689	4.59
2	150	499			499	3.33
3	150	458			458	3.05
4	150	326			326	2.17
Total	**600**	**1,972**	**0**	**0**	**1,972**	**3.2867**
			Average (± SE x (SQR(1+1/r)) =	**3.2867 ±**	**1.1186 =**	**2.1681**
					Number Tested Fruit =	**2,400**
					Estimated Number of Treated FF (Average) =	**5,203**
Crimson Seedless	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 3**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	1,391			1,391	5.56
2	250	1,291			1,291	5.16
3	250	1,278			1,278	5.11
4	250	1,388			1,388	5.55
Total	**1,000**	**5,348**	**0**	**0**	**5,348**	**5.3480**
			Average (± SE x (SQR(1+1/r)) =	**5.3480 ±**	**0.2722 =**	**5.0758**
					Number Tested Fruit =	**4,000**
					Estimated Number of Treated FF (Average) =	**20,303**
Crimson Seedless	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 4**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	963			963	3.85
2	250	733			733	2.93
3	250	742			742	2.97
4	250	899			899	3.60
Total	**1,000**	**3,337**	**0**	**0**	**3,337**	**3.3370**
			Average (± SE x (SQR(1+1/r)) =	**3.3370 ±**	**0.5134 =**	**2.8236**

Number Tested Fruit =						**4,000**
Estimated Number of Treated FF (Average) =						**11,295**
	Total combined Estimated Number =					**40,075**
Crimson Seedless	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 1**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	150	26			26	0.17
2	150	20			20	0.13
3	150	13			13	0.09
4	150	15			15	0.10
5	150	11			11	0.07
6	150	3			3	0.02
7	150	17			17	0.11
8	150	2			2	0.01
9	150	11			11	0.07
10	150	20			20	0.13
11	150	8			8	0.05
12	150	6			6	0.04
13	150	20			20	0.13
Total	**1,950**	**172**	**0**	**0**	**172**	**0.0882**
Average (± SE x (SQR(1+1/r)) =				**0.0882 ±**	**0.0505 =**	**0.0377**
Number Tested Fruit =						**6,050**
Estimated Number of Treated FF (Average) =						**228**
Crimson Seedless	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 2**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	1,501			1,501	6.00
2	250	1,795			1,795	7.18
3	250	1,734			1,734	6.94
4	250	1,914			1,914	7.66
Total	**1,000**	**6,944**	**0**	**0**	**6,944**	**6.9440**
Average (± SE x (SQR(1+1/r)) =				**6.9440 ±**	**0.7763 =**	**6.1677**
Number Tested Fruit =						**4,000**
Estimated Number of Treated FF (Average) =						**24,671**
Crimson Seedless	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 3**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	1,122			1,122	4.49
2	250	989			989	3.96
3	250	800			800	3.20
4	250	1,566			1,566	6.26
Total	**1,000**	**4,477**	**0**	**0**	**4,477**	**4.4770**
Average (± SE x (SQR(1+1/r)) =				**4.4770 ±**	**1.4571 =**	**3.0199**
Number Tested Fruit =						**4,000**
Estimated Number of Treated FF (Average) =						**12,080**
Crimson Seedless	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 4**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	1,608			1,608	6.43
2	250	1,521			1,521	6.08

3	250	3,018			3,018	12.07
Total	**750**	**6,147**	**0**	**0**	**6,147**	**8.1960**
			Average (± SE x (SQR(1+1/r)) =	**8.1960 ±**	**3.8812 =**	**4.3148**
					Number Tested Fruit =	**3,000**
					Estimated Number of Treated FF (Average) =	**12,944**
					Total combined Estimated Number =	**49,923**

Table 3. Table grape 'Thompson Seedless' CT for QFly at 1°C, 2°C and 3°C

Thompson Seedless	**1°C**	**12 Days**	**Confirmatory Controls - Qfly - Cage Infestation**			
TREATMENT UNIT	No.FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	400	180			180	0.45
2	400	720			720	1.80
3	400	120			120	0.30
4	500	415			415	0.83
5	500	340			340	0.68
6	500	535			535	1.07
7	2,651	80			80	0.03
8	1,884	57			57	0.03
9	2,325	93			93	0.04
10	2,445	807			807	0.33
11	900	468			468	0.52
12	624	349			349	0.56
13	1,083	87			87	0.08
14	1,380	69			69	0.05
15	1,469	103			103	0.07
16	1,000	910			910	0.91
17	1,000	860			860	0.86
Total	**19,461**	**6,192**	**0**	**0**	**6,192**	**0.5065**
			Average (± SE x (SQR(1+1/r)) =	**0.5065 ±**	**0.4979 =**	**0.0086**
					Number Tested Fruit =	**80,284**
					Estimated Number of Treated FF (Average) =	**690**
					Total combined Estimated Number =	**690**
Thompson Seedless	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 1**
TREATMENT UNIT	No.FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	200	339			339	1.70
2	200	212			212	1.06
3	200	353			353	1.77
Total	**600**	**904**	**0**	**0**	**904**	**1.5067**
			Average (± SE x (SQR(1+1/r)) =	**1.5067 ±**	**0.4485 =**	**1.0582**
					Number Tested Fruit =	**5,400**
					Estimated Number of Treated FF (Average) =	**5,714**
Thompson Seedless	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 2**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	190	1,700			1,700	8.95
2	190	1,024			1,024	5.39

3	190	489			489	2.57
Total	**570**	**3,213**	**0**	**0**	**3,213**	**5.6368**
			Average (± SE x (SQR(1+1/r)) =	**5.6368 ±**	**3.6882 =**	**1.9487**
					Number Tested Fruit =	**2,278**
					Estimated Number of Treated FF (Average) =	**4,439**
Thompson Seedless	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 3**	
TREATMENT UNIT	No.FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	1,927			1,927	7.71
2	250	2,177			2,177	8.71
3	250	1,399			1,399	5.60
Total	**750**	**5,503**	**0**	**0**	**5,503**	**7.3373**
			Average (± SE x (SQR(1+1/r)) =	**7.3373 ±**	**1.8346 =**	**5.5028**
					Number Tested Fruit =	**2,237**
					Estimated Number of Treated FF (Average) =	**12,310**
Thompson Seedless	**2°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 4**	
TREATMENT UNIT	No.FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	58			58	0.23
2	250	294			294	1.18
3	250	175			175	0.70
4	250	185			185	0.74
Total	**1,000**	**712**	**0**	**0**	**712**	**0.7120**
			Average (± SE x (SQR(1+1/r)) =	**0.7120 ±**	**0.4314 =**	**0.2806**
					Number Tested Fruit =	**2,125**
					Estimated Number of Treated FF (Average) =	**596**
					Total combined Estimated Number =	**23,059**
Thompson Seedless	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 1**	
TREATMENT UNIT	No.FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	166	736			736	4.43
2	166	1,356			1,356	8.17
3	166	804			804	4.84
4	166	730			730	4.40
5	166	859			859	5.17
6	166	1,670			1,670	10.06
Total	**996**	**6,155**	**0**	**0**	**6,155**	**6.1797**
			Average (± SE x (SQR(1+1/r)) =	**6.1797 ±**	**2.5576 =**	**3.6221**
					Number Tested Fruit =	**5,000**
					Estimated Number of Treated FF (Average) =	**18,110**
Thompson Seedless	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 2**	
TREATMENT UNIT	No.FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	3,935			3,935	15.74
2	250	3,750			3,750	15.00
3	250	4,251			4,251	17.00
4	250	3,876			3,876	15.50
Total	**1,000**	**15,812**	**0**	**0**	**15,812**	**15.8120**
			Average (± SE x (SQR(1+1/r)) =	**15.8120 ±**	**0.9531 =**	**14.8589**
					Number Tested Fruit =	**4,000**

Estimated Number of Treated FF (Average) =						**59,436**
Thompson Seedless	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 3**	
TREATMENT UNIT	No.FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	3,180			3,180	12.72
2	250	2,150			2,150	8.60
3	250	2,257			2,257	9.03
4	250	1,750			1,750	7.00
Total	**1,000**	**9,337**	**0**	**0**	**9,337**	**9.3370**
Average (± SE x (SQR(1+1/r)) =				**9.3370 ±**	**2.7038 =**	**6.6332**
Number Tested Fruit =						**2,000**
Estimated Number of Treated FF (Average) =						**13,266**
Thompson Seedless	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 4**	
TREATMENT UNIT	No.FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	250	1,608			1,608	6.43
2	250	1,521			1,521	6.08
3	250	3,018			3,018	12.07
Total	**750**	**6,147**	**0**	**0**	**6,147**	**8.1960**
Average (± SE x (SQR(1+1/r)) =				**8.1960 ±**	**3.8812 =**	**4.3148**
Number Tested Fruit =						**2,000**
Estimated Number of Treated FF (Average) =						**8,630**
	Total combined Estimated Number =					**99,442**

Table 4. Combined results for table grape CT for QFly at 1°C, 2°C and 3°C

Combined	**1°C**	**12 Days**
	Estimated Number of Treated FF (Average) =	**82,863**
	Efficacy =	**99.9964**

Combined	**2°C**	**14 Days**
	Estimated Number of Treated FF (Average) =	**105,625**
	Efficacy =	**99.9972**

Combined	**3°C**	**14 Days**
	Estimated Number of Treated FF (Average) =	**182,450**
	Efficacy =	**99.9984**

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Appendix 7: Efficacy calculation for the draft PT Cold treatment for *Ceratitis capitata* on *Prunus avium, Prunus domestica* and *Prunus persica* (2017-022A)[61]

Table 1. Stone fruit cherry (‘Sweetheart’ & ‘Lapin’) 1°C & 3°C CT for MedFly

Cherry Sweetheart	**1°C**	**16 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	5	8,147			8,147	1629.40
2	5	8,975			8,975	1795.00
3	5	9,342			9,342	1868.40
Total	**15**	**26,464**	**0**	**0**	**26,464**	**1,764.2667**
Average (± SE x (SQR(1+1/r)) =				**1,764.2667 ±**	**141.3679 =**	**1,622. 8988**
Number Tested Fruit =						**30**
Estimated Number of Treated FF (Average) =						**48,687**
Cherry Lapin	**1°C**	**16 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	5	16,141			16,141	3228.20
2	5	17,210			17,210	3442.00
3	5	16,249			16,249	3249.80
Total	**15**	**49,600**	**0**	**0**	**49,600**	**3,306.6667**
Average (± SE x (SQR(1+1/r)) =				**3,306.6667 ±**	**135.9067 =**	**3,170.7600**
Number Tested Fruit =						**30**
Estimated Number of Treated FF (Average) =						**95,123**
	Total combined Estimated Number =					**143,810**
Cherry Sweetheart	**3°C**	**20 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	5	11,247			11,247	2249.40
2	5	12,792			12,792	2558.40
3	5	12,449			12,449	2489.80
Total	**15**	**36,488**	**0**	**0**	**36,488**	**2,432.5333**
Average (± SE x (SQR(1+1/r)) =				**2,432.5333 ±**	**187.3672 =**	**2,245.1661**
Number Tested Fruit =						**30**
Estimated Number of Treated FF (Average) =						**67,355**
Cherry Lapin	**3°C**	**20 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	5	16,117			16,117	3223.40
2	5	17,204			17,204	3440.80
3	5	16,895			16,895	3379.00
Total	**15**	**50,216**	**0**	**0**	**50,216**	**3,347.7333**
Average (± SE x (SQR(1+1/r)) =				**3,347.7333 ±**	**129.3517 =**	**3,218.3817**

[61] Abbreviations: FF: fruit flies; MedFly: Mediterranean fruit fly (*Ceratitis capitata*); SQR:square root of a number

Number Tested Fruit =	**30**
Estimated Number of Treated FF (Average) =	**96,551**
Total combined Estimated Number =	**163,906**

Table 2: Stone fruit plum ('Angelino' & 'Tegan Blue') 1°C & 3°C CT for MedFly

Plum Angelino	**1°C**	**16 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.50	16,412			16,412	2188.27
2	7.50	14,311			14,311	1908.13
3	7.50	15,332			15,332	2044.27
Total	**22.5**	**46,055**	**0**	**0**	**46,055**	**2,046.8889**
			Average (± SE x (SQR(1+1/r)) =	**2,046.8889 ±**	**161.7563 =**	**1,885.1326**
					Number Tested Fruit =	**45**
					Estimated Number of Treated FF (Average) =	**84,831**
Plum Tegan Blue	**1°C**	**16 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.50	17,233			17,233	2297.73
2	7.50	16,825			16,825	2243.33
3	7.50	17,452			17,452	2326.93
Total	**22.5**	**51,510**	**0**	**0**	**51,510**	**2,289.3333**
			Average (± SE x (SQR(1+1/r)) =	**2,289.3333 ±**	**48.9920 =**	**2,240.3414**
					Number Tested Fruit =	**45**
					Estimated Number of Treated FF (Average) =	**100,815**
					Total combined Estimated Number =	**185,646**
Plum Angelino	**3°C**	**20 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	12,993			12,993	1732.40
2	7.5	11,121			11,121	1482.80
3	7.5	12,014			12,014	1601.87
Total	**22.5**	**36,128**	**0**	**0**	**36,128**	**1,605.6889**
			Average (± SE x (SQR(1+1/r)) =	**1,605.6889 ±**	**144.1573 =**	**1,461.5316**
					Number Tested Fruit =	**45**
					Estimated Number of Treated FF (Average) =	**65,769**
Plum Tegan Blue	**3°C**	**20 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	11,498			11,498	1533.07
2	7.5	11,348			11,348	1513.07
3	7.5	11,587			11,587	1544.93
Total	**22.5.**	**34,433**	**0**	**0**	**34,433**	**1,530.3556**
			Average (± SE x (SQR(1+1/r)) =	**1,530.3556 ±**	**18.5969 =**	**1,511.7586**
					Number Tested Fruit =	**45**

Estimated Number of Treated FF (Average) =	**68,029**
Total combined Estimated Number =	**133,798**

Table 3. Stone fruit nectarine ('Artic Snow' & 'August Red') 1°C & 3°C CT for MedFly

Nectarine Artic Snow	**1°C**	**16 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	7,221			7,221	962.80
2	7.5	6,137			6,137	818.27
3	7.5	6,852			6,852	913.60
Total	**22.5**	**20,210**	**0**	**0**	**20,210**	**898.2222**
Average (± SE x (SQR(1+1/r)) =				**898.2222 ±**	**84.8515 =**	**813.3708**
Number Tested Fruit =						**45**
Estimated Number of Treated FF (Average) =						**36,602**
Nectarine August Red	**1°C**	**16 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	8,825			8,825	1176.67
2	7.5	9,737			9,737	1298.27
3	7.5	9,075			9,075	1210.00
Total	**22.5**	**27,637**	**0**	**0**	**27,637**	**1,228.3111**
Average (± SE x (SQR(1+1/r)) =				**1,228.3111 ±**	**72.5545 =**	**1,155.7566**
Number Tested Fruit =						**45**
Estimated Number of Treated FF (Average) =						**52,009**
Total combined Estimated Number =						**88,611**
Nectarine Artic Snow	**3°C**	**20 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	9,894			9,894	1319.20
2	7.5	8,945			8,945	1192.67
3	7.5	8,764			8,764	1168.53
Total	**22.5**	**27,603**	**0**	**0**	**27,603**	**1,226.8000**
Average (± SE x (SQR(1+1/r)) =				**1,226.8000 ±**	**93.4446 =**	**1,133.3554**
Number Tested Fruit =						**45**
Estimated Number of Treated FF (Average) =						**51,001**
Nectarine August Red	**3°C**	**20 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	11,875			11,875	1583.33
2	7.5	10,982			10,982	1464.27
3	7.5	9,560			9,560	1274.67
Total	**22.5**	**32,417**	**0**	**0**	**32,417**	**1,440.7556**
Average (± SE x (SQR(1+1/r)) =				**1,440.7556 ±**	**179.7530 =**	**1,261.0026**
Number Tested Fruit =						**45**
Estimated Number of Treated FF (Average) =						**56,745**

	Total combined Estimated Number =	**107,746**

Table 4. Stone fruit peach (‘Snow King’ & ‘Zee Lady’) 1°C & 3°C CT for MedFly

Peach Snow King	**1°C**	**16 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	6,320			6,320	842.67
2	7.5	5,772			5,772	769.60
3	7.5	6,251			6,251	833.47
Total	**22.5**	**18,343**	**0**	**0**	**18,343**	**815.2444**
			Average (± SE x (SQR(1+1/r)) =	**815.2444 ±**	**45.9525 =**	**769.2920**
					Number Tested Fruit =	**45**
					Estimated Number of Treated FF (Average) =	**34,618**
Peach Zee Lady	**1°C**	**16 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	10,887			10,887	1451.60
2	7.5	9,075			9,075	1210.00
3	7.5	9,245			9,245	1232.67
Total	**22.5**	**29,207**	**0**	**0**	**29,207**	**1,298.0889**
			Average (± SE x (SQR(1+1/r)) =	**1,298.0889 ±**	**154.0679 =**	**1,144.0210**
					Number Tested Fruit =	**45**
					Estimated Number of Treated FF (Average) =	**51,481**
					Total combined Estimated Number =	**86,099**
Peach Snow King	**3°C**	**20 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	7.5	8,225			8,225	1096.67
2	7.5	7,872			7,872	1049.60
3	7.5	8,819			8,819	1175.87
Total	**22.5**	**24,916**	**0**	**0**	**24,916**	**1,107.3778**
			Average (± SE x (SQR(1+1/r)) =	**1,107.3778 ±**	**73.6828 =**	**1,033. 6950**
					Number Tested Fruit =	**45**
					Estimated Number of Treated FF (Average) =	**46,516**
Peach Zee Lady	**3°C**	**20 Days**	**Confirmatory Controls - Medfly**			
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	8	12,046			12,046	1606.13
2	8	10,725			10,725	1430.00
3	8	11,450			11,450	1526.67
Total	**22.5**	**34,221**	**0**	**0**	**34,221**	**1,520.9333**
			Average (± SE x (SQR(1+1/r)) =	**1,520.9333 ±**	**101.8521 =**	**1,419.0812**
					Number Tested Fruit =	**45**
					Estimated Number of Treated FF (Average) =	**63,859**
					Total combined Estimated Number =	**110,375**

Table 5. Combined results for stone fruit CT for MedFly at 1°C and 3°C

Cherry Combined	1°C	16 Days
	Estimated Number of Treated FF (Average) =	143,810
	Efficacy =	99.9979

Cherry Combined	3°C	20 Days
	Estimated Number of Treated FF (Average) =	163,906
	Efficacy =	99.9982

Plum Combined	1°C	16 Days
	Estimated Number of Treated FF (Average) =	185,646
	Efficacy =	99.9984

Plum Combined	3°C	20 Days
	Estimated Number of Treated FF (Average) =	133,798
	Efficacy =	99.9978

Peach/Nectarine Combined	1°C	16 Days
	Estimated Number of Treated FF (Average) =	174,710
	Efficacy =	99.9983

Peach/Nectarine Combined	3°C	20 Days
	Estimated Number of Treated FF (Average) =	218,121
	Efficacy =	99.9986

Appendix 8: Efficacy calculation for the draft PT Cold treatment for *Bactrocera tryoni* on *Prunus avium*, *Prunus domestica* and *Prunus persica* (2017-022B)[62]

Table 1. Stone fruit cherry ('Sweetheart') 1°C & 3°C CT for QFly

Cherry Sweetheart	1°C	14 Days	Confirmatory Controls - Qfly			Replicate 1
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	110.00	2,381			2,381	21.65
2	110.00	2,084			2,084	18.95
3	110.00	2,311			2,311	21.01
4	110.00	2,052			2,052	18.65
Total	**440**	**8,828**	**0**	**0**	**8,828**	**20.0636**
			Average (± SE x (SQR(1+1/r)) =	**20.0636 ±**	**1.6623 =**	**18.4013**
					Number Tested Fruit =	**1,600**
					Estimated Number of Treated FF (Average) =	**29,442**
Cherry Sweetheart	**1°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 2**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	110.00	1,000			1,000	9.09
2	110.00	923			923	8.39
3	110.00	933			933	8.48
4	110.00	1,018			1,018	9.25
Total	**440**	**3,874**	**0**	**0**	**3,874**	**8.8045**
			Average (± SE x (SQR(1+1/r)) =	**8.8045 ±**	**0.4829 =**	**8.3216**
					Number Tested Fruit =	**1,494**
					Estimated Number of Treated FF (Average) =	**12,432**
Cherry Sweetheart	**1°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 3**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	110.00	1,092			1,092	9.93
2	110.00	960			960	8.73
3	110.00	817			817	7.43
4	110.00	1,110			1,110	10.09
Total	**440**	**3,979**	**0**	**0**	**3,979**	**9.0432**
			Average (± SE x (SQR(1+1/r)) =	**9.0432 ±**	**1.3830 =**	**7.6602**
					Number Tested Fruit =	**2,086**
					Estimated Number of Treated FF (Average) =	**15,979**
					Total combined Estimated Number =	**57,853**
Cherry Sweetheart	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 1**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	110.00	850			850	7.73
2	110.00	987			987	8.97
3	110.00	857			857	7.79

[62] Abbreviations: FF:fruit flies; QFly: Queensland fruit fly (*Bactrocera tryoni)*; SQR: square root of a number

4	110.00	789			789	7.17
Total	**440**	**3,483**	**0**	**0**	**3,483**	**7.9159**
Average (± SE x (SQR(1+1/r)) =				**7.9159 ±**	**0.8467 =**	**7.0693**
Number Tested Fruit =						**2,400**
Estimated Number of Treated FF (Average) =						**16,966**
Cherry Sweetheart	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 2**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	130.00	1,179			1,179	9.07
2	130.00	1,351			1,351	10.39
3	130.00	1,303			1,303	10.02
4	130.00	1,248			1,248	9.60
Total	**520**	**5,081**	**0**	**0**	**5,081**	**9.7712**
Average (± SE x (SQR(1+1/r)) =				**9.7712 ±**	**0.6362 =**	**9.1350**
Number Tested Fruit =						**2,582**
Estimated Number of Treated FF (Average) =						**23,587**
Cherry Sweetheart	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 3**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	110.00	368			368	3.35
2	110.00	203			203	1.85
3	110.00	323			323	2.94
4	110.00	169			169	1.54
Total	**440**	**1,063**	**0**	**0**	**1,063**	**2.4159**
Average (± SE x (SQR(1+1/r)) =				**2.4159 ±**	**0.9648 =**	**1.4511**
Number Tested Fruit =						**2,400**
Estimated Number of Treated FF (Average) =						**3,483**
Cherry Sweetheart	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 4**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	110.00	2,188			2,188	19.89
2	110.00	2,112			2,112	19.20
3	110.00	2,645			2,645	24.05
4	110.00	2,652			2,652	24.11
Total	**440**	**9,597**	**0**	**0**	**9,597**	**21.8114**
Average (± SE x (SQR(1+1/r)) =				**21.8114 ±**	**2.9424 =**	**18.8690**
Number Tested Fruit =						**2,400**
Estimated Number of Treated FF (Average) =						**45,286**
	Total combined Estimated Number =					**89,322**

Table 2. Stone fruit plum (‘Angelino’) 1°C & 3°C CT for Qfly

Plum Angelino	**1°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 1&2**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	50.00	1,202			1,202	24.04
2	50.00	1,481			1,481	29.62

3	50.00	1,325			1,325	26.50
4	50.00	1,509			1,509	30.18
5	50.00	1,376			1,376	27.52
6	50.00	1,238			1,238	24.76
Total	**300**	**8,131**	**0**	**0**	**8,131**	**27.1033**
			Average (± SE x (SQR(1+1/r)) =	**27.1033 ±**	**2.6987 =**	**24.4047**
					Number Tested Fruit =	**500**
					Estimated Number of Treated FF (Average) =	**12,202**
Plum Angelino	**1°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 3**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	50.00	1,466			1,466	29.32
2	50.00	1,359			1,359	27.18
3	50.00	559			559	11.18
Total	**150**	**3,384**	**0**	**0**	**3,384**	**22.5600**
			Average (± SE x (SQR(1+1/r)) =	**22.5600 ±**	**11.4469 =**	**11.1131**
					Number Tested Fruit =	**500**
					Estimated Number of Treated FF (Average) =	**5,557**
					Total combined Estimated Number =	**17,759**
Plum Angelino	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 1**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	50	236			236	4.72
2	50	387			387	7.74
3	50	381			381	7.62
Total	**150**	**1,004**	**0**	**0**	**1,004**	**6.6933**
			Average (± SE x (SQR(1+1/r)) =	**6.6933 ±**	**1.9745 =**	**4.7288**
					Number Tested Fruit =	**500**
					Estimated Number of Treated FF (Average) =	**2,359**
Plum Angelino	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 2**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	16	697			697	43.56
2	16	474			474	29.63
3	16	738			738	46.13
4	16	491			491	30.69
5	16	706			706	44.13
Total	**80**	**3,106**	**0**	**0**	**3,106**	**38.8250**
			Average (± SE x (SQR(1+1/r)) =	**38.8250 ±**	**8.7410 =**	**30.0840**
					Number Tested Fruit =	**390**
					Estimated Number of Treated FF (Average) =	**11,733**
Plum Angelino	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**			**Replicate 3**
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	19	876			876	46.11
2	19	1,171			1,171	61.63

3	19	972			972	51.16
4	19	714			714	37.58
5	19	825			825	43.42
6	19	841			841	44.26
Total	**114**	**5,399**	**0**	**0**	**5,399**	**47.3596**
			Average (± SE x (SQR(1+1/r)) =	**47.3596 ±**	**8.9128 =**	**38.4468**
					Number Tested Fruit =	**566**
					Estimated Number of Treated FF (Average) =	**21,761**
Plum Angelino	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 4**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	20	1,483			1,483	74.15
2	20	1,397			1,397	69.85
3	20	1,595			1,595	79.75
4	20	1,095			1,095	54.75
Total	**80**	**5,570**	**0**	**0**	**5,570**	**69.6250**
			Average (± SE x (SQR(1+1/r)) =	**69.6250 ±**	**11.9775 =**	**57.6475**
					Number Tested Fruit =	**384**
					Estimated Number of Treated FF (Average) =	**22,137**
Plum Angelino	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 5**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	16	316			316	19.75
2	16	218			218	13.63
3	16	312			312	19.50
4	16	366			366	22.88
5	16	349			349	21.81
Total	**80**	**1,561**	**0**	**0**	**1,561**	**19.5125**
			Average (± SE x (SQR(1+1/r)) =	**19.5125 ±**	**3.9236 =**	**15.5889**
					Number Tested Fruit =	**400**
					Estimated Number of Treated FF (Average) =	**6,236**
					Total combined Estimated Number =	**64,226**

Table 3. Stone fruit nectarine ('Artic Snow') 1°C & 3°C CT for Qfly

Nectarine Artic Snow	**1°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 1**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	15	1,284			1,284	85.60
2	15	611			611	40.73
3	15	1,605			1,605	107.00
4	15	1,813			1,813	120.87
Total	**60**	**5,313**	**0**	**0**	**5,313**	**88.5500**
			Average (± SE x (SQR(1+1/r)) =	**88.5500 ±**	**39.1573 =**	**49.3927**
					Number Tested Fruit =	**274**
					Estimated Number of Treated FF (Average) =	**13,534**
Nectarine Artic Snow	**1°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 2**	
TREATMENT	No. FRUIT	No. Pupae			TOTAL	

UNIT	/ TRAY	1st sieve	2nd sieve	3rd sieve	# PUPAE	AVERAGE / FRUIT
1	10	1,146			1,146	114.60
2	10	1,007			1,007	100.70
3	10	1,073			1,073	107.30
4	10	890			890	89.00
5	10	1,300			1,300	130.00
6	10	1,301			1,301	130.10
Total	**60**	**6,717**	**0**	**0**	**6,717**	**111.9500**
			Average (± SE x (SQR(1+1/r)) =	**111.9500 ±**	**17.6635 =**	**94.2865**
					Number Tested Fruit =	**300**
					Estimated Number of Treated FF (Average) =	**28,286**
					Total combined Estimated Number =	**41,820**

Nectarine Artic Snow	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 1&2**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	10	422			422	42.20
2	10	590			590	59.00
3	10	818			818	81.80
4	10	559			559	55.90
5	10	340			340	34.00
6	10	841			841	84.10
Total	**60**	**3,570**	**0**	**0**	**3,570**	**59.5000**
			Average (± SE x (SQR(1+1/r)) =	**59.5000 ±**	**21.9518 =**	**37.5482**
					Number Tested Fruit =	**240**
					Estimated Number of Treated FF (Average) =	**9,012**

Nectarine Artic Snow	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 3**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	10	61			61	6.10
2	10	108			108	10.80
3	10	226			226	22.60
4	10	296			296	29.60
5	10	81			81	8.10
6	10	114			114	11.40
7	10	88			88	8.80
Total	**70**	**974**	**0**	**0**	**974**	**13.9143**
			Average (± SE x (SQR(1+1/r)) =	**13.9143 ±**	**9.3455 =**	**4.5688**
					Number Tested Fruit =	**240**
					Estimated Number of Treated FF (Average) =	**1,097**

Nectarine Artic Snow	**3°C**	**14 Days**	**Confirmatory Controls - Qfly**		**Replicate 4**	
TREATMENT UNIT	No. FRUIT / TRAY	No. Pupae			TOTAL # PUPAE	AVERAGE / FRUIT
		1st sieve	2nd sieve	3rd sieve		
1	10	1,007			1,007	100.70
2	10	1,262			1,262	126.20
3	10	1,585			1,585	158.50
4	10	1,315			1,315	131.50
5	10	1,329			1,329	132.90

6	10	1,196			1,196	119.60
Total	**60**	**7,694**	**0**	**0**	**7,694**	**128.2333**
Average (± SE x (SQR(1+1/r)) =				**128.2333 ±**	**20.4099 =**	**107.8234**
Number Tested Fruit =						**240**
Estimated Number of Treated FF (Average) =						**25,878**
	Total combined Estimated Number =					**35,987**

Table 4. Combined results for stone fruit CT for Qfly at 1°C and 3°C

Cherry Combined	**1°C**	**14 Days**
Estimated Number of Treated FF (Average) =		**57,853**
	Efficacy =	**99.9948**

Cherry Combined	**3°C**	**14 Days**
Estimated Number of Treated FF (Average) =		**89,322**
	Efficacy =	**99.9966**

Plum Combined	**1°C**	**14 Days**
Estimated Number of Treated FF (Average) =		**17,759**
	Efficacy =	**99.9831**

Plum Combined	**3°C**	**14 Days**
Estimated Number of Treated FF (Average) =		**64,226**
	Efficacy =	**99.9953**

Nectarine Combined	**1°C**	**14 Days**
Estimated Number of Treated FF (Average) =		**41,820**
	Efficacy =	**99.9928**

Nectarine Combined	**3°C**	**14 Days**
Estimated Number of Treated FF (Average) =		**35,987**
	Efficacy =	**99.9917**

Appendix 9: Efficacy calculation for the draft PT Irradiation treatment for *Carposina sasakii* (2017-026)

Reps	Control Numbers	Surviving Adults	Control Mortality	Treated Counts	Adjusted Count
1	404	357	11.63%	7421	
2	338	308	8.88%	4951	
3	344	319	7.27%	4865	
4	328	328	0.00%	5767	
5	467	396	15.20%	7576	
Totals	**1,139**	**1,043**	**8.596%**	**30580**	**27951**
				Calculated Efficacy =	**99.9893**

Appendix 10: Efficacy calculation for the draft PT Irradiation treatment for *Bactrocera tau* (2017-025)

85 Gy Treatment

Reps	Control Numbers (Larvae)	Surviving Adults	Control Mortality	Treated Counts	Adjusted Count
1	4429	4092	7.61%	48700	
2	6951	6425	7.57%	58435	
Totals	**11,380**	**10,517**	**7.588%**	**107135**	**99005**
				Calculated Efficacy =	**99.9970**

72 Gy Treatment

Reps	Control Numbers (Larvae)	Surviving Adults	Control Mortality	Treated Counts	Adjusted Count
1	4429	4092	7.61%	48700	
Totals	**4,429**	**4,092**	**7.609%**	**48700**	**44994**
				Calculated Efficacy =	**99.9933**

Appendix 11: Efficacy calculation for the draft PT Irradiation treatment for *Bactrocera dorsalis* (2017-015)

Reps	Control Numbers	Surviving Adults	Control Mortality	Treated Counts	Adjusted Count
1	5706	4595	19.47%	64,143	
2	5712	4659	18.43%	36,541	
Totals	**11,418**	**9,254**	**18.953%**	**100,684**	**81,602**
				Calculated Efficacy =	**99.9963**

Appendix 12: Action points arising from the June 2018 TPPT meeting

	Action	Agenda Item	Responsible	Deadline
1.	Update the *List of topics for IPPC standards* with the changes agreed to at the 2018-06 TPPT meeting (titles, Treatment Leads, priorities, deletions, status changes)	4.1	Secretariat	2018-10
2.	Present the following draft PTs to the SC for approval for consultation (once finalized by the TPPT): - Cold treatment of *Ceratitis capitata* on *Vitis vinifera* (2017-023A) - Cold treatment of *Bactrocera tryoni* on *Vitis vinifera* (2017-023B) - Cold treatment of *Ceratitis capitata* on *Prunus avium, Prunus domestica* and *Prunus persica* (2017-022A) - Cold treatment of *Bactrocera tryoni* on *Prunus avium, Prunus domestica* and *Prunus persica* (2017-022B) - Irradiation treatment for the genus *Anastrepha* (2017-031) - Irradiation treatment for *Carposina sasakii* (2017-026) - Irradiation treatment for *Bactrocera tau* (2017-025) - Irradiation treatment for *Bactrocera dorsalis* (2017-015)	4.1, 4.2, 4.3, 4.4, 4.5, 6.6, 6.7, 6.8	Secretariat	TBD
3.	Present to the SC the two CATTS treatments against *Cydia pomonella* for inclusion in the *List of topics for IPPC standards* (i.e. for inclusion in the TPPT work programme), with priority 3 so that the TPPT can better assess the information from the submitter	5.1, 5.2	Secretariat	SC November 2018
4.	To ask the submitter to provide further information on how the number of treated insects and number of insects in the control were estimated for the Irradiation treatment for *Drosophila suzukii* (2017-017)	6.1	Mr Matthew SMYTH	Next TPPT meeting
5.	To ask the submitter to provide further information on the infestation methods and the artificial diet (considering the discussion of the TPPT), the reasoning why sixth instar was not considered in establishing the most tolerant life stage and how the number of treated insects were calculated for the Irradiation treatment for *Epiphyas postvittana* (2017-018)	6.3	Mr Daojian YU	Next TPPT meeting
6.	To ask the submitter to provide additional information on the most tolerant life stage – whether eggs are indeed the most tolerant life stage and the containment period before fumigation to allow all eggs to hatch for the Sulfuryl fluoride fumigation treatment for *Chlorophorus annularis* on bamboo articles (2017-028)	6.4	Mr Eduardo WILLINK	Next TPPT meeting
7.	To work with the submitter to compare the radio-tolerance of the economically important species of the Tortricidae family to support the effectiveness of a generic dose of the Irradiation treatment for eggs and larvae of the family Tortricidae (generic) (2017-011) and justify how it can be assumed that the treatment is efficacious against the non-tested species as well	6.5	Mr Matthew SMYTH	Next TPPT meeting

	Action	Agenda Item	Responsible	Deadline
8.	To ask the submitter to provide more data and justification on why these are the economically important species, how they are representative of all ants (Hymenoptera: Formicidae) and either provide more data or consider reducing the scope for the Irradiation treatment for ants (Hymenoptera: Formicidae) hitch-hiking on fresh commodities (2017-014)	6.9	Mr Scott MYERS	Next TPPT meeting
9.	To inform the SC of the TPPT's recommendation on the fumigation draft as requested by the SC-7	7.1	Secretariat	2018 November SC meeting
10.	To recommend to PMRG the following topics for consideration: correcting sample sizes, measuring treatment temperatures from trials, and estimating treated insect numbers	8.1	Secretariat	By the next PMRG meeting (Tentative: August 2019)
11.	To ask guidance from the SC how and if the TPPT, or other body/group, could provide the input requested by the MBTOC: to provide a list of the top 10–20 key pests for which methyl bromide is used in quarantine and pre-shipment application, including possibly a list of key alternatives used in various regions	8.2	Secretariat	2019 May